March 22, 1927. 1,622,015

J. M. WILLIAMS, JR

INTERNAL COMBUSTION ENGINE

Filed March 29. 1921 2 Sheets-Sheet 1

Fig. 1.

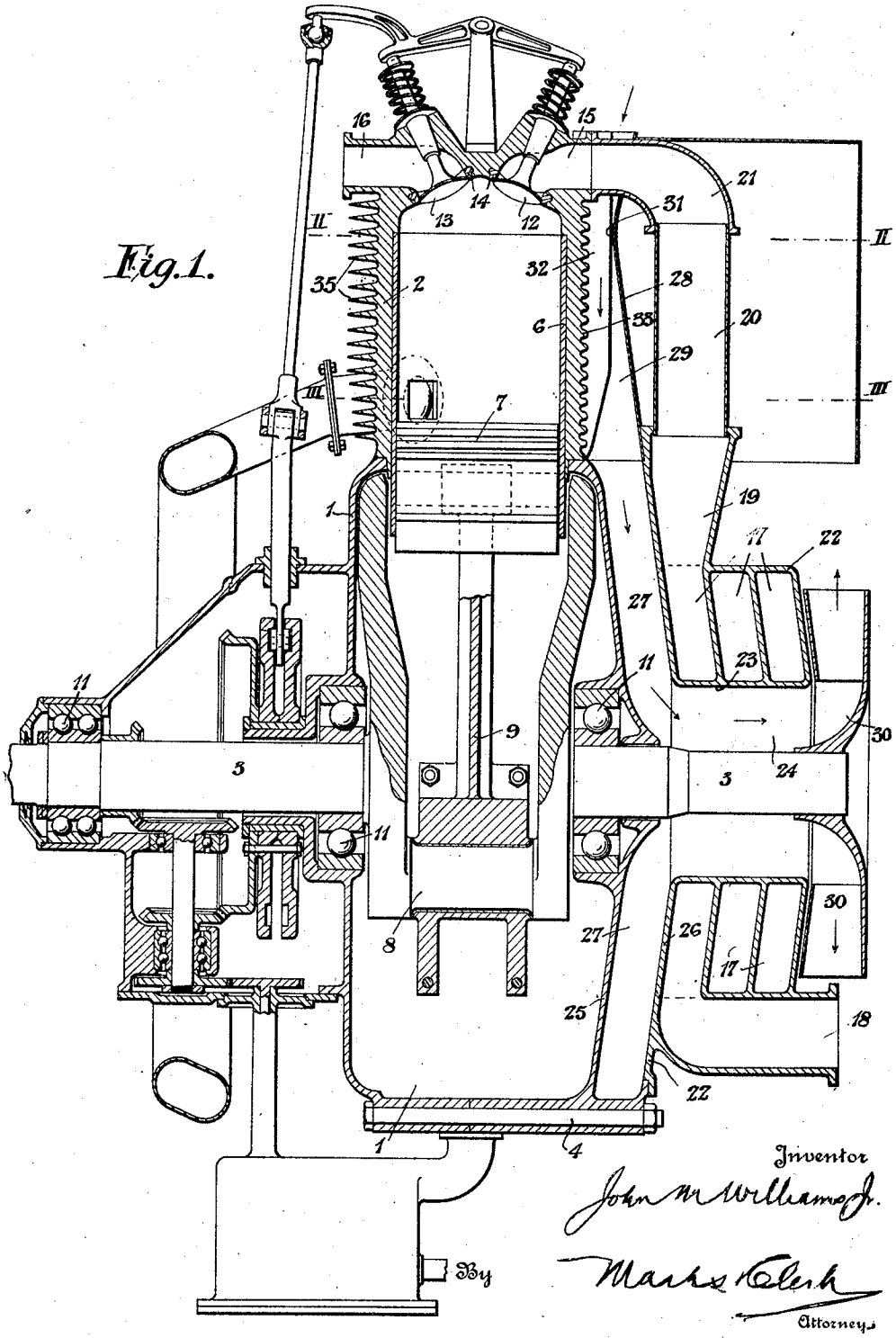

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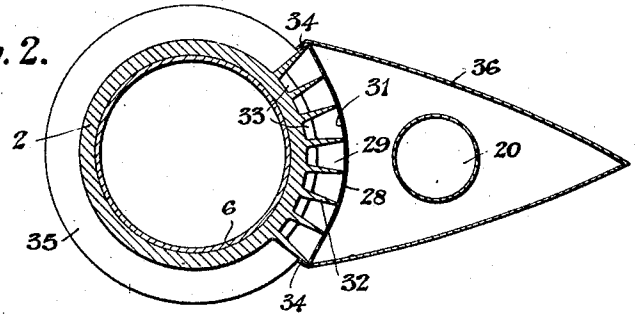
Fig. 2.



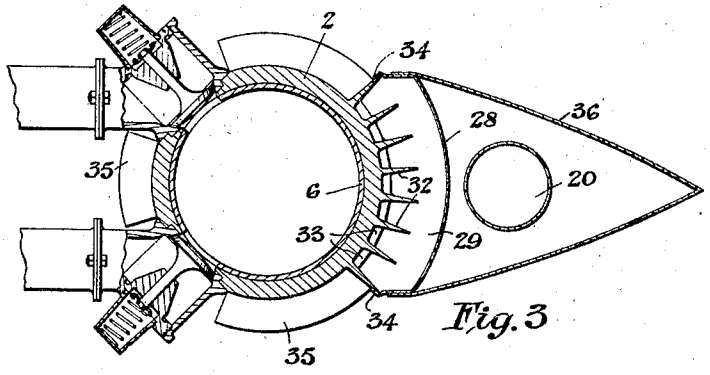


Fig. 3

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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

Application filed March 29, 1921. Serial No. 456,559.

This invention relates to internal combustion engines, and particularly to engines of the radial type adapted for use in the propulsion of aeroplanes, although the invention is not restricted to its use with this type of engine, as the features thereof are applicable to engines of other types.

The objects of the invention are primarily to provide a new and improved method of and means for effecting an efficient and uniform cooling of the cylinder or cylinders of the engine.

With this object in view the invention comprises the method of operation, and the novel combinations and constructions which will now be described in greater detail, and will be clearly pointed out in the claims appended hereto.

The invention will be described in detail as applied to an engine of the radial type, it being understood that this engine is selected for purposes of illustration only, and not with any intent to limit the invention thereto.

In the accompanying drawings:

Figure 1 is a longitudinal sectional view through the crank casing and one of the engine cylinders.

