Oct. 21, 1924. 1,512,404

E. R. BURTNETT

INTERNAL COMBUSTION ENGINE

Filed April 4, 1924 2 Sheets-Sheet 1

Fig. 1.

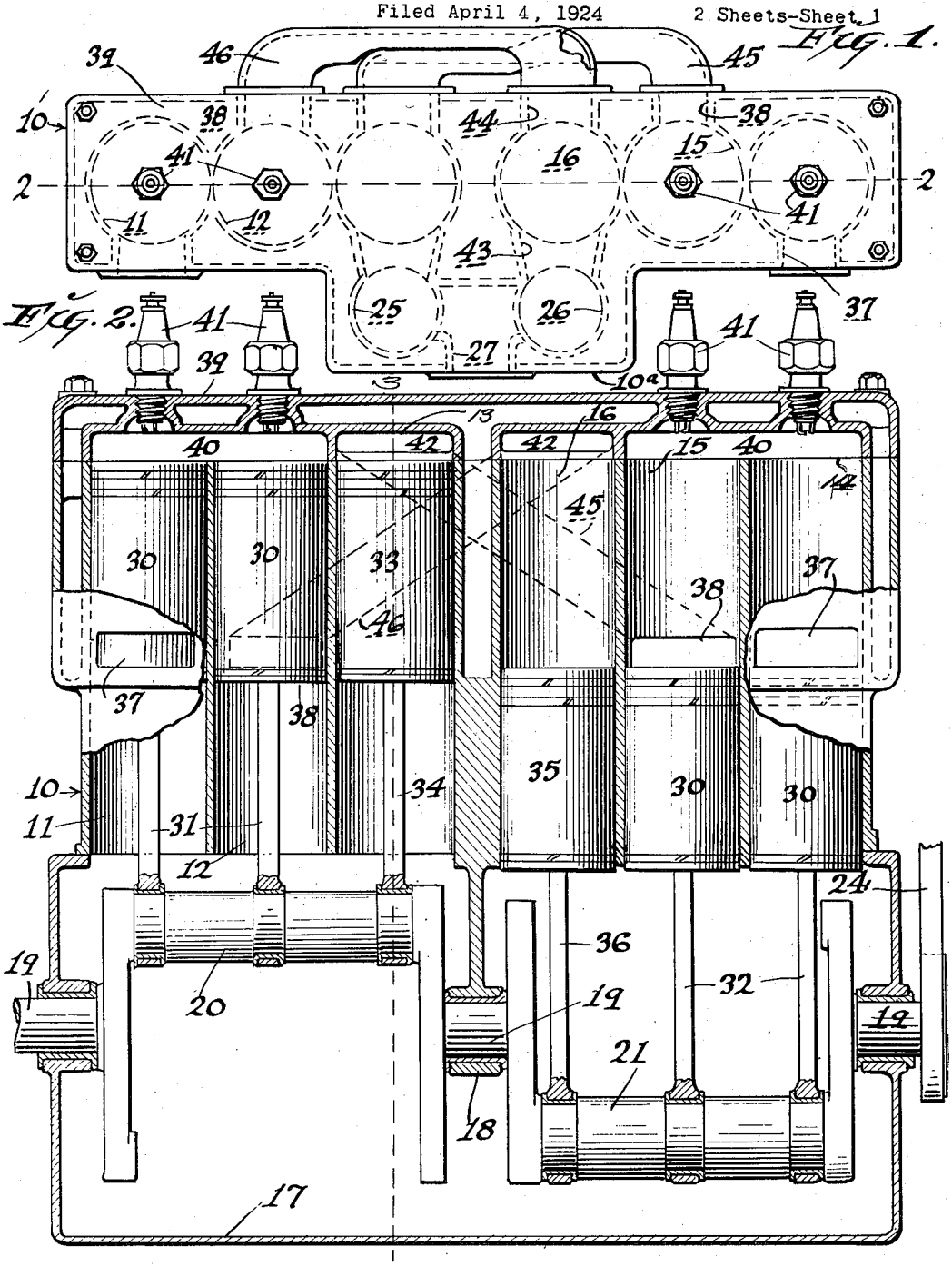


Fig. 2.

