May 22, 1956 L. J. VAN SLOOTEN 2,746,437

HYDRAULIC VALVE LIFTER

Filed March 30, 1953

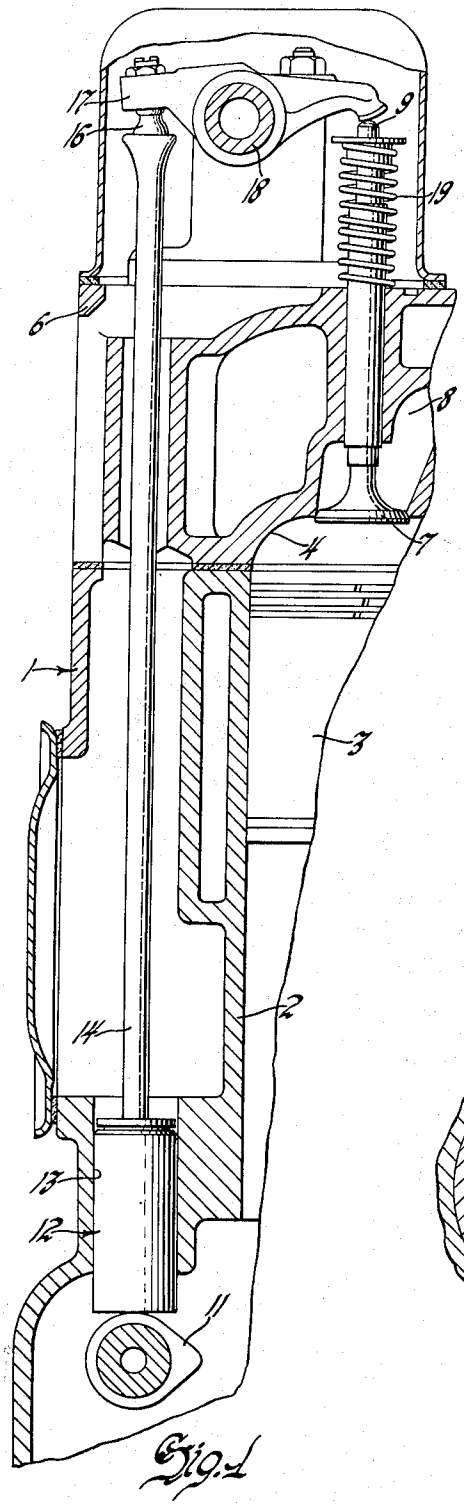


Fig. 1

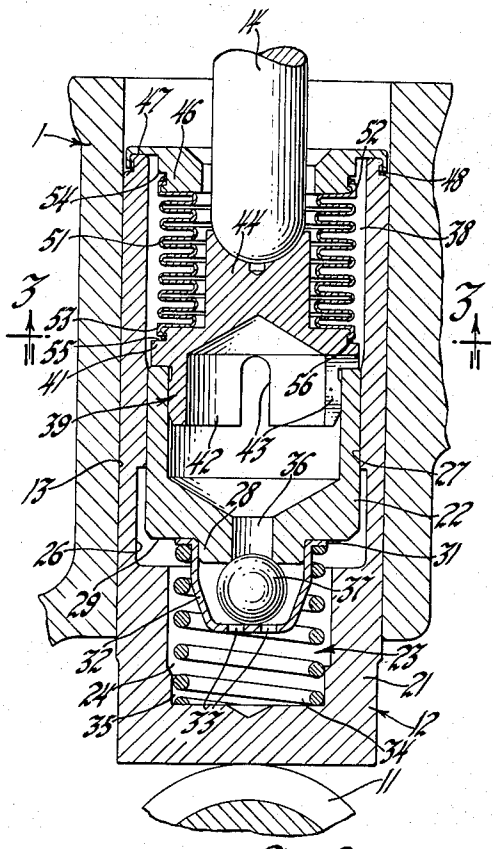


Fig. 2

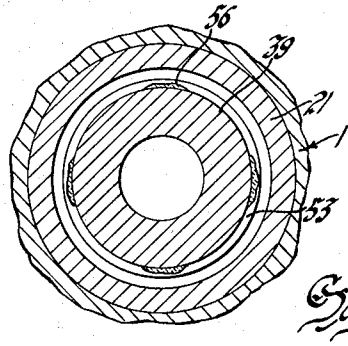


Fig. 3

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United States Patent Office 2,746,437
Patented May 22, 1956

2,746,437

HYDRAULIC VALVE LIFTER

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Application March 30, 1953, Serial No. 345,594

6 Claims. (Cl. 123—90)

This invention relates to hydraulic valve lifters for automatically taking up excess lash in the valve trains of internal combustion engines and the like, and particularly to such lifters of the "self-contained type" in which the hydraulic fluid is sealed within the assembly with no provision for its replenishment from any external source during operation.

