July 3, 1956 P. F. BERGMANN 2,752,901

HYDRAULIC TAPPET ANTI-VARNISH STRUCTURE

Filed March 21, 1955 2 Sheets-Sheet 1

Fig. 1.

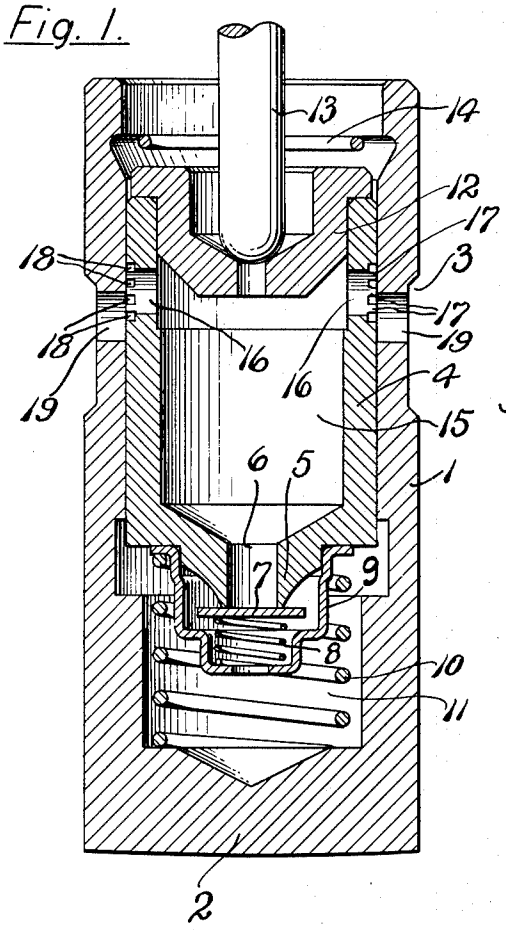


Fig. 2.

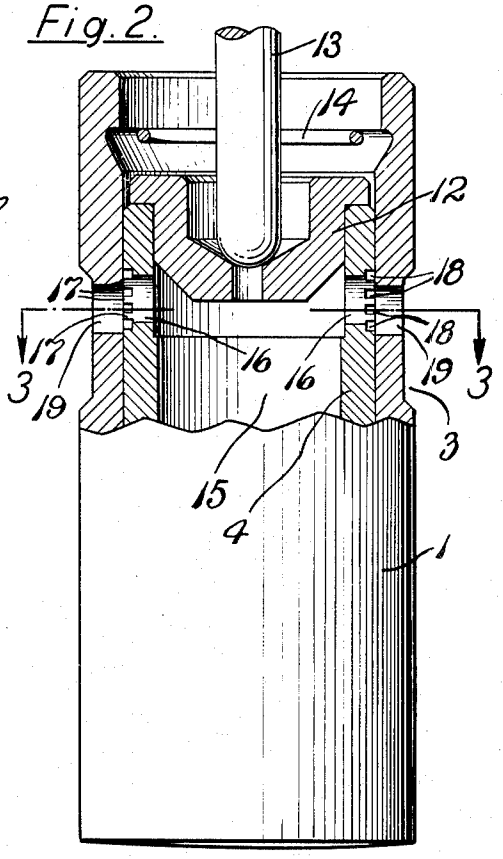


Fig. 4.

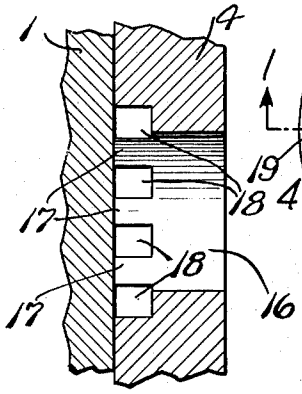


Fig. 5.

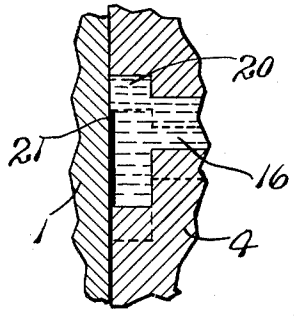
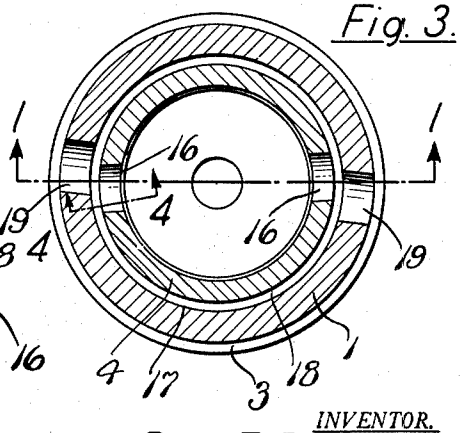


Fig. 3.



