DANTE GIACOSA

FORTY YEARS
of Design with Fiat

CENTRO STORICO FIAT

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The previous edition of this book, *Forty years of Design with Fiat*, has been published by Automobilia in 1979. Under specific instructions by Mrs Mariella Zanon di Valgiurata, Dante Giacosa's daughter, this edition is a faithful copy of the first 1979 edition, also for the biographies of the main characters of the story (where the only update is the date of their death when happened after 1979).

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Anyway, nothing makes us happier than to talk about ourselves.
Our own experience as a people has become a source of ecstasy.
And here am I, doing it, too.

Saul Bellow, *Jerusalem and back*

I wish to express my gratitude to those people who encouraged me to write this book about my life's work and those whose assistance made its publication possible. I would like to thank Wanda Vigliano Mundula, a close collaborator as my secretary from 1946 to 1975, for her far-sightedness in preserving documents. Then I would like to thank all those who have aided my memory and collected data and illustrations, among whom I should mention Maria Persico, Augusto Costantino, Antonio Amadelli, Ugo Romolo Vercelli.
I also feel indebted to Piero Casucci for having encouraged me with his suggestions and advice to tackle this task that was new and not entirely congenial to me.
Finally I wish to thank Oddone Camerana who, after reading only part of the text, urged me to complete and publish it.
D.G.

CHAPTER I

ABOUT FIAT AND ME

During the “Valletta period”, it was unheard-of for top level executives to retire because they had reached the age limit. The “Professore” himself left Fiat at the age of eighty-three, when he died! And in his lifetime, his trusted and faithful collaborators would never have given up their posts except for the same motive or, perhaps, health reasons. Keen as I was on my work, fully convinced that no other automobile maker could give me wider scope for my powers, loyal to the backbone, I had never dreamt of becoming an exception to the rule. Perhaps I too would have soldiered on to the age of eighty and seen my colleagues grow white-haired.

When the Valletta period was over many of his executives left as well, feeling age catching up with them. There was a certain trend in the direction of renewal that had been becoming more marked and spurred changes to the Fiat organization in the quest for a more modern set-up to mirror the immense expansion it had achieved. This delicate task was entrusted to American specialists. With professional tact, they systematically interviewed all the executives to collect the information necessary to plan the far-reaching changes that they later presented with firm conviction to the company’s board of directors.

The winds of change swelled the sails of these famous specialists, skilled at navigating such perilous waters as these, with lurking dangers on all sides. It meant an injection of youthfulness which I felt was salutary and would mean a real boost to Fiat.

The decision to make retirement compulsory at a certain age even in the case of managerial staff appealed to me. I took stock of things and prepared to leave the work which had given me such fulfilment (together with its share of headaches), relinquishing my position as head of design. The routine procedure laid down that retirement should date from the end of the year in which I turned sixty-five.

I was born on 3 January 1905, so I could have gone on as divisional manager until the end of 1970, by which time I would have been sixty-six. I had my good reasons for not doing so. I knew that the chairman and the general manager, who will come into my story frequently, wanted to give the company a structure based on the principle of decentralization, in accordance with a policy that reversed the trend of over fifty years of all Fiat’s activities.

From what was in the air and talks I had with the American experts I came to the conclusion that Fiat was going to radically modify its whole organization within the next few years, along the lines followed by General Motors. Production would be subdivided into separate large-scale sectors: automobiles, industrial vehicles, metalworking, tractors and agricultural machinery, civil engineering etc. In the same way the immense complex of the Research and Design Department and its related services, hitherto grouped under my direction, were to be split up and decentralized. This opened up prospects of radical changes in staffing, in working relationships, in the links between the various departments and even in mental outlook. It was clear that my presence might have created snags. I appreciated the numerous problems that had to be dealt with in imposing a rational and efficient organization under the new scheme. I might have been of use still to Fiat's top management in finding the most effective solutions to various problems, for instance in selecting staff, and laying down technical guidelines. But my presence, my age, perhaps my personality, might have constituted an impediment. Besides, I wanted my collaborators, to whom I had entrusted managerial posts in the various sectors of the Design Department, basing my judgment on their personal qualities as well as their specific aptitudes, to move upwards and deal directly with the General Management without my intervention. In this way they would be free to display their expertise, judgment and managerial capacities.

In a conversation with the general manager, Gaudenzio Bono, I put my views across and asked him to accept my resignation. I sensed that he was relieved. In my turn I accepted a position as consultant to the President and General Management. The newspapers got the news from Fiat's Press Office and so it got out that I was now so old that I thought it was time to give up designing new automobiles.

With a feeling of sudden emptiness, as if I had woken out of a long dream, I had reached the moment to break off my many sided, all-absorbing and intensive activity, one that had bound my body and soul to Fiat for over forty years. I had to change my outlook and fit into a different rhythm of life. I had occupied my office for a number of years; since my appointment as General Technical Director for the Motor Vehicles Section it had been moved from the sixth to the second floor of the "palazzina" at Mirafiori: now that it was shorn of the image of power it felt empty. At my work desk I felt alone. Among the youthful executives of the Gruppo Auto who occupied the second-floor offices, formerly reserved for the top positions in Fiat, starting with the President, I felt like an intruder. Yet I have not entirely relinquished research and design. I can still, when need arises, be of some help to those former colleagues of mine, as they sail amid the shoals and reefs of these troubled times, skilfully guiding the helm which was mine for so many years.

What has led me to write these memoirs, a new and laborious task for me? I had always shrugged off the urgings of journalists and friends, thinking that there would be time ahead for telling the tale of my life's work with automobiles. I imagined that when I retired I could devote myself finally to drawing and painting or sculpture, which had been my youthful interests, but I reckoned without the burden of time and its effect on the spirit and the body. The "divine afflatus" became fruitless yearning, the imagination and energy needed for confident and decisive execution gave way to meditation. Reflection turned hauntingly back to the things of the past. When a man has seventy years on his back his mind loses its suppleness and energy and is drawn above all to the insistent recall of his memories. When he has lived with his gaze strained towards the future, it becomes restful to turn his eyes back and look serenely and philosophically on the unchanging depths of the past.

Painting and sculpture would have demanded an effort beyond the energies that remained to me. So I gave up all idea of devoting myself to a labour that I felt I could no longer perform without fear of grave disappointments. A seasoned professional as a designer, I rejected the role of belated amateur. My respect for art saved me from the temptation to mistreat it. Instead I decided to devote part of my time to an account of those events that have left the deepest impression on my memory during the period when I played a leading role in designing automobiles for Fiat. But when I buckled down to the task I realized that as soon as one examines the past and tries to distinguish events and ideas, to fix their outlines, discover their causes and consequences and the often hidden links between them, all sorts of new difficulties arise, the difficulties inherent in all history. Nevertheless, I have decided to accept the risks involved in the undertaking, as I used to accept those I had to deal with whenever I embarked on a new design.

It is no use looking for objectivity in my account. Men who live intensely and have restless minds interpret events and ideas in ways that are modified according to the impress they receive from the world surrounding them and their range of interests. There is no such things as an objective account, any more than objective action. Anatole France has written that those who think they put nothing personal into their works are victims of the most deceptive of illusions: we speak of ourselves every time we lack the strength to keep silent. So I hope I may be pardoned if I write of things as I saw them and events as I lived through them. In the eyes of those who also took part my version may appear different from their memories of them. The landscape looks different as we view it from one direction or another and each person picks out those details that attract his attention. I have set myself the aim of giving an account of things as they appeared to me during my lifetime, with the purpose of providing an insight into a job with many facets, one that is not always sufficiently understood and appreciated even within the auto industry itself, where men are often organized into groups and prevented by increasing specialization from widening their knowledge of the work of others.

I hope this book will help to make known the contribution of design engineers to Fiat's industrial development in the period when the automobile underwent its major development.

Much might be said about the biggest private manufacturing corporation now in Italy. Its history began towards the end of the last century and has travelled the roads of the whole world. Italy owes much of its technological progress and even its social development to Fiat. Its whole history would be well worth writing but that is a task beyond me. I can only speak here of Fiat as it appeared to one of its design team. My memories and impressions after more than forty-five years engaged in research and design for the company are the basis of my account.

Looking back, I feel overwhelmed by the memories that throng my recollection. The more pleasurable ones, on which the mind lingers willingly, contrast with others that bring back the sting of defeat, of regret for failures in achievement caused by lack of willpower. To speak about them I shall have to try to order my stock of memories and make some coherent choice of the most significant episodes.

My working life falls into two distinct periods. The first went from 1928 to 1946. Almost eighteen years; essential in licking me into shape, giving me experience, advancing step by step through the various stages of a career in the Engineering Division until I had demonstrated to Fiat's top management that I was finally capable of taking over total responsibility for design. The second period begins in 1946, when I was nominated director of the Engineering Division, and ends in 1970, the year when I retired after reaching the age limit. These were twenty-four years of extremely complex and varied work that saw me engaged in nearly all fields of activity: I was in charge of designing automobiles, industrial vehicles, special models and in particular military vehicles; in addition I was responsible in different ways for supervising other sectors, such as agricultural and industrial tractors, high-speed marine and industrial diesels and so forth. The Design Centre operated under my management from its inception.

I consider it useful, if not essential, to define the significance of the word "design". It comprehends the conception, working out and final definition of the created object before it is materially executed. It is an imaginative process whose development is made possible by the application of the sciences which constitute engineering, covering constructional science, mechanics, electrical engineering, electronics and a wide field of knowledge including technology, economics, commodity marketing etc. In the automobile field (as in architecture), aesthetics, biology and ergonomics are also extremely important. If any one of these factors is neglected, the efficiency of the machine will be diminished. If insufficient attention is given in designing an automobile to the stress borne by its component parts and the choice of materials to use in making them, then breakdowns and an unacceptable degree of wear will occur during use. Anthropometry, the study of human proportions and dimensions, and ergonomics, the study of the relationship between man and his tools, are among the sciences which the automobile designer must draw on in his work.

The automobile, as a machine conceived by man to achieve rapid movement, has reached such a degree of perfection that it has become a mobile living-space. The car designer is comparable to an architect. It is logical to think of automobiles in terms of aesthetics and styling.

Aesthetics in its original signification concerned the reactions of the senses and the brain, a mode of responding to sensations; one of the possible reactions to the perception of forms, colours, sounds, flavours etc. Beauty generates a favourable aesthetic reaction but it may also happen that repulsive objects, landscapes that are squalid and confused, decidedly ugly, possess aesthetic qualities. Fashion is a question of aesthetics.

Style is an effective way for the automobile to create a favourable aesthetic reaction, fashion-wise, in a context of commercial competition. An automobile may be ugly but aesthetically valid at the moment when it is presented to the public and launched on the market. It will not last long, however, for aesthetic reactions change with time. Many will remember the big American models in 1960, which were decorated with enormous fins on the back mudguards, as ugly as they were useless, caricatures of aeronautical inspiration, the expression of a decadent aesthetic. Even today there are still people who get a thrill out of a roar from the exhaust pipe and others who like science-fiction forms; but these aesthetic reactions are ephemeral. Only beauty is unchanging. One should never be able to apply the tag of the fable to an automobile: "*o quanta species... cerebrum non habet*" (how beautiful it is, but it has no brain). A beautiful appearance is not enough. A brain is essential. The ideal of beauty demands beauty in itself joined with a beautiful form. In the case of the automobile as with all the works of engineering and science, this is achieved by the painstaking search for perfection, with every part in harmony with the whole, in accordance with the supreme principle of economy. Economy is here understood as a science, as the art of justly ordering the parts within the whole, achieving the just relationship between dynamic qualities as well as between intrinsic and aesthetic ones.

Economy in physical phenomena and in works of engineering finds its measure in “performance” or “efficiency”, the relation between the energy available and the energy expended to obtain it: this principle reigns in all manifestations of nature (which is continually evolving) and determines its beauty. Anything which lacks a raison d’être from the point of view of economy fails to contribute to animal and vegetable life, to scientific and technological progress and also to ideal beauty. The same is true of man and social life. Politics without economy is doomed to failure. If its “performance” is low and continues to fall the consequences can only be disastrous. It is logical that the engineer, especially the designer whose work tends towards progressive increase in efficiency, should regard politics with mistrust.

I am not a scientist but as an engineer I feel an affinity with science. I am interested in the position of scientists when confronted with politicians. Scientists are reserved and often distrustful of politicians. Morality and politics are imprecise and full of uncertainties.

Oppenheimer said: “Science progresses by dwelling on points of doubt; politics proceeds by hiding them. It does not progress; it functions.” And again: “All members of the scientific community possess in common the rigour of relations between colleagues, the absence of ambiguities in the terms they use, the objectivity of the communications which pass between them.” There is an abyss between the behaviour of scientists and the methods of politicians. The world has now become so complex that governments will have to adopt new methods. Scientific thought is beginning to penetrate.

To govern nations, rational thought and a knowledge of the fundamentals of mathematics and physics are needed, without which it is impossible to have a clear vision and understanding of events.

The design of a new model is fraught with far-reaching consequences, a great adventure. It becomes even more of an undertaking when the objective is large-scale production. The decision to embark on such an enterprise is an act of immense responsibility but it is impossible to evade it, for it is imposed by the inevitability of progress, involving the survival of the factory itself. During the long period that I was working as an engineer with Fiat, the final decision to undertake production of a new model was always taken by the President. The managing director and general manager shared in the process of decision-making. Vittorio Valletta was for a long time both President and managing director. He possessed all the qualities required for both tasks. He could be persuasive and winning and had all the qualities needed for leadership. Many good qualities together with a number of less good ones. He was very popular with his employees. No-one doubted the rightness of his decisions. Now, looking back, some look like mistakes but perhaps more time will have to pass before a judgement can be formed.

The general manager listened to the opinions of the men in charge of design, production and sales, and submitted his conclusions to the President. The latter always kept abreast of the development of work and especially the ideas behind this development. He would weigh and examine every aspect of the proposals put forward during meetings reserved to the three or four directors in charge of their execution, then made his decision.

Secrecy was scrupulously preserved. The minutes of these meetings, generally kept very brief, were numbered and kept personally by those who had taken part.

While I was still quite young (twenty-nine years old) I had the privilege to take part in a meeting presided over by senator Giovanni Agnelli when the decision was taken to manufacture the little Fiat 500, later called the *Topolino*.

Seated around the big oval table of the "Report room" at Lingotto were Valletta, Rambaldo Bruschi, central engineering director, Guido Soria, sales director, commendatore Alessandro Genero, director of works and production, Tranquillo Zerbi, chief engineering director, Cavaliere Andrea Prever, director of the Experimental Division. Senator Agnelli got each to state his viewpoint and listened carefully. His severe, finely shaped features, his clear attentive eyes and intense, probing gaze showed signs of impatience whenever anyone's words went beyond the strictly essential. He summed up briefly, saying what was to be done. Resolute and incisive, he would express himself in dialect whenever the "pure" Italian word was not forthcoming, as happened from time to time.

Called on to justify some snags we had run into during tests of the Fiat 500 *Topolino* and report what I intended to do about them, I struggled to explain as best I could, hampered by my shyness. I was heartened by the vaguely sympathetic attitude which I felt was aroused by my youth and relative inexperience.

From then until I was promoted director of the Technical Division I had very few occasions to be present at meetings of the directors. The Technical Division was represented by Antonio Fessia. Before every meeting Fessia called me to give him a picture of the situation and as I dealt with each aspect in turn he would dictate whatever he thought worth reporting to his secretary, who put it down in shorthand. After each meeting Fessia would let me know what decisions had been taken and I would go ahead with the work, after turning the information

Giovanni Agnelli, senator, born in Villar Perosa (Pinerolo) in 1866. A cavalry officer, he gave up his military career in 1892 and for a number of years devoted himself to administering the family estate. In 1899 he founded the Fabbrica italiana automobile Torino as a joint stock company, becoming his managing director and, after 1920, its President. The firm has used the acronym Fiat since 1906. He also promoted other important enterprises. In the industrial field he set up the first Italian factory for ball bearings (1906), RIV at Villar Perosa; he opened the large Vetrococke works in Porto Marghera (1923) and the immense hydraulic system at Moncenisio (1920-23). Among his activities in the field of tourism, mention should be made of the winter-sports centre he founded at Sestriere (1932) and Milan-Turin super highway (1932). In the social welfare field he founded the two large sanatoria named in memory of his children Edoardo and Tina (both of whom died tragically young) in the Alps at Fenestrelle as well as the Edoardo Agnelli hospital in Pinerolo and the Edoardo Agnelli international institute for the care and education of the young.
In 1923 he was nominated senator and in 1937 received an honorary degree from the Turin Polytechnic. He died in Turin in 1945.

Andrea Prever, born at Giaveno (Turin) in 1886. He joined Fiat in 1905 as an electrical technician, running the Fiat Engine Testing Department in corso Dante and subsequently becoming responsible also for the Aero Engines Test Section. He then was appointed director of the automobile and truck testing sector at Lingotto.In 1928 he was made director of the Test Department. He died in Giaveno in 1938.

over in my mind and interpreting it as I thought fit. The reasons for certain decisions and remarks about future policy were kept secret as far as possible. The minutes had written on them: “Top secret”.

In 1946, when I was appointed director of the Motor Vehicle Technical Offices, I became the “chief engineer”, in charge of designing automobiles and other vehicles manufactured by Fiat.

Being in charge of the technical offices did not mean merely being the director, as far as I was concerned, but developing my work into a larger scale: conceiving and foreseeing all the activities relevant to design. It meant following the progress of projects on the drawing board day by day and the gradual evolution of the new model of auto, truck, bus or other vehicle, seeing it in relation to Fiat's other programmes.

The telephone, correspondence, frequent visitors, meetings, preparation of reports, visits to motor shows and factories abroad, conferences, discussions with colleagues and collaborators in other divisions – sales, servicing, production –, the organization of tests and examination of their results together with a variety of other tasks never interfered with my constant involvement in design development. It was a strenuous job, which combined the hustle of action with the fascination of research and reflection.

Design also means evaluating difficulties, identifying the key issues, getting hold of the various possible solutions and choosing the ones that are going to do the job as simply and completely as possible.

The vehicle, in its first provisional configuration, is broken down into independent elements which are then entrusted to de sign engineers and developed in a detailed study. The synthesis of the single elements worked out in this way leads on to the reconstruction of the vehicle in its definitive shape which may in some cases be different from that envisaged initially.

Quite often I would find myself having to start all over again at this point. When the finished design was presented to me, I might find it was possible to vary the choices made at certain points and so improve the result from the technical or economic viewpoint. I could not be satisfied until I had got the new ideas set down on the drawing board. I felt the urge to explore all possible avenues. And then I had to allow for the fact that the programmes were subject to change by the presidential board following the traditional visits to motor shows or secret information about the trends and projects of competing manufacturers.

Follow all avenues. It is not easy. Today there is the assistance provided by systems engineering, mathematical models are worked out and entrusted to computers and one has to believe the results they print out. In those days we relied on our knowledge of the calculus, our common sense and our intuition. Perhaps there was more of a kick in it that way.

What can be more wonderful than to experience an intuition that suddenly lights up a long, tortured, perhaps unfocused process of reflection and finally puts an end to the uncertainty that accompanies mental labour? I feel sorry for anyone who classifies, judges and decides everything without the least twinge of doubt in facing the future, without ever feeling the intimate emotion of uncertainty which is always lurking in thought and pervades all issues of the spirit.

One of man's distinguishing traits is to meditate and waver in doubt. It is a distinguishing trait of the designer to probe, have misgivings and second thoughts, focusing his mind on the future that draws continually closer. Anyone engaged in design knows that once his work is complete his only certainty is that there will be scope to improve it.

Everything alters with the slow stillicide of time, even men, their thoughts, their ideals, even moral laws. I remember reading somewhere: "There is something impertinent about burning for an ideal."

The smattering of philosophy that I learnt together with Latin at high school must have made some impression on me since as I have grown older I have invariably gained more pleasure from reading philosophy than anything else, always finding it stimulating. People for whom reading is a necessity and a deep inward pleasure find philosophy perhaps the most varied and abundant subject, the one that brings greatest fulfilment. It is like a sphere with a multitude of facets, like the soul of man itself, and its greatness lies in its applicability to the whole range of knowledge. It helps man to accept his profound ignorance by teaching him resignation and infusing him with courage. For a man immersed in his work it is an aid to thought, the sweetest pleasure with which to while aways his moments of leisure.

My profession left me little enough time to read anything that was not concerned with the techniques of auto-building but I managed to read some of those works that by their content stimulate the mind and thoughts. My reflections often dwelt on the difficulties of living in the world of work. I realized the importance of these problems early in my days with Fiat when, to practise English (which I was studying on my own), I would translate word for word, the dictionary always to hand, an American handbook published by General Motors dealing with the relationships between departmental heads and workmen.

This stimulated me to reflect on the nature of certain work relationships. One of these was of particular interest to me: this was discipline, obedience. This often

Comparison between the Welleyes 3½ HP and the Topolino in piazza Carignano, Turin. A jump of 36 years.

came back to me later on, assuming aspects in certain circumstances that affected me deeply.

I no longer recall when it was – years since – that I came to the conclusion that discipline is a spontaneous emanation of culture and upbringing. That without culture and hence discipline there can never be freedom and consequently a democratic regime could not prosper even in the factory.

It is a problem that concerns both those who have to make laws and those who have to respect and apply them; a problem that in big companies affects both the executives and their colleagues and employees, office workers and factory hands.

The way in which an instruction or order is expressed is related to discipline and obedience. When orders are given to solve a problem or deal with a situation which clearly justifies them, obedience arises spontaneously and does not disturb the course of events that follows. But if the orders are not accompanied by any justification and appear to those on the receiving end as an authoritarian act whose reasons are concealed, then the problem of the legitimacy of obedience arises.

Sensitive minds cannot bear to be spoken to in such a way that no reply is possible and feel an instinctive impulse to rebel. I have always shown respect for the values of the hierarchy without which no organization can operate efficiently and produce good results but I have stubbornly defended freedom of thought, including that of my staff, and this has been to my own advantage.

I have found myself in situations where I wondered whether a disciplined mind should obey even though it was certain that the order would have had negative results if carried out. And the answer I gave myself was that discipline, properly understood, involved a meditated form of obedience.

I think that an order should be interpreted in relation to its purpose. It often happens that the person giving the order does not know the procedures and the difficulties involved in executing it nor the possible unforeseen factors that may arise. It is then legitimate to act according to the circumstances and the means available. Nevertheless, one may have to submit to some bitter experiences.

I have always scrupulously respected the established hierarchy and when the principal features of a new project have been decided I have been careful to apply the project instructions contained in the initial schedule embodying the essential specification of the model. In developing the project, with extremely rare exceptions, I made my decisions on my own, bearing in mind always the limitations imposed by economic considerations and holding myself fully responsible for the results.

I have never considered it necessary to discuss projects in meetings with a number of other people during the phase of conception and design. I don't think a committee can turn out a good design. It was Kettening, General Motors' great designer in the Twenties, well-known as the inventor of the electric starter, who described a camel as a horse designed by a committee.

On the other hand, I have always given serious consideration to all the suggestions put forward by my staff and designers, examining and discussing them together. Fiat made available to me the necessary equipment to get the required results from the Design Department and in consequence my job was to make sure the schedules were executed by applying the proper techniques and with the minimum expenditure of time and energy.

I considered it my duty to foresee, identify and then resolve the problems that were going to crop up in the future. Only by sharing the designer's sense of the future is it possible to envisage what is or is not going to be possible: this was my constant thought. And as soon as my mind got caught by an idea that looked worth going into more deeply I had no rest until I could check its validity by drawings and calculations.

The bug of creativity and inventing new things got into my bloodstream early. I have experienced the thrill of solving intriguing problems. I have been stimulated by imagining new things and felt the satisfaction of seeing them brought into being. I have seen the future transmuted into the present, imagination transformed into reality, while my mind restlessly sought new scope for action and my thoughts returned steadily to the drawing board.

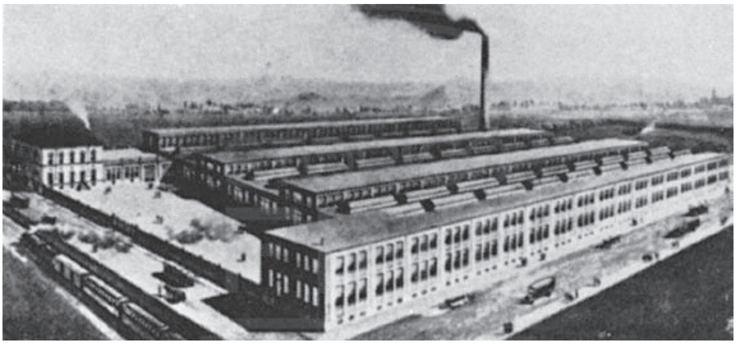
CHAPTER II

EARLY YEARS AT WORK

In 1927 I took my degree after five years at the Polytechnic and presented myself at the recruiting office for military service. At the Officer Training School in Bra I indulged my passion for drawing at the quartermaster-sergeant's desk by sketching in the figures missing from the notes handed out by the weapons instructor. I did not take advantage of this to get out of the courses of instruction, drill or fatigue duty, though the last-mentioned was by no means light, in our unheated barracks in a freezing winter. At the end of the course in June 1928 I was graded second among all the students at the school. This was a very much better result than I had attained at the Turin Polytechnic.

My only aspiration was to start work as soon as possible and so save my father the expense of supporting me in Turin. I returned to the "bed-sitter" I had occupied as a student. My family was still in Alba, waiting to decide if and when to move to Turin. Everything depended on me, but it was by no means easy during that period of economic crisis for an engineer fresh from university to find work. I had no idea whom I could turn to or how to present myself. Every day I looked through the job ads in the papers. My first interview took place in one of Olivetti's offices in via Roma, near piazza Castello. A magnificent old gentleman with a flowing beard, no less a personage than Olivetti himself, interviewed the young engineers with a manner that was benevolent and encouraging. He subjected me to a bland, almost paternal cross-examination. Among other things he wanted to know whether I liked the idea of going to work in Ivrea. I said I preferred to stay in Turin (and thought of Fiat).

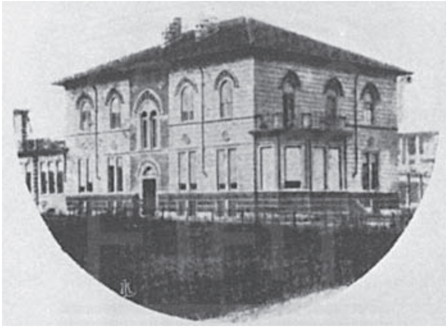
Further attempts with factories in Turin brought no success. Finally I turned up at no. 122 corso Ferrucci in answer to a classified ad in *La Stampa*: "Design engineer wanted." It was for SPA. The door opened, the doorman led me into a cold bare room



Aerial view of the SPA works in corso Ferrucci, Turin, 1923.

on the left of the lobby: the visitors' lounge. I don't remember how long I had to wait, building dreams of the future ahead of me. They were broken into by the entrance of a tall, rangy gentleman, slightly stooped, with an olive complexion and a thin nose than jutted sharply over a toothbrush mustache. He introduced himself as Alfano, an engineer and the head of the technical office. He was a gloomy-looking Sicilian, somewhat taciturn. He asked me few questions, finally wanting to know my educational training. Timidly I said: "I have a degree in mechanical engineering". He rested his hand on the table-top and pushing himself with an effort up from the chair – he suffered from pains in the back – so took his leave of me with a doleful expression and slowly went out the door leaving it open behind him. I didn't give up. There was a blonde, a friend of mine, whose father was the ex-President of an important mechanical engineering firm. I spoke to him and be promised that he would have a word with "Valletta". This was how I learnt that Valletta was the general manager of Fiat and that SPA had been part of Fiat since 1926. The general manager of Fiat was a certain Torcetta.

A month later I was taken on as a design engineer earning 845 lire a month (470 being my salary, and 375 a special allowance). On 2 November I presented myself to Signor Alfano equipped with my case of compasses, ready to draw. He did not even give me a chance to prove myself but told me to put the standardization table in order. I was a bit downcast for a little over a month, then I took the initiative of tracing the chassis of a truck, the *25 C* model, which the draughtsman alongside me was working on. In this way I showed myself able to draw rapidly and won my spurs as a design draughts man, which at that time and in that milieu meant a good deal more than a degree in engineer-



SPA, acronym of the Società Piemontese Automobili, founded in Turin in 1906 by the entrepreneurs Michele Ansaldi and Matteo Ceirano. The firm's name was changed two years later in Società Ligure Piemontese Automobili, with the transference of the premises to Genoa following its merger with the Flag company in Genoa and the addition of Genoese capital. For trading reasons, the acronym was retained and production continued in Turin. In the period before the First World War it was one of the largest Italian manufacturers of autos, aero engines (the earliest being designed by Aristide Faccioli) and motor trucks, which led to government orders on such a large as to determine the company's future development. In 1926, following the credit squeeze and the upset caused on the stock market by the failure of the Banca Nazionale di Sconto, backers withdrew and control of the company passed to Fiat, which concentrated its plant on truck production, as it was later to do with OM. SPA ceased to exist as a separate legal entity in 1947, being merged with Fiat, but the marque is still used to designate one of the company's divisions.

Cesare Momo, engineer, born at Carrara in 1876. Shortly after taking his degree in Turin in 1901 he entered Fiat where he worked under Enrico. He designed the multiple-disk wet clutch which was soon adopted on all Fiat autos, as well as the rear axle he invented. In 1906 he left Fiat to work for the Gallinari shipyards in Leghorn. In 1911 he produced the design for the Caesar auto. In 1915-18 he partnered Brezzi in the technical management of the Ansaldo aircraft manufacturing works. After the war, in 1919, he was put in charge of engineering at Ansaldo and then of SPA in Turin, which Ansaldo had taken over. He retained this managerial post even after Fiat took over ownership of SPA. He retired some years after the end of the Second World War. He died in Torre San Giorgio, near Saluzzo (Cuneo), in 1966.

ing. I also learnt that the director superior to Alfano and in charge of the whole Research Department was Cesare Momo.

Momo, an engineer, was already an elderly man with wide experience as an expert designer of automobiles and trucks and an innate flair for the job. He was small in stature with fair hair that was on the point of becoming grey and a moustache tinged yellow from the nicotine of a stubby "toscano" cigar that he had constantly clenched between his lips, whether or not it was it. Spectacles could not hide the shrewd smile in his clear, bright eyes. He would tackle any problem with serene good-nature, maintaining that a designer should never be afraid of difficulties. "Why shouldn't we be up to the job of designing even an aeroplane or a submarine? Just study the problems involved and solve them sensibly," he would say, smiling pleasantly. At the same time he would be drawing the complicated transmission system for a military transport with four wheel drive and steering. This taught me a lot, including how to behave with colleagues and subordinates.

He talked about the great engineers who had been technical directors with Fiat. There was Aristide Faccioli, the first head engineer with Fiat, who left the firm because of clashes with Giovanni Agnelli over technical policy; Giovanni Enrico who had also been one of Momo's masters; Carlo Cavalli, a law graduate and a brilliant draughtsman and designer who started his career under the guidance of Giovanni Enrico in 1905. Cavalli had designed the *Taunus*, *Zero* and *501*, and the *18 NL* and *15 Ter* trucks. He left Fiat in 1928.

Aristide Faccioli, engineer, born in Bologna in 1862. After taking his degree in Turin he secured his first patents at an early age: for a double-action gas engine in 1883, and for improvements to four-stroke engines in 1885. After becoming head engineer of Ceirano in 1898, where he designed the "Welleyes" auto, which was to be the prototype of the first Fiat auto, he moved to Fiat in 1899, becoming its first technical director. He left the Turin firm in 1901 and attempted to set up his own autoworks but the venture soon failed. He then turned to aircraft design and built the first Italian powered-aircraft in partnership with SPA: this was the "SPA-Faccioli" triplane, which made its maiden test-flight on the Venaria Reale airfield near Turin, piloted by his son Mario. A lighter biplane with a more powerful engine was tested by Mario Faccioli in 1910, with highly satisfactory results, but it did not prove possible to take these ventures any further. Faccioli withdrew into seclusion and died in Turin in 1920.

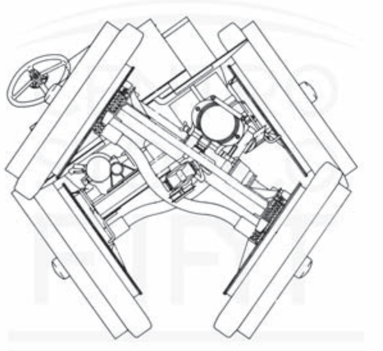
Giovanni Enrico, engineer, born at Casale Monferrato in 1851. After taking his degree in 1876 he opened a small engineering workshop where he manufactured and experimented with steam-powered machinery, boilers and other machines, but had to close down two years in 1884.
He became director of the Rome electric power station and then of the Edison power station in Paderno d'Adda. In 1901 Giovanni Agnelli took him on at Fiat as technical manager in place of Aristide Faccioli.
He brought wide technical experience to the service of the company, of particular value in a period when specialized workshops did not yet exist and the automaker had to posses specific knowledge in all relevant fields of manufacturing. In 1906 he retired on health grounds.
He died in Pinerolo (Turin) in 1909.

Carlo Cavalli, born in Val Vigezzo, 1878. Cavalli graduated in Law, in accordance with his father's wishes, but his real love was engineering. In 1905 he entered Fiat's technical office and immediately gave proof of his powers. In 1919 he was officially appointed director of this office and retained the post until 1928, when he was forced through illness and exhaustion to retire to his native valley.
He had the merit of having been the first to fit a racing engine with a compressor, but the project for which he is remembered is the *501*, the first Fiat auto built in large numbers after the Great War.
He died in 1947 in Santa Maria Maggiore (Novara).

Giulio Cesare Cappa was an engineer who entered Fiat in 1914 and resigned in 1924, a year after the new works at Lingotto were opened. He had contributed to the design of the A 14 aircraft engine and the *509* and *519* model autos. The designs of these two models displayed Cappa's distinctive style. He was not very successful. At Fiat he was considered "fanciful" and his designs too recherché, unsuited to production on an industrial scale. I met him many years later and understood the reasons for his lack of success in the Fiat milieu.

Early in May 1929, SPA's Technical Department was transferred to Fiat and given room on the fifth floor of the "palazzina" at Lingotto, the new and up-to-date works inaugurated in 1923. I received a letter signed by Torcetta, the general manager of SPA, informing me that as from 1 May 1929 I was transferred to the employment of Fiat as a draughtsman in the offices of Veicoli Pavesi with a salary of 950 lire (530+420). This office consisted of a small group of draughtsmen who dealt with the designs of Pavesi military tractors, intro-

Giulio Cesare Cappa, engineer, born in Voghera (Pavia) in 1880. After taking his degree in mechanical engineering in Turin in 1905, he took part in the second international Automobile Exposition in Turin the same year, displaying the prototype of an ingenious single-cylinder water-cooled motorcycle.
The engineering director of Aquila Italiana, he designed and produced numerous innovations.
In 1914 he joined Fiat as head of the technical office, contributing to the design of the A14 aero engine, the *509* and *519* autos and the *804* racer which won at Strasbourg in 1922.
In 1924 he set up on his own, designing an airplane engine for the French La Lorraine company.
Appointed Itala's engineering consultant, he designed the model *61* auto and the *11* and *15* racers.
In 1924 he went over to the Ansaldo company where he designed a "battalion cart" to military specifications.
He worked as consultant for Breda, Piaggio, Alfa Romeo, CEMSA and Caproni.
He died in Voghera in 1955.

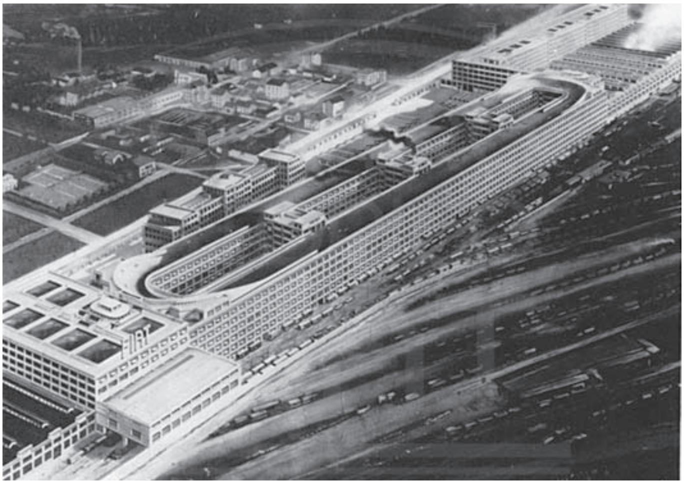


The Pavesi tractor, highly original in concept, was articulated so that the two axles could be set at practically any angle to each other.
The maximum degree of variation could be achieved when the vehicle was not cornering; at full lock the deviation could not exceed 30°.
The special steering system enabled the vehicle to be coupled together to form long trains and exactly follow the path taken by the towing vehicle. This was the feature described as "adjustable arc steering".
The large wheels, solid tyres and tilting grip-plates enabled it to travel on any terrain.

ducing such modifications and improvements as experience suggested. It was part of the Military Vehicles Division and formed part of a group of engineering offices under Momo which included the Agricultural Tractors Division and the Racing Division under the charge of the engineers Rossi and Gorrini. Momo was the internal director of the Military Vehicles Division but Gorrini also had a hand in it. I threw myself into perfecting the Pavesi tractor, an articulated tractor with all-wheel drive of a very original design and incomparable in performance off the road and over the most rugged terrain. Such was the validity of the Pavesi's functional scheme that it was taken up again by the Americans in the Sixties in plans for off-road military transports.

The work accomplished in those years was both extremely useful to me and highly absorbing. I kept as dose as possibile to Momo, even acting as his secretary and filing-clerk. The correspondence, the basic schedules (lists of designs) and instructions for modifications were all handwritten. We had no typewriters. I enjoyed drawing and liked to follow the work of the draughtsmen. They took a liking to me and did not mind my interest in their work. In this way I shared in the designing of a number of military vehicles, ranging from the Pavesi to a small tank derived from the English Garden Lloyd and including the chassis of an armoured car with a driving position at either end, a six-wheel drive truck that got the nickname *Dovunque* ("Anywhere") and eventually, over the years, gave rise to a long series of military vehicles derived from it. I also worked on a little cross-country vehicle, the "battalion cart", designed on the basis of specifications laid down by the War Ministry to travel along mule-tracks in the mountains. In short, it was a period of intense activity that trained me to turn my hand to the most varied problems. I was also given the task of designing a trailer for trucks. I went thoroughly into the problems of the adjustable turning arc for road trains. I helped Rossi in preparing material for the racing team that took part in the last Coppa delle Alpi with the *525 SS*: the drivers were Nazzaro, Salamano, and Giaccone.

The work of designing and numerous other tasks that were carried out in the engineering division were dispatched quickly and efficiently under Momo's direction. The wide scope of the studies done and problems tackled was absorbing and



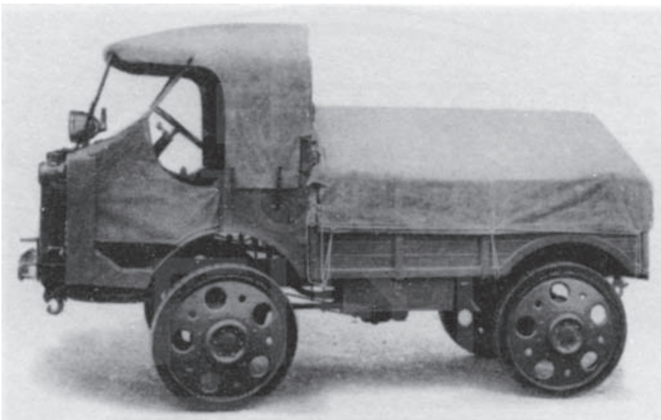
An aerial view of Fiat's Lingotto works with the elevated track for vehicle testing.

also exciting for me. I worked incessantly and with a sense of fulfilment. But this happy period did not last long.

Some difficulties must have cropped up at SPA, perhaps as a result of the remoteness of the Engineering Department from the factory, which was still in corso Ferrucci, or for some other reason unknown to me. Anyway the decision was made to split up the offices under Momo's direction. Military Vehicles was moved from Lingotto back to its old premises in corso Ferrucci. The work on competition models was abandoned (Rossi had died in a road accident), a decision reinforced by the fact that some years before senator Agnelli had directed all the racing cars to be scrapped as a result of the death of Bordino, Fiat's great racing champion. Among these models was the *806*, built according to the formula current in the period with a 1.500 cc engine, the winner of the Monza Grand Prix in 1927 when it averaged 152,2 km/h. Gorrini managed to salvage only a compressor, a connecting rod and a piston, which was used for some time in the office as a paperweight, eventually disappearing.

Towards the end of 1930, after an economically troubled period for the whole country, Fiat decided to cut wages. The crisis was caused by the government's economic policy and the world depression caused by the American slump. In Italy it had begun in 1925, when the State had tried to reduce the balance of payments deficit, going so far as to try to attain self-sufficiency in food production by a campaign for growing cereals without counting the cost. It had also increased customs tariffs and empowered the Ministry of Finance to block imports or establish quotas.

The "Battalion cart" produced by OM and SPA.



Felice Nazzaro (right) and Carlo Salamano in the 525 SS specials built for the 1929 Coppa delle Alpi.

Bartolomeo Nebbia, technical designer, born in Castello d'Annone (Asti) in 1891.
After joining Fiat in 1911 as a designer, he was promoted head of the engines technical office in 1920 and office manager in 1930. In 1940 he became service manager under Fessia, and in 1953 was put in charge of the Industrial Engines Department. He left the company in 1958, retaining his links with Fiat as consultant. He died in Castello d'Annone in 1978.

As the lira continued to fall, in 1926 the government was forced to stabilize its exchange rate at 90 to the pound sterling and declare the Banca d'Italia the only bank of issue. There followed a period of deflation, with a fall in prices and wages and an increase in unemployment. Nevertheless the Italian economy improved slowly. Fiat and other companies such as Edison, Snia Viscosa, Montecatini and Pirelli began to look up. But then the 1929 world depression had its repercussions on industrial output in Italy, which naturally affected Fiat as well.

My salary went down from 950 lire to 875 monthly. I was not much concerned by this. I was completely absorbed in work and money meant little to me. Nor did I bother much about political and economic developments: work was my main concern and I had no thought for anything else. I lived alone and my salary was adequate.

With the return of the Military Vehicles Division to SPA in corso Ferrucci, the tractor sector under Gorrini was transferred to Modena. I had taken a great liking to Momo and was sorry to have lost his guidance. I stayed on at Lingotto where Tranquillo Zerbi, the engineer in charge of the whole Technical Division, assigned me to the Motor Vehicle Engines Section. The director of this office was Bartolomeo Nebbia, whom the draughtsmen affectionately called *Bartamlin* in dialect. I was meant to work on engines for industrial vehicles, a department run by Alessandro Bertolino, but the positioning of my drawing-board near Nebbia's desk was supposed to imply some sort of direct subordination to the office manager. I certainly never imagined that Nebbia, after being named Cavaliere del Lavoro (a title awarded to prominent figures in industry), would many years later come to be working under me and that a close and enduring friendship was to develop between us.

In this way a knowledge of engine design was now added to the experience of designing vehicles acquired under the guidance of Momo. To start with I was given the job of studying combustion and regulation chambers for Diesel engines in the *632* and *634* model trucks. On 1° January 1931, my salary was increased but a year later, in February, there was a 10% cut, caused by the country's economic problems.

Since I had been working at Lingotto some important developments had matured at Fiat. In 1929, after production of the *509* (with an engine of about 900 cc) had stopped, a start was made on production of the *514* (about 1.500 cc) in a variety of models: sedan, coupé, cabriolet-royal, torpedo tourer and sports car, the *514 L* having a stretched wheelbase. Under Zerbi's direction the *508* project began, the three-gear model that was later to be known as the *Balilla*.

In 1931 production was going ahead with the *514*, the *515*, the *522 C* and *L*, the *524 C* and *L* and the *525 N*, *S* and *SS*. Three engines were used: a 1.438 cc four-cylinder engine was used for the *514* and *515*, a 2.516 cc six-cylinder for the *522* and the *524*, and another six-cylinder, a 3.739 cc engine, for the *525*.

The aviation sector was working at full pitch. A team of Fiat AS 1 aircraft won the *Coupe Internationale de Tourisme*. Three Fiat AS 2s flew right round Africa, a distance of 28.900 km, and the D'Ascanio helicopter, powered by a Fiat engine, won the world records for duration, distance and altitude for helicopters.

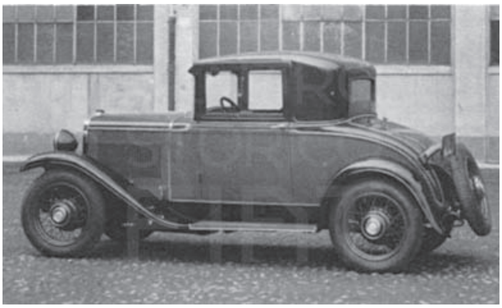
Fiat took part in the Schneider Trophy competitions with its supercharged aircraft engines. The newspapers were full of them and an excited public took an interest in the races which had become the preserve of the British and Italians.

In 1932 the new fighter plane, the CR 30 single-seater biplane designed by Celestino Rosatelli and powered by an A 30 RC engine came first in the Coppa Dal Molin.

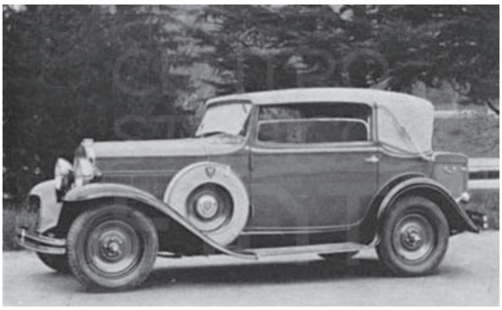
The Aero Engines Division envisaged development of new water-cooled engines intended for construction by more up-to-date methods and so better able to compete price-wise with foreign products. The technology of welded plate-metal cylinders was to be replaced by cylinders embedded in a cast-aluminium block. Super charging was also to be developed after its successful trials in the Schneider trophy races and the speed record achieved by the Macchi seaplane. The pilot had been Agello and the engine a 24-cylinder Fiat AS 6 driving two counter-rotating airscrews, the brainchild of Zerbi.

Celestino Rosatelli, engineer, born in Belmonte Sabino (Rieti) in 1885.
He took his degree in Rome and began work as an aircraft designer in 1915, working for the engineering control service of the air force. He carried out his early work in collaboration with Savoia and Verduzio, both engineers, contributing to the production of the SVA (Savoia-Verduzio-Ansaldo). In 1918 he took up a post as technical director of Fiat Aviation, where he remained for over twenty-five years, designing personally more than 60 types of aircraft.
He died in Turin in 1945.

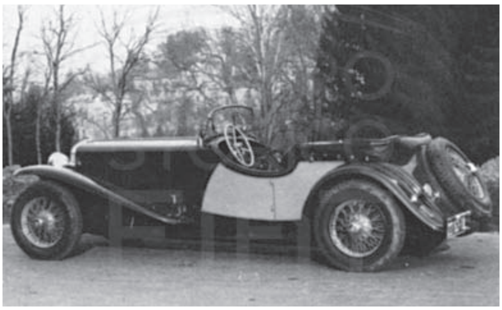
In planning new engines, the director of the Aero Engines Section, the engineer Vandone, and the head of the Technical Division Bona, thought it would be useful to boost the design office by bringing in an engineer who could contribute some new ideas and, fresh from his studies, might be capable of clarifying some of the problems involved in supercharging. On Zerbi's instructions I moved over to the Aero Engines



514 coupé-roadster (1929-31).



522 C Cabriolet Royal (1931-33).



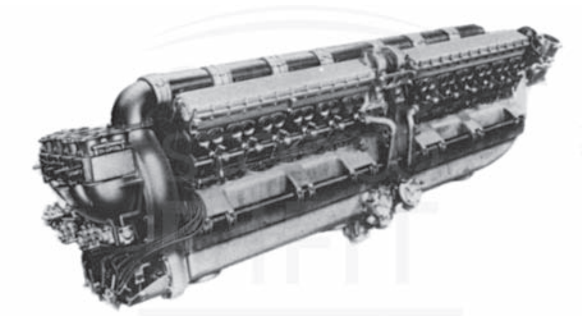
525 SS torpedo sports (1931).

Technical Office on June 1, 1932. The premises were not far from the "palazzina" at Lingotto in a building which also housed the test chambers and the premises of the experimental section.

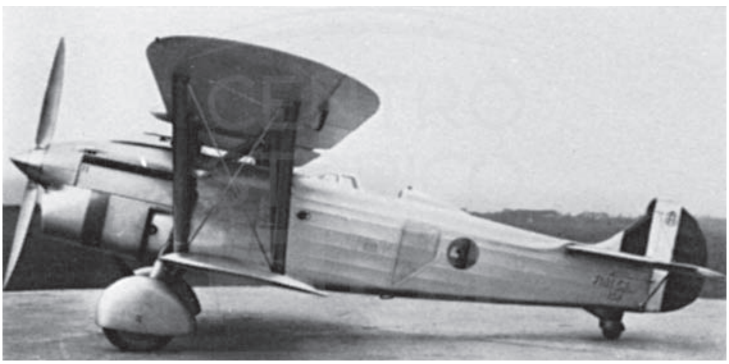
I found myself among the specialist designers, proudly conscious of practising advanced and refined techniques. The problems connected with lightness, functioning conditions at high altitudes and safety required a familiarity with highly specialized materials and manufacturing technologies utterly remote from the mass-produced automobile.

My work began with the study of supercharging as a way of counteracting the decrease in atmospheric pressure caused by altitude and then gradually widened out to cover the engine as a whole. The draughtsmen, who were older than I was and the mainstay of the section, began to respect my abilities without feeling put out by the fact that I had an engineering degree. Some of them, the oldest and most highly respected, had previously collaborated on the design of racing cars. In fact the constructional technique adopted for the latest racing engines was the same as that used for aero engines. Their names – Vaglienti, Massimino, Morra, Trevisan – carried authority among our group of specialists and in the workshop.

On 23 October 1932 Mussolini came on a visit to the Fiat plant. Like all the rest I was present at the turnout of Fiat workers in the Lingotto works organized to welcome the leader in due style. He was dressed in "civvies" with the usual black shirt and work-clothes. He wore a round grey hat with the brim turned up in front, appearing somewhat at odds with the heroic expression on his face and his imperious bearing. After a brief introduction by senator Agnelli, Mussolini made a speech to the crowd



Fiat aero engine AS 6 (1931).



Fiat CR32 fighter-interceptor (1934), designed by Celestino Rosatelli. The airplane was fitted with an A 30 in-line engine.

that thronged the whole length of the factory. The speech was brief and to the point, his stern gaze appearing somewhat less self-confident and overbearing than usual but he stood hands on hips, as ever, and chest puffed out, his chin jutting forward as if to dominate the big wooden anvil in front of him on the tail rostrum. He was absurd and pathetic at the same time and received coldly restrained applause.

It brought to mind another occasion, an encounter on a much smaller scale which took place in Pesaro six years earlier. I was a student and a member of the GUF athletics club in Turin. Together with a number of other university students I had been chosen for the team representing Italy at the "Student Olympics" (now called the "Universiadi").

The track team had gone to Pesaro in July to train together. Towards the end of the training period the secretary of the party, Filippo Turati, came to Pesaro to inspect us. Lined up in our track kit, all wearing the black shirt decorated with a badge consisting of a tricolor oval surmounted by the imperial "fasces" neatly embroidered on it, we gave him a light-hearted welcome in the true student spirit of those days. The Fascist leader began to advance with a martial gait ill-suited to his appearance, decidedly mournful despite the sparkle of his belt, bandoleer and boots and the Zouave-style ribbon adorning his stiff cap. He was about to move down the line of darkly clad athletes standing shoulder to shoulder when suddenly the figure at the head of the line, struck by a sudden inspiration, drawn from the comedy *Madame sans gêne* put on a few days earlier at the theatre in Pesaro, jerked his head sharply towards the athlete on his left and barked: "The emperor". The cry passed from mouth to mouth along the line while heads turned in rapid disciplined succession, carrying the words down to the very end of the row where the last shout of "the emperor" died away on the lips of the last athlete, the smallest, relegated to that position as we had been drawn up by height. With his eyes gazing skywards, stiffly standing to attention, he looked as if he was made of marble but was actually bursting with suppressed laughter, while the wretched party official, astonished and disconcerted, passed us in review. He did not envisage that there was a further humiliating "ragging" in store for him that evening.

Now, ten years later, in the midst of the crowd of workmen clapping the Duce at Lingotto, I thought of the attitude of university students like myself towards Fascism. We hardly spared a thought for politics, absorbed in study and the crazy student rags we amused ourselves with. Our biggest worry was making ends meet. Many of us saved money by not buying newspapers while the radio was only in its infancy then. Ignorance of what was going on was a part of our carefree existence. The cheap seats at the cinema, the gallery in the theatre or music hall, were the haunts of the university students of Turin and the scenes of their boisterous talk, which had nothing political about it.

At the Polytechnic violent brawls sometimes broke out between "freshers" and "sophomores", an outlet for our youthful aggressiveness, light-hearted strikes to demonstrate for or against certain lecturers. Only a few isolated students interested themselves in politics. In the main their ideas were oriented towards Utopian notions of society based on an ingenuous philosophy woven out of anarchist aspirations. We read Nietzsche and discussed the philosophical writings of our professor of theoretical mechanics, Filippo Burzio and his *Demiurgo*.

Life seemed simple, especially in the case of students like myself who lived in Turin away from their families, free, accountable only to themselves, with no cares other than eking out a meagre allowance till the end of the month. We felt free and in fact we were, even though we felt some irritation at the sight of the stuffed shirts in Fascist uniform, a dagger thrust prominently into the shiny belt, strutting about in via Roma and under the arcades in piazza Carlo Felice where we used to mingle with the rest of the crowd in the early afternoon and evening, in front of the "Casa del Caffè". The general feeling among us was that our brains were only just sufficient for our studies and that it was better not to waste them on politics.

On 14 November 1932 I was appointed departmental head and my salary went up from 1.260 lire monthly to 1.500.

Halfway through 1933 senator Agnelli decided to accept or perhaps request the resignation of Vandone, the director of the Aero Engines Section, and replace him by Fessia, from the technical office of the Automobile and Truck Section where he had been head of the Estimates Office.

Fessia, an engineer, was born in 1901 and entered Fiat in 1923, rapidly carving out a career for himself. The Estimates Office had been organized under him in such a way as to deal with the needs of the various design offices: auto engines, industrial vehicle engines, auto chassis, truck chassis. He had introduced a system of calculation charts which could be applied systematically to components of the engines and chassis so as to provide comparative data about the various different models and relate the results of the estimates with the results of the practical trials. In this way he produced information about all the data related to the vehicles Fiat had produced in the past and those now in production or being designed.

Fessia had a strikingly distinctive personality. As a person he was not congenial to everyone and in general did not inspire liking; but he was a brilliant conversationalist with a wide range of topics at his command, always intelligent and cultured. These were qualities he sometimes misused. He did not conceal his regret at not having followed classical studies and used occasionally to drop a Latin phrase into his conversation to show off his knowledge of the language. He was a keen music-lover and a skilful amateur pianist, or so he gave one to understand. His greatest gift was an infallible memory: his powers of recall were so rapid that they seemed electronic. This made it easy for him to pick up other languages, an ability on which he piqued himself. He

Antonio Fessia, mechanical engineer, born in Turin in 1901. He took is degree in 1923 and entered Fiat in 1925, securing an appointment as assistant director of the technical offices in charge of automobile and truck design. In 1932 he became director of the Aero Engines Technical Office, concentrating mainly on mathematical calculations and theoretical aspects of engineering design. In 1936 he was appointed director of the central technical office for mechanical engineering, a post which he held until 1946, when he left Fiat for CEMSA in Saronno, a company of the Caproni group.
Here he built the first modern Italian front-wheel drive auto, though it never got beyond the prototype stage. From 1950 to 1955 he did work for the Ducati firm in Bologna, for Pirelli, and Deutsche Fiat, at the same time holding a post as lecturer in automobile construction technology in the engineering faculty of Milan Polytechnic.
In 1955 he was taken on by Lancia, first as a consultant and then as central technical director. Here he was responsible for the various Lancia model whose names begin with "F": *Flaminia*, *Flavia* and *Fulvia*, the last two being front-wheel drive models.
He was also President of the CUNA, head of the coordination committee of the CECA and Italy's representative on the international traffic commission. He died in Borgomasino (Turin) in 1968.

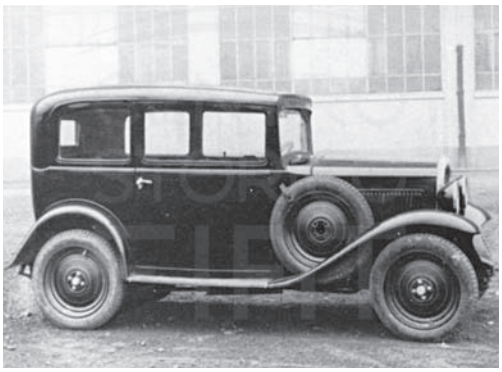
was ambitious and enjoyed talking about himself, with me for a listener. As a director he was first rate. He was easy to work for and showed complete confidence in me. He was a mathematician, I a designer and we got on swimmingly. He was impulsive and open-minded, I calm and reflective. Together we made an efficient pair.

He was friendly towards subordinates who tagged along with his ideas. With his equals he was extremely combative and was always making enemies. He would try to bring up subjects that enabled him to demonstrate his superiority, even when they had nothing to do with work. He was never friendly toward the rivals be invariably made. He had outbursts of impatience, irritating caprices and a streak of cussedness that sometimes carried him away. At that time I used to listen to him quite dumbfounded by his gift of the gab, impressed by his feats of memory and his sudden brainstorms. But it would also cross my mind that we were wasting time when we could have been getting down to the job, which was my main concern, especially when he began to expatiate, as be often did, on his prowess as a womanizer.

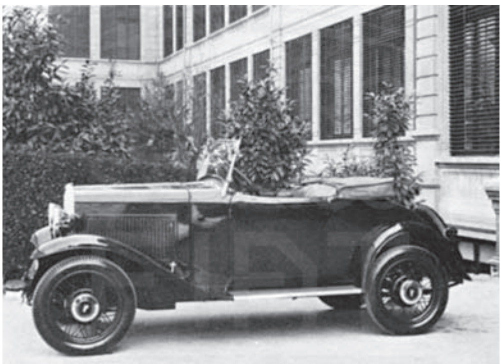
On 12 April 1932, the Milan Motor Show was the scene for the launching of the Fiat *508 Balilla*, selling for 10.800 lire. A poster came out announcing, "At last a car for the people. Fiat's gift to the Italians, the new *Balilla*". The engine had been designed by Nebbia, the chassis by Martinotti and the coachwork under the direction of Schaeffer. The layout and estimates had been done by Fessia. Although Zerbi had been in charge of the project, the success of the *Balilla* had brought Fessia to the fore and helped to make him a rival of Zerbi. His promotion to director of the technical office for research into aero engines was the first outcome of this.

The Aero Engine Office was moved to the Lingotto "palazzina" where it occupied the room on the north side of the fifth floor, the same one where I had worked on Pavesi vehicles and military vehicles under Momo a few years earlier. We were in contact with the technical offices for automobiles and trucks, which Fessia did not want to give up.

With my promotion to departmental head I had been given the responsibility for designing water-cooled engines. My immediate boss was Carlo Felice Bona, who eventually became a close friend of mine. We made a thorough study of Rolls-Royce and Hispano-Suiza engines: I managed to find out how the cylinder barrels were mounted in the famous Hispano-Suizas designed by Birkigt by going on a tour of the Paris



508 Balilla standard sedan (1932).

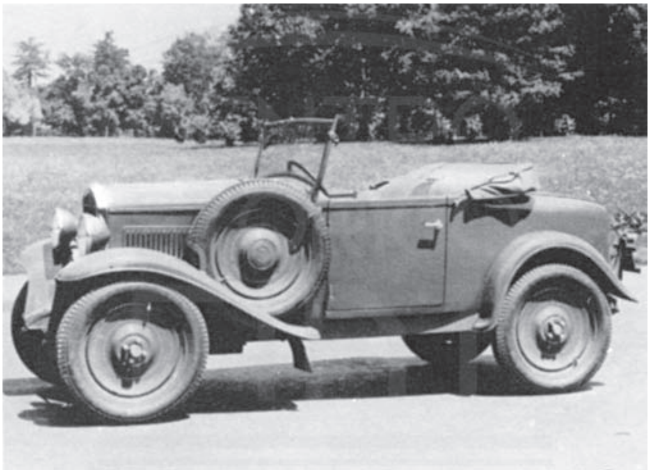


508 sports car, pre-production prototype (1932).

works in the guise of an air force officer. In this way we designed the A 33 RC engine, including the powerful and complicated carburettor which was fully self-regulating in relation to variations of temperature and pressure caused by changes of altitude.

In the meanwhile the *508 S* sports version of the *Balilla*, with an engine having a higher than usual compression ratio, enjoyed a great success in the economy model section of the Mille Miglia.

It was in this period that the Fascist state created the Institute for Industrial Reconstruction, known as IRI, with the aim of boosting industrial production and making use of capital lying idle in the major banks (the credit system was in fact to a great extent at a standstill). In this way 1933 saw the start of the period of the Italian economy



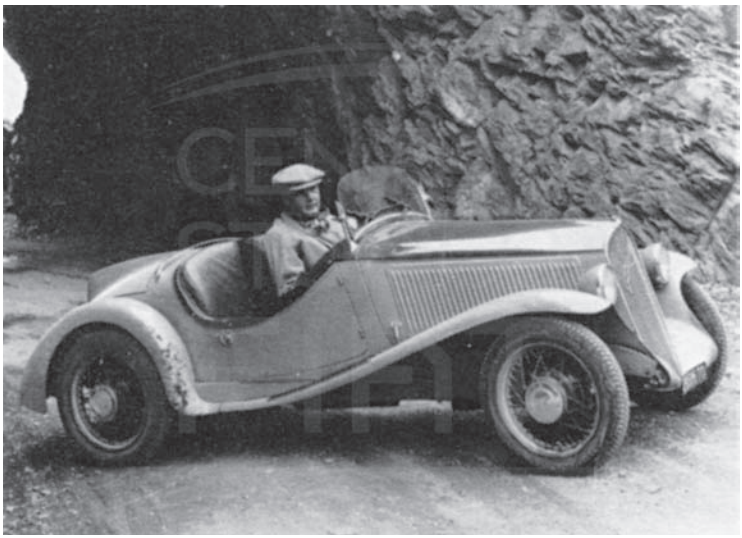
508 patrol car (1933).

The Balilla in the Campidoglio for the presentation of the new model to the citizens of Rome (1932).

characterized by the coexistence of closely linked private and public sectors.

I only caught distant echoes of these events. They did not arouse my interest greatly. Political happenings belonged to another world. Alone in my own world, my mind engrossed by problems of design, I felt at home. I was on the best of terms with my colleagues and fellow-workers. Difficulties and setbacks neither daunted not upset me: they spurred me on to exert my inventiveness all the more.

508 S sports car (1933). Felice Nazarro at the wheel after a test drive.



CHAPTER III

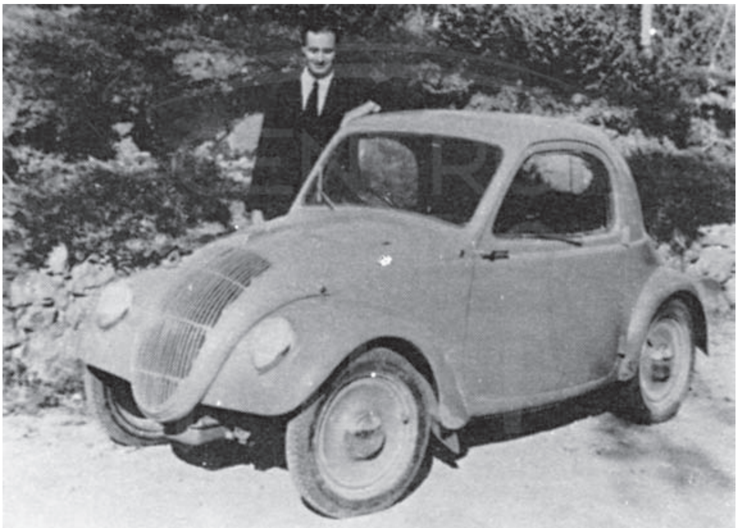
THE "ZERO A" PROJECT LEADING TO THE 500 TOPOLINO

"Giacosa, senator Agnelli wants to produce a small automobile, an economical model that could sell at 5,000 lire. Do you feel up to designing a chassis and engine for it?"

These were the words Fessia addressed to me in his office on the top floor of the Lingotto "palazzina" one morning. The design offices were on the fifth floor, where light came flooding into the long room and lit up the drawing boards. It was not yet spring but you could sense it in the air. And at the age of twenty-eight it is not easy to conceal one's enthusiasm. My eagerness was not in the least damped by fear of difficulties or setbacks nor the prospect of new and demanding responsibilities.

My answer was prompt, emphatic: "Of course I feel up to it". I could not hide my jubilation. Fessia had probably reacted in the same way to Agnelli's proposal but now that he had reflected on it he became silent, despite the fact that he was much more extrovert and talkative than I was. Perhaps he was worried about the enterprise, on whose success or failure hinged his whole future. He was already riding on the crest of the wave, with a position to defend, while I had my future ahead of me still. Nothing worried me, absorbed as I was in my passion for designing.

I never learnt the whys and wherefores of Agnelli's decision to turn responsibility for the economy-model project over to Fessia, who chafed at his subordination



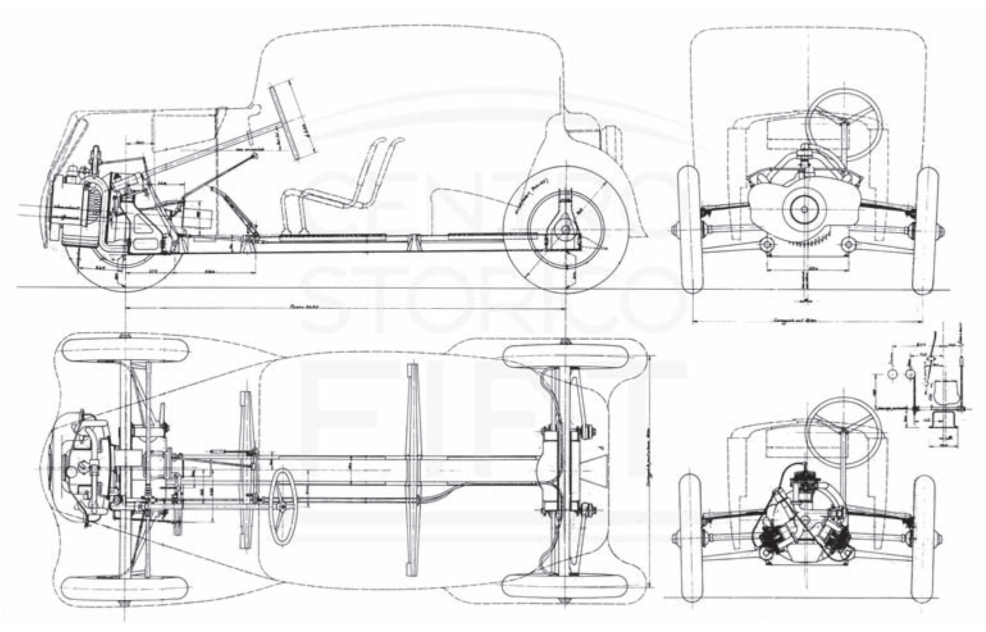
The "Zero A" prototype of the future 500 "Topolino". Leaning against the auto is Dante Giacosa. The photo was taken by Antonio Fessia on 7 October 1934 at the top of Andrate rise, during the first drive of the newly-built auto.

to Zerbi. With this new model Fiat hoped to make a significant step forward in the direction of mass production. It was rumoured that the decision had been a blow to Zerbi, with his all excellent qualities, and that it was due to the intervention of Genero, who had become works manager in place of Ugo Gobbato and appreciated Fessia's abilities, hacking him with all his considerable energy.

Without giving up my work on aero engines I at once set about examining the project for the economy model. A quick decision was made with Fessia on the designation to give the model. Our idea was to evoke the image of the auto that seemed the most significant of past models and most worthy of being commemorated: the "tipo *Zero*". We called the new utility car the "Zero A", the A standing for aero since it was planned in the Aero Engines Section.

While the Milan Motor Show was the venue for the presentation of the four-gear *Balilla*, selling at 11.250 lire for the two-door version and 12.950 for the four-door, I set out to design the "Zero A" which was intended to sell at 5.000 lire or little more. It was an unforgettable *tour de force*. While Schaeffer at the Coachwork Division got out sketches of the body along the lines of the style adopted for the Fiat *1500*, with a certain American suggestion about it that had been most happily expressed in a model by Chrysler, I went thoroughly into the question of engines, chassis, suspensions etc.

Rodolfo Schaeffer, engineer, born in Turin in 1893. He entered Fiat's Coach Building Department in 1920 and in 1925 became director of the firm's Special Coachwork Section in via Madama Cristina.
In 1929 he became director of Fiat's coachwork technical office.
From 1948 to 1952 he was director of CANSA in Novara. In 1953 he returned to Turin, working for Fiat's railroad materials section at the company's headquarter in corso Marconi. He died in Turin in 1964.



Plans of the front-drive "tipo 500" designed in 1931 under the guidance of Oreste Lardone.

In Germany at that time there was a spate of little three and four wheel autos. The three-wheelers – the Framo-Stromer, Hercules, Bully and Goliath – were powered by two-stroke engines and did not warrant consideration, except as a demonstration that the three-wheel idea was definitely a non-starter. Among the four wheelers there were the following models: the DKW, with a 600 cc engine, two-stroke with twin-cylinders and water-cooled, with front-wheel drive, three gears and a weight of 340 kg; the Standard *Superior*, with a 400 cc rear-mounted engine, twin-cylinders, two stroke, water-cooled, three gears and weighing 345 kg; the Hanomag with a 500 cc engine, single-cylinder, four-stroke, air-cooled and weighing 320 kg. In France I came across the Salomon *Maior* with a 535 cc engine, single-cylinder, four-stroke and water-cooled, weight 400 kg. The top speed of these "minis" was around 70 km/h.

Our economy model was meant to be markedly superior to them in terms of comfort, performance and appearance at a comparable cost of production. The problem was far from simple. It was difficult to choose the engine size. We needed an output of dose on 20 hp with an engine capacity that did not exceed the limit of 6 hp as calculated by the system used in Italy for tax purposes (the so-called "fiscal horsepower"). At that time there was a general conviction at Fiat that to guarantee the durability of the engine without having recourse to costly materials and methods of production the engine should turn at no more than 4.000 revs per minute. There was no hesitation over the choice of the number of cylinders: four. The engine was to be front-mounted and the vehicle was to have rear-wheel drive.

We did not give any consideration to the possibility of front wheel drive. This attitude seems to have grown out of the wish – or rather the need – to avoid stiff opposition from Agnelli. The memory was still fresh of the failure of an experimental economy model with front-wheel drive built a few years earlier and of an unfortunate accident that happened during a trial when the senator himself was in the passenger seat. This accident gave rise to a real aversion for front-wheel drive which lasted a long time and it took me and my collaborators long and patient persuasion to get the President to allow production of the first front-drive vehicle nearly thirty years later.

Senator Agnelli was a man of few words, firm in his decision. He had taken on another designer, Oreste Lardone, with an original and unconventional approach, who had previously worked with Cappa at the Itala works. Agnelli entrusted him with the job of competing with the technical office then engaged on the design of the *508 Balilla* by designing a less traditional type of economy model.

Lardone came up with a front-wheel drive model with a two-cylinder air-cooled engine, two features that certainly did not appeal to Genero, the man in charge of production. He did not like innovations and still less the sophisticated design of Lardone's project. Worse still, during one of the first trials on the Cavoretto rise Agnelli happened

Oreste Lardone, design engineer, born in Turin in 1894.
He joined Fiat in 1909 and then changed to Itala where he worked under Giulio Cesare Cappa. Returning to Fiat in 1931, he was put in charge of the project for a twin-cylinders front-drive economy car. With Fiat again after the Second World War he headed projects for adapting land vehicle engines to use on water craft. He became director of the higher technical vehicle management.
He died in Turin in 1961.

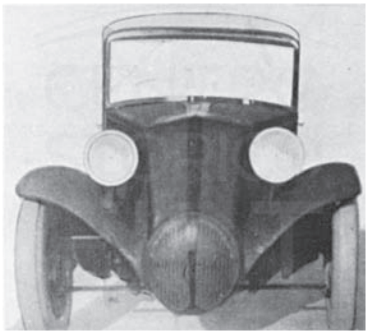
to be a passenger and had to hop nimbly out of the vehicle when the engine suddenly caught lire. This regrettable incident together with other features, such as its noisiness, the heat from the engine and other shortcomings of the model influenced Agnelli's decision.

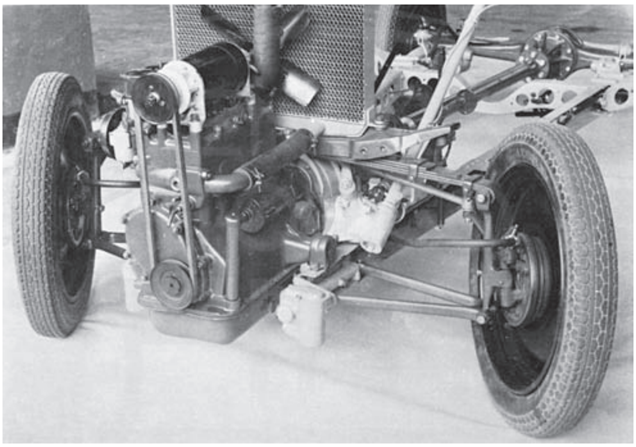
He had had enough of this particular model and Lardone was fired. Many years later, when the "senator" was no longer alive, I was able to take on Lardone, who was very able, and place him in charge of an office for planning marine and industrial units equipped with engines derived from those of automobiles or trucks.

So it came about that it was sensibly decided to adopt a traditional scheme of transmission for the "Zero A", with a four-cylinder water-cooled engine. My job was to design the car so that it would be comfortable, functional and cheap to produce.

Having calculated the weight of all the units making up the chassis, I decided that it was going to be possible to keep the weight down to 250 kg. The weight of the coachwork was envisaged at 180-200 kg. With an overall weight of 450 kg the auto would have to sell at about 12 lire per kilo as compared with the 17 lire per kilo of the three-gear *Balilla*. Senator Agnelli's request seemed downright unreasonable but we set to work with a will.

A scale model and a drawing of the front view of Lardone's "tipo 500". Photos from the archives of Mario Revelli de Beaumont, who collaborated on the design of the coachwork in the work team directed by Schaeffer.

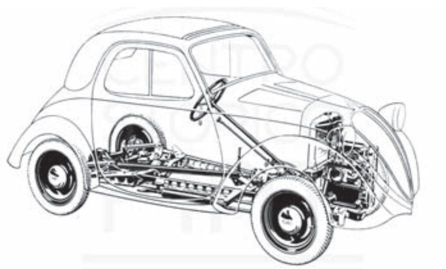




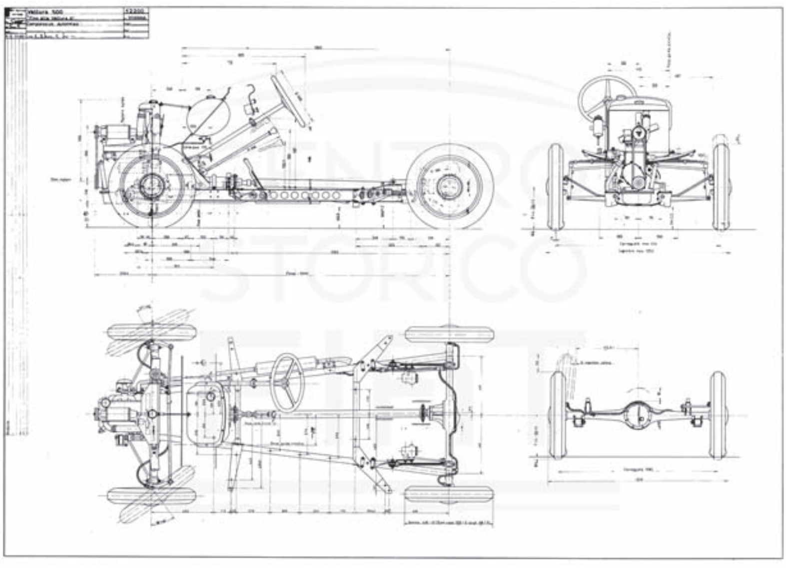
Front view of the chassis of the 500 "Topolino" with the engine projecting in front and independent front suspension with a transverse leaf-spring.

I began by sketching out the chassis and suspension. My nights were made restless by the whirl of ideas that I tried to get down on paper during the day to compare their various degrees of validity. Simplicity was the touchstone: simplicity and cheapness.

I liked the look of the coachwork and followed developments with the greatest interest, eager to lend a hand. A makeshift workshop had been set up and a wood and plaster dummy was being prepared to plans produced by Schaeffer's expert designers. I tried to have the body made wider level with the dashboard but it was no good: Schaeffer was convinced that the styling would suffer. Still, the design appealed to me. My work was to build a chassis with simple, low-cost mechanicals adapted to the metal structure of the coachwork and so making a single functional and harmonious whole. The driver's position was chosen so as to make the coach work as compact as possible but allowing room behind the two seats for luggage or two children. As it was sketched out, with the seat well forward compared with the norm for that period, it seemed made for front-wheel drive. The cars of that period normally had the engine placed between the front axle and the dashboard. The driving position was placed well back to allow space for the engine; the engine hood began at the dashboard and ended level with the front axle. In the case of the "Zero A", however, there was not enough space between the dashboard and the wheels to take the engine. It could have been fitted between the front wheels, with its centre of gravity approximately on the vertical plane passing through the wheel-axle, as



The drawing shows clearly how the structure of the chassis was conceived in relation to the shape of the coachwork, used for the first time in a Fiat model as an integral part of bearing structure.



The design of the chassis as a whole from the four main viewpoints. The drawing is dated 8 August 1935.

began to be done some years later, but in that case it would have been impossible to adopt the simple and economical system of independently sprung wheels that I had chosen. After various attempts, I felt the best compromise would be to place the engine in front of the front axle, a solution similar to the system now adopted with front-wheel drive vehicles.

I designed a chassis consisting essentially of two C-profiled spars open on the outside and two transverse spars to join the longitudinal spars together at the ends. The chassis was very short, since the front cross-spar was level with the front axle and the back one with the leaf-spring suspension attachments. The ring-shaped front cross-spar acted as the support for the radiator, the steering box and the engine and gear units as well as for the front suspension. The gear box was fitted into the ring-shaped cross-spar and the engine was projected completely in front of the cross-spar and the front axle.

I said jokingly to Fessia that the engine was supported by the chassis in the same way as an airplane engine was supported by the cabin of a plane. He was enthusiastic about this, ready to accept every argument that proved the validity of the decision to have the model designed by a division specializing in aeronautics.

My first idea was to support the engine-gearbox unit with a rubber ring attached to the cross-spar and wrote a note for the management to accompany the drawings. In it I said: "Between the engine and the clutch-gearbox there is a circular plate of sheet metal which is supported by a rubber ring attached to another plate forming part of the main cross-spar of the chassis. The engine therefore juts out in front of the chassis. The radiator will be supported either by the coachwork or else by the engine itself, or, if possible, by the front cross-spar which is to support the suspension and the steering box." This was followed by a list of the pros and cons of the system . After developing my designs and calculations I found it cheaper to attach the engine by means of two rubber elements instead of a complete ring, which would be on the heavy side and more expensive. When the drawings had been taken further the solution turned out to be valid.

As for the engine, I had to solve the problem of volume. The engine hood, with its distinctive sloping profile that was eventually to become so familiar to Italians, was of a shape and size that precluded fitting the radiator in front of the engine. The engine could just be squeezed in as long as it was kept very small. An engine with opposed

One of the pre-production prototypes of the 500 "Topolino". The flush-fitted headlights with sloping glass continuing the line of the mudguards tried out on the first "Zero A" model had proved inefficient.
To overcome the defect, the arrangement shown here, similar to that of the 1500, was tried and then also abandoned for externally fitted headlights, which were more practical and easier to adjust. The position of the windscreen wiper was also changed.

cylinders would have solved the problem except that it cost too much. Essentially my task was to keep the length and height of the engine down to extremely small dimensions. To limit the length the only thing to be done was to reduce the diameter of the cylinders, which led to increasing their stroke and hence the height. Side-valve distribution was chosen essentially to limit the height of the engine but also because of its simplicity and economy. For the same reasons I suggested mounting the crankshaft on only two bearings, the front one on rollers, the back one on ball bearings. This would bear the thrust of the clutch during manoeuvring.

I developed the designs and came to the conclusion that to fit the engine into the hood of the coachwork it was necessary to keep the diameter of the cylinders down to 52 mm. With a stroke of 67 mm the engine capacity came to 569 cc.

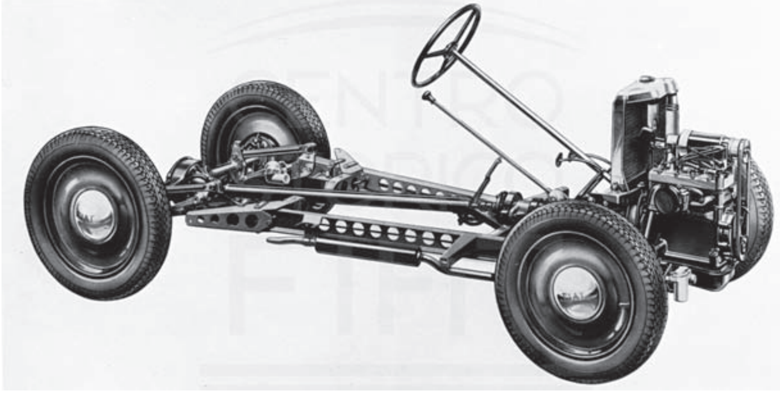
I turned the design of the engine over to Virgilio Borsattino, a very studious, cultured, thoughtful and painstaking technician. I had had occasion to appreciate his personal qualities and his skill in designing carburettors for aero engines. The dimensions of the "Zero A" engine were about the same as those of the carburettor of the A 33 RC aircraft engine which we had just finished designing.

On 1 June 1934 we began work and before the August holidays came round we had handed in all the designs for the engine to the workshop so that the prototype could be built.

It was the simplest expression of a four-cylinder water-cooled engine: there was no water pump as circulation was ensured on the thermosiphon system; no fuel pump since it had a gravity feed; a very rudimentary oil pump, since it only had to take the oil as far as the piston rods and cylinders, which were splash-lubricated without pressure; there was no regulation of the tappets and the crankshaft was mounted only on two bearings. Nothing more economical could have been conceived.

The same criteria of simplicity and economy underlay the plans for the chassis. The structure seemed too bold and original to most people but Fessia always backed me up and bolstered my confidence.

I had conceived the chassis not as a rigid independent frame work of the sort then in use, which could even have a seat fixed on it and be driven about by the test-driver, but as an element which would contribute to the rigidity of the whole only when it had been attached at numerous points to the metal structure of the body work. As I have already mentioned, it consisted of two longitudinal spars lightened by numer-

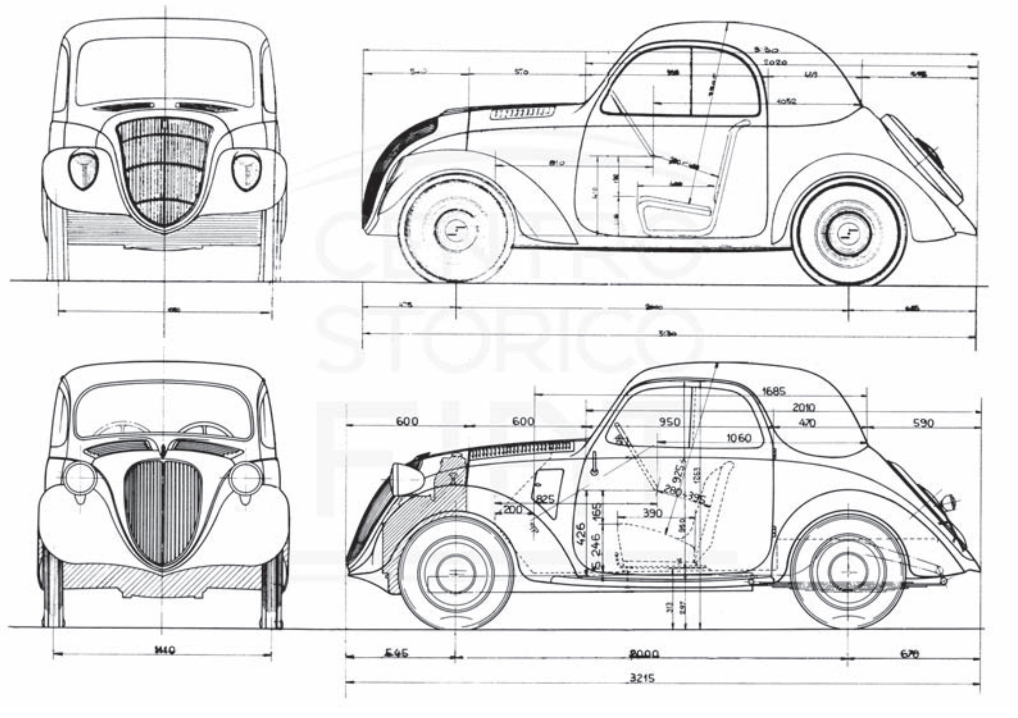


Chassis of the 500 "Topolino", first series, in the version with demi-leaf suspension. The longitudinal spars and the brackets, pierced with holes for lightness, can be seen clearly.

ous holes, which went from the front cross-spar and finished up under the floor of the cab just behind the two seats. The front cross-spar was surmounted by the transverse spring of the suspension, fixed in the middle, in a sort of rigid container with a cross-section shaped like an inverted U and made of plate metal, in which the spring settled downwards as the wheels moved upwards until it gradually lost its flexibility and absorbed the movement completely. This housing for the spring also had the function of supporting the radiator placed vertically on top of it, behind the engine. The steering box was attached to the left side of the cross-spar.

This brief outline almost leaves me surprised at how much I managed to do, young and inexperienced as I was, sustained only by intuition and enthusiasm.

The idea of exploiting the capacity of the bodywork to support the luggage trunk jutting out behind the chassis at the back, thanks to its metal shell structure, looked risky but no one was able to shake my quiet confidence. The springs of the rear suspension, which later got the name of "balestrini" ("bow-springs" in Italian) were fitted so that they projected like an elastic extension of the longitudinal spars. To support the torque of the rear axle I adopted struts that also served to transmit the movement of the frictional damper shock-absorbers. During trials the latter proved to be inadequate and had to be replaced by the oleo-plunger type which were more functional and efficient but also more expensive. I went steadily ahead, following out my own ideas, as I was to go on doing with most of the projects I tackled in the years ahead.



Comparison of the coachwork designs of the "Zero A" prototype and the 500 "Topolino" production model shows the rapid stylistic evolution during the project's development. The designs are dated 9 August and 3 December 1934.

Since the coachwork was much lower than on any previous models – the "Zero A" was Fiat's first automobile not to have a running board – it was necessary to put a "tunnel" on the floor for the transmission shaft, but it looked too high arid obtrusive to my eye. To make it lower the only thing to be done was to lower the transmission. So I arranged the shaft as the continuation of the countershaft of the gearbox. The performance in fourth gear was lower than with the usual direct connection system but the gearbox was simpler in construction and the space taken up by the tunnel was appreciably reduced. This system also had to be abandoned because of the noisiness of the gearwheels in fourth and the traditional direct-mesh system was adopted. Naturally the tunnel had to be raised proportionately to the centre-distance of the gearbox.

To proportion the wheels and tyres to the test of the vehicle we decided to make use of smaller tyres than usual. Fessia got Poli, the technical manager at Pirelli, to come to Turin and there was a meeting, which to my mind is of historic importance in the history of the tyre, at which we fixed the measures of the tyre and the wheel rim at a nominal 15 inches. This was the origin of the 4,25-15 tyre, then manufactured for the first time.

The engine was built in record time by the Experimental Constructions workshop, working all through the August holidays, and was delivered to the test room on 15 September. When a few minor flaws had been set right the engine ran smoothly and turned out slightly more power than envisaged but the noise-level was disturbingly high.

The first time we took the car for a test-drive was a great occasion. Fessia and I felt as if it were a triumphal march: we alone in "our" automobile followed by a four-gear

500 "Topolino" standard sedan (1936).

The 500 soon became most popular in the version with a hood that opened, enabling one grown-up or two children to sit at the back.

Balilla driven by Giuseppe Peirolero (a first-rate test-driver who had done outstandingly in the recent road-races) and accompanied by a mechanic. It took place on 7 October 1934 on the Turin-Ivrea-Andrate-Biella-La Serra-Vestigné-Borgomasino-Cigliano-Motorway-Turin route. The Andrate-Biella stretch was a mountain-road at that time, running between woods, narrow, surfaced with gravel and dusty. We took turns at the wheel, testing the road holding and the sturdiness of the suspension. When the test was over Fessia took a photo of me by the side of the car.

On the road back from Biella, driving towards Turin, after the steep and winding route that goes past Serra and cuts out Ivrea, we went through Fessia's hometown, Borgomasino. He drove through it at a fantastic speed to impress his astonished fellow townsmen. On the motorway we clocked our top speed: 82 km/h. It fully came up to the speed envisaged in our forecasts.

Nothing had gone wrong, road holding was excellent when compared with the vehicles then in production (they did not have independent suspension on the front wheels), the brakes worked well, dispelling my concern over the unusual distribution of the vehicle's weight because of the forward position of the engine.

Three days later the car had been fully run-in and reached the speed of 86 km/h. Things looked set for success. The results achieved suggested that the model as a whole was just what the President and all of us wanted but the excessive noise from the engine was a serious drawback which had urgently to be corrected. And we still did not know what was causing it.

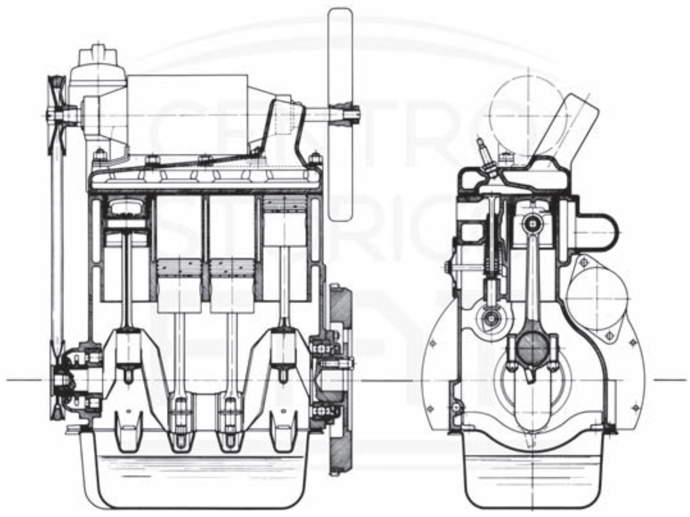
My notebook jotting show the interest aroused by the "Zero A" in those early days.

11.10.34 – I was summoned by Agnelli to report on the bearings of the driving shaft which seem to be making the noise. Among other suggestions, Nadella bearings have been proposed. Huyer says that because of radial play these would be equally noisy.
– While Prever will try out bronze bearings, Villar Perosa is to make two roller bearings with all provisions to improve the engine from the point of view of noise (the ball type of bearing is to be replaced by roller-bearings).
– Advised Orefice that the rear springs with 70% and 80% flexibility should have a dead load of 9 mm instead of 19 as indicated on the first drawing.
– The second engine has been taken out alter 69 hours and the bearings of the main shaft given to Huyer to examine. The engine was immediately refitted with new hearings supplied by Batuello. When we removed the rear hearing there was some difficulty in slipping it off the shaft because of the lack of anything (on the inner washer) to get a purchase on.

12.10.34 – Rubber mountings (hardness 3) for engine and gearbox delivered to Prever in the presence of Agnelli.
– Zerbi suggests Allison hearings instead of hall-bearings and roller-bearings and says that the same length would be adequate to make them do: he advises making an estimate.
– Prever suggests replacing the present bearings with gunmetal.
– The senator cut discussion short by saying that if the new rubber mountings and special bearings improve the noise problem to the point where it is acceptable it is to be left at that.
– The circuit of Avigliana was completed an average of 63 km/h.
– Before 14.30 hrs the mountings of rubber (hardness 3) were fitted and the auto

tested by Prever and Genero. The mountings of rubber of hardness 3 have had no effect on the noise.
– Called on to report by the senator. I was questioned about the stability of the *1500*, for which he wants to try the type of suspension used for the "Zero A", so I have to give Zerbi the blueprint of the suspension.
– In the comparison between the *1500* and the "Zero A" mention was made of the ratio between wheelbase and track, which is 1,8 for the "Zero A" and 2,2 for the *1500*.
– The auto was jacked up and a check showed that the rear shock absorber arms are touching the coachwork.
– Prever says that more flexible rubbers for the engine mountings have produced no perceptible improvement.
– In the presence of Bruschi, Zerbi, Genero and Prever, tests were carried out on the engine vibrations using gunmetal bearings instead of roller or hall hearings. Noise due to vibration was deafening: according to Prever, three times greater than with ball hearings.
In consequence the following procedure was followed:
1° – Fan belt removed - noise persisted.
2° – Chain housing removed - noise persisted.
3° – Sump removed - noise persisted.
4° – Oil pans removed - noise persisted.
5° – Distributor cap removed - noise persisted.
6° – Tried reducing ignition advance - noise decreases.
7° – Two gaskets fitted under the head - noise disappears.

So now the impression is that the crankshaft is either too strong or too weak. Audisio insists on its being made lighter.
Later I was sent for by senator Agnelli and it was decided (since the shaft is under greater strain than the Balilla's) to reinforce it as much as possible. A shaft with pierced collar-pieces and with larger crank arms was designed immediately. (Audisio notified in case of difficulty in mounting pistons.) Still in the morning, a trial was made with two extra gaskets between the head and the crankcase but there was only a very slight improvement compared with the improvement achieved on the test



Longitudinal section and cross-section of the "Zero A" engine, in the first version with rolling crankshaft bearings and splash lubrification. Drawing dated 24 July 1934.

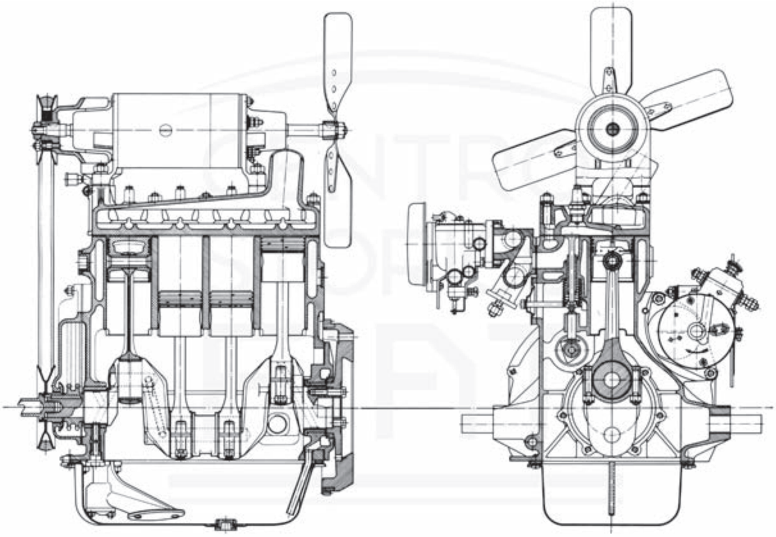
bench. In the afternoon at 15.30 hrs I gave Genero the designs for the three types of crankshaft: one derived from the present one by piercing the pins and the other two new ones, both reinforced, one solid and the other pierced.

What a lot we got done in a day! We said little and worked without let-up. Senator Agnelli was impatient, eager to get things finished, to decide as soon as possible whether this was the model to put into mass production. Every detail interested him. He was afraid that if too many people had a finger in the matter it would slow down the solution of problems as they cropped tip during testing.

While we were working on the design and development of the "Zero A" I continued, as head of the Aero Engines Division, to busy myself with work on the A 33 RC engine intended for fighter aircraft. Fessia was mainly concentrating on the development of air cooled aircraft engines which Fiat, following the trend in the USA, Britain and France, intended to adopt instead of water-cooled ones. This and his research into new types of tanks took up so much of his time that he could not follow the increasingly pressing work going on to bring the "Zero A" to successful completion.

In this way I came to take many decisions without consulting him and found myself having to discuss details of construction directly with senator Agnelli, Zerbi and Prever.

The noisiness of the engine was finally practically eliminated by producing a crankshaft with pins larger in diameter and gunmetal bearings. The substitution of slide bearings



Longitudinal section and cross-section of the 500 "Topolino" engine in the version chosen for production.

for rolling or antifriction bearings led to a slight loss of power because of increased friction but there were advantages in terms of lightness and cost. The new crankshaft caused big problems in dismantling the pistons. The big end would not pass through the cylinders and so to get the pistons out the crankshaft had to be dismantled, which was an unacceptable solution. So I decided to make the rods longer and shape the crankcase so that when the engine was being dismantled the rods could be pushed just far enough into their respective cylinders to enable the pistons to emerge at the top of the cylinder block sufficiently to slip off the pins and finally lift out the pistons.

The main sections of the engine had to be redesigned so as to slightly increase the length of the rods. Having replaced the two rolling hearings at the end of the shaft with smooth ones, it was then necessary to adopt forced lubrification but this was no problem. Other modifications, such as the adjustment of the tappets, enabled the engine to perform satisfactorily in rigorous endurance tests on the work bench and mounted on the vehicle. The final version of the engine met with everyone's approval. Fiat never built, either before or afterwards, such a simple and economical four-cylinder engine. The chassis was ready. I had the design modified slightly so that there was the minimum waste of metal in the bodywork.

When we had achieved satisfactory results in trials, a second prototype vehicle was built with all the modifications suggested by the first. The coachwork had also been changed in some points. The flush-fitting headlights with sloping glass that followed the line of the mudguards were replaced by projecting lights, only partly recessed in a small niche. This improved the lighting and solved the problem of adjusting the beam. After further trials and various improvements, the model was finally judged fit for production, to everyone's great satisfaction. In the final version its weight was nearly 100 kg more than the first "Zero A" prototype. The technical offices of the workshop undertook to complete the studies already under way for tooling-up. In that period when everything used to fill me with enthusiasm I often visited the workshop. The foremen frequently mentioned to me difficulties in production that called for changes in design or required explanation.

I still remember clearly the discussions I had with one particularly energetic and enterprising works foreman by the mime of Quaglia who thought he could make some improvements to the hydraulic system of the brakes. We had to do a lot of tests before we reached agreement, working flat-out all the time to keep within the deadlines.

Everyone worked with a will to get out this new model, destined to be a memorable milestone for Fiat. It marked the start of mass production, which was the whole reason for the construction of the Lingotto factory, 500 m long, five stories high and equipped with its wonderful raised circuit. The rate of output soon rose to 100 vehicles daily. I was very proud and satisfied.

The launching of the automobile, which the Sales Division decided to call the *500,* took place on 15 June 1936. The smallest car in the world to be put into mass-production (569 cc) sold for 8.900 lire. It had a top speed of 85 km/h, with room for two people and 50 kg of luggage, weighed 535 kg and consumed 6 litres of fuel every 100 km.

It had an enormous success. The most enthusiastic of all seemed the English. *The Light Car* in one of its issues, which I unfortunately have not kept, published a little rhyme in which the *500* was called *Little Mouse* (in Italy it was nicknamed "Topolino", the Italian name for Walt Disney's Mickey Mouse).

The Motoring Muse
No. 102. – MOUSE-LIKE
(*A new small Fiat is called "Topolino" – "little mouse"*)

Of cars with quaint new names I read,
But "Little Mouse" is quaint indeed.
For exercise let's try to name
The virtues that a mouse can claim:
A streamline shape; suspension low;
An ideal power-weight ratio;
The power to squeeze through narrow spaces;
The power to grip in greasy places;
Phenomenal acceleration;
No sign of starting hesitation;
As silent as a well-oiled ghost...
Such virtues any mouse can boast.
One drawback I could name, perhaps:
A way of getting caught in traps! – E.S.T.

Production of the "Topolino" continued after the Second World War with the 500 B version.
Below: the coachwork assembly line in the new Mirafiori works (1948).

CHAPTER IV

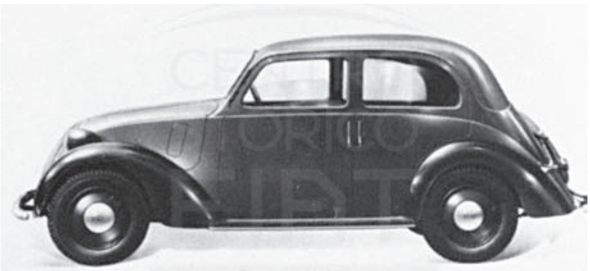
THE “8 A” AND “8 B” PROJECTS

THE *508* C AND *508* C *MM*

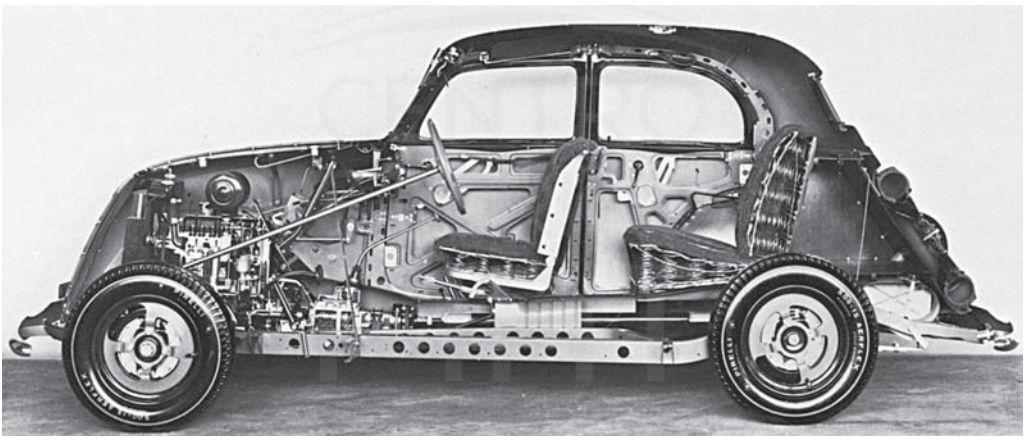
In the same period as trials and development of the first “Zero A” prototype were going on we started studies for the model that was to replace the four-gear *Balilla*, a more up-to-date version of the three-gear *508 Balilla*.

Fessia had the idea of getting out two designs, one with a four-cylinder engine and the other with six cylinders, both 1.100 cc, with overhead valves. He accepted my suggestion that the prototypes should be built with independent suspension on all four wheels and an aluminium-alloy cylinder block.

We decided to designate the new model the “8A” with reference to the 508, in whose design Fessia had played an important part, the “A” denoting as with the *Topolino* that the project was carried out by us in the aviation sector. In 1934 I still belonged to the Aero Engines Division which was run by Fessia. At this point a digression is necessary.



508 C Nuova Balilla 1100 standard sedan (1937).
This model repeated the rounded shape introduced so skilfully by the six-cylinder 1500. The design is even more justified in this case because of the new manufacturing technique used for the all-metal body-shell (the 1500 still had some wooden elements, useful for reducing noise but complicating production).



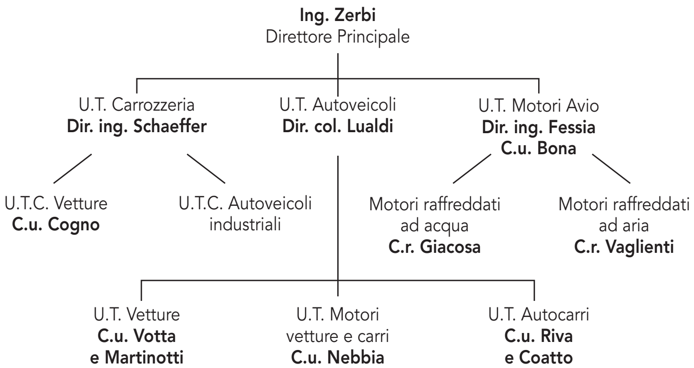
I knew little about the upper hierarchy at Fiat. I was aware that senator Giovanni Agnelli was at the top as President and that Vittorio Valletta was general manager, while next came the central managers – Rambaldo Bruschi in charge of the technical side and Guido Soria as head of commercial operations.

I knew commendatore Alessandro Genero, the production manager, a man of Prussian inflexibility of discipline who liked to be called plain "Signor Genero", and the director of supply services, respected by everyone for his strict moral rectitude, well-known for his extremely simple, almost monastic way of life. The personnel manager, Ubaldo Giuglini, was regarded as a great ogre by the design draughtsmen.

Rambaldo Bruschi, engineer, born in Forlì in 1885. Graduated in engineering in Turin, he started work with Edoardo Bianchi firm in Milan. Subsequently he went to the United States to learn the latest developments in his field of study. On his return in 1923 he was employed by Agnelli in the Fiat offices at Villar Perosa, where he worked together with Guido Fornaca. In 1930 he was appointed central director and in 1942 he became a member of Fiat's board of directors. He died in Turin in 1966.

Bruschi, tall, imposing and haughty, rarely took part in technical discussions. He usually listened and very occasionally came out with some carefully deliberated suggestion, leaving decisions to Genero and Zerbi. He was from Romagna, a lover of music, singing and good cuisine and also very keen on astronomy. His fetish for order and punctuality was well-known. Watch in hand he would check whether the office door opened earlier or later than the set time. He kept track of the passing of every second. In time I also came to know his profoundly human qualities.

In 1934 the technical offices were still organized according to the following scheme:



The success of the "Zero A" prototype led to big changes.

From 1 January 1935 Fessia was appointed director of the Mechanical Engineering Technical Office, this title being used to indicate that his management covered the Automobile Design Division in addition to Aero Engines, so including automobiles and trucks but excluding their bodywork. I was made head of the Automobile Technical Office under him and given responsibility for designing engines and chassis. Until then engines and chassis had been designed in two separate offices under different managers with separate responsibilities: Nebbia being responsible for engines, Votta and Martinotti for automobile chassis, Riva for industrial vehicle chassis. Colonel Lualdi had been their superior but only in the formal hierarchical set-up.

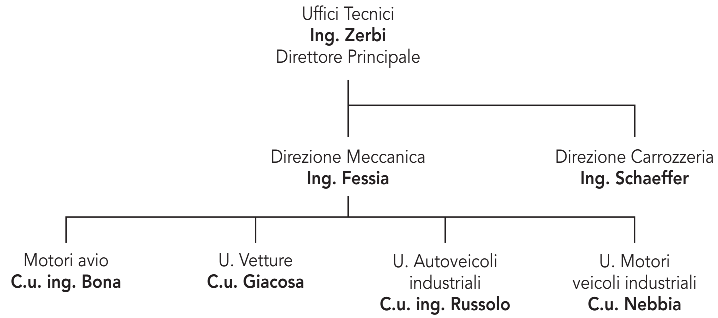
Colonel Lualdi and Votta left Fiat, having reached retiring age.

Martinotti, whom Fessia had considered a rival during the planning of the *Balilla* and then the *1500*, was transferred to SPA together with Riva, who was put in charge of the Special Vehicles Technical Office. At SPA Martinotti, who had been appointed office manager, was given scope for his great abilities as a designer, including the field of military vehicles.

This diagram of the organization of the technical offices after the changes in 1935 shows the extent to which Fessia had increased his authority and importance.

Emilio Martinotti, born in Occhieppo near Vicenza in 1892. He joined Fiat in 1923 and worked in the technical office under Cavalli. From 1929 he worked under Zerbi and became a manager.
He was made head of the vehicle and special applications office of SPA in 1935, and in 1943 he became service manager.
From 1947 to 1959 he directed the Tractor and Special Vehicles Office of the Fiat technical design management. He died in Turin in 1970.

Francesco Bellicardi, born in Pertengo (Vercelli) in 1910. After a training as an industrial technician he entered Fiat in 1930 and was assigned to the Aero Engines Department. Then he won promotion through a company examination to the technical offices where he became a draughtsman and calculations expert. In 1950 he was made service manager and in 1952 was appointed manager of the Weber carburettor factory in Bologna, of which he became President.



Zerbi was also in charge of supervising the design sector of SPA and the Railroad Material Division.

The Automobile Technical Office had three departments. The Estimates Department was run by Francesco Bellicardi, the Engines Department by Rocco and the Chassis Department was provisionally being run by myself, supported by two head design engineers: Tasso, from SPA, and Giuseppe Morelli.

Each of these departments included a group of designers handling modifications to models already in production, a very important and delicate job which was carried out with the assistance and collaboration of the works offices.

The models in production in 1935 were: the four-gear *Balilla* in the two-door sedan version (the *508*) and a sports model (the *508 S*); the *Ardita* (*518 C* and *518 L*, the short and long wheelbase versions: the *Ardita 1750* and the *Ardita 2000*), as well as the six-cylinder *Ardita 2500* (the *527* and *527 S*).

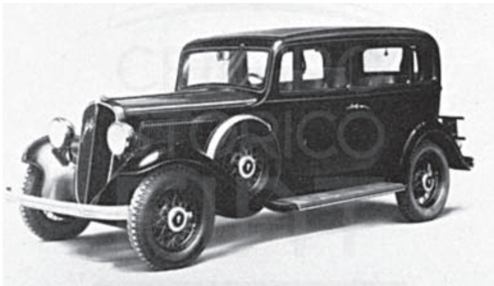
The same years saw the launching of the *1500*, a completely new automobile with a six-cylinder engine and overhead valves, Dubonnet independent suspension on the front wheels and a highly sophisticated X-shaped chassis. The coachwork was of sheet metal on a wooden frame that made the car attractive and noise-free. It enjoyed a great success due to its graceful styling, quietness and comfortable suspension, cutting into the sales of more powerful models including those produced by Fiat. Over the following years the *1500* continued to evolve, meeting the requirements of the Italian market until 1948.

The various models of the *Ardita* were gradually phased out. The *Ardita 2000* in the "colonial" version and the *Balilla* for military use (*508 M*) were used in the Abyssinian war.

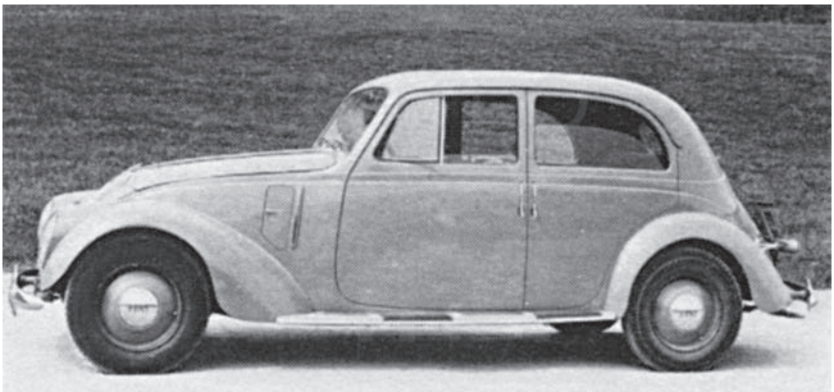
Early in 1935 Zerbi asked me to get out a development programme for the "8 A" project. This was the first official expression of the new responsibilities that had been laid on me. I was then thirty years old, I had just designed the chassis of the *Topolino* and my only concern was to get busy on new projects, my mind being wholly projected towards the future. With a team of about fifty design draughtsmen at my disposal I had no aspiration beyond that of translating the ideas teeming in my brain into designs. I used to fancy that in the world of the imagination ideas had a life of their own, continually giving rise to new ideas and going to swell an immense, never-ending reservoir of the imagination into which one could dip with skilful discrimination.

I was further convinced that a careful and discriminating evaluation of the pros and cons was not enough but there was a special flair involved in design. I shared

508 Balilla standard sedan, 1934 model.



518 L Ardita 2000 three-light sedan (1933).

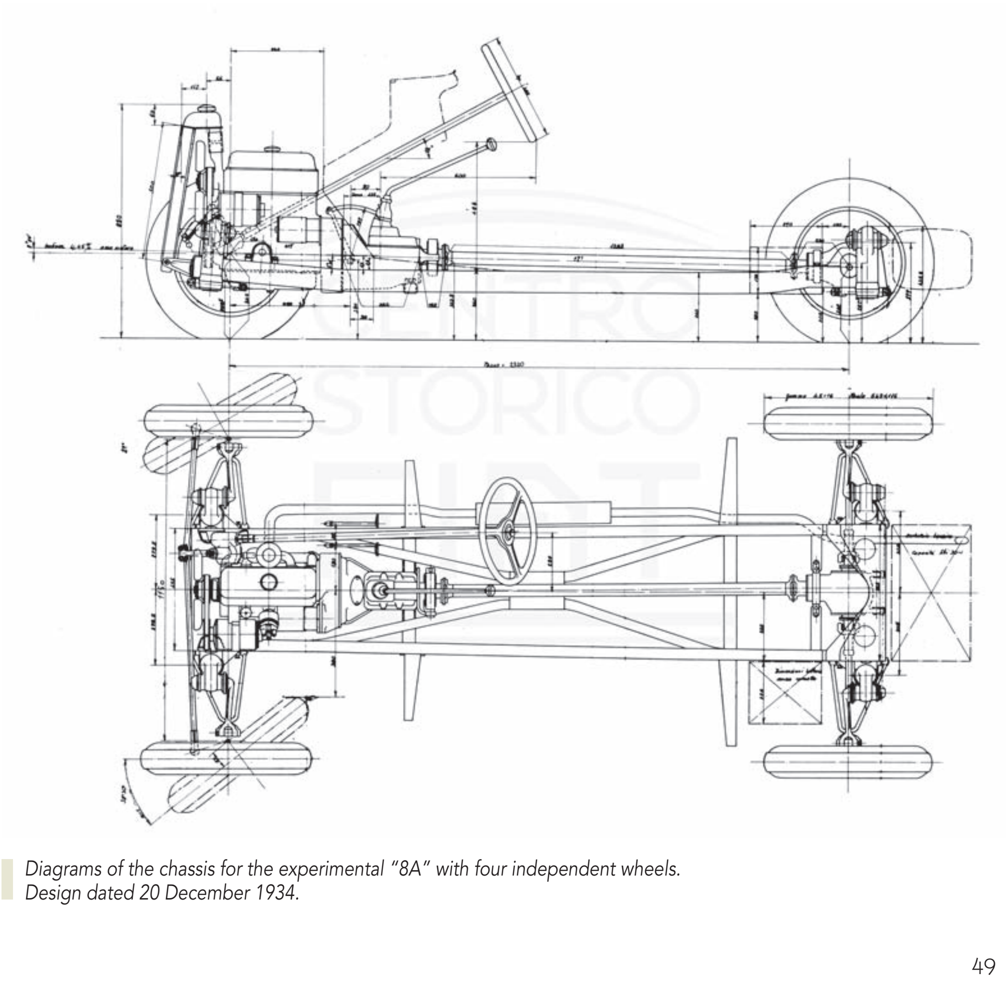


1500 B sedan. This is the second-series six-cylinder 1500 model, with the coachwork practically unchanged, introduced in 1935.

my ideas with the draughtsmen, trying to express myself in plain, down-to-earth language and making good use above all of my pencil. I have always considered it a duty to communicate an idea when one has pinned it down in one's own mind.

