Sept. 5, 1950 A. O. KUTZ 2,521,176

VALVE GEAR FOR OPERATING POPPET VALVES OF INTERNAL-COMBUSTION ENGINES

Filed Sept. 16, 1947 2 Sheets-Sheet 1

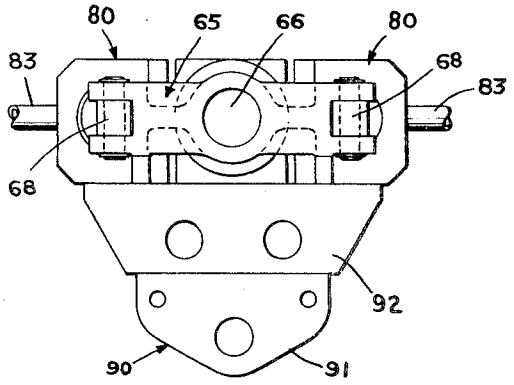


FIG. 3

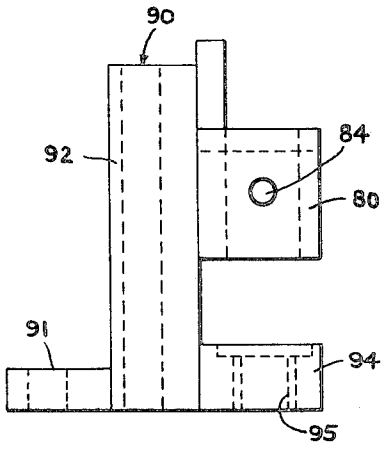


FIG. 4

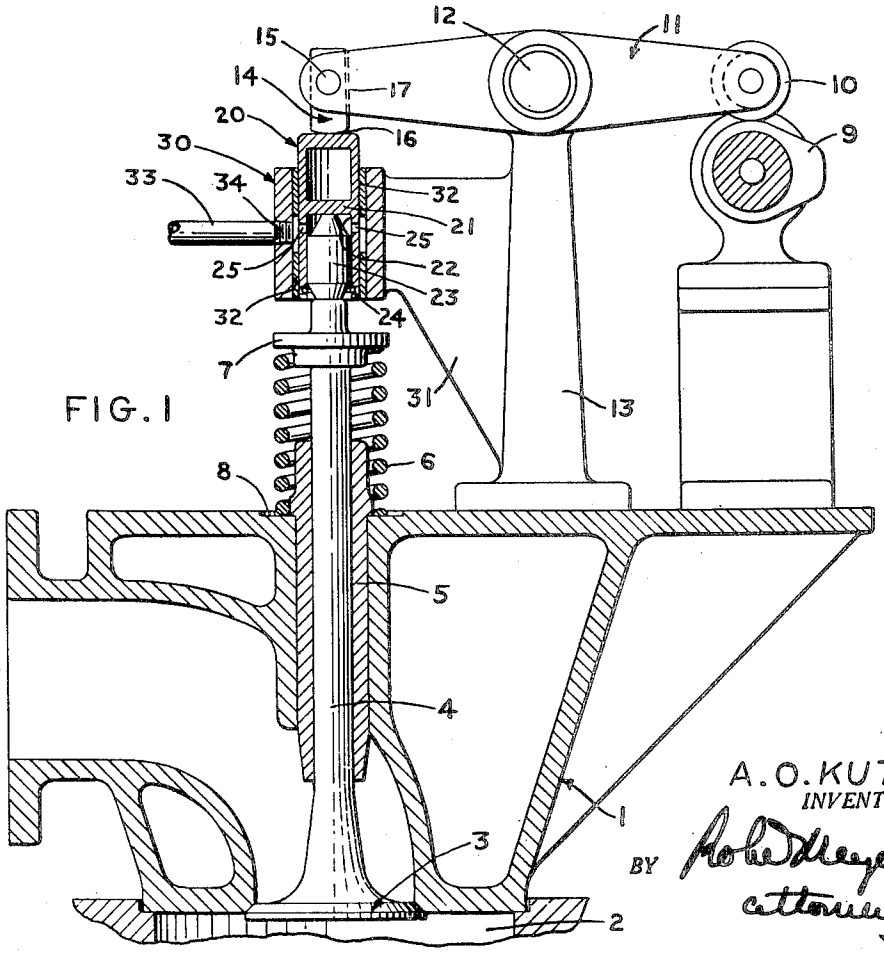


FIG. 1

A. O. KUTZ
INVENTOR.
BY Robert D. Meyer
attorney

Sept. 5, 1950 A. O. KUTZ 2,521,176

VALVE GEAR FOR OPERATING POPPET VALVES OF INTERNAL-COMBUSTION ENGINES

Filed Sept. 16, 1947 2 Sheets-Sheet 2

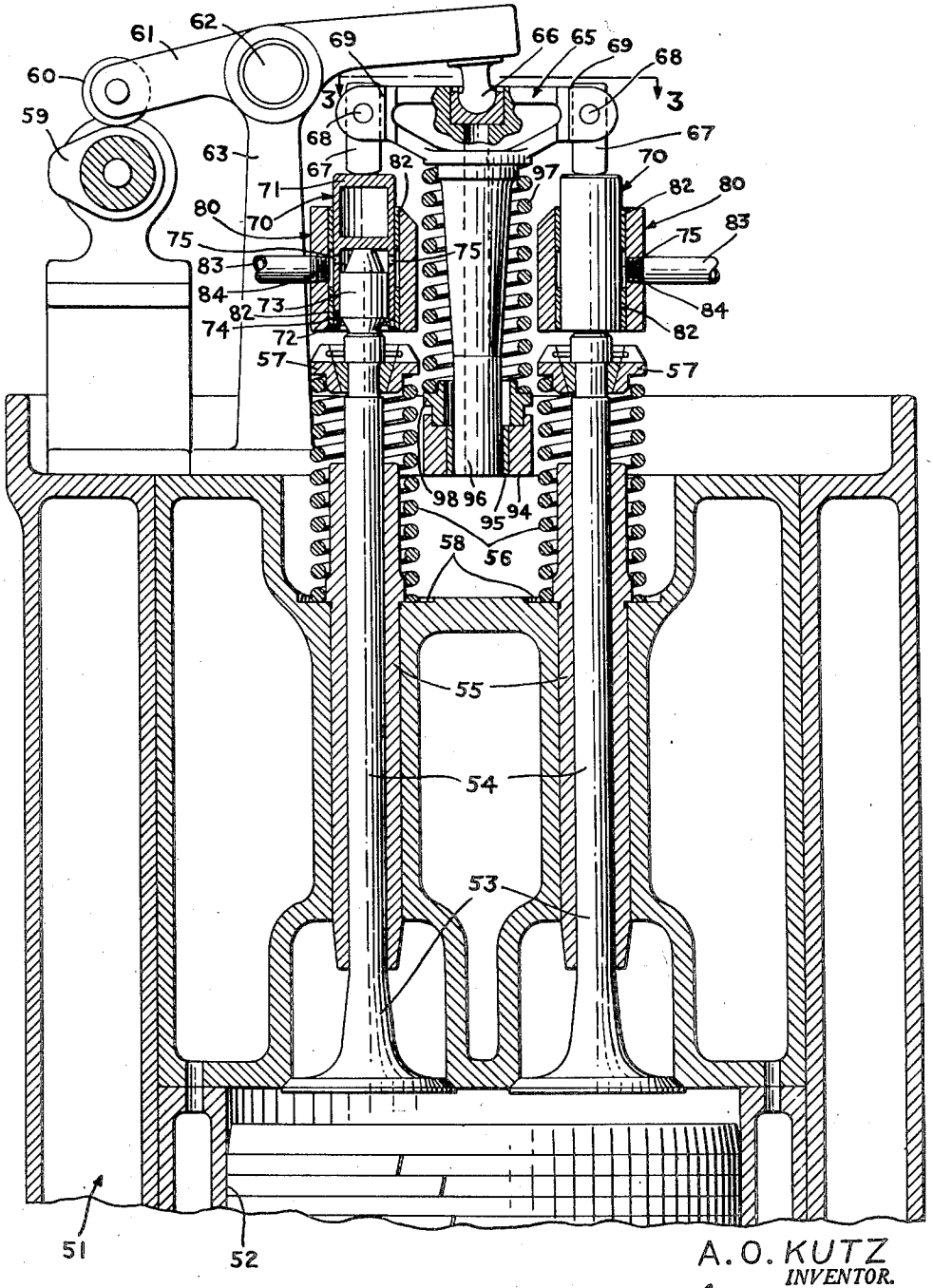


FIG. 2

A. O. KUTZ
INVENTOR.

BY Robert Meyer
Attorney

Patented Sept. 5, 1950

2,521,176

UNITED STATES PATENT OFFICE

2,521,176

VALVE GEAR FOR OPERATING POPPET VALVES OF INTERNAL-COMBUSTION ENGINES

Arthur O. Kutz, Buffalo, N. Y., assignor to Worthington Pump and Machinery Corporation, Harrison, N. J., a corporation of Delaware

Application September 16, 1947, Serial No. 774,332

5 Claims. (Cl. 123—90)

1

This invention relates to mechanisms for operating reciprocating valves and, in particular, refers to means for eliminating both transverse forces on the valve stems and lost motion between the valves and their operating mechanism.

It will be recognized, even by those not in the art, that in actuating a poppet valve it is highly desirable to apply a force which has no component transverse to the axis of the valve since such side thrust may cause sufficient wear on the valve guide and stem to result in serious operating difficulties. Nevertheless, it is almost universal practice in the construction of internal combustion engines to actuate the valves by means of pivoted rocker arms which, of