Aug. 4, 1925. 1,548,560

J. W. SMITH

AERONAUTICAL MOTOR

Filed Aug. 27, 1920 2 Sheets-Sheet 1

FIG. I.

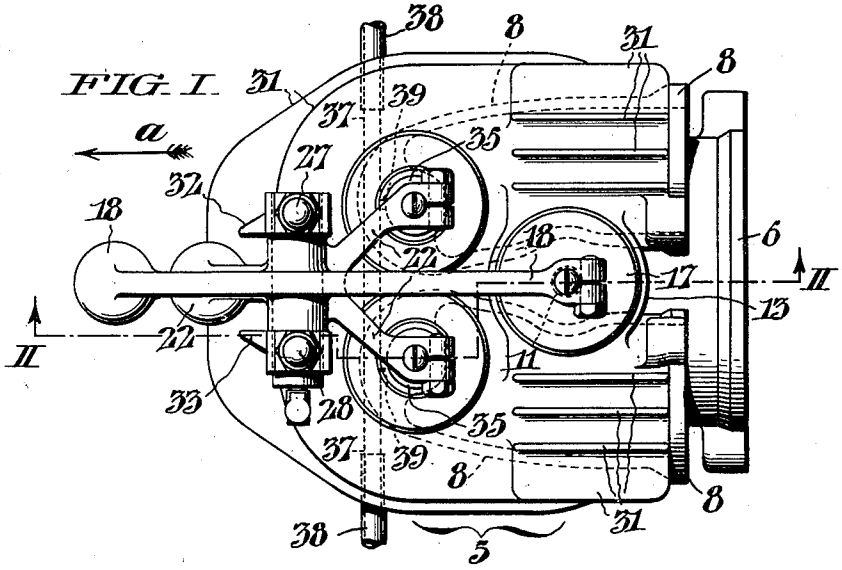
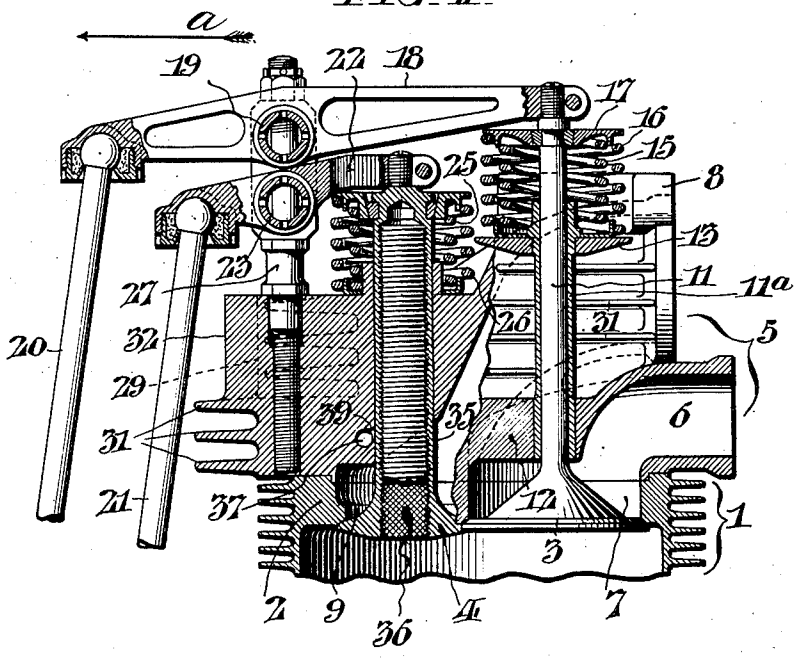


FIG. II.



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FIG. III.

