June 6, 1939. P. MANISCALCO 2,161,069

INTERNAL COMBUSTION ENGINE

Filed May 27, 1937 4 Sheets-Sheet 1

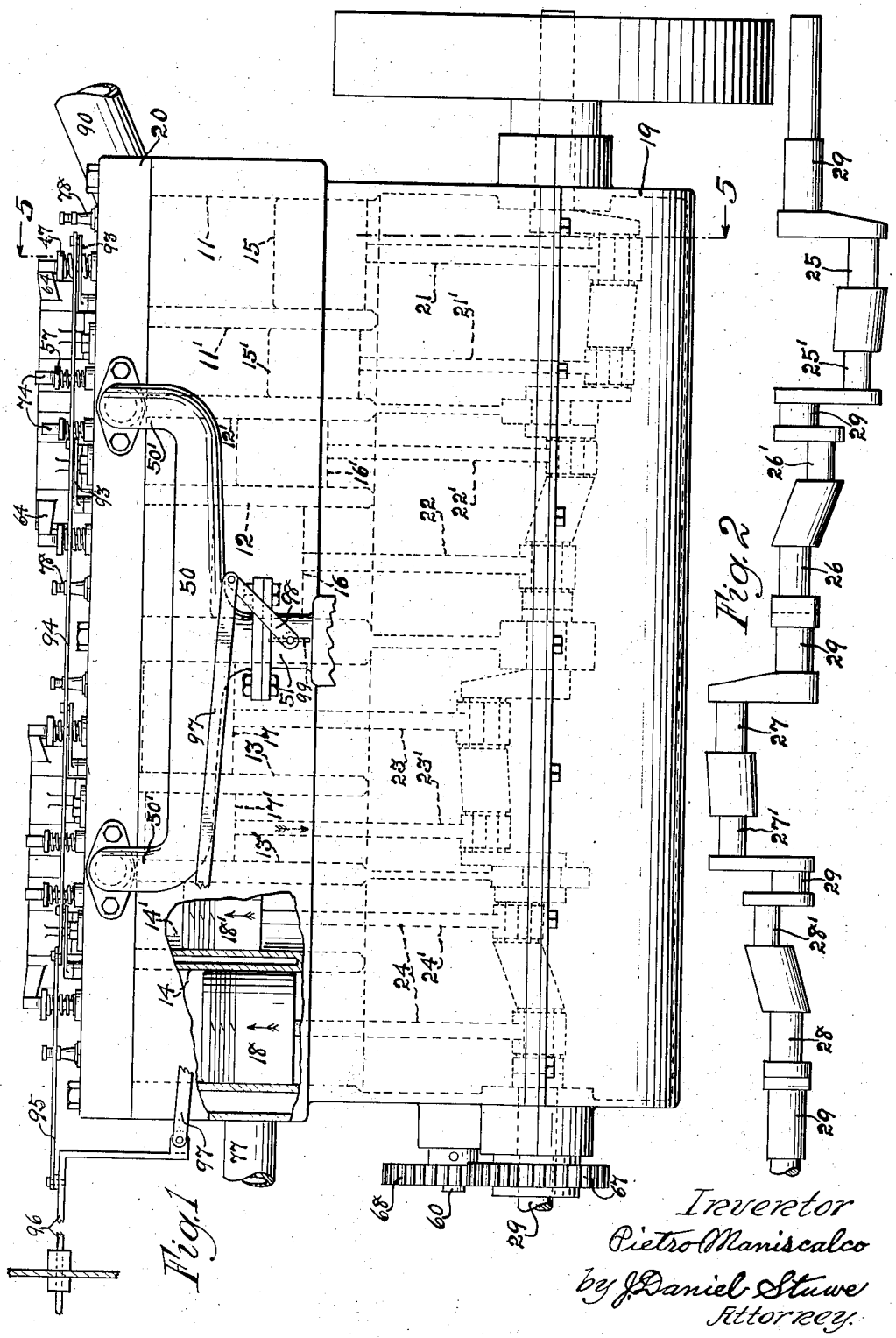

