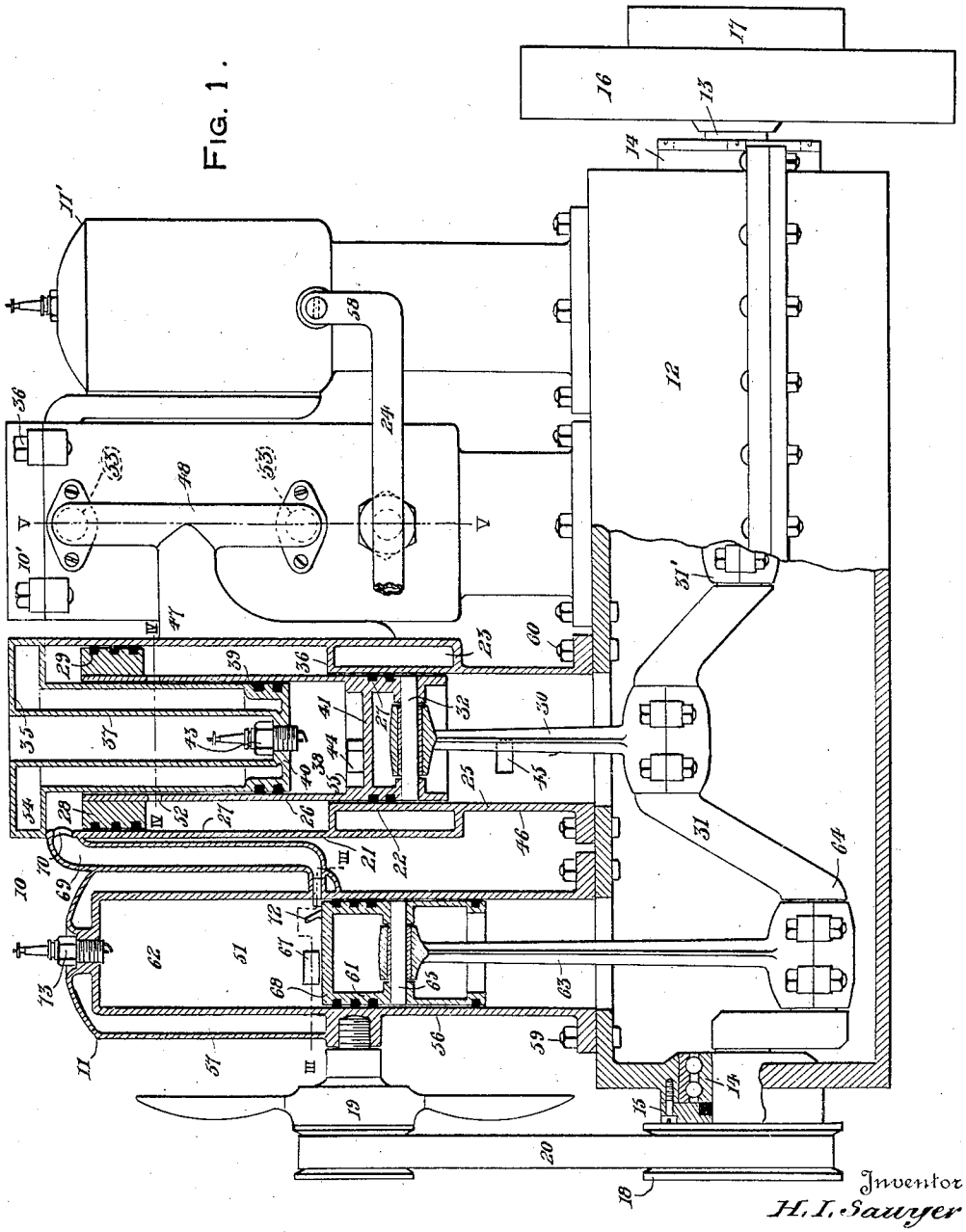
H. I. SAWYER, DEC'D.
F. OLESON, ADMINISTRATOR.
TWO-CYCLE GAS MOTOR.
APPLICATION FILED FEB. 19, 1920.

