A. HOLMES.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JAN. 2, 1917.

1,314,648. Patented Sept. 2, 1919.

FIG. 1.

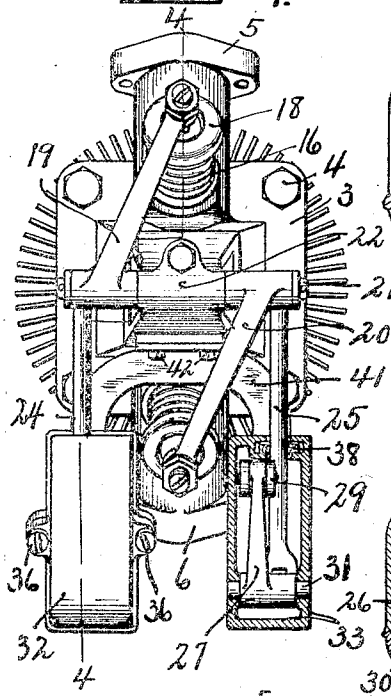


FIG. 3.

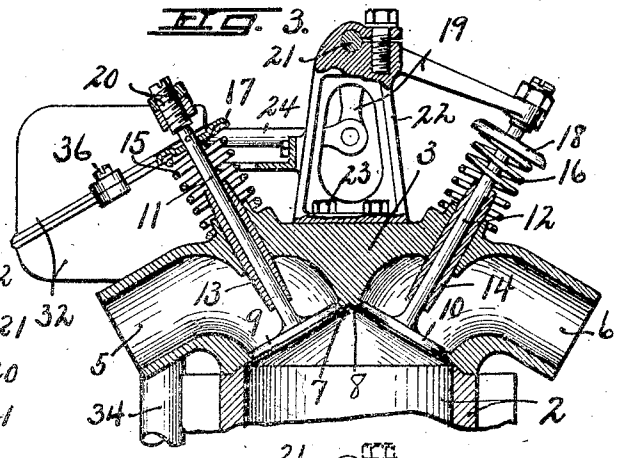


FIG. 4.

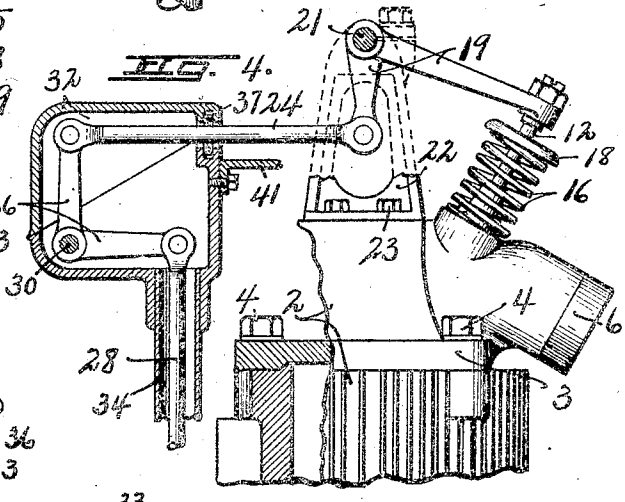


FIG. 2.

