Dec. 4, 1923. 1,476,359

E. A. FORD

SLIDE VALVE INTERNAL COMBUSTION ENGINE

Filed May 10, 1921 2 Sheets-Sheet 1

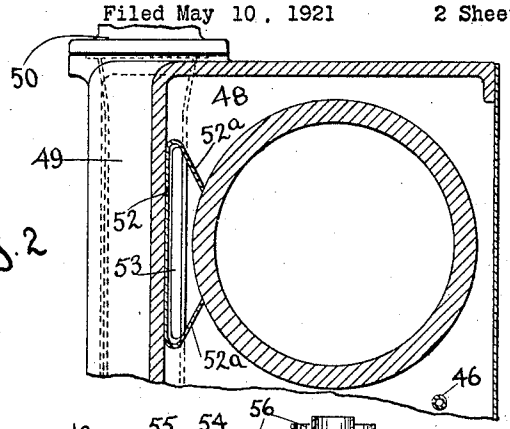


Fig. 2

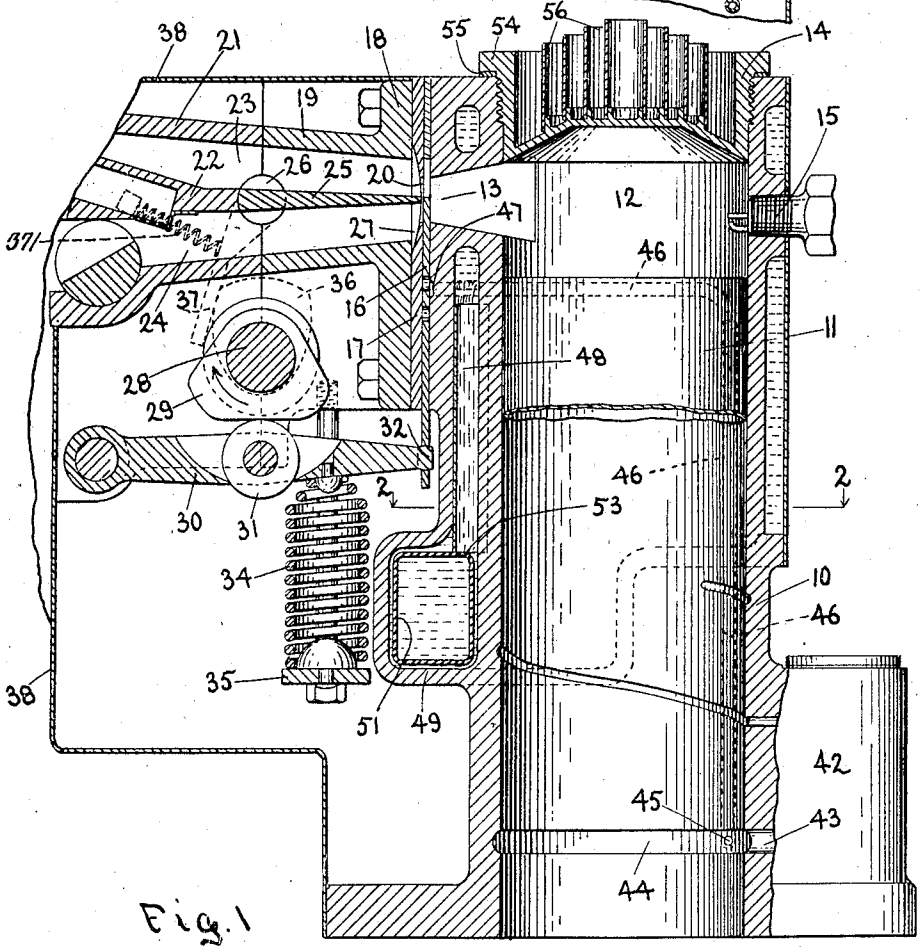


Fig. 1

INVENTOR
Eugene A. Ford

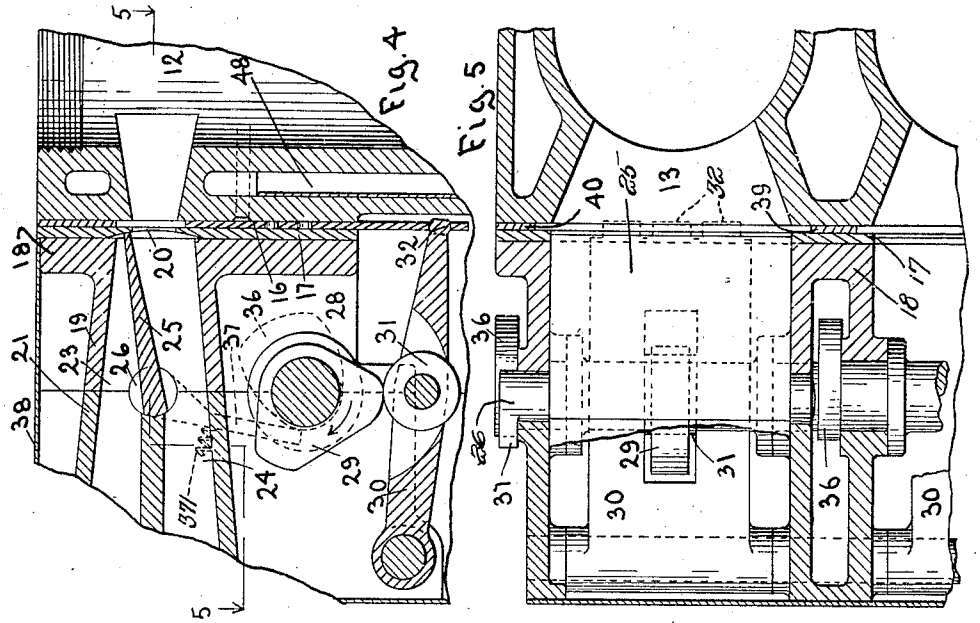
by Wright, Brown, Quinby & Craig
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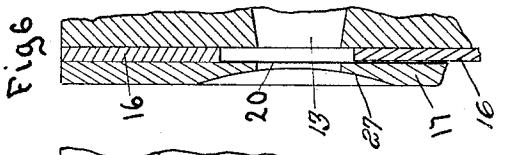
