Feb. 19, 1924. 1,484,320

E. H. BELDEN

VALVE OPERATING MECHANISM FOR ENGINES

Filed March 21, 1919 4 Sheets-Sheet 1

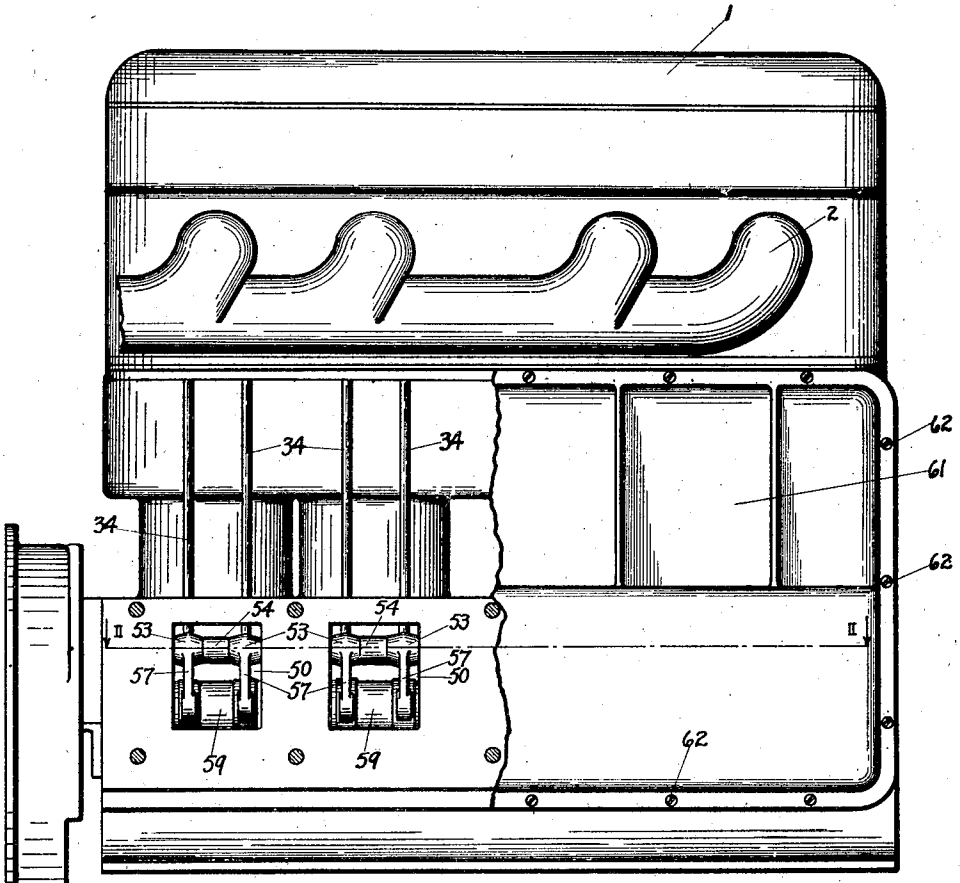


Fig. I.

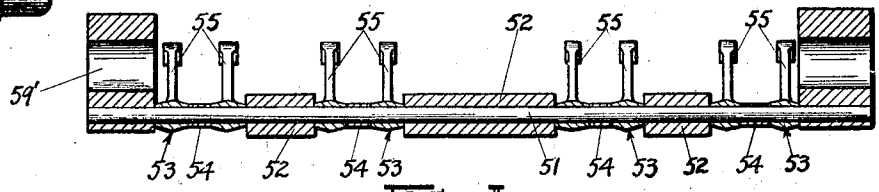


Fig. II.

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VALVE OPERATING MECHANISM FOR ENGINES

