Aug. 17, 1926. 1,596,401

E. R. BURTNETT

INTERNAL COMBUSTION ENGINE

Filed July 16, 1924

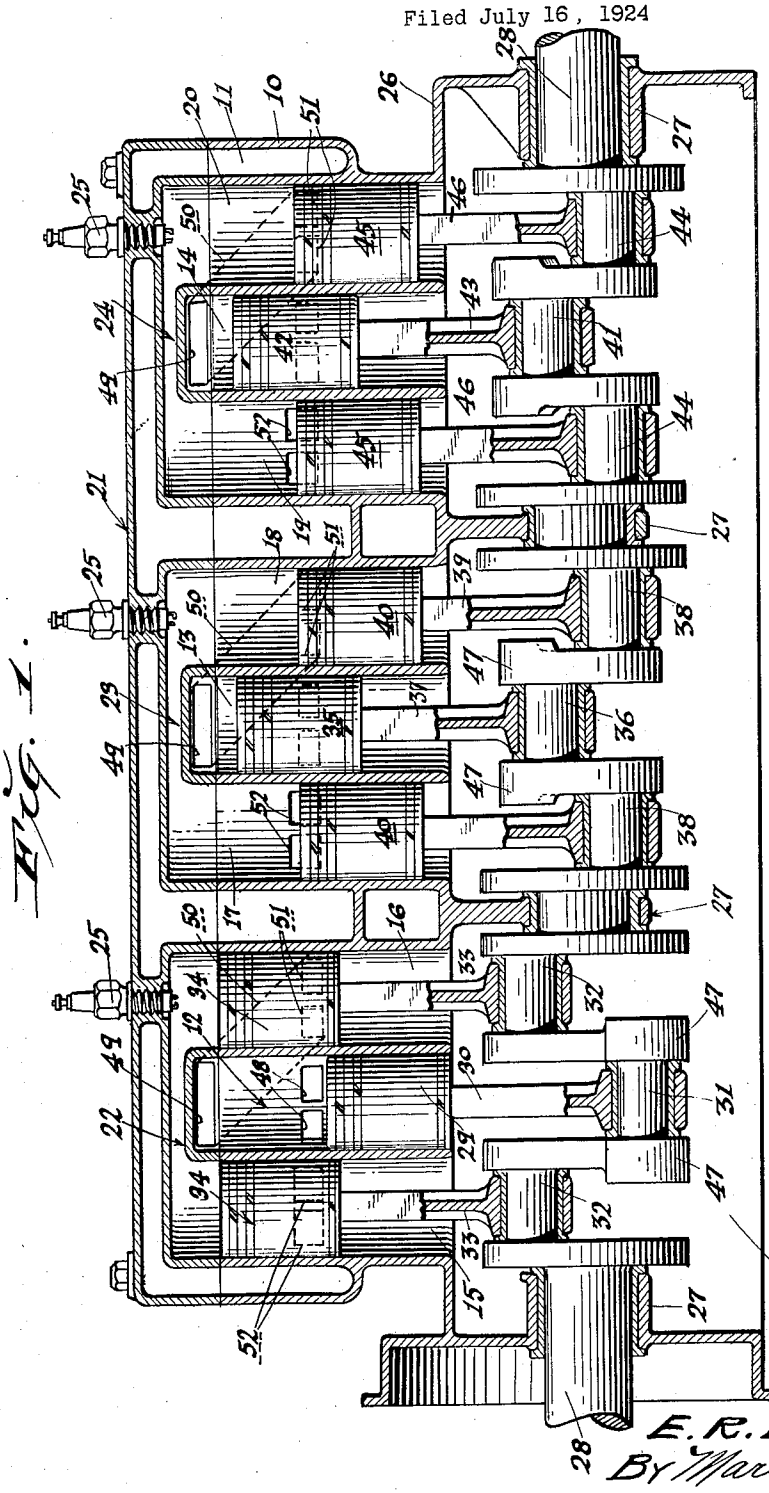


Fig. 1.

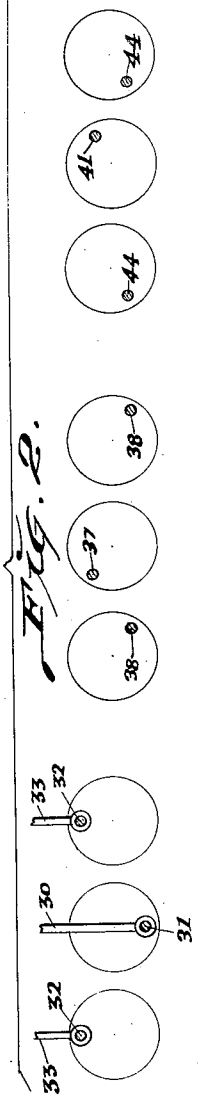


Fig. 2.

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EVERETT R. BURTNETT, OF LOS ANGELES, CALIFORNIA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE AUTOMOTIVE VALVES CO., OF LOS ANGELES, CALIFORNIA, A VOLUNTARY TRUST.