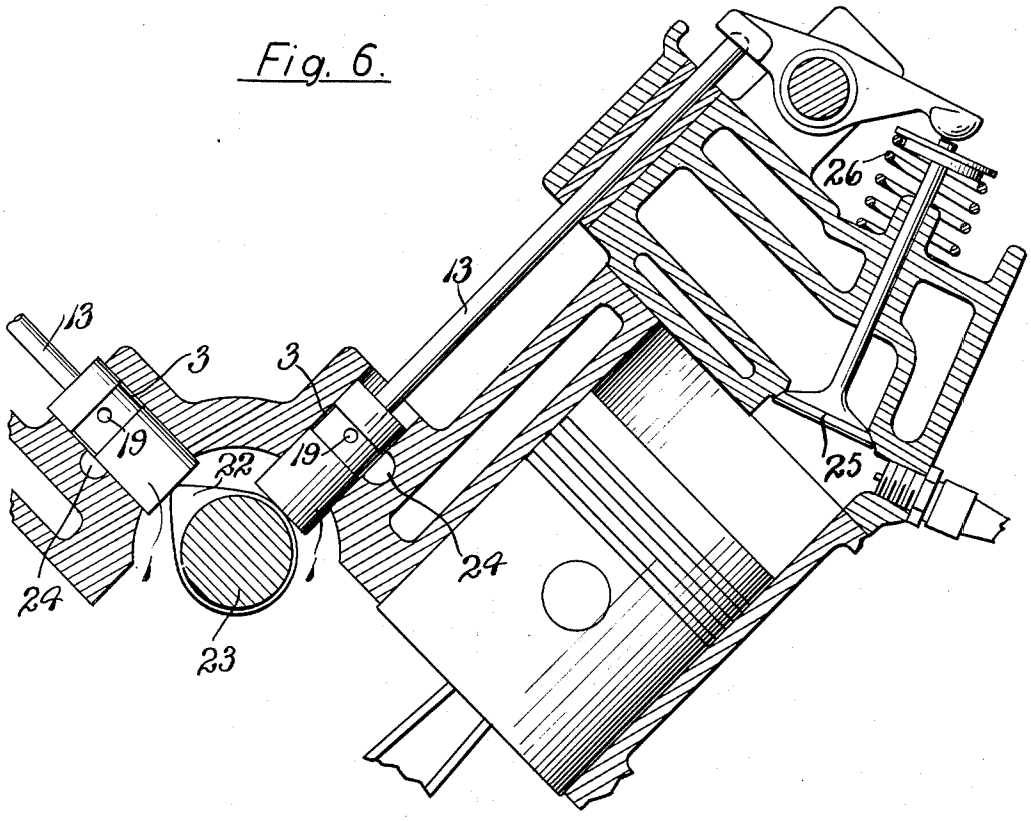
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HYDRAULIC TAPPET ANTI-VARNISH STRUCTURE

Filed March 21, 1955 2 Sheets-Sheet 2

Fig. 6.



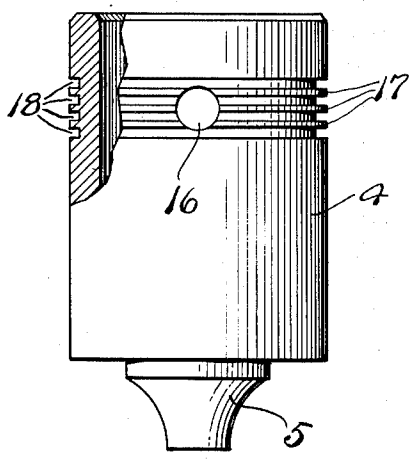


Fig. 7.