Filed March 21, 1919 4 Sheets-Sheet 2

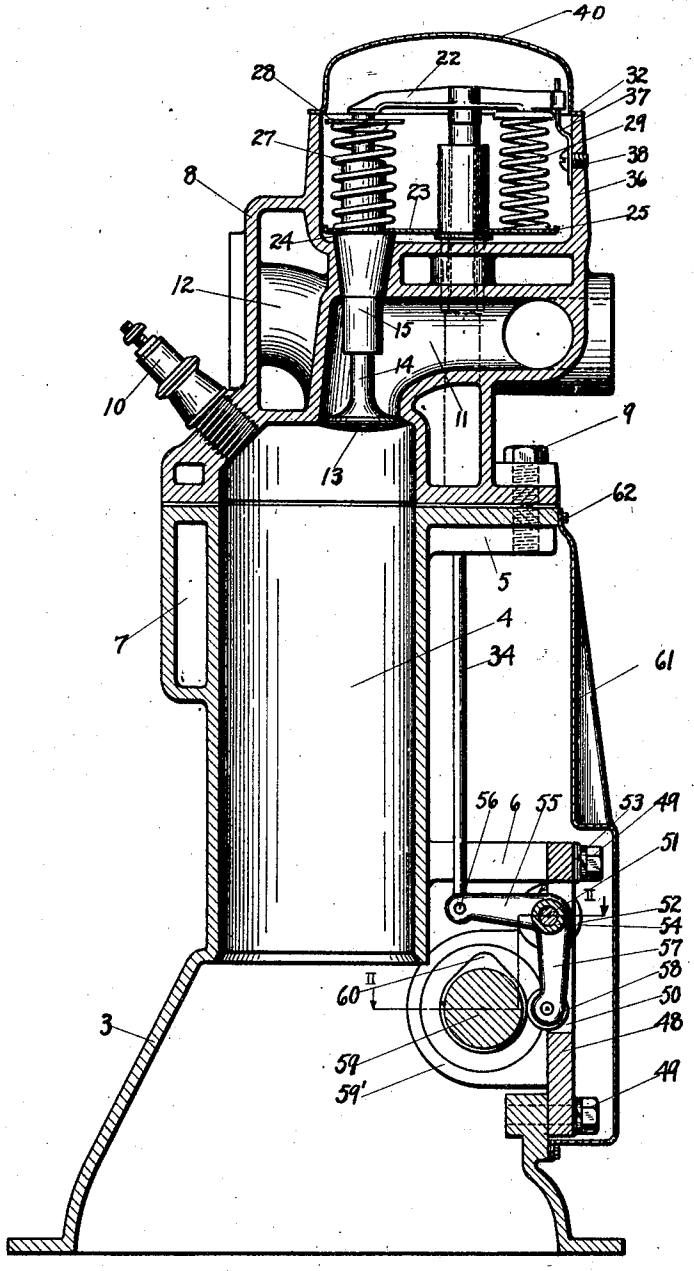


Fig. II.

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VALVE OPERATING MECHANISM FOR ENGINES

Filed March 21, 1919 4 Sheets-Sheet 3

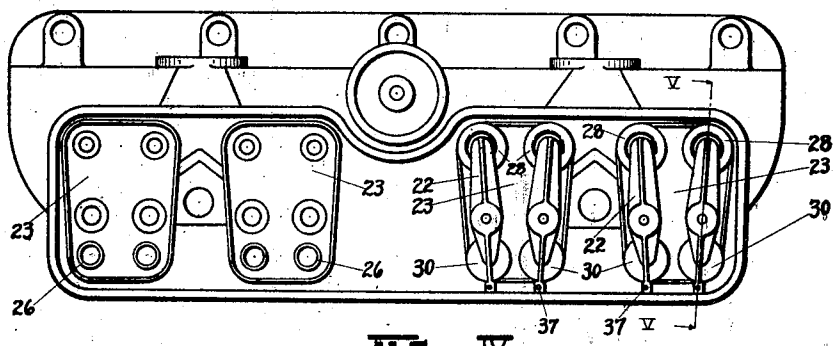


Fig. IV.

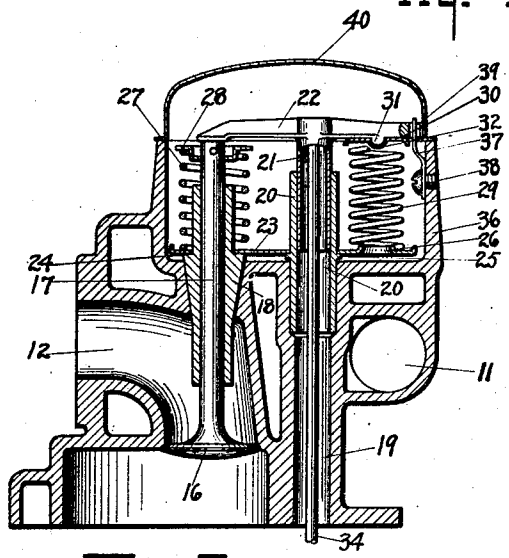


Fig. V.

