July 3, 1923. 1,460,831

H. L. THOMPSON

INTERNAL COMBUSTION ENGINE

Filed May 27, 1921 3 Sheets-Sheet 1

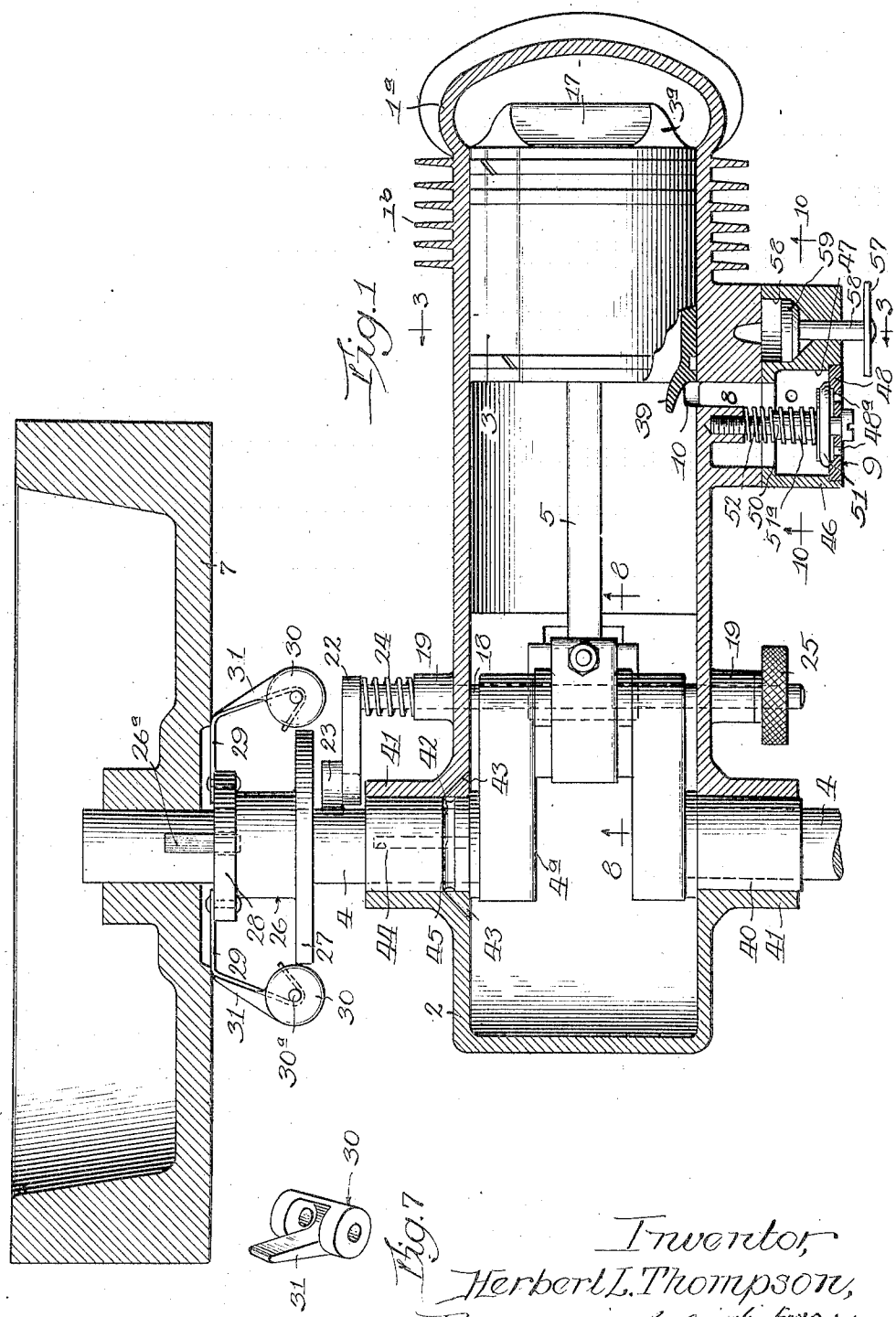


Fig. 1

Fig. 7

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INTERNAL COMBUSTION ENGINE

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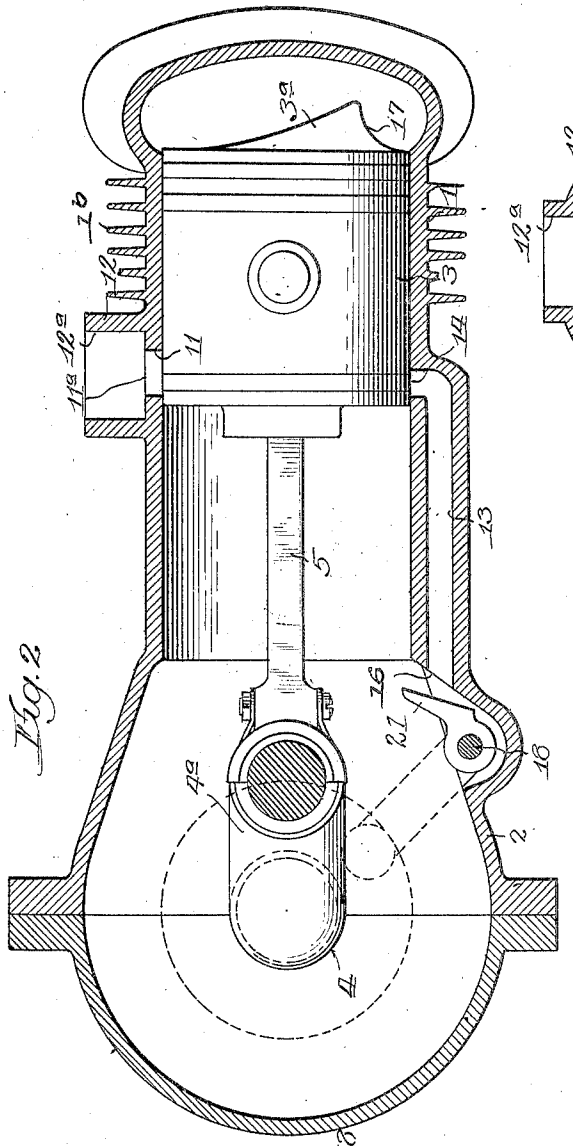


