Sept. 29, 1936. F. B. STEARNS 2,056,056

ENGINE CYLINDER

Filed Oct. 11, 1932 2 Sheets-Sheet 1

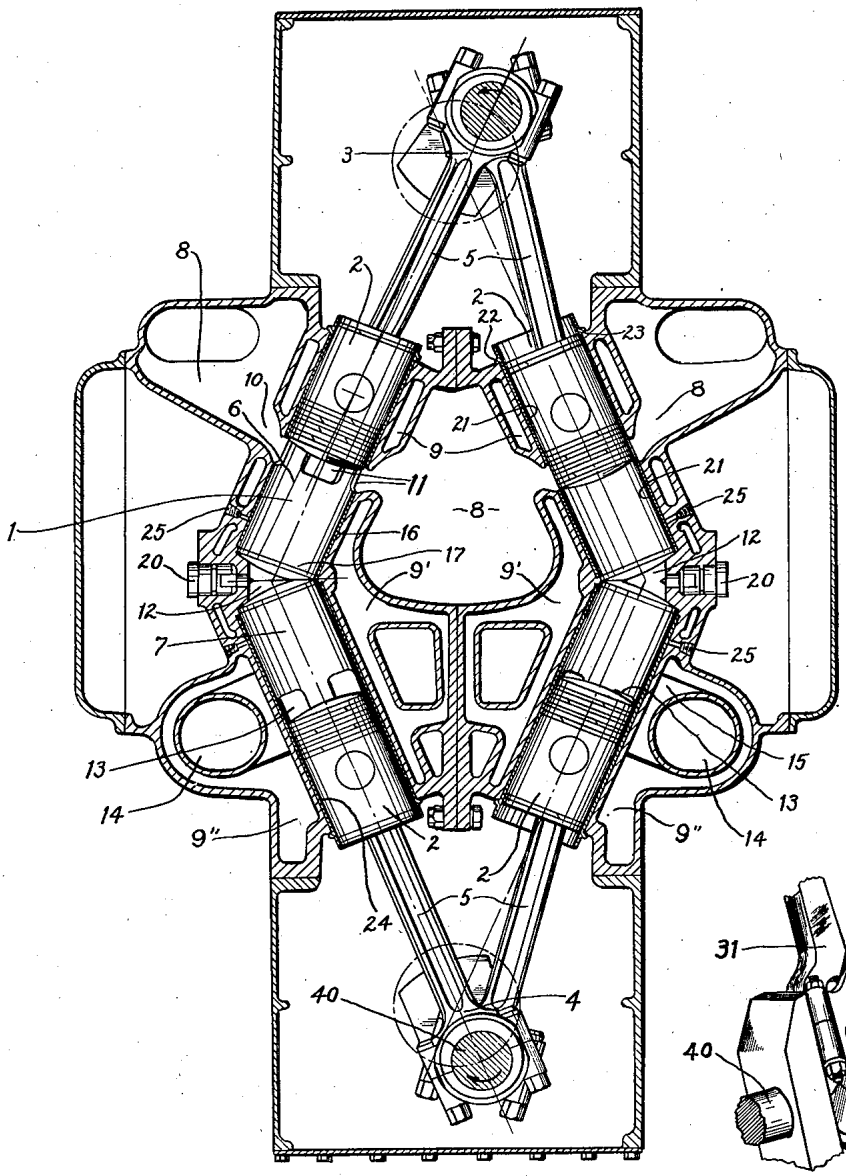

FIG 1

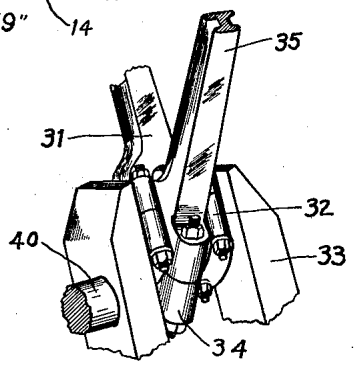

FIG 3

INVENTOR.