INTERNAL-COMBUSTION ENGINE.

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My invention relates generally to internal combustion engines, and more particularly to engines of the two stroke cycle type, the principal object of my invention being to provide a multi-cylinder engine made up of a plurality of units, each unit comprising a gaseous fuel pumping cylinder that is effective in precompressing gaseous fuel and forcing the same into a pair of combustion chambers, and which latter are connected at their head or inner ends by a clearance chamber that is common to both of said combustion chambers.

Further objects of my invention are to generally improve upon and simplify the construction of multi-cylinder two stroke cycle internal combustion engines, to provide an improved crank shaft arrangement wherein the cranks for the pistons in the cylinders of the various units are arranged in relation to each other so as to minimize centrifugal couple and to rotate under all speeds with minimum vibration and with greatest advantage in power output.

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 vertical section taken lengthwise through the center of an engine embodying the principles of my invention;

Figure 2 is a diagrammatic view illustrating the arrangement of cranks in the crank shaft of my improved engine.

Referring by numerals to the accompanying drawings, which illustrate a practical embodiment of my invention, 10 designates a cylinder block the walls of which are preferably formed with communicating chambers 11, through which may be circulated a fluid cooling medium, and formed in said block and suitably spaced apart are three gaseous fuel precompression and pumping chambers 12, 13 and 14.

Formed in the block 10 and immediately adjacent to chamber 12 are combustion chambers 15 and 16, and a similar pair of combustion chambers 17 and 18 are formed in the block adjacent to pumping chamber 13. A third pair of combustion chambers 19 and 20 are formed in the block adjacent to pumping chamber 14. The chambers just described are disposed in a row with their axes parallel and occupying the same radial plane with respect to the axis of the crank shaft. Thus each pumping chamber is arranged between a pair of combustion chambers, and each set of three chambers constitutes a power unit for the engine.

Suitably secured on the head end of the cylinder block 10 is a head block 21 in the under side of which are formed three chambers 22, 23 and 24. The ends of chamber 22 communicate directly with combustion chambers 15 and 16, thereby providing a common clearance compression and combustion chamber. In a similar manner, chamber 23 connects the head or inner ends of the combustion chambers 17 and 18, and chamber 24 connects the head or inner ends of the combustion chambers 19 and 20.

Seated in the upper portion of head 21 and preferably at points above the chambers 16, 18 and 20 are spark plugs 25, the terminals of the electrodes of which project, respectively, into the common clearance chambers 22, 23 and 24. Cylinder block 10 surmounts a crank case member 26, the same being provided with four or more properly spaced bearings 27 for a crank shaft 28, which latter is provided with nine cranks or throws, one for each engine cylinder.

A piston 29 that is arranged for operation in pumping chamber 12 is connected by a connecting rod 30 to a crank 31 on shaft 28, said crank being disposed between and arranged diametrically opposite to, or 180° from, cranks 32 that are located beneath the combustion chambers 15 and 16. Connecting rods 33 connect the cranks 32 with pistons 34 that are arranged for operation within combustion chambers 15 and 16. A pumping piston 35 is arranged for operation in chamber 13 and connecting said piston with a crank 36 on shaft 28 is a connecting rod 37. Arranged to the sides of crank 36 and diametrically opposite thereto are cranks 38 that are connected by connecting rods 39 to pistons 40 that are arranged for operation within combustion chambers 17 and 18.

The cranks 36 and 38 for the power unit controlling the cylinders 13, 17 and 18 are arranged 120° in advance in the direction of crank rotation from cranks 31 and 32 that are associated with the power unit compris-

ing the cylinders 12, 15 and 16. A crank 41 is arranged beneath pumping cylinder 14 and connecting said crank with a piston 42 that is arranged for operation within said cylinder 14 is a connecting rod 43. Cranks 44 are arranged to the sides of crank 41 and beneath the chambers 19 and 20, said cranks 44 being disposed diametrically opposite to crank 41.

Pistons 45 are arranged for operation within combustion chambers 19 and 20, said pistons being connected to the cranks 44 by connecting rods 46. The cranks 41 and 44 are disposed 120° in advance in the direction of crank rotation of cranks 36 and 38, and 240° in advance in the direction of crank rotation of cranks 31 and 32. Thus the three sets of cranks for the three power units of the engine are disposed 120° apart, said arrangement tending to eliminate centrifugal couple and producing uniform torque and an even flow of power in the crank shaft. These last mentioned advantageous results are enhanced by the arrangement of suitable counterbalancing weights 47 that may be formed integral with or fixed to the arms that are arranged to the sides of cranks 31, 36 and 41.

Formed through the side wall of cylinder block 10 and communicating with the intermediate portions of the pumping chambers 12, 13 and 14 are gaseous fuel inlet ports 48 that receive gaseous fuel from a suitable source of supply, such as a carbureter. Formed through the side wall of block 21 and leading from the upper or inner ends of the pumping chambers 12, 13 and 14 are compressed gaseous fuel outlet ports 49 that communicate with the upper ends of inclined transfer ducts 50, the lower ends of which latter communicate with fuel transfer inlet ports 51 that are formed through the wall of cylinder block 10 and which communicate, respectively, with the intermediate portions of combustion chambers 16, 18 and 20.