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HYDRAULIC TAPPET ANTI-VARNISH STRUCTURE

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Application March 21, 1955, Serial No. 495,521

3 Claims. (Cl. 123—90)

The present invention relates to hydraulic tappets and is particularly concerned with the elimination of certain obstructing deposits which, being deposited at the inner side of a hydraulic tappet body in opposition to an annular groove around the inner movable piston of the tappet, in the course of time and under certain operative conditions of the engine and of the tappet, may either temporarily or in some cases permanently hold the tappet piston or plunger in a lower position than it is supposed to be and either temporarily or permanently defeat the operation of the tappet. When such defeat or destruction of the operation of the tappet becomes permanent it can be cured only by removal or replacement of the defective tappet or by reconditioning such tappet before it is put back into place. When temporary stopping or defeating the operation of the tappet takes place, or until the piston thereof again becomes freed so that it can make its longitudinal movements within the tappet body as it should in normal operation, undesirable tappet noises occur which may last for greater or less times in accordance with how soon the tappet piston is freed from the holding effects of such deposit.

Such deposit in practice is known as "varnish." Such varnish is deposited from oil with which tappets are supplied, usually from the lubricating oil of the internal combustion engine in which the tappets are installed. The deposit is of a hard, somewhat gummy physical type or nature and if permitted to deposit on the inner side of the tappet body opposite the annular groove around the tappet piston or plunger within the body, from which groove passages lead to the interior of the piston, when the piston moves downwardly beyond its normal operative position, which it does at times, the scraping or attempted scraping of such varnish deposit from the interior of the tappet body by such piston results in the scraping edges of the piston either embedding in such varnish or the tappet piston above the groove may partially ride over such varnish and become wedged in place, so that the spring below the piston which acts to move it upwardly does not have sufficient strength to break the tappet piston loose from such varnish deposit.

With the present invention a novel improvement in the tappet and particularly in conjunction with the tappet piston is provided which insures that there will be either no varnish deposit at the inner side of the tappet body as described, or that whatever minor deposit does take place will be so narrow in width that it can be readily taken care of and removed by movement of the piston so that under all conditions of operation the piston remains free to move within the tappet body substantially the same after long use as it was in the beginning.

An understanding of the invention and the novel structure which it embodies may be had from the following description taken in connection with the accompanying drawings, in which,

Fig. 1 is a somewhat enlarged longitudinal vertical section through a tappet in which my invention is embodied, with the piston in an operative position substantially as it will be when the tappet and engine are cold.

Fig. 2 is a similar section and partial elevation illustrating the position of the piston within the tappet body after an engine has been operated and is hot and expansion of the component parts of the engine valve line has taken place in accordance with the increases in temperature.

Fig. 3 is a horizontal section on the plane of line 3—3 of Fig. 2 looking downwardly.

Fig. 4 is an enlarged fragmentary vertical section substantially on the plane of line 4—4 of Fig. 3.

Fig. 5 is a section similar to Fig. 4 showing the previous structure of the tappet piston and the varnish coating that occurs therein, which my present invention replaces.

Fig. 6 is a partial transverse section through a V-type internal combustion engine illustrating the environment in which hydraulic tappets and those having my invention may be used, and

Fig. 7 is an enlarged elevation with some parts broken away and in section of the internal piston or plunger of a hydraulic tappet having my invention incorporated therewith.

Like reference characters refer to like parts in the different figures of the drawings.

The hydraulic tappet with which my invention is used includes a hollow tappet body **1**, open at its upper end and having a closed lower end **2**. A relatively wide shallow annular groove **3** is made around the tappet body between its middle portion and upper end. Within the body, a hollow piston **4** is mounted for vertical movements, closed at its lower end by a lover end extension **5**, except at the central portion thereof, there being a central vertical passage **6** through the lower end portion **5**. A thin, flat disk valve **7** may close the lower end of the vertical passage **6**, normally being held thereagainst by a light pressure coiled spring **8** between such valve and the sheet metal cage **9** of the form shown in Fig. 1. The upper end of the cage is outwardly flanged and surrounds the lower end projection **5** of the piston. A coiled compression spring **10** at its upper end engages said cage flange and at its lower end bears against the bottom **2** of the tappet body. There is provided a liquid pressure chamber **11** between the lower end of the piston **4** and the lower end **2** of the tappet body in which pressure chamber spring **10**, cage **9** and valve **7** and spring **8** are located.

The open upper end of the piston **4** is closed by a closure member **12** as shown which has a centrally located seat against which the lower end of push rod **13** bears. In practice, a retaining wire spring ring **14** is located within an annular groove in the inner side and upper end portion of the tappet body to hold the parts against disassembly in handling, shipment and the like.