Figure 2 is a sectional plan view taken on the line II—II of Figure 1;

Figure 3 is a sectional plan view taken on the line III—III of Figure 1.

The invention is illustrated in connection with an internal combustion engine of the radial type, particularly adapted for use in connection with aeroplanes, and it comprises a central crank casing 1 from which radiate a plurality of cylinders 2 of which any suitable number may be provided, there being nine cylinders in the engine illustrated which are angularly spaced substantially equal distances apart about the axis of the crank shaft 3, the cylinders being secured to the crank casing in any suitable or usual manner. The crank casing is divided in the plane of the cylinder axes, the two parts being connected together by means of bolts 4.

For convenience of illustration only one of the nine cylinders 2 is shown in the drawings, namely the uppermost cylinder, it being understood that the remaining eight cylinders will have their axes angularly disposed about the crank shaft 3.

The cylinders are provided with liners 6 within which recipro-pistons 7, the uppermost piston, illustrated in the drawings, being connected to the crank pin 8 of the crank shaft 3 by means of a master connecting rod 9 as usual in engines of the radial type, the remaining pistons being connected by means of connecting rods 10 to the master connecting rod. The crank shaft 3 is rotatably supported by means of anti-friction bearings 11 in the crank casing 1, the forward end of the crank shaft being connected to the driving propeller or propellers in the usual manner.