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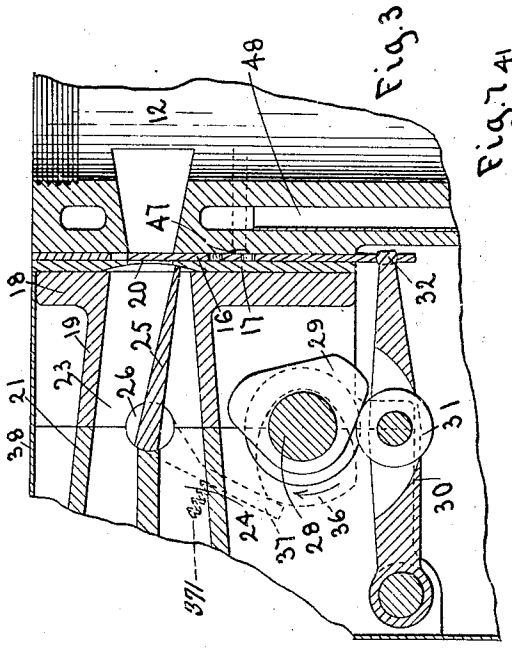
E. A. FORD

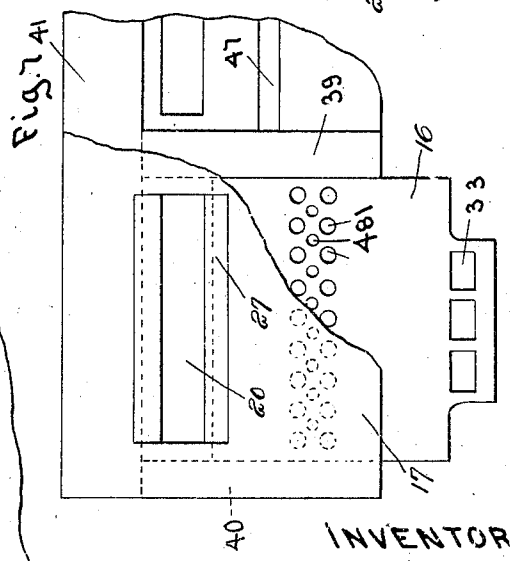
SLIDE VALVE INTERNAL COMBUSTION ENGINE

Filed May 10, 1921 2 Sheets-Sheet 2









INVENTOR
Eugene A. Ford
by Wright, Brown, Quinby & Macy
Attys

Patented Dec. 4, 1923. 1,476,359

UNITED STATES PATENT OFFICE.