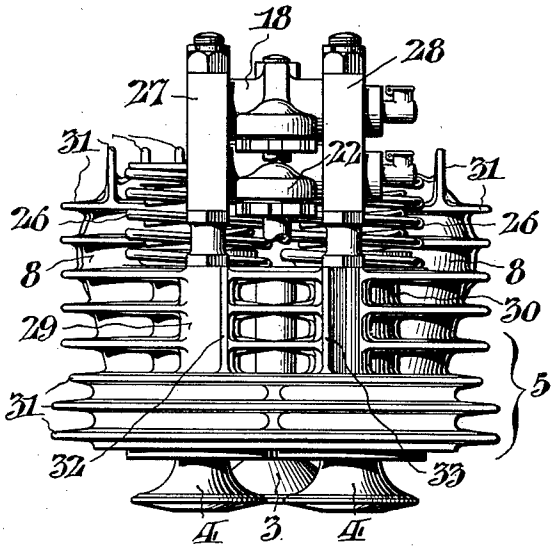
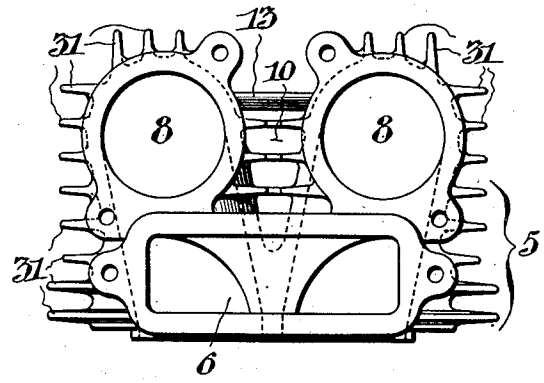


FIG. IV.



WITNESSES:

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Patented Aug. 4, 1925. 1,548,560

UNITED STATES PATENT OFFICE.

JOHN W. SMITH, OF PHILADELPHIA, PENNSYLVANIA.

AERONAUTICAL MOTOR.

Application filed August 27, 1920. Serial No. 406,476.

To all whom it may concern:

Be it known that I, JOHN W. SMITH, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and the State of Pennsylvania, have invented certain new and useful Improvements in Aeronautical Motors, whereof the following is a specification, reference being had to the accompanying drawings.

This invention relates generally to internal combustion engines, and more particularly to the type used as aeronautical motors.

In such motors, especially of that variety in which the cylinders are arranged radially about a centrally located crank case, and on account of such motors occupying a lateral position in the air craft, the head resistance offered to flight becomes a factor of utmost importance in determining the efficiency of the machine as a whole. As a consequence of this, and in view of the multiplicity of cylinders usually employed in such motors, this consideration must of necessity enter into the design of all its constituent parts. To this end one object of my invention is to reduce to the very minimum, not only the head resistance of the cylinders and the crank case, but that of the other associated parts such as the cylinder heads, fuel inlets, exhaust outlets, valves, etc.

Other objects of my invention are to utilize the inherent force of the exhaust gases in tending to promote rather than to retard flight; and to secure more efficient dissipation of the heat transmitted to the various parts of the valve structure, (both movable and immovable), during combustion incidental to the operation of the motor.

The advantages of my invention will become readily apparent from the detailed description which follows.

In the drawings, Fig. I is a plan view of the outer end of one cylinder of an aeronautic motor conveniently embodying my invention.

Fig. II is a staggard section of the structure as viewed in the direction of the arrows II—II in Fig. I, showing at once, the details of both the intake and exhaust valves and their actuating appurtenances.

Fig. III is a front end view of the cylinder head and the associated parts.

Fig. IV is a rear end view of the cylinder head, the valves having been omitted for the sake of clearness.

