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SELF-CONTAINED TYPE HYDRAULIC VALVE LIFTER

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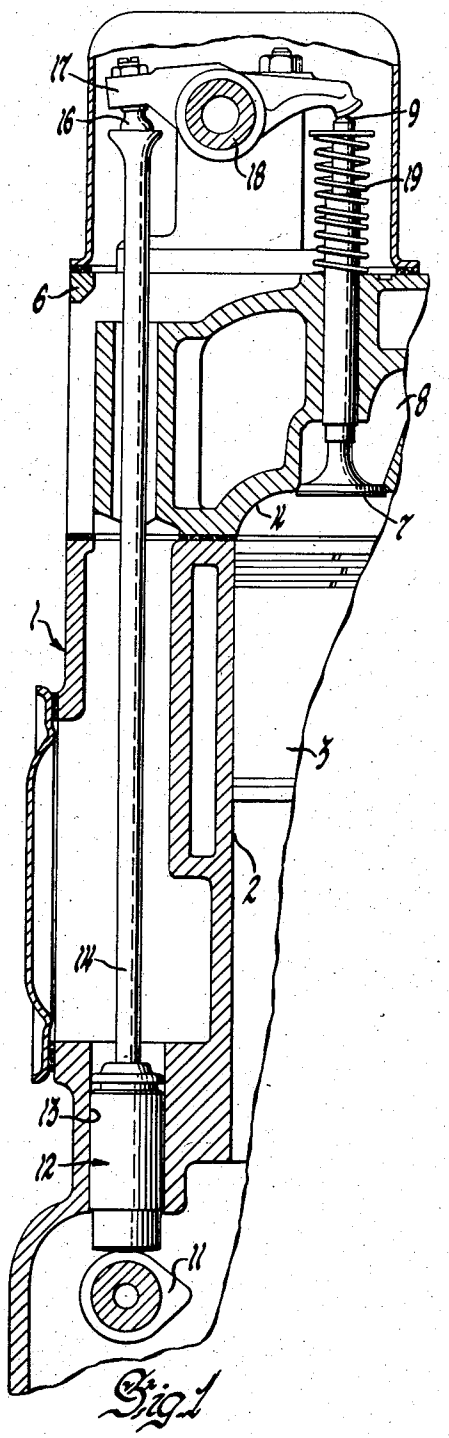