Fig. 1

Fig. 2

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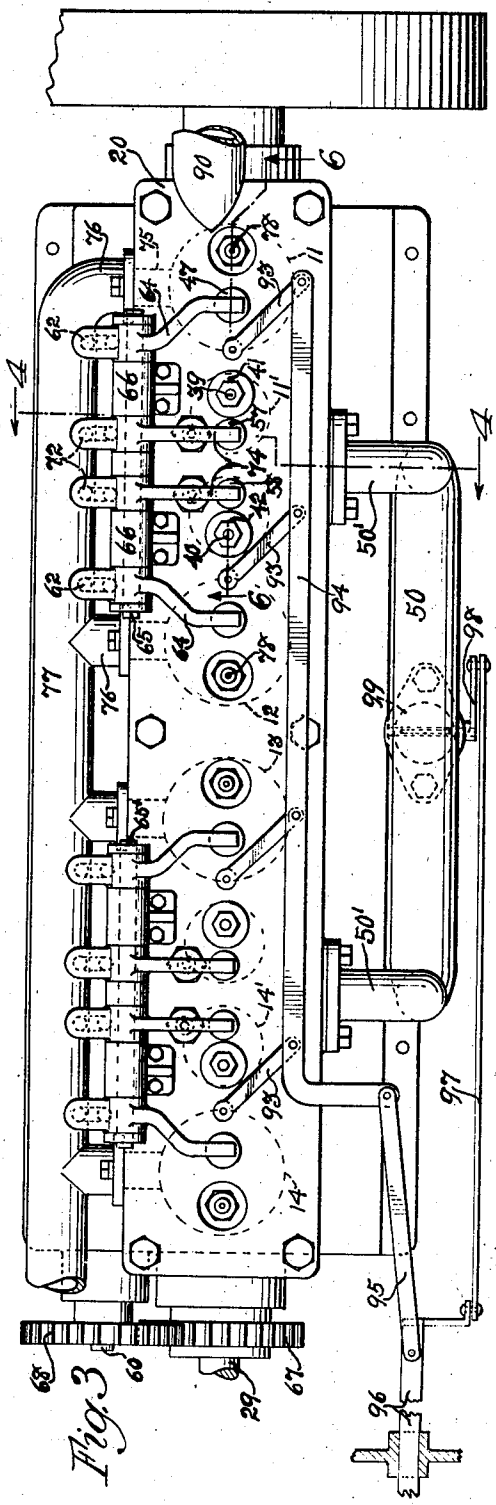