Fig. 2

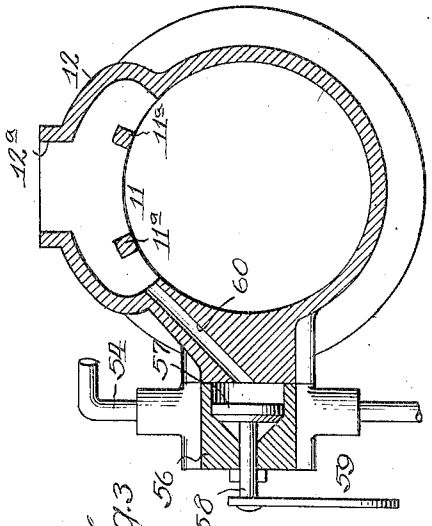


Fig. 3

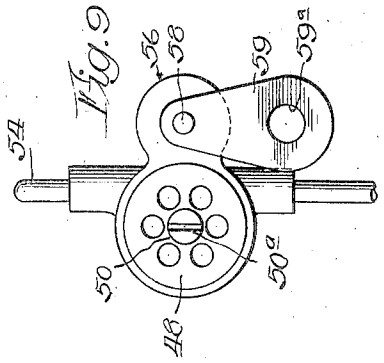


Fig. 9

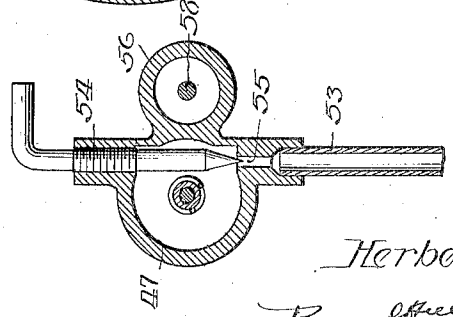


Fig. 10

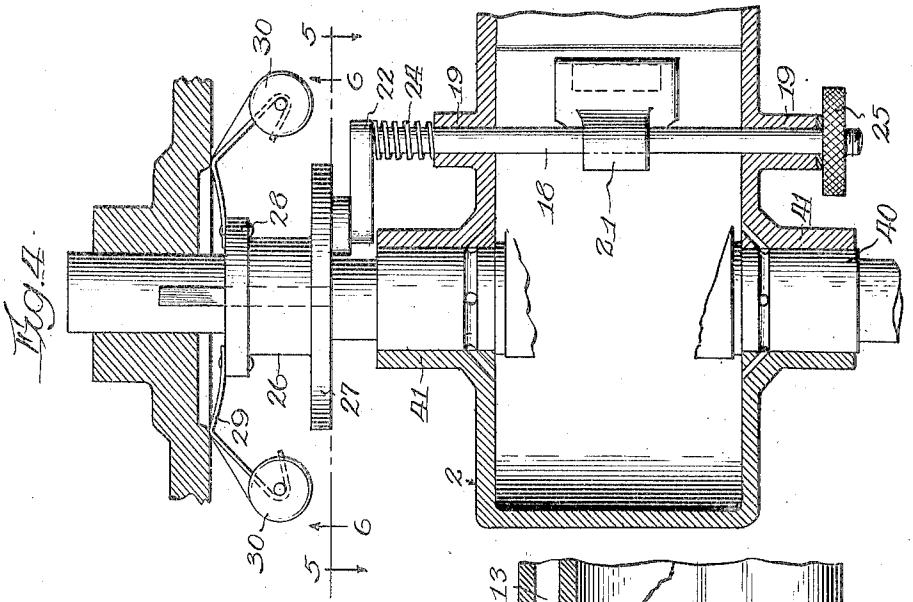
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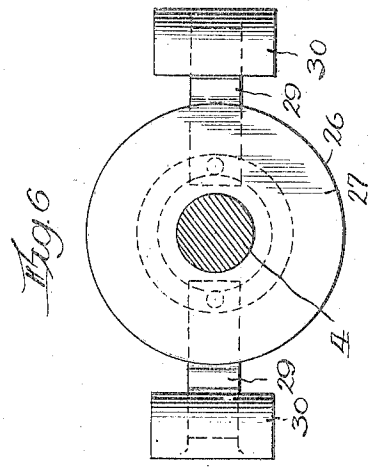
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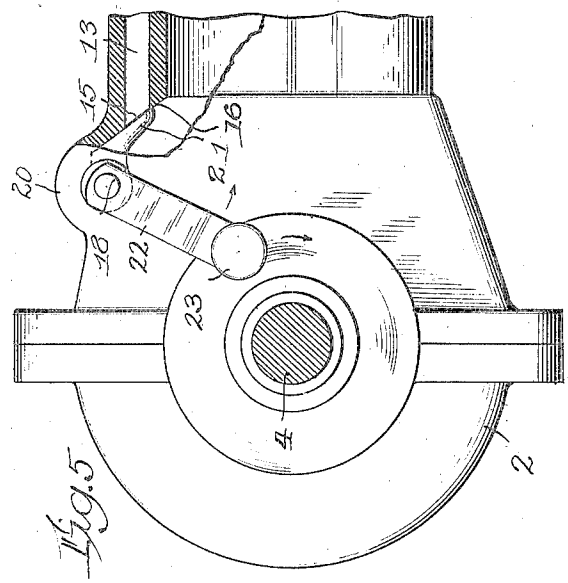
H. L. THOMPSON

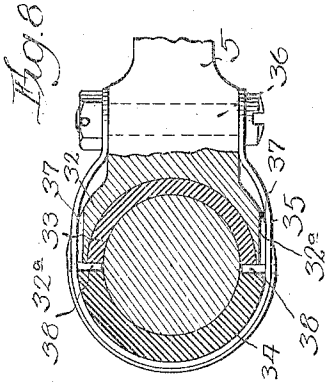
INTERNAL COMBUSTION ENGINE

Filed May 27, 1921 3 Sheets-Sheet 3









Inventor,
Herbert L. Thompson
By Offield Kolisch & Hinton Atty.

Patented July 3, 1923. 1,460,831

UNITED STATES PATENT OFFICE.

HERBERT L. THOMPSON, OF ELGIN, ILLINOIS, ASSIGNOR TO BURGESS-NORTON MANUFACTURING COMPANY, OF GENEVA, ILLINOIS, A CORPORATION OF ILLINOIS.

