Sept. 1, 1959 C. B. LEACH 2,902,014

VALVE ACTUATING MECHANISM FOR ENGINES

Filed June 1, 1954 2 Sheets-Sheet 1

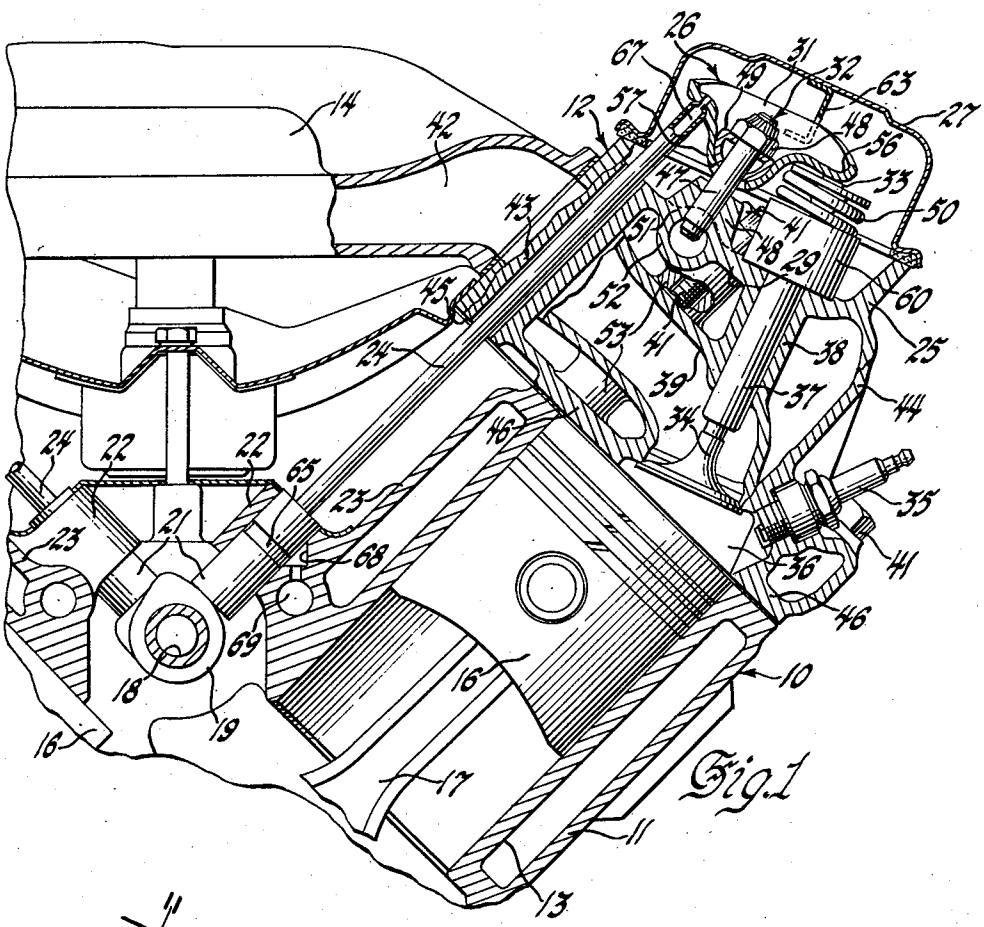