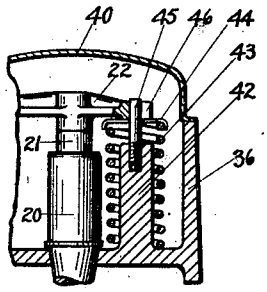


Fig. VII.

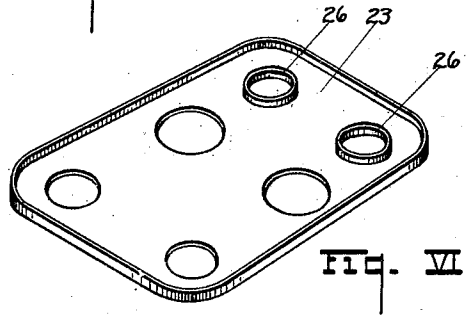


Fig. VI.

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VALVE OPERATING MECHANISM FOR ENGINES

Filed March 21, 1919 4 Sheets-Sheet 4

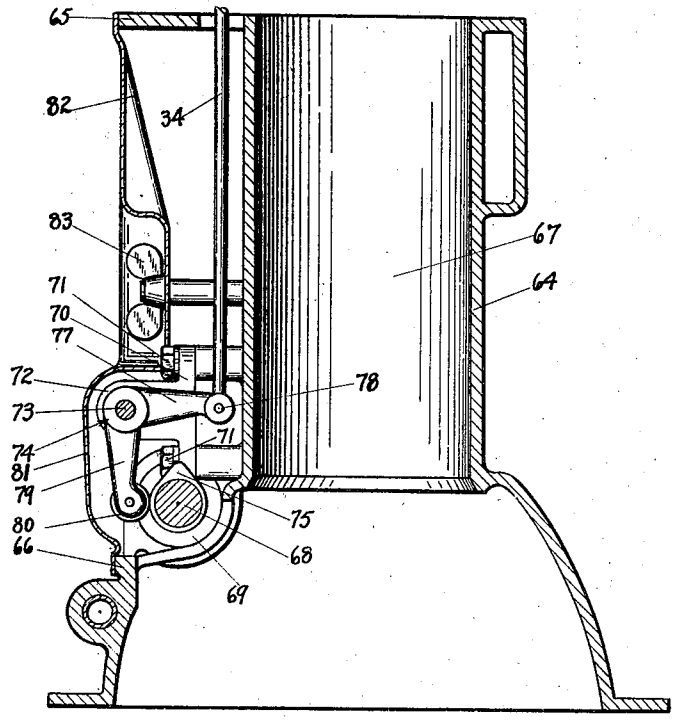


Fig. VIII.

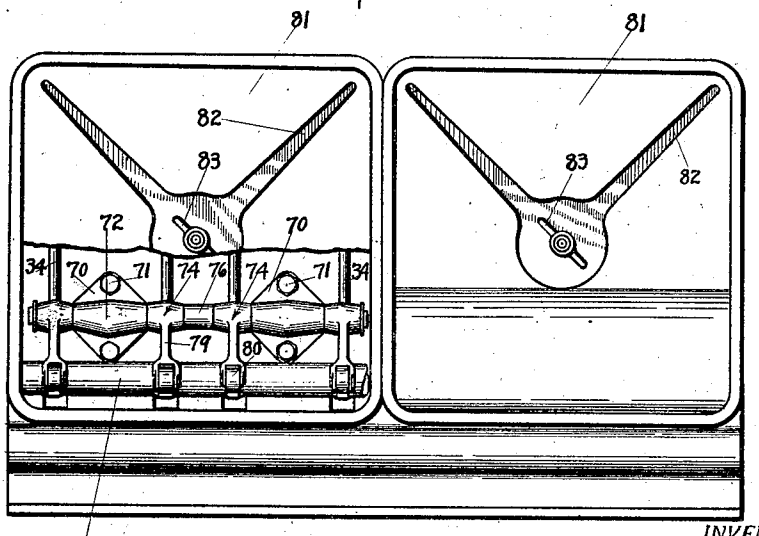


Fig. IX.

INVENTOR.
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ATTORNEY

Patented Feb. 19, 1924. 1,484,320

UNITED STATES PATENT OFFICE.

EDWARD H. BELDEN, OF TOLEDO, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE WILLYS-OVERLAND COMPANY, OF TOLEDO, OHIO, A CORPORATION OF OHIO.

VALVE-OPERATING MECHANISM FOR ENGINES.

Application filed March 21, 1919. Serial No. 284,140.