Frank Ballou Stearns

BY Stough and Canfield

His ATTORNEYS

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ENGINE CYLINDER

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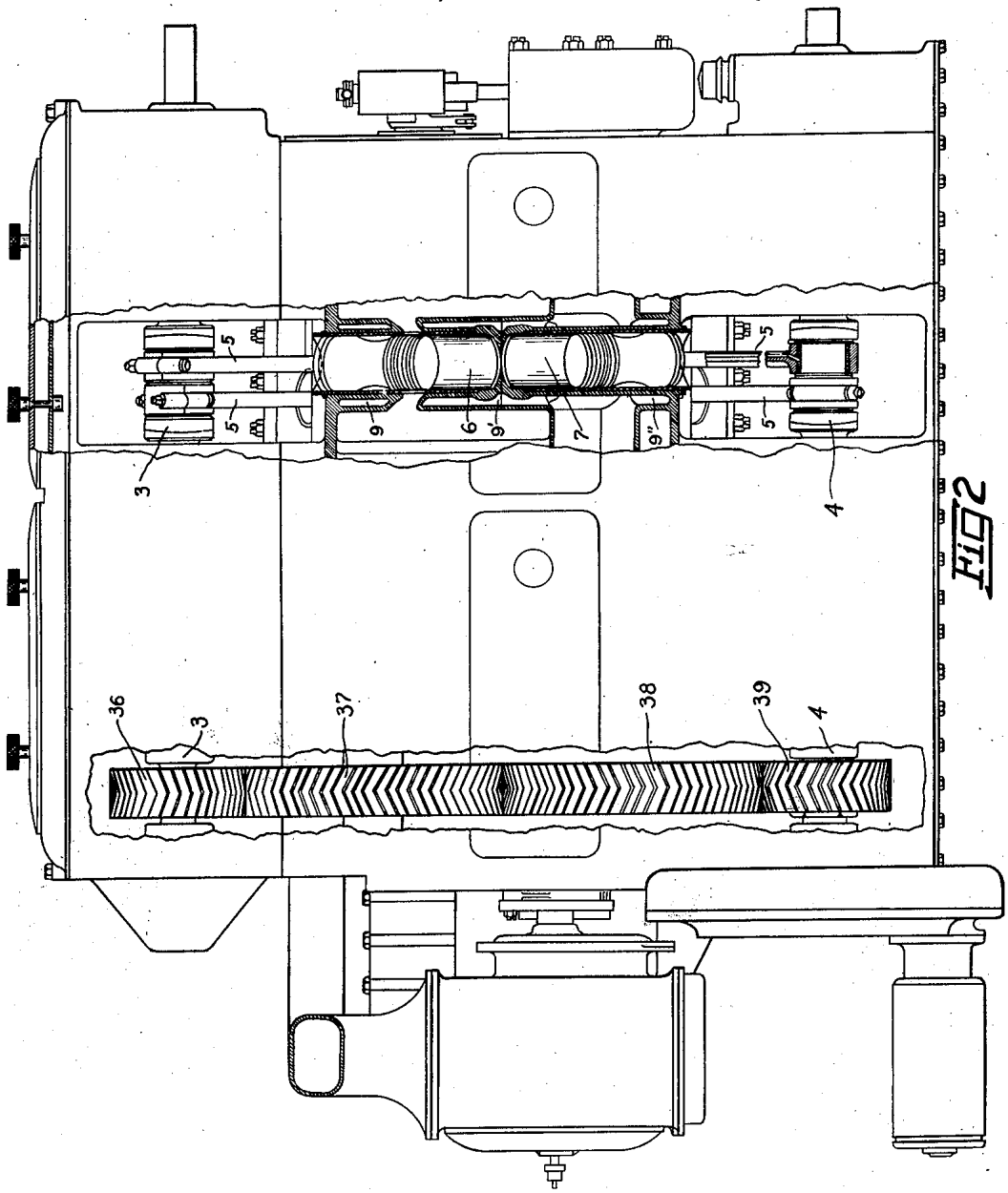

FIG 2

INVENTOR.

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Patented Sept. 29, 1936 2,056,056

UNITED STATES PATENT OFFICE

2,056,056

ENGINE CYLINDER

Frank Ballou Stearns, Shaker Heights, Ohio

Application October 11, 1932, Serial No. 637,277

12 Claims. (Cl. 123—53)

This invention relates to multi-cylinder internal combustion engines, and more particularly to multi-cylinder internal combustion engines having two opposed pistons disposed in each cylinder connected to parallel crank shafts.

