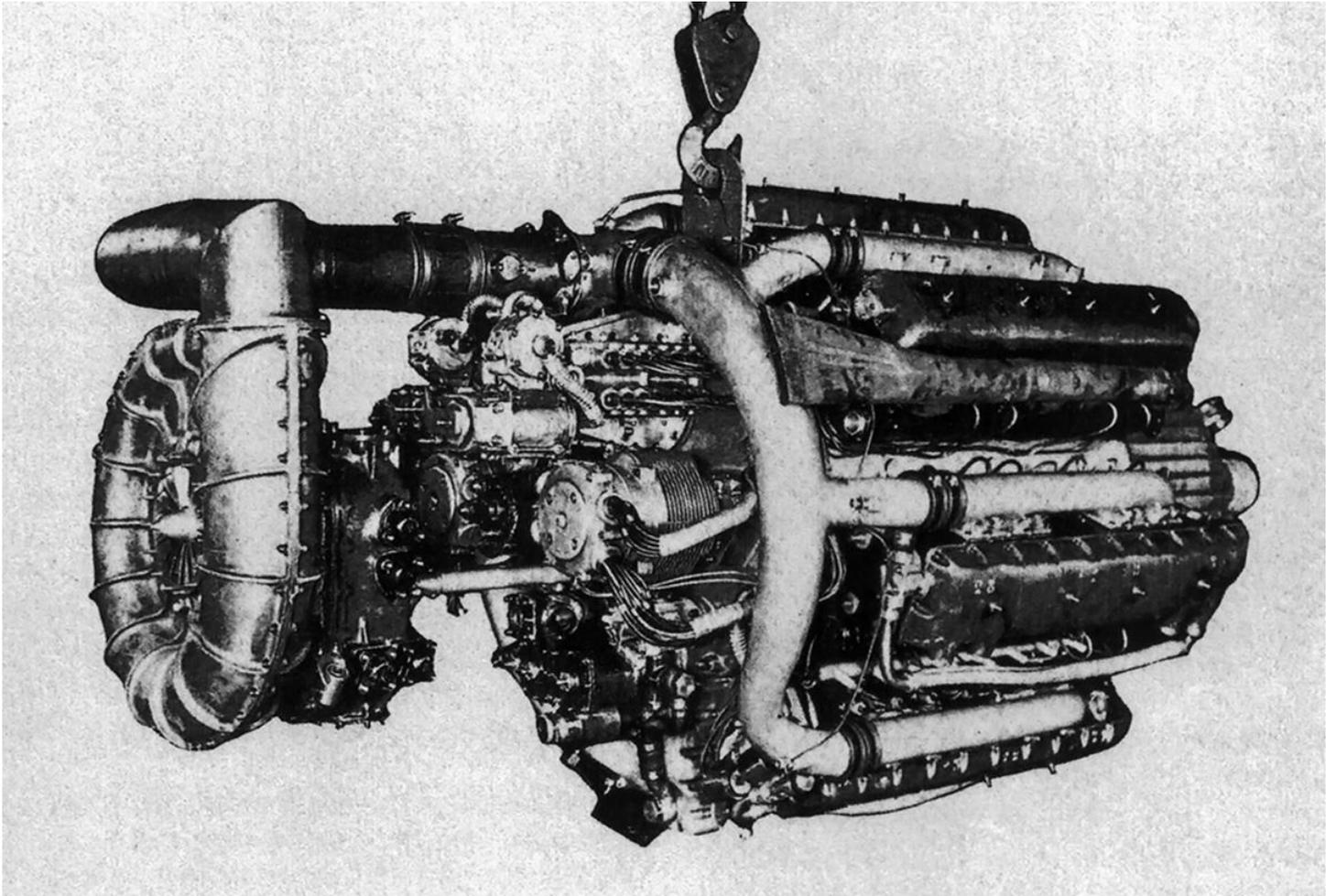


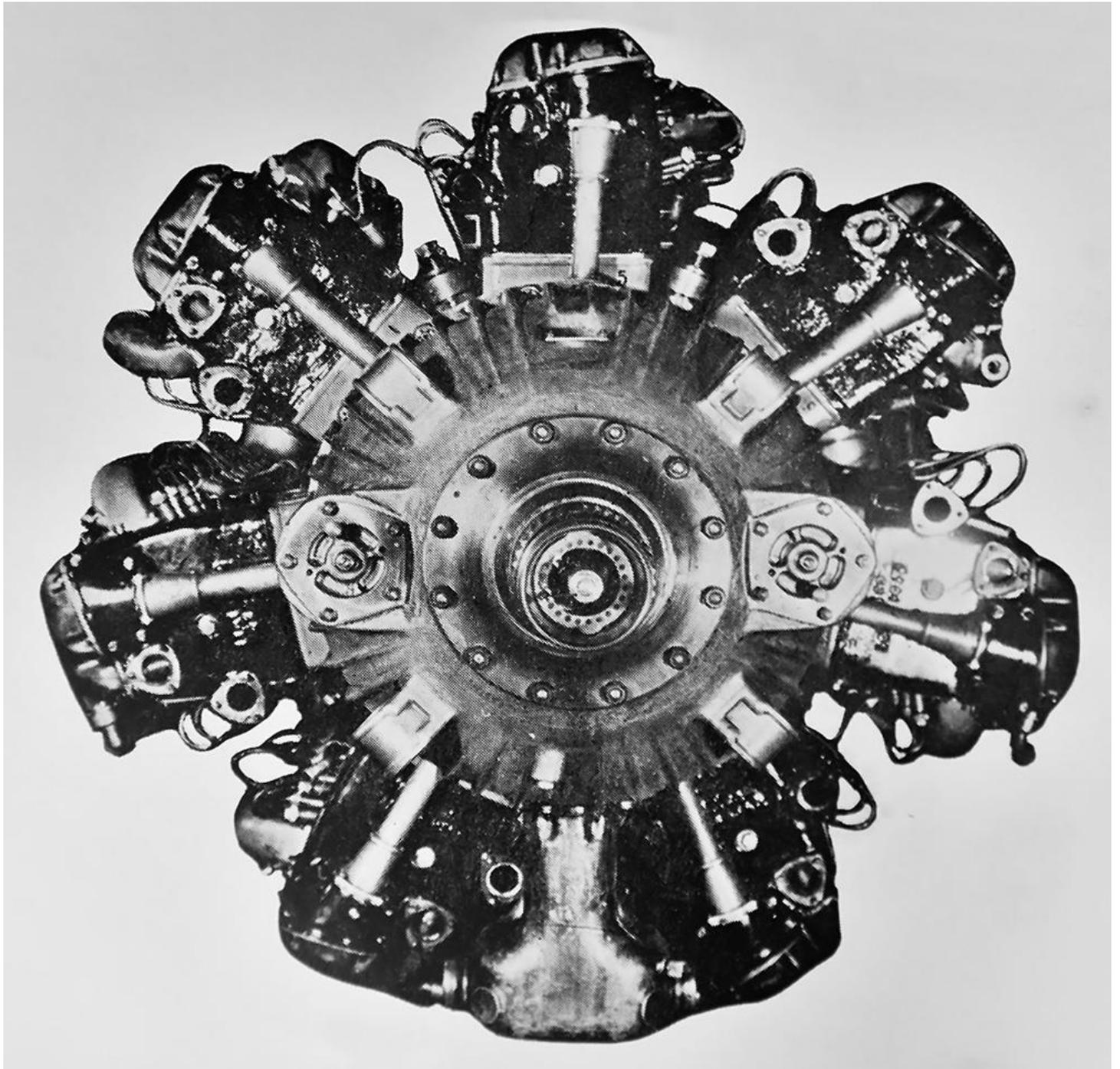
Alfa Romeo 1101



In the early 1930s, Alfa Romeo began to build aircraft engines based on foreign designs that it licensed for production. By 1938, Alfa Romeo had obtained licenses to produce the Armstrong Siddeley Lynx, Bristol Jupiter and Pegasus, De Havilland Gypsy Major and Gypsy Six, and Walter Sagitta inverted V-12. The company had also used its knowledge and experience with licensed production to design its own engines. However, Alfa Romeo's own D-series radial engines of the early 1930s were not successful, and its 135 engine, an 18-cylinder air-cooled radial first run in 1938, suffered from reliability issues. Giustino Cattaneo had designed the 135, but he left Alfa Romeo in 1936, before the first engine was built. Still, the design of these original Alfa Romeo engines owed much to the foreign engines built under license. In 1938, Ugo Gobbato, Managing Director of Alfa Romeo, tasked the Special Studies Service (Servizio Studi Speciali / SSS) to design an entirely new aircraft engine. The SSS was Alfa Romeo's secret or special projects department. Wifredo Ricart, a Spaniard who escaped his country's civil war and fled to Italy in 1936, was in charge of the new engine's design, which was designated 281.

