

The conservative restoration brings the 1907 Fiat 130 HP back on the track

O restauro conservativo traz o Fiat 130 HP de 1907 de volta às pistas

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Abstract

The Fiat 130 HP, from the collection of the Museo Nazionale dell'Automobile of Torino, was the winner (driven by Turinese driver Felice Nazzaro) of the 1907 Grand Prix of the French Automobile Club, which took place on the Dieppe circuit. The car underwent a painstaking conservative and functional restoration from 2019 to 2021: this restoration has been essential for the museum to consolidate a new method, which considers historic cars as works of art and which follows the restoration guidelines of cultural heritage. Interventions were coordinated by MAUTO Restoration Center and carried out by craftsmen specialized in this sector. They included both the mechanics, which required thorough works, including the reconstruction of structural elements of the engine, and the bodywork, whose original color was rediscovered through scientific analyses. Other elements, which had been changed over the years and did not respect the original features of the vehicle, were corrected.

Resumo

O Fiat 130 HP, da coleção do Museo Nazionale dell'Automobile de Turim, foi o vencedor (conduzido pelo piloto turinês Felice Nazzaro) do *Grand Prix*, do Automóvel Clube Francês, de 1907, que teve lugar no circuito de Dieppe. O carro foi submetido a um restauro conservativo e funcional de 2019 a 2021. Este restauro foi essencial para o museu consolidar um novo método, que considera os carros históricos como obras de arte e que segue as orientações de restauro do património cultural. As intervenções foram coordenadas pelo Centro de Restauro MAUTO e realizadas por artesãos especializados neste sector. Incluíram tanto a mecânica, que exigiu trabalhos profundos, incluindo a reconstrução de elementos estruturais do motor, como a carroçaria, cuja cor original foi redescoberta através de análises científicas. Outros elementos, que tinham sido alterados ao longo dos anos e que não respeitavam as características originais do veículo, foram corrigidos.

KEYWORDS

Conservation
Historic car
Engine
Grand Prix
Felice Nazzaro
Functionality

PALAVRAS-CHAVE

Conservação
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Felice Nazzaro
Funcionalidade

Introduction

The Fiat 130 HP (Figure 1) was the protagonist of an extraordinary feat with its victory in the 1907 French Grand Prix. The car was driven by Felice Nazzaro, a Torino-born driver and test driver, who proved his skills by taming a racing car with unique technical features. The car is powered by a 4-cylinder twin block vertical engine with a capacity of over 16,000 cc, featuring innovative V90° overhead valves, 130 HP power, and a weight of 1025 kg. With a four-speed gear change, it reaches 160 km/h, topping 200 km/h. The cooling system consists of a huge radiator with over 8000 small brass tubes, in which water flows under the thrust of a centrifugal pump located in the bottom right side of the engine crankcase. The engine features a mixed splash and total loss lubrication system; oil drops onto the several bearing brasses from a mechanical pump, located on the dashboard, which consists of several pumping elements placed in a tank [1-2].

Many original mechanical parts remained, as proven by the “FN” punches (the initial letters of Felice Nazzaro): this feature proves the unbelievable authenticity and originality of this unit.

In recent years, this incredible car, which now belongs to the MAUTO – Museo Nazionale dell’Automobile in Torino, underwent a painstaking restoration aimed at solving a serious problem with its engine, which broke after a dynamic demonstration in the late 90s. The engine had such serious gaps in both the cylinder blocks and the crankcase that its look and functionality had changed. The complex works, which have given new life to one of the cornerstones of Italian racing cars at the dawning of sports races, has become a key case study on the dynamic conservative restoration method.



Figure 1. The fiat 130 HP 1907 after the restoration work.

The history of the Fiat 130 HP

The year of 1907 marked a symbolic moment for the history of automobile: besides the triumphal victory of Itala in the Beijing-Paris race, that was a year of sports wins for Fiat and of great mechanical development in all sectors. Back then, the international sports season was dominated by three races: the Targa Florio along the Madonie circuit, the Emperor Cup on the Taunus circuit, and the French Grand Prix at Dieppe, each one with its own rules. Car manufacturers were obliged to have different types of cars, whose features satisfied each specific type of race formula. Fiat focused on racing and committed to design three very different engines, which were entrusted to a team of drivers headed by Felice Nazzaro. The three cars became famous as the Fiat 28/40 HP “Targa Florio”, the “Fiat Taunus” and the Fiat 130 HP “Grand Prix de France”: all three of them featured a 4-cylinder twin block vertical engine, four-speed gear change, chain transmission, pedal break on the differential gear, wooden wheels, and ignition system with a LV (low voltage) magneto. Nazzaro made a clean sweep in all three competitions, earning Fiat an outstanding status (Figure 2) [3].

