F. A. STANDIFORD.

INTERNAL COMBUSTION ENGINE.

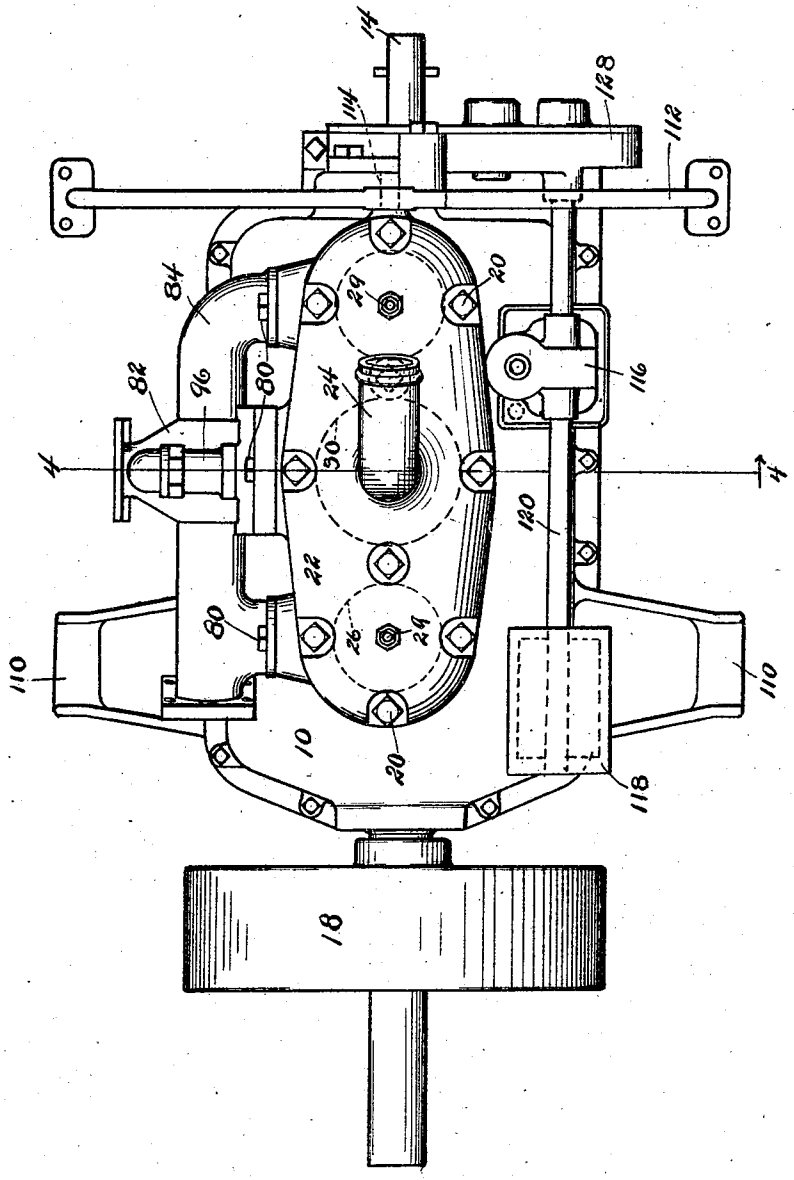
APPLICATION FILED JAN. 2, 1918.

1,417,697.

Patented May 30, 1922.

5 SHEETS—SHEET 1.

Fig. 1.



WITNESS:

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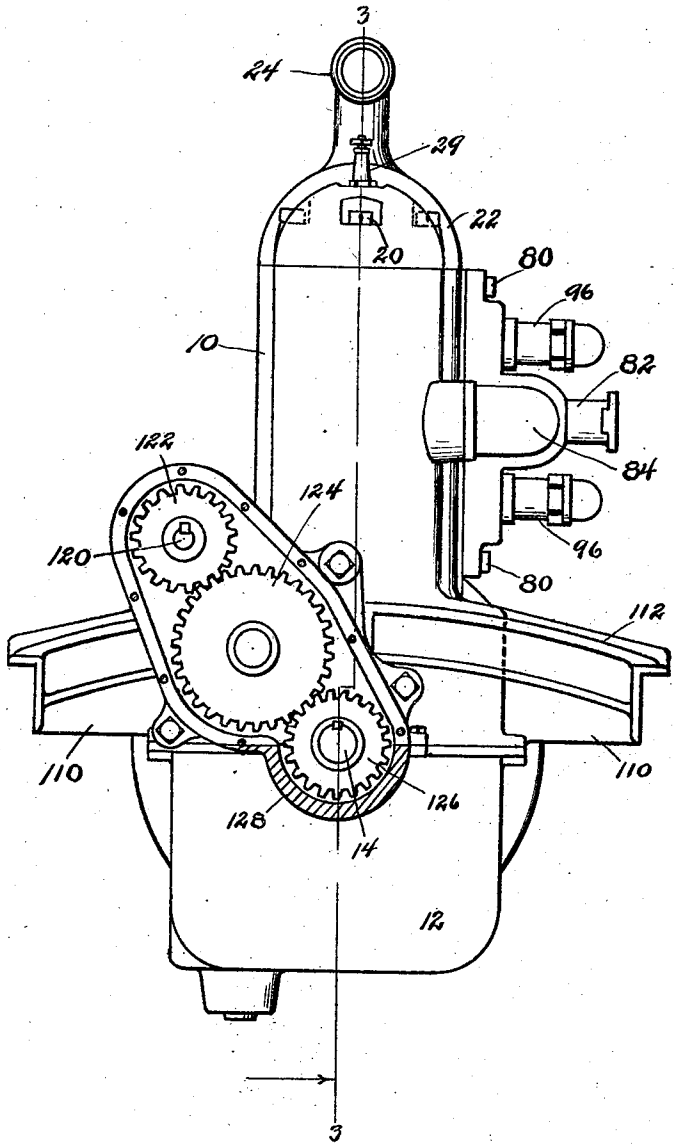

Fig 2.

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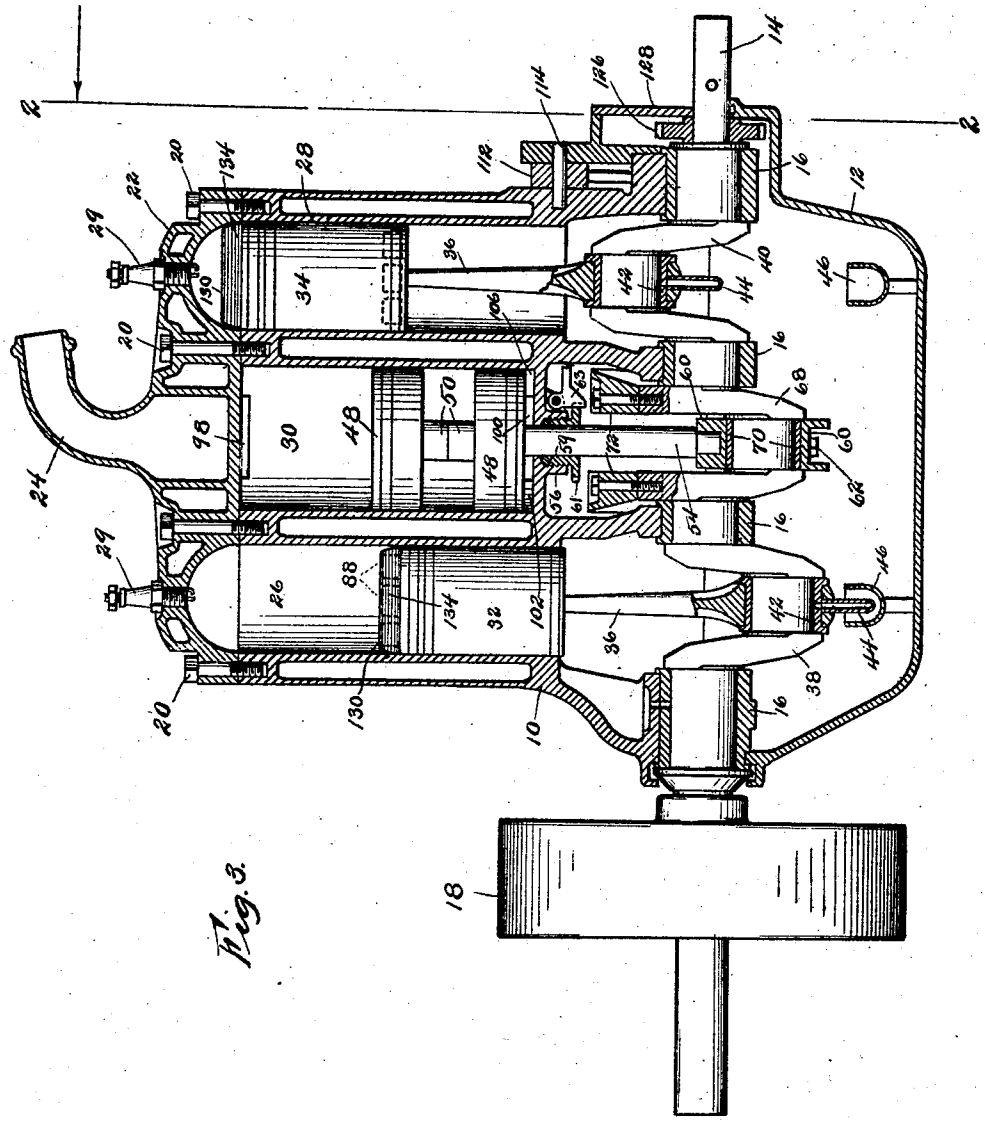

