A. O. McCOLLUM.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JAN. 8, 1908.

912,150.

Patented Feb. 9, 1909.

FIG. 1

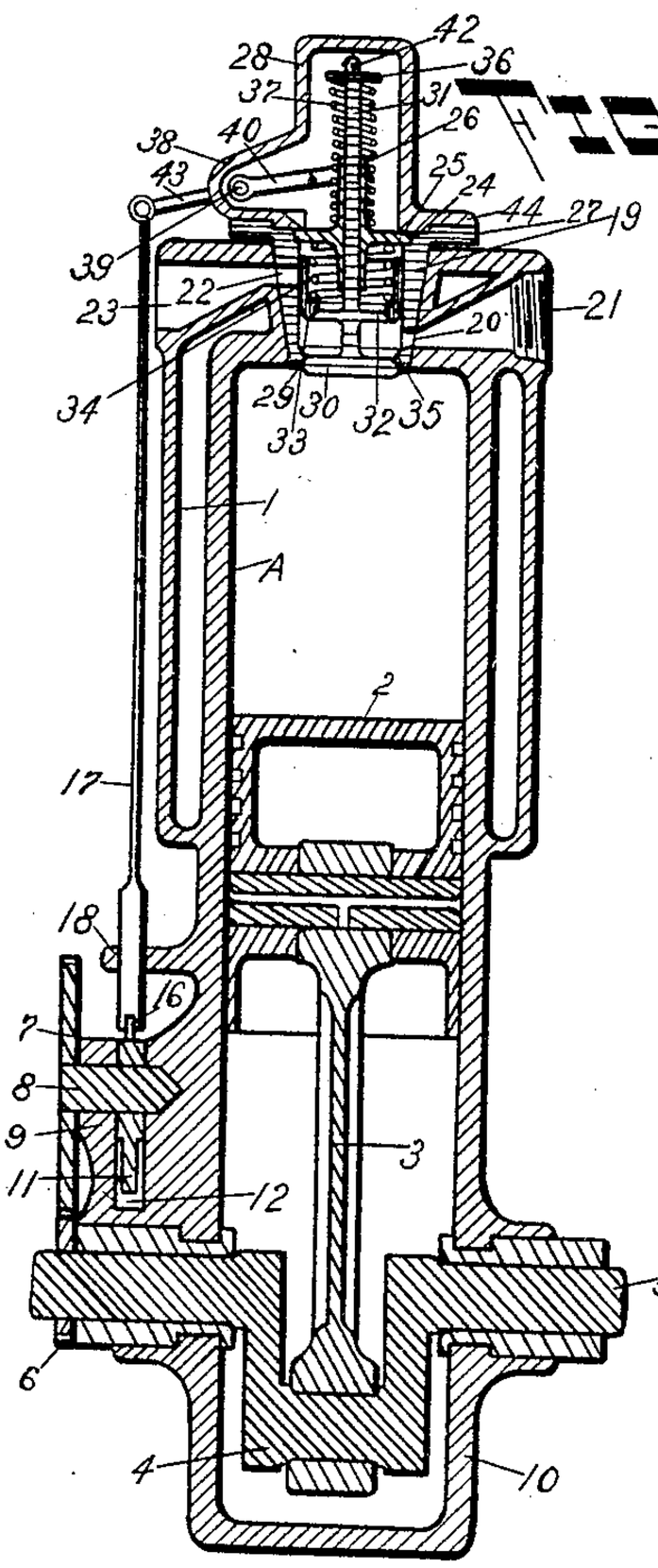


FIG. 2

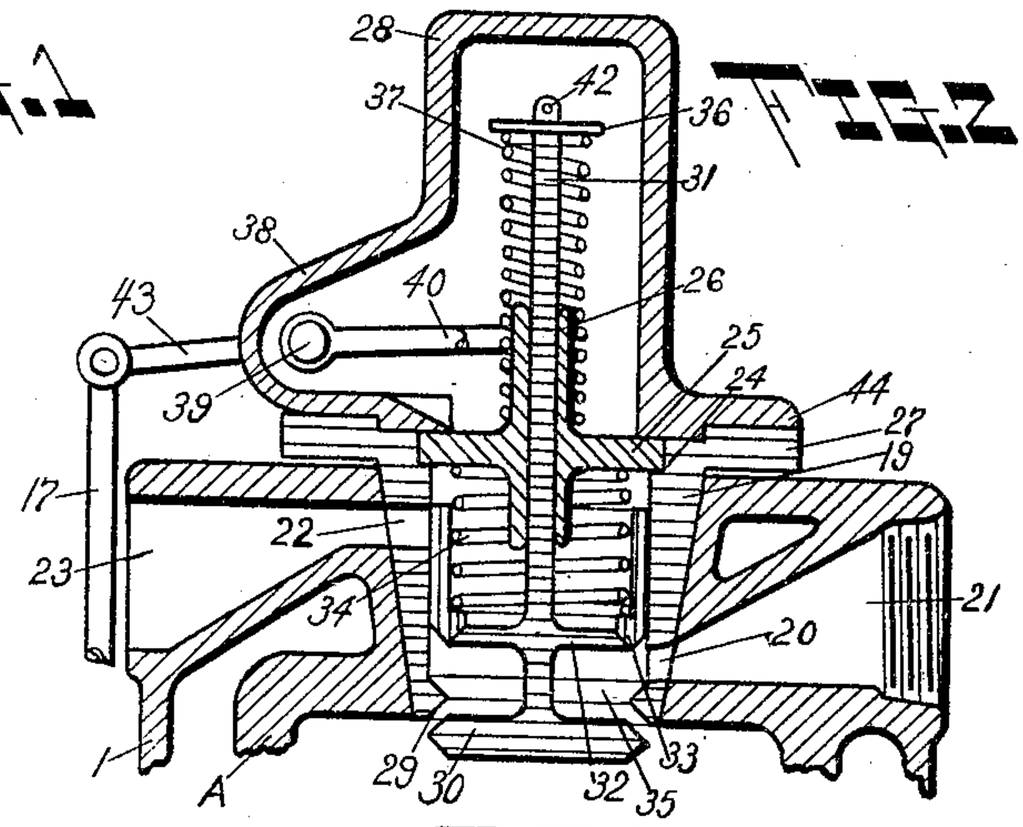


FIG. 3

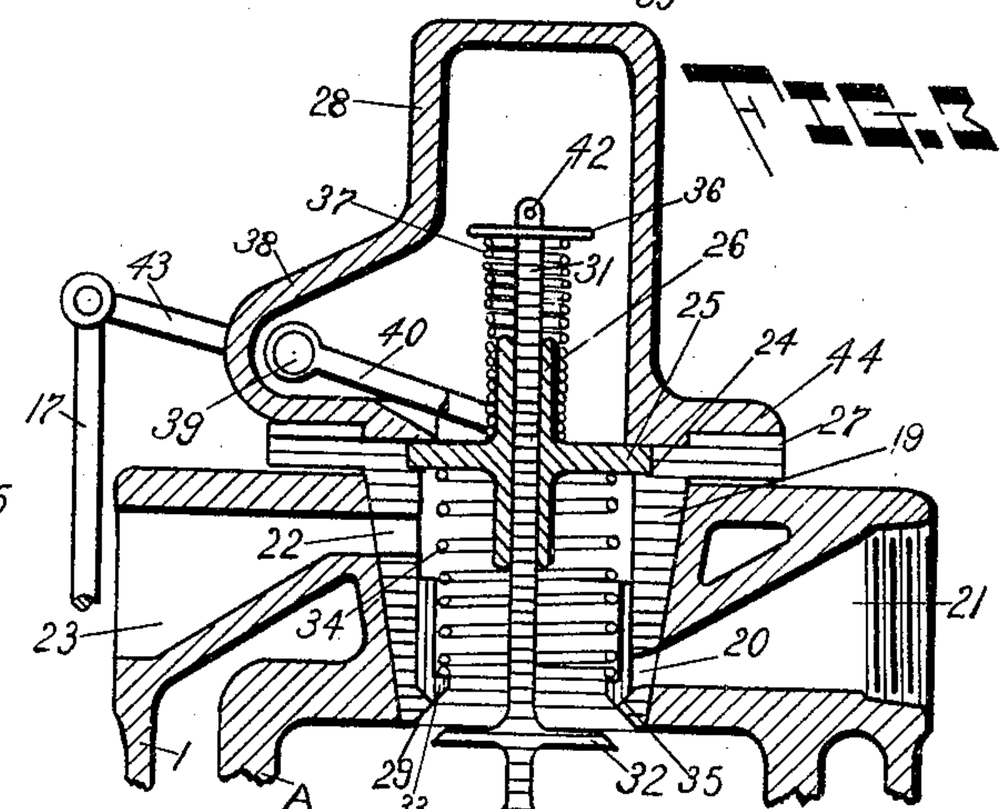


FIG. 4

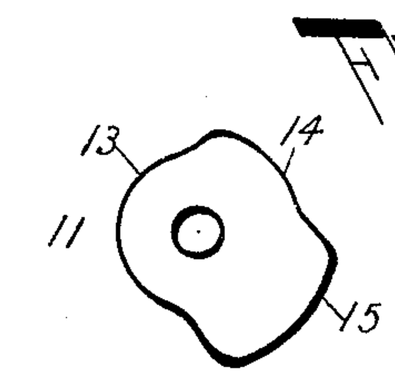


FIG. 5

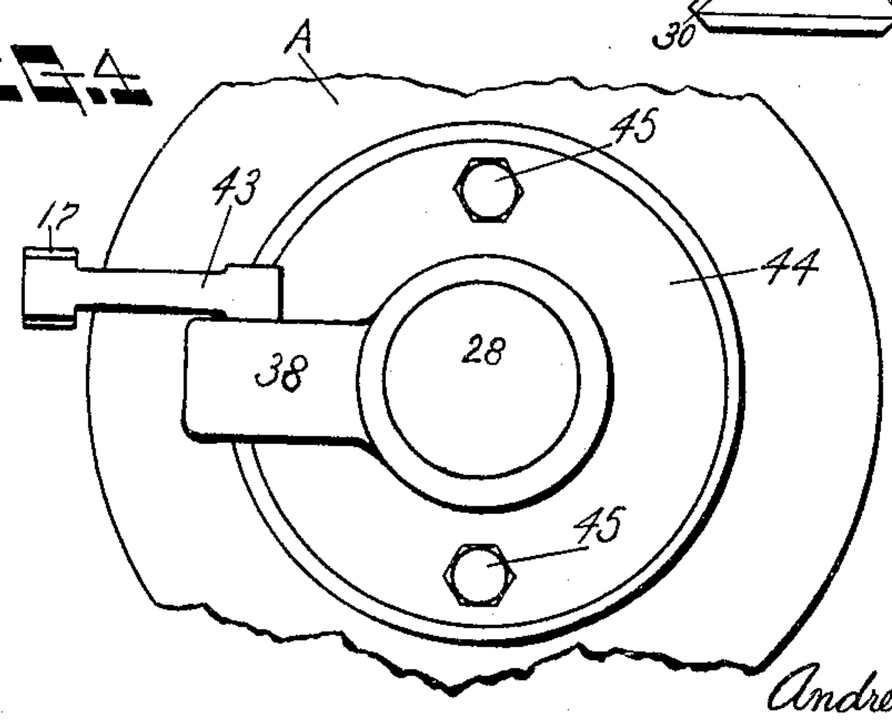
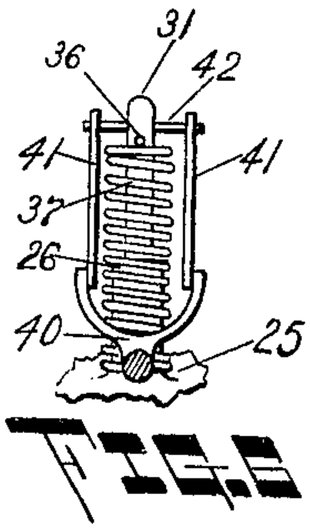


FIG. 6



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UNITED STATES PATENT OFFICE.

ANDREW OSLA McCOLLUM, OF REESE, MICHIGAN.

INTERNAL-COMBUSTION ENGINE.

No. 912,150. Specification of Letters Patent. Patented Feb. 9, 1909.

Application filed January 8, 1908. Serial No. 409,783.

To all whom it may concern:

Be it known that I, ANDREW O. McCOLLUM, a citizen of the United States, residing at Reese, in the county of Tuscola and State of Michigan, have invented certain new and useful Improvements in Internal-Combustion Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to internal combustion engines, and more particularly to valves and valve gear therefor.

One object is the provision of improved means whereby a single opening into the cylinder constitutes both an inlet and an exhaust port for the engine, such opening being controlled by a mechanically operated compound valve.

Another object of my invention is the provision of a single valve stem equipped with two valve heads simultaneously movable, one of the valve heads controlling the communication between the respective inlet and outlet ports and the main port communicating with the cylinder, the other valve head operating to prevent the commingling of the exhaust gases with the fresh combustible mixture.