To all whom it may concern:

Be it known that I, EDWARD H. BELDEN, residing at Toledo, county of Lucas, State of Ohio, have invented certain new and useful Improvements in Valve-Operating Mechanism for Engines, of which I declare the following to be a full, clear, and exact description.

This invention relates to internal combustion engines, and particularly to new and improved arrangement of the valve operating mechanism for controlling the operation of the intake and exhaust valves.

One object of the invention is to provide an improved arrangement of the valve operating mechanism wherein a portion of said valve operating mechanism is conveniently mounted upon an offset portion of the cylinder casing in such a manner as to be readily accessible.

A further object of the invention is to provide an improved form of valve operating mechanism wherein a portion of said mechanism is capable of being detachably secured to the cylinder casing, in such a manner as to be capable of removal therefrom as a unit.

A further object of the invention is to provide an improved form of cylinder casing so constructed as to permit the attaching of a cover thereto in such a manner as to inclose a portion of the valve operating mechanism.

A further object of the invention is to provide an improved mechanism of this character, wherein means is provided for preventing rotation of the valve operating head.

A further object of the invention is to provide an improved mechanism of the character described wherein the cam shaft and rocker arm operated thereby are detachably secured to the cylinder casing in such a manner as to be readily accessible, and be capable of removal therefrom as a unit.

A further object of the invention is to provide a mechanism of the character described, which is of simple construction and efficient in operation.

Further objects of the invention relate to economies of manufacture and details of construction as will hereinafter appear from the detailed description to follow.

The objects of the invention are accomplished in one instance by the devices and means described in the following specification, but it is evident that the same may be varied widely without departing from the scope of the invention, as pointed out in the appended claims.

A structure constituting one embodiment of the invention, which may be the preferred, is illustrated in the accompanying drawing forming a part hereof, in which:

Figure I is a side elevational view of an internal combustion engine, having a portion of the cover plate broken away to show the relative position of certain parts of the valve operating mechanism.

Figure II is a horizontal sectional view, taken along the line II—II of Figures I and III, and showing the manner of mounting the rocker arm and the cam shaft upon the detachable plate.

Figure III is a vertical sectional view, taken transversely of the internal combustion engine illustrated in Figure I, and showing the relative position of the valve operating mechanism in connection with one of the engine cylinders.

Figure IV is a top plan view of the internal combustion engine, with the cover plate removed, and illustrating the relative position of the cross head and the plate upon which the cross head controlling springs are adapted to seat.

Figure V is a vertical sectional view, taken along the line V—V of Figure IV, and showing the relative position of the various parts of the valve operating mechanism which are positioned near the top of the engine.

Figure VI is a perspective view of one of the plates upon which the cross head controlling springs are adapted to seat.

Figure VII is a vertical sectional view, illustrating a modified form of controlling means for preventing rotation of the valve cross head.

Figure VIII is a vertical sectional view, taken transversely of the internal combustion engine, and illustrating a modified form of mounting for the cam shaft, and cam shaft actuated rocker arms.

Figure IX is a side elevational view of the internal combustion engine shown in section in Figure VIII, having a portion of the cover plate broken away to show the relative position of the cam shaft, and the

rocker arm actuated thereby according to the modified form of the invention illustrated in Figure VIII.

Similar reference characters refer to corresponding parts throughout the several views, and the sectional views are taken looking in the direction of the small arrows at the ends of the section lines.

In embodiment of the invention illustrated herewith, 1 indicates an internal combustion engine provided with an intake manifold 2, communicating with the several intake passages of the cylinders. 3 designates a cylinder casing, which comprises a plurality of cylinders 4 of the usual construction, and an upper and lower offset portion 5 and 6, which offset portions are offset laterally from the plane of the engine cylinders upon one side thereof for a purpose which will be described more in detail hereinafter.

