Feb. 18, 1936. R. J. HERRINGTON 2,031,042

INTERNAL COMBUSTION ENGINE

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Fig. 1

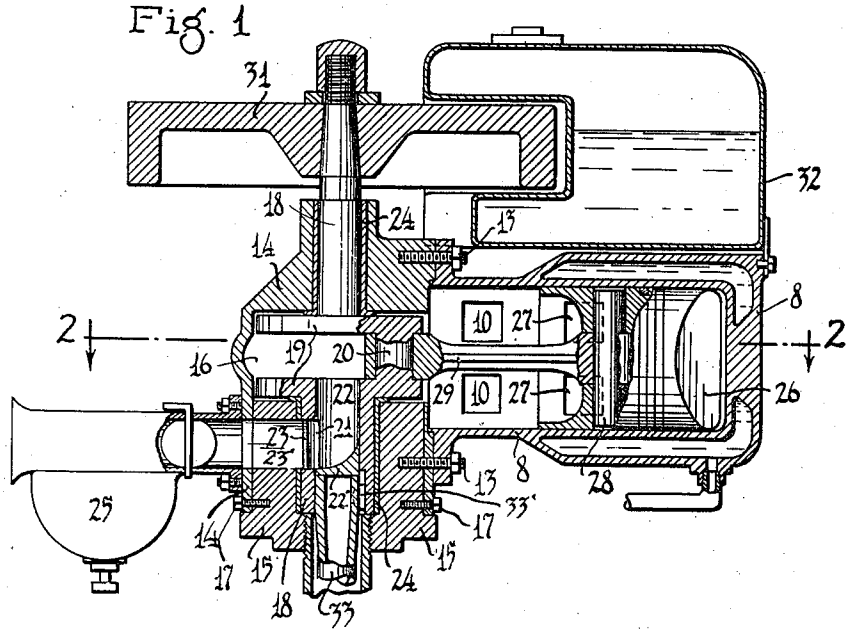


Fig. 2

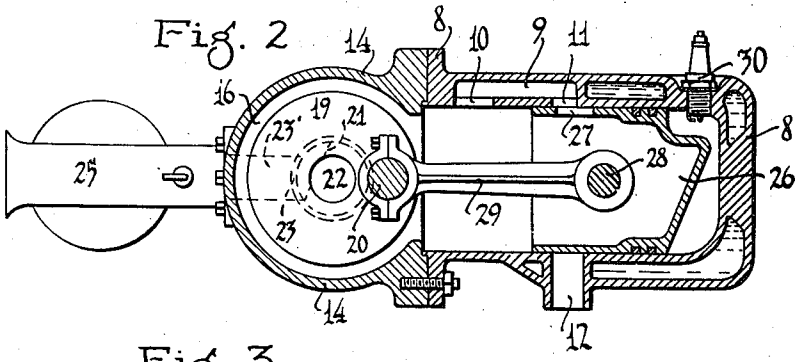
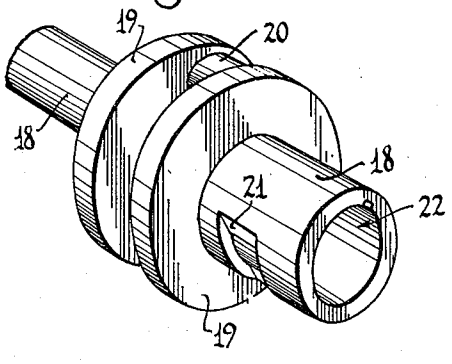