A further object of my invention is the provision of means for preventing the access of dust, dirt or other extraneous material to the valve and its gear.

A still further object is the provision of a valve seat and valve capable of being easily and quickly removed from the cylinder without trouble or delay.

Still another object of my invention is the provision of a simple yet accurate valve mechanism which is positive in operation and one which will not readily become out of order.

To these and other ends, therefore, my invention consists in certain novel features and combinations such as will be more fully described hereinafter and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a cross-sectional view through a cylinder equipped with my invention, and showing the valve mechanism in closed position; Fig. 2 is an enlarged detail cross-sectional view showing the arrangement of parts when the valve mechanism occupies its exhaust position; Fig. 3 is a similar view showing the position of the valve during the entrance of a fresh mixture, *i. e.*, in the inlet position; Fig. 4 is a top plan view of the exterior showing the dust-cap; Fig. 5 is a detail view of the cam; and Fig. 6 is a detail view of the links connecting the yoke arm and valve stem.

(A) indicates an engine cylinder of the closed base type with its water jacket (1) preferably cast integral so that the cylinder head and water jacket are formed of one casting. Within the cylinder is a piston (2) connected by rod (3) to the crank (4) of a shaft (5), the ends of which crank shaft may be journaled in the base in any convenient manner to prevent endwise movement of the shaft.

A gear (6) on the shaft (5) meshes with a second gear (7) on a cam shaft (8) suitably journaled in any convenient manner, as for instance, in an enlargement (9) of the crank case (10), the enlargement being recessed so that the cam shaft (8) extends across the recess, a cam (11), shown in detail in Fig. 5, being keyed on that portion of the cam shaft extending across the recess (12) of the crank case. The cam is divided into three concentric portions, (13) (14) and (15) respectively, the periphery of the cam being engaged by a roll (16) carried at the lower end of a slidably supported rod (17) passing through one or more guides (18) and preferably forked at its upper end for a purpose hereinafter set forth. The inner end of the cylinder is provided with an opening preferably tapered as shown, in which is received an exteriorly tapered hollow valve casing or cage (19), which is ground to tightly fit the tapered opening and thus avoid the use of packing. The wall of the valve-casing is provided near its inner end with an aperture (20) communicating with the exhaust port (21) in the cylinder wall and forming a continuation thereof, a similar opening (22) near the upper end of the valve casing communicating with the inlet port (23). The outer end of the valve casing is shouldered, as at (24) to receive the annular flange (25) located intermediate the ends of a valve stem tube (26). There is also an annular flange (27) on the upper end of the valve casing, such flange being seated against the exterior surface of the cylinder, the flange (27) being shouldered to receive

the lower end of a dust-cap (28), the end of the dust-cap overlapping the annular flange (25) and retaining it in place.

The inner end of the valve casing is formed into a seat (29) normally occupied by an exhaust valve (30) carried on the inner end of the valve stem (31) slidingly received in the tube (26). A second valve (32) which I may term the "inlet valve", is also carried by the same valve stem and is located above the exhaust valve. The inlet valve is somewhat smaller than the exhaust valve and is adapted to pass freely through the open inner end of the valve casing on which the seat (29) is formed.

The interior of the valve cage (19) is cylindrical in which slides a sleeve or bushing (33) whose inner end is normally supported on the inlet valve, the inner face of the sleeve being shouldered to form a seat for one end of an expansion spring (34), the opposite end of which spring engages the stationary circular flange (25). The bushing normally covers and closes the inlet port (22) and is also adapted to close the exhaust port (21), a seat (35) being formed interiorly of the cage just below the exhaust port.

The valve stem (31) extends through the tube (26) and at its upper end is provided with any suitable abutment (36) against which one end of a spring (37) bears, the spring encircling the tube, its opposite end engaging the outer face of the annular flange (25).

The dust-cap (28) incloses the valve tube and spring and is provided with an offset chamber (38) in which is journaled a crank (39), one arm (40) of which is forked at its outer end to embrace the spring and tube, links (41) (41) connecting the forked ends of the arm with a pin (42) on the outer end of the valve stem (31). The remaining arm (43) of the crank extends in a direction opposite to the arm (40) and lies outside the dust-cap, the free end of the exterior arm (43) being received between and pivotally connected to the forked end of the rod (17). A flange (44) on the dust-cap overlies the flange (27) of the cage and the two are fastened to the cylinder by the bolts (45) (45). When it is desired to inspect the cylinder, repair, or clean the valves or what not, all that is necessary is to remove the bolts, whereupon the dust-cap, crank or rocker and valve mechanism can be lifted out and swung back on the pivotal connection between the exterior arm (43) and the rod (17) without removing rods, tubes, or other parts of the engine to inspect the valve.