INTERNAL-COMBUSTION ENGINE.

Application filed May 27, 1921. Serial No. 472,944.

To all whom it may concern:

Be it known that I, HERBERT L. THOMPSON, a citizen of the United States, and a resident of Elgin, in the county of Kane and State of Illinois, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to improvements in internal combustion engines, and more particularly to an internal combustion engine of the two cycle type, especially designed to provide a simple, efficient, and dependable power unit for a number of uses where the characteristics suggested are especially desired, as, for instance, in the driving of small vehicles, boats, farm machinery, power tools, and the like.

The object of the invention is to provide certain new and useful improvements in the construction and design of the so-called "two-cycle" engine, including an improved means for automatically governing the speed of the engine under varying load conditions, an improved system of lubrication providing for the automatic distribution of oil thruout the moving parts, and the provision of a superior type of carburetor especially designed to establish proper conditions of combustion for starting the engine, these several features, among others, co-operating to promote ease and certainty in operation, low cost of maintenance, flexibility of power output, and an increased number of uses to which an internal combustion engine may be satisfactorily adapted.

An internal combustion engine or motor embodying the invention is hereinafter fully described and illustrated in the accompanying drawings, in which—

Fig. 1 is a view in vertical section of the engine, taken axially of the crank shaft,

Fig. 2 is another view in vertical section taken transversely of the crank shaft,

Fig. 3 is a horizontal cross-sectional view thru the cylinder and carburetor, taken on line 3—3, Fig. 1,

Fig. 4 is a view in vertical section thru the crank case, as in Fig. 1, showing the governor in extended position,

Fig. 5 is a detailed view of the crank case, taken on line 5—5 of Figure 4, showing the governor valve in closed position,

Fig. 6 is a cross-sectional detailed view of the governor, taken on line 6—6 of Fig. 4,

Fig. 7 is a perspective view of one of the governor weights,

Fig. 8 is a detailed view in cross-section thru the connecting rod head and crank pin, as taken on line 8—8 of Fig. 1,

Fig. 9 is a view in end elevation of the carburetor, and

Fig. 10 is a view in vertical section thru the carburetor, as taken on line 10—10 of Fig. 1.

An internal combustion engine of the "two-cycle" type is that characterized by reason of a peculiar sequence of events, carried on during one cycle or production of a power impulse and which distinguishes such engines from the so-called "four-cycle" type of internal combustion engines. In construction and operation, the engine about to be described in detail follows the general and fundamental principle of the two-cycle motor by devoting two strokes or one revolution of the fly-wheel to each explosion or impulse, and utilizing the crank case as a compression chamber in which the explosive mixture is initially compressed during the downward stroke of the piston and conducted to the combustion chamber during the succeeding upward stroke of the piston, whereupon the mixture is ignited to drive the piston downwardly on its succeeding power stroke. This briefly is the fundamental principle of two-cycle operation and to this extent the construction of all two-cycle motors may be said to be universal.

The motor herein described is preferably of the horizontal type and comprises in general a cylinder 1 having an enlarged chamber 1^a. The cylinder is preferably air-cooled and therefore equipped with external radiating fins 1^b of approved design and arrangement, a crank case 2 beyond the cylinder, a piston 3 mounted in the cylinder, a crank shaft 4, and a connecting rod 5 connecting the crank 4^a of the crank shaft with the piston thru the medium of a wrist pin. Mounted upon the crank shaft adjacent to the crank case is the usual fly-wheel 7. Connecting with the cylinder is an intake passage 8 communicating with the cylinder and combustion chamber thereof by means of an inlet port 10. A carburetor or mixing valve 9 is mounted on the cylinder and controls the passage of the hydrocarbon mixture into the intake passage 8, as will hereinafter be pointed out. Displaced circum-

