J. W. VAN METER.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED AUG. 7, 1919.

1,361,648.

Patented Dec. 7, 1920.

4 SHEETS—SHEET 1.

Fig. 1.

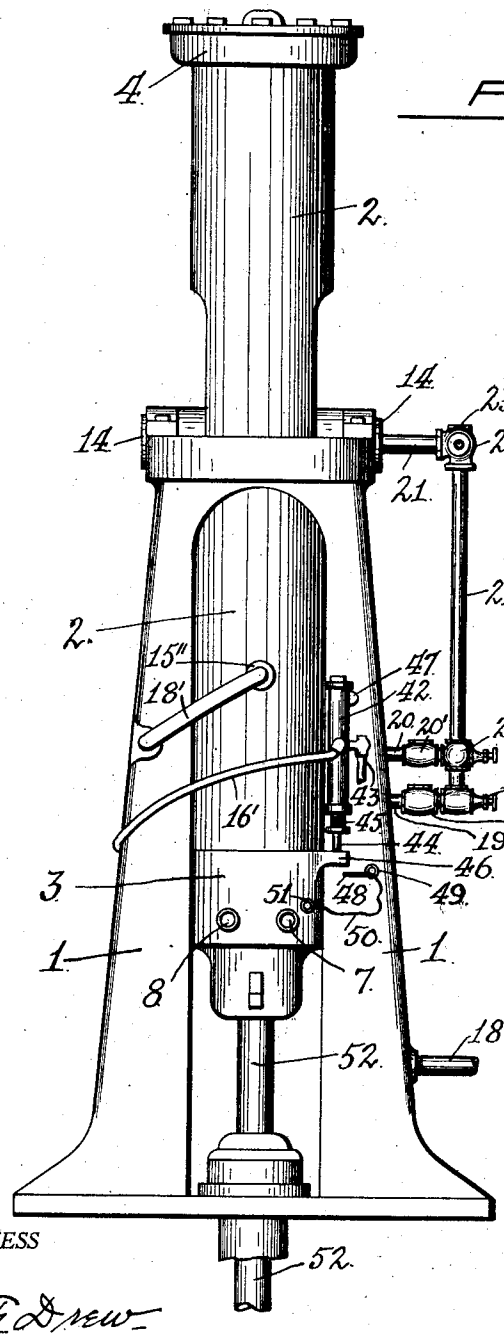
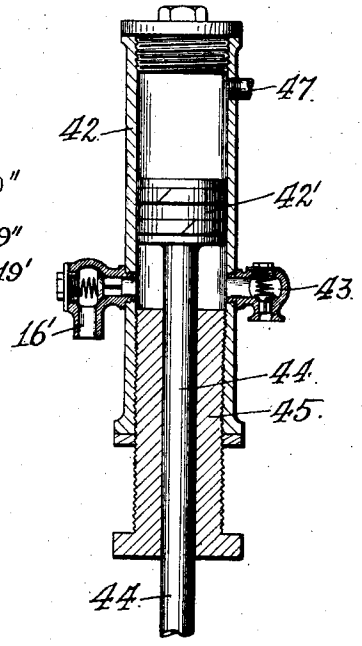


Fig. 5.