In our studies for the engine of the "8 A" we took the engine of the *Balilla Sport* as our point of reference. This had been built in a first version with a 108 S side-valve engine, then it was fitted with the 108 CS with overhead valves. Studies had also been made for an aluminium-alloy crankcase. The diameter of the cylinders was increased to 68 mm and the arrangement of the various parts and their design were adapted to the application of a new cylinder head, featuring a specially designed combustion chamber. I spent a lot of time on this point, trying to give the chamber a very compact shape and the spark plug a position that would favour rapid progressive combustion. The outcome was a type of head that was then taken over by nearly all the manufacturers, the first being the English in their models in the class corresponding to our *1100*. The combustion chamber of the 108 C is still used today whenever simplicity, economy and efficiency are sought in combination.

In addition to the four-cylinder engine, I had a six-cylinder one designed at the same time, with the same capacity, in accordance with my instructions. Being lower

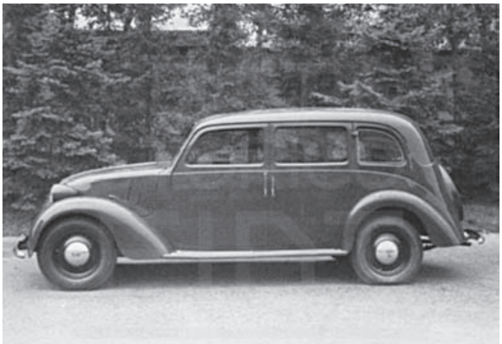


Diagrams of the chassis for the experimental "8A" with four independent wheels.
Design dated 20 December 1934.

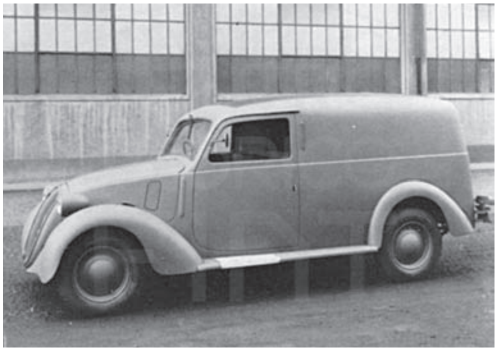
and longer, the six-cylinder resulted in a lower, more streamlined look for the engine hood, altogether more attractive. It also solved the vibration problem and gave a certain stamp of class to the auto but it was substantially more expensive. Fessia, vying with Zerbi, was out to demonstrate that a lighter machine, even if it had a smaller engine, could still equal the performance and quality of the *1500*.

The only substantial difference between the chassis of the four-cylinder version and the six-cylinder one was their length but the coachwork of each looked quite different. They had independent suspension on all four wheels. I had persuaded Fessia to accept this solution which had never been tried at Fiat and was ahead of its time. I showed him that it was possible to make the front and rear suspension the same and so keep costs within acceptable limits.

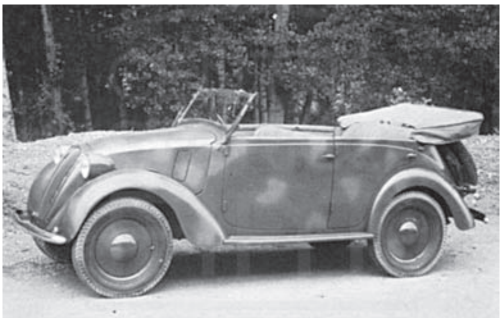
André Dubonnet, French racing driver and constructor, born in 1897. His first victories were won at the wheel of the Hispano-Suiza: in 1921 he had a win in the Coupe Boillot at Boulogne, the following year in the Monza autumn Grand Prix, and in 1924 took fifth place in the Coupe and sixth in the Targa Florio. He then went over to Bugatti, gaining a fifth place in the Targa Florio in 1926 and other good placings in subsequent years. He retired from racing in 1928 after winning the Bugatti Grand Prix at Le Mans.
Some years later he embarked on his activities as a constructor, mounting a type of independent front suspension which bears his name on a four-door sedan built at his works at Courbevoie.
Dubonnet carried on his research work for many years and has made numerous innovations in both automotive and aeronautical fields.



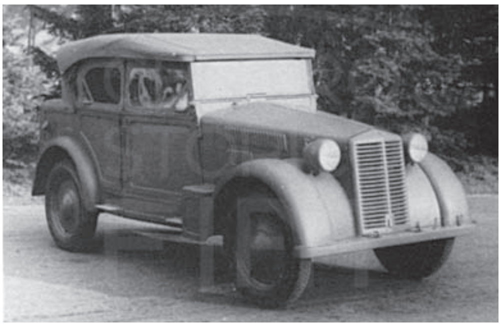
508 L "stretched" sedan (1937).



508 C-1100 all-metal van.



508 C-1100 colonial torpedo-tourer (1937).



1100 colonial torpedo-tourer, 1938 series.

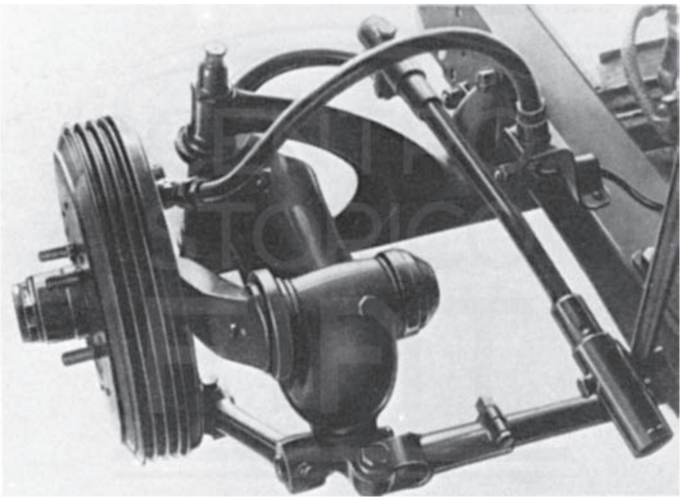
When I studied the Dubonnet-type suspension of the *1500* I was able to see its advantages and disadvantages, concluding that the most advantageous system in all respects was a quadrilateral arrangement incorporating some constructional features of the Dubonnet system. At this point I feel that some technical explanations are needed and shall try to put them in simple terms.

When the front wheels cushion the ride by moving up and down to follow the bumps on the road they must not turn to either side if the steering wheel is held still nor should they wobble from side to side if the driver lets go of the wheel.

In automobiles with leaf-spring suspension and a rigid axle it was difficult to achieve the desired stability: generally the steering wheel juddered and this was naturally most unpleasant for the driver. To get round this, Dubonnet had devised a particularly ingenious independent suspension system. The axle was rigidly fixed to the chassis and the springing was fitted in between the wheel and the wheel-pivot at the very end of the axle. The coil springs, housed in pressed metal cylinders, moved together with the front wheel during steering and so the steering rods were not subject to any movement absorbed by the springs. The vibrations of the steering wheel were imperceptible and the handling pleasant. But it sometimes happened that the auto would start to *shimmy*, which in some of the *1500s* could become dangerous.

This phenomenon usually occurred when the front wheels hit a jump or met with a series of rough patches on the road. The wheels would begin to shudder violently, jerking the steering wheel about and causing the vehicle to shake. (The phenomenon was called "shimmy" after the dance in vogue in those years.) Sometimes it got so bad that the driver was forced to stop the car.

This was critical. A long time passed before the causes were identified. Models presenting this fault were fitted with hydraulic shock absorbers on the steering linkage. The drive gearing was modified, the position of the casing of the suspension springs was corrected, vibration dampers were fitted, all helping to produce some improvement but without really solving the problem. The frequency of occurrence



Dubonnet front suspension of the Fiat 1500.

was also reduced by having resort to the dynamic balancing of the wheels, for the first time ever at Fiat, but while cases were less common they still occurred.

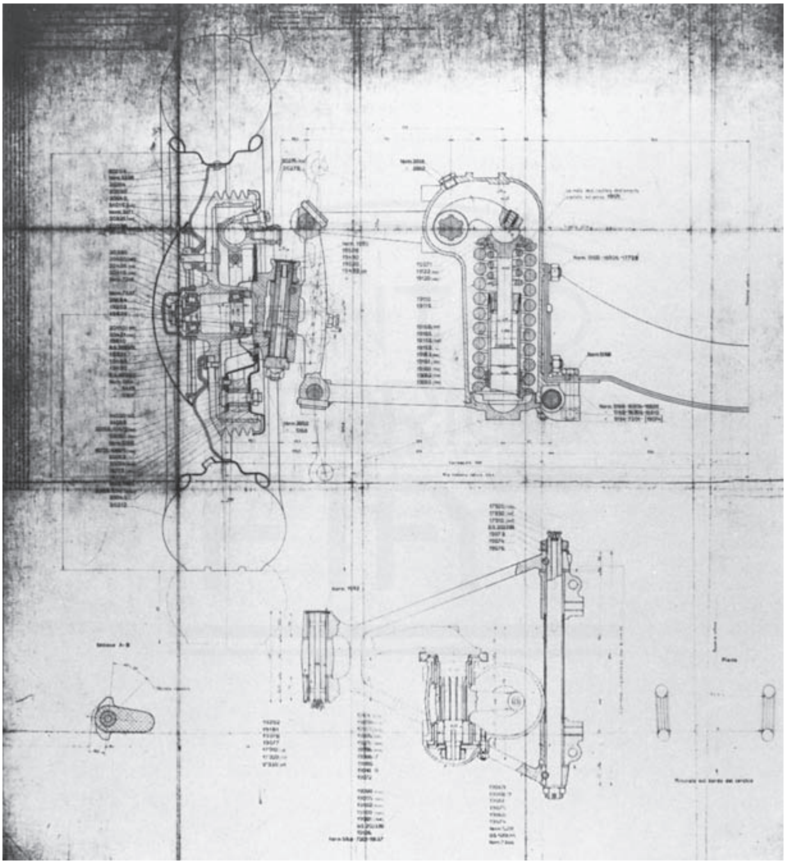
Finally, after much thinking and rethinking, I realized that the cause of the fault was basically inherent in the distinctive feature of the Dubonnet system. The inertia of the mass, the sum of the mass of the wheels and the suspension system, was such that when the wheel-suspension system was jolted into movement by a succession of bumps on the road, it began to oscillate in harmony with the elastic system formed by the steering mechanism and the chassis.

The defect was finally eliminated only when the Dubonnet suspension was replaced on the *1500 D* by a suspension of the type designed for the "8 A".

The Dubonnet suspension on the *1500* did, however, present some interesting features. The spring and the shock absorber were enclosed in a casing that was almost completely filled with oil. This casing, essentially two halves of pressed plate metal welded together, was light and sturdy but involved an accurate and costly manufacturing process.

When I tackled the "8 A" project, I thought hard about this and turned out a lot of drawings which I got my collaborators to develop further, then arrived at the following decisions:

– to adopt the quadrilateral suspension system instead of the Dubonnet;



Cross-section of the independent-wheel front suspension of the 508 C-1100. Design dated 2 September 1935.

– to fit the coil spring and the shock-absorber into a casing similar to the Dubonnet one but manufactured more simply and cheaply by casting;
– to design the casing and the suspension levers so as to form a unit that could be fitted to the chassis with only a few bolts for both front and rear wheels, shaped so as to allow the axle shafts to pass through them to transmit changes of direction to the wheels.

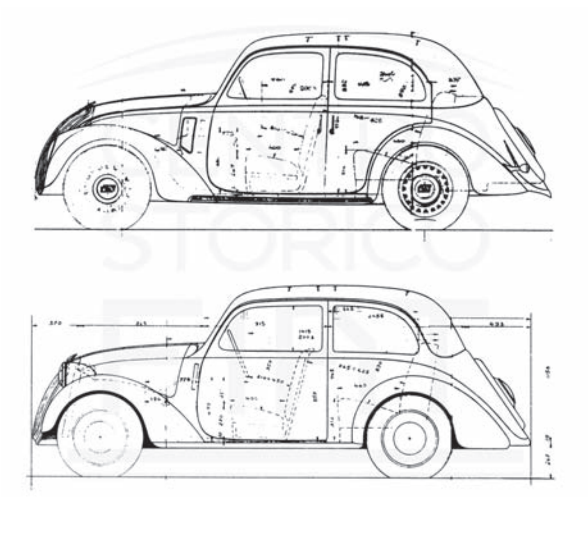
The subsequent development of the project led me to suggest having the suspension-casing made of malleable cast iron instead of aluminium alloy. I was afraid that any breakage during trials might blight the whole project.

I was also afraid that the independent suspension on the back wheels and the indispensable universal joints used for transmitting drive to the wheels might produce a lot of noise and excessive wear, but the project was completed with independent suspension on the back wheels. The chassis had a rear cross-spar similar to the front one though not quite identical and like the latter had the suspension casing fitted to its ends. The bevel gearing with the differential was fitted inside aluminium casing attached to the same cross-spar at the rear of the chassis, secured by rubber mountings.

As for the basic structure underlying the whole, it seemed natural to apply the same system that had given good results in the *500*: a simple chassis, lightly built with longitudinal members having a C-section and made lighter by piercing, flexible in itself but sufficiently rigid when bolted at numerous points to the frame of the metal coachwork.

The designs of the two “8 A” and “8 B” models were quickly finalized. The “8 A” prototype was the first to be built.

The trials were promising right from the start. Performance was good, as were suspension and road holding. Nothing suggested the problems of oversteering and understeering that loomed so large years later, after the Second World War. However, my misgivings about the independent suspension on the rear wheels were confirmed. The axle casing and the universals set up vibrations and juddering caused by the play between their components, imparting vibrations to the inside of the coachwork to an unacceptable degree.



Above: plan of the “8 A Esp. I” sedan (9 January 1935).
Below: plan of the two-door “8 A Esp. II” sedan (9 July 1935).
The “8 A” design envisaged a chassis with independent suspension on all four wheels.

Genero and Zerbi immediately came out against the independent rear suspension – partly for reasons of cost – and insisted on a normal axle.

So I had to redesign the chassis for another prototype with a conventional rear axle fitted to the chassis by leaf-springs. The front suspension was not modified. It was so devised that the axle shaft could pass through it and could have heen adapted, if need be, for front-wheel drive. This feature in fact was put into use years later for the *Campagnola* which thus had the same front suspension as the *1100*.

While the vehicle was being built at top speed – in its developed form it was baptized the *508 C* – Fessia and I spent our days off in trying out the "8 B". Its six-cylinder engine and the sporting qualities it got from its independent suspension all round made us eager to drive it flat-out along the roads that – in those days – were practically deserted. We were speed-mad, not the least worried by the immense flurry of dust rising behind us.

What did it matter if the engine was noisy, if you could hear the whirring of the axle-gearing and the rattling of the differential, the sliding of the axle shafts and universals, when the car was reserved for me alone, the sole customer? And on I went, at breakneck speed.

This was a pleasure only we of the technical office could indulge, in this way getting our own back on "the production boys".

The strictest discipline reigned at Fiat. The example was set by the man who had founded the company and kept the reins in his own hands, with his immense energy contributing to make it ever bigger and stronger. The military stamp of the former cavalry lieutenant had its influence on work and especially on the conduct of the men in charge of the factory, who found that discipline made their task simpler and got results. Perhaps this was the reason why the design directors in the period before Guido Fornaca took over the management had had some stiff clashes with Agnelli. Rather than betray their convictions or relinquish their ideas they had preferred to hand in their resignations, as happened with Aristide Faccioli, the first of Fiat's technical directors, and Giovanni Enrico who succeeded him in the post.

Forty years after the foundation of the company, the technical offices were still kept subordinate to the factory. Zerbi

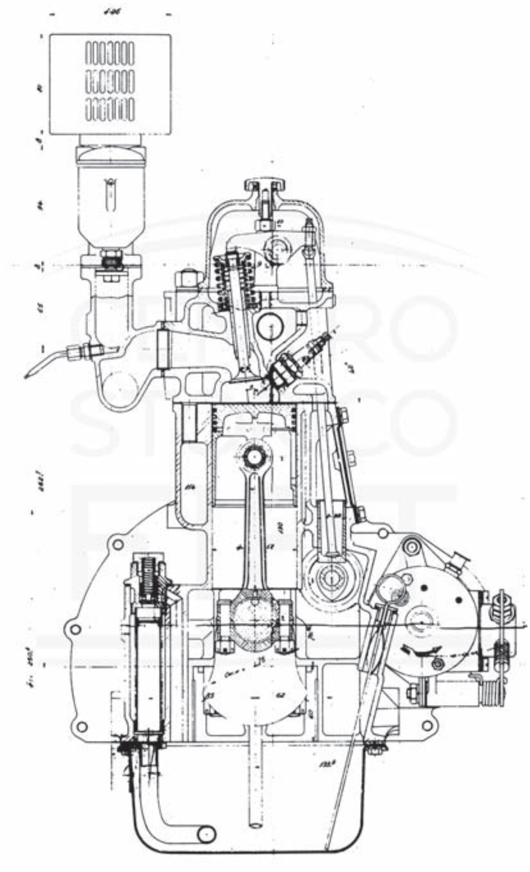
Guido Fornaca, engineer, born in Turin in 1870. After a brief period working in Romania on railroad construction, he entered the Savigliano works. In 1906 he was taken on at Fiat by Giovanni Agnelli to replace Enrico in running the technical office.
In 1916 he was appointed general manager and in 1917 became a member of the board of directors. When Giovanni Agnelli became President in 1920, Fornaca took his place as managing director.
Ill-health forced him to leave this post in 1927 and he died in Turin in 1928.

Alessandro Genero, born in Turin in 1888. Self-taught, he qualified as a mechanical relatively late in life. In 1906 he entered Fiat as a fitter, working in the section where Revelli patent machine-guns were manufactured and soon revealed his technical skill, intelligence and intuitive insight. He gradually worked his way up through the company hierarchy, occupying more responsible posts: head of the Test Department, works foreman, director of Machine Engineering.
From 1929 to 1940 he was production manager of the Lingotto works and from 1940 of the Mirafiori works. He became a member of Fiat's board of directors in 1946 and of SEAT's board of directors in 1950. He achieved a world-wide reputation as an expert in industrial organization.
He died in Turin in 1970.

and even Fessia rarely managed to get their way when they came up against the opposition of the production manager, Genero. He was a great figure. He was, as they say, a man who had worked his way up from the bottom. He had been discovered by Agnelli when he was working in the factory in corso Dante, a leading workman in a department making Revelli machine guns. He was of outstanding intelligence, with clear down-to-earth ideas which he expressed concisely, unshakable self-confidence and immense firmness Agnelli liked and trusted this simple, uncultivated man while he had misgivings about the designers and their wayward impulses. Suggested innovations and technical arguments, whose various aspects he sometimes failed to understand, irritated him.

Ugo Gobbato, engineer, born in Volpago del Montello (Treviso) in 1888.
After taking his degree in Mechanical engineering at the Zwickau (Saxony) Polytechnic, he entered Fiat in 1919 as director in charge of planning and organization of the motor vehicle works (later Lingotto).
In 1930 he was sent by Fiat to work for NSU in Germany. From 1933 he was in charge of the Alfa Romeo works in Milan. He died in Milan in 1945.

Genero had succeeded Ugo Gobbato after a series of clashes which only reached my ears as distant echoes. Gobbato left and went to Alfa Romeo, where he remained as managing director until the tragic day when he was killed, during the dire period of partisan warfare. There were many at Fiat who remembered him for his humane qualities and his abilities as an engineer.



Cross-section of the 108 A Esp. I engine (68x75 mm).
A transitional engine, between that of the Balilla and the engine adopted for the 508 C-1100.
Design dated 23 April 1935.

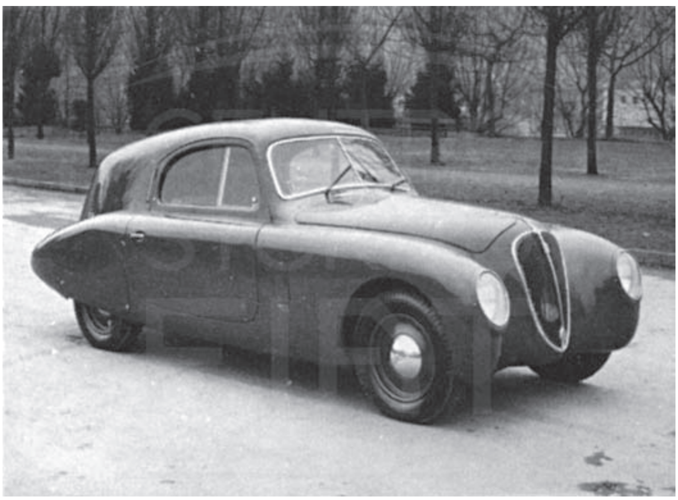
Not even when Valletta was nominated managing director and general manager did the technical offices feel secure against the works staff. The Vehicle Testing Division was not under the authority of the director of design but directly responsible to the central manager, Bruschi. The workshop for experimental constructions, and hence for prototypes came under production management, meaning Genero. Power was in the hands of those engaged in the production side and design was conditioned by the orders concerning technological matters that they issued.

This being the state of affairs, the General Management could be almost certain that any error on the part of the technical offices in its choice of constructional methods would be brought to light and corrected. On the other hand the heads of the design sector had the greatest difficulty in showing up the inaccuracies and mistakes of the factory. The Test Department, for its part, considered itself the sole infallible judge in carrying out tests. The rivalry, by this time traditional, between the technical offices, Testing and Production was exploited by the General Management to get information from all these sources. In the midst of this atmosphere thick with rivalries I was like an outsider who just happened to be passing through, blissfully unaware of the rival factions struggling for power and proceeding unperturbed on my own way.

Youth, my love for my work which led me to fix my thoughts wholly and solely on the objectives I had set myself, my optimism, which made me think of problems and setbacks as only incidentals that could be overcome, my confidence in other people's sense of fair play and decency: all these cut me off from the rivalries which often blazed up between the most prominent personalities and also the discontent which often spread among the draughtsmen. My serenity and enthusiasm helped me to disregard the harsh and sometimes overhearing manner of certain departmental heads and works foremen.

By trying to make myself useful to all those whom I had to work with I had become popular not only in the technical offices but also with the technicians in the testing service and the factory.

The success of the *500* contributed to my personal success. The *508 C-1100* in its final version was soon ready. Since the coachwork was along the same lines as the



Prototype of the 508 C MM aerodynamic coupé built by the Carrozzeria Savio (1937).

1500 it took its place between the *500* and the *1500* to form a range of three models with common stylistic features. But the *500* and the *508 C* also possessed advantages of design and simplicity.

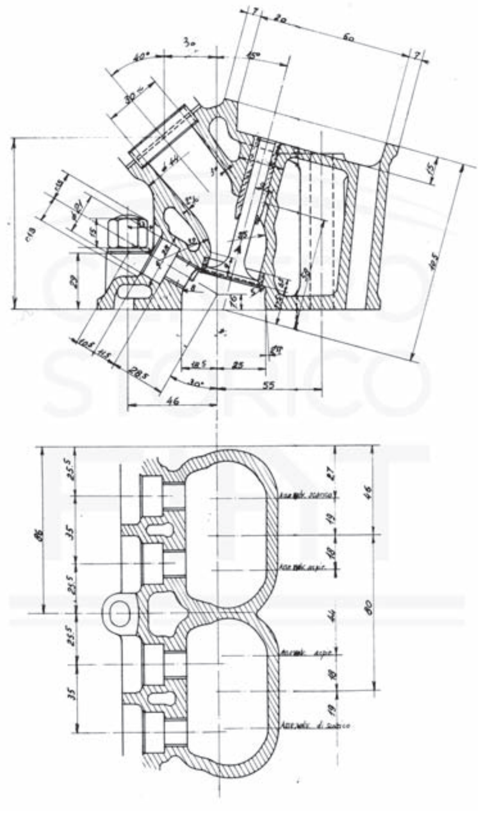
The new automobile was put into production and launched in 1937 as the *Balilla 1100*. But the name *Balilla* was soon forgotten, remaining linked with the previous model. The designation *1100* for many years distinguished the numerous models that were derived from it and were very successful.

The engine developed 32 hp at 4.000 revs. The vehicle weighed 850 kg and had a top speed of 110 km/h.

A year later, in 1938, we were able to launch the *1100 Mille Miglia*, one of the most interesting sports models because of its performance which was achieved by a careful study of the shape of the coachwork. It was a curious process that led to the adoption of that particular form, unusual and also highly original for its date.

Carrying on with our studies for development of the *500* we built a prototype van derived from the little sedan model and noted with surprise that tests showed the van to be much faster than the automobile.

This meant that the aerodynamics of the van were superior to those of the sedan, since the only difference between them was the shape of the rear. I immediately thought of making use of this factor in the design of the coachwork for the *1100* sports coupé which was intended to provide a publicity boost for the *508 C* by taking part in competitions. A number of models were built on a scale of 1:5 and a series of



Among the various studies connected with the 108 C ohv engine, originally conceived for the sports versions of the Balilla and later adopted almost unaltered for the 508 C-1100, there was an attempt at adopting double combustion. The idea behind this design, which goes back to 7 March 1933, was to make combustion quicker and more reliable by fitting each cylinder with a second spark plug. This device was incorporated and tested on an experimental six-cylinder engine with a capacity of 1.900 cc.

tests in the wind tunnel belonging to the Polytechnic (set up by professor Panetti in the enclosure of the Castle of Valentino for aeronautical studies) furnished the form offering the least air-resistance.

As it had been settled that the chassis should be the same as that of the standard sedan, it was unfortunately not possible to make the new model lower nor appreciably reduce the front area. The only available way to increase the speed was to refine the shape of the coachwork as far as possible so as to improve its streamlining. This was achieved by cutting down its roominess inside and visibility behind.

With a power unit supplying only 42 hp we attained a speed of 140 km/h, an outstanding achievement for an auto of that weight and size. It should be borne in mind that the gasoline available in 1937 meant that the maximum compression ratio was 7:1. The engine reached its maximum power output at only 4.400 revs. This model was first in its category in the Mille Miglia, with a record breaking 112 km/h.

The *508 L* "stretched" version was also quickly designed and put into production. In 1939 production also began of the *Torpedo 508 M* for military use, which continued to be manufactured until 1945.

CHAPTER V

FROM 1936 TO 1941 – THE *2800* AND "700" EXPERIMENTAL MODELS "1300", "1900" AND "400"

In October 1935 Mussolini declared war on Ethiopia and on 9 May 1936, with the fighting over, proclaimed the foundation of the Italian empire. The world, disappointed by the failure of the economic sanctions intended to punish us, observed in astonishment as the emperor of Ethiopia, small and dark, was ousted by another emperor, equally pint-sized but white, King Vittorio Emanuele III.

I was irritated by the clamour of acclaim raised by the massed crowds but not distracted from my almost feverish activity among the drawing boards lined up in the big hall on the fifth floor of the south wing of the Lingotto "palazzina". Even the rare discussions about political events that sometimes took place at Fiat could not distract me. When Zerbi, looking gloomy and upset, suggested tactfully that it would be best for Fiat if its executives joined the party I agreed, as did the others.

The sanctions and the consequent system of national economic independence promoted by Mussolini had some effect on our projects. In order to avoid having to pay out foreign currency for manufacturing licences we had to make every effort to replace components patented abroad with equivalent ones devised by ourselves and just as functional, of the same quality and, if possible, without involving greater costs. So it came about that one day Zerbi asked me to receive Mr Philip Baldwin, who had been mentioned to Bruschi and then introduced to the director of our Purchasing Department, Peradotto, by Pasquale Borracci, director of the Officine Galileo, well known as an automobile enthusiast and writer for the press.

Tall and loose-limbed, with features that struck me as more English than American, lit up with a shrewd expression by two piercing blue eyes, Philip Baldwin would hold a big cigar between his lips as he talked slowly, in an astonishing blend of Tuscan coloured by an American accent. I realized that this was not the usual run-of-the-mill amateur inventor but an impressive and attractive personality. He said that he had been born in Florence where his father, a doctor, had chosen to settle in a house on the banks of the Arno. Filippo, as in true friendly American style he wanted me to call him after a few meetings, had spent his youth in Italy and his man-

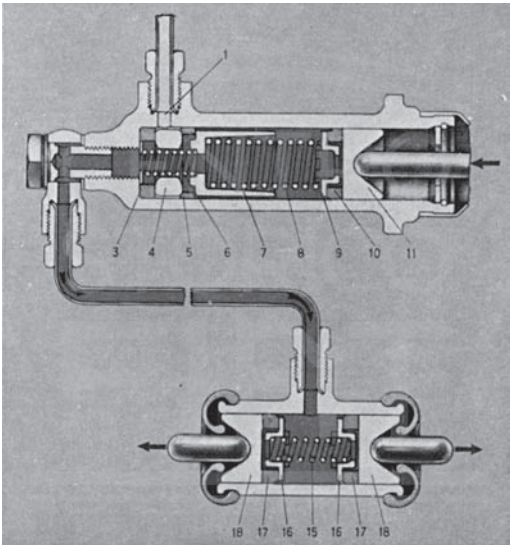
> **Pasquale Borracci**, engineer, born in Florence in 1888.
> In 1922 he was appointed technical superintendent of motoring by the RACI, of which he became a director in 1923. In 1922 he founded the association of the Italian sporting press. In 1936 he was member of the team that won the Italian marksmanship competition. Between 1968 and 1975 he was President of the Florence Automobile Club and promoted the construction of the international motor-racing circuit at Mugello, opened in 1974.
> He contributed to numerous automobile and motorcycle magazines in Italy and abroad, his journalism being of an unusually high level on the technical plane. [He died in 1987].

hood between Florence and Minneapolis, where his family lived. He had married a Russian whom he met while on a mission organized by the International Red Cross to help the Soviet people during the famines caused by the civil war. When I met him he was about fifty years old and lived in Florence with his two children, dividing his energies between collecting old silver and his special invention, which was what had brought him to Fiat.

He had worked out a hydraulic control for regulating shock absorbers and had realized, as they were being developed during trials, that with suitable adjustments the system could be adapted to controlling hydraulic brakes, which were just beginning to be used in Europe at that time. Fiat had adopted hydraulic brakes on the *500* but the patent belonged to Lockheed and we paid them so much per vehicle for the manufacturing rights. The Baldwin system would save us having to pay out dollars if it turned out to be valid.

I told Zerbi that Baldwin's suggestion was worth looking into and he okayed a collaboration which was to last a long time, ending only with Baldwin's death in August 1973.

The endless, minute variations applied to Baldwin's system to make it simpler and safer went on until the start of the Second World War and were resumed when the war ended and Baldwin, set free from the internment to which Americans in Italy had been subjected for its duration, was able to return to his painstaking and tenacious research. The Baldwin system for hydraulic brake control was put into production by Fiat in 1948. It gave Fiat an appreciable economic advantage since it was the cheapest and simplest type to be developed either in Europe or America. Its quality and safety are indisputable. When, at the age of eighty-six, death put an end to his assiduous work of developing the system, to which I had contributed advice and suggestions, he was known and respected by manufacturers of hydraulic brakes the world over. His goodness and patience, intelligence and perseverance, together with the most flawless honesty, shed lustre on our friendship.



Working of the Fiat-Baldwin hydraulic brake-control system. The master cylinder and the small cylinder are shown in the braking position. The illustration is taken from a pamphlet by SIACI, the company set up in Florence by Philip Baldwin to exploit his patents.

In 1936 there were two events of the greatest importance for my future. On 5 June the *500* was successfully launched and on 19 October my marriage took place. It was the success of the *500* that linked me definitively to Fiat and helped to decide me to tie the second, closer knot. We went on our honeymoon in a *500* and my bachelor days were over. I was thirty-two. Two years later our daughter Mariella was born.

Tranquillo Zerbi, mechanical engineer, born in Saronno (Varese) in 1891. After qualifying at the Mannheim School of Engineering in 1912, he gained experience at the Sulzer company in Winterthur and at the Franco Tosi works in Legnano, where he widened his knowledge of diesel engine design.
In 1919 he joined Fiat as a design engineer, helping to solve problems connected with supercharging and so enabling Fiat racing-engines to perform successfully in the 1922 French Grand Prix, at Strasbourg and in the competitions at Monza and Brescia in 1923.
His designs secured even greater successes for Fiat in the aeronautical sector, during the golden half-decade of Italian aviation, marked by the world speed record (709.209 km/h) set in 1934 by Francesco Agello in a plane powered by the Fiat AS 6 engine.
In 1929 he was put in charge of Fiat's technical offices and superintended the design of the *508 Balilla* and the *1500*. He died in Turin in 1939.

In 1937, after the launching of its *508 C* and the *508 C Mille Miglia*, Fiat produced out 67.000 automobiles. It had work force of 40.000 employees. In the same year the *500* won the world speed record for its category with 145 km/h.

I began to write the treatise on internal combustion engines entitled *Motori Endotermici* which the publisher Hoepli had been urging me to do. In this work I was greatly helped by Francesco Bellicardi, an industrial engineer who had been for some time a valued member of the team at the Automobile Engineering Division as head of the estimates group and also acted as Fessia's assistant lecturer in his course at the Polytechnic on automobile engineering. My book came out in 1938 and had a good readership.

At the end of October of the same year I returned from Paris, where I had been to the Motor Show, to find my mother dying of a cerebral embolism. She passed away a few days later. In 1939, one year later, I lost my father, who died of a heart attack. My grief at the death of my parents, for whom I had felt not only the deepest love but also profound gratitude, respect and admiration, was mingled with the cares of having to administer the estate left to me and my brother Valerio, fourteen years my junior. My sister Velia, Donadei by marriage, had been living in the country for some years now, together with her husband and two daughters, Mirella and Renata.

In 1939 the Fiat company was itself to suffer a grave loss. On 11 March Zerbi was unexpectedly struck down by angina pectoris. He was only fifty-three years old. His grave is in the cemetery of Pecetto, a village in the hills outside Turin where he had bought a country home that he loved deeply. On it Fiat placed a stone sculpture of an air-cooled radial engine. My mind often reverts to that plot of earth surmounted by a stone engine. Zerbi's reputation was bound up with water-cooled in-line engines. One of these engines, a twenty-four cylinder job with counter-rotating screws, had won the world speed record for seaplanes for Fiat and Italy. An engine of this sort would have been the fitting monument for Tranquillo Zerbi.

Zerbi had joined Fiat in 1919. He had taken part in the designing of racing cars in the days of Fornaca and the great sporting successes in the international sphere. His career had been rapid and his merits had won full recognition. He was dubbed

Grand'Ufficiale della Corona d'Italia. Numerous models were designed under his direction and Fiat began design and production of diesel engines for trucks. He was a first-rate designer and director. Straightforward and good-hearted, never one to waste words, he was well-liked by his subordinates. He also had the ill-fortune to earn rivals, envious of his success, against whom he could not and would not defend himself. Though he was built like a wrestler his heart was unable to bear up against the fierce rivalry.

Asrael Callabioni, born in Turin in 1907. After joining Fiat in 1925 as a draughtsman he gained quick promotion and became director of the works technical offices of the Lingotto and Mirafiori works. He made an important contribution to the project of the Fiat Foundry in the Soviet Union.
He was killed in an air-raid in 1940.

Fessia took over Zerbi's place and so assumed entire responsibility for directing Fiat's whole design section.

I was promoted to assistant director of the Automobile Division as from 1 January 1940. This gave me greater authority but my responsibilities were unchanged in connection with studies for new models and updating of vehicles already in production. The latter process consisted of modifying the components in compliance with suggestions passed on by the works engineers to make manufacturing and assembly simpler and safer and especially modifications designed to eliminate flaws that have emerged during use by buyers and improve overall quality. This is an intricate job, involving collaboration by the engineers in the technical offices and workshops, those in charge of tooling-up and equipment and finally the decision of the company's top management whenever large outlays and increases in costs are required. Nowadays this is a complex operation and calls for the participation of even more people. At that time the works director, Genero, was responsible for this particular task. He systematically hunted out the person responsible for a given defect, whether it was a fault of manufacture or design. Then he would organize a full-scale trial during which those responsible were called on to produce the relevant documents. In our case, at the technical offices, we had to produce designs and instructions for modifications with the relative details. The workshop employees had to present the "body of the crime", the defective component itself, while the testers came armed with test-reports etc. The judgments passed by Genero were extremely harsh, couched in the fiercest terms. Everyone was afraid of them. Towards me he displayed a certain gentleness but this did not make his strictures less severe. They had at least the merit of being almost primitive in their clarity and simplicity. This was all to the good of discipline, which was very strict.

The experience I gained from optimizing mass-produced models was extremely useful in designing new autos and forming new projects that my mind churned out continuously, driving me to develop them with an eye to future applications. Fessia backed me up. He listened to my suggestions and discussed them, always ready to support any proposal that looked worth following up. He would often encourage the most daring ideas among those I timidly put forward. He would gaily take up positions that seemed too reckless to me, embroiled as I often was in arguments over technical points with my colleagues in the workshops. Clashes became particularly fierce whenever the design of some part called for special or costly manufacturing equipment. These would involve the men at the Workshop Technical

Division, headed by Asrael Callabioni, another character who was not a whit inferior to Genero in drive, energy and toughness. Sometimes Fessia would stick his oar in, making great play with his culture and remorseless powers of debate, confusing and humiliating less adroit adversaries. The consequence was that he made not a few enemies.

On the other hand I tried to be friendly and make myself liked in order to maintain the peace of mind that I needed to do my job. I had only one guiding principle: to achieve the best results from every point of view – technical, economic, aesthetic.

Returning to my account of the projects carried out, I have to go back in time a moment. In 1935, when I was appointed head of the Automobiles Division, I took over from my predecessors a number of projects launched under Zerbi's instructions for models bigger than the *1500* to replace the *518* C (the *Ardita 1750*) and the *527* (*Ardita 2500*).

These led us to design, in successive phases, two six-cylinder in-line engines, one a 1.750 cc producing 65 hp and the other a 1.650 producing 55 hp. The first of these was mounted in 1936 on an experimental vehicle which we called the "1700", with room for five and independent suspension all round, repeating the scheme of the experimental "8 A" and "8 B". The coachwork was an adaptation of the *1500*, with the result that it weighed too much (1.350 kg) and performance was poor.

In the case of the second engine, which had an overhead camshaft, we followed up with a four-seater sedan weighing 990 kg and with independent suspension on front wheels only, using a variable flexibility system I devised and protected with a Fiat patent. The prototype, called the "546", was tested in 1938.

I also had a 2.000 cc V8 engine designed with overhead valves and an aluminium cylinder block specially designed so as to be manufactured by die-casting. The "548", conceived along the same lines as the "546" but bigger, was never built. Only one experimental engine was made.

In the same period studies had been begun for a new model (half-way between the *500* and the *1100*) designated the "700" and we also began projecting a bigger model with a 2.800 cc six-cylinder engine, intended to fill the role of a dignified company automobile.

From the interchange of ideas between the General Management, sales management and technical management I formed an idea of future plans and organized my work accordingly. On my own initiative I began studies of a chassis which appealed to me as original and up-to-date, with the *2800* transverse rear engine. I had singled out

Six-seven seater sedan with dividing panel and interphone for use as a company limousine, model 2800 (1938-44).

a particularly versatile and intelligent designer, though one that lacked that flair for the practical which is indispensable for mass-production projects. He was suitable for the initial phase of this assignment, however, because I intended to have my ideas developed rapidly since, as always happened, these would require a whole series of trials to check the advantages and disadvantages of the features envisaged.

The group consisting of the engine and transmission was beginning to emerge in detail. The transmission consisted of the clutch and the final gearing torque, arranged so as to allow the engine to be fitted transversely at the rear of the automobile and jut out only very slightly. Since the design of the power plant was to be matched by a new and original layout of the chassis and coachwork, I thought it would be possible to overcome all the problems that might crop up with road holding as a result of the vehicle's barycentre being rather far back.

Luigi Gajal de la Chenaye, born in Turin in 1894. He joined Fiat at a very early age and by the time he was twenty-eight was already a branch manager, concentrating mainly on the commercial sector.
In 1928 he was appointed to head Fiat's sales management in Italy and ten years later became Fiat's head manager. Associate general manager of Fiat in 1946, he was appointed to the board of directors.
In 1955 he became vice-President but at his own request the post was taken by Giovanni Nasi.
Among his other activities, he promoted the reconstitution of the ANFIA and was a founding member of the ATA. He died in Turin in 1963.

My studies were cut short when I learnt that it had been decided to get out designs for a traditional type of automobile with seating for five plus two folding seats. The engine was to be a six-cylinder in-line not exceeding 2.800 cc.

I knew that all attempts over the previous year to create a large limousine had been failures. The most recent prototypes built, one with an engine of about 6.000 cc, the other 4.000 cc, had been judged too heavy, deficient in performance and expensive. American automobiles of about the same size were much lighter and performed better.

Why the decision to have the Technical Division attempt a project that was quite likely to fail? The opinion of the Commercial Division, not openly expressed but represented most authoritatively by the blue-blooded Luigi Gajal de la Chenaye, was that the Technical Division calculated the structures of its vehicles according to excessively high standards of sturdiness with the result that they were too heavy. This opinion was justified.

The same methods were used for calculations for big autos as or small ones. Since vehicles were often driven in Italy with a full load, with a larger number of passengers than those for which the coachwork had been designed, these calculations took such conditions into account as well as maximum speed and the very worst roads. The application of these criteria to large autos resulted in very heavy models as compared with the available engine-power. The problem was aggravated by the need to use relatively small engines so as to cut down road tax and promote sales.

When I had looked into the position with American models, I pointed out that their mechanicals were much lighter in comparison with engine capacity and output because their overall dimensions were calculated on the supposition that they would be carrying only one or two passengers and at lower than maximum speed. These were evidently the reasons for the discrepancy between American results and ours. I produced some notes on the subject. I shall quote the essential parts:

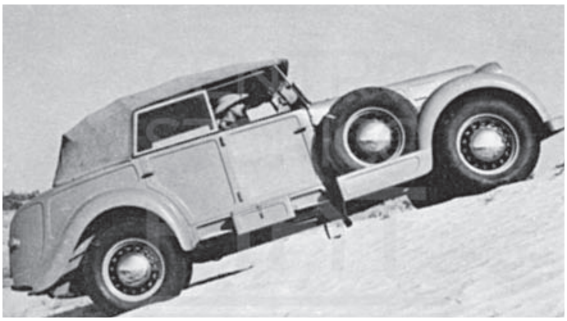
> The basis of design and principles on which calculations are based in fixing the dimensions of component parts in Fiat automobiles start from the context of driving in Italy:
>
> – many narrow twisting roads with prevalently mountain gradients;
> – great variations in the nature of the road surface;
> – frequent overloading;
> – a wide range of needs, tastes and attitudes to be catered for;
> – tendency to regard driving as if it was a sport;
> – road tax system based on the engine capacity and number of cylinders;
> – scarcity of fuel;
> – law-octane fuel.

Nevertheless, the *2800* project was immediately started. It was to be a completely new automobile. The body, however, was to differ from the *1100* only in its dimensions.

Brakes required special attention. Since at that time there was no safe and economical servo-braking system available we had to find a solution that would ensure maximum efficiency without it. Drum brakes of the biggest diameter permitted by the wheels were adopted, with aluminium cooling fins and automatic-wind brake-shoes, each worked by its own hydraulic cylinder. Another problem was the choice of the type of steering mechanism. The weight on the front wheels was much greater than on the other Fiats and without servosteering it was difficult to make the handling light. After a lot of study which went on all through the experimental period we finally got results that even the hard-to-please Salamano found good and he had the last say in accepting or rejecting the vehicle.

This automobile fully came up to the standards set for it: it was sturdy, quiet, road holding was excellent, brakes and steering safe. Salamano could take his favourite mountain roads in sporting style. But the coachwork built for seven people made it too big and heavy.

After long testing and a lot of modifications the prototype was approved and final designs were sent to the Works Department for it to go into standard production. It came out in 1938. A military model was derived from it which enjoyed some success because of its practical and rugged qualities. Between 1938 and 1944 a total of 621



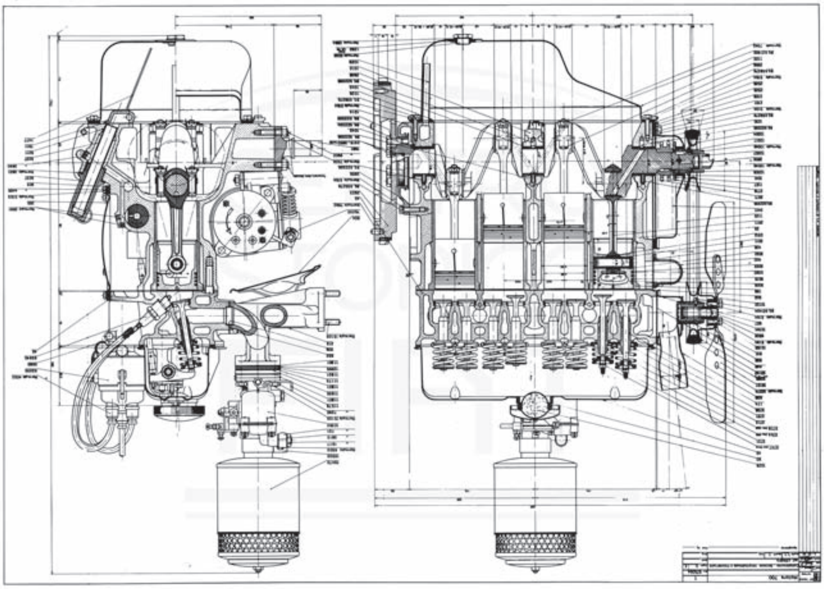
2800 colonial torpedo-tourer (1939).
This auto, of which a few were built as staff cars, appeared in two versions, one with the spare wheels beside the engine hood and the other with them at the rear.

chassis were produced, of which 288 were fitted with sedan bodywork and 210 fitted out as military staff cars. The rest were never utilized.

Fiat's programmes in that period envisaged increasingly important development of economy models. For this reason I laid the stress on development of the "700" even while the *2800* was being planned. The "700" was to be a four-door four-seater so designed as to be easily adapted for production with a sun-hatch and as a two-seater convertible.

The coachwork also acted as a support for the mechanicals, the chassis having been done away with. This solution was here taken into consideration for the first time by Fiat. To get Genero to accept it we had had to purchase an Opel *Olimpia*, the first auto with bearing coachwork built by mass production methods, in order to display the system's advantages in terms of cast and quality. This was the only way we could keep the weight of the "700" down to 650 kg as envisaged. My calculations also suggested that to keep within this limit the crankcase and big end would have to be made of aluminium. Naturally the gear casing would have to be of light alloy. The design of the engine was a long job, involving close collaboration between the technical office and the specialists in the aluminium foundry. The crankcase had to be die-cast to make manufacturing quicker and cheaper. It was essential to shape it so that this procedure – very novel in those days – could be adopted.

The prototype engine was built in a brief span of time, about two months. It was a hard job to bring it to perfection not so much because of difficulty achieving the desired output of 22 hp but to eliminate certain snags that caused it to consume a lot of oil. The pulsing of air and oil in the crankcase, spurting from the blow-bys of the cylinders, was much above normal and pushed the oil upwards through the passages of the valve drive-rods until it reached the rockers and the valves themselves. The oil oozed between the shanks of the valves and their slides into the cylinders where it got burnt up. The crankcase had to be modified so as to ensure a freer passage

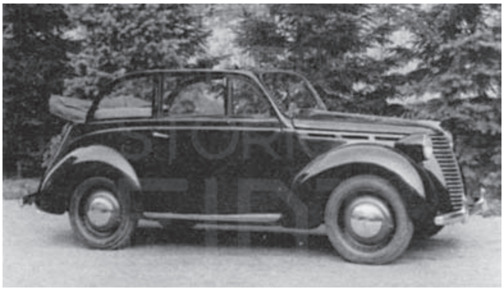


Longitudinal section and cross-section of the engine for the "700", the utility model which never went into production, on account of the outbreak of war. The engine block was designed for die-casting in aluminium. Design dated 3 December 1941.

between the case and the head through the region of the tappets to slow down the spurting of the gases and we also fitted a special type of breather pipe to the outside. All this work was the result of having to die-cast the aluminium crankcase. The engine finally passed all its tests and was approved by the Engine Testing Division. The automobile with its bearing coachwork was perfected without particular problems. The independent front suspension was of the quadrilateral type designed to produce through the use of spiral springs a degree of flexibility that would decrease with increase in load.

The engine-clutch-gearbox unit was supported on a plate-metal cross-tie that bore the steering and the radiator in addition to the front suspension. All this was attached by a few bolts to the coachwork. Although its underlying conception was modern, its shape was quite mundane, the style in fashion after the period of streamlining that had left its mark on the *1500,* the *500* and the *508 C-1100*. It looked stale to me: only the engine really satisfied me. Nevertheless, senator Agnelli and Valletta decided to put it into production and began tooling up the new Mirafiori works to manufacture it. The first crankcases manufactured by the equipment for mass-production were magnificent. I was so proud of them that I never missed a chance to show them to foreign visitors, who were invariably amazed when they visited the Fiat works.

This automobile was presented to Mussolini on 15 May 1939 during the inauguration of the new Mirafiori factory but production was prevented by the outbreak of



Prototype of the "700 Esp. II" (1939), derived from the economical model and featuring a top that opened. The outbreak of the war prevented it from going into production.

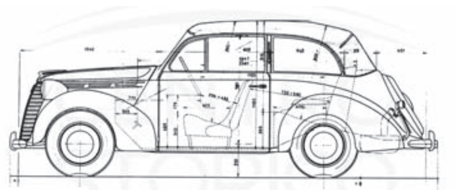
Metal two-door "700" sedan (1939). This clearly reveals the stylistic affinity with its larger "sister-car" the 1100 B, marketed from 1948 on.

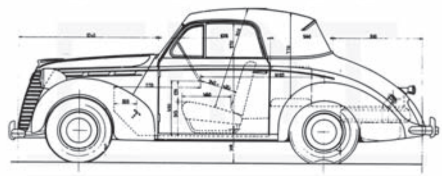
the war. This meant that our technique of manufacturing aluminium alloy engines was stillborn, when it might easily have been widely applied to the production of economy models. The "700" was soon forgotten. A prototype is kept in the Automobile Museum in Turin.

The "700" was not the only model produced in those years. Two others were designed and tested; supplying new experience and data that were to prove extremely useful in determining the types developed after the war.

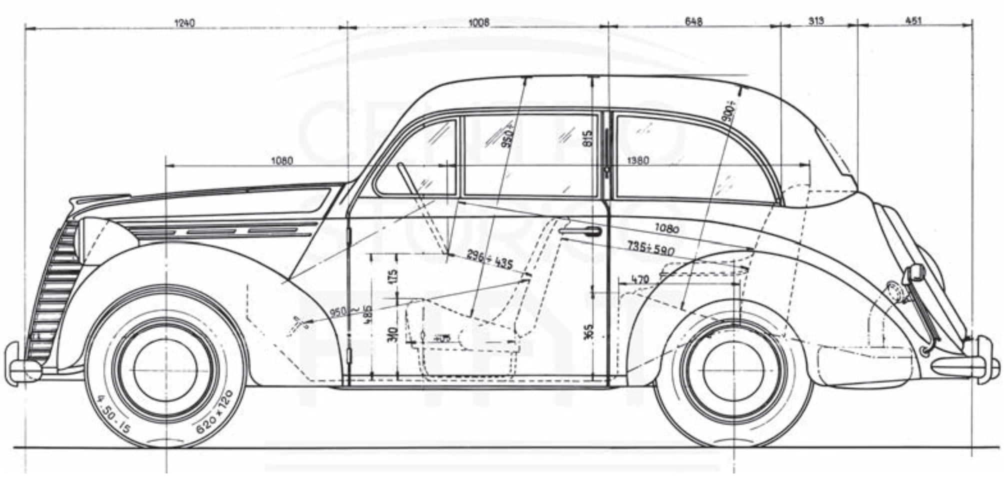
These were a "1900" with seating for five and weighing 1.180 kg and a "1300" four-seater weighing 890 kg. The first of these had a 1.900 cc engine developing 60 hp at 4.400 revs and the second a four-cylinder version derived from the first with a capacity of 1.300 cc and an output of about 36 hp at 4.400 revs. The crankcases of the two engines were so designed as to make it possible to manufacture them from aluminium alloy by die-casting.

I had had a head designed whose valves, driven by rods and tappets, were placed so as to enable each cylinder to be fitted with two spark plugs. My idea was that this device would help to activate combustion and so make it possible to cut consumption by feeding a "poor" mixture into the engine. In that period, when the government's policy was one of economic self-sufficiency, there was a strong commitment to research into saving fuel. Engines were devised that ran on mixtures of alcohol and





From top: plan of the "700 Esp. II" sunhatch-version (21 August 1939) and the two-seater convertible (14 September 1939), respectively the third and thirteenth derivations from the basic model. The plan of the metal sedan, reproduced at the foot of the page, is dated 26 July 1939.



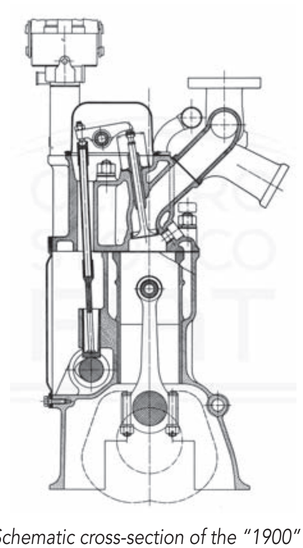
water or alcohol and gasoline. Gas-producers were experimented with. For a while I drove round in an 1100 fitted with a gas-producer that used wood as fuel.

The "1900" and "1300" were designed on the bearing coachwork principle. They had independent front suspension on the flexible quadrilateral system previously patented.

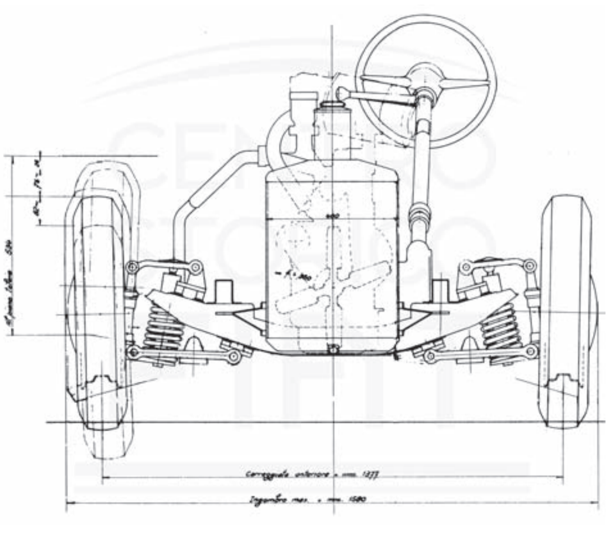
I was a strong supporter of the bearing coachwork system and Fessia naturally agreed with me but the attitude of Bruschi and Genero was on the whole disapproving. They tended to comply with a well-known ruling by Agnelli that the most sensible technical and commercial policy was to copy successful developments by the older and hence – in his opinion – more experienced foreign companies.

Since all the American automobiles had chassis, the decision to go over to bearing coachwork was the subject of debates and criticisms that went on for years. It was my lot to have to discuss the matter directly with senator Agnelli. The plating of the coachwork of the "1900" was being constructed in the experimental coachwork shop on the same level as the track, near the north curve on the roof of the Lingotto factory. Agnelli made me get into his *1500* that was waiting for him in the courtyard. His unlit pipe was in his mouth as usual. "Let's go and look at this auto without a chassis", he said in his assertive tone of voice. During the drive up the ramp that spirals up to the track I tried to overcome my tension and explain the functional and especially the economic benefits of the system.

He listened silently, his silence continuing throughout the inspection of the vehicle's framework while I poured out my explanations. He would not give me the satisfaction of saying outright that I was right but he gave me a handshake with a smile of approbation and went off, leaving me to my work with the shop foreman and his men, who were skilfully welding the plates together.



Schematic cross-section of the "1900" and "1300" engines with aluminium crankcases and pressed-in liners. The head is designed for ignition by two sparkplugs per cylinder. The design is dated 11 January 1940.



Diagrammatic front view of the "1900" chassis with variable-flexibility front suspension. Design dated 22 September 1943.

From then on all Fiat autos were built with bearing bodywork, the logical conclusion to the evolution of a system that I had devised for the *500* and the *1100*, in which the automobile's overall rigidity was the product of the interaction of the coachwork and a chassis reduced to two light longitudinal struts joined by tie-spars.

In this unit body-chassis system, the floor of the coachwork and the chassis are combined in the platform, suitably designed and strengthened, which becomes the most important part of the stressbearing section of the body. The total number of parts is notably reduced and the weight saved is a little less than the weight of the discarded chassis.

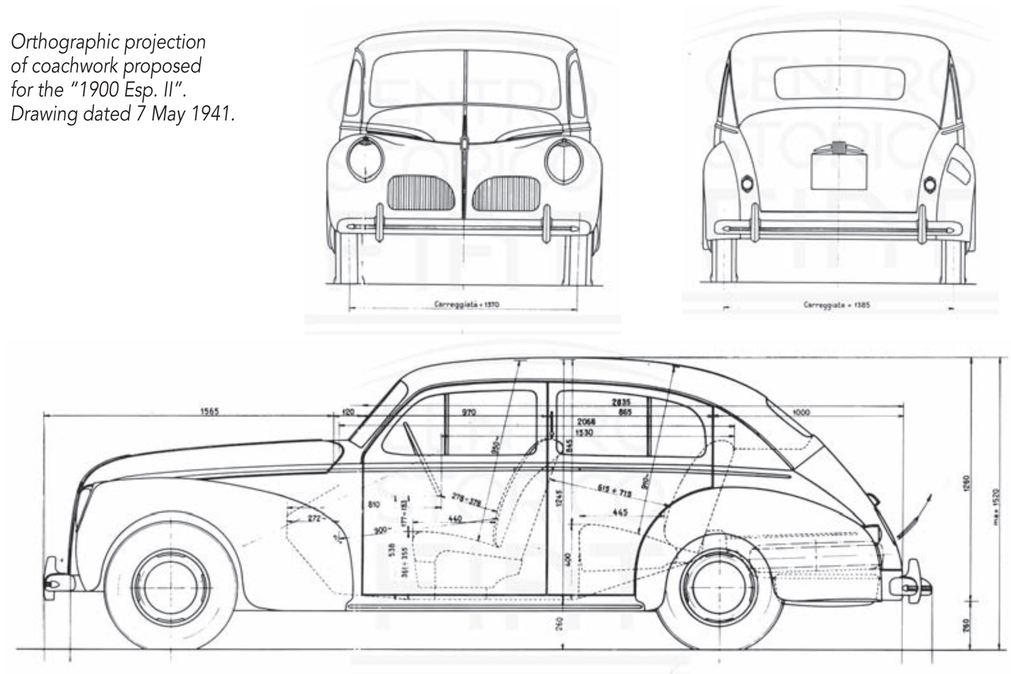
There was good reason for fearing that there would be more noise than in vehicles fitted with chassis. In fact there were serious problems in deadening the noise from the engine and the suspension but they were eventually overcome. Now all European automobiles have the bearing coachwork system. The Americans have also followed suit, though rather late in the day.

The "1900" was built and tested in 1939-1940. The "1300" was not completed. Two engines had been tested on the bench, the mechanicals and coachwork were built, but trials could not be carried out. Italy was caught up in the war.

We learnt a lot from the "1900" trials. That it was not advisable, for one thing, to adopt variable flexibility on the front suspension. It only complicated matters without much benefit and increased the weight and cast. We also learnt much about the rear suspension.

I studied ways to prevent the car from leaning over too much on bends, without resorting to a stabilizer bar. At that time we did not know much about the drift-effect of tyres and our ideas were hazy concerning the influence of the roll-centre of the suspension and hence the roll-axis on the vehicle's behaviour when cornering. I thought that the inclination caused by the centrifugal effect could be effectively

Orthographic projection of coachwork proposed for the "1900 Esp. II". Drawing dated 7 May 1941.



remedied by anchoring the coachwork to the rear axle at a point above the wheel-axis so that the overturning torque, created by centrifugal force acting on the barycentre, would be reduced by acting on the axle along a very short spar. Among the numerous possible arrangements the simplest and lightest seemed to be a suspension with spiral springs fitted on two longitudinal struts supported by the axle, converging towards the vehicle's median axis and there hinged to the body shell with rubber fittings. The axle and two struts formed a triangle. To join the axle to the coachwork transversely, a bar almost as long as the axle housing was hinged to the coachwork at one end and to the axle at the other. There was nothing new here, except that this bar was fitted parallel to the axle and as high above it as possible in the space available. When the first model had been developed and final trials to perfect it were being made we noticed that the rear suspension caused slight sideways jolting to the passengers, which we thought unacceptable in a modern automobile of this class.

After reflection and checks I realized that the defect was caused by the position of the transverse bar. We placed it lower, on a level with the mid-axle, and the transverse vibrations diminished till they were imperceptible. We also learnt that this defect could be eliminated by allowing a bit more sideways "give" in the suspension. The outcome was a vehicle that was more comfortable to ride in but leant slightly towards the outside when cornering at speed. Salamano's collaboration was, as always, precious in this work.

Another project that I look back on with some regret was for a smaller automobile than the *500*, called the "400". I've always had a special preference for small cars. My family was far from well off and since early childhood I had been brought up to be thrifty, never to waste anything and to make everything I needed last as long as possible: clothes, books, possessions. My mother taught me to make use even of things that seemed to be quite worn out, and it was an enjoyable game for me to imagine ways of turning clothes and other odds and ends to some use. My concern for the economic aspects of problems helped me a lot in my career as a designer. I have always been ready to redesign any mechanism an endless number of times as long as I could glimpse a possibility of cutting the cost. Time and again I have had a design redone from scratch in the effort to reduce the number of components, perhaps to save just one screw! Besides, the instructions I was given, especially at that time, were all aimed at cutting costs. I certainly needed no urging to comply. Simplicity and beauty go hand in hand and nearly always add up to low manufacturing costs. I shall have occasion to dwell on this topic again.

So my personal preference was for the small and economical automobile that could be bought by as wide a public as possible, the little car that could be used to go to work or for a drive at weekends and did not take up much parking space. In Japan I have seen tiny autos parked by their drivers in little shops where their owners hardly had room to move between the wares displayed and the vehicle parked there.

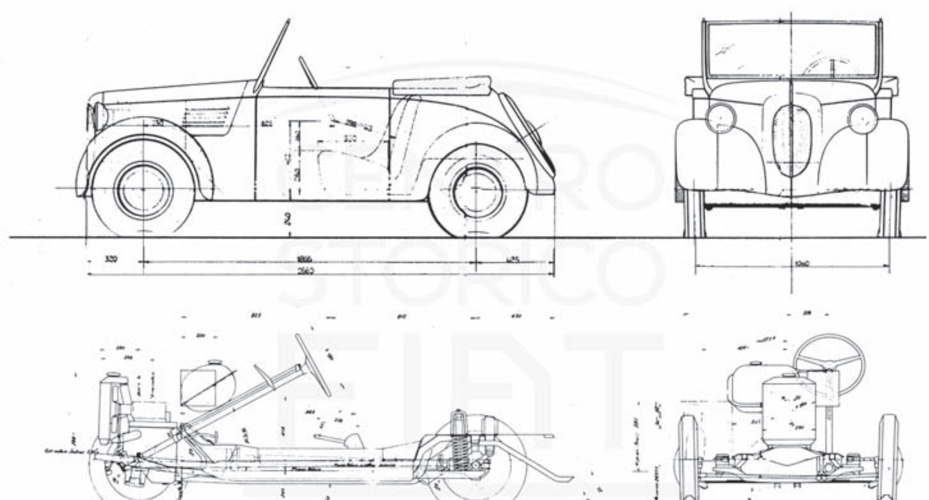
The first version of the "400", designed between 1939 and 1940, was a success as far as concept and design went. It was an open two-seater, a *cabriolet* that could be covered with a light folding hood. The four-cylinder in-line engine with side-valves, like the *500*, had a capacity of 400 cc and produced 14 hp. It had four gears, independent suspension in front with a transverse leaf spring and spiral springs at the rear.

Since the model had no hard roof, the platform of the bodywork was constructed to be very sturdy and rigid, the outcome being a rather unusual shape. It was rapidly constructed and I had it subjected to deflection and torsional tests without taking it off the massive cast-iron bed on which the prototype coachwork was being constructed. With a series of modifications the desired results were achieved.

The vehicle weighed 412 kg, a mere 2 kg more than the weight envisaged in the design. Unfortunately it could only do a few days' tests before it had to be moved, along with the other prototypes, away from Lingotto and out of the city to escape the bombardments.

The plans had been for the "400" to replace the *500* when the "700" went into production. The Fiat range would then consist of the "400", "700", *1100*, "1300", "1900". The war not only prevented this from being achieved but changed a lot of other things at Fiat as it did all over the country.

The projects and prototypes we worked on in the 1937-1940 period were very important to the development of our design technique. The innovations we introduced were to reappear in different forms in the models that emerged after the war years: the bearing bodywork, the structure of the high-speed synchronized gearbox, the new joints used for the suspension, the structure of the short-stroke engine and so forth.



Technical drawing of one of the first versions of the "400" light utility auto (fifth study for the coachwork, dated 22 September 1941). Below, a later design for the chassis, dated 22 September 1943.

CHAPTER VI

THE WAR AND THE A 40 AERO ENGINE

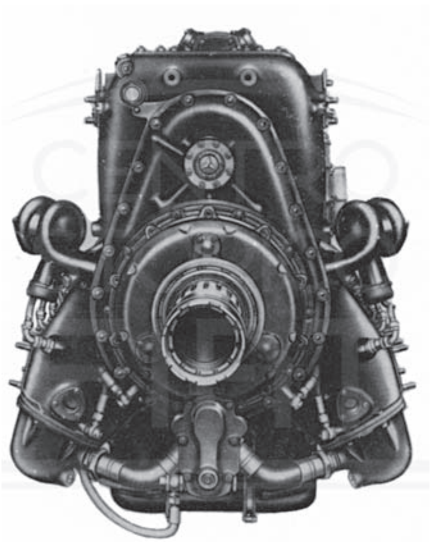
THE ELECTRIC *TOPOLINO*

In 1939 the Spanish civil war ended in victory for Franco, a victory shared by Mussolini and Hitler. Italy seemed proud of itself and acted as if it were confident of the invincibility of the regimes set up in Germany and Italy. But more thoughtful minds were filled with foreboding.

The German invasion of Poland on 1 September and the declaration of war by France and Great Britain had intensified the widespread atmosphere of apprehension. Almost incredulous, people gazed at the German newsreels exalting the glorious feats of the German army, avoiding the terrible spectacle of death and the fearsome consequences of those very feats of arms. They hoped that Mussolini would preserve Italy's neutrality and avoid the atrocities of war, and continued to work as if there was no threat to peace.

But there was a special section of the Mirafiori works where preparations were being made for the production of Daimler Benz inverted VI2 engines, with fuel injection and water-cooling. Engines designed for wartime use, modern, supercharged for high altitudes. I could appreciate their refined design and advanced technology.

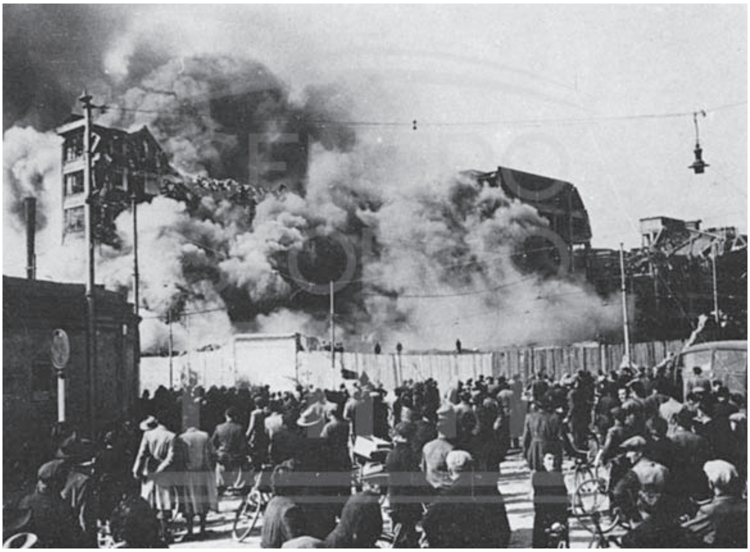
Early in 1940 the fears of Italy's entry into the war became overwhelming. There was a feeling that something extremely grave was about to happen. On June 10 we received a peremptory order. All office workers and factory hands were to stop work and line up, ready to proceed to the public squares and the courtyards of the Fascist district headquarters. I had to join those columns of gloomy, anxious, fearful men. When the booming, belligerent voice of the Duce came fiercely over the loudspeakers, announcing the declaration of war, my heart missed a beat and the crowd was shaken by perturbation. "We'll have the French bombers over our houses tonight," I said. They came the night after.



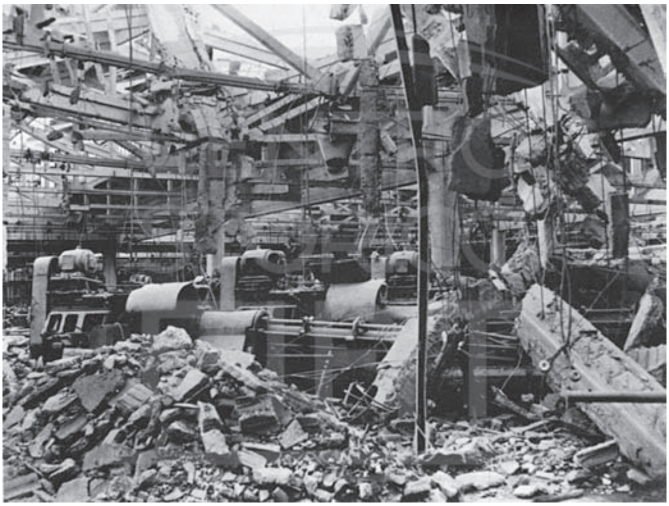
Front view, prop-shaft side, of the Fiat RA 1050 aeroengine, built under licence from Daimler Benz.

I was alone at home because my wife and children were in the country. I couldn't get to sleep, my mind was so troubled, after the events of the day. Drowsing between sleep and waking I imagined the most terrible events. Suddenly the wailing of sirens, the first air raid alarm, made me scramble out of bed and race to the window. The city was shrouded in darkness but overhead there was a brilliant web of parabolic lines, streaks of light that looked like spurts of luminous water, accompanied by a staccato, threatening rattle. The machine guns on the roofs and terraces of the buildings sought to strike down the airplanes whose engines I could not hear, so far away they were. Black-shirted gunners, merging with the darkness, swung their old-fashioned machine-guns to and fro, firing upwards at random so that the shells fell back on them and us. It was a marvellous sight and tragicomic at the same time.

Some bombs exploded that night and there were casualties. The Mirafiori factory was also hit but damage was slight. The consternation was disproportionately



The inhabitants of Turin examining the effect of an air raid on the Fiat Lingotto works (29 March 1944).



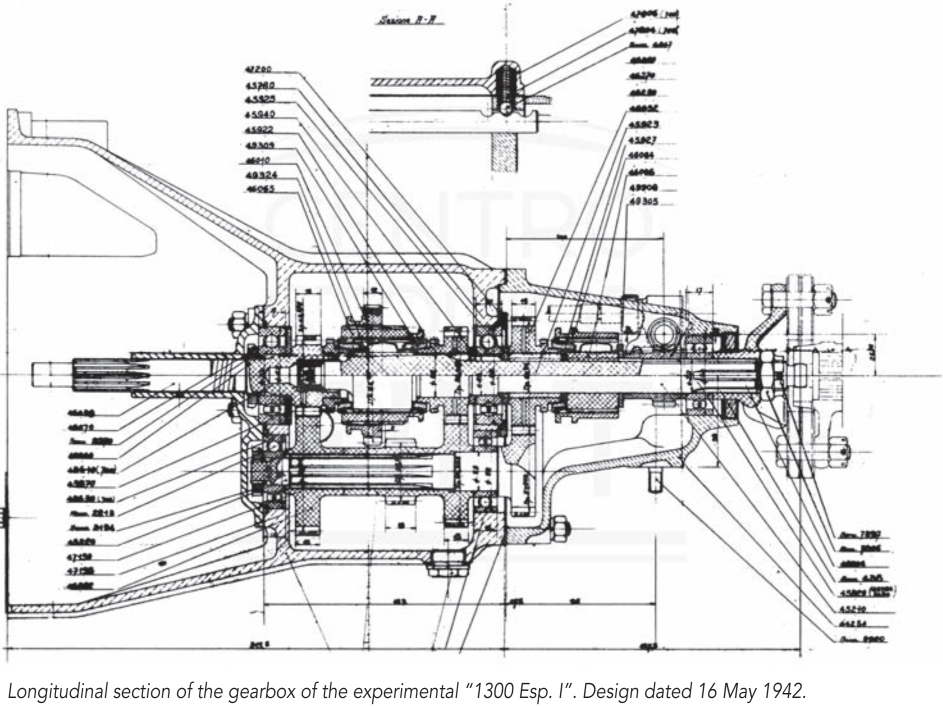
Damage to a section of the Mirafiori works caused by the air raid of 29 March 1944.

great, sparking off a series of flights every evening towards the hills and countryside beyond the outskirt of the town. Autos with hooded lights and whitened mudguards scuttled along the country roads to wait until the air raid was over and the all-clear sounded. At Lingotto air raid shelters were improvised in the basement of the office block where the canteen had been. It was to be the start of a busy period of provisional decisions, frequent moves, eventful journeys, a search for newer and safer shelters, for food and fuel.

After the rigours of the first winter in Turin I moved my little family permanently into our country house in the Albese hills and felt easier in my mind, free to move about as the war and occasion compelled but feeling overwhelmed by that cruel and brutal change that was sweeping everything – people and events – before it in its irresistible course. Anything can become a habit, even the anguish of the new and unexpected, the disruption of all our habits and customs, even our ideas.

So work resumed its old importance again. The experimental prototypes of the six-cylinder "1900" and the "400" were undergoing trials and the continuous intervention of the technical office was needed to perfect them. The design of the "1300" with four-cylinder engine derived from the "1900" was completed. The "700" was perfected with a view to starting production after the war.

Among the sketches and designs I did at that time I find a set dated July 1941 for an engine-transmission unit laid out transversally for use on a small automobile, one a rear-engined job and another with front-drive. There are also a number of studies for replacing cast-iron or steel parts with aluminium alloys of interest to Simca, which had been building the *500* for some years and had recently begun assembly of the *1100*.



Longitudinal section of the gearbox of the experimental "1300 Esp. I". Design dated 16 May 1942.

For the gearbox I had worked out new solutions aimed at cutting down noise and making it easier to engage the gears. After producing and comparing a number of different ideas I picked an arrangement in which the bearings of the two gear shafts were brought closer together. By reducing the length of the span of the two shafts in this way it was possible to reduce the diameter of the shafts given equal deflection under stress. The transmission gained in lightness or, if weight was kept constant, in strength and quietness when running.

This type of transmission, which was adopted ten years later in the *1400*, is still today the most suitable, in my opinion, both functionally and economically.

At that time the American fashion of putting the gear lever on the steering column had also spread in Europe. This arrangement was justified by the use of a single bench-seat in front, making room for a third person if necessary. Though this was logical enough on the wider American models, it was out of place in our small and narrower ones. Since the fashion had caught on, some attempt was made to justify it by saying that it made it easier for the driver to get out on the passenger side since he did not have to clamber over the gear lever. For the same reason the hand brake was placed under the dashboard, which was neither practical nor very secure.

With regard to the gearbox, I thought that on a small and inexpensive model intended for a mass public it ought to be so simple as to make it easy for anyone to get the hang of it. Since an automatic gear system was out of the question because of its cost, I thought the aim could be achieved with a centrifugal – therefore automatic – clutch and a gear-change worked by a pedal. A simple and inexpensive solution was called for, provided it was also functional. I turned the problem over to a clever young design engineer with a passion for research, quick in getting down his ideas on paper and with a real flair for design: this was Angelo Mosso, on whom I gradually placed an increasing share of responsibility and ever greater reliance.

A gearbox can take many different forms, but only a few are really suitable when the requirements are the utmost simplicity and limitation on costs involved in producing an economy model.

The numerous designs turned out here were to be useful not long after, when Piero Dusio asked me to design a small sports car which eventually developed into the Cisitalia. In this case, however, since we were aiming at a racing car, the problems were not so restrictive.

While work was going on regularly in the technical office – due allowance being made for upset arising out of the war – the Test Division had almost completely ceased carrying out trials. Fearing that the Lingotto factory might be bombed, Fessia had given the order to transport the machinery and vehicles to a safe place. All the most valuable equipment, the experimental prototypes, automobiles, lorries and buses, the files with designs and documents containing all the precious store of studies and know-how accumulated by the Fiat company since its foundation were moved to Cigliano. At Lingotto the Experimental Division was reduced to a skeleton staff to maintain contact with the technical office and management.

Cigliano is a sizeable town on the Turin-Milan super-highway, not far from Borgomasino, an ancient town perched on a hillside the last outcropping of the morainic spurs of the Serra. Borgomasino was Fessia's hometown. The old family home was there and it was Fessia's heartfelt desire to build a house there himself. The events leading up to the evacuation of the cities, hit by bombardments, finally made him decide to carry out the project.

When all the equipment, machinery, test benches, vehicles and so forth were removed bodily to Cigliano he was able to satisfy at one and the same time the need to assert his authority as director and his yearning for his hometown as danger threatened, but the technical office lost the precious assistance of the Experimental Division.

Carlo Felice Bona, mechanical engineer, born in Asti in 1898. He graduated from Turin Polytechnic in 1922 and the following year entered Fiat, joining the work group headed by Tranquillo Zerbi. Some years later he was appointed head of the Aero Engines Technical Office. After the Second World War he was appointed vice-director of the central Auto-Aero Test and Research Laboratory, of which he later became director. He left Fiat in 1967 on reaching retirement age, retaining a link with the company as consultant until 1969.
He died in Turin in 1970.

Early in 1942 the technical offices were also scheduled for evacuation. Since the air raid shelters in the Lingotto factory were quite inadequate we were ordered to move to the office block at Mirafiori where the air raid shelters offered much greater protection. The few bombs that had so far fallen on the Fiat factory had caused slight damage to the workshops and had not touched the managerial section or the offices. We had the impression that the enemy only wanted to strike at the production plant. We moved without much concern.

We did not remain long on the top floor of the Mirafiori "palazzina" but in that time we managed to complete the design for an aero engine.

The Air Ministry had asked us to design an engine for a high performance military aircraft and so Fessia had assigned the Aero Engine Division, headed by Bona, the task of planning a 16-cylinder V engine. But at the same time he wanted to involve me and my division in the project, perhaps thinking I might have a better idea or in order to be able to present an alternative design. It was not the first time that two designers had been pitted against each other at the company with the idea of benefiting by the spirit of competition. In this way I returned, after a lapse of years, to the job of designing an aero engine.

The new engine was supposed to attain a power of 2.000 hp at 8.000 m altitude and be so devised as to permit a small-bore cannon to shoot through the tube of the prop-shaft.

Busy as I was with the numerous studies for automobiles and worried that I might not be sufficiently abreast of the latest developments in the field of aviation I came close to refusing such an arduous and complex assignment, partly because none of my designers were familiar with aero engines and I knew well enough the difficulty of putting them in the picture without much time at my disposal.

It occurred to me that high-altitude flight, where the scarcity of oxygen sets limits to fuel-input, might have led the countries engaged in the war to completely abandon traditional technologies in favour of new approaches and so mean that our design would shortly be quite out of date. Nevertheless I got to work with my usual enthusiasm which soon spread to my staff.

After a brief period of intensive research I presented the scheme for a 24-cylinder engine laid out on an X-shaped arrangement consisting of four rows of six cylinders with their axes set at 90° to each other. Inside the V formed by the two upper rows the prop-shaft was inserted with the barrel of the cannon fitted to its prolongation. The inverted V of the lower rows contained the dynamic air intake, a large vent housing the centrifugal compressor attached to the rear of the engine. The engine was very compact and shaped so that it could be fitted snugly into the aircraft without offering much wind resistance.

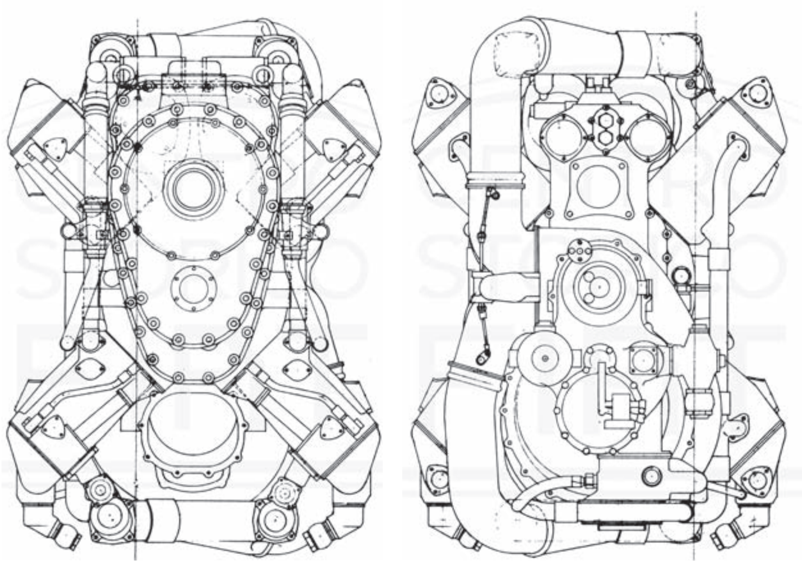
The plan was okayed with the order to get the designs done as quickly as possible. I mobilized the entire office, suspending all work on automobiles.

I clearly remember the difficulties of designing the compressor and the original two-speed gearing to maintain power automatically up to the altitudes prescribed by the technical specification of the Air Ministry.

There was an even knottier problem to be solved. Usually every problem produces at least one basic problem on whose solution everything depends. When there are no elements for a comparison with the past then the only thing to do is to fall back on your own inventiveness and on projections. In the case of the A 40 engine the basic problem was the linkage system. To design the engine as a whole we took six months, and for six months we continued to churn out calculations and drawings to see which type of linkage would present fewest risks. When all our calculations had been done I finally opted for a “master rod” plus three smaller rods. I felt that we could afford to take the risk of a certain degree of lateral pressure on the jacket of the piston attached to the master rod and the project was rapidly completed. The result was an engine with fuel injection by means of three injectors above the valves. I had devised a special system for regulating the flow of air through the intake ducts into the cylinders, controlled automatically by components sensitive to variations in altitude and temperature. We also designed the 24-cylincler injection pump.

The A 40 project was a really exceptional achievement. All the designers involved were proud of it. They had never done an aero engine before, many of them had never worked on an engine of any sort. They had had confidence in me and been infected by my enthusiasm. The engine was built but unfortunately the vicissitudes of the war prevented it from being perfected.

Diagram of front and rear views of the 24-cylinder A 40 aero engine. Design dated 22 January 1943.



The feverish work on the A 40 engine was followed by resumption of the serene and systematic activity of designing automobiles. But during the night between the 20th and the 21st of August 1942, when the whole city was pounded by massive air strikes, the "palazzina" at Mirafiori was hit and some damage done to the technical offices. We had to move out. We were given good accommodation in a building less easily identifiable by airplanes: the Duca degli Abruzzi school, about half a mile from Mirafiori.

The engineering divisions for automobiles, mechanicals and coachwork were moved into the ground floor and the other offices occupied the upper floors.

Fessia's office was on the first floor, next to the Aero Engines Office. On the second floor there was ex-general Savoia, Fiat's director of the Aviation Section. An air raid shelter, deep below the school playground, protected us during air raids. We often had to use it.

Everyone busied himself with his own affairs. Fessia never came into my offices, never bothered to look into what I was up to and I did not object to this arrangement. I had loads of ideas to turn into drawings and certainly never gave my draughtsmen time to feel bored.

The strike of March 1943 (arising out of the firm opposition of the workers to the transport of machinery for manufacturing aero engines from workshop 17 to a tunnel in western Gardesana near Riva del Garda) had no repercussions on work at offices in the Duca degli Abruzzi school. We were cut off from them and such news as reached us was fragmentary and belated.

It was in that period that I had submitted for my inspection the design of one of the components that the Germans intended to have manufactured in the workshops in Gardesana. No-one knew exactly what it was, yet it was known that it was some part of an aviation engine. I could tell immediately that it had nothing to do with one of the traditional piston-engined Daimler Benz or Junkers engines but it was something quite different. In fact it was the turbine for the jet engine of the Messerschmidt aircraft, something whose existence was undreamt of in Italy, even

The Mirafiori office-block in corso Giovanni Agnelli, Turin (photo taken in 1959).

though Campini had made an aircraft with the propeller enclosed in a tube, the precursor of the jet engine.

Our 24-cylinder A 40 engine and the 16-cylinder one designed by the Aero Engines Division had all at once been superseded and become useless. The fears that had dogged me when I began my studies of the A 40 in 1940 had been fully justified. In my attempt to imagine what developments there might be in the future for flight at higher than 10.000 m I had envisaged rocket propulsion and even studied explosives that contain oxygen and do not need air for combustion. But I had never thought of the turbine and its possible applications in aviation.

The A 40 engine project had served no purpose other than to improve the engineering experience of my colleagues and provide work for the highly specialized workshop bands in the experimental construction of aero engines. Two prototypes of the A 40 were actually built but they were never tried out.

The “1900” and the “400” were at Cigliano when I asked them to be brought to Turin so that we could examine the working of the suspension and steering to provide data necessary to continue a line of research recently begun.

The two vehicles were taken to a garage in Lingotto which unluckily got a direct hit from a bomb during the night. I can still feel the surge of anger and frustration at the check we received. We felt defeated and dejected. But I doubt if anyone, apart from ourselves, spared the matter a thought: concern for damage caused to the factory and personal fear were uppermost.

Deprived of the “400” we threw ourselves with redoubled energy into designing other small cars. I was always thinking about ways of replacing the *Topolino* with a better and cheaper auto. I tried to imagine what progress might have been made with the spur of competition between rival manufacturers if the war had not intervened. I also foresaw that the war was going to give a boost to new methods of production, new materials and discoveries.

Among the notes that I had prepared for the General Management and intended to present as soon as there was an opportunity to direct its attention towards the automobile of the future, there is one that reads:

> It is therefore predictable that as a result of the technological progress achieved during the war by the automobile industry and the improvements in fuels and lubricants, the automobiles that will emerge after the war will be marked by an appreciable saving in weight, lower manufacturing costs, better materials and notably superior quality. So it is necessary to begin designing post-war models right now, freeing ourselves rationally from the restrictions of outworn schemes and traditional production systems. Through the careful study of the vehicle as a whole, and especially of the mechanical units of which it is composed and each single component, the maximum economy should be sought in costs, cutting down on weight and production times while at the same time improving quality.

Following these criteria I organized the work of the office and assigned various functions to the groups of draughtsmen according to their aptitudes.

The elderly head of the Engines Division, Rocco, had left Fiat a few years earlier to devote himself to his family. I replaced him with the draughtsman who had most experience among the engine design specialists and stood highest in general esteem and my confidence: Villata. Sulotto, an excellent colleague of Rocco, had gone over to the Aero Engines Division. At the end of the war he went into politics with the Communist Party and was elected deputy. The Chassis Division was also composed of expert draughtsmen, among whom the elderly Tasso and Morelli occupied the highest places and there were some promising youngsters. Franzi was the expert in electrical and hydraulic components.

During this troubled period, fraught with hazards even for civilians, work went on serenely since there were no schedules and deadlines to be kept to: when the designs were completed it was pleasant to let one's imagination wander off to the most disparate projects. It was practice for everyone, an excellent exercise that helped to transform the younger draughtsmen into proficient designers. In the period of post-war reconstruction the technical office was to respond promptly to the new demands made on it by virtue of its preparation and its capacity to produce proposals that were the fruit of long deliberation.

Mario Marchisio, electronic engineer, born in Turin in 1890. After working for the Ercole Marelli company, he became after director of automobile electrical equipment with Fiat. At the start of 1930 he was appointed director.
In 1942 he became a lecturer at the Turin Polytechnic. He is the author of *L'Elettricità nell'automobile e nell'aviazione*, and one of the founding members of the Associazione tecnica dell'automobile (AT A) of which he was vice-President in 1948-50.
For a long time he was editor in chief of the *ATA* review. He was one of the founders of FISITA, the International federation of professional associations of automobile engineers.
[He died in 1962].

While preparing for the challenges of peace-time we had to struggle in the meanwhile with the difficulties of travel caused by evacuations, food shortages and the perils of air raids. Everyone had his problems to deal with. It often happened that the draughtsmen stooping over their drawing boards were preoccupied not by the designs that lay before their eyes but by the problems they would have to solve to get back home, sometimes in villages far from the city.

The reports were contradictory and alarming. The defeat in Africa, the check given to the Germans at Stalingrad, the tragic events in Italy in 1943, the landing of the British and Americans in Sicily on 25 July, the fall of Mussolini, the surrender of Badoglio followed by his declaration of war on Germany and then the German occupation: all these had their effect on people's behaviour. Yet work went on.

Events at the "school" were affected by what was happening in the world beyond. The was no shortage of adventures, of head long rushes into the underground shelter below the playground where we beard the rumble and shuddering of the ground caused by bombs falling in the vicinity, sometimes very close to us, blowing doors and windows off their hinges, shattering panes of glass and sending our papers flying off the drawing boards, a bewildering muddle of blueprints among the dust and splintered glass.

Life had its interesting and even amusing aspects. At the school there was also Mario Marchisio, the engineer in charge of technical services for designing and manufacturing electric equipment, much older than me but energetic, extrovert, always ready to try something new. Not one for half-measures: it was all or nothing where he was concerned: like the on/off setting on those hot-bulb engines that he reminded me of, with a few straggling fair hairs on his head and his face lit up by his big eyes, a cold blue in colour but restlessly alive. He was responsible for the foundation of the ATA, the Association of automobile engineers, and the conception of the FISITA, the International federation of automobile engineers and technicians' associations.

I suggested to him that we should convert a scooter built by Belmondo – a brilliant inventor and a pioneer in various fields of engineering – to electric traction. Since Marchisio had the use of a workshop that was still in working order on the basement floor of the Lingotto "palazzina", it was easy to adapt the little scooter to run off a battery feeding an automobile starter-motor.

I often used the scooter to get to and from work. But when my apartment in via Cristoforo Colombo was half demolished by bombs I had to give up. Later, after having to shift about for a bit, I found accommodation along with Marchisio at Ville Roddolo in Moncalieri, a mental hospital which Fiat had bought and turned into a boarding house for its employees evacuated from the city. I then suggested to Marchisio that we should repeat the operation on a *Topolino*.

We soon got out plans and designs to fit it with a big chest containing 420 kg of accumulators and an electric engine to replace the gasoline-driven original. We retained the clutch and gearbox and added a big rheostat salvaged from a bus. The auto was put together in the underground workshop in Lingotto. Marchisio installed equipment to recharge the batteries in the playground of the school and another one in the garden of Ville Roddolo. In this way we were able to travel daily back and forth between Turin and Moncalieri, storing up electric energy by night at Moncalieri and by day at the Duca degli Abruzzi school. The auto's top speed was 45 km/h and, thanks to the gears, had no trouble in taking us at a walking pace up the steepest mule-tracks on the hills of Moncalieri where we went looking for wild-flowers after work was over. This was one of Marchisio's passions: he expected me to make drawings for a special collection he had. After the *500* we also built an electric *1500* for senator Agnelli.

One day some Fascist soldiers raided the school, in search of some of our draughtsmen who belonged to the underground resistance movement. I heard shots in the entrance and on the stairs. The employees were mostly herded into the gymnasium, which served as a canteen, and for twenty minutes they had to keep their hands up under the threat of guns. Not all the hunted men managed to make their getaway in the school's winding corridors and the neighbouring houses. Two of them, first-rate draughtsmen, Barbero (many years later nominated assistant director of the Styling Centre) and Rinaldi (now divisional head) were captured and put in prison. It caused a great stir at the time.

In the air raid shelter, the boxes that were supposed to be filled with sand to absorb blasts from explosions were actually filled with weapons that the young draughtsmen belonging to the SAP (the partisan Patriotic Action Squads) active in the city had hidden in readiness for an uprising. In the classrooms, behind the teachers' desks which had been turned into tables for the directors, there were air vents covered with gratings fitted into the wall a few inches from the floor. When the uprising finally broke out, engineer Bona was requested courteously by one of his draughtsmen, Massano, to move away from the blackboard for a moment. Under his astonished gate, the young Massano deftly removed the grating and in next to no time had extracted pistols, grenades and rifles from the air vent.

Leafing through the notes, sketches and drawings that have survived (normally only the drawings of models that have been built are kept in the files), I am made aware that the engines designed in this period are too numerous for all of them to be mentioned.

Among the many small four-cylinder jobs, there is a “600 Esp.” with horizontal 58×60 mm cylinders and side valves. Under the date 10.3.44 there is the “600 Esp.” engine-gearbox set for front-wheel drive.

The design of the new engines and transmission systems was closely connected with the concept of the chassis, whose construction I then planned. Not that I supposed that these chassis would actually be built. All I had to do was to complete their designs so as to be able to compare the different solutions and evaluate their merits and defects in relation to cost.

Among the most significant I recall a “400” chassis with an transverse two-cylinder rear engine; two chassis with four-wheel drive; one with a four-cylinder engine and the other with six (with the designations “1095” and “585”); and lastly, most interesting

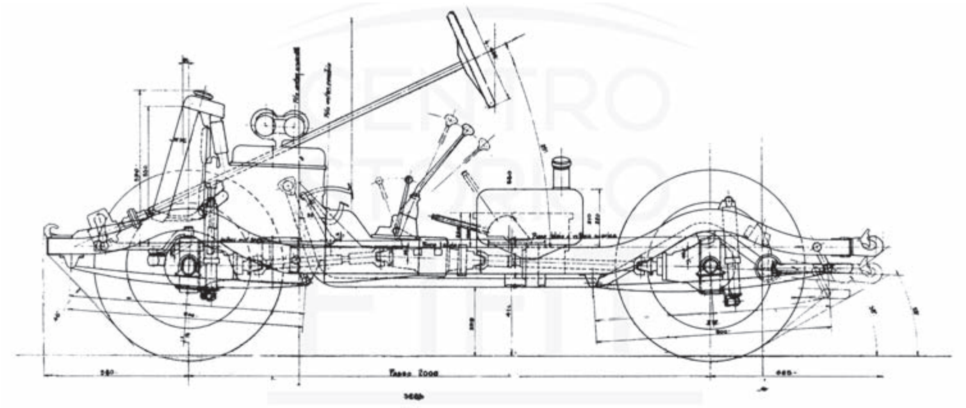
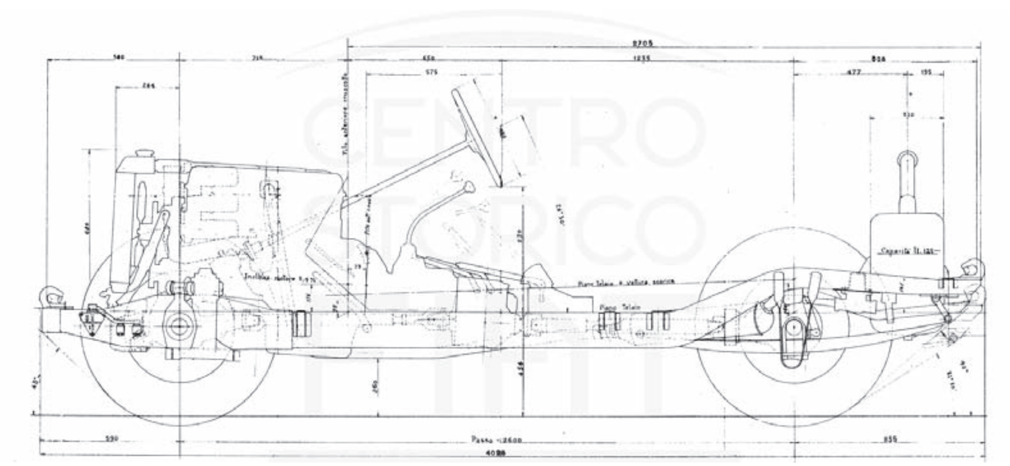


Diagram of the chassis for the four-wheel drive “1095”. This was an army off-road vehicle, designed using components of the 1100 auto. Design dated 20 July 1943.



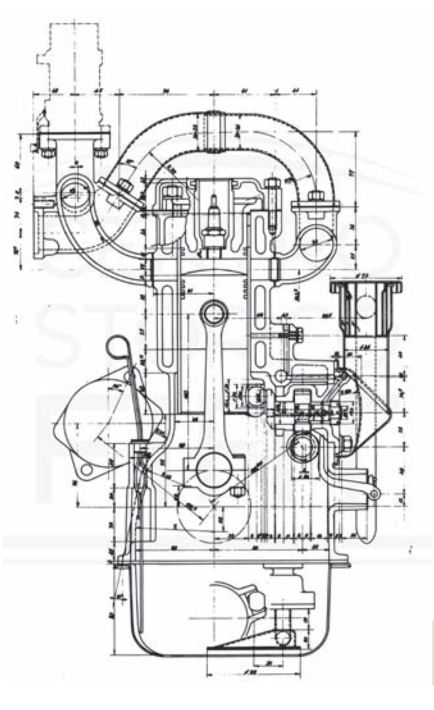
The “585”, another four-wheel drive off-road vehicle, designed using components of the 2800. Drawing dated 18 February 1943.

of all, one that I called the "tipo 100", with front-wheel drive and a transverse 500 cc engine with four horizontal in-line cylinders. This was part of a set of three solutions to the problem of the small, low-cost automobile, with clue consideration given to the fundamental parameters of practicality, safety and cost. The three versions studied were: a conventional layout, with a front engine and rear-wheel drive, and then two versions with engine and gearbox mounted transversely, one with front-wheel drive and the second with the engine at the back and rear-driven. But front-wheel drive, with merits such as the added stability of the automobile and the extra room it leaves for the coachwork, was still considered as insufficiently reliable or safe since it involved using homokinetic joints, delicate and costly to manufacture, for transmission of drive to the wheels. Homokinetic ball joints were at that tune only in an early phase of development.

Fiat had never permitted the least risks to be taken involving transmission, steering and brakes. After the accident to Lardone's automobile, front-drive was considered by everyone – starting from Agnelli himself – a useless and costly risk. To champion this technique meant simply asking for trouble. I dared not even mention it. My name would have been mud and I would have forfeited the regard of the "big shots", which I had won by my sense of duty and eye for economies. Nevertheless, I went on studying front drive, led by that urge or inner passion that enables one to overcome any obstacle. Moreover, I had a presentiment that one day a solution was going to be found that would win acceptance through its practical and economic advantages.

Numerous other studies were carried out in 1944 involving larger models, in the 1.200÷1.300 class or even bigger. Designs were also made for engines making use of a Ricardo-type timing gear or else a system of my own devising.

Towards the end of the year, when we could see that the defeat of the Germans was imminent and were awaiting the arrival of the Americans, there occurred the events that led to the Cisitalia project.



Study for an engine, designated "tipo 108 F", using the Ricardo sleeve timing system. Dated April 1944.

CHAPTER VII

THE CISITALIA INTERLUDE

In October 1944, perhaps earlier, a certain signor Casalis came to the Duca degli Abruzzi school for a meeting. His business was custom-built coachwork and he was the right-hand man of commendatore Piero Dusio, whose name was a household word in those days. Dusio was the President of the Juventus football club and had a linger in various industrial enterprises. He also had a certain reputation as a racing driver, having gained a good placing in the most famous race of them all, the Mille Miglia. I did not know him personally. Casalis brought the conversation round to him. After asking me for some technical data he needed to build Ghia coachwork on Fiat chassis he got onto the subject of competition driving and told me that Dusio was considering building a racing automobile. Casalis was a clever talker and with a touch of flattery implied that no one was better qualified than myself to help Dusio achieve his aim. In conclusion he invited me to consider his message as a fully fledged offer from Dusio. While Casalis was giving me this spiel my mind was already busy trying to give concrete shape to some ideas. My answer was straight to the point: "First I have to get the go-ahead from Fiat. As for the racing-car project, I think the situation we're in, with the war and the German occupation, makes it doubtful whether we'll be able to carry it through. Only some sort of compromise solution seems possible. Perhaps we won't come up to Dusio's expectations. Anyhow, give me time to think it over."

Piero Dusio, industrialist and racing driver, born in Scurzolengo (Asti) in 1889. A keen auto fan, he began his career as a racing driver in 1930, taking part in track racing. In 1931 he competed successfully in the Aosta-Great St. Bernard and the Biella-Oropa races at the wheel of an Alfa Romeo. He also drove an Alfa Romeo in the race to the Maddalena Hills (1933) and the Coppa Ascoli (1934), gaining good placings. In 1936 he entered Formula 1 racing, driving a Maserati in the Italian Grand Prix. Two years later he drove an Alfa Romeo in the Mille Miglia, coming third in the overall placings, and won the Stelvio race.
At the end of the Second World War he founded Cisitalia to build racing autos, constructing a revolutionary Grand Prix racer.
He drove his own autos in competitions, making a victorious debut in the Coppa Brezzo on the Valentino circuit (1946). Subsequently he came fourth in the Cairo Grand Prix and second in the Coppa d'Oro delle Dolomiti.
Financial troubles in his company led him to emigrate to Argentina in 1948, where he died in 1975.

The idea of designing a racer appealed to me and I could not keep my mind from mulling over ways it might be done. I thought it best to ask Bruschi to give the project his go-ahead. And should I mention it to Fessia or not? Fessia was completely taken up with the house he was building in Borgomasino and he would probably have turned the idea down, to avoid complicating things.

"Anyway," I thought, "the Fiat management hasn't assigned me any definite duties and ever since we had to move out of Mirafiori into the school because of the war I've been wholly responsible for work in the office. We could even spend our time on work that has nothing to do with Fiat, as they do in the workshops, and instead here we are, hard at it designing automobiles. Then this collaboration with Dusio could be of benefit to Fiat. Anyhow, it's not going to get in the way of work in the office".

This was how I tried to justify the assent that, deep down, I had already decided to give to Dusio's proposal. "We knock off at 5 o'clock. That leaves me lots of time to spend designing. All I need is a room and a drawing board – or better, three drawing-boards – so I can get someone to give me a hand". Actually I had neither a room nor the boards. I had been bombed out of my home in 1942. Since then I had shifted from pillar to post, finding accommodation wherever I could , finally ending up comfortably enough settled in at Ville Roddolo in Moncalieri.

Dusio fixed a date to see me. He plied me with arguments to demonstrate the merits of his project, putting them across with the irresistible charge of enthusiasm that was so typical of the man: smiling, likeable, full of drive, always going straight to the point. To clinch matters he threw in an invitation to make use of part of his Villa in corso Galileo Ferraris. This villa was extremely beautiful and had a magnificent air raid shelter deep down underneath it. Though the Villa had been damaged by incendiary bomb it was still inhabitable. The Dusio family had moved out of Turin but a caretaker and one servant still lived downstairs in the basement, where the kitchen was. They spent their time playing card or bowls. Dusio offered me a pleasant bedroom on the top floor with a bathroom and two other rooms for the drawing board. A palace, no less, even though the heating was provided by a cast iron stove that burnt wood.

I accepted eagerly, though I was haunted by doubts about the success of the enterprise. I said that we could rule out the construction of an auto conceived along completely new lines. With relatively modest means and for a reasonable outlay it

The Cisitalia office block in corso Peschiera, Turin.

would be feasible to build a small automobile using an engine and other mechanicals produced by Fiat.

With components of the *500* and *1100* I would be able to design a single-seater with adequate performance. An auto that might be pitted against the small single-seater used in the United States for dirt-track racing.

The idea appealed to him. He envisaged a set of racers completely alike which could be driven by his racing-driver friends – Nuvolari, Taruffi, Cortese, Brivio, Biondetti, Chiron and the rest – in spectacular races where everyone started on the same footing. He asked me if it would be possible subsequently to build a sports car based on the racer. I saw no reason why not, within the limits of the resources offered by his workshop.

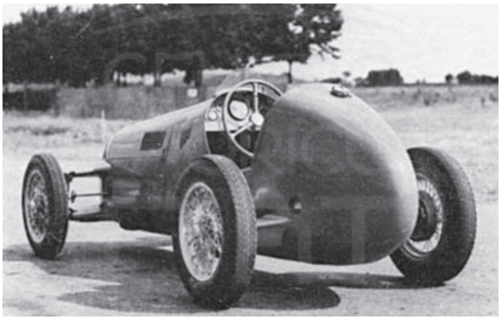
The workshop was a dignified-looking building in corso Peschiera. The façade bore, in imposingly large lettering, the sign "Cisitalia", standing for Consorzio industriale sportivo Italia. The inside was almost bare. It was used for making bicycles with the trade name *Beltrame*. So building the car meant starting from scratch, but Dusio's eagerness was overwhelming and swept away all misgivings. His dream was going to be transformed into reality in the shortest time possible.

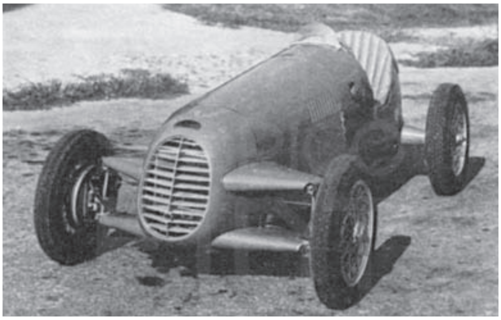
I got down to the work of designing straight away and after covering innumerable sheets with sketches, calculations and designs I felt my ideas had crystallized to the point where I could say fairly definitely how I was going to build the car and to give some idea of its leading features. I decided at this point to send Dusio a brief description of the racer as I envisaged it: a very light single seater put together out of parts of the *500* and driven by an *1100* engine whose output had been boosted.

My note said:

> The *1100* will be transformed so as to get the maximum output possible. The gearbox will be a special type worked by a pedal and will have to be designed from scratch. The transmission shaft will be placed lower to enable the seat to be lowered. To enable this to be done and also to make it easier to change the ratios of the gears to the axle, a cylindrical gear coupling will be added in a housing attached to the axle. To make the wheels spin in the right direction the axle will be installed upside-down and the gearbox, fitted behind the axle housing, will be easy to get at. The front suspension and the steering box will be the same as on the *500 Topolino*. The rear suspension will be specially designed with spiral springs. As for the chassis, I'm reserving a decision until the project is under way.

The prototype of the Cisitalia racer (1946).



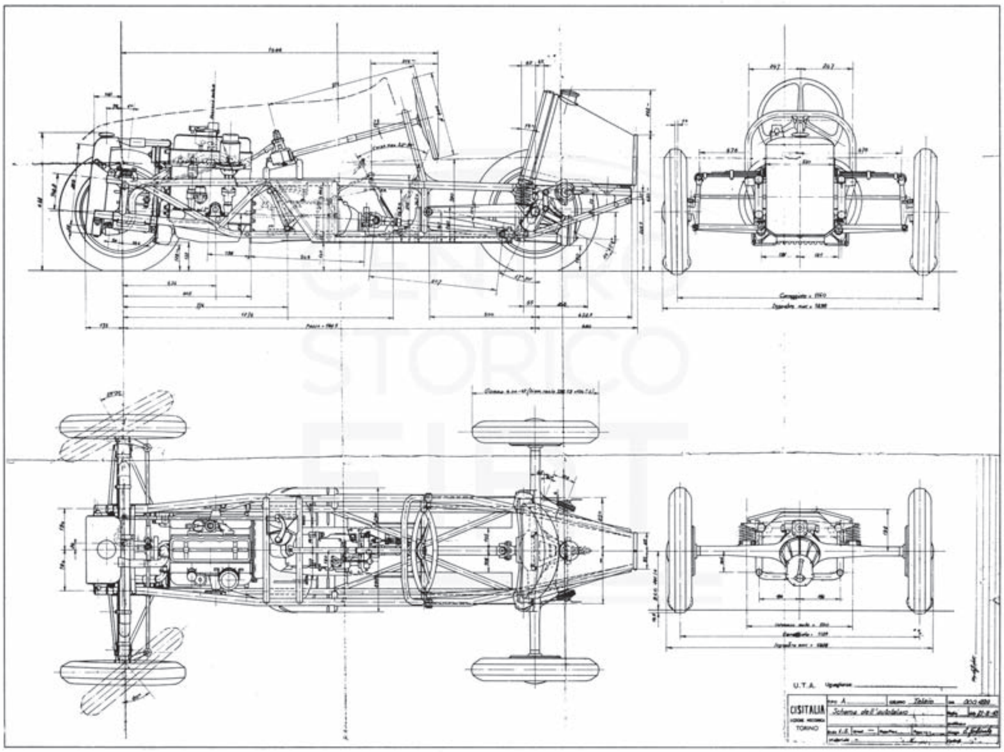


Dusio's reply was prompt. He sent me a letter giving his wholehearted approval and confirming my appointment in charge of the project and as consultant to the Cisitalia firm until the end of 1945.

I packed my two suitcases for the umpteenth time and moved out of Ville Roddolo in Moncalieri to Villa Dusio in corso Galileo Ferraris, Turin. Despite damage caused by air raids the bedroom was still attractive and stately with a magnificent bathroom. The two rooms for use as technical studios were more than adequate. I started work with the help of an excellent draughtsman, named Grosso. We used to leave the Duca degli Abruzzi school as soon as the knock-off siren went and for two or three hours he would do the drawings with me by his side. On Saturday and Sunday we worked all day. I even went on until late at night. The city was plunged into the silence and darkness of the blackout. All by myself, my eyes fixed on the brief sparkles flaring up between the circular cover and the cast-iron rings covering the flames in the little stove, I could see in my imagination the friendly roar of its engine.

Leonardo da Vinci's words were often in my mind: "... and if you are alone you will belong to yourself alone but if you are in the company of a friend you will belong only half to yourself…"

When I came to draw the chassis it came spontaneously into my mind to build it of tubing. That will appeal to Dusio, I thought, seeing he builds *Beltrame* bicycles in his workshop.



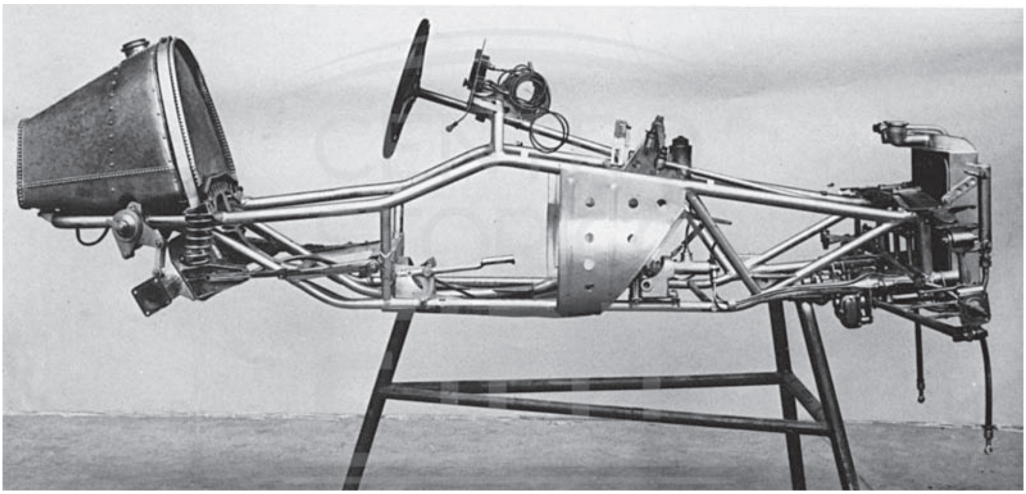
Plan of the chassis of the Cisitalia racer: the drawing is dated 21 August 1945.

By having the chassis made of slender tubes placed in carefully calculated position I was able to solve a variety of problems: minimum waste of space, great rigidity against flexion and torsion, lightness, facility of production for the Cisitalia workforce, which was expert at welding tubes. The aluminium sheets used for the body, a simple shell protecting mechanical parts, was intended to have no function beyond that of cleaving the air.

The tubular chassis is still a valid solution in the design of racing automobiles even today. But at that time it aroused comment and astonishment. When the little Cisitalia racers were brought together in the courtyard of the Palazzo del Valentino, in readiness for the signal to move to the starting line for their first race, my friend Massimino, a former colleague and draughtsman in Fiat's Aero Engines Department (later a racing car designer in the Bologna section of the company) came up to me with his characteristic ironic manner. *"Ngegné! Che curage... quel telaio in tubi!"* he said in Piedmontese dialect. ("Engineer, what a nerve you've got. That chassis made of tubes!"). Some years earlier, looking over the plans for the chassis of the *500 Topolino* he had said, as always in dialect: "Engineer! What a nerve! That chassis with those thin longitudinal spars! And those springs sticking out behind!"

Alberto Massimino, designer, born in Turin in 1895. Having gained an engineering diploma abroad, he joined Fiat in 1924, on the staff of the Special Engineering Department. He planned and designed chassis for racing autos and, in 1926, the coachwork of the famous 806/504 Grand Prix model, becoming head of the design team. In 1928 he left Fiat to join the Aero Engines Department of the Stabilimenti Farina, where he remained until 1931.
Between 1931 and 1937, after his return to Fiat, he was put in charge of aero-engine design.
In 1938-39 he was a designer with the Scuderia Ferrari and from 1941 to 1943 with Enzo Ferrari's airplane and automobile works.
From 1944 to 1952 he directed the technical office of the Alfieri Maserati Works.
He was a consultant for Ferrari and Stanguellini from 1952 onwards.
He died in Modena in 1975.