ferentially from the inlet passage 8 thru an angle of 90 degrees, is an exhaust port 11, (Figs. 2 and 3) extending thru an arc of substantially 90 degrees, the port being preferably reinforced by vertical bridge members 11^a—11^a. The exhaust port 11 connects directly with an exhaust manifold or chamber 12 opening to the atmosphere thru an opening 12^a. Diametrically opposite the exhaust port is a vertical passage 13 formed in the cylinder wall, said passage communicating with and connecting the cylinder and crank case by means of ports 14 and 15 respectively. The cylinder port 14 is located with respect to the piston travel so that it is closed thereby in all positions except at the end of the downward stroke when it is momentarily opened and communication is established between the cylinder and the crank case. The lower port 15 of the passage 13 communicates with the crank case at the upper portion thereof, and is located in an oblique face 16 of the crank case, which serves as a valve seat, as will hereinafter appear. The top of the piston is provided with a projection 3^a forming a curved baffle 17 co-operating with the port 14 of the passage 13, as will be hereinafter set forth.

The construction thus far described is typical of the two-cycle engine, as is the general mode of operation, which may be briefly described as follows: Assuming that the piston 3 in the position shown in Fig. 1 has just completed an upward stroke, thereby uncovering the inlet port 10 to communication with the crank case, a charge of the explosive mixture from the carburetor is drawn into the crank case. During the downward stroke the charge is compressed in the crank case and upon the opening of the port 14, by the piston on reaching the lower end of the stroke, this charge is by-passed thru the passage 13 into the cylinder above the piston. Just previous to this event, the exhaust port is uncovered and the entrance of the fresh charge drives out or "scavenges" the burned gases in the cylinder. During the upward stroke of the piston, the charge is compressed in the combustion chamber, and on approaching the end of the stroke, the charge is ignited, the piston driven downward, and another cycle is commenced.

In engines of this type, means are usually employed for controlling the performance of the same under load so that the power is increased proportionately as the load is increased, and vice versa. Devices which automatically control the performance are termed "governors" and it is one form of governor that will now be described. Extending thru the crank case and parallel to the crank shaft 4 is a rock shaft 18 journalled in bearings 19—19, and projecting therebeyond. The shaft 18 is housed within a semi-circular extended wall portion 20 immediately below the port 15 of the vertical passage 13. Fixed to the shaft 18 is a wing valve member 21 adapted in the rocking movement of the shaft to seat upon the valve seat 16, and cover the port 15. At one end of the shaft adjacent the fly-wheel 7 is an arm 22 extending radially toward the crank shaft, and having at its end a friction disc 23. Surrounding the shaft 18 and between the arm 22 and bearing 19 is a coil spring 24 acting to resist the endwise movement of the shaft in a direction from the fly-wheel, and also to exert a yielding rotative force upon the shaft in a direction to hold the valve 21 in open position. The opposite projecting end of the shaft 18 is threaded and carries a thumb wheel 25 wherewith the endwise adjustments of the shaft 18 are made. Mounted upon the crank shaft between the fly-wheel 7 and the engine proper is a sliding sleeve 26 keyed to the shaft by a key 26^a and having an integral friction disc 27 at its inner end facing the engine. At its outer end adjacent the fly-wheel is provided a smaller disc 28 to which are fixed two radial spring arms 29—29 diametrically disposed to each other, these arms being flat spring metal strips bent substantially at right angles so that their free ends terminate adjacent the periphery of the friction disc 27 and the point of bending located in close proximity to the face of the fly-wheel. At the ends of the arms 29—29 are mounted weights 30, the same being cylindric in shape and having V-shaped portions removed into which the bent over ends of the arms 29—29 are fitted and secured by pins 30^a—30^a. Each of the weights 30 is further provided with a finger 31 which extends to the point of bend in the arms and lies flatwise against the outer face thereof, the ends of said fingers being rounded and spaced a short distance from the face of the fly-wheel.

The operation of the governor and the valve is clearly shown in Figs. 1, 2 and 4, wherein Fig. 1 shows the parts in a position when the engine is stationary, it being observed that the valve member 21 is in open position, the friction disc 27 is out of contact with the contact member 23, and the weights 30—30 are in their normal positions. As the speed of the motor is increased the spring arms 29—29 are gradually flexed; that is, they approach a straight line position, the ends of the fingers 31 of said weights bearing against the face of the fly-wheel and forming the fulcrum point about which the outer end portions of the spring arms turn. Under the action of centrifugal force on the weights, the arms function somewhat in the nature of bell crank levers which are fulcrumed at the point of contact with the fly-wheel, thereby exerting a force