Formed through the wall of block 10 and leading from the intermediate portions of combustion chambers 15, 17 and 19 are exhaust ports, such as 52, and if desired these ports may all communicate with a suitably arranged exhaust manifold.

All of the ports 48, 51 and 52 occupy practically the same plane, and said ports are wholly uncovered and open only when the respective pistons are at the lower or outer ends of their travel.

Inasmuch as each pumping piston moves simultaneously with and in opposition to the reciprocating movement of the combustion pistons with which it is associated, each pumping piston will be at the lower or outer end of its travel when the associated combustion pistons are at the upper or inner ends of their travel and when so positioned the gaseous fuel inlet ports into the pumping chamber will be fully uncovered and open so as to admit a charge of gaseous fuel from the source of supply. As the pumping piston moves upward or inward, the gaseous fuel inlet ports are closed and during the succeeding upward or inward travel of said piston, the gaseous fuel within said pumping chamber will be compressed in the upper portion thereof, and in the transfer duct that leads from the outlet transfer port at the upper end of said pumping chamber. As the pumping piston approaches high center, the combustion pistons associated therewith or within the adjacent combustion chambers approach and pass their low centers, thereby simultaneously uncovering the exhaust ports and the precompressed gaseous fuel inlet ports, and the precompressed charge of gaseous fuel entering the uncovered inlet ports rushes upwardly through the combustion chamber into which said ports open, and said gaseous fuel passes from thence through the common clearance chamber that connects the head portions of the combustion chambers, and said gaseous fuel then passes downwardly through the combustion chamber having the exhaust ports, with the result that the products of combustion of the previously ignited charge are expelled through said exhaust ports.

On the succeeding upward or inner strokes of the pistons within the combustion chambers, the precompressed gaseous fuel charge drawn into said chambers will be compressed in the common clearance chamber that connects the head portions of said combustion chambers, and as said combustion chambers pass their high centers this compressed charge of gaseous fuel will be ignited by a spark produced between the terminals of the electrodes of the corresponding spark plug. Obviously the expansion following combustion of this compressed gaseous fuel charge will act upon the pistons in the usual manner to drive the same downward or outward upon their power stroke.

By providing an engine having three power units, each unit comprising a pair of connected combustion cylinders and a gaseous fuel pumping cylinder, and arranging the cranks to which the pistons of the three units are connected 120° apart, the crank shaft of the engine is driven so as to produce with minimum vibration a relatively high degree of power, and this smooth running effect is enhanced by reason of the fact that the crank arms to the sides of the cranks to which the pistons in the pumping chambers are connected are provided with counter-balancing weights.

The symmetrical arrangement of the cylinders forming the power units in my improved arrangement, and likewise the symmetrical arrangement of the connections be-

tween the pistons and the crank shaft, is effective in equalizing the stresses and torque impressed on said crank shaft by the power pistons, and likewise the strains impressed on said crank shaft by the resistance offered to the pumping pistons during the precompression of the gaseous fuel charges.

It will be understood that various minor changes in the size, form and construction of my improved two stroke cycle internal combustion engine may be made without departing from the spirit of my invention, the scope of which is set forth in the appended claims.

I claim as my invention:

1. In a two stroke cycle internal combustion engine, a series of nine cylinders arranged in row, the entire series of cylinders being arranged to form three power units, each comprising a pair of combustion cylinders and a single gaseous fuel pumping cylinder, said pumping cylinder being arranged between the pair of combustion cylinders of the unit with which it is associated, the members of the pair of combustion cylinders of each unit being connected at their head ends by a common clearance chamber, the pumping cylinder of each unit being provided with a gaseous fuel inlet port and with a pumped gaseous fuel outlet port, a duct leading from said outlet port to the intermediate portion of one of the adjacent combustion cylinders, the other combustion cylinder of the same unit being provided with an exhaust port, pistons arranged for operation within the three cylinders of each unit, and a crank shaft having nine separate throws to which all of the pistons are separately and respectively connected.

2. In a two stroke cycle internal combustion engine, a series of nine cylinders arranged in row, the entire series of cylinders being arranged to form three power units, each comprising a pair of combustion cylinders and a single gaseous fuel pumping cylinder, said pumping cylinder being arranged between the pair of combustion cylinders of the unit with which it is associated, the members of the pair of combustion cylinders of each unit being connected at their head ends by a common clearance chamber, the pumping cylinder of each unit being provided with a gaseous fuel inlet port and with a pumped gaseous fuel outlet port, a duct leading from said outlet port to the intermediate portion of one of the adjacent combustion cylinders, the other combustion cylinder of the same unit being provided with an exhaust port, pistons arranged for operation within the three cylinders of each unit, a crank shaft having nine separate throws to which all of the pistons are separately and respectively connected, and the corresponding members of the three sets of cranks being arranged 120° apart.

In testimony whereof I affix my signature.

EVERETT R. BURTNETT.