Fig. 3

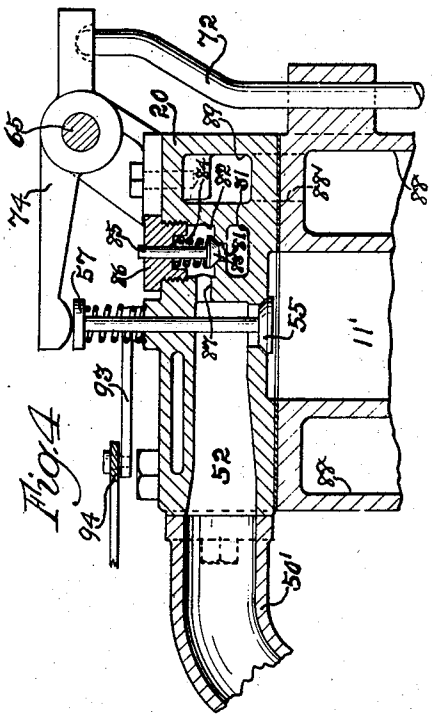

Fig. 4

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Fig. 5

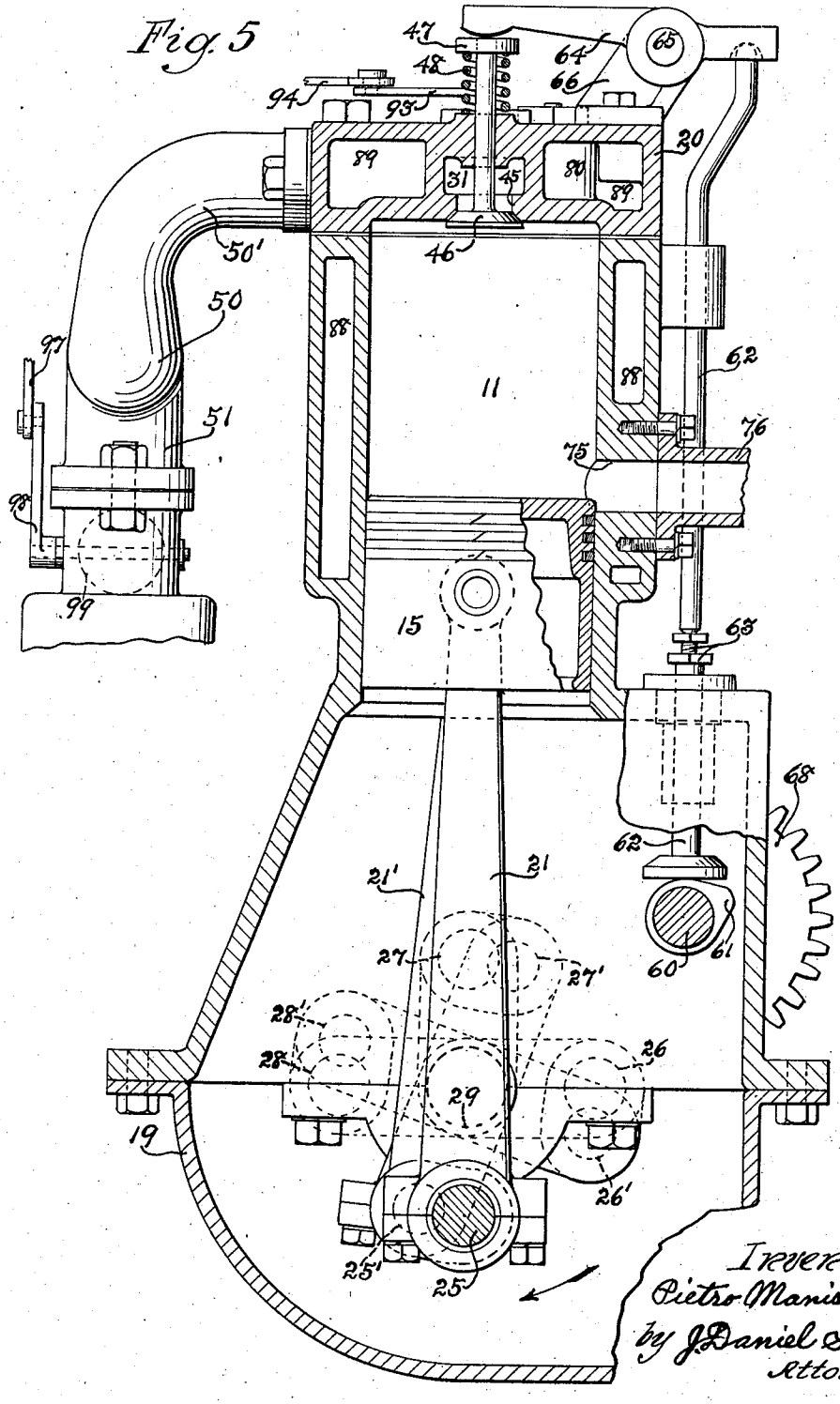

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Fig. 6

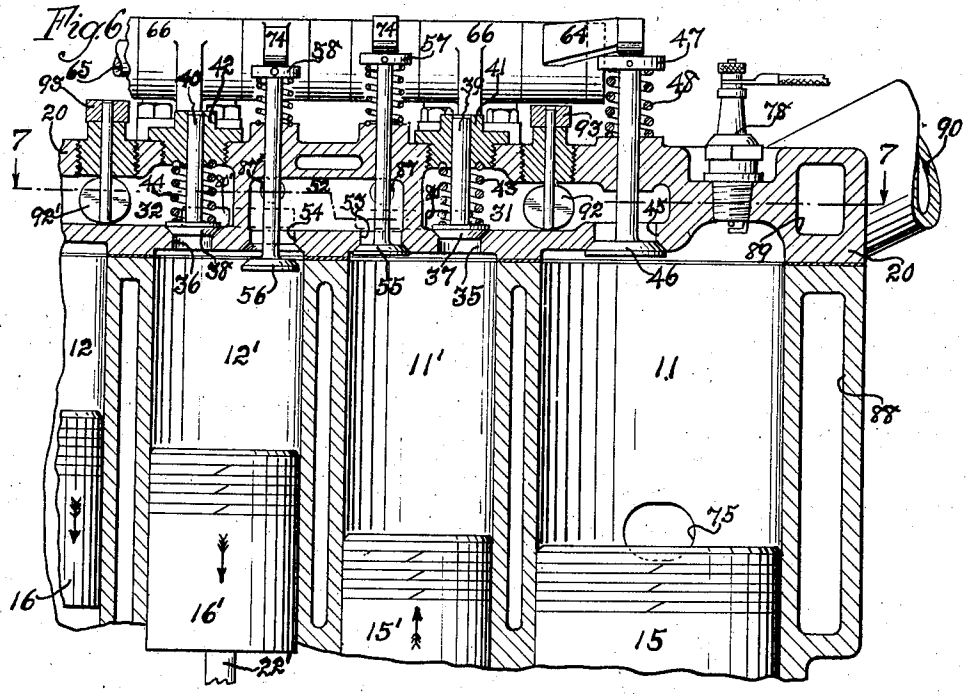
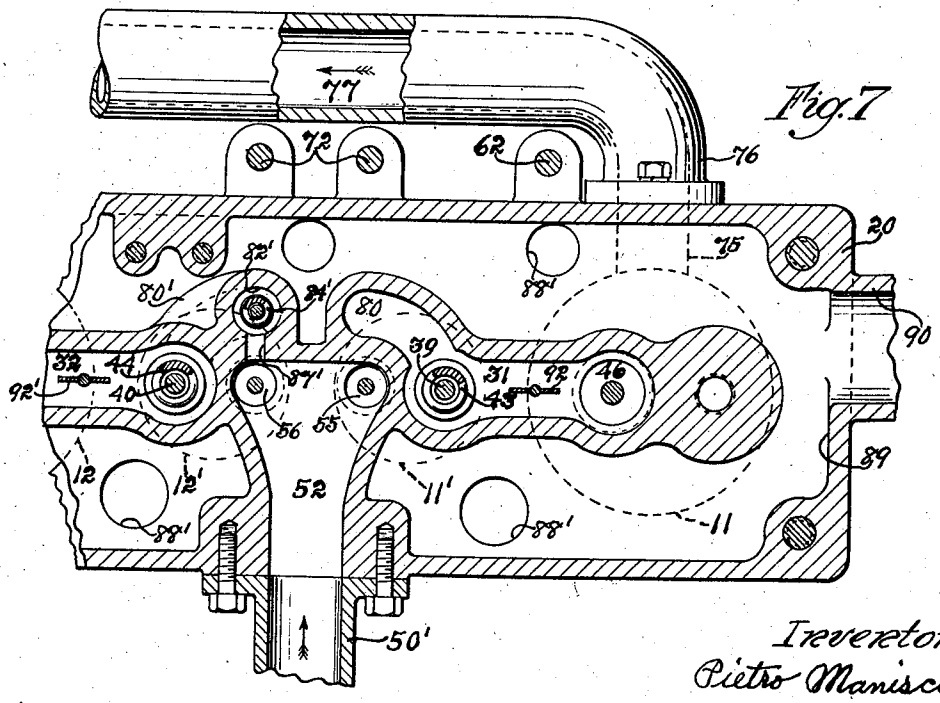


Fig. 7



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UNITED STATES PATENT OFFICE

2,161,069

INTERNAL COMBUSTION ENGINE

Pietro Maniscalco, Toledo, Ohio

Application May 27, 1937, Serial No. 145,078

9 Claims. (Cl. 123—59)

This invention relates to an improved internal combustion engine.

One of the objects of this invention is to provide an internal combustion engine of the two-cycle type which comprises a plurality of sets of cylinders, each set including a combustion cylinder and a precompression cylinder, all mounted in line, and using only one crank shaft and one cam shaft in operating all of said cylinders.

Another object of this invention is to provide such an engine wherein each precompression cylinder is positioned at a slight advance of stroke relative to its companion combustion cylinder in the set.

These and various other objects and advantages are attained with this invention, as will become apparent from the following description, taken in connection with the accompanying drawings illustrating this invention in its preferred form, it being apparent that various other forms and modifications may be resorted to for carrying out the objects and purposes of this invention.

In the drawings:

Fig. 1 is a side elevational view of my improved engine, parts being broken away.

Fig. 2 is a view of the crank shaft.

Fig. 3 is a plan view of this invention.

Fig. 4 is an enlarged vertical sectional view, taken on line 4—4 of Fig. 3.

Fig. 5 is an enlarged vertical sectional view, taken on line 5—5 of Fig. 1.

Fig. 6 is an enlarged vertical sectional view, taken on line 6—6 of Fig. 3.

