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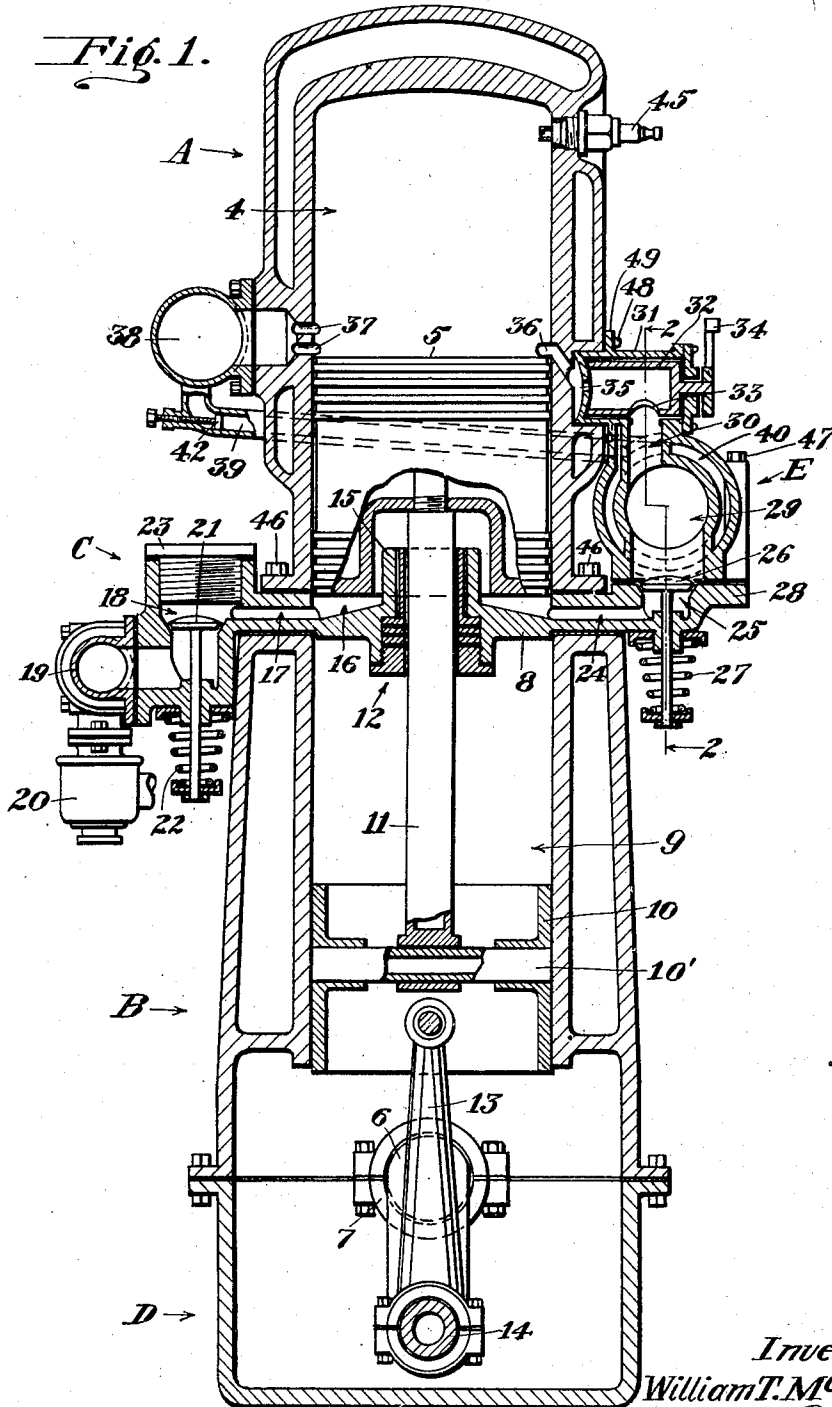
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INTERNAL COMBUSTION ENGINE