1,360,689.

Patented Nov. 30, 1920.
3 SHEETS—SHEET 1.

FIG. 1.



Inventor
H. I. Sawyer

By T. O. Bynum.
Attorney

H. I. SAWYER, DEC'D.
F. OLESON, ADMINISTRATOR.
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3 SHEETS—SHEET 2.

FIG. 2.

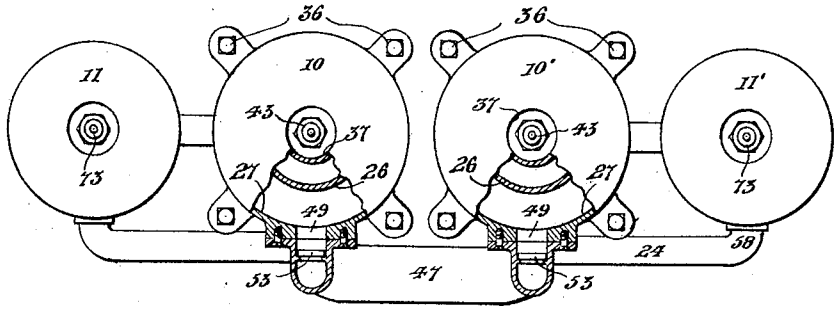


FIG. 5.

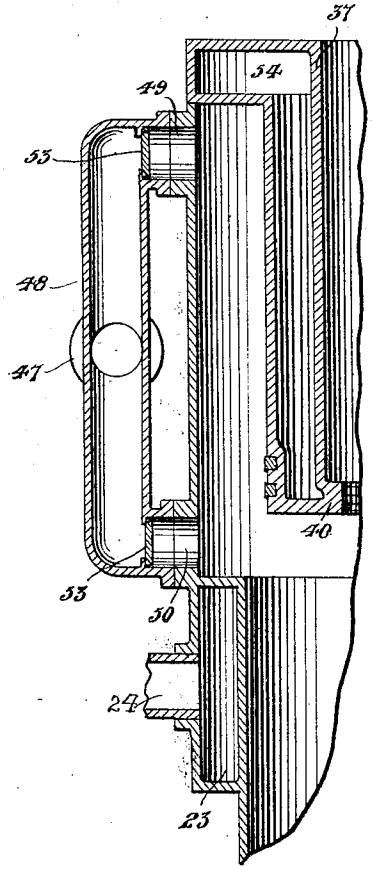
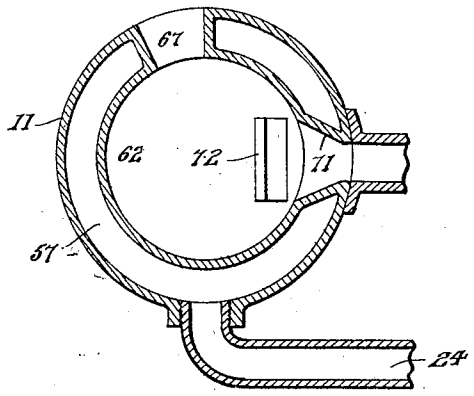


FIG. 3.



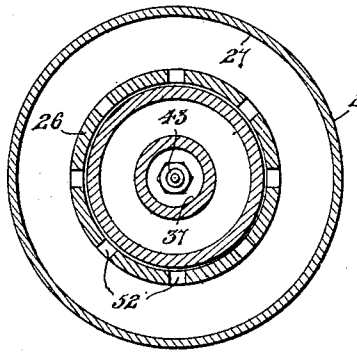


FIG. 4.

Inventor
H. I. Sawyer

By T. O. Bryant
Attorney

H. I. SAWYER, DEC'D.
F. OLESON, ADMINISTRATOR.
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3 SHEETS—SHEET 3.

FIG. 6.