Fig. 3



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Fig. 4

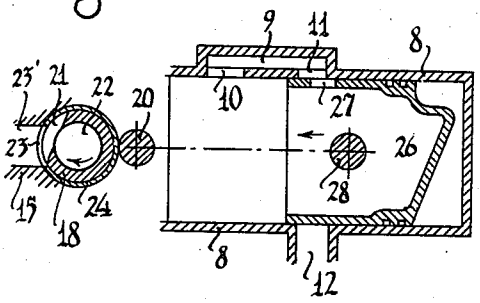


Fig. 5

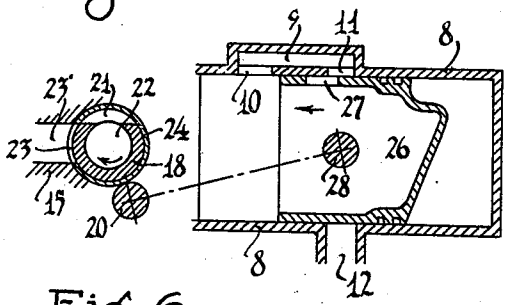


Fig. 6

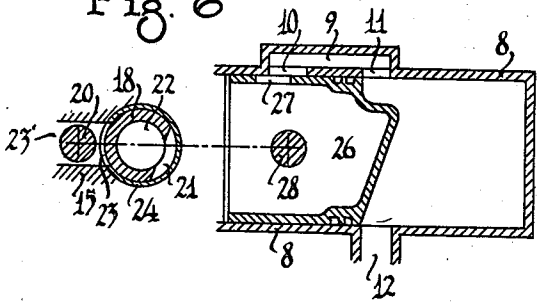
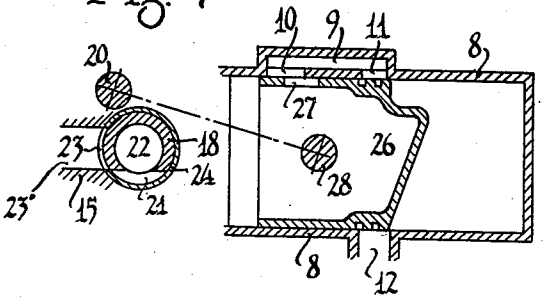


Fig. 7



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2,031,042

INTERNAL COMBUSTION ENGINE

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Application October 1, 1934, Serial No. 746,336

1 Claim. (Cl. 123—73)

My invention relates to internal combustion engines (particularly two-stroke cycle engines) of the type wherein the explosive mixture is drawn into the crank case. More specifically, the invention relates to an improved valve means for controlling intermittent flow of explosive mixture into the crank case of such engine in timed relation to the piston thereof. An important object of the invention is to increase the efficiency of such engines, while at the same time simplifying the construction thereof and effecting resultant savings in production and maintenance costs.

Several different types of valve mechanisms are at the present time employed for controlling intermittent flow of fuel into the crank case and maintaining proper timing thereof in relation to the engine piston, but from the standpoint of efficiency, it is generally recognized that those engines employing rotary valves for the purpose stated are most desirable.

For the purpose of this case, engines of the type described and employing rotary valve controlled fuel intake passages to the crank case may be divided into two distinct classes, to wit: (*a*) those engines employing rotary valves formed entirely independent of but driven from the crank shaft of the engine, and (*b*) those employing rotary valves for the purpose set forth which are afforded in part by a member carried by or formed as an integral part of the engine's crank shaft.

Obviously, engines employing rotary valves of class (*b*) above, have the advantages of simplified construction due to the elimination of all driving connections and certain other parts required in engines of class (*a*) above. However, hitherto employed rotary valve mechanism whether of class (*a*) or of class (*b*) has required delicate fitting and adjustment between the co-operating rotary and non-rotary valve-forming elements in order to maintain a seal against loss of crank case compression during the intervals the valves are closed, and this results in relatively high cost of manufacture and maintenance, since this sealing of the valve mechanism against compression loss has been, in previous engines, entirely independent of and in addition to the sealing against crank case compression loss at the crank shaft bearings. It will be obvious that in any engine of this type wherein the crank case is closed and subject to pressure, the crank case must be sealed against loss of compression between the journal of the crank shaft and the bearing therefor at the point or points where the crank shaft works through the crank case, this being true regardless of what type of valve mechanism is employed for controlling flow of explosive mixture into the crank case. As is well known, such a compression seal is usually provided by the oil film necessary to lubricate the bearings.

In accordance with the instant invention, which relates particularly to engines of class (*b*) above, a rotary valve for the purpose set forth may be readily provided without any special fitting or adjusting of any parts not necessary, independent of any and all mechanisms for the purpose set forth. This I accomplish by providing a radial port in one of the crank shaft journal bearings, this port being exposed at its inner side to the contained crank shaft journal, and at its other side communicating with a carburetor or like fuel supply device, and further providing a crank shaft with an axial or substantially axial fuel intake passage which opens at one end into the central portion of the crank case and at its other end communicates with a peripheral port opening through the crank shaft journal within the said bearing and co-operating with the port in said bearing. In this very simple manner, a highly efficient rotary valve is provided with a minimum of labor substantially without involving any parts for this purpose, and the valve will remain compression-tight as long as will the bearing and journal in which it is incorporated. Also, since in engines of this character, the lubricant is customarily mixed with and fed to the crank case with the combustible mixture, the bearing in this instance will be better lubricated than in other engines, due to the fact that such lubricant is directed in this instance against the crank shaft. The above and other important objects and advantages will be made apparent from the following specification and claim.

