

Nov. 22, 1949

Filed Dec. 10, 1945

D. L. MCCOY
TWO-CYCLE ENGINE, CRANKCASE
COMPRESSION, VALVE CONTROL

2,489,150

2 Sheets-Sheet 1

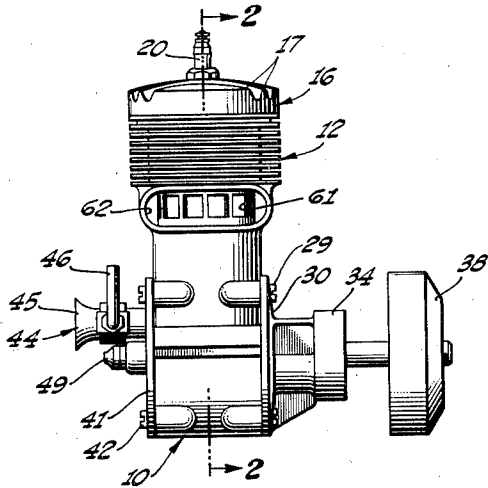


Fig. 1.

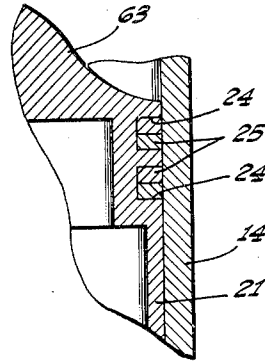


Fig. 6.

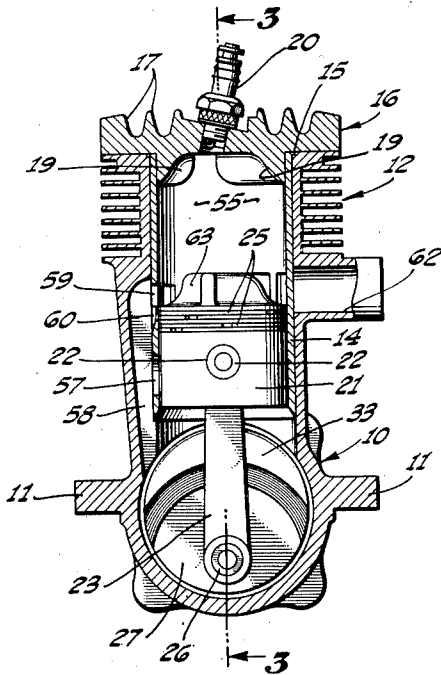


Fig. 2.

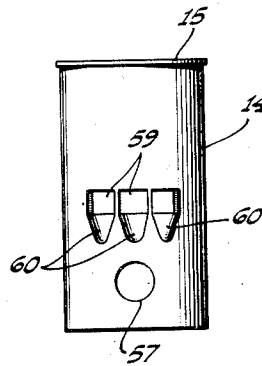


Fig. 7.

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2 Sheets-Sheet 2

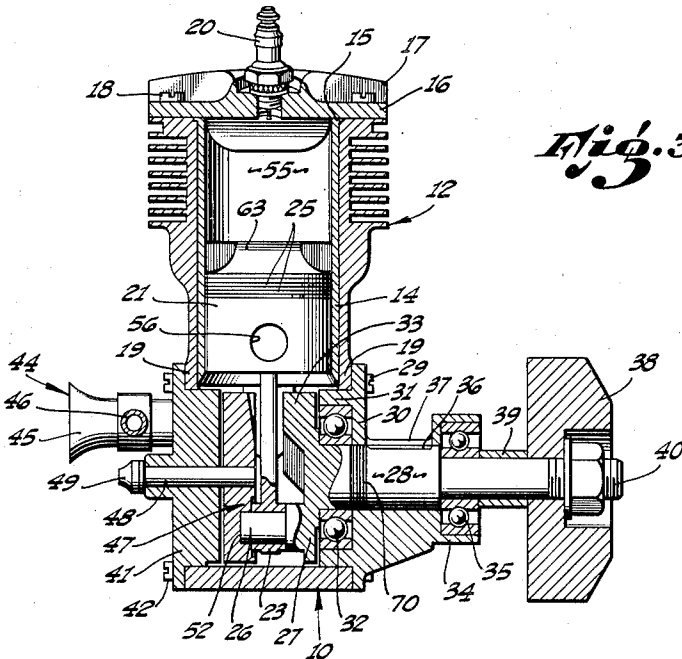


Fig. 3.