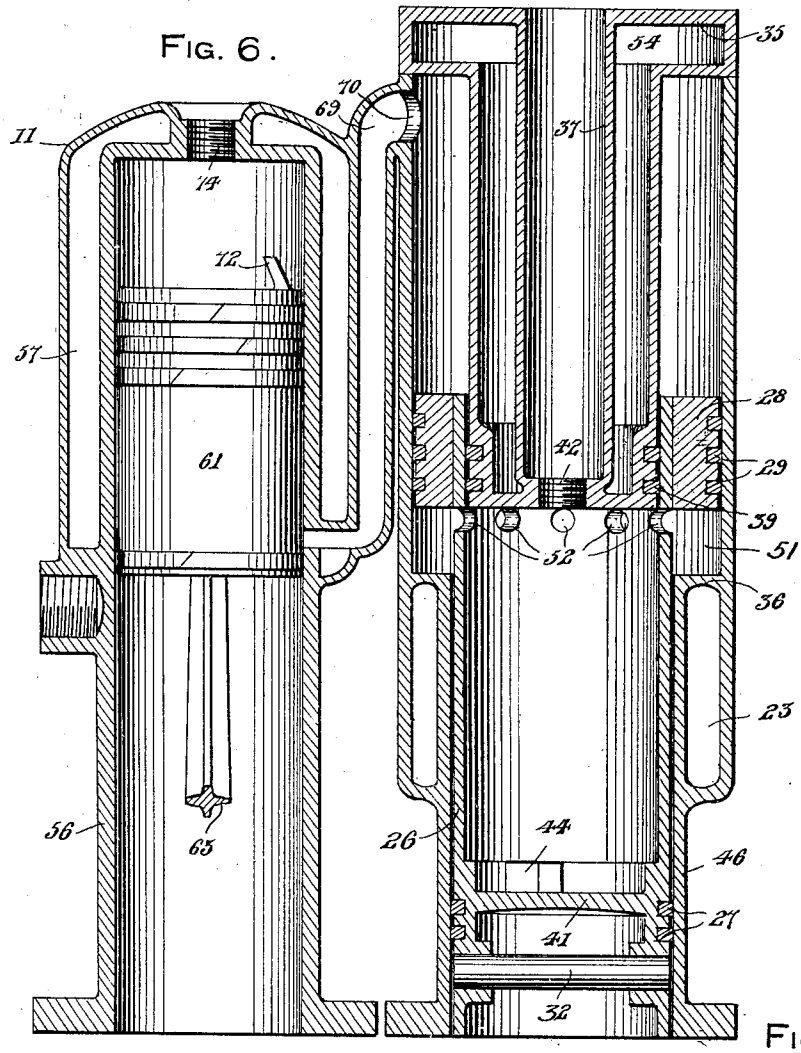
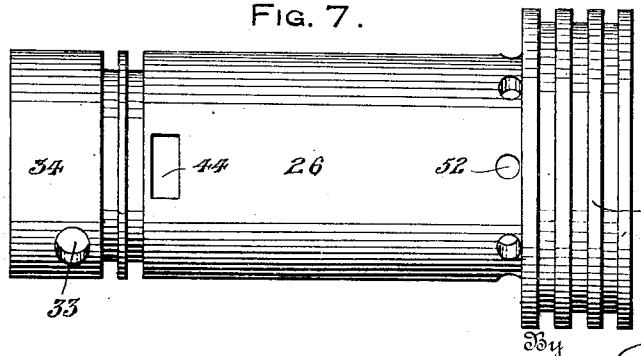
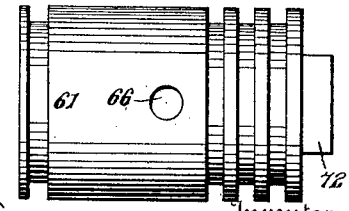


FIG. 8.

FIG. 7.





Inventor
H. I. Sawyer

By

Attorney

UNITED STATES PATENT OFFICE.

