J. N. KIEFFER.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 29, 1909.

Patented Apr. 18, 1911.

989,984.

FIG. 1.

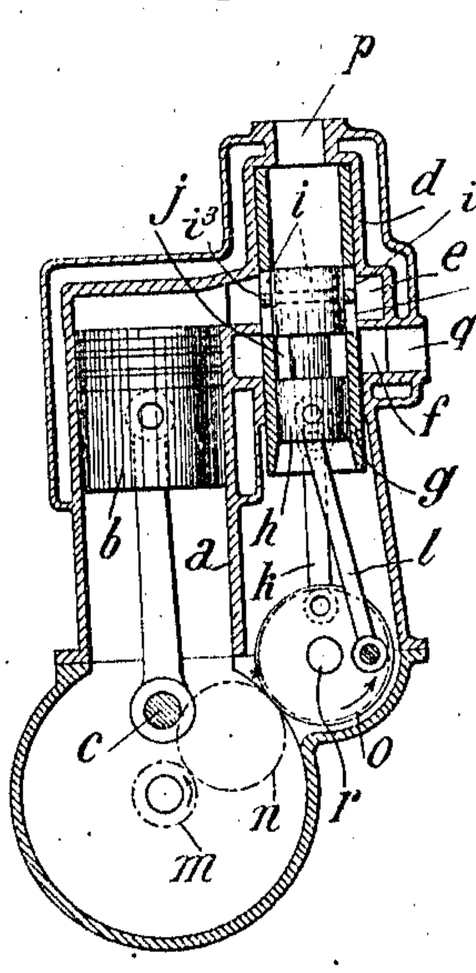


FIG. 2.

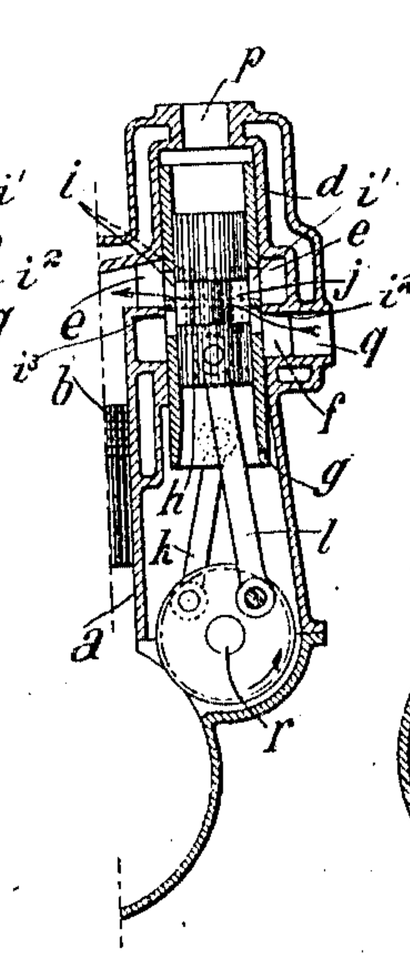


FIG. 3.