Fig. 1

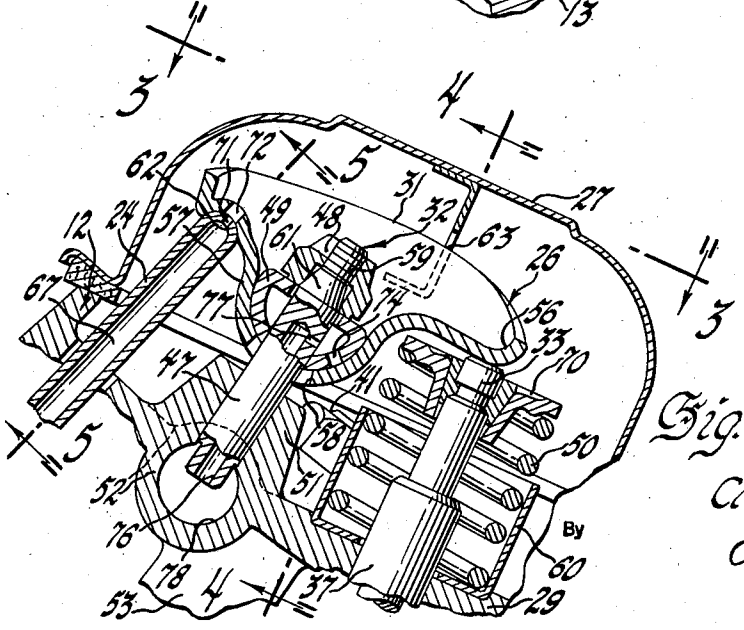

Fig. 2

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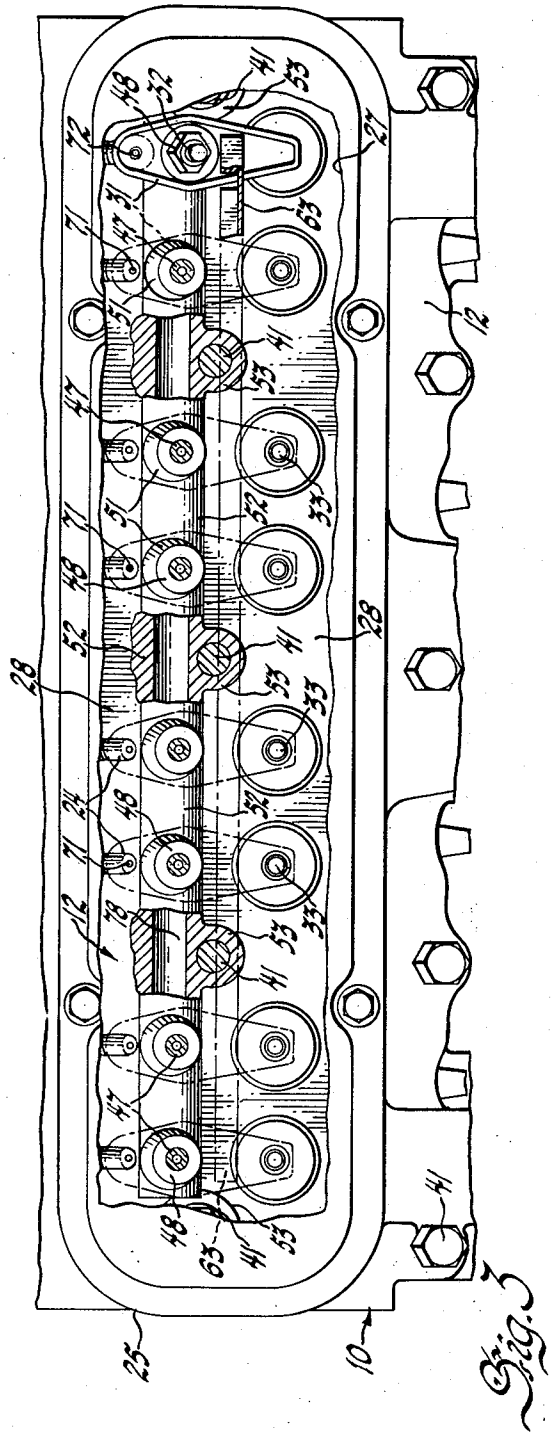