HOWARD I. SAWYER, OF POMEROY, WASHINGTON; FRANK OLESON, ADMINISTRATOR OF SAID HOWARD I. SAWYER, DECEASED, ASSIGNOR TO H. I. S. MOTOR CORPORATION, OF POMEROY, WASHINGTON, A CORPORATION OF WASHINGTON.

TWO-CYCLE GAS-MOTOR.

1,360,689. Specification of Letters Patent. **Patented Nov. 30, 1920.**

Application filed February 19, 1920. Serial No. 359,763.

To all whom it may concern:

Be it known that I, HOWARD I. SAWYER, a citizen of the United States of America, residing at Pomeroy, in the county of Garfield and State of Washington, have invented certain new and useful Improvements in Two-Cycle Gas-Motors, of which the following is a specification.

The primary object of the invention is the provision of an internal combustion engine or gas motor of the two-cycle type that is noiseless in operation, possesses great strength and may be constructed of any desired size with any number of pairs of cylinders.

A further object of the invention is the provision of explosive motor employing cooperating pairs of cylinders without valves, valve gears or cam shaft and capable of operation in either direction desired, the construction being inexpensive to manufacture and proving a strong light-weight power plant.

With these general objects in view, the invention consists of the novel combination and arrangement of parts hereinafter more fully described in connection with the accompanying drawings and in which like reference characters designate corresponding parts throughout the several views.

In the drawings,

Figure 1 is a view of the motor illustrating one pair of cylinders in side elevation and the forward pair of cylinders in vertical longitudinal section,

Fig. 2 is a top plan view thereof partially broken away,

Figs. 3 and 4 are enlarged horizontal transverse sectional views taken upon lines III—III and IV—IV, respectively, of Fig. 1,

Fig. 5 is a vertical sectional view taken upon line V—V of Fig. 1,

Fig. 6 is a vertical sectional view of the forward pair of cylinders upon an enlarged scale with the pistons at the opposite extremities of their strokes from that shown in Fig. 1 and with parts removed,

Fig. 7 is an elevational view of the piston employed with the main cylinders, the packing rings being removed and Fig. 8 is a similar view of one of the pistons employed with the auxiliary cylinders.

It will be understood at the outset that my motor contemplates the provision of one or more pairs of cylinders, herein termed main and auxiliary cylinders such as 10 and 11, respectively, the same being preferably mounted upon a two-part crank case 12 with a crank shaft 13 journaled in end bearings 14 longitudinally of said crank case 12. The main bearings 14 are provided with suitable packing glands 15 with a fly-wheel 16 upon the shaft 13 at one end of the motor and a suitable clutch 17 adjacent the fly-wheel. A pulley 18 upon the opposite end of the shaft 13 drives the fan 18 carried by the adjacent cylinder 11 by means of the usual connecting belt 20.

The construction of main cylinders 10 being identical, one of the same will be now described and thereafter the description of one of the auxiliary cylinders 11 will be set forth as well as the coöperation of the two cylinders of a pair in the motor construction. The main cylinder 10 comprises a tubular portion 21 with an annular water jacket 22 forming a waist line, the chamber 23 of the water jacket communicating with a water supply pipe 24 at one side of the motor adapted to connect with a suitable source of water supply not herein illustrated.

This manner of arrangement provides a contracted bore 25 in the lower part of the cylinder 10 for the reception of the reciprocating piston 26 having packing rings 27 slidably engaging the inner wall of said reduced bore 25. The bore 27 of the cylinder 10 above the water jacket 22 is the full diameter of the cylinder and within which the upper enlarged end or head 28 of the piston 26 reciprocates with similar packing rings 29 rendering gas-tight the sliding engagement of said head 28 with the inner face of the bore 27. A piston rod 30 connects the wrist 31 of the crank shaft 13 with the transverse pin 32 carried through perforations 33 in the lower portion or bottom 34 of the piston 26.

