PATENT SPECIFICATION

Application Date: Oct. 25, 1935. No. 29508/35. **463,984**

Complete Specification Left: Aug. 21, 1936.

Complete Specification Accepted: April 9, 1937.

PROVISIONAL SPECIFICATION

Improvements in or relating to Supercharging Internal Combustion Engines

We, THE FAIREY AVIATION COMPANY LIMITED, of North Hyde Road, Hayes, in the County of Middlesex, a British Company, ARCHIBALD GRAHAM FORSYTH, of "Venlaw," Burdon Lane, Cheam, in the County of Surrey, a British Subject, and GEORGE JAMES SMITH-PERT, of 131, Mulgrave Road, Cheam, aforesaid, a British Subject, do hereby declare the nature of this invention to be as follows :—

This invention relates to supercharging internal combustion engines, especially internal combustion engines intended for use on aircraft and has for its object to enable such engines to operate at high altitudes without substantial loss of power.

To this end and in accordance with the present invention an internal combustion engine provided with a supercharger driven by the engine itself is provided also with a supercharger driven by an exhaust turbine, the arrangement being such that said engine driven supercharger may be operated alone (at low altitudes) or both superchargers may be operated simultaneously (at high altitudes), in which latter event the second supercharger delivers air to the intake of the first supercharger. Preferably, a conduit connecting the two superchargers is formed with a branch pipe communicating with the ambient atmosphere, said branch pipe being provided with a butterfly valve, by which it may be opened and closed and constituting the normal intake of the first supercharger. Preferably said butterfly valve is interconnected with similar valves for closing the engine exhaust pipes for bye-passing the engine exhaust gases, or a part thereof, to the exhaust turbine, the arrangement being such that when said butterfly valve in the branch pipe is closed the valves with which it is interconnected are closed to direct the passage of exhaust gases to the exhaust turbine. It is preferred to mount the twin superchargers upon the sides of an "**H** type" engine, but they may also be mounted conveniently upon the sides of "**V** type" engines. Radial type engines, however, do not lend themselves readily to the fitting of such twin superchargers.

The valve in the branch pipe and the valves interconnected therewith may be controlled manually from the pilot's cockpit, but if desired, they may be controlled by a barometric capsule or the like disposed in the induction pipe of the engine so that the exhaust driven turbine is "cut in" when the pressure in the induction pipe falls below a predetermined minimum value, said barometric capsule may also be interconnected with the throttle of the engine, so that when the second supercharger is cut in, with a resultant sudden increase in engine power, the throttle opening is reduced by the action of the barometric capsule and the rate of engine revolution is prevented from rising to a dangerous value.

The twin superchargers may be disposed on the inlet or the outlet side of the carburettor as may be preferred.

Preferably the fuselage is cut away so as to leave the exhaust turbine exposed to the slipstream, means, controlled from the pilot's cockpit, being provided for enclosing by a cover plate, said exhaust turbine when the latter is inoperative. In this way, efficient cooling for the exhaust turbine is effected when the latter is operating whilst, when it is idle, a good streamline form is presented.

Dated this 25th day of October, 1935.

A. M. & WM. CLARK,
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53 & 54, Chancery Lane, London,
W. C. 2.

COMPLETE SPECIFICATION

Improvements in or relating to Supercharging Internal Combustion Engines

We, THE FAIREY AVIATION COMPANY LIMITED, of North Hyde Road, Hayes, in the County of Middlesex, a British Company, ARCHIBALD GRAHAM FORSYTH, of

[*Price* 1/-]

"Venlaw," Burdon Lane, Cheam, in the County of Surrey, a British Subject, and GEORGE JAMES SMITH-PERT, of 131, Mulgrave Road, Cheam, aforesaid, a British Subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

It is known to deliver scavenging and charging air to the cylinders of a two-stroke cycle internal combustion engine by means of two blowers, one of the centrifugal type and driven by an exhaust turbine, and the other of the piston type and driven directly from the engine, said blowers operating in parallel or "in series" (as desired), in which latter event the exhaust driven centrifugal blower delivers compressed air to the inlet side of the engine driven blower which in turn delivers air further compressed to the inlet ports of the two-stroke cycle engine.

It has also been proposed to provide for use with a two-stroke cycle internal combustion engine for an aircraft, a centrifugal scavenging pump, directly driven from the engine, which is so dimensioned that it is sufficient to provide the scavenging air when flying below a given altitude and, in addition, to provide a supplementary centrifugal blower, "in series" with said pump, which may deliver air to the inlet side thereof (e.g. at high altitudes), and which is driven by means of an exhaust turbine.