Fig. 3

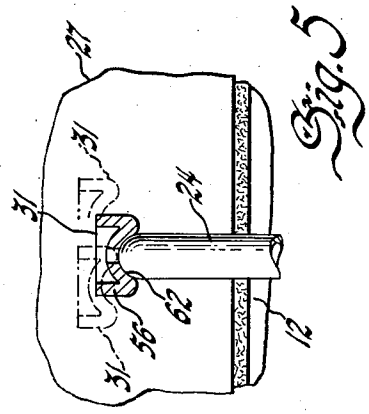

Fig. 5

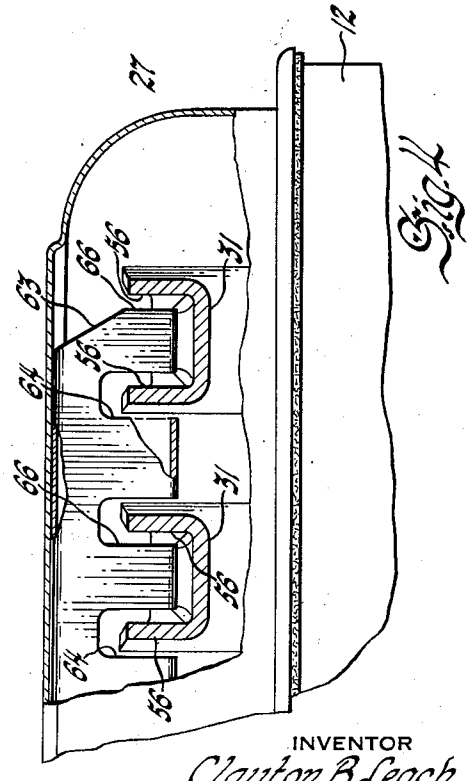

Fig. 4

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VALVE ACTUATING MECHANISM FOR ENGINES

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Application June 1, 1954, Serial No. 433,405

4 Claims. (Cl. 123—90)

This invention relates to a valve actuating mechanism for engines and has particular relation to valve actuating mechanism especially applicable for use with valve in head internal combustion engines for automotive and other uses.

In the construction of engines it has heretofore been the practice to employ valve actuating mechanism utilizing rocker arms mounted in parallel relation for oscillation upon an elongated shaft. The shaft is usually mounted at a plurality of places throughout the length thereof on rocker shaft supports which are secured to the outer wall of the head of the engine. Such rocker shafts and the mounting thereof on the head of the engine is relatively expensive and since the rocker arms are all mounted on a single shaft it is difficult to adjust the lash or operating clearance of one rocker arm without affecting the other rocker arms on the same shaft. Even when all of the rocker arms are properly adjusted it is difficult to retain this adjustment for any considerable length of time. Any appreciable distortion of the head which might result from tightening or loosening of one or more of the head bolts or from temperature changes that occur under different operating conditions of the engine is likely to distort the rocker shaft out of the position in which the rocker arms are properly adjusted and this may cause a variation in the adjustment of several rocker arms with respect to the valve stems and push rods with which they are associated.

It is now proposed to provide a valve actuating mechanism especially applicable for use with valve in head engines and in which the rocker arms are independently mounted upon the engine head and each rocker arm may be adjusted with respect to its push rod and valve stem independently of any other rocker arm. It is also proposed to provide a valve actuating mechanism in which each of the rocker arms is directly and rigidly supported upon the upper end of the cylinder block and in such a way that distortion of the head will not materially affect the adjustment of any of the valves. It is further proposed to provide a means for limiting the possible rotational movement of the rocker arms in such a way that the ends of the arms may not become disengaged from either the push rods or the valve stems when the clearance is increased by a sticking valve.

In the drawing:

Figure 1 is a fragmentary cross sectional view of a valve in head V type engine employing a valve actuating mechanism embracing the principles of the invention.

Figure 2 is an enlarged view of the upper part of one of the heads of the engine disclosed by Figure 1 and illustrating in more detail certain of the structural and operational features of the valve actuating mechanism employed in the engine.

Figure 3 is a fragmentary plan view of the engine disclosed by Figure 1 with parts of the valve actuating mechanism cover and of the head and the valve actuating mechanism broken away to better illustrate certain features of the valve actuating mechanism embracing

the principles of the invention. Figure 3 is taken substantially in the plane of line 3—3 on Figure 2 looking in the direction of the arrows thereon.

Figure 4 is a fragmentary view partly in side elevation and partly in longitudinal section through the valve actuating mechanism shown by the preceding figures and illustrating particularly a means for limiting the lateral movement of the rocker arms of the valve actuating mechanism when certain conditions occur during the operation of an engine. Figure 4 is taken substantially in the plane of line 4 on Figure 2 looking in the direction of the arrows thereon.