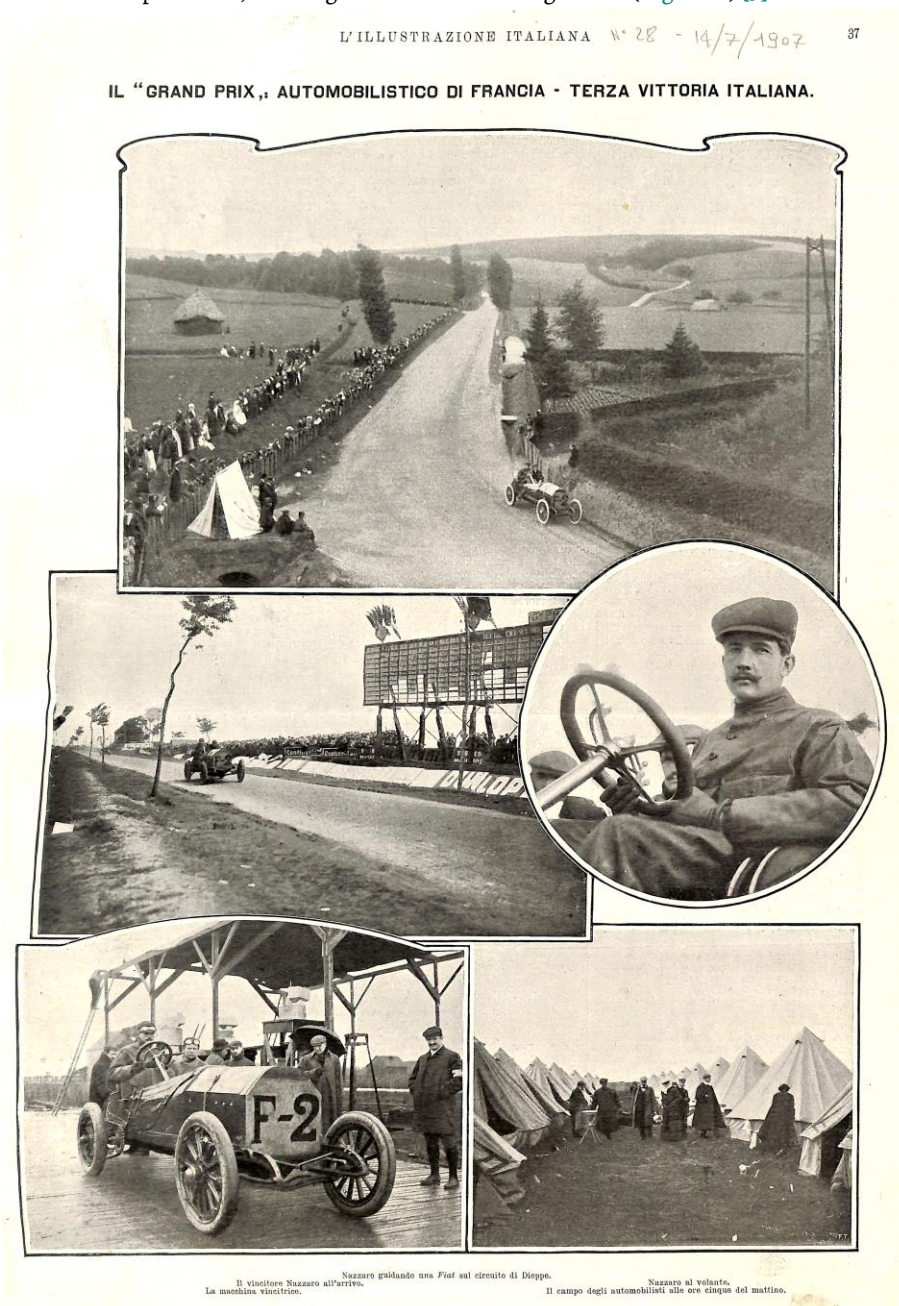


Figure 2. An article on the Fiat F2's victory at the French Grand Prix [4, p. 37].

The design and the Grand Prix

The Fiat 130 HP derived from the 100/110 HP, whose design had been entrusted to Giovanni Enrico, an engineer: a mechanical behemoth with a capacity of over 16,000 cc, featuring innovative V90° overhead valves, 130 HP power, and a weight of 1025 kg, capable to achieve the speed of 160 km/h, topping 200 km/h. Three units were made for the Grand Prix of France: at the wheel were Vincenzo Lancia (under the name of F1); Felice Nazzaro (F2) and Louis Wagner (F3) [5]. Nazzaro's sports masterpiece took place on the Dieppe circuit. After a very prudent start to save fuel, the driver, who had already won the Taunus and the Targa Florio, slowly increased its pace according to a time scheme, using up all resources of his car in a grand finale [6]. The overall average speed of over 113 km/h was achieved by Nazzaro by carefully rationing consumption: when the tank was checked after his victory, it appeared that he had been able to save 12 L out of the 230 L allowed (the consumption admitted was up to 30 L per 100 km, for a 770 km distance) [7].

From the Grand Prix to the arrival at the museum

A few years after its incredible victory, the mechanical project of the Fiat 130 HP was already obsolete, but the prize record of this car won it a place in the French branch of Fiat, which was run by E. Loste; as it often happened with car manufacturers that achieved outstanding victories in sports races, Fiat used its successful car to advertise the brand.

The trail of the Fiat "F2" was lost in the 1910s, until Auguste Antony, a famous mechanic and manufacturer of cyclecars, became its owner: in order to drive it on the road, he made technical improvement to the mechanics, added headlamps, indicators and the number-plate; some recently discovered pictures witness these changes [8].

After the end of World War II, Francis Mortarini, a famous French trader of historic cars, rediscovered the relics of the Fiat 130 HP in Antony's garden: so, he decided to buy it and get it restored, during which he eliminated some of the additions made by Antony, and subsequently proposed it for sale to Carlo Biscaretti di Ruffia for the Museo Nazionale dell'Automobile [9]. The museum had no funds available for the purchase, and he asked Fiat for help: Fiat tried to exchange it for a new 1100, but the price asked was much higher. Fiat, however, provided the funds required for the purchase and, before donating the car to the museum in 1956, carried out a second restoration to correct the previous restoration mistakes made by Mortarini [10].