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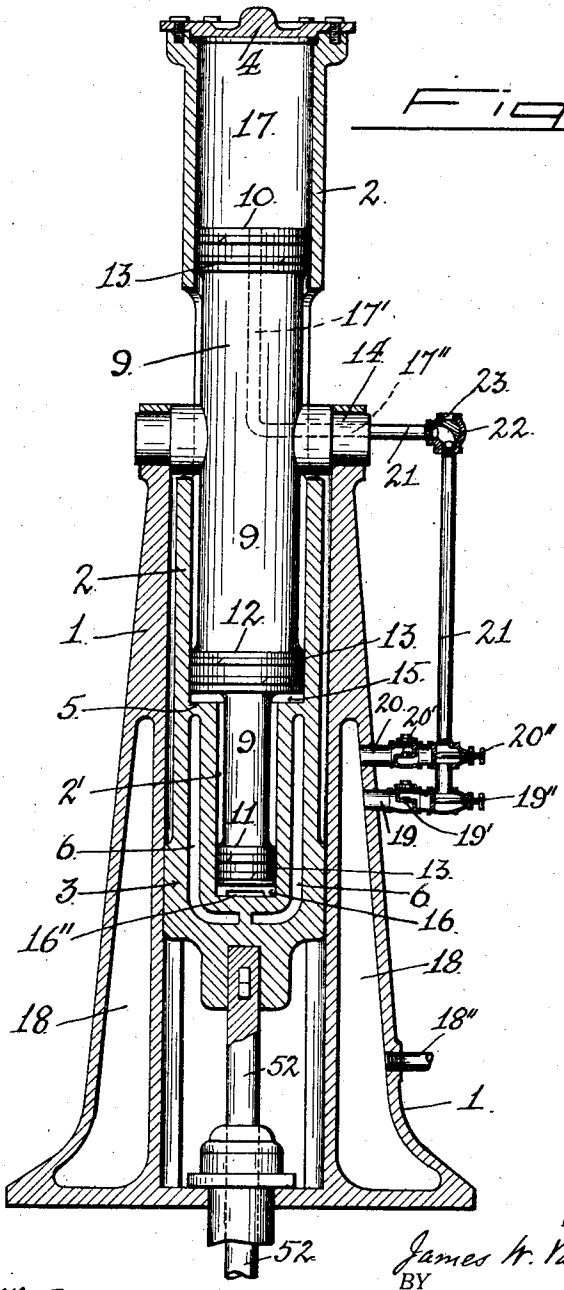
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4 SHEETS—SHEET 2.

Fig. 2.



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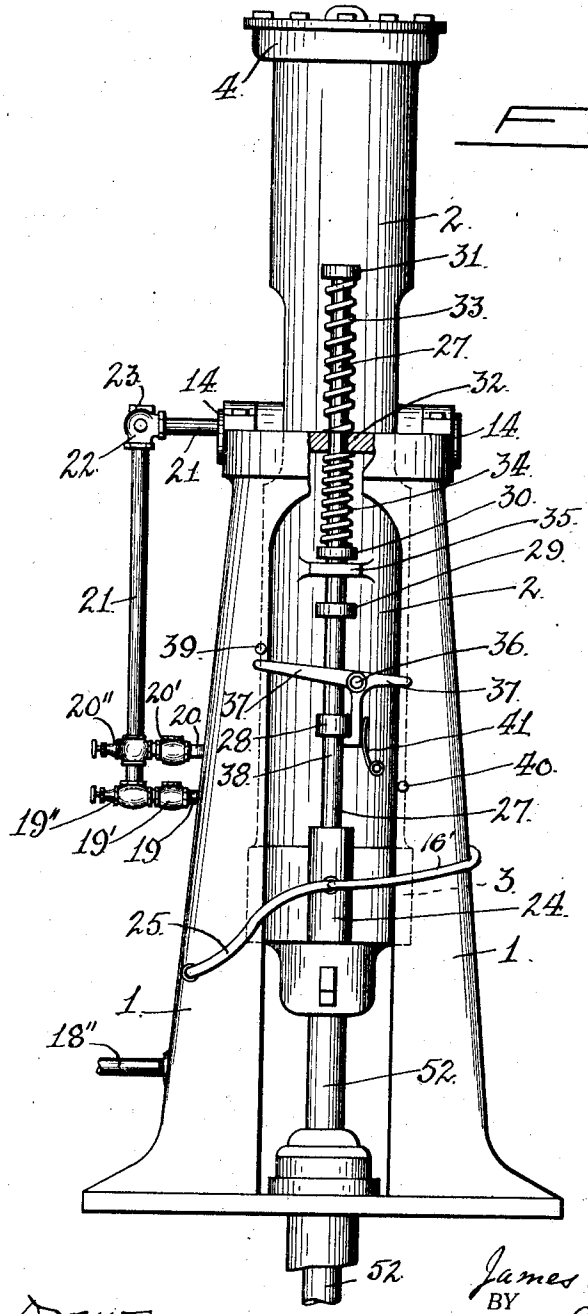
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4 SHEETS—SHEET 3.

Fig. 3.