According to the present invention, means for supercharging an internal combustion engine comprise a supercharger driven by an exhaust turbine and a supercharger driven by the engine itself, the arrangement being such that the engine driven supercharger may be operated alone (at low altitudes) or both superchargers may be operated together (at high altitudes) in which latter event, the first supercharger delivers air to the intake of the second supercharger, admission of air to the intake of the second supercharger, when this latter alone is in operation, being controlled by one or more valves which are interconnected with similar valves controlling the admission of exhaust gases to the exhaust turbine, said interconnected valves being operated by a barometric capsule or the like disposed in the induction pipe of the engine. Preferably, the barometric capsule or the like is interconnected with the throttle control of the engine, so that when the supercharger driven by the exhaust turbine is "cut in", with a resultant sudden increase in engine power, the throttle opening is reduced by the action of the barometric capsule, and the rate of engine revolution is prevented from rising to a dangerous value.

It is preferred to mount the twin superchargers upon the sides of an "H type" engine, but they may also be mounted conveniently upon the sides of "V type" engines. Radial type engines, however, do not lend themselves readily to the fitting of such twin superchargers.

The twin superchargers may be disposed on the inlet or the outlet side of the carburettor as may be preferred.

One form of the invention will now be described by way of example with reference to the accompanying diagrammatic drawings of which Figure 1 is a side elevation of an internal combustion engine and its associated superchargers, Figure 2 is an end elevation thereof, parts being omitted for the sake of clarity and parts being broken away, and Figure 3 is a section on the line 3—3 of Figure 1.

As shown in the drawings, the internal combustion engine 11 is formed with exhaust ports 12, 12A and inlet manifolds 13, whilst upon said engine 11 there are mounted an exhaust driven turbine 14, which drives directly a supercharger 15. The two pairs of exhaust ports 12A, 12A of opposed cylinders of the engine 11 communicate by inlet ducts 16 with the turbine 14, the exhaust gases from said turbine 14 being discharged to the atmosphere by a pipe 17, when they have served their purpose. The supercharger 15, the rotor of which is integral with that of the exhaust driven turbine 14, is formed with an air inlet pipe 18 and an air discharge pipe 19. The air discharge pipe 19 communicates with an air intake pipe 20 open at one end, as at 21, to the atmosphere, and communicating at the other end with the choke tubes 22, 22, of twin carburettors (not shown). Within each choke tube 22 there is mounted the usual butterfly valve 23 said valves being under the automatic control of a barometric capsule indicated at 24 as well as under the control of the pilot. The choke tubes 22, 22 communicate by a duct 25 with the inlet side of a further supercharger 26, mounted upon and driven by the engine 11. The supercharger 26 is formed with a discharge duct 27, by which the petrol-air mixture from the choke tubes 22 may pass to the inlet manifolds 13, 13 of the engine 11.

The inlet ducts 16 are each provided with a butterfly valve 28 whilst the air intake pipe 20 is provided with a pair of butterfly valves 29, 29, said butterfly valves 28, 29 being interconnected and controlled automatically by a barometric capsule 30. The arrangement is such, however, that when the butterfly valves 28 are open the butterfly valves 29 are closed and vice versa. The barometric capsules 24 and 30

indicated diagrammatically in Figure 1 are in reality situated in the air intake pipe 20 between the butterfly valves 29 and the choke tubes 22.

In operation when the aircraft is at a comparatively low altitude and the atmospheric pressure is therefore relatively high the barometric capsule 30 maintains the valves 28 closed and the valves 29, 29 open so that the exhaust turbine 14 and the supercharger 15 are inoperative. The engine driven supercharger 26 however sucks air past the open valves 29, 29 through the choke tubes 22, 22 and delivers the petrol-air mixture to the inlet manifolds 13. When the aircraft reaches a high altitude, however, where the air is rarer the capsule 30 opens the butterfly valves 28 and closes the valves 29. A part of the engine exhaust gases then passes by the inlet ducts 16 to the exhaust turbine 14 to operate this latter. The supercharger 15, driven by the turbine 14, then delivers air drawn through inlet pipe 18 under pressure to the air intake 20 whence the air passes to the choke tubes 22, 22 and is mixed with petrol. The resultant mixture then passes through the engine driven supercharger 26 and is delivered, under increased pressure, via the discharge duct 27, to the inlet manifolds 13. When the exhaust driven turbine is cut in there is a sudden increase of engine power but the rate of engine revolution is prevented from rising to a dangerously high value by the action of the barometric capsule 24 which closes to a greater or lesser degree the butterfly valves 23, 23.

