G. F. MURPHY.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 12, 1907.

984,695.

Patented Feb. 21, 1911.

2 SHEETS—SHEET 1.

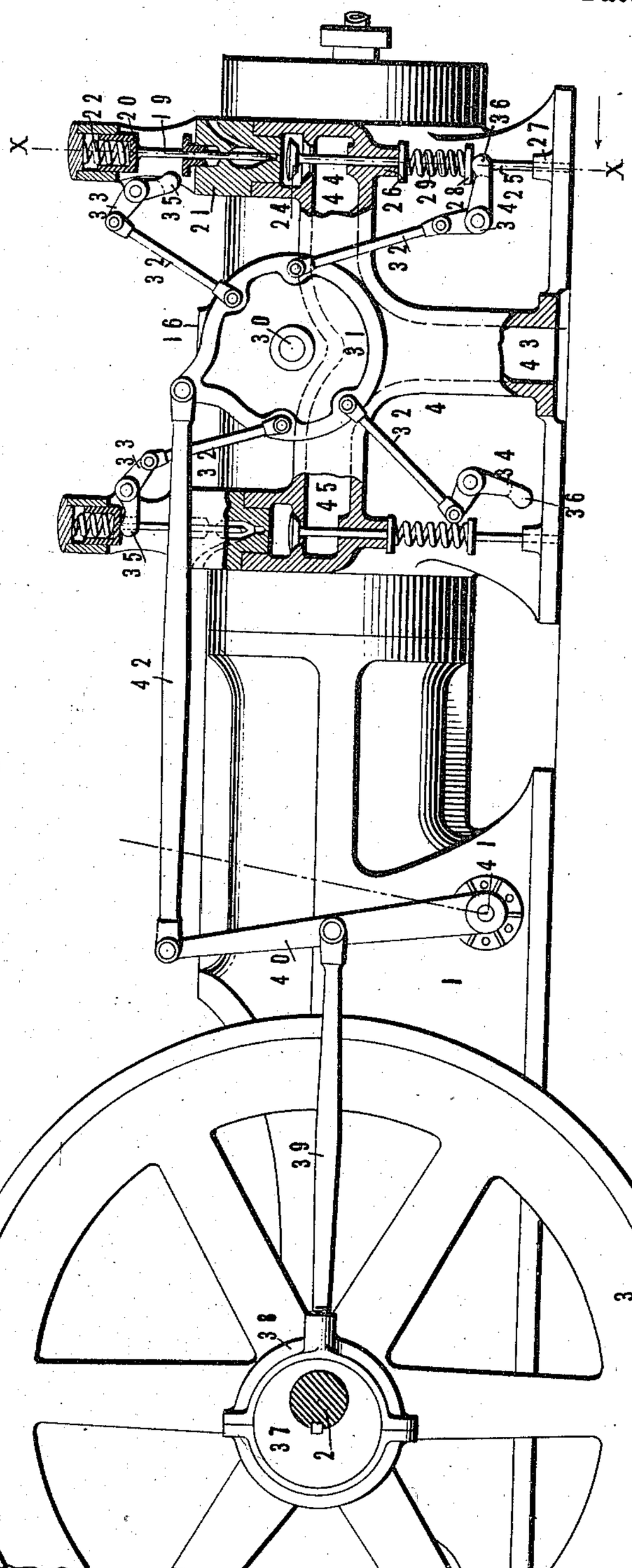

FIG. 1.

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2 SHEETS—SHEET 2.

Fig. 2.