Each cylinder 2 is provided with two inlet valves 12 and two exhaust valves 13 these valves seating upon seats 14 in the cylinder head, the inlet valves controlling communication between the cylinder and inlet passages 15 while the exhaust valves control communication between the cylinder and exhaust passages 16 which may discharge freely into the atmosphere as indicated.

The combustible mixture from a suitable carbureter or carbureters is supplied to the inlet passages 15 of the respective cylinders from chambers 17 each of which receives mixture through an inlet 18, the mixture passing from the chambers through outlets 19 connected by pipes 20 and elbows 21 with the respective inlet passages 15, each elbow 21 being branched to communicate with the two corresponding inlet passages 15. In the case of the nine-cylinder engine illustrated in the drawings three chambers 17 are provided each of which has three outlets 19 connected by pipes 20 and elbows 21 with the inlet openings 15 of three cylinders symmetrically arranged about the axis of the crank shaft. The chambers 17 are formed in a casing 22 which is secured by bolts or in any other suitable manner to the rear side of the crank casing 1.

When the aeroplane or other vehicle on which the engine is mounted is moving forwardly the air strikes the front portions of the several cylinders and is deflected around the sides thereof, thence flowing rearwardly in such manner that the rear portions of the cylinders will be unexposed to the action of the cooling air and will, therefore, become overheated. This unequal cooling of the cylinders causes distortion thereof and consequent sticking of the pistons and one of the objects of the present invention is to provide an improved and simple means for cooling the rear portions of the cylinders to prevent the overheating of the same and the

consequent unequal cooling of the cylinders.

According to the particular construction of this cooling means, as illustrated in the drawings, a passage or passages are provided at the rear of the several cylinders and means are provided for forcing or inducing a current or currents of air through these passages, which current or currents flowing over the rear portions of the cylinders effectively cool the same.

As illustrated in Figure 1, the casing 22 is provided with a central opening 23 concentric with the crank shaft 3 and forming therewith an annular passage 24. The casing 22 is secured to the crank casing 1 in spaced relation to the rear wall 25 of said crank casing, thereby providing between said wall 25 and the forward wall 26 of the casing 22 an annular chamber 27 which communicates at the central portion thereof with the annular passage 24. At the rear of each cylinder 2 is arranged a casing or plate 28 which forms with the adjacent position of the cylinder wall a passage 29 communicating at its inner end with the annular chamber 27 and open to the atmosphere at its outer end.

Mounted upon the rear end of the crank shaft 3 and rotatable therewith is a fan or suction blower 30 which may be of any suitable or known type and which is arranged when the crank shaft 3 is rotated to induce a current of air through each of the passages 29 into the annular chamber 27 and from thence through the annular passage 24 and out through the fan or blower, the air current induced through each of the passages 29 flowing over the rear surface of the corresponding engine cylinder so as to effectively cool such rear surface. As already stated, the air flowing rearwardly relatively to the cylinders when the aeroplane or other vehicle is moving forwardly effectively cools the front and side portions of the cylinders so that with the present invention applied the entire cylinder is properly and uniformly cooled at all parts of the same, thus avoiding distortion of the cylinders and increasing the efficiency of the engine.

It is preferred to incline or curve the casings 28 relatively to the axes of the corresponding cylinders in substantially the manner indicated in Figure 1 in order to form a substantially Venturi shaped passage 29 having a restricted portion 31 positioned at about the hottest point in the length of the cylinder, namely opposite the combustion space thereof. This arrangement will cause an increased velocity of the air current at this restricted portion of the passage which will increase the cooling effect of the air upon this part of the cylinder.

Each of the cylinders 2 may be provided within the passage 29 with vertical or longitudinal fins 32, as illustrated particularly in Figures 2 and 3, and between these fins the cylinder wall may be provided with corrugations or projections 33, these fins and corrugations materially increasing the cooling effects. The side edges of the casing or plate 28 may be suitably secured to the side fins 32, as indicated at 34, in Figures 2 and 3, these side fins, if desired, being of greater radial dimension than the remaining fins of the group. At the restricted portion 31 of the passage 29 the casing 28 is substantially in contact with the fins 32, as indicated in Figure 2. Horizontal or transverse cooling fins 35 may be provided around the front and side portions of the cylinders as indicated.