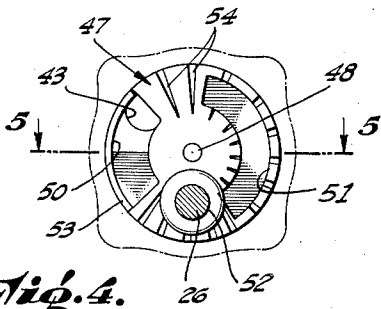


Fig. 4.

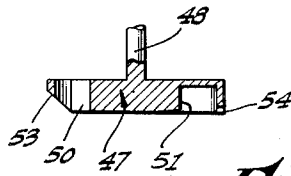


Fig. 5.

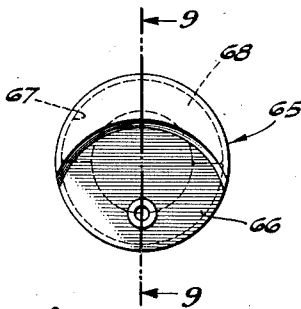


Fig. 8.

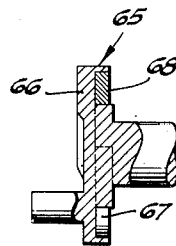


Fig. 9.

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2,489,150

TWO-CYCLE ENGINE, CRANKCASE COMPRESSION, VALVE CONTROL

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16 Claims. (Cl. 123-73)

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This invention relates to internal combustion engines and more particularly contemplates two port, two cycle model engines of the character commonly employed as power units in model airplanes and automobiles.

It is the general object of the invention to provide an engine which is productive of increased speed and power incident to more effective direction of the fuel, greater compression, and more efficient ignition, embodied in an integral crankcase and cylinder assembly in which both sides of the crankcase are removable for greater facility in inspection, servicing and assembly.

More specifically an object hereof is the provision of an engine of the type alluded to having the lower rim of the intake port or ports bevelled, in combination with the angular disposition of the spark plug whereby a streamlined passage for the vaporized fuel from the crankcase to the point of ignition is assured.

Another object is to provide a counterweighted crankshaft incorporating an oil seal intermediate its ends to reduce the loss of oil from the crankcase bearings in operation, the counterweight comprising a separate element of easily variable size and weight which enables the critical balancing the shaft during the process of manufacture with greater facility and economy in both time and materials.

Another object is to provide a counterweighted rotary intake valve operable to control the admission of vaporized fuel into the crankcase embodying a centrifugal supercharger to expedite and increase the volume of flow of fuel into the crankcase while the valve is open during the compression stroke of the piston and correspondingly augment the quantity of fuel introduced into the cylinder while the valve is closed during the downward stroke of the piston.

Another object is the provision of a piston formed with a pair of annular grooves each adapted to accommodate sealing means, comprising a pair of structural separate expansible rings, so as to assure a maximum oil retaining surface in each ring assembly while obviating excessive play therebetween which might result in tilting or angular displacement of the rings with respect to the cylinder wall.

Still another object is the provision of a fitting to encircle the crankshaft combining a removable closure plate for one end of the crankcase and a mounting for a timer, the intermediate web having an opening therein to accommodate an ignition control, adapted for actuation by a cam integral with the crankshaft.

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Numerous other objects and corresponding advantages such for example as relative economy of manufacture, simplicity of construction, compactness, facility of assembly and disassembly, and greater speed and power per unit weight will be apparent to those of skill in the art upon examination of the following description read in the light of the accompanying drawings in which:

Fig. 1 is a side elevation of a motor embodying my invention.

Fig. 2 is an enlarged sectional view taken on lines 2-2 of Fig. 1.

Fig. 3 is a sectional view taken on lines 3-3 of Fig. 2.