Figure 5 is a fragmentary view of the valve actuating mechanism as a push rod and its rocker arm might appear partly in cross section and partly in elevation on line 5—5 of Figure 2. Figure 5 also illustrates in dotted lines certain undesirable positions that an individually mounted rocker arm might assume during the operation of an engine except for the rocker arm movement limiting means which forms a part of the invention.

The engine 10 embracing the invention comprises a water jacketed block 11, a pair of engine heads such as that indicated at 12 and secured to each bank of aligned cylinders 13 employed in the block and an inlet manifold 14 extending between the heads 12. The cylinders 13 are adapted to receive pistons 16 connected to the engine crankshaft by connecting rods 17 and adapted to reciprocate in the cylinders 13 during the operation of the engine. The engine 10 may employ a crankshaft driven camshaft 18 provided with cams 19 for operating valve lifters 21 which are mounted for reciprocating movement in bosses 22 projecting inwardly from the inner walls 23 of the banks of cylinders 13. The lifters 21 are adapted to engage push rods 24 for driving valve actuating mechanisms 26 located in covers 27 secured to flanges 25 extending from the upper walls 29 of the engine heads 12. The valve actuating mechanisms 26 for each head comprise rocker arms 31 which are pivotally and rotatably mounted on aligned rocker arm supports 32 disposed near the valve stems 33 of a pair of valves 34 for each of the cylinders 13. The valves 34 are inlet and exhaust valves which open into combustion chambers 36, one for each cylinder of the rows or banks of cylinders indicated at 13. The valves 34 are resiliently held in closed position by springs 50 which are compressed between the upper walls 28 and valve retainer washers 70 secured in the upper end of the stems 33. The springs 50 may be provided with vibration damping devices 60 which may be seated on the upper walls 28 and in which the lower ends of the springs 50 may be slidably retained. Spark plugs 35 project through the heads and into the combustion chamber 36 for igniting the charges compressed therein. The valves 34 are reciprocally mounted in valve guides 37 secured in openings formed in valve guide supports 38 that extend inwardly from the upper wall 29 of the heads 12 and terminate in the outer walls of inlet passages 39 and the exhaust passages for the inlet and exhaust valves indicated at 34. Figure 1 shows one of the valve guide supports 38 terminating in the outer wall of an inlet passage indicated at 39 for an inlet valve indicated at 34. The inlet passage extends from the valve 34 to the inlet manifold 14. In addition to the upper walls 29 the heads 12 comprise inside walls 43, outside walls 44 and inner walls 46. The inner walls 46 extend along the upper ends of the cylinders 13 and are secured to each bank of cylinders by bolts 41 extending through the heads 12. The rocker arm supports in the present instance are formed by studs 47 having heads 48 against which hemispherical bearings 49 are adapted to be supported. The studs 47 are adapted to be press fitted in

openings or sockets formed in bosses 51 projecting from the upper wall 29 of the head 12.

In order that all of the supports 32 supporting the rocker arms 31 shall be rigidly supported in the upper walls 29 of the heads it is proposed to employ reinforcing means in the form of a beam or tubular enlargement 52 which is formed integrally with the upper walls 29 of the heads 12 and extends substantially throughout the length of the heads 12 in parallel relation to the valve stems 33. In order to further reinforce the upper walls 29 of the heads 12 to insure an extremely rigid support for each of the rocker arms 31 it is proposed to provide additional supports 53 in the form of a row of columns extending between the upper walls 29 and the lower walls 46 of the heads 12. The columns 53 merge at the upper extremities thereof with the upper walls 29 and the beams 52 and at the lower ends thereof with the walls 46. The lower ends of the columns 53 are disposed immediately above and between the ends of the cylinders 13 and the inner walls 23 of the water jackets for the cylinders of the engine. The column 53 may be tubular in form for receiving certain of the head bolts 41.