It will be obvious that the tension of the spring (37) will normally return and hold the exhaust valve to its seat, overcoming the tension of spring (34) which by pressing against the bushing tends to open the valves.

The device is applied to what is known as a four-cycle or an Otto-cycle engine.

Assuming the piston to be shown starting on its compression stroke, the fresh charge having just been drawn in, the roll (16) on the rod has slipped off of the highest portion (15) of the cam onto the lowest portion (13) of the cam and the piston moves in to compress the charge, the valves being in closed position. The charge compressed, is ignited and the piston makes its power or expansion stroke, the valves still remaining closed. About the commencement of the succeeding exhaust stroke, however, the roll (16) rides up onto the medium portion (14) of the cam, thereby imparting an upward thrust to the rod (17) which is transmitted through exterior arm (43) and interior arm (40), to the links (41) which are moved downward, carrying with them the valve stem (31) against the tension of the spring (37) and operating to move the valves (30) and (32) to their intermediate or exhaust positions, shown in Fig. 2, from an inspection of which it will be seen that the exhaust valve (30) has been moved inward uncovering its seat and the exhaust port (21), the inlet valve (30) having moved down to a point above the exhaust port (21) and with the bushing operating to prevent the exhaust from being forced up into the valve cage to commingle with the live charge. The piston having completed its exhaust stroke, now moves outward upon its suction stroke, whereupon the roll (16) rides onto the highest part (15) of the cam and through the mechanism described operates to force the exhaust valve (30) further into the cylinder (see Fig. 3), the inlet valve passing through the lower open end of valve cage (19) to permit the bushing (33) to rest in its seat (35) below the exhaust port, covering the latter to prevent the suction from drawing a portion of the exhaust back into the cylinder and leaving the inlet port (22) free and uncovered, whereby a new charge is drawn into the cylinder. It will be observed that the hot exhaust gases come into contact with both valves and impart a portion of their heat thereto; also that the fresh charge is drawn in through the same valve cage and around both valves, the new charge thus being subjected to a preliminary heating before entering the cylinder as well as operating to cool the valves to prevent expansion thereof. There are no pockets, ridges, bolt heads or projections in the cylinder to become heated or collect soot. The spring (34) may be omitted as the bushing can operate by gravity, but its action is made certain by the spring. Upon the commencement of the power stroke, the rod (16) rides off onto the low portion (13) of the cam, thereby allowing the spring (37) to return the valves and bushing to the closed position shown in Fig. 1.

The action of the valves can be properly timed to the stroke of the piston and the arrangement admits of the use of heavier hydrocarbons than are ordinarily used. By casting the cylinder in one piece the liability of leakage is reduced to a minimum, it being impossible to provide an absolutely tight packing between the head and the body of the usual cylinder and the cage fitted in a ground seat prevents leakage therearound and requires no packing.

The two valves on the one stem possess this advantage that but a single valve actuating means is needed, and it is only necessary to time one of the valves with the stroke of the piston and a single valve opening only is required, reducing the liability of leakage.

It is plain that many changes might be made in the form and arrangement of the several parts described without departing from the spirit and scope of my invention, and hence I do not wish to limit myself to the exact construction set forth.

Having thus fully disclosed my invention, what I claim as new is—

1. A compound valve for engines comprising a hollow valve casing having inlet and exhaust ports, seats formed on the inner end of the casing and interiorly of the casing below the exhaust port, a single valve stem suitably supported within the casing, exhaust and inlet valves carried by the stem and spaced apart from each other, the inlet valve being smaller than the exhaust valve, the latter normally retained on the seat at the inner end of the casing, a bushing slidingly received within the casing, the bushing normally supported by the inlet valve to cover the inlet port and separating it from the outlet port at all times, and a single means for operating the exhaust valve to uncover the exhaust port while preventing an intermingling of the exhaust and fresh gases and for projecting the inlet valve through the opening normally closed by the exhaust valve to permit the bushing to rest on the seat within the casing below the exhaust port to close the latter and open the communication between the inlet port and the cylinder.