The motor cylinder, a portion of which is shown at 1 in Fig. II, has a closed end 2, which affords seats for the intake valve 3 and the exhaust valves 4—4, of which there are two in number, (Fig. III). These valves are supported for guidance and have extended bearing in a mounting or head superstructure 5 which may be bolted or otherwise attached to the cylinder 1. Integrally formed with the head 5 is a fuel inlet or intake-conduit 6, which extends rearwardly from, and opens through or communicates with the port 7 in the aft or rear portion—having reference to the position of the engine with respect to the direction of flight as shown by the arrows *a* in Figs. I and II—of the end 2 of the cylinder 1. From Fig. IV, it will be observed that the inlet 6 is rectangular in cross section, shallow, and of a breadth corresponding substantially to that of the head itself, so as to offer very slight head resistance. Overlying the inlet 6 and extending in parallelism thereto, are rearwardly discharging, relatively spaced, exhaust outlets or conduits 8—8, likewise integrally formed with the head 5. The outlets 8—8 open through or communicate with exhaust ports 9—9 in the fore or forward portion of the cylinder end 2, whence they extend upward and rearward, side by side but separate. By thus aligning the outlets 8, in the direction of flight, their head resistance is reduced to a minimum, and their rearward discharge at the same time tends to assist flight rather than retard progress as would be the case to a greater or lesser extent in any other position. The space or crotch 10 intermediate the outlets 8—8 serves to afford passage and permit impingement of the air against the central portion of the cylinder head 5 in a manner hereinafter noted.

The inlet valve 3 has a stem 11 which is guided in a sleeve 11^a secured at its lower end, in the base portion 12 of the head 5, and at its upper end, in a cross piece 13, bridging the outlets 8—8, and extends between said exhaust conduits 8—8. Valve 3 is normally held in closed position by a pair of coaxial, helical springs 15, 16 operative upwardly against a disk 17 at the top of its stem 11, and is actuated by means of an arm

18 fulcrumed at 19, and adapted to be controlled by any appropriate mechanism coordinated with a push rod 20. Movement of the exhaust valves 4 is similarly brought about through the instrumentality of a push rod 21, which is connected to one end of an actuating lever 22, fulcrumed at 23. This lever 22 is bifurcated, as shown in Fig. I, so as to be capable of actuating the two exhaust valves 4—4 simultaneously. These valves 4—4, like the intake valve 3, are normally held in closed position by coaxial helical springs 25 and 26. The fulcrums for the actuating levers 18 and 22 are supported by posts 27 and 28 which are threaded into integral upstanding lugs 29 and 30 of the cylinder head. The interval between the lugs 29 and 30 is, in effect, a continuation of the passage or crotch 10 between the outlets 8—8. As best seen in plan in Fig. I, the fore portion of the cylinder head 5 is convergent or stream-line so that its head resistance is, as a result, appreciably lessened. The head 5 together with its integral projecting parts is formed with outstanding fins 31, which run longitudinally with respect to the direction of flight, so as to be substantially non-resistive, but which afford collectively an extensive surface area for heat radiation. The head resistance of the lugs 29 and 30 is also substantially minimized by provision of the auxiliary deflecting fins 32 and 33.

From the above, it will be apparent that by reason of the disposal of the exhaust valves 4—4 and their protruding appendages in the fore portion of the cylinder head 5, they are directly exposed, during flight, to the cooling influence of the air, and that by provision of the interval or crotch 10 between the exhaust outlets 8—8, both the inner sides of the latter and the central portion of the head 5 are efficiently cooled by passage of air therethrough,—the numerous projecting fins cooperating in a well known manner to dissipate the heat.

Referring once more to Fig. II, it is to be particularly noted that the construction of the cylinder 1 is such that the explosions are entirely confined thereto, and as a consequence, the greater portion of the heat evolved during combustion is directly dissipated by the cylinder fins so that the head 5 may be reserved more particularly for the purpose of disposing of that portion of the heat conducted through the valve stems. In order that the latter may be accomplished with rapidity, the head 5 is, in practice, constructed of a metal high in thermal conductivity, preferably aluminum or aluminum bronze. For a like reason, the exhaust valves 4—4 and their stem prolongations 35 have been provided axially with cores 36 of any suitable solid material, metallic or otherwise, having similar properties. Here again aluminum or an aluminum alloy may be used to advantage more especially on account of its lightness. It is important to note that the stems 35 of the exhaust valves 4—4 are of comparatively large diameter, so as to afford extended bearing of ample surface area for heat transmission, and that their bore is such as to leave but very thin shells within which the cores are received. For the purpose of maintaining efficient contact between the core 36 and the inner surface of the shell of the exhaust valve stem 35 regardless of differences in the coefficient of expansion of the two dis-similar materials used in its construction, I prefer to provide the meeting surfaces with complementary, interfitting ridges. When a metallic core is used, such a construction may be obtained simply by screw threading. When a fusible substance is used, the inner surface of the shell may be either screw threaded or serrated in any appropriate manner to form grooves into which the material may run when in a molten state. In the case of screw construction any unequal expansion of the two materials will obviously tend to effect binding of the threads, thus enhancing the efficiency of the interlock. By this arrangement, the heat imparted to the exhaust valve heads by reason of their direct exposure to this heat of combustion is readily transmitted to the cylinder head 5, and as quickly disposed of by the latter through radiation.