The principal object of the invention is to provide an improved construction for lifters of the aforementioned type comprising a generally cup-shaped cylinder having a slidably fitted plunger therein and the open end of the cylinder cup sealed by an expansible bellows which is enclosed within the cylinder above the plunger, the opposite ends of the bellows being sealingly connected in a novel manner to the side walls of the cylinder and to a thrust transmitting member laterally supported by and resting on the plunger, the assembly as a whole providing a compact design of few parts particularly adapted to low cost manufacture and assembly.

The means by which this and other objects of the invention are attained will be more clearly understood from the following description of a preferred embodiment, having reference to the drawing wherein:

Figure 1 is a sectional view of a portion of an internal combustion engine having a valve operating train incorporating my lifter.

Figure 2 is an enlarged sectional view similar to Figure 1, showing the internal construction of the lifter.

Figure 3 is a sectional view through the lifter, taken on line 3—3 of Figure 2.

Referring now in detail to the drawing, there is shown in Figure 1 an engine cylinder block and crankcase structure designated generally by the numeral 1 in which is located a working cylinder 2 having the usual piston 3. Closing the upper end of the cylinder 2 and forming a combustion chamber 4 above the piston is a cylinder head 6. At 7 is a poppet valve controlling communication between a cylinder head port 8 and the combustion chamber 4 and having a stem 9 slidably mounted for reciprocation in the cylinder head. In conventional manner, reciprocal movements of the valve 7 are effected by rotation of a cam 11 which is suitably supported in the crankcase 1 and driven in timed relation with movements of the piston 3. Completing the valve operating train, I have shown my lifter 12 operatively engaging the cam 11 and slidably supported for reciprocation in a lifter bore 13 formed in the crankcase 1. Upward movements of the lifter are transmitted by the usual push rod 14 to an adjusting screw 16 fixed in one end of the rocker 17, which latter is arranged to oscillate about an axis represented by the rocker shaft 18 suitably supported on the cylinder head 6, the other end of the rocker being in driving engagement with the upper end of the valve stem 9. A valve return spring 19 having one end secured to the valve stem and its other end seated against the cylinder head is also shown, and serves to maintain the valve in closed position as illustrated in Figure 1.

As shown in Figure 2 the lifter 12 comprises telescoping

cup-shaped cylinder and piston members 21 and 22 arranged in nesting relation. Between the closed end of the lifter cylinder 21 and the adjacent end of the lifter piston 22 is a fluid pressure chamber 23 which is normally maintained filled with fluid for transmitting thrust from the cylinder to the piston during opening movements of the engine valve 7. This pressure chamber includes a well 24 which opens upwardly into an enlarged diameter portion 26 of preferably greater diameter than the bore 27 of the cylinder and extending upwardly beyond the lower end of the piston outer periphery. The lower end of the piston has an extension 28 of reduced diameter forming a shoulder 29 at its juncture of the main body to the piston. Loosely journalled on the extension 28 and having an external flange 31 rotatably seated against the shoulder 29 is a cup-shaped cage member 32 whose end wall is provided with one or more apertures 33 which provide communication between the interior of the cage member and the portion of the chamber 23 externally thereof. The lower end 35 of the well 24 is of smaller diameter than the main portion thereof and forms a loose fit about the lower end of a piston biasing spring 34 whose upper end loosely embraces the cage member 32 and maintains the flange 31 of the cage seated against the shoulder 29 of the piston. Extending through the bottom wall of the lifter piston and its extension 28 is a fluid supply passage 36, through which fluid may pass through the interior of the piston to the pressure chamber 23. A check valve accommodating such flow but preventing flow of fluid in the reverse or upward direction through the passage 36 is provided in the form of a ball 37 which is of larger diameter than the passage 36. The seat for this ball 37 is formed by the lower end of the extension 28, and when the ball is in engagement with this seat and the cage flange 31 is in abutment with the piston shoulder 29 only a predetermined small clearance (on the order of a .004–.008 in.) exists between the ball and the bottom wall of the cage member. The side walls of the cylinder member 21 extend above the operating range of the piston 22, forming an enclosure 38 whose internal diameter is preferably made larger than the cylinder bore 27.