The car has been on display at the museum since 1956, and is rarely started. Only in the 70s it takes part in some important events in Italy and abroad, such as the 1974 "Semaine Internationale Automobile", held on the occasion of the eightieth anniversary of the Automobile Club of France. The last one was at the end of the 90s, when during an event it suffered the breakdown of the carter and cylinder block.

The restoration

As mentioned in the introduction, the engine of the Fiat 130 HP was seriously damaged, which made it impossible to admire, both statically and dynamically, one of the racer engines characteristic of the early twentieth century. A painstaking conservative functional restoration was carried out from 2019 to 2021. The works, coordinated by the Restoration Center of the MAUTO, and carried out by artisans specialized in this sector, included: the mechanical section, which required thorough interventions, because of a break in the front cylinder block after the engine packed up in the late 90s, including the reconstruction of structural parts of the engine; the bodywork, which had been modified several times over the years without respecting the original features of the car. Through studies and scientific analyses, the materials of the car have been examined to correct elements not in keeping with the original historical period were corrected.

The bodywork

Though the original project only included works on the mechanical part, it soon seemed clear that also the bodywork required restoration. In fact, previous restoration works had greatly changed the look of the car, even if its bodywork had always been painted various shades of red.

After the car was disassembled, the frame, without the mechanical part, underwent several studies and analyses, which led to the identification of its original color under several elements that had never been disassembled. The original color was analyzed through a spectrophotometer and resulted of a definitely darker shade; unfortunately, a very little quantity of the original paint was left and therefore the decision was made to fully repaint it. However, the Italian legislation does not allow the use of paints in use at the beginning of the 1900s, therefore a modern paint has been used, with RAL similar to the original, and applied by brush. Additionally, during the paint stripping stages several brass elements were identified that had been wrongly painted: they were cleaned, and oxides were removed [11].

The radiator

One of the most demanding works was the reconstruction of the radiator. In order to preserve the original features of the piece, the decision was taken to rescue the external brass shell of the radiator and fully reconstruct the radiating mass. About 90 % of the original mass was clogged with scale and dirt, and several spots had been repaired, which cut off some areas. The cooling water no longer flowed properly and overheating, breaks or damages to the mechanical parts of the engine could likely occur.

So, it was necessary to carefully unsolder the brass shell of the radiating mass and then, after counting the number of brass tubes forming the radiator, cut each tube in the predetermined length. The most painstaking work was creating a template for the craftsman to insert each tube, leaving a 1-mm space between each other in order to let water flow properly and obtain the best cooling power. Once the pre-assembly work was carried out, the radiating mass was soft-soldered and subsequently joined to the external shell in a single body (Figure 3) [12].

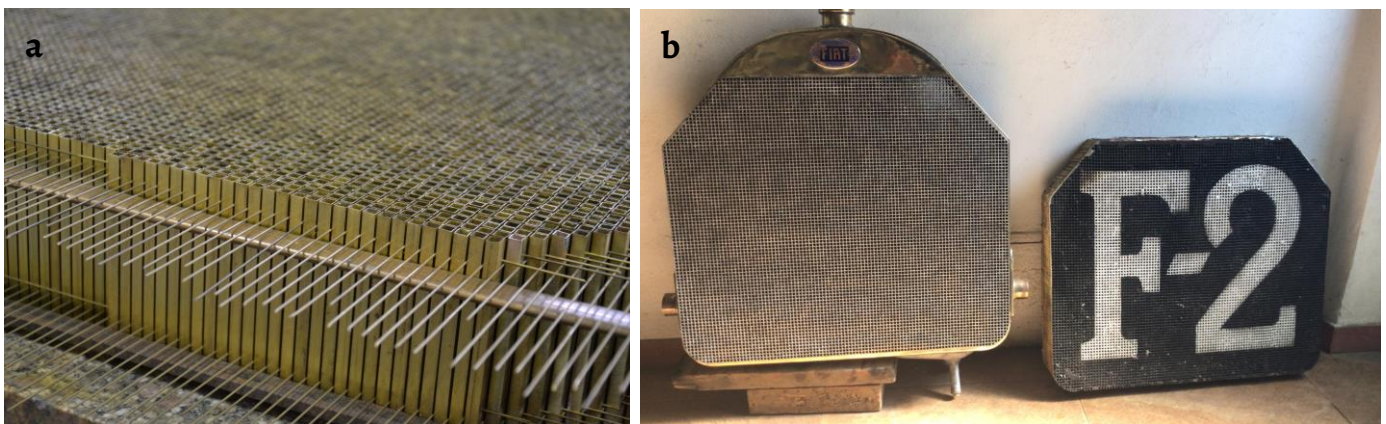


Figure 3. Radiating mass: a) the construction; b) on the left the completed radiator and on the right the original radiating mass (now preserved in the museum depots).

