

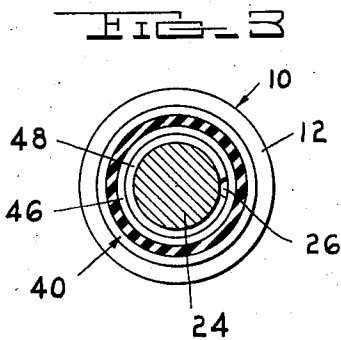
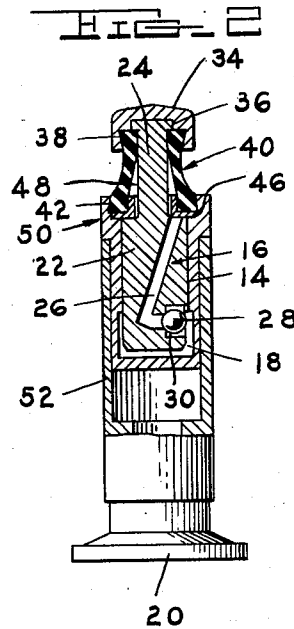
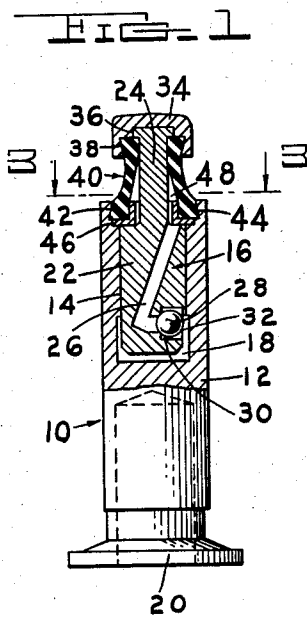
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HYDRAULIC COMPENSATING MECHANISM

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HYDRAULIC COMPENSATING MECHANISM

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This invention relates to valve gear systems of internal combustion engines and more particularly to automatic self-compensating hydraulic tappets therefor.

Broadly the invention comprehends the provision of a self-contained hydraulic tappet employed in the valve gear system of internal combustion engines for cooperative operation with the poppet valves thereof in automatically compensating for changes in the operating length of the system.

An object of the invention is the provision of a simple and effective self-contained automatic compensating or adjusting hydraulic mechanism.

Another object of the invention is the provision of a self-contained hydraulic tappet or mechanism having the operating fluid therefor permanently and hermetically sealed within the unit so as to prohibit seepage of fluid therefrom or contamination of the fluid with dust or other foreign substances from without the tappet.

Another object of the invention is the provision of a self-contained hydraulic tappet comprising a minimum number of parts forming an economical and efficient structure.

A further object of the invention is the provision of an automatic compensating self-contained hydraulic tappet comprising a tappet body, a plunger reciprocable in the body having a valve therein, and a fluid sealing element arranged between the plunger and body effectively sealing the operating fluid within the tappet and being effective as the tensile return means for extending the plunger relative to the body and for maintaining a slight pressure head on the supply of fluid in the reservoir when the tappet is subjected to normal operating conditions.

Other objects and advantages of the invention will appear from the following description taken in connection with the drawings, forming a part of the specification; and in which:

Fig. 1 is a vertical cross-sectional view of a hydraulic compensating self-contained hydraulic tappet;

Fig. 2 is a vertical cross-sectional view of a modified form of the tappet shown by Fig. 1; and

Fig. 3 is a cross-sectional view taken substantially along lines 3—3 of Fig. 1.

The present invention is directed at the provision of an automatic compensating or adjusting mechanism for use with the valve gear train of internal combustion engines or the like for properly adjusting the operating length thereof, that is simple and economical of construction and effective and efficient in operation.

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The automatic adjusting mechanism herein devised is specifically in the form of a self-contained hydraulic tappet for use in the valve gear train of internal combustion engines and comprises four major elements, a cylindrical tappet body having a cavity therein closed at one end and open at the other end, a plunger reciprocable therein having a valve controlled passage therethrough and forming in cooperation with the closed end of the tappet body a hydraulic compression chamber, a cap member seated on one end of the plunger and the combined flexible diaphragm and sealing element fixedly arranged at the cap end of the plunger of the open end of the tappet body forming a low pressure fluid filled reservoir therewithin having communication with the compression chamber by way of the passage in the plunger.

The combined flexible diaphragm sealing element serves the dual purpose of extension springs for normally biasing the plunger outwardly relative to the tappet body and as an effective sealing means for permanently and hermetically sealing the operating fluid in the tappet body under all conditions of operation. By so providing an automatic compensating mechanism, the self-contained nature of the device adaptable to a variety of installations especially in internal combustion engines without the requirement for engine design embodying hydraulic fluid supply means.