Fig. 7 is a horizontal sectional view, taken on line 7—7 of Fig. 6.

This invention embodies an improvement over the internal combustion engine disclosed in my prior Patent No. 2,058,705, granted October 27, 1936.

In the engine disclosed in my said prior patent the precompression cylinder and its companion combustion cylinder are connected at an angle to each other, substantially in a V-shape. In the present invention illustrated herein the precompression cylinders as well as the combustion cylinders are all mounted in line, and their piston rods are all connected to the same crank shaft, as best shown in Figs. 1 and 2. Likewise, only one cam shaft, provided with a plurality of cams thereon, is needed herein for operating the intake valves of all the combustion cylinders and all the precompression cylinders.

In the drawings my improved engine is illustrated as comprising four sets of cylinders mounted in line, including, respectively, the sets of combustion and precompression cylinders 11 and 11', 12 and 12', 13 and 13', and 14 and 14'. These cylinders contain, respectively, the pistons 15 and 15', 16 and 16', 17 and 17', and 18 and 18'.

The cylinders arise from a crank case 19, and a cylinder head 20 is removably mounted upon said case and cylinders. Piston rods 21 and 21', 22 and 22', 23 and 23', and 24 and 24', are pivoted, to the pistons 15 and 15', 16 and 16', 17 and 17', and 18 and 18', as best shown in Figs. 1 and 5. At their lower ends these piston rods engage, respectively, the journal portions 25 and 25', 26 and 26', 27 and 27', and 28 and 28' of the crank shaft 29.

As illustrated in Figs. 1 and 2, the crank shaft is arranged and has its journal portions positioned so that the journal portion for each piston rod of a precompression cylinder is placed at a slight advance, approximately 15° to 20°, in the direction of travel, ahead of the journal portion for the piston rod of its companion combustion cylinder; so that the precompression cylinder piston of each set will have a definite advance of stroke relative to the piston of its companion combustion cylinder. In this engine which has four sets of cylinders and pistons, each set is positioned 90° in advance of the succeeding set, as illustrated.

The two cylinders 11 and 11' of one set, and likewise the two cylinders 12 and 12' of the next set, etc., are operatively connected, respectively, by storage chambers 31, 32, etc. These storage chambers are conveniently provided in the cylinder head 20 and said chambers are connected at one end, respectively, thru ports 35 and 36 with cylinders 11' and 12', said ports being closed by valve elements 37 and 38 having stems 39 and 40 which are slidable in nuts 41 and 42, respectively, and urged by springs 43 and 44 to the closed position. Said nuts and valves are adjustable, and each spring holds the valve element closed until the fuel mixture is sufficiently compressed in the precompression cylinder to force the valve open, whereupon the mixture passes into the storage chamber. As shown in Fig. 6, each of said storage chambers is connected at its other end thru a port 45 with the combustion cylinder, which is closed by a valve element 46 having a head 47 on its stem provided with a suitable spring 48 to urge the valve to its closed position.

An intake manifold 50 receives the fuel mixture thru a connection or neck 51 from suitable fuel mixing means, not shown herein. Said man-

ifold 50 has a pair of branches 50', each of which communicates with an inlet chamber 52 provided in the cylinder head 20. Each inlet chamber is enlarged at its inner end, as shown in Fig. 7, where it communicates thru a pair of ports 53 and 54 with a pair of precompression cylinders, as shown in Fig. 6 by cylinders 11' and 12'. Said ports 53 and 54 are closed by valve elements 55 and 56, respectively, having heads 57 and 58 on their stems, being urged by suitable springs to the closed position.

The cylinders are all mounted in line, and the inlet valves 46, 55, 56, etc., of the several cylinders are opened mechanically, by the use of one cam shaft 60, which is provided with a cam for each of said inlet valves. As shown in Fig. 5, cam shaft 60 has a cam 61 thereon adapted to actuate a rod 62 which includes means 63 to adjust the rod for length. At its upper end this rod actuates a lever 64 pivoted on a shaft 65 mounted by bracket means 66 on the cylinder head. Said lever engages and actuates the head 47 on the stem of inlet valve 46 of the combustion cylinder 11, so as to open said valve at the proper time for the admission of a fuel charge to cylinder 11, thru the operation of timing gears 67 and 68 which are mounted on crank shaft 29 and on cam shaft 60, respectively. Said cam shaft may be provided in two portions, as indicated in Fig. 3, including the portion 65 associated with cylinders 11, 11', 12', and 12; and the portion 65' associated with cylinders 13, 13', 14', and 14.