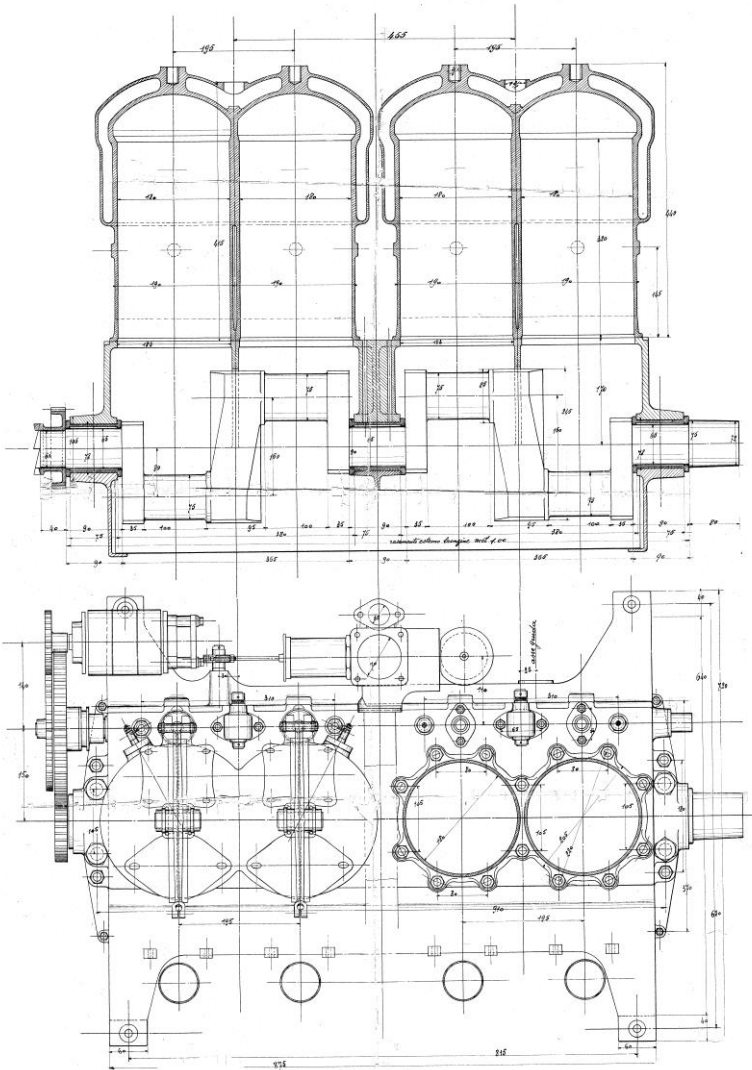
The engine and the mechanical parts

Analysis of the projects

Research carried out on historical documents kept at the Documentation Center of the MAUTO and the Fiat Historical Center before starting the restoration works showed the existence of a number of original designs (Figure 4). In particular, they were essential to thoroughly study the several structural elements of the engine, gear and clutch. And they were valuable in reconstructing mechanical parts and missing or non-original elements [13].

a

Compressore Motore 100 II tipo 1905 (dettaglio)



b

Pompa centrifuga per Motore 100 II tipo 1905 (diam. 110 mm 1500^o). Scandaglia Siderale.

200.11

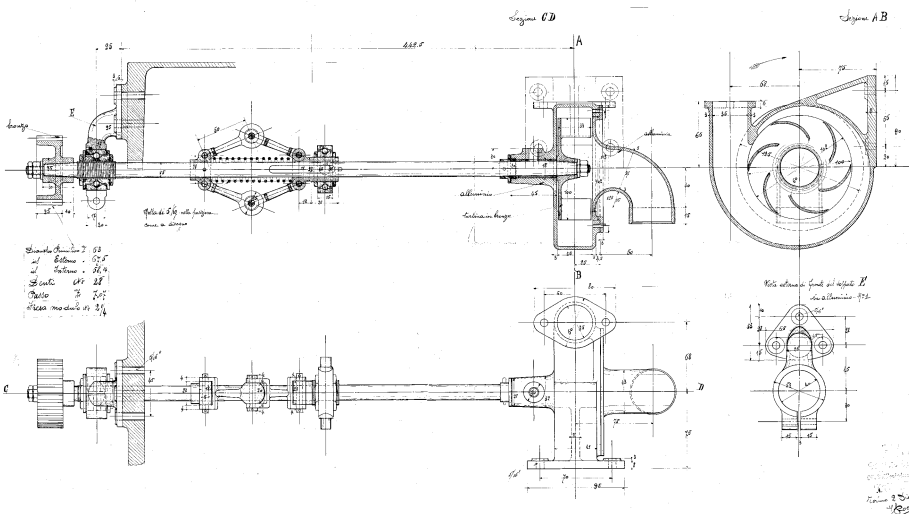


Figure 4. The original technical drawings from Centro Storico Fiat [14]: a) cylinder blocks and carter; b) water pump and watt regulator.

Disassembly

The restoration work started by disassembling all parts of the car in order to evaluate in detail all works to be carried out. For a proper analysis, also the engine was disassembled in order to check the size of the damage occurred when the engine packed up [15-16].

A careful restoration project was made only after accurately studying the historical documents and fully disassembling the car: with a view to restore the vehicle to its operational condition, the project kept in mind the originality and the incredible history of this unit [17].

Reconstruction of the crankcase and the sump

As the results of the engine breakdown, the crankcase and the sump were heavily damaged and twisted, and brakes and gaps could be no longer rescued. The material itself, aluminum, could be no longer repaired and, consequently, the decision was taken to replace those parts; the original elements are currently kept in the museum storage areas.