The side walls of the piston member terminate at the lower end of the enclosure 38, and resting on the end of the piston side walls is a plug-like member 39 which serves to transmit piston thrust to and forms a lower seat for the push rod 14. This plug or seating member is elongated as shown, having a flange portion 41 intermediate its ends which abuts the end face of the piston side walls and a depending hollow skirt portion 42 which extends into and laterally bears against the internal side wall surfaces of the piston. The flange 41 is of somewhat smaller diameter than the external periphery of the piston, whereby its marginal extremities are substantially spaced from the internal periphery of the enclosure 38, and the skirt portion 42 is provided with one or more notches 43 extending from the lower end thereof and terminating in the flange portion 41 to form fluid passages connecting the interior of the piston with the enclosure 38. Above the flange 41 the seating member 39 is formed with an upstanding portion 44 whose upper end is shown spherically recessed to receive the spherically shaped lower end of the push rod 14.

Spaced above the seating member 39 at the open end of the enclosure 38 is a ring shaped member 46 which embraces the push rod 14 and has its internal periphery slightly larger than the external periphery of the portion 44 of chamber 39. The main body of this ring 46 protrudes into the cylinder member as shown, and has an external flange portion 47 at its upper end which overlies the end face of the cylinder side walls. A fluid tight joint between the cylinder member 21 and ring 46 is pro-

vided by press fitting the down-turned outer extremities of the ring flange portion 47 onto the reduced diameter portion 48 of the cylinder side walls. Extending between and abutting the oppositely disposed faces of the ring 46 and the flange 41 is an expansible bellows 51 which is generally tubular in form and has its opposite ends provided with flanges 52 and 53 respectively which are spun into external grooves 54 and 55 formed on the peripheries of the ring 46 and seating member 39. To insure obtaining a fluid tight connection at these points, as well as at the connection of the ring flange 47 in the groove 48, a fillet 56 of solder or any suitable adhesive material is extended around the bottom of each groove as shown.

In operation, lifting movements of the lifter cylinder 21 in response to rotation of the cam 11 are transmitted to the lifter piston 22 through the medium of the hydraulic fluid which is trapped within the pressure chamber 23 upon closure of the piston passage 36 resulting from the ball check valve 37 moving to its seated position at the lower end of this passage in response to increased fluid pressure in the chamber 23. Continued upward movement of the lifter cylinder is then accompanied by upward movement of the lifter piston which, in turn, transmits this movement through the push rod seat member 39 to the push rod 14, causing the rocker 17 to rotate on its shaft 18 and open the engine valve 7 against its return spring 19. The spring 19 serves both to close the engine valve and to return the lifter to its initial position after each lift stroke of the cam. Any wear or thermal contraction of the parts which would tend to create an endwise clearance between the upper end of the engine valve stem and the cam when the engine valve is in closed position is taken up by the lifter spring 34 urging the lifter piston out of its cylinder and the lifter cylinder against the operating face of the cam. In order that the lifter may also accommodate any lengthening of the valve train resulting from thermal expansion of the parts as the engine heats up in operation, a certain amount of fluid leakage past the lifter piston from the pressure chamber 23 during each lift stroke is provided for in the fit between the lifter piston and the cylinder bore 27. This leakage fluid is returned to the interior of the lifter piston via the notches 43 in the push rod seat 39. As the volume of the pressure chamber is increased by the action of the lifter spring 34 in urging the piston outwardly of its cylinder after each lifting stroke the resultant pressure drop in the chamber 23 permits the ball check valve to leave its seat to the extent permitted by the cage member 32 and sufficient fluid then flows downwardly through the passage 36 to replenish this leakage from the interior of the piston. At the start of the next lift stroke the fluid pressure in the chamber again rises, causing the ball check valve to again seat itself and the operating cycle to be repeated.

Above the flange 41 the cylinder side walls and the bellows 51 provide additional storage capacity for the hydraulic fluid. This fluid is placed in the piston 22 and enclosure 38 prior to sealing the ring flange 47 to the cylinder, and after the latter operation is made at final assembly no further addition of fluid is required during the life of the lifter. A very compact unit is thus obtained which does not depend upon any external source of fluid in operation, and by reason of the bellows being enclosed within the cylinder member 21 it is protected against accidental damage both during service operations on the engine and handling prior to installation.

Having thus described a preferred structural embodiment illustrating the principles and advantages of my invention, minor modifications will readily suggest themselves to persons skilled in the art. Such modifications, however, shall not depart from the spirit and scope of the invention as defined by the following claims.

I claim:

1. In a longitudinally extensible thrust transmitting device comprising slidably interfitted driving and driven members having the side walls of the outer member extending longitudinally beyond the corresponding end of the inner member, means forming a fluid sealing closure for the said end of the inner member, said means being substantially wholly contained within the outer member above the inner member and including a seating member in direct thrust transmitting coaction with said end of the inner member, a bellows having one end seated on said seating member and a ring sealingly securing the other end of the bellows to the outer member, said ring having a portion facing said seating member and in endwise abutting engagement with the bellows.