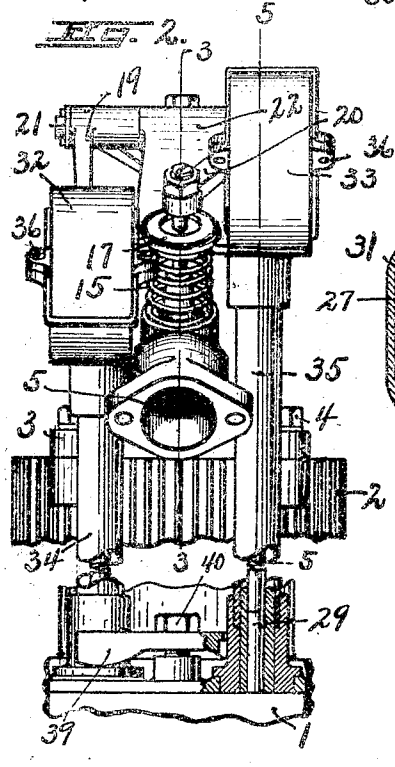
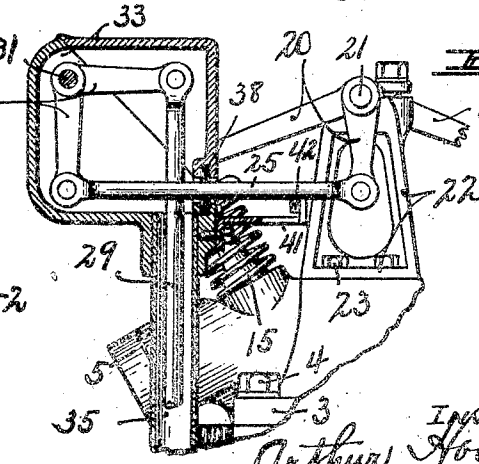


FIG. 5.



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INTERNAL-COMBUSTION ENGINE.

1,314,648. Specification of Letters Patent. Patented Sept. 2, 1919.

Application filed January 2, 1917. Serial No. 140,112.

To all whom it may concern:

Be it known that I, ARTHUR HOLMES, a citizen of the United States of America, and resident of Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Internal-Combustion Engines, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

This invention relates to certain improvements in internal combustion engines having the valves located in the cylinder head and has perhaps more specific application to the valve operating mechanism and associated parts for actuating the valves.

The primary object of the invention is to produce an efficient valve-operating mechanism which shall automatically compensate for changes in valve clearance and valve timing resulting from non-uniform expansion of the cylinder and other parts due to unequal variation in the temperature to which said parts are subjected under operating conditions.

It has been customary to so form the cylinder head that a line connecting the centers of the valves lies in parallelism with the cam shaft adapted to actuate the lifter rods under which circumstances the valve passages leading to the suction and exhaust yokes have utilized substantially the entire expanse of the cylinder head. Otherwise it was either necessary to provide two cam shafts, one for actuating each valve, or else a single cam shaft was located upon the top of the cylinder and driven from the engine base. These two latter solutions are alike complicated and somewhat expensive and involve the use of an increased number of parts.

The valve mechanism of this invention not alone substantially prevents any change in valve clearance and valve timing but permits the valves to be placed laterally of the cylinder in such position that the line connecting their centers lies substantially perpendicular to the axis of the actuating cam shaft. With this construction the valves are adjacent the suction and exhaust yokes giving a freer and shorter passage for the gas and increasing the efficiency of the engine. With this construction the valve operating mechanism is of such a character that the walking beams for operating the valves are both actuated from a unitary cam shaft.

Further, this valve mechanism and the positioning of the valves laterally of the cylinder permits the cylinder head to be inclined downwardly and laterally from its central portion forming plane portions disposed at an angle to each other and converging upwardly. With this construction the valves lie at an angle to the horizontal plane and have their seats in the oppositely inclined walls of the cylinder head thus permitting the use of a materially larger valve. For instance, with a 30° angle of inclination to the horizontal, the valves can be made 40% larger than when the suction and exhaust ports are formed in a substantially horizontal upper wall. This allows better operation with regard to the incoming and outgoing gas effecting a greater scavenging of the cylinder and increasing the efficiency of the engine.

Further, this valve mechanism and positioning of the valves makes the design of the cylinder head much simpler and leaves a considerable portion of the cylinder head unobstructed permitting the use of a removable cylinder head which is a great advantage in construction and in the ease and rapidity with which the cylinder may be cared for and allows easy accessibility for cleaning and grinding the valves.

Other objects and advantages will appear from the following description taken in connection with the accompanying drawings in which—

Figure 1 is a top plan view of an embodiment of this invention.

Fig. 2 is a side elevation of a portion of the same.