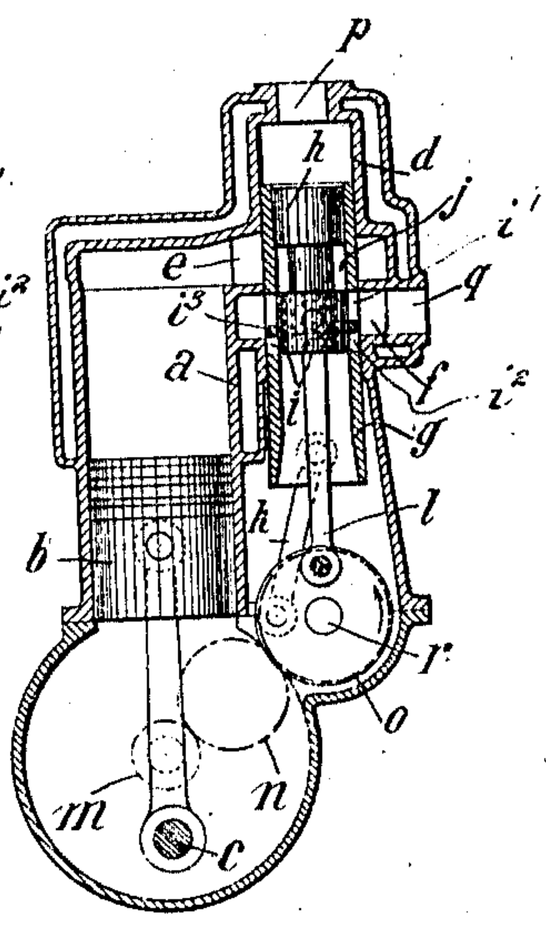


FIG. 4.

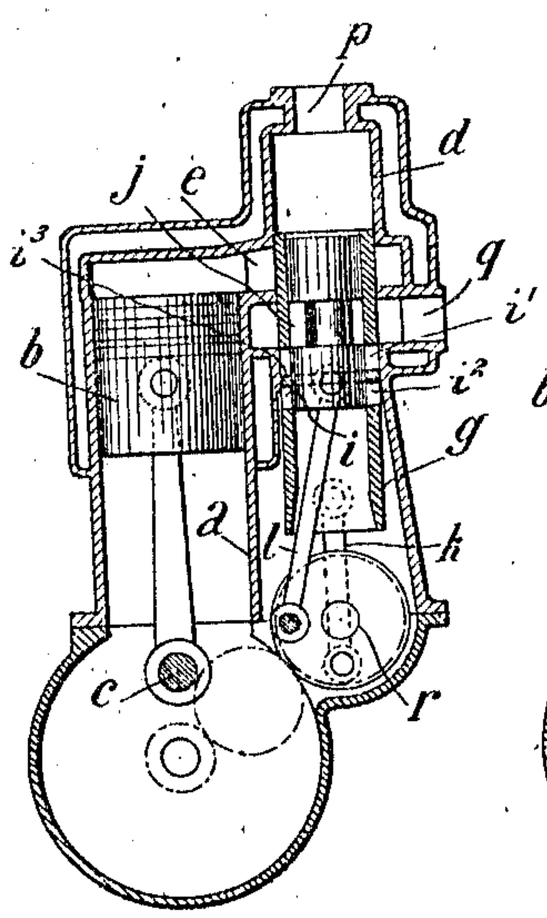


FIG. 5.

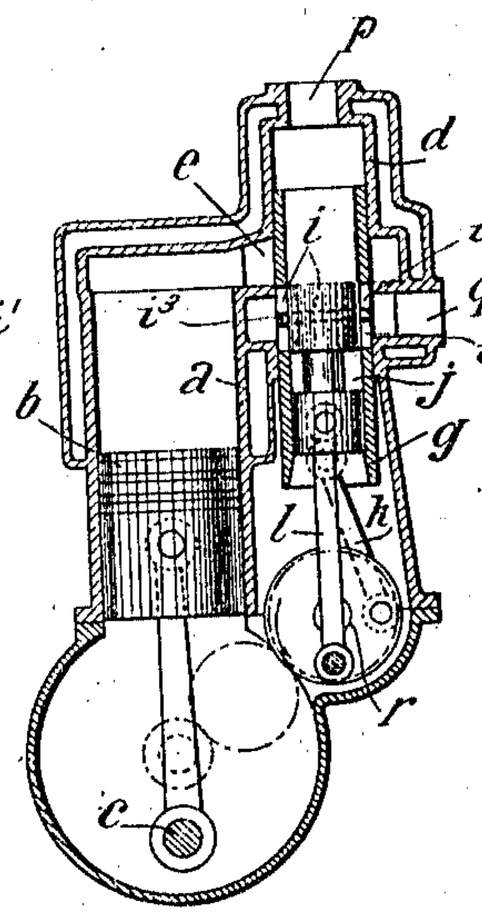
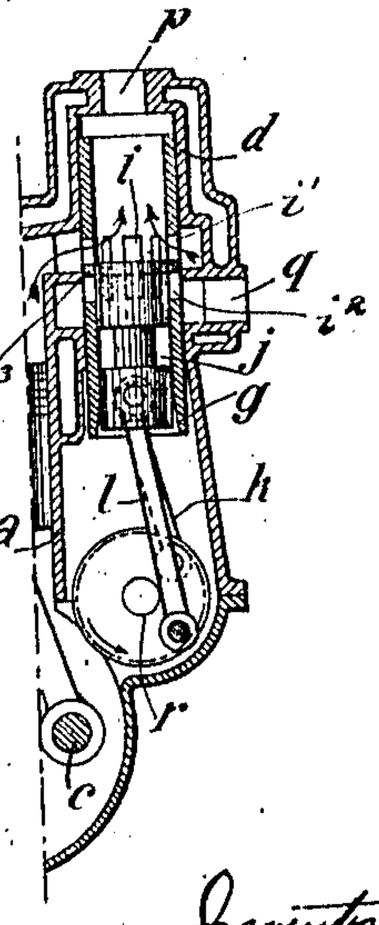