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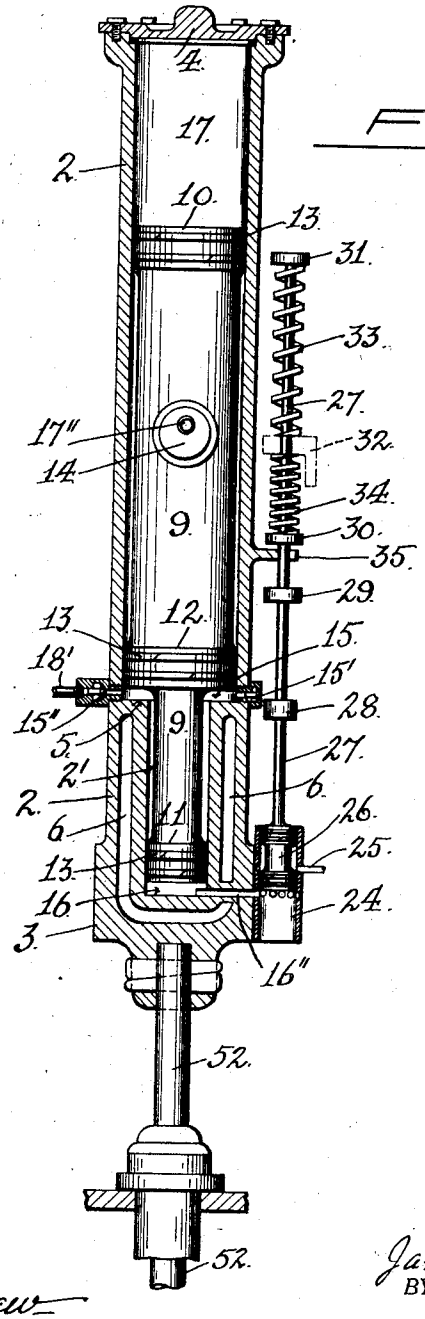
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4 SHEETS—SHEET 4.

Fig. 4.



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,361,648. Specification of Letters Patent. Patented Dec. 7, 1920.

Application filed August 7, 1919. Serial No. 315,839.

To all whom it may concern:

Be it known that I, JAMES W. VAN METER, a citizen of the United States, residing at the city and county of San Francisco 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 the class of internal-combustion-engines.

The object of my invention is to provide a simple, compact, and economical engine adapted for any purpose, but especially for use in connection with a machine or device to which the power of the engine is to be applied directly, as for example a direct connection of its reciprocative member with the reciprocating rod of a pump, or with the hammer of a pile driver.

To this end, my invention consists in the novel internal-combustion-engine, and in the construction, arrangement and combination of the parts thereof, as I shall hereinafter fully set forth in the following specification, and shall point out in the claims.

In the accompanying drawings, a form of my invention, which I deem the best, is illustrated, though it must be understood that, within the scope of my claims, changes in form, construction and arrangement may be made without departing from the invention.

In these drawings Figure 1 is an elevation of my engine.

Fig. 2 is a vertical section of the same.

Fig. 3 is an elevation of the same taken from the side opposite to that of Fig. 1.

Fig. 4 is a vertical section of the cylinder taken through the valve shell, the frame of the engine being omitted.

Fig 5 is a vertical section, enlarged, of the fuel pump and its connections.

1 is a base frame within which is fitted for reciprocative movement the cylinder 2, the lower portion 3 of which is exteriorly enlarged and forms a sliding fit and guide with the interior walls of the frame, 1.

The cylinder 2 projects from and reciprocates through the top of the frame, and the upper end of said cylinder is fitted with a head 4.

The bore of the cylinder 2, at its lower portion, is interiorly contracted as shown in Figs. 2 and 4 thus forming a reduced bore 2′ which joins the main bore at a shoulder 5. The lower portion of the cylinder is water-jacketed at 6, the water entering at 7 and discharging at 8 (Fig. 1) from suitable flexible connections, not shown. 9 is a piston upon and over which the cylinder 2 reciprocates.

This piston has three functioning heads indicated in Figs. 2 and 4 by 10, which is the upper one, 11, the lower one, and 12, the intervening one. These heads are fitted with packing rings 13, the upper head 10 and intervening head 12 being of the same diameter and fitting the larger portion of the cylinder bore, and the lower head 11, being of smaller diameter and fitting the smaller bore 2′ of the cylinder.

The piston 9 is fixed in position by a cross pin 14, seated in the top of the frame 1, said pin passing through the piston, the cylinder 2 being slotted over the pin.

Between the intervening head 12 of the piston and the internal shoulder 5 of the cylinder is formed an air cushion chamber 15.