Fig. 3 is a section taken on line 3—3, Fig. 2.

Fig. 4 is a section taken on line 4—4, Fig. 1.

Fig. 5 is a section taken on line 5—5, Fig. 2.

The invention, as shown, comprises a suit-

able base —1— upon which cylinder —2— is mounted, the cylinder —2— being formed with a removable head —3— secured to the body of the cylinder in any suitable way, as by bolts —4—.

The cylinder head —3— is provided with suction and exhaust conduits —5— and —6— positioned at opposite sides of the cylinder and adjacent the suction and exhaust yokes, respectively.

The cylinder head —3— is formed with inclined walls —7— and —8— through which the conduits —5— and —6—, respectively, pass, and these walls —7— and —8— may be inclined at various angles to the horizontal, as desired. The greater the angle, the larger the valve which can be used with a cylinder of predetermined diameter.

In the illustration shown, the walls are inclined at angles of substantially 30° to the horizontal and are formed with valve seats surrounding the conduits —5— and —6—, respectively, in connection with which valves —9— and —10— operate to normally close the communication with the cylinder through the conduits.

With walls inclinded at substantially 30° to the horizontal, the valves —9— and —10— can be made substantially 40% larger than would be possible with a cylinder head having a flat interior surface.

The valves —9— and —10— are carried and actuated by suitable valve stems —11— and —12— extending through bushings —13— and —14— secured in openings in the cylinder head.

The valves are normally held in closed position by springs —15— and —16— mounted upon the respective valve stems and tensioned between the cylinder and washers —17— and —18— mounted upon and secured to respective valve stems.

It will be noted that the conduits —5— and —6— are adjacent their respective yokes (not shown) and constitute unobstructed direct passageways for the passage of gas.

The valves —9— and —10— are adapted to be actuated by walking beams —19— and —20—, respectively both constructed in the form of bell-cranks and pivotally mounted upon pin —21— carried by a bracket —22— secured in any suitable manner upon the cylinder head, as by bolts —23—.

The walking beams —19— and —20— are themselves actuated to operate the valves by links —24— and —25—, respectively, which links are in turn actuated by bell-cranks —26— and —27—, respectively, reversely operated by lifter rods —28— and —29—, respectively, the lifter rods being actuated in any usual manner, as by cam shaft within the engine base.

In the specific illustration shown, in order to compensate for changes in valve clearance and valve timing by reason of expansion of the engine cylinder as a result of high temperatures generated at high speeds, one end of the links —24— and —25— is connected to respective walking beams and moves upwardly with the walking beam as the cylinder expands.

The other end of each link is connected to its respective bell-crank, the bell-cranks being pivoted upon shafts —30— and —31—, respectively, mounted in housings —32— and —33—, respectively, which housings are carried by tubes —34— and —35—, respectively, secured in any suitable manner to a practically cold part not exposed to the high temperature to which the cylinder is subjected so that the housings and the shafts —30— and —31—, the bell-cranks —26— and —27— and one end of the links —24— and —25— remain in practically stationary position under any conditions of expansion of the cylinder and parts carried thereby.

As a result of this, the valve clearance does not change because the links —24— and —25— are of sufficient length so that the relatively short arc through which they move, due to cylinder expansion, is for all practical purposes a straight line and, therefore, the walking beam is not actuated by such movement.

For instance, if the links —24— and —25— are substantially 4″ in length and the cylinder should expand vertically .050 of an inch (which is about the maximum expansion), the valve clearance would be varied only approximately .0001 which is an entirely negligible quantity.

It will be noted that the operation of bell-cranks —26— and —27— is reversed by pivoting one at the lower and the other at the upper portion of its respective housing and connecting the lifter rods to opposite ends of respective bell-cranks, so that link —24— pulls bell-crank or walking beam —19— to operate valve —10—, while link —25— pushes bell-crank or walking beam —20— to actuate the valve —9—.