Instead of providing the vertical fins and corrugations 32, 33 the horizontal transverse fins 35 may extend all the way around the cylinder, these fins being notched or cut away within the passage 29 so as to facilitate the inward flow of air through said passages. This arrangement facilitates the construction of the cylinder and it permits free circulation within the passage 29 all around the cylinder wall and fin surfaces.

The fan or blower 30 may, if desired, be arranged within a suitable casing at the rear of the casing 22, such casing being provided with suitable outlets for the discharge of the air. It will also be understood, that instead of the blower inducing air downwardly through the respective passages 29, it may be arranged to draw in air through the passage 24 and force the same upwardly through the various passages 29, the blower in this case preferably being located within the annular chamber 27 formed between the casings 1 and 22. It will also be understood that other means than a blower may be provided for the purpose of inducing or forcing air through the passages 29 at the rear of the respective cylinders.

If desired a streamline casing 36 may be provided at the rear of each cylinder, the side walls of which converge rearwardly to conform to the normal streamline flow of the air and thereby prevent the formation of a vacuum at the rear of the cylinder, which vacuum tends to reduce the forward speed. The front end of these walls are connected to the side fins 32 of the cylinder wall. The inlet pipes 20 and elbows 21 are, as indicated, enclosed by this streamline casing 36 so as to further prevent reduction of speed by air pressure against these pipes and elbows, and to prevent undue cooling of the mixture flowing to the cylinders.

The cooling features hereinbefore described are also applicable to engines in which cylinders are arranged one behind another in the direction of movement of the aeroplane or vehicle to which the engine is applied. With such arrangement of the en-

gine cylinders the passages 29 communicating with the annular chamber 27 would be provided at the rear portion of the rearmost cylinder and similar passages would be arranged between the adjacent cylinders, which passages would communicate by means of side passages or conduits with the annular chamber 27 so that when the suction fan or blower was operated air would be drawn not only through the passages at the rear of the rearmost cylinder but also through the passages between the adjacent cylinders so as to effectively cool all surfaces of all of the cylinders. The passages between adjacent cylinders may be divided by plates constructed to provide substantially Venturi-shaped air passages, for the purpose above stated.

I claim:

1. In an internal combustion engine, the combination with an engine cylinder having the forward and side portions thereof exposed to the cooling action of air flowing relatively to the engine, of passage forming means applied to the rear portion of said cylinder and coacting with the rear portion of the cylinder wall to form a passage extending along the rear portion of the cylinder having an air inlet and a discharge outlet to atmosphere, and means driven by the engine for producing a current of air through said passage and in contact with the rear portion of the cylinder wall.

2. In an internal combustion engine, the combination with an engine cylinder having the forward and side portions thereof exposed to the cooling action of air flowing relatively to the engine, of passage forming means applied to the rear portion of said cylinder and coacting with the rear portion of the cylinder wall to form a Venturi shaped passage extending along the rear portion of the cylinder having an air inlet and a discharge outlet to atmosphere, and means driven by the engine for producing a current of air through said passage and in contact with the rear portion of the cylinder wall.

3. In an internal combustion engine, the combination with an engine cylinder having the front and side portions thereof exposed to the cooling action of air flowing relatively to the engine, of a casing member secured to the rear portion of the cylinder wall and coacting with said rear portion to form a passage extending longitudinally of the cylinder and having an air inlet and a discharge outlet, and means driven by the engine for producing a current of air flowing through said passage and in contact with the rear portion of the cylinder wall.

4. In an internal combustion engine, the combination with an engine cylinder having the front and side portions thereof exposed to the cooling action of air flowing relatively to the engine, of a casing member secured to the rear portion of the cylinder wall and coacting with said rear portion to form a passage extending longitudinally of the cylinder and having an air inlet and a discharge outlet, and means driven by the engine for producing a current of air flowing through said passage and in contact with the rear portion of the cylinder wall, said casing member being shaped to form a restricted portion in said passage.