course, apply forces having components parallel and transverse to the valve axes. Aside from ignoring it, the problem of side thrust thus presented can be solved in two ways; first, by designing the valve actuating mechanism so that the transverse component is so small as to have no appreciable effect during the designed life of the engine, and, second, by providing means to absorb or withdraw the transverse component completely so that only an axial force is transmitted to the valve stem. The present invention is in accordance with the second method whereby side thrust on the valve is completely eliminated.

Another problem, which is accentuated by the expansion and contraction of parts associated with an internal combustion engine, is that of lost motion or slack between the rocker arm and the valve. This has been more or less satisfactorily solved by those who have provided the art with so-called lash adjusting mechanisms. In their preferred form these comprise, in essence, pressure loaded pistons which bear on the ends of the valve stems. However, in the past, when the lash adjusters have been used with the rocker arm type of valve operating mechanism, they have been mounted in movable bores so that they simply transmit whatever forces are applied to them. If side thrust was to be removed, suitable means therefor had to be incorporated in the linkage between the rocker arm and the lash adjusters.

The concept of the present invention is to arrange the lash adjusters so that they perform the double function of eliminating lost motion and of absorbing the transverse component of rocker arm motion. To this end they are mounted in a stationary bore which may be in the engine block or head or in a bracket attached thereto. The side thrust applied to the lash adjuster is thus transmitted to the walls of the bore instead of

2

to the valves which, therefore, receive only direct axial thrust. With this arrangement of the lash adjusters there may be associated a novel combination of pivoted pusher rods for actuating the adjusters and a loosely mounted arm for actuating the pusher rods, the function of this combination being to decrease the side thrust while transmitting rocker arm forces to the lash adjuster.

The invention consists in various features of construction and arrangements of parts which will be described in connection with the preferred embodiments illustrated in the drawings in which

Figure 1 is a vertical section of a portion of an engine cylinder and shows the invention applied to a rocker arm mechanism for operating a single valve.

Figure 2 is similar to Figure 1 and shows the invention applied to a rocker arm mechanism for operating dual valves.

Figure 3 is a selected plan view along the line 3—3 of Figure 2.

Figure 4 is a side elevation of a bracket which may be used to support certain elements embodied in the invention.

In Figure 1 the invention is embodied in an engine 1 having a cylinder 2 with a reciprocal valve 3 which has a stem 4 mounted in a guide 5. The valve 3 is yieldably biased to a closed position by means of a spring 6 which is compressed between the combined cap and spring retainer 7, fixed to the top of the valve stem 4, and a suitable stationary part of the engine 1 circumjacent the valve guide 5, as shown at 8.