upon the sleeve 26, sliding the same toward the arm 22 and into frictional engagement with the contact member 23 at the end thereof. Now, assuming that the crank shaft is rotating in a clockwise direction, as indicated in Fig. 5, the frictional engagement between the disc 27 and member 23 rotates the rock shaft 18 in a counter-clockwise direction, thereby carrying the valve member 21 into closed position over the port 15. Manifestly, the valve member 21 may assume positions between fully opened and closed positions, depending upon the speed of rotation of the crank shaft and the resulting position of the sliding sleeve 26 so that at any speed of the engine the valve member 21 will be moved to a corresponding position, thus controlling the amount of the explosive mixture which passes from the crank case, thru the passage 13 and into the combustion chamber. Controlling the volume of the explosive mixture admitted to the combustion chamber manifestly has a direct bearing upon the character of the ignited charge, and therefore, the power that is delivered to the piston during its power stroke. It follows, therefore, that the power output of the motor may be accurately governed to meet various load conditions by increasing the volume of mixture admitted to the combustion chamber as the load increases and the speed of the motor decreases, or vice versa.

In some forms of internal combustion engines, and particularly small engines of the two-cycle type, the system of lubrication adopted is that if mixing the lubricating oil with the hydrocarbon fuel and introducing the same into the motor thru the carburetor and inlet port. It is proposed to adopt such a system in the engine herein disclosed and it is further proposed to insure a more perfect lubrication by adopting certain details of construction pertaining more especially to the crank shaft and connecting rod bearings whereby a sufficient supply of lubricant at these points will be insured.

Referring first to the connecting rod bearing at the point where the same is connected with the crank pin, the same is preferably constructed in the following manner: As clearly shown in Fig. 8 the crank end of the connecting rod 5 is formed to provide a semi-circular shaped bearing section 32 forming the integral half of the bearing. Retained within this section is a semi-circular section 33 of the bearing bushing. The removable half of the bearing consists also of a semi-circular section 34 which abuts along its edges with the corresponding edges of the upper bearing sections 32 and 33. The sections of the bearing are connected together and held in place by means of a yoke or strap 35 which encircles the bearing sections and engages vertical slots 32^a—32^a cut in the sides of the upper bearing section 32. The ends of the strap 35 are anchored to the connecting rod immediately above the bearing by means of a bolt 36 passing thru the ends of the strap and the connecting rod. The central portions of the slots 32^a are cut slightly deeper, thereby forming vertical passages 37—37 between the strap and the vertical faces of the slots 32^a which communicate at their lower ends with radial passages 38—38 cut in the upwardly facing edges of the removable bearing section 34 and extending axially of the bearing thruout the central portion thereof. Thus it will be seen that if a quantity of lubricant is directed so as to strike the bearing from above, a considerable part of the same will find its way to the entrances of the vertical passages 37—37 and ultimately reach the bearing surfaces to be lubricated, this action being facilitated by capillary action between the surfaces of the strap 35 and the bearing. In order to direct the lubricant into the path of the bearing, a baffle plate 39 is provided at the lower edge of the piston 3, this baffle plate being preferably cast integral with the piston and so located and so shaped that when the inlet port 10 is opened or uncovered by the piston at the end of its upward stroke, said baffle plate is positioned immediately in front of the open inlet port 10 with the result that each change of the incoming explosive mixture carries with it its content of lubricating oil, which strikes the baffle plate and is deflected downwardly and inwardly toward the connecting rod bearing, which at that moment will be at the top of its circular path of movement. Thus during each rotation of the crank shaft a quantity of lubricating oil will be deflected downwardly in the form of a spray, a portion of which collects upon the surface of the connecting rod and parts of the bearing and find its way into the oil passages and thence to the bearing surfaces.