Fig. 4 is a front elevation of the rotary valve, and, in section, the crankpin by which it is actuated, showing also the intake port in the end plate of the crankcase.

Fig. 5 is the section taken on lines 5-5 of Fig. 4.

Fig. 6 is a fragmentary view of the dual ring assembly associated with the double-grooved piston of my invention.

Fig. 7 is an elevation of the cylinder-insert depicting the bevelled lower rim of the intake ports.

Fig. 8 is an end elevation of a modified form of crankshaft showing the crankpin and in dotted lines the novel counterweight therefor.

Fig. 9 is a sectional view taken on lines 9-9 of Fig. 8.

Referring to the drawings more in detail the numerals of which indicate similar parts throughout the several views, 10 designates a generally cylindrical crankcase having a pair of integral oppositely-disposed and laterally-projecting lugs 11 by which the motor may be clamped into position in the fuselage of a model airplane or the chassis of a model automobile. Cast integrally with the crankcase 10 and superimposed thereabove is an axially vertical air cooled cylinder block 12 having heat-radiating annular fins encircling its upper end. A tubular cylinder-insert 14 of a length slightly greater than the length of the stroke of the piston, hereinafter more specifically referred to, is pressed into the bore of the cylinder block 12 and is formed at its upper end with an annular rim 15 adapted to seat in a complementary groove delineating the upper end of the cylinder bore.

A circular cylinder head 16 formed with a plurality of heat-radiating fins 17 on its upper surface, is adapted to be secured to the cylinder block 12 by screws 18 or the like. The underside of the cylinder head is built up in two arcuate sections as at 19 which frictionally engage op-

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posite arcs of cylinder-insert 14 and assist in forming a tight seal with the cylinder block. In this respect the underside of head 16 conforms in contour with the shape of the upper end of the piston, the former being somewhat concave for the reception of a spark plug 20 threaded through the head.

The piston assembly, consisting generally of a hollow piston 21, wrist pin 22 and connecting rod 23, are largely of conventional construction.

However, the piston 21 is formed with a pair of annular grooves 24, each of sufficient size to accommodate two resilient expansible rings 25 which are closely fitted and function to expand against the cylinder wall to produce a gas-tight seal between the cylinder 14 and piston 21. The abutting ends of rings 25 may be of any form well known in the art but the ends of each ring should be offset with respect to the ends of the complementary ring in each groove 24. By the provision of the double ring assembly in each groove, oil, trapped within the groove, emerges not only from between the adjoining surfaces of the groove 24 and the respective rings 25 but also from between the rings themselves, thus forming a triple oil seal without increasing the number of grooves. As each ring 25 is individually expansible, it functions as an independent seal, and further, as the rings of each pair thereof are contiguous they tend in operation to activate one another and obviate sticking.

The lower end of the connecting rod 23 is journaled on a crankpin 26 projecting eccentrically from the crank arm or web 27 of a crankshaft 28 supported in axial alignment with case 10 in a manner about to be described. A feature of the apparatus resides in the symmetrical crankcase 10, both ends of which are closed by fittings removably secured to the respective rims of crankcase 10. The end fitting 30 for the crankcase and through which the crankshaft extends is secured to the crankcase by screws 29 and is formed with a concentric annular bearing retainer 31, adapted to project into the crankcase, and houses a roller bearing race 32 in which one end of crankshaft 28 is journaled. 70 indicates a series of grooves in the crankshaft, forming an oil seal with the bore of fitting 30. The crank web 27, from which pin 26 extends, is circular but is formed with an integral arcuate counterweight 33 on the side thereof diametrically opposed to pin 26. The bore of a hub 34 comprising the outer end of fitting 30 is enlarged to accommodate a ball bearing race 35 which encircles and supports a diametrically-reduced outer portion of crankshaft 28 to balance the latter. A conventional form of timer mechanism (not shown) for the ignition system may be supported on hub 34 of fitting 30 in which bearing 35 is housed, and is actuated and controlled by a cam 36 integral with crankshaft 28 intermediate bearings 32 and 35, the fitting being formed with an opening 37 transversely aligned with the cam 36 for the reception of a follower comprising a part of the timer mechanism.