Movements of the valve 3 are actuated in the first instance by the usual rotary cam 9. Variations in the radii of the cam 9 are transmitted through the usual cam roller or follower 10 to the rocker arm 11 which, in response, rocks about its pivotal mounting 12 in the upright support 13 that is fixed to the engine 1.

At the valve end, the rocker arm 11 preferably, but not necessarily, carries a rocker push rod 14. The push rod 14 is pivoted to the rocker arm at 15 and has its lower, "pushing" extremity 16 convexly curved on a large radius. It is desirable that the valve end of the arm 11 be forked and the rod 14 be mounted within its legs so that there is but a slight clearance 17 between the side of rod 14 and the end wall of the bifurcation. This provision allows only a limited pivotal movement of the push rod 14 and insures operativeness of its extremity 16.

The push rod 14 bears upon the top of the lash adjuster device 20. This device bears upon the

cap 7 on the valve stem 4 to comprise the last of the parts which transmit the signals of cam 9 into reciprocal movement of the valve 3. The lash adjuster chosen for illustration is well known to the art and comprises a cylindrical housing 21 which has a recess 22 in its lower end. A piston 23 is slidably mounted in the recess 22 and restrained from excessive movement by a lock ring 24 in the wall of the cylinder 21. It is the lower end of the piston 23 which bears on the cap 7. The lash adjuster is actuated to prevent slack and lost motion by means of pressure fluid which is admitted to the recess 22 and top of piston 23 through the ports 25.

It is to be realized that the invention may embody any type of lash adjuster which may be broadly construed as the equivalent of the construction just described.

The lash adjuster 20 is mounted in a guide support 30 which is stationary. This guide support may be rendered stationary in any of a number of ways, as those in the art will realize, but in the preferred form it is formed on the end of the arm 31 which depends from the rocker arm support 13. The guide support 30 has a bore which is coaxial with the valve 3 and this may, if desired, be provided with the spaced liners 32. Pressure fluid to actuate the lash adjuster 20, usually oil from the engine lubricating system, is admitted to the guide support 30 by means of a suitable conduit 33 connected to the port 34 in the support walls. As shown, the lash adjuster 20 is mounted in the guide support 30 so that the cylinder 21 is closely fitted to, but reciprocal in, the liners 32. The ports 25 and 34 and the space between the inner ends of the liners 32 are adjusted so that oil may reach the recess 22 from line 33 in any suitable position of the cylinder 21.

It has been indicated above that an object of the present invention is to eliminate side thrust on the valve 3 due to the motion of the rocker arm 11. A mere inspection of the construction in Figure 1 will now show that this has been accomplished since the cylinder 21 and piston 23 are constrained by the stationary guide support 30 to move only in a direction coaxial with the valve 3. Thus, the piston 23 can apply only direct axial thrust to the valve cap 7, providing, of course, that their line of engagement is normal to the axis of the valve as shown in Figure 1. Transverse forces applied by the push rod 14 to the lash adjusted 20 are transmitted through the guide support 30 to the arm 31 and support 13.

In Figure 2 the invention is embodied in an engine 51 having a cylinder 52 with dual reciprocal valves 53 which have stems 54 mounted in guides 55. The valves 53 are yieldably biased to a closed position by means of springs 56 which are compressed between the retainers 57, fixed to the ends of the valve stems 54, and suitable stationary parts of the engine 51 circumjacent the valve guides 55 as shown at 58.

Movements of the valves 53 are actuated in the first instance by the usual rotary cam 59. Variations in the radii of the cam 59 are transmitted through the usual cam follower or roller 60 to the rocker arm 61 which, in response, rocks on its pivotal mounting 62 in the upright support 63 that is fixed to the engine 51.

The usual movable T-shaped bridge 65 is connected at its midpoint to the valve end of the rocker arm by means of a ball and socket joint 66. The outer ends of the bridge 65 are forked and carry the rocker push rods 67 which are pivotally mounted as shown at 68. As in Figure 1, slight clearances 69 are provided between the sides of the push rods 67 and the slotted bridge ends to limit the angular movement of the rods. The lower extremities of the rods 67 are convexly curved in the same manner as rod 14, previously described.