Between the lower piston head 11 and the base of the cylinder bore 2′ is formed an explosion chamber 16.

Between the upper piston head 10 and the head 4 of the cylinder is formed a compressed air chamber 17.

Air to the cushion chamber 15 is admitted from the outer atmosphere through a valved port 15′ in the cylinder at one side (Fig. 4) and is discharged through a valved port 15″ at the other side, said port delivering into a flexible hose 18′ leading into a compressed air reservoir 18 in the frame 1, as presently described.

To the explosion chamber 16, fuel and compressed air forming an explosive mixture, are admitted through a duct 16″ in the cylinder wall (Fig. 4), the products of explosion being discharged through said duct as will be hereinafter described.

To and from the compressed air chamber 17, compressed air is admitted and discharged through a duct 17′ (Fig. 2) in the piston and its head 10, and a communicating duct 17″ in the piston cross pin 14.

By reference to Fig. 2, it will be seen that the frame 1 is formed with an internal reservoir 18 which is fitted with a charging connection 18″, by which it may be initially supplied and replenished with compressed air from any suitable source, not necessary to show. Replenishing of the

reservoir is also had by means of air compressed in and delivered from the cushion chamber 15 through the hose 18'.

With the reservoir communicates an outlet connection 19 fitted with an outwardly opening check valve 19' and with a regulating valve 19'', Figs. 2 and 1.

Also with the reservoir 18 communicates an inlet connection 20, fitted with an inwardly opening check valve 20' and with a regulating valve 20''.

Both connections 19 and 20 communicate with a pipe 21, the other end of which connects with the duct 17'' in the piston cross-pin 14.

In the upper portion of the pipe 21 is fitted a three way cock 22, adapted to close the pipe, or to open it to the duct 17'' or to vent the air through a port 23 at will.

Secured to the lower portion of the cylinder 2, Fig. 4, is an open-ended valve-shell 24, which communicates with the duct 16'' leading into the explosion chamber 16. Compressed air from the reservoir 18 in the frame 1, is admitted to this valve-shell by a flexible hose 25, Fig. 3, and fuel is also admitted to the valve shell by the flexible hose 16' (Figs. 1 and 3) which joins the hose 25.

Within the valve shell is fitted for reciprocative action an "hour-glass" piston valve 26, which by its movement, successively and timely controls the communication of said shell with the duct 16'' and also controls the joint communication of the compressed air hose 25 and the fuel hose 16' and the discharge of the products of combustion as will presently appear.

Rising from the piston valve 26 is a stem 27, which carries a collar 28, above which is a collar 29, with still another collar 30 above, and finally a top collar 31.

Between the top collar 31 and a stop 32 of the frame 1, is a spring 33. Between said frame stop 32 and the collar 30 is a spring 34.

Extending from the side of the cylinder 2 is a fixed stop 35 which lies between the collars 30 and 29 and serves in conjunction with said collars to define the stroke limits of the stem 27 and its piston valve 26.

Referring now to Fig. 3, there is pivoted to the cylinder 2 at 36, a T-shaped lever 37, the extremity of the leg of which is provided with a catch 38, adapted to engage the stem collar 28, either above or below, as the case may be, according to the relative position of the cylinder and valve stem.

According also to the relative position of the cylinder 2 and frame 1, one arm of the T-shaped lever 37 is adapted to make and break contact with a fixed stop 39 in the frame 1, and the other arm of said lever is adapted to make and break contact with another fixed stop 40 in said frame 1.

A spring 41 controls the T-shaped lever 37.

In Fig. 1, 42 is a pump secured to the frame 1. This pump has a valve-controlled inlet connection 43 with a source of liquid fuel, not shown. It has also the flexible discharge connection 16' with the air hose 25 of the valve shell 24, which latter communicates through the duct 16'' with the combustion chamber 16 as heretofore mentioned.

This pump is shown more in detail in Fig. 5. It has a piston 42' normally cutting off the passage of the fuel, and is provided with a downwardly projecting stem 44, passing through a stuffing gland 45. With the projecting end of this stem, a lug 46 on the cylinder is adapted to contact. The upper portion of the pump barrel, above the piston has a connection 47 with the compressed air reservoir in the fixed frame 1.

In Fig. 1 is indicated the electric and ignition system comprising the contact 48, contact 49, circuit wires 50 and spark plug 51 in the combustion chamber.