Fig. 1

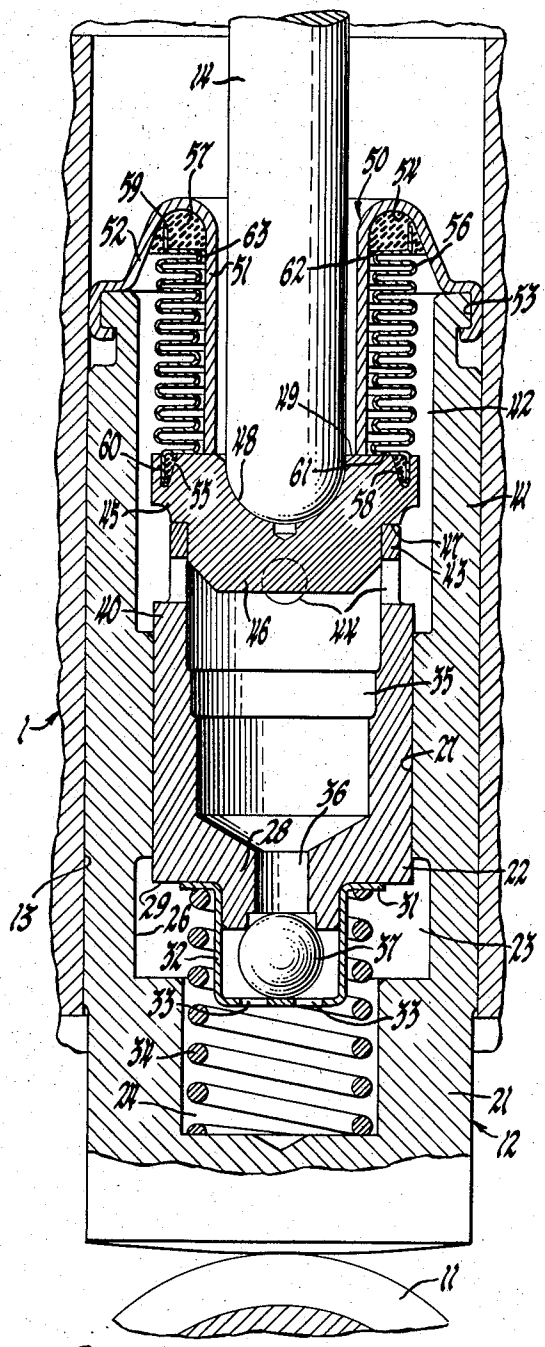


Fig. 2

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SELF-CONTAINED TYPE HYDRAULIC VALVE LIFTER

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

It is the principal object of the invention to provide an improved lifter device of the aforementioned type employing a cylinder, a plunger and a bellows seal between the thrust transmitting end of the plunger and its associated end of the cylinder.

A more specific object of the invention is to provide such a sealing construction in the form of a metallic tubular bellows having piston and cylinder connecting means associated with the respective ends of the bellows which serve in a particularly advantageous manner to support the adjacent bellows pleats against excessive localized bending stresses in operation.

A further object of the invention is to form the connecting means between the cylinder member and its associated end of the bellows with a rigid portion which serves both to protect the bellows from external injury and to prevent excessive movement of its piston associated end in the direction tending to collapse the bellows.

A still further object of the invention is to provide a bellows sealed hydraulic valve lifter which comprises a minimum number of parts of light weight and simple design which can be economically manufactured and assembled into a unit unsusceptible to damage in handling and capable of long service in operation.

The means by which these 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 improved lifter device.

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

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 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 plunger members 21 and 22 arranged in nesting relation. Between the closed end of the cylinder 21 and the adjacent end of the lifter plunger 22 is a fluid pressure chamber 23 which is normally maintained filled with fluid for transmitting thrust from the cylinder to the plunger 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 on the lower end of the plunger outer periphery. The lower end of the plunger has an extension 28 of reduced diameter forming a shoulder 29 at its juncture with the main body to the plunger. 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 providing communication between the interior of the cage member and the portion of the chamber 23 externally thereof. The side walls of the well 24 loosely fit the plunger 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 plunger. Extending through the end or bottom wall of the plunger and its extension 28 is a fluid supply passage 36, through which fluid may pass to the pressure chamber 23 from reservoir 35 interiorly of the hollow plunger. A check valve accommodating such flow but preventing flow 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 plunger extension 28 and when the ball is in engagement with this seat and the cage flange 31 is in abutment with the plunger shoulder 29 only a predetermined small clearance (on the order of .004–.008 in.) exists between the ball and the bottom wall of the cage member.

Above the shoulder 29 the plunger side walls 40 have a close sliding fit in the cylinder bore 27. The cylinder bore 27 extends only a limited distance above the pressure chamber enlargement 26, the upper side walls 41 of the cylinder being relieved on their internal periphery to form an annular extension 42 of the reservoir 35. The piston side walls 43 have their external periphery also relieved adjacent the open end and are provided with one or more apertures 44 interconnecting the reservoir 35 and its extension 42. The upper end of the plunger side walls 43 terminate within the lower end of the reservoir extension 42, and resting on the open end of the plunger is a push rod seat member 45 which serves to transmit plunger thrust to and forms a lower seat for the push rod 14. This seat member 45 has a depending portion 46 extending a short distance into and having a slip fit with the plunger upper side walls 43, the plunger thrust being taken by a shoulder 47 surrounding this depending portion 46. The upper surface of the seat member, including its central push rod seating surface 48 which is preferably made concave as shown, and

the surrounding annular surface 49 which is preferably made flat are both imperforate and form part of the sealing means preventing escape of fluid from the lifter device.

Also included in the sealing means is a rigid member 50, conveniently formed as a sheet metal stamping, and including a tubular portion 51 and a flange portion 52. The tubular portion 51 is of a diameter larger than the push rod 14 and extends coaxially of the cylinder a sufficient distance inwardly thereof to serve as a plunger stop means limiting outward movement of the plunger by abutment with the annular surface 49. The flange 52 which connects the upper end of this tubular portion to the open end of the cylinder, as by a spinning or any other suitable sealed connection 53, forms a pocket 54 facing the annular surface 49.