Filed Oct. 10, 1927

3 Sheets-Sheet 1



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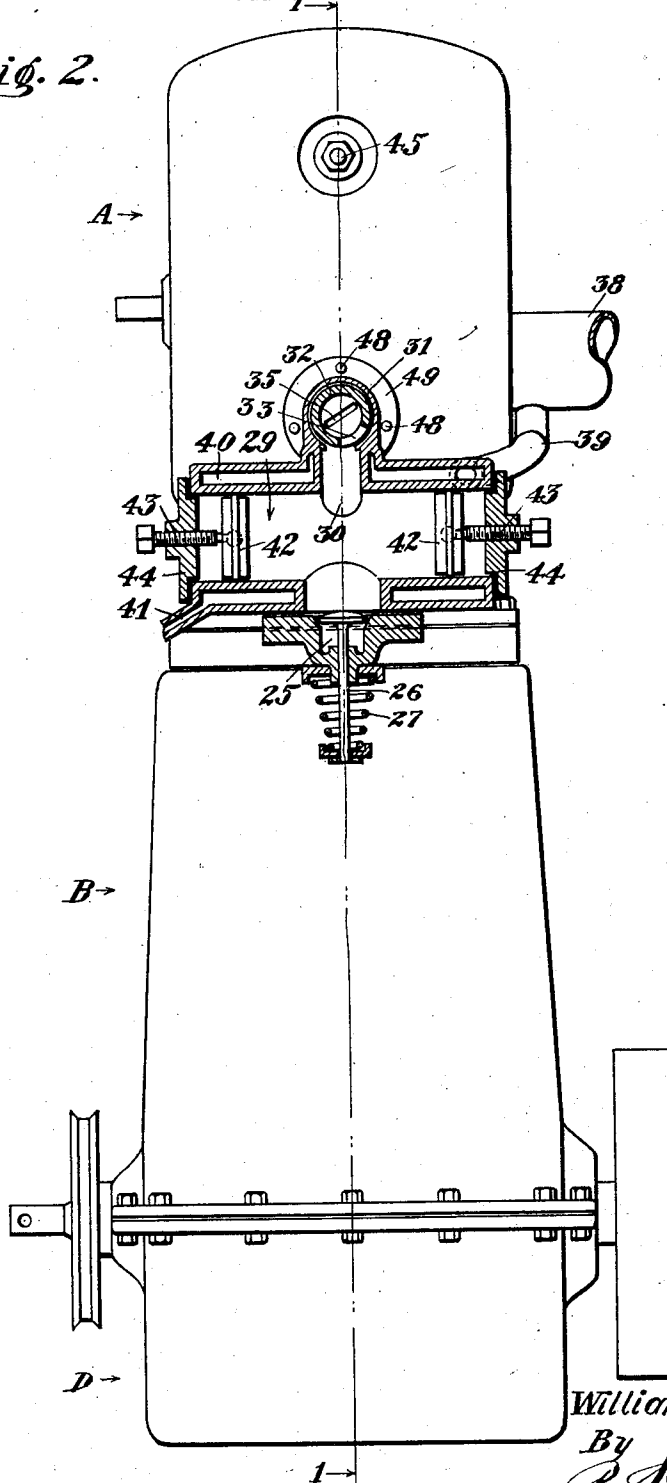
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Fig. 2.