Referring to the drawings for more specific details of the invention, 10 represents generally an automatic compensating mechanism in the form of a tappet for use in a valve gear system of internal combustion engines comprising a cylindrical tappet body 12 having a central cavity 14 therein closed at one end and open at the other end and having a cylindrical plunger 16 reciprocable therein and forming in conjunction with the tappet body a hydraulic compression chamber 18.

The tappet body 12 is adapted to be received in a tappet guide, not shown, for movement therein and has integral therewith at its closed end a mushroom-shaped head 20 adapted to be engaged by an engine cam member or the like, not shown.

The plunger 16 includes a portion 22 having a slightly smaller diameter than the diameter of the cavity 14 permitting of a predetermined hydraulic fluid leakage or leakdown along the corresponding walls thereof, a reduced portion 24, the purpose of which will hereinafter appear and provides a fluid passage 26 therethrough controlled as by a ball valve 28 seated in a cavity 30

in the plunger communicating with passage 26 and with compression chamber 18 by way of a relief passage 32 formed in the plunger. The ball 28 is adapted to be retained in cavity 30 through the cooperation of the plunger with the wall of the cavity 14 in the tappet body thereby eliminating the necessity of any positive retaining means normally incorporated in ball valve assemblies.

A cap member 34 is adapted to receive one end 36 of plunger 16 in press fit relationship therein and includes an annular recess adapted to receive one end 38 of a flexible sealing diaphragm 40 therebetween with end 36 of the plunger. The other end 42 of diaphragm 40 is received in embracing relation between an annular recess 44 formed in the open end of tappet body 12 and an annular internal ring 46 mounted in the open end of the tappet body. The ring 46 in addition to effectively sealing the end 42 of the diaphragm upon the tappet body is operative to limit the outward movement of the plunger relative to the tappet body. The diaphragm 40 as arranged between the plunger and tappet body provides a reservoir chamber 48 about the reduced portion of the plunger adapted to communicate with the compression chamber 18 by way of passage 26 provided in the plunger controlled as by ball valve 28.

The stiffness and resiliency of the diaphragm are predetermined so as to provide an effective tensile means operative to serve the purpose of extending the plunger relative to the tappet body upon the requirement of an elongation of the tappet during the normal working operation thereof. If under certain conditions of operation the diaphragm is not suitable to provide a sufficiently quick recovery for elongation of the tappet, spring means could be provided to assist the diaphragm through the incorporation of the spring means in association with or as a part of the diaphragm.

In the assembly of the tappet as a unit, the cavity in the tappet body is first initially filled with a suitable hydraulic fluid and then the combined assembly of plunger 16, ball valve 28, cap 34, diaphragm 40, and ring 46 are inserted in and upon the tappet body with the end 42 of the diaphragm and ring 46 arranged in effective sealing relation in the recess of the tappet body and with the fluid filling all the void spaces within the tappet body, cap, and diaphragm ready for operational use. The compression and reservoir chambers together with the connecting passages therebetween are adapted to be completely filled with fluid such that in the normal condition of the tappet the diaphragm acts to bias the plunger outwardly from the tappet body a distance as predetermined by the tensile strength and axial length of the diaphragm.

In a normal operation of tappet 10 when in installed position in the valve gear system of an internal combustion engine wherein the tappet is set at its proper initial length permitting of the extension and contraction of the tappet within predetermined limits, and upon the requirement for a contraction of the tappet because of the axial pressure being exerted upon the tappet at the extremities thereof, the fluid in the compression chamber leaks down along the wall between the plunger and tappet body at a rate predetermined in accordance with the clearance provided therebetween effective to provide for an automatic compensating adjustment of the tappet to take care of resultant variations of the length in the valve gear system. With the tappet in

assembled height in the gear train, the fluid in the reservoir is placed under a slight pressure head because of the predetermined stiffness of the diaphragm. As the fluid is transmitted to the low pressure chamber or reservoir 48, the intermediate section of resilient diaphragm 40 is moved radially outward providing the volumetric space for the displacement of the fluid transmitted thereinto. During this transmission of the fluid to the reservoir and because of the predetermined stiffness and resiliency of the diaphragm, the fluid in the reservoir is placed under a slightly greater pressure than normal effective to act upon the ball valve 28 thereby preloading the ball valve from the reservoir for subsequent operation of the tappet. With the tappet in the beforementioned position and upon the requirement for an extension of the tappet, the diaphragm in its capacity of a flexible tensile member operates to quickly and effectively move the plunger outwardly relative to the tappet body assisted by the pressure of the fluid in the reservoir acting upon the valve to unset same and replenish the fluid in the compression chamber upon the suction created therein as the plunger moves in an extended direction relative to the tappet body. This operation will continue until the tappet has been extended the required distance to take up the clearance in the valve gear train so as to provide for its subsequent, proper, effective, and quiet operation. This completes a normal cycle of extension and contraction of the tappet.