Preferably the fuselage is cut away so as to leave the exhaust turbine exposed to the slipstream, means, controlled from the pilot's cockpit, being provided for enclosing, by a cover plate, said exhaust turbine when the latter is inoperative. In this way, efficient cooling for the exhaust turbine is effected when the latter is operating whilst, when it is idle, a good streamline form is presented.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is :—

1. Means for supercharging internal combustion engines comprising a supercharger driven by an exhaust turbine, and a supercharger driven by the engine itself, the arrangement being such that the engine driven supercharger may be operated alone (at low altitudes) or both superchargers may be operated together (at high altitudes) in which latter event, the first supercharger delivers air to the intake of the second supercharger, admission of air to the intake of the second supercharger, when the latter alone is in operation, being controlled by one or more valves which are interconnected with one or more similar valves controlling the admission of exhaust gases to the exhaust turbine, said interconnected valves being operated by a barometric capsule or the like disposed in the induction pipe of the engine.

2. Means for supercharging internal combustion engines as claimed in Claim 1, wherein said barometric capsule is interconnected with the throttle control of the engine.

3. Means for supercharging internal combustion engines substantially as herein set forth, and as illustrated in the accompanying diagrammatic drawings.

Dated this 21st day of August, 1936.

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W.C.2.

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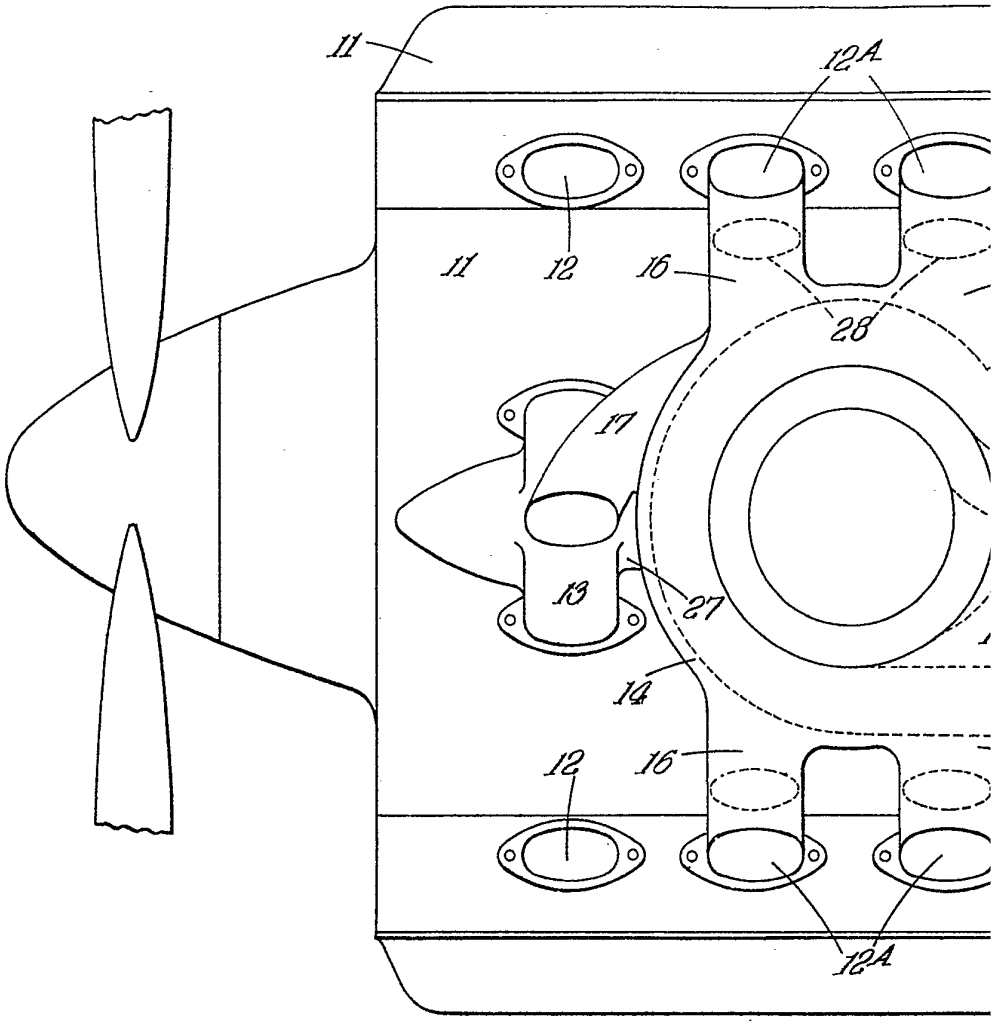