The switch is automatically operated by the lug 46 on the cylinder.

The connection 52 with the lower end of the cylinder, may indicate the rod of any machine or device, to which the power of the reciprocative cylinder of the engine is to be transmitted.

As I have herein illustrated my engine vertically disposed, I shall describe its operation in terms of vertical position, though it is to be understood that it may occupy a horizontal or any other position.

The operation of the engine is as follows:

Assume the cylinder to be at the limit of its downward stroke, and the valve-shell 24 primed with a charge of fuel, which priming may be conveniently done by a manual operation of the piston stem 44 of the fuel pump 42, and assume also the reservoir 18 in the frame 1 to be charged with compressed air. Both regulating valves 19'' and 20'' are now opened, and the compressed air from the reservoir 18 passes out through check valve 19', through regulating valves 19'' and 20'' pipe 21 and ducts 17'' and 17' into the chamber 17 in the top of the cylinder, above the uppermost head 10 of the fixed piston. Under the pressure of this air thus admitted to chamber 17 the cylinder 2 will rise. During this upstroke, the cylinder will compress the air in the cushion chamber 15 as its shoulder 5 approaches the piston head 12 and force said air out through the hose 18' into the reservoir 18. Also the lug 46 of the rising cylinder will, by contact with the rod 44 of the fuel pump 42, lift the pump piston 42' and draw into the pump, through connection 43, a fresh supply of fuel. Also during this stroke the spring 34 of the piston-valve stem 27 will be compressed by the collar 30 against the frame stop 32. Also the long arm of the T-shaped lever 37 will come in contact with the fixed frame stop 39 whereby the catch 38 of said lever will be

swung from under the collar 28 of the valve-stem. By thus releasing the catch 38, the compressed spring 34 forces down the valve-stem 27 and its piston valve 26 so that the valve now connects the air inlet hose 25 with the duct 16'' and thus compressed air from the reservoir 18 will pass into the combustion chamber 16, carrying with it the charge of fuel with which the valve-shell 24 had been primed initially. The lug 46 on the uprising cylinder 2, now contacts with the electric switch member 48 and closes the switch and the circuit to the spark-plug 51 and explodes the mixture in the combustion chamber.

Under the force of the explosion the cylinder 2 now moves on its down stroke, and the lug 46 descending, allows the piston 42' of the pump 42 to drive into the valve-shell 24, through the hose 16', a fresh charge of fuel. During this stroke it draws a fresh supply of air into the cushion chamber 15 and it forces the air from the upper chamber 17 back into the reservoir 18 through the inwardly opening check valve 20'. During this down stroke, also, the upper spring 33 of the valve stem 27 is compressed against the frame stop 32, and the short arm of the T-shaped lever 37, the leg-catch 38 of which had previously dropped in above the collar 28, to hold the valve stem down, comes in contact with the frame stop 40 whereby the catch 38 is swung back from above said collar 28, thereby allowing the compressed upper spring 33 to lift the valve stem 27 and its valve 26, the latter rising to a position to cut off the air inlet and open the duct 16'' to permit the exhaust gases from the combustion chamber to pass out through the open lower end of the valve-shell 24.

At the end of the down stroke, the compressed air from reservoir 18 again enters the upper chamber 17 and the operation is repeated.

The valve 19'' and 20'' are for regulating the speed, one regulating the upper and the other the down stroke.

I claim:

1. An internal combustion engine comprising a frame; a cylinder mounted in said frame for reciprocative movement relatively thereto, said cylinder at one end having a reduced bore; a piston fixed to the frame and fitted within the cylinder, said piston having a pair of spaced heads fitting the larger bore of the cylinder and forming, in conjunction with the ends of said larger bore, a pair of air chambers, said piston having also a third head fitting the reduced bore of the cylinders and forming, in conjunction with the base of said reduced bore, a combustion chamber; means for admitting air to one of said air chambers to form a cushion therein; means for supplying the other of said air chambers with compressed air and exhausting the same therefrom; means for supplying the combustion chamber with an explosive mixture; and means for exploding said mixture.