The design of the gear change worked by the clutch pedal had been devised long before in the Automobile Design Office at the Duca degli Abruzzi school, the inten-

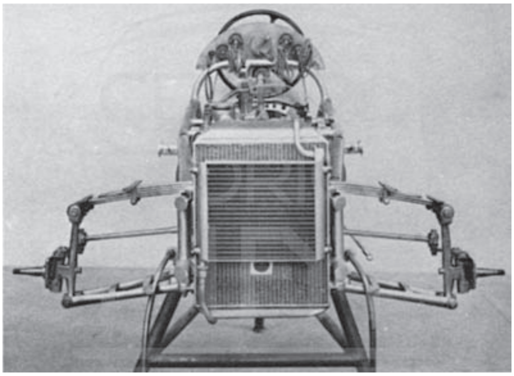


The chassis of the Cisitalia single-seater showing the transverse leaf-spring of the front suspension, identical to the system used for the "Topolino".

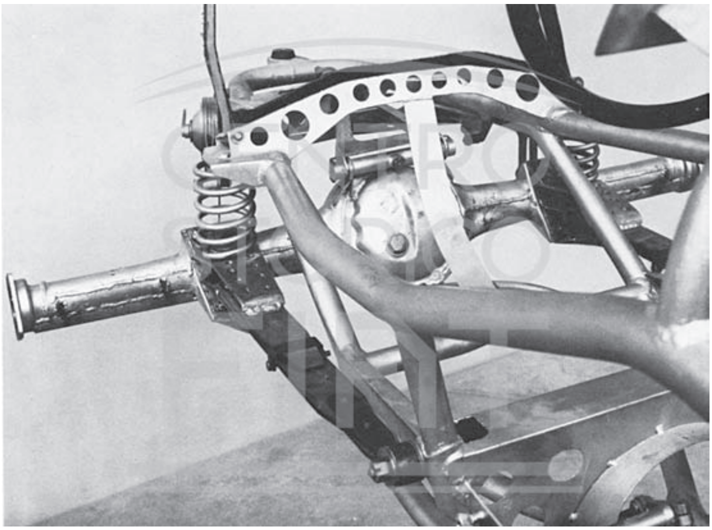
tion being to use it on one of the small autos planned for postwar production. The designer was the brilliant Angelo Mosso.

The idea was taken over and adapted to racing cars. There were three gears, too few really but I reflected along these lines: “When the war is over, with the state things are in, we’ll have to content ourselves with being able to race up slopes or on makeshift circuits which won’t give any opportunity for high-speed driving, so the main thing will be handling and the ability to change gear rapidly without letting go of the steering wheel.” Besides, a gear change worked by the clutch pedal could only be made simple if it had three gears. I wanted to build one and this seemed a good opportunity.

The all-mechanical system was so devised that when the pedal was pushed down its movement first disengaged the clutch and then changed the gear-ratio. There was a little lever under the steering wheel that enabled the driver to select first or reverse and then engage it by pressing in the clutch. To change up to second he just had to push down the clutch again and the same for third. Then by simply repeatedly pushing to second and back again to top. To return to first the lever below the steering wheel had to be returned to the appropriate position before pressing the pedal.



Front-view of the chassis of the Cisitalia single-seater.



Detail of the rear suspension and the attachment of axle to chassis in the Cisitalia racer.

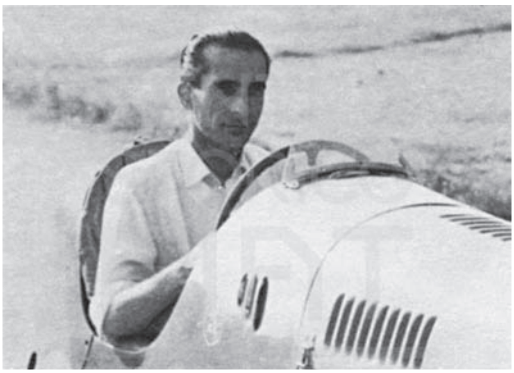
I thought that three gears would be adequate for a single-seater for the sort of competitions we had in mind but not for the two-seaters we planned to build at a later stage. This was to have the four-speed gearbox from the *1100* with the addition of an overdrive which I had already designed as a fifth gear to be fitted at the bottom of the gear shift itself.

The front suspension was taken over from the *500*, the brakes from the *1100*. The rear suspension had coil springs and had been influenced by the studies for experimental vehicles carried out by Fiat. The springs were fitted directly to the axle. Two longitudinal spars were fixed to the sides of the latter so as to be practically parallel, little more than two thin sections of metal, each attached at its front end to a link bolt joined to the chassis.

Cross-wise, the connection of axle to chassis was effected by a triangular metal shape hinged on one side to the centre of the gear case of the axle and joined to the chassis at its other end by means of a bolt fitted into a ball joint. When the axle moved, the pin fixed to the triangular connection moved freely in the ball joint fixed to the chassis and pressed against a spiral spring. The latter's elasticity endowed the suspension with a degree of flexibility, varying as the relation between axle and chassis varied. The rear axle together with the two longitudinal spars would act as a stabilizing force.

With the Fiat *1100* engine suitably adapted for the purpose, I envisaged an increase in power from the 32 hp of the normal version to about 60 hp. With a compression ratio of over 9.5:1 the power output achieved would in effect become 62 hp (DIN) at 5.500 revs.

When the designs were almost complete thought had to be given to building the prototypes, which involved finding the equipment and men for the embryo workshop in corso Peschiera. To perfect the engine and carry out tests a "testing hall" (so called because it usually contained a number of test benches, like the one at Lingotto) had to be fitted up. The person who was supposed to see to the installation of the equipment necessary was Casalis, but unfortunately he lacked the requisite know-how. I was worried about this and decided to mention it to Dusio who, prompt and decisive as ever, asked me if I had anyone to suggest. I mentioned the engineer Giovanni Savonuzzi, whom I had met at Fiat's Aero Engines Testing Division. He had made an excellent impression on me. Ettore Ferretti, his boss, also gave Dusio a good account of him. Savonuzzi changed over to Cisitalia from Fiat in August 1945.



Giovanni Savonuzzi at the wheel of the Cisitalia single-seater (1946).

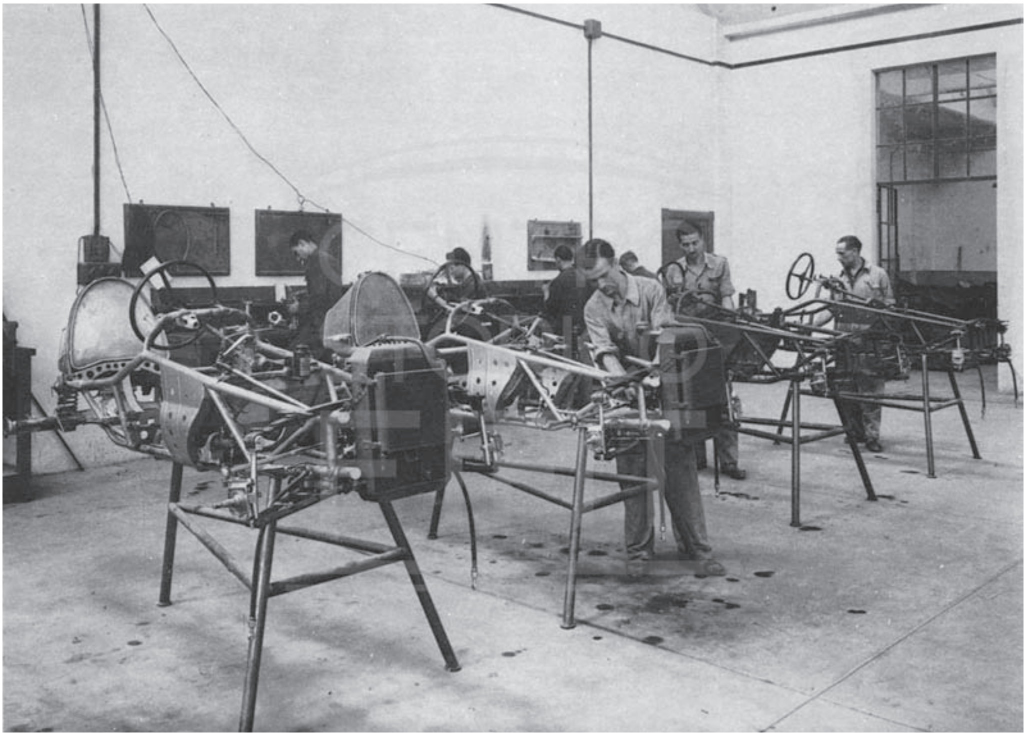
His presence at Cisitalia was invaluable. Intelligent and creative, full of drive and a tireless worker, within a few months he had completed the premises for testing the engines – designing them himself – and was getting the workshop organized.

He played a decisive part in perfecting the single-seater prototypes and subsequently also the completion of the two-seater version, after I had to give up my consultancy work for Cisitalia.

While Savonuzzi was preparing the workshop and having the testing shops fitted out I had the designs completed. I had done no more for the coachwork than to produce some sketches and a plasticine model carefully made on a scale of 1:5. I had just finished it and was thinking of having it taken round to Motto, the coachbuilders, when the German police raided the house – during my absence – in search of Dusio, who was accused of some crime or other. They hunted high and low for him, naturally in vain as he was hardly ever there. But when I came back I found my model had been squashed flat by the fist of some fulminating German.

Motto was a craftsman who could mould the panels of the bodywork into any shape without using a press, his only tool being a specially adapted pneumatic hammer. He knew how to weld aluminium plates and – the most important thing to my eyes – he understood me. Intelligent and enterprising, he set to work on the sketches and descriptions I gave him.

Supplying him only with a chassis fitted with the parts needed to keep it on its wheels, we began to build the first body, starting off with a few sketchy designs. My

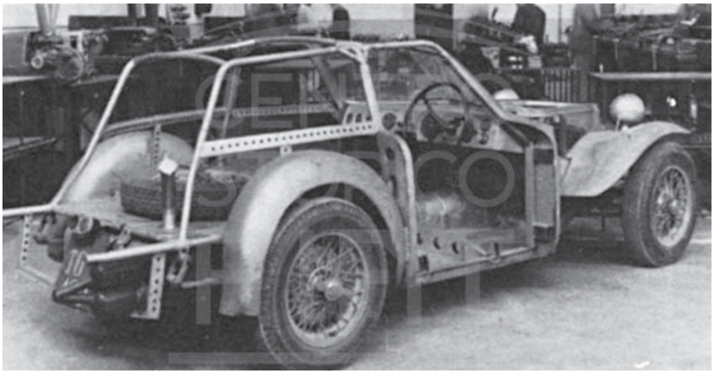


An unusually large number of Cisitalias were built for a racing model. In the photo: four chassis being built in the works in corso Peschiera (summer 1946).

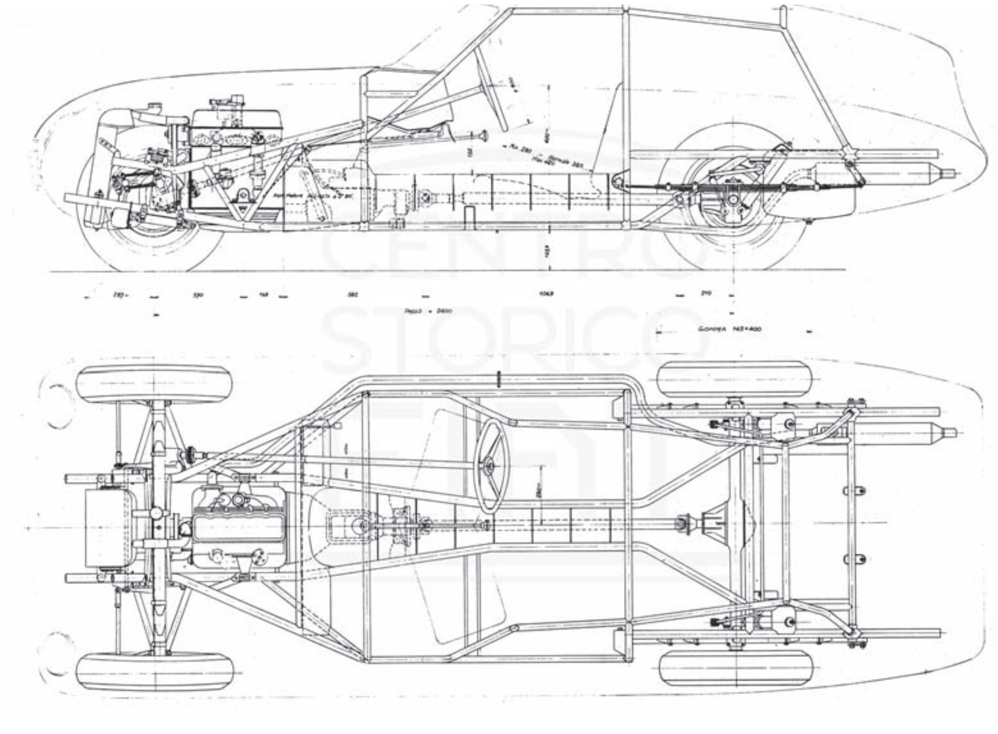
assistance was practically continuous during my free time in the evening and on Saturday afternoons and Sundays. I was there when he gave shape to the various parts of the coachwork and suggested where the forms should be varied with more or less marked curves.

When the work was done, the body corresponded exactly to the plasticine model.

An aesthetic whim had led me to conceal the workings of the front suspension with two bulges, like two small superimposed wings. To show Motto just what I meant I made a cardboard mock-up of them myself and attached them to the automobile body. These bulges were not useful nor practical for racing – rather they were



The two-seater Cisitalia coupé for road-racing also had a tubular chassis. In this photo, taken in the works, the auto appears without its coachwork but fitted with mudguards for its first test. The designs for the chassis of this model, executed in July 1945, anticipate the profile of the coachwork, whose form was to be even more radical but conceptually very similar to the form outlined by Giacosa for the Fiat 508 C MM (1937).



a pointless complication and meant additional dead weight – but they placated my aesthetic yearnings.

In the meantime Savonuzzi had completed the test rooms and the workshop and built the first prototype. It was the spring of 1946.

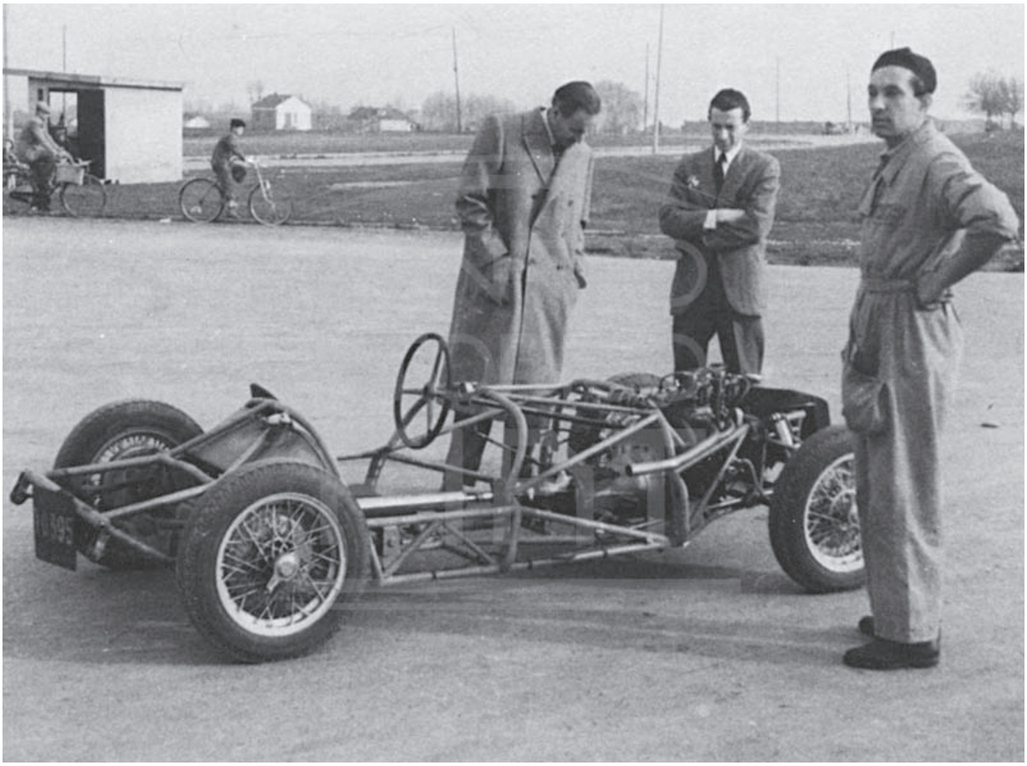
After the first drives along the roads adjacent to the Cisitalia works, at that time mostly surrounded by uncultivated fields, we decided to conduct a trial on the Superga rise, a very steep dirt road. Dusio, cheerful and optimistic, also tried out the vehicle.

I was bitterly disappointed. Whenever it started and when it was braked hard the rear axle jerked about in an alarming and, in my opinion, dangerous way. The shuddering of the front suspension set up reverberations. I immediately realized that my hurried calculations had not taken into account all the variable aspects of the behaviour of the suspension under the combined effects of the tangential stresses of the wheels and the unsuspended masses. The two longitudinal spars were far too rigid.

Although Dusio and Savonuzzi did not display dismay or anxiety I was very upset. The memory of that sudden revelation of the error I had committed still smarts.

Savonuzzi, with the help of Piero Taruffi who had been appointed racing manager, perfected the automobile by making a number of modifications.

The two rigid arms bolted to the axle were replaced by demi leaf-springs fixed

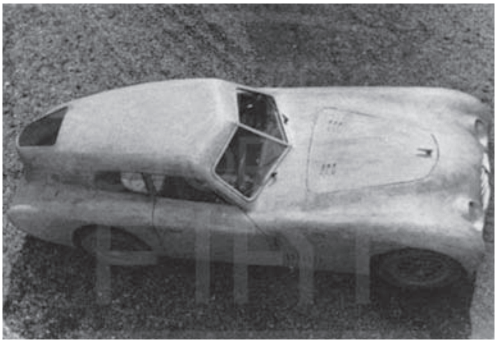


The Cisitalia 1100 two-seater sports car for road racing was produced at the time when Dante Giacosa was bringing his consultancy work to an end. Here we see him with Giusti, a small-scale constructor of sports cars, examining a chassis ready for testing.

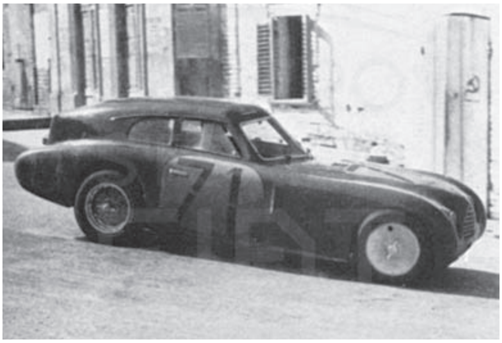
to the axle and their front ends attached to the ball joint, fixed to the chassis lower down than before.

At the end of August there were seven automobiles ready for the race to be held on the Valentino circuit, the park in Turin on the left bank of the Po. It was a day to remember: the first race on a closed circuit in Italy since the end of the war. In all, twenty-seven racers were contending for the Coppa Brezzi. The drivers of the seven Cisitalias were Piero Taruffi, Raymond Sommer, Tazio Nuvolari, Franco Cortese, Louis Chiron, Clemente Biondetti and Piero Dusio.

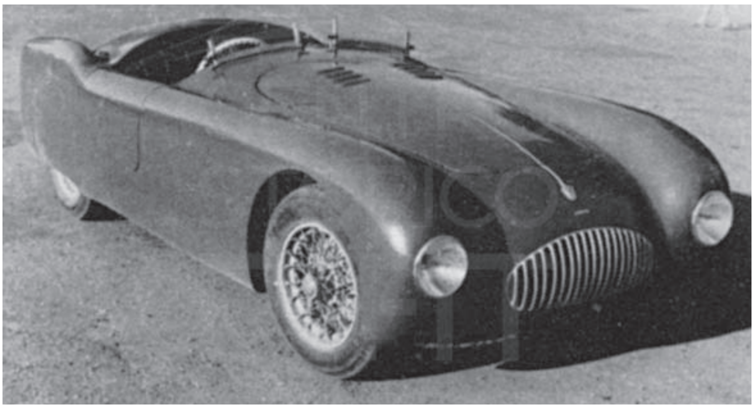
The Cisitalias dominated the whole race, even beating the three autos that Gordini had brought from Paris. Unfortunately Nuvolari, after overhauling all the other drivers in his usual style, amid the cheering of the crowd that had poured into the Valentino to watch, had to withdraw early from the race. I was very upset, feeling myself partly to blame. In designing the chassis I had left a space of just 45 cm between the lateral tubular spars for the driver to fit into. The steering wheel of the *Topolino*, which was much bigger in diameter than those now used on Grand Prix racers, made it very difficult for any driver who was not on the thin side to get in behind it. As I thought it was important for safety's sake as well as practical reasons for the driver to be able



The first Cisitalia coupé, here still unfinished, was built by Rocco Motto, a small Turin coachbuilder specialized in very lightweight competition models.



The same auto racing in the Coppa Acerbo (circuito di Pescara) in summer 1947.



An example of the "Nuvolari" sports model, one of the versions of the open two-seater produced by the Farina coach building works.

to get in and out of the seat easily, I decided to design a steering wheel that could be folded forwards and slipped easily off its column. After doing numerous sketches of various solutions I chose what seemed the simplest, lightest and safest.

Apparently Nuvolari had failed to make sure that the steering wheel was properly locked into the column when he took his place in the car. After he had taken a few bends at the furious speed which was typical of his style of driving, the steering wheel came away in his hands. Nuvolari tossed it away as useless and drove on, clutching the steering column and turning it by the short cross-spar to which the wheel ought to have been attached. After a few laps he had to pull out of the race, to the disappointment of the crowd. The winner was Piero Dusio followed by Franco Cortese and Louis Chiron. The Cisitalia had enjoyed a triumph which was reported by the press the world over.

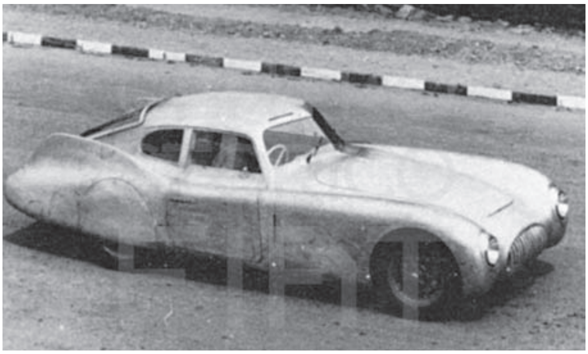
It looked as if Dusio's dream was coming true. After showing that he could hold his own among the champion drivers of the day he intended to launch the automobile he had created. Some of the single-seaters went to famous buyers, among them Hans von Stuck who specialized in uphill racing, in which he was the dominant figure. Galvanized by his success, Dusio conceived a plan which was to pave the way to industrial development. He considered organizing a big team of racers and drivers to go round the world putting on races that would pit the best Italian drivers against champions from other countries. He laid his plans before me and then suggested that I should leave Fiat and go over to Cisitalia as director of engineering. He said he had the financial resources to set up a factory comparable to the Lancia works and that everything was ripe for this great development. I did not ask him for time to reflect on the proposal. My reply was prompt and – untypically – single-minded. I told him that money was no longer enough to create an enterprise like the Lancia works, that the day of the pioneer was over and done with as far as the automobile was concerned. Many – too many – years would be needed and long patient work. The construction of the little Cisitalia racers was child's play in comparison, made possible by using mechanicals already being produced by Fiat and a body which was little more than an aluminium shell. I added that I could not bring myself to follow him along that particular path, that I could help him only if Fiat was a partner in the undertaking and that I would mention the matter to Bruschi for him.

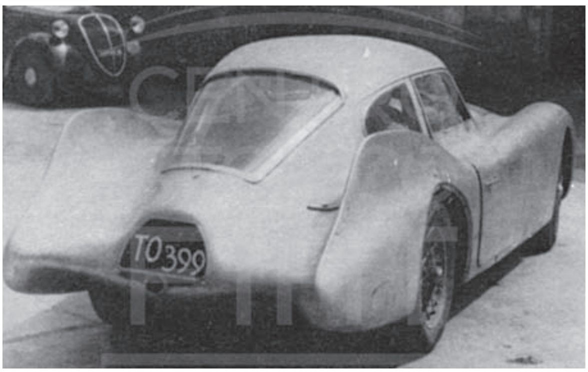
Piero Dusio (right) with Carlo Salamano on the occasion of the Circuito del Valentino, which he won at the wheel of a Cisitalia single-seater racer (August 1946).

The Cisitalia project had brought me thrills and pleasure but all in all it had been little more than a pastime. Dusio saw that I was never going to leave Fiat, where both my mind and my heart were committed. He was disappointed but not too upset. He asked me to prepare the plans for a two-seater based on the single-seat racer and I agreed, provided that this meant no more than producing an overall design. I worked on it one Saturday afternoon and all of the following Sunday, designing a simple framework of tubing adapted to the aerodynamic shape of a coupé body whose sections crosswise and lengthwise I had already sketched out. The platform of the coachwork was welded to the framework and the whole was so designed as to give maximum rigidity with minimum weight. Savonuzzi's job was to complete the project in all its details and build the automobile.

This was how I came to sever myself from Cisitalia. Bruschi, the director of Fiat's Central Engineering Division, wrote a letter to Dusio and another to me, confirming that my involvement in designing for Cisitalia was at an end.

The subsequent history of Cisitalia is studded with great successes, especially in the Mille Miglia races where much merit is due to Nuvolari. There was a great rush to get the coachwork designed and finally built in time for the June 1947 Mille Miglia, the first to be held in the post-war years. Savonuzzi proved to be a first rate stylist in designing the body on 1:5 scale for both the coupé and the sports models. The first coupé was built by Vignale, the departmental head in Giovanni Farina's Stabilimenti Farina (Giovanni being the elder brother of Pinin Farina). The coachwork was greatly admired and Dusio, in his enthusiasm and gratitude, rewarded Vignale





The second Cisitalia aerodynamic coupé was built by Alfredo Vignale on the basis of a model devised by Giovanni Savonuzzi. The large fins were intended to stabilize the vehicle at high speeds by moving back the centre of lateral pressure. In the background can be glimpsed a Topolino, the most popular vehicle in Italy after the war, when fuel was scarce.

so generously that the latter was able to set up his own coach building works, the Carrozzeria Vignale.

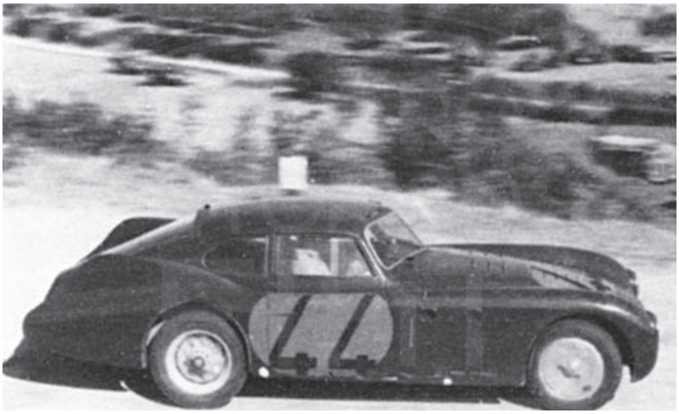
But this was not the end of the evolution of the Cisitalia coupé and sports-car coachwork. Other coach building concerns were interested and the sports model also passed through the hands of Giovanni Farina. Early in 1947 the seventh chassis for the two-seater was entrusted to Pinin Farina for designing but the vehicle was completed only in September.

The Mille Miglia was won by Biondetti with a big Alfa Romeo. The little Cisitalias came in second, third and fourth. Biondetti's victory was thrown in the shade by Nuvolari's extraordinary feat in the Cisitalia: though he had been held up 27 minutes by a quite straightforward defect in the electrical system caused by the rain, which the mechanic failed to diagnose, he came in second only 17 minutes behind. The Cisitalia coupé had been the fastest vehicle on the final stretch of highway, doing an average of 157 km/h for an hour and twenty-five minutes.

The story of how Dusio wanted to venture into the construction of a Grand Prix racer, following his numerous victories, is well known. He was brought into contact with Ferry Porsche and the team of designers that had worked as the Auto Union before the war. He decided to employ Ferry Porsche and his group, which included Rabe, Eberan von Eberhorst, Hruska and Carlo Abarth. Savonuzzi left Cisitalia in October 1947.

While the project for a supercharged 1.500 cc Grand Prix racer went ahead, the

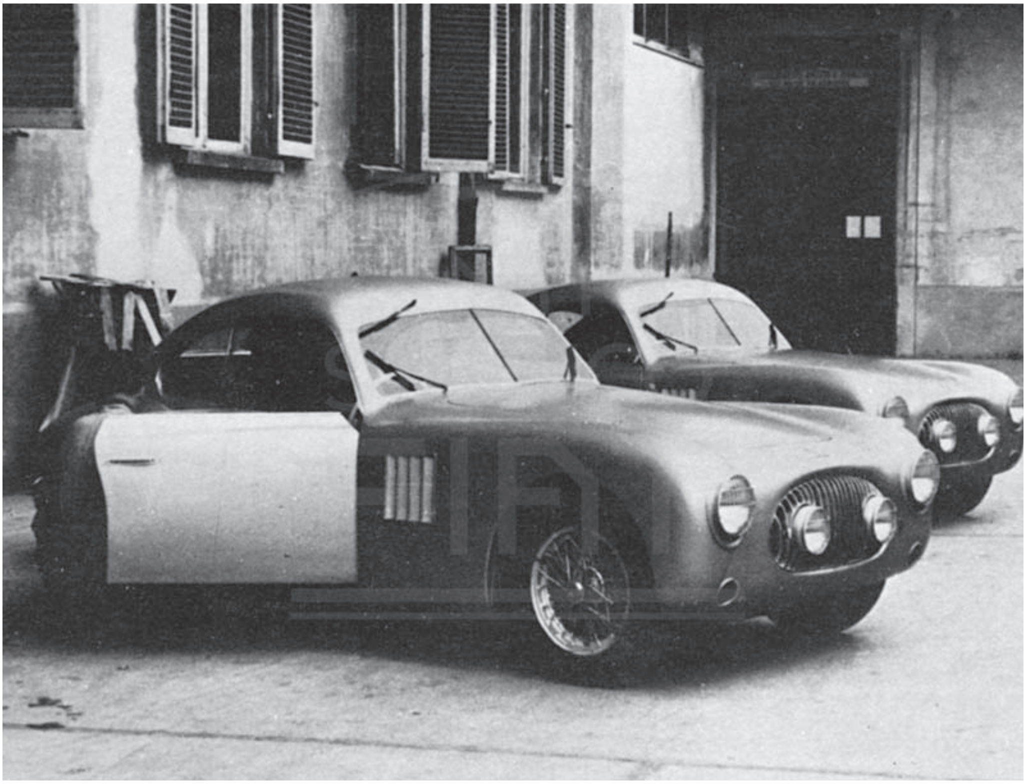
Rudolf Hruska, engineer, born in Vienna in 1915. After taking his degree in Mechanical engineering at the Vienna Polytechnic in 1935, he joined the Porsche company in 1938. In 1946 he made a contract with Piero Dusio, founder of Cisitalia, to design a Formula 1 racer at Porsche. The following year he moved to Turin as the Porsche delegate for the construction of the prototype.
In 1951 he entered Alfa Romeo as Finmeccanica's technical adviser, and in 1954 was appointed head engineer and in 1956 assistant general manager. In 1959 he began to work for Fiat as technical adviser to the President of Simca, Paris, and to Fiat's General Management in Turin, also playing an active part in the designs of Simca and Fiat racers built during that period. In 1967 Alfa Romeo commissioned him to produce a low-cost production model to be built in Southern Italy and in 1968 he was appointed managing director and general manager of Alfa Sud.
In 1974 he was put in charge of design and testing of the whole Alfa Romeo group. [He died in 1995].



The Cisitalia aerodynamic coupé (second version) racing in the Coppa Acerbo, summer 1947.

Cisitalia coupé with coachwork by Pinin Farina was having a runaway success, becoming one of the milestones of automobile styling history. It took first prize at all the styling competitions and exerted an enormous influence through the medium of all the specialized reviews. In 1951 the Pinin Farina Cisitalia coupé was chosen by New York's Museum of Modern Art as the finest example of contemporary design. But the enormous success of the Cisitalia was completely nullified by the immense expenses of the team led by von Eberhorst.

Carlo Abarth, constructor and racing driver, born in Vienna in 1908 but Italian since his father, who hailed from Merano, opted for Italian citizenship in 1918. Apprenticed in a motor-cycle factory, he became a tester and then a racing driver, winning his first victory in Strasbourg in 1928. After a serious accident in 1930, he returned to racing with a sidecar combination, winning further victories but another accident in 1939 forced him to abandon racing for good. He then settled in Yugoslavia, where he ran an engineering factory.
After the war, having rejoined his father in Merano, he became the sales representative for Porsche (Stuttgart) in Italy. He worked for Cisitalia as technical and competition manager. In 1949, when Cisitalia was forced to close down, Abarth set up a company his own, Abarth & Co., whose logo was its founder's astrological sign, a scorpion. The firm specialized in short-run production of grand tourers and adaptations of Fiat autos. In 1971 he ceded the company to Fiat, retaining a position as a consultant for the activities of the Abarth company. [He died in 1979].



A pair of the special coupés built for the Mille Miglia by the Farina coach building works, parked in the courtyard of the factory. This version foreshadows the final one, sold with the Pinin Farina marque and chosen in 1951 by the Museum of Modern Art, New York, as one of the eight most representative vehicles in world production.

After various ups and downs, including factors such as changes in the formula for racers, Dusio's fortunes failed him and Cisitalia went broke in 1949. Dusio managed to pay his creditors and went out to Argentina where he set up a group named "Autocar" to build light commercial vehicles using mechanical components built by a company in the USA. The 1500 Grand Prix racer, a highly sophisticated machine, was taken out to Argentina but never proved its worth.

CHAPTER VIII

THE "GRÉGOIRE" AND THE "102"
DEATH OF SENATOR GIOVANNI AGNELLI
REMOVAL OF VALLETTA AND HIS RETURN AS PRESIDENT

The war had moved from Africa onto Italian soil, waged between the Germans and the Allied armies, both – from the point of view of the divided Italians – invaders, seen sometimes as friendly and sometimes as hostile. The general chaos was overwhelming. The works where Daimler Benz aircraft engines were manufactured were heavily bombed. The resistance movement and the struggle against the Germans and Fascism was waged more openly. Strikes and workers' movements hit the big factories.

Fiat's top management, from Agnelli to Valletta and including other executives, was caught between two fires. On the one hand the workers were organized into parties and supported the resistance movement, while on the other the Germans were demanding work and productivity.

On April 25 1945 the Comitato di Liberazione Nazionale (a resistance organization) and the Comitato Militare called for a general strike and insurrection, informing Valletta that they were taking over the political, military and technical running of the company. Agnelli and Valletta were stripped of responsibility.

The management of Fiat was entrusted to technical commissars: Gaudenzio Bono was made director of SPA, Arnaldo Fogagnolo of Grandi Motori and Aurelio Peccei of the Commercial Division, assisted by a political commissar, Battista Santhià. These four were to some extent under the authority of a higher commissar, Antonio Giovanni Cavinato, who was said to have been designated by the American authorities.

Arnoldo Fogagnolo, engineer, born in Rovigo in 1897. He entered Fiat in 1917 and three years later completed his degree in Mechanical engineering. Assistant director of the heavy engines section in 1928, and head of the commercial sector, he became director of the latter section in 1938 and director of the Marine Division in 1946. In 1962 he was appointed central manager and in 1964 joined the board of directors. [He died in 1965].

Aurelio Peccei, graduate in Economies and business studies, born in Turin in 1908. He joined Fiat in 1930 and became a member of Fiat's policymaking committee from 1950 to 1973. He founded Fiat Concorde in Buenos Aires (1953) and Cordoba (1973), becoming its President. He was a member of Olivetti's board of directors from 1964 to 1967 and vice-President from 1967 to 1973. He was founding member (1968) and President (1968) of the Club of Rome. He was a member of the board of directors (1957-73) of Italconsult in Rome, becoming its President (1971-76), honorary President (1976-78) and again President (1978). He has published essays, articles and various texts (*Verso l'abisso*, *Quale futuro?*, *Le qualità umane*). [He died in 1984].

Giovanni Antonio Cavinato, born in Curtarolo (Padua) in 1895. A Physics graduate and lecturer at the Turin Polytechnic, he was a consultant for a number of companies working in the fields of mining, dam-building, pipelines, bridges etc. He was a parliamentary deputy and a member of Fiat's board of directors from 1947 onwards. This position ratified his nomination to the managing committee set up by the Comitato di Liberazione Nazionale after 25 April 1945. [He died in 1970].

Fessia was bewildered. Excluded from the struggle going on for the top jobs, cut off from Valletta and Agnelli, he felt isolated and had lost his usual spirit and pugnacity. He seemed to have grown more timid. He expressed political views that conflicted with his behaviour in the recent past and took up positions that surprised me. I had no real political opinions. I simply thought of work as the solution to every social problem. I listened in silence, but the high opinion I had formed of my director was shaken.

I could not help recalling a significant little episode that occurred when the *508 C-1100* project was under way. Every day at 5 pm senator Agnelli used to call Fessia into his office, attracted by the youthful head of the engineering section's brilliant powers as a speaker and his show of culture. Agnelli was a good listener. The personal interest the President showed in Fessia was known to everyone and had strengthened his position against Zerbi and Genero. But all at once these daily talks with Agnelli were broken off. Fessia was never again called in at 5 pm and Agnelli had no further dealings with him. I never knew the reason why. But this was not all. He had taken a decision at that time which was later to create a train of problems for him and actually jeopardized his future at Fiat. He wanted to deprive Salamano of his authority as head of the Prototype Testing Division.

Carlo Salamano had joined Lancia when little more than a boy and then came over to Fiat in 1911. After a tough career as mechanic, test-driver and racer, culminating with his winning of the European drivers championship at Monza in 1923, his intelligence energy and tenacity had taken him to a position as director of the Road Testing Division, directly responsible to Andrea Prever, head of testing. His prowess as a racing driver (he had won, among other important events, the Coppa delle Alpi in 1929, the last race Fiat entered its team in) led to his being given the honorary title of commendatore.

Carlo Salamano, test driver, born in Vercelli in 1891. In 1911 he entered Fiat as a test driver. When auto racing revived after the war, he was a member of the official Fiat team, winning the Italian and European Grand Prix at Monza in 1923. Having given up his competitive driving for Fiat in 1927 he returned to work as a test driver, making news again by his victory in the 1929 Coppa delle Alpi at the wheel of a Fiat *525 SS*, and once more in 1954 when he presented the Fiat turbine-powered auto on the runway at Caselle airport, achieving a speed of 250 km/h. As inspector and then vice-director of Fiat's Automobile Testing Department he collaborated in the perfecting of all the models produced while he worked for the company. He retired in 1962, retaining a link with the company as consultant. He died in Turin in 1969.

Dante Giacosa (left) with Carlo Salamano (copyright Paris Match).

In telling me of his decision, Fessia said that the development of the automobile towards more utilitarian qualities made it absurd for the final judgment to be left to an ex-racing driver whose only criteria were the toughness of the mechanical parts, performance, road-holding, handling and braking. What was more, he could not stand Salamano passing the results and his comments straight on to Agnelli and Valletta, setting himself up as a judge over the work of the technical office.

Salamano had consequently been deprived of his responsibility for testing prototypes, and forced to play second fiddle to Giuseppe Boncompagni, who after eight years spent as secretary to the Testing Division was promoted to departmental manager in charge of road tests. This downgrading was a bitter, unbearable humiliation for Salamano. He was utterly overwhelmed, as if he had contracted an incurable illness: he seemed to suffer physically, growing painfully thin. He gave the impression of nurturing unmixed hatred for the man who had taken away his only purpose in life. In that period, which seemed interminable to him, he brooded on schemes of vengeance against Fessia, dreaming of regaining the position that he believed to be his by right. The consequences began to be felt when work returned to normal after the chaotic days of the Liberation and malicious rumours began to circulate, tending to shed a baleful light on our director, who was said to have used the trucks of the Testing Division to transport materials to build his house in Borgomasino. Although Fiat had a wartime policy of being fairly open-minded in allowing everyone to try to offset the difficulties of the period as best they could, Fessia's image as a director was not entirely unscathed by the episode. However, he did not seem worried and was as self-confident as ever.

My dream was to design the coachwork of automobiles as well as the mechanicals, and I never missed an opportunity to mention this aspiration of mine to Fessia. My contention was that by designing the mechanicals and the coachwork together it would be easy to achieve out of this unified conception of the project that harmony which is the source of functional rationality, greater simplicity, reduced weight and lower costs. The vehicle designed in this way would also be more attractive. Fessia had no objections but he promised me nothing.

In the meantime, the development of projects which I undertook on my own initiative led to an intensification of my contacts with the Coachwork Division and often, closed in my own office, I used to practise designing bodies and illustrating points of styling. I compared shapes, dimensions and weights arising out of different layouts of the engine and transmission for both front-wheel and rear-wheel drive. For small cars it was by this time an acknowledged fact that the engine and transmission (including clutch, gear-box and the differential with its gearing) should, for reasons of weight and cost, form a single unit: the vehicle's drive system. But as I have said, it was easier to get Fiat to replace the traditional layout with a drive system set at the rear of the automobile than one involving front-wheel drive.

The President and the general manager were also influenced in this by Salamano, a stalwart supporter of the superiority of rear-wheel drive. Fessia had never told me what he thought on the subject. I was convinced that the best system for a small automobile should be judged on the basis of cast as the leading factor.

My calculations showed that a rear-engined automobile was cheapest but I did not reject out of hand the possibility of front drive and went on studying the layout of a drive system that would offer such benefits in terms of simplicity as to offset the costs of the homokinetic joints indispensable for the movement of the front wheels. In this state of uncertainty, I went back over the projects carried out before the war and repeatedly produced designs embodying different schemes, both front-driven and rear-driven. A new factor then cropped up to give a stimulus to these schemes.

Late in 1943 news came from France that in the midst of the German occupation and the resistance struggle the prototype of a new small car had been constructed to a design by J.A. Grégoire.

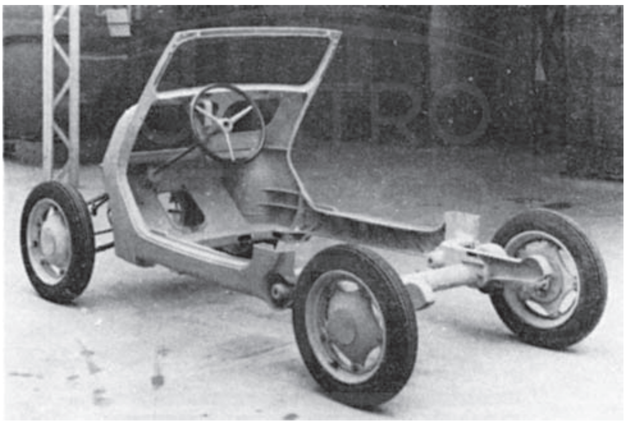
The story of the JAG, which later took the name of the AFG (Aluminium Français Grégoire) because it was built with the collaboration of the Aluminium Français Company, has been told in the motor magazines and by Grégoire himself in his book *50 ans d'automobile*.

I found myself partly involved in the story. Here's how.

In November 1943 Fessia had received some photographs and a detailed list of the technical data about the AFG from M. Dumas of Simca. This provided a thorough comparison with our *500 Topolino* which was being produced at Simca's Nanterre factory designated the Simca *Cinq*. The report contained a technical evaluation of the AFG and an economic analysis of the use of light alloys.

The vehicle, a typical French product, was advanced in conception. It had front-wheel drive and extremely cleverly devised independent variable flexibility suspen-

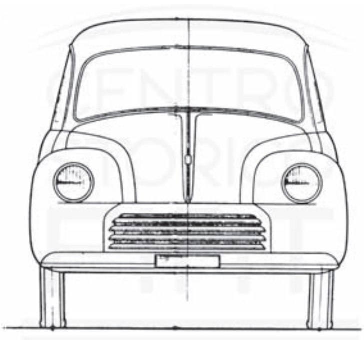
Jean Albert Grégoire, law graduate, novelist, racing driver and automobile manufacturer, born in Paris in 1899. With a passionate interest in autos, Grégoire carried out studies and experiments which led him and his friend Pierre Fénaille in 1926 to design and build the Tracta sports car with front-wheel drive. Later he designed the Compound, an auto made of light alloys with bearing coachwork and integral independent suspension, for the Amilcar company, which had been taken over by Hotchkiss. During the war he built a prototype electric-driven auto which set a new world record for road-distance travelled without recharging (250 km). Also during the war, he produced another prototype for the Société Aluminium Français: the AFG auto with front-wheel drive and a 600 cc ail-cooled engine with twin opposed cylinders, which was not put into production in France but was the basis of the design of the Dyna Panhard and other vehicles (the English Kendall, the American Kaiser, the Australian Hartnett). He also produced another auto of advanced design which was built by Hotchkiss from 1950 on. In 1953 he exhibited the Socema Grégoire at the Paris Motor Show. This was the first French turbine-driven auto. He had a worldwide reputation for his designs and patents of suspension systems, such as the variable suspension system and the pneumatic "aerostable suspension" system adopted by Renault. [He died in 1992].



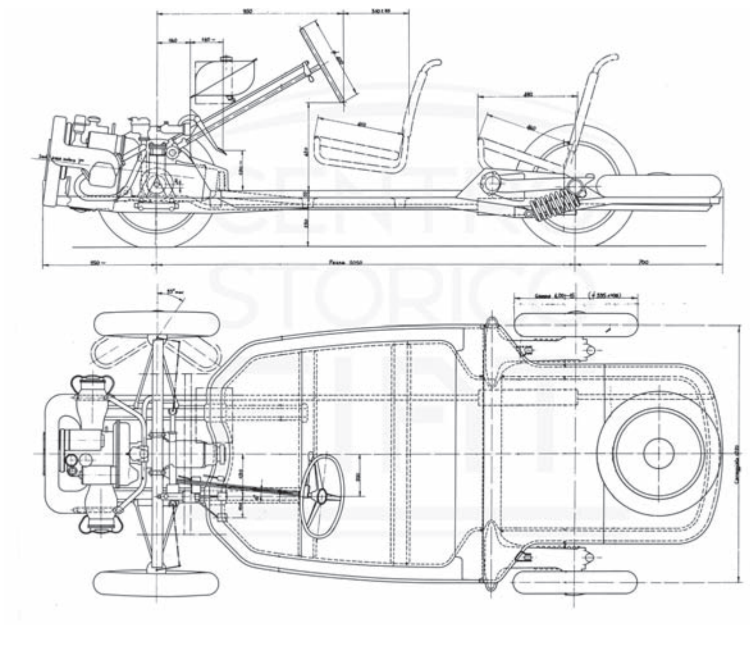
The basic structure, cast in light alloy, of the AFG (Aluminium Française Grégoire), an auto with a twin-cylinder boxer engine and exceptionally efficient suspension. (Photo Archivio Fanauto, November 1945).

sion on the rear wheels. The engine with two opposed horizontal cylinders made of light alloy was air-cooled and the rods were made of duralumin. The engine capacity was 594 cc. The coachwork was made of sheet aluminium plating with a wooden framework and borne on a very rigid chassis formed of large cast-aluminium alloy sections bolted together. The inside of the coachwork was sprayed with a paint composed of minute fibres. The seats were very simple, with a tubular frame work and no springs. The vehicle's weight, with an empty fuel tank, was 400 kg, exceptionally low for a four-seater.

In passing the document on to me Fessia had not made any particular observations. I felt that he did not consider the report important, nothing more than an



Front view of one of the coachwork proposals for the front-wheel drive "102 E1" derived from Grégoire's AFG design. Drawing of 2 October 1946.



The AFG was redesigned in Turin to make it more suitable to the production requirements of Simca (then controlled by Fiat). The principal aim of this operation was to cut down on the extensive use of aluminium, a major feature of Grégoire's design. The Turin designs had a platform in pressed plate. The design alongside incorporates Grégoire's system of variable-flexibility rear suspension. Undated design.

attempt by the Aluminium Français Company to promote the use of aluminium in auto manufacturing.

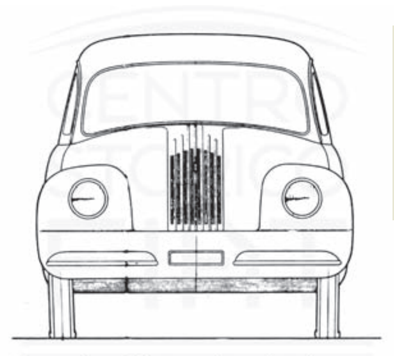
In 1944 Fessia had some more news to give me. Baron Petiet, the President of Simca, and Enrico Teodoro Pigozzi, the managing director, maintained contact with Valletta and kept him informed about the political developments in France. They reported that certain political currents had become established in De Gaulle's provisional government under the aegis of Communist ministers that were pressing for the nationalization of industries. The controller designate of the metalworking and electrical industries, M. Pons, had prepared plans for imposing a five-year programme on the automobile industry to give precedence to the development of utility vehicles, the Renault 4 hp and the AFG. Simca and Panhard were to be permitted to mass-produce the AFG, while the possibility of nationalization also loomed up ahead of Simca. It seemed essential to give serious thought to the "Grégoire" and make it into an economically acceptable proposition for production. I was called on to study the problem and express a technical opinion on the basis of full documentation which included the main blueprints. My judgment was on the whole favourable to Grégoire but against Aluminium Français.

The use of light alloys for parts that could be made of thin steel plate, with the same weight or little more and at much lower costs seemed quite unjustified. So I maintained that a chassis consisting of cast light alloy elements and aluminium coachwork on a wooden frame was unacceptable, especially for a model whose costs had to be kept down to the minimum. I went on to say that some of the mechanical components should be modified because of the indiscriminate use of aluminium in them, while the vehicle as a whole and in particular the front-wheel drive and the suspension added up to an excellent design and were worth adopting, provided the trials gave good results. I ended up with the proposal to redesign the model to fit in with the criteria of construction in use at Fiat, retaining the general layout of the design and details as laid down by Grégoire. I also asked for a prototype of the AFG so that I could test it thoroughly.

While I was awaiting the arrival of the AFG prototype in Turin I set studies of the model going, using Grégoire's design as the starting point but adapting it to a Fiat engine and bearing coachwork made of sheet steel.

The project, baptized the "102", was usually called the "Grégoire".

In Paris Pigozzi, assisted by President Petiet, managed to keep his chin above

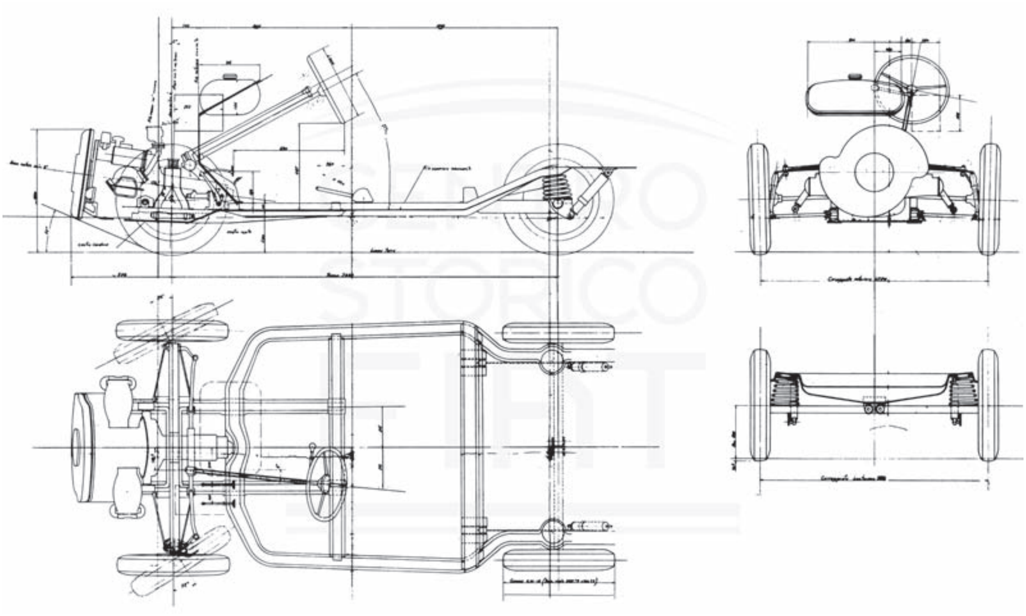


Front view of the second coachwork design suggested for the front-drive "102 E2". On the original drawing, dated 29 November 1945, Giacosa noted "this front didn't meet with approval". Nevertheless the same design solution was considered acceptable for the 1100 S sports model produced in 1947 (see page 116).

the troubled political waters and ably staved off the threat of nationalization hanging over Simca. At the same time in Turin the Fiat company was settling down again after the events that had led to the removal of Agnelli and Valletta from office. A number of executives in the technical offices had also been accused of collaboration with the Fascists and dismissed or, as they used to say at the time, purged. Among them were Bona, of the Aero Engines Office and Schaeffer, director of the Motor Vehicles Coachwork Technical Office (automobiles and industrial vehicles).

Fessia managed to manoeuvre skilfully throughout this troubled period and gained control of the Experimental Construction workshop, removing it from its subordination to production management. This change, which he had so dearly desired, seemed almost incredible at Fiat, where there was the deeply rooted concept that production management should be in supreme control. The President had always enabled production management to exert a certain check on the activities of the technical office and

Enrico Teodoro Pigozzi, born in Turin in 1892. While still a young man he moved to France, where he started a business supplying the Fiat foundries with ferrous materials. In 1928 he was already the manager of the SAFAF, Fiat's Paris branch, responsible for automobile sales in France. In 1932 he set up a small plant in Suresnes, near Paris, where Fiat autos were assembled using mechanical components which were either imported from Italy or manufactured under licence in Paris. In 1934 he bought the old Donnet Zédel works in Nanterre and was a partner in the foundation of Simca (Société industrielle de mécanique et de carrosserie automobile), which soon achieved its objective of building French autos to Fiat designs (Simca Cinq, Simca Huit) or (after the war) independently designed models (Simca Neuf etc.). In 1954 he took over the Ford France Factory at Poissy (Yvelines) for Simca. The President of Simca Industries and its general manager, he was made honorary President of Simca automobiles.
He died in Neuilly-sur-Seine (Paris) in 1964.



Diagrams of the "102 E1" chassis: one of the redesigns of the AFG with suspension designed by Fiat. Dated 14 October 1946.

hence on design through the medium of the workshop for prototypes. The changes made us feel in a stronger position and Fessia's authority and prestige increased. To defend and control his new conquest better he had the purchasing office of the prototypes workshop moved into the design room on the fifth floor.

After Schaeffer had been removed by the "purge committee", Fessia turned the Coachwork Division over to Cogno and not to me as I had hoped he might. Probably he had taken this decision for reasons of political convenience but I was disappointed and a certain discontent made itself felt among the draughtsmen in the Coachwork Division.

Cogno's only merit was of maintaining discipline by an assertive manner that was natural to him because of a curt way he had of saying things, not the sort of discipline that is created naturally in a spirit of collaboration when the subordinates feel respect for their boss because they appreciate his ideas and his abilities.

The production sector's offensive against Fessia, which flared up after the transfer of the Experimental Constructions workshop to his control, became open warfare, with Salamano stoking the flames. The technical offices also felt the effects of the struggle. We had the feeling that something important was impending to settle the crisis. I knew nothing about what was going on at the top managerial levels. Fessia did not confide his ideas and aims to me as in the past. I just went ahead with our studies on my own, with my usual commitment to the work. I never took the pressure off my draughtsmen and they backed me up with their intense interest in the problems I passed on to them.

Reports on the "Grégoire" came in increasingly frequently. On his visits, Pigozzi never failed to keep Fessia informed and often spoke to me directly to sound out my opinion of the car on which Simca's whole future seemed to depend.

Towards the end of 1945 we had the opportunity to test drive the "Grégoire" and take stock of its merits. I was, however, more than ever convinced of the need to redesign the vehicle completely to adapt it to mass production at a reasonable cost. This led me to push on with studies for the "102".

It was in the midst of all this that senator Agnelli died – on December 15 to be precise – and a deep sense of loss was felt at Fiat.

At the end of March 1946 something happened that was to have important consequences in my career.

My office on the fifth floor of the central section of the "palazzina" at Mirafiori was placed opposite to Fessia's, in a room overlooking the factory. I had moved a drawing board into it so that I could do sketches and drawings to check whether the ideas that came into my head were worth having developed by my draughtsmen.

I was grappling with the problem that had engaged my mind for some time, a comparison of the different possible arrangements consequent upon a given placing of the engine, when I heard the door being opened noisily.

I spun round on my stool and saw, to my great astonishment, the nose, the eyes and then the whole of Fessia's face appear in the doorway, with an expression that was tense and yet conveyed amusement.

"I'm all for front-wheel drive!" he almost yelled in his highpitched voice, then slammed the door shut and disappeared, leaving me open-mouthed in wonderment.

This was the first time Fessia had told me plainly what he thought about front-wheel drive. What had come over him? I found out the day after. He had resigned and left Fiat. That had been his goodbye to me and I had had no time to respond. I never knew the true reason for Fessia's resignation nor how the decision came to be taken. And I can't stand gossip.

Valletta returned to Fiat as President and managing director in April 1946.

I was appointed director of the Motor Vehicle Technical Offices, dealing with autos and industrial vehicles. The experimental services, the Electrical Equipment Office and the Technical Publication Office, despite the fact that they dealt almost exclusively with motor vehicles, were not brought under my control but made part of a much larger grouping, the Technical Design Division, which included aircraft and ground transports and was run by Giuseppe Gabrielli, director of the Aviation Section.

Giuseppe Gabrielli, born in Caltanisetta in 1903. After taking his degree in Mechanical engineering at the Turin Polytechnic in 1925, he went to the Aachen Technische Hochschule in Germany and took another degree at the school of aerodynamics there.
He joined Fiat and in 1931 he became manager of the Aviation Technical Office; in 1954 he was made manager of the Aviation Division, a position he held until 1968. Manager and director of Fiat, he was also President of Unavia.
He was known worldwide as an aeronautical designer and expert and held important posts in various technical and scientific organizations. For example, he was professor at the Turin Polytechnic and was Italian delegate for AGARD (the Advisory Group for Aerospace Research and Development). He died in Turin in 1987.

My collaborators and draughtsmen in the Motor Vehicles Technical Office felt somewhat put out at being subordinated, if only on paper, to Gabrielli's authority and hence to some extent to the aircraft sector. My authority seemed to have been diminished, but not for long. Soon everyone came to realize that in the motor vehicle sector the managerial decisions were not the prerogative of the divisional director but of the director of the Motor Vehicle Technical Offices.

In practice, design was divided into two sectors: aircraft and automobiles. I was responsible for automobiles and Gabrielli for aviation but he was officially my superior, being the divisional director.

Valletta had the idea of sending Gabrielli and me off together to the United States for a refresher course to update our knowledge of relevant techniques. Gabrielli would be enabled to get to know the automobile world and I would pick up new ideas and make contacts by visiting American factories and laboratories.

United by our common interests we would have to get along together and collaborate in a friendly spirit. The trip came off in December 1946. We spent Christmas in New York. Some not-so pleasant incidents, such as the fire that broke out at the Wilson Hotel, where we put up in New York after a thirty-six hour flight, helped us to get to know each other better and make us friends. Our friendship grew closer and more rewarding as time passed without altering our working relationship. Each of us attended to his own business, he stuck to aircraft and I to automobiles. Gabrielli took over Fessia's place as President of the CUNA (Commissione di unificazione dell'automobile) and I replaced him as lecturer in Motor Vehicle Engineering at the Turin Polytechnic. Some years later I was to take over from Gabrielli as President of the CUNA.

As director of the Motor Vehicles Technical Offices my first responsibility was their organization and the choice and training of staff.

I set up an Automobile Department and an Industrial Vehicles Department, each consisting of an Engine Office, a Chassis Office a Coachwork Office, an Estimates Office. Each department was served by a record-file and a secretary. The management of the technical offices had a secretary, record-file and shorthand-typist. At the time all the lists of designs and notes to the work were written out by the draughtsmen in longhand, avoiding much waste of time. By the end of 1946 the Motor Vehicles Department had a staff of 81 in all, including 4 executives, 68 technical draughtsmen and 9 others, comprising secretaries, filing-clerks and workmen.

The Industrial Motor Vehicles Department had a slightly higher number of draughtsmen.

Oscar Montabone, engineer, born in Turin in 1913.
He joined Fiat's Aero Engines Office in 1937 and in 1946 moved to the Motor Vehicle Design Office, where he became vice-director. From 1956 to 1962 he was director of the Simca engineering centre at Argenteuil.
In 1962 he became engineer to the Fiat General Management, with responsibility for coordinating and developing motor vehicle design. He was made joint director of Fiat's motor vehicle studies and design management in 1965. In 1970 he became assistant general manager and in 1972 head of the central research management. Following retirement in 1975 he has continued to work as a consultant for the Fiat group. He is the President of CUNA, SASN (Nardò experimental car track company) and of FEEMAS (air pollution research group set up by Fiat-ENI-Esso-Mobil-Alfa Romeo). [He died in 1986].

I retained my position as acting director of the Motor Vehicles Department and continued to play a direct part in designing as before. The head of the Industrial Motor Vehicles Department was Giuseppe Russolo, with the title of assistant director, while the experimental service was run by the engineer Ambrogio, both chosen by Fessia when he was in authority.

Salamano returned happily to his old position as head of the Road Testing Section.

I then set up a coordinating office under Francesco Bellicardi.

Oscar Montabone, from the Aero Engines Technical Office, was placed in charge of the Motor Vehicles Office, at that time consisting of 8 draughtsmen. Giuseppe Morelli was head of the Automobile Coachwork Office, with 24 draughtsmen. I appointed the admirably capable Alberti head of the Coachwork Office, with a strength of 24 draughtsmen and 3 plaster modellers to produce scale models.

Nebbia continued as office manager of the engines section in the Motor Vehicles Department: he had been my much honoured office manager years before. His assistant was Bertolino. The Coachwork Office, with 40 draughtsmen, was run by Ernesto Casula, who had been brought over from the Automobile Division, with Ettore Coatto and Mario Peila as his office managers.

I placed the engineer Mosso at the head of the Industrial Vehicles Coachwork Office. He had been head of the technical office in the aircraft factory at Cameri, then went over to the railroad material factory before his present appointment.

This arrangement enabled me to give a rapid and efficient start to the programme sketched out in 1946 and perfected in 1947 and subsequent years.

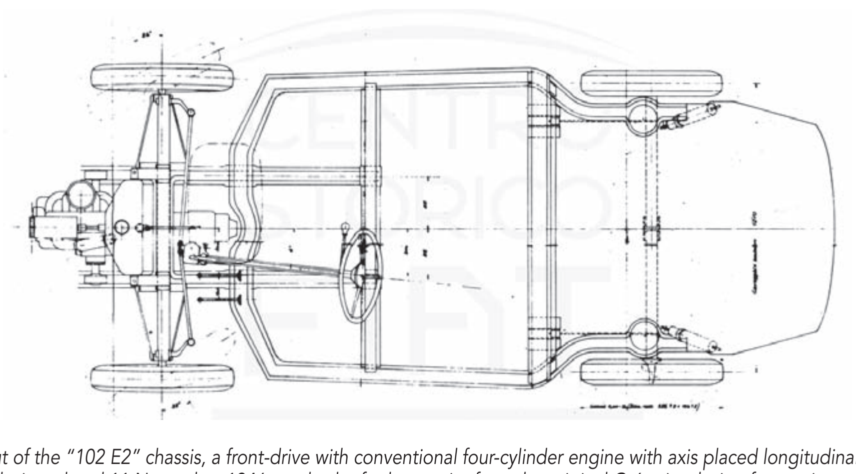
To get some order into the numbering of the models and designs I had laid down that new models should be designated by a three-digit number, of which the first should be 1 for automobiles, 2 for trucks, 3 for long-distance coaches, 4 for town buses. Later on 5 was used for tractors and 6 for engines for special purposes. This explains the reasoning behind the designations of automobiles in the project stage: “100”, “101”, “102” etc.

A short while before Valletta was reinstated at Fiat, I was summoned to a meeting in Valletta’s office in via Gramsci. Talking of programmes and especially the future of the *Topolino* I told him about the studies carried out during and after the war. He wanted to know what sort of model I thought it best to choose and I replied that to be sure of our choice we ought to build three prototypes, one of the traditional type, with the engine in the front and the drive wheels at the rear, another with front-drive and a third with the engine at the back. The latter two could incorporate the transverse engine-gearbox group which was already being designed, and I mentioned projects that we had designated the “100 E1” and “100 E2”.

Valletta agreed provided that the construction of the three experimental vehicles did not delay projects for other models that I might be called on to produce.

On 1 June 1946 I prepared a memo that served as the basis of discussion for the new programme of automobile production:

> During the last few years the studies of the technical office have been directed towards the production of new models.
> – The “100” model (one of the three experimental versions already designed) as a replacement for the *500* with coachwork for a 2 seater version plus two dickey seats, a power output of 14-16 hp, weight approx. 500 kg.
> – The “101” model as a replacement of the *1100*, with 4-5 seats, engine capacity of about 1.250 cc, output 36 hp, weight 830-850 kg.
>
> Now, with the appearance of the “Grégoire”, which looks like a very promising attempt at an ultralight four-seater, it is worth considering inserting a model of this type between the “100” and “101” to replace the *700*, which despite some features that are still quite modern is completely outdated because of its heavy weight and low performance.
> So we have for some time been engaged on studies for a four-seater, provisionally designated the “102”, with the same dimensions as the “Grégoire” but simpler and cheaper to build.



Layout of the “102 E2” chassis, a front-drive with conventional four-cylinder engine with axis placed longitudinally. This design, dated 11 November 1946, marks the furthest point from the original Grégoire design for an air-cooled two-cylinder boxer engine.

This memo was followed up with a report containing the results of the study of the “Grégoire”. Among its merits I noted lightness, roominess, excellent roadholding with its front-wheel drive, excellent suspension. But I also pointed out that the variable-flexibility rear suspension prompted doubts about the durability of the joints, subject to greater stress than we normally regarded as acceptable on our models and that the noise and vibrations set up by the two-cylinder engine made the vehicle, in this respect, markedly inferior to the Fiat *500*. We had also noticed excessively high oil temperatures in the engine and other minor snags. The main defect, which I regarded as unacceptable, was the excessive cost due to the indiscriminate use of aluminium.

In conclusion I stressed the advisability of completing the designs of the experimental “102” with bearing coachwork and so planned as to be fitted either with an air-cooled engine with two opposed cylinders or a water-cooled four-cylinder engine. A table providing a comparison between the *500* and the *1100* and the “100” and “101” then being designed completed the report.

I added that there might be an alternative to keep down production and marketing costs. This was to use the mechanicals of the “102” to produce a very small two-seater and a larger four-seater.

On 29 October 1946 a meeting was held by the presidential committee presided over by Valletta. The conclusions were recorded in the minutes (probably dictated by Genero) which are of interest because of their simple language – almost a translation from Piedmontese dialect – and their laconic conclusion:

Meeting of 29 October 1946

Presents:

Valletta	Bono
Bruschi	Gajal
Genero	Gabrielli
Maggiore	Giacosa

Construction programme: new models

To replace the *500* it was decided to build an automobile called the “102” by 1949; it should be adapted for:

2 seats
4 seats
with chassis incorporated in the coachwork

- Model “102” – with front transmission and two-cylinder air-cooled engine (Grégoire system).
- Model “102 E2” – with front transmission and water-cooled engine.
- Model “103” – with orthodox layout and water-cooled engine.

To replace the *1100* and *1500* it was decided to construct by 1948 a new automobile, the “101” with a capacity of 1.300 cc, weight about 900 kg:

to seat 4 very comfortably
to seat 5 comfortably
with chassis incorporated in the coachwork

- Model “101 E2” – with orthodox layout and water-cooled engine.
- Space inside the coachwork measuring 1.20 m at hip level.

- Class of vehicle superior to the *1100*.
- For the "1300" carry out straight away a study for derived models, stretched version, taxi, transport vehicles. For the last-mentioned a chassis will have to be worked out.
- Considering the heavy workload of the technical office it is suggested that the projects for new trucks be postponed so as to push ahead the projects for new automobiles.
- Gabrielli and Giacosa will arrange a temporary transfer of draughtsmen to accelerate the designing of the automobiles.

Updating automobiles – 1947

500 auto
- improvements to the engine bearings;
- improvements to suspension and springs;
- improvements to composition of the iron castings of cylinders to reduce wear;
- modification of the present engine to produce an overhead valve engine giving an output of at least 15 hp.

1100 auto
- improvements to engine bearings;
- improvements to composition of the iron castings of the cylinders to reduce wear.

Under Valletta's guidance Fiat gained new drive, getting its factories back into working order, reorganizing itself. The plant for producing prewar models was reactivated and increasing numbers of vehicles were steadily being turned out: the *500,* the *1100*, the *1500* and derived models, namely the *1100 L,* the vans designated the *1100 L, 1100 ALR, 1100 APL* and the *500* pick-up.

The Motor Vehicle Technical Offices with their two departments, Automobiles and Industrial Vehicles, dealt with the requirements of the Mirafiori and Lingotto autoworks and the SPA factories which turned out trucks and buses. The technical office for farm tractors and the Railroad Engine Office also took up much of my time since I was interested in every type of design problem and could not help getting to work alongside with my staff.

Naturally I devoted most of my time to automobiles. I shared out the work according to the technical training, experience and natural bent of the individual.

In a technical office three types of work can be distinguished in the design field. The first is routine work involving modifications that have to be made daily to various components so as to meet manufacturing requirements and introduce new technological processes into the constructional systems, or else to eliminate defects and flaws pointed out by buyers and finally to improve the vehicle's quality when it is in mass-production. It keeps the directors busy because they have to keep contacting their colleagues in the works and the After-Sales Service Department. The second task involves designing vehicles derived from models already being produced and which generally have to be planned and built according to a tight schedule. This work calls for concentration, speed, thorough knowledge of economic factors and experience. The third type of work, the most attractive, is that of designing new models: this calls for not only all-round engineering skills and a mastery of design but also imagination and a special flair.

As long as I was able to follow the designs directly myself, side by side with the departmental heads immediately subordinate to me in the hierarchy and with my draughtsmen, I always avoided setting up any closed departments or offices, by which I mean those consisting of a fixed number of permanent staff. As each case cropped up with its particular difficulties and degree of urgency I would choose the most suitable people to deal with it, transferring personnel from one type of work to another, explaining my reasons in every instance and asking them their opinion.

I have never given an “order”. I have always asked for collaboration and understanding. It was this attitude that made it possible to design an aircraft engine like the A 40 with a group of designers who until then had only dealt with automobiles.

It was inevitable in 1946 that the production programmes should arouse some uncertainty on the part of the top management. After years of war, when the whole commercial effort had been suspended, in a situation full of problems caused by shortages of primary materials, it was natural that there should be doubts about which new model should be launched first on the market. In addition, Valletta also had to settle the problem of financial backing for the construction of new plant and equipment, problems that were aggravated by the unsettled political situation.

Awaiting instructions from the President, I kept studies moving in two directions: the development of the *500*, *1100* and *1500* and optimization of the new “100” and “101” projects. This meant working flat out, with all the members of the Automobile Office pulling their weight with enthusiasm and full awareness of what was at stake, united with me in the common sense of purpose.

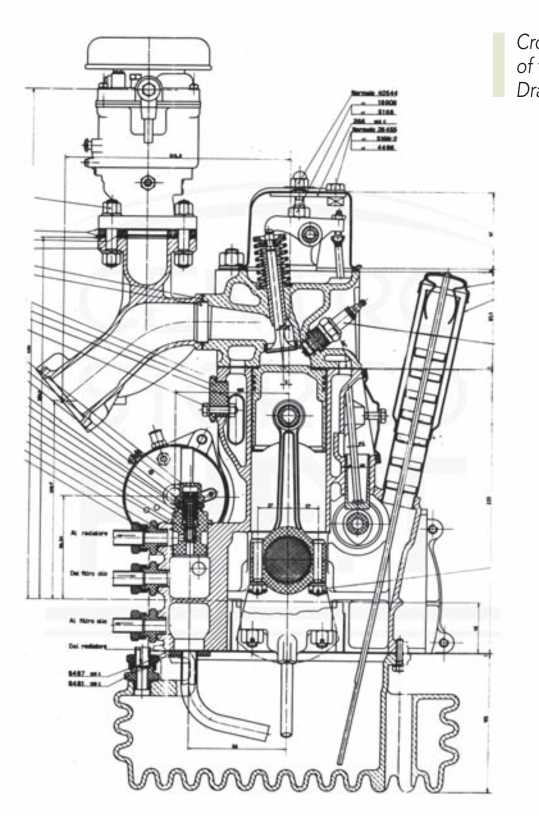
Valletta, accompanied by Avvocato Agnelli, Nasi and Bono, warmly greeting the Austrian journalist Patleich, known for his care and expertise in testing Fiat autos when they made their public debut. On the left, Dante Giacosa.

The project for the *1100 S*, the sports model of the *1100* and a direct descendant of the *508 C MM* built for the Mille Miglia races in 1938 and 1939, helped to galvanize the atmosphere. Fiat could not keep out of the 14th Mille Miglia to be held in 1947: this was a competition that mobilized auto manufacturers and aroused interest the world over; it marked the revival of the automobile industry after the war years. It was decided to go all out to build a coupé capable of putting up a good show in the race but also adapted to use as a tourer by a sporting clientele.

This was to be a development out of the *1100*, not so powerful and sophisticated as the Cisitalia but capable of at least 150 km/h top speed. Since the chassis had to be the same there was no alternative but to work on the engine to increase its output and adopt a lighter and more aerodynamic coachwork streamlined to make high speeds possible.

Gasoline fuel in those days did not exceed 60 octane and so high compression ratios were not attainable. With the addition of benzol and benzol-alcohol it was possible to get a ratio of 7.5. A new camshaft was designed to increase the maximum number of revs obtainable and stellite valves like the ones used for aircraft in those days were adopted. The engine was given an extra oil filler, an aluminium sump and a radiator to cool the oil. In this way a power output of 52 hp at 5200 revs was achieved with every guarantee of durability.

When the full-scale dummy model was being made I was almost continuously present. Snap decisions were called for to avoid errors. The driving position and



Cross-section of the 1100 S engine (1947-51). Drawing dated 7 May 1947.

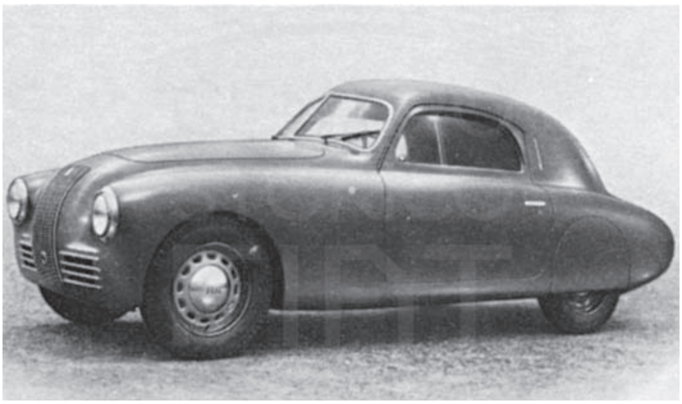
convenience in getting in and out were always checked carefully by me and I kept making improvements.

We soon reached our goal. The prototypes were subjected to thorough testing on the most difficult roads.

I always recall the trials conducted by Salamano at fantastic speeds along the narrow dusty twisting roads in the hills of Futa and Raticosa, a section of the Mille Miglia race route. Salamano was satisfied with it. The noise inside the car was deafening but that did not worry us. Italian motorists in 1947 were not particularly fussy about noise. The top speed reached was 155 km/h.

The new *1100 S* made its first official appearance in May 1947, presented by Salamano to the spectators at the hill-climbing race from Sassi to Superga. The first models produced were delivered to sales-agents and private buyers who took part in the 14th Mille Miglia, performing extremely well. In the overall placings Biondetti's 3.000 cc Alfa Romeo was first, Nuvolari's Cisitalia second, two more Cisitalias third and fourth, while fifth, sixth, seventh and eighth places went to the Fiat *1100 S*.

Fifty-four automobiles in all finished the course. The little 1.100 cc Cisitalias and the Fiats had beaten all the autos with more powerful engines except for Biondetti's Alfa Romeo 3000.



1100 S aerodynamic sedan (1947-51).

CHAPTER IX

DEVELOPMENT OF MODELS BORN BEFORE THE WAR: *500, 508 C, 1500*

In 1946 the Fiat works, in the full spate of reconstruction, resumed production of models that for obvious reasons were the same as before the war. The *500, 1100* and *1500* had made no progress, even though we were well aware of the numerous changes that it was advisable to make. Not for nothing had we built the experimental "700", "1900", "1300" and "400" prototypes, together with others derived from the *1500*, such as the "1700" with independent suspension all round, a 1750 model and a 1800.

The numerous designs rolled up and stowed away in the drawers of desks and filing cabinets embodied the precious know-how that we had acquired in the process. So it was natural that I and the other designers considered the *500, 1100* and *1500* well and truly outdated.

Fiat's top management, Valletta, Bono, Gajal, Bruschi and Genero may not have known all the facts about what we had managed during the wartime period but they were well aware of the great job done by the technical offices and the Test Department.

Erio Codecà, born in Ferrara in 1901. In 1926 he entered Fiat and two years later was given an important position in Budapest.
Subsequently transferred to Berlin as works manager of the local Fiat branch, he returned to Italy after the war and in 1947 became head of the Test Department. Later on he became manager at SPA. He died in Turin in 1952.

It was 1947 when Valletta called me to say that he had chosen Erio Codecà to run the Test Department. I was glad to hear it. I had known Codecà for years, having met him before the war in Berlin, where he was assistant to Piero Bonelli, manager of Fiat Germany. I was confident that Ambrogio and Salamano would find Codecà a director capable of giving the vehicle testing sector greater efficiency. We were under heavy pressure, with as many models to be tested as there were people delegated to test them. We were relying on Codecà to hire more personnel, perhaps by drawing upon people in other divisions of Fiat.

The programme for new models, approved by the President, confirmed the continuation of the "100", "102" and "101" projects, whose story we will take up in a moment. The "101" was meant to replace the *1100* and *1500*, while a version with an engine just under two litres was to be added to the range of major production models.

Then it would take some years for studies, testing and tooling up. So it was essential to get something done in the meantime to make the *500*, the *1100* and the *1500* more up-to-date and attractive, more competitive, in short. So it was decided to make some modifications to these three models for the first half of 1948. The modernized versions of these automobiles, with a newer coachwork and improved engineering, would be called the *500 B*, the *1100 B* and the *1500 D*.

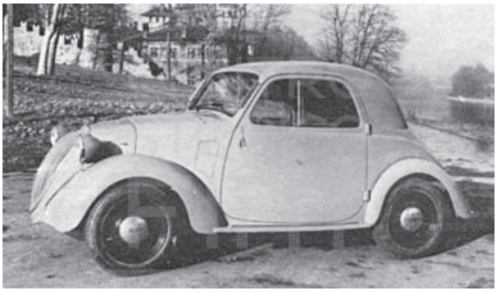
We brushed up the studies previously carried out to increase the output of the *500* engine. After going into the pros and cons of various solutions, the most convenient and economically attractive seemed to replace the head fitted with its side valves by a new one with overhead valves. Output would be increased from 13 hp to 16 hp at 4.400 revs. It was feared that increasing the revs any higher might lead to more frequent cases of wear in the cylinders, pistons and bearings and perhaps breakages in the rods and camshaft.

After the engine had been tried out on the test-bench the decision to adopt overhead valves was ratified. To reduce cylinder wear (one of the defects of engines in those days) measures were taken to improve the oil and air filtering systems and raise the quality of the cast iron. A fuel pump was also added because with the new head the carburettor was placed higher and gravity feed was no longer possible.

Numerous improvements were made to the vehicle, including reinforcement of the front of the chassis, modification of the suspension to produce variable flexibility, telescopic shock absorbers, strengthening of the cogs of the gears, a gauge for the fuel tank, a new type of steering wheel with two spokes and other changes. The front hood was modified, and there were changes to the instrument board, seats and all the upholstery. A windscreen wiper with two blades was added and the rear window made larger. The electrical system was much improved. The *500 B* prototype was ready by September and officially approved after hurried tests.

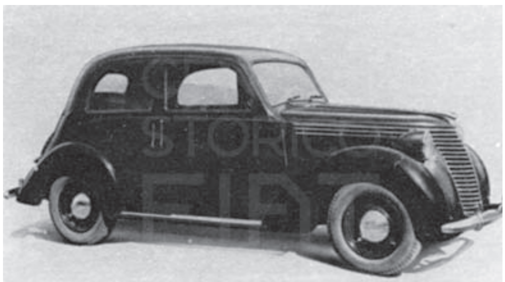
Similar improvements were proposed for the *1100 B* to mark its advance over the *1100* then in production. Since its engine already had overhead valves, the increased performance was achieved by improving the suction and exhaust ducts and increasing the diameter of the carburettor to 32 mm.

A marked improvement in the oil-filter system and hence in overall durability and life of the rod bearing was achieved through the addition of a cartridge filter, the



The 500 B was practically indistinguishable from the Topolino first series, except from minor details such as the clamps of the radiator grill.

Standard 1100 B sedan (1948-49).



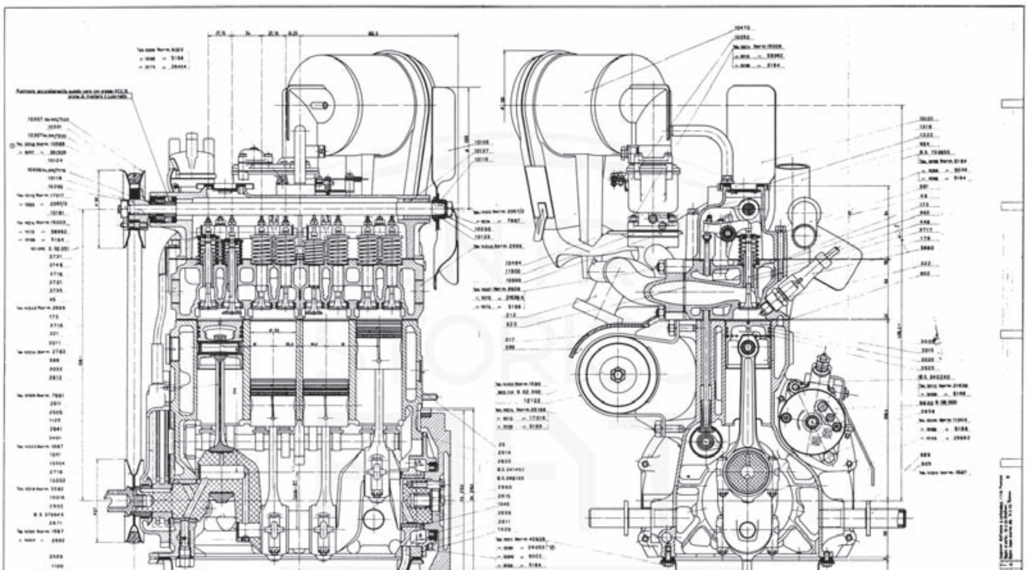
1500 D sedan (1948-49).

first time this was used in Italy. Instead of outdated antifriction metal, fine bearings were used, which were more durable. The *1100 B* started testing in August and was homologated by the end of October.

The alterations for the *1500 D* were more numerous and important. The shape of the coachwork was radically transformed in front to follow fashion and distinguish it from the previous model. The Dubonnet front suspension was replaced by a quadrilateral system similar to the *1100*'s, involving changes to the steering, which also became similar to the *1100*'s. The engine was altered in the light of experience and technological progress. Fine bearings to support rods like those of the *1100* were adopted. Engine output was boosted to 47 hp. The clutch was improved and a synchronized second gear added. The axle was made the same as that of the *508 L* (the stretched version of the *1100*).

The *1500 D* was also put into production in 1948 together with the *500 B*, when preparations were being made with all speed for the subsequent *500 C* model. This was to be more modern and have markedly different coachwork.

For some time the Simca company had been proposing to modify the coachwork of the Simca *Cinq*, identical with the *500*, to compete against the new small French four-seaters so much in the news. Renault had been nationalized and was planning to get out a cheap model to partner the AFG which, according to the schemes of the government then in power, would be built by Panhard. But the Panhard company did not in fact adapt itself to producing the AFG, since it produced an automobile which



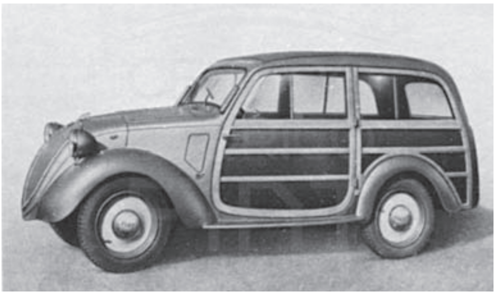
Longitudinal section and cross-section of the 500 B ohv engine, used also for the subsequent 500 C series. The drawing is dated 26 November 1948.

was completely different in both coachwork and mechanicals though it retained the general layout of the parts.

Simca had avoided nationalization and hence the big investments that would have been necessary to build the "Grégoire". It had no alternative now but to continue building the Simca *Cinq*. Pigozzi, taking advantage of the increased power provided by the overhead valve engine, had a modified body constructed to enable a pair of tiny seats to be squeezed into the back. The vehicle was to be called the Simca *Six*. The prototype presented at Turin led the Fiat management to work some features of the Simca *Six* into the *500* C, a version of the *Topolino* with modified coachwork.

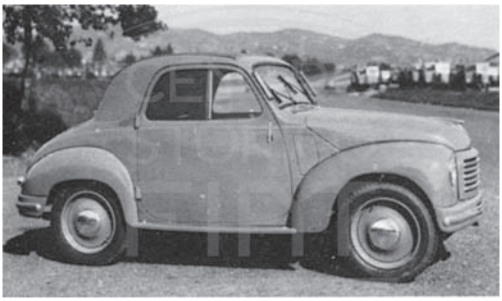
The *500 C* finally came out in 1949 with coachwork that distinguished it from the *500 B* in front and with the rear modified so as to contain a spare wheel. The *500 C* went on being produced until 1955. It was the first Fiat to be fitted with a heater, very simply designed so that two pipes brought warm air from the radiator behind the engine, just in front of the clash board. This was how I found a way to make use of the position of the radiator.

The *500 B* and *500 C* were also produced in a station wagon version, with the cab made of wood and masonite by the special coachwork section run by Schaeffer, now back at Fiat after the absence caused by the "postwar purge".



500 B Belvedere station wagon (1948-49). The sides of this little auto were made of masonite panels fixed to a wooden framework. It was a great success because of its roominess: for the first time a Topolino offered full seating for four people.

In the second series, the 500 C Belvedere station wagon was produced with pressed sheet metal side panels imitating a wooden framework, to facilitate production. The effect was emphasized by the contrasting paintwork of the recessed panels. This derived model outsold the normal sedan version during the last few years of production, perhaps the only such case in the history of the automobile.



500 C convertible sedan (1949-54).

I was living through a period of hectic activity, caught up in the projects of the "101" and "103" in addition to other studies that were being carried out. The design offices for automobiles at that time were nothing like the size they are now: there were nine designers for engines, twenty-five for chassis, twenty-five for coachwork, including the modellers for the styling team. The staff working on industrial vehicles was only slightly larger. All the same we managed to get through our work. At the end of the year I drew up a very concise balance-sheet of what had been done:

FIAT Torino, 30 December 1947
D.T.P. – Tech. Off.
Motor Vehicles

SUMMARY OF THE MAIN WORKS CARRIED OUT BY THE MOTOR VEHICLES TECHNICAL OFFICE IN 1947

Automobiles

Models entering production
- 1100 S
- 1100 ALR pickup and van

Left to right: Luigi Gajal de la Chenaye, Gianni Agnelli, Gaudenzio Bono and Vittorio Valletta with a 500 C in the background (spring 1954).

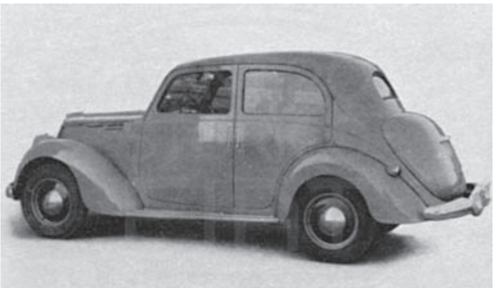
Experimental prototypes constructed
Engines:
- model 100 – 4 horizontal cylinders, engine-clutch-gearbox unit mounted transversely for front drive
- 102 E2 – 4 vertical cylinders with aluminium crankcase
- 102 E2 – 4 vertical cylinders with cast iron crankcase

Vehicles completed:
- 102 E1 – 2 cylinders engine with front drive and air cooling
- 102 E2 – model with 1.200 cc engine

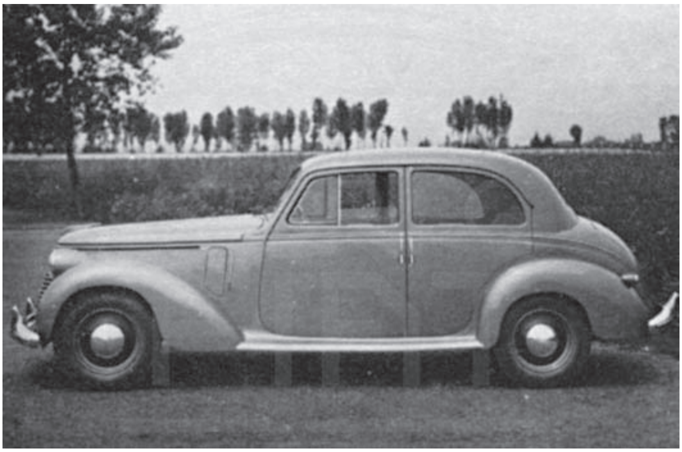
New models designed
Engines:
- 2 engines 101 E2; one measuring 75×78 and one 75×75 designed down to the final details and then replaced by the 101 definitively
- 2 complete studies for 103 engines with 4 cylinders for the small automobile

Chassis:
- 102 E2 studies completed
- 100 studies completed
- mounting of 102 E2 engine on 102 E1 vehicle

Coachworks:
- 102 E2 all designs sent to works
- 500 C designs being sent




Standard 1100 E sedan (1949-53).



1500 E sedan (1949-50).

Trucks

New models entering production

– City bus, heavy-duty 666 RNU

New model homologated

– 626 N4

– 666 N8

Experimental models constructed

– Engines – single cylinder Exp. XV

– Trucks – 666 N7 left-hand drive

New models designed

Engines:

– Single-cylinder Exp. XVI

– 201 4 cylinders

– 202 6 cylinders

Buses:

– 626 RN4 derived from truck 626 N4

– 666 RN8 derived from bus 666 N8

– 626 RN43 with bearing coachwork

– 672 RN three-axle 100 seats

Coachworks:

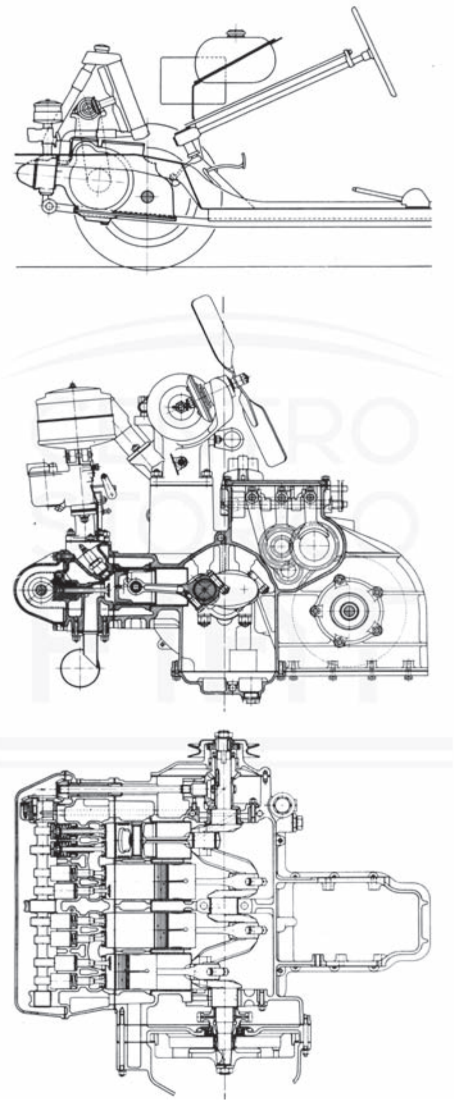
– 672 F trolleybus three-axle

1947 was a year of strenuous and hectic activity.

I thought that it would be hard to keep going at the same rate but the future was to teach me that it is difficult to fix the limits of human capacities.

1948 and 1949 were also tough years but rich in fulfilment. After the *500* C it was the turn of the *1100 E*, of the models derived from it, the *1100 ES*, the *1100 EL* (stretched) and the taxi version, then finally the *1500 E*. The "E" models differed from the previous ones by having a luggage trunk or "boot" accessible from the outside by means of a hatch. Until then the luggage was stowed immediately behind the back-rest of the rear seat, having to be passed in and out of the cab. The spare wheel, after we had tried various schemes, was fixed to the inside of the luggage hatch, not a particularly attractive solution but practical. This innovation was not easy to introduce because it meant changing the shape of the coachwork.

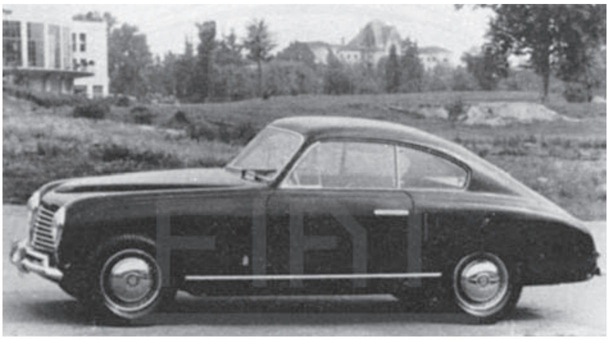
At the same time a number of commercial vehicles were designed, derived



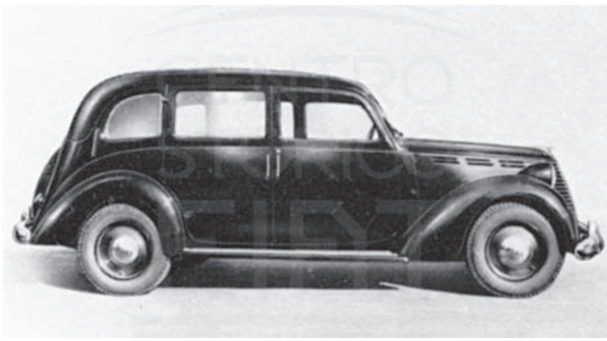
Cross-sections of the "100 E1" front-drive power unit with four horizontal cylinders and diagrams of its positioning in the vehicle. The prototype was completed in 1947 as part of the ambitious comparative project to establish the optimum design for a utility model of about 600 cc.
The horizontal cylinders, crank mechanism and gears were contained in a single die-cast aluminium element, divided into chambers to allow use of lubricating oils of different characteristics. Cooling was by radiator (without water pump) with auxiliary fan operated by two bevel friction-drive gears engaged by a thermostat mechanism when water temperature exceeded 85°C.

from automobiles like the *1100 APL* and the *2101*. I also had to deal with industrial vehicles; the *626 N4*, the *666 N8*, the *201* and *202* engines, the *626 RN* bus with a bearing structure and the biggest models, ranging from the *666 RN8* to the 672 *RNU*. In 1948 all the diesel engines for industrial vehicles were changed over to direct injection.

In the same period improvements were introduced in design, materials and manufacturing techniques. No time was wasted in talk; action was everything. But, as can easily be imagined, the biggest commitment in studies and research was devoted to new models envisaged by the long-term programme. Since circumstances led to the "101" model, the *1400*, being completed first and put into series production in 1949, making its public debut in 1950, I shall begin with the story of this automobile, the first for whose design I was fully responsible, including both mechanicals and coachwork.



1100 ES Pinin Farina coupé (1949-52).



1100 BL seven-seaters sedan (1948-50).

CHAPTER X

THE *1400*, EUROPE'S FIRST POSTWAR AUTO
NEGOTIATIONS WITH CHRYSLER AND NASH
IDEAS FOR AN 8V ENGINE AND BIRTH OF THE *1900*

A design is not something that springs fully equipped from the designer's mind in the way that Pallas Athena sprang from the brain of Zeus. The designer is only one cog in the great machine of scientific and technical development that determines progress. His ideas are not born of nothing; they are always related to studies, designs, projects previously carried out either by himself or others. So every new model contains something that relates it to previous models. Sometimes the connection is very subtle, sometimes it is glaringly evident.

Gaudenzio Bono, engineer, born in Turin in 1901. He graduated in Engineering in 1923 and entered Fiat in the same year, starting his career at the bottom and working his way rapidly up to the most important posts. Appointed assistant manager of Fiat in 1931, in 1939 he became manager of SPA, general manager of Fiat in 1946, managing director in 1955 and vice-President from 1969 to 1974. An expert in technology and company organization, he was for many years an associate professor at the Turin Polytechnic and the Amedeo Avogadro Industrial Institute, as well as being the chairman of the national Galileo Ferraris Institute of Electrical engineering from 1957 to 1973. He died in Turin in 1978.

In the case of the *1400* this connection laid in the prototypes with bearing coachwork built before the war, especially the "1900" and "1300".

The early studies that originated in the *1400* were undertaken towards the end of the war. The designs were given the designation "101" and this remained unchanged even when the vehicle was baptized the *1400*. The design was dropped and then taken up again whenever personnel became available and circumstances permitted in the technical office, finally nearing completion in 1945. In January 1946 it was possible to

Standard 1400 sedan (1950-54).

present a dummy model in full scale to Bono and Gajal de la Chenaye. The design of the body was done under the direction of Schaeffer, who was not present in person because he had been removed from office by the political committee that ordered the "purges" after the liberation.

Gaudenzio Bono was still the Commissar appointed by the Fiat Comitato di Liberazione Nazionale but in effect his authority was that of general manager: Gajal was commercial director, responsible for sales.

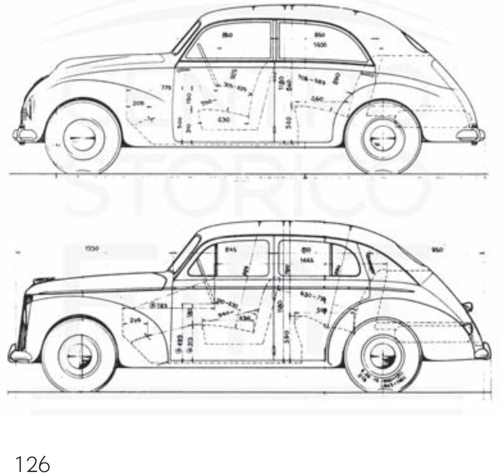
The "101", in its first version, the "E1", was conceived as a replacement for the *1100* and *1200*. The length was in fact the same as the *1100* while it was actually even wider than the *1500*, the six-cylinder model whose production had been resumed after the war.

Having done away with the chassis, I envisaged a weight of between 750 and 780 kg, much lighter than the *1100*, meaning more power, lower costs. The engine was 1.270 cc and had an output of 36 hp; with the cylinder block made, like the head, of aluminium its weight would be little over 100 kg.

After examining the model, Bono and Gajal agreed to the construction of two prototypes so I gave the go-ahead for completion of the designs.

At that time, as I have mentioned, I was not yet in charge of the design of coachwork even though I shared in the work. Only some months later, with the return of Valletta as President and general manager, I was appointed director of the Motor Vehicles Technical Offices, with my responsibility extended to include designing coachwork, which had been one of my aspirations. It was then that I applied myself wholeheartedly to the study of new forms in the tiny styling workshop attached to the Coachwork Office, where we were the first to work directly with life-size plaster models.

When the prototype had been built from the model approved by Bono and Gajal and road tests were about to begin, there was a change in our brief. This was because Valletta had come out strongly against the model during a meeting of the presidential committee held on 29 October 1946: he said that Fiat had to bring out as soon as possible an automobile capable of seating five people *comfortably*. "The '101 E1' does not meet this requirement and so it will have to be transformed into a bigger automobile," he said. This was a severe blow for me: not because I had to start again

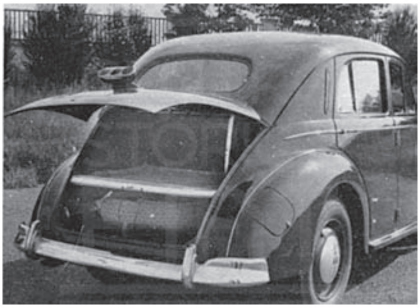


Designs of the two versions of coachwork for the prototype "101 E1" auto, dated respectively 20 December 1945 and 16 January 1946. The second corresponds to the model built.

from scratch but because I was convinced that it was more important to build a modern automobile in the *1100* class. I advanced objections, referring to the weight and cost of a bigger vehicle. After a short sharp exchange of data, Valletta said he would accept a weight of 900 kg. To avoid misunderstandings a minute was drawn up in which Valletta specified that the width inside should be 1.200 mm, measured across the back seat at hip level.

We called the new project the "101 E2" to stand for the second experiment. The tests carried out with the two "101 E1" models built gave excellent results. The engine turned out to be satisfactory in performance and durability, while despite the aluminium crankcase it was no more noisy than the cast iron engine. The rear suspension with its spiral springs was judged good as far as road holding went but unsatisfactory because of a certain roughness caused by the transmission. It also appeared that the vehicle needed a bigger torque, which practically meant an engine with a larger cubic capacity.

Armed with the insights gained from the "101 E1" we set out to design the "101 E2" with a roomier body, saving time by keeping the shape much the same as that of the "101 E1". We decided to redesign the engine, changing from a diameter of 72 mm and stroke of 78 mm to diameter and stroke of 75: a square engine.



Working prototype of the "101 E1" sedan, whose chassis foreshadowed many elements of the final design adopted for production of the 1400. Photos taken the 15 October 1946.

For the rear axle I had a new type of suspension designed. This had been in my mind for some time, my aim being to eliminate the defects of the "101 E1" and avoid having to add a stabilizer bar, which our factory considered at that time difficult and expensive to produce. Although this suspension was a completely new departure in design, it functioned on the principle adopted for the Cisitalia single-seater. This had spiral springs and two springy longitudinal spars consisting of a few demi leaf-springs connecting the axle to the body. A special cross-strut on the axle gave the system a degree of lateral springiness. This feature conferred a touch of quality and originality on the *1400*. It was tried out on the "101 E1" before being used on the "101 E2" and was perfected on the "101 E3" before it was adopted for production.

By May 1947 the designs for the "101 E2" engine were complete. The designs for the chassis and coachwork were also mainly finished and scheduled for delivery to the workshop by 15 October so that the prototype would be ready for testing by late February 1948. At this point I had to drop everything: Valletta had decided to send me off to the United States to catch up on technological progress in American industry. Construction was to be held up until I got back.

I was meant to accompany Bruschi, the ex-director of the technical administration centre, Genero, ex-director of production, both of whom were now on the board of directors, and Bono. It was decided to fly from Paris, but somehow there was no seat available for me and instead my passage was booked on the "Mauritania" sailing from Liverpool.

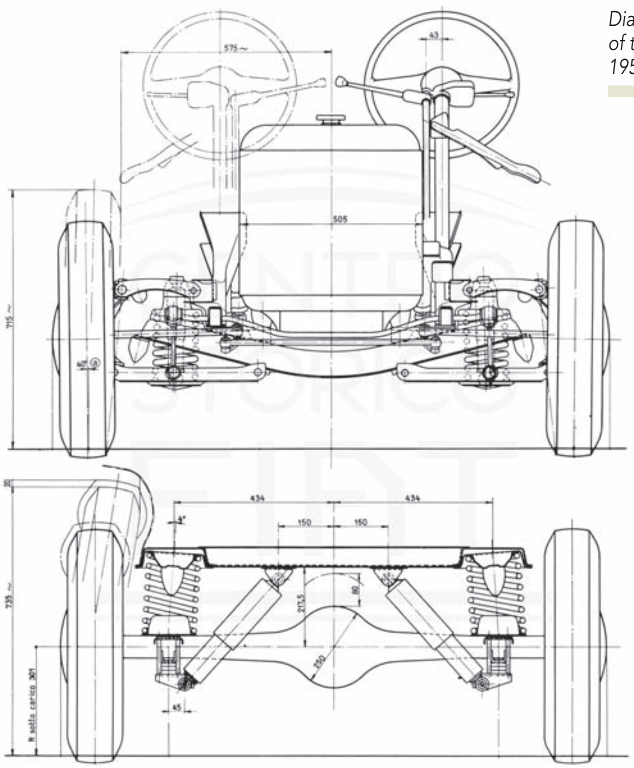


Diagram of the front and rear suspension of the 1400. This design, dated 25 May 1954, is for the "101 A" (1440 A).

I thought the other three must have wanted to exclude me from their discussions during the trip and the first encounters in the States, as they had the right to do. Perhaps I was wrong.

So I had to make the trip by sea. I caught the train for Paris on the evening of May 18. There I visited the Simca company for talks with Fiorelli and Dumas about the development of the *500* and *1100* and production problems before seeing Pigozzi. Two days later I took the train to London. On 21 May I took ship at Liverpool aboard the “Mauritania”. After a stormy crossing I reached New York on the 27th. Finally the sun was shining. The wonderful sight of the skyscrapers standing out against an azure sky made me forget the cramped conditions of my four-berth cabin and my alien fellow travellers, who had spent their time almost permanently stretched out there because of the violent pitching of the ship.

Armando Fiorelli, born in Foligno (Perugia) in 1896. After qualifying at the Foligno Industrial Institute in 1912, he joined Fiat in 1920 as a draughtsman in the works technical offices.
He was promoted to the departmental head in 1925 and assistant to the management sector in 1927. In 1929 he was appointed head of Fiat’s newly created After-Sales Service Department.
In 1931 he was put in charge of organizing the P.Z. Inz works in Warsaw, where Fiat vehicles were assembled for Poland, and in 1936 he was sent to the Simca works in France to direct French production of the Fiat *500 Topolino*. In 1944 he returned to Turin and was appointed director of Aeronautica d’Italia. He became director of the Mirafiori works in 1946, director of Fiat’s Motor Vehicles Division in 1955, and director of the Automobile Division and the Industrial Vehicles and Tractors Division in 1958. In 1963 he was awarded an honorary degree by the Engineering faculty of Pisa University. [He died in June 1981].

In the sunshine, in the marvelously clear spring atmosphere, New York looked beautiful. I was overwhelmed by the contrast with the gloomy silent ruins that I had seen in London and the bitter misery of the cities destroyed by the war. When I landed I had a few hours free to spend as I liked before taking the train to Detroit, where I was to meet up with the other three members of our party. I left my two suitcases at Grand Central Station, swarming with a busy crowd: I noticed that they stubbed out their cigarettes with the most surprising carelessness, at a time when in Italy people used to pounce on the rare and microscopic butts they came across to retrieve a few shreds of tobacco.

Dazed by my long voyage, the confusion of getting myself and my luggage off the ship, the milling crowd and rushing traffic, my eyes filled with the sunlight, I set off feeling exultant and lighthearted towards Forty-second Street, heading straight for the greater skyscrapers whose acres of glass gleamed in the sun.

I found myself in front of the monumental New York Public Library, and almost in a dream walked up one of the four great stone staircases set on the four sides of the building and leading up to the entrance. Inside there was a sudden gloom and silence in the cavernous lobby. Numerous corridors led off all round me, each with a sign over its entrance. I walked down one: perhaps I had read “internal combustion engines” written above it; though I often try to remember I can’t be sure whether I did or not. These corridors stretch away between walls lined with metal catalogue cabinets with rows and rows of drawers, each labelled to show the subject indexed on the cards it contains.

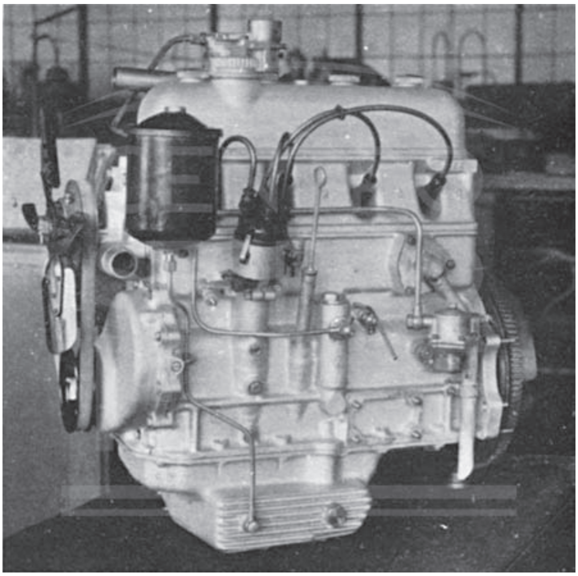
Half-way down the corridor I stopped. I pulled out the drawer in front of me and ran my thumb along the stack of cards that filled the drawer. It riffled open as if by magic. On the card facing me I read: Giacosa, *Motori Endotermici*. My surprise, almost consternation, was such that I read no further. I pushed the drawer shut and moved away as if in a trance. When I got to the end of the corridor I glanced back at the great room thronged with readers, with its brooding silence and then timidly sought the exit. I found myself back in the gleaming sunshine reflected from the sky-scrapers. Happy and lighthearted I wandered among the crowds on the sidewalk of Fifth Avenue. So the Americans knew about my book.

The month we spent in Detroit was extremely useful. I took back to Turin a diary crammed with technical data and information that have since been invaluable in the work of the technical offices and the factory. Of particular benefit to the "101" project was my long visit to the Chrysler works, with friendly exchanges of information and ideas with Mr. Herreshoff who was in charge of advanced engineering studies. The visit to the works, offices and laboratories of the Budd company was also very fruitful.

Fiat had already made a deal with Budd before the war for technical assistance in the application of patents for the construction of all-metal coachwork. The personal contacts made during the visit were the start of an intensive exchange of information regarding the design and construction of bodies that later was to lead us to ask for their collaboration in making dies and other equipment necessary to put the "101" into series production.

I got back to Turin later in June with the idea of redesigning the engine all over again and making improvements to perfect the coachwork and suspension.

The research that I had seen at Chrysler and General Motors had convinced me of the advantages of adopting an engine with a piston stroke markedly shorter than its diameter: the subsquare engine. The expectation of a progressive increase in the octane rating of gasoline fuel, then only 65 in Italy, led me to think that we would be able to adopt higher compression ratios even with a relatively flat combustion cham-



101 E1 engine with aluminium cylinder block: except for the cast-iron crankcase, this is essentially the engine adopted for the 1400.

ber, provided it was rationally designed. The possibility of fitting big-diameter valves would produce high speed rotation. It would be possible to increase the engine's displacement by increasing the stroke, which only involved inexpensive modifications. Since the geometry of the subsquare cylinder is favourable to opposed cylinder engines I had another look at the four-cylinder boxer setup, but soon though better of it. The greater complexity, the larger number of parts and the much higher costs are against the opposed cylinder type of engine whenever it is possible to use an in-line one.

Getting down to business I decided: 80 mm bore, 60 mm stroke. As far as I knew no engine to date had been made with such a short stroke I proportion to the diameter. With an engine measuring 1.206 cc I envisaged an output of 40 hp at 4.400 revs, quite adequate at that time for an automobile meant to weigh no more than 885 kg.

The engine was called the "101 E2", like the car itself. The designs were begun in early July and finished by the end of August. The designers, on their own initiative, normally did two hours overtime daily. They also gave up their summer holidays.

The engine, though slightly longer than the previous one, was placed further forward to make the cab roomier. This meant that its length inside became the same as that of the *1500* sedan while its overall length was the same as the *1100*. Modifications were made to the fascia, dashboard and side-panels level with the front wheels.

In collaboration with the factory, numerous small alterations were made to improve quality and facilitate mass production.

As for the tyres, I decided to ask the three Italian producers for a 5.50-14 size. Twelve years earlier ,when the smallest rim had been 16 inches, we had ordered 15-inch tyres for the *Topolino*: now we were getting even smaller, down to 14 inches.

At the start of October 1947 I took stock of the situation together with my collaborators. All designs for the model would be complete by 15 November. Since construction of the individual parts was synchronized with the consignment of the designs already going ahead, the first prototype was scheduled for completion within little more than two months by January 1948, the second by 15 May and the third by 15 June. On the basis of the results of tests we had given the go-ahead for the tooling-up of the factory to make the coachwork and mechanicals, starting late in January and finishing in August 1948. We beguiled ourselves into thinking we could start mass-production in spring 1949 as the President wished. In the meantime I had designed the stretched version, the "101 L", and its derived models.

In a presidential meeting held on 2 October 1947 we laid down the guidelines to be followed in developing the projects and the "101 E2" project was given the okay. This seems the right place to quote from the minutes of the meeting:

Presidential meeting

2 October 1947 – 18.15 hrs.

Presents: Valletta, Camerana, Bruschi, Genero, Bono, Gajal, Ghiglione, Gabrielli, Giacosa, Maggiore, De Regibus.

Programme studies and experimental automobiles and trucks

Reports on the situation in relation to the following decisions were presented by the Fiat General Management:

1) The dates indicated in the programme for presentation of designs, completion of experimental models and entry into production of the individual models are of fun-

damental importance and not only should be considered binding for all concerned but everything possible should be done to improve on them.
To this end:
a) the work schedules for studies and experiments is to be considered as definitive and the Technical Offices management may not modify them in any way without explicit authorization to be given in a special presidential report;
b) the General Management is to be informed weekly of the progress of work in relation to the programme so as to be able to rectify any delays well on schedule;
c) every two weeks the General Management will report on the development of the work schedule with regard to studies, experimental tests, production forecasts during the presentation of the presidential report.
2) The managements of the Technical Design Division and the Motor Vehicles Technical Offices are requested to devote thorough study to the problem of equipment and accessories which at present take up valuable time and work, unlike the procedure in the United States. This means the experience of other countries should be drawn on as fully as possible, taking out the rights to licenses where necessary and, if need be, purchasing directly abroad those components that cannot be obtained conveniently in Italy, whether for reasons of price or quality.
3) With the aim of intensifying and accelerating the development of new models, the management of the Technical Design Division and the Motor Vehicles Technical Offices together with the General Management must devote thorough study to the problem of the men needed in the Design Department, Experimental Constructions Department, Test Department, and propose transfers and possible additions to individual sectors.

