Aug. 29, 1944. C. VOORHIES 2,356,900

TAPPET CONSTRUCTION

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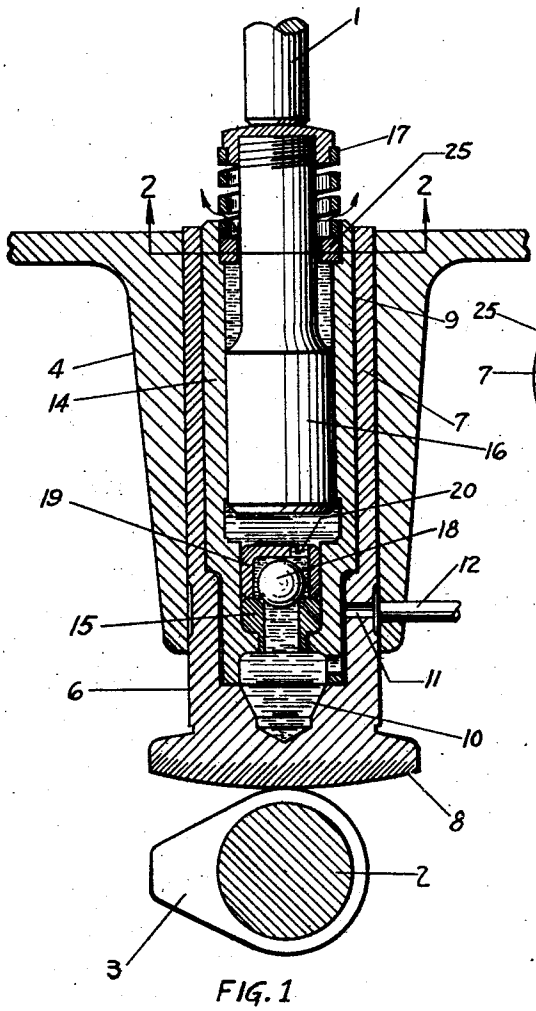


FIG. 1

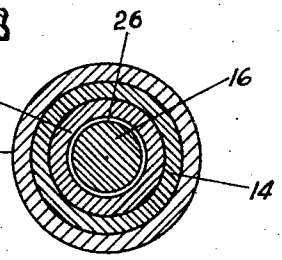


FIG. 2

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TAPPET CONSTRUCTION

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9 Claims. (Cl. 123—90)

This invention relates to hydraulic self-compensating tappets in general, and, more particularly, concerns such a tappet construction embodying an element imparting a dashpot action thereto to effect a desired operation thereof when used in the valve operating mechanism of an internal combustion engine and the like.

It has been found in certain internal combustion engines that excessive deflections occur in some engine parts or the valve operating mechanism imparts a false motion to the valves thereof at high engine revolutions, and, when hydraulic self-compensating tappets are employed, if this condition becomes severe enough a hydraulic condition occurs in such tappet constructions known as "pump-up." Accordingly, to accommodate normal operation of the hydraulic unit a dashpot means is incorporated above the plunger to retard the rapid action thereof in following up a valve bounce. This retarded movement of the plunger restricts the rate of compensation but permits the normal range of compensation and prevents the plunger following up during the extremely short time interval of the valve bounce.

Among the objects of this invention is the provision in a hydraulic self-compensating tappet of a dashpot means incorporated therein to afford selective operation thereof; the provision in a hydraulic self-compensating tappet as described of a dashpot element associated with the tappet plunger and so constructed and arranged as to afford the normal range of tappet compensation but restrict the rate of compensation and prevent "pump-up" during a condition of valve bounce.

Further and other objects and advantages of the invention reside in the novel combination and arrangement of parts about to be described, when taken in conjunction with the drawing forming a part of this specification, and, which are more particularly pointed out in the appended claims.

In the drawing like reference characters denote corresponding parts in the several views, and in which:

Fig. 1 is a vertical sectional view of a portion of an internal combustion engine adjacent the cam, camshaft and valve stem with a tappet embodying the teaching of this invention interposed therebetween, and

Fig. 2 is a sectional plan view on the line 2—2 of Fig. 1 illustrating one form of dashpot element.

Now having reference to the drawing there is illustrated a sufficient portion of an internal combustion engine to designate the setting of the invention. The numeral 1 represents the lower foot end of a conventional poppet valve stem which is urged downward on its seat (not shown) in a well known manner. The numeral 2 represents a camshaft with a cam 3 thereof. The numeral 4 indicates a conventional tappet guide sleeve provided in the cylinder block of the engine.