Fig. 3.

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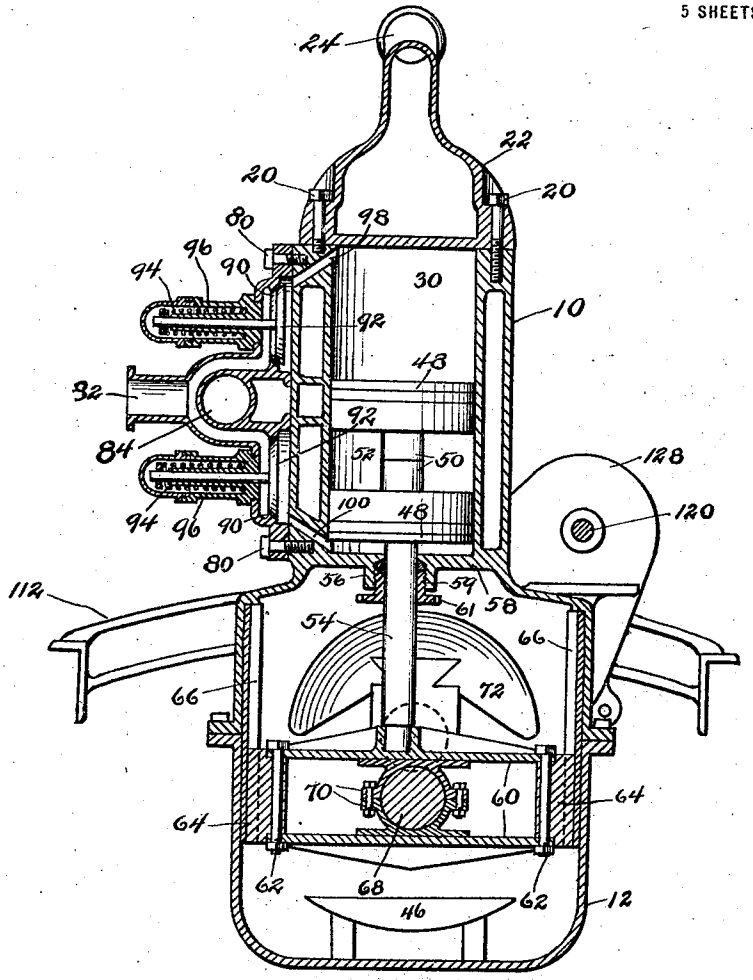

Fig. 4.

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5 SHEETS—SHEET 5.