2. The combination with an internal combustion engine provided with a head having a tapered opening, and inlet and exhaust ports in the head communicating with the opening, of an exteriorly tapered hollow valve casing seated in the opening, ports in the valve casing registering with the inlet and exhaust ports of the head respectively, a single valve stem slidable in the casing, an exhaust and an inlet valve arranged in tandem and secured rigidly to the stem, means for actuating the stem to allow either port to communicate with the cylinder of the engine, and a slidable bushing in the casing, the bushing adapted to be supported by the inlet valve, a seat in the casing for the bushing, the inlet valve capable of movement independent of the bushing, the bushing adapted to close the inlet and exhaust ports successively.

3. The combination with an internal combustion engine, provided with a head having an opening therein, and inlet and exhaust ports in the head communicating with the opening, of a hollow valve casing received in the opening and provided with apertures registering with the inlet and exhaust ports in the head, a single valve stem slidable in the casing, imperforate inlet and exhaust valves arranged in tandem and rigidly secured to the stem, and means for actuating the stem to open the inlet port or the exhaust port to the engine.

4. A compound inlet and exhaust valve comprising a hollow casing having inlet and exhaust ports, a single valve stem slidable in the casing, imperforate inlet and exhaust valves arranged in tandem and secured to the stem, a bushing slidable in the casing and adapted to rest upon the inlet valve, the bushing adapted to close the inlet and exhaust ports successively relative to the hollow casing, and valve operating means.

5. A compound valve comprising a hollow casing having inlet and exhaust ports, a single valve stem slidable in the casing, inlet and exhaust disks arranged in tandem and secured to the stem, the inlet valve being smaller than the exhaust valve, a seat formed on the casing for the exhaust valve, the inlet valve capable of passing through the seat, a bushing slidable in the casing, the bushing adapted to rest upon and be controlled by the inlet valve to close the inlet and exhaust ports successively relative to the hollow casing, a seat for the bushing, and means for actuating the valve stem, to force the inlet valve through the exhaust valve seat.

6. A compound valve comprising a hollow casing having inlet and exhaust ports, a seat formed interiorly of the casing, a valve stem, imperforate inlet and exhaust valves arranged in tandem and secured to the stem, a bushing slidable in the casing and normally engaging the inlet valve, the bushing adapted to be stopped by and rest upon the seat, when the inlet valve is projected through the area surrounded by the seat, and valve operating means for actuating both the valves and the bushing simultaneously.

7. A compound valve comprising a casing having inlet and exhaust ports, inlet and exhaust valves associated with the casing, a bushing normally supported on and controlled by the inlet valve, a single valve stem carrying the inlet and exhaust valves, a valve stem tube received in the casing, a

shoulder formed in the casing, an annular flange carried by the tube and received on the shoulder, a dust-cap inclosing the valve stem and tube and overlapping the shoulder, means for securing the dust-cap in position, and means for actuating the inlet and exhaust valves.

8. The combination with an engine having an opening therein, of a compound valve received in the opening, the valve comprising a casing having inlet and exhaust ports, inlet and exhaust valves associated with the casing, a bushing normally supported by the inlet valve, a flange on the casing extending around the opening, the flange being shouldered, a shoulder formed in the casing, a valve stem tube received in the casing, a flange on the tube received on the shoulder in the casing, a dust-cap seated in the shoulder on the flange, means for securing the cap and casing to the engine, a valve stem sliding in the tube and carrying the inlet and exhaust valves, and means actuating the valve stem for simultaneously operating the inlet and exhaust valves.

9. The combination in an internal combustion engine, with a compound valve, of a dust-cap inclosing the valve, a cam actuated rod, and a crank journaled in the cap, one arm of the crank connected with the valve, the other arm of the crank located externally of the cap and pivotally connected to the rod to permit the cap and valve mechanism to be swung on the pivotal connection for inspection.

10. A compound valve comprising a valve casing having inlet and exhaust ports, a valve stem, inlet and exhaust valve disks arranged in tandem and secured to the stem, the exhaust valve normally closing one end of the casing, a cover for the upper end of the casing, means normally retaining the valves in closed position, a bushing loosely supported on the inlet valve within the casing, and normally closing the inlet port, a spring engaging the cover and the bushing respectively and tending to force the bushing to uncover the inlet port against the tension of the valve closing means, a seat in the casing adapted to limit the movement of the bushing in one direction, the inlet valve capable of passing through the area inclosed by the seat, and means for actuating the valve stem against the tension of the valve-closing means.

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

ANDREW OSLA McCOLLUM.

Witnesses:

H. HERMAN HEINLEIN,

JESSIE McCOLLUM.