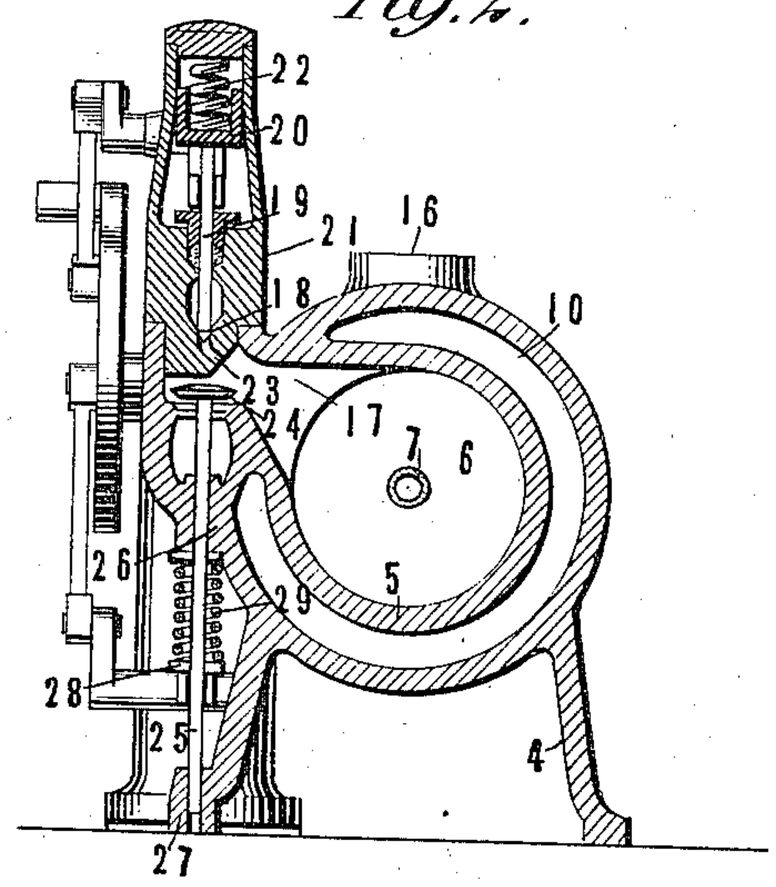
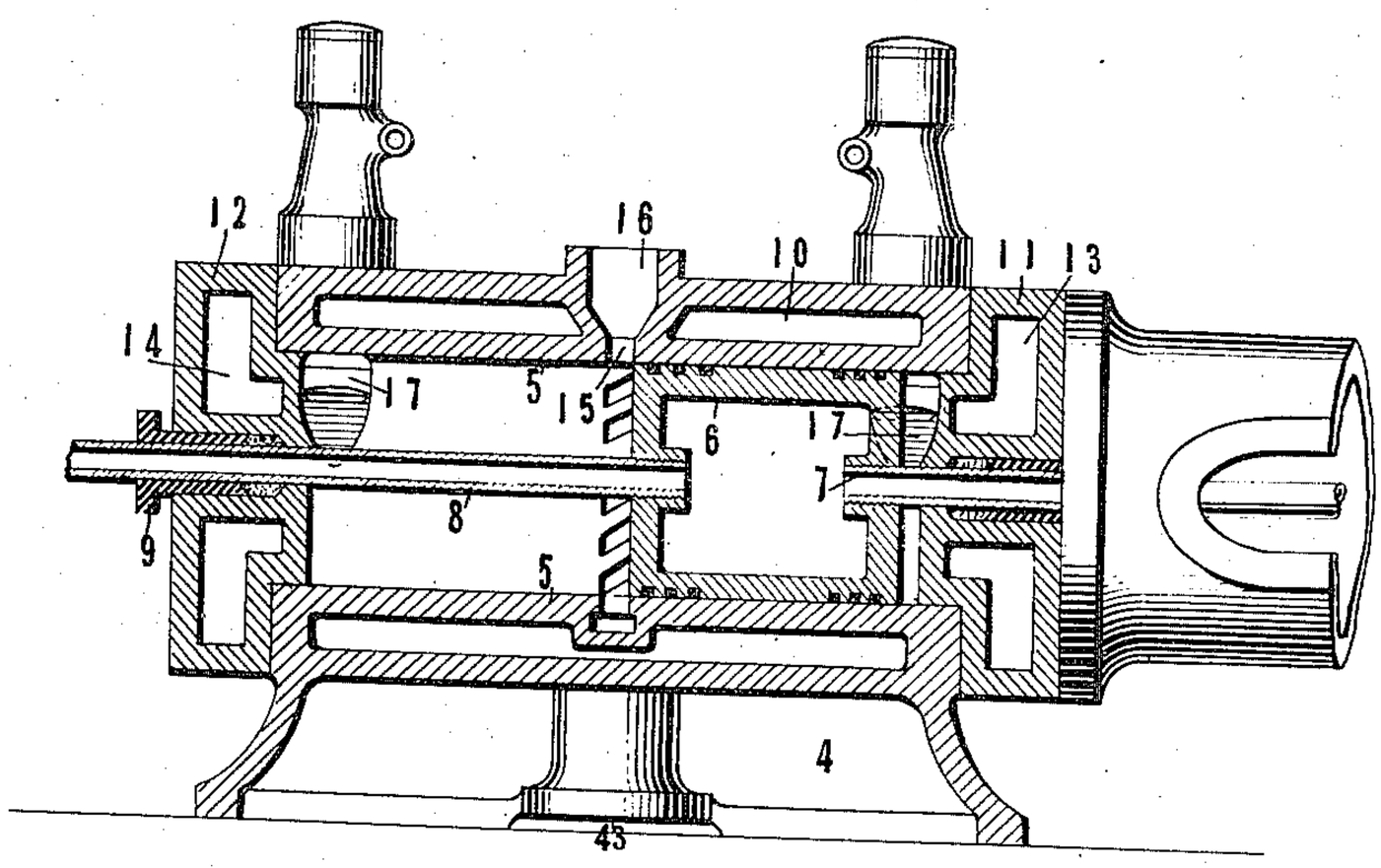