The 281 was an inline radial that consisted of seven cylinder banks, each with four cylinders. The liquid-cooled engine was equipped with a single-speed, single-stage centrifugal supercharger. The 281 engine had a 4.72 in (120 mm) bore, a 4.33 in (110 mm) stroke, and displaced 2,126 cu in (34.83 L). With the bore larger than the stroke, the oversquare engine was designed to have a relatively small diameter and operate at higher rpm. The engine had an estimated output of 1,480 hp (1,089 kW) at 3,000 rpm. The 281 was designed with then-current power requirements in mind, but did not consider future demands for power increases. The 281 design produced basically the same power as the 135, although it was 35 in (.88 m) in diameter compared to 55 in (1.40 m) for the 135. Realizing that a more powerful engine was needed, Ettore Pagani, also of the SSS, completed a design study in 1939 of an enlarged 281 to produce an excess of 2,000 hp (1,471 kW). This engine became known as the 1101. The 281 was never built.

The Alfa Romeo 1101 was initially designated 101, but it was also referred to as the 1.101 and 1.1.01. However, 1101 has become the most common designation. The design team for the 1101 consisted of Ricart, Orazio Satta, and Giuseppe Busso. The engine had a cast aluminum crankcase with seven cylinder banks mounted radially around its center and spaced at 51.4 degrees. The upper cylinder bank extended vertically from the crankcase. Each cylinder bank contained four cylinders and was made from cast aluminum with an integral cylinder head. Wet cylinder liners made of nitrided steel were installed in the cylinder block. Each cylinder had one intake valve and one sodium-cooled exhaust valve. The intake valve was 2.56 in (65 mm) in diameter, and the exhaust valve was 2.20 in (56 mm) in diameter. The valves for each cylinder bank were actuated via hydraulic tappets by a single overhead camshaft. The camshaft was driven by bevel gears and a vertical shaft from the front of the engine. The one-piece crankshaft was supported by five main bearings. The pistons for each row of cylinders were served by a master connecting rod with six articulated connecting rods. The cylinders had a compression ratio of 6.5 to 1.



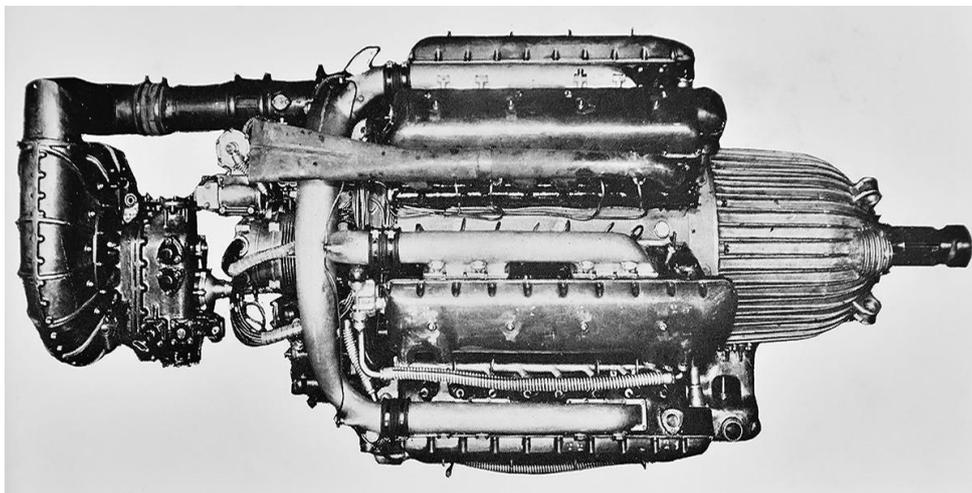
Front view of the 1101 illustrates the vertical drives for the camshafts. The four mounts on the front of the gear reduction are visible. A sump is positioned between the two lower cylinder banks.

Mounted to the front of the engine was a propeller gear reduction. Via planetary bevel gears, the propeller shaft rotated at .400 times crankshaft speed. Mounted to the rear of the engine were two fuel injection pumps and two magnetos. The primary injection pump had a maximum flow of 423 gallons (1,600 L) per hour and delivered fuel to the injectors mounted in the intake side of the cylinder head. The secondary fuel injection pump had a maximum flow of 132 gallons (500 L) per hour and delivered methanol (methyl alcohol) to injectors located in the intake manifold just before the intake port of each cylinder. The methanol was used to increase maximum power and reduce detonation. Each of the two magnetos fired one of the two spark plugs mounted in each cylinder.