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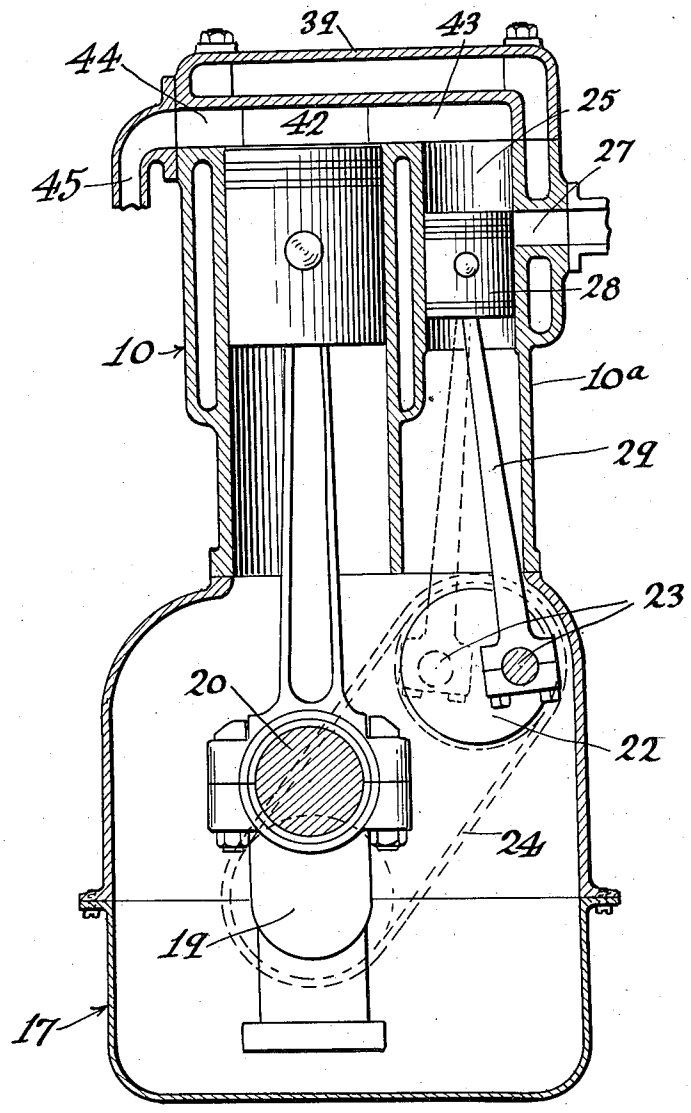
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FIG. 3.



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Patented Oct. 21, 1924. 1,512,404

UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

Application filed April 4, 1924. Serial No. 704,279.

To all whom it may concern:

Be it known that I, EVERETT R. BURTNETT, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to internal combustion engines, and has for its principal object the provision of a two combustion unit two stroke cycle internal combustion engine in which two pairs of combustion cylinders are combined with two gaseous fuel charge pumping cylinders in such a manner as to produce balanced reciprocatory masses and correct pump piston timing for the fuel charge induction to the combustion chambers.

To produce these desirable and advantageous results, I have provided a two throw crank shaft which functions as a shaft common to the six cylinders of the engine, and arranged the six cylinders in two sets, each set comprising a pair of connected combustion cylinders and a gaseous fuel pumping cylinder, and arranged the six cylinders forming the two sets in a row with the pairs of combustion cylinders adjacent to the ends of the cylinder block and with the pumping cylinders disposed adjacent to each other between said pairs of combustion cylinders.