In order to manufacture these elements properly, the metal alloy was analyzed with a quantometer, Optical Emission Spectrometer for the analysis of solid metals with ferrous and non-ferrous matrices (Bruker Q4 Tasman), a non-destructive analytical instrument, which revealed a 9 % aluminum and silicon alloy. Then, a 3-D scanning was made, which made it possible to digitally reconstruct the elements. Thanks to these new technologies, the original technical drawings were compared with the digital reconstruction and small adjustments could be made, so that the crankcase and the sump could be properly re-created. Starting from the digital reconstruction, the sand casting mold was made through quick prototyping, then the melting with Al-Si (9 %) alloy was carried out. One new piece only can be made with this methodology, since, once the casting is finished and cooled, the sand mold must be destroyed to take out the raw finished product. Finally, the cast was finished by sanding, smoothing and polishing (Figure 5).

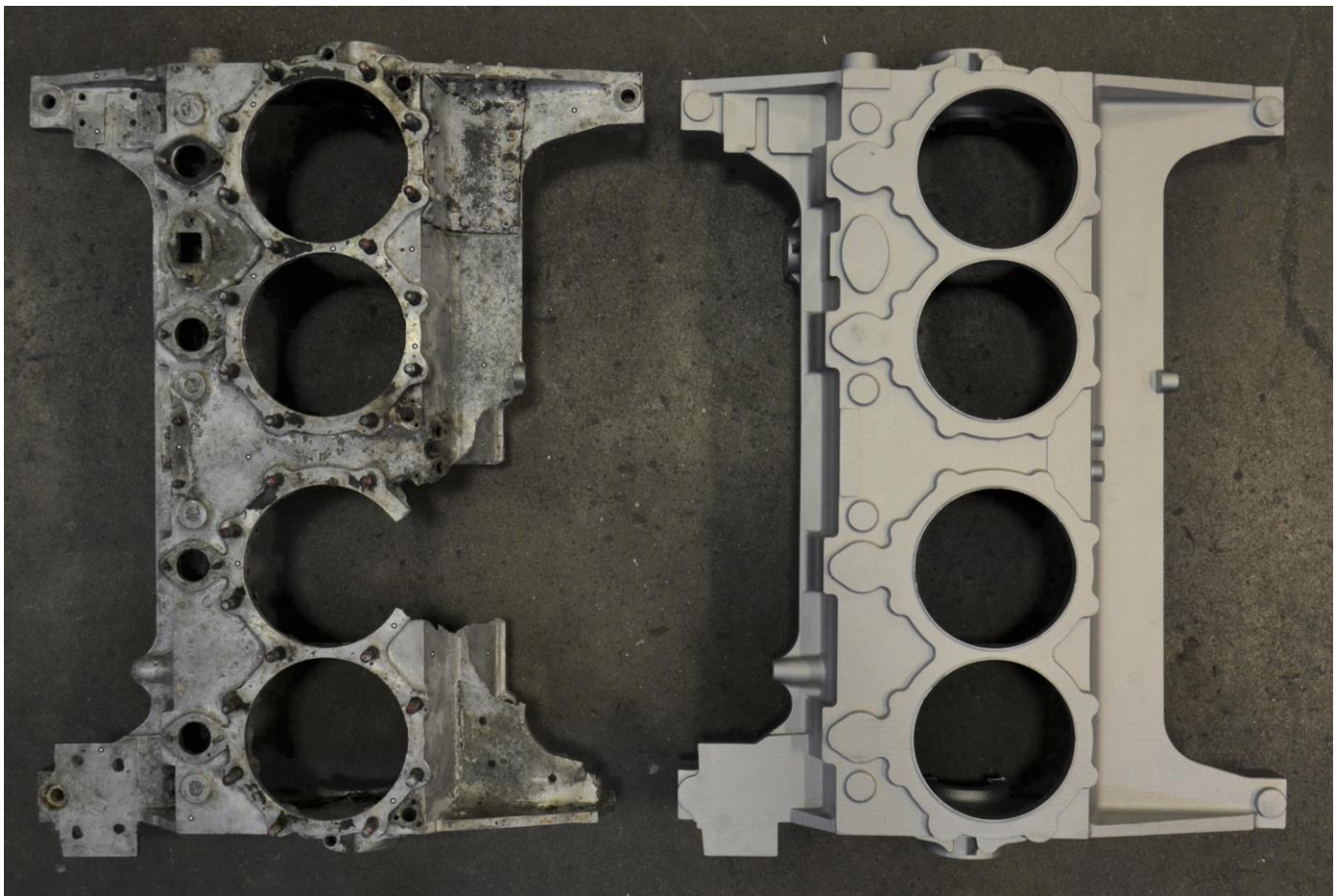


Figure 5. The original carter and the rebuilt one.

Then, the oil drains in the crankcase were reconstructed with a fully handmade work, which was carried out by copying the drains and the relevant inclinations of the original crankcase. These drains serve to collect oil, which is poured onto the engine walls by splashing when the engine is running. Oil is collected in these drains and, when it drops, lubricates the main bearing brasses [18].

Restoration of the cylinder block

Also the front cylinder block showed strong damages and gaps caused by the breakdown and, after a deep analysis, the decision was taken to repair it with a cast iron inset. In order to make this piece, it was necessary to start from a cast iron cylinder that reproduced the end part of the cylinder block leaning onto the basement, and then to cut a section of this ring to insert it in the missing part of the cylinder block. The new inset and the cylinder were joined by a welding process (Figure 6) that included heating the entire cylinder block. Then it was slowly cooled for 24 hours by dipping the entire block into a container filled with vermiculite, a mineral with excellent insulating properties. The original block was preserved thanks to this very complex work. During the cylinder block repair process, also the inlet valve, which was broken and showed several cracks on the cylinder head, was repaired [19].