5. In an internal combustion engine, the combination with an engine cylinder having the front and side portions thereof exposed to the cooling action of air flowing relatively to the engine, said cylinder having longitudinally extending fins at opposite sides of the rear portion of the cylinder wall, of a casing member secured to said fins and arranged to form therewith and with the rear portion of the cylinder wall a passage having an air inlet and a discharge outlet, and means driven by the engine for producing a current of air flowing through said passage and in contact with the rear portion of the cylinder wall.

6. In an internal combustion engine, the combination with an engine cylinder having the front and side portions thereof exposed to the cooling action of air flowing relatively to the engine, said cylinder having longitudinally extending fins at opposite sides of the rear portion of the cylinder wall, of a casing member secured to said fins and arranged to form therewith and with the rear portion of the cylinder wall a passage having an air inlet and a discharge outlet, and means driven by the engine for producing a current of air flowing through said passage and in contact with the rear portion of the cylinder wall, said rear portion of the cylinder wall being provided with corrugations extending transversely of said passage.

7. In an internal combustion engine, the combination with an engine cylinder having the front and side portions thereof exposed to the cooling action of air flowing relatively to the engine, said cylinder having longitudinally extending fins at opposite sides of the rear portion of the cylinder wall, of a casing member secured to said fins and arranged to form therewith and with the rear portion of the cylinder wall a passage having an air inlet and a discharge outlet, and means driven by the engine for producing a current of air flowing through said passage and in contact with the rear portion of the cylinder wall, said rear portion of the cylinder wall being provided with corrugations extending transversely of said passage, and with longitudinally extending fins within said passage.

8. In an internal combustion engine, the combination with the engine cylinder of driven means for producing a curent of cool-

ing air flowing in contact with a portion only of the exterior of said cylinder, and means for confining said air to contact with said portion of said cylinder, said means being formed to produce an increase in the velocity of said current at one part of said portion.

9. In an internal combustion engine, the combination with the engine cylinder of means forming, together with a portion only of the cylinder wall, an air passage having a restricted portion and an outlet to atmosphere, and driven means for producing a current of cooling air through said passage.

10. In an internal combustion engine, the combination with the engine cylinder of means forming an air passage at the rear of the cylinder wall having a restricted portion opposite the combustion space of said cylinder, and driven means for producing a current of cooling air through said passage in contact with said wall.

11. In an internal combustion engine, the combination with the engine cylinder of means forming, together with a portion of the cylinder wall, a Venturi shaped air passage, and driven means for producing a current of cooling air through said passage.

12. In an internal combustion engine, the combination with the engine cylinder of means forming, together with a portion of the cylinder wall, an air passage, said wall being provided with transversely extending corrugations within said passage, and driven means for producing a current of cooling air through said passage.

13. In an internal combustion engine, the combination with the crank casing of casing means secured to said crank casing in spaced relation to the side wall thereof to form an annular chamber surrounding the crankshaft of the engine, means extending radially from said casing means in the rear of an engine cylinder to form an air passage extending along the rear portion only of said cylinder and communicating with said annular chamber, said means having an air inlet and a blower means mounted on and rotatable with the crankshaft in operative relation to said chamber to produce an air flow through said chamber and said passage.

14. In an internal combustion engine, the combination with the crank casing of the engine of a mixture intake casing having a chamber therein and means connecting said chamber with the inlet port of a cylinder of the engine, said intake casing being secured to the crank casing in spaced relation to the side wall thereof to form an annular chamber therewith surrounding the crankshaft of the engine, means extending radially from said intake casing in the rear of said cylinder to form a passage extending along the rear portion only of said cylinder, said passage having an air inlet, and a blower means mounted on and rotatable with the crankshaft in operative relation to said annular chamber to produce an air flow through said chamber and said passage.

In testimony whereof I affix my signature.

JOHN M. WILLIAMS, JR.