FIG. 6.



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UNITED STATES PATENT OFFICE.

JOSEPH NICOLAS KIEFFER, OF SÈVRES, FRANCE.

INTERNAL-COMBUSTION ENGINE.

989,984. Specification of Letters Patent. **Patented Apr. 18, 1911.**

Application filed October 29, 1909. Serial No. 525,372.

To all whom it may concern:

Be it known that I, JOSEPH NICOLAS KIEFFER, a citizen of the French Republic, residing at Sèvres, Department of Seine and Oise, France, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification, reference being had to the accompanying drawing, forming a part hereof.

This invention relates to internal combustion engines of the four cycle type in which the combustible mixture, formed outside of the engine cylinder, is introduced into the engine cylinder and is compressed therein, and in which, after combustion, the burned gases are driven out of the cylinder before the introduction of the next charge.

The invention is particularly concerned with the devices which control the admission to the cylinder of the fresh charge and the escape of the burned gases.

In engines of this type, as heretofore constructed, lift valves, operated either by pressure of the gases or of the atmosphere or by cams through suitable intermediate mechanism, have generally been employed, and experience has shown that the use of such valves is open to many objections. It has also been proposed to control the admission and exhaust by sleeve like valves surrounding the piston and interposed between the same and the wall of the cylinder, such sleeve like valves being operated through suitable mechanism from the engine shaft, but this arrangement also involves difficulties, particularly in manufacture, as well as those due to friction.

It is the object of this invention to provide for the control of admission and exhaust by means which shall obviate the objections to both general forms of controlling devices above referred to and this result is accomplished by making use of coöperating, relatively reciprocating valves located externally to the cylinder and operated positively through suitable mechanism from the engine shaft.

The invention will be more fully explained hereinafter with reference to the accompanying drawing in which one convenient and practical embodiment thereof is illustrated, and in which—

Figures 1, 2, 3, 4, 5 and 6 are views in longitudinal section showing successive positions assumed by the working parts during the complete cycle of the engine, Figs. 1, 3, 4 and 5 showing the cylinder and piston as well as the valve chest and valves, with their connections, while Figs. 2 and 6 are partial views showing the valve chest and valves with a small portion only of the piston and cylinder.

In the engine shown in the drawing, the main cylinder *a* receives as usual the piston *b* which, through the crank *c* drives the main shaft. Adjacent to the cylinder *a* and formed in a single casting therewith, or otherwise as may be preferred, is a valve chest *d* which is preferably cylindrical in cross section. The cylinder *a* is adapted to communicate, near its head end, through a port *e* with the valve chest *d* at a point about the middle of the length of the latter, the port *e* being preferably continued as an annular chamber or recess in the wall of the valve chest. Fitting in the valve chest *d*, so as to reciprocate therein, is a sleeve valve *g* and fitting within the sleeve valve *g*, so as to reciprocate therein, is a piston valve *h*. The sleeve valve *g* has near its middle a circumferential series of ports *t*, preferably formed as a double series of ports i' and i^2, separated by a narrow, imperforate wall i^3. The piston valve *h* is provided, near its middle, with a chamber or channel *j*, which is adapted to register, in certain relative positions of the two valves, with the circumferential series of ports *i*. The two valves *g* and *h* are connected by rods *k* and *l* respectively to crank pins placed 90 degrees apart on a crank shaft *r* which is driven through suitable gears *m*, *n* and *o* from the main shaft of the engine at half the speed of rotation of the main shaft.