Fig. 3.



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INTERNAL-COMBUSTION ENGINE.

984,695. Specification of Letters Patent. Patented Feb. 21, 1911.

Application filed October 12, 1907. Serial No. 397,206.

To all whom it may concern:

Be it known that I, GEORGE F. MURPHY, residing at Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to internal combustion engines. One of the objects thereof is to provide a practical and reliable engine of the above type, characterized by high power and efficient action.

Another object is to provide an engine of this character in which ignition of the fuel is derived from the heat of compression.

Another object is to provide simple, compact and durable valve mechanism for an internal combustion engine.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings wherein is shown one of various possible embodiments of this invention, Figure 1 is a side elevation, certain parts being in section in order to show the construction more clearly. Fig. 2 is a transverse sectional view taken substantially along the line X—X of Fig. 1. Fig. 3 is a longitudinal sectional view taken through the center of the cylinder of the engine.

Similar reference characters refer to similar parts throughout the several views of the drawings.

As tending to cast light upon certain features of this invention and render them more readily and fully understood, it may here be noted that in the use of internal combustion engines the igniting means and the valve mechanism are found to be the most vulnerable parts. Spark plugs become quickly covered with soot or their circuits broken, and the valves are likely to fail to act with precision and certainty, and these features are among those which have retarded the broad commercial use of engines of this general type. It may also be noted that in the case of four cycle engines, and also to some extent in two cycle single acting engines, there is a resultant uneven torque on the crank shaft and a heavy balance wheel is almost necessarily employed. It may also be noted that in the use of two cycle engines, unless the cylinders are thoroughly cleaned or scavenged after each working stroke it may even, in some cases, prevent ignition.

The above and other defective features are eliminated and many positive advantages attained in constructions of the nature of the hereinafter described.

Referring now to Fig. 1 of the drawings, there is mounted upon any suitable bed, a casting or frame 1 having journaled therein the crank shaft 2 provided with a balance wheel 3. Also mounted upon the bed is a cylinder casting 4, the cylinder 5 being provided with a hollow piston 6 best shown in Fig. 3 of the drawings, from which a hollow piston rod 7 leads to the ordinary cross head, pitman and crank, by which connection is made with the crank shaft. A hollow rod or tube 8 passes rearwardly from piston 6 through a suitable stuffing box 9, and may lead to any desired source of cooling fluid. The cylinder itself is formed with a jacketing space 10, and its heads 11 and 12 are also provided with jacket water passages 13 and 14. It is to be understood that the water is led to these several passages as well as through the piston 6 by any desired form of hydraulic connections, the same not being herein shown, as they, in themselves, form no part of the present invention. It may here be noted that the rod 8 serves not only as a conduit for cooling fluid, but also aids in holding the piston in alinement and preventing any tendency of the same to bind or cut.

At the center of the cylinder are disposed a series of openings which collectively form an exhaust port 15 leading to an exhaust passage 16.