A shaft extending from the rear of the engine powered a remote, two-speed, centrifugal supercharger. The 1101 engine as built did not have a supercharger mounted in a housing that attached directly to the rear of the crankcase. Some sources indicate that the engine had a two-stage supercharger, but photos show just the remote supercharger with no other stage apparent. Two-stage supercharging was certainly planned for future versions of the 1101 engine. Air entered the back of the supercharger, where it was compressed to provide 11.4 psi (.78 bar) of boost. A duct extending from the supercharger was intended to incorporate an aftercooler, but surviving photos do not show one installed. From the duct, the air entered a semi-annular manifold located at the rear of the engine. Seven individual runners extended from the semi-annular manifold and connected to each cylinder bank. The runners had four outlets grouped in two pairs of two and mounted to the left side of the cylinder bank. Each cylinder bank had four exhaust ports on its right side, and the exhaust ports for the middle two cylinders of each bank were grouped together.

A centrifugal water pump, most likely mounted to the lower rear of the engine, flowed coolant at 14,530 gallons (55,000 L) per hour. The coolant was a mix of 70 percent water and 30 percent ethylene glycol. Double dynafocal engine mounts were located on the back side of each cylinder bank. The propeller gear reduction housing also had four mounts.

The engine was officially designated Alfa Romeo 1101 RC37/87. The "RC" stood for Riduttore de giri (gear reduction) and Compressore (supercharged), and 37/87 designated the critical altitudes (in hectometers) at which maximum continuous power was obtained with its two-speed supercharger. The engine had a 5.31 in (135 mm) bore and a 4.92 in (125 mm) stroke. This gave the 1101 a displacement of 3,057 cu in (50.10 L). However, since the strokes of the articulated rods were slightly longer than that of the master rod, the engine had an actual displacement of 3,066 cu in (50.25 L). Takeoff power was 2,200 hp (1,618 kW) at 2,625 rpm. For one minute at emergency power and 2,800 rpm, the engine produced 2,300 hp (1,692 kW) at 7,546 ft (2,300 m) in low gear and 2,150 hp (1,581 kW) at 26,247 ft (8,000 m) in high gear. For five minutes at military power and 2,700 rpm, the engine produced 2,000 hp (1,471 kW) at 10,827 ft (3,300 m) in low gear and 1,900 hp (1,398 kW) at 28,215 ft (8,600 m) in high gear. Maximum continuous power was achieved at 2,625 rpm, with the engine producing 1,850 hp (1,361 kW) at 12,139 ft (3,700 m) in low gear and 1,750 hp (1,287 kW) at 28,543 ft (8,700 m) in high gear. The 1101 had a diameter of 44.7 in (1.14 m) and was 97.2 in (2.47 m) long. The engine weighed 2,535 lb (1,150 kg) without accessories.