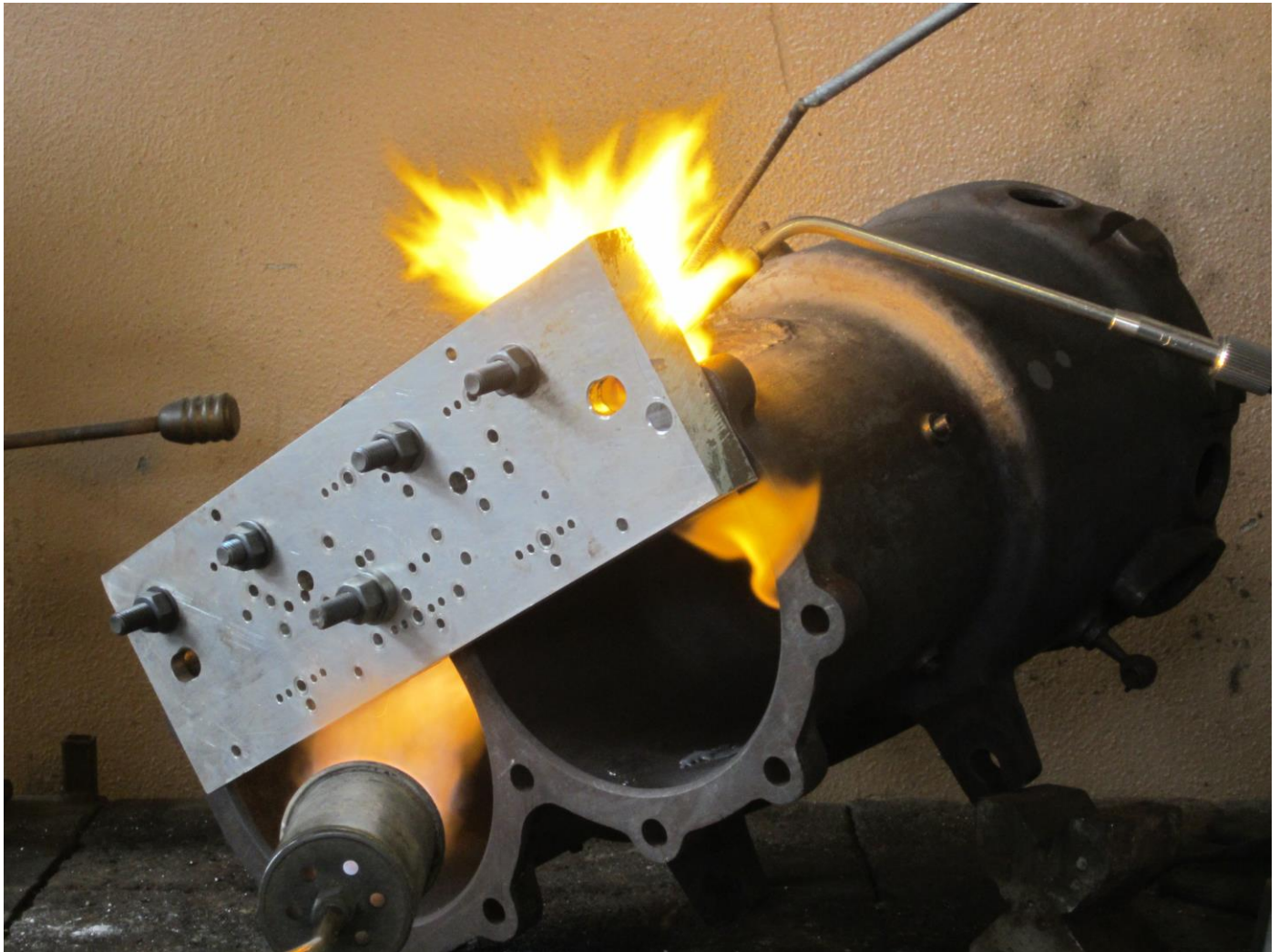


Figure 6. The welding of the cylinder block.

Revolution control and magneto

In the 1910s, Antony removed the revolution control of the car, which is a key element for the proper engine operation. The control designed by engineer Enrico, similar to a centrifugal governor, was originally linked to the FIAT carburetor. Due to the modernization of the car ignition and carburetion system, the Fiat carburetor had been replaced with a more reliable Claudel carburetor in the 1910s. On that occasion, the revolution control was eliminated, and a mechanical revolution counter was added. The decision was taken to restore the revolution control and connect it with the high voltage magneto ignition system for electricity to be disconnected when the revolutions established for the engine were exceeded [20-21].

The Bosch magneto in the car was in good conditions and only had to be magnetized again and the lightning conductor had to be reconstructed. The museum purchased a second magneto, which will be used as spare part in case of emergency [22].

Reconstruction of mechanical parts

Some mechanical parts had to be reconstructed, because they did not properly perform their function. They included pistons and segments, piston-rods (Figure 7), inlet and exhaust valves, camshaft, water pump and runner, and main bearing brasses. The latter ones were made of white metal, as they appear in the original drawings, and the inner grooves, which distribute oil onto the surface, were handmade as in the original unit. Specific patterns and tools often had to be made for complex operations like these [23].