Engines have heretofore been employed wherein the cylinders are arranged in the shape of a V and connected to a common crank shaft located generally at the apex of the V. Such a construction has numerous advantages well understood in the art, such as allowing a more compact motor than if the cylinders were placed in line and the advantages found in employing a relatively shorter crank shaft for the same horsepower such as relatively less vibration and torque.

I contemplate an internal combustion multi-cylinder engine wherein substantially two V-shaped structures are placed together generally in the form of a diamond with two opposed pistons occupying a common cylinder, and each of the said pistons being connected to a different of two parallel crank shafts. The opposed pistons are actuated simultaneously by the expansion of gases, thus in effect combining in a single unit two generally V-shaped units. The advantages of a V-shaped unit over a straight-line motor such as compactness, vibration, and balance, will generally be relatively increased in a diamond-shaped arrangement of the cylinders. Various other advantages are attained in employing an opposed piston type cylinder such as compressing an initial charge to relatively twice the value attained in a single piston type cylinder.

It is an object of my invention therefore to provide a multi-cylinder internal combustion engine having parallel crank shafts and a generally diamond-shaped arrangement of the cylinders.

It is another object of my invention to provide a multi-cylinder internal combustion engine wherein opposed pistons connected to parallel crank shafts are disposed in the same cylinder.

Another object of my invention is to provide a multi-cylinder internal combustion engine wherein the cylinders are provided with an improved combustion chamber.

Another object of my invention is to provide a multi-cylinder internal combustion engine wherein opposed pistons connected to parallel crank shafts and disposed in a common cylinder will be simultaneously actuated by the expansion of gases therein.

Another object of my invention is to provide a multi-cylinder internal combustion engine having opposed pistons in a common cylinder connected to parallel crank shafts wherein a plurality of said cylinders are disposed in parallel planes.

Another object of my invention is to provide a multi-cylinder internal combustion engine having two generally V-shaped cylinders disposed in a generally diamond-shaped arrangement in a common plane.

Another object of my invention is to provide a multi-cylinder internal combustion engine having opposed pistons connected to parallel crank shafts and disposed in a common cylinder and a second similar cylinder in a parallel plane having opposed pistons connected to the said crank shafts, the connecting rods engaging a common crank of the crank shaft.

Another object of my invention is to provide a multi-cylinder two-cycle internal combustion engine, employing opposed pistons in a common cylinder wherein the intake and the exhaust ports of said cylinders are controlled by the reciprocation of the pistons.

Another object of my invention is to provide a multi-cylinder internal combustion engine having opposed pistons in a common cylinder, provided with intake ports adapted to impart a cyclonic and longitudinal impetus in the direction of the combustion chamber to a fuel charge drawn therein.

Another object of my invention is to provide a multi-cylinder internal combustion engine having cylinders provided with exhaust ports adapted to accelerate the exhaustion of gases therefrom.

Another object of my invention is to provide a multi-cylinder internal combustion engine which is relatively compact.

Another object of my invention is to provide a multi-cylinder internal combustion engine having a minimum of vibration.

These and other objects of my invention will become more apparent to those skilled in the art to which my invention appertains, from a consideration of the following drawings and description wherein like figures refer to like parts, and wherein:

Fig. 1 is a transverse cross-sectional view of an engine embodying my invention taken partly on one plane through a cylinder and partly on a spaced parallel plane through an adjacent cylinder;

Fig. 2 is a side elevational view of the engine of Fig. 1 with outer parts broken away to reveal inner parts thereof;

Fig. 3 is a partial perspective view of a modification of my invention.

Referring to Figs. 1 and 2, in the embodiment of my invention described, generally V-shaped cylinders indicated at 1 have disposed therein pistons 2 which are reciprocatingly joined to an upper crank shaft 3 and a lower crank shaft 4 by connecting rods 5. The cylinders 2 are generally V-shaped and comprise an upper section 6 and a lower section 7 diverging respectively upwardly and downwardly and integrally joined at the apex of the V to form a continuous open-ended cylinder.