On the outer end of the crankshaft a balanced flywheel 38 is secured, being clamped between a sleeve 39 encircling shaft 28 and abutting against the bearing race 35, by a nut and washer assembly 40 threaded on the end of the shaft.

The opposite end of crankcase 10 is enclosed by a plate 41 secured in place by screws 42 or the like to the rim of the crankcase. A fuel intake port 43 (Fig. 4) is eccentrically disposed in the plate 41, into which port a simple conven-

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tional type carburetor 44 is secured by suitable means. Carburetor 44 comprises generally a tubular member 45 having a flared outer end through which air is drawn in response to the suction created by piston 21 on the upward compression stroke of the latter. The liquid fuel is supplied to the bore of member 45 through a tube 46 fitted into a lateral opening intermediate the ends of the carburetor. The tube 46 is equipped with a manually actuated jet valve (not shown) to regulate the volume of the liquid fuel admitted into the bore of member 45 where it is vaporized and drawn with the air into the crankcase.

The intake port 43 is controlled by a counter-weighted rotary valve 47 comprising a disk mounted upon a spindle 48 journaled concentrically in plate 41. A nut 49 threaded on the projecting end of spindle 48 externally of the crankcase maintains valve 47 in close relationship with the inner surface of plate 41 over the intake port 43. An arcuate slot 50 is formed in the disk 47 on a radius of a length corresponding to the offset of port 43 from the axis of the valve. Slot 50 is preferably of a width substantially equal to the diameter of the intake port 43 which may be varied in specific embodiments as may also the length of slot 50 which determines the period of each complete revolution of disk 47 during which the valve remains open. An arcuate cut-out 51 is formed in the surface of the disk 47 opposite to that which is held in contiguous relation with the end plate 41, and in a position diametrically opposed to slot 50, in order to balance the valve.

The rotary valve 47 is actuated and synchronized with the operation of piston 21 by the crankpin 26, the end of which is accommodated in a bearing 52 provided in the adjacent surface of disk 47. In order to expedite the flow of vaporized fuel from slot 50 in the valve, the rim of the latter flanking the slot is reduced in thickness as indicated at 53. An important feature of valve 47 is its incorporation of a plurality of spaced, radially-disposed grooves 54, generally V-shaped in cross section, which are formed in the inner face of the disk and flare outwardly toward the periphery of the latter. It will be appreciated that with valve 47 rotating at high speed the opposite surfaces of each groove 54 function, respectively, to draw fuel-laden air from crankcase 10 adjacent the face of the valve into the groove and to forcibly eject the air radially of the valve so as to supplement the suction of piston 21 in effectively filling the crankcase with vaporized fuel under pressure.

A passage for the flow of fuel from crankcase 10 into the combustion chamber 55 comprises a port 56 in the lower wall of hollow piston 21, the center of which port 56 lies on a radius of the piston forming a right angle with the axis of wristpin 22. Port 56 is adapted to register, with the piston 21 at the bottom of its stroke, with a port 57 of like size and shape in the lower end of cylinder-insert 14. A vertical passage 58 cast into the cylinder block 12 at the outside of cylinder-insert 14 communicates at its lower end with the crankcase and with port 57 and extends upwardly to encompass three rectangular ports 59 arranged in a horizontal plane in cylinder-insert 14 at a level slightly above the upper end of piston 21 when the latter is at the bottom of its stroke. The lower outer rim of each port is bevelled as at 60 to expedite the flow of vaporized fuel from the passage into the com-

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bustion chamber 55 during operation, as will appear.

The exhaust gases are discharged during the downward stroke of the piston, and to this end four exhaust ports 61 are provided in cylinder-insert 14 in an arc opposed to that in which the bevelled intake ports 59 are disposed, but at a slightly higher level than the latter. These gases ejected from combustion chamber 55 through ports 61 are discharged from the unit through a conduit 62, elongated in cross section, which is cast integrally with the cylinder block 12. Spark plug 20 threaded through the cylinder head 16 is disposed to form an acute angle with the axis of the cylinder, i. e., its axis coincides substantially with a line extending into the concavity between the usual arcuate raised portion 63 of the top of piston 21 and the intake ports 59 when the piston is at the bottom of its stroke, as seen in Fig. 2.