The invention above outlined is illustrated in the accompanying drawings wherein like characters indicate like parts throughout the several views.

Referring to the drawings:

Fig. 1 is a vertical section taken axially through a single cylinder internal combustion engine of the two-cycle type, embodying my invention;

Fig. 2 is a horizontal section taken on the line 2—2 of Fig. 1;

Fig. 3 is a perspective view of the engine crank shaft; and

Figs. 4, 5, 6 and 7 are diagrammatic sections showing the cylinder, piston and crank shaft, and illustrating the relative positions of the said parts during different positions of one complete or two stroke cycle of operation of the engine.

The engine herein illustrated is of the marine outboard type and hence the cylinder thereof is shown as horizontally disposed with the axis of the crank shaft vertically disposed. The cylinder 8 is shown as being water-jacketed for cooling, but of course, might be air cooled so far as this invention is concerned. Also, of course, the character of the engine as far as to the service it is employed for or designed to fill is not material so far as this invention is concerned. At one side of its wall, the cylinder 8 is provided with a transfer passage 9 terminating in ports 10 and 11 that open into the interior of the cylinder; and at its other side the cylinder is provided with an exhaust port 12. The passage 9 and ports 10, 11 and 12 are conventional in character and common in engines of the two-cycle variety.

The flanged base of the cylinder is rigidly secured, as shown, by means of nut-equipped studs 13 to a crank case shown as being made up of telescoped members 14—15, the former being hollow to afford a crank shaft and fuel compression chamber 16. As shown, the member 15 is in the form of a large cylindrical block or head telescoped into the shell of member 14 and additionally secured thereto by means of screws 17.

The engine crank shaft is made up of axially aligned sections 18, disc-like crank blades or flanges 19, and a crank pin 20, which parts are rigidly connected, being preferably integrally formed. The shaft sections 18 are formed to afford suitable journals immediately outward of their flanges 19. The crank shaft journals are mounted directly in bearing sleeves or bushings 24 contained in the crank case members 14 and 15.

Having now described certain elements common to all engines of this character, I will proceed to describe my improved rotary fuel intake valve, as here illustrated, and which valve, it will be seen, is provided without addition of any part or parts over and above those essential independent of any and all valve mechanisms and without complicated assembly and adjusting or fitting of the otherwise essential parts. The rotary element of this valve is afforded by the lower crank shaft journal section 18, which, for this purpose, is provided with a peripheral circumferentially extended port 21 that is exposed to the intermediate portion of the lower crank shaft journal bearing 24 and leads into the crank pressure chamber through an axial passage 22. The non-rotary element of this valve is the lower and essentially provided crank shaft journal bearing 24 which, for this purpose is provided with a radial port 23 that opens onto the face of the lower shaft journal and under rotation of the shaft is brought into intermittent registration with the shaft bearing port 23.

The port 23 is connected to a suitable source of combustible mixture, such as the conventional carburetor 25 through an intake passage 23' in the crank case members 14 and 15. The axial crank shaft passage 22 is most readily formed by drilling completely through the lower shaft section and then plugging the same as at 22'. Having now completely described my very simple but highly efficient rotary intake valve, I shall return and go on with the description of other cooperating but more or less conventional parts of the engine.

Working in the cylinder 8 is a hollow piston 26 that is formed with a port 27 and is provided with a diametrically extended wrist pin 28, which latter is connected to the crank pin 20 of the engine crank by a connecting rod 29. The numeral 30 indicates a spark plug suitably applied through the closed combustion chamber forming end of the cylinder 8. Rigidly secured to the projecting upper end of the upper crank shaft 18 is a fly wheel 31. The numeral 32 indicates a gasoline or fuel supply tank shown as connected to the cylinder and supported above the same. This fuel tank will, of course, be provided with a suitable connection to the carburetor for the supply of gasoline thereto, which connection, however, being well understood, is not shown.

In accordance with standard practice in engines of this character, lubricating oil is mixed with the gasoline in tank 32 and is fed into the engine crank case with the combustible mixture of gasoline and air for the purpose of lubricating the various parts of the engine.