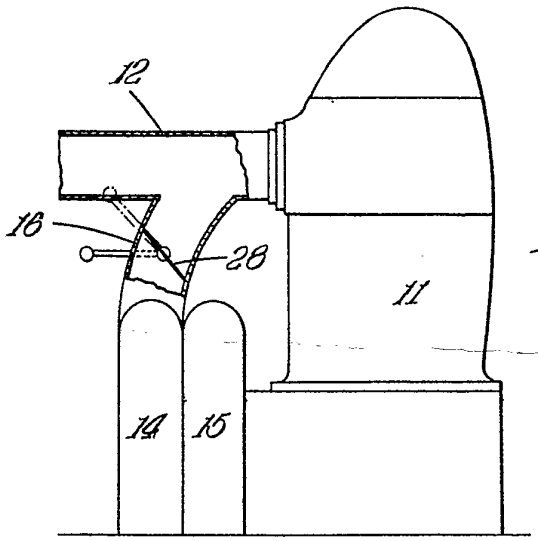

Fig. 2.

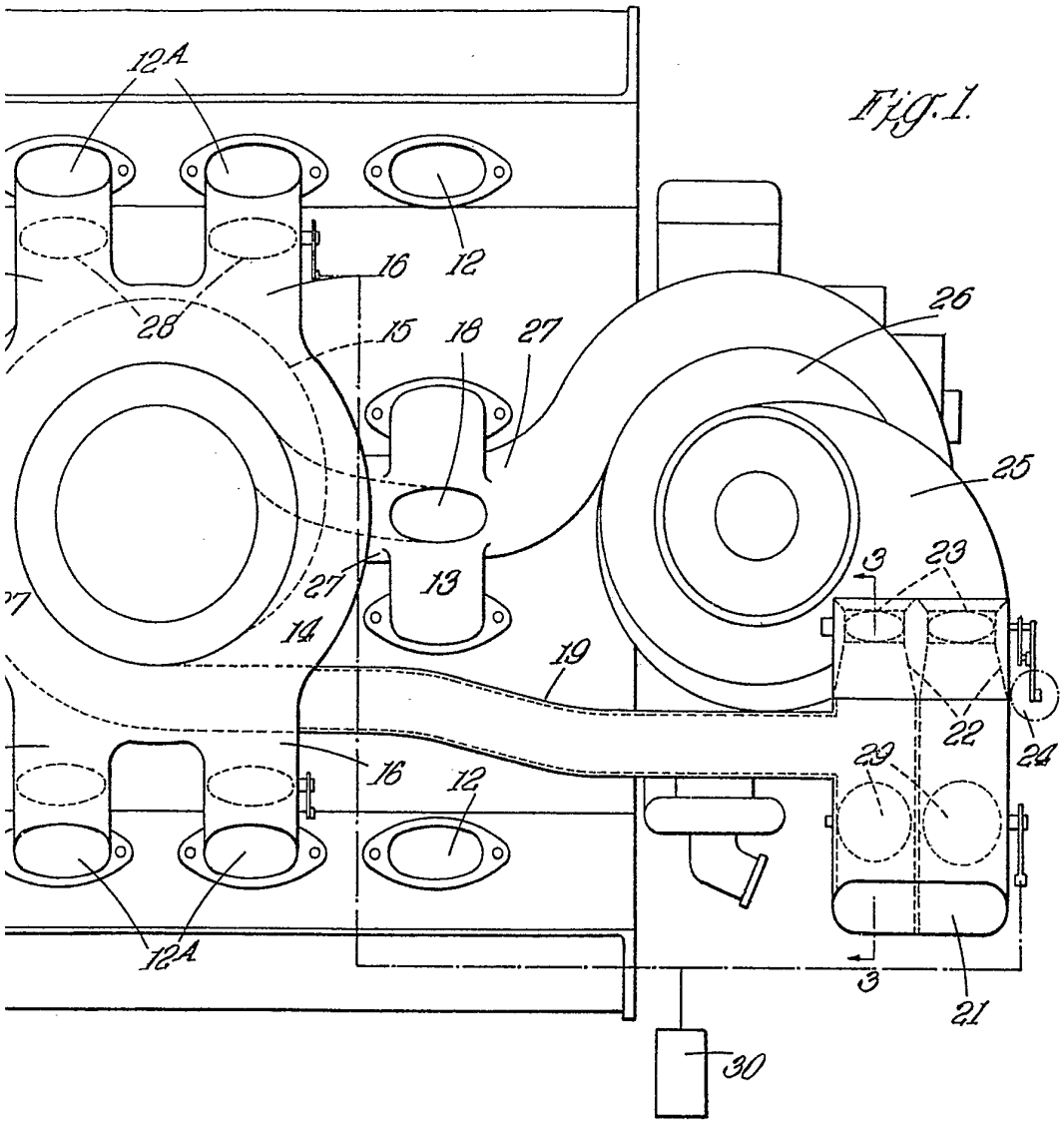

Fig. 1.

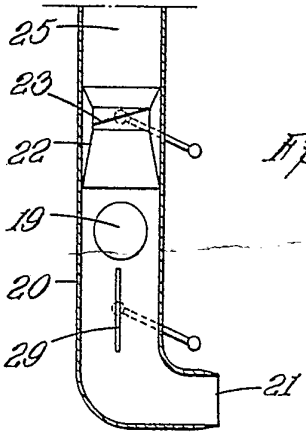

Fig. 2.

Fig. 3.

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