With the motor assembled, which operation is greatly facilitated due to the fact that both ends of the crankcase 10 are removable, thus permitting subsequent removal of either the crankshaft 10 or rotary valve 47 without displacement of the parts on the opposite side of the connecting rod 23, the motor may be started manually. As will be observed from an examination of Fig. 4, the rotary valve begins to open as piston 21 reaches the bottom of its stroke. On the upstroke ports 59 are immediately closed by the body of the piston whereupon a partial vacuum is created within the crankcase drawing vaporized fuel from the carburetor into the case through intake port 43 and slot 50 of valve 47 which is of a length to maintain its registry with the intake opening until the piston nears the top of its stroke. It will be observed that, as hereinabove generally described, as the fuel is admitted it is thrown from the periphery of valve 47 incident to the reduction in thickness of the disk at the outside of slot 50 and is blown into the cylinder 14 below piston 21 by the trailing sides of the radial grooves 54 in the face of the disk so as to increase the draft through carburetor 44 and permit the entry into crankcase 10 of a maximum amount of fuel before valve 47 closes.

The firing of piston 21 by spark plug 20 through the conventional cam-operated timer mechanism (not shown) is determined by adjustment of the timer so as to occur just prior to the instant the piston reaches the top of its stroke.

As piston 21 moves down on its power stroke the fuel vapor is compressed in the crankcase. The exhaust ports 61 are first uncovered by the piston as the latter nears the bottom of its stroke, whereupon part of the volume of these gases, still expanding, are released from the cylinder through the exhaust ports 61 and conduit 62. Immediately thereafter, as piston 21 continues its downward movement the intake ports 59 are uncovered and ports 56 and 57 move relatively into registry. Accordingly the vaporized fuel under slight initial pressure as the result of the centrifugal fan action of the rotary valve disk 47 and subsequently further compressed by the downward movement of the piston 21, rushes into the combustion chamber 55. The velocity of this flow of the vapor is further increased by rotary valve 47 which functions as a centrifugal blower supercharging combustion chamber 55 by increasing the pressure on the fuel in the crankcase 10 and thereby augmenting the volume of fuel admitted into the combustion chamber to be compressed and fired on the next

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succeeding stroke of the piston. Due to the bevelling 60 of the lower rim of each of the ports 59 and the contour of the adjacent confining wall 63 of the piston, the initial surge of the fuel is directed into the upper part of the cylinder 14 effectively displacing the exhaust gases in the side of the cylinder opposite that in which the exhaust ports 61 are located. The angular disposition of spark plug 20 assures the thorough cleansing of the threaded concavity in the underside of the head in which the spark plug is located, as well as in the end of the spark plug itself, of all exhaust gases by the jet of the vaporized fuel, the latter being directed in line with the axis of the plug. As the fuel continues to flow into the combustion chamber the remainder of the exhaust gases are forced out through the ports 61, the upper zone of the cylinder having been first effectively cleansed to obviate trapping of all incombustible matter. Reversal of the direction of movement of piston 21 initiates the next cycle of operation as hereinabove described, the intake ports 59 and exhaust ports 61 closing in quick succession.

In Figs. 8 and 9 I have illustrated a modified form of counterweighted crankshaft 65, the circular disk or web 66 being formed with a wide annular groove 67 in its surface opposite to that from which the crankpin 26 eccentrically projects, to accommodate a structurally separate counterweight 68 composed of a soft metal or the like. It will be appreciated that this form of counterweight is extremely simple to manufacture, the groove 67 being easily formed in a conventional manner whereupon the metal in molten form is poured into the groove at approximately the desired position, after which shaft 65 is balanced by removing or adding to the easily workable metal, in accordance with requirements.