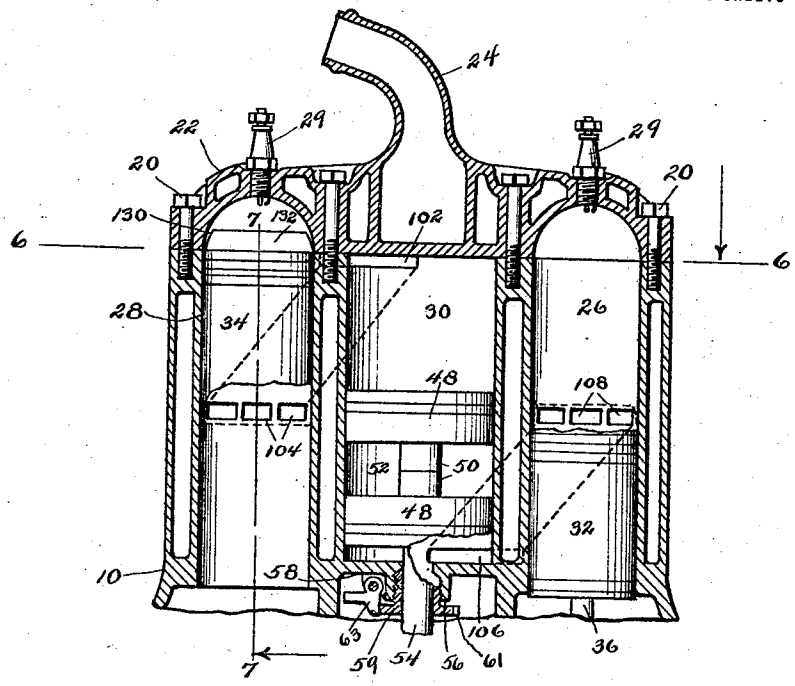


Fig 5.

Fig 6.

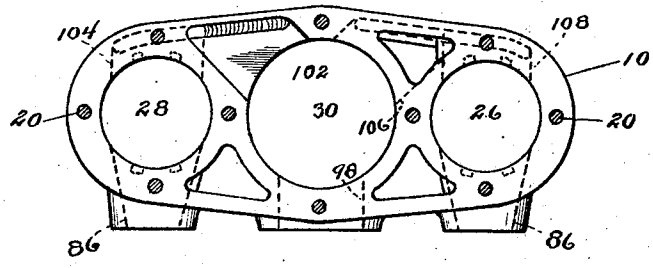
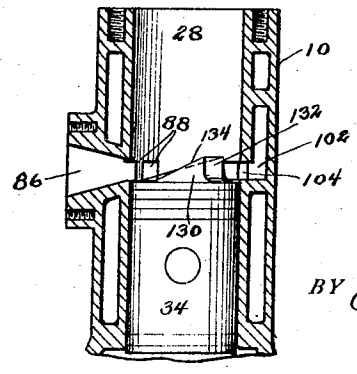


Fig. 7.



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,417,697. Specification of Letters Patent. Patented May 30, 1922.

Application filed January 2, 1918. Serial No. 210,065.

To all whom it may concern:

Be it known that I, FREDRICK A. STANDIFORD, a citizen of the United States, residing at Coldwater, in the county of Comanche, State of Kansas, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a full and exact specification.

The present invention relates to internal combustion engines, and aims to provide various features of improvement in connection with the general construction and operative arrangement of the different parts of this class of engines.

Accordingly one of the objects of the invention is to devise an improved construction of three-cylinder engine having one of the cylinders thereof arranged as a pump cylinder for alternately feeding the explosive charges to the remaining cylinders and simultaneously expelling the exhaust gases therefrom. In carrying out this feature of the invention an improved pump cylinder construction is provided, as well as a novel form of counterbalanced crank shaft for effecting a smooth running action and properly balanced relation of the moving parts.

A further object is to provide an improved form of piston in the combustion cylinders whereby a more effective inflow and discharge of the gases therefrom is obtained.

It is also an object to provide features of improvement in relation to the manifold connections to the engine cylinders and the mode of conducting the explosive charges into the combustion cylinders and removing the exploded gases from the same.

A still further object is to devise an improved arrangement of drive connections leading to the magneto and pump elements of the engine.

It is also sought to improve generally this class of engines and to provide a construction which will be of comparatively simple design, and practical, economical and efficient in its operation.

With these general objects in view, the invention will now be described with reference to the accompanying drawings, wherein is illustrated one form of embodiment of the proposed improvements, after which those features of the construction which are deemed to be novel will be set forth and defined in the claims appended hereto.

In the drawings—

Figure 1 is a plan view of an engine constructed in accordance with the present invention;

Figure 2 is an end elevation of the same, with parts in section as represented by the line 2—2 of Figure 3;

Figure 3 is a central longitudinal vertical section taken on the line 3—3 of Figure 2;

Figure 4 is a transverse section taken on the line 4—4 of Figure 1;

Figure 5 is a sectional view similar to the upper half of Figure 3, but looking in the opposite direction and illustrating the pistons in different operative positions;

Figure 6 is a horizontal section taken on the line 6—6 of Figure 5; and

Figure 7 is a vertical sectional view of one of the combustion cylinders, taken on the line 7—7 of Figure 5, but showing the piston at the opposite end of its stroke.