Fig. 2 illustrates a modified form of automatic compensating device wherein an intermediate or separate cylindrical body 50 is provided adapted to be received in a tappet body 52. By incorporating a member of the structure of body 50 in the automatic compensating device per se replacing body 12 of Fig. 1, the operating unit is adaptable to various sizes of tappet bodies per se or like operating mechanisms requiring automatic elongation and contraction.

While this invention has been described in connection with certain specific embodiments, the principle involved is susceptible of numerous other applications that will readily occur to persons skilled in the art. The invention, therefore, is limited only as indicated by the scope of the appended claims.

What I claim is:

1. A fluid self-contained length compensating mechanism comprising a hollow cylindrical body having closed and open ends and providing an annular recess at its open end, a plunger reciprocable in the cylinder having a portion fitted for reciprocation in the hollow of the cylinder and a reduced portion extending axially therefrom beyond the open end of the cylinder, a cap press fitted on the end extremity of the reduced portion of the plunger having an annular recess at its open end and providing in cooperation with the plunger an annular groove, an elastic sleeve diaphragm arranged in hermetically sealing relation between the plunger and cylinder having one annular end clamped in the annular groove between the cap and plunger and its other end fitted in the annular recess in the cylinder, said plunger providing at one end thereof with the closed end of the cylinder a compression chamber and with the diaphragm about its reduced portion a reservoir chamber and valve means in the plunger providing one-way communication between the reservoir and compression chamber.
2. A fluid self-contained length compensating

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mechanism comprising a hollow cylindrical body having closed and open ends and providing an annular recess at its open end, a plunger reciprocable in the cylinder having a portion fitted for reciprocation in the hollow of the cylinder and a reduced portion extending axially therefrom beyond the open end of the cylinder, a cap press fitted on the end extremity of the reduced portion of the plunger having an annular recess at its open end and providing in cooperation with the plunger an annular groove, an elastic sleeve diaphragm arranged in hermetically sealing relation between the plunger and cylinder having one annular end clamped in the annular groove between the cap and plunger and its other end fitted in the annular recess in the cylinder, an annular ring mounted upon the end of the diaphragm fitted in the annular recess in the cylinder clamping said end in the annular recess, said plunger providing at one end thereof with the closed end of the cylinder a compression chamber and with the diaphragm about its reduced portion a reservoir chamber and valve means in the plunger providing one-way communication between the reservoir and compression chamber.

3. A fluid self-contained length compensating mechanism comprising a hollow cylindrical body having closed and open ends and providing an annular recess at its open end, a plunger reciprocable in the cylinder having a portion fitted for reciprocation in the hollow of the cylinder and a reduced portion extending axially therefrom beyond the open end of the cylinder, a cap press fitted on the end extremity of the reduced portion of the plunger having an annular recess at its open end and providing in cooperation with the plunger an annular groove, an elastic sleeve diaphragm arranged in hermetically sealing relation between the plunger and cylinder having one annular end clamped in the annular groove between the cap and plunger and its other end fitted in the annular recess in the cylinder, an annular ring mounted upon the end of the diaphragm fitted in the annular recess in the cylinder clamping said end in the annular recess, said ring having an internal diameter that is

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less than the external diameter of the portion of the plunger reciprocable in the cylinder, said plunger providing at one end thereof with the closed end of the cylinder a compression chamber and with the diaphragm about its reduced portion a reservoir chamber and valve means in the plunger providing one-way communication between the reservoir and compression chamber.

4. A fluid self-contained length compensating mechanism comprising a hollow cylindrical body having closed and open ends and providing an annular recess at its open end, a plunger reciprocable in the cylinder having a portion fitted for reciprocation in the hollow of the cylinder, a reduced intermediate portion and an enlarged head portion, a member press fitted on the head of the plunger having a portion thereof extending axially of the reduced portion of the plunger and providing in cooperation therewith an annular groove, a flexible sleeve diaphragm arranged in hermetically sealing relation between the plunger and cylinder having one annular end clamped in the annular groove between the cap and plunger and its other end fitted in the annular recess in the cylinder, said plunger providing at one end thereof with the closed end of the cylinder a compression chamber and with the diaphragm about its reduced portion a reservoir chamber and valve means in the plunger providing one-way communication between the reservoir and compression chamber.

5. A claim according to claim 4 wherein an annular ring is mounted upon the end of the diaphragm fitted in the annular recess in the cylinder clamping said end in the annular recess.

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