EUGENE A. FORD, OF WEST NEWTON, MASSACHUSETTS, ASSIGNOR TO R. E. D. ENGINE COMPANY, INC., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SLIDE-VALVE INTERNAL-COMBUSTION ENGINE.

Application filed May 10, 1921. Serial No. 468,339.

To all whom it may concern:

Be it known that I, EUGENE A. FORD, a citizen of the United States, residing at West Newton, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Slide-Valve Internal-Combustion Engines, of which the following is a specification.

This invention relates to valve gears for internal combustion engines and has for its objects to provide a slide valve for such engines, and means for the efficient cooling, lubrication and packing of the slide valve and to associate therewith a simple means for coupling a single admission and exhaust port in the engine cylinder controlled by said valve, exclusively with separate passages for combustible mixture and exhaust gases.

Referring to the drawings in which the preferred embodiment of my invention is illustrated,

Figure 1 is a sectional view of one cylinder of an internal combustion engine containing this preferred embodiment.

Figure 2 is a cross section on the line 2—2 of Figure 1.

Figures 3 and 4 are fragmentary longitudinal sections illustrating the action of the valve gear and showing the same in different positions.

Figure 5 is a horizontal section on line 5—5 of Figure 4.

Figure 6 is a detail sectional view on an enlarged scale of the mount or guide means for the valve, showing a fragment of the valve therein.

Figure 7 is a fragmentary view showing in elevation the slide and its guideway.

Like reference characters designate the same parts wherever they occur in all the figures.

This invention is applicable to an engine having any number of cylinders, and in a plural cylinder engine the same mechanism is duplicated as to each cylinder. In these drawings one of the units of a plural cylinder engine is shown for illustration.

Referring now first to Figures 1 and 2, 10 represents the engine cylinder and 11 represents the piston which is adapted to reciprocate therein in the usual manner. 12 represents the clearance space of the cylinder and 13 a port through which both the combustible mixture is admitted and the exhaust gases are discharged. 14 is the cylinder head and 15 a spark plug or equivalent ignition device.

The outer face of that wall of the cylinder block through which the port opens is finished with a plane surface and provided with a guideway, the character and construction of which will be later described in detail, and in such guideway is placed a slide valve 16, which is retained by a cover plate 17. Over the outer face of the cover plate is secured a fitting 18 having a passage or nozzle 19 which registers with the port 13; and the cover plate 17 has a port opening 20 in register therewith. Registering with the passage 19 is a connection 21 having an interior partition 22 which separates two passages 23 and 24 from one another. One of said passages is the intake or supply passage for the combustible mixture and the other is the exhaust passage. For the purposes of the present specification it is not important which passage is the intake and which the exhaust.

A switch partition or septum 25 is located in the passage 19 and registers with the partition 22, and is provided with trunnions 26 adapted to turn in bearings formed in the abutting side walls of the passage conduits 19 and 21, whereby the switch is enabled to oscillate so as to put either of the passages 23 or 24 exclusively in communication with the ports 20 and 13. The movable end of the switch 25 projects close to the plate 17, and the adjacent surface of the latter is recessed at 27 to provide a concave surface concentric with the trunnions 26, into a substantial contact with which the switch extends. Thus the end of the switch in all of its positions is equally close to the surface of the plate.

A cam shaft 28 operates both the slide valve 16 and the switch 25. It drives the valve by means of a cam 29 and a lever 30 having a roll 31 on which the edge of the cam bears, and having one or more fingers 32 extending into holes 33 (see Figures 5 and 7) in the valve. A spring 34 is supported by an abutment 35 and bears against the lever 30, holding its roll against the cam 29 and returning it and the valve after the valve has been displaced by the action of the cam. For operating the switch, the

shaft is equipped with a cam 36 which acts on an arm 37 secured to one of the switch trunnions 26.

The stationary parts 17, 18, and 22 are secured together and to the cylinder block by bolts or any other means known in the art, and said parts together with the movable parts, are enclosed in a casing 38.