For the sake of simplicity, the several cam-operated rods 62, and likewise the several levers 64 for operating the valves of the combustion cylinders, are made alike. Similarly, the rods 72 and also the levers 74 for the precompression cylinders are like said rods 62 and levers 64 in construction, as illustrated by Figs. 4 and 5. Each rod 72 operates a lever 74 which is pivoted on shaft 65 and actuates head 57 on the stem of valve 55, to open said valve at the proper time.

An exhaust port 75 provided in the peripheral wall of the combustion cylinder communicates thru a branch portion 76 with exhaust manifold 77. Said port 75 and the operating mechanism for valve 46 are so arranged and timed that the valve starts opening before exhaust port 75 is fully uncovered by the descending piston, thereby assisting the piston in clearing dead gases from said cylinder. When port 75 is next closed by the ascending piston 15, then the combustion cylinder 11 will be filled with a clean fuel mixture from storage chamber 31; whereupon lever 64 raises from valve head 47, and spring 48 closes valve 46. Piston 15 then completes its upward stroke and the highly compressed fuel mixture is fired by the action of a spark plug 78 mounted in the upper end of cylinder 11, whereby piston 15 is forced downward and the burnt gases are ejected thru port 75 into the exhaust manifold.

A safety valve is provided for each storage chamber to prevent accumulation of excessive pressure therein. With the two adjoining chambers 31 and 32, as shown in Figs. 4, 6, and 7, this comprises a pair of channels or bypasses 80 and 80' which curve and converge rearwardly from said chambers 31 and 32, and have ports 81 therein, connected with vertical bores 82 and 82', provided with a pair of valve elements 83 adapted to close said ports 81 thru springs 84 and 84' positioned on the valve stems 85 which are slidable in nuts 86 threaded in said bores 82 and 82', respectively. A pair of ports 87 and 87' connect said two bores 82 and 82' with the inlet chamber 52.

When the pressure in any of the storage chambers becomes excessive, the force will lift valve 83 against the action of its spring 84 enabling the excessively compressed gas to pass from chamber 31 thru port 81, bore 82, and port 87, back into inlet channel 52. The tension of the spring and the action of the valve are adjustable by manipulating the nut 86 which is threaded in the bore.

The cooling means in this engine includes jackets 88 having interconnected cooling chambers therein arranged around the cylinders, said chambers communicating thru channel means 88' with cooling chambers 89 in the cylinder head. A hot water return pipe 90 conducts the hot water from said cooling chambers to suitable radiator means (not shown).

Means for controlling the feeding of the fuel mixture includes control valves 92, 92', etc., which are provided in the storage chambers 31, 32, etc., to definitely control the flow of fuel mixture thru each of these chambers to its associated combustion cylinder. A link 93 extends from the stem of each of said valves to an operating bar 94 which is connected thru a link 95 with the throttle control rod 96, whereby a throttle link 97 is operated to actuate the throttle lever 98 and thereby the throttle valve 99 which is provided in the connecting neck 51 leading to the intake manifold. These several control valves 92 are thus synchronized with the throttle valve 99, and upon operating the control rod 96 said valve 99 and all the control valves 92 will be operated in unison.

I claim:

1. In an internal combustion engine, a plurality of sets of cylinders, each set including a precompression cylinder and a combustion cylinder also a conduit connecting the two cylinders, all the cylinders being mounted in line and having the precompression cylinders positioned in pairs of two adjoining cylinders, a spring-held valve for admitting fuel charge above a certain pressure from a precompression cylinder to the conduit, a tappet valve for admitting fuel charge from the conduit to its combustion cylinder, an intake manifold and a branch conduit for conducting fuel charge therefrom to each two adjoining precompression cylinders, a pair of inlet ports leading from each branch conduit to said two adjoining cylinders and provided each with a tappet valve, a cam shaft and means actuated thereby for operating all of said tappet valves, a piston in each cylinder, and one crank shaft and piston rods operatively connected thereto and to all of said pistons.

2. The subject matter set forth in claim 1, wherein the conduit between the cylinders of a set is arranged to serve as a storage chamber and is provided with a control valve therein.