As will be noted from Figure 3 of the drawing the engine 10 is provided with one inlet and one exhaust valve for each of four cylinders of each bank of cylinders of the engine. There is also one rocker arm 31 and one stud 47 for each valve for each cylinder of the engine. Each of the studs 47 is supported in one of the two bosses 51 for each cylinder of the engine. The bosses 51 will be seen to project directly upwardly from the part of the upper wall 29 in which the beam 52 is formed. As will be further noted from examining Figure 3 one of the columns 53 is located on each side of each cylinder of the engine and the columns merge at the upper ends thereof with the beam 52 to provide one beam section supported by two of the columns 53 for each cylinder of the engine. Each of the sections of the beams 52 for each cylinder of the engine therefore is supported at the opposite ends thereof directly above the inner walls of the water jacket of the engine and between the inner walls 23 and the cylinders 13. The bosses 51 are between the ends of the sections of the beam 52 for each cylinder of the engine and two of the columns 53. It will, therefore, be apparent that each section of the beam 52 supports two of the rocker arms 31 and is reinforced at the opposite ends thereof by supporting columns 53 which extend through the water jacket of the head 12 and are directly supported at the lower ends thereof upon the upper end of the block of each bank of cylinders in directly opposed relation to the cylinders and the inside walls 23 of the water jacket of each bank of the cylinders of the engine 10.

Again referring to Figure 1 it will be apparent that each section of the beam 52 is further reinforced by a transverse truss member consisting of the inner walls 43 of the heads 12 which are supported at the opposite ends thereof on the ends 45 of the block 11 and an obliquely disposed brace or support consisting of the valve guide supports 38, the passages 39 and the part of the inner wall 46 which forms the large end of the combustion chamber for each cylinder of the engine 10. This obliquely disposed wall extends from one edge of the section of the beam 52 for each cylinder of the engine to the opposite side of each cylinder of the engine.

With such beam and column and reenforcing truss structure it is believed to be apparent that each rocker arm for each cylinder of the engine will be supported upon the block of the engine in such manner that the proper operation of the valve actuating mechanism of the engine will be insured.

Each of the rocker arms 31 is formed of sheet metal and in such manner as to provide a peripheral flange 56 extending entirely around and outwardly from the opposite ends and sides thereof. Within the flange 56 and intermediate the ends thereof each rocker arm is inwardly formed to provide an enlargement 57, the outer surface of which and within the rocker arm depression provides a hemispherical bearing surface terminating in an opening 58 at the inner extremity of the depression and extending through the wall forming the enlargement 57. The hemispherical bearing surface within the enlargement 57 is adapted to seat against the hemispherical bearing member 49 which is secured upon the stud 47 and against the head 48. The head 48 may be formed in any desired manner although in the present instance it is considered desirable to provide a removable head in the form of a nut which may be removed from the stud 47 to permit the rocker arms 31 to be installed and removed after the studs 47 have been inserted in the bosses 51. It is preferable that the nut 48 shall be a self-locking nut of a suitable design so that the adjusted position of the rocker arm 31 will not vary after the rocker arms are installed in proper position with respect to the valve stems 33 and the push rods 24. In the present instance it is considered further desirable to have the nuts 48 secured substantially in a uniform position upon all of the studs 47. For this purpose the nuts 48 are formed to provide threaded outer ends and recessed and conically tapered inner ends adapted to fit the threads 59 and tapering shoulders 61 with which each of the studs 47 is provided. It will be apparent that when the heads 48 are tightened on the threads 59 of the studs 47 that the inner recessed and tapered ends of the nuts will engage the tapering surfaces 61 on the studs and that the nuts will be locked on the studs when the torque applied to the nuts reaches a predetermined value.