Fig. 1 illustrates the tappet assembly in operating position, with the cam in the "down" position, and the engine cold, showing a typical positioning of the piston **4** in relation to the body **1**. Fig. 2 shows the same tappet, also with the cam in the "down" position, after the engine has been brought up to operating temperature. It will be noted that the piston **4** is in a lower position in relation to the body **1**, than in Fig. 1. The reason for this is that all the parts of the engine have increased in size due to the increase in temperature, for example, the push rod **13**, Fig. 6, the stem of valve **25**, and even the body **1** of the tappet. The tappet assembly is shorter in length to keep the total valve train the correct length so that valve **25** is not held off its seat when the tappet is on the lower part of the cam.

The chamber **15** within the piston **4** is a liquid receiving chamber, which liquid in internal combustion en-

gines is in general supplied from the lubricating oil used in internal combustion engine operation. The oil comes into such chamber near its upper end portion through radial openings **16** made through the walls of the piston **4**. Such openings are generally in a plane in which the groove **3** around the outside of the tappet body **1** is located.

Around the outer side of the piston **4** symmetrical with the plane of the central axis of the opening **16** a plurality of spaced annular ribs and grooves **17** and **18** are provided. The ribs shown as three in number and the grooves shown as four in number but which may be varied in number, are of narrow width and vertically in Figs. 1 and 2 are all across the outer ends of the passages **16**. Other passages **19** generally at the same level with the passages **16** and the grooves **18** are made through the walls of the tappet body **1** so that lubricating oil from the engine entering the passages **19** will fill the grooves **18** and pass through the passages **16** into the inner chambers **15** of the tappet piston whether or not passages **16** and **19** are radially aligned.

In the tappet structures as now used a groove such as at **20** (Fig. 5) of a width equal to or more than the combined width of the grooves **18** is made around the piston **4**. Such groove of relatively much greater width than the grooves **18** always leaves a surface at the inner side of the walls **1** of the tappet body against which the lubricating oil used is in constant contact engagement. Over such surface, particularly any part of it which is not passed over by the piston **4** in its vertical movements, the varnish deposit collects as indicated at **21**. Such deposit is of a thickness substantially greater than the clearance between the piston **4** and the walls of the tappet body **1**, this clearance being less than one-half thousandth of an inch. Thus the varnish deposit **21** presents an obstruction to the downward movement of the piston **4** at the times that the engine is stopped, and an engine valve is held in open position by reason of the cam which lifts the tappet being positioned with its nose or lift against the bottom **2** of the tappet body. Under such conditions and with the heavy force exerted by the engine valve spring which equals substantially 110 pounds, the slow leakage of oil upwardly from the pressure chamber **11** between the piston and the tappet body will force the piston **4** downwardly, the engine being at rest and not operating, so that such varnish at **21** is reached and either wedges between the walls of the body **1** and piston **4** or is attempted to be cut therefrom by the downwardly moving piston **4** which at its outer edges of the upper end of the groove **20** may become embedded in such varnish.

Upon starting the engine under such a tappet condition the resistance to moving upwardly of the piston **4** because of varnish wedging or embedding therein is too great for the spring **10** to overcome which spring is of only a few pounds weight. Thus after an engine has started and a tappet which has been in a position to hold an engine valve in open position while the liquid was stopped, is moved to close the engine valve, upon such engine valve closing there is a separation of the lower end of the push rod **13** from the member **12** against which it bears. With a stuck piston **4**, as described above, and on continuing rotation of the camshaft which carries the cam which actuates the tappet there will be slack, or clearance between the various members of the valve train, that will cause loud, so-called tappet noises. If such wedging or embedding is sufficient, that under engine vibration or other vibration effects, release of the piston **4** does not occur, the tappet noises will continue indefinitely and the tappet will have to be replaced or repaired and reconditioned.

With my invention the surfaces upon which the obstructing varnish as at **21** collects is restricted to a plurality of surfaces which would be equal in width each to the width of a groove **18** if the piston **4** remained in constant position and did not move back and forth in the tappet body **1**.