Adjacent one marginal extremity of the portion of the annular surface 49 surrounding the tubular portion 51 is a recess 55. Extending into this recess 55 and into the pocket 54 are the opposite ends of a tubular bellows 56 which loosely surrounds the tubular portion 51, and completing the sealed connection between the cylinder open end and the push rod seat 45 are upper and lower annular bodies 57 and 58 of solder or other relatively low melting point metal in which the longitudinally out-turned upper and lower flanged ends 59 and 60 of the bellows are imbedded. It will be observed that the lower end pleat 61 of the bellows abuts the flat annular surface 49 adjacent the recess 55, and the solder 58 in this recess is of such depth that its upper surface is flush with the annular surface 49 to cooperate in supporting the end pleat 61. Similarly, the upper body of solder 57 is deposited to such a depth in the pocket 54 as to provide a flat surface 62 adjacent the bellows end flange 59 to abuttably support the upper end pleat 63 of the bellows.

During operation, as the plunger reciprocates in the cylinder the bellows will elongate and contract to maintain a fluid tight connection between the push rod seat 45 and the rigid stamping member 50. By reason of the full width mating engagement of the end pleats 61, 63 with their respective supporting means afforded by the annular surface 49 and the adjacent flush surface of the solder 58, and by the surface 62 of the upper solder body, excessive localized bending stresses in the bellows are avoided and its resultant fatigue failure has been practically eliminated. In addition, the arrangement whereby the bellows end flanges 60 and 59 are imbedded in the solder further ensures that all endwise loading of the bellows is substantially coaxial, whether in tension or compression. The provision of the recess 55 and the pocket 54 facilitate convenient assembly of the bellows to the push rod seat 45 and the rigid member 50 in production since the deposits of solder can be initially installed in each, after which first one end of the bellows and then the other may be imbedded while maintaining the solder in molten condition. The spinning or crimping of the sheet metal flange to form the connection 53 with the cylinder is preferably done after completing the sub-assembly of the last three mentioned parts.

The tubular portion 51, in addition to serving as a stop limiting contraction of the bellows, shields the internal periphery of the bellows from external damage during handling of the lifter and during insertion and removal of the push rod 14 in the engine. The tubular portion 51 also serves to support the bellows against any abnormal lateral deformation resulting from an excessive pressure developing within the reservoir and its extension 42, and the flange portion 52 of the sheet metal stamping serves to cooperate with the tubular portion in shielding the bellows upper end against damage in handling.

While only a single preferred embodiment of the invention has been disclosed, it is appreciated that numerous minor changes in the construction and arrangement of the parts may be made without departing from the spirit and scope of the invention as defined in the following claims.

I claim:

1. In an automatically extensible and contractible thrust transmitting device of the self-contained-fluid type having a cylinder and a plunger reciprocable therein, a body of fluid within the cylinder, said cylinder and plunger having means respectively movable therewith presenting facing longitudinally spaced apart surfaces, one of said surfaces being formed at least in part by a body of relatively low melting point material, and a bellows expandible longitudinally of the cylinder having at least one of its ends defined by a surface facing and parallel to said one surface and a flange, said bellows surface being in abutment with said one surface and said flange being embedded in said material.

2. In an automatic longitudinally adjustable thrust transmitting device comprising slidably interfitted plunger and cylinder members, a body of fluid for transmitting thrust between the plunger member and one end of said cylinder member, at least one of said members having side walls defining a reservoir for fluid to be supplied to and returned from said body with change in length of said device, a stop member limiting movement of the plunger member away from said body, said stop member and the other of said first two named members having facing surfaces in longitudinally spaced apart relation, each of said surfaces being formed at least in part by a body of relatively low melting point material, and a tubular bellows having end pleats abutting said surfaces and longitudinally extending flanges embedded in said material.

3. A hydraulic valve lifter of the self-contained-fluid type comprising generally cup-shaped cylinder and plunger members in slidably nesting relation and forming a fluid pressure chamber between their respective end walls, an imperforate push rod seat abutting the open end of the plunger member, a push rod seat retainer having an elongated portion extending longitudinally of the cylinder member above said push rod seat and an imperforate flange connected to the open end of the cylinder member in a sealing relationship, an annular body of relatively low melting point metal bonded to both said push rod seat and said flange, and a tubular bellows loosely surrounding said elongated portion having end pleats abutting said annular bodies and terminating with oppositely directed longitudinally extending flanges embedded in said annular bodies.