In previous restoration works, original bolts and nuts had been replaced with commercial bolts and nuts. 90% of the bolts were reconstructed as they appear in the original drawings. As a matter of fact, since this was a racer, engineer Enrico designed special low nuts and hollow-head bolts to reduce their weight.

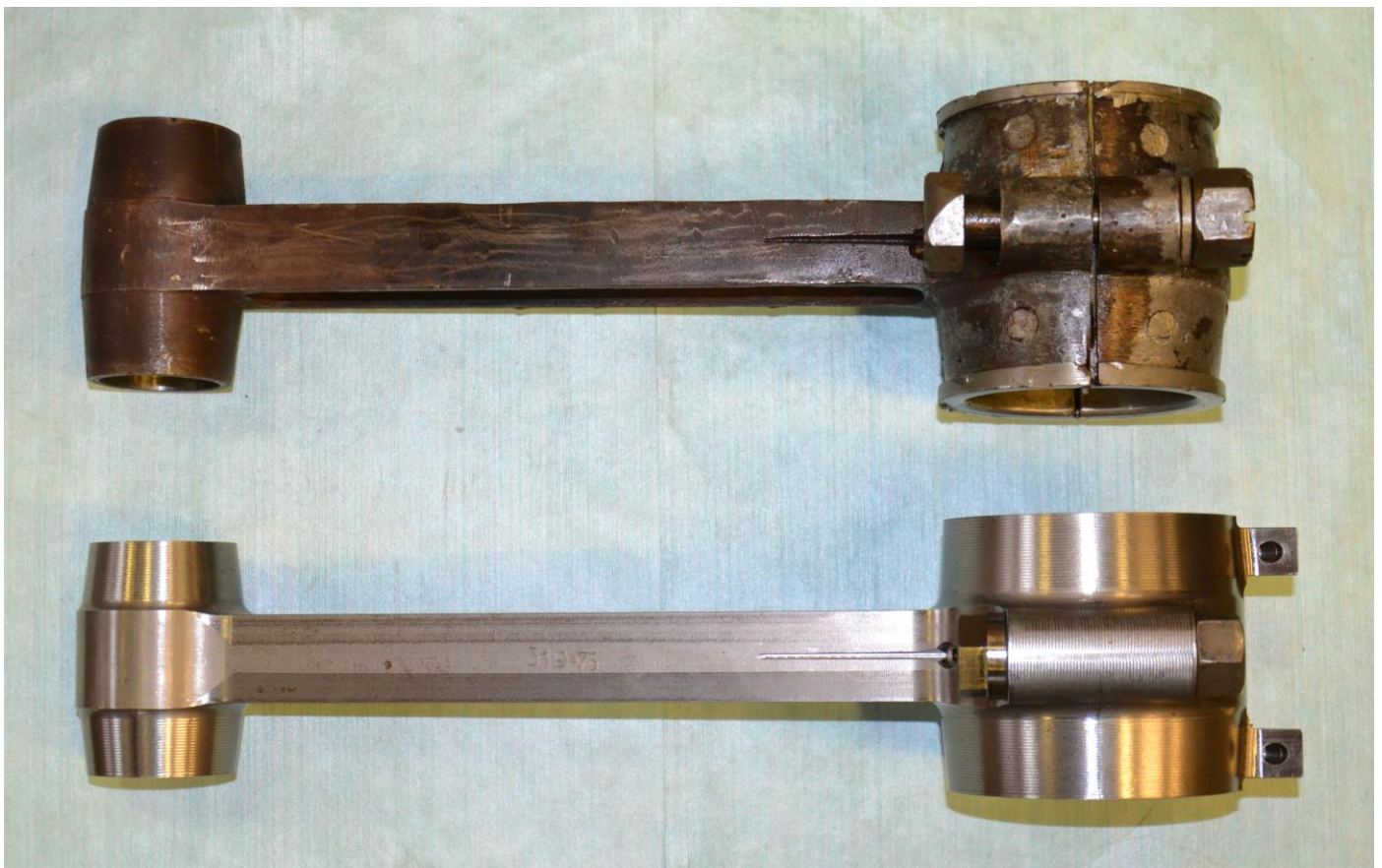


Figure 7. The original piston-rods and the rebuilt one.

Crankshaft restoration and balancing

The crankshaft has been straightened, rectified and strengthened in the rear main bearing, where a previous strengthening work had been carried out as the result of the breakdown of piston no. 4. This old repair has been strengthened for safety in order to avoid future cracks in that area. Additionally, brass closing cups, which collected oil to lubricate the bearing brass of the piston-rods, have been made. The flywheel was in good conditions and was balanced with the crankshaft (Figure 8) [24].



Figure 8. Crankshaft balancing.

Brench tests and circuit tests

After the full restoration of the mechanical parts, the engine was reassembled and tested on the bench for dynamic stability tests, fine-tuning and final adjustment. The engine was tested for over 40 hours of actual running (Figure 9).