In one end of the valve chest *d* is an exhaust outlet *p* and at about its middle is the inlet *q*, which preferably terminates in an annular chamber or channel in the wall of the valve chest, surrounding the sleeve valve *g* so as to supply the charge to all of the ports *i* thereof, and separated, by a partition wall, from the annular channel *e* which communicates directly with the head end of the cylinder *a*.

The operation of the engine is as follows: When the piston *b* is in its extreme rearward position, at the dead point of its stroke, after the expulsion of the burned gases and preceding the introduction of the fresh charge, as shown in Fig. 1, the ports *i* of the sleeve valve *g* register fully with the

port or channel *e* but are covered by the upper portion of the valve *h*, the inlet *q* being closed by the portion of the sleeve valve *g* below the ports *i*, so that there is at that instant no communication between the cylinder and the inlet *q* or the exhaust *p*. The crank pins to which the valve rods *k* and *l* are connected are then in the positions shown in Fig. 1 so that, as the valve shaft *r* continues its rotation in the direction indicated by the arrow, the valve *h*, being then on its up stroke, uncovers the ports *i* of the sleeve valve *g*, and the latter, then beginning its down stroke, opens the inlet port *q*, thereby placing the inlet *q* in communication with the interior of the cylinder *a*, as shown in Fig. 2. Therefore as the piston moves forward and produces a vacuum behind it, the valves *g* and *h* progressively increase the sectional area of the passage through which the explosive mixture is drawn into the cylinder *a* from the inlet *q*. As the piston *b* reaches the forward limit of its stroke, as shown in Fig. 3, the shaft *r*, rotating at half the speed of the engine shaft, completes a quarter rotation and the valve *h* is moved up to its highest position while the valve *g* is moved half way down to its lowest position, so that the lower portion of the valve *h*, below the channel *j*, then closes the ports *i*, which at that time register with the inlet channel *q*, so that communication between the inlet *q* and the cylinder *a* is cut off. As the engine shaft continues its rotation and the piston *b* moves from its lowest or forward position back to its highest or rearward position, as shown in Fig. 4, the fresh charge is compressed behind the piston, the port *e* being closed, during the whole of this period, by the sleeve valve *g*. Ignition of the charge in the cylinder, behind the piston, being now effected, the piston moves forward in its working stroke, as indicated in Fig. 5, the port *e* continuing to be closed by the sleeve valve *g*, while the valve *h* moves to its lowest position. In the second rearward movement or scavenger stroke of the piston, as indicated in Fig. 6, the sleeve valve *g* moves upward, so as to place the ports *i* in registration with the ports *e*, thereby placing the cylinder in communication with the exhaust *p*, while the valve *h* also moves upward, but more slowly than the valve *g*, so that the lower portions of the ports *i*, in the sleeve valve *g*, are closed or cut off from communication with the inlet *q* by the upper portion of the valve *h*. As the upward movement of the two valves continues, the ports *i*, of the sleeve valve *g*, are closed by the upper portion of the valve *h* and all parts are restored to the positions shown in Fig. 1, when the cycle of operations is renewed as before.

It will be understood that the form and relative arrangement of the valves *g* and *h* and the character of the means by which the valves are caused to have their required movements may be varied to suit different conditions of use and that the invention, therefore, is not limited to the details of construction and arrangement shown and described herein.

I claim as my invention:

1. In an internal combustion engine, the combination with the main cylinder and piston, and the crank shaft driven by the piston, of a cylindrical valve chest having inlet and exhaust ports and a port communicating with the main cylinder, and two cylindrical valves relatively movable within the valve chest and one within the other and controlling the inlet and the exhaust through said ports, and means driven from the crank shaft, and at one-half the speed thereof, for actuating said valves.