Referring to the said drawings in detail, the present engine construction is illustrated as comprising an engine cylinder casting 10 to the bottom of which is connected in the usual manner a housing section 12 cooperating with the lower portion of said casting 10 to form the crank case, within which is housed the crank shaft 14 working in the several bearings 16 and carrying a fly wheel 18 outside the crank case. Secured to the top of the casting 10, as by capscrews 20, is a cylinder-head casting 22 having a water connection 24 adapted to be connected with the engine radiator (not shown) in any preferred manner. The said cylinder and cylinder-head castings are constructed to provide three cylinders, namely, two outer combustion cylinders 26 and 28 provided with the spark plugs 29, and an intermediate pump cylinder 30, as clearly illustrated in Figures 3 and 5. Within the cylinders 26 and 28 operate pistons 32 and 34, respectively, the same operating in a two-stroke cycle and reciprocated by means of connecting rods 36 from the cranks 38 and 40, respectively, on the crank shaft 14. The bearing caps 42 of said rods are provided with oil splash and pick-up fingers 44 adapted, on their down strokes, to enter the splash cups 46 at the bottom of the crank case, as shown in Figure 3. Within the cylinder 30 operates a plunger of double-piston form

comprising a pair of pistons 48 separated by means of short central posts 50 and leaving a dead air space between said pistons as indicated at 52. This double-acting plunger is reciprocated by means of a connecting rod 54 secured to the lower piston 48 and passing out through a stuffing box 56 in the lower head 58 of the cylinder 30. The gland 59 of said stuffing box is provided with an exterior notched flange 61 adapted to be engaged by a gravity dog 63 for retaining the gland in any given set position. The lower end of the connecting rod 54 is carried in a vertically reciprocating bearing box comprising parallel spaced plates 60 the ends of which are secured by bolts 62 to slide blocks 64 operating along vertical guideways at opposite sides of the crank case (see Figure 4). Said bearing box is reciprocated by means of an intermediate and relatively shorter crank arm 68 of the crank shaft 14, this arm 68 being provided with bearing caps 70 operating within said bearing box by sliding engagement with the inner faces of said plates 60.

For balancing the movements of the crank shaft as thus arranged the crank arm 68 is provided with a pair of counterweights 72 of arcuate form on opposite sides of the rod 54 and projecting in the opposite direction from said arm 68, as clearly shown in Figures 3 and 4. The construction described is such as to provide a pumping cylinder of relatively larger size than the combustion cylinders and having a plunger of relatively shorter stroke, adapted to quickly and forcibly deliver the proper explosive charges to the combustion cylinders alternately from the opposite ends of the pump cylinder, as will be hereinafter more fully explained.

Manifold connections and passages for the intake and exhaust gases are provided by means of the following construction. A manifold casting is secured by means of capscrews 80 to one side face of the cylinder casting 10 and provides an intake manifold 82 communicating with the opposite ends of the pump cylinder 30, and an exhaust manifold 84 communicating by way of passages 86 and ports 88 with each of the combustion cylinders 26 and 28 (see Figures 3 and 7). The intake manifold is provided with ports 90 controlled by valves 92 held normally closed by means of coil springs 94, the valve stems and springs being retained within casing plugs 96 removably connected with the manifold casting as shown in Figure 4. From one of the ports 90 an inlet passage 98 leads to the upper end of the cylinder 30, and from the other of said ports 90 an inlet passage 100 leads to the lower end of said cylinder. Leading from the upper end of the cylinder 30, on the opposite side from the passage 98, is a passage 102 extending on an incline downward (see Figure 5) and discharging through ports 104 into the combustion cylinder 28, while from the lower end of said cylinder 30 extends an inclined passage 106 leading upward and discharging through ports 108 into the cylinder 26.

The engine is adapted to be mounted upon the auto chassis by means of the bracket arms 110 at the rear and the yoke hanger 112 to which connection is made with the engine by means of a suspension pin 114 at the front end of the casting 10.

The engine magneto 116 and pump 118 are arranged in alinement to be driven from the same actuating shaft 120, which is provided with a gear 122 (see Figure 2) in mesh with a gear 124 which is driven from a gear 126 keyed to the crank shaft 14, said gears being encased within a housing 128.