Each cylinder is provided with the usual water jacket 7 within which is adapted to circulate the cooling liquid for reducing the temperature of the cylinders in a manner well known in the art. The cylinder head casing 8 has the lower surface thereof formed in such a manner as to fit upon the upper surface of the cylinder casing, and is adapted to be secured thereto by a plurality of bolts 9. Spark plugs 10 are carried by the cylinder head casing in such a manner as to communicate with the upper portion of each cylinder in the usual manner, while the cylinder head casing is also provided with the usual intake passages 11 and exhaust passages 12 communicating with the interior of each cylinder and the intake and exhaust manifolds in the usual manner. Positioned within each of these intake passages 11 is an intake valve 13 provided with a valve stem 14 which is adapted to be slidably positioned within a valve sleeve 15 carried by the clyinder head casing in such a manner as to be capable of reciprocation therein. In a similar manner an exhaust valve 16 is positioned within each of the exhaust passages 12, each of said valves being provided with a valve stem 17 extending upwardly therefrom and slidably mounted within a valve sleeve 18 carried by the cylinder head casing, in such a manner as to be capable of reciprocation therein. Offset laterally from each of the intake and exhaust valve stems is a vertically positioned cylindrical opening 19 formed in the cylinder head casing, within the upper portion of which opening is positioned a tubular sleeve 20 having a portion thereof extending within the tubular opening 19 in such a manner as to be frictionally retained therein, and an upper portion projecting above the upper end of the cylindrical opening 19 and adapted to serve as a guide for the tubular member 21, which may be formed integral with or secured to one of the valve operating cross heads 22. Positioned in proximity to the upper surface of the cylinder head casing is a spring supporting plate 23, of sufficient size to extend over the intake and exhaust valves of each cylinder, and which is adapted to be supported by shoulders 24, formed upon the valve sleeves 15 and 18, and shoulders 25 formed upon the tubular members 20 corresponding to and oppositely positioned laterally with respect to the intake and exahust valves of one of the cylinders. Each of the spring supporting plates 23 is provided with upwardly projecting circular flanges 26 formed upon the upper surface thereof, and arranged to guide the lower ends of the springs 29. A coiled spring 27 surrounds the upper portion of each of the intake and exhaust valve stems, each of said coiled springs bearing against the upper surface of the spring supporting plate, and at its opposite end against a washer 28, which is secured in any suitable manner to the upper end of each of the valve stems. Each intake and exhaust valve is adapted to be actuated by one of the cross heads 22, the movement of each cross head being controlled in such a manner that direct pressure will be exerted upon the upper end of the valve stem in a direction axially of the valve stem by means of the tubular sleeve 21 sliding within the tubular guide 20, and each cross head together with the valve actuated thereby, will be returned to its normal position after actuation of the valve by means of the springs 27 surrounding the valve stem and a similar coiled spring 29, oppositely positioned from the spring 27 with respect to the tubular sleeve 21, and arranged in such a manner as to bear at its opposite end against the upper surface of the plate 23 and the under surface of a plate 30 carried by that end of the cross head which is oppositely positioned from the end of the cross head bearing against the valve stem with respect to the tubular member 21. Each of the springs 29 is retained in proper position with respect to the upper surface of the plate 23 by means of one of the circular flanges 26 formed upon the upper surface of said plate, and the upper end of said coiled spring is retained in proper position with respect to the cross head by means of the flanged plate 30 carried by the cross head. The flanged plate 30 is retained in position relative to the cross head by means of the projection 31 formed upon the cross head, fitting within a correspondingly formed depression 32 in the flange 30. A link 34 is connected to the cross head 22 intermediate the ends thereof, and extends downwardly thereform being housed within the passage 19 formed in the cylinder head casing, said link 34 being adapted to be connected at its opposite end to one of the

rocker arms for the purpose of communicating movement to the cross head in such a manner as to reciprocate the same for the purpose of actuating the corresponding valve controlled thereby.

The cylinder head casing is provided with an upwardly extending wall 36 of such height as to extend to a point substantially level with the upper end of the several valve stems, and adapted to inclose the upper portions of the valve stems and a portion of the operating mechanism associated therewith in such a manner as to protect the same from injury while permitting ready access thereto. An upwardly extending pin 37 is secured to the side wall 36 at a point adjacent one end of each of the cross heads 22, by means of a screw 38 threaded within the side wall of the cylinder head casing. The upper portion of each of the pins 37 is disposed within an opening 39 formed in one end of the cross heads, thus permitting the cross heads to be readily reciprocated by means of the connecting link 34, but preventing rotation of the cross head with respect to the connecting link 34, so as to insure proper engagement between the opposite end of the cross head and the end of the corresponding valve stem at all times, and under all conditions of use. A cover member 40 formed of relatively thin material is adapted to be positioned upon and suitably secured in any desired manner to the upper portion of the wall 36 formed on the engine casing, in such a manner as to inclose that portion of the valve operating mechanism which is positioned within the wall 36, and prevents the admission of dust or dirt into contact therewith. It will be understood, however, that the cover 40 is capable of being readily removed to permit access to the valve operating mechanism for the purpose of adjusting or removing the same. It will be seen upon reference to Figure IV, that each of the spring supporting plates 23 is adapted to accommodate the intake and exhaust valves of one cylinder, and serve as a support for the springs, which are adapted to assist in controlling the operation of the same.