A cup-shaped head 35 is secured to the top of the casing 21 by bolts 36 and projects axially within the enlarged bore 27 to a point slightly spaced above the top or shoulder 36 of the water jacket 22, said inwardly projecting portion 37 of the head 35 being positioned within the chamber 38 of the piston 26. Packing rings 39 are provided upon the periphery of the inner end 40 of said head

portion 37 for slidable contact by the adjacent wall of the tubular piston 26 and it will be apparent from Fig. 1 of the drawings that the piston 26 may reciprocate within the casing 21 with the chamber 38 between the inner end 40 of the head portion 37 and the bottom disk 41 of the piston 26 forming a main and explosion chamber 38 for the main cylinder. A spark plug opening 42 in the head end 40 receives a usual form of spark plug 43 while an exhaust port 44 through the side of the piston 26 adjacent the bottom disk 41 thereof effects communication between the explosion chamber 38 and an exhaust port 45 through the lower portion 46 of the main cylinder casing when the piston 26 is at the lower extremity of its stroke as illustrated in Fig. 6 of the drawings.

An intake manifold 47 receiving combustion mixture from a carbureter, not shown, communicates by means of a branch pipe 48 with intake ports 49 and 50 leading into the enlarged bore 27 of the casing 21 at points above and below the piston head 28 respectively. The upward or return stroke of the piston 26 draws explosive mixture through the inlet port 50 to the compression chamber 51 between the jacket top 36 and the piston head 28 while the downward movement of the piston 26 upon its power stroke compresses the explosive mixture within the chamber 51 forcing the same through side ports 52 in the piston 26 adjacent its head 28 and into the main explosion chamber 38 when the piston 26 has sufficiently lowered to uncover the ports 52 below the bottom 40 of the head 35. At such times, the compressed explosive mixture is entering the explosion chamber 38 through ports 52 from the compression chamber 51 and the products of combustion are passing through the exhaust ports 44 and 45 to the atmosphere. Check valves 53 are provided for the inlet ports 49 and 50 within the adjacent ends of the branch pipe 48 permitting entrance of the explosive mixture but automatically closing the same for preventing any return of the explosive mixture when placed under compression by the piston head 28. The upward movement of the piston 26 compresses the charge within the explosion chamber 38 and at a suitably timed moment, the spark from the plug 43 ignites the charge and the explosion lowers the piston 26 upon its power stroke imparting rotation to the power shaft 13 through the piston rod 30 and wrist 31.

The head 35 is formed hollow with a water space 54 therein for cooling the head and it will be seen that the spark plug 43 may be readily inserted or removed through the passage 37 to the head 35 by any suitable instrument, not shown. A thicker portion 55 is provided in the piston 26 adjacent the bottom disk 41 thereof through which the exhaust port 44 extends. The auxiliary cylinder 11 comprises a tubular casing 56 having a water jacket 57 surrounding the upper portion thereof communicating with a branch pipe 58 of the water supply pipe 24 while bolts 59 connect the auxiliary cylinder 11 upon the top of the crank case 12 in a manner identical to the securing of the main cylinders 10 thereon by the bolts 60.

A piston 61 reciprocates within the bore 62 of the casing 56 being connected by a piston rod 63 with a wrist portion 64 of the power shaft 13 and with a transverse pin 65 extending through perforations 66 in the sides of said piston 61. An exhaust port 67 through the side of the cylinder 11 is opened above the top 68 of the piston 61 when said piston is lowered as shown in Fig. 1, the said exhaust port 67 being closed during the upward compression stroke of the piston 61.

A supply pipe 69 leads from the compression chamber 51 of the cylinder 10 at a point above the piston head 28 for conducting compressed explosive mixture from the chamber 51 through the port 70 to a flaring inlet port 71 in the adjacent sides of the auxiliary cylinder 11. This inlet port 71 is positioned to be uncovered when the piston 61 is lowered as illustrated in Fig. 1 of the drawings whereby the explosive mixture under compression enters the explosion chamber 62 of the cylinder 11 striking against the inclined baffle plate 72 carried by the top 68 of the piston 61 and upwardly deflecting the incoming charge so as to be unaffected by the spent gases exhausting through the port 67.