It will be apparent that each of the rocker arms 31 may be both rotated and oscillated upon the supports 32. However, in order to prevent rotation of the rocker arms 31 during the normal operation of the engine it is proposed to provide outwardly disposed sockets in the push rod engaging ends of the rocker arms to operatively receive the rounded and substantially hemispherical ends of the push rods indicated at 62. During the normal operation of the engine when the valves of the engine are operating properly it will be apparent that the engine push rods will remain in the sockets in the ends of the arms 31 and the rocker arms therefore will not rotate upon the supports 32. However, if one of the valves should cease to function properly and should remain open within the port the valve is adapted to close then a condition might arise such as that indicated by Figure 5. The full line cross sectional view of the push rod end of the rocker 31 in Figure 5 indicates the position of the rocker arm under normal operating conditions. The broken line views of the rocker arm indicate how the rocker arm might rotate in either direction in the event the valve operated by the rocker arm should remain permanently open. It will be apparent from the broken line views of the rocker arm that the socket in the end of the rocker arm might be moved far enough in one direction or another from the operative position of the push rod that the rocker arm might be forced out of operative position with respect to the push rod. In order to insure against the occurrence of such an event it is proposed to employ rocker arm rotation limiting means such as that disclosed by the preceding figures of the drawing and indicated by the numeral 63. Such means is in the form of an elongated channel extending throughout the length of the cover 27 and secured to the cover by welding or otherwise securing one of the flanges of the channel to the inner surface of the upper wall of the cover. The channel 63 is wide enough to extend downwardly into the zone of operation of the rocker arms 31 and is there provided with notches 64 and 66 for each rocker arm that are appreciably wider than the thickness of the flanged edges 56 of the rocker arms, the width of the notches 56 is such that should one of the valves of the engine become inoperative and the rocker

arm thereof tend to rotate in either direction into either of the positions shown in broken lines in Figure 5 the flanges on the valve will engage the member **63** at the edges of the notches and limit the movement of the rocker arm so that the rocker arm will not be able to reach the position illustrated in broken lines in Figure 5.

In order to lubricate the valve actuating mechanism **26** within the covers **27** it may be desirable to provide hollow push rods as is indicated at **67** and to supply the hollow push rods with oil from the valve lifters **21**. The interior of the valve lifters may be supplied with oil through openings extending from grooves **65** in the side walls thereof. The oil so supplied is received from passages **68** supplied by oil galleries **69** connected in any suitable manner to the outlet from the oil pump of the engine. The oil so supplied to the passages **67** in the push rods **24** may be metered outwardly of the upper ends thereof through passages **71** where the oil may be employed in lubricating the sockets in the push rod engaging ends of the rocker arms **31**. The oil from the passages **71** also may be supplied to the depressions within the inner walls of the rocker arms **31** through openings **72** which may be formed in the sockets in the push rod engaging ends of the arms **31**. The openings **72** may be directly aligned with the openings **71** or they may be formed somewhat out of alignment so as to register only to a slight extent during each operative movement of the push rods **31**, thereby providing a control for the amount of oil supplied to the depressions in the rocker arms **31**. The oil supplied by the openings **71** and **72** to the depressions in the rocker arms **31** may thereafter be employed in lubricating the engaging surfaces of the spherical bearing means on the rocker arms **31** and the rocker arm supports **32**. Such oil also may spread to the opposite ends of the rocker arms by surface tension movement along the inner surfaces of the rocker arms and may move beyond the flanges **56** around the valve stem engaging ends of the rocker arms and outwardly upon the exterior surface of the rocker arms for lubricating the valve stems and the engaging surfaces of the rocker arms and the ends of the valve stems. The oil so supplied will flow downwardly by gravity upon the valve stems and will be distributed along the engaging surfaces of the valve stems on the valve guides **37**.

The flanges **56** at the valve stem engaging ends of the rocker arms may be employed not only for stiffening the ends of the rocker arms but for controlling the amount of oil that may be supplied from the interior of the rocker arms to the upper ends of the valve stems. It will be apparent that the greater the height of the flanges **56** at the valve stem engaging ends thereof the less will be the amount of oil so supplied.