The cylinders are preferably water-cooled and to this end the cylinders are suitably jacketed thus providing cooling passages substantially surrounding the cylinders as indicated at 9, 9', and 9''. A relatively large air chamber, generally indicated at 8, substantially surrounds the upper cylinder section 6 and is adapted to supply air thereto through a plurality of ducts 10 terminating in preferably equally spaced radial ports 11.

The lower section 7 is provided with a plurality of preferably equally spaced radial exhaust ports 13 communicating with an exhaust manifold 14 encircling the section 7 by radial ducts 15 which progressively increase in area from the section walls to the manifold. The relatively large manifold 14 together with the progressively enlarged ducts 13 leading thereto accelerates the exhaustion of gases from the cylinders.

The upper and lower sections of the cylinder 1 are similarly bored, being provided with a bore 16 extending a major portion of the section length, a coaxial bore 17 of substantially the piston diameter, terminating in a coaxial crowned portion conforming to the crown of the piston.

The combustion chamber 12 is provided with a thick wall adapted to have a fuel injection element 20 rigidly mounted therein and progressively decreases in cross-sectional area from the said wall to a point diametrically opposite. A relatively great turbulence will be imparted to a combustible mixture, first due to the longitudinal impetus given to the incoming charge, and secondly, due to the convergent lateral squeezing toward the fuel injection element 20 as the charge is compressively confined within the combustion chamber 12 by the piston.

I preferably provide liners 21 having a circular flange 22 which are press-fitted within the upper section 6 with the flange 22 seating upon a suitably machined face 23 of the section. The liner is provided with intake ports aligned with and complementary to the ports 11 to ensure a minimum of frictional resistance to the ingress of air. The lower section 7 is provided with liners 24 generally similar to the liners 21 with the exception that the ports therein are in alignment with the exhaust ports 13.

Lubricant is supplied to the cylinders through aligned apertures in the liners and section walls, generally indicated at 25, and adapted to communicate with a lubricating system, preferably of the forced feed type.

In operating the engine, the incoming charge of air is drawn through the intake ports 11 and performs the dual function of scavenging the burnt gases which remain in the cylinders and completely filling the cylinders with a fresh charge of air. The air is then forced into the combustion chamber 12 by the pistons. The pistons are preferably so disposed that the upper piston lags about 1.8° behind the lower piston, the exhaust ports thus being uncovered prior to the intake ports being covered before the intake ports are closed. The exhaust intake ports are preferably substantially equally spaced from the combustion chamber 12. When the upper piston is at substantially the top of the compression stroke, the air is sufficiently compressed to have attained fuel firing temperature and a charge of fuel is injected by the element 20 and the ensuing expansion of the gas forces the pistons in opposite directions. The pistons will thus substantially balance each other and eliminate to a large extent the vibration and lack of balance encountered in a single-piston type cylinder.

The connecting rods 5 are preferably journaled on a common crank 40 of the crank shaft, thus permitting the use of a relatively shorter and less expensive crank shaft.

Air is supplied to the intake ports by means of a relatively large air chamber which substantially surrounds the upper cylinders, the air preferably being supplied to the air chamber from a rotor impeller blower so that it reaches the chamber in the form of an undulating stream, and the pressure being so synchronized with the piston cycle as to enter the cylinder at the peak pressure of the supply. This means that a maximum volume of pressure of air may be supplied to the cylinder with a minimum of compressive effort due to the undulating shape of the air stream.

Referring to Fig. 3, I have shown a modification of my invention wherein the cylinders are substantially similar to those described in connection with Figs. 1 and 2 but are disposed in a common plane and a connecting rod 31 having a yoked head 32 which engages a crank 33 on either side of an intermediately disposed head 34 of a connecting rod 35. The operation of the engine is as previously described, but by having the cylinders disposed in a diamond-shaped arrangement in a common plane, a more compact motor having a relatively shorter crank shaft may be built.

The upper crank shaft 3 and the lower crank shaft 4 are preferably joined by a train of gears comprising a pinion 36 integral with upper crank shaft 3, gear 37 meshing with pinion 36 and also a gear 38, the gear 38 in turn meshes with a gear 39 integral and co-axial with the lower crank shaft 4. The upper and lower crank shafts are thus synchronized and power may be taken from either crank shaft, and/or any of the intermediate gears. I have preferred to illustrate my invention with a Diesel type internal combustion engine, but it is understood that it is equally applicable to any engine in which the pistons are actuated by the expansion or explosion of gas.