Preferably, as shown, the housings —32— and —33— are each formed of two sections united diagonally of the housing and secured together in any suitable manner, as by bolts —36—, the shafts —30— and —31— being pivotally mounted in the body sections of the housings to which the tubes —34— and —35—, respectively, are secured in any suitable manner, as by brazing or the like.

The housings —32— and —33— are provided with openings for the passage of the links —24— and —25— and these openings may be formed with surrounding recesses —37— and —38— to receive suitable packing to prevent the escape of lubricant with which the housings may be packed.

In the specific illustration shown, the tubes —34— and —35— are rigidly secured to base

—1— by clamp —39— adjustably secured to the base by bolt —40—. Any other suitable method, however, may be utilized for supporting the housings —32— and —33— in a stationary and substantially rigid condition.

The housings may, if desired, be secured to the bracket —22— by a yoke —41— formed, as for instance, of relatively thin sheet metal having its opposite ends secured to respective housings and its intermediate portion secured to the bracket, as by bolt —42—.

This yoke prevents lateral movement of the housings relatively to the cylinder and relatively to each other, but permits the vertical expansive movement of the bracket and cylinder under high temperature conditions without movement of the housings, due to the vertical flexibility of the yoke when formed of thin sheet metal.

The placing of the valves upon an angle and the location of the valves and conduits leading therefrom at the sides of the cylinder adjacent the suction and exhaust yokes, respectively, gives high engine efficiency, while permitting the use of a removable cylinder head of great advantage in the care and attention during service.

The valve-operating mechanism not only efficiently actuates the valves so positioned from a single cam shaft, but also prevents for all practical purposes any change in valve clearance and valve timing.

Although I have shown and described one specific construction, form and arrangement of parts as illustrative of an embodiment of my invention, I do not desire to limit myself to the same as various changes may be made in the details of form, construction and arrangement without departing from the spirit of this invention as set forth in the appended claims.

What I claim is:

1. In an apparatus of the class described a cylinder having an inlet port and an exhaust port, valves for said ports, walking beams for actuating the valves, relatively long links having one end connected to the walking beams and movable in a direction substantially normal to the axis of the cylinder and mechanisms for actuating said links reversely to move respective valves to open position, said mechanisms arranged to actuate respective links under substantially identical conditions under varying temperatures to which the cylinder is subjected.

2. In an apparatus of the class described, a cylinder including a head formed with upwardly converging walls, ports extending through said walls, valves for said ports inclined with respect to the axis of the cylinder, valve stems carrying said valves and extending through the cylinder head, a pin mounted on the intermediate portion of the cylinder head, bell-crank walking beams carried by the pin, links disposed substantially normally to the axis of the cylinder and connected to the bell-crank walking beams, and mechanisms each including a bell-crank, for reciprocating said links, respectively, said mechanisms operating said valves under substantially identical conditions under varying temperatures to which the cylinder is subjected.

3. In an internal combustion engine, a cylinder provided with a port, a valve for said port, a walking beam mounted on the cylinder for actuating said valve, a link for actuating the walking beam, mechanism including a lever for reciprocating said link, and means for preventing lateral movement of said mechanism relatively to the cylinder while permitting free expansion of the cylinder in an axial direction substantially independently of the mechanism.

4. In an apparatus of the class described, a base, a member secured to the base, a housing carried by the member, a bell-crank mounted within the housing, an actuating rod for operating the bell-crank, a link actuated by the bell-crank, a walking beam actuated by the link, valve mechanism actuated by the walking beam, and a member connecting the housing to the cylinder to prevent relative lateral movement of the housing and cylinder while permitting free expansive movement of the cylinder in an axial direction substantially independently of the housing.