Heretofore difficulty has been encountered with the use of slide valves for internal combustion engines in preventing overheating of such valves, in lubricating them, and in making them sufficiently leakage tight. I have incorporated in my valve gear and in the engine structure a construction which causes the valve to prevent appreciable leakage of the gas under compression from the port when the valve is closed, together with efficient means for lubricating and means for assuring the cooling of the valve to such a temperature that it will not become roughened by burning off of the lubricant and sticking to the cylinder wall. The construction referred to is more particularly shown in Figures 6 and 7, in conjunction with Figure 1. The valve is a flat plate, preferably of hardened steel, ground on both sides to a smooth and true surface. The outer surface of the cylinder against which it lies is likewise ground to a smooth plane surface, and on this surface are mounted hardened steel plates or strips 39 and 40 which define the guideway in which the valve travels, and an end plate or strip 41 which closes the end of this guideway. In a plural cylinder engine, preferably a single plate 41 extends the whole length of the cylinder block at the upper limit of the surface whereon the several valves bear, and a series of guide strips 39 are provided between the ports of the several cylinders to delimit separate and independent guideways for the several valves. These plates or strips are ground on both surfaces in true parallel planes and to a thickness enough greater than that of the valve to give clearance. Then the outer plate 17 is likewise preferably of hardened steel, ground on its inner surface to conform with the outer surfaces of the guide plates 39, 40, and 41. A sufficient degree of accuracy in dimensions of finish is possible to cause this plate, when applied to the cylinder block as described, and bolted fast, to make leakage-tight joints with the guideway-bounding plates and to permit free travel of the valve with a clearance for the latter of not more than one one-thousandth of an inch. The edges of the valve approach the guide strips 39 and 40 with approximately the same amount of clearance and thereby the valve is fitted so closely to the cylinder wall and to its guides that leakage of the working gas, even in the absence of lubricating oil, is substantially prevented.

However, leakage of gas is further prevented and the valve lubricated by the following means. A chamber 42 receives oil from a pump, not shown, and delivers oil through a port 43 into a groove 44 inside of the cylinder, to pack the piston 11 against leakage of the working fluid. From this groove a small eduction port 45 opens into a pipe 46, and the pipe runs alongside the cylinder as shown in Figure 2 and discharges into a groove 47 which extends across the outer face of the cylinder block over which the valve travels. This groove being kept constantly filled with oil distributes a film of oil over the face of the valve as the latter travels, and delivers oil into holes 481 which are cut through the valve, whereby oil is allowed to flow between its outer face and the surface of the cover plate also. The oil in groove 44, being confined between the piston and cylinder wall, is subjected to the working pressure of the gas in the cylinder, which pressure is transmitted through the contents of pipe 46 to the oil in groove 47. Any loss of oil which might occur by leakage is replenished by the pump. Thus the slide valve, as well as the piston, is sealed against leakage during the compression and working strokes of the engine.

A water jacket space 48 is provided between the cylinder wall proper and the outer wall of the cylinder block, as shown in Figure 2, a part of this space being thus back of the wall against the face of which the valve bears. I have provided in and adjacent to that part of the water jacket means for compelling flow of the water entering the jacket first into thermal contact with that wall of the cylinder block against which the valve bears, wherefore substantially the coolest water in the jacket is made available for cooling the valve.

Following the usual practice in engine cooling systems, the cooled water from the radiator enters the bottom of the jacket and the heated water is returned to the radiator from the top part of the jacket. In this design there is arranged at the bottom of the jacket and along that side of the cylinder block where the valves are mounted a trunk 49 to which the water from the radiator is conducted. In Figure 2 the numeral 50 represents the end of the radiator connection which is joined to this trunk. In the trunk I place a pipe 51, which substantially fills the trunk and is arranged with its entrance end in register with the connection 50. In the jacket space between the cylinder wall and that part of the outer wall against which the valve bears I provide a partition 52 which extends in an up and down direction and the lower end of which is practically in contact with the pipe 51, its upper end being near the walls of the port. This partition is so made as to delimit from

the rest of the jacket a vertical passageway immediately back of the valve. Preferably the partition is made of sheet metal bent on longitudinal lines between its edges and its middle zone so as to provide two wings 52ª of such width as to cross the space beween the inner and outer walls of the cylinder block, the central zone of the partition then bearing on the outer wall of the block and the edges bearing on the outside of the cylindrical inner wall. The form and position of the partition may, however, be reversed and the central zone be shaped to fit the inner cylindrical wall and its edges arranged to cross into substantial contact with the outer wall. Or the partition might be made as a complete tube having continuous peripheral walls and appropriately shaped to fit the space in which it resides.