It will thus be seen that I have provided a model motor of simple construction embodying a rotary intake valve, actuated by the crankpin 26 and operable to perform the dual function of controlling the ingress of fuel while expediting its flow from the carburetor into the crankcase 10, and subsequently from the crankcase into the combustion chamber 55 where it is directed, as the result of the combination of the novel form of intake ports 59 and the inclination of spark plug 20 to positively eject all exhaust gases from the combustion chamber and particularly from the firing zone, all of which is embodied in an integral crankcase and cylinder construction, both ends of which are removable to facilitate assembly.

While I have shown but one embodiment of my invention and but a single modification of counterweighted crankshaft, it will be apparent to those of skill in the art that proportion, shape and number of the parts may be varied to meet specific requirements, that the external design of the cylinder block 12 and head 16 may be altered by the addition or rearrangement of heat-radiating fins 13 and 17, that the radial grooves 54 in the rotary valve 47 be of different cross-sectional shape and may, in particular constructions, be extended to the center of disk 47, that it is not essential for the grooves 54 to be flared outwardly as shown, and that these and other changes may be effected without departing from the spirit of my invention as defined in the appended claims.

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

1. In an engine, a cylinder block, a cylinder insert disposed within said cylinder block, and a

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crankcase below said cylinder block, said insert having an intake port therein communicable with said crankcase through said block, the edge of said intake port adjacent the lower arc of the latter being bevelled.

2. In an engine, a cylinder block and a crankcase connected to said block, and a cylinder insert within said cylinder block, said cylinder insert having a fuel intake port therein, said block and crankcase being formed with a passage communicating said intake port with said crankcase, said intake port being bevelled at its lower edge to expedite the flow of fuel from said crankcase through said passage and port into the upper bore of said cylinder insert.

3. In an engine, a cylinder block and a crankcase connected to said block, a cylinder insert within said cylinder block, said cylinder insert having a fuel intake port therein, said block and crankcase being formed with a passage communicating said intake port with said crankcase, said intake port being bevelled at its lower edge to expedite the flow of fuel from said crankcase through said passage and port into the upper bore of said cylinder insert, a cylinder head superimposed upon said cylinder block, and a spark plug projecting through said cylinder head, said spark plug being disposed in substantial axial alignment with said intake port.

4. In an engine, a crankcase, a cylinder block connected to said crankcase, said crankcase being open at one end, a structurally separate fitting having an axial bore and comprising an end plate secured to said crankcase to close said opening, and a timer mounting integral with and spaced from said plate, a crankshaft projecting through the bore of said fitting, and a slot in said fitting intermediate said timer mounting and said end plate.

5. In an engine, a crankcase, a crankshaft extending through one end of said crankcase, a fuel intake port eccentrically disposed in the opposite end of said crankcase, a rotary valve within said crankcase having an eccentric opening therein intermittently registerable upon rotation of said valve with said intake port, a counterweight for said rotary valve comprising a slot therein diametrically opposed to said opening in said valve, and a crankpin carried by said crankshaft engaged with said valve to impart rotary movement to the latter.

6. In an engine, a crankcase, a crankshaft extending through one end of said crankcase, a fuel intake port eccentrically disposed in the opposite end of said crankcase, a rotary valve within said crankcase having an eccentric opening therein intermittently registerable upon rotation of said valve with said intake port, and a crank pin carried by said crankshaft to impart rotary movement to said valve, the face of said valve being formed with a plurality of radial grooves to expedite the flow of fuel, admitted through said intake port, into said crankcase.

7. In an engine, a crankcase, a cylinder block superimposed above said crankcase, a crankshaft extending through one end of said crankcase, a crankpin carried by said crankshaft, a piston reciprocable in said cylinder, a connecting rod interposed between said piston and crankpin, one end of said crankcase having a fuel intake port therein, and a rotary valve within said crankcase controlling said intake port, said crankpin being engageable with said valve for actuating the same, the inner surface of said valve being formed with a plurality of radially-disposed grooves to centrifugally discharge fuel vapor ad-

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mitted by said valve into the crankcase upwardly into said cylinder block.

8. In an engine, a cylinder block, a cylinder insert disposed within said block, a crankcase below said cylinder block, a piston reciprocable within said cylinder insert, said insert having an intake port therein communicable with said crankcase through a passage extending through said block laterally of said piston, said insert and piston having ports aligned with said passage adapted to register with one another when the piston is adjacent the bottom of its stroke to afford an auxiliary passage from said crankcase to said intake port.