In the type of internal combustion engine to which my invention relates, it is desirable to so ratio the displacement of the pump cylinder, to the combined displacement of the two combustion cylinders formed by a common compression clearance and forming one combustion unit so that, at full load and open throttle, the atmospheric value of fresh fuel charge inducted to the combustion chamber will be less than the combined dual cylinder combustion chamber displacement. Hence, the weight of the pump piston is less, in relation to the combined weight of the two pistons of the dual cylinders forming the combustion unit, and since the crank to which the pumping piston is connected must be oppositely arranged, in respect to degrees of crank rotation, to the crank to which the combustion pistons are connected, to which the said pump cylinder provides the fuel induction function. Since there is a difference in weight owing to the difference in size between the pump and the combustion pistons, the pump crank if located adjacent the combustion cylinder unit crank of the crank shaft and with the two cranks arranged 180° apart results in a variation in the inert forces and causes undue and undesirable vibration.

Therefore, it is a further object of this invention to arrange two way twin fuel charge transfer ducts, so as to provide a duct from the pump cylinder furthermost from one of the combustion cylinder units to one of the respective pair of combustion cylinders.

This permits the use of a two throw crank shaft with the two pistons of one pair of combustion cylinders, and the one piston of the adjacent pump cylinder directly connected to one of the two crank throws. As a result of this arrangement, the inertia forces are balanced since they are divided into two reciprocatory elements that are practically equal in weight, each element consisting of three pistons and connecting rods and connected to one crank throw which is 180° in relation to the other of the two cranks of the crank shaft to which the other element of three pistons and connecting rods are so connected.

With the foregoing and other objects in view, my invention consists in the features of construction and combination and arrangement of parts hereinafter more fully described and claimed, reference being had to the accompanying drawings, in which—

Figure 1 is a top plan view of a two stroke cycle internal combustion engine constructed in accordance with my invention;

Figure 2 is a vertical section taken on the line 2—2 of Figure 1;

Figure 3 is a vertical section taken approximately on the line 3—3 of Figure 2.

Referring by numerals to the accompanying drawings, which illustrate a practical embodiment of my invention, 10 designates a cylinder block in which are formed six piston chambers, the same being arranged in two sets, and each set comprising a pair of combustion chambers and a gaseous fuel pumping chamber. I prefer to arrange these chambers as illustrated in Figure 2, with a pair of the combustion chambers at each end of the cylinder block and with the gaseous fuel pumping chambers immediately adjacent to the center of the block.

The numerals 11 and 12 designate the combustion chambers at one end of the block and 13 the adjacent pumping chamber, these three chambers taking up practically half of the cylinder block and the other set comprising combustion chambers 14 and 15, and a gaseous fuel pumping chamber 16.

Block 10 is arranged above a suitably formed crank case 17 in which is arranged suitably located bearings 18 for a crank shaft 19 having two throws or cranks 20 and 21. These cranks are disposed diametrically opposite to each other or 180° apart, and crank 20 is positioned beneath the chambers 11, 12 and 13, while crank 21 is positioned below chambers 14, 15 and 16.

Arranged for rotation in suitable bearings in the upper portion of the crank case is a piston valve actuating crank shaft 22 having formed near its center a pair of cranks, such as 23, the same being diametrically opposite to each other or 180° apart. Shaft 22 is driven from crank shaft 19 and at the same speed therewith, preferably by means of a sprocket chain 24 that passes around sprocket wheels that are located on said shafts 19 and 22.

Formed on one side of the cylinder block and directly opposite to the pumping chambers 13 and 16 is a secondary block structure 10^a, in which is formed a pair of piston valve chambers 25 and 26, the valve chamber 25 being in direct transverse alinement with pumping chamber 13 and valve chamber 26 being in transverse alinement with pumping chamber 16. Formed through the wall that surrounds the upper portions of the valve chambers 25 and 26 is a gaseous fuel inlet duct 27, the inner portion of which branches and communicates directly with said valve chambers 25 and 26.

Arranged for reciprocatory movement within the valve chambers 25 and 26 are piston valves, such as 28, the same being connected, respectively, to the cranks 23 of shaft 22 by connecting rods, such as 29. Thus as shaft 26 is rotated, the piston valves 28 are reciprocated within their respective valve chambers to alternately uncover and cover the gaseous fuel inlet duct 27, which latter is connected to a suitable source of gaseous fuel supply, for instance, a carbureter.