The rods 67 bear upon the lash adjusters 70 which are no different than adjuster 20 which has been described in connection with Figure 1. Thus, they comprise cylinders 71 having recesses 72 with pistons 73 held therein by the lock rings 74. Pressure fluid to actuate the lash adjusters 70 is admitted through the ports 75 to the recesses 72. The pistons 73 bear upon the top ends of the valve stems 54 to apply forces thereto.

The lash adjusters 70 are mounted in stationary guide supports 80. These may, if desired, have spaced liners 82 and have ports 84 for the admission of pressure fluid through conduits 83. As before, the cylinder 71 is carefully fit for reciprocating movement in the liners 82 and the ports 84 communicate with the recesses 72 and pistons 73 through ports 75.

Though the invention is not so limited, the guide supports 80 are conveniently parts of a bracket 90. This bracket, which appears most clearly in Figures 3 and 4, is fixed to the engine 51 by means of bolts (not shown) through its flange 91 and upright body section 92. The guide supports 80 are fixed to and suitably positioned upon the body section 92 so that they project over and are coaxial with the valves 53.

It is also convenient to mount the bridge 65 on the bracket 90. For this purpose the bracket 90 has a central flange 94 at its lower end which carries a bushing 95. The central leg or shaft 96 of the T-bridge is mounted in the bushing 95 and the dimensions are arranged so that it is a loose fit. The bridge 65 is yieldably biased upward toward the rocker arm 61 by a compressed spring 97 encircling the shaft 96 between the top of the bridge and a washer 98 resting in an annular recess about the bushing 95.

As was the case with the device of Figure 1, an important feature of the construction of Figure 2 is the stationary guide bore 80 for each lash adjuster 70. Because of this construction, the lash adjusters 70 not only eliminate lost motion in accordance with the prior art but also eliminate transverse forces due to the motion of the rocker arm 61 so that only direct axial forces are applied to the valves 53.

Another important feature of the device of Figure 2 is the loosely mounted, semi-floating T-bridge 65, particularly, when used in conjunction with the pivoted pusher rods 67. The bridge 65 may be moved somewhat in a transverse direction and thus adjusts itself to non-axial loading by the rocker arm 61. This reaction reduces the transverse component of rocker arm force which is transmitted to the push rods 67. Since the push rods 67 are pivotally mounted at 68 and convexly curved on their lower ends, they tend to remain axially aligned with the valves 53 despite the tilting of the bridge 65. The outcome of the combined action of the floating bridge 65 and the pivoted, convex push rods 67 is thus to decrease to some extent the transverse force applied to the lash adjusters 70.

In addition to reducing the number of parts and providing a more economical construction, the present construction has not only removed side thrust on the valves but has also reduced the inertia of the rocker arms by mounting the lash adjusters in stationary guides. This ar-

rangement also eliminates the necessity for running oil conduits through the rocker arm and bridge in order to actuate the lash adjusters. In the present invention, the lash adjusters can be connected directly to the source of pressure fluid, as shown by conduits **33** and **83**.

As set forth above, except as claimed, it is not intended to limit the invention to the specific construction illustrated and, in particular, it will be recognized that it can be applied to a rocker arm mechanism for operating more than two valves of various types or dispositions.

What is claimed is:

1. In an internal combustion engine having a cylinder, reciprocable valves for said cylinder, a rocker arm for providing valve opening forces, means for pivotally mounting said rocker arm on said cylinder, said means provided with stationary bores therein in axial alignment with said valves, reciprocable lash adjusters slidably fitted in said bores for transmitting axial forces only to said valves and provided with flat force receiving surfaces, means operatively connecting said rocker arm to said lash adjusters including, a movable bridge operatively connected to said rocker arm, arms on said bridge provided with pivotally mounted push rods having convex surfaces in engagement with said flat force receiving surfaces of the lash adjusters to allow substantially tangential contact therewith at all times, a stem on said bridge to loosely mount said bridge on said cylinder in parallel alignment with said bores to allow a relatively small degree of transverse movement in said bridge whereby substantially axial forces will be delivered to said lash adjusters for opening said valves.