9. In an engine, a cylinder block, a cylinder insert disposed within said block, a crankcase below said cylinder block, said insert having an intake port therein communicable with said crankcase through said block, and a piston within said cylinder insert, said insert and piston having ports adapted to register with one another when the piston is adjacent the bottom of its stroke to afford an auxiliary passage from said crankcase to said intake port, said intake port being beveled to expedite the flow therethrough of gaseous fuel to said cylinder.

10. In an engine, a cylinder block, a cylinder insert disposed within said block, a crankcase below said cylinder block, a piston within said cylinder, said insert having an intake port therein communicable with the bore thereof above said piston and a second port therein, said piston having a port therein communicable with said second port in said insert when said piston is adjacent the lower end of its stroke, and means forming a passage within said block communicating said ports in said insert with one another and communicating said first port with said crankcase around said piston.

11. In an engine, a crankcase, a crankshaft extending through one end of said crankcase, a fuel intake port eccentrically located in the opposite end of said crankcase, a rotary valve within said crankcase having an eccentric opening therein intermittently registerable upon rotation with said intake port, and a crankpin carried by said crankshaft engaged with said valve to impart rotary movement to the latter, and rotary means within said crankcase actuated by said crankshaft to expedite the flow of fuel upwardly into said cylinder in response to centrifugal action thereof.

12. In an engine, a cylinder, a piston reciprocally disposed within said cylinder, a crankcase below said cylinder, a crankshaft extending through one end of said crankcase, a fuel intake port eccentrically disposed in the opposite end of said crankcase, a rotary valve within said crankcase having an eccentric opening therein intermittently registerable upon rotation with said intake port, and a crankpin carried by said crankshaft engageable with said rotary valve to impart rotary movement to the latter, and a connecting rod pivoted to said piston and said crankpin, respectively, to impart reciprocating motion to said piston, and centrifugal pump means within said crankcase actuated by said crankshaft to expedite the flow of fuel through said intake port.

13. In an engine, a crankcase, a cylinder block connected to said crankcase, said crankcase being open at one end, a structurally separate fitting having an axial bore and comprising an end plate secured to said crankcase to close said opening, a timer mounting connected to and spaced from said end plate, said fitting having an open-

ing therein between said end plate and said timer mounting, and a crankshaft projecting through the bore of said fitting having a cam integral therewith transversely aligned with the opening between said timer mounting and said plate for actuating a timer carried by said mounting.

14. In an engine, a cylinder having an intake port and an exhaust port therein diametrically opposed to one another, a cylinder head superimposed on said cylinder, the underside of said head being concave and formed with spaced depending arcuate portions tapered to the cylinder wall and lying in the diametric plane of said ports, a spark plug threaded into said cylinder head intermediate said depending arcuate portions, said spark plug being inclined toward said port, and a piston in said cylinder carrying means formed to direct fuel vapor entering said cylinder through said intake port in a direction coinciding with the axis of said spark plug.

15. In an engine, a cylinder block forming a cylinder therein, means including a fuel intake port forming a flow passage for vaporized fuel into said cylinder, a rotary valve in said flow passage adjacent said port having an eccentric opening therein intermittently registerable, upon rotation of said valve, with said intake port to control the flow of vaporized fuel into said combustion chamber, the face of said valve being formed with a plurality of grooves extending toward the periphery of said valve to expedite the flow of fuel through said flow passage and eccentric opening.

16. In an engine, a crankcase having a fuel intake port therein, a crankshaft extending through one end of said crankcase, a rotary valve within said crankcase having an eccentric opening therein intermittently registerable, upon rotation of said valve, with said intake port to ad-

mit vaporized fuel into said crankcase, means associated with said crankshaft to transmit rotary motion to said valve, the face of said valve being formed with a plurality of grooves extending in a direction transverse to the axis of said valve to expedite the flow of fuel admitted into said crankcase through said intake port and eccentric opening.

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