2. In a longitudinally extensible device having a cylinder member open at one end and a piston slidably fitting the cylinder member and having its end nearest the open end of the cylinder member terminating a substantial distance from said cylinder open end, said piston being hollow and provided with a plug having a flange portion abutting said end of the piston, an upstanding portion extending toward the cylinder open end and a depending portion extending into and laterally bearing on the internal side wall surfaces of the piston, a tubular bellows within the cylinder member loosely embracing said upstanding portion and sealingly secured at one end to said flange, and a ring sealingly securing the opposite end of the bellows to the open end of the cylinder member and having its internal diameter sufficiently large to freely receive said upstanding portion, said ring having a transversely extending seating surface in end-wise abutting engagement with a portion of its adjacent end of the bellows.

3. In a hydraulic lifter having cup-shaped piston and cylinder members in slidably nested relation and forming a fluid pressure chamber between their respective end walls, said piston member having its side walls terminating within the cylinder member in longitudinally spaced relation from the open end of the cylinder member side walls, and sealing means for the open end of the cylinder member substantially wholly recessed within the cylinder member including an elongated piston thrust transmitting member having a flange intermediate its ends in abutment with the open end of the piston member, a ring having a portion press fitted over the open end of the cylinder side walls and a longitudinally expansible bellows having its oppositely disposed ends abutting the oppositely facing portions of said ring and flange, said thrust transmitting member having an end portion depending into the piston member from said flange and laterally supported by the side walls of the piston member.

4. In a hydraulic lifter having cup-shaped piston and cylinder members in slidably nested relation and forming a fluid pressure chamber between their end walls and an enclosure for the storage of fluid outwardly of the piston end wall, said piston member having its open end terminating within the cylinder member in spaced relation from the open end of the cylinder member, a push rod seating member defining a relatively large portion of said enclosure adjacent said pressure chamber, said seating member having oppositely disposed end portions slidably fitting the open end of the piston member and extending therefrom toward the open end of the cylinder, respectively, and having a flange intermediate its said portions abutting the piston outer end, said flange and slidably fitting end portions of the seating member having connecting passages providing fluid communication between the interior of the piston member and the interior of the cylinder member above the piston member, and an expansible bellows loosely surrounding said seating member extending portion, said bellows being wholly contained within the lateral confines of said cylinder member above the piston member and having its oppo-

sitely disposed ends sealingly secured to said flange and to the open end of the cylinder member, respectively.

5. In a self-containing-fluid type hydraulic valve lifter comprising slidably nested cylinder and piston cups having their respective end walls defining a fluid pressure chamber and the interior of the piston cup constituting an adjacent reservoir for fluid entering and leaving said chamber, said cylinder cup having extended side walls forming an enclosure outwardly of the piston cup, a ring member having a flange resting on the open end of the piston cup and a portion depending from the flange and laterally bearing on the internal side wall surfaces of the piston cup, said flange having its lateral extremities spaced from side walls of the cylinder cup and provided with passage means in fluid communication with said reservoir, an annular member forming a seat in oppositely disposed spaced relation to said flange, and a tubular bellows having its opposite ends abutting said seat and flange, said ring and annular members each having a peripheral external groove facing the internal side wall surfaces of the cylinder cup, said cylinder cup having a peripheral external groove adjacent its outer end, said annular member having a flange portion overlying the outer end of the cylinder cup and terminating in said cylinder cup groove, and said bellows having flange portions at its opposite ends terminating in the respective grooves of said ring and annular members.

6. In a hydraulic lifter having cup-shaped piston and cylinder members in slidably nested relation and forming a fluid pressure chamber between their respective end walls, the interior of the piston member forming an adjacent reservoir for fluid entering and returning from the pressure chamber, an expansible bellows disposed wholly

within the cylinder member between the open ends of the piston and cylinder members, said bellows defining with the internal periphery of the cylinder member an extension of said reservoir, an annular member fixedly secured to the cylinder member open end and in abutment with the end of the bellows nearest the open end of the cylinder member, said annular member having an external peripheral groove into which said end of the bellows is crimped and sealingly secured, and a push rod seating member having an upstanding portion loosely received within the bellows and an adjacent flange portion resting on the open end of the piston member, said flange portion being in abutment with the opposite end of the bellows and having an external peripheral groove into which said opposite end of the bellows is crimped and sealingly secured, said seating member having a portion depending from said flange portion and slidably fitting the internal periphery of the piston member, said flange and depending portions of the piston member being provided with connecting passages maintaining fluid communication between said reservoir and reservoir extension.

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