Arranged for reciprocatory movement within the pairs of combustion chambers 11 and 12 and 14 and 15 are pistons, such as 30, and the pistons within the chambers 11 and 12 are connected by suitable connecting rods 31 to crank 20, and the pistons within chambers 14 and 15 are connected to crank 21 by connecting rods 32. A piston 33 is arranged for reciprocatory movement within pumping chamber 13, and said piston is connected to crank 20 by a connecting rod 34. A piston 35 that is arranged for reciprocatory movement in pumping chamber 16 is connected to crank 21 by a connecting rod 36.

Formed through the walls of block 10 that surround the combustion chambers 11 and 14, which last mentioned chambers are located at the ends of the block, are exhaust ports 37 that are located so that they are wholly uncovered and open only when the pistons 30 within said chambers are at the lower or outer ends of their travel. Formed through the walls of the block that surrounds combustion chambers 12 and 15 are gaseous fuel inlet ports 38 that are located so that they are wholly uncovered and open only when the pistons that operate within said chambers are at the lower or outer ends of their travel.

Secured in any suitable manner on top of the cylinder block 10 is a head block 39 that closes all of the chambers, including piston valve chambers 25 and 26, in said cylinder block 10, and formed in the under side of said head block adjacent to its ends are longitudinally disposed shallow recesses 40 that establish communication between the upper or head ends of the combustion cylinders 11 and 12, and the other pair of combustion cylinders 14 and 15. These chambers 40 constitute combined clearance, compression and combustion chambers.

Seated in the upper portion of block 39 and preferably at points in line with the axes of combustion cylinders 11, 12, 14 and 15 are spark plugs 41, the terminals of the electrodes of which project into the chambers 40. Formed in the under side of a head block 39 directly above the pumping chambers 13 and 16 are shallow recesses, such as 42, and the recess above pumping chamber 13 communicates by means of a duct 43 with the upper end of piston valve chamber 25, while the other recess 42 communicates by means of a similar duct with the upper end of piston valve chamber 26.

Leading through the side of head block 39 from the recesses 42 are ducts 44 and leading from the duct 44 that is above pumping chamber 13 to the inlet port 38 into combustion cylinder 15 is a precompressed gaseous fuel transfer duct 45 and a similar precompressed gaseous fuel transfer duct 46 extends from the duct 44 that is above pumping chamber 16 to the inlet port 38 that enters combustion cylinder 12.

Inasmuch as the cranks 20 and 21 of the crank shaft of my improved engine are arranged directly opposite to each other, the two sets of pistons will work or travel simultaneously in opposite directions, thereby producing a counterbalancing effect that will tend to eliminate vibration and increase the efficiency of the engine. As the pair of pistons in each pair of combustion chambers approach and pass high center, the gaseous fuel charge previously drawn into the com-

bustion chambers and precompressed within the corresponding clearance chamber 40 will be ignited by sparks produced between the ends of the electrodes of the corresponding spark plugs and the expansion following combustion of the ignited fuel charge will drive the corresponding working pistons 30, as well as the corresponding pumping piston 33, downward or outward, and as such action takes place the opposite three pistons are travelling inwardly or upwardly within their respective chambers. As each pumping piston travels downward or outward, the corresponding piston valve 28 is moved downward, thereby uncovering the corresponding gaseous fuel inlet port 27, and as the result a charge of gaseous fuel is drawn through the uncovered port or duct 27 and this gaseous fuel passes through the upper portion of the corresponding piston valve chamber, the duct 43 and through the corresponding chamber 42. As the power pistons 30 approach low center the exhaust port 37 will be uncovered or opened slightly in advance of the uncovering of the inlet port 38 to the adjacent combustion chamber, due to the fact that the exhaust ports are slightly wider than the inlet ports and as the exhaust ports are thus opened a material reduction in pressure within the combustion chambers takes place, and as soon as the inlet port in the adjacent combustion cylinder is uncovered and open a charge of gaseous fuel which was precompressed in the pumping chamber of the other set of cylinders will enter said inlet port and pass upwardly through the corresponding combustion chamber through the corresponding clearance chamber 40 and thence downwardly through the combustion chamber that is provided with the exhaust port, and this in-rush of precompressed gaseous fuel will drive before it the products of combustion resulting from the previously ignited charge within the combustion chambers, and said products of combustion will be forced out through the corresponding exhaust port.