2. In an internal combustion engine having a cylinder, reciprocable valves for said cylinder, a rocker arm for providing valve opening forces, means for pivotally mounting said rocker arm on said cylinder, said means provided with stationary bores therein in axial alignment with said valves, reciprocable lash adjusters slidably fitted in said bores for transmitting axial forces only to said valves and provided with flat force receiving surfaces, means operatively connecting said rocker arm to said lash adjusters including, a movable bridge operatively connected to said rocker arm, arms on said bridge provided with pivotally mounted push rods having convex surfaces in engagement with said flat force receiving surfaces of the lash adjusters to allow substantially tangential contact therewith at all times, means providing a stationary bore for said bridge which is parallel to the other bores, a stem on said bridge loosely mounting said bridge in said bore to allow a relatively small degree of transverse movement on said bridge whereby substantially axial forces will be delivered to said lash adjusters for opening said valves.

3. In an internal combustion engine having a cylinder, dual valves for said cylinder, reciprocable hydraulic lash adjusters engaging the ends of said valves, a support fixed to said engine, said support having bores coaxial with the valves and of substantially the same diameter as said lash adjusters, said lash adjusters being slidably mounted for transmitting axial forces only to said valve, a T-bridge having arms projecting over said lash adjusters, said lash adjusters having force receiving ends comprising plane surfaces normal to the valve axes, push rods pivotally connected to said bridge arms and having convex surfaces engaging said adjuster force receiving ends, said T-bridge having a stem, said support fixed to said engine having a bore slightly larger than said stem, said bore being parallel to and between said adjuster bores, said bridge being mounted in said bore to allow a small degree of transverse movement of said bridge, a rocker arm providing valve opening forces, said T-bridge being connected to said rocker arm to receive valve opening forces therefrom, and spring means urging said bridge against said rocker arm and valve opening forces.

4. The combination with an internal combustion engine having a cylinder, of a plurality of valves in said cylinder, valve cams for said valves, and at least one support between said valves and said valve cams, a rocker arm pivotally mounted on said support and having one end engaging said cam and the other end extending over said valves, a semi-floating spring mounted T bridge loosely mounted on the end of said rocker and extending over said valves, and a support having stationary guide bores in alignment with said valves between said T bridge and said valves, lash adjusters closely fitted to said bores, said adjusters operatively connected to the T bridge and to the end of said valve, a central flange on said support, a bushing in said flange to loosely receive said T bridge so that it may be moved in a somewhat transverse direction to adjust itself to non-axial loading by the rocker arm, said T bridge in cooperative relationship with said support whereby only axial thrust is transmitted from said rocker arm to said valve.

5. In an internal combustion engine having a cylinder, a plurality of reciprocable valves for said cylinder, a rocker arm for providing valve opening forces, means for pivotally mounting said rocker arm on said cylinder, said means provided with stationary bores thereon in alignment with said valves, a movable bridge operatively connected to said rocker arm including, arms thereon substantially perpendicular to the axial line of said bores, a main stem substantially parallel to said bores, and convex face push rods pivotally mounted on the ends of said bridge arms, said main stem loosely mounted in said cylinder to allow said bridge to move a relatively small amount in the direction transverse to the axial valve opening forces of said rocker arm, reciprocable lash adjusters slidably mounted in said bores for engagement at one end with one of said valves and at the other end with one of said push rods, said movable bridge and said lash adjusters so constructed and arranged that the valve opening forces received from said pivotal push rods will have a small transverse component of force and only the axial component of said force will be delivered to said valves by the lash adjusters.

ARTHUR O. KUTZ.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,687,911	Vincent	Oct. 16, 1928
1,696,866	Seaman	Dec. 25, 1928
1,798,938	Hallett	Mar. 31, 1931
1,905,888	Berry	Apr. 25, 1933
1,996,807	Hallett	Apr. 9, 1935
2,054,928	Church	Sept. 22, 1936
2,380,051	Kettering	July 10, 1945
2,411,775	Bronander	Nov. 26, 1946