As just suggested, the introduction of the lubricating oil with the mixture and its dispersion by the baffle plate 39 fills the crank case with an oil spray or mist, a portion of which lubricates the connecting rod bearing, as described. A further portion is utilized for lubricating the crank shaft bearings, as will now be set forth. The crank shaft bearings comprise the usual form of bushings 40 retained within integral bearing sleeves 41 of the crank case, having an arrangement of oil grooves and passages as follows: Intermediate the ends of each bushing 40 is provided an annular oil groove 42 surrounding the outer surface of said bushing. Extending obliquely thru the wall of the crank case adjacent the bushings 40 is a series of circumferentially arranged oil

holes or passages 43 which connect the interior of the crank case with the oil groove 42, the latter in turn communicating with a longitudinal oil groove 44 formed in the internal surface of the bushing by means of a radial oil hole 45. Bearing in mind the existence of the spray of oil in the crank case, and calling attention to the so-called "breathing" of the motor, a term used to express the passage of air backwardly and forwardly thru any openings in the crank case which communicate with the atmosphere, due to the reciprocating motion of the piston, it will now be pointed out the function of the oil passages and grooves of the crank shaft bearings. For mechanical reasons, a certain degree of air leakage exists between the crank shaft and bearings, and by reason of the oil grooves and passages, a more complete communication with the atmosphere is established so that perfect inhaling and exhaling of the oil laden air of the crank case is carried on thru said oil grooves and passages. In other words, a quantity of oil is being continually and alternately forced in and out of the bearings; thus a constant circulation is maintained and fresh oil supplied to the bearing surfaces while the engine is in operation.

As previously described, the carburetor 9 of the motor is associated with the inlet passage 8 communicating with the cylinder, said carburetor comprising in general a casing 46 in which is formed a mixing chamber 47 communicating directly with the intake passage 8 and also with the atmosphere thru a series of air openings formed within an annular plate 48 secured in the block 46, and at the outer end of the mixing chamber 47. This plate 48 is preferably circular and the air openings 48^a arranged circumferentially about its center, at which point is a screw 50 which is anchored in the cylinder wall and carries a valve member 51 adapted to seat against the plate 48 and to close the air openings 48^a. This valve post is provided with a cylindric head 50^a projecting from the face of the plate 48. The valve member is slidably mounted on the screw or valve post 50, and yieldably held in closed position by means of a coil spring 52 surrounding the valve post 50 and the tubular stem 51^a of the valve member. Communicating with the mixing chamber 47 is a feed pipe 53 thru which the liquid hydrocarbon is supplied to the carburetor. A needle valve 54 seats within a restricted passage 55 communicating directly with the mixing chamber 47 and serves to regulate the supply of the liquid hydrocarbon to the carburetor. As clearly shown in Fig. 9, the valve 48 is vertically disposed and faces outwardly from the cylinder. Immediately adjacent and at one side (the right in Fig. 9) of the mixing chamber 47, is a small cylinder 56 arranged parallel to the mixing chamber. Within the cylinder is mounted a plunger consisting of a head 57 fitting in the chamber of the cylinder, and a plunger rod 58 arranged parallel with the axis of the mixing valve 51, said rod carrying at its outer end a plate 59 provided with an enlarged end portion having a circular opening 59^a therein having the same diameter as the head 50^a of the valve post 50. This plate, which is free to swing or rotate in a vertical plane and with the plunger and rod, is adapted, during the operation of the engine to hang freely in a vertical or depending position as shown in Figure 9, and displaced thru an angle of 90 degrees from the center of the plate 48. On the other hand, the plate 59 is adapted to be moved axially with the plunger, and to be fitted over the plate 48 with its opening 59^a engaging the head 50^a of the post 50 and the surrounding portion thereof, covering the air openings 48^a in said valve plate 48. As clearly shown in Fig. 2, the chamber of the cylinder 56 communicates directly with the exhaust chamber 12 of the cylinder, and indirectly with the combustion chamber of the engine thru an oblique passage 60 extending thru the cylinder wall. Thus the variations in pressure created within the exhaust chamber are transmitted to the cylinder, and act on the plunger 57 to move the same axially.