The rocker arms also may be lubricated by oil supplied to the hollow interior of the hemispherical bearing members **49** and distributed to the spherical bearing surfaces of the rocker arms by openings indicated at **74**. Oil may be supplied to the openings **74** by passages **76** and **77** formed in the studs **47** and communicating with the hollow interiors of the bearing members **49** and an oil gallery **78** which may be formed in the supporting beam **52**. The oil gallery **78** may be made to communicate with the gallery **69** through suitable passages formed in the block and head of the engine or may be connected to the oil pump of the engine in any other desirable manner. It will be apparent that the oil supplied to the spherical bearing means by the openings **74** will move by surface tension throughout all parts of the interior of the rocker arms **31** and may be made to lubricate the valve stems in the manner previously described and may even be employed in lubricating the socket engaging ends of the push rods **24** through openings similar to those indicated at **72**. It will be apparent that it may be desirable under such circumstances not to supply oil to the push rods **24** and not to provide the openings **71** in the socket engaging ends of the push rods **24**.

I claim:

1. A valve operating mechanism for an engine having a head and a valve in said head and a rocker arm for operating said valve, a support for said rocker arm, said support having an inner end secured in an opening in said head and an outer end terminating in a tapering shoulder and a threaded end, said shoulder being inwardly of the inner extremity of said threaded end of said support, spherical bearing means on said support and inwardly of said threaded end and said shoulder, spherical bearing means on said rocker arm and inwardly of and engaging said support bearing means, said bearing means supporting said rocker arm on said head, and a nut having a tapering internal surface thereon, said internal surface being complementary to said tapering shoulder, said nut engaging said threaded end and said shoulder and said support bearing means and fixing said bearing means on said support, said nut being limited in the movement thereof in one direction on said threaded end by said nut engaging said shoulder, said nut being movable on said threaded end and toward and away from said shoulder.

2. A valve operating mechanism for an engine having a head and a valve in said head and a rocker arm for operating said valve, a support for said rocker arm, said support having an inner end secured in an opening in said head, spherical bearing means on said support, spherical bearing means on said rocker arm and inwardly of and engaging said support bearing means, said rocker arm being disposed to engage said valve and to operate said valve in the plane of oscillating movement of said rocker arm and said valve, a valve mechanism cover secured to said head and enclosing said valve and said support and said rocker arm, and stop means supported by said cover and projecting inwardly of said cover and adjacent said rocker arm, said stop means being spaced from said rocker arm in the plane of oscillating movement of said rocker arm and permitting said oscillating movement of said rocker arm and said valve, said stop means also being disposed to limit rotational movement of said rocker arm on said support, said rotational movement being limited to permit said oscillating movement of said rocker arm and said valve but to prevent movement of said rocker arm out of said plane of oscillating movement of said rocker arm and said valve and the operative disengagement of said rocker arm and said valve.

3. A valve operating mechanism for an engine having a cylinder and a head closing said cylinder and a valve in said head and a rocker arm operating said valve, said head being formed to provide spaced inner and outer walls, said inner wall closing the end of said cylinder and said outer wall providing a valve guide for said valve, a pair of columns extending between said inner wall and said outer wall and disposed on opposite sides of said cylinder and in directly opposed relation to and extending axially away from said cylinder, a single support disposed on said outer wall and between said columns and supporting said rocker arm for operating said valve, and a beam formed in said outer wall and extending along said outer wall and between said columns and inwardly of said support, said beam being thicker than said outer wall and merging with said support and said columns and said outer wall, said beam and said support and said columns providing a rigidly integrated truss within said head and supporting said rocker arm between said columns and over and upon said cylinder.

4. A valve operating mechanism for an engine having a head and a valve in said head and a rocker arm for operating said valve, a support for said rocker arm, said support having an inner end secured in an opening in said head and an outer end terminating in a threaded end, a spherical bearing means on said support and inwardly

of said threaded end, spherical bearing means on said rocker arm and inwardly of and engaging said support bearing means, said bearing means supporting said rocker arm on said head, a nut engaging said threaded end and said support bearing means and securing said bearing means on said support, and abutment means on said nut and said support and inwardly of said threaded end on said support and limiting the inward movement of said nut on said support, said means determining the exact location in any one of an infinite number of positions of said bearing means on said support and the position of said rocker arm relative to said head.

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