A spark plug 73 is provided in the opening 74 provided therefor in the top of the auxiliary cylinder 11 and it will be understood that the upward return stroke of the piston 61 compresses the charge within the chamber 62 and the spark occurring at the plug 73 at a suitably timed moment explodes the charge lowering the piston 61 upon its power stroke and imparting an impulse to the power shaft 13.

The complete operation of my motor will be understood from this detailed description of one unit thereof consisting of a pair of cylinders including a main and an auxiliary cylinder such as 10 and 11, respectively. The wrists 31 and 64 upon the shaft 13 for the adjacent cylinders 10 and 11 are oppositely positioned so that an explosion occurring upon each downward or working stroke of the pistons 26 and 61 provides two impulses at diametrically opposite points during each revolution of the shaft 13. The provision of another pair of cylinders such as the main cylinder 10′ and auxiliary cylinder 11′ of the same construction and operat-

ing in the same manner may have their respective pistons, not shown, connected to intermediately positioned diametrically opposite wrists 31′ upon the shaft 13. It will be understood, however, that the motor may be formed of one or any number of pairs of main and auxiliary cylinders for providing a six or eight cylinder motor or any greater multiple of two cylinders desired.

This construction of compressing arrangement for the explosive mixture drawn into the main cylinder 10 from the intake manifold 47 obviates the necessity of tappet valves or cam operated fluid controlling means as ordinarily provided in an explosive motor and while the structure is rendered more simple and inexpensive to manufacture, it is positive in operation, possesses great strength and requires little attention and few repairs. The charges for both the motor explosion chamber 38 and auxiliary explosion chamber 62 are compressed and forced therein by the piston head 28, the explosion mixture entering said cylinders when the entrance ports 52 and 71 respectively are opened while the upward strokes of the pistons 26 and 61 further compress the charge for ignition and explosion during the alternate operation of the main and auxiliary cylinders of the pair or unit of the motor plant. While the form of the invention herein set forth and described is believed to be the preferable embodiment thereof, it will nevertheless be understood that minor changes may be made therein without departing from the spirit and scope of my invention as claimed.

What is claimed as new is:

1. A motor comprising a main and auxiliary cylinder, oppositely reciprocating pistons within said cylinders adapted for compressing the explosive charges of said cylinders respectively upon the return strokes of the pistons, the piston of the main cylinder having a tubular portion provided with inlet ports uncovered when said main piston is at the limit of its power stroke, an annular head upon said main piston outwardly of said ports and inlets for explosive mixture entering the main cylinder at opposite sides of the limits of movement of said piston head whereby the power stroke of the main piston is adapted for compressing and feeding the charge to the main explosion chamber and the return stroke of the main piston is adapted for compressing a charge for the explosion chamber of the auxiliary cylinder.

2. A motor comprising a main and auxiliary cylinder, oppositely reciprocating pistons within said cylinders adapted for compressing the explosive charges of said cylinders respectively upon the return strokes of the pistons, the piston of the main cylinder having a tubular portion provided with inlet ports uncovered when said main piston is at the limit of its power stroke, an annular head upon said main piston outwardly of said ports and inlets for explosive mixture entering the main cylinder at opposite sides of the limits of movement of said piston head whereby the power stroke of the main piston is adapted for compressing and feeding the charge to the main explosion chamber and the return stroke of the main piston is adapted for compressing a charge for the explosion chamber of the auxiliary cylinder, a cup-shaped head upon the main cylinder extending inwardly of the tubular portion of the main piston with a spark plug receiving opening at its inner end opposite the bottom of the main piston, said main piston and main cylinder having exhaust ports adapted for alinement when the main piston is at the limit of its power stroke.