2. An internal combustion engine comprising a frame having a chamber forming a reservoir for compressed air; a cylinder mounted in said frame for reciprocative movement relatively thereto, said cylinder at one end having a reduced bore; a piston fixed to the frame and fitted within the cylinder, said piston having a pair of spaced heads fitting the larger bore of the cylinder and forming, in conjunction with the ends of said larger bore, a pair of air chambers, said piston having also a third head fitting the reduced bore of the cylinder and forming, in conjunction with the base of said reduced bore, a combustion chamber; means for admitting air to one of said air chambers to form a cushion and exhausting the same into the frame reservoir; check-valve controlled connections to and from the compressed air reservoir in the frame to and from the other of said air chambers; means for supplying the combustion chamber with an explosive mixture; and means for exploding said mixture.

3. An internal combustion engine comprising a frame having a chamber forming a reservoir for compressed air; a cylinder mounted in said frame for reciprocative movement relatively thereto, said cylinder at one end having a reduced bore; a piston fixed to the frame and fitted within the cylinder, said piston having a pair of spaced heads fitting the larger bore of the cylinder, and forming in conjunction with the ends of said larger bore, a pair of air chambers, said piston having also a third head fitting the reduced bore of the cylinder and forming, in conjunction with the base of said reduced bore, a combustion chamber; means for admitting air to one of said air chambers to form a cushion and exhausting the same into the frame reservoir; check-valve controlled connections to and from the compressed air reservoir in the frame to and from the other of said air chambers; means for regulating said connections; means for supplying the combustion chamber with an explosive mixture; and means for exploding said mixture.

4. An internal combustion engine comprising a frame having a chamber forming a reservoir for compressed air; a cylinder mounted in said frame for reciprocative movement relatively thereto, said cylinder having at one end a reduced bore; a piston fitted within the cylinder and fixed by a cross pin to the end of the frame, said piston having a pair of spaced heads fitting the larger bore of the cylinder and forming, in conjunction with the ends of said larger bore, a pair of air chambers, said piston having also a third head fitting the

reduced bore of the cylinder and forming, in conjunction with the base of said reduced bore, a combustion chamber; means for admitting air to one of said air chambers to form a cushion and exhausting the same into the frame reservoir; an air duct leading into the cross pin of the piston and through said piston and one of its heads into the other of said air chambers; a pipe communicating with said duct, valve controlled inlet and outlet connections between said pipe and the compressed air reservoir in the frame; means for supplying the combustion chamber with an explosive mixture; and means for exploding said mixture.

5. An internal combustion engine comprising a frame; a cylinder mounted in said frame for reciprocative movement relatively thereto, said cylinder at one end having a reduced bore; a piston fixed to the frame and fitted within the cylinder, said piston having a pair of spaced heads fitting the larger bore of the cylinder and forming, in conjunction with the ends of said larger bore, a pair of air chambers, said piston having also a third head fitting the reduced bore of the cylinder and forming in conjunction with the base of said reduced bore, a combustion chamber; means for supplying to and exhausting from one of said chambers a cushion of air; means for supplying to and exhausting from the other of said chambers, compressed air; means for supplying the combustion chamber with compressed air, comprising a connection from a source of compressed air, a valve shell carried by the cylinder, a valve in said shell controlling said connection, said valve having a stem, springs on the stem for reciprocating it and stops on the stem and fixed frame for automatically calling into operation said springs to move the valve in time with the cylinder strokes; means for supplying the combustion chamber with fuel to form with the compressed air an explosive mixture; and means actuated by the stroke of the cylinder for exploding said mixture.

6. In an internal combustion engine, the combination of a cylinder member and a piston member one movable relatively to the other, and forming a combustion chamber between them; means for introducing liquid fuel to said chamber; a connection with a source of compressed air to admit said air to said chamber in timely relation to the admission of the fuel; and means for automatically controlling said air connection comprising an open ended valve-shell carried by the movable member; a piston valve therein controlling the passage of the air through said shell, said valve having a stem, springs and coacting parts to reciprocate the stem and its valve by the movement of said member, a trip lever carried by said member to control the reciprocation of the valve-stem, fixed stops for automatically operating the trip lever; and an electric ignition system actuated by the movement of said member to explode the mixture of fuel and air in said combustion chamber.

7. In an internal-combustion-engine, the combination of a cylinder member and a piston member, one movable relatively to the other and forming between them a combustion chamber; means for introducing liquid fuel to said chamber, comprising a connection with a source of fuel, a barrel let into said connection, a piston to control the fuel passage through the barrel, a connection of said barrel with a source of compressed air to force the fuel therefrom into the combustion chamber, and means carried by the movable member to operate the piston; a connection from a source of compressed air to furnish said air to the combustion chamber in timely relation to the admission thereto of the fuel; means for automatically controlling said last named connection by the movement of the movable member; and an electric ignition system actuated by the movement of said member to explode the mixture of fuel and air in said combustion chamber.