Model "101 E2"
Since particular attention is to be given to the noise-level of the engine, it has been decided to carry out trials with an engine having a cast-iron cylinder block.
At a later stage studies will also be devoted to the possibility of fitting a two litres engine for markets where American competition is particularly strong.

From the minutes it will be seen how the hierarchy of the company was respected on the formal plane. The Technical Design management, meaning Gabrielli, is always referred to in it even though in practice Gabrielli was not involved and only heard about the problems affecting motor vehicle production at the rare meetings he happened to attend.

The engine was built in record time and sent on 2 November to the Test Department for trials on the test bench. It weighed 105 kg, with an aluminium crankcase and its power output was the same as the previous 1.300 cc engine at the same number of revs, even though its capacity was approx. 100 cc smaller. The designs of the chassis were presented to the works on 15 November. Construction of the first experimental model was completed on schedule. The experimental "101 E2" model was ready to start trials by the end of January 1948. But it was not to be plain sailing even this time.

The political and economic situation in Italy was critical and full of hidden perils. Valletta saw the United States as the only possible source of help for the reconstruction of Fiat and the "101" was one of the arguments he was relying on to gain sympathy and backing so that he could get the American banks to grant him the loans needed to build plant.

In short, Valletta wanted the new automobile to appeal to the Americans. In a person-to-person talk I had with him he said that the "101" had to be designed so as to fall in with American taste. "We might have to build it in the United States," he said with his broadly ironical smile, and added some wry comments on the political setup in Italy.

The upshot was that we had to make the cab yet bigger so that three people could sit side by side on the front seat, which was of the bench type as in American models. This was made possible by placing the gear-shift on the steering column.

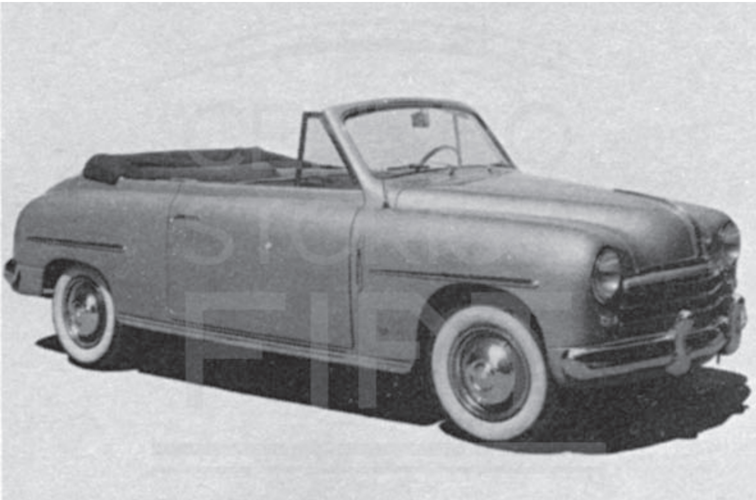
I was not persuaded that the Americans would like the car just because it could seat three in front. Anyway, I had to go back to square one and design a "101 E3". In the meantime relations with the States were being intensified. Chrysler sent its top experts in the export field to Fiat. Thought was given to the possibility of mounting Fiat diesel engines on Dodge trucks and building Fiat autos with Chrysler mechanicals.

Nothing came out of these schemes but the friendly relationship between Fiat and Chrysler continued.

Then a delegation arrived from the Nash company, led by Mr. Mason. A deal was made to work on an automobile to be sold in the United States, to consist of the mechanicals of the *Topolino* and a cheap body designed by Nash: a very original open two-seater, cheap to manufacture. The right and left side doors were to be the same, so one opened frontwards and the other back and the two side panels were completely symmetrical, the front and back being the same shape. Contacts with Nash went on for a while then were dropped.

To me, looking at things from the technical point of view, it all seemed a bit of a muddle. The politico-economic reasons were kept secret by those in the know. Where money was involved the engineers were treated as if they belonged to the caste of the Untouchables.

To make my life more complicated, there was the attitude of Fiat's top management on the occasion of the Geneva Motor Show in March 1948. As a result of the impres-



1440 cabriolet (1950-54). Some examples of this model, fitted with a 1900 engine and mechanical transmission, were supplied to the Highway Police for patrol-work.

sions they had received at the show, Bruschi, Bono, Genero and Gajal got into what appeared to me a quite unreasonable flap and held two long meetings at Geneva on the morning and afternoon of the same clay. They got out a lengthy report in which they listed all the features they thought the "101 E3" ought to have.

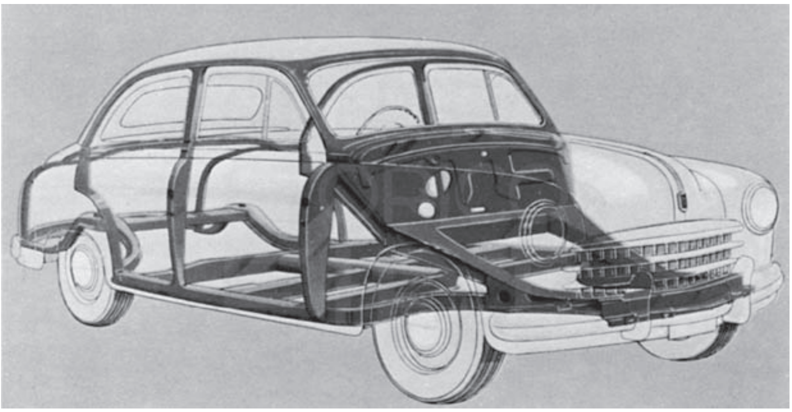
The engine should be increased to 1.298 cc, as close as possible to 1.300 cc without going beyond so as to keep the road tax down, and its output should enable it to do up to 120 km/h. Then it was decided that the "101" should be so designed as to make it possible to derive a six-cylinder narrow V model from it, with the maximum engine capacity compatible with the space available in the engine hood. This limousine was supposed to be turned out at a rate of 7-8.000 units a year.

Then there followed various explanations and instructions concerning the derived models such as the station wagon and taxi. My opinion was accepted with regard to the taxi and station wagon models. As I had often suggested, the extra folding seats were eliminated as was the partition between back and front seats. The minutes of the meeting, which were promptly communicated to me, did not neglect to offer advice about the electrical equipment, heating, inside and outside door handles, steering wheel and so forth.

A few days later I was summoned to another meeting of the same people. The general director explained everything that had been decided at Geneva about the 6-cylinder V model. I returned to my suggestion to consider a four-cylinder two litre engine derived from the "101" or else an eight-cylinder V, which was easier to balance than a six-cylinder V.

It was a particularly trying period for me. I was annoyed at receiving such peremptory instructions. I also feared that the modifications would cause delays to the designs. Breaks in the swing of the work clamped the draughtsmen's enthusiasm. Anyhow, I took the more sensible suggestions into consideration when I was getting out the new design and promised my designers that the "101 E3" would be the final version.

The wheelbase was increased by 15 cm (from 2.500 mm to 2.650), the track by 35 mm (from 1.285 to 1.320), the overall width by 85 mm (from 1.565 to 1.650). I calculated that the weight would reach 990-1.000 kg provided that the crankcase was still made of aluminium alloy. If it was decided to make it of cast iron the weight would go up to 1.020 kg, perhaps more. The engine capacity of 1.300 cc was becoming inadequate.



Explanatory diagram of the structural solutions for the shell of the 1400: the first Fiat with bearing coachwork, i.e. without chassis.

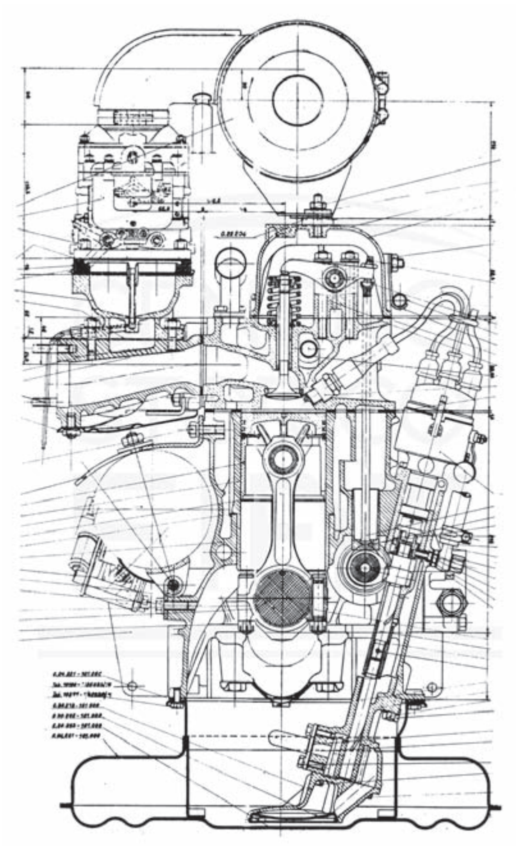
I was troubled by the thought of having to fight to get the engine made bigger. I was also worried about problems involving the rear suspension which had to be adjusted to take the greater weight and wider variations in loading: from one to six people, with their luggage. Another problem was the vibration of the engine and the various components transmitting drive to the wheels. I also had to get used to the idea that the “101”, which I had thought of as a model to take the place of the *1100*, was now intended as a replacement for the *1500* and to become, if need be, a luxury model in the two-litre class.

To avoid doubts about the main features of the automobile I wrote a letter to Bono.

For the attention of the General Management

Model 101 E3

The 101 E3 has been developed in accordance with precise instructions laid down by the President following a study of the 101 E2 which was designed on the basis of the definitive programme of 10 October 1947.
It has been established that the automobile should have seating for six with a width of 1.30 m at shoulder level and an inside length 5 come longer than the 101 E2.
At a second stage (Meeting of the Executive Board 2 February) it was also decided that the engine hood could contain a more powerful engine, preferably a six-cylinder



Cross-section of the 101 A engine for the 1400 A. Drawing dated 4 March 1954.

> one. To attain this goal the wheelbase had to be made 15 cm longer and the overall length increased by 15 cm as compared with the 101 E2.
> Because of the increased loading it is necessary to redesign the rear axle increasing its weight. The vehicle's total weight will be 1.010-1.020 kg, retaining the aluminium crankcase. The result is a vehicle with the same weight as the present 1.500 and with a frontal area which is greater.
> From the viewpoint of space utilization and weight the result is truly remarkable. It has the same space inside as the De Soto with an overall volume that is much less and total weight that is 400 kg lower.
> From the viewpoint of relation between torque and weight the vehicle fails to come up to its competitors in the same class and if the engine capacity is kept down to 1.300 cc as fixed at the meeting in Geneva it will quite certainly be outdone in pickup and "guts" by all the British automobiles of the same engine capacity (e.g. Austin 40) and comparable passenger loading (Vanguard five-seater).
> The 1.300 cc engine was adequate for the 101 E2 whose weight was approximately 900 kg but not for the 101 E3, which should have a 1.500 cc engine.

I consulted my collaborators and decided that the designs of the "101" engine in its final version would be finished by 15 May. The bore of the pistons was fixed definitively at 82 mm, the stroke would be decided once the engine capacity was finalized: I hoped to be able to get it raised to at least 1.500 cc.

The completely new plaster dummy for the model had been almost finished and all the designs had to be in by the end of July. It was 1948 and the absolute deadline for going into production had been fixed at the end of 1949, a date of vital importance for Fiat. This meant we had a year and a half to get out the final designs, build the prototypes, test them and tool up the factories for production. Today an undertaking of this sort would be unthinkable.

The Experimental Workshops would have to work all through the summer holidays to build the three engines of aluminium, one of cast iron and four bodies. The first "103 E3" prototype would have to be completed by October 1948 to make the starting date for production a feasible prospect. When I had got all this organized, not without a struggle, I began the battle over the engine size.

The opponent I had to overcome was the commercial director, Luigi Gajal de la Chenaye. He was a person whom I greatly esteemed and as time passed I came to appreciate his good qualities even more strongly.

He was a typical Piedmontese, a man of few words, speaking his mind concisely, clearly and sincerely. He was tall and lean, upright of carriage. The gaze of his dark eyes was direct and penetrating, with a shrewd intelligence lighting up his smooth features and olive complexion. It was the face of a Spanish hidalgo, occasionally softened by a flickering smile. His personality aroused a certain awe.

He insisted that 1.300 cc was the maximum limit because it was essential to keep the road tax down and because he thought it would mean lower consumption. We had a long discussion about it in his office. After explaining why 1.600 cc was the most suitable size I said I was willing to consider 1.500 cc which would be acceptable but only just adequate. He tried to bring me round to his point of view, even going so far as to try flattery, saying I was capable of designing a 1.300 cc engine better than any in the past that would still turn out the speed and acceleration aimed at. I tried in vain to make him understand that power output was one thing and torque another. In the end we had to compromise, both dissatisfied, and agreed to fix it at 1.400 cc.

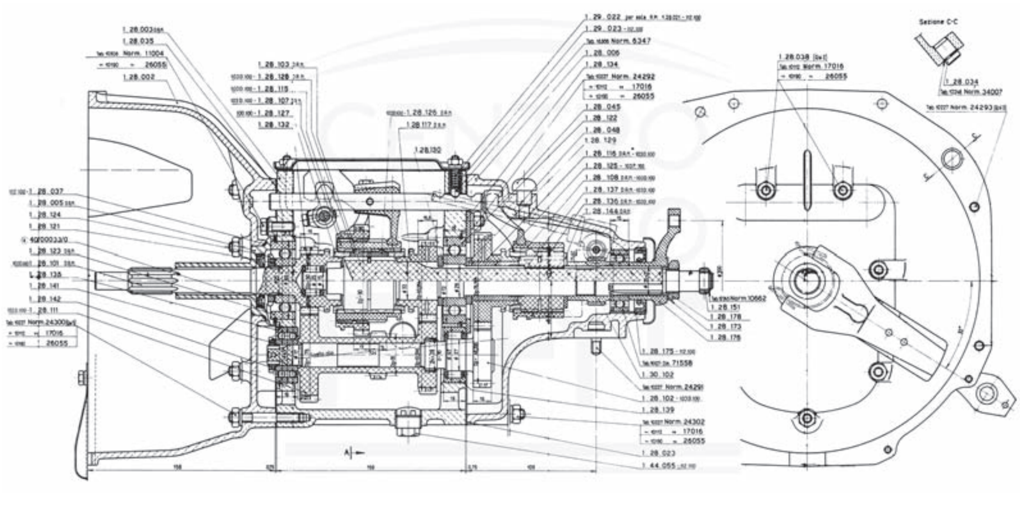
The designs for the "101 E3" engine with a diameter of 82 mm and stroke of 66 mm, were sent to the factory on 15 May, on schedule. The engine would supposedly be ready for testing by 15 August.

I still was not easy in my mind. I wrote another letter, addressing it to Valletta, Bono, Gajal – who had then been appointed co-director general – and Armando Fiorelli, director of the Automobile Section (at that time he had the title of cavaliere, not having yet been dubbed commendatore nor given his doctorate in Engineering *honoris causa*).

I gave a brief outline of the ups and downs of the "101" project, said that the weight of the vehicle would be not less than 1.040 kg and that the 1.400 cc engine would consequently prove inadequate, especially if the crankcase was made of iron, which would add 20 kg to the weight. As for the derived model, which was supposed to have an engine of 1.800-2.000 cc, I brought out exact figures to show the advantages of shelving the idea of the six-cylinder V engine and sticking to the four-cylinder derived from the "101", with modifications to the crankcase, a new crankshaft, new rods and various secondary changes.

An engine of this sort would have been interchangeable with the "101" and the auto would have been able to compete with foreign makes of the same class. The engine could also be used for the light two-ton utility truck, for the reconnaissance vehicle required by the military authorities and for various uses in agricultural equipment. Fiat would save a lot in investments and it would help bring down the cost of the automobile quite markedly.

To overcome the vibration problem I suggested that the two litre engine should be fitted with a hydraulic joint or a special flywheel with pendular masses then being studied.



Cross-section of the 101 B gearbox adopted on the 1400 B and on some autos of the 1900 B model.

I emphasized the advantages of keeping the aluminium crankcase, including the fact that it helped balance the distribution of weight on the wheels. I thought it would be acceptable if the casing of the conical gearing of the rear axle and the gearbox housing were made of cast iron. I enclosed with the letter a documented memo on the weights involved and a thorough economic breakdown of the construction of the engine.

The matter of the aluminium crankcase remained undecided for some months, then manufacturing factors decided the issue and it was decided that the *1400* engine would have an iron crankcase. This decision turned out to be wise in the long run.

My suggestion for a *1900* engine derived from the *1400* was approved and enabled the various *1900* models to be built as well as the *Campagnola* and the light *615* lorry. The same engine was further transformed into a diesel and put into production in 1953. I also had the eight-cylinder engine designed: Gajal had wanted it to power a luxury automobile but in the end it was used for the *8V* sports car.

Perfecting the "101 E3" was fairly laborious work despite the experience gained previously with the "101 E1" and "101 E2". We ran into a lot of difficulty with the vibration problem and trying to discover how to get rid of it. The absence of chassis made it hard to stop or reduce the transmission of noise and vibration to the inside of the cab. The new rear suspension caused the axle to jolt about over bumpy surfaces and when the brakes were jammed on hard on asphalt. We were able in the end to make the defect almost imperceptible. To screen out the vibrations we fitted rubber inserts wherever possible, even between the sections of the steering mechanism. Inside the transmission shaft, which is usually just a rigid tube, I had a thin shaft inserted which absorbed the torsional vibrations from the engine as it spun round.

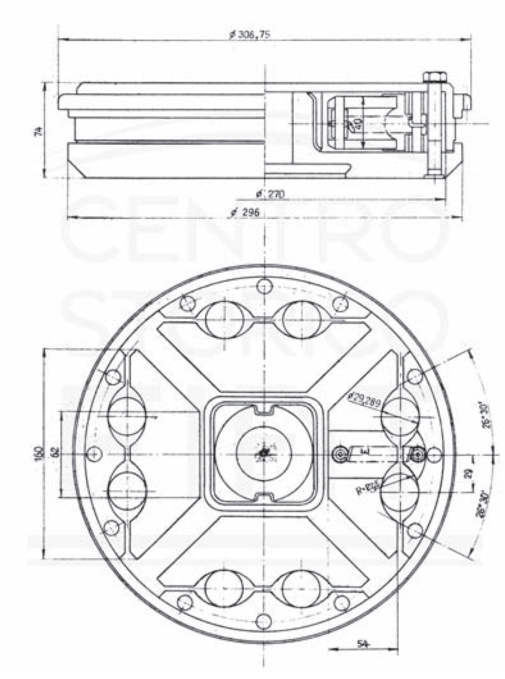
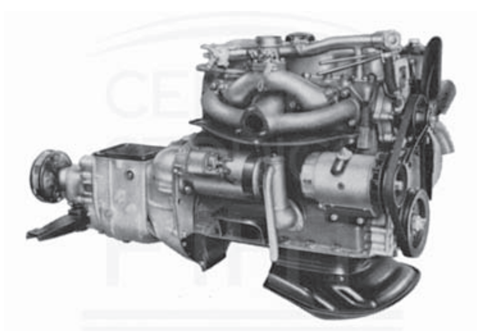


Diagram of the pendulum damper studied to reduce vibrations of the 105 engine for the 1900 auto. The vehicle was finally produced with a hydraulic joint (torque convertor) placed between engine and gearbox in the clutch position.



The diesel engine of the 1400 D (1953-56).

The dedicated work of Salamano, Montabone, Montanari, Bellicardi, Mosso, Villata and Nutarelli, together with everyone else who collaborated round the drawing boards, in the test rooms, in the workshop, all contributed to the solution of numerous problems. The vehicle's steering, road holding and braking were gradually perfected, noise levels were reduced. The result was eventually a good quality vehicle, easy to drive and safe.

Salamano had played an important, even decisive part. Strong, fearless, intelligent, simple yet shrewd, he had a sensitive nature but a tough character, as hard on himself as he was on his collaborators and subordinates. He never stopped learning and improving as director of vehicle testing.

During trials he never shrank from a dangerous manoeuvre to test the reliability of every component of the automobile yet his driving was always careful and deliberate, especially in traffic. His wrists of steel, the quickness of his reflexes, his outstanding skill as a driver, courage and above all his invincible tenacity in getting right to the bottom of things – whether he was investigating steering, cornering, the vehicle's behaviour when it was made to veer sharply out of control, brakes, suspension, noise-levels, the response of the engine in the most unpredictable situations – had all become a legend even among his fellow workers and subordinates. From the people he worked with he expected whole-hearted dedication to the work and set the example himself. He treated them with a good-natured roughness reminiscent of a sergeant-major and they liked and admired him, even modelling themselves on him.

Quite often he would want to hear my opinion before expressing his own view, especially if there was some difficult problem, and would get me to try out the car. After explaining how I was supposed to drive it he would make me repeat the manoeuvre until the effect we had to check showed itself. Whenever I got into trouble he would burst out into hearty guffaws, especially if I looked scared.

Our relationship was marked by a sincere, mutual respect and liking. Our long debates were playful in tone, which prevented them from degenerating into pointless wrangling and provided a great deal of amusement to listeners and not least ourselves. All the same, they helped us to get to grips with the problems and work out solutions. We nearly always got positive results this way though occasionally we had to settle for a compromise. At bottom it was usually me who was hypercritical and the less satisfied of the two, haunted by the fear that I had missed the best solution while he had no misgivings.

Carlo Salamano was an important and representative character. He considered himself the first champion of Fiat's technical prestige. He never permitted doubts of his judgment because it was the judgment of Fiat itself.

The vehicles reflected his personality as if they were children whom he had brought up so that they absorbed his character, the good and the bad in it: basically sturdy and great-hearted even if lacking in refinement. In fact he never bothered much about appearances, especially the inside of the automobile. Safety and functional qualities were his main concern.

If Salamano could be blamed for anything it was his deep-seated aversion to front-wheel drive. As the years passed he managed to overcome this sufficiently to help us in the construction of the *Primula*. But that was when he was seventy years old.

It was decided to commission the Budd company to produce the dies for the bodies. Agreements were made to have the designs of the body shell revised by Budd in order to adapt them to the American system of manufacture. All measurements had to be given in inches and fractions of inches, a laborious and boring task for our office. At this point Giuseppe Alberti, the very competent head of our Coachwork Division, who had been working flat-out on the construction of the plaster dummy model and the design of the coachwork, was sent off to Detroit to help in completely revising the designs to facilitate the pressing of sections and welding of parts by the most modern systems. Alberti won the admiration and well-earned praise of our friends at Budd.

For the construction of plant and machinery needed for series production about a year was necessary. In this time various alterations were made to the model. It was a year of strenuous work for the technicians in the workshop because the Design Office kept asking for improvements to be made that had been suggested in the course of testing. The workshop always protested at these requests because they often involved variations in the equipment and so notable delays and increased costs. Sometimes big changes were involved and these would be discussed at meetings in the presence of the General Management, which would judge and decide. Nevertheless production began early in 1950, only slightly behind schedule.

The *1400* was presented at the 1950 Geneva Motor Show and was a great success. The French *Auto Journal*, known for the severity of its judgments, dubbed it the "European Automobile".

The silence and smoothness of the engine, excellent road holding, safe and pleasant handling and comfort were all qualities that placed the *1100* on a plane well above other European makes of the same engine size and this was acknowledged by everyone. The newspapers were enthusiastic in their comments, fully rewarding the efforts of my fellow-workers and those in charge of production.

In a radio interview I said that one of the features of the *1400* was that it was "big inside and small outside", a phrase that was taken up and used for utility models in later years.

The *1400* was the first Fiat automobile to put into series production with a bearing bodywork and showed how a rugged and noiseless car could be mass-produced cheaply even without a chassis.

Carlo Salamano surrounded by a crowd of curious onlookers during the presentation of the turbine auto (spring 1954).

I had begun my campaign for bearing coachwork with the design for the "700" in 1936, when Lancia had been building models without chassis for years, and only managed to see the concept accepted for production in 1950. This shows just how doggedly Fiat stuck to its traditions and also the fear of making mistakes displayed by the decision-makers.

The history of the *1400* is closely bound up with the *1900* that was derived from it.

The *1400* was the first engine to be markedly subsquare. I had tested 1.600 cc and 1.750 cc engines based on the *1400* and got excellent results but my suggestion for a two-litre automobile to be produced by simply increasing the cylinder capacity of the *1400* engine and modifying the *1400* automobile in some features of its mechanicals and coachwork clashed with Gajal's attitude.

Gajal acted as the spokesman for the aims of the sales organization and was able and energetic in putting forward his views, which were not necessarily the same as those of the engineers and production chiefs and often led to conflict with them. He had not given up the idea of a model perhaps derived from the *1400* but fitted with a six or eight cylinder engine.

I knew that the works would be against a V engine, with its cylinders aligned in two rows, because it would involve costly equipment and especially skilled labour. At the same time I was attracted by the idea of designing such an engine and so in addition to the designs I had already got out for a four-cylinder *1900,* based on the *1400*, I had some drawings made of six and eight cylinder jobs of about 2.000 cc.

I discarded the six-cylinder in-line engine as too long, the six-cylinder V because not perfectly balanced and finally the eight-cylinder V set at 90° because it was too wide. Then I started studies for a narrower V8, which while not perfectly balanced has the advantage of being extremely compact and enabling a crankshaft to be used that is easy to manufacture. To these evident reasons were added other subtler considerations involving engineering and production factors leading me to choose a narrow V with an angle of 70°. This study was the basis for the *8V* sports car which I shall discuss later on.

The *1900* engine, designated the "105", was soon designed and built. The increase from 1.400 to 1.900 cc was simply achieved by increasing the stroke, involving a new crankshaft, a slight increase in the height of the crankcase and other slight modifications. The cost of alterations to the machinery already built for the production of the "101" engine would be minimal, much less than for a completely new engine. But some solution had to be found to the problem of vibration, which would increase with the adoption of a bigger engine.

At that time we did not know how this could be solved by a carefully gauged degree of elasticity in the suspension. The problem was aggravated by the fact that the engine would be supported directly by the coachwork.

Salamano had become extremely fussy about the degree of vibration after his experience of the smoothness of American autos, and in his usual way wildly exaggerated the shuddering set up in the coachwork by the engine. Since all attempts to cushion the engine with elastic supports was of no avail, we thought of modifying the drive transmission to screen the vibrations or transform them into smaller ones on different frequencies. We had two ways open to us.

The first was the easier: it meant putting a hydraulic joint between the engine and the clutch. The second was more difficult: to fit a pendular flywheel to the engine.

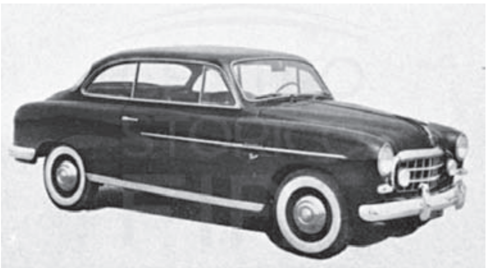
This was a concept difficult to translate into design and production. It meant devising the flywheel so as to transform the impulses coming from the cylinders into smaller ones at higher frequency so that they would easily be absorbed by the elastic supports of the engine-gearbox unit. And the result would have to be comparable to the output of an eight-cylinder engine with the same total capacity.

The engineers Oscar Montabone and Vittorio Montanari, who took the problem in hand, achieved the desired results after doing a brilliant job of calculation and experimentation. The sflywheel had weights attached to it that moved to and fro like a pendulum according to a prearranged motion, transmitting the twisting movement with rhythmical variations that could easily be controlled. But we worried about the durability of the device and lacked time to carry out sufficiently long tests so we decided to give up this new and ingenious solution. In consequence, the *1900* was fitted with the hydraulic joint as mentioned above.

The *1400* and *1900* evolved through the years and required continuous work on the machinery as well as the bodywork. The first successor to the *1400* was the *1400 A* followed by the *1400 B*, while the *1900* was succeeded by the *1900 A* and *1900 B*. Then there were the cabriolet versions of the *1400* and *1900*, and the *1900 Gran Luce* and the *1900 A* and *B Gran Luce*. Finally there was the *1400 D* with the *1900* engine transformed into a diesel.

The *1900* engine in its gasoline and diesel versions was fitted to the *Campagnola* and light commercial vehicles: the *615* and derived models. Its working life was a long one. In 1976 it was still being mounted on the *237* light truck. The same holds true for the *1400* gearbox which still seems to me one of the simplest and most up to date in design.

Standard 1900 sedan (1952).



Two-door 1900 Gran Luce limousine.

CHAPTER XI

THE “103” PROJECT LEADING TO THE *NUOVA 1100*

THE PERIOD 1946-51

At the presidential committee meeting held on 29 October 1946 I was called on to set out my ideas concerning the small automobile, the future of the *500* and another automobile in the class immediately above it. So I mentioned the studies and projects worked on during the war, winding up with some consideration of the recent developments in France. The final decision (as I have already mentioned) was to build three prototypes by the end of 1949: two with front-wheel drive the same size as the “Grégoire”, one having two opposed cylinders and air-cooling, the second with a four-cylinder water-cooled engine, while the third was to have conventional rear-drive like the “700”. The two front-drive models were called the “102 E1” and “102 E2” and the third the “103”.

The designation “103” was therefore used for the first time in 1946 to indicate an experimental utility model with rear drive and the engine in the front, seating four and weighing 650 kg. The engine was a 750 cc four-cylinder job, water-cooled and turning out 22 hp (15.6 kW), mid-way between the *500* and the *1100*.

I immediately started studies of the coachwork and construction of the full-scale plaster dummies. From then on the skilful designers and plaster-workers in the models shop were almost continuously at work on mock-ups of the three models, varying their dimensions and styling to keep step with the evolution of our ideas and programmes in tune with market developments, technical innovations and fashion.

Standard 1100/103 sedan (1953-56).

A year later, in October 1947, the construction of the "102 El" prototype was practically complete. The "102 E2" engine was on the test bench but the vehicle would only be ready by late January 1949. For the "103" I did no more than to have the designs of the vehicle as a whole and of some of the mechanicals worked out and compared. I foresaw that the prototype could not be built before 31 July 1949. Eight or nine months were needed.

The design and construction of an engine could be completed in a fairly short time, much less than the time taken to build the coachwork. This meant that in a span of five or six months a number of engines of different types could be built while the same period was only just enough to do the designs of the chassis and coachwork.

Work went ahead on the "103" without too many interruptions. Using plaster mock-ups, I experimented with new forms in a search for simple and functional solutions to produce an attractive line. Alberti, as skilful as ever, and the head modeller Carusio threw themselves into the work, displaying all their experience and flair. My judgment provided a stimulus for progressive improvements. I also had some studies done for the mechanical components. But the feverish activity imposed by the crash programme forced us to break off these studies from time to time because we had to attend to the development of industrial vehicles as well. As a result the project began to fall behind schedule. We were up to our necks in work: Valletta never let slip an opportunity to take on more work at Fiat. Early in 1949, for instance, there was a prospect of supplying Argentina with 2.300 buses and he decided that Fiat would tackle the job. After a meeting which he presided over, enlivened by the presence of the sales management, he issued his decisions in the form of an injunction addressed to me and the other executives concerned. Since one of the conditions of the tender for Argentina was that the engine should be at the rear, like most American buses, he gave his approval for the purchase of a Mack bus to serve as an example as I had suggested. In his communiqué he ordered:

> The management of the Industrial Vehicles Department will set up an office immediately to study the mechanicals and coachwork of motor vehicles for public transport, providing the necessary managerial and executive technical staff according to the decisions taken by Giacosa and Russolo today [which was 18 January 1949]. The office will draw on its knowledge of what has already been produced in this field and seek the assistance of the General Management in finding and procuring whatever material may be necessary to speed up studies, obtainable from Italian or foreign companies. It will complete the project for an urban transport vehicle, making use of the mechanicals already in existence for the *640* and *680*. The studies will be carried out by the Experimental Constructions Service of the Automobile Section at absolute top speed, so that within six months of the present date the chassis will be ready for road tests etc.

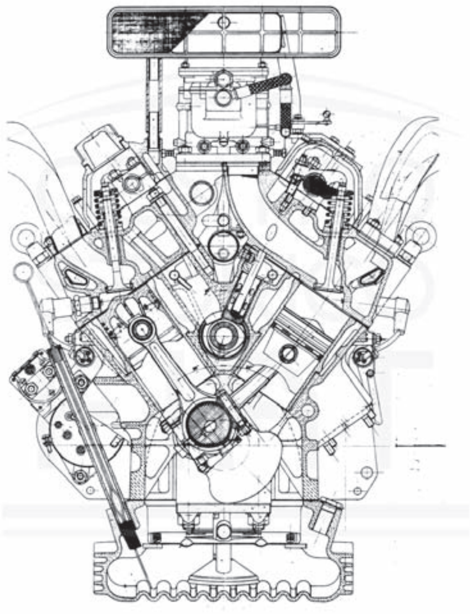
The Mack bus with its transverse rear engine was procured. It was an example of advanced construction but not too far ahead of the European technology of the day. The technique of building buses in the USA was extremely refined, aeronautical in inspiration, while in Europe and especially Italy it was crudely derived from motor trucks. In my opinion European buses still have not reached the constructional perfection of American buses of those days although immense strides have been taken in comfort and elegance.

The Argentinean contract came to nothing in the end because of changes in that country's government. Valletta's decision at least served to produce a modern bus and make some rapid progress in our knowledge of that particular technology.

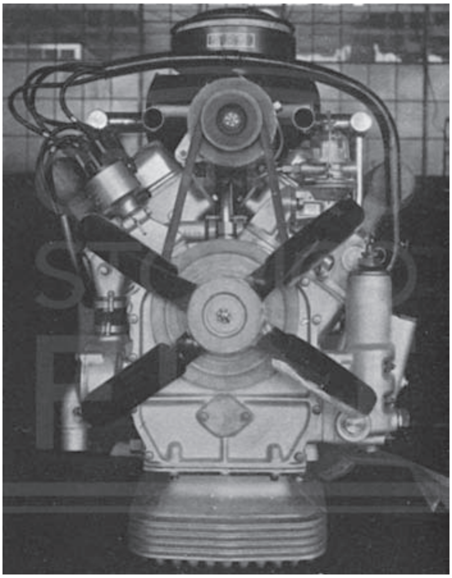
In the same period a development programme of the Simca *Huit*, a faithful reproduction of the *508 C*, was carried out with the Simca company. With Pigozzi and his French collaborators, Dumas, Bergeret and Niellou, we decided on the changes to be introduced in the short term. In 1949 the engine was to be enlarged, the gear shift would be placed on the steering column according to the fashion of the time (it had already been introduced on the standard production model of the *1100*) and changes would be made to the front and rear of the coachwork. In 1950 the coachwork would be completely redesigned and the chassis revised.

In March Gajal told me that a contract had been drawn up with the Instituto Nacional de Industria (INI) to build an automobile factory in Spain and manufacture Fiat models there. It had been decided to present the leaders of the Spanish government with the new "101" and a *640 N* truck. From that moment we were involved in a new work which began with the construction of the SEAT factory in Barcelona and is still going on today.

After the negotiations with Chrysler and Nash, the Willis Overland company came on the scene. Like Nash they were interested in manufacturing a small auto for the USA. They proposed building the *1400* in the States and fitting it with the power plant and transmission of their jeep. This scheme was also stillborn because there were too many problems to solve, much more difficult than the mere technical ones. The same considerations put paid to an agreement with Freuhauf, the big American



Transverse section of the 104.004 engine in the version that powered the 8V competition model (1952-54).



In the version designed a tourer and for use as a company auto, which the commercial management wanted to be the basis for a prestige model, the 8V engine differed externally in such auxiliary attachments as the larger air filter for quieter air intake.

road haulage company, which was hoping to get OM and Fiat to build its trucks and semi-trailers at lower prices than in America.

The way that incidents like these kept cropping up and interfering in the work was a great hindrance to all of us as we worked towards the imminent launching of the *1400*. It was immensely important, involving production of a model completely unlike the ones built by Fiat until that time, a hazardous undertaking after the long period of stasis during the war.

As the first automobile for whose design I was wholly responsible, it haunted me with ill-concealed misgivings. On the eve of its commercial launch we had to turn out technical data for an astonishing number of people and I got caught up in the production of blurb and fact-sheets for the sales drive being run by Gino Pestelli and his brilliant and dynamic collaborator Maria Rubiolo.

Despite all this the office went ahead rapidly with its work and I was able to develop other projects which were barely mentioned during the presidential meetings. These included the *8V* and the *Campagnola*. The V engine had the designation "104". The idea of mounting it on a sports car for a small production run was attractive and aroused the keenest interest among the design engineers. It also appealed to Gajal, which encouraged me to go ahead with the idea.

The designs for the engines were completed in January 1950 and were immediately followed up by those for the chassis. The actual chassis itself consisted of two tubular spars running lengthwise and joined together by cross-spars to which was welded the bottom of the coachwork. The project was designated the "106" but the automobile was eventually known as the *8V* like the engine. So far it had not been decided where to build it, the decision being held over until the tests had been successfully completed.

I had other matters to occupy my mind. I was afraid that in the race for progress that had been speeded up by the new wartime technologies we might well have been overtaken by others. I always remembered what had happened to piston engines in aviation, suddenly superseded by jets. So I had a talk with Bellicardi, head of the estimates office and as reliable and capable as ever, telling him of my intention of studying a turbine for automobiles as Rover had done in England. He would have to mug up the theory of it with the help of his ablest assistants. This was the start of the turbine-powered auto, whose history is intertwined with the *8V* since, as we shall see, the two vehicles shared the same suspension braking and other systems.

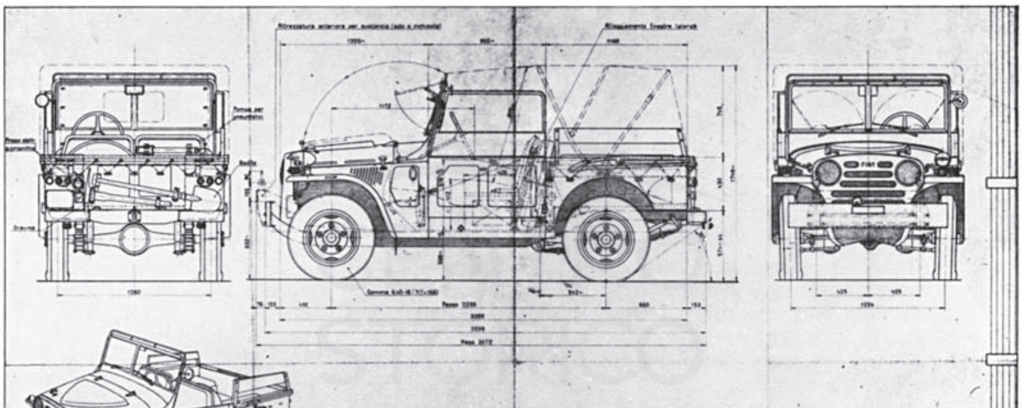
The Military Authorities, as the top-ranking officers in the Vehicles Division of the Defence Ministry were referred to, were following the latest developments in the

Carlo Salamano at a ford, testing a prototype of the Campagnola still fitted with a sloping engine-hood that was later redesigned.

field of transport; they wanted our opinion on ways to replace the outdated *508 CM* and *2800 M* military vehicles, derived from the corresponding standard production models with modifications to adapt them to rough terrain and different coachwork. I was ready for this question as some time previously I had started studies of four-wheel drive vehicles conceived so as to make use of mechanicals from standard production models as far as possible. Since the *1400* was already being mass-produced it was logical to consider making use of the *1900* engine based on the *1400*. I had a chassis designed and added the *1900* engine, the front suspension of the *1100*, the gearbox of the *1400/1900* with the addition of a newly designed reducer equipped with drive-transfer to the front wheels and axles derived from the *1400/1900*.

General Saroldi, director of the Military Vehicles Department, came to Turin and in off-the-record talks mentioned that the Defence Ministry was thinking of an Italian-made jeep. When he heard of the project we were at work on he expressed satisfaction since it corresponded fairly closely to the military specifications.

The project, designated the "1101", was completed rapidly by a few capable designers. I felt there was some risk, with the political troubles of the time, that the factory-hands might resist the construction of a military vehicle so I advised the draughtsmen to refer to it as an agricultural vehicle. There was a song much in vogue at the time that went, "Oh campagnola bella..." ("Oh pretty country girl...") so I said: "We'll call it *Campagnola* not jeep." I was deeply involved in this project. I thought the idea of doors that folded right the way back towards the rear was a



Assembly drawing of the "1101 B" military tourer, one of the most recent versions of the Campagnola. Drawing dated 6 May 1960.

good one. The designs were handed in to the machine shop for the prototype to be built early in March 1950.

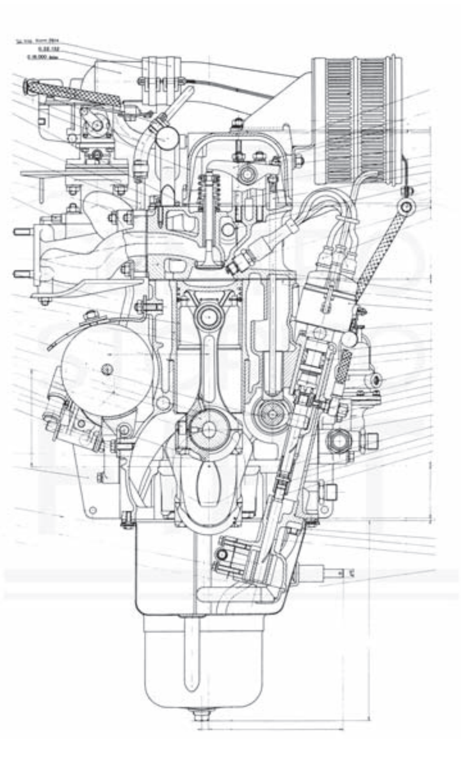
To perfect the steering and check the ruggedness and durability of the universals on the front wheels Salamano had trials done on the sandy banks of the Po. He told the test drivers to do figure eights at full lock on the sand and to change over from each other, two hours in one direction and two in the other, going on in reduced first gear day and night without stopping until breakdown point was reached. There was no equipment in our workshop capable of simulating conditions of this sort.

The *Campagnola* eventually came out regularly in 1951, two years after the start of the project.

Without a moment's respire we went on simultaneously with studies for the "103". By building further models we modified the form and style, while the dimensions were also varied until they matched the size of the cab of the *1100*. After a series of changes involving discussions with the General Management the "103" became closer in its general appearance to the *1100* than the *500*. For the time the project was being developed using an engine of approximately 950 cc.

Lightness was the basic factor. The structure had to yield a power-weight ratio at least equal to the *1100*, which my calculations suggested could be achieved through use of bearing coachwork.

Trials to display the performance of the Campagnola in its final version (1951).



Cross-section of the 105.007 engine which powered the first series of the Campagnola (civilian model) and the military AR 51 torpedo tourer.

Particular effort, involving many designs, went into the wear resistance and mounting of the mechanicals, power plant, steering, suspension and the rest of the vehicle.

The design never seemed simple enough to me: I kept working on it to adapt the structure, composed of a few easily manufactured items, to a simple and rapid system of assembling the mechanicals. Simplicity means safety. It makes it easier to do a good job and cuts manufacturing costs.

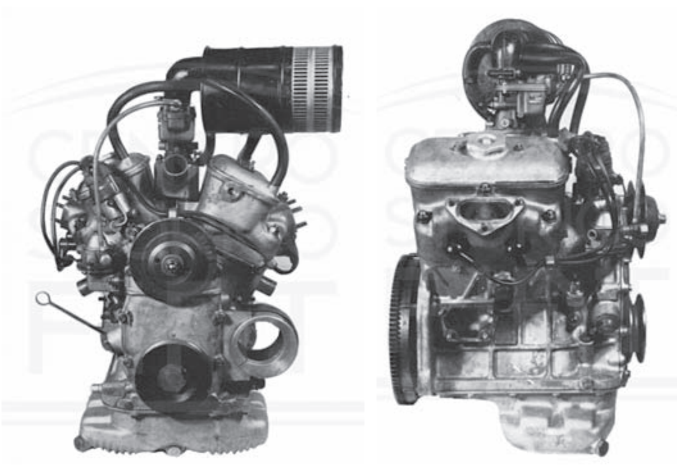
The "103" was finally to cost much less than the *1100*. The factory made its contribution with modern production methods but it was also the technical office's task to produce a design enabling such methods to be introduced as cheaply as possible while improving the quality.

While Alberti was in the United States with the Budd Company working on the presses for the *1400* I kept modifying the plaster mock-ups to adapt the styling to the structure of the body, trying to simplify it still further. The body shell was reduced to no more than a few large panels, one for each side. On Alberti's return, however, it was necessary to make some alterations to allow for the instructions provided by Budd.

We were still in January 1950 when the designs of a 620 cc engine for the "102 E3" were finished, followed in February by designs for a 980 cc engine similar to the *1100 B*, intended for the "103". For the small auto, the "100", I was having various designs done with four and two cylinder engines of 450-500 cc, both water and air cooled.

Nothing was said about the "103". But I rightly thought that the *1100* would eventually become outdated and have to be replaced by a new model, which would be more urgent than the intermediate 900-1.000 cc auto. So I envisaged the "103" as a possible substitute for the *1100*.

With this in mind I had a four-cylinder V engine designed with the idea of planning a front-driven version together with a traditional model. The highly compact engine was in fact suited to front wheel drive. My schedule was to pass all the designs, including the coachwork designs, to the workshop by the end of November. In the meantime we gave the workshop the designs for the "102 E3" (weight envisaged at 620-640 kg), for which two engines were to be tried out: the 614 cc "102 E3" and the 680 cc "102 E4".



View of front and right-hand side of the "103 E5" engine with a capacity of 944 cc. This was one of the solutions envisaged for the future 1100/103, when it was still considered that its engine should be kept to under 1 litre. The intention was to use this engine with front-wheel drive. It was then Ford Germany that brought out an auto of this type (the Taunus 12M) with a design by Raviolo, then chief engineer with Ford in Britain.

At the same time various engines were being tested on the bench, including the "105"-*1900* derived from the *1400* and the "104", the *8V*. To increase the output, attempts were made to boost the compression ratio (despite the low octane rating of fuel in those days) by varying the shape of the combustion chamber. We worked on the valves and the shape of the cams to increase the number of revs but we came up against the limits of the crankshaft bearings. To try to raise these limits, we urged firms specializing in manufacturing bearings to improve their anti-frictional materials. We tried out bearings coated with copper and lead alloys, aluminium alloys and so on. We discovered some benefits to be gained by finer oil filtering and additives to the oils themselves. The technical office and the experimental services worked together to improve engines in the design of their components, the materials used in construction and all the factors that affected their workings.

I was so caught up in this wide-ranging and many-sided activity that it was sometimes difficult to keep the President and the General Management in the picture. The sales management knew little about the work of the technical offices because it was generally informed of developments by Gajal through his close contact with Bono. Bono's attitude was that the Design Department ought not to be influenced by those in charge of the commercial side except through his intervention. It was only in the field of public transport and military vehicles that he had authorized me to have

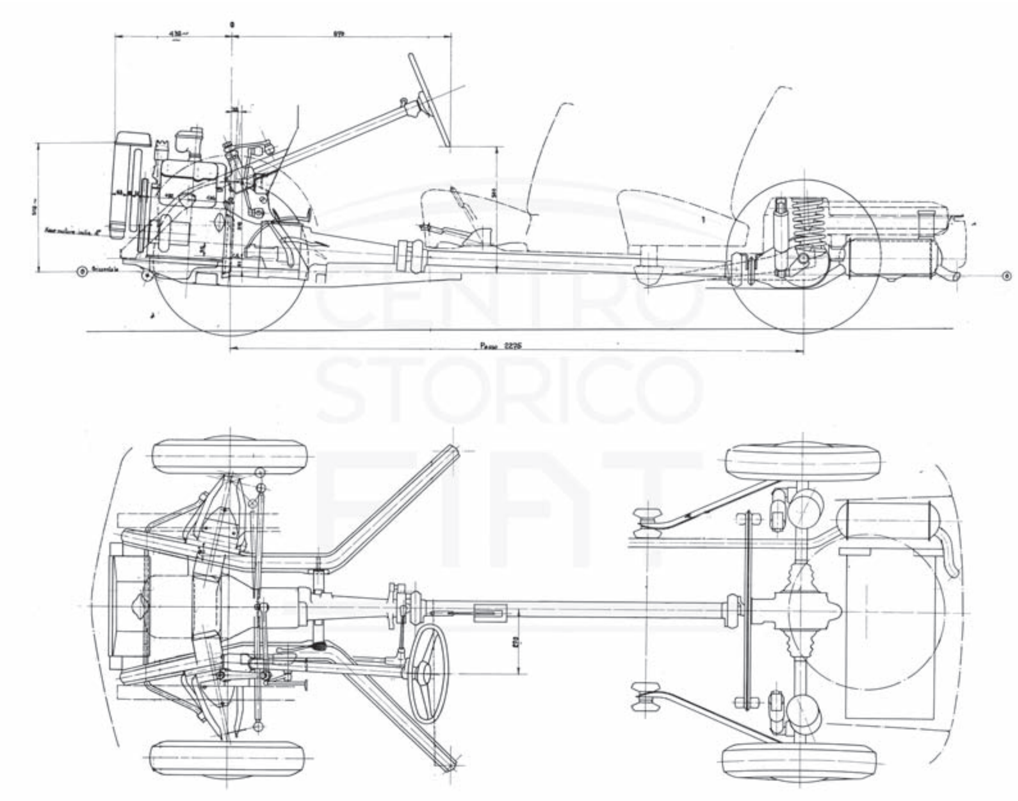


Diagram of the "103 E3" chassis with V engine, front drive and independent suspension on all four wheels. Part of the preliminary design studies for the 1100/103.

direct contacts with the parties involved, with the assistance of two engineers, one of whom was delegated to negotiate with the Ministry of Transport and the other with the Defence Ministry.

Bono must have been afraid that the design section was going to stray from the guidelines he had laid down for it or perhaps he simply wanted to take stock of the situation, so he wrote me a letter that was "strictly confidential":

> Recapitulating the instructions with which you are to comply in the pursuance of the work of design and experimentation… It is urgently necessary to complete as soon as possible the design and construction of experimental models for each of the two arrangements as follows:
> 1) *light* (635/650 kg) using the gearbox and (reinforced) axle from the *500* and its own engine (750 cc).
> 2) *medium* (approx. 730 kg) with capacity equal or slightly superior to the *1100*, engine of approx. 970 cc obtained by reducing the stroke of the present *1100*, maximum speed approx. 110 km/h and consumption not more than 6,5 litres per 100 km; gearbox 1100 E-1400 at least initially.

This was followed by suggestions for the smaller vehicle the *500 C*: "Reduce weight and cost, improve accommodation at the back, improve mechanicals." And so forth.

I interpreted the letter as a signal to proceed immediately to the final design of the small car, choosing between the numerous designs under the designations "102" and "100" and to complete the "103" project, which represented the medium-sized automobile to replace the *1100*. So it was time to call a halt and choose solutions that would meet the wishes of the General Management. It suited me, too, to get down to business. As I had envisaged, the "103" took precedence over everything else, being chosen to replace the *1100* as soon as possible.

As the 1951 summer holidays drew nearer I made a survey of the situation. I gave up the idea of the boxer engine so it was a question of choosing finally between the various in-line arrangements and the V engine. Two four-cylinder in-line engines had been built and tested. The engine capacity was about 1.000 cc but it would not be difficult to increase it.

As for the vehicle, a prototype had been built with inside dimensions the same as the *1100* in length and a few centimetres wider.

The coachwork was very light and the vehicle weighed a mere 740 kg as compared with the 890 kg of the *1100 E*. The clutch and gearbox were taken over from the *1100 E*, the steering from the *1100*, the front suspension had a new design on a quadrilateral arrangement. The rear suspension was independent for each wheel, of the swinging half-axle type as used by Volkswagen. The road trials had shown that while suspension and road holding along the straights were excellent the same defects appeared in cornering as with the Volkswagen. On corners taken at high speed the car leaned over dangerously, tending to overturn. To offset this the roll-centre had to be lowered.

After going thoroughly into the problem and designing other types of independent suspension we decided to avoid complicated arrangements unsuited to an inexpensive model and adopt a normal axle with suspension similar to that on the *1400*. But to maintain its roominess inside we had to lengthen the wheelbase by 5 cm.

The President asked us to alter the two front seats into a single bench seat and to make some changes to the rear of the coachwork. This brought the weight up to 800 kg. I had another look at the front-wheel drive version: I calculated we could save about 60 kg by fitting the 4V engine together with an aluminium crankcase.

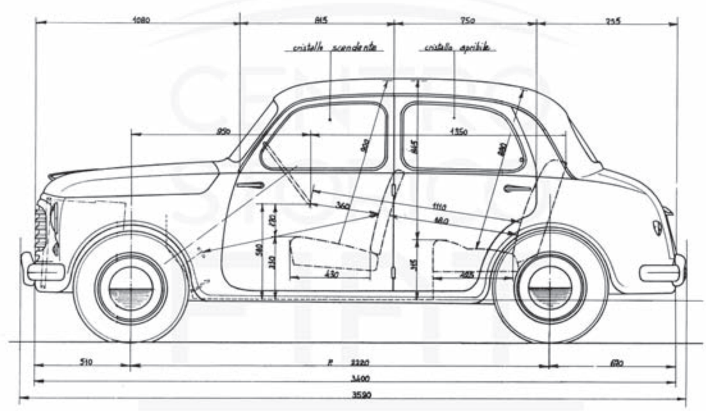
At the end of July the presidential committee met (comprising Valletta, Bono, Gajal, Camillo Ghiglione, Gabrielli, Giacosa, Franco De Regibus) and I gave a full and detailed survey of the situation. The weight of 800 kg for the "103 E2" was judged too great. Reference was made once more to the "102", weighing only 660 kg, "not with the intention of adopting it," as De Regibus specified in the minutes, "but to decide whether it was not possible to hit on an intermediate solution, lighter than the '103 E2' without reducing the spaciousness or the class of the vehicle". I sketched out the possibility of adopting front-wheel drive and explained the merits of the system.

> The general manager insists on the need to keep the overall weight down to not more than 750 kg and the President points out that the solutions basically come down to these two:
> a) to make use as far as possible of the mechanicals of the *1100* to produce an orthodox automobile with mechanicals weighing 382 kg and coachwork weighing 363, a total of 745 kg excluding the spare wheel and heater.

(Valletta knew that the total weight would actually be at least 800 kg but did not want to contradict Bono)

> b) to build a front-wheel drive vehicle with a 4V aluminium engine weighing 716 kg (mechanicals 353 and coachwork 363) which could be increased to 745 to provide more room inside and general alterations to the coachwork.
>
> It should be considered that despite the fact that the vehicle described in b) has been to a large extent designed already and despite the experience already gained by Fiat in the field of front-wheel drive

(this was put in out of consideration for statements made by me during the discussion)

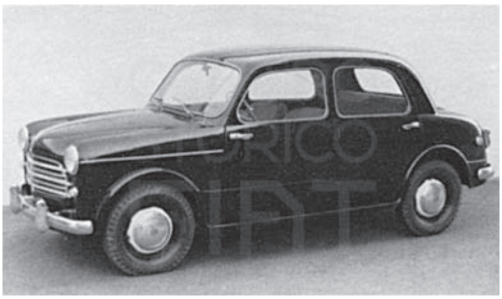


Preliminary study for the "102" sedan with "102 E5" engine and stretched wheelbase. One of the first indications of the styling trend was finally embodied in the 1100/103. Drawing dated 4 January 1951 (the 1100/103 was presented in 1953).

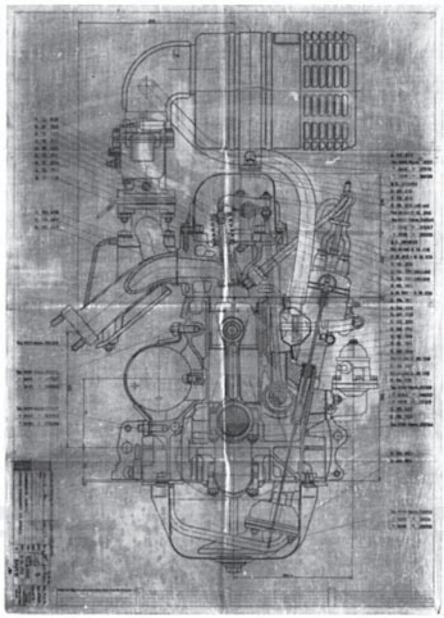
this vehicle would still involve a great deal of work in designing, testing and tooling-up, leading to a long delay before it could be put into standard production. For this reason it is decided to opt firmly for the orthodox type of automobile.

The minutes of the meeting went on to give a precise list of the features of the auto, substantially those of the "103 E2". To cut down on weight I was allowed to make it slightly smaller and to put two separate seats in front instead of the bench seat. The weight had to be kept within the limit of 772 kg. Gajal requested that the auto should be designed so as to provide us with two versions. One would be an economical model (one tone paintwork, bare minimum of instruments on the dashboard, utility seats), the other a deluxe model to be sold at 80/100.000 lire more. The meeting continued the next day but as there were still outstanding issues to deal with it was resumed a week later and went on all day.

The work schedule of the technical offices for autos and trucks was examined and discussed, model by model, and important decisions were taken, naturally valid until they were changed. In the rest of my career I never again saw the top management of the company devoting its attention to the work of designing. Apart from the "103" the subjects considered included: the minimal auto (I was given the go-ahead to carry out studies and freedom to choose the most convenient solution, with the engine-transmission unit either all in front or at the back); the "105" auto (which I proposed fitting with a 1.640 cc "101" engine which had given excellent results in tests); the *1900* diesel engine for the light *615* truck; the *Campagnola*; the *8V* automobile; the front-driven "2101" van, which I had thought of designing with the help of Luigi Fabio Rapi, recently taken on at Fiat; the medium and heavy weight industrial vehicles together with the urban buses and intercity coaches, which presented a more confused and complicated situation than did automobiles.



Pre-production prototype of the 1100/103 sedan (1953).



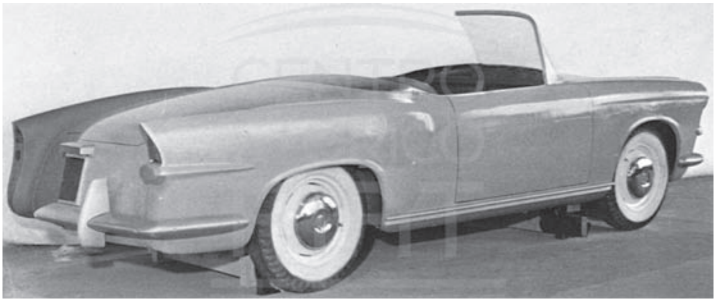
Cross-section of the 103.000 engine intended to power the first series of 1100/103 autos (1953-56).

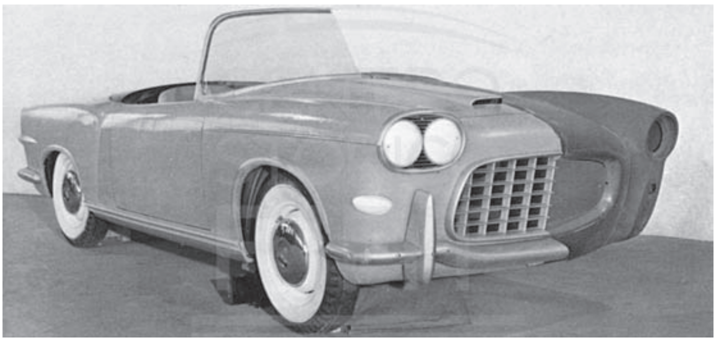
The designs of the "103" were resumed. Since the V engine and front-wheel drive had been discarded the project soon reached final definition. The *1100* was adopted in a revised and much improved form, the gearbox was taken over from the "101", the rear axle was of the traditional type but with hypoid gearing. The main innovations were the bearing coachwork, the position of the engine, placed well forward between the wheels, the mounting of the power unit, front suspension and the steering on a small chassis-frame attached by a few bolts to the coachwork to form a light and rigid whole. The quadrilateral front suspension with spiral springs was the outcome of long and careful study, a completely new design to achieve the best results with the utmost simplicity.

As soon as possible, I intended to present the President, Bruschi and Genero with a prototype of what I considered the definitive version of the coachwork, using the engine, clutch, gearbox and transmission of the *1100* to save time, but this meant getting the designs ready by 15 November, which was impossible.

In December there was still part of the final design to be done. The machine shop was requesting a number of modifications for production reasons and we for our part were making alterations suggested by the results of testing. The heating equip-

Station wagon of the 1100/103 (1953-56).





Full-scale mock-up to examine styling suggestions being considered for the 1100/103 TV Convertible. Note the contrast of double and single headlights, the latter being chosen for production.

zment was here for the first time being designed as an integral part of the bodywork and required continual development. The electrical equipment was late in completion. But by January the designs were ready, enabling the construction of a second prototype to be completed and a start to be made on a new one. A few months later we had the final prototype in our hands and could compare weights.

The model with spiral-spring rear suspension of the “101” type weighed 761 kg (we had had to strengthen the wheels, which added 6 kg to the weight, the shock absorbers, adding 2 kg, the mini chassis-frame and front suspension, adding 6 kg). With leaf-spring suspension (considered more economical) at the rear, the weight went up to 780 kg, partly because the metal flooring was increased in thickness from 0.8 to 1 mm and the rear axle and silencer were reinforced.

The third model was even heavier because of the reinforcement of the coachwork and the addition of a radio. This brought the weight to 812 kg.

The final perfecting of the model took the whole of 1952. We had a difficult time trying to reduce the noise levels of the exhaust. The bearing coachwork arrangement makes noise problems acute. The suspension required a lot of work to find the ideal position for the anti-roll bar, to reduce the vibrations coming from the engine, transmission and suspension; the brakes, heating and ventilation all required attention. This meant that I had to accompany the tireless and exacting Salamano on numerous test drives.

While work went on, the machine shop was tooling up for series production. The new assembly line had been devised specially for the particular layout of the “103”, with the engine and other mechanical parts at the front of the auto applied to the chassis-frame fastened to the coachwork.

Finally, at the start of 1953, the Mirafiori works began production. A batch of 50 automobiles was set aside for road tests. The vehicles allocated to test drivers of the after-sales service section and the works revealed some defects which were immediately remedied.

The “103” was presented as the *Nuova 1100* at the Geneva Motor Show in the two versions suggested by Gajal at the price of 945.000 lire and 975.000 lire. The first had separate front seats, no chrome trim and weighed approximately 810 kg; the second had a bench seat in the front, more elegant trim and more accessories and weighed about 825 kg. The top speed was 116 km/h.

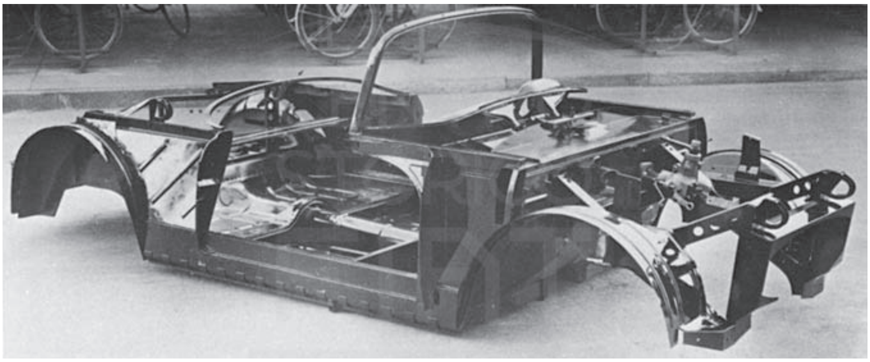
The *1100/103* was much more lively than the *1100* and was a great success, especially with the more adventurous drivers. Enzo Ferrari sent me his congratulations. In October the more powerful version, the *103 TV* (fast tourer), was presented at the Paris Motor Show; in 1954 the *103 Familiare* came out at Geneva, and in 1955 we presented the *103 TV Trasformabile*, a sports car whose styling was based on a design made by Rapi with my assiduous help.

Derived models and the *103* itself underwent rapid evolution in the following years to keep public interest alive, sensitive to every change in style or mechanicals. In 1956 257.000 had been produced and the sedan and its derived models was given the designation *1100/103 E*. Thanks to a series of improvements the engine power was increased from 36 to 40 hp in the normal version and from 50 to 53 in the *TV* version. The suspension and coachwork were further improved.

In 1957 the *103 D* was presented at the Turin Motor Show. In the same year the *1200 Gran Luce* sedan was also produced. The *TV* sports model became the *1200 TV*. Both the *103 D* and the *1200 Gran Luce* were distinguished by the complete remodelling of the rear to keep pace with fashion. In 1959 the*1200 TV* sports was to be replaced by the *1200 Cabriolet* with coachwork by Pininfarina, less original than the previous model but more fashionable and refined. The *103* was again updated with the *H* version, presented at Geneva in 1959 and from 1960 to 1962 with the *Export* and *Special* versions, the last-named being a restyling of the *Gran Luce*. In 1962 the umpteenth version of the *103* was called the *1100 D* even though the engine had been raised to 1.200 cc and power to 50 hp at 5.000 revs. Thanks to the increase in the octane rating the compression ratio reached 8.1. Production of the *103* went on for 16 years, ending in 1969 when the *124* came out. So the *1100/103*

Fabio Luigi Rapi, mechanical engineer, born in Florence in 1902. He took his degree in Milan, where he also followed courses in Architecture and Aircraft construction, developing his powers of design and sensitivity for aerodynamic shapes. In Milan he also found his first job on the staff of OM's diesel engineering centre.
Between 1934 and 1935 he moved to Isotta Fraschini as head of the motor truck test sector. While he still held this position in 1938 he began – more for his own pleasure than because of any instructions from the management – his prolonged work on the design of a high-class limousine intended to revive the automobile production of the old Milanese marque. The design led in 1948 to the 8C Monterosa, for which Rapi also designed the coachwork, built by Zagato, Touring, and Boneschi. When Isotta Fraschini ran into trouble, he moved to Fiat in 1949 as assistant director of the technical office for special coachwork, becoming its director in 1952. Between 1955 and 1956 he was at Simca's Poissy works to set up and direct the Coachwork Design Office. When he returned to Turin he ran the Styling Studies Office (staff of 52) which was merged with Boano's work team (staff of 32) to form the Fiat Styling Centre in 1959.

Standard 1100/103 E sedan (1956-57). In addition to some changes in styling, the auto's engine (103 E.000) had been redesigned and turned out some 10 % more power than the previous one.



The body-frame (before being covered with the metalwork of the body-shell) for the 103.400 sports-model, which was marketed with the designation 1100/103 TV Trasformabile (1954-55).

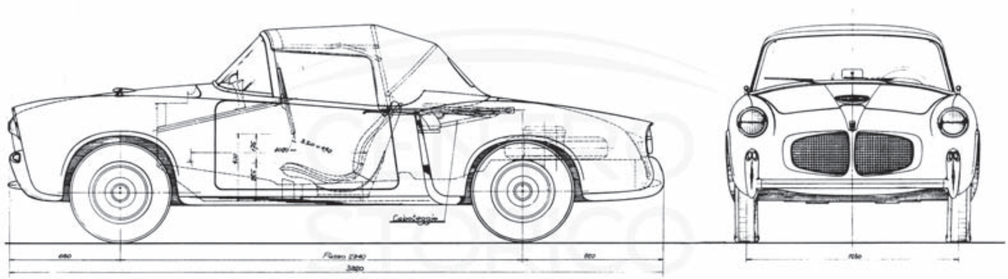
had a long and glorious life. Its engine had been planned in 1935 and was steadily perfected and adapted to numerous subsequent applications. It was the typical four-cylinder overhead valve medium-sized engine, taken as a model and imitated by most European manufacturers.

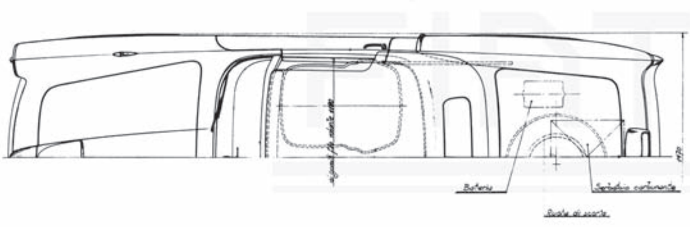
I recall a dispute I got into with a well-known American designer and automaker of the day, one Mr. Fageol, over the combustion chamber of this engine. It all started with a visit to his Twin Coach factory in Kent (Ohio) in 1947. I was with Bruschi, Bono and Sossi, the last-named being Fiat's representative in the States who had organized the trip.

The Twin Coach was a magnificent vehicle, completely up to date and made of aluminium alloy with pneumatic suspension and a flat gasoline engine mounted in a mid-position. When I saw the engine head I pointed out to Bruschi and Bono that it was the same as the one on our *1100*. Mr. Fageol, who was showing us around, noticed with ill-concealed disapproval that we were giving a lot of attention to this feature and attentive as ever to detail bore it in mind.

A year after our visit we received a letter from him, warning Fiat against exporting *1100* automobiles to the USA because he held the patent for the combustion cham-

Cabriolet-sports 1100/103 E Trasformabile (1956-57). Apart from some minor changes in accessories, the second series of this model was powered by the new 103 E engine.





The designs of the first series. The styling of this model was the object of particular attention by Luigi Fabio Rapi.

ber. To prove to him that Fiat had been manufacturing the disputed part ever since 1934 we sent him the designs, publicity material and reviews. It was not enough. We actually had to show that the design was known in the United States before he had been granted his patent. After a lot of research among automobile collections we traced a *508 CS* sports model (the *Balilla* “Coppa d’Oro”) and finally the dispute came to an end.

When I think of the *103,* which had a production run totaling about one and a haf million vehicles, I regret letting motives of cost and weight induce me to make savings on the width of the body. With an extra eight or ten centimetres it would have been much more comfortable and attractive. The evolution I have sketched out was the outcome of strenuous effort. To make partial modifications to coachwork and yet harmonize the new with the old is a difficult and frustrating job, while the results, as often as not, are far from attractive. It requires special flair. Perhaps this is why I have been described as a perfectionist. In the case of the *103* it was a particularly wearisome task when taken in conjunction with studies for new models: the *600,* the *Nuova 500,* the *850,* the *2100,* the *1300* and the *1500*.

Standard 1100 R sedan (1966-69). Originally planned for export to Pakistan, where there is a Fiat assembly plant, the last of the 101 series was also produced in Italy in fairly large numbers (over 100.000), bearing in mind that the new 124 was on the market at the same time.

CHAPTER XII

THE “100” PROJECT LEADING TO THE *600*

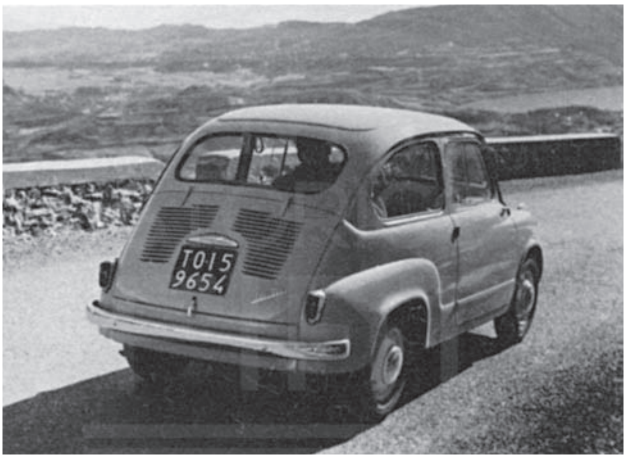
With its new plant, Fiat went ahead with its plans for development in all sectors: design, production, sales network, after-sales service etc. New design offices were set up, such as the Special Vehicles Technical Office and the Heavy Engines Technical Office.

Auto production soared as we harvested the fruits of the intensive work of previous years in the design offices and research workshops. New horizons began to open before us.

Valletta was able to repay the American loans which had enabled him to repair the factories and install plant for the production of new models. Everything centered on automobile production.

Bono managed to set ever higher targets, profiting by the drive and concentration with which everyone devoted himself to the task. The offices in charge of design, including design of plant and equipment, and the factory itself were all going flat out to meet the schedules set by the general manager and Valletta.

Fiorelli, the man in charge of production, went to the United States together with his technicians to see how things were done in the works run by General Motors, Ford, Chrysler and others belonging to manufacturers of the most modern machinery for mass production. He was proud of the Mirafiori factory, working without respite to perfect it. Within a few years he had transformed it into the most modern in Europe, able to stand comparison with the big American auto works.



One of the first 600s to be registered (1955).

As for me, I did my best to keep up with the immense workload. I reorganized the offices to try to save time and make bureaucratic procedures, paper work, filing, reproduction of designs and their classification and distribution as simple and rapid as possible. We even went so far as to prepare the sensitized paper used for copying designs in a little laboratory run by the same staff as were responsible for reproducing designs.

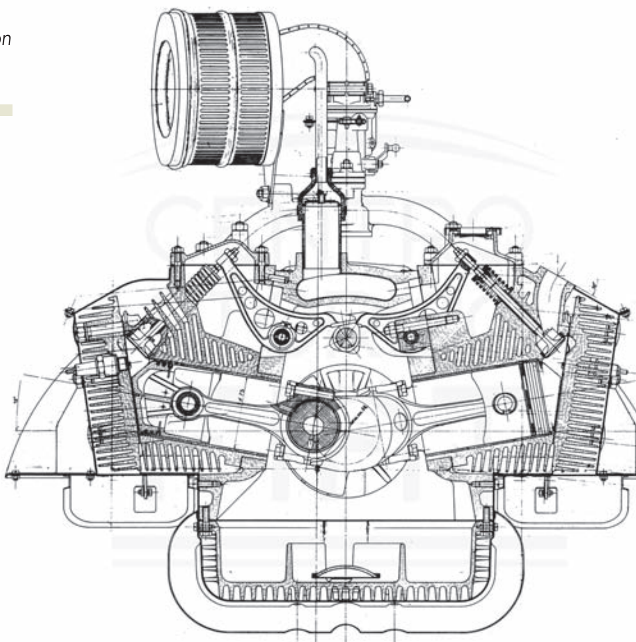
A whole volume could be devoted to the organizational evolution of the company, so deeply did everyone involved feel their responsibilities and strive to solve problems as they came up, with a desire to display their own abilities to the full and pride in their achievements and abilities, intertwined with petty intrigues and rivalries.

After the *103* project had been finalized in 1951 the moment arrived for the choice of a model to replace the *500 C*. The *500 C Giardinetta* with its wood and masonite coachwork had been successful and sold well but it could not go on being produced in large numbers for many years. So it was essential to find a modern four-seater to replace it.

The experimental "400" had shown that only a two-seater could be kept down to 450 kg with the normal layout, meaning the engine in front and back-wheel drive. To produce a little four-seater whose weight would not exceed that of the *500* and at a lower cost we had to abandon the traditional layout and adopt the arrangement of the engine-transmission unit either wholly in the front or wholly at the back. The calculations had been borne out by the "100" and "102" prototypes.

Tests of the "102", especially the "102 E2"prototype with its four-cylinder water-cooled engine, had yielded good results. This was an up-to-date and attractive vehicle that would have made a first-rate replacement for the *500 C* except that the price

Cross-section of the "100 E2" experimental engine, a suggested solution for the rear-engined utility model later to become the 600. Dated 3 May 1951.



would have been much higher. Besides, there were some misgivings about transmission to the front wheel, especially the homokinetic joints.

Then there was the ruling so clearly given by Valletta during the presidential committee meeting when the "102" and front-wheel drive came up: "While its study should be continued, we should direct our efforts towards a vehicle of the orthodox type".

I had answered at the time that only front-wheel drive or the engine placed at the rear would enable four people to be fitted with the necessary minimum of comfort into an auto of the same size as the *Topolino*, or perhaps slightly smaller. This was an indispensable condition if we wanted to produce a vehicle weighing and casting less than the *500* with better all-round performance.

It was the energy with which I supported this viewpoint, certainly not any gift of eloquence on my part, that caused a minute to be drawn up at the end of the debate, reading:

> *Model 100* – The Management of the Motor Vehicles Technical Offices is authorized to carry out its own studies, with complete freedom of choice as regards the position of the engine.
> The speed must not be less than 85 km/h and the weight should be approximately 450 kg, the coachwork being 250 kg and mechanicals 200 kg. It should provide seating for 4 people with a degree of comfort corresponding to that shown in the drawing and plaster mock-up inspected by the members of the present committee. The Management of the Motor Vehicles Technical Offices is requested to speed up these studies as much as possible, as the vehicle is to enter production as soon as possible after the *103*.

These instruction did not worry me unduly. I knew what had to be done. The weight of 450 kg was wishful thinking but I was careful not to argue about it. All that mattered at that moment was that I was free to choose the position of the engine. The second bout of this unforgettable meeting confirmed the decision:

> Final decisions: *Model 100* – Confirmation of the decisions of the previous report – Four-seat vehicle, weight 450 kg – Transmission-engine unit either wholly in front or wholly at the rear.

Now it was up to me. I had to fight my own battle with doubts and uncertainties and it was no easy matter.

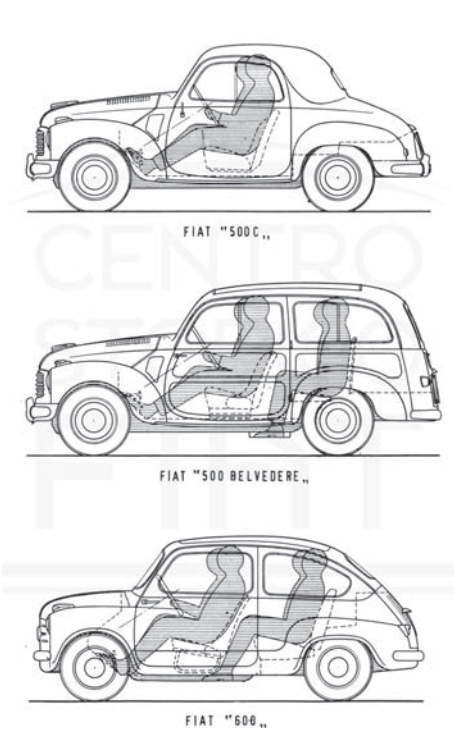
I tackled the problem by systematically examining the various possible arrangements to work out the pros and cons of each and weigh up their merits as thoroughly and objectively as possible.

In the model workshop on the top floor of the Mirafiori "palazzina" I first had a mock-up made to measure the roominess of the automobile inside, to enable us to place the steering wheel and controls in the most convenient position and make the doors large enough for it to be easy to get in and out. I have always been extremely particular about the driving position and ease of access. With my long legs it was easy for me to show my assistants how to shape the door opening and how much to allow for leg-room so that the pedals could be suitably positioned in the limited space available.

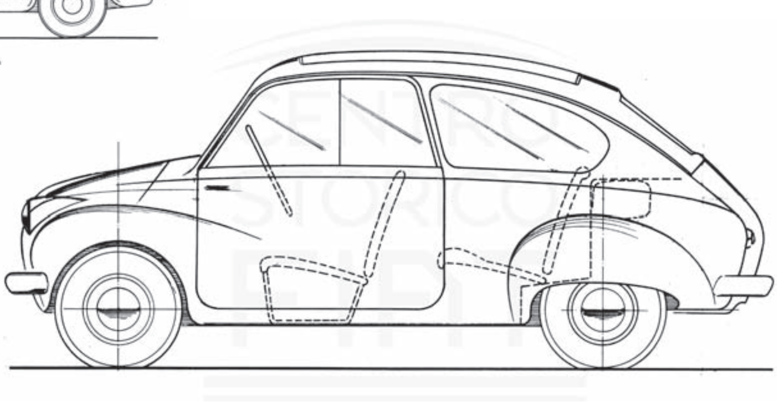
When the dimensions of the cab had been established we moved ahead rapidly to model its shape. I was exhilarated, as always, to see the way the creamy smooth plaster was spread rapidly by hand over the wooden framework before it hardened. I had planned the mechanical components so that they could be contained by the absolute minimum plate metal surface, so I urged Alberti and the other plasterworkers to reduce the size of the engine hood and the rear. I myself filed away at the initial shape to get rid of the angular edges and achieve the maximum compactness with curved lines so as to cut the use of metal plating, and hence its weight, to the minimum.

At the same time the mechanicals were being designed, in weight, to the minimum.

At the same time the mechanicals were being designed, in particular the air-cooled engine with two opposed cylinders. It was essential to make a systematic comparison as soon as possible between the two positions, front or rear, and I had mobilized the best designers and calculators to do it.



The 600, whose slight increase in engine size and appreciably improved performance created the image of a larger auto, was actually smaller in overall volume than the 500 Belvedere. The drawing compares the volume and accommodation of the two versions of the 500 C and the new 600.



Preliminary drawing for the coachwork of the future 600, dated 21 July 1951. The final version was to be more bulky and less streamlined.

The urgency of the "100" and the other numerous projects on the schedule at that time made it necessary to expand the offices and alter their structure so that they could get through the new projects with the utmost efficiency. Staff were needed, but above all a choice had to be made of those who were capable of occupying positions of responsibility according to the type of work for which they showed special aptitude. By delegating various tasks to engineers or specialized technicians capable of carrying them out with energy and skill I could devote most of my time to the "100" project. Bono was fully behind me in my proposal and helped in the choice of staff.

On 31 May 1952 an announcement was made that as from 1 June 1952 the Motor Vehicles Technical Offices would be subdivided into three departments:

1) *Research and Development Department*, under the charge of Oscar Montabone with the grade of assistant director.

2) *Design Departments* subdivided as follows:
- Automobile Department, with myself as interim director;
- Department for derived models of automobiles and special coachwork for automobiles, run by assistant director Luigi Fabio Rapi;
- Heavy Engines Department, run by assistant director Osvaldo Gorrini;
- Industrial Vehicles Department, run by assistant director Mario Persia;
- Department for special vehicles and agricultural tractors, run by assistant director Emilio Martinotti;
- Electrical Equipment and Accessories Department, office manager Zoppi.

3) *Test Department*, run by assistant director Giuseppe Russolo.
The department was divided into three parts: Engine testing; Dynamic tests; Road tests.

Montabone was responsible for advanced studies in all sectors of automobile production including the development of the turbine engine, then being tried out on the test-bench and also the design of the vehicle for which the turbine had been conceived. He was not happy about the new arrangement: in his eyes the transfer from the Automobile Office to the new department was a move on my part to get him out of the way. This was not true. I set great store by the construction of the turbine-driven auto, but caught up as I was in the "100" project and everything else, I could not give it the attention I would have liked to. It was Montabone's job to carry on with the task and see it through to completion. He did it with all his usual care and enthusiasm but ever after believed that I had done him a bad turn. The office manager of the Auto Department's Estimates Office was Montanari, who had worked together with Montabone on the *1400*, the *103* and other projects belonging to the same period. Persia came to us from OM in Brescia and replaced Russolo, who was transferred to the Test Department. There he in his turn replaced Codecà who had been promoted to general manager of SPA. Rapi came from the Isotta Fraschini company. Gorrini, after being transferred to Fiat Modena as technical director, had resigned and freelanced for a number of different firms then finally rejoined Fiat. I had once been subordinate to him but now the roles were reversed.

The decisive element deciding me in favour of the rear-engine transmission arrangement was cost. The front arrangement was attractive because of the technical advantages presented by frontwheel drive and even more because of the space it would leave free for the coachwork but it would have made an economy model of the size we aimed at much more expensive than the rear-engined arrangement.

In those days the cost and hence the weight of the material used in manufacture played a preponderant part in determining the total cost so that the rear-engined model as we had conceived it, being lighter, was also cheaper. Besides, we were by no means sure of being able to find homokinetic joints for front-wheel drive that would be sufficiently cheap and yet reliable, suited to a utility model intended for mass production.

This was why we opted for the "all at the rear" arrangement. I then thought that air-cooling was preferable because of its practical qualities. I could have adopted one of the opposed two-cylinder engines already built for the "102", although it was larger, but instead I decided to try an engine conceived along different lines in my quest for greater simplicity and lower costs.

The two cylinders were not set at 180° to each other but with their axes forming a V of about 150°. The valves were almost horizontal, fitted into the angle formed by the cylinders, not on the head, and worked by a camshaft in line with the middle of the crankcase. The valves were consequently at the side of the cylinders and set at a sharp inclination to them so that the two combustion chambers took on an unusual shape which ought, in my opinion, to have been more efficient than a chamber with side valves of the conventional sort. However each of the cylinders had a shape that presented serious problems with heating, because it seemed likely that there could be deformation caused by the big differences of temperature in the zone round the valves and ducts.

Montanari was skeptical: he was very good at finding weaknesses and always ready to point out difficulties. But I wanted to go on with it. I was not fully satisfied with the design but I thought it was worth trying. "Ignorance can be useful at times," I said. "Ignorance of difficulties helps us to face up to the future". But he was right. The engine was simple but inefficient. The combustion chamber gave poor results. The deformities due to heating duly appeared. Perhaps remedies could have been found by tinkering with the details and studying careful modifications but it would have taken too long, more than we could afford to waste. The deadline for completing the model was looming up.

The two-cylinder engine was mounted on the prototype all the same. There had been a lot of innovations. One of them was more revolutionary than all the rest. This was the gearbox. My idea of an economical auto in those days included the belief that it should be as widely owned as possible. I believed that it ought to cost so little that it could be bought by people who until then had never even dreamt of buying a car. For this reason I wanted to make driving it easy, natural and safe. The first step in this direction was to get rid of the clutch pedal so I had the gear change used for the Cisitalia single-seater redesigned and modified to suit the "100" and had a hydraulic joint fitted between the engine and the clutch, as on the *1900*. The designs were complete by March 1952 and the prototype was ready for trials before the summer holidays. It was a completely up-to-date auto driven with only two pedals: the accelerator and brake. Salamano was surprised at the new method of driving and had a hard time getting used to it. Unfortunately it took a bit of an effort to move the lever at each gear change and the three forward gears were really too few for an auto with an engine of only 600 cc, despite its hydraulic joint.

After a brief period of trials in which I took turns at the wheel with Salamano I realized that it was going to take a long time, perhaps years, to transform my conception into reality and remove all the shortcomings, so I decided, without any hesitation, to replace the engine-drive unit with a conventional water-cooled four-cylinder in-line engine with four gears. I got the project under way and soon had the principal features designed. Bono listened to what I had to say and gave his approval but demanded that the designs should be ready within four months and handed in to the machine shop. "Lock yourself up somewhere with your designers," he said, "and don't come out again until the designs are finished." And that is just about what I did.

I chose ten designers, the most able, the ones that understood what I wanted without needing too much explanation. Among them were Saroglia for the engine, Mosso, Bruno and Nutarelli for the gearbox and the rest of the chassis. Eventually they were to become office managers, service managers and assistant directors. Mosso finished his career as director of the Technical Design Office for Fiat operations abroad.

I had the team accommodated in a separate room where it was really possible to lock ourselves in and we got down to business. On 20 January 1953, when work was in full swing to get the *103* into production, I sent a note to Valletta, Bono and Gajal setting out the characteristics of the "100" in its definitive version. Four-cylinder 570 cc engine, output 16 hp; envisaged weight of the automobile unloaded 515 kg, top speed 88 km/h. The speed and horse-power figures may well seem laughable today but in 1953 they were excellent for a small economy model.

I now had a clear picture in my mind of the auto, down to all the details. Not for nothing had I got out designs of small engines by the dozen over the past few years. Saroglia, capable as ever, taciturn like every true Piedmontese, whatever surprise he might have felt at my ideas always heard me out with a patient smile and faithfully translated my concepts into drawings. The engine had to be built with the smallest possible number of parts. As soon as I saw a chance to make the slightest simplification in the design we would either modify the drawing or start all over again. To eliminate the intake tube I decided it should be cast as part of the engine head itself and the carburettor would be fitted directly to it.

A long hollow arm, the water pipe, was fitted to the side of the crankcase with the water pump at its end. The axle of the pump in its turn would be fitted with the fan to cool the radiator, placed to the side of the engine. Saroglia occasionally displayed some bewilderment when he saw my sketches but then he would get down to work with a will and the design would take shape to his and my complete satisfaction.

The "100" engine is a model of simplicity, and simplicity means reliability. Any other design would have meant higher costs for Fiat and the people buying its cars. Millions of them have been built because through the years its capacity has been increased while its structure and outer dimensions have remained the same, prolonging its working life on the *850*, then on the *A 112* and the *127*. Saroglia unhappily never lived to share in the fortunate development of the engine designed in 1953. He died a few years later.

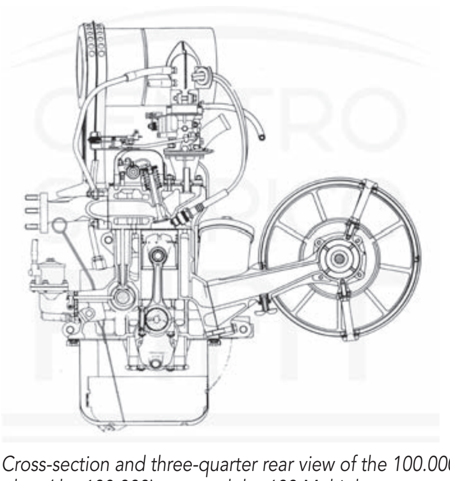
The four-cylinder engine placed lengthwise behind the rear axle took up all the space in the rear section of the coachwork. It was impossible to fit a fan and radiator into the space between the engine and the coachwork without lengthening the body and hence increasing both weight and cost. So I had the idea of putting the radiator at the side of the engine. The fan, fitted on the shaft of the water pump, would blow the air to cool the radiator towards the front, in the opposite direction to the movement of the automobile. Warmed by the radiator, the air could be funneled into the central tunnel of the coachwork and so serve to beat the inside of the cab and defrost the windscreen. This avoided having to fit a separate heater. Some of my fellow-workers felt slightly skeptical about the idea. It seemed illogical to expect the air to be blown forward against the movement of the vehicle. However, everything worked smoothly right from the start. The only flaw was that the pipe that led the air away from the radiator pointed downwards and tended to blow up a cloud of dust from the ground when the engine was revved with the vehicle stationary. There were lots of unsurfaced roads in those days. To eliminate the defect all that was needed was a simple change in the shape of the metal deflector, controlled by a thermostat that cut off or reduced the flow of air from the radiator.

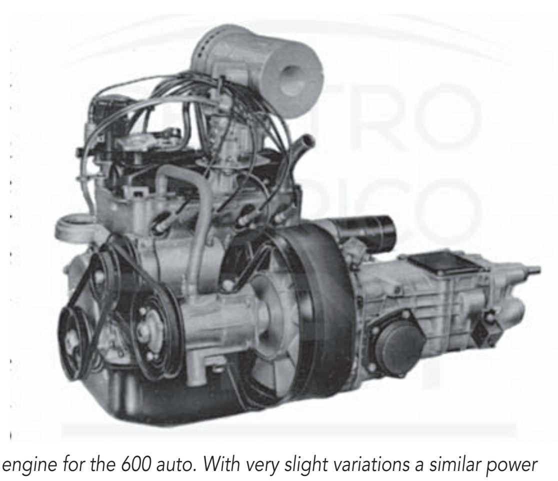
The automobile was completely new in the conception of every detail. The independent front suspension was the fruit of a train of thought that had started in the States when I visited Chrysler in 1947 and had a series of talks with Mr. Herreshoff, chief engineer in the advanced studies section. The transverse leaf-spring fixed to the chassis or coachwork so as to fulfill the twin functions of an elastic spring and an anti-roll factor is the simplest and most economical to date. It has the further advantage of taking up very little space. The elimination of the anti-roll bar means a substantial saving from the economic viewpoint, including running costs, because of the absence of joints and supports which a bar requires.

This type of suspension is still used on the front wheels of the *126* and the rear of the *128*.

It would take up too much space to relate how and why the various problems that cropped up in the design of the “100” were resolved.

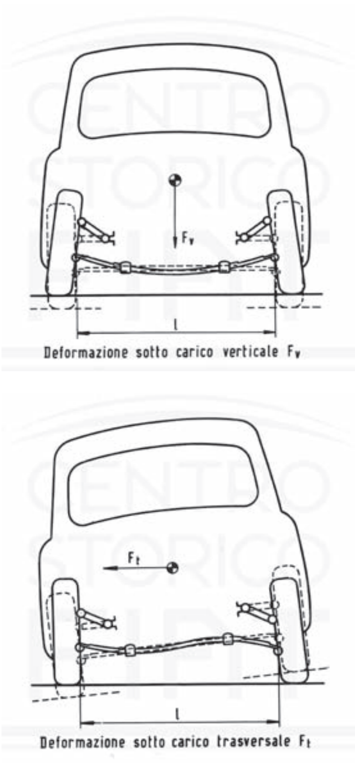
The distribution of weight on the wheels caused a good deal of head-scratching because of the centre of gravity being rather far back, giving rise to problems with cornering. When the engine is placed behind the back wheels there are certain



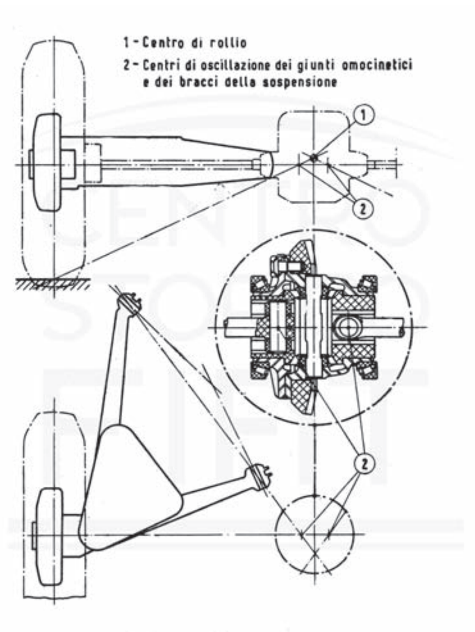


Cross-section and three-quarter rear view of the 100.000 engine for the 600 auto. With very slight variations a similar power plant (the 108.000) powered the 600 Multipla.

advantages. For instance, when the load varies from one to four people the centre of gravity does not shift greatly and the balance of the vehicle is only slightly affected. This means it is not necessary to alter the distribution of the braking on the wheels as the load varies. Another advantage is that the focus of the headlamp beams does not change. On the other hand, there are problems with cornering. Since the barycentre of the vehicle is towards the rear it moves in a curve that tends to close in on itself: the phenomenon known as oversteering. This arises out of a variety of factors such as the deformation of the tyres, the position of the roll-axis, the system of levers and rods which make up the steering mechanism. When the engine is at the rear the influence of these factors is intensified. The importance of the position of the roll axis of the rear suspension was clearly borne out by the tests conducted with the “102 E2” and the first “103” prototype, both with independent suspension on the rear wheels. For this reason the roll centre had to be lowered as far as possible in the design of the rear suspension of the “100”, which was of the swinging axle-shaft type. To do this without complicating the suspension and the axle-shafts I had the articulated coupling of each of the axle-shafts fitted inside the relative planetary gearing of the differential. The roll centre was as low as could be attained with that sort of suspension but not enough to make me feel easy about the results. In fact as soon as the prototype was completed and Salamano started his tests he immediately showed up the tendency to oversteer.



Drawing of the attachment and distortions of the front transverse leaf-spring of the 600 auto.



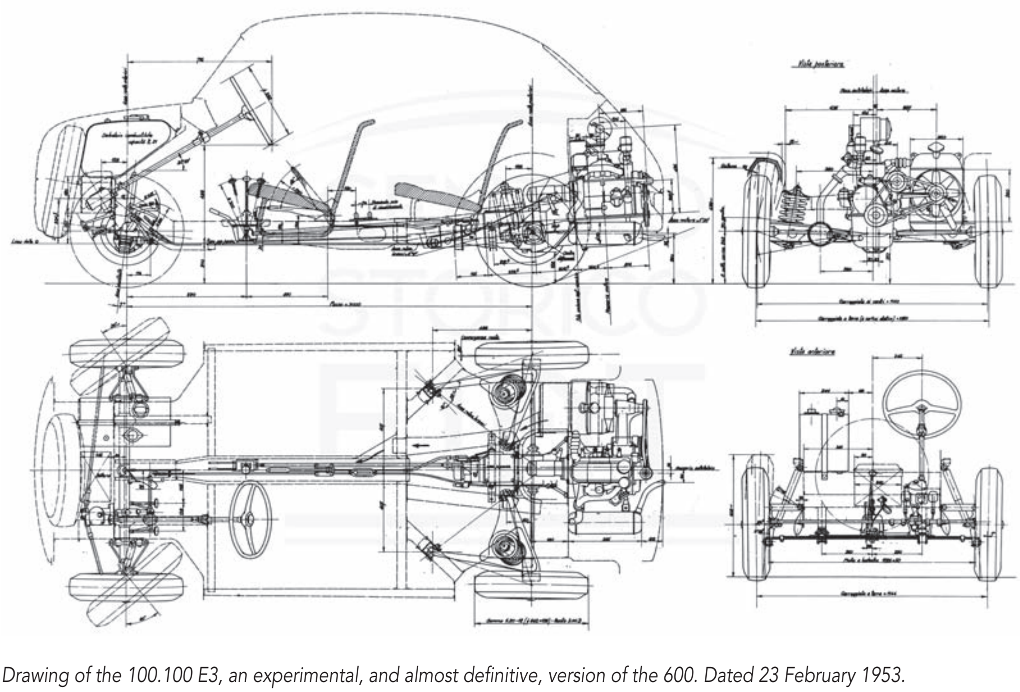
Drawing of the oscillating rear spar suspension and detail of the differential unit for the 600.

zHe would drive flat out and then jerk the wheel round, making the automobile heel over dangerously.

When cornering at speed it looked as if it was going to overturn. I was worried. At night I even indulged thoughts of front-wheel drive, which does not involve problems of this sort, but I was careful not to mention it out laud. A series of tests was planned to try to find out what was at the bottom of the fault. We moved the battery from the rear to the very front of the auto but the improvement was negligible. We tried putting a weight in front of the auto, resting on a bracket sticking 50 cm out from the bumper. The car became more stable but not to the extent of eliminating the fault. So something had to be done about the suspension and the steering. Probably the inclination of the auto during cornering caused the front wheels to turn slightly inwards, so accentuating the bend. A graph was made to chart the precise behaviour of the wheels as the springs were flexed. The front outside wheel on a bend turned inwards a little more than necessary. Since on a bend it is the front outside wheel that becomes charged with centrifugal energy and dominates the steering, we had to modify the position of the joints on the steering rods so that as the car leaned over the steering angle of the wheels would be reduced in due proportion. With this modification and a change to make the rear slightly lower the vehicle's stability was judged acceptable. Fortunately the "100" in its long lifetime never had problems with road holding.

By mid-year the prototype, in what could be considered the final version, was in an advanced stage of preparation. But the President had not yet given his approval.

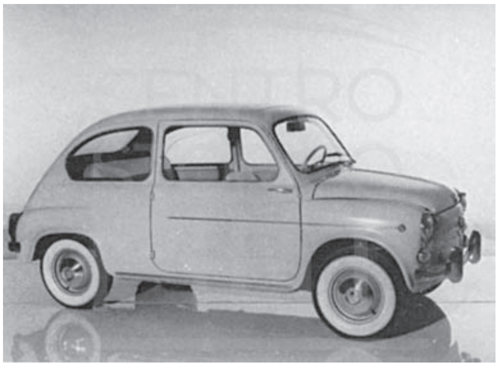
When I had put forward the rear-engined version and supported it with the arguments set out above I had always avoided mentioning that it would not be possible



Drawing of the 100.100 E3, an experimental, and almost definitive, version of the 600. Dated 23 February 1953.

to derive a model with estate car or station wagon coachwork from it, as had been done with the *500*. The *500 Belvedere* station wagon was in great demand and production was constantly rising. How would we replace it when the *500* was replaced by the *600* with its engine at the rear? No one mentioned it but I felt uneasy and it gave me some sleepless nights. I foresaw that the moment would come when the General Management would want to know how I was thinking of replacing the *500 C Giardiniera* and I racked my brains to think of a solution. The presence of the engine was a hindrance to the placing of the rear door. Then space had to be found equivalent to that in the *Giardiniera* between the back-rests of the front seats and the section containing the motor. To create such a space the only thing to be done was to move the driver's seat further forwards. "If I can arrange the seats over the front axle we'll be all right," I thought. "To bear the heavier weight on the front wheels the *103* suspension will do fine. There will be some difficulty in arranging for easy access to the front seats and finding a practical layout for the steering and pedals. We'll see." I quickly sketched out a scheme to discuss with Alberti, as keen as ever to tackle innovations and problems, and we decided that we would definitely get the Model Shop to make a mock-up for the front section and see in practice whether the scheme was feasible or not. The condition that the rear of the vehicle should be the same as that of the "100" was a tough one in designing the coachwork but otherwise how could I claim that it was another version of the "100" (which I had better start referring to as the *600* since that was to be its final designation) if we did not retain at least the rear? The mock-up showed that getting in and out was not particularly difficult. Access and the roominess of the inside would have been improved by making the wheels smaller in diameter but unluckily that was not a possibility. The clearance would have been reduced below the acceptable minimum. The brakes would also have become inadequate because the diameter would have been too small.

600 sedan, third series, with wind-down side windows (1957).



Standard 600 D sedan (fifth series, April 1960). Three months after the celebration of the first million produced, the 600 was equipped with a new engine, with the engine capacity boosted to 767 cc (62x63,5 mm). A further one-and-a-half million of this model were produced in the 1960-70 period.

When the plaster dummy had been constructed I could hardly say that I was happy with it but I decided to press ahead and perfect the design.

The new vehicle was baptized the "100 familiare" and designs were begun for construction of the prototype. It would be easy to demonstrate that despite the lack of a rear door the vehicle with its large side door had an advantage over the estate car in its ability to seat six people or take a heavier and bulkier load.

When I had got together full and precise details with designs to prove how much roomier the new vehicle would be than the *500* C *Giardiniera* I put Bono and Valletta into the picture. This was the position half-way through 1953.

Valletta felt a decision had to be made, the replacement for the *500* could not be put off to later than 1954. He foresaw a fall in sales of the *500* and was afraid of foreign competition. His attitude was well-known. "We have to concentrate incessantly on finding work for our factories," he said to me. "The responsibility rests squarely on us, everything depends on us, remember that. Not for the sake of the shareholders but for the workmen and ourselves." But he did not want to take the decision with the backing of Bono and Gajal alone, as he was to do later on for many years. He called a meeting of the presidential committee as a whole: Giovanni Agnelli, Count Camerana, Bruschi, Genero, Bono, Gajal, Ghiglione, Fiorelli, De Regibus.

RIV, later RIV-SKF, company founded in 1906 by Giovanni Agnelli to manufacture ball and roller bearings, which were at that time imported from abroad. The first factory was set up at Villar Perosa, the home town of Agnelli, who intended in this way lo help solve the local unemployment problem.
It has recently been merged with the international SKF (Svensk Kullager Fabriken) group, becoming one of the largest companies in the world in this sector.

The meeting took place on 15 July 1953 in the RIV building, lately completed in corso Vittorio Emanuele II. On the top floor, there was the big room for board meetings adjoining the office of Agnelli, the President of RIV, and here the members could look out on the restful green spaces of the Valentino park. I was present like a defendant in a court of law, armed with my rolls of drawings and files crammed with data. The only business on the agenda was the "new economy fourseater model to replace the *500*".

Everyone present had tried out the auto and Valletta wanted to have their opinions and involve them in responsibility for the choice. I was keyed up but determined to defend the project, the outcome of so many years of research and work.

The minutes of the meeting, under the seal of official secrecy, are drawn up in an impersonal and restrained style. They do not reflect the atmosphere of diffused, dignified tension that made the big shots in the Fiat world more taciturn and solemn than usual. I think it is worth looking at the first few paragraphs and some of the most significant passages:

> Valletta summarized the various considerations affecting the choice of specifications for the four-seater automobile to be built as a replacement for the *500*.
> As is known three solutions have been put forward:
> – with the engine-drive unit in the front;
> – traditional with engine in the front and rear drive-axle;
> – with engine-drive unit at the rear.
>
> In practice the choice was restricted to the first and third solutions and the latter has been chosen since the front-wheel drive version, despite a number of undoubted

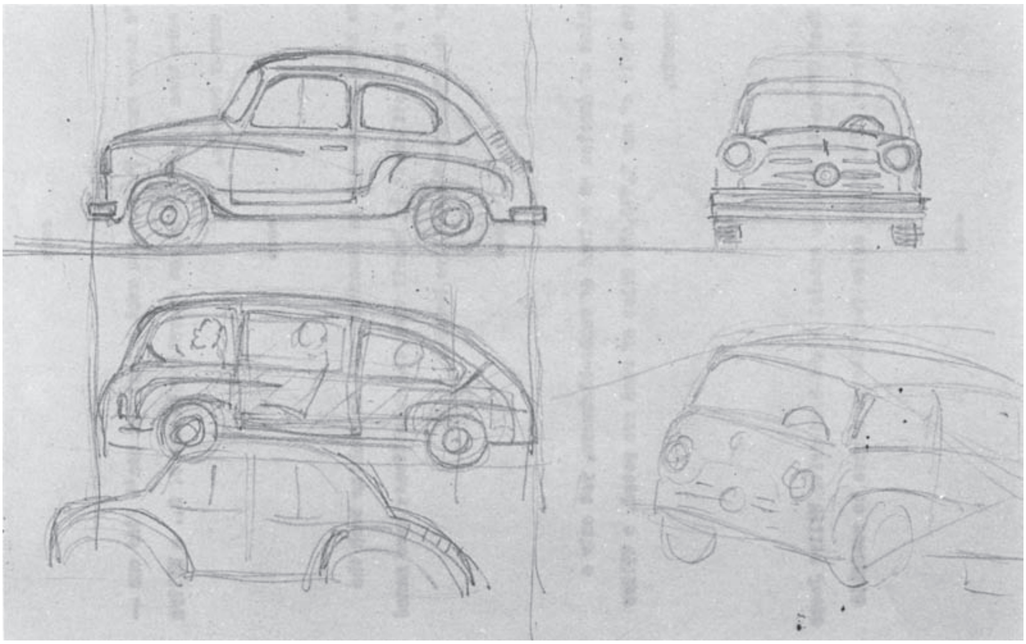
advantages, presents various drawbacks among which Valletta listed the reduction of the steering angle, the need to place the front seats further back with consequent loss of leg-room in the front seats.

(I don't know who gave the President this idea).

Valletta stated that the version with the engine-drive unit at the rear, designed by the management of the Motor Vehicles Technical Offices, also envisages a derived station wagon version with room for six seats. This latter version could easily be transformed into a two-seater with ample space for goods and baggage.
Valletta stressed the extreme urgency of starting production of the "100" in both the 4 and 6 seater versions. The deadline should be set no later than early 1955 since the present favourable trend of the auto market should not distract attention from the possibility of a downturn in the national economy, with inevitable repercussions on customer demand, switching it from the *Nuova 1100* towards models cheaper to buy and run.

The two rows of folding seats made the 600 Multipla (1956-69) suitable for mixed use. It was also popular as a mini-taxi.

An autograph sketch by Dante Giacosa done on the back of a cyclostyled sheet, during the period when the 600 Multipla project was under way. The design of this variant model was conditioned by the need to make the fullest possible use of the same components as the basic model and so keep down the need for new production plant.



The members were then presented with the designs and drawings for both the "100" four-seater and the station wagon model derived from it, as well as a preliminary study for a low cast model in the two versions with front-drive and the engine in the rear.
Giacosa explained the reasons which favour the engine-drive group being placed at the rear of the "100", providing data concerning the weights envisaged, which are as follows:

	model "100" 4 seater kg	derived stn. wgn. 6 seater kg
– engine-drive unit at the rear	515	660
– engine drive unit in front	545	6-seater not feasible
– traditional	570	

Valletta than invited those present to express their opinion and make other comments concerning the prototype vehicle tested by them. The opinions of the individual members may be summarized as follows...

At this point there were the replies of the members of the committee, starting with Agnelli and ending with Fiorelli.

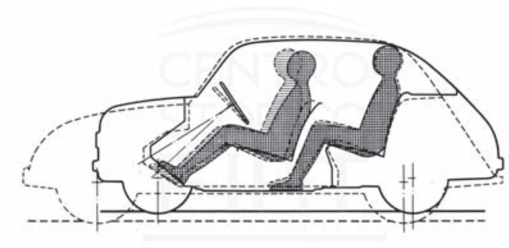
Agnelli was very brief in his comments. He said that he thought the auto was first-rate, perhaps a little too speedy.

Gajal mentioned the campaigns being conducted on the political plane for an ultra-economical auto and referred to the possibility that some industrially powerful company might embark on mass production of an economy model even smaller and cheaper than ours. He praised the "100" and considered its performance excellent. He predicted immense success for it and expressed the wish that it might be sold at the price of 1.000 lire per kg.

Bruschi expressed reservations on both the technical and aesthetic plane and said that some slight modifications to make more room in the luggage trunk would be advisable. He had some doubts as to whether the public, accustomed to the *500 Belvedere*, would be so favourable towards the "100" station wagon because of its rather bulky appearance and warned against the risks of being overhasty in putting the model on the market.

Count Camerana said that he considered the "100" automobile a notable step forward as compared with the *500*.

Genero came out with his usual criticisms of the noise levels, insisted on the need for thorough testing to be sure of the vehicle's durability and recommended making



Comparison of accommodation and overall length of the Citroën 2 CV (dotted line, silhouette of the driver in lighter shading) and the Fiat 600.

allowance for future increases in the compression ratio. To my utter astonishment he said he would have preferred front-wheel drive.

Ghiglione echoed Gajal's opinions.

Bono defended the choice of the rear position for the engine and drive-wheels, referring to the draw-backs of the front enginedrive unit arising out of the double steering and drive function of the front wheels. He then announced that the minimum auto weighing 380 kg was already being studied and that it would be completed at top speed to forestall any other industries that might be tempted to embark on a similar project.

Fiorelli was all for the auto, agreeing with Bruschi on the need to improve the luggage space.

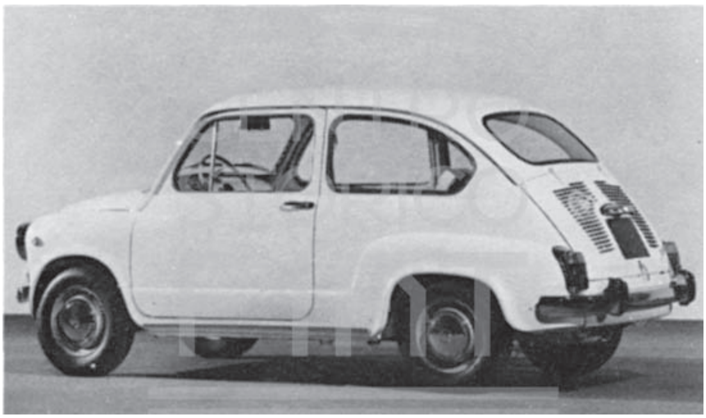
Giancarlo Camerana, born in Rome in 1909. After taking his degree at the Florence agricultural school he moved to Turin, where he cultivated interests in a wide range of different fields. In 1939 he was made vice-President of Fiat.
Before he turned forty he had become President of the Turin Industrial Union. His initiative led to the creation of the International Engineering Display on the Turin exhibition site. He died in Turin in 1955.

Finally it was my turn to reply. I dealt with front-wheel drive, saying that a version of the "102" weighing 600 kg was ready for tests, that the construction of a front-drive vehicle would be more expensive and intricate and that it would weigh more than the "100". I promised that the "100" would be improved as suggested and added that with the engine in the final version having cylinders measuring 58×60 mm it would achieve 19 hp. I added that the minimum auto was in the initial stage of study and that its weight could only be kept down to the figure mentioned by Bono by limiting its performance and especially its speed.

In closing the discussion Valletta summed up saying that the "100" auto was approved by all present and adding that there were no doubts as to the necessity and urgency of producing the minimum auto as well.

The decision gave a spur to the work of perfecting the prototypes while there was feverish activity at the machine shop to design plant and machinery for production. Ten experimental autos were built and allocated to the test service and the after-sales service. The tests led to recommendations for a fair number of small but important modifications. The factory, under the direction of the incomparable Fiorelli, was rapidly tooled up for production and by the start of 1955 everything was ready.

At the Geneva Motor Show in 1955 Fiat launched the "100" on the market as the *600*. The two-seater *500 Topolino* had been replaced by the four-seater *600*, selling



The fast batch of the 600 D (fourth series) was also equipped for the Italian market with big projecting headlights and rubberized bumper guards of the type previously intended for export (November 1965).

at a lower price. With the advent of the *600* Fiat turned out 232.000 autos that year: 200.000 more than in 1930. In 1956 production began of the sunhatch version and the six-seater *600* station wagon, which the Sales Division decided to call the *Multipla*. I was so pleased with this *Multipla* that I bought one for my wife. She had to use it for at least six months.

In 1957 I was invited by the Institution of Mechanical Engineers, the old-established British association, to deliver one of the Clayton Lectures. I was given a great reception at the institution's London centre, where an audience thronged two large auditoriums to listen to my lecture on the subject of "Problems of the small utility car". In it I gave a full survey of these problems and explained how we had tackled them in the *600*. The lecture aroused widespread interest, with a column in *The Times* being devoted to it.

Someone in the works sent me this sonnet:

The 600

You are so lovely, who would ever say
That you were born of factory's heavy toil?
You seem made by some skilled couturier
Or like a flower that grows in fertile soil.

On your first appearance, best of cars,
Your great success and all the fans you made
Aroused the envy of the other stars
And even put our Lollo* in the shade.

The limousines that tower in empty pride
Dwarfing you, in price and stature grand,
Dare them to race you up some mountainside:

You'll scale the heights and share the pride we feel
Guided by the firm and steady hand
Of our beloved Valletta at the wheel.

L.P.

* Lollobrigida.

CHAPTER XIII

THE *8V*, THE *1900* AND THE DIESEL ENGINE
FESSIA RETURNS TO FIAT
PRESENTATION OF THE TURBINE AUTO
SIRA

The design of a model intended for series production means incessant and unflagging effort on the part of the project director as well as the whole design team, from the design engineers to the detailers who draw the plans of every single part, down to every last screw, bolt and pin. But the time available is no greater than that allowed for the design of any other model, even short-run production models made in limited numbers or a single experimental prototype.