As the pistons start on their upward or inward strokes, the inlet and exhaust valves will be covered and closed, and the charge of precompressed gaseous fuel drawn into the combustion chambers will, as the pistons therein continue to travel upwardly or inwardly, be compressed within the common clearance chamber 40, and as the corresponding pumping piston moves upwardly or inwardly the charge of gaseous fuel drawn into the chamber in which said piston operates while the corresponding inlet duct 27 was open will be compressed in the corresponding recess 42 and transfer duct 45 leading therefrom, and thus this precompressed gaseous fuel will be transferred to the combustion chamber of the other set of cylinders and admitted to the combustion chamber having the inlet port 38 when the corresponding power piston 30 approaches the outer end of its stroke and uncovers and opens said inlet port.

Thus, it will be seen that I have provided a two stroke cycle internal combustion engine having two sets of cylinders, each set comprising a pair of combustion cylinders and a gaseous fuel pumping cylinder, the pistons that operate within said cylinders being connected to the two throws of a crank shaft so as to provide balanced reciprocating masses which in operation minimize and practically eliminate vibration, and materially increases the effectiveness and smooth running qualities of the engine.

Obviously minor changes in the size, form and construction of my improved internal combustion engine may be made without departing from the spirit of the invention, the scope of which is set forth in the appended claims.

I claim as my invention:

1. The combination, in a two stroke cycle internal combustion engine, of six cylinders arranged in a row, a piston within each of the six cylinders, a crank shaft having two crank throws, three of the six pistons within the six cylinders being connected separately to each of the two crank throws of the said crank shaft, four of the six cylinders functioning as combustion chambers, the remaining two of the six cylinders functioning as gaseous fuel charge pumping precompression chambers, the four cylinders adapted to combustion formed as two combustion units, the two pairs of combustion cylinders being joined at the head ends by a compression clearance common to the members of each pair of combustion cylinders, the two pistons within one pair of combustion cylinders joined by the said common compression clearance, being connected to one of the two crank throws of the said crank shaft, the piston of the pump cylinder adjacent the said pair of combustion cylinders being connected to the same crank throw to which the adjacent combustion cylinder pistons are also connected, ports formed in the walls of each pair of combustion cylinders, valvular means for controlling the fuel charge admission to the two pumping cylinders, the two cylinders on each end of the row of six cylinders being adapted to combustion and the two center cylinders of the row of six cylinders being adapted to the pumping function of the fuel charge, a precompressed fuel charge transfer duct leading from one of the two pump chambers to the second cylinder of the end pair of cylinders adapted to combustion furthest from the said pump chamber, a fuel charge transfer duct leading from the other of the two pump chambers to the second cylinder of the other end pair of cylinders adapted to combustion, and said

fuel charge transfer ducts crossing each other, each with an offset of the same duct capacity as the other.

2. In a two stroke cycle internal combustion engine, two sets of cylinders, each set comprising a pair of combustion cylinders and a gaseous fuel precompression cylinder, a crank shaft having two cranks that are disposed diametrically opposite each other, pistons arranged for operation within all of the cylinders, the pistons in one set of cylinders being connected to one of the cranks of said crank shaft and the pistons within the other set of cylinders being connected to the other one of the two cranks of said crank shaft.

3. In a two stroke cycle internal combustion engine, two sets of cylinders, each set comprising a pair of combustion cylinders and a gaseous fuel precompression cylinder, a crank shaft having two cranks that are disposed diametrically opposite each other, pistons arranged for operation within all of the cylinders, the pistons in one set of cylinders being connected to one of the cranks of said crank shaft, the pistons within the other set of cylinders being connected to the other one of the two cranks of said crank shaft, and piston valves arranged for operation in proper time relation to the movement of the pistons within the pumping cylinders for controlling the admission of gaseous fuel charges to said pumping cylinders.