Although I have shown and described embodiments of my invention, I contemplate that numerous and extensive departures may be made therefrom without departing from the spirit and scope of my invention and the appended claims.

I claim:

1. In a multi-cylinder internal combustion engine, two parallel crank shafts, a cylinder structure comprising a pair of cooperating members adapted to be secured together and forming a closed air chamber therebetween extending longitudinally of the engine, each of said cylinder structure members having a generally V-shaped cylinder therein, the cylinders of the two cylinder structure members being disposed in generally diamond formation outwardly of said longitudinally extending chamber, each of said V-shaped cylinders being provided with inlet and outlet ports, and communicating ducts joining said longitudinally extending chamber and the inlet port in each of said cylinders and air pump means

supplying air under pressure to said longitudinally extending chamber.

2. In a multi-cylinder internal combustion engine, two parallel crank shafts, a cylinder structure comprising a plurality of pairs of generally V-shaped cylinders disposed in generally diamond formation with the axes of each of the V legs intersecting the axis of a different one of said crank shafts, the cylinder structure having a chamber positioned therein between a pair of the V legs of the cylinders and extending longitudinally of the engine, each of said V-shaped cylinders being provided with inlet and outlet ports, and communicating ducts leading from said longitudinally extending chamber to the inlet ports in each of the cylinders.

3. In a multi-cylinder internal combustion engine, two parallel crank shafts, a cylinder structure comprising a pair of cooperating members adapted to be secured together and forming a chamber therebetween extending longitudinally of the engine, each of said cylinder structure members having a generally V-shaped cylinder therein, the cylinders of the two cylinder structure members being disposed in generally diamond formation outwardly of said longitudinally extending chamber, each of said V-shaped cylinders being provided with inlet and outlet ports, means for supplying air to said inlet ports, said means comprising manifolds individual to each of said cylinder structure members, and a manifold common to both of said cylinder structure members, said longitudinally extending chamber constituting the common manifold.

4. In a multi-cylinder internal combustion engine, a pair of parallel crank shafts, a cylinder structure comprising a plurality of pairs of generally V-shaped cylinders disposed in generally diamond formation with the axes of each of the V legs intersecting the axis of a different one of said crank shafts, the cylinder structure having a chamber positioned therein between a pair of the V legs and extending longitudinally of the engine, each of said V-shaped cylinders being provided with intake ports and outlet ports and means for supplying air to said inlet ports, said means comprising a manifold individual to each of the pairs of the V-shaped cylinders and a manifold common to both of the pairs of V-shaped cylinders, the longitudinally extending chamber constituting the common manifold.

5. In a multi-cylinder internal combustion engine, a pair of parallel crank shafts, a cylinder structure comprising a plurality of pairs of generally V-shaped cylinders disposed in generally diamond formation with the axes of each of the V legs intersecting the axis of a different one of said crank shafts, the cylinder structure having a chamber positioned therein between a pair of the U legs and extending longitudinally of the engine, each of said V-shaped cylinders being provided with inlet ports and outlet ports, and means for supplying air to said inlet ports, said means comprising a manifold individual to each of the pairs of V-shaped cylinders and positioned outwardly of the cylinder and a manifold common to both of the pairs of V-shaped cylinders, the longitudinally extending chamber constituting the common manifold.

6. In a multi-cylinder internal combustion engine, a pair of parallel crank shafts, a cylinder structure comprising a plurality of pairs of generally V-shaped cylinders disposed in generally diamond formation with the axes of each of the V legs intersecting the axis of a different one of said crank shafts, the cylinder structure having a chamber positioned therein between a pair of the V legs and extending longitudinally of the engine, each of said cylinders being provided with radially spaced inlet ports and outlet ports and an air supply chamber encircling said inlet ports and means for supplying air to said inlet ports, said means comprising manifolds individual to each of the pairs of V-shaped cylinders and a manifold common to both of the pairs of the V-shaped cylinders, the individual manifolds and the common manifold each communicating with the chambers surrounding the cylinder inlet ports.