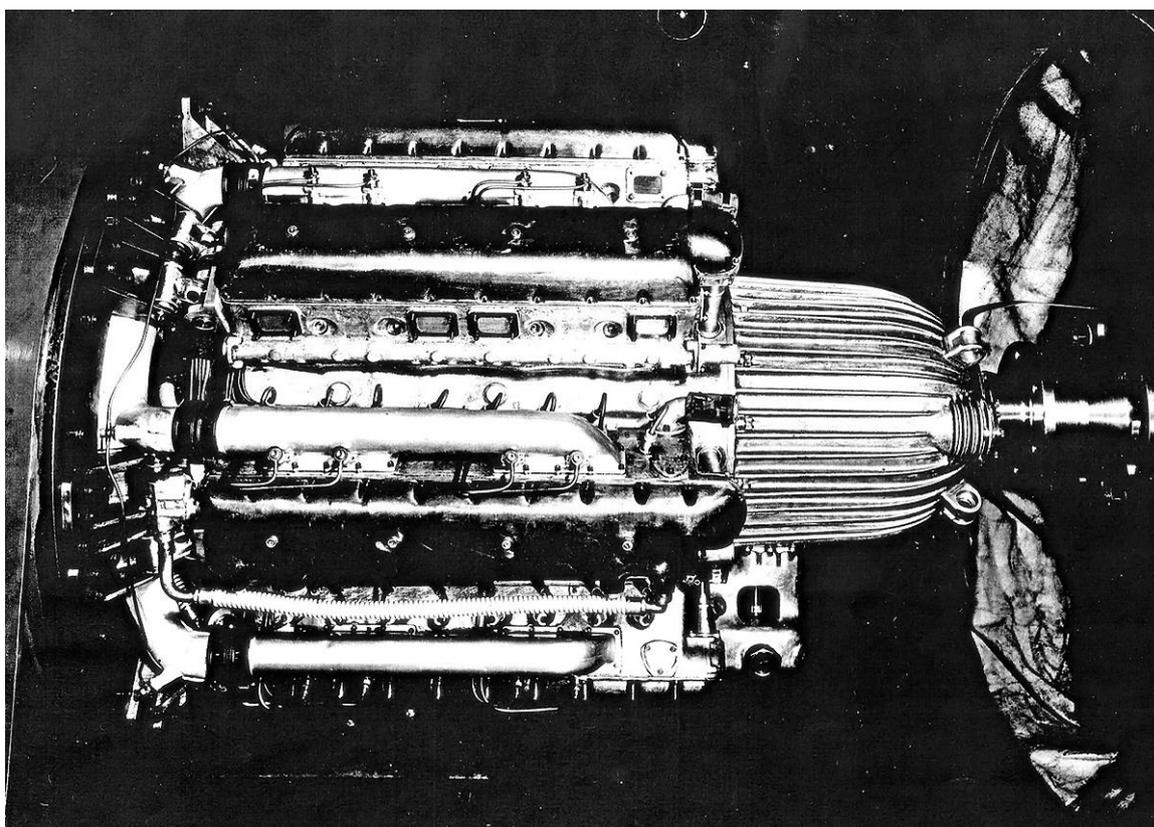
Alfa-Romeo-1101-supercharger-side

The 1101's aftercooler was to be incorporated into the induction pipe between the supercharger and the ring manifold. Note the shaft housing extending back from the engine to power the supercharger.

The 1101 was designed and built at Alfa Romeo's plant in Pomigliano d'Arco, near Naples, Italy. As the 1101 was being built, Italy had secured licenses from Germany to build the Daimler-Benz DB 601 and DB 605 engines and tasked Alfa Romeo with their production. This led to the formation in 1941 of Alfa Romeo Avio, a division focused solely on producing aircraft engines. The 1101 engine was completed in late December 1941 and first run in early January 1942. Under tests, the 1101 experienced detonation issues that damaged the pistons and cylinder heads. These issues were caused by the 87 octane fuel and the timing of the fuel injection system.

Development of the engine progressed until early 1943, when the war situation required the dispersal of factories away from populated areas. The 1101 engine project was moved to Armento in northern Italy, near the Swiss border. The move caused delays, but the entire project was suspended on 8 September 1943, following news of the Italian armistice. The Armento plant housing the 1101 fell in the territory controlled by the newly formed Italian Social Republic (Repubblica Sociale Italiana), which was mostly controlled by Germany. It is not clear if work on the 1101 engine was resumed or stayed suspended, but by mid-1943, the Armento plant housed nearly all of the engine's documentation, the prototype engines, and parts for approximately 20 pre-production examples. On 18 June 1944, all of the materiel in the Armento plant was destroyed by Italian partisans (resistance fighters) to prevent its use by the German military.

Future development of the 1101 included two-stage supercharging to increase the engine's military power rating to 2,300 hp (1,692 kW). Most likely, this configuration would include an additional centrifugal supercharger incorporated in a housing mounted directly to the rear of the crankcase and mechanically driven from the crankshaft. Investigations were also conducted into turbocompounding the engine. The turbocompounded 1101 would utilize five turbines. Three turbines would be positioned at the front of the engine to recover power from the exhaust and feed it back to the propeller shaft. The remaining two turbines were turbosuperchargers (first stage of supercharging) positioned at the rear of the engine to feed air into the engine's centrifugal supercharger (second stage of supercharging). The turbocompounded engine was expected to weight 20 percent more, increase fuel efficiency by 15 percent, and produce 2,600 (1,912 kW) hp. However, no such engines were built.