The numeral 33 indicates an extension of the crank shaft for transmitting power therefrom to the propeller or other power-driven device not shown. This extension 33 is keyed to the lower crank shaft section at 33'.

The exact relation of the valve-acting elements in respect to the movements of the crank shaft and piston throughout a complete two stroke cycle will appear from a description of the operation of the engine, attention now being particularly called to Figs. 4 to 7, inclusive.

Figs. 1 and 4 show the position of the movable parts of the engine when the crank shaft is on its outer dead center and approximately at which time the explosion takes place. The crank shaft is assumed to rotate in a clockwise direction in respect to said views, Figs. 4 to 7, inclusive. When the crank shaft is moved from its inner dead center approximately 60 degrees, the parts will be in the position shown in Fig. 5, and the piston will, under the force of the explosion, be moving toward the open end of the cylinder. At this time the exhaust port is closed, the crank shaft compression chamber is cut off from the explosion chamber, and the crank shaft journal intake port 21 is then closed. When the crank shaft is moved 180 degrees from its position in Fig. 4, see Fig. 6, and has reached its inner dead center, the crank shaft journal intake port 21 will still be closed, the cylinder exhaust port 12 will be fully opened, and communication will be established between the crank shaft compression chamber and the explosion chamber of the cylinder, so that the explosive mixture compressed within the crank shaft compression chamber and within the piston, under inward movements of the piston, will be blown into the cylinder with the expected result that the latter will receive its charge of explosive mixture and the burned gases will be exhausted and blown out through the exhaust port 12.

When the crank shaft has moved approximately 60 degrees from its inner dead center shown in Fig. 6 and has then moved approximately 240 degrees from its outer dead center, as shown in Fig. 7, cylinder exhaust port 21 will still be open but will be about ready to close; and at such time port 11 will just have been closed. Just slightly in advance of the complete closing of the exhaust port 12, transfer port 11 will have been closed. As the crank shaft completes its rotation back to

its outer dead center shown in Fig. 4, two things will be performed, to wit: The explosive charge will be compressed in the explosion chamber of the cylinder and partial vacuum will be produced in the crank shaft compression chamber, so that a new explosive charge will be drawn into the crank shaft compression chamber. It will be noted that the crank shaft journal port 21 will begin to open as soon as the crank commences its above described movement beyond its inner dead center and will remain open more or less until the crank again reaches its position shown in Fig. 5. The movement of the crank back to the position shown in Fig. 4 completes one cycle of the operation of the engine.

A further statement of the timing and operation of the engine is substantially as follows: The cylinder exhaust port will be open while the crank is moving from approximately 140 degrees to 260 degrees from its outer dead center; the transfer ports will be open when the piston is moving from 130 degrees to 230 degrees past its outer dead center; and the intake valve port of the crank shaft will be open while the crank is moving from 240 degrees past its outer dead center back to its outer dead center and again approximately 60 degrees past said outer dead center.

It should be noted that the head block 15 forms a removable part of the crank shaft casing and which head block, when removed, makes removal or application of the integrally constructed crank an easy matter.

It is well known that the clearances between crank shaft journal bearings and the shaft journals in any engine must be very small in order to prevent undue vibration and wear, but in engines of the two-cycle variety such as herein described, such clearances must also be maintained sufficiently close that the required film of lubricating oil will provide a seal against compression leakage from the crank case. With such facts in mind, it will be readily seen that so long as such customary requirements are satisfactorily complied with, the valve sealing problem will automatically be taken care of and further the fact that the fuel and lubricant mixture is directed directly onto the face of the affected shaft journal gives further assurance that ample oil will always be present to further insure a positive seal against compression leakage either through bearing port 23' or to the atmosphere between the shaft and bearing.

What I claim is:

In a two-cycle internal combustion engine, a crank case having a closure removably secured in the lower end thereof, a vertical crank shaft journaled in a bearing in said closure, the lower section of said crank shaft being formed with an axial tubular bore which communicates at its upper end with the lower central portion of said crank case and at its lower end with a radial port in said shaft which has sealing engagement with the surrounding surface of said journal bearing, and a fuel and lubricant mixture admission port extending radially through said closure and journal bearing below said crank case and adapted to communicate with said radial port in said tubular shaft upon rotation thereof, whereby mixture drawn upwardly through said shaft into said crank case during operation will drain into the bore of said shaft adjacent its surrounding bearing surface when the engine is idle, prolonging the life of said bearing and improving the starting and slow speed operation of said motor.

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