In the upper side of the tube 51 is a slot 53 which registers with the passageway delimited by the above described partition. In a multiple cylinder engine there is such a partition, passageway, and emission slot adjacent to each valve, and the only outlet from the pipe 51 is by means of this slot 53 or a number of such slots. Thereby the stream of cooled water flowing to the jackets is at once directed into thermal contact with the wall with which the valve is in contact, and between the valve and the source of heat, before flowing to other parts of the jacket and being heated; wherefrom it follows that the valve and its guideway are kept at a lower temperature than other parts of the cylinder, and may be kept at as low a temperature as is needed to prevent overheating, by the simple expedient of insuring that the water entering the jacket is cool enough. That is, I have provided a special means for so directing the flow of the cooling water, that the temperature of the valve may be certainly kept below a definite prescribed limit. The relatively cool combustible mixture flowing past the valve and the structural parts adjacent thereto contribute to this effect.

The operation of the slide valve and switch will be readily understood from the foregoing description. There remains only to be said that the cam 36 which operates the switch is shaped and timed properly in relation to the valve-operating cam 29 to place and retain the switch at one side or the other of the port during the suction and exhaust strokes, respectively, of the engine. The position of the switch during exhaust is that shown in Figure 3, and its position during the suction stroke is that shown in Figure 4. Figure 1 shows it in mid-position in the course of shifting from the position shown in Figure 3 to that shown in Figure 4. This shift occurs between the exhaust stroke and the suction stroke of the engine, and at that time the valve and the switch move in unison in order that the intake passage may be closed off from the cylinder until the exhaust flow has ceased. That is, the cams are shaped and timed with respect to each other and to the engine cycle to cause the valve to move approximately in unison with the switch when the engine piston approaches the dead point on the exhaust stroke. It will naturally be understood that suitable means, such as a spring 371 or otherwise, are provided to retain the switch-operating arm 33 in engagement with the driving cam therefor.

Another invention which may be used with the engine disclosed in this specification and which I claim in a divisional application consists in the fact that the cylinder head is constructed to be made adjustable and at the same time gas tight, whereby to alter the volume of the clearance space. To this end the cylinder head is made as a plug which is screwed into the cylinder, and is provided with a flange 54 between which and the end of the cylinder is placed a washer 55. When the head is fully screwed in, the clearance space is at the minimum, but by screwing out the head more or less this space may be enlarged. In any such adjustment the head may be made tight by inserting a sufficient number of washers between its flange and the end of the cylinder; and thereafter when reduction in size of the clearance space is desired, one or more of the washers may be removed and the head screwed in further in proportion.

Such an adjustable head is not susceptible of being water cooled, wherefore in order that it may be effectually air cooled, I make it of hollow construction, with a deep and wide recess in its outer side, and mount therein cylindrical radiating ribs 56 which are conveniently thin walled metal tubes of different diameters fitted and secured to ribs integral with the cylinder head, the latter being most conveniently a casting. By making the inner radiating tubes longer than the outer ones, all the ribs are exposed to air flowing over the engine and such air flow is deflected in the spaces between the ribs.

What I claim and desire to secure by Letters Patent is:

1. In an internal combustion engine having a cylinder and a jacket for cooling liquid, a slide valve arranged to cooperate with said cylinder and means for directing the cooling fluid entering the jacket into thermal contact first with the wall against which said valve bears.

2. An internal combustion engine comprising a cylinder having a port, inner and outer walls with a space for cooling fluid between them, through which said port opens, a slide valve arranged to travel in contact with the outer surface of said outer

wall across the port, and means for directing the cooling fluid entering said space into thermal contact first with the wall against which the slide valve bears.

3. An internal combustion engine having a slide valve and a water jacket, and means for directing a stream of cooling water in said jacket between part of the engine wall against which the slide valve makes contact and the source of heat within the cylinder.

4. In an internal combustion engine a cylinder block having inner and outer walls with a space between them for cooling water, a port passing through said walls, a slide valve on the outer side of the outer wall arranged to travel across the outer opening of said port, a cooling water conduit passing into the lower part of the jacket space and having an upwardly directed emission outlet, and a partition within the jacket space extending within said orifice and defining a water channel along the rear side of that part of the wall whereon the valve bears, whereby the coolest water in the jacket is brought into thermal contact with the valveway and valve.

In testimony whereof I have affixed my signature.

EUGENE A. FORD.