After the *1400*, new models came out at the rate of at least one a year: in 1951 the *Campagnola*; in 1952 the *8V* and *1900*; in 1953 the *1100/103*, the *1100/103 TV* and the *1900* diesel; in 1954 the *103 Familiare*, the *1400 A* and finally, in 1955, the *600* as the replacement of the *500*. We all made every effort to meet the strict deadlines laid down by Bono, which meant making the working day longer both in the morning and the evening. In principle I was against overtime, one reason being that I was afraid the draughtsmen could not stand up to the strain of such a long day when all of Saturday and often Sunday morning as well had been given up to the job. But the draughtsmen felt differently about it. They thought that if they spent more time on the job they could slacken the pace and tension and so work more freely. Every day I dealt rapidly with all the mail, passing it on to the relevant offices, snatching every second between one phone call and another. Even when I was listening to someone on the phone I would run my eye over a letter or some technical report, underlining the main points (naturally when the phone call did not require my full attention). I avoided having meetings as far as possible so that staff would not be called away from their work. I preferred to coordinate our activities by talking individually to the person concerned, perhaps on the phone or in my office but more often than not by

Carlo Salamano poses with one of the first 8V sports coupés (1952).

passing by their drawing board or dropping in on the test section to see what was going on and lend a hand. I went round the offices, looked at the drawings, gave advice, expressed my opinion, listened to suggestions, tried to stimulate the creative abilities of the ablest workers by giving them a free hand, coordinated the work by getting the staff engaged on the same problem to come with me from one drawing board or workshop to another. This was my approach, whether we were designing autos, engines, trucks, tractors, military vehicles, refrigerators or whatever else, always trying to find the commonsense solution, embodying economy, simplicity and practicality. No words were wasted: the brain and the pencil were kept busy. The night brought rest, reflection and time to let one's imagination play around the most awkward problems.

Among the numerous tasks and duties of a director is the assignment of work to one's staff according to their aptitude, training, culture and experience. Character, personal qualities, including the ability to communicate, to collaborate, to get along with others are just as important as the sense of initiative and responsibility. It is the director's job to make allowance for the fact that the work of technicians, especially design draughtsmen and engineers, calls for notable mental concentration and effort which eventually have their effects on character and the physical constitution. Individuals who lack a certain toughness or resilience of fibre may show signs of physical or mental strain. This makes it very important to pay attention to human relationships and ensure serenity and job satisfaction. One of the most important factors is to make staff feel that they are indeed doing useful and important work in a climate of consideration and respect.

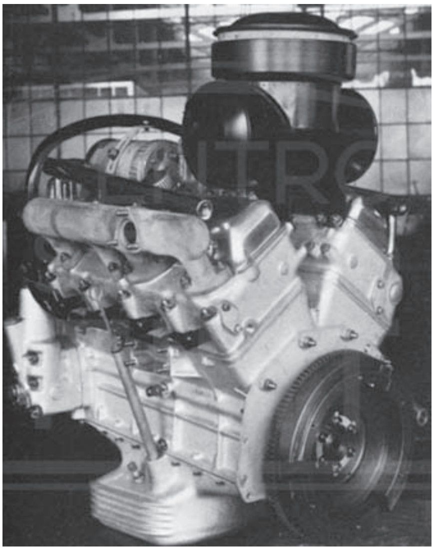
I was always being troubled by breaks in the intense rhythm of my work. There would be visits from important people, interviews with inventors, from the simplest and most modest to the most conceited, all of whom I heard out patiently. There were frequent trips abroad, attendance at the presentation ceremonies for new models, interviews and time spent travelling about. At times I would even be called on to speak in public. A phone call from Gino Pestelli or Mariuccia Rubiolo announcing some occasion at which I would not only have to be present but also give a talk used to upset me almost physically. Until the day came and I finally shed the tension I would suffer terrible anxieties. Even my work suffered and such events were by no means uncommon. There was one terrible occasion when I had, for the first time, to make a speech in front of a select English audience. My knowledge of English was limited to what I had picked up studying on my own and translating technical reviews and books. But I knuckled under obediently when Valletta passed the task on to me. He had received an invitation from the Council of Industrial Design to present a paper in London on the occasion of a conference to be held at the Royal College of Art on the 19 and 20 September 1951. He gave me the letter of invitation saying that it was up to me to represent Fiat on the occasion. It is clear that he had mistaken the real meaning of the subject of the conference.

Gino Pestelli, journalist, born in Figline Valdarno near Florence in 1885. He joined Fiat in 1929 as head of the Press and Advertising Office. He was later appointed head of the press and public relations management. He then joined the management committee. He died in Turin in 1965.

Valletta, who did not know English, probably thought the conference was limited to design as such, full stop. The subject was actually: *Design Policy within Industry as a Responsibility of High Level Management*, which was the theme I then developed. I treated the subject in accordance with my convictions, trying to relate them to the policy of Fiat in that period. Nowadays the Italians would use the word *filosofia* (philosophy) in this context to express the meaning of *policy*. Anyway, I said in no uncertain terms that the choice of design, understood as the intrinsic and aesthetic values of a given project, should be the responsibility of the director of design. Then I branched out into a subject that has always appealed to me, the intimate relationship between engineering and art.

This was presented as the main paper to a large audience including the teachers and many students of the course in Industrial design at the Royal College of Art as well as numerous representatives of industry and made quite a stir. It was a big success with the architects and designers and aroused some surprise and bewilderment among the managerial levels in British industry. And at Fiat? No comment. A cavernous silence.

The *8V* automobile, which I have already referred to, deserves more attention, partly because of the reputation it gained for itself. The first tests of the *104-8V* engine had led to the heads and distribution controls being completely redesigned to produce more power. Following the good results obtained in trials it was decided to build a chassis directly derived from that of the *1400*, simply increasing the wheelbase to 2.850 mm, a decision which had the merit of falling in with the wishes of Gajal, the co-general manager. The chassis, designated the "104", was passed to Pininfarina so that the great coachbuilder could get out a preliminary study of the coachwork. This was all in 1950. Bono showed a certain antipathy for the project and Valletta seemed to ignore it. For my part I was against it, because the automobile was too big and heavy for an engine of a mere two litres or little more, even if it had eight cylinders. The prototype with coachwork by Pininfarina confirmed expectations. It aroused



The 104 engine in the version intended for a tourer and as the power plant for a prestige auto, later transformed for competition use. The photo shows clearly the two banks of cylinders forming a V of 70°.

little interest and was turned down for production by Fiat. In the meantime we had gone on perfecting the engine, awaiting approval for construction of the “106” sports model with independent suspension all round.

In a letter to Valletta, Bono and Gajal I suggested that the tourer with the *8V* engine should be derived from this and not from the *1400*.

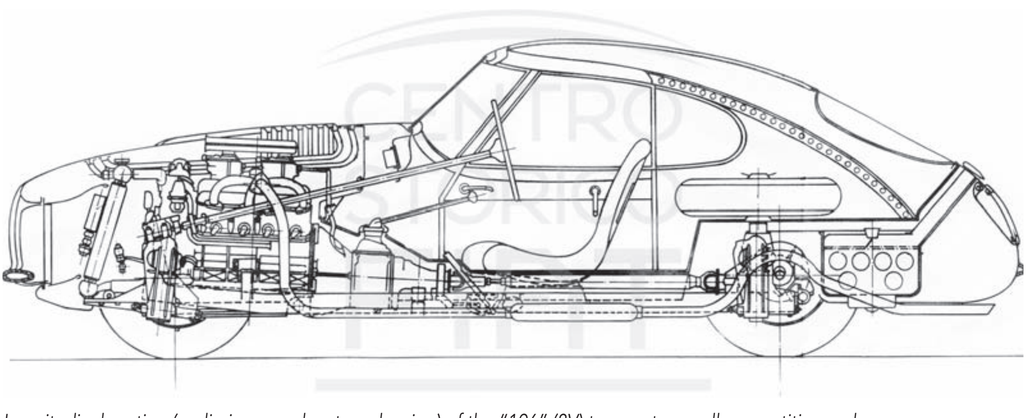
There followed the decision to build the “106” prototype and see the results. To avoid overburdening the Experimental Workshop it was decided to entrust the construction of the chassis and the assembly of the mechanicals to SIATA, Ambrosini’s outfit specializing in doing conversions of Fiat’s standard production models into sports cars. At that time Hruska, originally from Cisitalia, was working for the firm as a consultant. The coachwork was styled by Rapi, with some help from me in the choice of the design and, when the wooden model was being made, in the definition of the final form.

The auto was soon completed. Salamano helped to perfect its handling and already excellent road holding. By carefully weighting the antiroll bar he obtained a marked degree of understeer which enabled bends to be taken at higher speeds but which tended to be a bit off-putting for racing drivers accustomed to autos which oversteered. Production was mainly carried out by the Experimental Constructions Workshop and was limited to 114 vehicles. It came out in 1952 with the designation *8V* and won many sporting awards, arousing great enthusiasm among auto buffs.

A reinforced plastic body built by the Lingotto Experimental Workshop was presented at the Geneva Motor Show in 1954, while the production of aluminium-plate bodies continued until the end of the year, when it was closed down for economic reasons.

After the episode of the “106” the eight-cylinder engine was abandoned. It was now accepted that the *1900* was to be the only Fiat model above the *1400* class.

During the period when the *1900* was being tested I had followed the example of Mercedes and got designs done for a diesel version, starting with an engine of 1.640 cc. When I mentioned it to Bono he was all for it and, as usual, urged me to work fast. For economic reasons we decided to unify the engine size at 1.900 cc. This was the maximum that the *105* engine could take in the gasoline version at 4.600 revs per

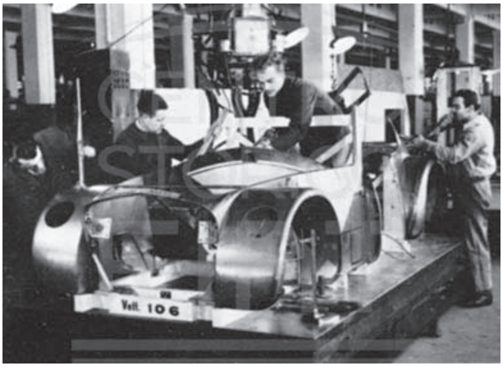


Longitudinal section (preliminary explanatory drawing) of the “106” (8V) two-seater small competition sedan. Dated 28 April 1952.

minute and in the diesel version at 3.200 revs per minute. The increase in size made it easier to solve the exhaust fume problem, which was insoluble with small diesel engines in those.

The designs and experimental engines were completed in a very short time. As we had chosen the Ricardo *Comet* type of combustion chamber we had the right to consult the celebrated English inventor and ask for the collaboration of his experts, since Fiat had – and still has – a consultancy contract which Bruschi and Zerbi had been responsible for as long ago as 1930, at the start of studies on pre-combustion chambers on diesel engines for trucks.

But I was against bringing in our English friends because I was afraid that their intervention might be a source of delay. It was lucky I did not bring them in, because in an exceptionally short time the engine was perfected and judged ready for being put into mass production. It was mounted on the *1400* auto and called the *1400 diesel* though it was actually a *1900* engine.z



Some phases during assembly of metal coachwork on an 8V coupé made of sheet steel (1952).

The 8V coupé of Auricchio and Bozzini placed fifth in the 2000 class of the 1952 Mille Miglia.

The *1400 diesel* was presented to the public six months after the *1900*, in 1953. Towards the end of the year the diesel version of the *Campagnola* also came out.

In spring of 1952, when the stir caused by the presentation of the *8V* at the Turin Motor Show had not yet died away, a grave episode disrupted work at Fiat and caused agitation among the executives. On the evening of April 17, Erio Codecà went for a walk with his dog as usual and as he was crossing the road was killed by a number of shots fired from a pistol. At the time he was director of SPA. It was an assassination with a political motive, so Valletta told me, engineered by the Communists to spread fear and panic among Fiat's executives. It was a blow for all of us. I lost a precious colleague and a friend. His memory is bound up with the journeys I made to Germany both before and after the war. The true motive behind this vile murder is still a mystery.

While work was going on at top speed in Turin to turn out new models with the least possible delay, Deutsche Fiat at Heilbronn in Germany was setting up a small technical office which was to be of great service to Fiat in training personnel in the design sector and in producing prototypes that proved valuable to us in our studies. This office was started in 1952 with the return of Antonio Fessia to Fiat.

One day in March Valletta called me into his office and with a mischievous look said: "Giacosa old chap, how do you feel about the possibility of Fessia coming back to us? As you know, he teaches at the Milan Polytechnic but he's practically unemployed. Fessia could be useful at Fiat."

From time to time Fessia's name had come up after his resignation from Fiat. He had joined CEMSA as technical director: this was a firm belonging to the group headed by Gianni Caproni which also controlled the Isotta Fraschini company. CEMSA manufactured small arms until 1944 but Fessia directed the firm towards the construction of automobiles and designed a front-wheel drive model. This, the "F 11", had a 1.100 cc boxer engine with four opposed cylinders and was rather over elaborate and heavy (as was the Lancia *Flavia* fifteen years later). He had sought the aid of some of Fiat's design engineers for the project. With coachwork by Bertone, the

Antonio Fessia reading a paper to an ISO conference in Turin, September 1961.

"F 11" was presented at the Paris Show in 1947. Before industrial production began ten were produced but CEMSA went out of business and had to close down. Fessia then found a job with the Ducati company, where he put one of his wayward ideas into practice, fitting a motorcycle with automatic transmission along the lines of the sort used on American autos, with a torque convertor. The motorcycle was not a success and production was soon given up.

While Valletta was talking I was busy turning the matter over in my mind. Fessia, a theoretician and first-rate mathematician, was a both rational and wayward; a great conversationalist, a director with drive. He was capable of judging and choosing between designs done by others but incapable of doing them himself and so – in my opinion – not the right person to guide the thoughts and hand of a designer.

Ambition, made turbulent by some inner tangle of motives whose source I could not define but vaguely intuited, made him quarrelsome, pugnacious, capable of placing his own personal satisfaction before the interests of the organization he belonged to. If he returned to Fiat he would consider me a rival. Still, I had an affectionate sympathy for him, admiration for those qualities which he possessed and I lacked, and gratitude for the confidence he had always shown in me when he was my boss.

After a moment's thought I told Valletta that I had no reason to oppose Fessia's return to Fiat, provided that he was not going to be in a position to interfere with my work at Mirafiori.

Fessia came back on 1 April 1952 and was sent to Fiat's assembly plant at Heilbronn in Germany where Piero Bonelli was general manager. He was put in charge of a technical office with a number of draughtsmen and a young engineer sent from Turin, Vittorio Montanari.

Returning to the front-wheel drive concept, Fessia had a small two-seater designed with a two-cylinder engine derived from the *1100* by eliminating the two intermediate cylinders.

Built without much care and not properly tuned, the auto was sent to Turin to be examined by the General Management and subjected to tests. The engine shuddered and vibrated excessively; the front suspension with the wheel bearings made of aluminium seemed unsafe. The wheel-joints also looked inadequate and the coachwork was unattractive.

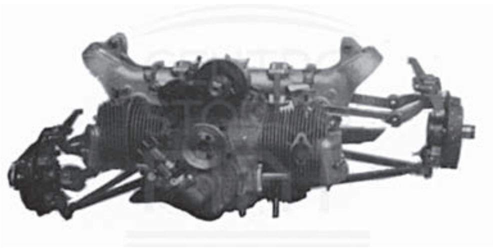
Salamano looked gloatingly at the wretched prototype, the victim doomed to show that front drive was unworthy of a Fiat automobile, anticipating the pleasure he would have in telling Valletta and Bono that Fessia's brainchild was below par. I was not of his opinion but Salamano was not a man to be convinced by words. His first trial run on the Pino rise was enough to split the universals and damage the front suspension. The little auto was sent back to Heilbronn and that was the last we heard of it. Later on Fessia had a prototype with a four-cylinder 1.100 cc V engine built.

Piero Bonelli, born in Turin in 1896. He entered Fiat in 1916 as head of the Export Department.
In 1927 he was given responsibility for Fiat sales in Germany, a position he held until he had re-established Fiat's position in the German market in the post-war period.
In 1955 he became director for central Europe and joined the management committee.
Honorary President of Steyr Fiat and Österreichische Fiat and for over forty year President and managing director of Deutsche Fiat. He retired in 1967 and died in Turin in 1978.

Whenever I met Bonelli he would complain bitterly of Fessia's excesses and the sums spent on testing. Relations between Bonelli and Fessia grew more and more strained to the point where Bonelli threatened to resign if Fessia was not removed from Fiat's German branch. "It's either me or him," he said.

In the nick of time an opportunity presented itself to Valletta: in 1955 he allowed Fessia to go over to Lancia. Lancia then adopted front-wheel drive but this was obviously not the reason for the progressive decline of that once-glorious marque. The choice of models, their excessive weight and high manufacturing costs were, in my opinion, the reasons for failure.

While Montabone and his team of engineers and technicians, led by the highly efficient Bellicardi, went ahead purposefully to complete the tests of the turbine engine and build the chassis, skilfully adapting the *8V* for the purpose, Rapi was at work designing the coachwork. The one-to-five scale model was tested in the wind tunnel at the Turin Polytechnic and the results seemed satisfactory. I had everything ready for the auto to be built: this would show that the Motor Vehicle Design Section was also capable of producing a small turbine, that our design engineers were on a par with those in the Aeronautical Division and if needed they could enable Fiat to complete with any foreign manufacturers in the small turbine field. Five years' study had been needed to train engineers and technicians specializing in fluid dynamics and the particular technology of constructing high-speed turbines able to withstand



The prototype NSU-Fiat F03 with a two-cylinder air-cooled boxer engine and front-wheel drive, built under the direction of Antonio Fessia during his period at Heilbronn.

The prototype NSU-Fiat F05, also built at Heilbronn, with a two-cylinder water-cooled engine which incorporated components of the Fiat 1100 engine. This small car was also designed with front-wheel drive (1952-53).

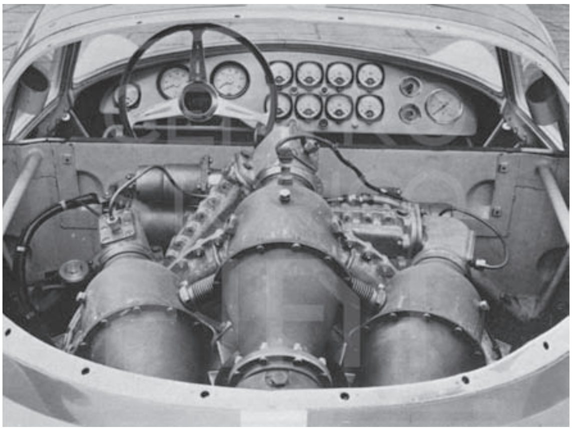
the rapid and extreme changes in temperature that occur in automobile engines. The automobile was there as a concrete testimony to the abilities of the team of young men who had thrown themselves with enthusiasm into this far from easy task. For Fiat it was precious experience gained. It showed that the turbine was not yet suited to the private automobile nor may ever become so, but it should still be thoroughly studied and perfected for other uses.

The presentation of the turbine engine to the authorities and the press was an event that caused quite a stir all over the world. It was a festive occasion for me and my fellow-workers, with the shrill whistling of the engine providing the high point of a bright spring day in 1954 at the Turin Motor Show. I had given a talk on the subject the evening before to the Turin Rotary Club, the invitation being extended to me by Bono. The talk had as its subject: "Experimental Innovations in Motoring". On the runway at Caselle airport, placed at our disposal for the presentation of this unusual automobile, there was a festive throng of the leading representatives of the city, journalists and Fiat executives, from the President down. My wife and daughter were also happy to be there. Fiat got a good deal of benefit in the way of publicity from the turbine auto. I was satisfied because my effort had proved useful in different ways.

With the construction of that prototype Fiat made a sterling investment in terms of staff who had and still have an important role in developing design and research. Twenty years later some of the technicians who had helped build the first turbine have been working together again under Savonuzzi on the design and testing of a turbine engine that is incomparably more advanced, intended for trials on buses and trucks. Their experience and knowledge of the theoretical and practical problems involved have been invaluable.

The stir caused by the turbine auto was renewed with the emergence of the *1400 A*, including the diesel version, the *1100/103 Familiare* and the *1900 A Gran Luce* sedan, in a more powerful version with improved coachwork.

At that time Valletta called me with an idea that gave me quite a surprise. He wanted to enable me to carry out research and develop designs without being hampered by tradition and the milieu at Fiat. He understood the importance of creativity. I listened to him surprised, flattered, inwardly satisfied. Coming to the point, he



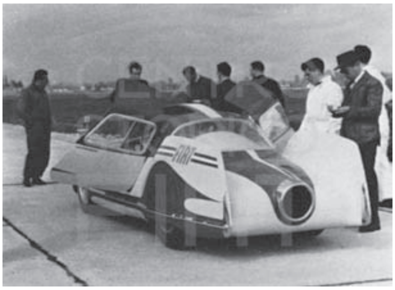
Partial view of the turbine engine and the vehicle's dashboard.

had decided to set up a company with me in sole charge to study and develop new designs in the field of engines and automobiles. The company was to be called SIRA: Società industriale ricerche automobilistiche.

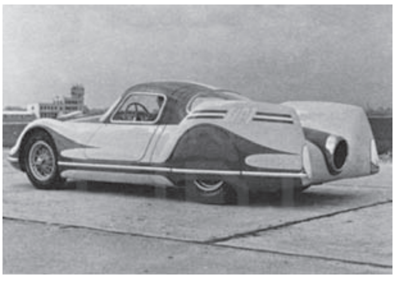
I asked the management of the Construction Section at Fiat to find me premises. They came up with a set of offices in the centre of the city, where corso Vittorio Emanuele II crosses corso Galileo Ferraris to form a large circular space with, in the centre, a statue of the "gentleman king", the father of the fatherland, who overlooks trees and houses from the top of his lofty column on its great octagonal base. There, far from the works and offices of Mirafiori, I could meditate under the sovereign protection of the great and good, martial and bewhiskered king.

By knocking down some dividing walls we made room for a studio where a dozen or so draughtsmen could work. This was enough for me. I did not intend to burden myself with the organization and administration of an experimental workshop which would have distracted part of my time and energy from designing, the most interesting and exhilarating part of any project as far as I am concerned.

The premises are still occupied by SIRA and my office is still there, in one of the corners, with its sides facing east and south. From its windows I can look out over the roofs of the city and gaze on the hills to the east and, far to the south, when the atmosphere is clear and the sky red with sunset, the familiar silhouette of Monviso.



Spring 1954: scene at the presentation of the turbine auto on the runway of the Caselle Torinese airport.



The turbine auto with Carlo Salamano at the wheel during the trials and the presentation of the vehicle to the motoring press on the runway of Caselle Torinese airport. Spring 1954.

CHAPTER XIV

THE “110” PROJECT FOR THE *NUOVA 500*

STUDIES FOR THE ENGINE

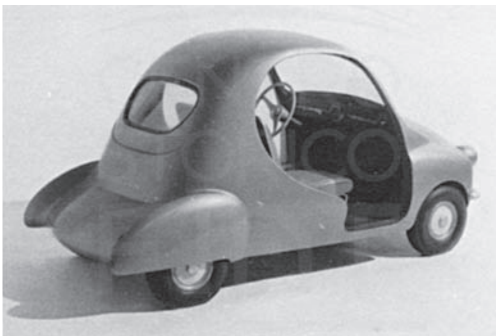
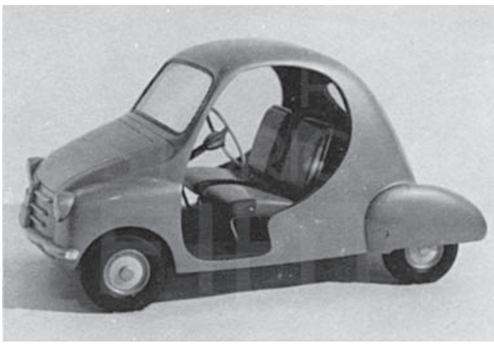
MANY PROBLEMS

While the *600* was in the experimental phase we had resumed studies for the minimum auto, even smaller and cheaper. The Italians wanted to become auto-owners and would willingly put up with being a bit cramped provided they could travel on four wheels. However small it might be, an automobile would always be more comfortable than a motor scooter, especially when the weather was cold or wet.

After the experimental “400” in 1939 we had not studied any automobile as small and light as this one. It had to be worked out again from the beginning. The 500 cc “100” with a transverse engine and front-wheel drive designed in 1947 had never been built. The engine had been tried out on the test-bench and then discarded to make way for the “102” engines.

Corradino D’Ascanio, engineer, born in Popoli (Pescara) in 1891. At an early age he built and flight-tested a glider of his own construction. He took his degree in Engineering in Turin in 1914 and was an engineering officer with an aviation detachment during the Great War. In 1930 he built a helicopter with which he set international records for altitude (18 m), duration (8 min 45 sec), and distance (more than 1 km).
He also designed the Vespa motor scooter, built by Piaggio and sold all over the world.

Reports came from Germany of mini autos, half-way between the auto and the motorbike. Bonelli, the local director, was pressing for an ultra-economic automobile to be put into the planning stage. Fiat Germany had an assembly plant at Heilbronn and a coachwork factory in the nearby town of Weinsberg. A design engineer by the name of Bauhof was at work there. He had a lively imagination and a restlessly enterprising spirit. Shy and retiring but with a fertile mind, persistence and diligence,

Scale model of a mini-car inspired by the styling of the Vespa scooter built by Piaggio.

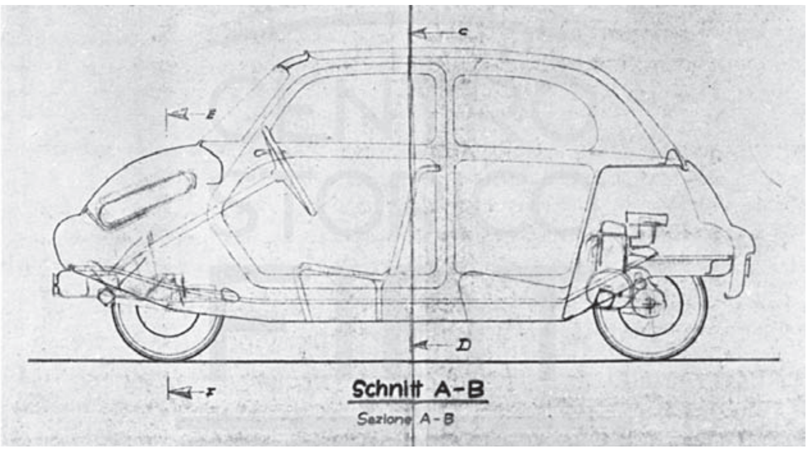
he succeeded to some extent in carrying out his ideas. Bonelli had authorized him to design a small car and he sent me his drawings.

I liked this Bauhof, who even managed to speak some Italian when defending his ideas. Not that many words were needed since his drawings spoke eloquently for themselves. He proposed a single-cylinder two-stroke air-cooled engine built by ILO, or else a two-stroke double-pistoned engine on the Garelli system built by Triumph Germany. Although I was against two-stroke engines for a variety of reasons I tried out the ILO engine in Turin on the test-bench. As I had predicted, it turned out to be unsuited to the sort of vehicle Fiat had in mind. But Bauhof's ideas about coachwork construction interested me and I kept them in mind when studies were under way in the technical office at Mirafiori. This was in 1953.

In the meantime Bauhof had had his prototype built and sent to Turin. I found it highly interesting in its extreme simplicity but the managerial reactions in the different departments were unanimous in considering it too rough and ready and inadequate to serve as an automobile.

For some time I had been getting preliminary models made of small unconventional automobiles meant to compete with the motor scooter, especially with the Piaggio company's fantastic Vespa, the brainchild of D'Ascanio, the helicopter designer. I went so far as to have a model made whose form was inspired by the Vespa. These designs were an enjoyable pastime for my mind when it was not absorbed in the

Prototype of the utility model built to Bauhof's designs in the Weinsberg workshops of Deutsche Fiat (1953).



Explanatory sketch (by Bauhof himself) showing the arrangement of volumes in longitudinal section of a utility model with two-stroke single-cylinder ILO rear-mounted engine. The outline of the drive-system was added by Giacosa to Baushof's sketch for the coachwork (undated).

numerous harassing problems of the immense programme that was being planned in the period just before the *600* went into production.

While I had the first designs developed, with the wheels, suspension and steering, I kept wondering whether it was economically justified to make the various components smaller than in the *600*, seeing that the loads and stresses they had to bear would be only slightly smaller. If they could be standardized with the *600* it would mean a big saving in investments in machine tools, but the increased weight would lead to higher costs all the same. Only careful calculations that took into account the numbers produced and the size of investments could provide an answer to the problem. But in those days it was not yet possible for me to do this. So I settled for a middle course in developing the project, using common sense as my guide.

I had no doubts about the engine: it would be a two-cylinder, tour-stroke, in-line engine with air-cooling. In-line engines, with the cylinders placed side by side, are by far the simplest and cheapest sort of two-cylinder engine. The engine-transmission unit can be mounted transversely without any trouble and this position has the advantage of being simple and mechanically very efficient since it does not involve bevel gearing and helicoidal cogs. Then if the engine unit is placed at the back of the auto the drive can be transmitted simply to the wheels with a single universal for each semi-axle, as long as one is only aiming at a cheap model with modest performance. All the studies we had conducted, including ones with engines having two opposed cylinders, led me to the same conclusion.

In those days I was right to consider air-cooling simpler, more practical and economical than water-cooling, one reason being that the increased fuel consumption caused by the more powerful fan was not so great as to matter. So I had the designs developed along the lines suggested. The new auto was designated the “100”.

I gave the job of designing the engine to Giovanni Torazza, an engineer who was the only university graduate among those on my staff available who knew how to do technical drawings. I had first met him when he had just finished studying and was looking for a job. What interested me was his degree thesis: a plan for an engine with an unusual layout, four parallel cylinders arranged with their axes along the sides of a square. An imaginative person with a real creative flair. I had given instructions for him to be taken on but the bureaucratic procedures at Fiat had dragged for so long that in the meantime the young engineer had taken a job with Lancia. I had not given up my intention of having him to work with me and eventually the day came when I was able to snaffle him from Lancia and get him into Fiat. Gianni Lancia, who used to run his company with a very firm hand in those days, told me I had pulled a fast one on him but let it go at that. A little earlier I had got onto friendly terms with him.

I gave Mosso the task of designing the gearbox, which was placed transversely with the engine and so called for a completely new arrangement.

I gave particular attention to the coachwork, concerned as I was to make the model attractive with a light structure but one that would also be rugged, combining simplicity with economy. I had two plaster mock-ups built to full scale, one similar to the *600*, the other completely new. Not a day went by without my spending some time in the modelling shop, always working together with Alberti. He exerted himself particularly in studying the structure and composition of the body shell. In shaping the plaster he aimed constantly at reducing the plate metal surface so as to reduce weight and costs, just as I had done with the *600*.

When I presented the two unpainted mock-ups to Valletta and the other members of the presidential committee they looked mutely bewildered. Confronted by those white, ghostly shapes, without knowing the tangled history of alterations, revisions, modifications without end that lay behind their forms, they did not dare to voice criticisms. But after they had studied the aesthetics involved and the reasoning that had led to the various choices made they began to thaw a bit. Since they had to choose, they decided to back me up and gave their approval to the new model. Fiorelli abandoned his usual taciturnity to say that he thought the new shape was more attractive than the *600*'s, for which I was grateful to him.

The brevity of the ceremony and its favourable conclusion was a tremendous fillip to me and my team. We could finally go right ahead along the lines we had chosen.

Now that the coachwork had been accepted the new model "110" was discussed for the first time in the meeting for "Reports on new models", held on 18 October 1954. Those taking part were Valletta, Bono, Gajal, Fiorelli, Montabone, De Regibus, and naturally myself.

Since "110" sounded a bit meaningless the model was designated the "400" on that occasion.

It was decided that the engine should turn out 14 hp, its capacity should be 480 cc with overhead valves but slightly more if we opted for side valves, a speed of 85 km/h and fuel consumption of 4,5 litres per 100 km. Weight should be 370 kg. The specimen

Full-scale plaster mock-up of the 110-518, a coachwork design for the Nuova 500, August 1954.

The side view of the 110-518 clearly shows the cutaway rear, designed as a result of the sales management's concern lest a four-seater 500 might compete with the 600. This version would have accommodated two children in the back with difficulty. The compromise between two seats and full space for four finally harmed initial sales of the Nuova 500, which, though more spacious, could not accommodate four adults comfortably.

model was to be examined on 30 June 1955 and production was scheduled to start in mid 1956. A four-seater model instead of the two-seater had to be prepared for the German market by late January 1955 (though Valletta in principle had ruled out the production of a model different from the standard Fiat in Germany). A prototype also had to be built for Autobianchi with different luxury coachwork.

The schedule was fearfully tight since the project had been fitted into a programme packed with other work. The same meeting fixed the deadlines for construction of the *600* equipped with a sunhatch, the *600 TV*, the *600 Multipla* and the pickup, all to be put into production in the course of 1955. A new version of the *1100* was called for, with a 1200±1300 engine (to camouflage it we called it the *1100* "Argentina"), and two completely new models: the "111", which was beginning to be mentioned as a replacement for the "101"-*1400* and "105"-*1900*, and the "112" with a 2.300 cc engine. But I was not unduly bothered. I was beginning to realize that Bono was not particularly demanding about deadlines since he himself had need of the indulgence of others because of his own disregard for punctuality.

The first specimen of the "110" was built before the end of the same month, the designs having been prepared in advance, even before the meeting of the presidential committee that fixed the deadlines and specifications for it. Tests were now started.

The suspension of the engine-transmission unit was awful, creating marked vibrations in the coachwork. This defect, perhaps not the worst brought to light by the first tests, was immediately and over-hastily considered, by those responsible for the tests and by Montabone himself, to be the result of a fault in design. For the sake of objectivity but without concealing my opposition, I accepted the suggestion that we should try placing the engine lengthwise instead of transversely. For the sake of speed the test was carried out using the gearbox of the *600*.

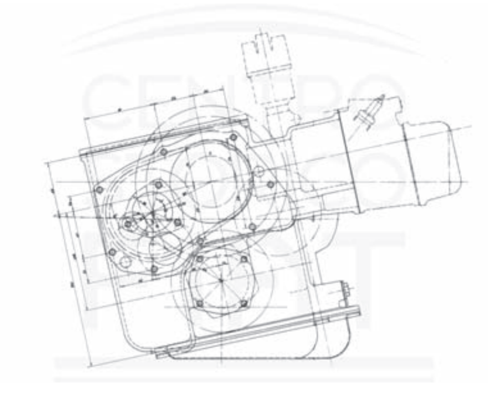
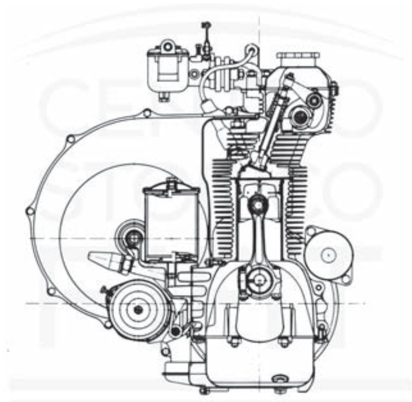


Diagram of the "500 X" engine-gearbox. The design, dating from April 1938, was intended to produce an economy model with a four-cylinder transverse engine laid out for front-wheel drive.

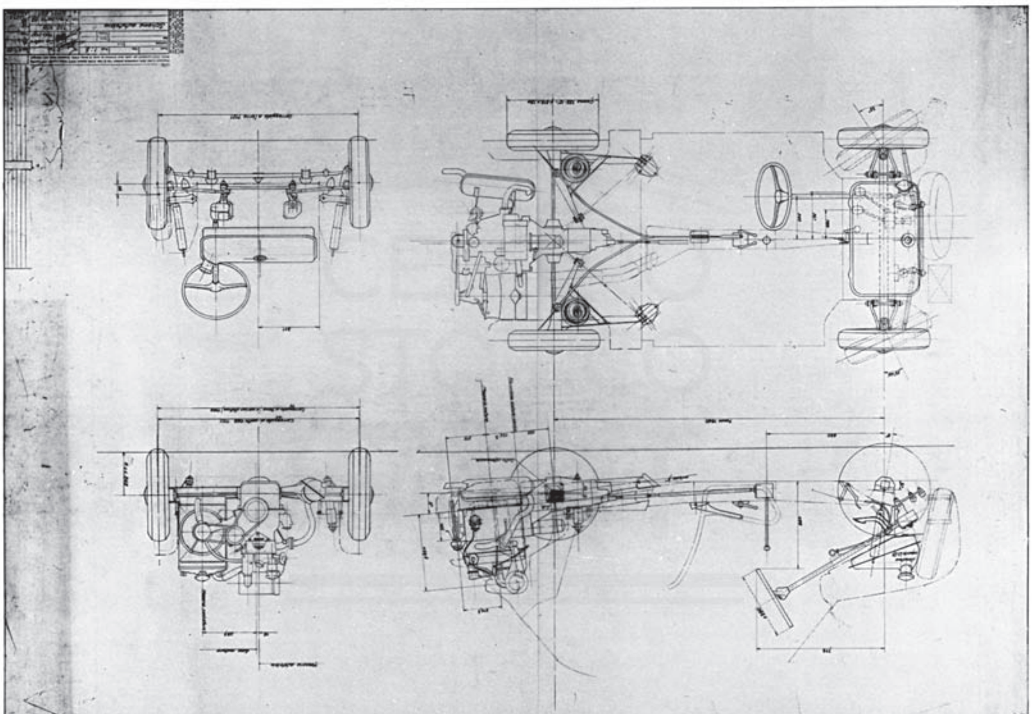


Various engine designs were compared for the minimal auto, the project that lead to the Nuova 500. Five of the six engine designs were constructed and fully tested between 1953 and 1955. Above, cross-section of the air-cooled two-cylinder "110 E1" engine (66x70 mm, 479 cc). May 1953.

After a series of attempts using various types of elastic connections between the engine and the body shell, the suspension of the power plant was considered acceptable as far as vibrations went. Unfortunately the same tenacity in solving the problem both theoretically and practically had not been applied to the initial design. Montabone's pragmatism, to call it that, had won the day. This meant that a simple, economical and compact arrangement, the transverse engine, was abandoned. The principle was put into practice a few years later by the NSU company in Germany.

Bono thought it advisable to review the project with the men in charge of production and in the presence of Fiorelli and Montabone. I promised to have a second look at the various possible arrangements but I came back to overhead valves with a camshaft in the crankcase. Then they looked into the structure of the engine and the crankshaft, and I argued strongly in favour of the system as it stood, with the crankpins set side by side, the only arrangement that enables the phases of the two cylinders to be spaced regularly at 180° from each other.

The experience gained with experimental engines with two opposed cylinders built earlier for the "102" and then for the *600* and our studies of the Volkswagen engine were very useful. For the cylinder barrels we found it best to use the classical system also used by Volkswagen in its famous "people's auto".



Diagrams of the 110.100 chassis, a provisional version of the Nuova 500, designed with a water-cooled engine. Drawing dated 6 April 1959.

The aluminium crankcase was designed so as to be manufactured by pressure casting. In the case of the crankshaft, long and careful study led us for the first time to choose cast iron instead of forged steel. To learn the technique of pearlitic iron casting we turned to a German firm, which was commissioned to build the first specimens. We spent a long time perfecting the system of circulating the air to cool the head and cylinders and the air filters for the engine. Since the dimensions of the crankcase did not leave room to fit a cartridge filter for the oil we used a centrifugal filter placed at the front end of the drive shaft. We spent a lot of time testing and perfecting it and the result was excellent. Each part was gradually being improved and most of the uncertainties were fading.

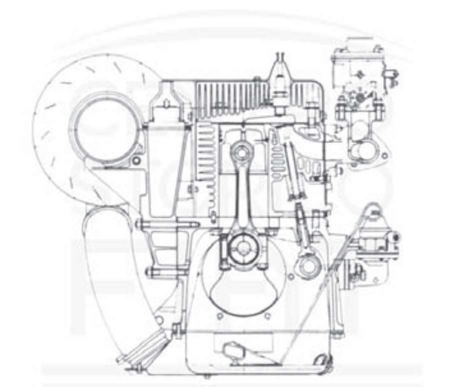
It was a strenuous period of research and revision. Valletta, Bono and Gajal evidently consulted Genero and Fiorelli and also sounded Salamano and Montabone for their personal opinions, which were not always the same as mine.

To convince everyone and most of all myself that the design as it had been developed was best suited to our aims, I had further versions of the engine designed, calling them “Test 2”, “Test 3”, “Test 4”: two opposed cylinders, two cylinders placed side by side with overhead valves, two cylinders placed side by side with side valves. In the end we stuck to the original solution with modifications mainly to make allowances for assembly and manufacturing requirements.

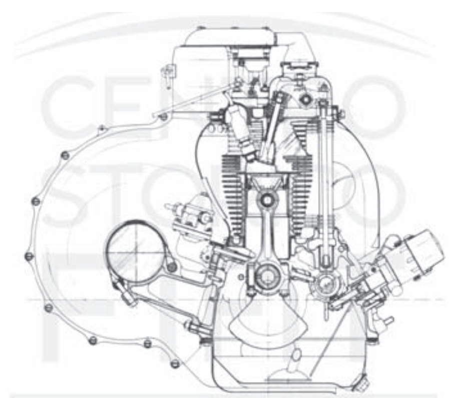
In April and March 1955 the designs were progressively completed and sent to the machine shop. The auto designs were designated “110 E3”, the engine designs “110 E5”. I was sure that most of the defects of the first prototype, especially the vibrations and deficiencies in handling and road holding, would be eliminated or reduced to acceptable levels.

After the designs for the right-hand drive version and the “110 B” Autobianchi had also been sent to the machine shop, I suggested building five engines, two for left-hand drive autos, one for right-hand and two “110 B” engines. I envisaged construction of the first prototype by the end of June.

Fiorelli informed me on April 2 that investment in production would be about 7.000 million lire for an output of 300 autos a day and 10.000 million for 500 a day.



Cross-section of the air-cooled two-cylinder “110 E4” engine (70x70 mm, 539,5 cc). February 1955.

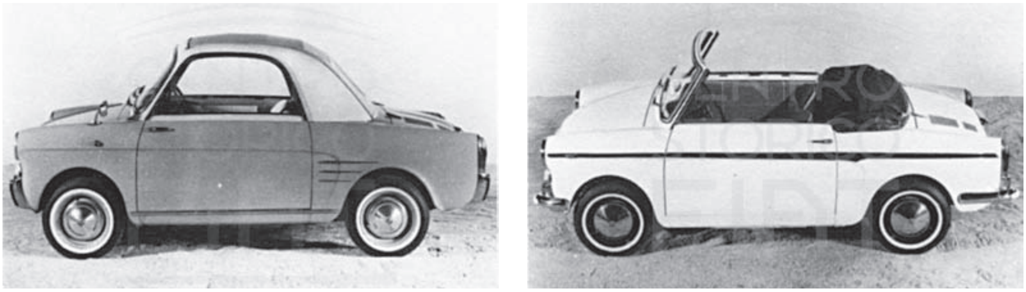


Cross-section of the air-cooled two-cylinder “110 E5” (66x70 mm, 479 cc). April 1955.

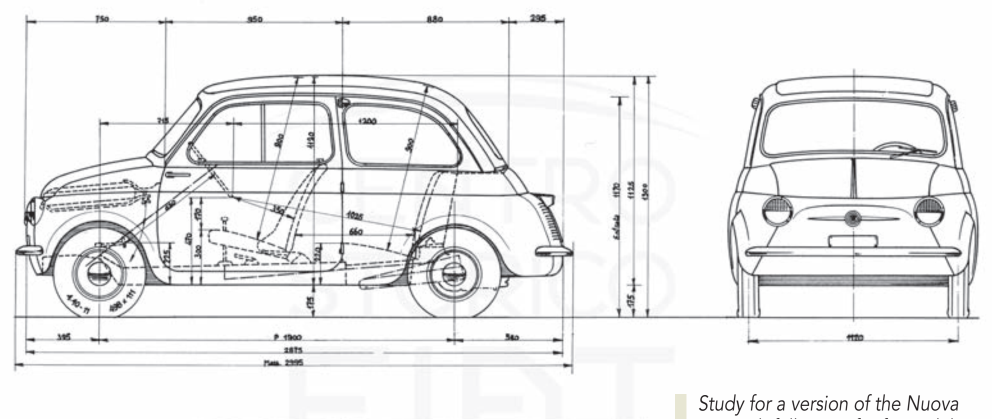
Valletta decided to provide for production of 500 units a day of the mechanicals and the moulded sections of the bodywork and only 300 units of the parts produced by the subsidiary works at Lingotto, with the intention of assigning the difference to a factory that was to be built in Naples.

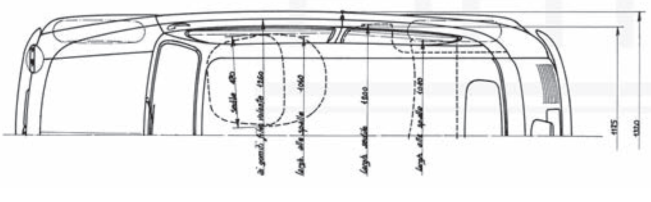
While work was proceeding on the prototypes, I continued to work on the old model, making continual improvements in accordance with the latest designs. Early in June I reported that there were still some fairly serious defects such as the noisiness of the engine, a certain irregularity in the carburetion caused mainly by the shaking of the engine and excessive sensitivity of the steering, a result of the oversteering characteristic of rear-engined autos.

It seemed as if the noisiness of the engine could be dealt with – but only partially – by using drive gears for the camshaft made of a plastic material reinforced with nylon, while the irregular carburetion could be remedied by improvements to the carburettor. The third defect, which was really serious, involved us in tests



The Bianchina, produced by Autobianchi at Desio, was practically a deluxe version of the Nuova 500, using almost identical mechanicals. Various versions were made: coupé convertible, cabriolet (illustrated here) and four-seater.

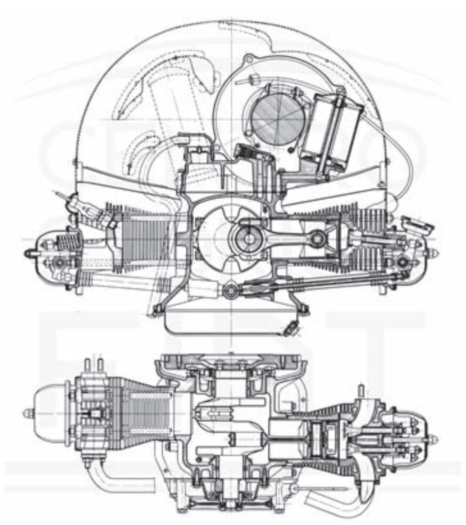




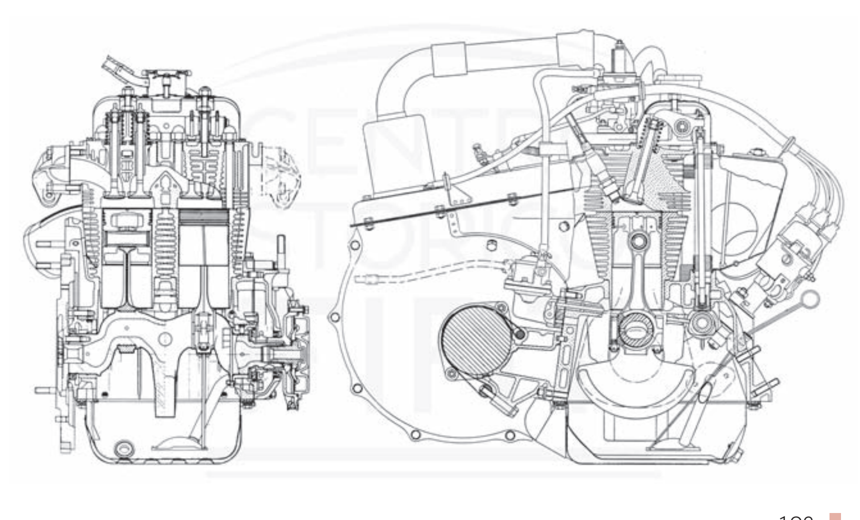
Study for a version of the Nuova 500 with full space for four adults. This design, designated the 110-540, was not followed up for fear that it might damage sales of the 600. It was reconsidered in the period when the Nuova 500 was to be replaced by the 126. Design dated 27 August 1954.

which showed that it could be corrected by placing an additional weight of 40 kg on the front wheels. Since this was not a feasible solution I asked for more time to work on the problem and requested that the date for completion of the final prototype should be deferred.

During the *600* project I had always felt sure of Bono's support because of his serene confidence in my decisions. With the "110", on the contrary, he seemed to have misgivings, especially about the engine. While he accepted the arguments I used in defence of my design and the project went ahead according to my instructions, he never let slip a chance to urge me not to abandon the study of an engine with two opposed cylinders and even a single-cylinder version. I tried to show with the relevant figures that two in-line cylinders were the best and most economical way of solving the problem. I pointed out that the "110" would be competing with the *600* whose extremely simple four-cylinder engine was mass-produced at such a low cost as to make it doubtful whether any cheaper engine could be built, even with only two



Sections of the "110 E6" engine with two horizontal opposed cylinders in the "boxer" arrangement. Bore 68 mm, stroke 60 mm (an "oversquare" arrangement), and capacity of 135,8 cc. This was one of the most sophisticated alternatives proposed for the Nuova 500 engine. July 1955.



Longitudinal section and cross-section of the 110 engine in the final version installed in the Nuova 500 (1957).

cylinders. Any engine with two opposed cylinders would cost more than the four of the *600*. Perhaps he let himself be influenced by Valletta or Gajal or someone else, but he seemed to have doubts about the validity of my arguments. This attitude of him also affected choices made for the "111" and "112" projects for new models to replace the *1400* and *1900*.

Despite all this, work on the "110" went straight ahead without any wavering. At this moment Valletta decided to send us off on a trip to the States, which served to ease the tension. It was to be a long one: from 3 September to 10 October. I was one of a group comprising Genero, Bono, De Regibus (as Bono's assistant), and Mario Tronville (as Genero's assistant). Genero was on the board of directors and Bono had great respect for him. Genero had been his director in the Lingotto works early in his career and his superior until 1946.

Ben Omega Petrazzini, born in Castello d'Annone (Asti) in 1897. After entering Fiat in 1914, working first at the Test Department of the works in corso Dante, he was transferred to Lingotto after an interval as works foreman for aero engine production.
In 1945 he was in charge of automobile production at Mirafiori, later becoming chief executive at Fiat automobiles. He died in Turin in 1973.

We left Turin for Paris on the evening of 3 September. Pigozzi met us at the Gare de Lyon, together with Cherier, who was manager of INTEC, Fiat's Paris office, Corziatto, the head of Simca, and Trouvé, who was in charge of public relations. Pigozzi invited us to his home for lunch. Then we had time for a work meeting and a quick visit to the Louvre before catching our flight.

The next morning we arrived at New York's international airport after eighteen hours of flying, having stopped over at Shannon and perhaps Gander as well, though I'm not sure. In the United States Labor Day was being celebrated. Garibaldi, manager of Fiat's New York office, was there to meet us with some of his executives. Panamerican Airways laid on a big Cadillac to take us to the Hotel Ambassador where we met up with Fiorelli, Gioia (at that time director of the metalworking section), Petrazzini (assistant director of the Mirafiori works), and other directors specializing in plant and equipment: Delzanno, Fattori, Tronville, all men formerly close to Genero who were now working under Fiorelli. The group led by Fiorelli was about to start a round of visits carefully planned to be of the maximum service in enabling Fiat's factories to introduce the most up-to-date manufacturing techniques.

Fiorelli had taken over from Genero in the management of the works and did not take very kindly to Genero's authoritarian presence during this round of visits, intended to provide inspiration for future technical developments in the Mirafiori works. This meant that Genero simply unloaded his opinions onto me.

Two views of an estate-type coachwork prototype, suggested for the project that led to the Bianchina Panoramica.

The trip was very instructive for all of us, though extremely strenuous. We went to Philadelphia, then back to New York, then off to Chicago, where the fantastic machine-tools display was being held and the awe-inspiring "Powerama" exhibition was put on by General Motors, then to Decatur, South Bend, Cincinnati, Columbus, Canton, Cleveland, Detroit, Buffalo, Trenton, Schenectady, Mahwah, New York.

The diary I completely filled on the return voyage aboard the "Andrea Doria", accompanied by Genero and his trusty aide Tronville, is packed with significant information.

Every day we visited one and sometimes two factories. We met a lot of important people. At General Motors' Technical Centre, not quite completed, I was received by Mr. Earl, the vice-President who had set up their styling section, and then I was taken round on a lengthy visit by Mr. Mitchell, who was to be his successor. This tour made a profound impression on me. I told Mitchell that the Technical Centre could be considered the Versailles of the modern age: the realm of the "Roi soleil" and that of General Motors. But I was also bewildered and overwhelmed by that outstanding example of modern architecture, by so much beauty and such display of wealth.

Not far from the highway that streaks through the heart of Detroit, the General Motors tower flashes out the number of autos built every day, increasing by one unit every forty seconds. GM's profits at half-year equaled the entire Fiat turnover for a year.

Meanwhile in Turin Montabone was carrying on with the work according to a programme I had fixed before leaving. A memo reached me in the States keeping me in the picture. Designs for the "E4" automobile had been completed in accordance with my instructions. This model had a special arrangement of the pedals, rack-and-pinion steering and the spare wheel stowed behind the dashboard under the hood, which was fixed instead of being hinged to open outwards. Designs were also complete for the engine with its two opposed cylinders. The final version of the "E5" was designed with a more practical arrangement for the fuel tank, spare wheel and battery. The front hood could be opened.

The report also contained data concerning the tests made and information about all the other projects being carried out. The *600* station wagon, the "101 B" (*1600*), the "112" (the new *1600* or *1900*), the turbine engine and numerous other studies.

When I got back I found the latest "110" experimental auto well on the way to being perfected. The engine was practically ready for approval after coming through the severest tests.

It was decided to hold a meeting to examine the situation with regard to new models. All the experimental prototypes were taken to the ancient Stupinigi Palace to be examined and discussed peacefully in the serene atmosphere of the beautiful garden. Count Camerana also took part as vice-President of Fiat and head of the commercial sector.

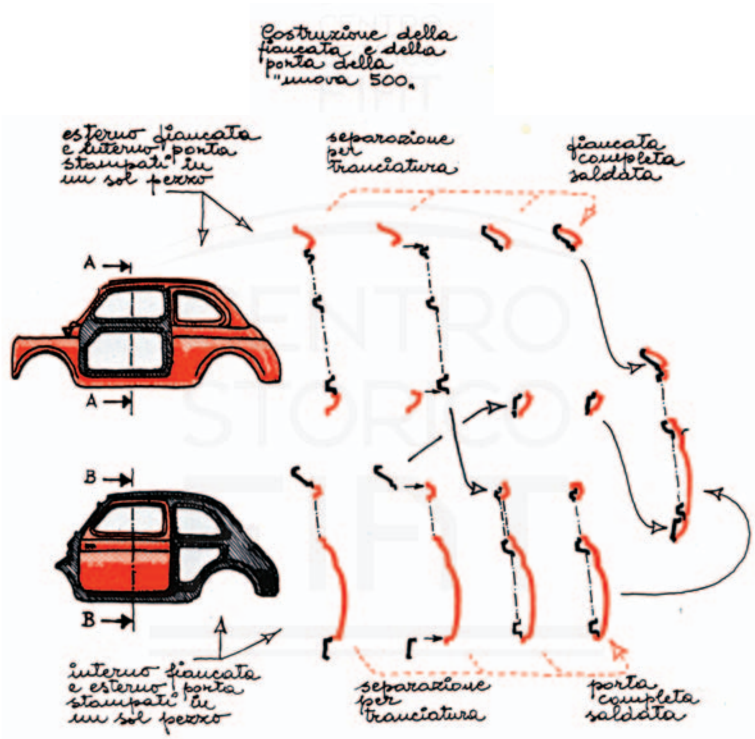
The minutes of the meeting headed "Report on new models, 18-10-1955" lists the prototypes ranged impressively in the forecourt between the castle and the garden. They were: the "400" in the two versions, Fiat and Autobianchi; the *600* sunhatch model; the *600* station wagon (later baptized the *Multipla*); the *1100* (1956); the *1100 TV*; the *1100 I* pickup; the *1400* (1956) with a 1.600 engine; the *1900* for Yugoslavia; the *1900 Gran Luce*.

The long discussion that followed led to the formulation of a work programme extending to 1958. Like all programmes, it was liable to changes arising out of changes in the market situation.

The Fiat and Autobianchi prototypes of the "400" – as the "110" was still being called by the commercial management – were approved but Bono asked once again that tests of the engine with two opposed cylinders should be continued right up to the end of the month until the engine was perfected.

On 4 January 1956 the first report on new models for the year was delivered. For the first time at such a meeting those present included Gianni Agnelli and Giovanni Nasi, who did not however take part actively in the discussion of the plan concerning new models for 1957 and after. It was confirmed that the little "110" would go into production in spring 1957, to be followed a few months later by the "110 B", the Autobianchi version. Fears were voiced that the public might consider the latter more attractive than the Fiat version so it was decided to put its price up, closer to that of the *600*, limiting demand to not more than fifty per day since the Autobianchi works at Desio could not turn out a larger number. There was also a suggestion that the roles should be reversed, with the Fiat works producing the "110 B" and the Autobianchi works being used for the

Giovanni Nasi, engineer, born in Villar Perosa (Turin) in1918, the nephew of Senator Agnelli. After the war he became mayor of Sestriere. In 1955 he was made President of the Centro italiano per la viabilità invernale, President of the Salone della Tecnica, President of SAI, of FITUR spa and vice-President of IFI.
In the period 1959-71 he was vice-President of Fiat. [He died in 1995].

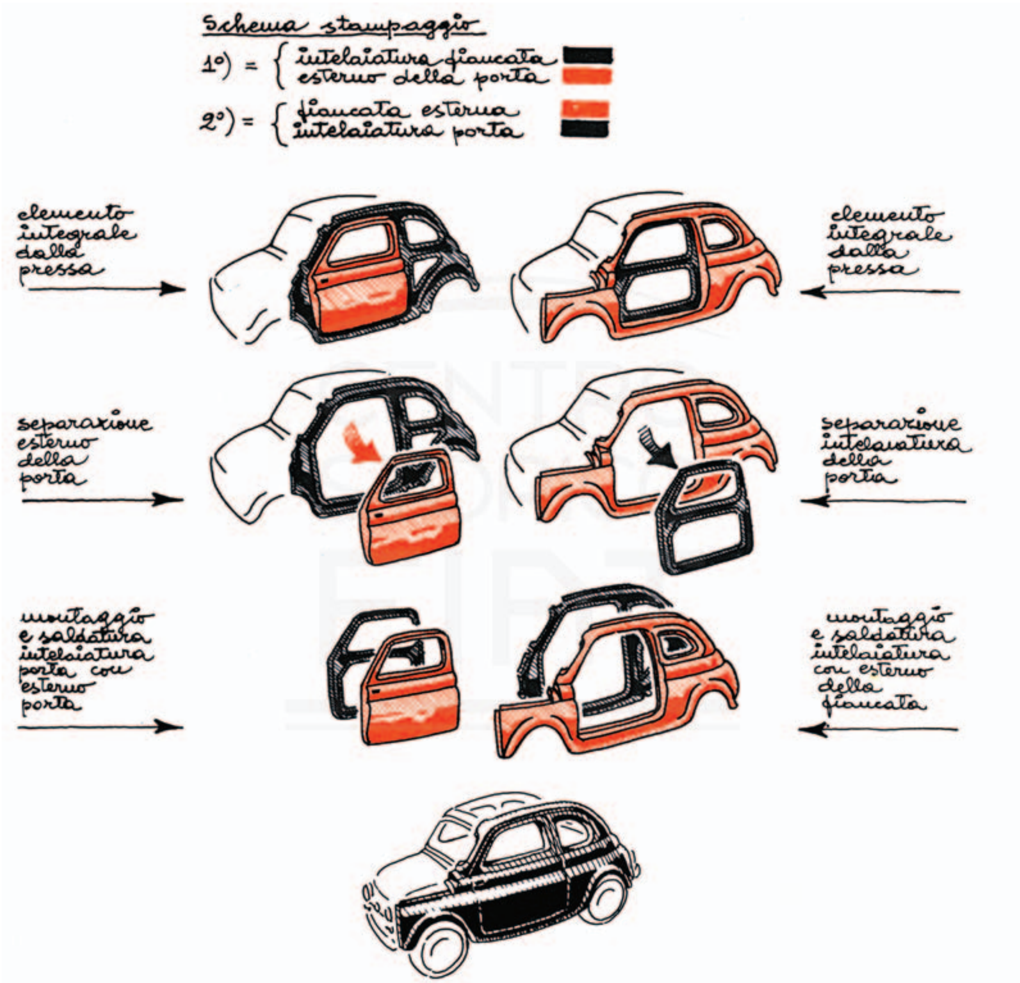


In studying the system for pressing the panels of the coachwork of the Nuova 500, every effort was made (as always in design) to achieve maximum economy of materials, reducing weight to improve performance but also to reduce the final cost of the product. Since the metal is supplied in sheets or ribbons of standard sizes, there is the problem of the left-over "snippets" which are difficult to reutilize and are generally sent for scrap. One big cause of waste could be in cutting the gap where the doors go. The schemes shown here (originally drawn for the periodical "Stile Industria") show how the problem of reutilizing the material was solved in this case.

Gianni Agnelli, lawyer by training, nephew of the founder of Fiat, born in Turin in 1921. A close collaborator of professor Valletta, under whose tutelage he gained his knowledge of the job, he became managing director of Fiat in 1963 and then, in 1966, took over full responsibility for the Fiat group of companies as President, Valletta having reached retiring age. Under his guidance the company broadened its development, promoting international operations such as the building of Togliattigrad, the USSR's auto manufacturing city.
He is also President of IFI (Istituto finanziario internazionale), which under his leadership has become a centre for large-scale business operation, of RIV-SKF and the Fondazione Agnelli. From 1974 to 1976 he was President of the Confindustria (Italian employers' federation). He is the mayor of Villar Perosa. [He died in 2003].

"110" but the idea was immediately squashed by Fiorelli and me, basing our rejection on technical and economic grounds.

Since there was some risk of the "110" creating competition for the *600* it was proposed to study a "600 A" with a more modern form. Bono brought up his idea of an engine with opposed cylinders once again and had the following statement written into the minutes: "Considering the probable need for future reductions in costs and



prices, studies will immediately begin with these ends in view, including the design of an air-cooled engine with two or four opposed cylinders." He was overlooking the fact that these very studies had already been made and that cost forecasts showed that engines with opposed cylinders were definitely more expensive than in-line ones. Such engines are not best suited to a small economy model. I was thoroughly informed on the subject because I was engaged in getting the SIRA technical office to develop opposed cylinder engines with highly original features. The general manager did not push the point any further and the matter ended there.

It always gives me great satisfaction to have saved the difference between the cost of an opposed cylinder engine and the extremely simple *500* engine, which is still being manufactured for the *126* in a slightly modified form. There were no more debates over the "110" after that and the attention of the General Management turned towards studies for the future, on which we had been engaged for some time.

While the two versions of the "110" were being subjected to the process of improvement which nowadays is called "optimization" (including modification of the front hood to improve its looks) the technical offices of the machine shop were designing the installations and equipment necessary for the assembly lines. At the

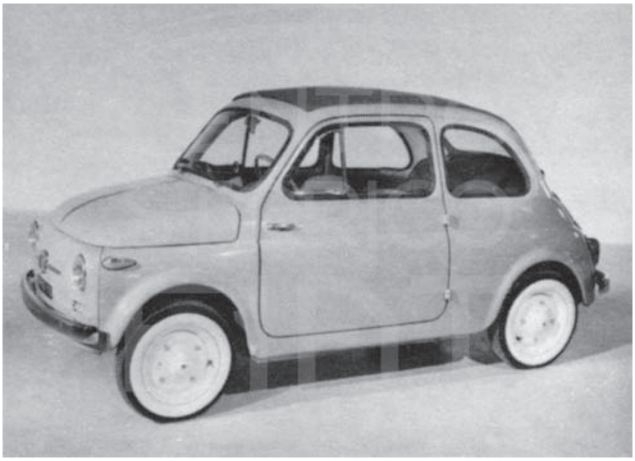
Master model for the coachwork dies of the Nuova 500. The master model is full-scale model of great accuracy made, at the time of the 600 and 500, in solid mahogany (later replaced by synthetic materials). It reproduced the form of all the surface accurate measurement point by point. This process is not so important now, following the arrival of new automatic plotter terminals attached to computers, making it possible to eliminate the manual plotting of sections.

same time the prototypes were totting up the kilometres, being driven along all sorts of roads and in all types of weather with results that finally gave grounds for confidence.

Unfortunately it was during these tests that a tragic accident occurred: a fearsome head-on collision which cost the life of Luigi Vestidello, our best test-driver after Salamano. The story of the *500* is closely bound up with the memory of this painstaking, tireless worker, a man who considered his job a mission.

The "110" was finally passed for production. Type-testing, on which approval for production depends, represents the final goal for the design section, whereas for the works it is only the starting point. As the date for production drew closer the factory was the scene of feverish activity to prepare the installations and equipment, to get in supplies of all the materials and accessories needed and carry out a complete check of them. Discussions began with suppliers and the working arrangements were settled.

The Press Office, guided by the President and the General Management and run by Gino Pestelli with the energetic help of Mariuccia Rubiolo, called on me for help



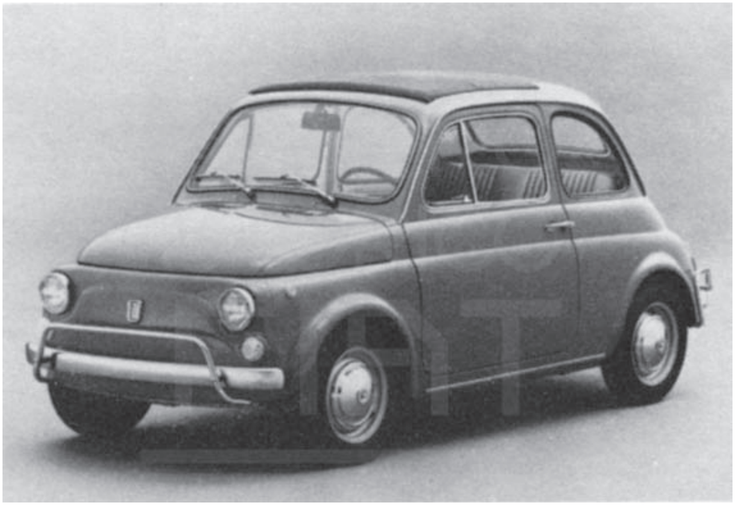
Nuova 500 convertible, standardized version, 1957.

Nuova 500 convertible, third series, built in 1959 with new mechanicals and retaining its previous coachwork (economy version).

in preparing the publicity build-up. The presidential committee decided to call the "110" the *Nuova 500*, evoking the memory of the much-famed *Topolino*. "Twenty years after the original *500*," went the blurb, "the *Nuova 500* follows in its wake with equal success: completely new, modern, costing less and more economical to run, a worthy successor to the world's first utility model, produced by the Turin automaker." The slogan "Great Little Auto" was invented. People called it simply "the *500*".

The build-up went ahead in grand style. A television studio was set up in the Lingotto works one hot July evening and even I was called on to give an interview live from alongside the assembly lines.

The 500 Giardiniera (1960) was actually a different vehicle from the sedan, being powered by a horizontal engine specially designed to leave more space for the load platform and for the opening of the rear door.



Nuova 500 L (luxury model), the last of the 500s, produced from autumn 1968 onwards.

CHAPTER XV

THE STUDY AND RESEARCH COMMITTEE

INCOMPARABLE LEADERSHIP OF BONO

ENRICO PIGOZZI ACQUIRES FORD FRANCE

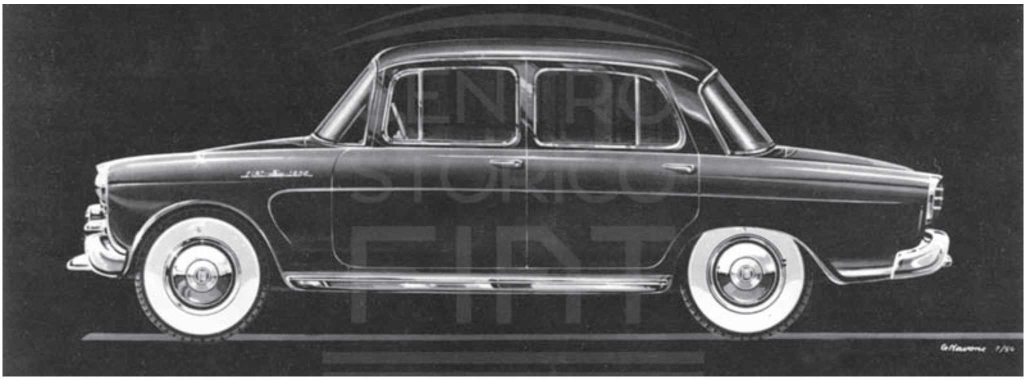
THE "111" AND "112" PROJECTS LEADING TO THE *1800*

Italy had risen anew from the ruins of the war. The Italians exerted themselves, using their wits and their will to work, far outstripping the tardy developments in the political sphere. Their quickness and practical intelligence made it possible for the politicians themselves, mere onlookers, to speak of an economic miracle. The objectives were clear to everyone and neither uncertainties nor laziness impeded the drive to attain them.

The political parties were locked in conflict but the work of reconstruction and the quest for affluence went ahead without check.

Fiat had boosted production and grown into an industrial giant. The Mirafiori works had to be extended. A new factory at Mirafiori Sud was planned. Now it was being said that the firm needed a new organizational set-up capable of dealing with the expanding demand.

The aviation sector was opening up new possibilities of work. A first step was taken in November 1954 when the Presidential Department officially stated that "the need to reorganize and reintegrate the aeronautical sector and the objective of providing it with the essential cohesion of aims and functioning" had led to the abolition of Aviation Management and its replacement by the Aviation Division, comprising technical services for the design of aircrafts and their Engines, Production and Testing Departments, commercial and administrative sections, technical communications



One of the first designs for a replacement for the 1400 (variously designated the 1600, the 1700 and the 1800 on the drawing boards, the capacity not being decided on, and officially designated 111 and 112), the project that eventually produced the 1800-2100, with a roof that recalls American styling of the period. Drawing dated 1954.

services, maintenance and inspections services. The management of the Aviation Division was given to Giuseppe Gabrielli.

At the same time (11 November, St. Martin's Day!), instructions were given for the "construction of the company's aero works and subsidiary automobile works", specifying their staff and the names of the directors.

Further measures were taken at the end of the year. The first concerned the institution of the Fiat study and research committee: "The presidential authority hereby institutes a committee under its own control and that of the General Management. The committee's responsibility is to coordinate and stimulate both inside and outside the Fiat company all forms of study and research which may affect the company's activities either in relation to present production or future developments." Then followed a list of specific responsibilities.

The organization and duties of the committee in relation to the various sectors of work "figured" (the ward used) in a large organization chart.

The committee consisted of Gabrielli, Domenico Taccone (director of the Metalworking Division), Arnoldo Fogagnolo (director of the Marine Division) and one supplementary member, Aldo Zazzaroni (director of the Central Research and Control Laboratories). "The function of dealing with and directing the practical implementation of the committee's decisions" was assigned to Gabrielli with the aid of Carlo Felice Bona.

The Technical Design Division, comprising the Aviation Engineering Offices and the Motor Vehicle Engineering Offices, was not even mentioned. Its abolition was a foregone conclusion since it had never existed except on paper. I had always been in direct contact with the general manager without having to pass through the medium of Gabrielli, who had never concerned himself with the motor vehicle side even though he was nominally director of the Technical Design Division. This is in fact borne out by a second order dated 31 December 1954: "The technical design offices for automobiles, motor trucks, tractors and special vehicles with the other services and departments at present grouped under the control of the Technical Management for Motor Vehicles will be made directly subordinate to the General Management".

The Aviation Technical Offices were transferred to the Aviation Division, those for Railroad and Tramway Materials were transferred to the Railroad and Tramways Materials Division and Heavy Engines to the Marine Division.

Immediately afterwards a communiqué dated 1 January 1955 announced that Armando Fiorelli had been promoted director of the Motor Vehicles Division, retaining management of the Automobile Section, and I received a letter signed by Val-

Domenico Taccone, engineer, born in Cassine (Alessandria) in 1890. In 1915-16 he was engineer in charge of plant at the Ansaldo steel works. He joined Fiat in 1922, on the staff of the ironworking section, in 1945 becoming director of the iron foundry section and in 1958 central manager. He joined Fiat's board of directors in 1951. President of the Italian Metalworking Association and vice-President of CECA's advisory committee. He died in Turin in 1974.

Aldo Zazzaroni, graduate in Chemistry, born in Bologna in 1891. Held various post at Fiat between 1915 and 1945: head of the Research and Control Laboratory, head of test service at Fiat foundries, director of the mining section. In 1945 he became assistant director of the Cogne works in Aosta and in 1949 was made director of Fiat's Research and Control Laboratories. He is President of the AICMA, of the Primary Materials Commission and of the Technical Commission for Automobile Standardization (CUNA). Since 1964 he has been a consultant with Fiat.

letta which informed me, along with various flattering expressions, that I had been promoted to director in chief.

The "orders" signed by Valletta and the communiqués by Bono were sent out to all the divisional managements. The letter, on the other hand, was personal in character. The title of director in chief had a special meaning and had been invented many years before for Zerbi. I naturally retained control over the Motor Vehicles Technical Offices.

The changes in organization and the hierarchy had no practical effects on my work but they gave me food for thought on the subject of my superiors and their attitude towards me. It is difficult to avoid being sensitive to matters that touch our pride, especially when they involve the prestige of the group we belong to. I wondered why I was not one of the members of the research and study committee, since I had shown I was one of the technical directors with the most active interest in research. And why weren't the Motor Vehicle Design Offices considered a division on an equal footing with the factories?

The information that my managerial division was no longer part of the Technical Design Division but came under the General Management was in itself flattering, but it might also imply more direct control over design by the General Management and that caused me some concern.

Anyway I soon recovered my usual serenity and continued to consider myself free, as in the past, to do whatever studies and projects I thought useful for the company's future.

In August of the same year, 1955, Bono was appointed to the board of directors as well as holding the post of general manager. After the premature death of count Gian Carlo Camerana, vice-President of the company who was closely connected with the commercial side of the work, his place was taken by Luigi Gajal de la Chenaye. The top positions were therefore distributed as follows: Vittorio Valletta, President and managing director, Gaudenzio Bono managing director and general manager, Gianni Agnelli and Luigi Gajal de la Chenaye vice-Presidents.

Bono ran Fiat with great authority and energy, stepping up the pace of work relentlessly and implementing Valletta's policies. He himself was on the job early and late, getting to the office before eight in the morning and staying there until two in the afternoon; then there would be a break until four, after which he would work through until nine or ten at night. Every evening he took home a big valise bulging with documents and correspondence to be looked through next morning as soon as he got up. Like Valletta he spent holidays working at the office. He kept in touch with everything, wanted to know all about everything and, if possible, to have the last word even on minor issues. The waiting room of his office was filled with executives waiting to be received. They sometimes had to wait hours because the general manager was not punctual and tended to draw out talks by going off on some unforeseen tack. Taking advantage of his good nature, they would often make unimportant demands on him, asking him to settle trivial points that they could just as well have decided for themselves. I spared him interruptions of this sort and to avoid long waits got in touch over the phone whenever the subject permitted.

During meetings he would order, in a tone that brooked no contradiction, that certain urgent tasks should be completed in an incredibly short time, forcing staff to work late at night and on holidays. He seemed absurdly demanding but if a job was not done on time despite every effort he was properly understanding. His wish to monopolize everything and run the whole show himself did not make for an open exchange of ideas between the directors of the various different sectors. He would have liked to be in on everything. Where design plans were concerned, he liked to hear the opinions of the commercial management and then mine separately. When he had collected the essential facts and got the views of the people in charge of the various sectors, he reported to Valletta and together they came to a decision.

At any rate, I was left free to choose and develop my plans for the future. Bono never set limits to the studies we wanted to do or to construction of experimental engines and prototypes. For this I am grateful to him. He knew how careful I was to guard against expense even when I would dearly have liked to try something new, build prototypes according to some original idea, branch out into research. His liberality in this regard always proved its usefulness.

Gaudenzio Bono was an engineer who had entered Fiat immediately after taking his degree. He started work as a factory hand, in accordance with the regulations for training young engineers. Ugo Gobbato was the production manager at that time, and Bono always felt a sense of gratitude towards him.

He deservedly made rapid progress in his career at the works, first at Lingotto then at Mirafiori and afterwards at SPA, where he became director of the firm. Appointed Commissar during the period of the Liberation he was made general manager when Valletta returned as President in 1946.

His knowledge of problems of production and organization was immense. Since he had never worked in the technical offices, however, he knew little about the innumerable problems that crop up in their work and though he realized that studies and designs required time for reflection he behaved as if they could be turned out by mass-production.

During meetings, which became more and more frequent as Fiat grew bigger, his behaviour was often typical of a person overburdened with work and responsibilities. When he was particularly worried and tense he rarely used to let anyone put in a word. He went on speaking for hours and worked off his nervous strain with overbearing and even violent outbursts that were sometimes quite unjustly directed at people who were doing their utmost to carry out their duties, yet one was always induced to forgive him when, in a more relaxed mood, he would talk affably and sympathetically with a little group of two or three people. In any case I was never the object of these outbursts of his.

Fiat came first in his thoughts but he would never have gone as far as Valletta, who used to say: "Fiat first, the family second". Still, Valletta's opinions were gospel where Bono was concerned, admitting no doubt. "Valletta said so," meant that discussion was at an end.

On the various ceremonial occasions that cropped up from time to time such as church services, anniversaries, speeches at the year's end and so forth, he stood stiffly to attention like a guardsman on the left of Valletta, dressed in a jacket of impeccable cut, tie and shirt perfectly matched, his gaze severe behind the gleam of his spectacles and his lips firmly pressed together. As the years passed he grew stouter and began to show signs of flagging. While he was listening his eyelids would begin to droop and veil his drowsy gaze. But when he resumed speaking it was clear that he had not missed a word of what had been said in the meantime. Bono was the driving force behind all the activities that made Fiat great.

In 1955 the immense new works at Mirafiori Sud were built, covering 330.000 m². Output climbed past 1.000 autos daily.

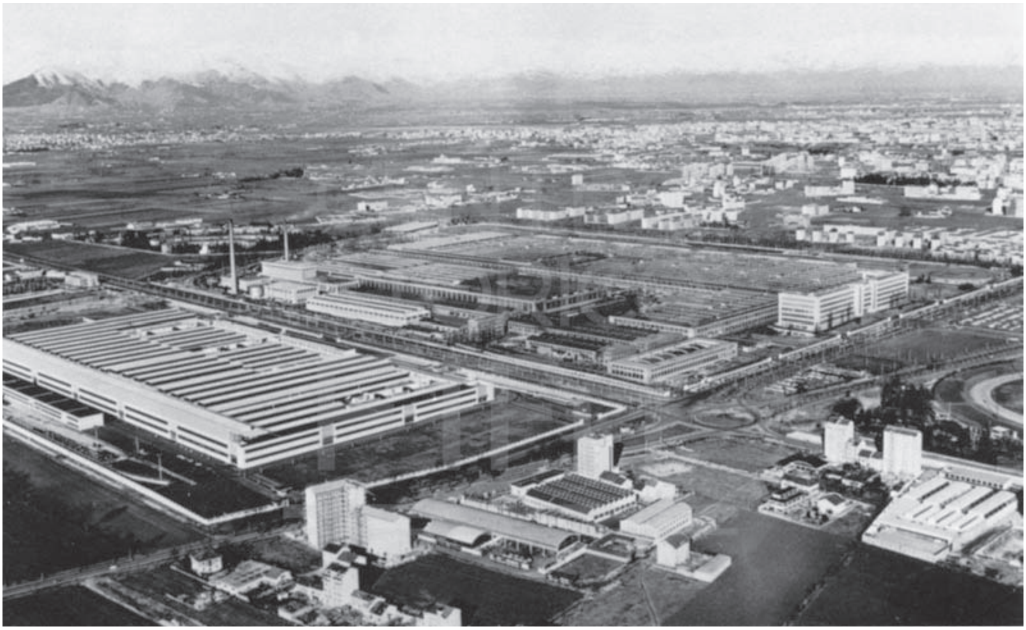
While Fiat was mainly concerned with the Italian market, Simca in Paris was fighting it out in a much wider market against aggressive competition. Under Pigozzi's energetic and intelligent guidance Simca had been restructured and remodernized. The Suresnes works had been transformed by Armando Fiorelli and achieved considerable productive potential.

Pigozzi had gradually set up a Technical Engineering Office and some test workshops. He now tentatively had some prototypes built, based on the Fiat models being produced in the factory. This was the origin of the *Aronde,* derived from the *508 C-1100* with the engine boosted to 1.300 cc. A stylized swallow became Simca's new emblem.

Designs and experiments were done by French engineers under the guidance of Marchetti, an engineer who had been at the Turin Polytechnic with me and then emigrated to France. He first worked for Hotchkiss and then went over to Simca.

Fiorelli and I often went to Paris to give Pigozzi and his staff the benefit of our experience.

To strengthen Simca and make it more competitive it was essential to increase its productive capacity and complete its range of models with an automobile in the 2.000 cc class, much in demand in France and elsewhere in Europe. For this reason Pigozzi had far-sightedly begun negotiations with Ford to purchase Ford France and its factory at Poissy. In 1954 Ford was completing work on a new model with a 2.300 cc V8 engine, conceived with side valves along the usual American lines of the period. The auto was up-to-date in design with practical features and performance that were



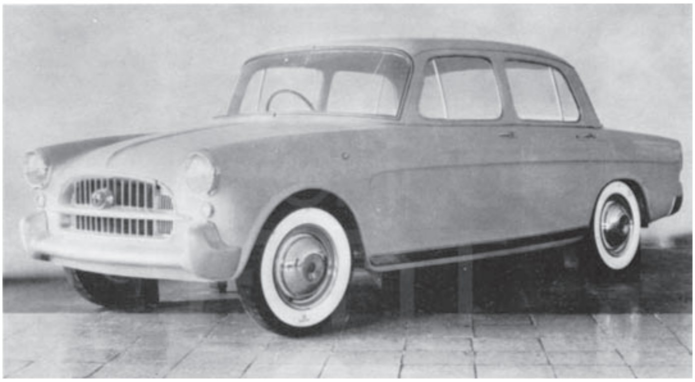
In 1955 the new Mirafiori Sud works were completed. They are separated from the earlier Mirafiori works (opened 1939) by via Settembrini, a broad road under which there are tunnels for the long conveyor belts that transport components from one factory to the other, distributing them to the various works departments.

to be found only in American cars but combined with European dimensions. Some prototypes were tested in great secrecy on a mysterious road network in the midst of the Black Forest, not far from Stuttgart.

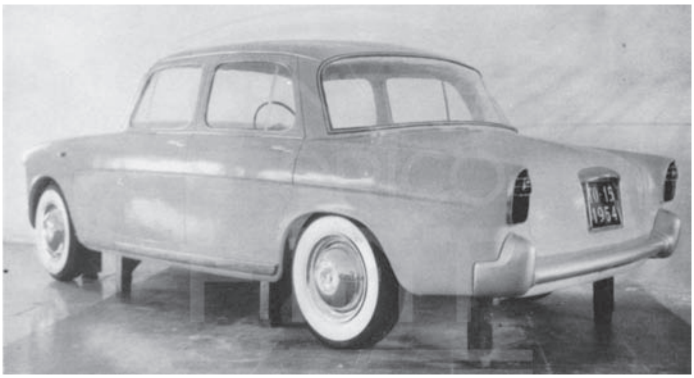
Pigozzi wanted Salamano and me to examine and test these prototypes to give our opinion. We went to Germany and gave the autos a tough testing on narrow, bumpy roads twisting through the firs of the Black Forest. We came out in favour of the model and the deal was settled. The Poissy factory was taken over by Simca. The *Vedette 8V* was presented to the press in October 1954.

This was the start of a phase of steady growth for Simca's engineering offices and plant. Eventually Pigozzi needed the help of an expert technical director. He applied to Turin and the choice rightly fell on Oscar Montabone, my closest collaborator, at that time assistant director of the Motor Vehicle Design Department. Montabone went to Paris in November 1956. Corziatto, one of the most able members of Fiorelli's staff, and director at SPA, was also sent to Paris as Simca's general manager.

To return to Turin and the projects. By 1955 the *1400* and *1900* were a bit on the old side, even though they had been improved by modifications to the mechanicals and coachwork in the *1400 A* and *1900 A* versions and had been given a more powerful engine. The *B* versions were being made ready with further improvements but they were inevitably becoming dated and more had to be done to meet the competition from the most recent foreign models. Thought was now being given to a new model to reverse the situation.



Full-scale plaster mock-up based on the design on the previous page. The year in which it was made appears on the number plate: 1954 (August).



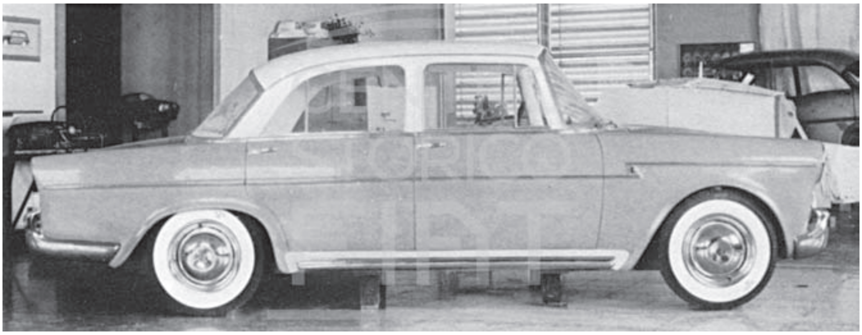
For my part, years earlier, as soon as the *1400 A* and the *1900 A* had been launched on the market, I sketched out some projects. Two quite distinct concepts were chosen and designated the “111” and the “112”. Then I had some mock-ups made in the styling workshop to embody new forms and compare their merits and defects.

The presidential committee devoted its attention to the “111” and “112” for the first time at the end of 1954. At that time three experimental engines were being built and two sets of mechanicals for the chassis. The designs of the coachwork were also being done. But no decisions were taken. The Commercial Division had returned to its suggestion for an eight-cylinder engine. There were frequent discussions after this because while I kept on with the studies those in charge on the managerial side were dogged by understandable doubts.

Their uncertainty came up against the need to make a quick decision because the *1400* could not be kept in production after July 1957: there was a firm commitment to hand over the moulds for the coachwork of the *1400* to Seat in Barcelona on that date with a view to starting production in Spain.

While we were waiting for a decision, I kept on with designs for a type of coachwork which would make it possible for the engine hood to house either a four-cylinder engine derived from the *1400* or else a narrow V8 derived from the *8V*'s “108”. I soon saw that the project had grave defects. I told Bono this and the idea of having two alternative engines so markedly different from each other was to given up.

It was decided all the same to build a purely experimental chassis with an eight-cylinder 2.350 cc engine and a hydraulic joint of the *1900* type with an electromagnetic clutch, the body to be commissioned from an outside coachbuilder. Half-way through 1955 a presidential committee meeting decided to build the new model on



Full-scale plaster model made in 1955 (30 July), the year being shown on the number plate. A refinement of the previous 111 model, retaining its styling and curved lines. This model, never produced, would have been very similar to the models produced by Simca.

1400 mechanicals, with a more powerful engine and completely new coachwork for which I provided a drawing.

But then in October Gajal still had some doubts and persuaded the presidential committee to agree merely to present the *1400 B*, whose specifications had already been decided, in spring 1956, and in the meantime to work towards a more advanced and carefully thought-out design. So the mechanicals remained the same while various improvements were made to the coachwork: a rear window of the *1900* type, new upholstery, petrol cap accessible from the outside, new fascia, new radiator grill, two-tone paintwork etc. The *1900 B* would have the *Gran Luce* coachwork by Boano and the mechanicals of the *1400* without the hydraulic joint but with spring leaf suspension at the back. The more elegant appearance and lower cast would make it more competitive when compared with foreign models with engines of the same size.

The frequent changes in instructions, however justified, made it difficult for me to get on steadily and systematically with the project, especially since the changeable ideas of the agents and General Management had nothing to do with sound technical arguments.

The burden of work kept me continually on the go, with the *600* going into production, the "110" project to work on, development of the *103*, industrial vehicles and a host of other tasks all claiming my attention.

At the start of 1956, Bono felt it was time to put an end to all the chopping and changing. He got out a programme himself and gave it the significant heading: "Final decision for automobiles: 1957 and following years".

This is the section dealing with the "112" project:

> *Mod. 112-112 bis*
> This automobile, intended to replace the *1400*, will have completely new coachwork, the main features of which are to be as follows:
> – inside dimensions corresponding to those of the *1400*;
> – outside dimensions reduced to the minimum possible across the middle;
> – rear window that opens to aid ventilation.

(This idea was a non-starter because previous tests had shown that the degree of ventilation was unbearable).

> The mechanicals are initially to remain the same as those of the *1400* and will be modified in the second phase to produce the model 112 bis.
> The main features of the 112 bis, making it an auto capable of meeting competition from the most advanced international models in the class of medium autos, should be as follows:
> – four-cylinders 1.500÷1.600 cc engine or else V8 2.300 cc.; it should in either case possess torque providing the auto with acceleration at least equal to the *1100 TV*;
> – independent rear suspension;
> – automatic clutch with semiautomatic gear change;
> – power steering;
> – hydro-pneumatic suspension on all wheels;
> – weight not to exceed 1.050 kg.

The deadlines for producing the 112 and 112 bis models are as follows:

Mod. 112

– plaster mock-up: late Nov./mid Dec. 1955;
– design four-cylinder prototype: end March 1956;
– design eight-cylinder prototype: end June 1956;
– construction prototype: end May/mid June 1956;
– final designs four-cylinders: end Aug. 1956;
– final designs eight cylinders: end Nov. 1956:
– start production: end Sept. 1957.

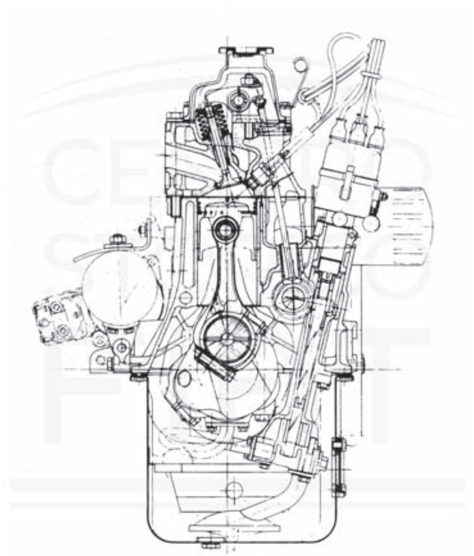
Mod. 112 his:

– prototype: March 1957;
– start production (indicative date): 1959.

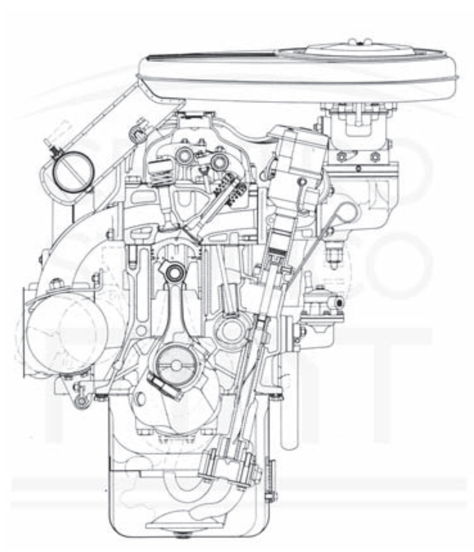
It was typical of Bono to fix impossibly tight schedules for production of new models. Some of us might mutter that it was a pipe-dream but no one dared raise objections for fear of arousing his wrath. We kept quiet and hoped that eventually he would reconsider his intransigent statements and accept a schedule that fell within the realm of the possible. This was what usually happened.

After a few months I told him that I had got out the designs not only for the four-cylinder engine but also for a six-cylinder in-line engine, both having a capacity of 1.800 cc.

As I have already mentioned, at that time our theoretical and experimental knowledge of engine suspension systems was fairly limited and we could not be confident of solving the vibration problem with a four-cylinder engine of 1.800 cc or bigger. The *1900* engine had involved using a Föttinger-type hydraulic joint. But the combina-



The first design for the 112 E2 engine had a head with a triangular combustion chamber and all the valves lined up on a single plane. Cross-section, dated 25 February 1957.



Aurelio Lampredi's final design for the boosted 112 engine with "polyspherical" chamber and intake and outlet valves on two planes.

tion of a four-cylinder engine and a hydraulic joint turned out in practice to be more expensive than a six-cylinder in-line engine which had the additional advantage of being perfectly balanced and so free from vibrations, functioning smoothly and easily.

My suggestion had the further attraction of linking up with the Fiat tradition of six-cylinder engines, broken when the *1500* was taken out of production in 1950. Another reason that weighed heavily was the possibility of deriving a four-cylinder engine from the six-cylinder one, with many of their parts in common. Standardization of many components of the two engines was an immense economic advantage. The four-cylinder engine could be mounted on a new model to replace the *1100/103*. Bono gave his approval straight away.

Having taken over the idea, he wrote a long memo on the new models in which he expatiated upon the technical, commercial and productional reasons which made it advisable to introduce a modern automobile with an 1.800 cc six-cylinder engine to replace the *1400*. The memo also dealt with the programme for other models, which we need not go into here.

He got Valletta's approval for the programme and sent me a letter mentioning this fact, saying that it had to be implemented straight away. The time allowed for planning, completing the designs, testing the prototype and tooling up was a mere fifteen months. It was then November 1956 and the car was planned for launching at the Geneva Motor Show in March 1958. Naturally this was a sheer impossibility.

I tried to put my viewpoint across but I was certainly not very diplomatic about it. Bono was annoyed and got out another memo: "Specifications of the automobile to replace the *1400*". It was three pages long and had been initialed by Valletta. The note was sent to me along with a letter from Valletta himself, energetically expressed but courteous in tone.

The letter was encouraging, unlike Bono's note, which contained, among other things, some rather elementary and wordily phrased advice which might have been useful to a novice but not to someone like me who had shown clearly enough by his achievements that he could do without it.

I sent a firm letter to Valletta detailing all the points of the technical note I considered impossible.

Valletta was patient but authoritarian. He sent me another letter, ignoring my observations and stressing the need for haste, disputing my estimates of the weight and ending up with a request, which was more like a command, that the weight should without fail be made 50 kg less than my estimate. This also turned out to be quite impossible. Still, the work went on with every effort to get it done in time.

Fortunately I already had designs for both the engine and the other mechanical parts in an advanced stage.

At that time the Americans were putting all their effort into designing pneumatic suspension systems and in Europe Citroën had produced its hydropneumatic system. As far as I was concerned, I had played about with various designs for pneumatic and hydropneumatic elastic suspension systems but I came to the conclusion that cost and the risk of defects were against it. The traditional system using metal springs is simple, reliable and cheaper, therefore preferable in my opinion, even though it does not keep the level of the vehicle constant as the load varies. The Americans also came to the same conclusion.

There was no reason to abandon the front-suspension system that had given such good results with the *1400* and *1900* but I decided to adopt torsion bars instead of spiral springs so as to make the front cross-member simpler and lighten the non-suspended parts and the front of the auto. The special arrangement of the levers made it possible to have a very small tubular cross-member placed under the engine. The design was simple and neat. The layout of the engine, suspension mechanism, steering and the various parts that are normally fitted under the front hood had been carefully planned to make the whole so compact that it could be housed inside a hood not much longer than the ones over four-cylinder engines. This was facilitated by the shape given to the coachwork bearing this requirement specially in mind. Everything was carefully calculated and proportioned so as not to exceed the prearranged weight limit.

For the rear suspension I decided to perfect the arrangement that had been giving results for years on the *1400*. It does not need lubrification, is lighter than an equivalent leaf-spring system and does not involve using a stabilizer bar since the antiroll effect is achieved mainly through the elastic spars fixed to the axle housing and, in the second place, by means of the housing itself, which helps stabilize the vehicle with its torsional elasticity. Compared with leaf-spring suspension this system cuts out two rubber bearings as well as the stabilizer bar and its fittings. Within the speed range fixed for the model, suspension and road holding proved to be first-rate.

Though much had been done in the field of automatic transmission, an automatic gearbox was out of the question for this model. Its production costs had to be kept within the limits of the *1400*. Our only chance of improving the gearbox laid in synchromesh on engaging first. So it was decided to adopt a traditional gearbox with all the gears synchronized. Two types were built: one had three gears and an "overdrive",

The fore-carnage and rear-carriage of the 1800-2100 is effectively simple in design.
The front suspension with its torsion bars is still – over twenty years later – used in modern autos.

the other had four gears. Following tests and bearing economic factors in mind the normal four-gear system was finally adopted. The cast iron housing was retained, as on the *1400*, to reduce noise levels.

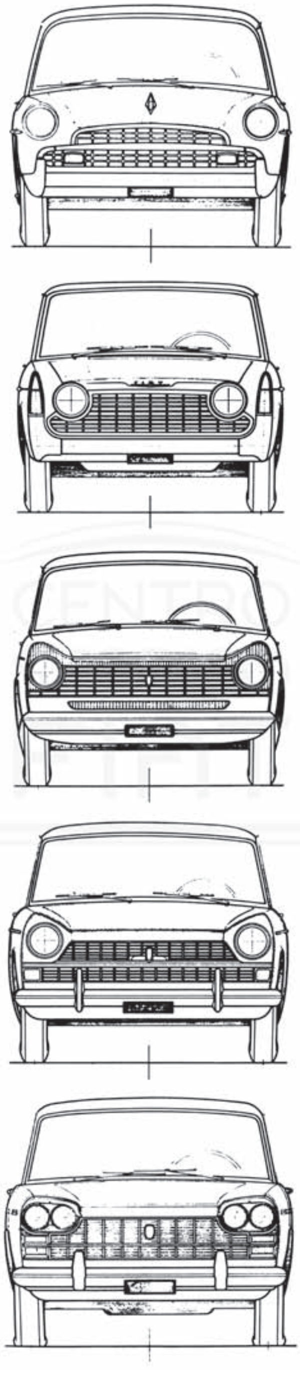
The *1800* engine in its initial version was designed with a triangular combustion chamber which is both highly functional and extremely simple to manufacture but as the model was perfected it was felt that more power was called for.

In the meantime Aurelio Lampredi, Ferrari's head design engineer, had been taken onto the staff and he was given the problem to deal with. He skilfully produced a sophisticated and naturally more expensive design for a new combustion chamber, which was very close to the hemispherical ones used for racing engines. The problem was not simple since it involved replacing the previous head with a new one without modifying the rest of the engine. The placing of the bolts holding on the cylinder block had to be kept the same to avoid having to remake the production machinery then being produced.

The new chamber was excellent. We called it "polyspherical" because of its shape, which consisted of three intersecting spherical surfaces. Renault adopted a combustion chamber of this type in 1977, calling it "trispherical".

Another original feature of the engine was its centrifugal filter, which we considered essential at that time to ensure the durability of the bearings even in long trials at 6.000 revs. In those days paper filters capable of functioning with an engine at high revs were not available. Special attention was given in designing the engine to making the crankcase highly rigid. To avoid deformation of the cylinders we chose an engine block incorporating the cylinders instead of inserting separate cylinder barrels as had been done with the *1400* and *1900* engines.

The styling of the coachwork deserves some attention. When the *1400* and *1900* were being manufactured the stylistic modifications to the model intended to replace them had been limited to a partial evolution of the form. A beginning was made by trying to achieve a line that could be manufactured by using moulds easy to produce. Some plaster mock-ups had been made following these lines. Eventually, however, the rapid development of competitive models decided



The final form of the front end of the 1800 and later the 2300 was the result of a long series of different efforts, the main stages being shown here. Note the characteristic eyelids over the headlights.

us to completely remodel the coachwork and produce a fully up-to-date form capable of lasting a long time.

Lots of designs and some plaster models were produced, covering a range of shapes and even, up to a point, of dimensions. A comparison of them provided us with the data for a preliminary choice. Since the weight limit had to be maintained at all costs, the designs had to avoid forms that would involve increasing the outer volume and using more metal. The top speed had not been set very high at first and so I concentrated on reducing weight and improving roominess inside instead of improving the aerodynamics. When the plaster was being shaped one of the leading concerns was to reduce the surface area to economize on metal panels just as a dressmaker with a limited quantity of cloth tries to fashion it into the most attractive garment.

Before the layout of the design had been definitively fixed the first mock-ups were modelled with rounded forms. Then Alberti and I decided to change over to shapes with stiffer lines. Initially we spent a lot of effort trying to fit a flat and almost vertical pane of glass to the back of the cab. Subsequently and by degrees the glass was inclined and finally given a curving shape.

The straight, clean-cut lines of the sides that distinguish the coachwork of the *1800* grew out of a sort of over-correction of a defect of the *1400*. Because of the curve of

When the moment came for a final choice of shape, Giacosa decided to abandon curved forms for a stiffer and straighter line, unusual at that date. The drawings show the first steps towards the final, more restrained, shape.

the side-panels, which is visible when one studies the plans of the *1400* coachwork, and the curves of the various vertical sections, the vehicle's waistline runs along the side panels below the windows towards the front and the rear, appearing to droop at an angle that is particularly disagreeable to the eye. This effect is particularly marked about half-way up the rear door.

To avoid this defect, we first of all shaped the plaster to look like a box with clearly marked straight edges which we could work on without losing touch with a completely horizontal waistline or one that was at most only slightly curving. These straight edges left a marked impression on the whole subsequent operation of defining the form.

I have also been asked why the engine hood was cut off so abruptly at the front end. Mention has previously been made of the need to reduce length and breadth to a strict minimum. In Italy there is even less space available for driving and parking than in other countries and so every centimetre saved is all to the good. A long streamlined shape for the hood would have meant better aerodynamics but it would have increased both volume and weight. The abrupt way the coachwork ends in front of the radiator is certainly not aerodynamically valid but it helped to keep volume and weight within the limits established.

When the coachwork was completed Pinin Farina was called in to pass judgment and suggest possible improvements. The full-scale plaster model was painted and carefully finished then sent off to him. His modifications enhanced the linearity of the coachwork with a touch of elegance. He also modified the grill and trim in front with a certain improvement to the overall effect.

1800 sedan: the two-tone colour scheme was a standard feature of the first series (1959-61).

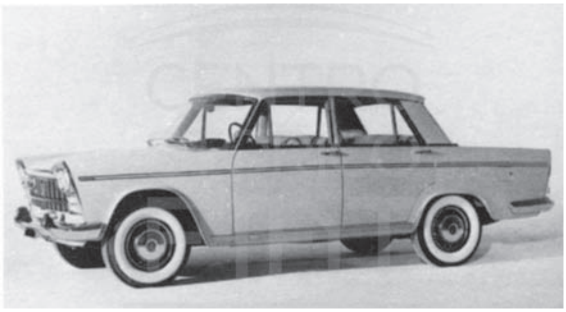
The 1800 estate was designed to allow the use of almost all the dies of the sedan version (1959-61).

Two months before the model was to enter production I wanted to change the placing of the headlights, which seemed too low. Bono backed me up decisively, getting the works to agree to modify the moulds for the front section. It meant a tremendous effort but they managed to make the necessary changes without holding up the start of production.

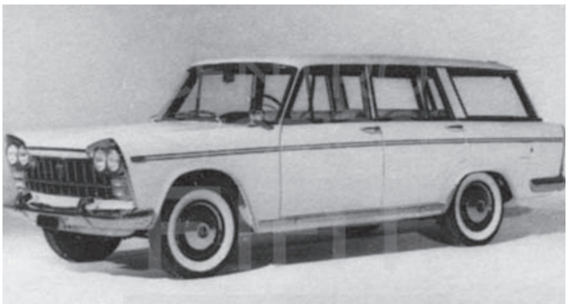
The *1800* and *2100* were presented at the Geneva Motor Show in 1959, the models including the *Familiare* (a station wagon version). A *2100 Special* was also produced with longer and more sophisticated coachwork. The *2100* engine differed from the *1800* only in the bore of the cylinders, which was increased from 72 to 77 mm. While production was getting under way I was already starting studies for the improvements that were to be introduced some years later, when they became necessary for commercial reasons.

Giambattista (Pinin) Farina, after 1961 surnamed Pininfarina, born in Turin in 1895.
At an early age began work in the coachwork shop run by his brother Giovanni, later named the Stabilimenti Farina. After a trip to the United States which enabled him to gain an insight into the most up-to-date auto-manufacturing techniques, he lift his brother's firm in 1930 and set up his own company, where he organized production along avant-garde lines, effecting a change in automobile styling that became established all over the world.
In 1958 he moved his works to Grugliasco (Turin) and the following year ceded control of the firm to his son Sergio and son-in-law Renzo Carli. He died in Lausanne in 1966.

In 1961 it was decided to transform the *2100* into the *2300*, with modifications to the form of the coachwork to distinguish it more clearly from the *1800*. There were changes in the styling caused by the adoption of paired headlights after the fashion introduced by the Americans. The shape of the engine hood was also altered, the mudguards remodelled and the design of the grill changed. The engine was increased from 2.100 cc to approximately 2.300 by changing the stroke of the pistons from 73,5 to 79,5 mm.



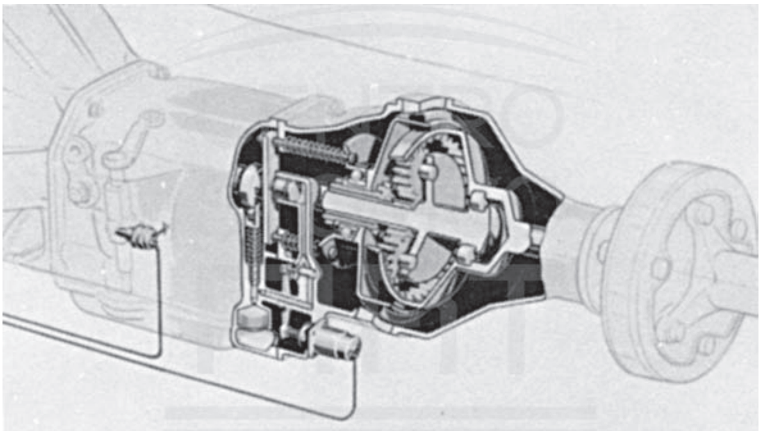
Standard 2300 sedan (1961).



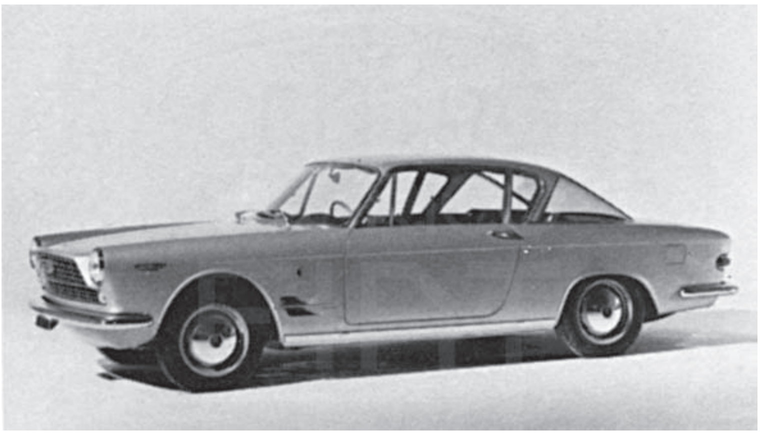
The station wagon coachwork, absent in the 2000 range, reappeared in the 2300 range (1961-63).

We increased the engine of the *1800 B* to 86 hp and fitted it with disk brakes all round, like the *2300*, and normal leaf-spring suspension at the back. The decision to adopt leaf-springs instead of spiral springs was aimed at lowering the load-floor of the station wagon version by 10 cm and eliminating the projecting housings of the spiral springs. Since economic reasons made it essential for all the models to have the same platform, the system was extended to the *1800 B*. The leaf-spring system also made it possible to get round some difficulties encountered in trying to fit disk brakes.

The *2300 Berlina Speciale* had a wheelbase 8 cm longer and an overall length of 4,70 m. In autumn 1961 the *2300 S* was launched with the magnificent coupé coachwork built by Ghia.



Explanatory drawing of the overdrive system with remote-controlled engagement/disengagement by kick-down, an optional extra on the 2300. The alternative version had automatic gearbox with oleodynamic torque convertor.



2300 coupé, first series (1961). More a tourer than a sports car proper, it has coachwork by Ghia. The two versions produced had maximum speeds of 175 and 190 km/h.

CHAPTER XVI

CHANGES IN THE ORGANIZATION

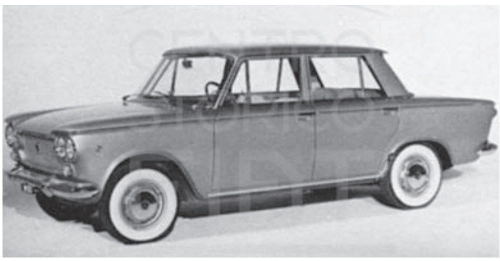
THE STYLING CENTRE

THE "116" PROJECT LEADING TO THE *1300-1500*

In 1956 Valletta and Bono made some changes in organization to adapt it gradually to Fiat's expansion. The first move was the appointment of two assistants to the General Management.

A bulletin was sent round to the executives saying that Franco De Regibus and Paolo Ragazzi had been appointed "assistants to the General Management with the duty of aiding engineer Bono in the application of policy and in developing the programmes laid down by him in agreement with the divisional management of the various sectors of the Fiat group and its associated companies". De Regibus retained control of coordination management and Ragazzi his managerial post with the Heavy Engines Division. A series of brief communiqués subsequently announced numerous changes in the managerial levels of sectors, divisions and departments. There were no changes in the management of the Motor Vehicle Technical Offices but there was something in the air.

In 1957 the "110"-*Nuova 500* did not have that immediate popular success that everyone at Fiat had expected. Demand was below forecasts and the sales organization, perhaps even the General Management, tended to lay the blame for this on its design. They were forgetting that just a month before it went into production, the commercial management had asked during a technical review of the project for the top speed to be reduced and the auto to be made less attractive to avoid competing with the *600*. But when the top speed was raised to that of the prototypes some time later and some features of the coachwork were improved, especially when coupled with a decrease in price, it had an immense success. In the meantime the atmosphere had grown somewhat strained.



The 1300-1500 (two models with almost identical coachwork but engines of different capacity); unveiled in 1961, it was the real successor to the 1400.

Unfortunately health reasons led to the resignation of Luigi Gajal de la Chenaye as Fiat's vice-President and the company lost a shrewd, honest and very experienced man. His place was taken by Giovanni Nasi, nephew of senator Giovanni Agnelli.

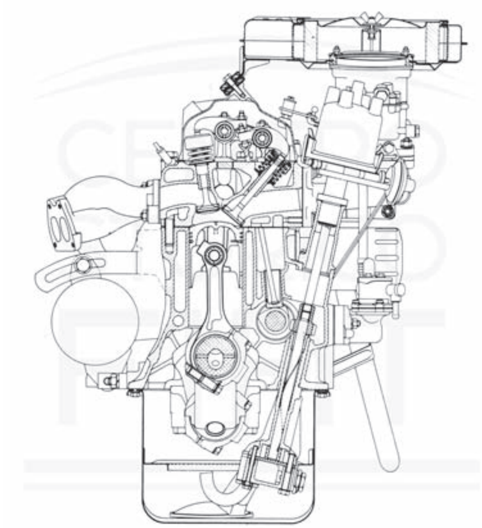
Engineer Enrico Minola was made divisional director in charge of the commercial sector, his powers covering control of the Publicity Department, transport, foreign plants and production, lubricants sector, Tax Department and the public transport company.

Enrico Minola, born in Novara in 1900. After taking his degree in Mechanical engineering, he joined Fiat in 1924, staying there for his entire career, devoted mainly to the commercial sector. After posts in branch offices in Italy and abroad he was made vice-director for sales in Italy; in 1957 he became director of the Motor Vehicle Commercial Division and a member of the executive council. In 1967 he became vice-president of the Italian employers' association. He is on the boards of various transport companies (STUI, SADEM, SITA) and of fiat group companies in the highways sector.
He is managing director of SEAT, the Spanish company manufacturing fiat vehicles under licence.
[He died in 1984].

In 1958 (while the finishing touches were being put to the "112"-*1800* and work was proceeding on the "116"-*1300*) other changes were being prepared. The aim behind them was to make a first step towards a restrained degree of decentralization and confer a certain independence on the major productive units which were assuming impressive dimensions in terms of size and staff.

These changes were made public on October 11. The first and most important affected the Motor Vehicles Division. The communiqué was worded as follows:

> The Motor Vehicles Division has technical and productional control over 11 factories in Italy as well as responsibility for production and assembly plants overseas.
> At present, however, it is necessary to differentiate the productional and design techniques of motor vehicles from those of industrial vehicles and tractors, in view of the steady increase in the number of models. Moreover, the procedures followed in design, testing methods and productional techniques are increasingly becoming closely intermeshed. This means that in order to organize programmes more closely



The 1300-1500 estate: the station wagon version of the "116" unveiled in 1961.

Cross-sections of the 116 and 115 engines (1.295 and 1.481 cc) are practically identical with the 1800-2100 engine apart from the number of cylinders.

and coordinate work more fully it appears more than ever essential for each division to comprise not only the plant but the relevant offices for design and project studies. The diversities of design, testing and production that differentiate automobile production from the production of industrial vehicles and tractors has led to the decision to organize the Motor Vehicle Division into two separate divisions:

– *Automobile Division* with its own technical design and engineering offices and its own production plant.
– *Industrial Vehicle and Tractor Division* with its own technical design and engineering offices and its own production plants. The head of the two divisions is to be comm. Armando Fiorelli. Comm. Fiorelli, in addition to carrying out duties as engineering consultant for the presidential office, will also be responsible as in the past for the design and installation of the production and assembly plants abroad and act as director and adviser to all Fiat divisions for the purchase of machinery in relation to the production targets to be achieved. To implement the above aims:
– *The Automobile Division* will be organized as follows:
  a) Technical Design Offices and Automobile Studies headed by Vittorio Montanari.
  b) *Production plants*:
  Auto Section
  Spare Parts Section
  Subsidiary Automobile Plant Section
  Marine Plant Section, Pisa
  Naples Plant Section
  Auxiliary Production
  Plant Auto Bianchi Plant, Desio
  headed by their individual directors.
– *The Industrial Vehicle and Tractor Division* will be organized as follows:
  a) Technical Design and Study offices for Industrial vehicles, for Tractors and Special Vehicles and for Railroad Engines, headed respectively by Mario Persia, Emilio Martinotti, Osvaldo Gorrini.
  b) Production Plants:
  SPA Section
  Cameri Plant Section
  Modena Plant Section (with due consideration for liaison with the Marine Division)
  Florence Plant Division (headed by their individual directors).