It will thus be apparent that a simple and effective construction has been devised for carrying out the desired objects of the invention. In the operation of the engine, fuel gases are sucked in alternately through the ports 98 and 100 past the valves 92 into the pumping cylinder 30. Figure 4 of the drawing shows the plunger 48 at the finish of its downward stroke, during which stroke the upper valve 92 has remained open and the lower valve closed, whereby a charge of gas has been drawn into the upper end of the cylinder 30 and a charge expelled from its lower end through the passage 106 and ports 108 into the cylinder 26; at the same time the entry of the new charge into the latter cylinder (wherein the previous charge has just been fired) has caused the exhaust gas to be expelled through the ports 88 and the exhaust passage 86 into the exhaust manifold 84. As the plunger starts on its upward stroke, due to the firing of the charge in cylinder 28, the reverse of the foregoing operations takes place. The upper valve 92 is closed and the lower valve is opened, and a charge of gas is sucked into the lower end of the cylinder 30 through the intake passage 100, while the charge in the upper end of said cylinder is forced out through the passage 102 and ports 104 into the other combustion cylinder 28, expelling the waste gas therefrom through the exhaust passage 86 as soon as the ports 88 of said cylinder have been uncovered by the piston 34. Since the ports 104 and 108 are covered during the greater portion of the intervals of the plunger's movements, the gas is compressed within the pump cylinder 30 to a considerable extent and is forcibly discharged through said ports into the combustion cylinders as the ports are momentarily opened during the reversal of the pistons' movements; and the fuel charges are still further compressed as the pistons move upward prior to the firing of the charges. In order to properly direct and control the flow of the fuel gas into the combustion cylinders

and facilitate the discharge of the exhaust gases therefrom, each of the pistons 32 and 34 is provided with a working face of peculiar contour comprising, as illustrated in Figure 7, a raised portion 130 formed with an abrupt deflecting surface 132 adapted to be positioned opposite the inlet ports of the corresponding cylinder, and a gradually inclined surface 134 extending in the direction of the exhaust ports 88. By means of this construction the intake gases are deflected directly upward within the cylinders and the exhaust gases are at once directed to the discharge ports and effectually discharged therethrough with very little opportunity for intermingling with the fresh charge of fuel being admitted. The pumping cylinder 30 is of course properly porportioned for receiving and compressing the correct quantity of fuel gas at either end for delivery to the combustion cylinders at each stroke of the plunger, and the proportions are such as to provide for a comparatively short plunger stroke, for effectiveness in the work of compression and for securing greater speed and force in the discharge of the gas from the pumping cylinder into the combustion cylinders.

A smooth and effectively balanced action is obtained by means of the crank shaft arrangement and construction and the operative connections to the double-acting plunger.

It is also apparent that a more simplified and compact arrangement for driving the magneto and pump elements is obtained by connecting them up in alinement for actuating by a single shaft driven from the crank shaft in the manner illustrated.

While the foregoing shows what is now regarded as the preferred form of embodiment of the improvements, the right is reserved to such formal changes and modifications as may fairly fall within the scope of the appended claims.

What I claim is:

1. In an internal combustion engine, a pair of combustion cylinders, a pump cylinder arranged in communication with said combustion cylinders, a crank shaft provided with a pair of oppositely moving pistons operating in said combustion cylinders, said combustion cylinders each having fuel inlet and exhaust ports maintained closed by the corresponding piston and adapted to be uncovered at about the end of the explosion stroke of the piston, said pump cylinder having its opposite ends in communication with said inlet ports respectively, and a double-acting plunger operating within said pump cylinder to deliver fuel charges therefrom alternately through said inlet ports to the combustion cylinders and to expel the exhaust gases therefrom, each of said pistons having its working face formed with deflecting surfaces arranged to deflect the incoming gas toward the opposite end of the corresponding cylinder and the exhaust gases in the direction of the exhaust ports of that cylinder.

2. In an internal combustion engine, a pair of combustion cylinders, a pump cylinder arranged in communication with said combustion cylinders, a crank shaft provided with pistons operating in said combustion cylinders, a double-acting plunger operating in said pump cylinder to deliver fuel charges therefrom alternately to said combustion cylinders, said crank shaft being provided with a crank arm having a sliding bearing-box vertically reciprocated thereby and operatively connected with said plunger, and counterweights carried by said crank shaft on opposite sides of said crank arm and projecting in a direction opposite to the direction of said crank arm.

In witness whereof I affix my signature.

FREDRICK A. STANDIFORD.