3. A motor comprising a main and auxiliary cylinder, opposite reciprocating pistons within said cylinders adapted for compressing the explosive charges of said cylinders respectively upon the return strokes of the pistons, the piston of the main cylinder having a tubular portion provided with inlet ports uncovered when said main piston is at the limit of its power stroke, an annular head upon said main piston outwardly of said ports and inlets for explosive mixture entering the main cylinder at opposite sides of the limits of movement of said piston head whereby the power stroke of the main piston is adapted for compressing and feeding the charge to the main explosion chamber and the return stroke of the main piston is adapted for compressing a charge for the explosion chamber of the auxiliary cylinder, a cup-shaped head upon the main cylinder extending inwardly of the tubular portion of the main piston with a spark plug receiving opening at its inner end opposite the bottom of the main piston, said main piston and main cylinder having exhaust ports adapted for alinement when the main piston is at the limit of its power stroke, communicating water jackets for said main and auxiliary cylinders, the auxiliary cylinder having an exhaust port adapted to be uncovered when the auxiliary piston is at the limit of its power stroke and an inclined baffle plate upon the auxiliary piston between said exhaust port and the inlet for the explosive charge during the exhausting and charging of the auxiliary cylinder.

4. A motor comprising a pair of main and auxiliary cylinders, a crank shaft, oppositely reciprocating pistons within said cylinders, connecting rods between said pistons and crank shaft, a cup-shaped head upon the main cylinder projecting inwardly of the main piston and having a spark plug opening at its inner end adjacent the bottom of the piston, an annular head upon the outer end of the piston between the inwardly pro-

jecting portion of the cylinder head and the outer wall of the main cylinder forming compression chambers for explosive mixture at both sides of the piston head within the main cylinder, the main piston having ports at one side of its piston head adapted for admitting a charge to the explosion chamber of the main cylinder when compressed by said piston head, a conduit between the explosion chamber of the auxiliary cylinder and the main cylinder at the opposite side of said piston head whereby an explosive charge is communicated to the auxiliary cylinder during the opposite reciprocation of the main cylinder head.

5. A motor comprising a pair of main and auxiliary cylinders, a crank shaft, oppositely reciprocating pistons within said cylinders, connecting rods between said pistons and crank shaft, a cup-shaped head upon the main cylinder projecting inwardly of the main piston and having a spark plug opening at its inner end adjacent the bottom of the piston, an annular head upon the outer end of the piston between the inwardly projecting portion of the cylinder head and the outer wall of the main cylinder forming compression chambers for explosive mixture at both sides of the piston head within the main cylinder, the main piston having ports at one side of its piston head adapted for admitting a charge to the explosion chamber of the main cylinder when compressed by said piston head, a conduit between the explosion chamber of the auxiliary cylinder and the main cylinder at the opposite side of said piston head whereby an explosive charge is communicated to the auxiliary cylinder during the opposite reciprocation of the main cylinder head, a branch supply pipe for explosive mixture entering the main cylinder at opposite sides of the limits of movement of the main piston head, check valves adjacent the opposite ends of said branch pipe adapted for preventing return of the explosive mixture to the branch pipe, water jackets for the main and auxiliary cylinders and water supply means communicating therewith.

6. A motor comprising a plurality of pairs of main and auxiliary cylinders, oppositely reciprocating pistons within the cylinders of each pair, communicating conduits between the interiors of the main and auxiliary cylinders of each pair, an annular head for the piston of each main cylinder, valved inlets for explosive mixture for each main cylinder at opposite sides of the limits of movement of the piston head thereof whereby a charge is received and compressed in the main cylinder for the auxiliary cylinder of each pair at one side of the head thereof and a charge is received and compressed at the other side of said head within and for each main cylinder, cup-shaped caps for the main cylinders projecting inwardly of the main pistons, spark plugs at the inner ends of said caps adjacent the bottoms of the main pistons, water jacketing means for the main and auxiliary cylinders and water supply means for said jackets.

In testimony whereof I affix my signature.

HOWARD I. SAWYER.