In the modification illustrated in Figure VII, is shown a modified form of controlling means for preventing rotation of the cross member with respect to the connecting link 34. In this form of the device a boss 42 is formed integral with the main portion of the cylinder head casing, and extends upwardly therefrom within the wall 36, being positioned opposite from the corresponding valve stem with respect to the tubular bearing sleeve 20 and the tubular guide member 21 carried by the cross head. A coiled spring 43 surrounds the boss 42, and is adapted to bear at one end against the upper surface of the cylinder head casing and at its opposite end against a flanged washer 44 carried by the end of the cross head for the purpose of controlling the force exerted by the coiled spring against the end of the cross head in such a manner as to properly assist in returning the cross head to its original position after actuation of the valve. A pin 45 is threaded within the upper portion of the boss 42, and is adapted to be positioned within an opening 46 formed in the end of the cross head to serve as a guide for the same and prevent rotative movement of the cross head with respect to the connecting link 34, and the tubular sleeve 20.

It will be apparent from the above description that the force exerted upon each of the valve stems is controlled in such a manner as to act in a direction substantially parallel to the axis of each valve stem, thus preventing any binding or bending of the valve stem by reason of force exerted thereagainst at an angle to the longitudinal axis of the valve stem. Upon actuation of the cross head by the connecting link 34 in such a manner as to depress the same, the corresponding valve will be depressed, thus providing an opening from the interior of the cylinder to the corresponding passage formed in the cylinder head casing, and upon release of the force exerted upon the cross head by the connecting link 34, the corresponding springs 27 and 29 are positioned in such a manner as to exert pressure against the opposite ends of the cross head and insure the return of the same to its normal position without the possibility of any binding action between the tubular member 21 and the guide sleeve 20.

The extension 6 formed upon the lower portion of the cylinder casing is provided with an opening therein extending along the entire length of the casing, upon which is positioned a plate 48 firmly secured to the casing by means of a plurality of bolts or screws 49. This plate 48 detachably secured to the offset portion of the cylinder casing is provided with a plurality of openings 50 formed therein and spaced from each other in a direction longitudinally of the plate in such a manner as to expose to view the cam shaft and the rocker arms actuated thereby. A rod 51 is mounted in a plurality of bearings 52 carried by the plate 48 and a plurality of rocker arms 53 are properly mounted upon the rod 51, being arranged in pairs and having their bearing portions separated from each other by means of spacing sleeves 54 mounted upon the rod between the bearing portions of the arms. Each pair of the rocker arms 53 are preferably mounted upon the rod 51 at such points as to coincide with the opening 50 formed in the plate 48. Each of the rocker arms 53 is provided with a laterally extending arm 55, which is adapted to be pivotally connected to the

connecting link 34 at 56, and each rocker arm 53 is provided with a downwardly extending arm 57, which is provided with a roller 58 adapted to engage the cam shaft 59 in such a manner as to be actuated by one of the cam elements 60 carried thereby. The cam shaft 59 is rotatably mounted in bearings 59', which are formed integral with the plate 48 in such manner that the cam shaft 59 and the rocker arms 53 are capable of being readily detached from the cylinder casing as a unit. By means of the openings 50 formed in the plate 48, the rocker arms and the cam shaft are partially exposed to view in such a manner that they may be inspected without being detached from the engine casing. By mounting the rocker arms and cam shaft upon the plate 48, these parts are capable of being detached from the cylinder casing as a unit for the purpose of replacement or repair, thus rendering them readily accessible and at the same time positioning these parts in such a manner as to exert a direct downward pull upon the connecting links 34 along a line substantially parallel with the longitudinal axis of the corresponding valve stems. The cam shaft 59 is driven from the main crank shaft of the engine or any other suitable movable part in such a manner as to impart rotative movement thereto at a speed proportional to the speed of the engine crank shaft. The cam elements 60 are suitably positioned upon the cam shaft 59 in such a manner as to engage with the rollers 58 mounted upon the arms 57 of the several rocker arms in such a manner as to properly actuate the several rocker arms for the purpose of operating the corresponding valves at proper intervals. A cover plate 61 is adapted to be secured to the upper and lower offset portions of the cylinder casing by means of a plurality of screws 62 in such a manner as to inclose the lower portions of the connecting links 34 and the cam shaft together with the several rocker arms associated therewith to protect the same from injury and to exclude dust and dirt therefrom.