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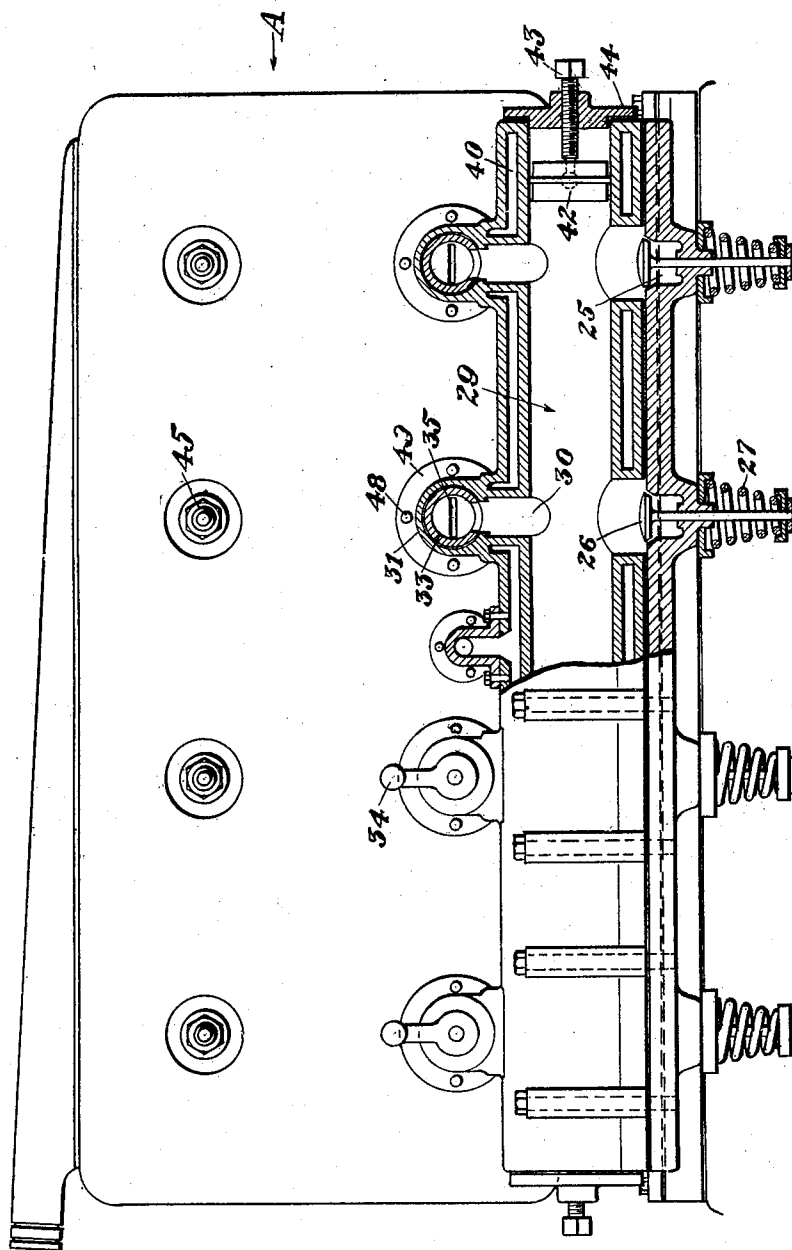
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Fig. 3.



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INTERNAL-COMBUSTION ENGINE

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This invention relates generally to internal combustion engines, especially engines of the two-cycle type, and more particularly pertains to a construction for effecting the supply of the explosive fluid or fuel charge to an engine cylinder; the invention also relating to an improved method of operating internal combustion engines.

A primary object of the invention is to provide a means and method for delivering a mixture of hydrocarbon vapors and air to the explosion chamber of an internal combustion engine whereby the charge will be subjected to a plurality of expansion and compression actions before firing thereof, so as to produce a more thorough combination of the vapors and air and render the charge of more gaseous nature than is effected by the methods now generally in use, thereby enhancing the combustibility of the charge and increasing the degree of expansion on firing in relation to the volume of the charge and thus obtaining a higher efficiency.

Another object is to provide a means whereby the charge may be subjected to a compression action before being admitted to the engine cylinder embodying means whereby the degree or extent of such compression may be varied to meet various conditions.

Another object is to provide an arrangement in a two-cycle engine whereby initial compression of the explosive charge will be effected by downstroke of the engine piston exteriorly and apart from the crank case, and not in the crank case as ordinarily practiced, thus obviating fouling of the lubricating oil in the crank case, and in such manner that compression of the charge will cushion the downstroke of the piston and thereby relieve bearing strains and minimize vibration.

Another object is to provide a construction in multiple cylinder two-cycle engines whereby the extent of compression of the explosive charge will be the same in each cylinder and whereby a substantially uniform explosive mixture will be delivered to each cylinder.

Another object is to provide an internal combustion engine of the above character in which the parts are so constructed and ar-

ranged as to facilitate their assemblage and render the parts readily accessible.

Another object is to provide an improved fuel compression chamber arranged for communication with the engine cylinder or cylinders, embodying means for regulating its capacity whereby the pressure of the gaseous fuel therein may be varied.