5. In an internal combustion engine, a base, a cylinder mounted on the base, a port in the cylinder, a valve for said port, a bell-crank pivotally mounted on the cylinder for actuating said valve, a link disposed substantially, normally to the axis of the cylinder and having one end connected to said bell-crank, a second bell-crank having one end connected to said link, a tube mounted on the base, a housing carried by the tube, said housing inclosing and pivotally carrying said second bell-crank, and a lifter rod extending through said tube and adapted to actuate said second bell crank under substantially identical conditions, under varying temperatures to which the cylinder is subjected.

6. In an internal combustion engine, a base, a cylinder mounted on the base, a port in the cylinder, a valve for said port, a bell-crank pivotally mounted on the cylinder for actuating said valve, a link disposed substantially, normally to the axis of the cylinder and having one end connected to said bell-crank, a second bell-crank having one end connected to said link, a lifter rod for actuating the other end of the second bell-crank, and a member mounted on said base and pivotally carrying said second

bell-crank under substantially identical conditions, under varying temperatures to which the cylinder is subjected.

7. In an internal combustion engine, a cylinder, a port in the cylinder, a valve for said port, a bell-crank pivotally mounted on the cylinder for actuating the valve, a relatively long link disposed substantially normally to the axis of the cylinder connected to one end of the bell-crank, a second bell-crank pivotally carried by a part of the engine remaining relatively cool under high temperature operating conditions, said second bell-crank having one end connected to said link, and a lifter rod for actuating the other end of said second bell-crank under substantially identical conditions under varying temperatures to which the cylinder is subjected.

8. In an internal combustion engine, a cylinder having a port, a valve for said port, a bell-crank walking beam pivotally carried from the upper end of the cylinder and moving vertically with the upper end of the cylinder when the latter expands under high temperature operating conditions, a link disposed substantially normally to the axis of the cylinder and secured to one end of the walking beam, a second bell-crank having a pivot remaining in substantially stationary condition during vertical expansion of the cylinder under high temperature operating conditions, said second bell-crank having one end connected to said link and means for actuating the other end of said second bell-crank to operate the valve.

9. In an internal combustion engine, a cylinder having a base, a port in the cylinder, a valve for said port, a bell-crank walking beam pivotally carried from the upper end of the cylinder and moving vertically with the upper end of the cylinder when the cylinder expands under high temperature operating conditions, a relatively long link disposed substantially normally to the axis of the cylinder and secured to one end of the walking beam, a second bell-crank having a pivot carried from the base of the cylinder and remaining in substantially stationary condition during vertical expansion of the cylinder under temperature operating conditions, said second bell-crank having one end connected to said link and a lifter rod for actuating the other end of the second bell-crank under substantially identical conditions under varying temperatures to which the cylinder is subjected.

10. In an apparatus of the class described, a cylinder provided with a port, a valve for said port, a walking beam mounted on the cylinder for actuating said valve, a relatively long link disposed substantially normally to the axle of the cylinder and connected to the walking beam for actuating the same and mechanism supported and arranged to actuate said link under substantially identical conditions under varying temperatures to which the cylinder is subjected.

11. In an apparatus of the class described, a cylinder having a base, a port in the cylinder, a valve for said port, a walking beam mounted on the cylinder for actuating said valve, a relatively long link disposed substantially normally to the axis of the cylinder and connected to the walking beam for actuating the same and mechanism carried from said cylinder base and including a pivoted bell-crank for actuating said link under substantially identical conditions under varying temperatures to which the cylinder is subjected.

12. In an apparatus of the class described, a cylinder having a base, an inlet port and an exhaust port in said cylinder, valves for said ports, bell-crank walking beams for actuating said valves, relatively long links having one end connected to the walking beams and movable in a direction substantially normal to the axis of the cylinder and mechanism for actuating said links reversely to move respective valves to open position, said mechanism including pivoted bell-cranks carried from the cylinder base and actuating respective links under substantially identical conditions under varying temperatures to which the cylinder is subjected.

In witness whereof I have hereunto set my hand this 30th day of December 1916.

ARTHUR HOLMES.

Witnesses:

E. A. THOMPSON,

BERTHA N. SWART.