7. In a multi-cylinder internal combustion engine, a pair of parallel crank shafts, a cylinder structure comprising a plurality of pairs of generally V-shaped cylinders disposed in generally diamond formation with the axes of each of the V legs intersecting the axis of a different one of said crank shafts, the cylinder structure having a chamber positioned therein between a pair of the V legs and extending longitudinally of the engine, each of said V-shaped cylinders being provided with radially spaced inlet ports, an air supply chamber encircling said inlet ports, means for supplying air to said inlet ports, said means comprising manifolds individual to each of the pairs of V-shaped cylinders in a manifold common to both of the pairs of V-shaped cylinders, the individual manifolds each communicating with the chambers surrounding the inlet ports of the cylinders of one of the pairs, the common manifold communicating with the chambers surrounding the inlet ports on both of the pairs, the individual manifolds each communicating with the common manifold through the chambers surrounding the cylinder inlet ports.

8. In a multi-cylinder internal combustion engine, a pair of parallel crank shafts, a cylinder structure comprising a plurality of pairs of generally V-shaped cylinders disposed in generally diamond formation with the axes of each of the V legs extending generally toward a different one of said crank shafts, the cylinder structure having a chamber positioned therein between a pair of the V legs and extending longitudinally of the engine, each of said V-shaped cylinders being provided with intake ports and outlet ports and means for supplying air to said inlet ports, said means comprising a manifold individual to each of the pairs of V-shaped cylinders and a manifold common to both of the pairs of V-shaped cylinders, the longitudinally extending chamber constituting the common manifold.

9. In a multi-cylinder internal combustion engine, a pair of parallel crank shafts, a cylinder structure comprising a plurality of pairs of generally V-shaped cylinders disposed in generally diamond formation with the axes of each of the V legs extending generally toward a different one of said crank shafts, the cylinder structure having a chamber positioned therein between a pair of the V legs and extending longitudinally of the engine, each of said V-shaped cylinders being provided with inlet ports and outlet ports and means for supplying air to said inlet ports, said means comprising a manifold individual to each of the pairs of V-shaped cylinders and positioned outwardly of the cylinder and a manifold common to both of the pairs of V-shaped cylinders, the longitudinally extending chamber constituting the common manifold.

10. In a multi-cylinder internal combustion engine, a pair of parallel crank shafts, a cylinder

structure comprising a plurality of pairs of generally V-shaped cylinders disposed in generally diamond formation with the axes of each of the V legs extending generally toward a different one of said crank shafts, the cylinder structure having a chamber positioned therein between a pair of the V legs and extending longitudinally of the engine, each of said cylinders being provided with radially spaced inlet ports and outlet ports, and an air supply chamber encircling said inlet ports and means for supplying air to said inlet ports, said means comprising manifolds individual to each of the pairs of V-shaped cylinders and a manifold common to both of the pairs of the V-shaped cylinders, the individual manifolds and the common manifold each communicating with the chambers surrounding the cylinder inlet ports.

11. In a multi-cylinder internal combustion engine, a pair of parallel crank shafts, a cylinder structure comprising a plurality of pairs of generally V-shaped cylinders disposed in generally diamond formation with the axes of each of the V legs extending generally toward a different one of said crank shafts, the cylinder structure having a chamber positioned therein between a pair of the V legs and extending longitudinally of the engine, each of said V-shaped cylinders being provided with radially spaced inlet ports, an air supply chamber encircling said inlet ports, means for supplying air to said inlet ports, said means comprising manifolds individual to each of the pairs of V-shaped cylinders in a manifold common to both of the pairs of V-shaped cylinders, the individual manifolds each communicating with the chambers surrounding the inlet ports of the cylinders of one of the pairs, the common manifold communicating with the chambers surrounding the inlet ports on both of the pairs, the individual manifolds each communicating with the common manifold through the chambers surrounding the cylinder inlet ports.

12. In a multi-cylinder internal combustion engine, two parallel crank shafts, a cylinder structure comprising a plurality of pairs of generally V-shaped cylinders disposed in generally diamond formation with the axes of each of the V legs extending generally toward a different one of said crank shafts, the cylinder structure having a chamber positioned therein between a pair of the V legs of the cylinders and extending longitudinally of the engine, each of said V-shaped cylinders being provided with an inlet and an outlet port, and the inlet ports in each of the cylinders communicating with said longitudinally extending chamber.

FRANK BALLOU STEARNS.