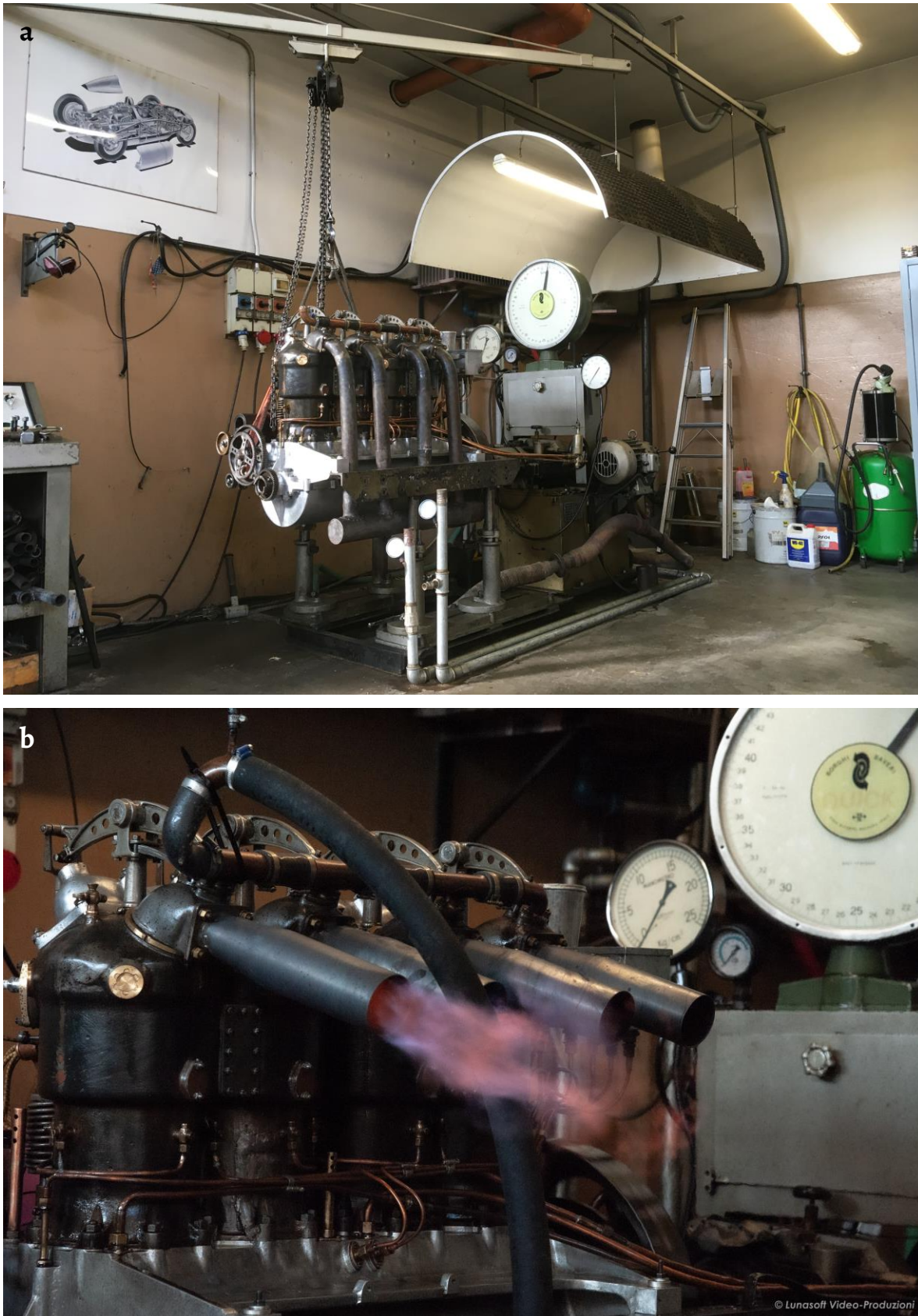


Figure 9. a) The engine on the test bench; b) engine tested on the test bench with free exhaust.



Figure 10. The positioning of the engine on the chassis.

After the initial tests, when the engine was connected with the original silencer, the decision was taken to use the open exhaust. Even if the silencer unit was strongly bolted to the bench and the engine, the strong stress and vibrations made it rock, which caused small cracks around the valve seat of cylinder number 4. In order to avoid further problems with the engine's original casts, then, four funnels were assembled that functioned as open exhaust. These funnels were also planned in the original project of the car, which could be used with either this system or the low silencer if the regulations of a specific race so required (as in the French Grand Prix).

Once the tests were over, the engine was positioned on the frame with the relevant alignment with the change gear and leveled on its supports, and the car was reassembled (Figure 10).

Finally, the Fiat 130 HP was tested several times on both unpaved roads, which were most common back in time, and on a circuit, where, on the contrary, top speed, acceleration, braking times and operation at different numbers of revolutions with the adjustment of advancement and delay were tested [24].

Conclusion

The restoration of this unbelievable unit has led the Restoration Center of the MAUTO to consolidate a new working method on historic cars, which follows the restoration principles and guidelines of cultural heritage and applies the foundations set out in the Charter of Turin. Cars are studied, starting from the materials kept at the Documentation Center of the Museum, analyzed and restored with scientific methods, but are mechanically functional at the same time: this requires an accurate study of each element, which considers their originality, proper functionality and safety.

Setting in motion such important vehicles from the historical and technological point of view is key to pass on to new generations technical, scientific and mechanical aspects that currently are no longer found in cars, yet are the evidence of car evolution. Additionally, hearing, listening, and observing these engines take visitors back in time and let them feel the same thrill and feelings of the audience attending races in the early 20th century, when these cars were ignited before the start-line.

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