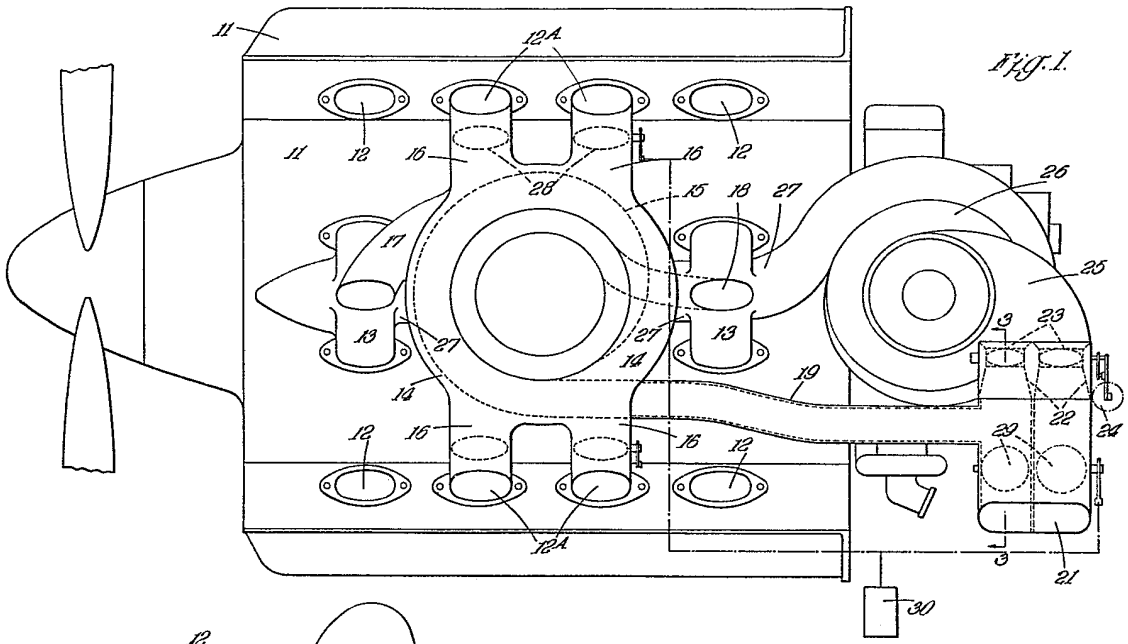

Fig. 1.

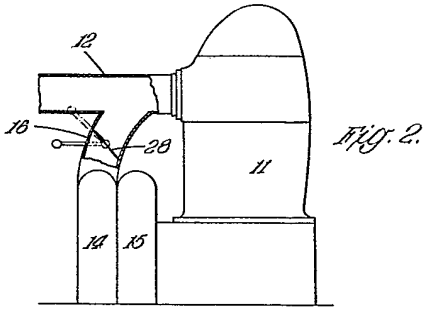

Fig. 2.

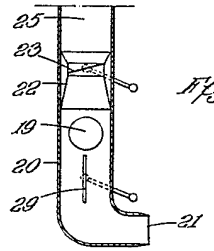

Fig. 3.

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