At each end of the cylinder is provided a recess or chamber 17 laterally offset, and

preferably substantially of the shape indicated in Figs. 2 and 3 of the drawings. It is to be understood that by the term "offset" is meant extending laterally with respect to the axis of the cylinder. Considering now the valves leading to these chambers which are substantially identical in construction at each end of the cylinder, there is, as shown in Fig. 2 of the drawings, a fuel valve 18 of a reciprocating type, having upon the upper end of its spindle 19 a cup 20 telescopically fitted within a casing or cap 21 mounted upon the cylinder casting 4. Within cup 20 and interposed between the same and the top of the casing 21 is a spring 22 normally urging the valve toward its seat, as shown in Fig. 2 of the drawings. From the valve seat, moreover, a passage 23 leads in a direction toward the axis or center line of the cylinder, whereby the fuel entering from the valve is thrown toward the center of the corresponding end of the cylinder, and thus readily mixed with the air therein as hereinafter described in detail. Immediately below valve 18 and likewise transversely disposed with respect to the cylinder is a valve 24 having its spindle 25 guided as at 26 and 27. Upon the spindle 25 is fixed a collar 28 and between this collar and the guide 26 and abutting against these parts, is a spring 29 tending to force the valve 24 against its seat. This valve, as hereinafter described, is adapted to admit air to the chamber 17 through which it passes to the cylinder 5, the walls of the chamber diverging toward the cylinder, as shown in Fig. 2, in order to diffuse the entering fluid more uniformly.

Turning now to Fig. 1 of the drawings, there is shown rotatably mounted upon the cylinder casting as at 30 a wrist plate 31, which is connected as by the several pivotal links 32 with corresponding pivotally mounted bell crank levers 33 and 34. The former of these levers are adapted to alternately engage the spindles of fuel valves 18 with their bifurcated ends 35 and raise the same, and the latter are similarly related through their bifurcated ends 36 to the spindles 25 of the valves 24.

Mounted upon the crank shaft 2 is an eccentric 37 from the eccentric strap 38 of which link 39 leads to a lever 40 pivoted as at 41 to the casting 1. From the upper or free end of this lever a link 42 leads to the wrist plate 31, and is adapted, upon the engine being operated, to oscillate this member and operate the several valves. It may here be noted that the above described parts are so formed and driven as alternately to actuate the valves 18 opening the same during the later stage of the compression at the corresponding end of the cylinder, and also to open alternately the air valves 24 at each end of the cylinder at a point of time approximating the end of the corresponding working stroke. These valves are also operated in such manner as to open the air valve at one end of the cylinder simultaneously with the opening of the fuel valve at the opposite end.

There is provided a common source of compressed air supply within the conduit 43 which branches as at 44 and 45 to the two valves 24, and it is to be understood that this source of supply is maintained in any desired manner, preferably by the use of a separate blower. It is also to be understood that the fuel is injected under high pressure, and preferably accompanied by high pressure air, into the cylinder at the end of compression.

In connection with the action of cylinder 5 and the parts associated therewith, it is to be noted that the several parts are so formed and driven as to carry the compression at each end to such a high extent that the compressed fluid, preferably air, will reach a temperature at or above that at which the preferred fuel will ignite, this action being facilitated by reason of conformation of the chambers 17 into which a considerable portion of the air is compressed. These chambers formed by the cylinder walls and piston as indicated at the left-hand of Fig. 3 of the drawings have all of their dimensions substantially greater than the length of the untraversed portion of the cylinder, by which is meant the shortest distance between the piston and adjacent cylinder head at the end of the stroke. The compressed fluid will thus retain its heat more readily than if it were confined merely in the substantially flat space remaining between the piston and the corresponding head of the cylinder. This of course is due to the fact that a sphere possesses a maximum volume for its surface, and any space approximating a sphere will, to a corresponding degree, approximate this condition of minimum radiating surface for the volume of its contents. The provision of chambers of this nature is of peculiar value in a double-acting, two cycle, compression to ignition engine as the large amount of liquid fuel to be evaporated and ignited requires an economical use of the available heat and the accurate timing of explosions and scavenging air would be interfered with if there were a large loss of heat to the cylinder walls and piston varying with the temperatures of these parts.

In order to avoid the chance of ambiguity in the meaning of certain terms used throughout this description and the following claims, it may here be noted that the expression "wrist plate" is broadly used as designating any rocking member or its equivalent, and that by the term "ignition temperature" is meant such a point of temperature as will cause ignition of the de-

sired type of fuel. The term "charge" is also used in a broad sense as designating any fluid which may be contained in a cylinder, whether the same be pure air or a mixture of air with a vapor, gas or other fluid.