The management of the Industrial Vehicle and Tractor Division is further to assume responsibility for coordinating motor truck production between SPA and the OM factory in Brescia, the OM factory in Milan and the Modena plant, and finally for coordinating railroad engine production between Heavy Engines, the Railroad and Tramway Division and the OM Factory in Milan.

Signed: V. Valletta

The Motor Vehicle Division was in this way subdivided into two further divisions but Fiorelli remained in charge of both.

Fiorelli was a man of deeds rather than words. His achievements included the Polski Fiat works in Poland, built before the war, and the Simca works at Suresnes near Paris. Devoted to his job, down-to-earth and intellectually brilliant, his ambition was to make Mirafiori the most modern and efficient autoworks in Europe, not a whit inferior to the ones in the United States.

To realize his aspirations he had to be in a position to design the plant in accordance with his own ideas and to choose the most up-to-date and efficient manufacturing techniques. This meant that it would also be useful, if not essential, for him to have a say in the design of new models. He thought that design should be more closely adapted to the requirements of production.

Bono, while holding that a designer ought to be free to exert his creative faculties within the limits imposed by the company's economic policy, could not fail to appreciate the advantages of a rationalized approach to production in a period of rapid expansion. So, with Valletta's approval, he agreed to the absorption of the various design offices into their relevant divisions.

Another brief communiqué a few lines long stated that engineer Paolo Ragazzi, director in charge, would assist Fiorelli in the Industrial Vehicle and Tractor Division as manager of division offices and plant, which was not at all to Fiorelli's liking.

As for the technical offices, a further communiqué was issued, dated 11 October 1958 like the others. It ran as follows:

> *Design Research Offices*
>
> With a view to enabling the company to keep in the forefront of progress in automobile design and make use of all the sources of energy available at present or in future it has been resolved to set up an *Advanced Motor Vehicle Engineering Section* to carry out research, conduct studies and produce experimental models connected with the development of automobiles, motor trucks, buses, tractors and railroad engines.
> This section will have the widest possible scope in discharging its functions, including research, experimental designs, and testing of all the types of vehicles referred to above, with schedules planning developments for five-year periods and longer. A coherent programme, renewable quarterly, will be submitted by the management of the section itself to the Presidential Office and the General Management for approval and budgeting.
> These advanced design studies will provide the data needed by General Management in order to create developmental and production programmes undertaken yearly in accordance with Fiat's technical and commercial necessities.
> The Advanced Motor Vehicle Engineering Section will be directed by engineer Dante Giacosa under the immediate supervision of the Presidential Office and the General Management. Its staff will be nominated in a special service communication.
> Naturally engineer Giacosa will also be given duties by the General Management concerning the definitive solutions of routine problems in design and production as well as the opportunity to pass judgment on designs produced by the Technical Design Offices of the Automobile Division and the Industrial Vehicle and Tractor Division.
>
> Signed: V. Valletta

These measures were completed by another communiqué:

> The following personnel are to form part of the General Management as Assistant Directors:
> – engineer Niccolò Gioia as the personal assistant of the General Manager for all matters regarding Fiat's technological and enginering activities and all other tasks and duties entrusted to him by the General Manager;
> – dr. Franco De Regibus as the personal assistant of the General Manager for all general, commercial and administrative matters.

> Since engineer Paolo Ragazzi has been transferred to a different post, the General Coordination Management is to be eliminated and the relevant offices taken over by the respective Directors named above, who will be responsible for their functioning.
>
> Signed: V. Valletta

The Commercial Division was not changed and continued to look after the sales organization for both autos and industrial vehicles.

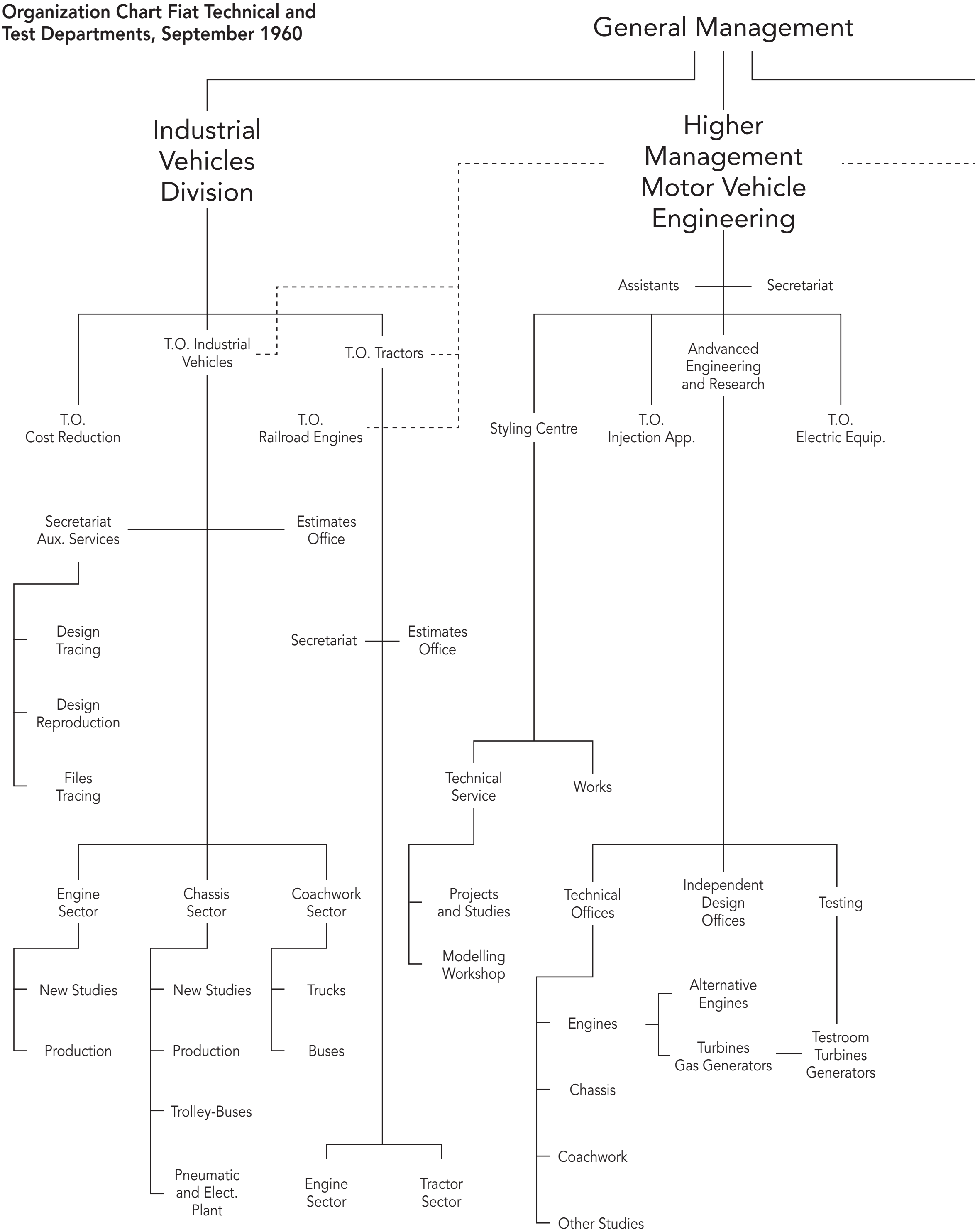
The new set-up basically favoured the production side, in the sense that it oriented design towards the most economical manufacturing techniques thanks to a closer tie between design and production methods. There is no doubt that the ideal would be to fuse the objectives of the design engineers with the most up-to-date technological manufacturing processes through close and selfless collaboration between the Design Department and the Works Engineering Department, that has to plan production methods. But this means that the staff involved should be fully aware of this purpose and capable of always placing the interests of the company before their personal ambitions, even if it means sacrificing their deepest convictions. Fiat's top management rightly relied on Fiorelli's personal qualities and balanced judgment.

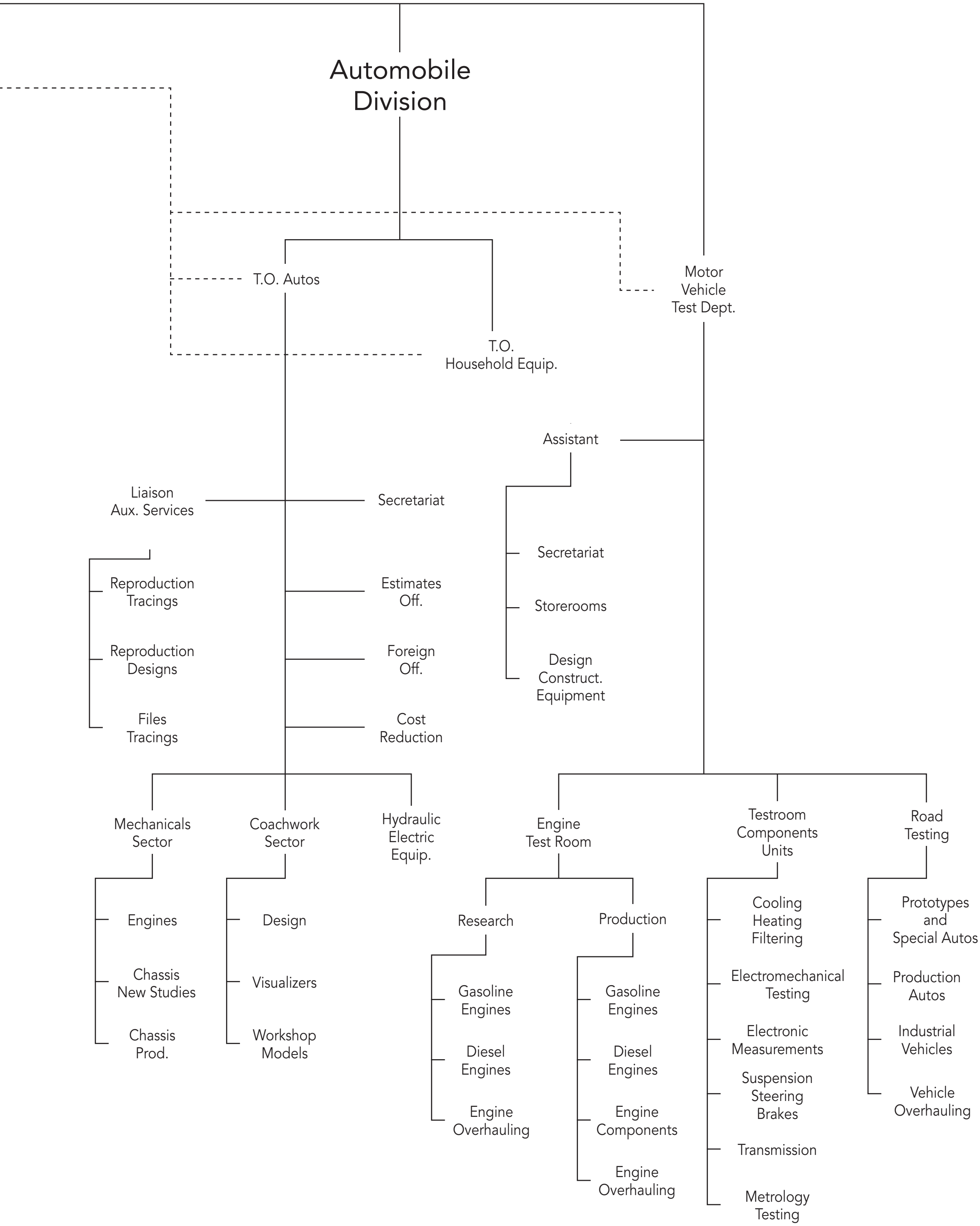
Unfortunately the personnel in the engineering and design office and the works were not ready to respond to the changed situation. The inflexible outlook (which is one of the results of the rigid discipline of the Piedmontese), the tendency towards rivalry between the various divi-

Niccolò Gioia, engineer, born in Florence in 1914. He joined Fiat in 1938; in 1945 he was appointed sectional manager and assistant manager of the Ironworking Division. In 1958 he became assistant manager with Fiat's General Management and in 1967 assistant general manager.
He became general manager in 1969 and a member of the board of directors in 1970.
After over forty years dedicated to the company he died in Seoul, South Korea, while on a business trip in 1979.

One of the large workshops for making plaster models at the Styling Centre in via La Manta (1962). In the foreground, one of the 1:5 models made during design exploration for the 1300-1500. Note the continued influence of the 1800 in the treatment of the roof panel and angularity of the body sides.

Organization Chart Fiat Technical and Test Departments, September 1960




Automobile Division
T.O. Autos
T.O. Household Equip.
Motor Vehicle Test Dept.
Assistant
Liaison Aux. Services
Secretariat
Reproduction Tracings
Reproduction Designs
Files Tracings
Estimates Off.
Foreign Off.
Cost Reduction
Secretariat
Storerooms
Design Construct. Equipment
Mechanicals Sector
Coachwork Sector
Hydraulic Electric Equip.
Engines
Chassis New Studies
Chassis Prod.
Design
Visualizers
Workshop Models
Engine Test Room
Testroom Components Units
Road Testing
Research
Production
Gasoline Engines
Diesel Engines
Engine Overhauling
Gasoline Engines
Diesel Engines
Engine Components
Engine Overhauling
Cooling Heating Filtering
Electromechanical Testing
Electronic Measurements
Suspension Steering Brakes
Transmission
Metrology Testing
Prototypes and Special Autos
Production Autos
Industrial Vehicles
Vehicle Overhauling

sions and departments, personal ambitions, an inadequate professional training and the inability of certain executives to maintain amicable relations with their peers and subordinates led to results that failed to come up to expectations. Despite this, the projects already under way and the programme for new models did not suffer, partly because the Automobile Design Offices had remained behind in their old premises on the fifth floor of the company's office block, so helping to give the impression that nothing had changed.

As for me, I now found myself able to devote much more time to studies for the future and the work of the Styling Centre. I was immediately impelled to organize the workings of my mind, to lay down guidelines for my imagination, to sift and select the spate of ideas that thronged my mind, jostling one another aside in the quest for the best. The basic task was to check, either through drawings or other means at my disposal, how far certain ideas could feasibly contribute to concrete advances along the path of progress. It was only after careful selection and evaluation of the scope for further development that I would pass an idea on to the study and design offices to be worked out in more detail. In order to put this procedure into practice I needed the assistance of a suitable person, someone who could understand me, interpret my ideas and contribute from the resources of his own imagination, translating my concepts into drawings, models, photomontages, diagrams and charts. I knew just the man for the job: Ugo Romolo Vercelli.

He had been educated at the Istituto internazionale Edoardo Agnelli, trained to the severe discipline of the Salesian brothers, and had started work at Fiat in the experimental construction workshop as a draughtsman. Podestà mentioned him to me as worthy of promotion to the technical office so I had him assigned to the department for special derived models which had been set up in 1952 under Luigi Fabio Rapi. He soon revealed his exceptional abilities as a designer. Like Leonardo da Vinci he could use his left or right hand with equal skill, even for writing. But Vercelli's powers were not just those of a draughtsman. Behind his unassuming manner I discovered the highest personal qualities and an extraordinary flair for imaginative inventions, supported by a wide and accurate knowledge of the various fields of mechanical engineering, technology, design, printing and photography. Deeply versed in music, he has made musical instruments with the same passion as he devoted to mechanical models (including perfect reproductions of railroad locomotives). With his great powers of memory and the ability to express his ideas clearly and accurately he was the ideal assistant for me. He remained with me as long as I worked for Fiat and his abilities never ceased to astonish me.

I gave him a big studio all to himself, taking up half of the southern end of the fourth floor of the Mirafiori "palazzina".

I had moved from the magnificent central office on the fifth floor to a second-floor office in a corridor lined with the offices of the other directors, not far from Bono's.

Vercelli had a large wall where he could display my planning charts. He had fixed a series of big panels to it where designs, the sections of autos, and tables with data and information could be put up and moved around easily. There were tables, shelves and stands where models made of wood, plasticine or other materials could be made and displayed. The room was complete with tools and work benches, and everything needed for photographic reproductions. Vercelli would lock himself in and work there all alone.

The idea of taking over the Boano coachwork firm to enlarge the model shop and create the Styling Centre had been Luigi Gajal's brainchild. He had always shown a lot of interest in the work of coach building firms, maintaining close contact with them, sponsoring their efforts, keeping up with their progress and finding out what they needed so that he could help them with advice and support where necessary. He gave them timely warning whenever Fiat was about to launch a new model and arranged for us to prepare chassis suited to being fitted with special coachwork. Whenever important motor shows were in the offing the coachbuilders were given all the relevant information well beforehand so that they could produce their magnificent models and exhibit them at the same time as the standard production model was being presented.

Mario Felice Boano, coachbuilder, born in Turin in 1903. He worked for the Stabilimenti Farina and in 1930 followed Pinin Farina when he left his brother's works to set up on his own. Some years later he opened his own works where he designed and built wooden "masters" for coachbuilders.
In 1945 he entered into partnership with Ghia, becoming owner of the firm two years later.
In 1954 he founded his own coach building works and in 1958 made a deal with Fiat, under which he helped to set up the Fiat Styling Centre, for which he has worked as a consultant for nearly a decade.
[He died in 1989].

Commendatore Mario Boano had contributed to the successful development of the Ghia coach building firm in collaboration with its owner, Segre. Then, in 1952, he decided to set up on his own; with the help of his son, Gian Paolo, he founded the Boano coachworks with a workshop in via Giacinto Collegno. Gajal thought highly of Boano, with good reason, and wanted us to collaborate with him, especially in the stylistic development of production models. In this way we came to rely on his immense abilities as a craftsman and coachbuilder to produce numerous variants of the *1100/103* and the *1200*. Luigi Rapi kept up the relationship and made his own contribution to the work.

Luigi Fabio Rapi had entered Fiat in 1949 and was appointed head of the Special Derived Automobile Department. He had produced designs for an immense range of different vehicles, from vans to taxis and station wagons, but his best known and

External view of the Fiat Styling Centre in via La Manta.

most important models were the *Bianchina 500* and the *Panoramica*, the coachwork of the *8V*, of the turbine-powered auto and of the *103 TV* convertible.

In 1956 he had been transferred to Simca but in March 1958 he came back to Turin and I had placed him in charge of stylistic studies. In this role he kept up contacts with the Boano coachworks and followed its work, which centered mainly on development of the *103*, consisting of those modifications which even the Italians now describe with the English jargon term as *restyling*.

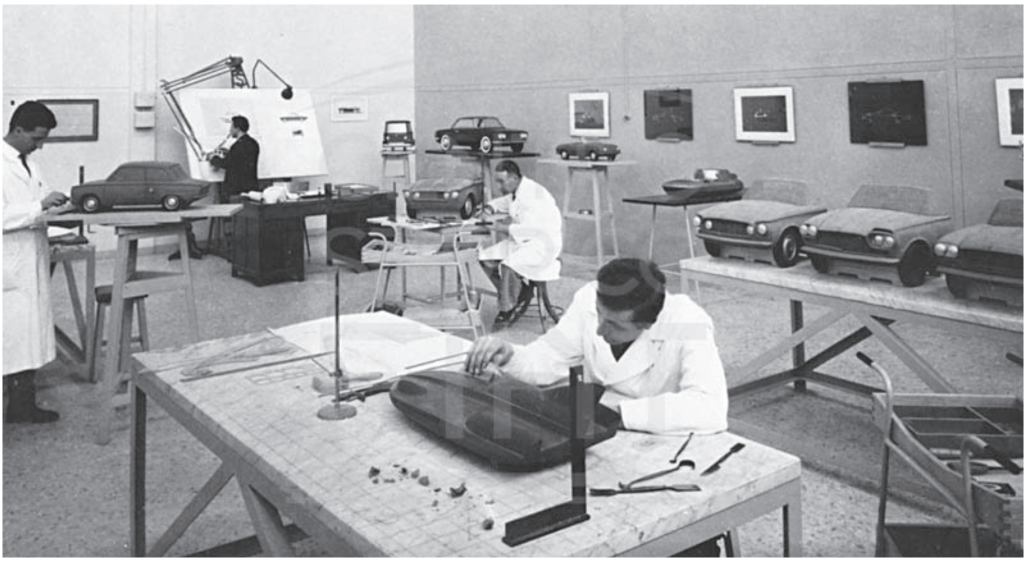
In October, as a result of negotiations mainly conducted by Gajal, a deal was concluded between Fiat and Mario Boano which led to the transfer of the whole Boano outfit (including father, son and staff) to Fiat, so forming the Fiat Styling Centre.

The Styling Centre was to comprise workshops to study form by using plasticine or plaster models, design studios, carpentry shops for wooden or plastic mock-ups, a workshop to build sheetmetal coachwork, a department for designing and making internal fittings such as fascias, upholstery and accessories. A special building was to be constructed in via Settembrini on a site in the immense Mirafiori Sud area near the big factory with machine presses for mass production. Rapi also worked on to this project.

While waiting for the building to be completed, we continued to construct plaster models in the old workshop on the fifth floor of the Mirafiori "palazzina", adjoining the technical office. It was there that the Boanos, father and son, learnt and practiced the technique of plaster modelling, quickly becoming masters of it. And there, too, the coachwork of the "116" was evolved, later to become the *1300/1500*.

When the Styling Centre's home was finally completed, Boano's plant and all his staff moved in together with Fiat's plaster modellers and design engineers, forming a highly efficient team.

It was my hope that Rapi would occupy a leading position at the Styling Centre alongside Mario Boano but I soon came to realize that it was not going to be possi-



One of the studios for designing and constructing small-scale models at the Styling Centre in via La Manta.

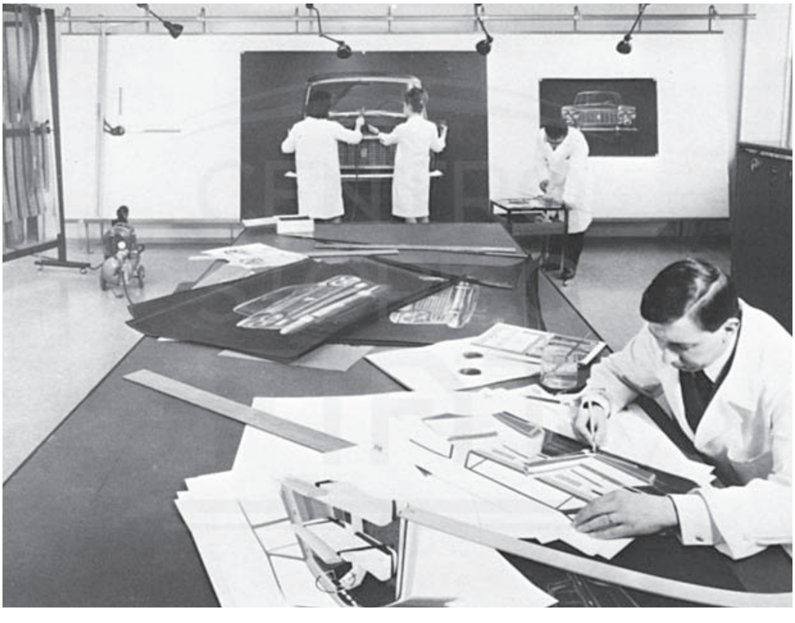
ble. Luigi Fabio Rapi was a brilliant designer. His touch as a draughtsman was deft and delicate, his use of colour masterly. His drawings were of outstanding subtlety. He lacked neither flair nor an understanding of technical matters but his temperament prevented him from fitting into a milieu that he considered banal and mediocre.

Short of stature, animated in manner, he had the typical Tuscan readiness of speech and a keen sensitivity that made him out of place in a work environment in which the Piedmontese dialect dominated and human relationships were guarded and slow to form. My patient and careful attempts to get closer to him and my diplomatic overtures were unavailing. His instinctive rejection was invincible. Eventually I found Rapi (whom I greatly respected) a place with Autobianchi, where he could continue to exercise his powers and satisfy his passion for design.

I now have to go back again in time to deal with an episode too important to bypass. This was the decision to build a Fiat automobile powered by an engine designed and constructed by the Maserati brothers. It was no more than a single episode in the immense productive activity at Fiat but it merits attention.

The story began on 11 July 1957, when I welcomed Ernesto Maserati to Mirafiori for the first time. The Maserati brothers had ceded their plant and the name of the company to the Orsi family in 1937. Subsequently they founded a new company

Ernesto Maserati, racing driver and automobile manufacturer, born in Voghera in 1898. At the end of the First World War he joined his brother Ettore in working for the company founded by his brother Alfieri in 1914: the Officine Alfieri Maserati, which built racing cars. After his brother Alfieri was involved in an accident on the Messina track in 1927, Ernesto devoted himself even more actively to racing, with brilliant achievements in the 1929 Mille Miglia, in the 1930 Monza Grand Prix and the 1932 Rome Grand Prix, which he won. In 1932, on the death of his brother Alfieri, he carried on his work by designing engines and autos for the family company. In 1937 he and his brothers sold the company and set up a new one in Bologna, OSCA (Officine specializzate costruzioni automobili). In 1963 it was taken over by MV Augusta. Ernesto Maserati died in Bologna in 1975.

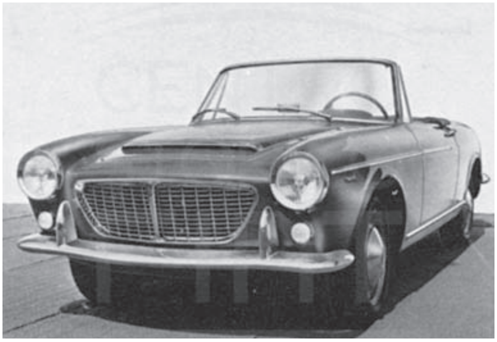


The Styling Centre also produced realistic life-size drawings, usually in pastels on coloured paper. In this way the plausibility of design solutions could be checked before moving on to the modelling stage.

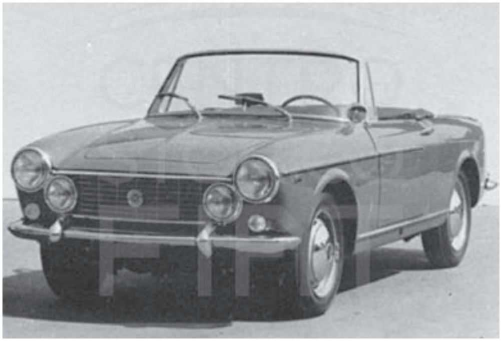
called OSCA. Finding themselves in financial straits they turned for help to Fiat. Gajal asked me to find a solution.

Ernesto Maserati was serious and unassuming in manner. He was a great expert in racing engines and awakened my interest and liking. We soon agreed to propose mounting an OSCA 1.500 cc engine on the *Cabriolet 1200* with coachwork by Pininfarina. After getting the go-ahead from the presidential office we carried out tests and modified the engine to fit our requirements, then decided to embark on short-run production. The *Cabriolet 1500* with the OSCA engine was launched in 1959 and 80 were produced. Then in 1962 the engine was increased to 1.600 cc and it was given the designation *1600 S*. This model turned out 100 hp SAE and reached a speed of 175 m/h. About 300 of this version were produced.

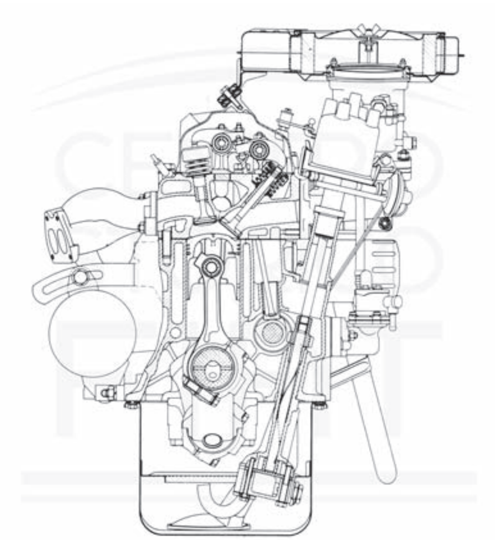
In 1957 it was envisaged that the production of the *1800* in two years' time would mean the end of the *1400*, which had put Fiat in a leading position with its original



1500 cabriolet with OSCA type 118 engine (1959-62).



The final series of this cabriolet, called 1600 S from 1963 onwards, had a redesigned front and important modifications aimed at more flexible operation. Coachwork by the Pininfarina works.



The OSCA 118 engine: cross-section showing the large diameter valves designed to obtain maximum power.

and up-to-date technology. When this happened Fiat would be unable to offer anything except the *1100* to those or its customers who could afford the *1400* but not the more expensive and powerful *1800*. So an effort was made to make the *1100* more attractive by means of the various modifications already described. In fact the *1200 Gran Luce* was one partial attempt to fill the gap between the *1100* and the *1800*, at least until the new "116"-*1300* was available.

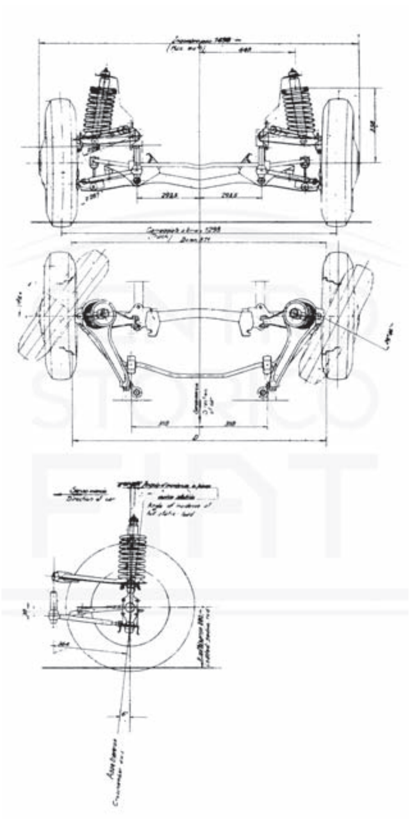
I had been engaged on the design of the "116" for some time and things had actually got to the point where I had some drawings done and could mention it to Bono as part of my argument in support or a six-cylinder engine for the *1800*. The "116" had soon become one of the most important items and had to be completed with the usual dispatch. The choice of the engine had already been made with the design of the "112" engine for the *1800*, planned to make it easy to adapt it to a four-cylinder arrangement using many of the same components.

This solution was a tremendous money-saver and gave excellent results. In fact the 1.500 cc "116" engine is still being produced in Poland and is not a whit inferior to the most up-to-date engines with overhead cams. The polyspherical combustion chamber with its valves arranged in a V has extremely effective anti-knock qualities. The engine occupies less space than an engine with twin overhead cams and unlike such engines does not require great accuracy in manufacturing since the camshaft is in the crankcase and the regulation of the valves is carried out in the traditional way by screws on the rocker arms. It has a twin-choke carburettor and turns out 65 hp at 5.200 revs.

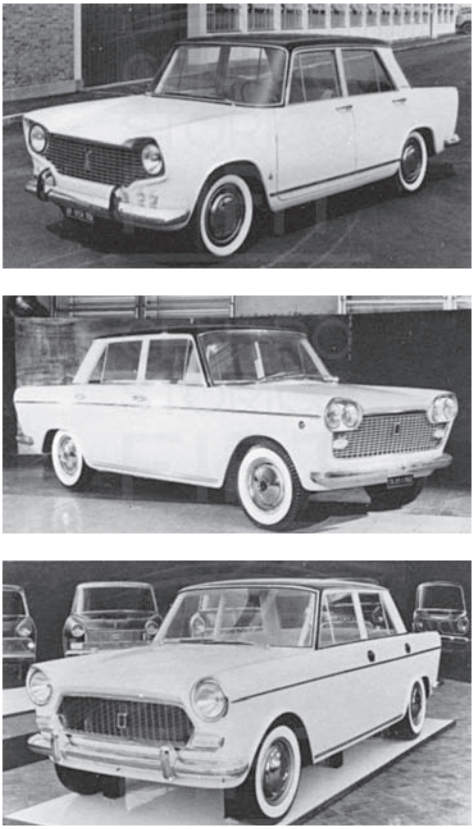
Work on the design of the auto was resumed early in 1958 but broken off from time to time during the year to give priority to other tasks. The most urgent jobs involved the *1800* and *2100* in their various versions.

I got to work moving along two different lines. The first, quicker and easier to complete, involved retaining the mechanicals of the *103*, only replacing the 14-inch wheels with 13-inch ones and, of course, changing the engine. The second plan involved new mechanicals and lighter independent suspension on all wheels.

While the "116" project gradually took shape in Turin, Montabone in Paris was directing operations for the design of an auto with independent suspension all round and a 1.500 cc engine derived,



The front suspensions of the 1100/103, simple and sturdy, was also used, with few variations, on the 1300-1500. Design dated 6 March 1961.



The first plaster mock-ups of the 1300-1500 modelled in via La Manta were reminiscent of the lines of the1800-2100. Studies made in 1959.

through some ingenious developments, from the *1100*. For economic reasons it would have been a good idea to standardize the chassis of our "116" and this Simca *1500*, differentiating the two models only through their engines and coachwork. But this idea, which might have led to immense savings in investments, servicing organization and the distribution of spare parts, was for some incomprehensible reason opposed by Fiat's General Management. In fact the decisions of the President and the General Management were always an obstacle to standardization with Simca.

Meanwhile studies continued for the coachwork. Boano had produced a preliminary effort with the construction of a prototype in sheet-metal in his workshop. Pininfarina showed little interest and only produced some sketches. In our studio on the fifth floor of the "palazzina" we produced two plaster dummies to full scale without coming to any final decision.

The final approved plaster model for the 1300-1500 drew strongly on the styling of the Chevrolet Corvair (and in turn probably influenced the NSU Prinz).

We settled on the most economical arrangement for the chassis, using the traditional rear axle and spring-leaf suspension, while Simca had also abandoned the idea of independent suspension all round. The platform of the coachwork was given careful study with the aim of obtaining maximum rigidity and the greatest simplicity of construction. The front suspension was of the *103* type, a jointed quadrilateral with the spiral springs superimposed on the upper spar. Light and robust, it was safe and gave the auto excellent handling qualities. All the improvements suggested by years of experience with the *1400* and the *103* were taken into consideration when designing each part of the mechanicals, from the suspension to the steering, from the clutch to the gearbox, from the transmission shaft to the structure of the hypoid gearing of the rear axle and the brakes. The front brakes were changed from the traditional drum type to disk brakes, which were less noisy and less heat sensitive, while guaranteeing more reliable performance.

The plaster mock-up of the auto, in what could be considered its final form, was presented to the presidential committee on 1 September 1959 and approved. A few days later I received the communication signed by Valletta confirming the decision taken, provided certain conditions were met:

Order no. 23187

Definition of the 116 automobile presented 1/9/1959

Present:
Valletta – Bono – Agnelli – Nasi – Gajal – Fiorelli – Giacosa – Gioia – Montanari – Mosso.
Decisions:
It was verified that the inner and outer dimensions were the same as those of the relevant designs and that the specifications were as follows:
- engine, 4 cylinders 1.295 cc or 4 cylinders 1.481 cc (optional);
- gearbox, 4 forward gears fully synchronized (new type);
- front suspension of the new type;
- rear suspension with leaf-springs and axle of the *1100* type with reinforced differential;
- weight equal to or less than 850 kg top speed 140 km/h;
- acceleration superior to the Giulietta T.I.;
- fuel consumption equal to or less than the Giulietta T.I.

The model is approved. (With regard to costs, it should be borne in mind that the sale price envisaged is the same as for the *1100* deluxe version).
- The suggested side ribbing for the hardtop is rejected.
- The front end, engine hood, radiator grill will be redesigned and produced for approval (after sheet-metal samples have been made).
- Volume and layout of trunk space are subject to revision after comparison with volume and layout of same space in new *600*.
- Note power-driven fuel pump requiring high-capacity feed tubes.

Experimental models:
- First complete model by end of October.
- Sets of mechanicals for workshop tests by mid November.
- Second model complete by end of November.
- Parkerized body shell for Mirafiori works by 10 December.

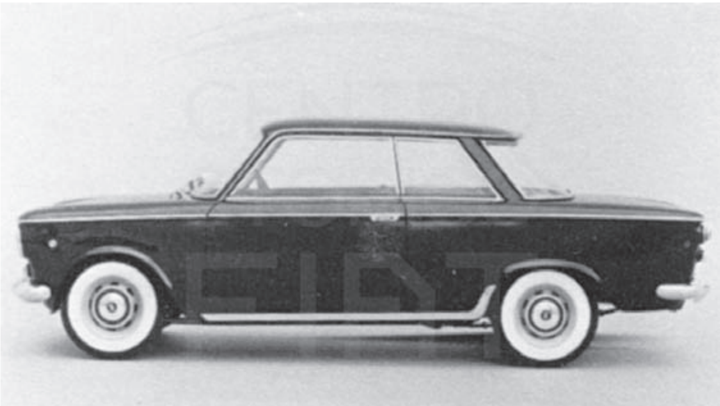
– Plated body shell for workshop tests absolutely no later than end of December.
– Third and fourth test models by end of January.

Production:

– It is decided that the Auto Section is to start immediately to produce the demonstration model, producing dies of the side panels, doors (with inner and outer covering), hard top according to the corrected design, windshield, rear window, floor and frame.
– It is the intention of the President that this auto should be in production by February 1961 with a daily output as from that month of at least 100 units per day rising to a maximum of 600 units per day.

Additional notes:

– As soon as design of the basic model is complete and even earlier in the case of many details the Automobile Technical Offices are to design the station wagon model in addition to a 2+2 coupé with a 1.295 cc engine or a 1.481 cc engine (optional). A two-seater sports model is also envisaged with the 1.500 cc OSCA engine and custom-built sports coachwork.
– During tests of the *116* prototype, trials should also be made using independent



This design for a two-door coupé corresponding to the styling of the production model sedan was developed as far as the 1:5 scale model, skilfully produced in sheet metal. The photographs taken of it were so realistic that they caused a flurry among the General Management, alarmed at photos of what they thought was a costly full-size model. This attractive design was never taken any further.

suspension on the rear wheels, already designed and constructed, with a view to future applications.

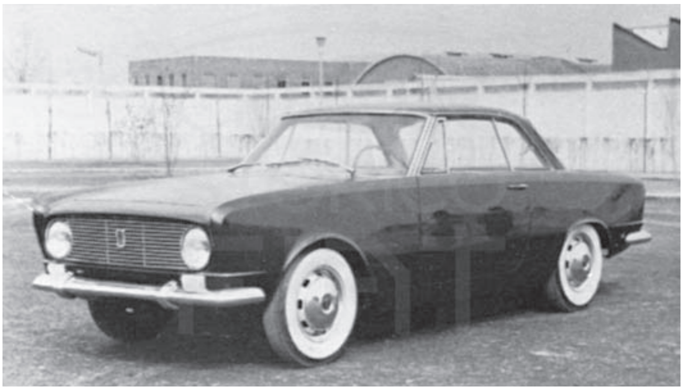
– Similar tests to be made for three-speed gearbox with overdrive. Maximum collaboration is requested of all sectors in order to bring forward the dates of production and increase output.

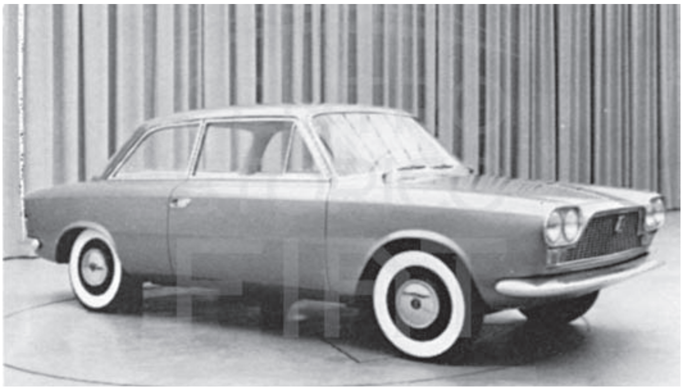
V. Valletta

Not all the instructions contained in this communiqué were complied with. The weight of the prototype at first was only slightly greater than the weight laid down beforehand but it continued to grow as trials went on and various deficiencies were corrected, in particular the changes introduced to make the coachwork more silent and comfortable and to improve the quality of the furnishings in keeping with the class of automobile aimed at.

The development of the body shell was based in particular on tests conducted in the workshop for static and dynamic stresses, especially the trials for fatigue. At that time the workshop had been made more efficient by newer and more complete instrumentation and under the direction of Locati and Franchini started studies of the behaviour of automobiles in the case of collisions, a field of research that gradu-

Full-scale model of a 1300-1500 coupé ("116/540" design 1) made in 1961.





Full-scale model of a 2+2 coupé on a 1300-1500 chassis made in 1962, with an attempt to follow the styling of the front part of the 2300 Ghia. It is diplayed in the Styling Centre Studio on a special revolving platform.

ally came to be of primary importance and saw Fiat in a leading position. Franchini has become one of the outstanding figures in the field of so-called “passive safety”.

The success of the *1300-1500* can be attributed not only to its mechanicals, which gave it excellent performance, good suspension and road holding, safety and easy handling, but also to the originality of the design of the coachwork and its great sturdiness.

Mario Boano was responsible for the vehicle’s styling. The early plaster mock-ups were based on the line of the *1800*, differing from one another mainly in the front end and the arrangement of the single or twinned headlights. Four such models were produced without achieving anything definite. The lines of the *1800* had grown stale: it was essential to get away from sharp straight edges.

It was a visit to the Paris Motor Show, where we saw the General Motors *Corvair* on display, that inspired the shape of the *1300*. This new American model followed the Volkswagen and the *600* in having a rear-mounted engine. We all felt the streamlined profile of the *Corvair* was very attractive as well as being functional from the point of view of production. Mario Boano adapted the style to the dimensions of the *1300* with great skill, by no means an easy task considering the difference in proportions.

The “116” was presented to the public at the end of April 1961 in the *1300* and *1500* versions of both the sedan and the estate.

CHAPTER XVII

THE "112" PROJECT AND THE SIMCA *1000*

THE PRODUCTION OF THE *850*

The changes affecting the company's organization had not interrupted the rate of work so that I not only had to complete the "116" project but also give my attention to perfecting the *Nuova 500* and the *600*, which were meant to come out in 1960 in the *500 D* and *600 D* versions, in addition to updating the *103* and giving the finishing touches to the *1800* and *2100*, for which the works were then being tooled up without a moment's respite. But, as usual, my thoughts were racing far ahead.

Foreseeing that in a few years' time a slightly larger auto than the *600* would be needed I began to have some drawings done, identifying them by the numbers "119" and "122". (The designation "120" had been given to the *500* station wagon, while "118" and "121" had been given to other projects which had been shelved).

In 1959, the year when I was given the Golden Compasses award for the *500*, production of the *1800* began and the "116" project was approved by the presidential office, enabling me to get on with the two projects.

My frequent contacts with Simca led me to take an increasing interest in what was being done abroad. I gave careful attention to the developments of the most important French, English and German automakers and their trends, making use of big charts displaying the comparative constructional features of the various types. I made the following note:

> Our winding roads, often in mountainous terrain, the built-up areas which offer little space for motor vehicles, the economic conditions governing the market, such as the difference in the standard of living between Northern and Southern Italy, the tastes of the Italians themselves: these are the reasons underlying a particular type of technology and design.

850 Super sedan, 1964.

Our automobiles are distinguished by their small size and engine capacity, their easy handling, outstanding performance, road holding, excellent braking, sturdiness. These are features which have made Italian autos admired abroad. Sporting victories have lent prestige to Italian engineering.

Many foreign companies have drawn on our achievements and adopted stylistic and technical innovations which we were the first to introduce successfully. By this I mean to show that automobile technology now advances on the international plane. It is no longer meaningful to talk of Italian, German, French or British technology. The European Common Market is bound to break down frontiers.

For our auto industry to survive against foreign competition it will have to evolve; defending the Italian market and expanding into Europe and the world. In Italy motoring is becoming increasingly popular and within a few years the economic situation and the traffic conditions will be much the same as in the most advanced industrialized countries in Europe. There is already evidence of a convergence of research in the technological field and of taste in the choice of models, an evolution leading towards a few clearly defined types of auto.

Europe is moving towards a rate of automobile ownership close to that of the United States. Within a few years Fiat will reach an annual production figure of one million automobiles.

Just as in the United States the public has oriented its choice towards a single standardized type of auto whose size and performance is suited to a big country, in the same way Europeans are moving towards a few types which respond most closely to the environmental and economic conditions prevailing here. Statistics show that the autos most widely sold in Europe are those that have a fuel consumption of between 8 to 10 litres per 100 km.

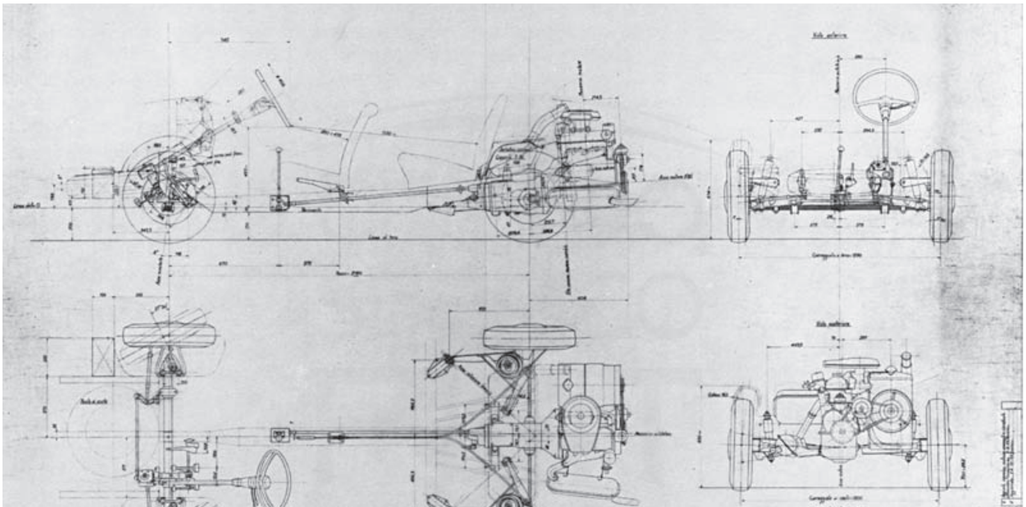


Diagram of the "122" chassis (provisional design from which the Simca 1000 was to evolve), dated 1 April 1959. The drawing shows its advantages over the 600: more space in the cab as a result of its longer wheelbase and more baggage space with new arrangement of the fuel-tank and spare wheel and the longer hood or bonnet.

> Consumption is a significant factor: it is the product of the weight of a vehicle, its dimensions, form and speed. The most popular automobiles sold in Europe have engines that vary from 1.000 to 1.500 cc. Their weight on average is 800 kg.
>
> The most widely sold model in Italy is the *600* because our economic condition is below the European average but the situation is bound to change soon. In my opinion we can forecast that the *600* ought to be replaced within a few years by a 1.000 cc model.

Pigozzi's conclusions agreed with mine: within a few years the model most in demand would be a four-seater weighing about 650 kg and having a 1.000 cc engine. He wanted an auto to be designed to these specifications. Simca had already produced some preliminary sketches.

At Fiat Bono would not take up a firm position, as always happened whenever long-range planning was proposed.

During all my forty years with Fiat long-term plans were never made for design. It was not for want of trying on my part (and from 1960 on I was a member of the company's policy making committee) or because no thought was given to the future. But Fiat's top management deliberately concentrated all their efforts on whatever had to be achieved within two or at most three years ahead. They relied on great speed in carrying out the projects, with the result that not infrequently changes would be adopted to fit in with changing circumstances. Projections of the long-term future were only approximate and lent themselves to different interpretations. When I tried to draw attention to plans relating to some five or six years ahead I could only get some vague observations. The result was that I limited myself to plans that could be developed in a variety of ways and left the door open to solutions that could be chosen when the time was ripe and that could be implemented with the utmost rapidity.

This procedure seemed to me to have its dangers: it meant relying on the prompt availability of large resources, both technological and financial, and above all on the abilities, spirit of self-sacrifice and sense of duty of the people working for the firm. Would Valletta be able to keep alive that company spirit which enabled him to utter his slogan: "Fiat before everything else"? Valletta was capable of galvanizing the people who worked for him and Bono could squeeze the last ounce of energy out of them, even rewarding them when the moment was ripe, but times could change.

The "1000" appeared to Pigozzi and me as the car of the future. Simca had carried out some preliminary studies and Montabone was bound to press for finalization of the project. While I was awaiting instructions from the presidential office I had designs developed on the basis of the two schemes already chosen, the "119"

Vittorio Valletta, born in Sampierdarena (Genoa) in 1883. He graduated in 1909 from the faculty of Economies and commerce at Turin University (at that time a commercial institute of higher education), and embarked on an academic career, starting as assistant lecturer in banking methods. One of his earliest professional activities was the running of Antonio Chiribiri's aircraft and automobile factory in Turin. In 1921 he was taken on by Giovanni Agnelli to reorganize Fiat but he continued his academic work for another decade. His career at Fiat was marked by rapid progress. He became central manager, then general manager, from 1928 he was managing director, from 1946 President and managing director, and from 1966 honorary President. He was one of the leading forces in Fiat's revival and development after the Second World War.
He was awarded the honorary title of cavaliere del lavoro and, in 1956, the title of honorary papal academic from Pope Pius XII. In 1959 the Turin Polytechnic awarded him an honorary degree in Industrial engineering. In 1966 he was made senator for life. He died in Le Focette di Pietrasanta (Lucca) in 1967.

and the "122", which differed from the *600* basically in their engines, dimensions and the shape of the coachwork.

The "119" had a 1.000 cc engine derived from the *1100*. The change consisted of a reduction in the travel of the pistons, which involved altering the engine shaft and a slight reduction of the height of the cylinder block. The "122" had an engine derived from the *600*, increased to 850 cc by enlarging the bore of the cylinders and their spacing. The two models differed in their wheelbase and so in their overall lengths.

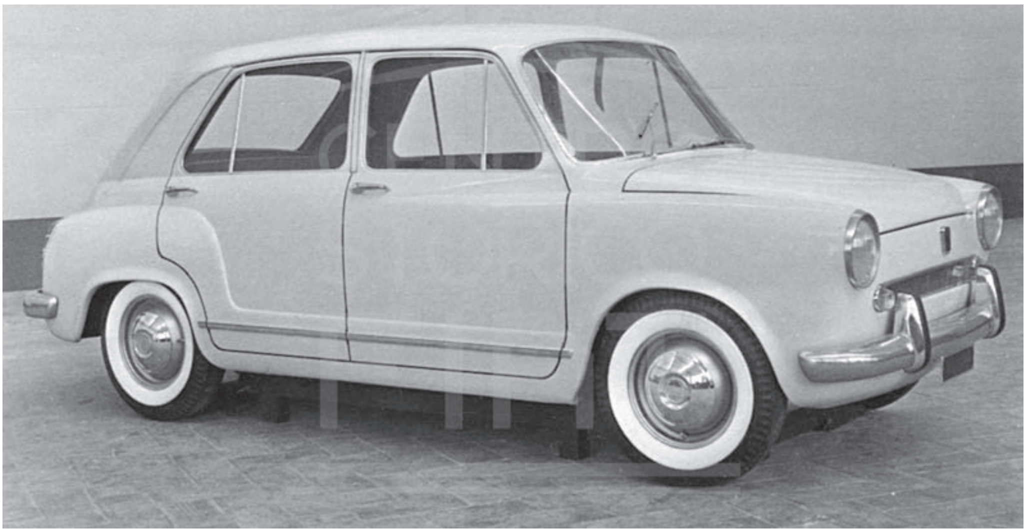
The "119" corresponded roughly to Pigozzi's plan for Simca, while the "122" was intended to anticipate what I believed would be the line taken by Fiat's top management.

The "119" did not win Bono's approval and so the design was shelved. The "122" was developed. The general scheme was close to the *600* but the coachwork was decidedly larger and more spacious, with a more rational layout of the mechanicals, especially the steering and the fuel tank.

The suspension was adapted to the larger track and modified to improve its springing; the arrangement of the engine-gearbox was improved by structural changes that also involved changes to the coachwork.

In contrast with my decision many years earlier when I designed the *600* and the *500*, which had the fuel tank in the front "hood" or "bonnet" space to shift the centre of gravity further forward, in the case of the "122" I preferred to place it behind the rear seat, level with the floor, so that it would be better protected in case of impact. To create the necessary space it was necessary to increase the wheelbase by a few centimetres and so the overall length of the auto.

The reasons behind this were sufficiently important in my opinion to justify the risk (slight enough anyway) created by increased weight resting on the rear-wheels.



Model "122 /540": approved final design, 1960 (plaster mock-up). These and the following illustrations show some of the many full-scale plaster mock-ups of the "122" made in the Styling Centre, to avoid producing a banal imitation of a large auto on a reduced scale.

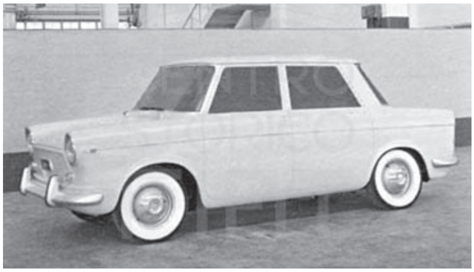
Naturally, rear-engined autos use the "hood" or "bonnet" in front as luggage space, so the presence of the fuel tank there cuts down the space available and could possibly lead to a fire in the case of collision.

News had also come from France that a law was to be proposed making it illegal for autos to have the fuel tank in the front. The new arrangement with the fuel tank towards the rear was a solution to the problem and also provided more room for luggage. There was also enough room above the tank and behind the back of the seat for a suitcase, as in the *600*.

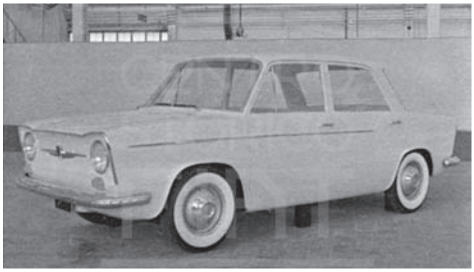
The Styling Centre produced a preliminary plaster model. The designs were sent to the workshop some months later and construction of the prototype began.

Bono had no time to follow all the developments in the project, busy as he was with myriads of problems, but he kept himself in the general picture by dropping in for quick visits to the experimental constructions workshop. On his visits he never got either me or Fiorelli to accompany him. He would have a talk with cavaliere Podestà, who was in charge there, to hear how work was going and hear his opinions. Podestà was experienced, capable and shrewd: he sometimes passed confidential judgments and suggestions with the aim of winning the esteem and confidence of the general manager. He acted in the same way towards me, too, as when he passed on the general manager's comments after a talk with him. I was careful not to spoil relations with the little cavaliere who was not under my authority but, as the man in charge of constructing prototypes, displayed great care and competence in carrying out the designs he received from our offices.

Model "122/540", design 2a, 1960 (plaster mock-up).



Model "122/540", design 3a, 1960 (plaster mock-up).



Model "122/540", design 6a, 1960 (plaster mock-up).

Model "122/540", design 1a, 1960. An early design suggestion, made in sheet metal, aiming at a shape reminiscent of the 600. The stylistic link between models, proposed for marketing reasons, was actually taken up later on by the 850, the eventual replacement for the 600 in the Fiat range.

The “122” was in the assembly stage. Bono noticed (or perhaps it was Podestà who pointed it out to him) that the tank was at the back, not far from the engine. Very likely Podestà overstressed the significance of this feature. The body shell had not been completed and so the back panel of the bodywork separating the tank from the motor was not evident. Bono and Podestà should have understood the reasons that had led me to place the tank towards the rear. Without consulting me, Bono gave Podestà the peremptory order to move the tank under the front hood, changing the shape to accommodate it. He either did not want or did not dare to inform me. It was Podestà who anxiously and timidly told me what had happened and asked me to provide the necessary designs.

I was surprised and badly put out. I could not in the least understand why the general manager had behaved in this unprecedented fashion. I had given him all the documentation relevant to the “122” project and he had approved construction of the prototype. I tried to conceive what reason could have led him to undermine my authority and prestige with the works and my staff. It was a shock to me. But I decided not to show any resentment and to put Bono’s behaviour down to a state of agitation caused by overwork. It was an aberration that could be pardoned in a man who was intolerably overburdened. He ought to have remembered what had happened a few years earlier, when he was forced to defend Fiat and me personally against the accusation of having caused the death of a young woman who died when a *600* caught fire after a terrific crash. The investigating magistrate accused us on the grounds that the position of the fuel tank at the front of the auto, liable to deformation in the case of a head-on crash, had been the cause of the blaze. It was an unpleasant and upsetting episode. We only got out of it by producing a fully documented report on the homologation given the model by the authorities in every country and by a series of crash tests carried out for the purpose. These showed that a head-on crash in itself was not enough, however disastrous, to set fire to the fuel spilt on the outside without some additional factor, such as a spark caused by the metalwork scraping along the ground. Anyway, the very thought of such an accusation being possible seemed a good enough reason to justify putting the tank further back in a more protected position. But the “122” prototype was built as Bono wanted, with the tank under the hood in front.

While tests of the first model were being conducted, new designs of the coachwork were experimented with. We eventually produced six plaster mock-ups, embodying different shapes.

Model “122/540”, design 9a, 1961 (plaster mock-up).

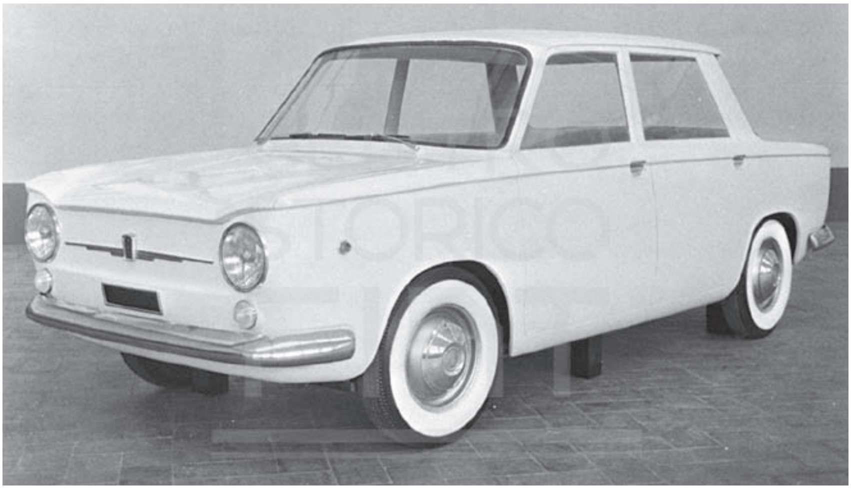
Model “122/540”, design 11a, 1962 (plaster mock-up).

One of these appealed to Pigozzi, who wanted it to serve as a model for Simca's design engineers – at that time working under the direction of count Mario Revelli de Beaumont. In this way the Simca *1000* bore the stylistic imprint of one of the plaster models produced at Fiat's Styling Centre. The sheet-metal prototype was built in Turin by a team of designers and specialist workmen under Mario Revelli's guidance. Despite the fact that they were given makeshift premises on the outskirts of the city they made an excellent job of it. Head design engineer in charge of the work on the body shell was Sibona, a man of excellent qualities. Pigozzi's growing enthusiasm contrasted with Bono's lack of interest. So while the Simca *1000* was successfully going through all its tests, winning final approval for the prototype and going into production, the "122" was silently shelved and soon forgotten.

Mario Revelli de Beaumont, born in Rome, 1907. At an early age he and his brother designed a racing motorbike which he himself rode to victory in the first Coppa del Mondo in Monza in 1925. He designed numerous specimens of automobile coachwork for the Stabilimenti Farina and the Ghia, Moderna, Sala and Castagna works.
From 1929 to 1931 he collaborated with Fiat in the Special Coachwork Department, while also producing patented inventions for accessories of various types. He collaborated with Pininfarina and Fiat in the early post-war period then with CANSA and Simca in Paris, General Motors (1952-54) and again Simca (1955-63).
Since 1954 he has worked as a free-lance with a design studio in Grugliasco (Turin).
[He died in 1985].

The Simca *1000* came out in September 1961 and had the success that Pigozzi had foreseen. It went on being produced for years and even survived changes in the company's ownership.

Soon after, we were again confronted with the problem of developing the *600* in anticipation of having to attract public interest by making some innovations. The General Management and the commercial sector felt that the *600* brought out in 1955 would have to be replaced by a more up-to-date version in 1963 or 1964. They considered that a model could not be expected to last more than nine or ten years.



Model "122/540", design 4a, 1960. This is the plaster mock-up chosen by the President of Simca as the basis for the Simca 1000. The final model was produced by a special work team in Turin headed by Mario Revelli de Beaumont.

The new project was designated the "100 G". The automobile, as we shall see, was to become the *850*.

The design of the *600* had been very carefully evaluated from the point of view of manufacturing costs while still in the planning stage. I had carefully studied every detail of its construction, seeking as always for the utmost simplicity. Consequently I knew for a certainty that any changes would mean more weight and an increase in costs without a proportionate improvement in quality. Moreover, I thought the *600* was the typical cheap automobile that ought to be kept in production for as long as possible, in the way the Volkswagen had been, perfecting it and if possible reducing its cost and hence its price.

The new project did not appeal to me. It was Montabone, recalled to Turin as a junior director with the General Management, who took charge of it.

A plaster mock-up was produced at the Styling Centre. This was reminiscent of some of the stylistic ideas worked out for the defunct "122" project. To increase space inside, the wheelbase was made 3 cm longer than the *600*. The coachwork was 4,5 cm wider and its overall length 36 cm longer. The 843 cc version of the "100 G" engine designed for the "122" was adopted. This was a skilful adaptation of the "100" engine, with the bore and stroke of the pistons increased from 60×56 to 65×63,5 mm. All the mechanicals corresponding to those of the *600* were slightly modified in accordance with the information gained by experience and more complete and sophisticated testing. There were no special problems involved and work went ahead smoothly and quickly.

But just a few months before the scheduled production date, spring 1964, a set-back threatened to hold the programme up. The tests that Montabone was having done at that point to evaluate the auto's aerodynamic qualities revealed the importance of the shape of the rear. Results showed clearly that the profile of the *850*'s rear end as it had been designed and approved was not aerodynamically efficient. In fact the *850*'s top speed was very little higher than the *600*'s, despite its greater engine-power, 40 hp as against 29.

Its coachwork, like that of the *600*, fell away at the back: a two-volume shape. Mon-

Dante Giacosa with his principal collaborators: from left to right, Russolo, Giacosa, Persia, Montabone and Martinotti.

tabone immediately had a sort of “trunk” or “boat” applied to the rear, only roughly fitted to it but enough to enable speed tests to be carried out. The results came up to expectations: the top speed was over 120 km/h as against the 110 km/h of the *600 D*.

But this brought us up against the problem of implementing the change in practice. The works had already got the dies for the coachwork ready and any change at this stage would mean putting back the start of production. I was also afraid that changes to the dies might not be made sufficiently accurately to reproduce the exact shape that the Styling Centre was modelling.

When Bono was told of this he unhesitatingly ordered the change to be made immediately. He refused to concede the slightest postponement for the date for starting production.

What was involved was remodelling the rear end of the plaster model, taking its profiles and tracing them on big sheets of aluminium, doing the designs of the elements of the body shell, modifying the wooden mock-up or “master” which is needed to produce the dies, have the dies made, and finally turn out a number of bodies as samples for the works and for stress trials in the workshops. All this had to be clone in the five months that lay between us and production day.

Working without keeping count of the hours until late into the night, the expert modellers at the Styling Centre managed in record time to modify the plaster model, complete down to final details and varnish. Though not entirely meeting with the approval of the stylists it was judged acceptable.

At that time there were none of those marvelous electronic devices that nowadays trace the shape of the master directly onto paper. A specialized draughtsman would make measurements point by point, a painstaking task requiring the utmost precision. To speed the process, the only possible method was to prolong the working hours morning and evening until weariness made it impossible to go on. This superb

850 coupé, first version, 1965.

850 sports model, designed and built by the Bertone coachworks, first version (1965).

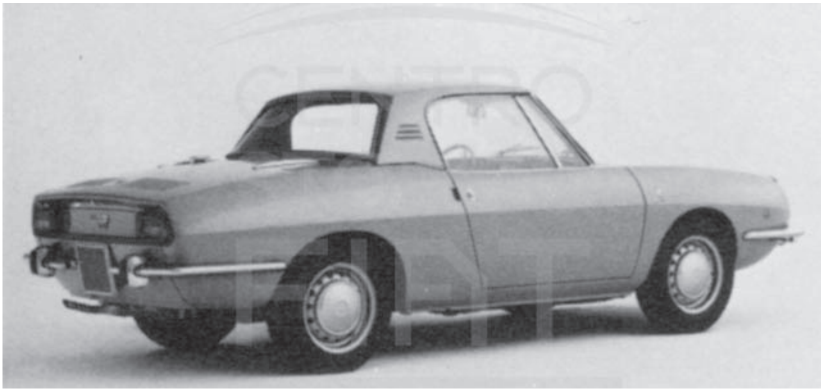
draughtsman and his assistants managed to prepare the plans and hand them on to the works so rapidly that they achieved what had seemed impossible: everything was ready for production to start on schedule.

Bono had once again managed to get what he wanted. All the draughtsmen and the works personnel who had taken part in the achievement were given a bonus.

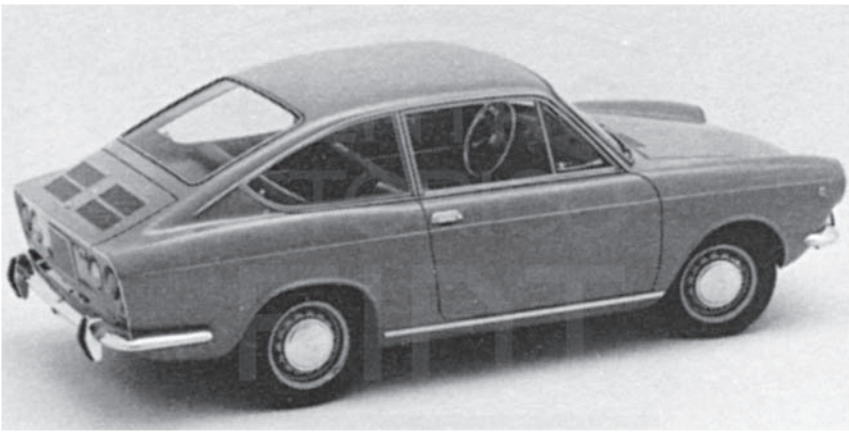
The *850* came out in 1969 and was a great success. People wanted to become car-owners and the stylistic incongruities went unheeded. It was like a bigger *600*, just that bit faster to make it go down well at a moment of expanding affluence in Italy. But production of the *600* also continued, since demand remained brisk.

Production of the *600* was finally abandoned in Italy at the end of 1969, nearly 14 years after it first saw the light. In this time about 1.600.000 of them had been built and it was still being turned out in Spain and Yugoslavia.

In the seven years during which the *850* was built, over one million were turned out in all its different versions: the standard saloon, super, station wagon, coupé, spider and sports models. The coupé with coachwork for which the Boanos, father and son, should be given all credit, was one of the most beautiful of all Fiat models.



850 sports roadster, second version (March 1968) with optical assemblies placed further back. The photo shows a model fitted with a production hardtop.



850 sports coupé, second version (1968).

CHAPTER XVIII

RESEARCH - AUTOMATIC GEARBOXES
THE ICE-CUBE PRODUCED BY SOLAR ENERGY
THE HOVERCRAFT
THE PNEUMATIC TRACK-BELT

There are moments when events and ideas are so closely intertwined that it seems only right to try to see them together and as a whole. But to do this – and it would be a by no means easy task, considering all the events that coincided with each other and overlapped – I would have to abandon the continuity of my story of each project and lose something in clarity. So I prefer to take each of the projects or other undertakings in turn and follow out its history, moving backwards and forwards in time, rather as a game-dog explores the terrain by criss-crossing his tracks while the hunter moves systematically over the ground.

I have now reached the point where the reader will be unable to form an accurate idea of the atmosphere in which I found myself operating during the second half of the fifties unless I provide him with further information about that richly attractive activity whose aim and inspiration is “research”.

During all my years of work I have never let slip any opportunity to engage either directly or indirectly in research, by which I mean what is normally called applied science but which should be more properly called technology, whose boundaries cannot always be very accurately defined since it is difficult to say exactly where a project begins and ends.

Not many years have passed since the term “research” began to be used by the scientist or engineer, before it was taken up by everyone and applied to just about any field of human activity. Before then, when one spoke of study or design it was taken for granted that this involved research, especially when the creation or development of something new was involved.

We had carried out a good deal of research in the course of our projects.

We tried to analyze and understand more thoroughly the process of combustion in our engines so as to improve the antiknock features of the engine head and increase the compression ratio, so cutting fuel consumption; power was boosted by improving the engine’s efficiency in relation to its capacity and hence the effective pressure and speed of revs. Noise and vibrations were reduced; durability and reliability were increased by advances in design and the use of appropriate materials. More modern manufacturing techniques were introduced to improve quality and economy.

The chassis involved designs for new types of clutches, automatic, semiautomatic and preselector gearboxes; pneumatic suspension systems (which were also being studied in the United States), different types of brakes.

In the styling workshop we sought incessantly to imagine new forms, sometimes even drawing on fashion for inspiration.

To put some order into the achievements with which this type of activity is studded I have to go back to the early years when I was first engaged in automobile design: to 1936 when I was head of the Automobile Technical Office under Fessia and Zerbi.

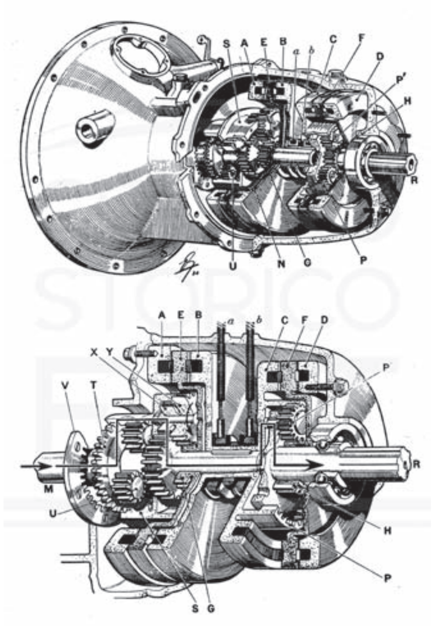
Zerbi was always deeply intrigued by anything new. It went against the grain with him to obey the instructions of the President, whose principal objective was mass-production at low costs, without risky innovations.

At that time Zerbi was interested in automatic transmission. As is well-known, the earliest automatic gearboxes were belt or friction driven with a continuous variation of ratio; then came gearboxes which were worked by the variation in the length of the arm of a crank which transmitted its motion by means of ratchets or free wheels (as in the De Lavaud system); then the systems using epicyclical gearing (Costantinesco and Spontan); then the Cotal system using electromagnetic clutches. The Austin-Hayes system also appeared, a friction transmission with continuous variation of the drive ratio.

Zerbi wanted to try out both the Cotal and the Hayes systems. We started with the Cotal on a *521* auto. The variation of ratio was worked by a lever under the steering wheel, so it was not really an automatic gearchange but it did away with the clutch pedal. Zerbi wanted to make it usefully automatic so he got a French man by the name of M. Fleischel to come to Turin. Fleischel had designed a mechanism for Cotal which varied the ratio automatically.

Fleischel worked with us for about a year but failed to make the gear-change work acceptably without causing a slight jolt which was unpleasant for passengers in the vehicle.

It was then 1937. Having shelved the Cotal system we tried the Hayes, an English device that changed the gear ratios continuously and automatically. The trials conducted by Salamano, especially up the rise to Superga, showed that it was not sufficiently reliable.



Explanatory diagram of the Cotal gearbox.
The system consist of two trains of epicyclical gearing constantly in mesh;
gears are locked by electromagnetic brakes operated by a circuit switch placed near the steering wheel in the cab.

After Zerbi's premature death studies of automatic transmission were broken off.

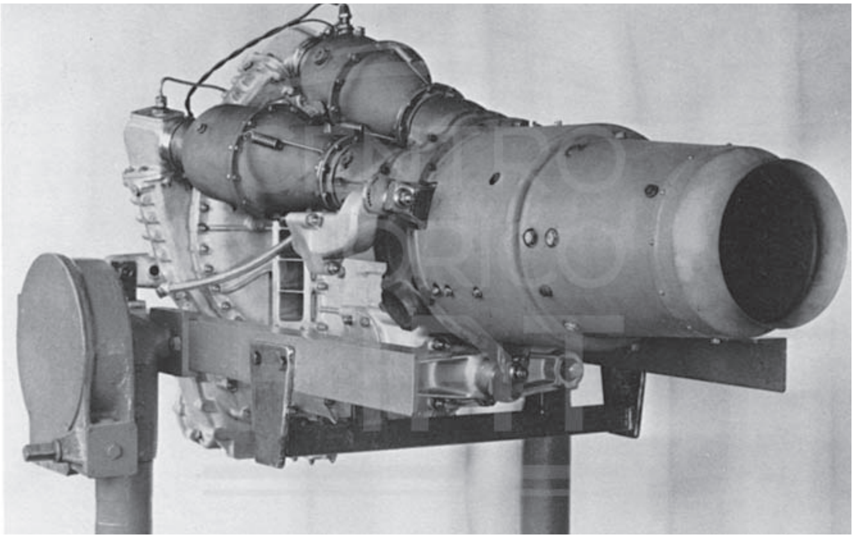
During the war years I made some studies on paper and decided to limit my objectives. I had a gearbox designed that was worked by the clutch pedal, intending it for the "100". In fact it was first mounted on the little single-seat Cisitalia.

After the war and the period of the Liberation, all the technical offices' efforts were concentrated on new models and it was then that this work, whose final objective was auto production, led to a resumption of advanced projects and research.

Whenever a design has been completed and the prototype is being built, put together bit by bit by the skilful hands of the assembly workers, the designer naturally imagines possible changes to simplify or improve it in part or as a whole. One gets the urge to start all over again but that would be out of the question, with the deadline for production looming up. But I at least used to give myself the pleasure of seeing the improvements that appeared to my mind's eye put down on paper. So as work went ahead on the prototype I used to get one of my staff to work on perfecting or, to use the jargon, "optimizing" the design which now appeared open to obvious improvement.

In this way I had formed in each of the design offices a group of a few draughtsmen trained to carry out exploratory work or research, to use the current term, in a quest for the best. The number of designers in these teams, one for engines, another for chassis, was increased or decreased as required. I assigned individual problems to the people whose particular abilities seemed best suited to solve them.

Moving along these lines I had started research into a turbine-powered auto, entrusting organization of the work to Bellicardi, whose thorough knowledge of the job was combined with a special flair for organization. Tactful and diplomatic, he knew how to manoeuvre skilfully among the maze of different organizations and offices whose collaboration was essential to me.



The "8001" turbine engine mounted on a special test-bed (1953).

In order to carry out the studies in the way that I wanted and in accordance with my own interpretation of technological advances, I tried to keep the whole business as secret as possible to prevent any interference from outside. At the same time I avoided any expenses that might alarm the offices in charge of budgeting.

After two years spent studying theoretical fluid dynamics and its application to compressors, combustion chambers and turbines, I chose two design engineers, one being Virgilio Borsattino, and started work on the actual design with a scheme that envisaged the turbine as an integral part of the automobile.

But we would not have been able to complete the designs for construction without first carrying out a series of tests to check that our calculations were correct and the individual components of the engine functioned according to plan. This meant we needed a workshop equipped with test benches and other instruments. We had to take measurements of the behaviour of air and gases passing through the various sections of the engine, perfect the combustion chambers and the shape of the rotor blades, the choke tubes of the two-stage centrifugal compressor and the turbine, the injection mechanism, regulator and so forth. We also had to make sure that the impellers turning at 30.000 rpm could stand the centrifugal strain. This meant we needed a pit, inside which we could set them spinning until breaking-point was reached, without danger to the observers. But the problem was where all this could be done and without having to ask for money.

Bellicardi had discovered that on the roof of the Lingotto building there were some vacant premises known as “Traversa D” in the middle of the auto testing track. They were vacant. He persuaded the director of the Lingotto section, engineer Perosino, to lease them to us for an annual rent that would be debited to the Auto Technical Office.

Bellicardi scrounged test benches, machinery and measuring instruments, from the workshops, which periodically got rid of these items in the systematic process of renewing plant. In this way we set up a makeshift workshop which we called the “Special testing workshop”, and began to carry out the tests that would enable us to obtain the data needed to complete the designs. I put Freilino in charge, choosing him from among the mathematical minds at my disposal. It was a good choice.

Work went ahead smoothly. Under Bellicardi’s direction, Freilino devoted himself with enthusiasm and great competence to perfecting the workshop and the testing techniques. His first step was the construction of an automated mechanism making use of the factory’s compressed air plant to take measurements of gasdynamic properties (temperature, pressure, flow, direction etc.) so as to check uniformity and other properties of flow, even at high temperatures, through “net maps” with meshes of different sizes.

Simulation tests were conducted with the centrifugal compressor choke-tube by making the flow visible and high speed tests were carried out on ball, roller and smooth bearings with floating or oscillating bushings by using a specially constructed test bench equipped with a centripetal turbine capable of reaching about 30.000 rpm.

We conducted tests of fuel atomizers we had specially designed, measuring delivery and the distribution of the flow, followed by trials with mixing and regulating devices. Then of course there were tests of all the secondary elements such as surface discharge spark plugs and sealants for placing between oil and gases.

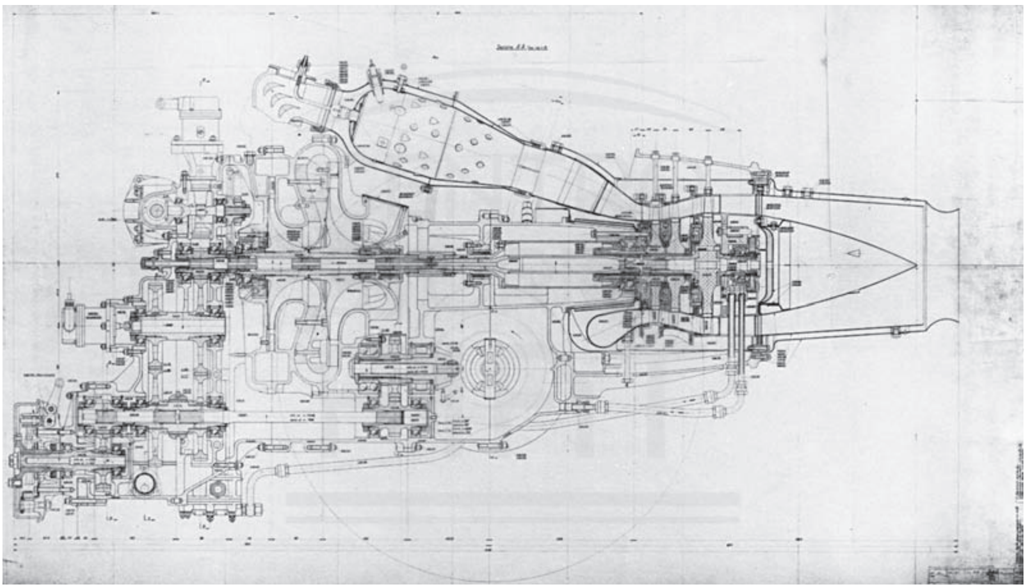
In 1953, when the "8001" auto engine had been built, we went ahead with tests on the components of the complete engine on special test benches. This was a complex and intricate phase that ended with the mounting of the engine on the automobile itself. Salamano carried out the first trials of the auto on the Lingotto circuit, accompanied by Freilino.

In 1954, after the turbine-powered automobile had been presented to the international press and the TV network, it was tried out on the Monza circuit. It was also taken to Rome to do a few laps of the Castel Fusano circuit before a Formula 1 race, in the presence of the mayor of Rome and other personalities. It was then exhibited at the Turin Motor Show.

The enlarged workshop was given the name "Experimental and Advanced Engineering Test Service". Freilino deservedly became the most authoritative expert on experimentation in the various sectors of advanced engineering.

In the meantime I had a design done for a low-powered turbomotor, the "8011", which I intended to use to see how far a simplified arrangement could be followed. It was built and tried out on the test bench but results were unpromising.

Experiments continued with the turbine engine of the automobile already built with the aim of optimizing its components and boosting its power output. To satisfy Salamano's ambition, I intended to make an attempt on the record for the flying kilometer held by Rover. We had to abandon the attempt just as we were approaching best results because Renault's *Etoile filante*, powered by an aviation turbo engine far more powerful than ours, took the record by doing slightly over 300 km/h, a speed which we would never have been able to reach. But our research did not end here,



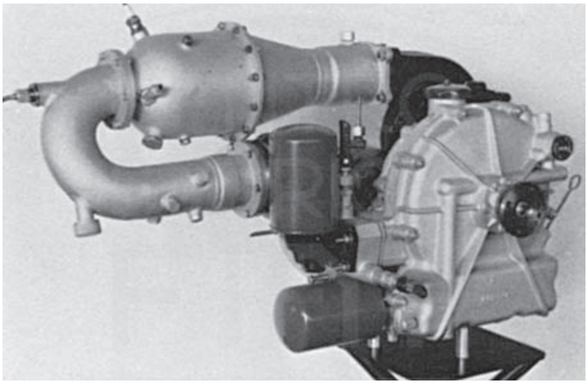
The turbine engine and turbine car were designed together by Giacosa, in order to make the most of the new form of propulsion while avoiding the most important problems. The publicity value of the project was not overlooked. This design, dated 8 November 1951, shows how the complex gearing assembly also included transmission gears and the differential attached to the axle shafts.

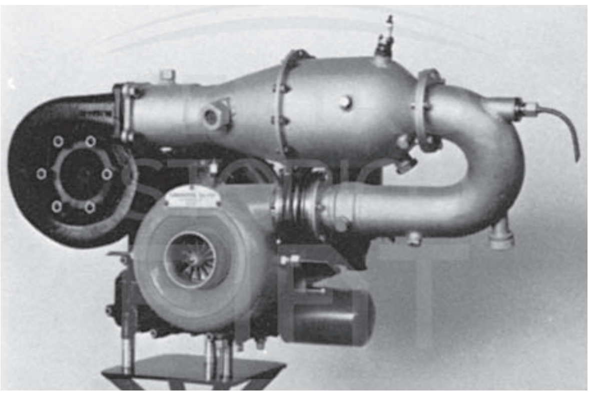
one reason being, as we shall see, that it also involved the project for a vehicle that travelled on a cushion of air.

For this purpose I ordered the purchase of a single-phase Rover 60 hp axial flow turbine and a 40 hp turbine-powered firefighting pump built by a small British firm called Budworth. The turbine engine is well-suited for fire-fighting because it turns out maximum power as soon as it starts to work. It does not need to turn over for some time like a piston engine to get warmed up before functioning at full power.

Bellicardi's staff started experimenting with the two small turbo-engines that turned out power at about 60.000 rpm. They were fairly rudimentary when compared with turbines intended to power vehicles but they were useful in experiments needed for our calculations and to perfect some of our testing equipment. These little power pumps whirled round at tremendous speeds and sent out a whistling sound that seemed to go unnoticed on the floor below the circuit, where the noise of the works machinery drowned any other sounds coming from outside. Everything seemed to be going ahead smoothly to the satisfaction of me and my staff. There were some rumours going the rounds of the Lingotto Works Departments and some curiosity was shown but not so much as to interfere with our work.

Then unexpectedly something happened that made me afraid we would have to abandon the whole undertaking. It was 1958. Overwork, uncertainty about Bono's attitude towards me and various personal anxieties had affected my health and caused an unbearable physical malaise.





The "8011" turbine-differential-compressor unit (1964). Compressor and turbine were connected by an epicyclical unit that transmitted movement to the drive shaft.

It was diagnosed as nervous exhaustion. I was forced to abstain from work for a number of brief periods in April and May and then spend June and July resting at Santa Margherita Ligure.

When I returned to Mirafiori I found Bellicardi in a tremendous flap. In great dismay he told me that Bono had ordered him to dismantle the workshop on the Lingotto track. The Rover turbine had been started up during the factory hands' siesta hour, when they were assembled in the works canteen, perhaps being lectured by some political propagandist. Bono had been told that the sudden whistling of the turbine had been interpreted as an alarm siren. Reports of the war in Indochina and the baleful memories of wartime air raids were weighing on people's minds and the unprecedented sound had spread panic, or so the general manager and the President were told. There was said to have been a general stampede to get away, with the result that work could only be resumed after some delay. Consequently Bono had ordered Bellicardi to suspend tests and move the workshop somewhere else. Bellicardi assured me that the version of the episode retailed to the general manager was exaggerated and wildly fanciful: for years the turbines had been tested and no one had ever taken any notice of the noise. Someone, he said, was wanting to stop our tests.

I got Bellicardi to look for a more suitable place. With a certain amount of effort we managed to find acceptable premises. When I went along to Bono to talk the matter over, the episode turned out to be of only secondary importance. I put him in the picture about the work done in the test shop and my objectives in carrying out such research. As always appreciative of anything that represented an innovation and might add to Fiat's prestige, he encouraged me to go ahead.

The workshop was moved from Lingotto to Mirafiori but tests with the turbo-engine were broken off for the time being.

The testing equipment was stowed away in a store room. I gave Freilino and his specialists other tasks which had been under way for some time. Foremost among these were trials of a gas generator with free pistons on the Pescara system, for which a special test centre had been set up at Mirafiori in 1957.

This gas-generator devised by the Marquis of Pescara, an extremely talented Spanish engineer, had already been taken up by Fiat in Zerbi's time and then abandoned. With the advent of the turbine engine it looked as if it could possibly have advantages for certain types of use. Fiat's Heavy Engines Department, assisted by an engineer who had collaborated with Pescara in developing his system, decided to design and build a generator of great dimensions to be fitted to a turbine-powered marine propellor. Taking advantage of the presence of the engineer, I had a small one designed and built, suitable for a bus. Essentially it was a power-pump intended to supply the gas to drive the turbine. Movement and drive were obtained by

Raúl Pateras Pescara, Marquis of Pescara, Spanish inventor and entrepreneur. In 1930, together with his brother Enrique, a mechanical engineer, he founded the Fábrica Nacional Pescara Sociedad Anonima, a small auto manufacturer better known as Nacional Pescara. In addition to producing some inventions, he built an eight-cylinder automobile with an engine of about three litres. A small number of these were produced and they brought his brother Enrique and other Spanish drivers successes in hill-climbing races, including some in international competitions. A single-seater which included a relatively high proportion of elektron in its construction made its debut during the trials for the Monaco Grand Prix in 1932 but a breakdown prevented it from taking part in the race. He is well-known in particular for the Pescara free piston engine-compressor.

means of a free piston system working on a diesel cycle without any cranks or turning shafts, which unfortunately turned out to be simple only in appearance. I had been attracted mainly by what looked like the possibility of mounting it on the bus to produce a functional and practical structure for the vehicle. But tests on the bench brought out problems that were going to be difficult to solve simply and reliably. After a long and fascinating sequence of experiments I had to abandon the idea, one reason being that it would enable me to set more urgent or important tasks before my talented research team.

Since research led in numerous different directions and required more space, I began to turn to the Research Centre in Heilbronn and the special centre set up with SIRA. The experimental workshop, essential for research and developing the programmes of the advanced engineering sector, grew in size and took on new tasks. Bellicardi and Freilino, with my support, made every effort to improve its stock of equipment and get new staff. Then we reached the point where it was clear to me that Bellicardi, who had been the driving force and mind behind the activities of the experimental workshop, occupied a lower position in the Development and Research Department than his abilities as a leader and organizer justified. I mentioned this to Bono, telling him he could rely on Bellicardi's experience and competence if he was looking for a sectional director. A few months later Bono called me in and said he was going to send Bellicardi to Bologna where he would be manager of the Weber carburettor factory. So I lost one of the most valued members of my staff but Fiat gained an extremely able and respected director who made the Weber company known all over the world.

After the tests with the Pescara gas generator, the workshop was given new premises at the Aero Turbine Centre built for testing turbojets. It was located on the left bank of a little river called the Sangone. There we began fitting out the equipment to resume tests on the auto turbine and its components.

In spring 1963 I thought it advisable to move the design office to premises by the Sangone as well. These had been specially built and would enable us to work in direct contact with the test workshop, so stepping up the rate of work and research. Mario Calovolo was placed in charge of this office.

The small workshop beside the test centre was enlarged. The specialized workmen and engineers who staffed it under Freilino's direction not only produced the most varied and sophisticated testing equipment but also engine components. In fact I later decided to make use of this side of its work for producing mechanical components and assembling electrically driven vehicles.

Ever since the war I had gone on thinking about electrically powered vehicles. That had been the time when we made up for the wartime fuel shortage by converting a *500 Topolino* and a *1500 B* to electric power. The fact that Fiat had given up building trolley buses (the public transport companies preferred motor buses for economic reasons) had by no means stopped me from considering the electric vehicle the most convenient solution to certain traffic and transport problems. There were also ecological advantages on the side of electric engines.

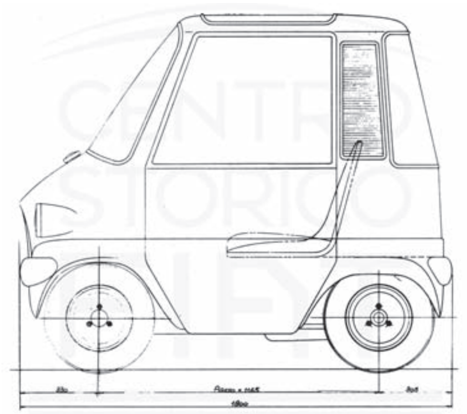
I set up a small team in the Electrical Engineering Office to study electrical equipment: batteries, engines, regulating devices. It was headed by Brusaglino, a young engineer who was very well qualified and who threw himself into the job.

This was in 1960. The work of this team and the office for studies in advanced engineering gave rise to numerous prototypes which have followed each other in a progressive sequence of more advanced types right down to the present date. They were built and tested at the Sangone experimental and test centre. Brusaglino is now the leading specialist in this forward-looking field of research.

Research into electrically driven vehicles had gone on alongside the equally interesting study of a new mode of locomotion, a cross between a surface craft and an airplane: the vehicle that rides on a cushion of air, commonly known as the hovercraft. The earliest studies, calculations and tests go back to 1962. In 1964 we managed to test a platform of this sort measuring 4×2,5 m and driven by a small turbine that powered a large propellor to provide lift and two small variable-speed screws to provide motion and steering. The guiding spirit behind this strange contraption was an engineer named Scholz who, with my encouragement, designed and piloted it.

In 1968, Freilino's workshop, which had grown in size and importance, was given the name "Special Testing Workshop" with responsibility for dealing with every kind of innovation, from research into fluid dynamics to anything else connected with alternative engines, turbines and electrical vehicles.

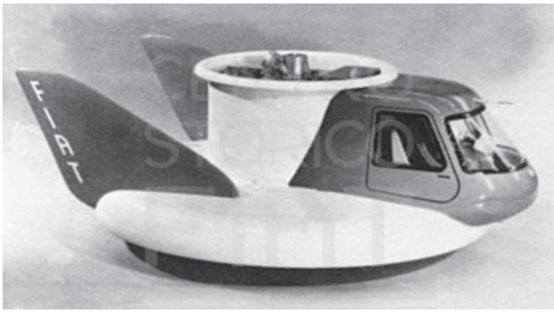
In the Sangone area premises were also found for the technical offices forming part of the Advanced Engineering Department, which designed alternative engines under the management of Giovanni Torazza. The small division at Sangone had become the nucleus of a Research Centre, the centre I had dreamt of setting up for



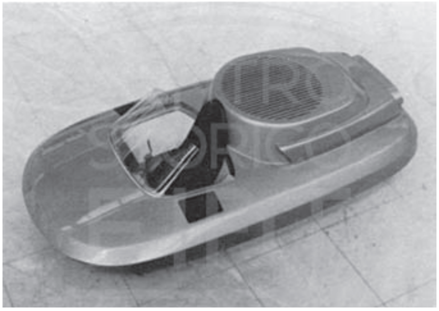
Studies were also made at SIRA of city cars. This design, dated 8 June 1963, is a variant (study 794) for the G. 26/518 small car. The G. 26 was revived in 1964 as the basis for a small electric auto.

years and which now seemed to be becoming a reality. It was not comparable to the most richly equipped American or European centres but it was exceptionally efficient.

Talking about research naturally leads one to consider the researcher, man himself. Humanity is engaged in a quest for progress but not everyone is equally aware of this impulse. Only a limited number possess the inherent urge of the research worker and the requisite abilities. Among these one commonly encounters imaginative characters whose intelligence is liable to follow wayward fancies in a way that is ill-suited to the everyday relations of life and work. They have difficulty in adapting



Reduced-scale working model in fiberglass-reinforced plastic built by the Styling Centre to test the performance of hovercraft, 1961.



1:5 scale model in resin built by the Styling Centre to arrive at a shape for a one-seater hovercraft: the model G 10/100 Aercar, 1961.

The turbine-engined experimental platform being tested on water with Luciano Scholz at the controls (1964).

to the set-up of an industrial organization and taking part in teamwork. They tend to isolate themselves and are incapable of winning the liking of their fellow-workers or the confidence of their colleagues and subordinates. They are generally rare individuals who sometimes arouse conflicting feelings in the people they come into contact with, often meeting with rejection. I tried to help such characters whenever I sensed positive qualities in them.

Maurizio Wolf was an engineer who had studied in Vienna and had a thorough grasp of mathematics. He entered the Estimates Department at Fiat when it was run by Fessia and displayed great ability. His perfect knowledge of German was useful in the work of the office.

Wolf was good-hearted and unassuming but his Teutonic thoroughness did not fit in with our own particular brand of the same quality, which his colleagues defended with the typical Piedmontese doggedness. He suffered from an isolation which was partly caused by shyness, an innate awkwardness in his relations with other people. It was an almost physiological block. He fell out with Fessia over some technical questions and also certain promises of promotion which had not been honoured. In all his time with Fiat, until he reached retiring age, he was dissatisfied and misunderstood by his fellows, who were often unfriendly to him. He blamed all his misfortunes on Fessia. He went through difficult moments, haunted by a sort of persecution mania which I tried to overcome by patient and repeated encouragement, giving him interesting and absorbing work so his job was made more interesting. I advised my friend Baldwin to get Wolf to assist him in developing some of his ideas for hydraulic braking systems. After a while he told me: "Our friend Wolf plunges into a sea of calculations and drowns in them." There was a certain truth in this. Baldwin tackled every problem with the power of his astonishing intuition and could not appreciate calculation, so obviously he could not understand the great attraction it exerted over the mind of an engineer like Wolf.

I always gave this loyal and capable worker all the help I could, though he created trouble for himself and even those around him. I got him to work on projects that required imaginativeness and a good mathematical mind. It was not always easy to think up a good subject for research or a design, especially when it had to be both suited to one individual's mental abilities and temperament and at the same time useful to the company we were working for. Sometimes I was afraid of being stuck for ideas but some bright idea would get me out of the fix. And Wolf with great tenacity would work the studies through to a conclusion, whether positive or negative.

In the forty years he spent working for Fiat, Wolf carried out numerous assignments, the outcome of varied, complex and demanding labour. He would spend the whole day stooped over his work table, rarely glancing up, absorbed in his designs and complex mathematical operations even at home, where his only company was his sister. I think it worth mentioning some of the work he did.

Among the technical offices under my charge there was one for household appliances. This had been set up when Fiat had decided to make refrigerators at its Lingotto works under license from Westinghouse.

I thought of an apparatus that could generate cold by using solar energy, to be used in countries like Egypt where the sun shines practically all the year round and ice can only be produced by expending energy. I approached Wolf tactfully, suggesting he should study the problem. After a year of assiduous work Wolf announced that the “Eliogel”, which was the name he had given his apparatus for making ice by utilizing the sun’s rays, had been assembled on the roof of the office block at Mirafiori and had produced a single block of ice. Wolf treasured that transparent cube more than if it had been a diamond. I was pleased to see him so happy about it, but after further thought decided to set the enterprising engineer to work on a task of more immediate interest to Fiat.

Another project Wolf worked on, which was both original and demanding, was a continually variable ratio gearbox, worked by rolling friction between ball bearings set between specially shaped disks. Wolf also made a special contribution to ideas for the turbine engine, studied stationary and rotating heat regenerators and designed a special fuel injection mechanism. He carried out the “8011” design, conceived to establish whether it would be feasible to use an engine consisting simply of a centrifugal compressor, a combustion chamber and a turbine impeller linked up by an epicyclical gearing system imparting power to the compressor and the drive gears. I intended this project to verify the feasibility of the system and whether it could reach

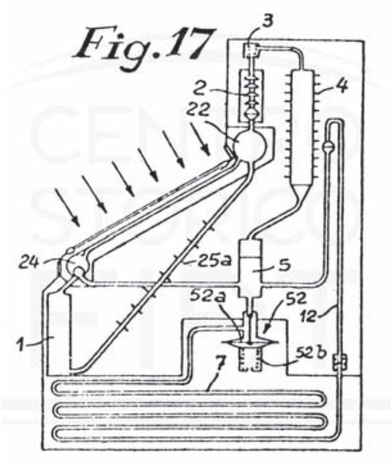
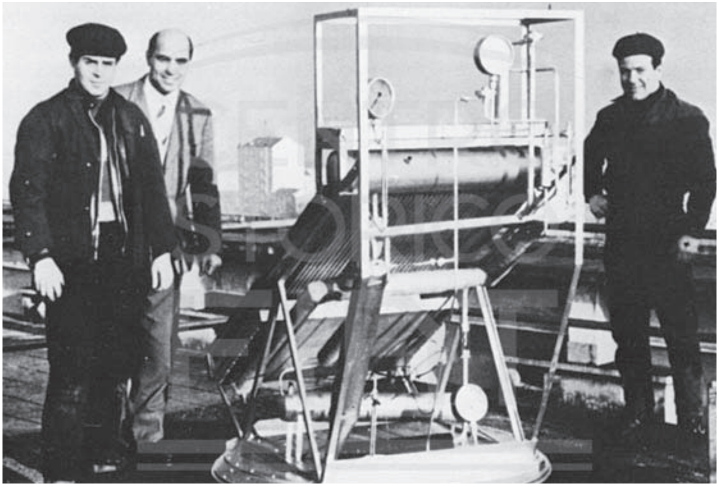


Diagram from the patent specification filed in 1958 for the “Eliogel” solar-energy refrigerator. The photograph shows the completed device together with the technicians who built it.



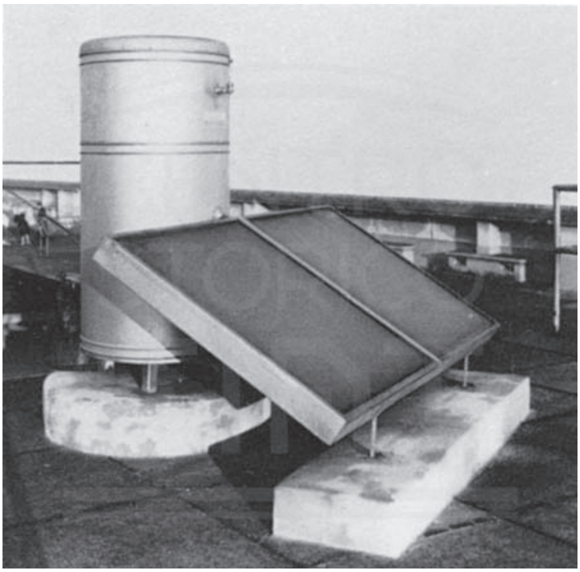
an acceptable degree of efficiency. A prototype was built and I was able to establish that the engine worked but the power output was inadequate. The prototype is kept in Fiat's historical collection, a memento of an interesting piece of research and an attractive design.

The memory of the "Eliogel" and Wolf's other studies regarding the possibility of utilizing solar energy link up with memories of another character. One day Giovanni Francia of the University of Genoa turned up at Mirafiori asking to see me. I remembered meeting him in the mountains, in Val di Susa, on the slopes across from Sauze d'Oulx at the end of a long mule track that wound its way along the mountainside to where a rough hut, little more than an emergency shelter, stood all alone on a small patch of level ground.

There I was approached by this lanky figure, with hair much longer than used at that time to be the fashion straggling about his lean features, his face lit up by a lively and intelligently enquiring expression. He was interested in my automobile, a *1500*, the old six-cylinder *1500* with its tapering, streamlined engine hood, and without more ado asked me about the Dubonnet independent suspension system which was one of the vehicle's features. My recollection of this pleasant episode prejudiced me in favour of this unusual character.

His lean bespectacled face and untidily dressed figure appeared in my doorway. He was a tireless talker and had a brilliant intelligence. A great individualist, jealous of his ideas, he was unable to collaborate with others and told me as much.

He had thought up a system for proportioning the braking action of each wheel of a vehicle to its grip on the road surface. This was intended to make braking safer even on bends when centrifugal force causes the pressure acting on each of the wheels to be distributed very differently from the normal distribution of weight. The idea was a good one but the mechanism for implementing it was somewhat complicated and looked rather unreliable to me. Another thing that made me doubtful was that Francia avoided telling me the constructional details involved, which was obvi-



Experimental apparatus for heating water with solar panels.

ously important to estimate the system's reliability. Reliability is the primary concern where brakes are involved.

As I had had a lot of experience of the wiles of inventors I listened somewhat dubiously to the glib explanations of the young lecturer from the engineering faculty at Genoa, who at times appeared to be withholding some of the relevant information. In the end, despite some lingering doubts about the merits of the system, I agreed to try it out, letting him use an *1100* for the tests.

He took a long time mounting his hydraulic mechanism on the auto, mainly because he meant to do without help from anyone, but in the end he brought it back to the Turin works and it was possible to begin trials. As usual the last word rested with Salamano and he was by no means wholly unfavourable in his judgment. As long as the mechanism worked properly braking on bends was more effective and safer. A sort of inverted pendulum, moved by the force of inertia in response to the auto's movement, set a system of valves in motion and caused the pressure of the liquid in the ducts of each of the brakes to vary. The way the mechanism had been built was primitive and the results unreliable and costly. The likelihood of breakdowns due to the complexity of the system was apparent. It lacked reliability.

I decided to discontinue the tests and persuaded the ingenious inventor, much against his will, to abandon the attempt and save the money he was spending on it. But the man interested me while his gift of the gab and eclectic imagination induced me to embark on further projects. One day he burst into my office to explain that he had developed a way of calculating the trajectory of space rockets that would make it possible to launch them by much simpler means than those used by either the Russians or the Americans. I was weak enough to give him a heating, overcome by his impassioned and glittering eloquence, studded with mathematical data and references to the infinitesimal calculus.

He came back on another occasion and wangled my permission to carry out trials meant to confirm this same theory. I advised him to get in touch with some American university research body but to no avail. He wanted to do the whole thing on his own and had some disastrous experiences. I was at the end of my patience and had decided to refuse him any help in the whole crazy business. To soften the blow a little I suggested he should devote some study to ways of utilizing solar energy. This meant resuming the research project Wolf had been engaged on some years earlier.

He took to the idea and it was the starting point of a field of work to which Francia devoted himself with all his unusual genius. After making a start in this direction with the aid of Fiat he embarked on a full scale career in the field. Professor Giovanni Francia is today one of the best known specialists in the field of solar energy and its exploitation.

Talking about men and research brings me back inevitably to the hovercraft. In 1960 there were frequent reports of attempts to build vehicles without wheels which rode just above the ground on a jet of air blasted out of narrow ducts between the rim of the vehicle and the surface of the ground, enabling them to move along without friction. I was intrigued by the idea of being able to share in the development of this particular form of transport that did away with roads and made it possible to glide across water. News came from Britain and Japan of fascinating air-cushion machines for travel over shallow reaches of water and sand-bars.

I gave Scholz the job of starting studies on the theoretical side.

Luciano Scholz, a brilliant mathematician, was also a linguist with a command, among other languages, of both Russian and Japanese. He was a man of exceptional education and intellectual powers but after a series of personal misfortunes he had been reduced to working in isolation. Before coming to us he had worked for the aeronautical sector under Gabrielli so he was acquainted with aeronautics and the problems of aircraft design. He accepted my suggestion with enthusiasm and got straight down to work.

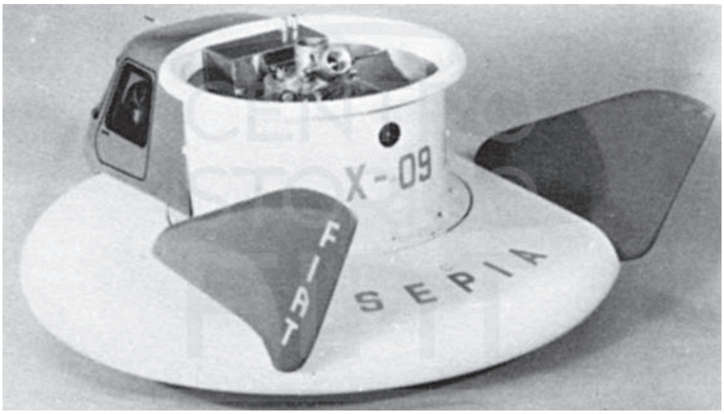
We decided as a first step to make a small scale model. Scholz with great skill built it using a 10 cc aero model engine. The result was a sort of radio-controlled toy that was easy to steer. When we tried it out on the floor of my second-floor office, without bothering about the racket created by the little engine, there was a general rush from the nearby offices to see what was going on. Among those who came running was Bono, who was highly amused by the antics of that fantastic toy. We had to put on a repeat performance for Valletta.

Feeling encouraged we went ahead with our studies and decided to build a vehicle capable of carrying one person. I asked the Styling Centre to help by making a working model out of epoxy resin, on a larger scale than the first one and fitted with a 5 hp engine, impellers of different shapes, and propellors. Confirmed by the data produced by these tests Scholz went on to develop the design for the full-scale vehicle with the aid of an experienced draughtsman.

Scholz was suffering from nervous exhaustion that also provoked other disorders and problems that kept interrupting the work, but when the vehicle – which could more accurately be described as a platform – began to function he seemed to have recovered. With great enthusiasm he took to piloting it and shared in all the trials carried out on water and on the shores of a tiny lake near Alpignano.

With a series of slight improvements we were able to probe some of the factors affecting the vehicle's ride over land or water. This was a useful and interesting experiment from which Fiat ought to have learnt how to avoid costly and pointless projects.

The scope for using hovercraft is limited to exceptional circumstances when the use of other means of transport is unfeasible. Its costs and fuel consumption are extremely high, more than the cost of a hydrofoil. Mass being equal, its fuel consumption is second only to that of a helicopter.



Rear view of the X-09 "Sepia" working model hovercraft. The name, almost identical with the Italian for cuttlefish, was also the acronym in Italian for Advanced Engineering Testing Service. The model was made in fiberglass-reinforced plastic and fitted with a radio-controlled single-cylinder 10 cc aero model engine.

Other problems are created by the violent blast of air needed to raise it and also the immense quantities of energy consumed, much of it in overcoming wind force and keeping it on route. Studies so far seem to show that hovercraft are economically viable only when they are of very large dimensions.

Its ability to hover over a firm surface may also prove useful in shifting heavy weights inside factories or over floors, provided there is no dust about. During a visit to plants specializing in manufacturing turbines and other research centres in California I had a chance to see some very simple devices of this sort. Standing on one of them I had fun lifting myself up and moving myself around with a negligible degree of effort.

To solve another of Gabrielli's problems Bono also decided to put an engineer named Salvatore Majorca under my charge. In the Aviation Division, Majorca had been responsible for tests of jet engines carried out in the Sangone turbine centre. Gabrielli was troubled by his restlessness. I myself had met him some years before. He had been introduced to me by Bruschi who wanted my opinion of a motor cycle that Majorca had devised and built, spending a lot of money out of his own pocket on it.

The motor cycle was very attractive in appearance and distinguished by the original design of the engine and the frame, the latter made of sheet-steel and of a novel and elegant shape. The wheels were connected to the frame and protected by it. Both ends of the frame had been prolonged and modelled into mudguards. The traditional forks had been done away with and the front wheel was steered by means of a system of rods comparable to the steering of an automobile. It was sprung by an ingenious elastic connection between the wheel and the hub, using rubber fittings that made for smooth running between the wheel itself and the axle.

I was not an expert rider capable of judging whether the motor cycle was safer and more comfortable than traditional machines, but it seemed pleasant and easy to control. I had my reservations about the elastic wheel because it was more complex, heavier and certainly more expensive to produce than an ordinary wheel fitted to one of the customary forks with normal springs.

Not being qualified to pass judgment without having comparative tests conducted by specialized riders I gave Bruschi an objective description of it, mentioning its merits and defects from the constructional viewpoint and adding some commonsense observations. That was the last I had to do with the matter. But my discussions with Majorca gave me an opportunity to appreciate the liveliness of his intelligence, despite the fact that it was combined with a certain stubbornness in defending his own views.

Majorca had been bitten by the inventing bug. He was what engineers nowadays mean by an inventor: an imaginative person full of enthusiasm for his ideas, dogged in defending them and trying to attain his goal. Talkative and argumentative, he would only give in – and even then reluctantly – when confronted with logic and hard facts. Last but not least, he was very good-natured.

I put him in charge of a small design team and called the group the Special Vehicles Office, part of the advanced engineering section.

He never relinquished the idea of the elastic wheel and every now and then came up with some new solution to the problem but all these attempts showed the system's weak points. From the wheel he went on to the pneumatic track-belt, made up of metallic plates each of which was fitted with an element rather like a tyre in cross-section placed across it. A caterpillar-driven vehicle of this sort would be able to travel smoothly along roads without damaging them. Though I had many doubts about the result I helped him to find a simple design that would be easy to manufacture. When I saw Majorca's enthusiasm after workshop tests on some components of the track I decided to go along with him and got him to design an experimental vehicle with other features that would provide useful information in developing caterpillar-type vehicles. This involved a chassis equipped with two engines, one for each of the track-belts, the aim being to see whether it was feasible to steer it promptly and dependably by simply varying the relative rate of drive of the two engines. This would have avoided having to install the complicated system of epicyclical gears normally used for steering. At the same time we would be testing Majorca's track.

To implement the project as cheaply as possible I decided to make use of two power plants from the *Campagnola* and their chassis, adapting them and welding them together side by side so as to form a single frame.

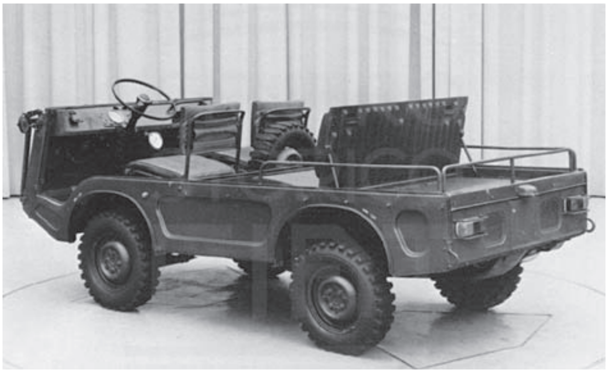
Majorca flung himself enthusiastically into finding solutions to the knotty problems involved. At the time there were none of the present day electronic devices that can be installed in engines and vehicles so we had to use a mechanical system to control

The experimental model 1120, not mentioned in the text, was designed to an idea of the author's by the Advanced Engineering Offices in 1959 and built in 1960 (completed in July). It was also nicknamed "Muletto". It could accommodate 5 passengers or 2 plus a load of 340 kg. In running order it weighed 580 kg unladen. The flat engine from the 500 estate supplied 23 hp and enabled it to do up to about 80 km/h and tackle gradients of up to 60°. It had independent drive on all four wheels and locking differentials. A magnificent off-road vehicle.

the steering. As the design was progressively developed solutions were found to the various problems that cropped up, eliminating most of the uncertainties.

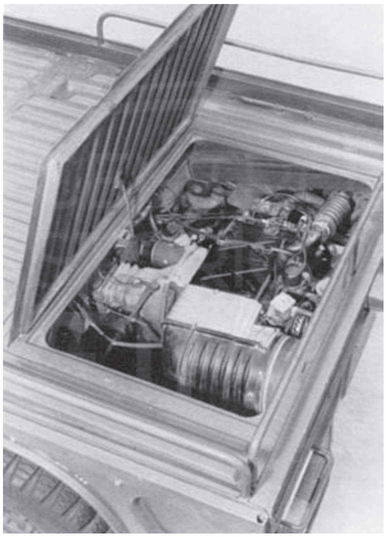
Majorca suffered intensely from a serious eye complaint. The thick lenses he had to wear to partially offset the progressive deterioration of his eyesight only enabled him to see a short distance. With his nose pressed to the drawing boards he would move his head about to inspect the drawings and to our astonishment not the least detail escaped him. He discussed the work animatedly and pushed the job on with splendid confidence. The treatment prescribed for his sight by Italian and Swiss specialists failed to bring about the least improvement. It continued to deteriorate until it reached the point where he could not recognize me when I got into the elevator with him until I spoke. Nevertheless the project was completed and the tracked vehicle was built and tested, with useful results. But the pneumatic tracks turned out to be impractical and lacking in durability.

Majorca went to a celebrated Spanish surgeon and was subjected to a difficult operation that almost miraculously restored his sight. He was happy and able to tackle new projects, but never completed them: some time after he was struck down by a serious and lingering illness that led to his death on 26 September 1967.



The 1121 was designed immediately after the 1120 with the aim of achieving a loading capacity of 500 kg as requested by the military authorities for the Campagnola. A 4-cylinder engine was specially designed, incorporating as many parts of the flat engine used for the 500 estate as possible. The result was an extremely compact 1.000 cc boxer engine turning out 36 hp. The vehicle was 3,25 m long and 1,42 m wide, and could float and be driven on water, moved by rotation of the tyres, the engine working while completely submerged.

The layout of the engine below the load platform of the 1120 (1960).