8. An internal combustion engine, comprising a frame; a cylinder mounted in said frame for reciprocative movement relatively thereto and having at one end a reduced bore; a piston fixed to the frame and mounted in the cylinder, said piston having a pair of spaced heads fitting the larger bore of the cylinder and forming, in conjunction with the ends of said larger bore, a pair of air chambers, said piston having also a third head fitting in the reduced bore of the cylinder and forming, in conjunction with the base of said bore a combustion chamber; means for supplying to and exhausting from one of said air chambers, air to serve as a cushion; a connection to supply to and exhaust from the other of said air chambers compressed air; means to control and regulate said compressed air connection; a connection for admitting compressed air to the combustion chamber; means actuated by the movement of the cylinder to automatically control said last named connection; means operated by a compressed air connection for supplying liquid fuel to the combustion chamber; means operated by the movement of the cylinder to timely control the admission of the fuel with relation to the admission of the compressed air; and an electric ignition system actuated by the movement of the cylinder to explode the mixture of fuel and air in the combustion chamber.

9. An internal combustion engine, comprising a frame having an interior chamber forming a reservoir for compressed air; a cylinder mounted in said frame for reciprocative movement relatively thereto and hav-

ing at one end a reduced bore; a piston fixed to the frame and mounted in the cylinder, said piston having a pair of spaced heads fitting the larger bore of the cylinder and forming, in conjunction with the ends of said larger bore, a pair of air chambers, said piston having also a third head fitting in the reduced bore of the cylinder and forming, in conjunction with the base of said bore, a combustion chamber; means for supplying air to one of said air chambers to form a cushion and exhausting the same into the frame reservoir; a connection from the compressed air reservoir of the frame to supply to and exhaust from the other of said air chambers, compressed air; means to control and regulate said compressed air connection; a connection from said reservoir of the frame for supplying the combustion chamber with compressed air; means actuated by the movement of the cylinder to automatically control said last named connection; means for supplying liquid fuel to the combustion chamber; a connection from the compressed air reservoir of the frame to operate said fuel supply means; means operated by the movement of the cylinder to timely control the admission of the fuel with relation to the admission of the compressed air; and an electric ignition system actuated by the movement of the cylinder to explode the mixture of fuel and air in the combustion chamber.

10. In an internal combustion engine, the combination of a cylinder member and a piston member relatively movable, said members being formed to provide a pair of chambers one at each limit of the stroke of the movable member, and a third chamber beyond said pair of chambers; means for introducing an air cushion to one of said pair of chambers and compressed air to the other; means for introducing an explosive mixture to the third chamber; and means for exploding said mixture in said third chamber.

11. In an internal combustion engine, the combination of a cylinder member and a piston member relatively movable, said piston member having three spaced heads; means for introducing air under pressure between one end of the cylinder and one of the piston heads; means for introducing air to the cylinder between the other two piston heads to form a cushion; means for introducing an explosive mixture between the other end of the cylinder and the third head of the piston; and means for exploding said mixture therebetween.

12. In an internal-combustion-engine, the combination of a reciprocative cylinder; a fixed piston having three spaced heads; means for introducing air under pressure between one end of the cylinder and one of the piston heads; means for introducing air to the cylinder between the other two piston heads to form a cushion; means for introducing an explosive mixture between the other end of the cylinder and the third head of the piston; and means for exploding said mixture therebetween.

13. In an internal combustion engine, the combination of a frame having an interior reservoir for compressed air; a cylinder mounted and guided in said frame for reciprocative movement relatively thereto; a piston fixed to said frame and having three heads fitted in said cylinder; means for introducing air from the frame reservoir into the cylinder between one end thereof and one of the piston-heads; means for admitting air into the cylinder between the other two piston heads and exhausting the same into the frame reservoir; means for introducing air from the frame reservoir into the cylinder between its other end and the third piston head; means for introducing liquid fuel into said last named space; and means for exploding the mixed air and fuel in said space.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JAMES W. VAN METER.

Witnesses:
WM. F. BOOTH,
D. B. RICHARDS.