4. A hydraulic valve lifter of the self-contained-fluid type comprising nesting generally cup-shaped cylinder and plunger members having slidably interfitted side wall portions spaced inwardly from their respective open ends and radially spaced other side wall portions adjacent their open ends, an imperforate push rod seat abutting the open end of the plunger member having an annular surface facing outwardly of the cylinder member, said surface having an annular recess therein, a push rod seat retainer including a tubular portion extending into the cylinder member and a flange portion sealingly connected to said other side wall portion of the cylinder member, said tubular and flange portions forming an annular pocket at their juncture facing said recess, an annular body of low melting point material within said recess and bonded therein to said push rod seat, a similar annular body of low melting point material bonded to said retainer within said pocket and defining a surface facing said annular surface, and a tubular bellows loosely embracing said tubular portion having end pleats abutting said surfaces and oppositely directed longitudinally extending flanges embedded in said bodies.

5. A hydraulic valve lifter of the self-contained-fluid type having a cylinder member open at one end, a hollow plunger reciprocable therein and having its corresponding

end open and spaced inwardly of the cylinder member from said cylinder member end, said plunger having its open end defining side walls radially spaced from the open end defining side walls of the cylinder member, said plunger side walls being apertured to provide communication between the interior of the plunger and the open end of the cylinder member, and means sealing the cylinder member open end to the plunger open end and limiting movement of the plunger outwardly of the cylinder member, said means including a rigid tubular member extending into the open end of the cylinder member, a push rod seat socketably fitting the plunger open end and having an imperforate annular surface facing the extended end of said tubular member, said tubular member having an out-turned flange at its other end sealingly connected to the cylinder member open end, and a tubular bellows loosely embracing said tubular member and bonded at its respective opposite ends to said surface and said flange.

6. A hydraulic valve lifter of the self-contained-fluid type having a cylinder member open at one end, a hollow plunger reciprocable therein and having its corresponding end open and spaced inwardly of the cylinder member from said cylinder member end, said plunger having its open end defining side walls radially spaced from the open end defining side walls of the cylinder member, said plunger side walls being apertured to provide communication between the interior of the plunger and the open end of the cylinder member, and means sealing the cylinder member open end to the plunger open end and limiting movement of the plunger outwardly of the cylinder member, said means including a rigid tubular member extending into the open end of the cylinder member, a push rod seat socketably fitting the plunger open end and having an imperforate annular surface facing the extended end of said tubular member, said annular surface being relieved adjacent one marginal extremity thereof by an annular recess, said tubular member having an outturned flange at its other end sealingly secured to the cylinder member open end, an annular body of solder substantially filling said recess and bonded therein to said push rod, an annular body of solder bonded to said flange and defining a surface facing said annular surface, and a tubular bellows having end pleats abutting said surfaces and terminating with longitudinally extending flanges embedded in said bodies of solder.

7. In a hydraulic valve lifter having nestably associated cup-shaped plunger and cylinder members defining a chamber for a thrust transmitting body of fluid between

their respective end walls and a reservoir above the plunger end wall for fluid entering and leaving said chamber, said plunger and cylinder members having their side walls adjacent their open ends radially spaced from each other, a push rod seat member abutting the plunger open end and having an imperforate push rod seating surface and a surrounding imperforate flat annular surface both facing outwardly of the cylinder member, a sheet metal retainer member including a tube extending longitudinally of the cylinder member having one end abuttable with said annular surface adjacent said seating surface and its other end provided with an external flange overlying the space between said plunger and cylinder side walls, said flange being sealingly secured to the cylinder member open end, and a tubular bellows sealingly interconnecting said annular surface and said flange externally of said tube, one of said plunger and retainer members having a passageway for flow of fluid between said space and the interior of the plunger member.

8. In a hydraulic valve lifter including a cylinder open at one end, a plunger reciprocable in the cylinder, and means for sealingly closing the open end of the cylinder including a tubular member disposed between the plunger and the open end of the cylinder and longitudinally extensible in response to plunger reciprocation relative to the cylinder, and a rigid member fixed to the cylinder member outwardly thereof from said tubular member and having a tubular portion extending inwardly of and shielding the internal periphery of said tubular member, said tubular portion being open at both ends to accommodate passage therethrough of external means in thrust transmitting relation with the plunger.

9. The invention defined in claim 8, wherein the plunger adjacent end of said tubular portion is operatively abuttable with the plunger to limit plunger movement outwardly of the cylinder.

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