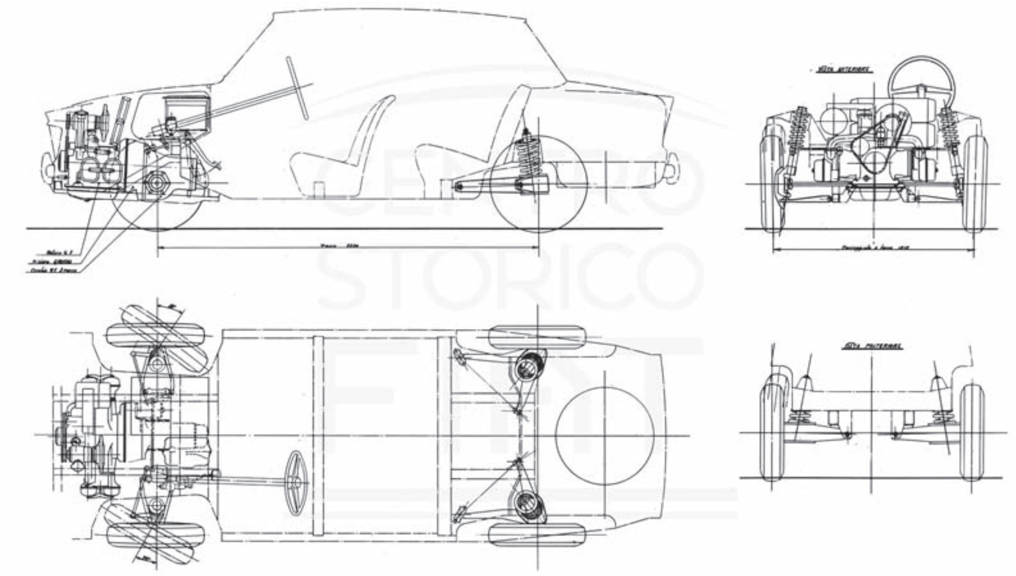
CHAPTER XIX

STUDIES CARRIED OUT BY SIRA

PROTOTYPES DESIGNED AND BUILT AT THE SMALL HEILBRONN CENTRE

Although the statutes of SIRA had conferred the widest powers on me I had chosen to back up its imposing name (Industrial Company for Automotive Research) with no more than an unpretentious design office which I intended to keep down to a staff of ten. I aimed with the help of this team to tackle the problems that fell outside the scope of the conventional project work at Fiat and required freedom in the exercise of one's imagination and powers of choice. I was also determined not burden myself with having to organize and run an experimental workshop or plant. These would only have distracted my energies from designing, which I consider the most exciting part of a project.

I picked a number of design engineers whose abilities and special aptitudes I was familiar with and put them under the charge of Aldo Leoni, a first-rate industrial engineer whose qualities I had learnt to appreciate personally through work done in collaboration with STATA. I immediately set him to work on an automobile based on



Among the plans for chassis produced by SIRA, the most original was certainly the G. 1 with front-wheel drive and with a G. 3 engine having two opposed cylinders and a semi-automatic gearbox with epicyclical gearing. Diagram dated 6 May 1958.

a new concept, combining the most advanced features with the indispensable factor of the lowest possible production costs. In short, a roomier and more comfortable machine than the Volkswagen with better performance and at a lower cost.

Reflection and calculations had led me to the conclusion (as previously with the *600* and the *Nuova 500*) that the simplest and cheapest arrangement of the mechanicals involved mounting the engine at the rear. I imagined a flat and very thin engine, like the one we were planning for the *500* station wagon, but placed transversely so that it would not project far over the rear axle. It would be possible to place such an engine under the flooring and so add a rear door to the coachwork. But unfortunately Montabone and Montanari had shown by calculations and tests with the *500* that a transverse engine would make it extremely difficult, if not impossible, to produce suspension capable of preventing the vibrations from being transmitted to the inside of the cab. Though I was not convinced that these problems were insoluble I preferred not to oppose the authoritative opinions of my own collaborators and gave up the idea of the transverse engine, at least for the time being. This was in 1954.

This left me no option but to place the engine and gearbox along the longitudinal axis and since a four-cylinder in-line engine would have been too long I chose an engine with four opposed cylinders (commonly called a boxer engine) like the one Porsche used for his Volkswagen.

I envisaged a vehicle weighing between 700 and 730 kg. The engine was to be large, big enough to enable a gearbox with only three speeds to be used, simple and cheap. A 1.500 cc engine with a power curve as flat as possible, even if it meant sacrificing the highest speeds, would be adequate according to my calculations.

I had a preliminary design done for an engine with four cylinders coupled in two opposing pairs, with water cooling, the whole arrangement very compact. I had various arrangements studied for the chassis, with different types of suspension, steering systems and brakes, trying to find the most rational and secure positions for the fuel tank and exhaust system.

Then I had a wayward notion which I was unable to resist putting into practice, motivated by a fear that a 1.500 cc engine would be considered too big, unacceptable for a utility vehicle. It was not fuel consumption that worried me, since it would be easy to show that it would be no more than the consumption of the 1.100 which was heavier and less aerodynamic, but the road tax, which in Italy is based on "fiscal horsepower" and would be too high. The formula used for calculating "fiscal horsepower" involves the factors of engine capacity and the number of cylinders. To reduce the tax all that would be needed would be to reduce the number of cylinders. This meant that a two-cylinder 1.500 cc engine would pay less tax than a four-cylinder 1.100. Without hesitation I started having designs done for a two-cylinder boxer engine.

Since SIRA's first purpose was research I was eager to try out a new idea which we had not explored until then. The traditional engine with two opposed cylinders has the two cranks of the drive shaft set at an angle of 180° to each other, which leads to the creation of a destabilizing torque that increases in direct ratio to the size of the centre-to-centre distance between the two cylinders. The centre-to-centre distance is in its turn greater in direct proportion to the diameter of the cylinders. To make the engine as compact as possible and so gain space, the natural tendency would be to increase the diameter and reduce the stroke of the pistons but this increases the destabilizing torque.

My idea was to eliminate the cause of the destabilizing force by making the two cylinders co-axial. This is an unusual solution which becomes feasible if the bore of the cylinders is made sufficiently large and the stroke very short and if one accepts the additional complication involved by having a crankshaft fitted with two cranks for one cylinder and only one for the other. So three piston-rods are needed. The connecting rod of one piston moves between the two rods of the other. This complication is offset by the fact that the engine as a whole is very compact, perfectly balanced and free from vibrations.

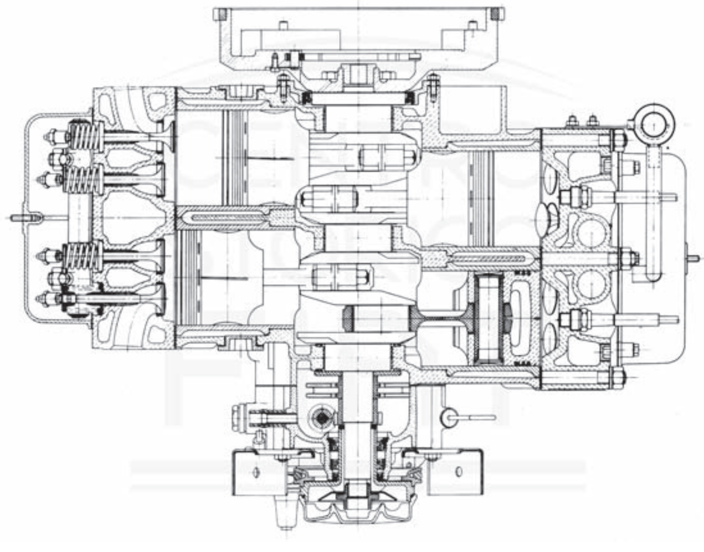
To avoid constructing two pistons of different shapes I decided to make them sufficiently large in diameter to be fitted with either a single rod in the middle or two at the sides. As the design was taken further it turned out to be convenient to make the stroke equal to half the bore.

I envisaged some difficulties in combustion because the surface of the walls of the chamber was large but I intended to solve the problem by adopting an appropriate shape, taking advantage of a certain freedom provided by the large bore of the cylinder in proportion to that of the valves and the possibility of finding room for either one or two spark plugs. The combustion chamber came to have an unusual shape as a result of this but I aimed to perfect it when we were carrying out trials to finalize the engine.

The designs of the two versions of this flat engine, one with two opposed cylinders and the other with four, were completely revised a number of times. My visits to SIRA were necessarily infrequent and so the observations I made after a lapse of time gave rise to modifications of the designs and hence to loss of time. But it also meant that it was possible to reflect and ponder the choices well.

In the 1954-58 period two four-cylinder engines were built, one water-cooled and the other oil-cooled, and two twin opposed cylinder coaxial engines, of which one was also oil-cooled and the other water-cooled. Air-cooled engines were also designed but I gave up the idea of having them built. I shall go into oil-cooling when

Horizontal cross-section through the axes of the cylinders of the 4-cylinder G. 1 boxer engine. Cylinder bore 94 mm; stroke 46 mm; total displacement 1.276 cc. All castings in aluminium alloy. Calculations envisaged 47 hp at 4.400 rpm. Its construction was completed by January 1947.

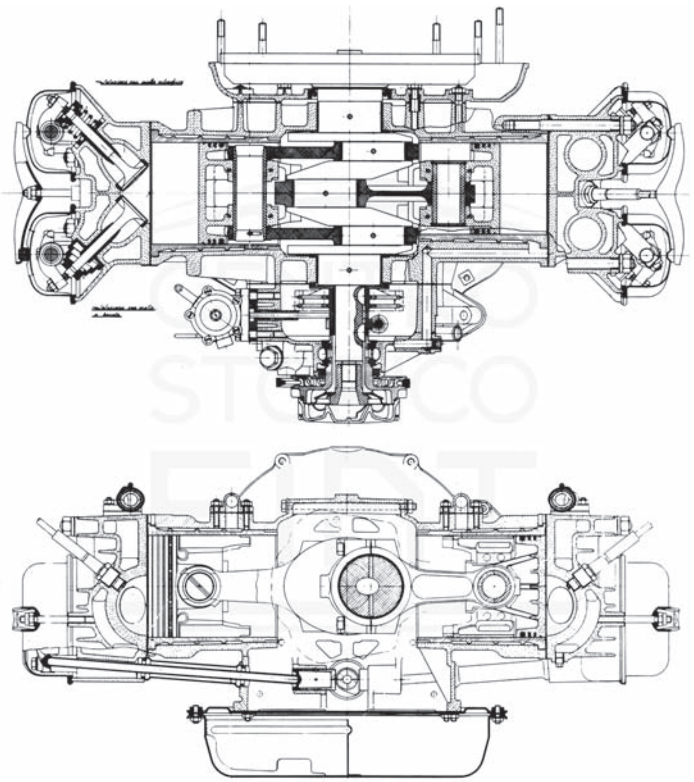


I come to deal with the three-cylinder "123" engines designed by the Research and Development Office.

I did not like these opposed cylinder engines. On principle I had always been against them, for economical and technical reasons, but seeing them there in front of me I simply did not like the look of them. Appearances count, after all. Then the two-cylinder engine created serious difficulties connected with manufacturing the crankshaft. Anyway, they had served to show that many things that look all right to the mind's eye are better avoided, left undone. This is one of the fruits of research, among other things.

As for the automobile, which was designated the "G. 1", we had collected a lot of designs for simple and ingenious solutions to problems such the suspension, steering and transmission systems. At this point I took the decision to entrust the continuation of the project to the Research and Development Office of the Advanced Engineering Sector at Mirafiori. As we shall see, in the wake of the studies started at SIRA the "123" projects were developed.

In 1957 I had Leoni transferred to Mirafiori as head of the Automobile Engines Office and replaced him with Virgilio Borsattino who remained in this post until he retired. Borsattino, an industrial engineer, had been a colleague and then a subordinate of mine in the Aero Engines Office. I had picked him in 1933 to design the *500* engine. When the Cisitalia project was being developed he had been transferred to the office run by Ferry Porsche and von Eberhorst, where he designed the famous



Vertical and horizontal sections through the axes of cylinders in the G. 3 engine with its unusual opposed co-axial cylinders. As a result of this feature one of the two pistons had a double piston rod connected to two crank pins. Several experimental models were made between 1954 and 1958, some incorporating experimental oil-cooling in place of traditional cooling with water.

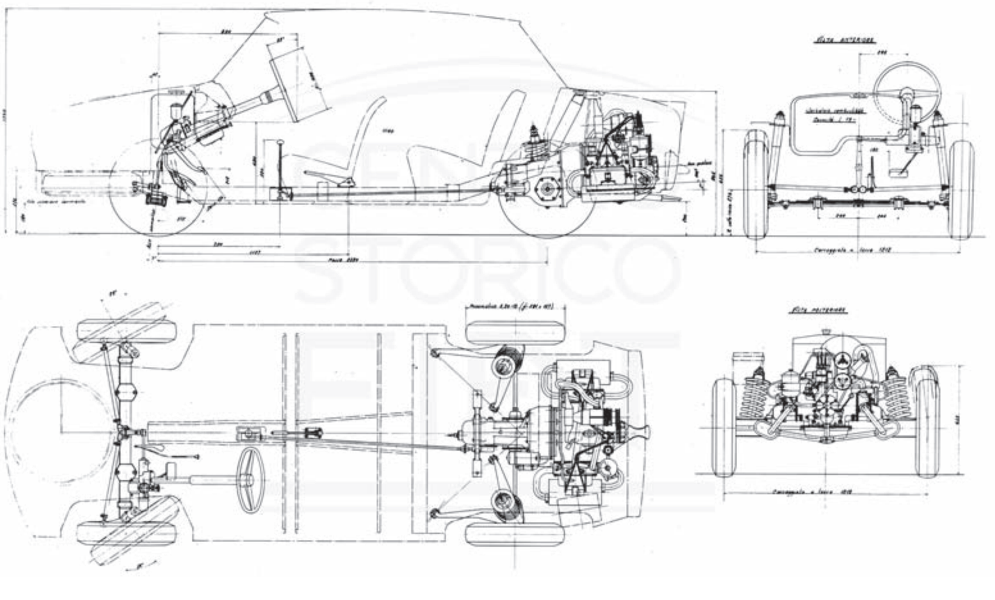
Formula 1 racing auto, prevented from taking part in competitions because of the bankruptcy of the Cisitalia firm.

Cavaliere Borsattino was quite bald, with an imposingly intellectual cast of feature. He was an intelligent and cultured man. On his own, he took up the study of Latin after having learnt English, French and German. He was versed in mathematics and a first-rate design draughtsman. Patient and painstaking, he approached every problem with the utmost serenity. He never showed a trace of incredulity or skepticism even when faced with the most abstruse problems. With perfect mental discipline, assiduously and patiently he would work out the way to transform any idea into a design, however difficult it might appear. Then with placid satisfaction he would shelve the result of his arduous labours when I was forced to admit that my ideas had not been valid. We would then exchange ideas and I would get him to try another solution. Extremely well-mannered, he never showed impatience or irritation.

The rolled-up drawings of flat engines and numerous versions of designs for the automobile itself were pigeon-holed and work began on a highly varied range of designs, complementing the ones being done at Fiat and also, to a lesser degree, by firms connected with Fiat in some way, such as the Carraro company (which later became AIFO), Aspera Motors and Piaggio.

It would be a long and wearisome task to mention all the projects carried out but it is worth looking at the ones that were original in design or produced good results when they were implemented. Lengthy studies were made of automatic gearboxes with epicyclical gears combined with electromagnetic or centrifugal oil clutches engines.

In 1960 we did the first designs for a go-kart. The aim was to publicize the little Aspera 3-5 hp engines that commendatore Salvatelli had decided to build under license



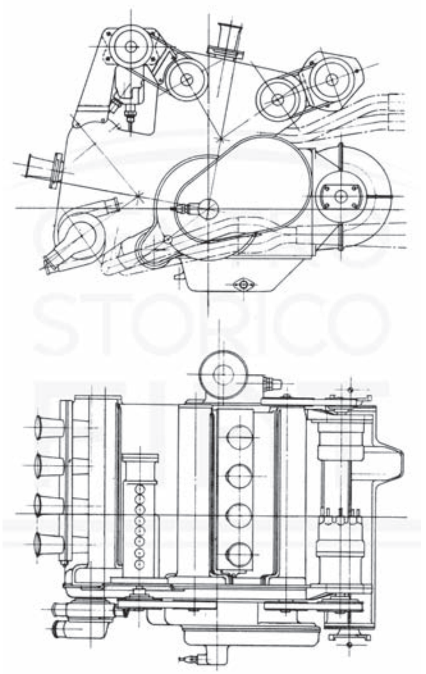
This scheme for the G. 1 auto with conventional 4-cylinder boxer engine mounted at the rear appealed to the author because of its simplicity, which meant that manufacturing costs would be lower (though only slightly) than the front-wheel drive version of the same engine.

from the American Tecumseh firm, distributing them in Europe to power lawnmowers, agricultural equipment, power-pumps and so forth. The go-kart was built by Marino Brandoli.

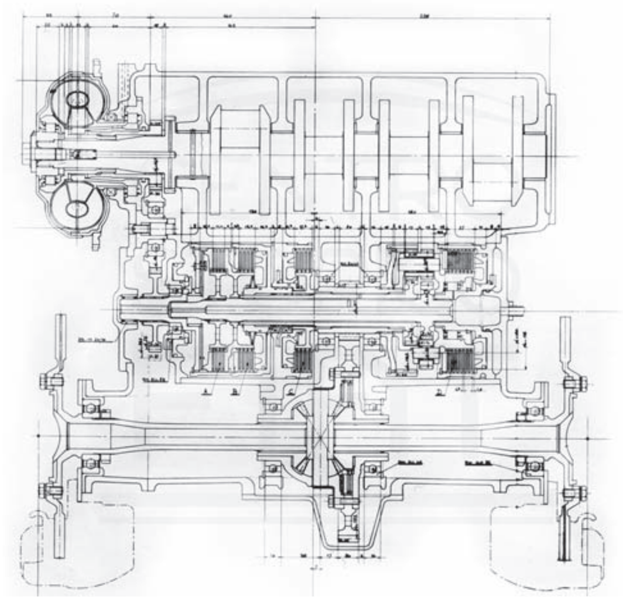
We worked on small vehicles for agriculture, pick-ups using the same mechanicals as Fiat autos, power-driven farm-machines. We did a fair number of conversion jobs on auto engines, turning them into power plants with reverse gear adapted to marine uses.

We amassed knowledge of all the problems relating to two-stroke outboard engines by studying the construction of the most famous marques and designing our own two and four phase outboards, including one four-cylinder model.

A number of studies conducted for Enzo Ferrari connected with the construction of a body shell-chassis unit for a Formula 1 racer gave me an idea for designing a racing auto with an engine rather less exaggeratedly powerful than the ones now in use. It seemed irrational and inhuman to me to put a man in the position of having to make use of a 500 hp



Provisional designs for the transverse drive unit for a small racing auto, comprising a V8 engine of about 1.000 cc and transmission. The design, made in May 1966, allowed for the use of a traditional five-ratio gearbox in some versions. It was intended for the G. 30 (the projected low-powered one-seater racer).



One of the numerous studies executed to investigate various aspects of problems connected with a transverse drive unit comprising an engine of 8 cylinders set in a V of 90 degrees. The design (dated 10 May 1966) is of a transmission mounted beside the engine, with three speed ratios, semi-automatic and fitted with oleodynamic converter.

engine mounted on a vehicle having a mass nearly ten times his own, so I wanted to see whether I could devise a single-seat auto with the least possible mass and an engine with a displacement equivalent to the commonest economy-model automobile engines. I had such an auto designed with an engine of a mere 1.000 cc arranged transversely behind the driver like present-day Formula 1 machines.

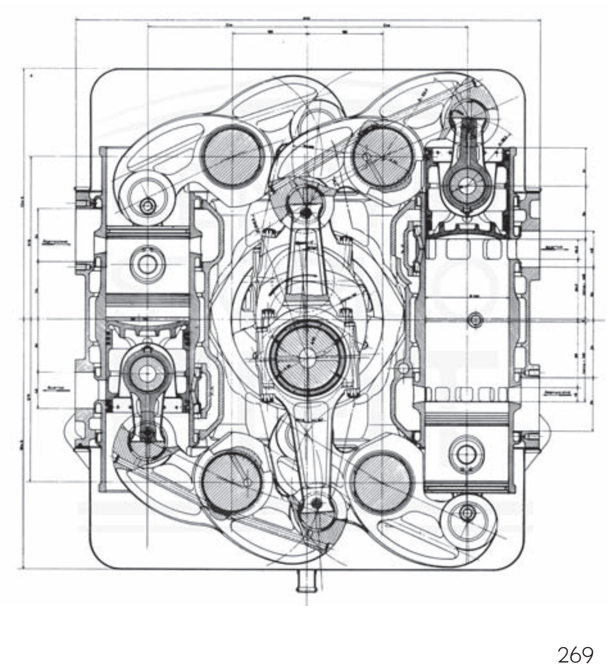
As time went by the work done at SIRA became increasingly complementary to the work of the design offices at Mirafiori while remaining in the field of advanced engineering: ideas were translated into designs and perfected through subsequent attempts at improvements and simplifications. These included transmission systems in which belts continually varied the gear ratios (as in the type tested on the *500* and later on other models), more sophisticated two and four stroke engines, reciprocating engines, rotary engines, agricultural machinery, marine engines utilizing jet propulsion. Our research followed the infinite paths of the imagination, translating ideas into concrete and communicable terms by that irreplaceable and all-embracing instrument which is design.

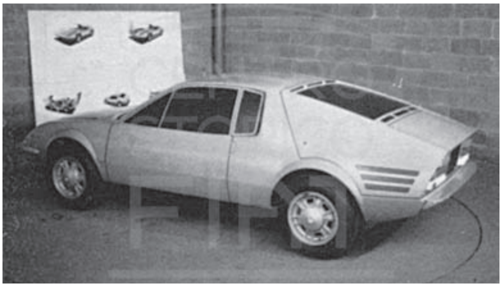
In 1964, when the Autobianchi plant at Desio was starting production of the *Primula*, I had an idea for turning out a sports model of this auto: a two-seater coupé with the same transverse engine but placed behind the seats and driving the rear wheels. In fact a transverse engine for a front-wheel drive vehicle can easily be moved back and adapted to rear-drive. The distribution of weight that results provides optimum conditions for road holding between tyres and the road surface.

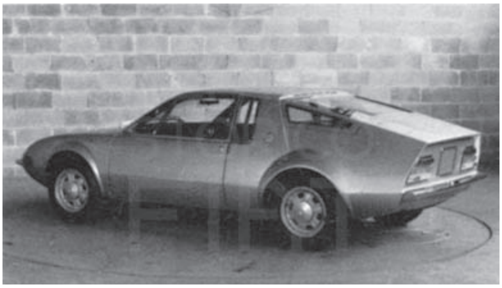
I thought it would be a good idea to utilize the mechanicals of the front-wheel drive vehicle with various modifications, rendered necessary by the layout of the new coachwork, the different distribution of the weight on the four wheels and its boosted performance. Since the components were to a large extent already being mass-produced, the new chassis would cost relatively little to build.

The designs with the designation "G. 31" were completed in 1966. The chassis

Cross-section of a modular diesel engine with opposed cylinders arranged in two banks on either side of the drive shaft. Note the link rods and rockers forming the kinematic mechanism needed for this type of arrangement. Study G. 29, design dated 18 March 1965.





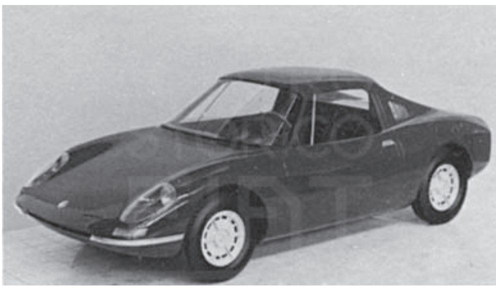


The first plaster model made at OSI for the G. 31 with a rear-mounted transverse engine was redesigned as in the second photograph. The first version was photographed 14 April 1967.

was built by Fiat in 1967. The general manager, at that time Gioia, suggested that I should ask OSI to look after the coachwork. OSI (Officina stampaggi industriali) was a company set up in 1960 by Arrigo Olivetti (by training a lawyer) and the then President of the Ghia outfit, Luigi Segre. When Segre died Arrigo Olivetti became the owner of OSI and he entrusted the running of it to Bianco. Bianco had a restless and enterprising spirit. He set up a technical design office which was staffed by men of the calibre of Sergio Sartorelli and Werner Höbl. The design and coachwork were done by Sartorelli. I made a substantial contribution to it myself even though I could only make brief and infrequent visits to the workshop. But when the auto was complete it was clear that the shape of the bodywork, very original for its period, needed to be slightly revised. Despite this it was presented to Fiat so that testing could begin.

In the meantime, the *124 AC* 1.600 cc engine with twin overhead cams had gone into production so I had the chassis redesigned to accommodate it, much more powerful than the *Primula*'s. So now we were faced with the likelihood of having to build a second prototype and design new coachwork embodying all the improvements suggested by experience. Together with Paolo Boano we decided to entrust the design of the coachwork to Pio Manzù. Pio had been on the strength of the Styling Centre since 1968. Before that he had worked together with Fiat's Press and Publicity Department and occasionally with me. From time to time he would send along some of his marvellously lucid designs, the distillation of deep reflection and study, embodying his vision of the automobile, especially the popular motor car, the economy model accessible to the widest possible public.

The comments accompanying them would be no more than a few essential



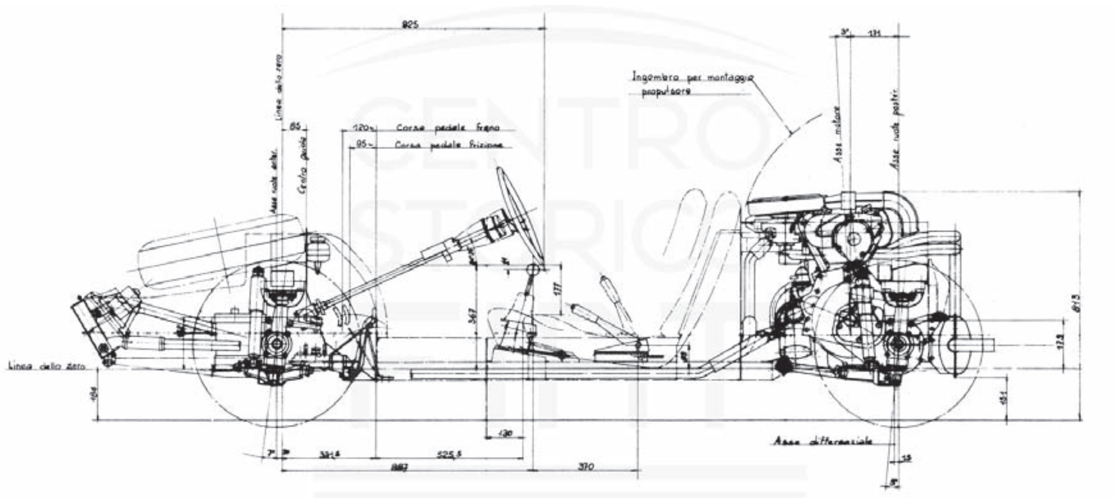
The G. 31 sports coupé designed by the Styling Centre, which produced a 1:5 scale model in 1965, was the author's favourite version.

words, beautifully lettered on almost blank sheets. The designs spoke for themselves. In fact only a drawing can give an exact idea of an automobile. The mind generally thinks and reasons in words but it is impossible to visualize a machine verbally.

So I had long been acquainted with Pio Manzù's deftness of hand and brilliant intelligence. He had been introduced to me on 20 September 1960 by Carlo Felice Bona who, as the reader will recollect, was then the director of the Central Research and Control Workshops. Bona was a keen historian and art-lover. The name Manzù made him tremble with excitement. All worked up he brought the young man into my office and entrusted him to my care, propelling him towards me with a gentle dab of his hand as if he were patting some precious object, his tall body stooping over Pio Manzù's slight figure.

Manzù was twenty years old. His look was thoughtful and intense; a strong nose dominated his small mouth. His long expressive face expressed his sensitive sincerity and courage and strength of will. He was studying in Germany at a school in Ulm. Industrial design in its true sense, applied to the automobile, was his dominant interest. He was passionately interested in autos. I listened to his fluent conversation which revealed his instinctive artistic bent and depth of sensibility. Naturally I thought that one day he might join Fiat and work at the Styling Centre.

Pio Manzù (Manzoni), architect, born in Bergamo in 1939. The son of the sculptor Giacomo Manzù, he studied at the Hochschule für Gestaltung in Ulm (Federal German Republic). He became prominent in 1962 when, together with Michael Conrad, he won the international competition promoted by "Revue Automobile" for the design of an original coachwork to be built on an Austin Healey 100 chassis. He joined the Fiat Styling Centre as a consultant in 1968 and devoted his attention to research into small autos. In 1967 he organized the automobile show at the San Marino Biennale. He died in 1969 in a road accident near the Brandizzo exit of the Turin superhighway.



Longitudinal section of the chassis for the G. 31.102 sports car with the twin-shaft 124 AC engine. Design dated 19 June 1967.

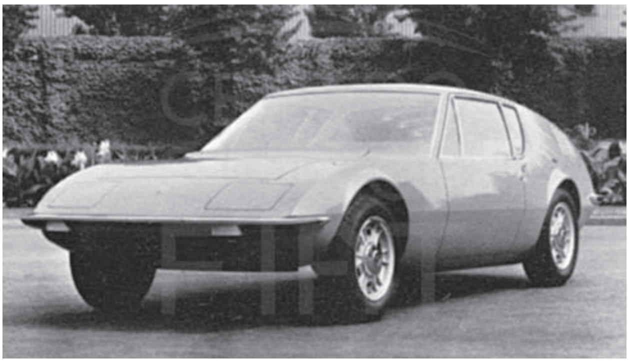
Some years passed before he turned up again. He came to tell me that together with a colleague he had won a competition for coachwork design reserved for students of industrial design. The prize was construction of the model by the Pininfarina coachworks.

This was the start of the collaboration that enabled us to get to know each other and gradually introduced Pio into the restricted artistic milieu at Fiat.

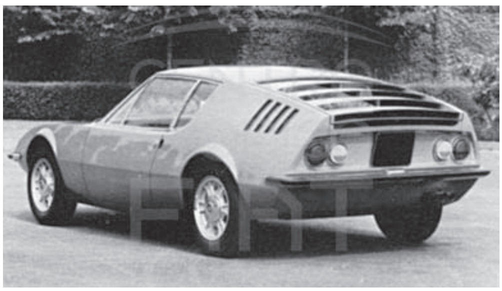
His marked personality and his ideas, not always unreservedly expressed, made me fear that it was not going to be easy for him to adapt to the working set-up at the Styling Centre, conditioned as it was by the innumerable requirements of industrial production. I was worried that his emotional sensitivity might be sorely tried by the inevitable toughness of his reception in a closed and select circle, so jealous of its own methods and traditions. This made me hesitate for some time, uncertain how to insert Pio into the staff under my charge. But after patiently working to prepare his future colleagues and Pio himself I decided to take him on at the Styling Centre. Even Giovanni Agnelli took an interest in this addition to the staff.

Manzù was given a large studio with draughtsmen and modellers together with the material to produce models of plaster of Paris, plasticine and clay. We got into the habit of calling him Pio. We knew that his father, the famous sculptor, had no wish for his son – of whom he was extremely fond – to be called by his own *nom d'art*, Manzù instead of Manzoni.

So it was Pio who had the job of modelling the new coachwork of the "G. 31" chassis in its most recent version, powered by the *124 AC* engine and perfected in numerous points of detail. For his part he showed the refinement of his sense of design and his skilful touch in shaping the plaster model. The result, which followed the general lines of the previous coachwork constructed by OSI, was a magnificent



Two views of the coachwork produced by the Styling Centre to the model made by Pio Manzù for the G. 31 with twin-shaft engine.



work of sculpture. We took a replica of it in plastic reinforced with strands of glass fibre and had it displayed at the Turin Motor Show on the Autobianchi stand. But it had already been decided to drop the "G. 31" derived from the *Primula* from the production programme and to bring out sports models similarly derived from the *128*.

The extremely attractive model displayed at the Turin Motor Show drew the attention of automakers, awaking their interest by its layout, with a transverse engine and rear-wheel drive. A few years later, in fact, we were to see the most up-to-date sports cars being designed along the same lines as the "G. 31" presented by Autobianchi.

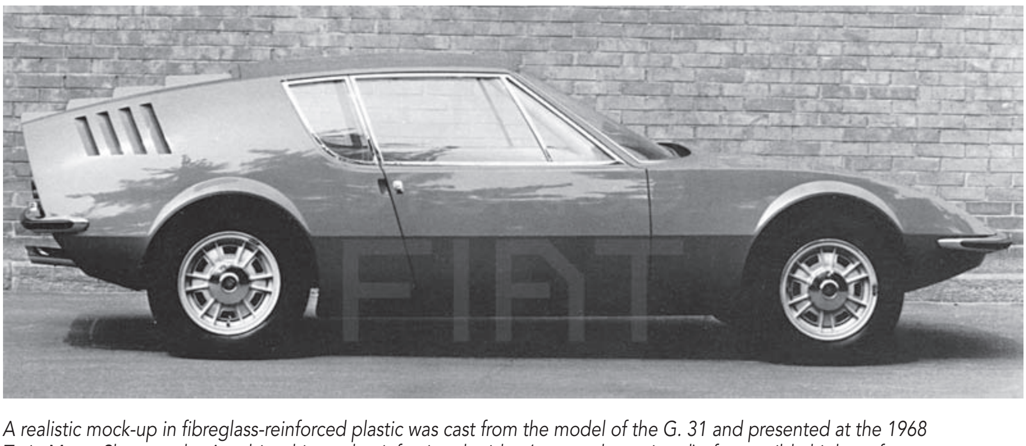
The Fiat *X1/9* which came out at the start of 1974 can be considered the translation into concrete terms of the concept that had led me in 1964 to design the "G. 31" at SIRA.

Progress is an unending advance to which each person makes his own contribution, great or small as the case may be, but always linked to what others have done and are doing. Those who claim all the credit for some step forward that they have accomplished are to be pitied, for in reality there is nothing that is wholly original.

My responsibility for running SIRA was also combined with having to run the *Forschungsabteilung*, which was the pompous title given to the little research and design centre accommodated at Heilbronn on premises provided by NSU-Fiat. I had taken it over when Fessia left Fiat for the second time to become engineering director with Pesenti's Lancia company.

The *Forschungsabteilung*, usually referred to as the *Forschungs* or *Entwicklung* (meaning "development"), comprised a staff of designers as well as a small experimental plant which was at first able to do no more than assemble machines and easily manufactured parts but then gradually developed to the point where it could turn out a complete auto body. Eventually the expansion of the Deutsche Fiat company made it possible to enlarge the scope of the centre to comprise a styling studio equipped for the construction of plaster or plasticine models.

Bono had allowed me to increase the number of design draughtsmen and approved my proposal to use the centre as a training ground for young engineers who had shown flair for design and had the necessary qualities for holding responsible positions.



A realistic mock-up in fibreglass-reinforced plastic was cast from the model of the G. 31 and presented at the 1968 Turin Motor Show on the Autobianchi stand, reinforcing the idea (never substantiated) of a possible high-performance Autobianchi sports model.

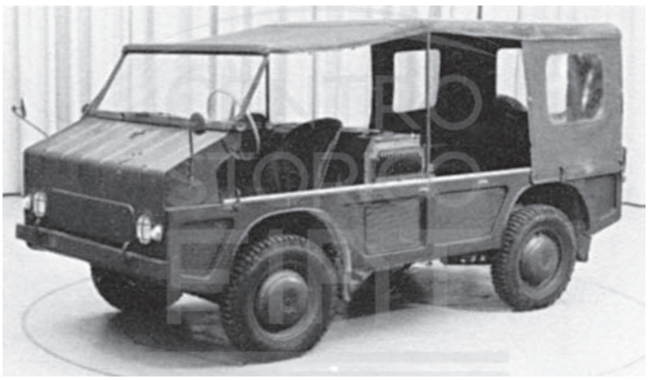
From 1954 the best engineers chosen from among those working for the Automobile Technical Offices succeeded one another at Heilbronn, each for a period of a few years. In order of time they were: Vittorio Montanari, Ettore Cordiano, Felice Cornacchia, Giuseppe Puleo, Michele Ponzio, Sergio Camuffo, Pier Giorgio Tronville, Carlo Magnino, Carmelo Messina. They now form the design staff at Fiat and Lancia. Ponzio reached the rank of director with the Design Department for agricultural tractors and earthmoving equipment and then left Fiat.

The little centre of Heilbronn is the best opportunity for Fiat's young engineers to round out their knowledge in the design sector, acquiring experience and displaying their capabilities, maturity and leadership. The study and work programmes were generally assigned directly by myself and they were chosen so as to be either directly or indirectly useful for Fiat. Naturally the engineer involved would be called on to discuss them and could make suggestions of his own.

From 1955 to 1976 twenty-four main projects were completed at Heilbronn and fourteen original and useful prototypes built, without mentioning the numerous secondary achievements.

The little "01" front-drive auto was built in 1955 when Montanari was running the office. In 1957 Cordiano was in charge of the design and construction of the "02"

The front-wheel drive 02 van was built at Heilbronn under Cordiano. The Fiat 500 motive unit, shifted to the fore carriage, had the engine at the back of the two seats.



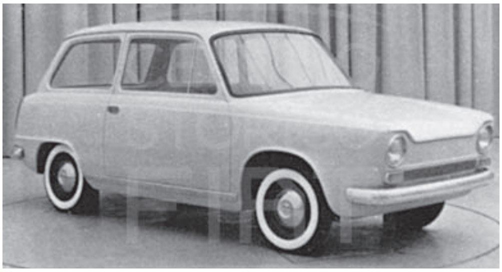
The tipo 06 was a four-wheel drive vehicle design for military use with a standard production engine (the 103 G of the 1200 Gran Luce) mounted transversely in a mid-position. Built in 1957 under Cornacchia.

pick-up van. It was taken to Turin and subjected to a series of tests to see if it was a feasible prospect for production. Economic considerations, especially the high cost of tooling-up, led to its rejection. The prototype was used for transport inside the Mirafiori Factory.

Other extremely interesting prototypes from the technical viewpoint were some small military vehicles and automobiles, all of them in the economy range and equipped with front-wheel drive, that were built and tested from time to time.

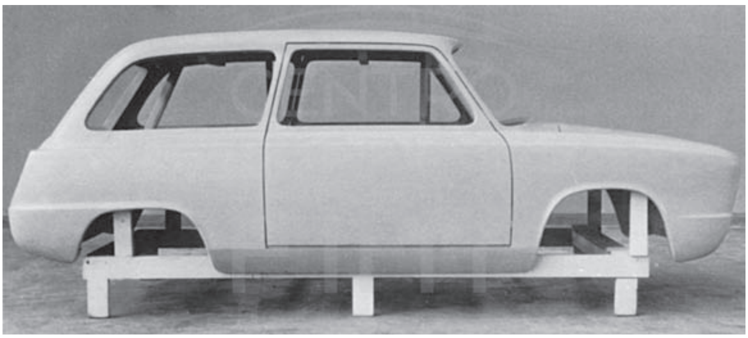
The military light truck designated "06" and the hatchback front-driven "07" coupé were designed under Cornacchia's guidance in the 1958-59 period. Puleo, who was at Heilbronn from 1961 to 1964, directed the project for a military tourer designated the "08" with a centrally mounted transverse engine, the "11" military light truck and the three-wheeled "10" pick-up. The last of these, which Puleo called the "Pully", was presented at the Frankfurt Motor Show in 1962, attracting the interest of engineers and road haulage firms. Many of the mechanical parts, starting with the power plant and drive unit, were taken over from the *500* station wag-

The tipo 07, the "Austria" (1960).



The tipo 07, design 4a (1961).

The tipo 07, design 5a (1961).



The experimental tipo 07 derived from the study made at Heilbronn under Cornacchia in 1958-59. The first version used the 2-cylinder air-cooled Steyr-Puch boxer engine. The second prototype had a 4-cylinder water-cooled engine derived from that used for the 600. The project was backed up by the Styling Centre, who produced several plaster models, drawing for ideas on the models made for the "122" sedan (the rear-engined auto that eventually led to the Simca 1000). The photo alongside shows the second design (1960), possibly the most modern-looking today.

on. In 1964 the "12" military tourer was built with Ponzio. Subsequently the model "14" was built, begun by Camuffo and completed by Tronville. This was a highly original little military vehicle intended for use by paratroops. Then under Magnino in the years 1972-74 there followed the "City Taxi" (Pio Manzù had already made contributions to its design from 1968 on), the model "17" and the little "19" sedan ("G. 40").

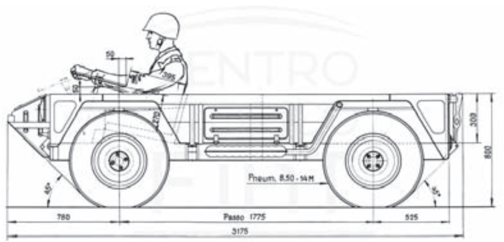
Between 1974 and 1976 Messina designed and constructed the front-driven sedans designated the "18" (*600 TA*), and the "23" ("G. 55"), at the same time conducting studies into semiautomatic transmission systems.

The model "23" sedan was the basis of a project recently developed in Turin with the aim of constructing a small economical auto to continue the evolution that led from the *500* to the *126* and is still going on.

The military vehicles designed at Heil-

The tipo 08 was a bearing-body version of the Campagnola, using the latter's mechanicals. The engine, front suspension and transmission to the front wheels were borne on a reduced chassis frame attached to the body with a few bolts. It was constructed in 1960 during the directorship of Puleo.

The tipo 10 three-wheel pick-up, also called the "Pully" after Puleo, the engineer in charge of the project, used mechanical components from the 500 estate. It was presented at the 1962 Frankfurt Motor Show.

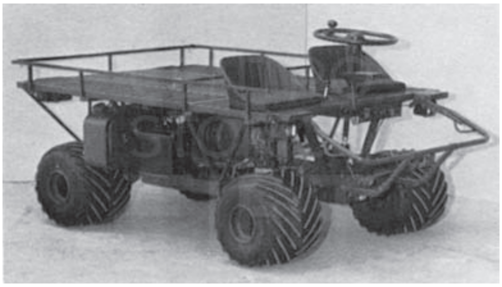


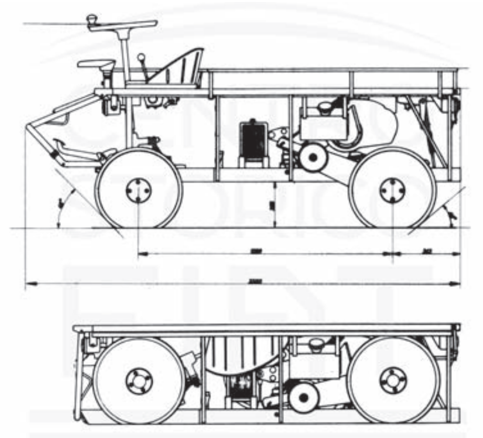
The tipo 11, designed to specifications of the military authorities as an infantry support vehicle was the fruit of lengthy work carried out partly at Heilbronn and partly in Turin at the Advanced Engineering Offices. The mechanicals were constructed in Turin, the coachwork at Heilbronn, where the first prototype was assembled and tested with an oil-cooled 3-cylinder 123 engine. Subsequent development led to the construction of further prototypes with the 116 engine and finally with the 103 engine. The vehicle could overcome practically any obstacle in off-road operations.

bronn for research purposes were part of a programme of studies that I considered would be useful for Fiat and the Study Centre of the Vehicles Department at the Ministry of Defence.

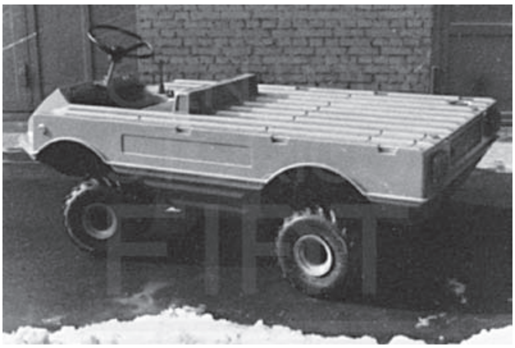
Among my many duties I also had to maintain contacts with the engineering services of the Defence Ministry. There was open and effective collaboration with the high-ranking officials of the Ministry's Vehicles Department. I talked with complete freedom about technical problems to officials from the staff and the study centre of the Ministry in a search for solutions that would respond to service requirements.

Another of my activities at Heilbronn involved studies and prototypes that I thought would contribute to progress in the specific field of travelling over mixed terrain. These would mostly be small vehicles with special features, often original and highly advanced, that I intended as solutions to problems I knew were of par-





The tipo 14, begun by Sergio Camuffo and completed by Tronville, was a light vehicle for use by paratroops. It can be folded for transport and dropping. In less than a minute it is ready for use. Dimensions of the vehicle when folded: 1,85x1,32x0,47 m. Experimental prototypes were built at Heilbronn using the flat Fiat 500 engine from the station wagon and the Piaggio 2-stroke Ape engine.



The tipo 17 was conceived as a small transport for use in airports etc. It was derived from the tipo 14 by simplifying the mechanicals. It had a fibreglass-reinforced plastic coachwork. The project was directed by Magnino in the period 1972-74.

ticular importance in the eyes of top officials in the Vehicles Department of the Ministry. At the same time it provided excellent training in design for the engineer running the little Study Centre.

When the prototypes (built amidst the greatest secrecy) had been completed and perfected they were moved to Turin for further trials and presentation to the military engineers.

The work carried out at Heilbronn gave the engineer running the centre every opportunity to gain experience in design, construction and testing, while Fiat benefited by a pool of know-how kept up-to-date in the field of off-road transport and teams of design engineers able to turn their hands promptly to projects that would meet the needs of the future.

The Heilbronn Study Centre was under my charge until 1976, when I decided to turn over full responsibility for running it to Cordiano and devote the powers remaining to me to SIRA.

At the Heilbronn Study Centre a number of designs for taxis were executed, based on practicality and low running costs. The illustration shows one example, using the mechanicals of the 127. The touch of Pio Manzù, who worked on the project until 1968, is clearly apparent in the style.

CHAPTER XX

ADVANCED ENGINEERING

THE "123" PROTOTYPES AND THE *PRIMULA*

The story of the studies and research left to my free initiative and the choices I made should be completed by an account of the most important work carried out by the officers of the sector that, from 1959 on, with the creation of the Higher Automobile Engineering Management, I entitled the Advanced Engineering Sector. The various different offices, whose functions were shown on the organization chart in Chapter XV, were run by young engineers whose period of training at Heilbronn had been followed by a number of years working in the Research and Development Department: Cornacchia, Cordiano, Puleo. In addition to these there were also Giovanni Torazza and Giovanni Candellero, the leading industrial specialist in automatic transmission and gearing. Cordiano, as the service director, held the most senior position. I entrusted him and his efficient staff with the job of resuming work on the project, begun at SIRA, to produce an auto whose specifications and low cost would enable it to reach the widest possible public.

As we shall see, this aspiration of mine was doomed to disappointment because the prototypes ventured too far beyond the conventional techniques of the period, and also because many years were to pass before Fiat would agree to consider front-wheel drive suited to large-scale production.

The story of the four "123" projects is highly significant. None of these produced an automobile for the motoring public but they each contributed to the underlying and essential evolution of the automobile, demonstrating the laborious process behind the development of a new model.

With the construction of four experimental autos whose weight ranged from 760 to 780 kg, two with front-wheel drive and two with rear-mounted engines, I aimed to collect information relevant to functional details and manufacturing costs and work

Autobianchi Primula sedan, 1964.

out which of the four versions was the least expensive, so providing the top management with the data for a reasoned choice.

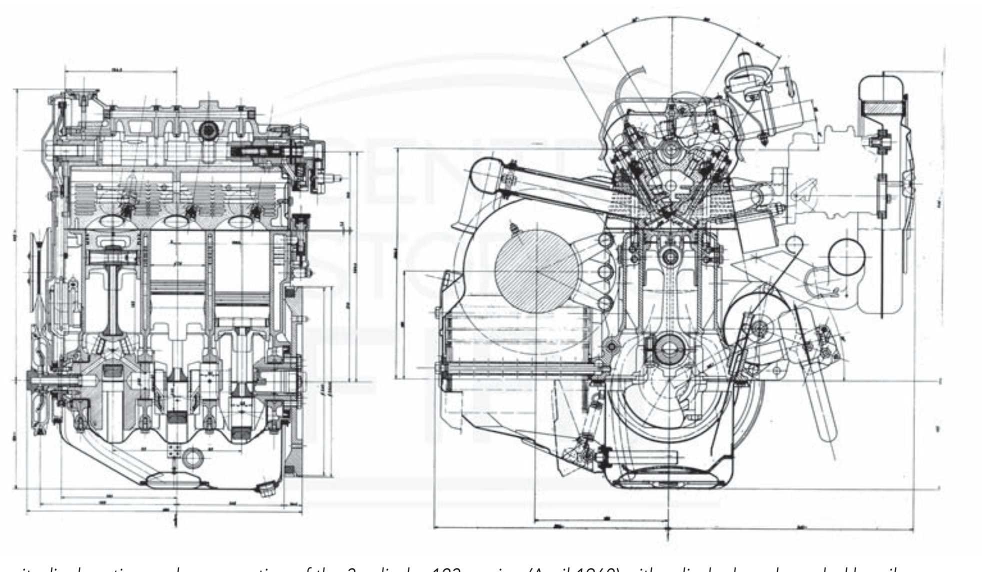
Circumstances made such an apparently straightforward procedure impossible. Many causes, including the difficulty of conceiving, designing and building four different prototypes simultaneously prevented a simultaneous comparison from being made, uninfluenced by the conflicting opinions and changeable moods of the hierarchy.

The two and four cylinder engines with opposed pistons that had been designed at SIRA did not come up to my expectations. For one thing they did not meet the criteria of being functional and cheap to manufacture. With greater commitment we embarked on the design of the three-cylinder in-line engine.

I wanted to experience at firsthand what it would be like to drive an auto of this sort so I had three of the six cylinders in the engine of an *1800* stripped of their pistons, rods and valves. The trial run did not correspond to the real situation, of course, since the mass of the engine and the rest of the auto was much greater, but I felt justified in forming a favourable judgment.

Though I was almost certain that the three-cylinder engine would never be approved unless it gave unexpectedly good results, far superior to expectations, I was equally certain that it was right to design and build it. A sacrifice on the altar of research that would pay for itself in the data it provided for future developments, despite the substantial costs involved.

Among the innovations to be tried out was oil-cooling of the cylinder barrels and air-cooling of the head. Tests with the engines built at SIRA, though only hurried and superficial, had been encouraging. It was essential to persist with them because oil-cooling opened up the possibility of reducing the spacing of the cylinders and hence



Longitudinal section and cross-section of the 3-cylinder 123 engine (April 1960) with cylinder barrels cooled by oil and cylinder heads cooled by air. Total capacity was 1.157 cc but Italian road tax would have been considerably less than that for the 103 engine.

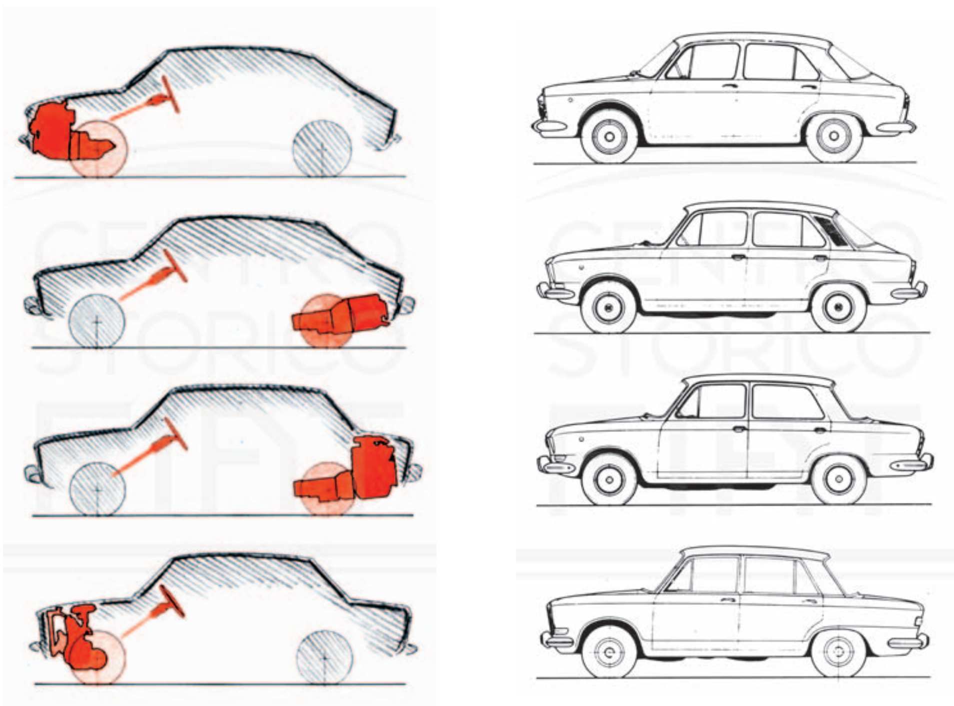
the volume occupied by the engine, and also of eliminating the water ducts with the pump and other components needed for circulation.

At that time Luigi Zandonà was in charge of automobile research. I got him to investigate the problem with laboratory tests. After lengthy studies he produced the data needed to move on to designing the engine. It was found necessary to cover the surface of the barrels with fine grooves where they came into contact with the oil, which was done by using a screw thread for the sake of convenience, and it was also necessary to keep the layer of oil very thin, no more than about one millimeter.

This information enabled us to go ahead with some confidence and design the engine. The reduced space between the cylinder barrels affected the overall length, which was much less than if the cylinders had been air-cooled like the engine head.

The three-cylinder engine was designed with an overhead distributor shaft between the valves which were laid out in a V arrangement and controlled by the rockers. A single oil pump was used to lubricate the various parts and also cool the cylinders. A small radiator acted as a heat exchanger between the oil and the air. It was fitted directly to the engine and would also provide warm air to heat the cab.

The engine had a displacement of 1.157 cc. I had two versions designed, the first with vertical cylinders, the second with horizontal ones. Torazza was responsible for the designs.



The G. 123 project involved the comparison of four different design solutions.
The show the four arrangements of the drive unit, the main variable envisaged by the author.
The coachwork for the four prototypes (E1, E2, E3, and E4) records the evolution from "two volumes" to "three volumes".
Evidently the first solution was too far ahead for current taste, successive solutions showing greater approximation to more conventional forms.

I intended to make a comparison between the various different possible layouts of the mechanical components of coachwork having a cab of given dimensions. The engine and transmission group, including the clutch, gearbox and the differential with its gearing were all to be made as small as possible.

As a gesture towards advanced engineering and out of my passion for innovation I revived some studies worked on at SIRA. I wanted to develop a design of a gearbox incorporating an automatic clutch. This would either function automatically or else, to cut costs, be worked by a small lever or switch mechanism without the need for a clutch pedal.

The drawing of it is far more expressive than any words could be. It shows how compact the transmission was and suggests the intense effort to attain simplicity that lay behind it.

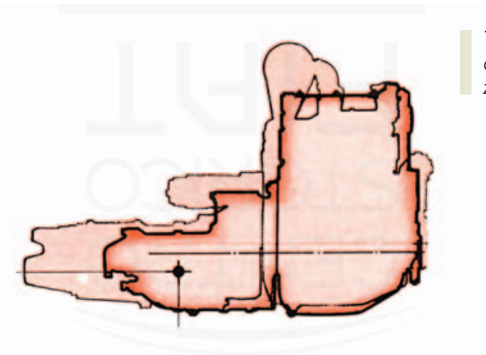
While the drive groups were taking shape, attention was also being given to the various layouts and structures which the two types of engine would be compatible with.

I picked out the most functional of the numerous schemes designed: front-wheel drive with the vertical engine, rear-drive with the horizontal one. The first of these was known as the “123 E1” and the second as the “123 E2”.

The design of the “123 E1” chassis was the object of patient study, calculations and planning which finally reached completion towards the end of 1959.

At the Styling Centre we started off with an original concept, tinged with that inevitable suggestion of the fashion of the moment that always creeps in, and then gradually reverted to forms closer to the style of auto that the motoring public was already accustomed to. This was in consequence of the brief passing visits and comments of the company’s top management, who would drop in at the Styling Centre and spend a few moments, among their other business there, on the models devised by the Advanced Engineering Sector. They considered these a useful exercise in design that would furnish suggestions for standard production models. Their very occasional and laconic comments left their mark, nonetheless, since they were the people, after all, who had to take the decision that could transform an experimental model into one mass-produced for the world’s roads.

In the quest for maximum practicality, I had the idea of designing coachwork that would make it possible to fit a door of the largest possible size at the back. A sort



The illustration shows how much smaller the G. 123 drive unit, with 3 cylinder engine and gearbox, zwas than the 600’s despite its almost double capacity.

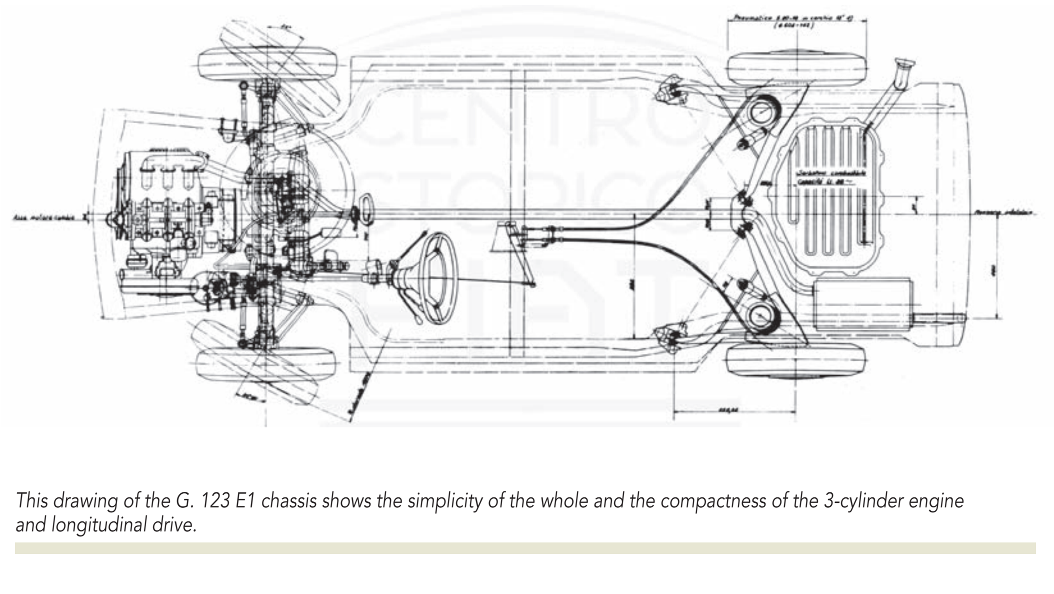
of cross between a station wagon and a sedan, in short. A two-volume auto, at that time a novelty but not highly thought-of by our commercial sector.

The plaster mock-up of the “123 E1” was finished in April 1961. The working prototype was presented to the presidential committee as soon as it was ready, in July. It was examined in silence while I described its leading features.

The form and dimensions were well-suited to front-wheel drive, with the vertical engine placed lengthwise, an automatic clutch working on the centrifugal oil system and semiautomatic transmission with epicyclical gearing. It had three forward gears worked either by a lever on the steering column or else three switches. The wet centrifugal clutch was the outcome of a series of tests that I had been conducting for some time, with results that were on the whole good.

Prudently restrained phrases of congratulation were the reward for an achievement which had involved long and strenuous effort, beyond the imagination of the people now gathered about it. But this was what I had expected and

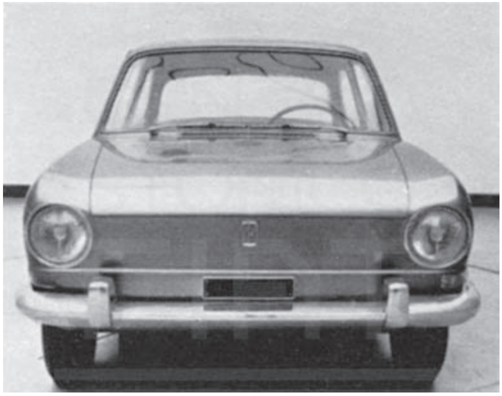
The G. 123 E1 had a large rear hatch.
The prototype was ready for testing on 1 August 1963.



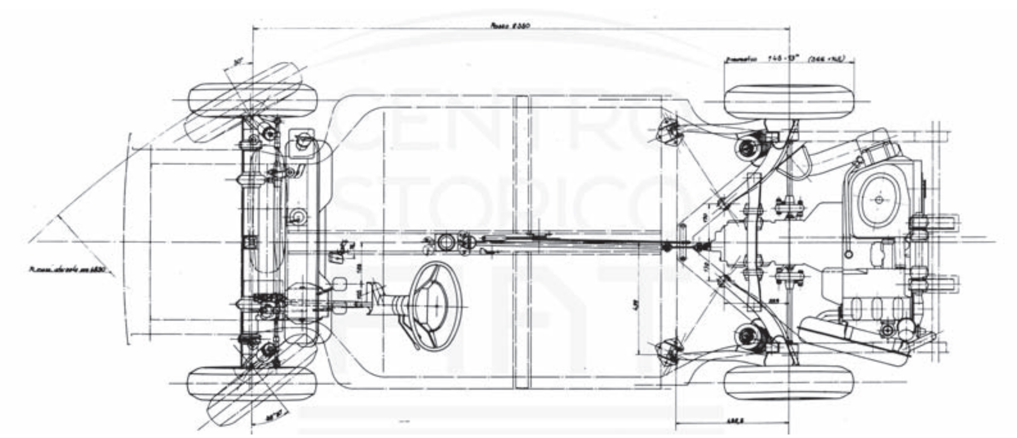
This drawing of the G. 123 E1 chassis shows the simplicity of the whole and the compactness of the 3-cylinder engine and longitudinal drive.

it was enough for me: it meant I could also get on with other projects that I had been developing for some time.

The designs of the flat engine for the rear-engined model were ready. The first innovation we discarded involved the semi-automatic gearbox with its epicyclical gearing. The first tests had been promising but circumstances would not allow us to devote full attention to resolving all the problems, which is essential when perfecting mechanism of this sort. We lacked the staff and equipment in our Test Department. Freilino's workshop was not yet ready for testing autos. So I had a traditional



The coachwork of the G. 123 E2 was a compromise between two and three volumes. The rear position of the engine and the particular type of cooling allowed the front grill to be eliminated.



This drawing of the G. 123 E2 chassis shows the extremely compact flat 123 E2 engine mounted at the rear. This arrangement made it possible to provide space for baggage at the back as well as in the front "hood" or "bonnet". Design dated January 1962.

transmission designed with a fully-synchronized four-speed gearbox similar to the *600* but with hypoid bevel gearing on the torque.

The plaster model was ready at the Styling Centre by May 1962. The prototype was completed in 1963, straight after the "123 E1".

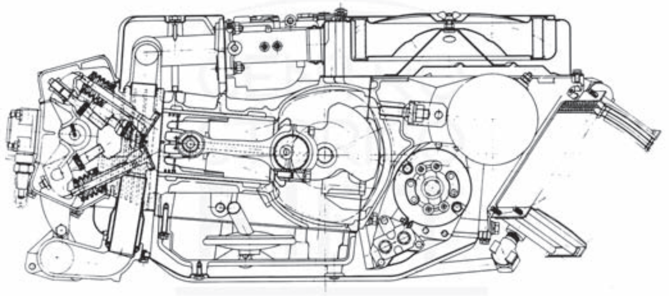
The tests of the "E1" and "E2" models could not be conducted as they ought to have been, with close and continuous collaboration between the staff of the technical office, who had produced the designs, and the test personnel because there was no unit with the sole task of carrying out tests for the Advanced Engineering Sector. Salamano was in charge of the trials but although he was always eager to investigate anything new he had to give priority to the prototypes of models going into production, which were always urgent cases. Because of the shortage of test drivers the prototypes produced by Advanced Engineering were unfairly neglected.

So while the design offices were working on increasingly advanced concepts the test drivers were fully taken up with the job of perfecting traditional types of autos, of fundamental importance to the production side, and could not follow our progress with the same constant commitment, relegating to a secondary position problems whose solution was essential if our studies were to get anywhere.

To make the position still more difficult, on 3 January 1962 Salamano, who had turned sixty-five and no longer felt that his health would permit him to go on working with that same tireless drive so characteristic of him, handed in his resignation. He still had a position as consultant to the General Management but relations between the management of the design sector and the Test Department were no longer so close as they had formerly been.

Fiat's decision to take part in the Exhibition of Italian Industry in Moscow, from 28 May to 12 June, involving all sectors in preparing some impressive display of their activities, also diverted attention from the work of the Advanced Engineering Sector.

Engineer Montabone, after running Simca's Technical Centre for seven years, was recalled to Turin. A communiqué announced that as from 1 September 1962 Montabone was to take up an appointment as engineering assistant to the General Management with the task of coordinating and developing motor vehicle design, supervising the Test Department and contacts with the Central Research and Control Laboratories, superintending the entry into production of new models and promoting the coordinated projects of the Higher Engineering Management of the motor vehicles sector. In short, Montabone was meant to assist Fiorelli and me and act as a contact with the General Management.



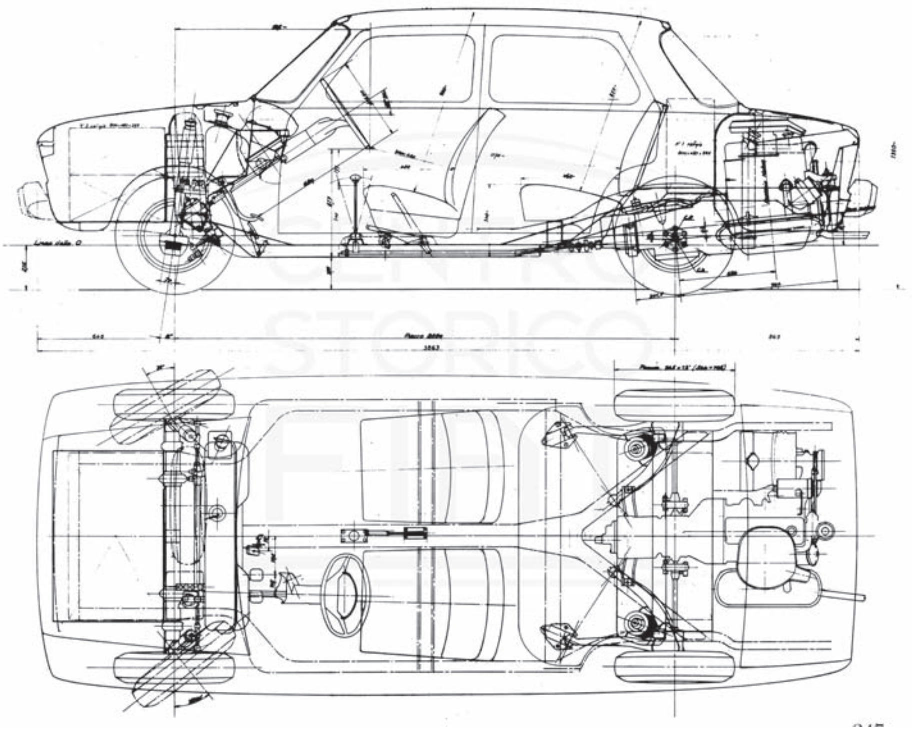
*The 123 E2 engine was extremely compact: like the E1 it had three cylinders (here placed almost horizontally) with oil-cooled pressed-in liners.
Besides the G. 123 E2, it was also mounted on the tipo 11 infantry support vehicle.
Note the oil radiator on the right of the drawing (dated May 1962).*

Montanari was sent to Simca to take Montabone's place and the latter started to give his attention to the Automobile Technical Office which was part of the Automobile Division. Montabone was a man of action, energetic and resolute. He imparted new drive to the short-term projects of the Auto Division and concentrated the work of the Test Department on them. The resources of the Test Department were only barely adequate to deal with the production needs of the company.

My attempts to create a specialized section for studying and testing automobiles conceived along completely new lines and a workshop for developing automatic transmission systems were fruitless. The prototypes built to designs by Advanced Engineering were shelved as curios or museum pieces.

For the time being I had to discontinue tests on the three-cylinder engine and semiautomatic transmission. So the "123 E1" and the "123 E2" were put in mothballs. But I carried on with the development of the "123 E3" project.

The G. 123 E3 differed from the two previous models principally in having the 103 standard production engine cantilevered out at the back, in an arrangement similar to that of the 600.
Design of the same model dated September 1962.



The plaster mock-up was ready by October 1962. The rearmounted power plant was traditional in conception, similar to that of the *600*. The engine was derived from the 1200 of the “103”. The transmission was taken from the “123 E2”.

The progressive abandonment of the innovations made in the “123 E1” was accompanied by a progressive waning of the enthusiasm of my collaborators. It should be added that the appearance of Alec Issigonis’s Morris *Mini* in 1959 had been a discouraging blow for us all. I knew that the Morris company had been testing the vehicle for some time but I never imagined it was so small and so amazingly successful in design. I was shaken and felt regretful that I had not persisted with my studies for a front-driven transverse-engined auto after the design for the little “100” in 1947.

I think I had better put in a few words to explain why I broke off my studies into front-wheel drive at that time. In fact I have often been asked why I opted for rear-mounted engines on the *600* and *500*. In 1947 we had constructed a power plant with the engine mounted transversely on the experimental “100” economy car. Why did I fail to keep going along these lines, especially when, as the drawings accompanying the patent show, the arrangement of the various parts was so simple and rational?

The layout of this design preceded the arrangement of the gearbox chosen by Issigonis. Since the gear shafts are arranged laterally and parallel to the crankshaft of the engine, the whole thing is very compact and can easily be fitted into the rather limited space between the front wheels when they are in the full lock position. But from the point of view of production this arrangement presents one drawback which I have always considered quite unacceptable for large scale production.

The components of the engine and gearbox are housed inside the same casing, i.e. inside the crankcase. This means they cannot be assembled and tested separately in different workshops, as can be done with the traditional type of gearbox fitted in line with the engine. Furthermore, when the gearbox is alongside the engine either a series of gear-wheels or else a chain has to be used to transmit drive from the motor or the gearbox. This means additional complications, higher noise levels, increased loss of power due to friction, heavier weight and higher costs. The *Mini*, with the transmission gears in the engine crankcase, presents these defects.

Issigonis once referred, during an interview, to my Fiat patent dated 1947, by then expired. But the design of the *Mini* was different from my idea. I had put the transmission gears in a separate chamber from the engine even though it was a part of the housing which acted as the cylinder block. In fact the components of the engine and the transmission were enclosed in a single shell mould casting. I admired the constructional simplicity of the *Mini*’s coachwork but I was against the high manufacturing cost of the mechanicals and the low clearance of the platform and the mechanical parts attached to it. Still, the attractive little British automobile made a deep impression on me because it realized the ideal of the minimal auto, compact, sporty, functional in form and pleasing to the eye.

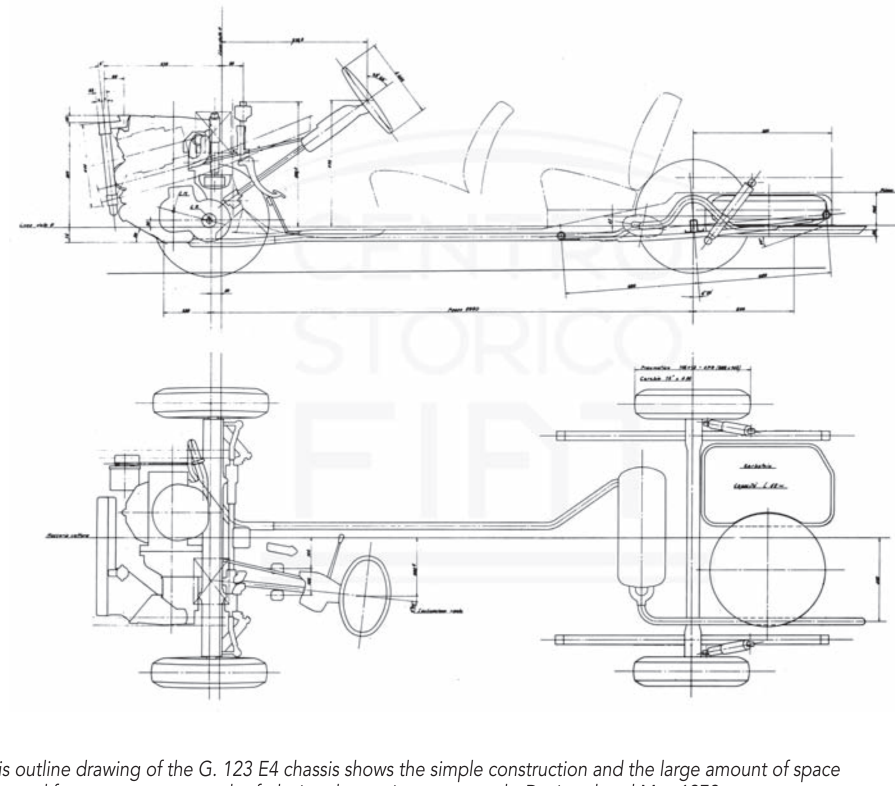
Finally the restless spirit of rivalry sprang up and we let ourselves be led by it. Without interrupting the design work on the “123” autos, we began to collect ideas for a front-driven transverse-engined 1.200 cc auto. I wanted an extremely simple machine which could be manufactured without having to set up costly or ambitious plant so that it would be easier to get the works to approve of it. The first studies were got out in 1961. The designs of the *103* engine, modified so that it could be mounted transversely, were done in 1962. The engine was designated the "103 G1". The vehicle designs were given the coding "109", the coding "108" having been used for a previous project.

Knowing the situation of the Autobianchi works, which had been discussed in special meetings of the General Management, I felt the "109" could well be the right auto to build at the new factory in Desio.

I spoke about the business with Autobianchi's manager, Nello Vallecchi. He agreed with me. He gave his personal attention and enthusiastic encouragement to the project, always backing me with his support even though Bono was somewhat put out by the way we collaborated so openly.

In the meantime the Styling Centre, which had been strengthened by the additional staff from the Boano coach building works, had moved into the specially built premises on the south side of via Settembrini. Here the Centre could draw upon design engineers, workshops for modelling masters in plaster or other materials, a studio for displaying models on turn tables and a shop for constructing fully coachbuilt models. But no sooner it had shown just how efficient and useful it was than it was obliged to move out.

Only a year had passed since the inauguration of the new premises when the new factory at Mirafiori Sud, forced to expand to increase production, took over the site of the Styling Centre. The low-profile, elegant building was rapidly knocked down



This outline drawing of the G. 123 E4 chassis shows the simple construction and the large amount of space reserved for passengers: a result of placing the engine transversely. Design dated May 1972.

to make room for a large three-storey building to house the Systems Office and plant needed for the factory.

The Styling Centre, while waiting for new and larger premises to be built in via La Manta nearby, was accommodated provisionally in an industrial prefab in via Correggio near corso Dante, the area where the very first Fiat works had stood. Here the Boanos, father and son, resumed their exhilarating work on the development of new models. Among other tasks, they had started to model the coachwork for a new coupé directly in wood: its dimensions were adapted to the *103* which at that time was being referred to as the *1100 D*.

My visits were frequent, enabling me to follow the attractive wooden model as it grew into shape and my mind would fly off to the “109” project which was also taking form on the drawing boards at the Advanced Engineering Centre. The result was that the coupé was progressively transformed into a four-seater sedan with a door at the rear, conceived as the coachwork of the “109”.

Meanwhile the design of the chassis went ahead. Cordiano and his draughtsmen tried to arrange the drive mechanism, consisting of the engine, clutch and gearbox, transversely between the front wheels, connecting the three elements solidly to one another in the usual way. Though the overall length was less than that of traditional drive mechanisms, the gearbox being shorter, it was still too big to fit between the front wheels at full lock since the auto itself and its track were rather on the narrow side.

I was willing to accept a track 10 cm larger than the *103* so as to make the model wider even if it meant increasing the weight and cost but even so the space was insufficient. It looked as though there was no alternative to making the track even wider or giving up the project but I was against any increase in width because lightness was one of the most important conditions for the auto’s success. So I insisted that some way had to be found to shorten the drive unit.

I remember the thrill I got when I was told that the problem had been solved. I was walking down the aisle between the drawing boards in the big design studio on

The G. 123 E4 had front-wheel drive, used a transversely-arranged 103 engine (a layout later to be used for the Primula) and had a particularly “orthodox” coachwork. With this design the author hoped to persuade the President to consider production of the first Fiat front-wheel drive model.

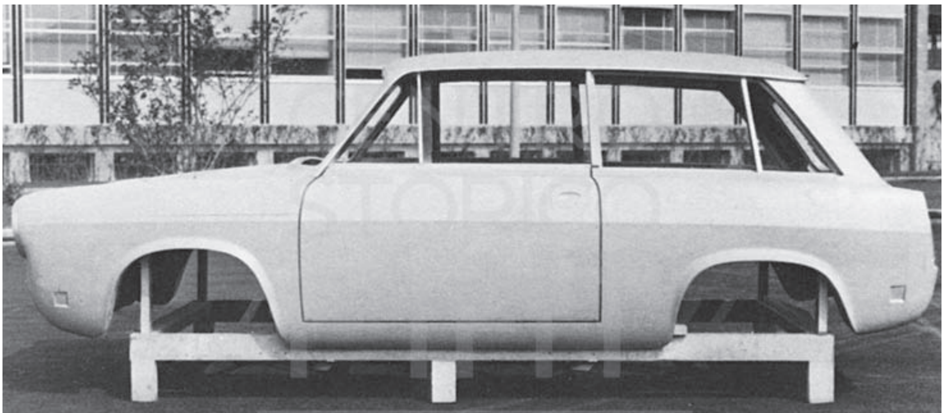
the north side when Cordiano came up to me smiling and said that it could be done quite simply by reducing space taken up by the clutch. With an ingenious system of hydraulic transmission to work the clutch and a rod inserted inside the drive shaft of the gearbox it was possible to do away with some of the components: the thrust bearing and the lever usually used to disengage the clutch. The overall length could then be reduced just enough to fit the drive unit between the wheels. The project was quickly completed.

I was at last confident that the arrangement of the drive mechanism was more simple, functional and economical than any other in existence, the successful outcome of an incessant, painstaking and assiduous quest for simplicity.

Nowadays this arrangement has become the classical layout for four-cylinder engines, adopted by all the big automakers for their most popular models. Its sim-

The model 09, the future Primula, first design (1961).

Full-scale model of the third design of the 09, presented in 1962.



Plaster mock-up of the second design for the 09 on display in the garden of the Styling Centre in 1961.

plicity and functional qualities are unrivalled. Friction is reduced to a minimum in the transmission and it costs less than any other possible layout.

The first body shell was built at Desio while the mechanicals were being constructed in the Experimental Workshop at Mirafiori.

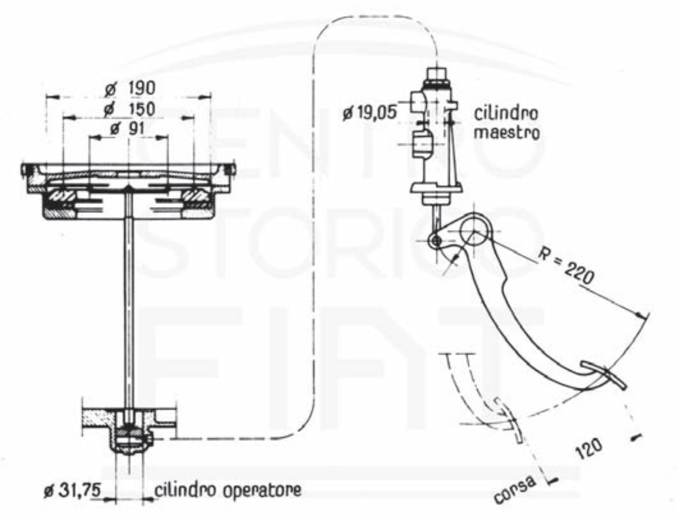
After tests at the workshop to check the body shell for deformation under the stresses it would be subjected to, the first experimental prototype was finally assembled and delivered to the Test Department for trials. These began on the Mandria track on 1 November 1963. We met with no particular snags during perfecting. The auto performed well on the whole. Despite Salamano's grudging attitude towards front-wheel drive the test drivers were satisfied.

The brakes had one new feature which was also reproduced or copied later on by rival manufacturers. The distribution of weight on the wheels of front-driven vehicles is such that between 55% and 60% of the weight rests on the front tyres and this increases when the auto is occupied only by the driver. During braking, the force of inertia leads to a change in the distribution of weight, which builds up on the front wheels and is reduced on the rear ones. As a result the latter tend to stop turning and to drag along the road surface. To avoid this defect, which could have caused accidents, we applied a simple and ingenious device to the brakes' hydraulic circuit which would be set working by the lift impulse of the rear of the vehicle and reduce the braking power proportionately.

The brisk approach of Luigi Zandonà, who had meanwhile been put in charge of the Test Department, meant that the model was rapidly given the green light. With my hand strengthened by this and the support of Vallecchi I began to suggest to meetings of the presidential committee that the "109" would be a convenient way to introduce front-wheel drive.

The discussions were continued in talks with Valletta and Bono. The importance of such a decision made the directors cautious in their attitude. Their confidence in me was countered by fears that my eagerness might have led me to disregard some of the risks. Finally Valletta decided that the experiment of putting the "109" into production at the Autobianchi works ought to be tried.

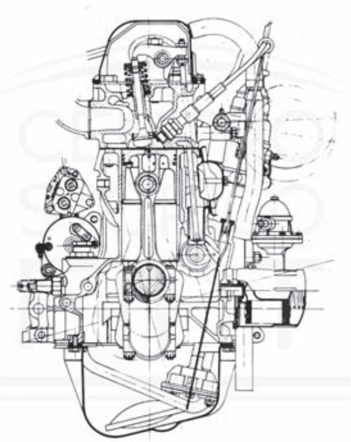
The hydraulic control system of the Primula clutch with coaxial rod to reduce width of the drive unit (February 1963).



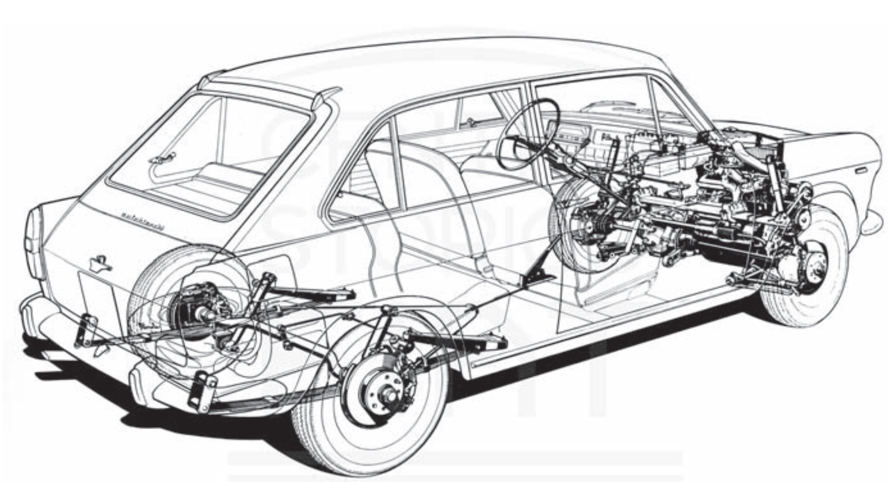
Further prototypes were built to enlarge the scope of trials while the Desio plant was rapidly getting tooled up for production. When the last snags had been ironed out, together with the problems and uncertainties that always appear when the factory takes over responsibility for large-scale production, construction began in mid-1964. So a few months after the debut of the Fiat *850*, the Autobianchi "A 109" was presented to the public as the *Primula*. The name, with its suggestion of spring and felicity, was one of Nello Vallecchi's happy ideas.

Though it lacked support from Fiat's sales organization, which saw it as a rival, it was well-received and a great success, especially in France, where the front-wheel drive and the rear door were highly appreciated, as they deserved to be.

Rear view of the 103 G. 1 power plant of the Primula in the version put into series production by Autobianchi of Desio. The transverse arrangement of the transmission was called "the Giacosa arrangement" by journalist Jean Bernadet.



Cross-section of the 103 G. 1 engine derived from the 103 engine of the Fiat 1100/103 and adapted to the transverse position by giving it a pronounced tilt forwards. Design of October 1962 originally produced for the G. 123 E4 experimental prototype.



Explanatory diagram of the layout of the mechanicals for the Autobianchi Primula, which originated in the 09 project developed by the Fiat Advanced Engineering Offices.

CHAPTER XXI

THE *124* AND THE "123 E4"

THE CONTRACT FIAT-USSR

In 1963 the Automobile Technical Offices were once again engaged in the important task of updating production models. The *600* and the *500* had to be modified so that the door hinges could be moved to the leading edge, in compliance with new regulations. Work was proceeding on the *500 F* to be brought out in 1965 and studies were made for a more modem design of the *600*'s coachwork. I suggested that the *500* sedan should be fitted with the flat engine of the station wagon to gain space for luggage and reduce cost by standardizing, but economic problems affecting the production lines stood in the way of this.

Under Lampredi's expert guidance an engine designated the "124" was being designed. This was to weigh 20 kg less than the sturdy old veteran *103*, whose capacity had been bumped up from 1.100 cc to 1.220 cc on the *1100 D*.

At the chassis office designs were being sketched out for the auto that was intended to take over from the *103/1200* and, if possible, also the "116"-*1300*. In this regard, the general manager expressed his viewpoint in a confidential note sent to me on 27 September 1963. It read as follows:

> The replacement of the *103/1200* by a new model whose coachwork will have a more up-to-date line, more space inside and a completely new engine-gearbox-differential system will involve immense outlay and make inroads on plans already formed to rebuild Mirafiori Centro. The simplest and least expensive solution would be to modify the present *1300* by increasing its roominess lengthwise by 5-6 cm, stow the spare wheel upright in the luggage trunk, mount a new model "124" engine (about 20 kg lighter), gearbox and suspension from the *1300* (cloche gear shift). The auto must weight 70 kg less than the present model and cost of materials must be 100.000 lire less than for the present *1300*.

124 standard sedan (1966).

The note also envisaged an output of a thousand units per day.

On 29 December the Styling Centre was the venue for a meeting between Valletta, Gianni Agnelli, Nasi, Bono, Fiorelli and Gioia. Together with Montabone and the Boanos, father and son, I presented a *103* with the new longer coachwork (made of plastic for the sake of rapidity), the prototypes of the *500* and the *600* with their doors hinged on the leading edges, the models of a new bodywork for the *600 G*, of a "116"-*1500* in a longer version, of a new 1500÷1700 and of a longer and wider version of the *2300*. As it was predictable, attention centred mainly on the *103*. The wheelbase had been increased by five centimetres and the track by four in accordance with instructions from the general manager. During the discussion that followed, I was asked to make it still longer and it was decided to adopt definitively the gearbox of the "116"-*1300*. This was the origin of the new model that was to be called the *124*, a conventional auto with the engine mounted in front and rear-wheel drive.

I pointed out that the "123 E4" was being built and that it would be a good idea to wait until it was completed in March and compare them. In fact, as soon as the "109" project was finished in its general outline and the main designs done, I had made an all-out effort on the "123 E4" with its transverse engine and front-wheel drive.

A few days later, when I had reflected on what was afoot, I sent a note to Bono containing various observations on the *103* he had inspected at the Styling Centre, which in my opinion would be dated and not very competitive by the time it eventually came out, and describing all the advantages of the "123 E4" with its front-wheel drive, greater roominess, lower weight and costs.

The "123 E4" synthesized all the experience acquired with the *Primula* and the previous "123" prototypes built. It could be considered as ready for mass production. This was my last attempt to convince the top management that a much more modern auto with front-wheel drive was needed to replace the *103/1200*. The prototype was rapidly built. As soon as it had done a few thousand kilometres and I was satisfied with results, I wrote a letter to Valletta and Bono painstakingly and accurately expounding the merits of the "123 E4", whose advantages could be summed up briefly as its roominess, which equaled the six-cylinder *1800*, and its weight, a mere 750 kg. This was followed by a comparison with similar models produced by the major rival automakers and an accurate description of its specifications and the reasons underly-

The front-wheel drive G. 123 E4, first version; with this design Giacosa and his team hoped to oppose the choice for production of the 124, a much less modern auto as far as style was concerned.

ing its engineering, information about the innovations it contained, observations on functional data, weight, costs and the results of testing. Fiat's top management preferred not to take any decision but await developments.

Adolfo Messori, engineer, born in Modena in 1902. A graduate in Mechanical engineering, he was working for Lancia in 1929 on the staff of the Test Department. In the same year he left to join Fiat, where in 1955 he became assistant director of the test team of the automobile works and in 1960 sectional director. He died in 1969.

At the Automobile Technical Office new impulse was given to the "124" project while the Advanced Engineering Department worked hard to perfect and tune the "123 E4", called the "123" for short.

With Montabone's return, the Automobile Technical Office had in effect reverted to his control and so moved back to within my managerial sphere of influence.

However I was taken up with the projects in course at Advanced Engineering, SIRA and at the Study Centre at Heilbronn, so I willingly let Montabone handle the projects for autos destined to go into standard production in the near future. Montanari left to replace him as manager of the Technical Centre at Simca and Montabone devoted himself with great energy to developing the *124*, whose essential features had to be lightness and low production costs. But the issue became clouded by the rivalry that sprang up, fomented by certain executives at the works who were perhaps irritated by the fact that they had been deprived of the technical office and intended to put forward a design of their own in competition with it. Leading the opposition was above all Adolfo Messori, an engineer and the director of the Test Department.

I first came across Messori when I was a student at the Polytechnic and he was already working for Lancia in its Test Department. I used to have my meals with some of my fellow students in a modest restaurant in corso Duca di Genova, now corso Stati Uniti. Messori was also a regular patron there, sitting by himself at a table opposite ours. He always had a far-away, thoughtful look about him. His eyes, which were big and dark, protruding slightly and veiled behind lids that drooped a little, gazed into the distance, his mind lost in far-off thoughts.

I felt attracted to that reserved character who sat stooped over his table, eating slowly and absorbed in profound reflection. I would have liked to know who he was. Perhaps he is an engineer, I thought. In fact he was. One day we got talking, about automobiles naturally enough. He confided that he was building a small auto on his own, working partly in his rented room, partly in a little mechanical workshop in via Nizza. We took to each other. He invited me round to look at the designs in his room and then in the workshop. I was there, amused and interested, when the weird and somewhat primitive vehicle was started up for the first time and made its first sputtering journey. In shape it was vaguely reminiscent of the Lancia *Lambda* torpedo tourer. It had a single-cylinder two-stroke engine with a jogged piston, i.e. one having two diameters, and it definitely did not go. The whole machine was meant to be-out of the usual and it was, if only because it was made out of the truly primitive bits and pieces that Messori had managed to scrounge. At least it enabled us to get to know each other.

When we came across each other once more at Fiat we remained on friendly terms. Sometimes work led to differences of opinion but we still managed to settle things amicably, even though Messori was sensitive and at times touchy.

His behaviour in the period when the *124* was being designed led to serious rivalry between the works and the technical office. On one side there was Messori, test director and backed by Fiorelli; on the other Montabone in his role as assistant director to the General Management which, in theory, would give him its support.

As for me, I thought that the *124* was superseded by the "123" and kept out of the rivalry. But I knew what was going on and was in a position to judge.

The design produced by the Automobile Office under Montabone's direction was sensible and praiseworthy from every point of view. The bearing structure of the coachwork was of extreme simplicity but the conventional layout of the mechanical components and the absence of any innovatory features to attract public interest made it, to my mind, unlikely to remain competitive over a sufficiently long period.

Messori had his design done in great secrecy by the designers in the office where plant was designed for the factory. He retained the form and overall dimensions of the Styling Centre's model of the coachwork but aimed to make it lighter by adopting a type of suspension using coil springs that he had devised and now illustrated with effective technical arguments. But his design meant that the platform had to be built out of a number of different sections which were not very large, differing in this respect from the technical office's design, which envisaged a simple leaf-spring suspension and so made it possible to reduce the separate sections to a minimum.

This new suspension worked fairly well though some aspects of it were open to facile criticisms. But the assertiveness with which Messori maintained his convictions admitted of no reply. Montabone's arguments were wasted. The two autos were both built, first the one designed by the technical office and immediately afterwards the one designed by the works.

During trials, the second one showed that the coachwork was not rigid enough and so the platform had to be reinforced. Overall, the two prototypes could be considered equal but the one designed by the technical office was simpler and would cost less. A choice was called for. Bono, with Solomonic wisdom, decided to have a third and final prototype designed, combining the best features of both. So it was that Messori's system was incorporated in the rear suspension of the *124* for reasons that had little to do with engineering. Naturally the technical office was given the job of executing the final designs.

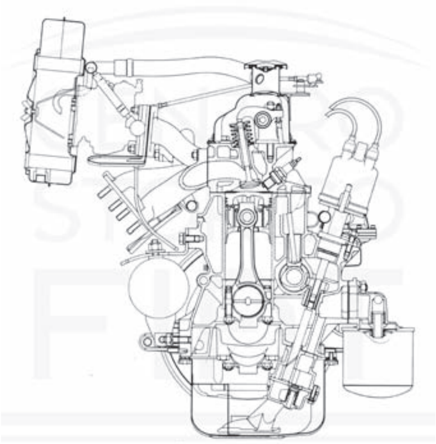
124 estate, the station wagon version presented in May 1966.

124 Special, unveiled on 6 October 1968, had an engine boosted from 1.197 to 1.438 cc, turning out 70 hp din.

There were some lively (not to say heated) arguments between Messori and the specialists in the Test Department, especially Zandonà, during the testing and perfecting of the fuel feed system for the engine. Then finally there was peace and quiet. A certain coldness reigned.

The tension between the staff of the technical office and the workshop had fortunately not lasted long but it directed the attention of the President and the General Management more closely to the *124*, which had automatically been chosen for production as soon as possible to replace the *103/1200* and the "116"-*1300*. Under Montabone's strict and energetic control and with the aid of the thorough tests carried out by the works, numerous modifications were made to improve the quality of every detail, increase the vehicle's durability and adapt the design to manufacturing techniques.

Model 124/540: plaster mock-up of design 2a, 1964.



Cross-section of the 124 A engine (1966).

Model 124/540: plaster mock-up of design 3a, 1964.

Model 124/540 with plastics coachwork (design 1a, 1963).

When the tests had been successfully completed, an unusually large number of specimen models were produced. Then the *124* was formally approved by the Test Department and favourably commented upon by the other sectors that examined and passed judgment on it: the works' test section, the After-Sales Service Department, the commercial management. It became progressively safer, more reliable and better suited to the needs of the motoring public, which was growing more demanding and experienced.

At the same time I had not given up working on the "123". While perfecting it I had got out designs for a new version with the *124* transverse engine. My arguments were listened to sympathetically but not considered sufficiently important to alter a programme that had now become final. Not even the support of a report produced by the commercial management, which had tested the two autos and came out in favour of the "123", had any effect.

Valletta adopted a policy of caution, waiting until front-wheel drive had been tried out for a few years by Autobianchi. This was the large-scale experiment that began in autumn 1964 with the launching of the *Primula*, only a few months before the Fiat *850* came out.

In 1965 the works turned out the *500 F* and the coupé, sports and station wagon versions of the *850*. The coupé was designed, as mentioned before, by the Styling Centre while the sports model was designed by the Bertone coach building firm which, was now engaged in short-run production.

Fiorelli, who had been awarded a well-deserved honorary degree in engineering by the Turin Polytechnic, was once again taking a new broom to the Mirafiori works, laying down an ultramodern assembly line for the *124*, scheduled for production in early 1966.

I was busy at Advanced Engineering, starting studies of a front-drive auto whose weight would be mid-way between the *850* and the *1100*, while I got the Styling Centre to do the preliminary designs and models for the coachwork.

In the period of fierce rivalry that led to the production of the *124*, Valletta had conceived that immense achievement whose first stage was the agreement between Fiat and the Soviet Union for the construction of a factory in the USSR and production of the *124*.

The auto industry in Russia was in a growth phase. The visits of Soviet delegations to our factories, starting in 1955 and repeated annually, created a certain climate of cordiality between us and some high-ranking figures in the Soviet Technical and Scientific Committee of the Council of Ministries, in the Automobile Industry Ministry and in the factories.

Piero Savoretti, President of Novasider, with a highly efficient organization in Moscow, was magnificent as a coordinator, an ambassador in the full sense of the word.

The first contacts in Moscow, in talks with J. M. Gvishiani, director of the Scientific and Technical Committee of the Soviet Council of Ministries, and other meetings which resulted in the framing of a protocol, were followed in 1965 by negotiations proper, a whole year of meetings, reciprocal visits, exchanges of information, including technical and economic data, followed finally by the drawing up of the contract.

I was one of the many actors in an operation which was directed with incomparable skill by Valletta. More than any of us, he believed in that enterprise which he intended to conclude successfully even at the cost of notable sacrifices for Fiat. As early as 1966, following an invitation from the Technical and Scientific Committee of the Soviet Council of Ministries, Valletta had sent me to Moscow at the head of a small delegation consisting of Zazzaroni, director of the Central Research and Control Laboratory, commendatore Ben Omega Petrazzini, director of machine production at the Mirafiori works, and Morello, assistant director of production plant.

We travelled from Moscow to Stalingrad and then Georgia, examining roads, visiting factories, talking to technicians and research workers. Looking around at that land, which was so utterly different from Italy in size, population density, standard of living, outlook, customs, climate and terrain, I thought about the ways we would have to modify our automobiles.

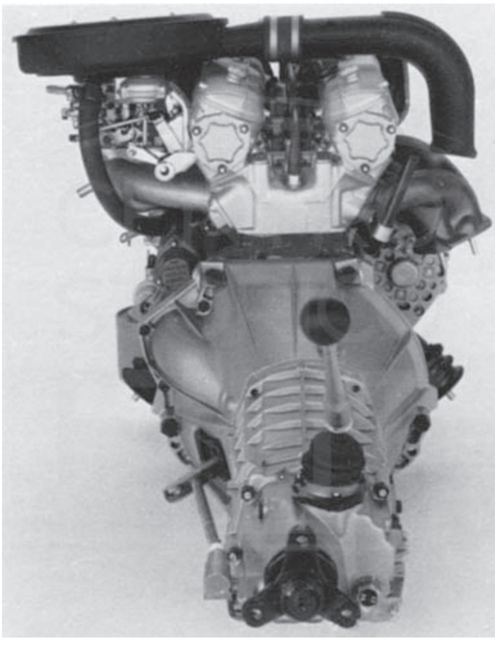
In 1965, when negotiations had reached the point where final agreement loomed close, Gioia and I went to Moscow to try to work out a preliminary schedule of work with the leading Soviet directors and engineers at NAMI, the central automobile research institute.

The meetings were presided over by engineer Strokin, Minister for the automobile industry. More an engineer than a minister, he had a thorough grasp of automobile technology. The numerous engineers from NAMI who took part in discussions were oriented towards front-wheel drive. They had tried out French, English and German autos and finally the *Primula*. The majority were in favour of the *Primula*, which appealed because of its dimensions and three-door or hatch-back coachwork, which they felt was suited to the mixed use which would be made of it in their country.

I had to put forward all the reasons that led us instead to choose a conven-

124 sports coupé designed by the Styling Centre represented an innovation when presented in 1967: a sports car with full space for four adults. It incorporated the net twin-shaft 124 AC motor, 1.438 cc.

The coachwork of the 124 sports roadster, presented in 1966, was (and, amazingly, still is) produced by the Pininfarina works. Today output is almost entirely for export to the USA. Consequently, it is equipped with a two litre engine designed to conform to the strict anti-pollution and safety standards in force on the other side of the Atlantic.



A rear view of the twin-shaft 124 AC engine installed in both the 124 sports models.

tional model like the *124*. Valletta had authorized me to suggest the "123" as well, but he intended that the choice should fall on the *124*.

Thinking back to the events of that period, I have often wondered what would have happened if the "123" had been designated the "125" or "126" to indicate a later project than the *124* and hence presumably a more modern one.

Perhaps our President, a skilful diplomat, would not in that case have allowed me to mention it to the Soviet committee, whose first concern was to choose the most advanced project possible. To satisfy them we had to design a motor specially for the purpose. The Russians wanted to participate in the project and since they considered the engine the most important part they concentrated on that. So I presented them with the designs of two engines which differed substantially from the *124* in the heads and the distributor control. After long meetings where I had to answer innumerable questions the choice fell on the project I had recommended.

I was perfectly frank and objective and everything went off as the President of Fiat had desired. I still had a misgiving that the choice of the *124* might not be ideal for that immense country but the Soviet engineers and above all the Minister and Assistant Minister were satisfied and confident about it.

It took nearly a year to complete the agreement through the compilation of the innumerable clauses of the contract. This meant a year of strenuous work for all sectors of our Automobile Division and the Construction Division. The contract was signed after production of the *124* got under way at Mirafiori and its subsequent appearance at the Geneva Motor Show in March 1966. The signing ceremony was conducted at Fiat's Historical Centre on May 4 in the presence of the top directors of the Soviet Ministry for the Automobile Industry and the men at Fiat who had done most to bring the negotiations to a successful conclusion. The signatories were the Soviet Minister Taraszov, who had succeeded Strokin, and Valletta.

The work then went forward rapidly. New offices were set up especially to deal with relations with the USSR. All over Italy a search was made for interpreters and translators who knew Russian. Communications with Moscow were speeded up.

Turin, 4 May 1966: in the board room of the Fiat Centro Storico, Minister Taraszov and Vittorio Valletta sign the "protokol", the preliminary agreement for the building of Togliattigrad to produce the 124 in the Soviet Union.

Numerous Soviet technicians were installed in Turin so that they could take part directly in the progressive stages of the great achievement, familiarizing themselves with the organization of Fiat, the methods used in design development and testing, the organization of the works and plant.

Trials of the *124* were also carried out in Russia and proved highly useful to adapt the auto to the needs of that immense country. The tests on a special track laid down not far from Moscow on a enormous area of land were extremely tough.

Meetings were always long drawn-out, one reason being that every phrase had to be translated. They were exhausting, almost continual and often led to clashes of opinion but the difficulties were nearly always ironed out with patience and willingness.

It would take a volume a part to go into all the various stages and events of this episode: the complications of personal relationships, reciprocal visits, journeys that were far from comfortable at times, sometimes even downright unpleasant for the staff of Fiat, unused as they were to the rigours of the Russian climate,

The 124 in the version for the Soviet Union, 1967.

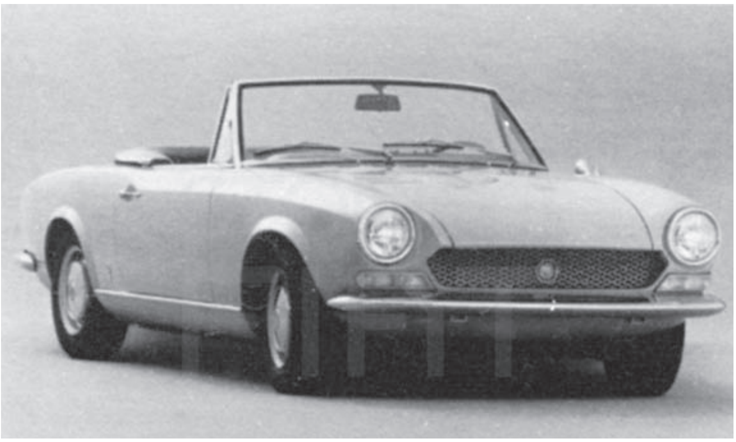
The Fiat 124 in the version for Romania, 1968.

The Fiat 124 in the SEAT version for Spain (first design, 1968).

especially as they experienced it during the building of the factory. But the long and the short of it all is that the first automobile built in the immense factory at Togliattigrad on the Volga was the Fiat *124*, with all the modifications required by the new environment.

In Turin the *124* with its 1.200 cc engine and accommodation for five became in practice the replacement for the *1300/1500*, not the smaller and lighter *1100*. So in February 1966, before the *124* came out, the *1100 R* (the *R* standing for "renewed") was announced, with its engine increased to 1.089 cc, cloche gear shift and some other innovations in the coachwork and mechanicals.

The 1600 124 sports coupé, boosted and with modified coachwork, produced from November 1969 onward.



At the same time as the coupé was redesigned and the 125 BC engine of 1.608 cc was adopted, Pininfarina introduced small changes to the roadster version.

CHAPTER XXII

THE “135” *DINO*

THE *125* AND THE *130*

At the end of 1964 rumours were bandied about in the corridors of the second floor (reserved for the offices of the top executives and including mine) that negotiations were going on between Enzo Ferrari and the President but no one knew the subject.

A visit by Bono to Maranello made the contacts official and marked the start of full collaboration. Behind it all lays a problem that Ferrari could not solve on his own. A new regulation had been issued for Formula 2 racing. It laid down that the 1.600 cc engine prescribed had to come from an automobile of which at least 500 units had been constructed in 1966. It was not necessary that the engine capacity should be the same, provided the same crankcase was used.

Ferrari had already built a 2.000 cc engine with six cylinders set at a V of 65°, a real racing engine with twin overhead cams for each row of cylinders and the cylinder block made of aluminium. To comply with the new formula he intended to reduce the capacity to 1.600 cc without, naturally, modifying the block. There still remained the more awkward problem of manufacturing 500 autos within the near future and this could only be solved by Fiat. So Enzo Ferrari was placing his 2.000 cc engine (to which he had given the name of Dino, the much-loved and deeply mourned son he had lost) at Fiat’s disposal.

The negotiations were smoothed by the presence of Gobbato, at that time manager at Maranello, and Bellicardi, manager of Weber, who acted diplomatically as intermediary.

Valletta, Giovanni Agnelli and Bono thought it a good idea to accept Ferrari’s proposal and made arrangements for the design of a sports car with the Dino engine.

But the engine had been conceived for racing and did not meet the test standards at Fiat to ensure durability and normal performance on the roads. It also needed modifications at some points to adapt it to series production, even though this could only be a very short run and special care would be devoted to it. This meant redesigning the engine to reinforce the components subject to greatest wear, avoid deformations and deterioration and achieve an adequate degree of durability. The work was done in our Engine Design Office by Lampredi, completely at his ease in this field.

The chassis, designated by the project coding “135”, was designed in the Automobile Technical Office under the direction of Cordiano by Sergio Camuffo, Salvatore Bruno, and Severino Nutarelli, all first-rate design engineers.

The mechanicals were given a traditional layout, with quadrilateral front suspension and the rear axle attached to the coachwork by single-leaf springs and longitudinal reaction bars. A five-speed gearbox was chosen.

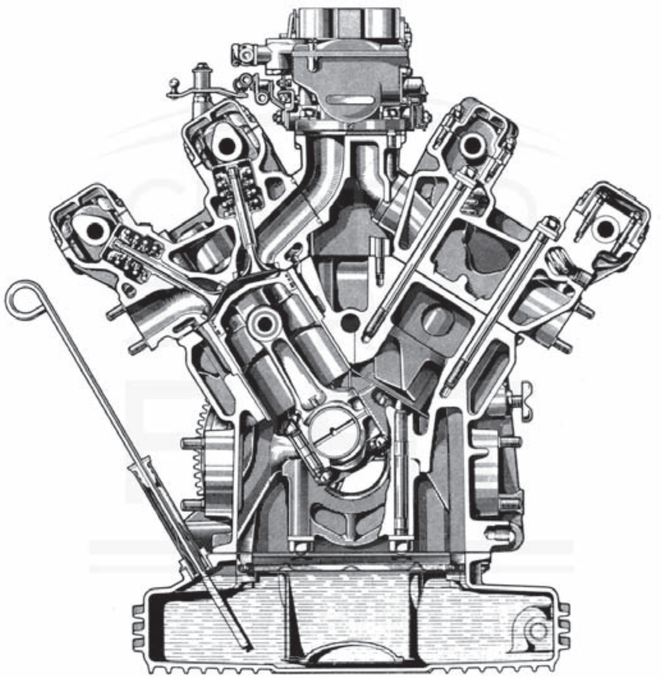
The sports coachwork, brilliantly successful, was designed and built by Pininfarina, who also derived a two-seater coupé from it.

Then Bertone, with the help of Hruska – who was with Fiat at that time as a consultant – produced a four-seater coupé with an elegant, streamlined and modern look to it. This triggered off a trend towards fast sporty-looking sedans.

Tests were conducted both at Fiat and the Ferrari works, in close collaboration. Ferrari had lost two valuable test drivers in a road accident so Montabone was asked to provide them with one of our ablest test engineers who had long experience that included road tests, Giuseppe Navone. The auto was rapidly perfected and tuned, the process being speeded up by the fact that since it had to have the performance of a racer it did not need all those refinements that are essential when silence and a comfortable ride are aimed at, as in normal vehicles used for travel or work. Problems such as road holding, safe and responsive handling, rugged and efficient brakes that would not overheat, were all familiar to us and could be solved easily since there were no cost limits to hinder us.

The *Dino* was launched at the Turin Motor Show in 1966 and went on being manufactured until 1969.

I cannot say whether its success was due to the Ferrari marque associated with it or the beautiful coachwork or intrinsic qualities. Still, in those three years we collected all the information about the car's performance in the bands of its owners and prepared designs for improvements we felt had become indispensable. In 1969 the engine was increased to 2.400 cc and the crankcase was made of cast iron, with clear improvement in noise-levels and durability. We also added independent suspension



The 135 B engine for the Fiat Dino resulted from an agreement with Ferrari to produce an engine with 6 cylinders angled at 65° with four overhead camshafts derived from a design for a racing car engine (1967).

at the rear. This feature, initially conceived at SIRA and then revised and perfected at Mirafiori under the guidance of Cordiano, produced a type of suspension that is probably the simplest and most efficient of all types of independent rear suspension with coil springs. It was adopted at the same time on the *130*, which was born in the same year, and displayed insuperable qualities of road holding and ease of handling.

At this point I have to go back in my story to 1964. In the last few months of that year the situation was as follows. The autos in production were: the small *500 D*, *600 D*, and *850* models; the medium-sized *1100 D*, *1300*, and *1500* in various versions, the convertible *1600* (OSCA), and the larger six-cylinder *1800 B*, *2300* luxury version, *2300* Ghia coupé.

Autobianchi had launched the *A 109/Primula*. Undergoing preparation for launching in 1965 were the coupé and sports versions of the *850*, the former being developed at the Styling Centre, the latter by Bertone.

In the Advanced Engineering Offices, work on the *Primula* was tapering off and I was getting work under way once more on studies for the auto that had been in my thoughts ever since 1954, when I had the first studies done for the "G. 1" project at SIRA. After the studies and trials for the "123" and the *Primula*, I and my closest collaborator, Cordiano, were coming to have a fairly clear picture in our minds of its final form. The project had to be worked out in compliance with certain fundamental conditions: weight approximately 700 kg, cab comparable in dimensions to the *1100* but more comfortable, front-wheel drive with a transverse engine, independent suspension all round, front suspension on the MacPherson system, a four-cylinder engine with capacity of about 1.000 cc.

The coupé version of the Fiat Dino was designed and produced by the Bertone coachworks some time after the presentation of the Pininfarina roadster version.

The Fiat Dino originally appeared as a powerful roadster, coachwork designed and produced by Pininfarina (1967).

Initially the project was coded the “1001”; successive developments led to its being designated “X 1/1” and finally it became the *128*. The plaster model of the coachwork was being developed at the Styling Centre.

In the Automobile Technical offices, the routine work on models in production that went on at top speed was supplemented by the task of perfecting the *124*, with the production deadline coming up in early 1966. The Russian project with all its implications took up a lot of everyone’s time, so that the working day was regularly prolonged and we were even working on holidays. All this did not mean, however, that we failed to tackle problems involving the choice of models for the future.

The *2300* was dating, especially the coachwork, and a new model was called for, capable of taking a bigger slice of the international market. The fine *2300* Ghia coupé and the luxury version of the sedan were not enough to bring production back to sufficiently profitable levels.

Although the problem had already been hanging over us for some time, the official policy was still unsettled and kept changing as time went on. At the Styling Centre we waited for a decision and in the meantime got out preliminary models in a quest for an attractive and functional form with a roomier cab than the *2300* and a slightly larger overall volume. This new model was called the *130*.

Visits by the presidential committee or individual members of it grew more frequent and gave me and Boano a chance to learn how the work impressed them. Though they did not come out with clearly expressed views or decisions we were inevitably influenced by their comments.

The styling features of the 128 were anticipated by a light transitional vehicle designated the 1001. One of the stages in the incessant search for the best solution for a front-drive auto with a capacity of around one litre. Since an engine of that size was not then available, experiments were started wing an 850 engine, installed transversely, combined with a gearbox derived from the one used for the Primula.

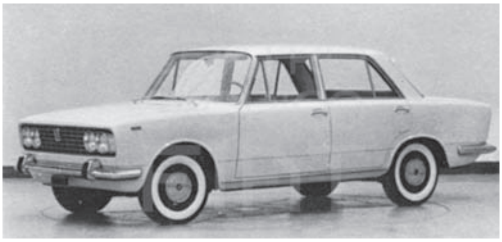
The plaster mock-up was consequently continually being revised. As time went on the comments on every modification passed by Gianni Agnelli, Valletta, Nasi and especially the more emphatic observations made by Bono led to an increase in its dimensions until it frankly challenged comparison with a Mercedes-Benz.

The reader will have already noticed that large automobiles, intended for the privileged few have never much appealed to me. I had never shaken off my taste for the small and the economical, the sort of auto that can have the widest possible ownership, a taste instilled in me in my first years of work with Fiat.

This was not the only reason for my feeling of uneasiness. I remembered the *2800*, an auto with excellent mechanical specifications that missed success because it was made too big and heavy for the engine size. I was afraid we were heading for the same mistake since once again a big auto was being proposed but with a relatively small engine, the capacity being slightly more than the *2300*.

I also recalled a more recent failure,

The 130/540, design 2a (plaster), 1963.



The 130/540, design 3a (plaster), 1963.

The 130/540, design 4a (plaster), 1966.

The 130 involved a whole series of full-scale plaster mock-ups. Size and styling were major concerns, made more pressing by the suggestions of the General Management. In the photograph: the first plaster mock-up, 1963.

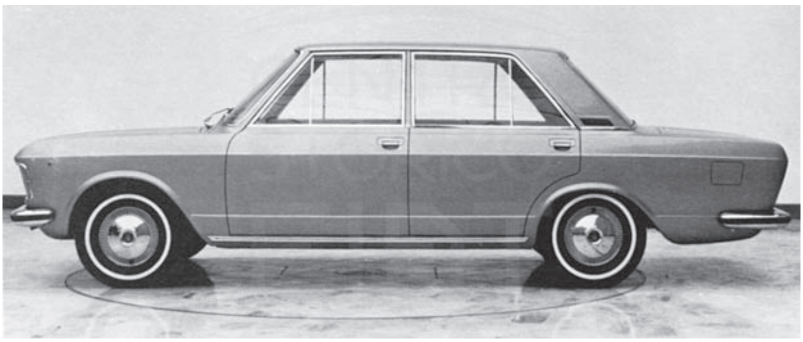
the construction of an auto on American lines (including the size) which was meant to be the top of the Fiat range. This was the brainchild of Rambaldo Bruschi, who liked big, imposing and prestigious things. He had got Valletta and Bono actually to set up a special technical office to deal with the project. The office was sited in Milan, to get away from the influence of the Fiat milieu and the Turin automobile tradition. Cesare Tonegutti was picked to run the office because Bruschi thought he had been responsible for the design of the Alfa Romeo *Giulietta*. In actual fact he had collaborated on that project under the direction of Satta.