Another object is to provide a means for regulating the communication between the compression chamber and the engine cylinder.

Another object is to provide a construction in an internal combustion engine for obviating piston slap and minimizing wear of the engine cylinder.

With the foregoing objects in view together with such other objects and advantages as may subsequently appear, the invention resides generally in the provision of an internal combustion engine in which the engine cylinder containing the piston is separated from the crank case by a wall through which the piston rod extends to afford a chamber apart from the crank case and below the engine piston to which the fuel charge is delivered and expanded on upstroke of the piston, and in providing a separate chamber to which the charge initially drawn into the engine cylinder below the piston will be delivered and be compressed on down stroke of the engine piston and thereafter be delivered to and be reexpanded in the engine cylinder above the piston preparatory to subsequent compression and firing.

The invention further resides in the parts and in the combination, construction and arrangement of parts hereinafter described and claimed and illustrated by way of example in the accompanying drawings in which:

Fig. 1 is a vertical mid-section on line 1—1 of Fig. 2 of a two-cycle internal combustion engine constructed according to the principles of the invention;

Fig. 2 is a view of the engine shown in Fig. 1 partly in side elevation and partly in section, the plane of section being along line 2—2 of Fig. 1;

Fig. 3 is a view, partly in section and part-

ly in side elevation of a four cylinder engine made up of engine units similar to the engine unit illustrated in Figs. 1 and 2.

Referring to the drawings more specifically, A indicates the upper portion of the engine casing which is formed with any suitable number of water jacketed engine cylinders 4 in each on which is reciprocally mounted a piston 5, and B indicates the lower portion of the engine casing between which, and the upper portion A is interposed an intermediate portion C; the lower portion including a detachable lower end section D constituting, with the lower end of the portion B, a crank case fitted with the usual crank shaft 6 supported in bearings 7. The intermediate portion C embodies a wall 8 which extends across the lower end of the engine cylinder 4 below the piston 5 and separates the engine cylinder from a water jacketed cylinder 9 formed in the portion B. Arranged in the cylinder 9 is a cross-head 10 having a wrist pin 10' to which is pivotally and slidably connected a stem 11 leading through a packing gland 12 on the wall 8 and connecting at its upper end with the piston 5. The cross-head 10 pivotally connects with the upper end of a pitman 13, the lower end of which pivotally connects with a crank 14 on the crank shaft. The cross head 10 is guided in the cylinder 9 and takes the side thrusts occasioned by the throw of the crank and pitman so as to relieve the piston 5 of such thrusts, thereby obviating piston slap; the piston being guided in the piston cylinder by the stem 11 riding in a guide-way 15 projecting upwardly from the wall 8 above the packing gland 12. The space 16 above the wall 8 below the piston 5 constitutes an intake chamber and communicating with this chamber is a passage 17 formed in the intermediate portion C leading to a valve chamber 18 communicating with an intake manifold 19 connecting with the discharge of a carburetor 20; a poppet valve 21 arranged in the valve chamber 18 normally closing communication between the intake manifold and the intake chamber 16 under the urge of a spring 22. The valve chamber 18 is formed in the intermediate portion C and is closed at its upper end above the valve 21 by a cap 23, the removal of which affords ready access to the valve 21 and its seat. The intake manifold is detachably connected to the intermediate portion C in the usual manner.

Leading from the intake chamber 16 opposite the passage 17 is a passage 24 formed in the intermediate portion C which connects with a valve chamber 25. An upwardly opening poppet valve 26 normally closes the valve chamber 25 under the urge of a spring 27. The stems of the valves 21 and 26 projecting downwardly through guide ways on the intermediate portion C and with the

springs 22 and 27 are arranged exteriorly of the engine casing so as to be readily accessible. Seating on a ledge 28 formed on the intermediate portion C is a casing E enclosing a compression chamber 29, which is placed in communication with the intake chamber 16 on opening of the valve 26 and from which compression chamber 29 leads a passage 30 opening to a valve housing 31 fitted with a hollow cylindrical valve 32 formed with a port 33 arranged to regulate the discharge end of the passage 30; the port 33 affording a communication between the passage 30 and the interior of the cylindrical valve 32. The valve 32 is fitted with a stem connecting with a handle 34 for affording a manual operation of the valve to regulate the discharge of the compressed gases from the compression chamber 29 according to requirements. The valve housing 31 is provided with an outlet port 35 leading from the interior of the valve 32 and communicating with an upwardly inclined intake port 36 opening to the engine cylinder 4 at a point immediately above the upper end of the piston 5 when the latter is disposed in its lowermost position.