The purpose of the plate 59, the plunger 57 and chamber 56 is to provide a means for facilitating the starting of the motor, it being well known that it is frequently difficult to obtain the proper mixture at starting, due to the low temperature that is present, and hence the incomplete vaporizing of the hydrocarbon fuel. Proper starting conditions are ordinarily promoted by introducing an excessive amount of the fuel, this being accomplished by decreasing or even shutting off the air inlet to the mixing chamber. The function of the plate 59 is therefore to provide a temporary closure for the air inlet openings 48^a during the starting of the motor, this being done by placing the plate 59 over said air openings, the engagement of the opening 59^a over the head 50^a of the post 50 retaining the plate in closed position against the face of the valve plate 48. This operation is accomplished by hand and immediately prior to starting the engine. The engine is then turned over by hand until an explosion of the mixture occurs in the cylinder and the first exhaust stroke is completed. The exhausting of the burned gases from the cylinder creates a pressure in the exhaust chamber 12 which is instantly transmitted to the plunger chamber 56, forcing the plunger outwardly, the plate 59 being thereby released from the post head 50^a permitting it to drop by gravity from the face of the plate 48, thereby uncovering the air openings

therein. In this manner the normal conditions of fuel and air mixture are automatically restored, and at the proper instant; namely, after the first impulse denoting ignition of a charge within the combustion chamber. By this novel expedient, the starting operation is reduced to that of primarily sealing the air inlet openings, the remainder being accomplished automatically.

Having described the several features embodying the invention, I claim as new and novel as pertaining to internal combustion engines, the following:

1. A valve operating mechanism comprising a valve member adapted to open and close a valve, a drive shaft, a governor comprising a friction disc slidable axially on said drive shaft, and a radial contact member operatively connected with said valve member and adapted to be displaced angularly by an amount proportionate to the friction exerted thereon by said governor controlled disc.

2. Valve operating mechanism comprising a valve member, a shaft, a friction member slidably mounted on said shaft, a contact member operatively connected with said valve member and mounted in the path of said friction member for frictional engagement therewith, and a governor connected with said friction member for moving the same axially of said shaft into and out of engagement with said contact member.

3. Valve operating mechanism comprising a valve member, a rock shaft on which said valve member is mounted, a drive shaft a friction disc slidably mounted on said drive shaft, an arm mounted on said valve shaft, and adapted for frictional contact with said disc, and means governed by the speed of said drive shaft for moving said sleeve into and out of frictional engagement with the arm of said valve shaft.

4. Valve operating mechanism comprising a rock shaft, a valve member mounted on said shaft and adapted to open and close a valve, a contact arm mounted on said rock shaft, a drive shaft, a disc slidably mounted on said drive shaft and adapted to frictionally engage said arm, and speed controlled means for moving said disc into and out of frictional engagement with said arm.

5. In a valve operating mechanism, the combination with a drive shaft, a valve, a valve member adapted to open and close said valve and comprising a rock shaft, a disc slidably mounted on said drive shaft, a rocker arm mounted on said valve shaft, and adapted for frictional contact with said disc, and a centrifugal governor for moving said disc into and out of frictional engagement with the arm of said valve shaft.

6. In a valve operating mechanism, the combination of a drive shaft, a fly-wheel, a valve member adapted to open and close a valve, a rocker arm connected with said valve member, and extending radially toward the drive shaft, a sleeve slidably mounted on said drive shaft, radial spring arms and weights at the ends thereof mounted on said sleeve, said arms being bent and adapted to fulcrum on the surface said fly-wheel at the point of bend, whereby the centrifugal force acting on said weights effects a flexing of said arms to shift the said sleeve into and out of frictional engagement with said rocker arm.

7. In a valve operating mechanism, the combination of a drive shaft, a rock shaft parallel with said shaft, a valve member mounted on said rock shaft and adapted to open and close a valve, an arm fixed to said rock shaft and extending radially toward the drive shaft, and a governor comprising a friction disc slidably mounted on said drive shaft and adapted to frictionally engage the end of said radial arm, yieldable arms mounted on said disc, and weights at the ends thereof, said arms and weights being actuated by centrifugal force to flex said arms and to effect the axial movement of said disc along said drive shaft.

8. In a valve operating mechanism, the combination of a drive shaft, a valve member comprising a rock shaft provided with a radial contact arm, a friction disc slidably mounted on said drive shaft, and adapted for frictional engagement with said contact arm, and radially extending spring arms mounted on said disc, bent at an obtuse angle and fulcrumed at the point of bend against a radial surface of said drive shaft, and weights at the ends of said arms.

In witness whereof, I hereunto subscribe my name this 19th day of May, A. D., 1921.

HERBERT L. THOMPSON.