In the modified form of the invention illustrated in Figures VIII and IX, the cylinder casing 64 is provided with upper and lower offset extensions 65 and 66 respectively, formed upon one side of the plane of the cylinders 67 and extending outwardly therefrom. A cam shaft 68 is rotatably mounted in a plurality of bearings 69 carried by the cylinder casing 64, and preferably formed integral therewith, the cam shaft being so positioned as to extend longitudinally of the plane of the engine cylinders and offset therefrom in substantially the same manner as the cam shaft illustrated in the construction shown in Figures I to III inclusive of the drawing. A plurality of bearing plates 70 are secured to a part of the offset portion of the cylinder casing, preferably by means of attaching screws 71, and each of these bearing plates is provided with a bearing portion 72. The bearing plates 70 are positioned in such a manner that the bearings 72 formed therein are in alignment and serve to support a shaft 73, upon which is mounted a plurality of rotatable rocker arms 74, said rocker arms being provided with bearing portions rotatably mounted upon the shaft 73 and being positioned in such a manner as to co-operate with a plurality of cam elements 75 carried by the cam shaft 68. Certain of the rocker arms 74 are adapted to be spaced from each other upon the shaft 73 by means of spacing sleeves 76 mounted upon the shaft, and each of said rocker arms is provided with a laterally extending arm 77 adapted to be pivotally secured to the usual connecting link 34 at 78. Each of the rocker arms is also provided with a downwardly extending arm 79, upon which is mounted a roller 80 adapted to co-operate with one of the cam elements 75 formed upon the cam shaft.

It will be observed that in the construction illustrated in this modification, the cam shaft is mounted in and directly supported by the cylinder casing, and the several rocker arms are carried by detachable plates 70 in such a manner that they are capable of being readily detached from the cylinder casing as a unit for the purpose of replacement or repair. A plurality of cover plates 81 are adapted to bear against the offset portions 65 and 66 formed upon the cylinder casing in such a manner as to inclose a portion of the operating parts of the valve operating mechanism and protect the same from injury. Each of the cover plates 81 is provided with a plurality of strengthening ribs 82, and is detachably secured to the cylinder casing by means of a wing nut 83. In the operation of the mechanism above described, the cam shaft 59 is adapted to be operated from the main crank shaft of the engine or any other suitable rotating part in such a manner as to give the same a speed of rotation proportionate to that of the main crank shaft of the engine. Upon rotation of the cam shaft, movement is communicated to the rocker arms by means of the several cam elements upon the cam shaft co-operating with the rollers carried by the downwardly extending arms of the rocker arms in such a manner as to communicate reciprocatory movement to the connecting links 34 through the laterally extending arms 55 of the rocker arm in such a manner as to actuate the several valve operating cross heads at suitable intervals in the rotation of the engine crank shaft. The several operating parts are so posi-

tioned that the pull upon the several cross heads is in a direction substantially parallel to the longitudinal axis of the corresponding valve stem, and the guide sleeve 21 secured to each cross head is adapted to slide within the corresponding sleeve 20 in such a manner as to prevent tilting of the cross head during its reciprocatory movement. The springs 27 and 29 serve to return the cross heads together with the valves actuated thereby to their normal position after having been displaced by reason of the pull exerted by the connecting links 34. Rotation of the cross heads with respect to the guide sleeves 21 is prevented by means of the pins 37 co-operating with the openings 39 formed in the cross heads, so as to insure the opposite ends of the cross heads being held in contact with the upper end portions of the corresponding valve stems at all times for the purpose of properly actuating the valve stems.

In the modified form of cross head control means illustrated in Figure VII, the pins 45 co-operate with openings 46 formed in the ends of the cross heads for the purpose of preventing rotation of the cross heads with respect to the guide members 21 and the sleeves 20, which serve as guides therefor. These cross head controlling means serve to insure proper action of the cross heads upon the corresponding valve stems at all times, and under all conditions of use.