The operation of the above described embodiment of this invention is substantially as follows: Assuming that the piston be in the position indicated in Fig. 3 of the drawings, the compression will have reached such a stage as to bring the temperature above the ignition point, and the corresponding fuel valve 18 is opened by wrist plate 31, which permits the fuel to be forced into the chamber 17, and to some extent into the cylinder itself. This fuel, which is preferably blown under pressure as above noted and thus to some extent sprayed into the compression space, immediately takes fire, and upon burning acts in conjunction with the reactive effect due to the air already compressed to give the energy for the return stroke of the piston. It is to be noted that the flaring conformation of the combustion chamber substantially fits the jet of liquid fuel sprayed into the same, and, hence, this fuel is instantly mingled in a substantially uniform manner with the body of heated air into which it is injected. The valve admitting the fuel is preferably held open for an appreciable period and the fuel thus continuously burned, in my preferred construction, throughout a portion of the working stroke. By reason of this action, together with the expansive force of the highly compressed air, there is provided a pressure upon the piston which is approximately uniform throughout a considerable portion of the working stroke, as distinguished from the highly irregular pressure of an essentially explosive engine, and a corresponding increase in efficiency is gained. Upon its approaching the end of this working stroke, the piston 6 uncovers the exhaust port 15 and permits the burned gases to exhaust. Simultaneously with this action the corresponding air valve 24 is opened and air is blown under pressure through the chamber 17 and throughout the effective length of this end of the cylinder passing out through the common exhaust port 15. This air is of sufficient volume and is so directed as to thoroughly cleanse the cylinder of any remaining burned gases and entirely fill this end of the cylinder with pure air so that upon the piston returning to such extent as to cut off the exhaust and start compression, it is pure air only that is compressed. This air is compressed to ignition temperature as above described, and the above cycle of operations repeated. At the opposite end of the cylinder the valves 18 and 24 perform similar functions, and the exhaust, as well as the discharged air passes out through the same exhaust port 15. These several valves moreover are so operated as alternately to supply fuel to each end of the cylinder at precisely the desired stage of compression, and substantially simultaneously with this admission of fuel air is admitted to clean or scavenge the opposite end of the cylinder.

It may here be noted that although certain features of this invention are of broader application, nevertheless one of the leading aims is to provide a two cycle double acting engine of this type, and for this reason, in my preferred construction, one of the fuel valves is opened at each stroke of the engine, thus providing two impulses or working strokes for each revolution of the fly-wheel.

It will thus be seen that there is provided an engine in which the torque is substantially even and continuous, due, not only to the fact that there is a working stroke for each stroke of the piston, but that the fuel is burned rather than exploded, thus resulting in a high degree of uniformity of pressure throughout the stroke, as above noted. It will also be seen that the several parts are simple, durable and reliable, and that their action is accurate and certain. The entire engine is of low first cost, and low cost of maintenance, and is well adapted to withstand the severe conditions of practical use.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein disclosed and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention what I claim as new and desire to secure by Letters Patent is:—

1. In an internal combustion engine, in combination, a cylinder, a piston in said cylinder, power transmitting means connected with said piston and driven therefrom, said cylinder, piston and last means being formed and proportioned to compress a charge in each end of said cylinder to ignition temperature, a source of compressed air supply, means adapted to lead air from said source of supply to said cylinder, a pair of valves adapted to spray fuel into the ends of said cylinder, a wrist plate, and means connected with said wrist plate and adapted upon the same being oscillated to open each of said valves alternately prior to the end of the corresponding compression

stroke and substantially simultaenously with the admission of air from said source of supply to the opposite end of the cylinder.

2. In an internal combustion engine, in combination, a cylinder, a piston in said cylinder, power-transmitting means connected with said piston and driven therefrom, said cylinder, piston and last means being formed and proportioned to compress a charge in each end of said cylinder to ignition temperature, a pair of fuel valves adapted to supply fuel to the ends of said cylinder subsequent to the earlier stages of the compression therein, a source of compressed air supply, a pair of valves adapted to open communication between the ends of said cylinder and said source of compressed air supply, a wrist plate, said several valves being positioned in a direction transverse to said cylinder, bell crank levers operatively related to said valves, and links connecting said levers and said wrist plate whereby said valves are operated upon said wrist plate being oscillated.