Alfa-Romeo-1101-test-side

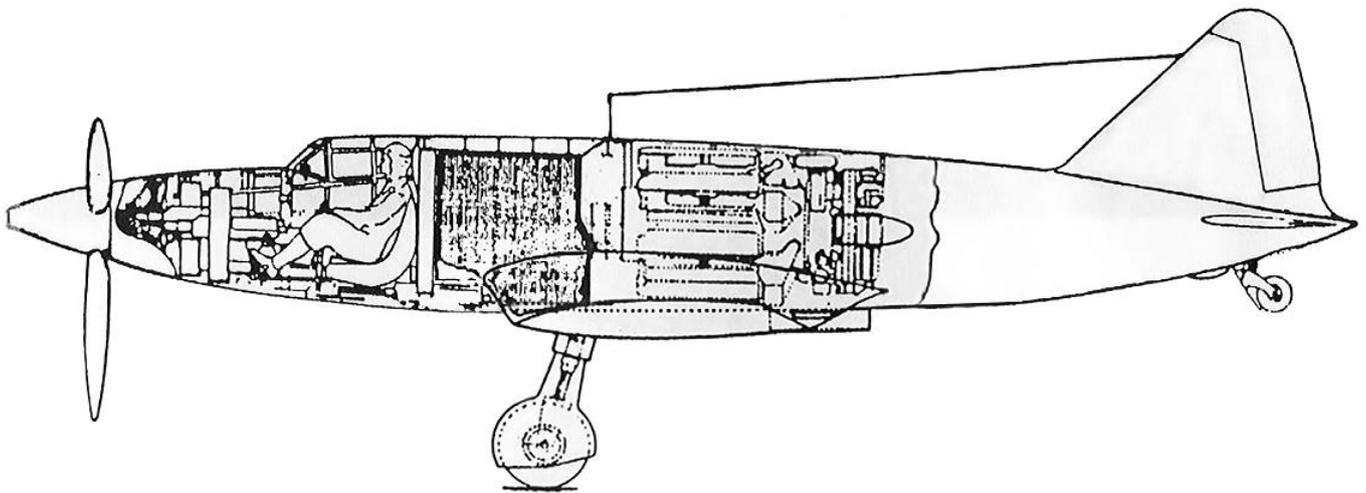
The 1101 mounted on what appears to be a test bed. This image gives a good view to the spacing of the intake and exhaust ports. Note the two dynafocal mounts on the back of each cylinder bank. It is not clear if the remote supercharger has been omitted or is just obscured by the mounting frame.

Other developments included enlarging the engine's cylinder, possibly with a 5.71 in (145 mm) bore and a 5.12 in (130 mm) stroke, so that total displacement was 3,668 cu in (60.1 L). Studies were also undertaken to create a 42-cylinder engine by having six cylinders per bank. Some sources indicate that this engine had a displacement of approximately 4,270 cu in (70 L). However, the bore and stroke of the 1101 would displace 4,586 cu in (75.1 L) with 42 cylinders. Therefore, the bore and stroke of the 4,270 cu in (70 L) 42-cylinder engine are not known.

The 1101 was proposed for at least three aircraft projects: the Alfa Romeo 1902—apparently a development of the Aeronautica Umbra MB-902 design, with the two engines buried in the fuselage and driving propellers on each wing via extension shafts and right-angle drives; the Caproni Vizzola MCT (Monoposto Caccia Trigona / Tr.1207)—a single seat fighter of a taildragger configuration with the engine buried in the fuselage behind the cockpit and driving a tractor propeller via an extension shaft; and the Savoia-Marchetti SM-96 (II)—a single seat taildragger fighter of a conventional tractor layout with the engine installed in the nose. None of these projects were built.

Two Alfa Romeo marine engines utilized 1101 components: the inline, four-cylinder 1001 engine used a single cylinder bank, and the V-8 1002 engine used two cylinder banks. Both of these engines were built during World War II and neither appear to have entered quantity production. The only known part of an 1101 engine to survive is a fuel injection pump stored at the Alfa Romeo Museum (Museo Storico Alfa Romeo) in Arese, Italy.

Note: The horsepower (hp) figures in this article are actually Cavalli Vapore (CV), which is 1.387% more than a standard hp (100 CV = 98.6 hp). The kilowatt (kW) values are based on CV.



Caproni-Vizzola-MCT-Alfa-Romeo-1101

A composite drawing of the Caproni Vizzola MCT (Monoposto Caccia Trigona / single seat fighter, designed by Emmanuele Trigona) with the 1101 engine installed in the fuselage.

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