By mounting the cam shaft and rocker arms upon an offset portion of the cylinder casing, the downward pull upon the cross head is exerted thereon in a direction substantially parallel to the longitudinal axis of the corresponding valve stem, and the manner of mounting the cam shaft and rocker arms is such as to render them readily accessible upon removal of the cover plate, and to enable the cam shaft and rocker arms to be removed as a unit for the purpose of replacement or repair. The provision of the openings 50 serves to provide means for inspecting the cam shaft and rocker arms without necessitating the removal of the same from the cylinder casing, and the cover plate 61 houses that part of the valve operating mechanism, and effectively prevents access of foreign matter thereto.

In the modified form of the invention illustrated in Figures VIII and IX, the operation of the various parts is substantially similar to that described above, and the cover plate 81 serves to protect the operating parts of the mechanism in a similar manner to the cover plate 61, shown in the modification first described. The cam shaft and rocker arm as shown in this modified form are positioned in such a manner as to cause the connecting link 34 to exert a direct pull upon the cross head in a direction substantially parallel to the longitudinal axis of the corresponding valve stem as in the modification illustrated in Figures I to III inclusive. In this form of the device the several rocker arms are capable of being removed as a unit for the purpose of replacement or repair, by means of the several detachable plates 70 within which the shaft 73 carrying the several rocker arms is mounted. It will be observed that in this form of the invention the cam shaft 68, which is preferably mounted in a portion of the cylindrical casing, is positioned in such a manner as to be readily accessible upon removal of the cover plate 81, thus rendering both the cam shaft and the rocker arms readily accessible upon removal of the cover plate, while being at the same time protected from the injury by means of the cover plate 81.

While I have shown and described in considerable detail a specific embodiment of my invention, it is to be understood that this showing and description is illustrative only and for the purpose of rendering my invention more clear, and that I do not regard the invention as limited to the details of construction illustrated or described, nor any of them, except in so far as I have included such limitation within the terms of the following claims, in which it is my intention to claim all novelty inherent in my invention broadly as well as specifically.

What I claim as new and desire to secure by Letters Patent is:

1. In a multiple cylinder internal combustion engine, a frame, a vertically disposed plate secured to said frame and extending longitudinally of said engine, said plate having inwardly projecting extensions thereon, a cam shaft journaled in said extensions and removable longitudinally from the plate, a rocker shaft journaled upon said plate, and a series of rocker arms carried by said shaft.

2. In a multiple cylinder internal combustion engine, a frame, a vertically disposed plate secured to said frame and extending longitudinally of said engine, said plate having a series of openings therein, a series of valve operating bell-cranks pivoted upon said plate and operable in said openings, and a cam shaft journaled upon said plate and adapted to actuate said bell-cranks.

3. In an internal combustion engine, a plurality of cylinders and a cylinder head therefor, having inlet and exhaust ports for each of said cylinders, valves for controlling said ports, a vertically disposed plate secured upon said cylinders, having aligned openings therein, bell-cranks pivoted upon said plate and operable within said openings, means operatively connecting said bell-cranks with said valves, and a cam shaft journaled upon said plate and adapted to actuate said bell-cranks.

4. In an internal combustion engine, a plurality of cylinders, intake and exhaust valves aligned with each of said cylinders, a vertically disposed plate removably secured to said cylinders, bell-cranks pivoted upon said plate and movable in openings formed therethrough, means operatively connecting the bell-cranks with said valves, and a cam shaft journaled upon the plate and operatively connected with said bell-cranks.

5. In a multiple cylinder internal combustion engine, a frame, a vertically disposed plate extending longitudinally of said engine and having inwardly projecting extensions thereon, a cam shaft journalled in said extensions, said plate being provided with a series of aligned openings, a rocker arm journalled in said plate at each of said openings, adapted to be operated by said cam shaft, and a sheet metal plate secured to said frame and covering said plate.

6. In an internal combustion engine, a casing, a valve, a cross head co-operating with said valve and movable bodily in a vertical plane, a connecting rod secured to said cross head, means carried by said casing for preventing rotation of the cross head relative to the connecting rod, a cam shaft, and a rocker arm operated by the cam shaft for actuating the connecting rod and the valve controlled thereby.

7. In an internal combustion engine, a plurality of valves, a cross head co-operating with each valve and movable bodily in a vertical plane, a connecting rod for actuating the cross head, means for returning the cross head to its original position after actuation by the connecting rod, means independent of the connecting rod for preventing rotation of the cross head relative to the connecting rod, a cam shaft, and a rocker arm operated by the cam shaft for reciprocating the connecting rod and the valve controlled thereby.

In testimony whereof I affix my signature.

EDWARD H. BELDEN.