2. In an internal combustion engine, the combination with the main cylinder and piston, of a valve chest having inlet and exhaust ports and a port communicating with the main cylinder, two valves relatively movable within the valve chest and one within the other and controlling the inlet and the exhaust through said ports, and means driven from the engine crank shaft and at one-half of the speed thereof for actuating said valves.

3. In an internal combustion engine, the combination with the main cylinder, piston and crank shaft, of a valve chest having inlet and exhaust ports and a port communicating with the main cylinder, two valves relatively movable within the valve chest and one within the other, the outer valve having a port adapted to communicate with the main cylinder, and the inner valve being adapted to place said port alternately in communication with the inlet and exhaust ports of the valve chest, and means driven from the engine crank shaft and at one-half of the speed thereof for actuating said valves.

4. In an internal combustion engine, the combination with the main cylinder, piston, and crank shaft driven by the piston, of a cylindrical valve chest having inlet and exhaust ports and a port communicating with the main cylinder, two cylindrical valves relatively movable within the valve chest and one within the other for controlling the inlet and exhaust through said ports, the outer cylindrical valve having a port which is alternately placed in communication with the inlet and exhaust ports of the valve chest, and means driven from the engine crank shaft and at one-half of the speed thereof for actuating said valves.

5. In an internal combustion engine, the combination with the main cylinder, piston, and crank shaft driven by the piston, of a cylindrical valve chest having inlet and ex-

haust ports and a port communicating with the main cylinder, two cylindrical valves relatively movable within the valve chest and one within the other for controlling the inlet and exhaust through said ports, the outer cylindrical valve having a series of ports which are alternately placed in communication with the inlet and exhaust ports of the valve chest, and means driven from the engine crank shaft and at one-half of the speed thereof for actuating said valves.

6. In an internal combustion engine, the combination with the main cylinder, piston, and crank shaft driven by the piston, of a cylindrical valve chest having inlet and exhaust ports and a port communicating with the main cylinder, two cylindrical valves relatively movable within the valve chest and one within the other for controlling the inlet and exhaust through said ports, the outer cylindrical valve having a port through which inlet to and exhaust from the main cylinder is effected, and means driven from the engine crank shaft and at one-half of the speed thereof for actuating said valves.

7. In an internal combustion engine, the combination with the main cylinder, piston, and crank shaft driven by the piston, of a cylindrical valve chest having inlet and exhaust ports and a port communicating with the main cylinder, two cylindrical valves relatively movable within the valve chest and one within the other for controlling the inlet and exhaust through said ports, the outer cylindrical valve having a port through which inlet to and exhaust from the main cylinder is effected, and the inner cylindrical valve being arranged to place said port alternately in communication with the inlet and exhaust ports of the valve chest, and means driven from the engine crank shaft and at one-half of the speed thereof for actuating said valves.

8. In an internal combustion engine, the combination with the main cylinder and piston, of a cylindrical valve chest having inlet and exhaust ports and a port communicating with the main cylinder, two cylindrical valves relatively movable within the valve chest and one within the other and controlling the inlet and exhaust through said ports, means for moving the outer cylindrical valve to shift its port into and out of communication with the main cylinder, and means for moving the inner cylindrical valve to place said ports successively in communication with the exhaust and inlet ports of the valve chest each time said port is in communication with the main cylinder.

9. In an internal combustion engine, the combination with the main cylinder and piston, of a valve chest having inlet and exhaust ports and a port communicating with the main cylinder, a sleeve valve having ports midway between its ends for communication with the inlet port and the cylinder port, a valve located within the sleeve valve having between its end portions a channel, and means driven from the engine crank shaft and at half the speed thereof to move said valves relatively to each other and to the valve chest.

10. In an internal combustion engine, the combination with the main cylinder and piston, of a cylindrical valve chest having inlet and exhaust ports and a port communicating with the main cylinder, of a sleeve valve having ports midway between its ends for communication with the inlet port and the cylinder port, a cylindrical valve located within the sleeve valve having between its end portions a channel, and means driven from the engine crank shaft and at half the speed thereof to move said valves relatively to each other and to the valve chest.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JOSEPH NICOLAS KIEFFER.

Witnesses:
CLAUDIUS LUSSON,
H. C. COXE.