3. The subject matter set forth in claim 1, wherein the spring-held valve in the conduit is adjustable for regulating the limit of pressure at which the fuel charge will pass from the precompression cylinder into said conduit, and a control valve is provided in the conduit for regulating the flow of said charge therethru to the combustion cylinder.

4. In an internal combustion engine, a plurality of sets of cylinders, each set including a precompression cylinder and a combustion cylinder also a conduit connecting the two cylinders, a valved port leading from each of said conduits to the

combustion cylinder, all the cylinders being mounted in line and having the precompression cylinders arranged in pairs of two adjoining cylinders, an intake manifold having branches, inlet chambers connected to the branches, each chamber being provided at its end with two valved ports leading into a pair of two adjoining precompression cylinders, a by-pass provided with safety valve means connecting each inlet chamber with a conduit which connects the two cylinders of a set, to prevent excess pressure of the charge in said conduit, a cam shaft and means actuated thereby for operating all of said valves, a piston in each cylinder, and a crank shaft and piston rods pivotally connected to said shaft and to all of said pistons.

5. In an internal combustion engine, a plurality of sets of cylinders, each set including a precompression cylinder and a combustion cylinder also a charge storing and conveying chamber in the cylinder head connection the two cylinders, all the cylinders being mounted in line and having the precompression cylinders arranged in pairs of two adjoining cylinders, inlet chambers in the cylinder head and means conducting fuel charge thereto, each inlet chamber being enlarged at its inward end and provided with two valved ports extending to a pair of two adjoining cylinders, a valve opening with a spring-held valve extending from each precompression cylinder to a storage chamber, a valved port extending from each storage chamber to a combustion cylinder, safety valve means including a by-pass extending from each storage chamber and a channel connecting the by-pass with said inlet chamber, also an adjustable spring-held valve in said channel whereby to regulate the limit of pressure of the charge in said storage chamber, cam shaft means for actuating the valves on the cylinder ports, pistons in said cylinders having piston rods thereon, and a crank shaft operatively connected to all of said piston rods.

6. The subject matter set forth in claim 5, wherein the spring-held valve in said storage chamber is adjustable for regulating the admission of fuel charge to said chamber, and a control valve is provided in said chamber for regulating the flow of said charge therethru to the combustion cylinder.

7. In an internal combustion engine, a plurality of sets of cylinders, each set including a precompression cylinder and a combustion cylinder also a conduit connecting the two cylinders, all the cylinders being mounted in line and having the precompression cylinders positioned in pairs of two adjoining cylinders, a spring-held valve for admitting fuel charge above a certain pressure from the precompression cylinder to the conduit, a mechanical valve for admitting fuel charge from the conduit to its combustion cylinder, an intake manifold and a branch conduit for conducting fuel charge therefrom to each two adjoining precompression cylinders, a pair of inlet ports leading from each branch conduit to said adjoining cylinders and provided each with a mechanical valve, a cam shaft and means actuated thereby for operating all of said mechanical valves, a piston in each cylinder, and a single crank shaft and piston rods connected to its crank portions and to all of said pistons, said crank portions being in sets having the portion for the precompression piston placed in advance, in the direction of rotation, of the portion for the combustion piston of the set, to provide a definite advance of stroke of the former piston relative to the latter piston.

8. In an internal combustion engine, a plurality of sets of cylinders, each set including a precompression cylinder and a combustion cylinder and a conduit connecting them, all the cylinders being mounted in one line, an automatic valve between each precompression cylinder and conduit to open above a certain pressure, a mechanically operated valve between each conduit and combustion cylinder, a control valve within each conduit, to definitely control the flow of fuel mixture therethru, a piston in each cylinder and a piston rod thereon, a single crank shaft having sets of crank portions connected to the piston rods of the sets of cylinders, the crank portion for the precompression piston of a set being positioned slightly in advance of the crank portion for the companion combustion piston, to provide a definite advance of stroke of the former piston relative to the latter piston, an intake manifold having branch conduits with mechanically operated valves, each branch conduit supplying fuel charge to a pair of said precompression cylinders, and a cam shaft and means actuated thereby for operating all of said mechanically operated valves.

9. The subject matter set forth in claim 8, wherein each of said conduits has a by-pass which is equipped with a safety-valve and which connects the conduit with the inlet part on the companion compression cylinder, to prevent excess pressure in the conduit.

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