3. In an internal combustion engine, in combination, a cylinder, a piston in said cylinder, power-transmitting means connected with said piston and driven therefrom, said cylinder and piston forming an offset chamber at each end of said cylinder, and said cylinder, piston and driven means being formed and proportioned to alternately compress charges within said chambers to ignition temperature, means adapted to spray fuel into said chambers, and means adapted to render operative said spraying means at each end during the later stages of the corresponding compression, all of the dimensions of said chamber being greater than the length of the untraversed portion of said cylinder.

4. In an internal combustion engine, in combination, a cylinder, a piston in said cylinder, power-transmitting means connected with said piston and driven therefrom, said cylinder, piston and last means being formed and proportioned to compress a charge at one end of said cylinder to ignition temperature, means forming a chamber offset from said cylinder and in communication therewith within which the charge is compressed, means adapted to spray fuel into said chamber, and means adapted to render operative said spraying means during the later stages of said compression, the walls of said chamber being formed to diverge, one from another, in a direction toward said cylinder.

5. In an internal combustion engine, in combination, a cylinder, a fuel valve co-acting with said cylinder, an air valve co-acting with said cylinder, an eccentric driven from said cylinder, and means connected with said eccentric and adapted upon being driven therefrom in one direction to open said air valve and upon being driven therefrom in the opposite direction to open said fuel valve.

6. In an internal combustion engine, in combination, a cylinder, two pair of valves each comprising an air valve and a fuel valve and each pair of which is adapted to co-act with one end of said cylinder, a wrist plate mounted upon said cylinder, separate springs tending to force said valves against their seats, means connected with said wrist plate adapted upon the same being oscillated to open said air valves alternately and adapted to open said fuel valves substantially simultaneously with the time of opening of the air valve at the opposite end of the cylinder, and means adapted to oscillate said wrist plate.

7. In an internal combustion engine, in combination, a cylinder, a pair of fuel-valves coacting with opposite ends of said cylinder, separate springs urging said valves toward their closed conditions, means adapted to lead scavenging air to said cylinder, and common means adapted to open said valves at each end of the cylinder substantially simultaneously with the admission of air at the opposite end, said valves being mounted to move in a direction transverse to said cylinder.

8. In an internal combustion engine, in combination, a cylinder, a piston in said cylinder, power transmitting means connected with said piston and driven therefrom, said cylinder, piston and last means being formed and proportioned to compress a charge at each end of said cylinder to ignition temperature and to form a flaring chamber having all its dimensions less than the diameter of the cylinder into which chamber the charge is compressed, means adapted to spray fuel into said chambers, and means adapted to lead scavenging air to the cylinder.

9. In an internal combustion engine, in combination, a cylinder, a piston in said cylinder and forming with said cylinder a chamber at each end thereof, all of the dimensions of said chambers being greater than the shortest distance from said piston to the adjacent cylinder head at the end of the stroke, power transmitting means connected with said piston and driven therefrom, said cylinder, piston and driven means being formed and proportioned to alternately compress charges within said chambers to ignition temperature, means adapted to alternately spray fuel into said chambers, and means adapted to lead scavenging air to said cylinder.

10. In an internal combustion engine, in combination, a cylinder, a piston in said cylinder and forming with said cylinder a chamber at each end of the cylinder, all of the dimensions of said chambers being

greater than the shortest distance from said piston to the adjacent cylinder head at the end of the stroke, power transmitting means connected with said piston and driven therefrom, said cylinder, piston and driven means being formed and proportioned to alternately compress charges within said chambers to ignition temperature, means adapted to lead scavenging air to said cylinder, and means adapted to spray fuel alternately into said chambers substantially at the same time as scavenging air is admitted at the opposite end.

11. In an internal combustion engine, in combination, a cylinder, a piston in said cylinder and forming with said cylinder an expanded chamber at each end thereof, power transmitting means connected with said piston and driven therefrom, said cylinder, piston and driven means being formed and proportioned to alternately compress charges within said chambers to ignition temperature, means adapted alternately to spray fuel into said chambers, and means adapted to lead scavenging air to said cylinder, said chambers being formed at one side of the cylinder adjacent the corresponding fuel spraying means.

In testimony whereof I affix my signature, in the presence of two witnesses.

GEORGE F. MURPHY.

Witnesses:
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H. M. SEAMANS.