The engine cylinder is formed with a pair of superposed exhaust ports 37 arranged opposite the intake port 36 which exhaust ports communicate with an exhaust manifold 38 and leading from the exhaust manifold is a conduit 39 communicating with a heating chamber 40 surrounding the compression chamber 29; the heating chamber being provided with an outlet 41 leading to atmosphere. The conduit 39 is fitted with a valve 42 for controlling the flow of exhaust gases from the manifold 38 to the heating chamber 40. This heating chamber and communication with the exhaust pipe affords a means for heating the compressed charge in the chamber 29 so as to effect an increase in the pressure of the charge confined in the compression chamber. The degree to which the fuel charge may be heated in the compression chamber may be varied by regulation of the flow of the exhaust gases through the heating chamber 40 by adjustment of the valve 42. Where it is unnecessary to heat the charge, valve 42 may be closed.

As a means for varying the capacity of the chamber 29, the latter is provided with adjustable end walls here shown as comprising pistons 42 carried on threaded stems 43 screwed into end plates 44 and projecting through the latter. The screws 43 serve as a means for enabling adjustment of the pistons 42 in various spaced relations to each other so as to vary the capacity of the compression chamber.

Assuming that the piston 5 is in its lowermost position as shown in Fig. 1, as when the crank 14 is passing center and about to move upwardly on its upstroke the operation will then be as follows:

On upward movement of the piston 5, the suction induced thereby in chamber 16 beneath the piston will act to draw the fuel charge from the carburetor into the chamber 16 through the passage 17; the valve 21 being opened by the suction induced by the piston during up stroke of the latter to permit the fuel charge to pass to the chamber. During the upstroke of the piston and the inflow of the fuel charge, the valve 25 will remain closed. This initial intake of the charge will effect expansion thereof. On termination of the up stroke of the piston, the chamber 16 beneath the piston will be filled with the fuel charge at substantially atmospheric pressure. On the down stroke of the piston, the charge is forced past the valve 25 into the compression chamber 29 which latter being of smaller capacity than the intake chamber 16 will effect compression of the charge in the compression chamber in which the fuel is confined during the downstroke of the piston until the latter uncovers the intake port 36, which occurs when the engine piston reaches its lowermost position. The compressed fuel will then rush into the engine cylinder through the upwardly inclined intake port and will then reexpand, and by being directed toward the upper end of the engine cylinder and will act to effect scavenging of the previously combusted charge.

It will now be seen that the fuel charge will be initially subjected to an expanding action on upstroke of the piston, to a compressing action on the downstroke thereof, and may be also expanded by the action of the heat surrounding the compression chamber, and on delivery of the charge while under pressure to the engine cylinder above the piston will then reexpand; and on upward movement of the piston will again be compressed in the engine cylinder. On termination of the up stroke of the piston the charge will be ignited in the usual manner by means of a spark plug 45. On ignition of the charge and its consequent expansion, the piston 5 will be impelled downwardly on its down stroke thus completing the cycle of operation.

By adjusting the end walls 42, of the compression chamber the extent of compression of the charge preliminary to its delivery to the engine cylinder can be varied as occasion requires, and by adjusting the valve 32 the flow of the charge to the engine cylinder may be accelerated or retarded according to requirements.

The intake of the carburetor connects with a suitable fuel supply and the speed of the engine is controlled by throttle as is common in internal combustion engine operations.

Where the invention is applied to a multiple cylinder engine as is shown in Fig. 3, the compression chamber 29 with its associated heating chamber is common to all of the

engine cylinders and constitutes an equalizing chamber whereby the fuel charges delivered to the several cylinders therefrom will be of like pressure; a separate regulating valve 32 being provided in the communication between the compression chamber and each of the cylinders.