4. In a two stroke cycle internal combustion engine, two sets of cylinders, each set comprising a pair of combustion cylinders and a gaseous fuel precompression cylinder, a crank shaft having two cranks that are disposed diametrically opposite each other, pistons arranged for operation within all of the cylinders, the pistons in one set of cylinders being connected to one of the cranks of said crank shaft, the pistons within the other set of cylinders being connected to the other one of the two cranks of said crank shaft, piston valves arranged for operation in proper time relation to the movement of the pistons within the pumping cylinders for controlling the admission of gaseous fuel charges to said pumping cylinders, and a precompressed gaseous fuel duct leading from the pumping chamber of each set of cylinders to one of the combustion chambers of the other set of cylinders.

5. In a two stroke cycle internal combustion engine, a series of six cylinders arranged in a row, the six cylinders being divided into two sets, each set comprising a gaseous fuel pumping cylinder and a pair of connected combustion cylinders, a crank shaft having two cranks disposed diametrically opposite each other, pistons arranged for operation within the chambers of one set of cylinders and connected to one of the cranks of said crank shaft and pistons arranged for operation within the chambers of the other set of cylinders, which last mentioned pistons are connected to the other crank of said crank shaft.

6. In a two stroke cycle internal combustion engine, a series of six cylinders arranged in a row, the six cylinders being divided into two sets, each set comprising a gaseous fuel pumping cylinder and a pair of connected combustion cylinders, a crank shaft having two cranks disposed diametrically opposite each other, pistons arranged for operation within the chambers of one set of cylinders and connected to one of the cranks of said crank shaft, pistons arranged for operation within the chambers of the other set of cylinders, which last mentioned pistons are connected to the other crank of said crank shaft, and piston valves operating in proper time relation to the movements of the pistons in the pumping cylinders for controlling the admission of gaseous fuel into said pumping cylinders.

7. In a two stroke cycle internal combustion engine, a series of six cylinders arranged in a row, the six cylinders being divided into two sets, each set comprising a gaseous fuel pumping cylinder and a pair of connected combustion cylinders, a crank shaft having two cranks disposed diametrically opposite each other, pistons arranged for operation within the chambers of one set of cylinders and connected to one of the cranks of said crank shaft, pistons arranged for operation within the chambers of the other set of cylinders, which last mentioned pistons are connected to the other crank of said crank shaft, pistons valves operating in proper time relation to the movements of the pistons in the pumping cylinders for controlling the admission of gaseous fuel into said pumping cylinders, and a precompressed gaseous fuel transfer duct leading from the pumping cylinder of each set to one of the combustion cylinders in the other set.

8. In a two stroke cycle internal combustion engine, a series of six cylinders arranged in a row, the six cylinders being divided into two sets, each set comprising a gaseous fuel pumping cylinder and a pair of connected combustion cylinders, the first and second cylinders from each end forming the pair of connected combustion cylinders of each set, the two center cylinders being the pumping cylinders for the two sets of connected combustion cylinders, the pumping cylinder third from each end being the pumping cylinder for the connected combustion cylinders first and second from the opposite end, a precompressed gaseous fuel transfer duct leading from the compression clearance of the said third cylinder from the end to the second cylinder of the two

connected combustion cylinders from the opposite end, a crank shaft having but two crank throws disposed diametrically opposite to each other, the pistons of the first, second and third cylinders from either end, being connected to one of the said cranks of the two throw crank shaft, piston valves operating in proper time relation to the movements of the pistons in the pumping cylinders for controlling the admission of gaseous fuel into the said pumping cylinders and ignition means located in the clearance chamber of each pair of combustion chambers directly over the precompressed gaseous fuel inlet ports into said combustion cylinders.

In testimony whereof I affix my signature.

EVERETT R. BURTNETT.