The cylinder head 5 has extending transversely through it a duct 37, the opposite ends of which are adapted to be connected by piping 38 to any suitable force lubrication system. At the region of the valve bearings, the duct 37 has lateral branches 39, by which the lubricant is fed to the valve stems, so that a thin film is constantly maintained above said stems, and at the same time, liquid contact between the stems and the stationary mounting. The circulation of the lubricant through the duct 37 will assist in carrying off heat imparted through the cores of the exhaust valves 4—4. An exhaust valve 4 constructed in accordance with the above will be just as efficient in one position as another, and therefore has special advantages over the liquid cooled type, in which a certain amount of space must be reserved for expansion and contraction of the liquid. For example, when valves of the latter type are employed in motors having their cylinders arranged radially about a central crank shaft, whence most of them will of necessity assume either angular or upside down positions, as a consequence, the liquor in those in lower cylinders will occupy the outer portions of the valve stems, and thus be out of direct contact with the valve heads. The efficiency of thermal conductivity of the valve structure will, as a re-

sult of the above, be appreciably impaired.

In the claims, as in the foregoing, I have used the terms "fore", "aft" and "rearwardly" with reference to the direction of flight.

Having thus described my invention, I claim:

1. In an aeronautical motor, the combination with a cylinder, of a cylinder head having a number of intake and exhaust valves, the inlets and outlets communicating with said valves being arranged in parallelism and aligned in the direction of flight, and said outlets having an intervening crotch affording a central cooling passage through the cylinder head.

2. In an aeronautical motor, the combination with a cylinder, of a cylinder head having a number of exhaust valves located in its forward portion with an inlet valve rearward thereof; and a series of offset discharge outlet and inlet conduits leading rearwardly from said valves, said conduits being spaced apart to afford intervening crotches through which cooling air may impinge upon the intermediate parts of the cylinder head.

3. In an aeronautical motor, the combination with a cylinder, of a cylinder head having a pair of exhaust valves located in its forward portion; offset discharge outlets leading rearwardly from said valves, said outlets being spaced apart to afford an intervening crotch through which cooling air may impinge upon the central portion of the cylinder head; and an intake valve located in the rear portion of the cylinder head in a central plane intermediate and below the exhaust outlets.

4. In an aeronautical motor, the combination with a cylinder of a head having a plurality of exhaust passages at its forward portion with an intervening crotch affording a cooling clearance, said exhaust passages leading rearwardly and terminating in discharge ports which exhaust in a direction oppositely and substantially parallel to the direction of flight.

5. In an aeronautical motor, the combination with a cylinder of a head having a pair of exhaust passages at its forward portion with an intervening crotch affording a cooling clearance, said exhaust passages leading rearwardly and terminating in spaced conduits arranged to exhaust oppositely and substantially parallel to the direction of flight, and an intake passage located at the rear portion of the head and terminating in an elongated port located between and below the aforesaid conduits whereby to effect a heat interchange between the intake and exhaust gases.

In testimony whereof, I have hereunto signed my name at Philadelphia, Pennsylvania, this 23rd day of August 1920.

JOHN W. SMITH.

Witnesses:
JAMES H. BELL,
E. L. FULLERTON.