An important feature of the invention resides in the construction consisting in interposing the intermediate portion C between the upper and lower portions A and B and connecting these portions together by means of bolts 46 which pass through flanges on the upper section A and extending through the intermediate portion C are screwed into the upper end of the lower portion B; in detachably mounting the housing of the compression chamber on the intermediate portion C which is effected by means of bolts 47 connecting the compression chamber housing to the ledge 28, and in forming the valve housing 31 integral with the housing of the compression chamber which is secured to the upper portion A of the engine by screws 48 passing through a flange 49 on the valve housing. This construction facilitates assemblage of the parts and renders them readily accessible.

While I have shown and described a specific embodiment of my invention, I do not limit myself to the exact details of construction and arrangement shown, but may employ such changes and modifications as come within the meaning of the appended claims.

I claim:

1. An internal combustion engine, an engine cylinder apart from the crank case, a reciprocal piston in said cylinder, a compression chamber, means for varying the capacity of said chamber, means whereby down stroke of the piston will effect delivery of a fuel charge to said compression chamber under pressure, means whereby the compressed charge will be delivered to the engine cylinder above the piston on termination of the down stroke of the latter, and means for regulating the flow of the charge from the compression chamber to the engine cylinder.

2. An internal combustion engine, an engine cylinder apart from the crank case, a reciprocal piston in said cylinder, a compression chamber, means for varying the capacity of said chamber, means whereby down stroke of the piston will effect delivery of a fuel charge to said compression chamber under pressure, means whereby the compressed charge will be delivered to the engine cylinder above the piston on termination of the down stroke of the latter, and means for regulating the flow of the charge from the compression chamber to the engine cylinder, and means for heating the fuel charge in said compression chamber.

3. In an internal combustion engine, an engine cylinder, a piston therein, a crank case,

a crank shaft therein, a wall separating the engine cylinder from the crank case beneath said piston, a cross-head between said wall and crank shaft, a guide for said cross-head, a stem pivotally and slidably connected to said cross-head, said stem leading through said wall and being affixed to said piston, and a pitman connecting said cross-head and crank shaft.

4. In an internal combustion engine, an engine cylinder, a piston therein, a crank case, a crank shaft therein, a wall separating the engine cylinder from the crank case beneath said piston, a cross-head between said wall and crank shaft, a guide for said cross-head, adapted to simultaneously guide said cross-head in longitudinal and rotary movement, a stem connected at one end to said piston and passing through said wall, the other end being slidably and pivotally connected to said cross-head, a pitman slidably and pivotally connected to said cross-head at a point below and at right angles to said stem connection at one end and at the opposite end to said crank shaft.

5. In an internal combustion engine, a crank case, a plurality of engine cylinders, apart from the crank case, a piston in each of said cylinders, an equalizing compression chamber apart from the crank case, means whereby up stroke of said pistons will draw fuel charges into the engine cylinders below the pistons, means whereby the down stroke of the pistons will compress the fuel charge in the compression chamber, means whereby a compressed fuel charge in said compression chamber will be delivered to each of said engine cylinders on termination of the down stroke of the pistons therein, and means for varying the extent of compression of the fuel charge in said compression chamber.

6. In an internal combustion engine, a crank case, a plurality of engine cylinders, a piston in each of said cylinders, an equalizing compression chamber, apart from the crank case, means whereby the up stroke of said pistons will draw a fuel charge into the engine cylinders below the pistons, means whereby down stroke of the pistons will compress the fuel charge in the compression chamber, means whereby the compressed fuel charge will be delivered to the engine cylinders on termination of the down stroke of the pistons therein, and means for independently regulating the delivery of the fuel charge to each engine cylinder from said compression chamber.

7. In an internal combustion engine, an engine cylinder, a reciprocal piston therein, a compression chamber apart from the engine cylinder having an outlet communicating with said cylinder, means whereby each reciprocation of said piston will effect delivery of a fuel charge to said compression chamber, a pair of pistons constituting end walls of

said chamber, and means for manually adjusting said pistons in various spaced relation to each other to vary the capacity of said chamber.

In testimony whereof I have affixed my signature.

WILLIAM T. McCABE.

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