The office was accommodated on premises provided by the Fiat branch in Milan. Tonegutti, an excellent engineer, not a designer as I understand the term, secured the collaboration of Franco Bertoldi for the mechanicals and Gatti for the coachwork, both noted design engineers working for Alfa Romeo.

The first I knew about it was when Valletta and Bono decided I had better have a hand in it and called me to put me in the picture. I went to Milan and had a look at the project, now at a very advanced stage. It had the coding "140".

The 130/540, design 5a (plaster), 1966.

The 130/540, design 6a (wood), 1966.



Full-scale model of the final design for the 130 coachwork, virtually identical with that which would be put into series production from 1969.

In size and weight the model was comparable to General Motor's *Cadillac*. The engine was a 4.200 cc V8 with an aluminium cylinder black and head, overhead valves worked by rockers and hydraulic valve tappets taking up the play of the valves. The automatic transmission was American, with a hydraulic torque converter and epicyclical gearing; the suspension highly sophisticated, hydropneumatic; the power steering and braking were part of a centralized hydraulic system. Everything that at that time (1956) was most sophisticated and advanced had been taken into consideration. Without the underlying direct experience and knowledge of manufacturing problems.

The design of the engine was revised, corrected and completed at SIRA. As for the chassis, I felt that little could be done and let construction of the prototype go ahead according to the designs already completed.

The engine was laboriously improved until it passed the durability tests. The auto turned out a dud. After a few trials that showed how long and difficult it was going to be to bring it up to the mark the attempt was abandoned.

The technical office in Milan was dismantled in 1958, after about two years' existence. Bertoldi and Tonegutti were moved to Turin, joining the staff of the Industrial Vehicles Technical Offices. Bertoldi became one of my most valuable aides in directing projects for special and military vehicles.

Apparently not even the disastrous failure of the "140" had made any impression and the top management now thought that the time had come to complete the range of models with a prestigious limousine, comparable to the Mercedes-Benz.

The undertaking was actually quite feasible in that we had the know-how and the means to do it. But it was also legitimate to suppose that the production of an auto so completely different in dimensions and the sophisticated manufacturing techniques involved would be difficult to fit into an organization like ours, directed towards manufacturing and distributing popular autos, whose main qualities were reliability and practicality, at a cost and hence a price that made them accessible to the largest possible motoring public.

This dulled my interest in the attention being given by my superiors to the *130*. Perhaps they were driven by the euphoria aroused at the time by the growing demand for autos both at home and abroad. Fiat could not keep up with the orders. Delivery to buyers was falling way behind so that many decided to turn to foreign makes. Valletta and Bono asked the works to increase production and urged that new personnel should be taken on.

At one of the meetings that were held regularly to discuss the problems of design, we heard Bono sternly directing the manager of the Automobile Division to step up the rate at which new staff were being hired so that production could reach 7.000 units a day.

As for the *130*, the forecasts of the general manager envisaged 250 units a day. This seemed dangerous to me, since it involved the construction of very expensive plant. I was not asked for my opinion, however, perhaps because they foresaw that I would be against the idea, my unusually cold and detached attitude being very clear.

All the same, the Styling Centre kept working on the plaster model which gradually took on the size and shape that the presidential group wanted. I had followed its development, going no further than to discuss the most obvious details with Paolo

Boano and intervening with the usual comments and suggestions. I took more lively interest in the chassis, which was being developed under the guidance of Cordiano.

As time slipped rapidly away, the date when the works were to begin production of the *124* loomed ahead of us. It was natural to worry about marketing problems which would arise with the insertion of a 1.200 cc model with more cab accommodation than the *1300/1500* and the same quality at a lower price.

As for the *103*, the public's interest would be boosted by the presence of the *1100 R* but a drop in demand was forecast because of strong interest in the *124*. It was envisaged that production of the *1300/1500* could be gradually tapered off and finally abandoned about a year after the launching of the *124*. The *1800* and the *1500 L* derived from it would hold out longer, perhaps another year. So it was essential to have a new model ready to replace them both. After thinking the problem over for some time, I concluded that the lack of time and economic advantages pointed towards maximum standardization with the *124*. So I proposed deriving the new model from the *124* with a few salient modifications to the coachwork and the engine. A *124* engine, transformed for competition use, was ready to hand, with its capacity raised to 1.438 cc and a new distributor with twin overhead cams on the valves with a V arrangement. But this was not enough. Bono wanted the auto to be roomier, with more comfortable seating at the back, and he urged me to work out a solution that could be realized within a short time without overburdening the workshop with the need for costly plant. The design had to be a certain winner without involving lengthy tests.

After looking at all the possible approaches, I suggested what seemed the best solution for our purposes. This was to lengthen the coachwork of the *124* by eight centimetres and fit it with the platform of the *1300*, also suitably lengthened. The *124* engine with its twin overhead cams would be boosted in capacity if possible. In fact Lampredi managed to increase it to 1.600 cc turning out 90 hp: more than the six-cylinder *1800*. In a few days we got out the basic information about the project, with designs, weight, performance, descriptions of the mechanical components and coachwork. The new auto was to be called the *125*.

This was early in 1965. As usual Bono set such a tight schedule for the design and construction of the prototype that I, and even more my staff, were aghast. "The *125* has to be presented at the autumn motor show," he said. "Even if it's impossible it has to be done."

The 130 coupé with Pininfarina coachwork (1971).

The 130 sedan (1969).

My own eagerness made me optimistic. In a few months the prototypes would be built and homologation by the Test Department would follow soon after.

I entrusted the project to Mosso, intellectually brilliant, immensely experienced and with a deeply practical cast of mind. The designs of the prototype and its construction were completed with unusual speed, everyone taking part being convinced that we were on the right track and knowing how committed I was to the success of the task.

The Styling Centre did not bother to make a plaster model. To speed things up the stylistic changes to the *124* were executed directly on the sheet-metal.

The completion of the *125* project was one of the great achievements of that period, even though the new model was not presented at the autumn motor shows of 1966 but in spring 1967. Fifteen months to design, build the prototype, lay down the lines and other plant for production: this is a record it would be hard to beat.

The *125* was the basis of the models subsequently built in Poland and Argentina.

We can now go back a little and take up the thread of the story of the *130* which was being called the "X 1/3" at that time. This type of coding had been suggested to me to bewilder the journalists and other inquisitive people who were nosing about after news of our new projects and models at the test stage. Above all, we wanted to confuse the people inside Fiat, including the ones on the commercial side, who

Sheet metal model for the 125 (1966). The derivation from the 124, still clearly evident here, was later to be attenuated with the help of changes in the trimming.

Front view of the 125 prototype (1966).

125 standard sedan (1967).

wanted to know what we were up to despite stringent orders from the presidential office that this should be a matter of the strictest secrecy.

The idea of the "X" was not an original one since it originated with Rakovic, the great general manager of ZCZ (standing for Zavòcli Crvéna Zàstava, the "Red Flag Factory"), the Yugoslav factory that was producing our models, starting with the *600*. In the discussions about future models he loved so much Rakovic used to refer to them as "X" models. So I took to referring to engines in the study stage as "X zero", autos as "X 1", trucks as "X 2". The vehicle that the public came to know as the *128* was referred to as the "X 1/1", the *A 112* as the "X 1/2", the *130* as the "X 1/3".

Since the *125* was now moving steadily towards production at an early date, the management's attention was again concentrated on the *130*, with the design being continually revised as the general picture changed, especially involving changes to the engine.

By now I had given up my initial idea of an automobile that would be the logical development of the 2300. The *130* had come to resemble a Mercedes-Benz 300 in weight and size: it needed a much bigger 6 or 8V engine.

The final choice was an engine with six cylinders forming a V of 60°. Lampredi, now working under Cordiano, found himself having to design two different V6 engines at the same time, the *130* and the *Dino*, the latter in the 2.400 cc version with a cast-iron cylinder block.

The design of the chassis was executed under the guidance of Camuffo, who had such expert design engineers as Bruno and Nutarelli working for him, the coachwork by Cornacchia. Cordiano directed the project, with my assiduous assistance. The design was taking final shape to my complete satisfaction.

125 special sedan, unveiled on 27 October 1968.

125 special sedan, definitive appearance.

CHAPTER XXIII

MANAGEMENT OF MOTOR VEHICLE DESIGNS AND STUDIES (DPSA)

THE “X 1/1” PROJECT FOR THE *128*

AN IMPORTANT LETTER

To avoid wearying the reader with an overlong sequence of projects and attempts to find solutions to the never-ending problems that we set out to tackle, I have only recounted the main ones. But as I retrace the most significant episodes that make up my story I find myself surprised by the sudden recollection of certain events that seem to force themselves on my attention as too important to omit. One such event was the construction of the *1500* and the *2300* in diesel versions which never got beyond the experimental stage.

The transformation of these engines, the first having four and the second six cylinders, from the Otto cycle to the Diesel cycle produced results that were wholly satisfactory. A *1500* was sent to England, to the Research Institute founded by Ricardo, the celebrated expert in combustion. Here the efficiency of the engine, which had the classic combustion chambers of the Cornet type, was confirmed.

But no one at Fiat except me took any interest in diesel engines for automobiles. Ever since the time of the *1400 D* they had been considered as of little interest commercially. So when the experiments were over the trials were broken off.

Another set of studies that engaged much of our energy concerned multi-fuel engines, both two and four stroke, mainly of interest to the military authorities. At that time all the NATO countries were conducting research into ways of adapting diesel engines to use gasoline. I carried out tests that included two-stroke engines and also had single-cylinder engines built to test specially shaped combustion chambers. We studied the layering of flow and turbulence and the effects of their variations in rela-

128 four-door saloon (1969).

tion to different types of direct injection into the combustion chamber. This work was conducted at Advanced Engineering in 1962 and 1963, then abandoned.

In 1964 and 1965, with the *Primula* in production, work was in full swing to develop it further by replacing the *103* engine with the *124* on both the coupé and the sedan. At the same time a start was made on what became the *A 111* a few years later.

Meanwhile the "X 1/1" was also being developed. I envisaged this vehicle as destined to become the most important model in the Fiat range. In ten years I had not managed to embody this idea – which had been followed up with the "G. 1" project at SIRA – in a concrete form acceptable to Fiat. But finally, after the success of the *Primula*, the long dream was going to come true.

I thought it a good idea to be able to offer the public two versions of the "X 1/1", a cheaper and simpler model weighing less and mounting an engine in the 850-900 cc range, and the other offering better performance with an 1.100 cc engine. While I was waiting for the new 1.100 cc engine to be developed I had the *850* power plant built with a gearbox capable of turning out power equivalent to an 1100.

At the Styling Centre the specimen coachwork was being built. The plaster model looked completely successful to me. The rear was shaped so that with a few slight changes to the body shell it could be fitted with a hatch of the sort used on station wagons or estate cars.

The first prototype was to be built with this coachwork. The power plant was derived from the *850*, in its turn derived from the *600*. The changes to the mechanicals and structure made the vehicle much lighter and more modern than the *Primula*.

The shape of the "X 1/1" (the future 128) constructed to the instructions of the author lent itself to the addition of a hatch at the rear.

The "X 1/1", design 1a (plaster mock-up): the front and leading edge of the side panels were more rounded than in the final version.

The weight was not going to be more than 700 kg so that even with an 850 cc engine its performance would be good, sufficient to carry out tests to perfect the coachwork and most of the components of the chassis.

The General Management did not follow the work of Advanced Engineering closely, though I sent them occasional pieces of information, so they knew little about the "X 1/1". This meant I could work in peace, lavishing much more care on the design. Both at the Styling Centre and at the design offices I compared different arrangements and chose the best solutions to the various problems that cropped up.

Towards the end of October 1965 the presidential office made a decision that was beneficial to the design work. This was the centralization of all the bodies engaged on design and research under a single managerial body, as in the days of the Management in charge of the Automotive Technical Offices.

Garino, the personnel manager, passed me a communiqué personally signed by Valletta. It may be of interest to read it in its original form, brief and to the point. It ran:

1) All the design, test and research work in the motor vehicle field (automobiles, industrial vehicles, tractors and special purpose vehicles) are to be centralized in the Management for Motor Vehicle Design and Studies, directly responsible to the General Management.
2) This Managerial Department will have two fundamental sectors, one with executive functions, the other with responsibility for research and design studies. The Management for Motor Vehicle Design and Studies will include:
   a) the Technical Offices for Design of Automobiles – Industrial Vehicles – Tractors and Special Vehicles;
   b) the Automobile Test Department and the Technical Centre for Tractors;
   c) the Research Offices (Advanced Engineering) previously forming part of the Higher Management for Motor Vehicle Engineering.
3) The Management of Motor Vehicle Design and Studies is to be directed by engineer Dante Giacosa, assisted by engineer Oscar Montabone as co-director.
4) The Auto-Avio Research and Control Laboratory and the Department of Technical Standards and Publications will collaborate closely with the Management for Motor Vehicle Design and Studies.
5) The Management of the Automobiles Division and the Management of the Industrial Vehicles and Tractors Division as well as the directors of the relative Sections will maintain continuous contact with the Management of Motor Vehicle Design and Studies and Design sectors subordinate to it with the aim of achieving the closest coordination of design and production and the best results in terms of quality and costs. This will be implemented through periodical communications between the Management of Motor Vehicle Design and Studies and the Managerial Sectors of the above Divisions, assisted where necessary by the relative Service Departments (Methods, Materials, Cost Analysis etc.).
   Naturally the programmes for new models and new studies will also be examined in appropriate meetings of the above Managerial Sectors: the relevant deliberations are to be submitted to the President and the General Management for decision.
6) The staffing of the various Services and Offices will be detailed in specific service communiqués to be approved by the General Management.

The new organizational set-up enabled me to make the working of the offices more efficient. Cordiano was appointed assistant director and placed in charge of the Automobile Design Offices and Puleo replaced him as head of the Motor Vehicle Research Office at Advanced Engineering.

The change also gave a boost to morale. The Motor Vehicle Technical Offices felt that they had been promoted to a higher level. The staff at Advanced Engineering saw their boss, Cordiano, promoted to a position of greater responsibility and felt more important because less cut off from the production side, which represented the ultimate goal of all our work. All the different design workers as well as the technicians in the Test Department and the various services felt satisfied at the prestige they had regained as part of the Design Sector.

I had the "X 1/1" design transferred from Advanced Engineering to the Automobile Offices now directed by Cordiano so that the details of its design could be worked out to fit in with production requirements. I then got Advanced Engineering to design a new front-driven auto to replace the *850* and the *600* and compete with the Morris *Mini*.

The overall length of this vehicle was to be no greater than the *500* station wagon, 3,20 m. Its transverse engine would be the same modified *850* engine as we were

The second version, clearly a three-volume shape, in conformity with reigning taste, avoiding any suggestion of continuity of line between the cab and rear volume.

The "X 1/1" design 2a (plaster mock-up); this version is closer to the final design as far as the handling of volumes is concerned, but the square headlights were considered too costly and were discarded.

using to form the drive unit of the "X 1/1" in its first experimental version. The new small auto was baptized the "X 1/2".

Early in 1966 the *1100 E* was launched, followed by the *124*, accompanied by a big publicity drive. The technical offices and the Test Department were busy in completing the designs for the derived models and perfecting them: the *124 Familiare* (station wagon), the cabriolet or sports version, the coupé.

The designs for the "135" *Dino* in the sports and coupé versions were completed. 500 units had to be manufactured within the year to comply with the competition ruling.

Studies for the *130* went ahead with good results. Half-way through the year, after the coachwork of the *125* had been approved, work continued flat-out to perfect it. Trials by the Test Department were followed by testing by the works' Test Section and the After-Sales Department.

The Turin Motor Show that year saw the début of the *124* sports, with its twin overhead cams driven by a cogged belt. The *Dino* was also presented with sports car coachwork designed and built by Pininfarina. The engine, for the first time on a Fiat model, was equipped with electronic transistor ignition. The 160 hp produced at 7.500 rpm was a very respectable achievement for a 2.000 cc engine.

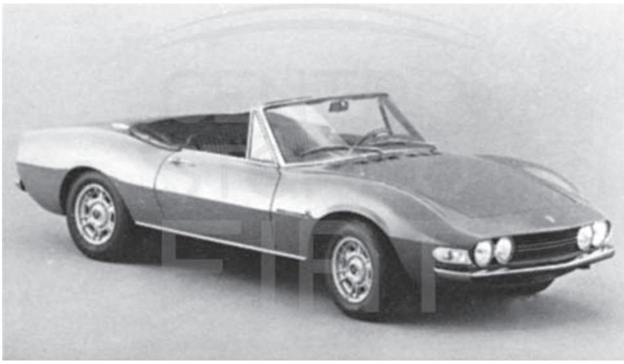
The public was also shown the *850 Idroconvert* equipped with a hydraulic torque converter. The clutch pedal had been eliminated and the changes of gear ratio were carried out by simply moving the gear-shift, which disengaged the clutch electrically as soon as the driver gripped it. But the system did not enjoy the success it deserved.

Autobianchi on its own initiative exhibited a version of the 600 *D* with plastic coachwork, calling the model the *Stellina*, a poorly conceived auto that was unsuccessful.

In the same year the Russian programme was topped off with production programmes for Yugoslavia, Poland and Argentina.

In Yugoslavia ZCZ was producing the *600* and *1300* and intended to expand. With this in mind the director, Rakovic, planned some minor changes to the *600* to make it more modern and a long-term programme for manufacturing a 1.000-1.100 cc model, which he called the "X auto".

In the case of Poland, I shared in negotiations with a delegation headed by the Polish Minister and Assistant Minister for the Automobile Industry. My suggestion that a special version of the *125* should be built was accepted. Argentina accepted the same model with some changes to the coachwork.



Dino 2400 roadster (1969).
Updating produced few styling changes but involved the adoption of independent suspension on the rear wheels as provided for the 130 saloon.

For these commitments abroad, which were time-consuming and required great experience and inventiveness, we had set up a special technical office under Angelo Mosso.

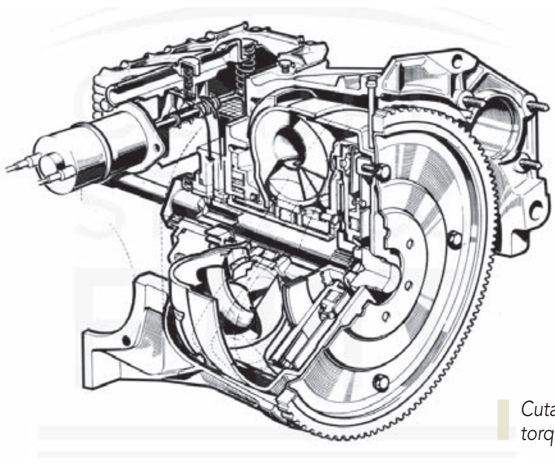
Trips, meetings, discussions with important people, who almost daily wanted to call on me, forced me to schedule every minute of my time carefully so as to leave some space for design work. I especially wanted to find time for the projects that interested me most and seemed to be most useful for Fiat: the "X 1/1", the small autos which would eventually take the place of the *500*, the "X 1/2", military vehicles, research into engines and transmission systems, the electric car, turbines, diesel engines and so forth. To these I brought all the strength of experience, practice and above all my first-hand knowledge of the work acquired over so many years on the job with the technical offices.

In 1967 everything began to happen at once. The presidential office wanted to hear what stage the *125* and *130* had reached. There were no problems with the *125*, it was now ready to go into production. The situation with the *130*, which the President still considered as the replacement for the *2300*, was unsettled, but the design of the mechanicals was moving ahead smoothly. My main attention, however, was concentrated on the "X 1/1" and the "X 1/2".

Lampredi had the job of designing a completely new engine for the "X 1/1". Its capacity was not yet settled and could range from 1.000 to 1.200 cc and perhaps beyond. This decision went down well with Buffa, who had taken over from Fiorelli as works manager, because for large-scale production of a model he preferred to install completely up-to-date plant in the factory rather than extend the existing plant for an engine that had already been in production for some years.

The new engine was designed with all the most modern innovations: overhead camshaft fitted directly to the valves with tumbler tappets, the shaft and attached components driven by a toothed belt and all those touches in the design of the mechanicals that would not only make them much more efficient but enable them to be manufactured by the latest technological systems.

The design of the "X 1/2" went ahead in accordance with my plans. I spent a lot of my time working alongside Puleo and his design engineers in the quest for sim-



Cutaway diagram of the "Idroconvert" oleodynamic torque convertor installed in the 850 saloon (1966).

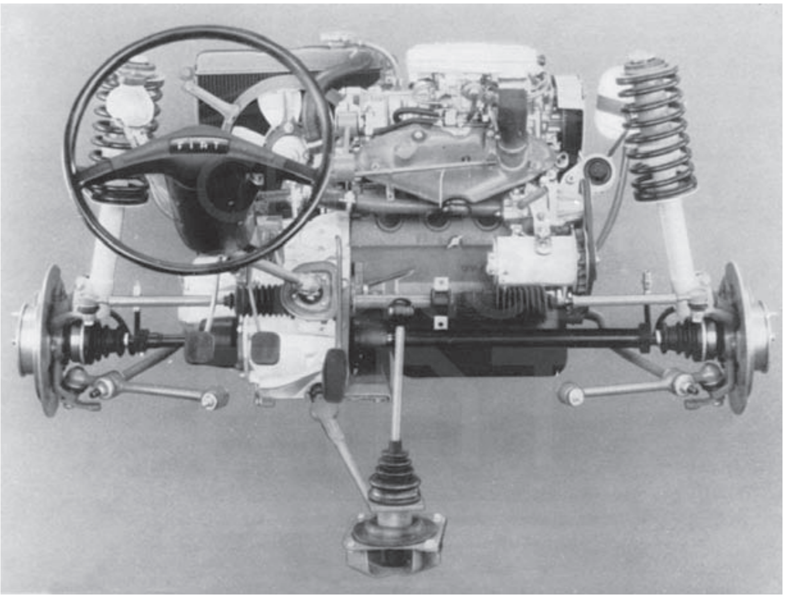
ple solutions. While the project was taking shape on the drawing boards, with the mechanicals progressively being combined with the coachwork in a simple and rational structure, I had a talk with Bono about it. I explained to him that the model's front-drive and transverse engine would enable us to make it roomier than the *850* despite its shorter overall length. Since it was lighter and simpler, it would cost less. And since it was to replace the *600* and the *850* the production target ought to be equivalent to at least the sum of those two models.

Bono nodded but disagreed about the advantages of manufacturing the "X 1/2" at the Fiat works. "Go ahead with the project," he said. "We'll decide later just where it'll be best to make it, probably at the Autobianchi works." Later on, when I was putting the facts before him again, he said more firmly: "We'll build it at Desio, at the Autobianchi works. We'll turn out a different sort of coachwork for Fiat." By this he meant a version with larger coachwork.

It did not strike me as logical for Fiat to manufacture a heavier and hence more expensive version when it would be trying to attract more buyers than Autobianchi. If anything Autobianchi ought to be making the more expensive version.

In the meantime the *130* project was gradually taking shape in all its details: a design involving extremely refined engineering for a large prestige auto, not closely conditioned by the usual strict limitations on cost. The technical specification that resulted was outstanding. While it was being perfected I felt some anxiety over what might happen if Fiat committed itself too exclusively to the *130* and neglected large-scale production models. I was especially worried about the future of the *1100*. I talked this over with Cordiano and together with him decided to push the "X 1/1" project.

In May Bono went to Montecatini for health treatment. I went to Montecatini myself to talk about my anxieties and promised to prepare a report for him.



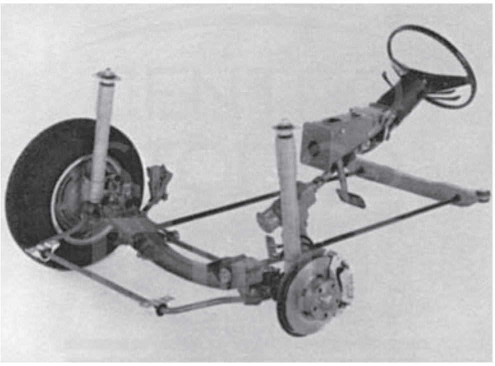
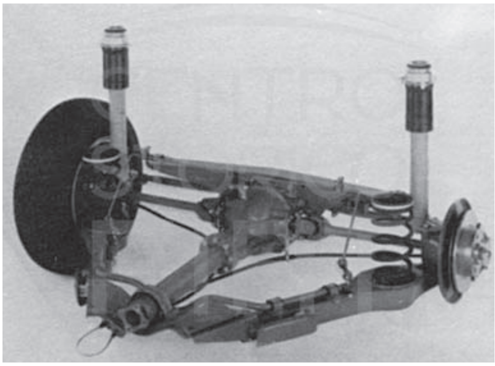
The drive unit of the 128 is very compact. The general arrangement is that proposed by the Primula project, with the advantage of a lighter and more powerful engine than the old 103.

On May 17 I wrote him a letter:

Dear Engineer Bono,
As promised I am sending you some information about the work in progress with regard to the future of our leading models and some of the observations that this has naturally led me to.
I hope you will excuse me for going into the matter at some length and for any lack of clarity.

1. *Model 130 auto*
   (The designs in the experimental phase bear the coding "X 1/3").

– The engine will be completed within a few days and tests can start. The designs of the mechanicals and the coachwork will be sent progressively to the works as from the end of this month, reaching completion with all the final details by 31 July of this year.
  The six-cylinder V engine is at present planned to have a capacity of 2.600 cc.
  The components of the chassis as well as the coachwork are all completely new. Nothing can be taken over from present models.
  The front suspension has torsion bars like the *2300* but with McPherson-type mechanism (patented by Fiat in 1927 but then launched by Ford nearly 25 years later with the "Versailles") to enable the V engine to fit in the hood. The rear suspension on the first prototype will be like that used on the *125*. A De Dion axle is being studied separately for mounting on the second prototype. Designs and perfecting will take a few months more than in the case of a normal rear axle.
– The *130* is therefore a model whose engine-size and quality make it superior to any built by Fiat so far and ought to put it in a class close to the Mercedes, without (in my opinion) equaling it in distinction because of the Americanized shape of the coachwork. I forecast that the *130* will require so much time to complete that it will be impossible to start production in 1968. It should be remembered that the Mercedes is the outcome of a continual process of refinement of a model that for many years has remained almost unaltered, faithful to the initial design.
– These considerations inevitably lead to the simultaneous reflection that it is also *urgent for Fiat to replace the 1100 R and implement a programme of modernization or renewal of the other production models*.

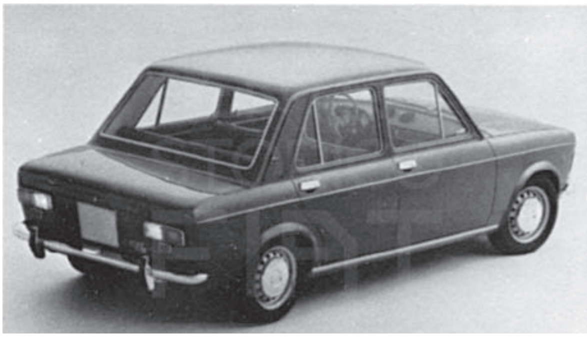



Independent suspension on the front wheels with torsion bars and ventilated disk brakes; independent suspension on the rear wheels with telescopic columns and axle-shafts acting as transverse torque bars: these are the essential features of suspension on the 130, resulting in very small space occupied by the springing.

It should not be forgotten that we shall soon have to cope with the launching within the Common Market of a new VW, a new Simca and other models in the 1000÷1200 class whose price and performance could have serious effects in Italy on sales of the *850* and the *1100 R*.
I am consequently worried by the fact that the work of the DEA (Motor Vehicles Test Department) should be wholly concentrated on a model like the *130* in 1967 and 1968.

– A useful measure would be to consider restyling the *2300* with only a few minor changes to the mechanicals as a stopgap while awaiting the completion of the *130*.
I have also considered the possibility of mounting the 6-cylinder *1800* engine (or better still the *2100*) on the *125*, but this is not possible without making the engine hood longer, which would be such a big task that it seems more logical to adopt completely new coachwork. As you know, at the Styling Centre I have already had studies made for new coachwork intended for the *125*. I think it would be advisable to resume those studies, giving due consideration to the possibility of mounting a six-cylinder in-line engine on the same coachwork. Such an engine could be produced rapidly because it would be derived from the *124 AC* engine of the coupé, with the addition of two cylinders.

2. *Model 125 auto*
We can be satisfied with this model as it is: minor changes to reduce vibration will make it even better and more attractive. I feel the coachwork cannot last more than another two years and should be redesigned. This should be done, in my opinion, in such a ways as to make it possible for an extra 10-12 cm to be added to the length of the engine hood so as to accommodate a 6-cylinder in-line engine (Ford and Opel strategy). This ties in with the previous recommendations.
3. *Model 124 auto*
With the improvements made since this model entered production it is quite satisfactory. The only improvement needed to the mechanicals is some modification of the rear suspension through the addition of two small spars fitted length wise and the elimination of the extension of the axle housing and its supports on the bottom of the coachwork. Tests (at present under way) of the sedan, coupé and sports models have so far given excellent results.
As regards the coachwork, the restyling for the USSR, which will be completed by the end of the month, promises good results.
4. *Model 1000 R and 850 autos*
I presume that Fiat considers it *urgent* to introduce *a model in the 1000÷1100 class,*

Four-door 128 saloon, 1969.

which will replace the *1000 R* while offering *850* buyers the choice of a decidedly better vehicle at only slightly higher price.

A preliminary design, with the coding "X 1/1", has been made using the *850* engine adapted to a transverse position. The prototype is being built; the coachwork is already complete. Accommodation measured lengthwise is equal to the *1100 R*; in width it is 4 cm larger. The overall length is 3.680 cm, i.e. 10 cm longer than the *850* and 8 cm less than the *1100 R*. These results have been made possible by the transverse engine and front-wheel drive.

The weight of the sedan *with 4 doors and the 850 engine will be approximately 700 kg*; *with 2 doors and lighter seats*, it could become 675 kg, little more than the *850* coupé.

– But it is clear that this auto (which must be in production before the end of 1969) *must have an engine of at least 1.000 cc*. For this reason I have started work on a project to mount an engine derived from the *124*, or even the *124* engine itself, with the modifications already designed for its application to the *238* and the *109 B* (new *Primula*). I have also had studies done on a new engine with a single overhead camshaft fitted directly to the valves as in the *124 C*. The gearbox will be of a size adaptable to transverse engines ranging from the 850 to the *124*. For engines of larger capacity than 1.200 cc the gearbox of the *109 B* (and the *238*) will be used instead. The automatic gearbox, designed originally for the *123* and now being perfected, will be redesigned for application to engines ranging from 850 to 1.200 cc. The weight of the two-door version with new engine will be 710 kg; the four-door will weigh about 730 kg (compared with the 820 kg of the *1100 R*).

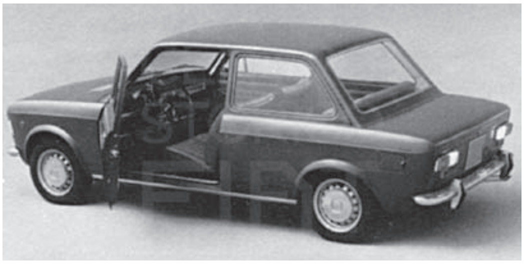
I think that if we concentrate maximum effort on this auto, in the first half of 1968 we will be able to plan for its entry into production during 1969.

5. *Model 850 and 600 autos*

Designs of the "X 1/2" auto for Autobianchi are underway. Accommodation length wise is equal to the *600 D*, while it is 3 cm wider. Overall length is 3.100 as against 3.295 cm for the *600* and 3.575 cm for the *850* (the BMC Mini is 3.060). This auto has the *850* engine modified for transverse mounting with front-wheel drive and will have the same gearbox as the "X 1/1".

The weight will be 590 kg like the *600 D* as compared with the 640 kg of the *850*.

128 station wagon, 1969.



Two-door 128 saloon, 1969. This version was marketed at a contained price, with differences in trimming details.

Acceleration will be far superior to the *850*. The cost of the mechanicals should be lower than in the case of the *600*. The cost of the coachwork will perhaps be slightly higher because of bigger windows and better accessories. This auto could be sold at the same price as the *600* while taking over the role of the *850*.
The designs will be completed by June 1967 in the case of the mechanicals and by 15 July in the case of the coachwork. A body shell is being prepared at the Autobianchi works, based on the preliminary designs and intended to serve exclusively for workshop tests.

– It will be easy to use this model as the basis for a derived station wagon version to replace the *Multipla* and a pick-up to replace the *600 T*.
I have also given thought to a version with an air-cooled engine. This has resulted in the planning of a two-cylinder horizontal *850* cc engine with a special design having a piston-balancing mechanism (studied some time previously and now improved). This engine could also find military applications and could possibly be considered for long-term development of the *500*, fitted with an automatic gearbox.

6. *Model 500 auto*
Continual revision and studies of this model have led to a single conclusion: that any new arrangement, perhaps using front-wheel drive, would not offer advantages sufficient to justify altering the present model and therefore it is advisable to leave it as it is, making only minor changes of detail to both coachwork and mechanicals and seeking to reduce production costs if possible.
In view of this I think it advisable to start planning such changes of detail immediately, especially with regard to the coachwork, and will devote some experimental work to refinements of the coachwork.
Enclosed with the present letter you will find a table containing a suggested plan for the next few years. You will also find a table for your own observations and suggestions.

I trust that all this will not cause you further anxieties or prevent you from enjoying a well-earned rest.
I send you my very best wishes for the treatment you are undergoing.

Dante Giacosa

The letter worked as I hoped. The effect was immediate. Bono, who had evidently immediately consulted Valletta and Agnelli, perhaps even Minola (the commercial manager) and Fiorelli, called me and said what I had been long wanting to hear: that not a moment was to be lost in implementing project "X 1/1", giving it top priority.

Before going any further I first had to get Bono's approval for the shape of the body. His judgment would be decisive in influencing the other members of the presidential committee. I invited him to make an early visit to the Styling Centre.

The inspection of a new model by people who have not shared in the process of chopping and changing which has led to the gradual development of its form is always a source of anxiety to those who have been in charge of the design, in this case Paolo Boano and myself. Usually a person who comes across a gleaming new model in a display room, with his mind and eye unprepared for the sight, feels somewhat surprised and bewildered. This bewilderment is even more marked when the mock-up has not been completed in detail and the chalky whiteness of the plaster dulls the forms and confuses the eye, just as snow deceives the skier's eye when it is not lit up by the sun. It is difficult for an untrained eye to imagine the final appearance of the model before it has been painted and given the finishing touches that give it a metallic sheen like the real thing.

The viewer is completely ignorant of the patient, repeated attempts to adapt style to function and also to manufacturing techniques without altering the dimensions laid down in the project guidelines. He may have some inkling of the intense labour that has gone into conceiving those forms but he knows nothing about all the phases the design has gone through as the model was being worked on by the skilful hands of the plaster modellers. Still, he feels obliged to express some judgment. So after running his eye over the surface, noting its lines, the play of light and shade, after examining it from the front, the side, the back, and various other angles, he begins to come out with some prudent comments.

Now when the inspection is carried out by a group of people, even a small one, the opinions (often hastily formed) occasionally conflict and approval is given (perhaps with the proviso that some vaguely indicated modification should be made) in a general atmosphere of indecision that only bewilders and disheartens whoever has directed the work and (even worse) the people who have carried it out with care and enthusiasm.

So you can imagine how I was feeling when Bono set foot inside the display room where the model was mounted on the turntable base that would enable him to view it from every angle. After he had studied it carefully he pronounced himself satisfied on the whole but added that he would have preferred the traditional type of luggage trunk or "boot" at the back. He thought that there was too much risk in the five-door or hatchback layout and said that the boys on the commercial side did not as yet consider it valid from the marketing point of view.

In the exultation I felt at the approval given at the end of the discussion I did not proffer any objections. Paolo Boano and I immediately gave instructions for another plaster model to be made with due regard for Bono's observations.

In this way a logical and functional design, already widespread in France and accepted for the *Primula* because it was to be made by Autobianchi, was only accepted by Fiat ten years later for the "138", the *Ritmo*, after it had already appeared in the various Volkswagen models.

The model of the coachwork of the "X 1/1" was redone. For the third time the plaster mock-up was subjected to changes that involved a complete reworking. The original forward-looking design was gradually discarded in favour of something more traditional, subordinate to the style in vogue at the time.

1300 Rally version of the 128 saloon:
a competition version of the two-door model, 1970.

CHAPTER XXIV

AVVOCATO GIANNI AGNELLI BECOMES PRESIDENT
DECENTRALIZATION
DEATH OF VALLETTA
THE *130* AND THE *128* - THE *A 111* AND THE *A 112*

With work involving the design and testing of numerous models simultaneously the situation grew somewhat complicated. The pace of work was almost unbearable, not only at the technical offices but in the works, which had to tool up for production against increasingly tight schedules.

As for me, to be able to find time for automobiles I cut my operations in other fields down to the minimum, leaving aside trucks and buses, tractors and earthmoving machinery but still retaining an interest in special and military vehicles.

We had stretched the capacity of our organization to its absolute limits. Many of the directors felt that those limits had been overstepped long since but they did their best all the same to get the results that the managing director expected and demanded, in accordance with a short-term plan whose deadlines had been fixed on the basis of rough calculations and had to be changed as events overtook us. Though the results could be described as on the whole excellent, we all lived in a state of nervous anxiety that bred weariness and sometimes even gloom.

But the policies of Avvocato Gianni Agnelli, formed in the wake of studies by American organization experts, began to make their influence felt.

In July 1967 Niccolò Gioia was appointed assistant general manager, with the duty of supervising five divisions: Automobiles, Industrial Vehicles and Tractors, Iron and Steel Making, Marketing, Agricultural Mechanization and a wide range of managerial sectors and services, many of them newly set up.

Immediately afterwards Fiorelli, who was getting on in years, handed in his resignation and Vincenzo Buffa was appointed director of the Automobile Division.

The formation of the “Group of Associated Companies and Firms” was announced. It included OM, Autobianchi, Fiat’s managerial office in Milan and other firms, under the direction of Corrado Ciuti, the central director.

This was followed in July by the resignations of Piero Bonelli, Enrico Minola and Carlo Felice Bona, either for health reasons or because they had reached retiring age.

On 1 August the announcement was made of the new Programmes and Marketing Management under Pier Luigi Saroldi and Giovanni Mario Rossignolo.

This was the start of that long series of gradual changes in the Fiat organization which led without any great upheavals to a radical decentralization of responsibilities. It marked the end of an era and fate so arranged things that it coincided with the death of Vittorio Valletta.

On 10 August, while Fiat was closed for the annual summer holiday period and everyone was enjoying some rest, we were grieved to hear the news of Valletta’s unexpected death. It occurred at his home in Focette on the Tuscan coast. A cerebral haemorrhage led to his death within a few hours, breaking down his naturally tough bodily fibre.

We all came together from even the furthest holiday resorts and gathered, all his fellow-workers, about the body where it laid in his home in via Genovesi, Turin.

For the past year, since the presidency had passed to Avvocato Giovanni Agnelli, Valletta had been honorary President. Managing director and general manager since 1928, he had directed Fiat for fifty years. His presidency began in 1946 and lasted twenty years.

Rising from the ruins of the war, Fiat had continued to grow under his incomparable guidance. From the 21.000 vehicles produced in 1946, production mounted to 255.000 in 1955, 1.365.000 (counting only automobiles) in 1967, and reached a peak of 1.633.088 vehicles (including Lancia and Autobianchi models) in 1969, after the appearance of the new models planned by Valletta. From the 55.000 employees of 1948 it had grown to 150.000 in 1967.

Avvocato Gianni Agnelli said of him: "As the continuer of the work of senatore Agnelli, the founder, Professore Valletta devoted himself wholly to Fiat's service for over forty-five years, with great commitment, ability and goodness of heart. He was the symbol of Fiat itself."

I worked thirty-eight years for him. I remember him with his brisk, energetic walk even when he had aged, small of stature but upright, his head held high on his muscular neck. Sheer concentrated energy: a "power pack", to use an Americanism. His thick hair grew white only in his last years. His large, slightly protruding eyes had an animated expression, at times authoritarian, often gentle and ironical, probing, shrewd, intelligent. Below his prominent nose his full lips barely covered his teeth and gums, which appeared whenever he smiled at some good news or joking remark.

When he received visitors he would sit erect at his desk, piled high with papers awaiting attention, his head held high and inclined

Corrado Ciuti, born in Florence in 1904. After taking a degree in Politics and sociology he entered Fiat in 1926 and was subsequently put in charge of various branches of the company in Italy. In 1940 he was put in charge of building the new Fiat factory in Florence, of which he became the director. In 1949 he left to become director of OM in Milan, later rising to President and managing director. In 1959 he became director of the Fiat Agricultural Machines and Special Operations Division and of the Rail and Tram Supplies Division. In 1968 he joined the Fiat board of directors.
He was President and managing director of Magneti Marelli from 1967 to 1974 and remained their honorary President. Subsequently he became President of the Piombino steelworks, AIFO, SRM Hydromekanik AB of Stockholm, the Banca Privata Milanese, and UICA (Association of Italian motor vehicle manufacturers).
He is on the board of Autobianchi, General Impianti, Impresit, Cogis, SFIMA (holding company for agricultural and industrial mechanization), Rinascente, IFIL, ANFIA, and on the board of the Lombard manufacturers' association and of the Italian employers' association. [He died in 1977].

Vittorio Valletta in 1921, the year in which he began to work for Fiat.

slightly to one side, his intent gaze fixed on the speaker while he listened carefully. He was a good listener. His profound insight led him straight to the heart of every problem. During meetings he disliked lengthy speeches and always brought the discussion back to the salient point. In every case he managed to conclude with a decision, a statement of principle, an order, a final judgment.

He expressed himself plainly and clearly so that everyone could understand him, firmly, like a leader. He knew how to speak to an audience composed of his employees, whether they were directors, office staff or the personnel in the factories, in their own language, in persuasive, human terms, arousing their enthusiasm or sense of responsibility as the circumstances required. Whoever turned directly to him would be given sympathy and encouragement, advice and help. He had the power to lead the people around him to give of their best for Fiat and would pardon their lesser failings.

He was shrewd, prompt and even unpredictable in his reactions. He once recounted that he was driving his *500*, the auto he drove in preference to all others, when he was stopped by a policeman. “Don’t you know this is a one-way street? Didn’t you see the sign at the end of the road?” “Certainly I saw it,” said Valletta, “but unluckily I didn’t see you!”

He was an early riser and would go out on horseback or have a workout in the gym for an hour. He travelled to Rome every week, spending two nights in the sleeping car. He always said he slept soundly. He was very scrupulous, careful to abide by the rules, setting the example by clocking in and out every morning and evening and placing his card in slot No. 1 on the rack reserved for directors.

When he happened to meet anyone as he was coming in or getting into the elevator he always greeted them with some pleasantry or encouraging comment. One day he said to me: “You see, Giacosa old chap, our job is above all to create work and to create work we need ideas. So you be careful never to run out of ideas.”

I regret not having had closer contacts with him. My direct superior was Bono, who presided over the technical meetings as managing director and general manager and Valletta rarely took part. He presided over meetings of the managerial committee which I attended from 1960 on, but these were held only two or three times a year. Other opportunities to meet him were few, limited to presentations of models at the Styling Centre or in the works and on the occasions when he summoned me to an interview.

During the last few months of 1967, work on the *130*, the “X 1/1” and the “X 1/2” made giant strides. Two *130* prototypes were undergoing testing, one with independent suspension on the rear wheels of the type also being experimented with on the “135” *Dino*. Three other test models were being built. The tests of the engine led us to finally give up the idea of automatic take-up of the play of the valve tappets. We decided to adopt the Borg Warner automatic gearbox and offer a four or five gear manual gearshift as an optional.

With the “X 1/1” we had got as far as testing the prototype with the 850 transverse engine and the first coachwork built by the Styling Centre, to a provisional design. The new 1.100 cc engine was also being perfected on the testbed.

The designs of the “X 1/2”, now completed, were being revised to include the latest changes to the plaster model.

Since it had finally been decided that the little auto was to be built at Desio it was given the designation *A 112*, the A standing for Autobianchi.

At this point Enrico Righetti began to concern himself with the progress of the model. He had been general manager at Autobianchi for over a year now, having

Autobianchi A 112 small sedan (1969).

Static model of the Autobianchi A 111.

Model for the Autobianchi A 111, almost identical to that actually produced from 1969 onwards. This coachwork was designed several years before as part of the project for the 123 autos, as a variant of the G. 123 E4. The design was taken down from the shelf when the new Autobianchi management wanted to replace the Primula with a more conventionally-styled vehicle.

replaced Nello Vallecchi, appointed general manager of Piaggio in Pontedera. Like Vallecchi, he came from the commercial sector and had been director or Fiat's branch in Rome. Righetti pointed out that Autobianchi would need a model with traditional three-volume coachwork to replace the *Primula*.

He was afraid of the competition of the "X 1/1" and maintained that the traditional type of sedan was better from the sales viewpoint than the two-volume hatchback, which was not very different from a station wagon or estate car. The proposal was approved by Fiat and so a design had to be done as soon as possible. But the Styling Centre was up to its neck in work and studies for a new model were impossible.

Boano suggested I should have a look at some of the plaster mock-ups previously done for the "123". One of these, the most recent one, intended for the "123 E4", was a very good piece of work. Lined up with the other specimen models that had been discarded, it was shrouded with a cloth, not so much to protect it as to hide it so that it would not arouse useless regrets. When we removed the dust-sheet it renewed the thrill of pleasure, almost as if we were seeing it for the first time. Given the finishing touches and with the front end slightly altered so that it could be fitted with some rectangular headlight glass that the supplier had already made for us and stored away, the plaster coachwork looked very desirable. We decided to present it to Righetti for approval, which was immediately forthcoming, so the designs were quickly completed. The *Primula* with its new coachwork was called the *A 111*.

January 1968. In a meeting called to review the state of new models, the discussion naturally dealt with the "X 1/1", the Autobianchi *A 112* and finally with the auto to take over from the *600* and the *500*, which was immediately baptized the "X 1/4". I pointed out the advantages of adopting front-wheel drive for this as well and so using the mechanicals of the *A 112*. Bono approved and rightly urged the need for the greatest possible standardization between the components of the autos, at the same time noting that the "X 1/1" and the *A 112* had to go into production by the end of the year. Buffa asked for authorization to start tooling-up for both coachwork and mechanicals straight away.

This meant that the moment had come to provide the works with the designs in their definitive form. To distinguish them from previous ones we decided to change the designations "X 1/1" and "X 1/2" to *128* and *A 112*. The "X 1/4" would become the *127*.

Autobianchi A 111 sedan (1969).

I had provided the three models with the same transmission. This standardization seemed both practical and money-saving, making things easier for the works and the spare-parts organization. However the works, contrary to its usual practice, preferred to manufacture two separate transmission systems, giving as its reason the savings in material and hence in weight which would be achieved by making the transmission of the *A 112* and the *127* lighter than that of the *128*. Besides, because of certain requirements in the use of space and plant, Buffa and his staff preferred to make use

The "X 1/2" design 2a (plaster), 1966.

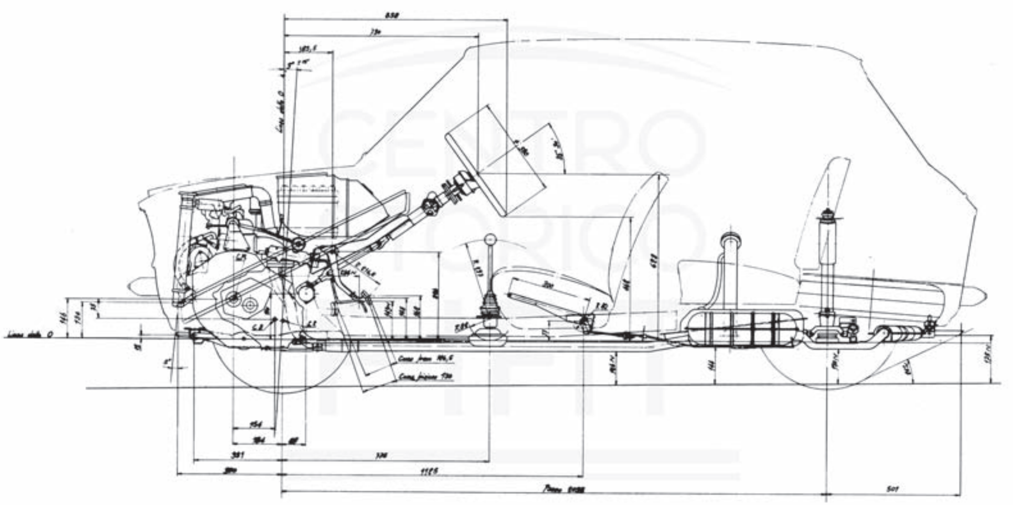
The "X 1/2" definitive design, 1968.

Plaster mock-up of the "X 1/2" small auto (eventually to become the Autobianchi A 112), made in 1966. The first stylistic studies tended towards great simplicity of line and wider opening for the engine hood to allow easy access to the mechanicals. But this did not find favour. It was decided to go for a more sporty form, as far as this was compatible with the small dimensions of the front hood. In this way the final form was arrived at, passing through the stages recorded in the illustrations that follow.

of two separate assembly areas rather than only one larger one. Cordiano thought it best to fall in with the wishes of the director of the Automobile Division and had a smaller and lighter transmission designed for the *A 112*.

Then we re-examined the rear suspension. Cordiano thought it would be adequate and convenient to have a conventional suspension consisting of a simple axle and two leaf-springs like the *Primula* and the various Lancia models. While I agreed in the case of the smaller and cheaper *A 112,* I was determined that the *128* should retain the independent suspension we had already tested on the "X 1/1". The *128,* as a modern auto having to compete with the French models fitted with independent suspension all round, ought also to have this advantage.

The "X 1/2" design 3a (plaster), 1967. The rear of the vehicle has here arrived at its final shape while the front of the hood or bonnet is still related to the complete opening later adopted for the 127.



Cross-section of the A 112.A 100 chassis. This design, dated 10 February 1969, allows us to appreciate the care taken to make the mechanicals occupy the minimum possible space. The design brief laid down that total length should not exceed that of the 500 estate.

The transverse leaf-spring devised for the suspension of the *600* and perfected for application to the rear wheels had merits which would justify its being used for a long time still. The abolition of the stabilizer bar, with the anti-roll function being carried out by the transverse leaf-spring, the simplicity of the spring itself with just two leaves (or indeed only one), its compactness, which means that the bottom of the body shell can be very simply designed without sacrificing space inside the cab: these are the outstanding merits of this suspension. While Nutarelli was working out the design with his usual skill, I worked alongside Cordiano, helping to find a simple solution to every problem.

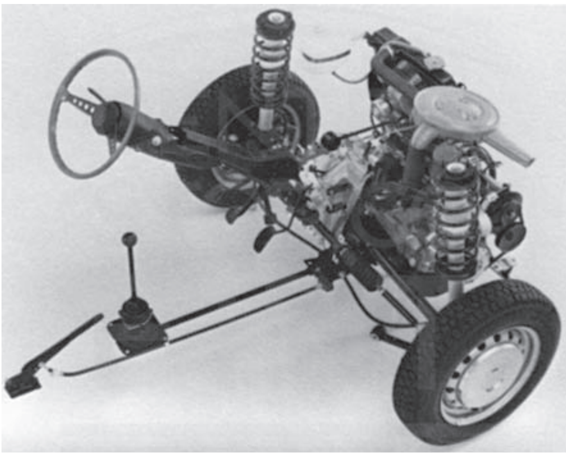
I consider the rear suspension of the *128* and the "138" (the *Ritmo*) to be one of the most functional, economical and simple of all. And when the transverse spring can be made of a single layer of synthetic material reinforced with glass fibre or some equivalent a further step forward will be taken in reducing its weight.

By the end of May we had three test models of the *128* ready while other eight were to come out at intervals before the end of June. During a meeting, with Umberto Agnelli, Nasi, Bono, Gioia, Buffa, Sergio Palmucci, Montabone and myself taking part, indicative dates were set for starting production: January 1969 for the four-door model, March for the two-door, May for the *Familiare*. After exhaustive discussion (as the minutes say) my suggestion for a model (hatchback) with the *A 112* power plant was rejected. It was decided not to go ahead with designs of the *Break* (a word which I had heard used for the first time by Rakovic to indicate the coachwork he wanted for the *128* to be built in Yugoslavia).

As for the *A 112*, Bono went over the reasons that had led to the decision to manufacture it at the Autobianchi works and then returned to a subject that was very much a bee in his bonnet. The rear end looked like a station wagon or estate car and he was against it. He wanted it to look like a sedan. So he asked me to modify the rear of the coachwork even if it meant putting production back from January to March.

I tried to change his mind by going through the whys and wherefores of the chosen form and explaining how difficult it was to get out an alternative version in a

Giacosa's "all in front and transverse" concept, as used in the 128, was continued and reduced in scale for the A 112.



short time and without redesigning the whole auto. In the end I had to knuckle under and say we would have a go. I was given ten days to present the plaster model. The alteration came out better than I had expected, to everyone's satisfaction.

Reference was also made to the other new models: the future *127*, the *124 Special* which we referred to as "Romania" to conceal its identity, the *125 Special*, referred to as "Autostrada", this model also higher-powered with its twin overhead cams, the *500* with a more attractive interior and better protection on the exterior, conceived as a city car.

I had had this version of the *500*, known as the *500 L* (for *Luxury*), fitted out at the Styling Centre. It had been proposed to Bono and approved by him without heeding the misgivings of the sales management. I later heard that they acknowledged that the model was attractive but thought this was not going to increase sales. Once again events proved Bono right, because with the appearance of the *500 L* sales of the *500* had a marked increase.

The "X 1/1" Yugoslavia, design 1a, three-door fastback, 1968.

The "X 1/1" Yugoslavia, design 2a, five-door, 1968. This hatchback with estate-style rear door was put into series production, with minimal changes, in ZCZ's Kraughievaç factory.

Rear view of the three-door version of the "X 1/1" Yugoslavia showing the rational design that suggests a similar version would also have had success in Italy.

At the same meeting the presidential office's production objectives were also revealed.

<table>
<tr><td>500 (new)</td><td>2.000 per day</td></tr>
<tr><td>"X 1/2" – 112</td><td rowspan="2">2.000 per day</td></tr>
<tr><td>"X 1/4" – 127</td></tr>
<tr><td>"X 1/1" – 128</td><td>1.500 per day</td></tr>
<tr><td>124 and derived mods.</td><td>1.000 per day</td></tr>
<tr><td>125 new</td><td>400 per day</td></tr>
<tr><td>130</td><td>100 per day</td></tr>
</table>

In 1968 the Motor Vehicle Design and Study Division (which the Americans would simply call "Engineering") comprised a staff of 1.700, divided as follows:

<table>
<tr><td>Management and Secretariat</td><td>5</td><td rowspan="8">226</td></tr>
<tr><td>Engineers staffing the management</td><td>3</td></tr>
<tr><td>Personnel Office</td><td>6</td></tr>
<tr><td>Administration Office</td><td>9</td></tr>
<tr><td>General Technical Services and Liaison</td><td>14</td></tr>
<tr><td>Programming and Homologation</td><td>15</td></tr>
<tr><td>Archives, Tracing and Design Reproduction</td><td>84</td></tr>
<tr><td>Technical Offices Auxiliary Equipment</td><td>90</td></tr>
<tr><td>Automobile Technical Offices Dept: Italy</td><td>290</td><td rowspan="2">382</td></tr>
<tr><td>Automobile Technical Offices Dept: Abroad</td><td>92</td></tr>
<tr><td>Industrial Vehicles Technical Offices Dept.</td><td>245</td><td rowspan="2">310</td></tr>
<tr><td>Technical Office Special Purpose Vehicles</td><td>65</td></tr>
<tr><td>Technical Centre Tractors: Technical Offices</td><td>190</td><td>256</td></tr>
<tr><td>Testing</td><td>66</td><td></td></tr>
<tr><td>Automobile and Industrial Vehicle Test Dept.</td><td>250</td><td></td></tr>
<tr><td>– Study and Research Dept: Engines and Turbines</td><td>40</td><td>120</td></tr>
<tr><td>– Vehicles</td><td>73</td><td></td></tr>
<tr><td>– Workshop</td><td>7</td><td></td></tr>
<tr><td>Styling Centre</td><td></td><td>160</td></tr>
<tr><td>Total</td><td></td><td>1704</td></tr>
</table>

This type of organization had the advantage of making all the different sectors directly involved in progress and aware of the advances in know-how acquired by each of them. Collaboration and the standardization of mechanical components were facilitated and produced good results from the economic point of view.

But half-way through the year, the presidential office, pressing on with its process of decentralizing executive responsibilities, arranged for the two biggest and most important divisions, Automobiles, headed by Vincenzo Buffa, and Industrial Vehicles and Tractors, under Bruno Beccaria, to be equipped each with its own design office. Subsequently they were also given their own commercial organization as well. The Management for Motor Vehicle Design and Studies was subjected to important new changes as a result of this.

On 8 July 1968 the following decisions were made known in a communiqué:

Bruno Beccaria, engineer, born in Brescia in 1915. In 1941 he entered OM, where he became works director in 1950, assistant general manager in 1959, general manager in 1964.
In 1968 he became director of Fiat's Industrial Vehicles Sector, and assistant general manager of Fiat in 1971. Managing director of Iveco in 1975, since 1979 he has been President of Fiat Auto. [He died in 2000].

Order no. 29337

The Management for Motor Vehicle Design and Studies must develop and intensify its activity in the field of studies, research and experiment along unified lines valid for FIAT and all its associated companies (FIAT – OM – Autobianchi – UNIC).
For this purpose and with the aim of also coordinating design and production more closely it has been decided to return responsibility for the Technical Design Offices to the individual divisions with executive powers. As from today the following modifications will be in force:

1) The Automobile Technical Offices (director engineer Cordiano) are to be incorporated in the Automobile Division directly responsible to engineer Buffa, director of the Division;
2) The Industrial Vehicles Technical Offices (director engineer Montanari) and the Tractor Technical Office (director engineer Negro) are to be incorporated in the Industrial Vehicles and Tractors Division, directly responsible to engineer Beccaria, director of the Division;
3) The Management for Motor Vehicle Design and Studies will naturally retain responsibility for policy in the automobile design field and for research and experimentation and will also retain its function of superintending the work of the Technical Offices referred to above;
4) The Management for Motor Vehicle Design and Studies will therefore be directly responsible for the following sections:
   a) Styling Centre (Boano)
   b) Programming, Liaison and Homologation Service (Sardone)
   c) Research and Study Sections:
   – Motor and Turbine Studies (Torazza)
   – Vehicle Studies (Puleo)
   – Special Testing Service (Freilino)
   – Electronic Installations Service (Villa)
   d) Design Offices:
   – Special Vehicles Technical Offices (Bertoldi)
   – Auxiliary Equipment Technical Offices (Premoli)
   – Vehicle Design Service (Foreign) (Mosso)
   – Motor Truck Design Office (Foreign) (Tonegutti)
   e) Test centres:
   – Motor Vehicle Test Department (Pinolini-Zandonà-Pollone)
   – Tractor Technical Centre (Tascheri);
5) Engineers Giacosa and Montabone together with the directors of the relevant divisions will examine the organizational problem arising out of the present service order, to be complied with in all details by 31.12.1968.

G. Bono

Turin, 8 July 1968

It was at this time that we began to give more serious effort to the creation of a Research Centre, something that we had never previously managed to set up. With this in mind I suggested to Bono that Giovanni Savonuzzi should be brought to Turin. Savonuzzi had been working for Chrysler under Huebner, vice-President of the Research Sector, with the specific task of designing their turbine-powered auto.

I thought Savonuzzi the best person to continue our research into turbines and organize the research centre which we were aiming at. In September 1968 he returned to Fiat, having left the company just after the war to work for Cisitalia, taking over the running of the turbine-engine centre and preparing suggestions for projects at the Research Centre.

With the transfer of the technical offices for industrial vehicles and tractors to the Industrial Vehicles Division, together with earth-moving vehicles, my work grew slightly less. Only slightly, because in actual fact I had for some time avoided working on projects for trucks and buses, as they were being developed according to a plan that I partly disapproved. All the same I went on devoting much of my energy to special vehicles, especially off-road ones. The design of vehicles of this sort, which are often amphibious, brings up a whole range of problems that continually recur in new forms as progress is made, giving the work its peculiar fascination. I enjoyed discussing it with the officials from the Defense Ministry's Vehicle Division, first-rate engineers. I felt we spoke the same language. I made frequent trips to Rome, there being a fair number of models requiring study. One of these was of particular interest: a reconnaissance vehicle designated the "VCL" *(Véhicule Commandement Liaison)* whose design was to be developed through collaboration between Italian, French and German companies under an agreement between the governments of the three countries.

Early in 1967 a group comprising Fiat-SAVIEM-MAN had been set up and I was put in charge of the design. In the course of this work, complicated by negotiations with the military commissions and representatives of the firms involved, I requested that BMW should also collaborate on the gasoline-engine version.

It was a long and arduous task, carried through with the greatest skill and efficiency by Puleo, who had the practical responsibility for producing the design in an office comprising engineers of three different nationalities. The work dragged on long after the construction of the prototypes so that when I ended my career with Fiat it was still going on.

Other projects carried out by the Experimental Vehicles Office run by Franco Bertoldi involved a whole family of vehicles, one derived from the other, such as a light

Dante Giacosa and Ettore Cordiano during a meeting. Copyright by Kurier, Vienna.

reconnaissance truck, an amphibious rescue vehicle, a two-ton amphibious truck, a two-ton non-military truck, all equipped with four-wheel drive. Then there were a whole lot of others, such as the "M 113" armoured transport, the troop-carrier, the new *Campagnola* and other less important vehicles.

The *850 Special* and the two new *850* coupé and sports models were followed up in 1968 by the *124 S* and *125 S* and the *500 L*. At the same time tests were going on for the new models, the *130*, *128*, *A 112* and *A 111* to remedy defects that showed up during trials. Most urgent of all was the *128*.

The latest causes of worry were the vibrations of the exhaust pipe, caused by the transverse power plant, and a tendency for the front to dip too sharply during hard braking or acceleration.

The Test Department had seven experimental models of the *128* to work on, but none of them corresponded precisely to the final version since it had not been possible to incorporate all improvements to the design in any of them. They also differed slightly from each other. The year was drawing to a close and only a few months were left to correct faults and perfect models.

The works, busy tooling up for production, pressed insistently for the final designs because every change meant loss of time and heavy expense in alterations to machine tools and plant.

The General Management confirmed that the date for launching the new model would be about mid-April with 3.000 four-door models (for immediate delivery) and 100 two-doors (delivery to start on 1 May).

The *Familiare* (station wagon) could possibly be postponed until 1 September 1969 but no delays were allowed for the *128* sedan.

Montabone was putting tremendous energy into the work and promised to present the General Management with the definitive model on 5 December, at the same time asking for a certain number of pre-production models to be built, starting from 10-15 January.

It can be imagined how everyone threw himself into the work to try to meet the production deadline. Past experience, a thorough knowledge of the job, the reciprocal confidence between men in different positions, strengthened over the years of work together, consciousness of the importance of each man's contribution, a spirit of emulation, the conviction of the job's importance, direct communication between the men in charge at every level and the ability to understand one another without wasting words, and finally the ambition to show that Fiat could put two new models – or rather four, counting the ones to be produced at the Autobianchi works – into production in a single year: this provided the drive behind the whole work force, from the top management down to the works foremen.

1969 was the year when the *130*, the *128*, the *A 112* and the *A 111* came out, not to mention the new *Dino 2400* and the various versions of the *128*. This was a record that helped to increase the admiration, not unmixed with a certain jealousy, of the foreign companies we were competing against.

First the *130* came out on the eve of the Geneva Motor Show, during the "Ides of March". The end of the same month saw the appearance of the *128* sedan in the four-door and two-door versions.

Autobianchi brought out the *A 111* (a new four-door sedan replacing the *Primula*) and the *A 112*, the little two-door auto fitted with a rear hatch which, like the *128*, is still in standard production ten years later.

The *128* was given the "auto of the year award" seven times over by panels of specialized motoring journalists in Sweden, Holland, Great Britain, Czechoslovakia, Denmark, Germany and Italy. A real triumph.

Of all the Fiat models and – if I may be permitted to commit a sin of pride and say so – probably all the autos the world over, the *128* is probably the one that gives the best "value for money". The arrangement of the engine and transmission, previously used on the Autobianchi *Primula*, started a trend that has become widespread owing to its extreme simplicity. It was applied some time later to the little Japanese automobiles, then to the new Volkswagens and the Ford *Fiesta*, and it is still finding converts.

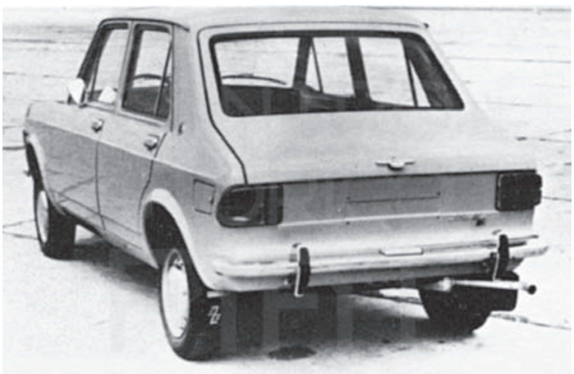
The *128* hatchback, a two-volume model, was never built by Fiat, which preferred the station wagon version, the *Familiare*. It was taken up by the Yugoslavs instead. Rakovic, ZCZ's general manager whose drive and sense of purpose had transformed the weapons factory into a big autoworks and the little country town of Kraughievaç into a modern industrial city, had for years been following the development of the *128* project with keen interest. He wanted to use it as the basis of a Yugoslav auto and worked like a Trojan to create an engineering centre capable of producing the design and perfecting the prototypes.

We did the designs for the engineering centre in Turin, the great achievement of Giacinto Sardone, one of my close collaborators. The centre was built and began to function but the young and inexperienced Yugoslav engineers were not up to the task of designing an automobile, not even when they could use the *128* as their starting-point. The task was quite clearly beyond their powers.

To satisfy Rakovic I got the Styling Centre to build the model of the *Break*, the hatchback. A group of Yugoslav designers was installed in Turin and here they learnt to handle plaster, building the model in their turn and executing the construction designs with the help of our experts and myself.

Rakovic, with great satisfaction, presented the ZCZ *1100* to Marshal Tito at the Belgrade Motor Show. Though it had been designed in Turin, the *Break* was still the outcome of his long and stubborn labour of persuasion and negotiation, made all the more difficult and complex by the political and financial state of the two countries.

Rakovic considered me his friend and had the greatest regard for my opinions and advice.



Rear view of the 128 Yugoslavia showing hatchback, judged not yet appropriate for the Italian market.

CHAPTER XXV

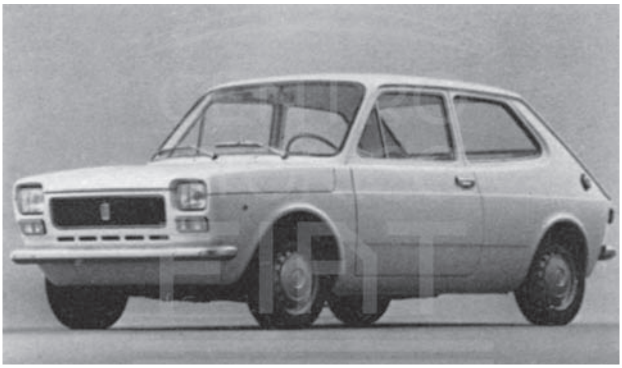
THE *127* AND PIO MANZÙ

MY RESIGNATION

TAKING STOCK

The styling of the *127* is the work of Pio Manzù. I had just finished the elegant plaster mock-up of the "G. 31" when Paolo Boano and I decided to get him to do the drawing for the *127* coachwork.

Pio, who loved simple autos, popular models without costly frills, functional ones for ordinary people, worked with real commitment on the *127*. His designs were simple in the extreme, pushing the principle as far as it would go. The drawings went through a process of progressive, delicate refinement, which seemed to convey a subtly sophisticated and intellectual authenticity. Helped by first-rate staff, skilled in modelling plaster, he made a model of the drawing we had approved. It was admirable in the delicacy of its handling and the mastery with which the form had been adapted to the pre-arranged dimensions and the volumes of the mechanical com-



Standard 127 sedan, spring 1971.

ponents under the engine hood. Perhaps he was even too scrupulous in this regard, for the hood seemed a little on the large side. All the same, the model, with its broad surfaces delicately smoothed and skilfully related to each other, modelled with loving care, was very attractive and we decided to present it to the presidential committee.

The ceremony, which Pio was looking forward to with a mixture of eagerness and anxiety, was to take place at 8 am on Monday 26 May 1969. But Pio failed to turn up.

That very morning we received the grievous news of his death on the Milan-Turin *autostrada*. He had been to Rome to visit his father and on his return stopped off at Bergamo, passing the night in the family home, high up in the wooded hills. Early the next morning he resumed the journey in his *500* to reach the Styling Centre on time. Whatever the cause – whether some sudden ailment or sleepiness, or perhaps because he tried to open the sunhatch while the auto was moving, as it has been suggested – he lost control of the vehicle. He was found lifeless in the little auto, which had run off the road and overturned.

For some time the *127*'s plaster model was left where it had been placed for the presentation, seemingly forgotten. Then as work became pressing again, we began to look at it realistically with a view to using it as the basis for the executive designs.

After studying it for some time Boano and I agreed that the source of our uncertainty about its overall appearance was the bulky look of the engine hood. Boano was hesitant about tampering with Pio's handiwork but gave instructions to the modellers to lower the top of the engine hood a few centimetres. The improvement was decisive and we were satisfied. The model was approved.

From then on my share in the *127* project was ended. It was completed under Cordiano's direction. The execution or the designs presented no difficulty since it was essentially a combination of a coachwork whose internal dimensions were slightly

During the construction of the full-scale plaster mock-up of the 127 coachwork at the Styling Centre, April 1969.

smaller than the *128*'s with the engine and other hardware from the *A 112*. Naturally it embodied all the improvements that grew out of our experience or the *A 112* and the *128* during production and use.

The *127* was launched as a standard production model with great success in spring 1971.

The *126* was conceived as the *500* enlarged just enough to accommodate four people rather more comfortably. Naturally this meant changing its shape. The engine capacity was increased a little by increasing the stroke and bore of the cylinders. It might seem as if such an apparently simple transformation would not take much time. Instead it was a long and knotty task, not so much for technical reasons as because of the economic, commercial and financial factors involved.

Basically we were asked to rework the *500* idea so as to produce a four-seater but with only a negligible increase in the costs of production. This problem had been in our thoughts for some time. The Styling Centre had been turning out designs and comparing plaster mock-ups almost incessantly. Some sheet-metal specimens of coachwork were also built, directly derived from the *500* body enlarged to improve accommodation.

The problem looked insoluble, because every change led to increased weight and cost. It also seemed impossible to give it a shape which would make it a worthy successor to the *500*.

The matter became the subject of exchanges of ideas and discussions with Bono and even Agnelli. I maintained that the transformation of the *500* into a four-seater was not a desirable solution because the increased cost could not correspond to a proportionate increase in quality. The best solution would be to make a number of alterations to the mechanicals and minor changes to the coachwork so as to reduce the vehicle's cost and sale price. My point of view was rejected by my superiors. As a result I devoted less attention to the problem, posed in these terms, while Paolo Boano continued to search for a design for the coachwork which would satisfy the wishes of the presidential committee and especially Bono.

At the start of l970 the plaster model began to emerge in something like the form that was finally chosen for the *126*.

Prototype of a variant with four comfortable seats for the updating of the Nuova 500.

This final phase of work which was crowned by the start of production of the *126* and *127* saw me taking part only as a consultant, little more than a privileged spectator. On 3 January 1970 the chequered flag signaled my arrival at the finish of my career. I had turned sixty-five so the time had come to hand in my resignation, in compliance with the sensible ruling that had been in force for some time by then, and I broke the tie that for over forty-one years had bound me to Fiat. So 1969 was the last year that saw me in charge of design.

I had been privileged to share in the expansion that took Fiat to new peaks in production, with 1969 seeing the launching of a record number of new models: the *128* sedan and station wagon, the *l30*, the *Dino 2400*, the *124* sports coupé, as well as the various Autobianchi models – the *A 112*, the *Primula 65 C*, the 1.436 cc *S* coupé, the *A 111*. In the same year Fiat took over Lancia and purchased 50% of Ferrari's capital.

But 1969 was certainly not the richest in projects and studies in my years as a director. This is clear from a glance at the record of my activities (carefully compiled by Wanda Vigliano Mundula, my incomparable secretary, on her own initiative), covering the years since 1946 and containing the names of the people I met, dates, places I visited, the subjects or conferences, talks and interviews. When I leaf through its pages I am struck by the number of unavoidable, rewarding, exhausting

Standard 126 sedan, shown to the press 22 October 1972.

and useful duties that complemented my day-to-day work. 1969 was a year which I remember not only because it was the year when man set foot on the moon but also for personal reasons.

In January there was my trip to the United States to take part in the annual international conference of the SAE, the American Society of Automotive Engineers, by far the most important of all the automolive conferences. I was present as President of the FISITA – the International Federation of Automotive Engineering Societies – accompanied by a small group of my engineers.

In February I went to Rome to assist Avvocato Agnelli, who had been invited by a parliamentary committee of inquiry to take part in a debate on the situation of the automobile industry.

In March I went to Stuttgart to receive “Hobby” magazine’s award for the *124 S*.

In April I was back in Rome with Avvocato Agnelli for the presentation of the *128* to members or the government, then off to Arbon, Switzerland, for a meeting or the FISITA council. While I was there I heard the happy and exciting news of the birth of my first grandchild, Cristina Zanon.

In May I went to Kraughievaç about the *128* and in June I was in Venice for a conference on the ideal safe automobile, at which I presented a paper. In the following months there were frequent visits to Rome, Paris, Milan, Belgrade, then with

At the annual celebration held for long-serving staff, Gianni Agnelli hands the award for 40 years’ service to Dante Giacosa.

Dr Umberto Agnelli to Copenhagen, Stockholm and Oslo. Finally Savonuzzi and I went to Eindhoven for a visit to the Philips laboratories.

There is also one sorrowful memory associated with 1969 for me: the death of an old friend, the incomparable Carlo Salamano.

At the end of 1970 my nomination as consultant to the presidential office and the General Management was announced. My previous responsibility as a director for design disappeared, transformed into the vague and theoretical functions of a consultancy.

Automobile design was now in the capable hands of Cordiano while research had for some time been directed by Montabone, who was completing the extremely difficult task of setting up the Research Centre, assisted by Savonuzzi and Pollone. Carlo Pollone, who had gained his experience in the Test Department, specializing in combustion studies, had become our specialist on the subject of noxious waste from engines. He had become the most authoritative ecological expert and was put in charge of setting up and running a well-equipped laboratory specially for this purpose. Similarly cavaliere Franchini was in charge or safety studies, covering the field of protection in case of accidents.

Umberto Agnelli, brother of Gianni, Law graduate, born in Lausanne in 1934. He gave early proof of his abilities as President of the Juventus soccer club, restoring its finances, and in the presidency of Piaggio, the SAI insurance company and the Fiat France in Paris, which doubled its turnover during the three years it was under his management. He returned to Turin in 1968 and took over the running of the international business sector at Fiat with the task of renewing the company personnel and coordinating the new Fiat undertakings world-wide. Appointed managing director of Fiat in 1970 he later became sole administrator and vice-President. He is also active in politics as a member of the Christian Democrat party and has been elected a Parliamentary senator for the Rome constituency. [He died in 2004].

Design and testing of industrial vehicles had passed to the Industrial Vehicles Division, together with the engineering side of the tractor and earthmoving machinery sector.

Decentralization of design was definitively established. The aim or retaining a degree of uniformity in technical developments led to the creation of the new Research Centre, run by Montabone with the title of Assistant Director General and staffed by some of the personnel who had previously been at Advanced Engineering.

In February I was invited to Warsaw by the Polish Minister for the Engineering Industry, Tadeusz Wrzaszczyk. He wanted to show how highly they appreciated my advice in the choice of a model to be built in Poland: the *125 P* with the “115” 1.500 cc engine. A tremendous hunt was organized in my honour in the north of the country, a hilly region near the coast. The Minister accompanied me, together with some directors of the autoworks, on the long journey, made more difficult by the heavy snow, and before I left Warsaw presented me with a rare crystal vase on which were chased my initials and the image of the *125 P*.

1970 was the year or the awards for the *128*, the first being presented in Amsterdam, where I went in the company of Umberto Agnelli, then to Germany once more where I received the Hobby award, the presentation taking place in Stetten, near Stuttgart. My collaboration with the Yugoslavs of ZCZ involved visits to Belgrade and Kraughievaç. Then my trips took me to Stuttgart, once more, and Heilbronn, then Brussels and finally Genoa where I received the Colombiana gold medal awarded by the Commune of Genoa on the occasion of the International Conference organized by the International Institute of Communications.

The encounters with journalists of every country, important personages and foreign delegations, representatives of the Italian Defence Ministry, writers, American and European engineers, all continued unabated for some years more until my duties for Fiat were over and I withdrew into my office at SIRA to concentrate on new projects and reflections on the past and the future.

The story is over. All that remains is to take stock and see what it all adds up to. To make this easier I have provided an overall picture of Fiat's productive activities, with a chronological list of the dates of appearance of all the autos and the time-span they remained in standard production. A panorama of forty years and more.

It is significant that the number of models being produced at any one time and the versions derived from them has steadily increased over the years, obviously excluding the war years.

Before 1936 the duration of each model in production was relatively short.

In 1927, which now seems a long time back, Fiat only had two models: the *509*, with an engine of approximately 1.000 cc, and the *520*, of about 2.250 cc. In 1928 the 3.740 cc *525* came out, without altering the situation significantly. But the *514*, which came out in 1930 with an engine of approximately 1.450 cc, seemed to make the range complete. However the *514* was soon superseded by the rapid progress made in that period and after remaining in production for three years was replaced by the *508 Balilla*. It is highly significant that an auto of nearly 1.500 cc was replaced by one of approximately 1.000 cc.

For a year, potential Fiat buyers could only choose between a utility model and a much more ambitious prestige model, the *522* with its six-cylinder 2.500 cc engine.

This was a brief transition period for other reasons as well. The President, senatore Giovanni Agnelli, had decided to call in an American expert to improve the organization of the works. The scientific planning of work was spreading in big firms through the theories of an American engineer, Frederick Winslow Taylor, and in the factories in the form of a system worked out by a Frenchman, Charles Bedaux, to boost worker productivity. In this climate of change, the *Ardita 518 C* came out in 1933, with its 1.750 cc four-cylinder engine derived from the *522*.

The Automobile Technical Office was given the task of designing a new auto with a six-cylinder 1.500 cc engine while the Aero Engines Office was made responsible for designing the *500*.

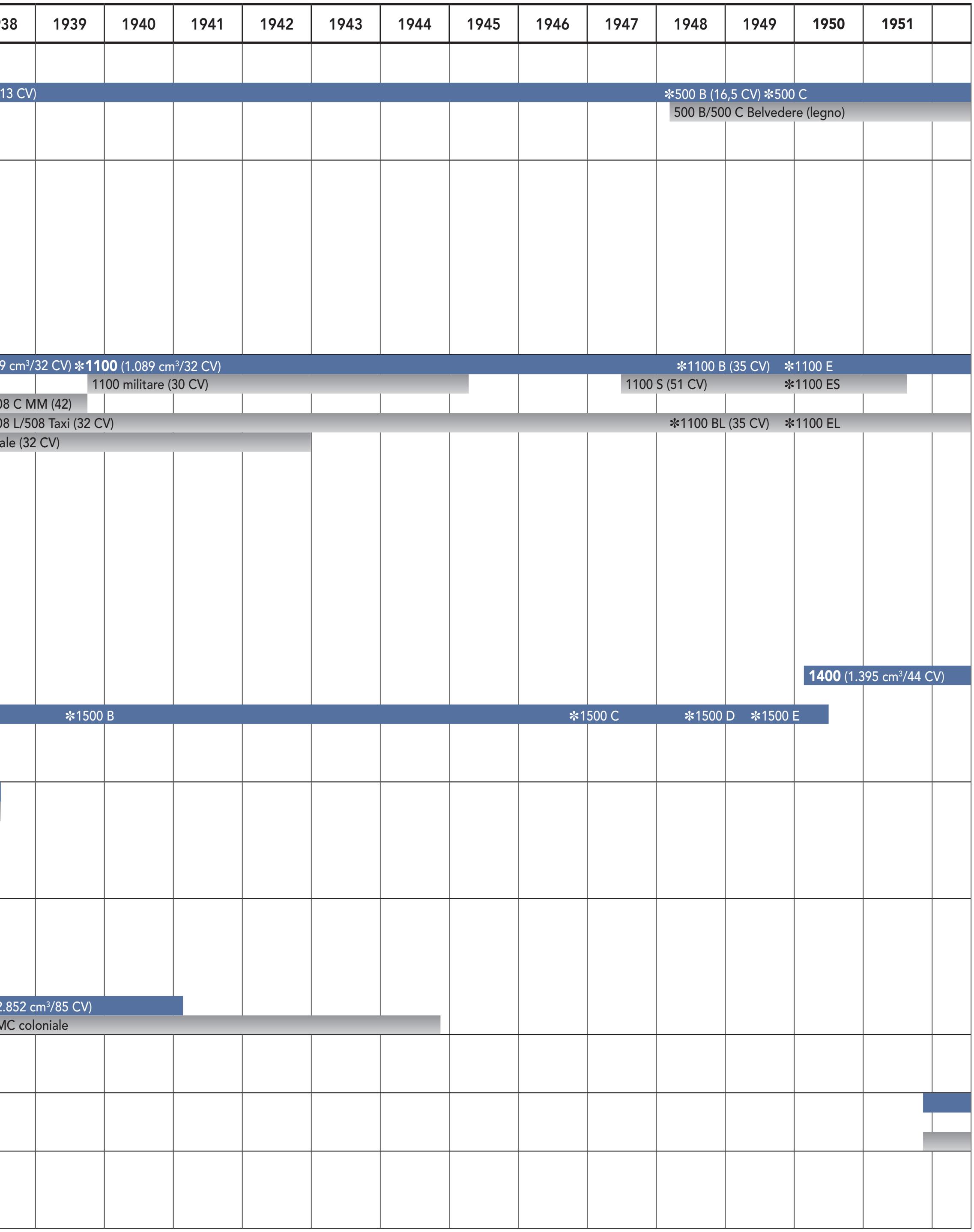
With the appearance of the *1500* and, a few months later, the *500 Topolino*, which began to roll off the production line at Lingotto in spring 1936, the range of four models boosted sales and ensured fuller use of plant.

This was the start of the era of the "modern" automobile, according to the classification of the FIVA, Fédération Internationale Voitures Anciennes, which classifies pre-1905 autos as "Ancêtres", those built from 1905 to 1918 as "Veteran", from 1919 to 1935 as "Vintage", and those from 1936 onwards as "Moderne". The Fiat *500* was the first Fiat to be classed as "moderne".

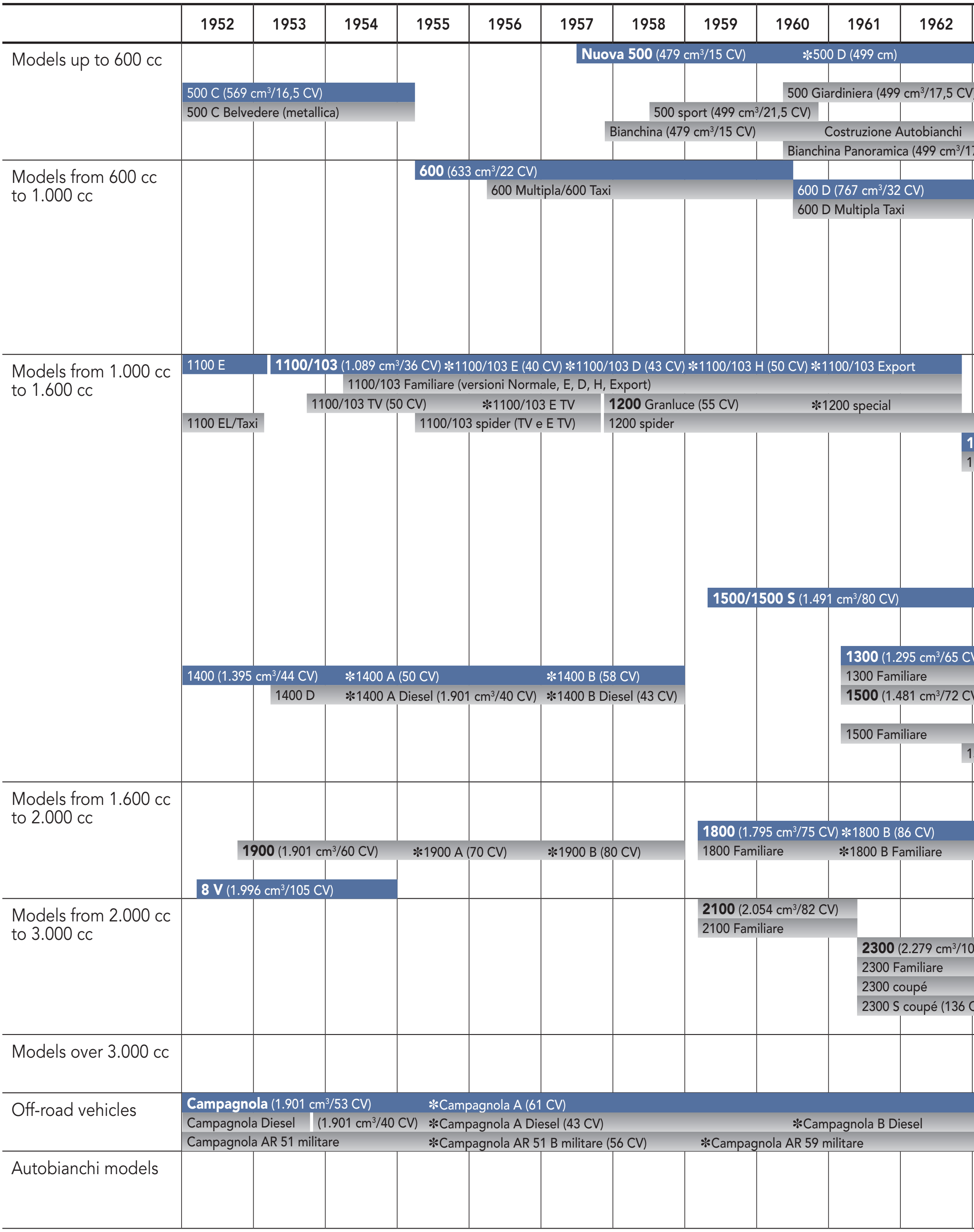
With its independent front suspension, its engine positioned in front of the front wheels, the radiator and fuel tank arranged so as to eliminate the water pump and fuel pump, its chassis and coachwork designed to fit together so that the combination

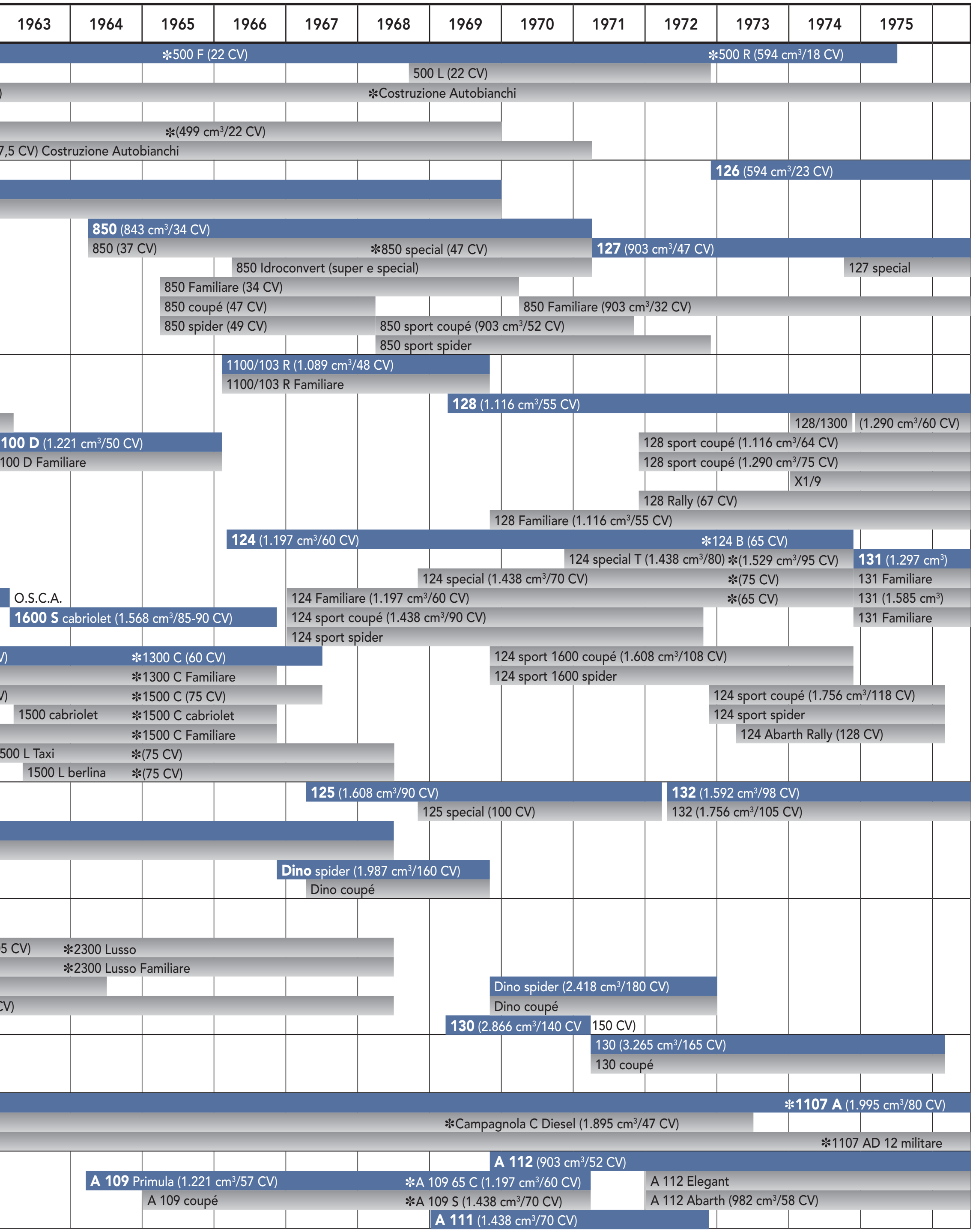
CHRONOLOGICAL TABLE OF FIAT AND AUTOBIANCHI MODELS FROM 1926 TO 1951

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	19
Models up to 600 cc											500 Topolino (569 cm³/		
Models from 600 cc to 1.000 cc	509 A 509 S 509 SM						508 Balilla (995 cm³/20 CV) ✻(24 CV) 508 M militare (20 CV)	508 S (30 CV) ✻508 CS (36 CV)					
Models from 1.000 cc to 1.600 cc	503 (1.460 cm³)			514 (1.438 cm³/28 CV) 514 S (34,5 CV) 514 MM (37 CV) 514 CA (37 CV) 514 L/514 Taxi (28 CV)						1500 (1.493 cm³/45 CV)		508 C (1.08 508 C coloni	50 50
Models from 1.600 cc to 2.000 cc								518 C Ardita 1750 (1.758 cm³/40 CV) 518 L Ardita 1750 518 A Ardita 2000 (1.944 cm³/45 CV) 518 S Ardita 2000 sport (54 CV) 518 Ardita 2000 coloniale (45 CV)					
Models from 2.000 cc to 3.000 cc	507 (2.296 cm³)	520 (2.244 cm³/46 CV)	520 T (1.866 cm³/35 CV) 521 (2.516 cm³/50 CV) 521 C			✻522 C (2.516 cm³/52 CV) 522 L (52 CV) 524 C (2.516 cm³/52 CV) 524 L	522 S (65 CV)		527 (2.516 cm³/52 CV) 527 S Sport (60 CV)	Ardita 2500		2800 (2 2800 CM	
Models over 3.000 cc	512 (3.446 cm³)		525 (3.739 cm³/68 CV) ✻525 N	525 S 525 SS (88 CV)									
Off-road vehicles													
Autobianchi models													

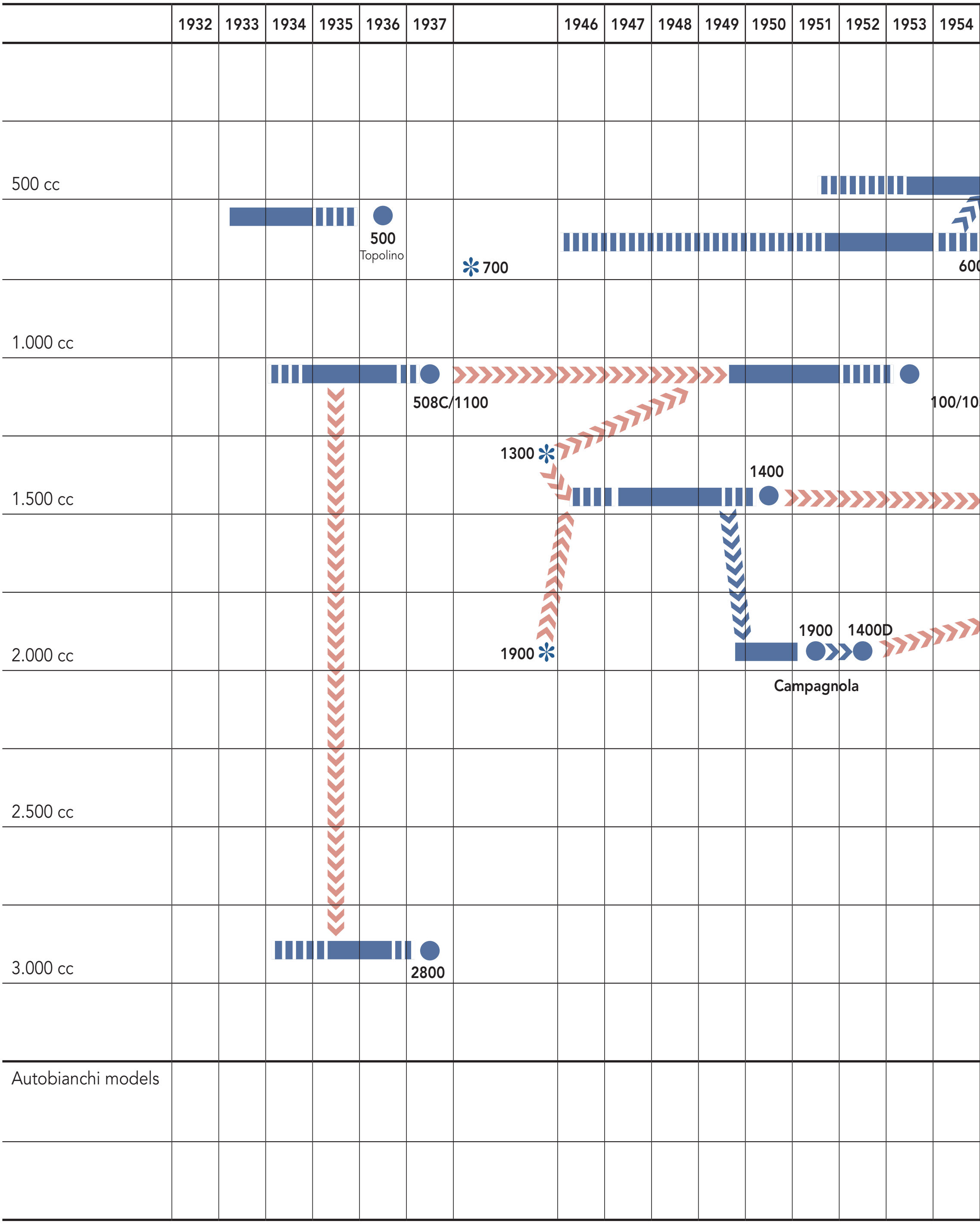

38
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
13 CV)
✻500 B (16,5 CV) ✻500 C
500 B/500 C Belvedere (legno)
9 cm³/32 CV) ✻1100 (1.089 cm³/32 CV)
✻1100 B (35 CV)
✻1100 E
1100 militare (30 CV)
1100 S (51 CV)
✻1100 ES
08 C MM (42)
08 L/508 Taxi (32 CV)
✻1100 BL (35 CV)
✻1100 EL
ale (32 CV)
1400 (1.395 cm³/44 CV)
✻1500 B
✻1500 C
✻1500 D
✻1500 E
2.852 cm³/85 CV)
MC coloniale

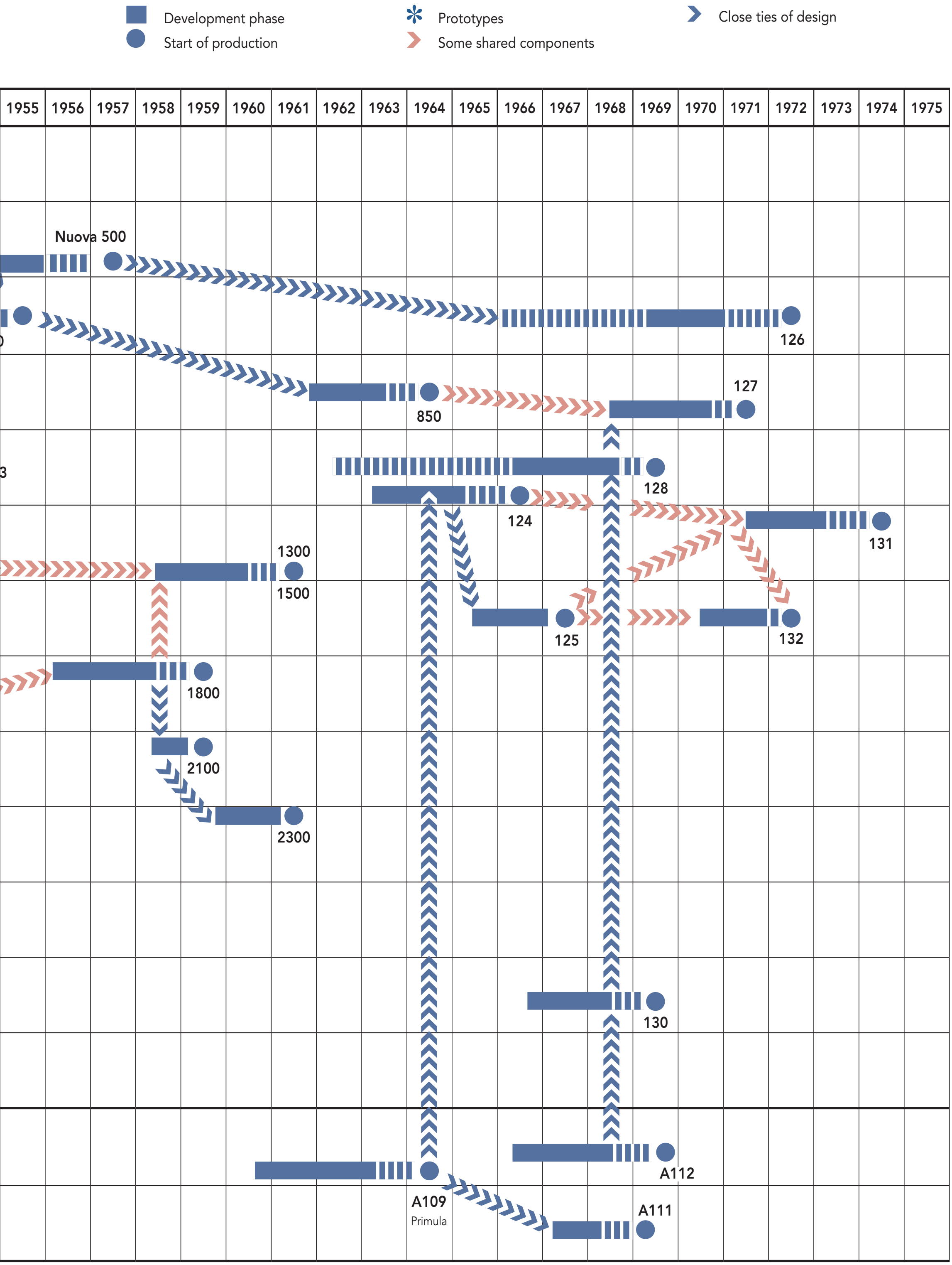
CHRONOLOGICAL TABLE OF FIAT AND AUTOBIANCHI MODELS FROM 1952 TO 1975




1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
✻500 F (22 CV)
✻500 R (594 cm³/18 CV)
500 L (22 CV)
)
✻Costruzione Autobianchi
✻(499 cm³/22 CV)
7,5 CV) Costruzione Autobianchi
126 (594 cm³/23 CV)
850 (843 cm³/34 CV)
850 (37 CV)
✻850 special (47 CV)
127 (903 cm³/47 CV)
850 Idroconvert (super e special)
127 special
850 Familiare (34 CV)
850 coupé (47 CV)
850 Familiare (903 cm³/32 CV)
850 spider (49 CV)
850 sport coupé (903 cm³/52 CV)
850 sport spider
1100/103 R (1.089 cm³/48 CV)
1100/103 R Familiare
128 (1.116 cm³/55 CV)
128/1300
(1.290 cm³/60 CV)
100 D (1.221 cm³/50 CV)
128 sport coupé (1.116 cm³/64 CV)
100 D Familiare
128 sport coupé (1.290 cm³/75 CV)
X1/9
128 Rally (67 CV)
128 Familiare (1.116 cm³/55 CV)
124 (1.197 cm³/60 CV)
✻124 B (65 CV)
124 special T (1.438 cm³/80)
✻(1.529 cm³/95 CV)
131 (1.297 cm³)
124 special (1.438 cm³/70 CV)
✻(75 CV)
131 Familiare
O.S.C.A.
124 Familiare (1.197 cm³/60 CV)
✻(65 CV)
131 (1.585 cm³)
1600 S cabriolet (1.568 cm³/85-90 CV)
124 sport coupé (1.438 cm³/90 CV)
131 Familiare
124 sport spider
V)
✻1300 C (60 CV)
124 sport 1600 coupé (1.608 cm³/108 CV)
✻1300 C Familiare
124 sport 1600 spider
V)
✻1500 C (75 CV)
124 sport coupé (1.756 cm³/118 CV)
1500 cabriolet
✻1500 C cabriolet
124 sport spider
✻1500 C Familiare
124 Abarth Rally (128 CV)
500 L Taxi
✻(75 CV)
1500 L berlina
✻(75 CV)
125 (1.608 cm³/90 CV)
132 (1.592 cm³/98 CV)
125 special (100 CV)
132 (1.756 cm³/105 CV)
Dino spider (1.987 cm³/160 CV)
Dino coupé
5 CV)
✻2300 Lusso
✻2300 Lusso Familiare
Dino spider (2.418 cm³/180 CV)
CV)
Dino coupé
130 (2.866 cm³/140 CV
150 CV)
130 (3.265 cm³/165 CV)
130 coupé
✻1107 A (1.995 cm³/80 CV)
✻Campagnola C Diesel (1.895 cm³/47 CV)
✻1107 AD 12 militare
A 112 (903 cm³/52 CV)
A 109 Primula (1.221 cm³/57 CV)
✻A 109 65 C (1.197 cm³/60 CV)
A 112 Elegant
A 109 coupé
✻A 109 S (1.438 cm³/70 CV)
A 112 Abarth (982 cm³/58 CV)
A 111 (1.438 cm³/70 CV)

GENEALOGY OF PRINCIPAL FIAT AND AUTOBIANCHI MODELS PRODUCED FROM 1932 TO 1975





Development phase
Start of production
Prototypes
Some shared components
Close ties of design
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
Nuova 500
126
850
127
128
124
131
1300
1500
125
132
1800
2100
2300
130
A112
A109
Primula
A111

of the two would confer the necessary overall rigidity on the vehicle, the *Topolino* could truly be called "modern": one of the simplest, most economical and functional autos to be put into series production.

So I might be tempted to say that my début as an automobile designer marked the start of the modern era of motoring at Fiat, but I would hardly be justified in doing so. It would be taking undue liberties with the facts: for the auto that really did succeed in being modern, superseding previous models and making them old hat, was the *1500*. Though it came out at the end of 1935 and so is classed as "Vintage", it fully deserves to be called modern, however much this might upset some collectors.

The *1500* was the first Fiat with independent suspension on the front wheels, with rack-and-pinion steering and aluminium brake drums. The streamlined look of the coachwork was new, almost revolutionary in Italy at that time, and it was the auto that gave us the idea for the layout of the engine, radiator and fuel tank of the *500* that distinguished it from all other cars. The *1500*'s smooth and elegant line did not last long, because changes in fashion and commercial reasons led to the front end being modified in the attempt to make the model superficially more imposing but spoiling the harmony or its proportions and form.

The *1100* and later the *500* met with the same fate. The *2800*, looking back forty years later, seems the typical expression of the fashion of that time.

To return to the chronological scheme. When the war was over and reconstruction was going on, the factories had practically to be rebuilt. This meant that design was free to draw on technological progress without the choice of models being conditioned by worries about all-out competitiveness. There were many difficulties all the same in establishing the specifications of the *1400*, the *103*, the *600* and the *Nuova 500*. These four basic models, completely new in design and the manufacturing techniques used, were designed and put into production in the space of ten months.

In 1957 the conditions for a high and steady level of production had been achieved. This meant that subsequent models had to meet the requirements of competition on the home and international markets, naturally making allowance for the available means of production and economic and financial factors. From that time on the choice of new models became a more complex matter. The men in charge of production and marketing, each with the best of reasons, influenced the policy of the top management. Decisions could not be taken without first discussing and carefully selecting the designs.

The new autos in this period were the *1800* and the *2100*, both excellent models with six-cylinder engines that appeared in 1959, followed two years later by the *1300* and *1500* with their four-cylinder engines derived from the six-cylinder one. Then the climate of opinion grew more troubled, with viewpoints that clashed and changed. All the same, there was still an underlying desire to make rapid progress, leading to the appearance of the *850* in 1964 and, two years later, the *124* and *125*, born amid a spirit of rivalry between the works and the technical office. This did not prevent the *850* from being followed rapidly by the launching or the "109" Autobianchi *Primula*, considered by the management as a dress rehearsal for the introduction of front-wheel drive in Fiat's own range.

The open-mindedness of the President, who had allowed me to develop the designs according to a policy of (to borrow a well-known expression from the politicians, however unacceptable it may be to mathematicians) "parallel but converging lines", gave excellent results despite the delay involved.

The success of the "109" *Primula* paved the way for the *128*, the *A 112* and the *127*, all with front-wheel drive and transverse engines.

The numerous other models that appear in this panorama of production are no more than side issues because of their limited scale of production when compared with the millions of units of the series models. Starting from 1936, they comprise the *2800*, the *Campagnola*, the *8V*, the *1900*, the *2300* coupé, the *1500/1600* OSCA, the *Dino* and the *130*, all models which were produced in small production runs but added to Fiat's prestige, contributed to technological progress and gave the staff working on the design and experimental side the stimulus of work that made a change from humdrum routine.

The *130* with its six-cylinder V engine was a modern and very refined auto, taken as a pattern by the leading European marques which belatedly followed in its wake.

Fiat, organized as it was for the mass production and marketing of small and medium-sized autos, was unable to maintain the *130* in the leading position it had acquired through a whole series of new features. Today, with the troubles afflicting industrial civilization as a result of the petroleum crisis, the decision to suspend production of the heavy and high-powered *130* seems almost providential.

I think there is no need to add further comments to this summary, partly because the reader will probably be capable of making his own observations. But it is worth pointing out how long the *1100* engine went on being produced. Designed in 1934-35 for the *508*, it went into series production in 1937 and was continually being improved in detail. Subsequently mounted on the *103*, it went on being produced with a capacity of 1.100 cc until the 1962 Turin Motor Show, when it was boosted to 1.220 cc, then reverted in 1966 to its original displacement. Transformed into a racing engine it was mounted on the Cisitalia and the *1100 MM*. Mounted transversely it powered the 1.221 cc version of the *Primula*. Production came to an end in 1969.

As my mind roams back over the events, linked by an invisible thread, that gave rise to the autos I designed in my forty years with Fiat, they seem to belong to the distant past. Many of those autos still throng the streets of our cities but they are already receding into the past. Others, the models that preceded them, have long since vanished into the abyss.

The events of the past are unchangeable in themselves but they appear differently to us at different periods of time, depending on our age, on the insight we have gained and even the place where we live and our mental outlook. Their significance and importance alter with the changes to our surroundings. Besides, every account is necessarily selective and certain judgments are only possible after a lapse of time.

I am now worried that I may not have provided a clear, objective and complete account of the facts and their settings. I note gaps, things I overlooked or failed to stress sufficiently. I remember facts that at first seemed insignificant and projects that absorbed much of my time without getting beyond the design stage and which I have omitted. A mass of fascinating, absorbing studies undertaken to test the validity of certain ideas and the feasibility of unorthodox concepts with which my work was studded and which I have passed over in silence.

Thinking of the men who have worked with me or for me (becoming numerous in my later years) with the common purpose of translating into reality concepts aimed at making automobiles safer and more useful, I realize that I have not been able to dwell on their abilities and merits. I know I have omitted the names of many who deserved to be mentioned for the contribution they made. I know also that the strenuous mental effort involved in their work makes designers especially sensitive. The work of designing subjects both mind and body to severe stress and is not always rewarded by even recognition, let alone appreciation, from the person who stands at the top of the ladder and gets all the credit. Creativity is not always considered a virtue.

Yet creativity lies at the heart of design and manifests itself through draughtsmanship, the indispensable means of expression, the designer's first and most valuable instrument. The design engineer should be aware of this and proud of it. A verbal description is not enough in technology. The drawing, embodying the design, is essential: redo it over and over again, perfect it until it is (I won't say certain, because nothing is certain in this world) at least highly probable that it will fulfill the result aimed at. The work of draughtsmanship stimulates the imagination, increases one's inventiveness. These considerations concern mankind in general and I should like to develop them further. Creativity is man's ability to produce new things, innovations in the unbounded sphere of science, technology, philosophy, every field of human activity as in art. It is felt as a natural drive towards possible new experiences. Scientific theories are generated by the creative imagination.

Whoever possesses a creative spirit usually displays a lively intelligence, a good dose of intuition, and is prone to give heed to what may seem irrational or unusual in himself and others. There are highly intelligent people with great powers of analytical reasoning who lack the richness and originality of ideas that distinguish those animated by the creative spirit. The latter may, it is true, appear psychologically unstable, even immature, but they have a capacity to extend their receptiveness to cover a range of experiences and patterns of behaviour which goes beyond the normal.

Modern political and industrial organizations tend to stifle and even suppress creativity. I have seen this happen even in small circles such as engineering offices. Men left on the sidelines. Snap judgments: "That won't work." Ironical comments.

Men in positions of responsibility often have an outlook that leads to success through conformism. They reject the unconventional and find it convenient to surround themselves with people who share their outlook and attitudes. Their decisions are shortsighted, their plans and actions lack the creative spirit.

By contrast, the man who is driven by this spirit resists prejudice and refuses to be halted even by what are generally considered impossible tasks. His approach and ideas are at variance with those of the conformist who prefers to climb on the bandwagon rather than think for himself.

When a company's work is based on the activities of committees its success depends on the individual's freedom to express himself and communicate and on an open-minded evaluation of his ideas, however radical they may seem at first glance. Decision-makers should be open to the most conflicting points of view, they should be able to tolerate doubts and uncertainties, and act after evaluating possible developments and foreseeable results, choosing if possible the shortest and most direct path.

It should be borne in mind that compromises are generally frustrating, while a creative undertaking repays by its success more than the difficulties involved. Creativity gives an added stimulus and scope to research. Without research progress would flag and without creativity the highest achievements are denied us.

Unfortunately it may happen that the decision-makers wield their power without realizing that their imagination and spirit of initiative have been sapped by an approach which is "systematic" but deficient in intuitiveness and intellectually impoverished.

The use of electronic computers leads to a tendency to treat every problem as if it were an exercise in systems analysis, distracting attention from the work or designing. In my opinion the mind loses in flexibility, the imagination becomes ossified and the insight needed to solve problems is blunted.

A design that is conceived and realized by a system organized for the application of a method in which a man is not valued for his individual qualities risks mediocrity and failure. As Saul Bellow has rightly said: "The system requires mediocrity, not greatness."

Another brake on creativity is bureaucracy, especially when it becomes an end in itself and degenerates into a lumbering and expensive mechanism. Bureaucracy and red tape weigh on relationships, creating offices whose only task is to control procedure and dull the spirit of enterprise, acting as a clog on action. For designers, bureaucracy can easily become an unbearable encumbrance, a time-waster, appearing to them as proof of the management's lack of confidence in them. Modern life is stuck with bureaucracy but it should be rationally organized so that its advantages are maximized and its disadvantages minimized. I was lucky enough to work in a set-up where bureaucracy was cut to the indispensable minimum.

The reader who took up this book hoping to find descriptions of the technological innovations which progressively improved the automobile's reliability, comfort and handling will probably feel disappointed. He will feel that I indulged myself in recounting personal episodes involving designs and projects while neglecting to go into technical details, which also interest automobile fans. But such people are well provided for by newspapers, reviews, books and encyclopedias that specialize in the subject.

I hope they will have found some compensation in hearing about things that were only known – and then solely in part – to the few people involved. Events belonging to the history of the automobile that testify to Italy's contribution to the technical and artistic development of this machine which seems to have become indispensable to man. I would be satisfied if the reader, mulling over these pages, learns to see something in the automobile that transcends the material, unvarying functioning of its mechanical parts.

No other machine gives that personal sense of extending and enhancing one's physical and mental powers. Of all the inventions of the past century, the auto is the one that has made the most profound impression on our way of life. It has freed the individual from the trammels of time and space. The range of our activities and the scope of our work have been immensely enlarged. It has created a broader sphere of interests and made a major contribution to the rapidity of change, steadily increasing until a few years ago, that distinguishes our modern civilization.

I have devoted the best part or my lifetime to this extraordinary machine, with passionate enthusiasm, but I must say that I have loved it above all because its intrinsic and aesthetic qualities make it the most attractive and stimulating subject for the work of the draughtsman, the engineer and the automobile designer.

Like Candide I can say that I have cultivated my garden.

I hope this book of mine will be of some use to the people at Fiat and encourage those who have taken the torch from my hands as they tread the path of progress and will one day pass it on to others in the quest for new goals.

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