Under such condition the surfaces covered by the ribs **17** would be free of any deposit of such varnish. In the operation of the tappet, the piston **4** has a slight reciprocating movement with each lifting of an engine valve due to seepage which occurs upwardly from the pressure chamber **11** between piston **4** and the walls of the tappet body **1** with a consequent short downward movement of the piston. The loss caused by such seepage is supplied by a flow of liquid past the valve **7** when the engine valve seats and the tappet may move away a slight distance from the lower end of the push rod **13** with a movement of the piston **4** by pressure of spring **10** back to its initial position. In addition to this reciprocating movement of the piston within the tappet body, there is also a further downward movement of the piston in relation to the tappet body from the time the engine is cold until it is raised to operating temperature. Because other parts of the valve train expand with the increase in temperature, the assembled length of the tappet decreases in length, such as is shown by the difference between Fig. 1 and Fig. 2. The amount of piston travel during the cold engine to hot engine cycle is small in relation to the width of the single groove **20** shown in Fig. 5, but it can be almost as much as, or a large portion of the width of each of the multiple grooves shown in Fig. 4. This long cycle movement of the finished piston surfaces across the surfaces of the tappet body bore, in addition to the reciprocating movement described above, is approximately as much as the width of each of the narrow multiple grooves, therefore this movement prevents any varnish deposits from forming. In case the total movement is not quite equal to the width of each of the narrow grooves, a very narrow rib of varnish might form opposite the lower part of each groove. These ribs would be so narrow that when the engine stops, and one of the cams is in the "up" position, as at **22** in Fig. 6, the valve spring **26** is of sufficient strength to cause the sharp edges of the piston grooves to shear off these narrow ribs of varnish without causing the piston to stick.

In Fig. 5 the dash lines indicate the lowermost position of the piston **4** and the full lines the uppermost position thereof, showing the range of travel of the piston **4** during normal engine operation. There is left a relatively wide surface which is open at all times to the lubricating oil and from which oil the varnish at **21** may be deposited upon such continuously open surface.

In Fig. 6 the operation of the tappets by cams is indicated by cams **22** upon the camshaft **23** which continuously rotates; the tappet at the right, being on the base circle of the cam and the other lifted to its open position. In such last position, if an engine stops so as to hold a valve lifted, any varnish deposit of the type shown at **21** in Fig. 5 will be acted against by the downwardly moving piston **4** with the constant danger of embedding in or wedging against the varnish. Oil from the engine lubricating system is supplied through the galleries **24** through the annular channels of the grooves **3** around the tappet body. An engine valve at **25** and the heavy weight valve spring **26** are shown in Fig. 6 in accordance with old structure. In Fig. 6 the valve **25** shown is closed because the lower end of the tappet is on the base circle of its cam. At the other side the valve actuated by its associated valve tappet or lifter will be held open if at such position when the engine stops. It is at such position with the engine stopped that the danger of varnish deposit wedging or sticking occurs under the heavy pressure of the engine valve spring **26** so that release of the piston when such pressure is removed does not follow from the much lighter weight spring **10**.

The construction described, though of simple character,

is one of exceptional successful utility. The invention is defined in the appended claims and is to be considered comprehensive of all forms of structure coming within their scope.

I claim:

1. In a hydraulic tappet having an outer hollow tappet body with a closed lower end and generally vertical walls, said walls having an oil passage therethrough, and a hollow spring lifted piston within said body with an oil passing opening therethrough at generally the same level as said passage through the body walls, the improvement comprising a plurality of narrow ribs around and at the outer side of said piston having narrow grooves between said ribs, said grooves communicating with the oil passing opening in said piston, and said ribs bearing against the inner sides of the tappet body walls.

2. In a hydraulic tappet having an outer cylindrical tappet body with a closed lower end, vertical walls and a cylindrical bore from its upper end to said closed lower end, said walls having a radial oil passing opening therethrough, and a hollow, cylindrical, spring lifted piston within said body closely but movably conforming to the bore in said body, and having an oil passing opening through a side thereof at generally the same level as the opening in said tappet body walls, the improvement comprising a plurality of narrow parallel ribs around the

piston, separated by narrow continuous grooves located substantially at the same level as said opening in said piston, all of said grooves communicating with said piston opening, and said ribs bearing against the inner sides of the walls of said tappet body.

3. In a hydraulic tappet having an outer hollow tappet body with a closed lower end and generally vertical walls, said walls having an oil passing opening therethrough, and a hollow spring lifted piston within, closely conforming to the inner sides of said walls and movable lengthwise thereof having an opening in a side thereof at generally the same level as the opening through said body walls, the improvement comprising, a plurality of narrow channels in the outer sides of said piston, extending thereabout, said channels separated by narrow ribs, the outer edges of which are flush with the outer surface of said piston, all of said ribs having ends at opposite sides of said opening through the piston, and all of said channels communicating with said opening in the piston and part of said channels communicating with said opening in said tappet body walls.

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