In this instance the hydraulic self-compensating tappet construction, as is well known to those skilled in this art, is interposed in the valve train between the cam contacting end of the tappet and the valve stem. The general construction of hydraulic tappet shown, exclusive of the dashpot element for retarding the rate of compensation in one direction, is covered in United States Letters Patent No. 2,074,034, issued March 16, 1937, and for the purpose of the present invention only so much of the operation thereof as is necessary to an understanding of this invention will be made, reference may be had to said patent for a more complete explanation of the construction and operation.

Generally designated by the numeral 6 is a hydraulic type tappet which in this instance has an elongated tubular body 7 of mushroom form with an enlarged cam contacting head 8, although the principle of the invention is equally applicable to a comparable type of tappet with a so-called cylindrical or barrel type body. The tappet body 7 has a hollow bore 9 open at its upper end for reception of a hydraulic compensating mechanism, to be described, and a reduced bore at its lower end to support the same and provide a reservoir 10 for operating fluid, in this instance pressure fed oil from the lubricating system of the engine. Operating fluid is supplied through a peripheral opening 11 in the side of the tappet body from a pipe line 12, or integral oil conduit in the engine block into the reservoir 10. The upper portion of the bore 9 is arranged for reception and support of a separate hydraulic compensating mechanism comprising a cylindrical sleeve member 14 having an enlarged bore at its upper end and a shouldered tubular seating element and suction tube 15 pressed therein at its lower end, which, when the member 14 is inserted in the tappet bore communicates the oil reservoir 10 with the interior of the hydraulic mechanism.

Positioned in the sleeve 14 is a plunger 16, the upper end of which contacts the lower end

of valve stem 1, or other part of the valve train; the plunger being reciprocably mounted in the sleeve and adapted to be biased outwardly therefrom with respect to the separate cylinder by means of a head end of a plunger spring 17. In the lower end of the separate cylinder is a ball check valve 18, which seats against and controls fluid flow through the upper end of the suction tube 15. A pressed in retainer cage 19 surrounds the check ball and affords predetermined limited travel thereto, while an opening 20 in the top of the cage communicates with the space between the lower end of the plunger 16 and the bottom of the enlarged bore in the separate cylinder.

In operation, of the construction so far described, the tappet would function in the usual manner to effect self-compensation, automatically, of any clearance present in the valve train between the camshaft and the end of the valve stem. As the camshaft rotates and the tappet head rides upon the cam, the tappet body moves downwardly in its guide under the influence of the spring pressed valve stem. Normally, and in a rigid and non-extensible type of tappet, the pressure of the valve stem against the end of the tappet would cease shortly before the tappet reached the base circle of the cam; thus relieving substantially all the pressure of the valve upon the tappet. In the device disclosed, however, when the pressure of the valve stem ceases, the coil spring 17 will urge the plunger outwardly and maintain its contact with the valve stem. This outward movement of the plunger reduces the pressure in the high-compression chamber above the check ball 18 and causes the ball to rise from its seat, under the relatively greater pressure existing in the oil reservoir 10. Operating fluid then flows past the check ball and fills this space. As the tappet moves upwardly under rotation of the cam, and with the check ball in seated position, oil in the chamber is trapped therein, thus affording an incompressible hydraulic column which maintains the plunger 16 in firm contact with the valve stem 1 during the entire stroke of the tappet. Provision is made for a predetermined escapement of fluid, due to the pressure of the plunger against the trapped oil thereunder by the relative fit between the plunger 16 and the cylinder 14. Such fluid escapement is facilitated by the reduced neck portion of the plunger which also serves to support the spring 17 in spaced relation to the plunger body and against the underside of the plunger head. The operating fluid so eliminated will be replaced as the cycle of operation is repeated. If complete loss of operating fluid occurs the plunger will bottom in the separate cylinder with a resultant lift loss in the valve and increased noise but still sufficient to permit operation of the engine.

The present invention utilizes the fluid escapement, around the neck portion of the plunger 16 and out the open upper end of the tappet bore, to act upon an annular washer like element 25, pressed into the separate sleeve 14, with the hollow center thereof provided with a predetermined fit or clearance 26 between the neck of the plunger to produce a dashpot action. The necessity for producing a selective operation of the tappet, or retarding the upward movement of the plunger, has been found to exist in some radial aircraft engines and other high-speed, light-weight internal combustion engines having peculiar operating characteristics at high engine speeds wherein excessive deflection and false motion of the valve travel occurs at high speeds. Consequently, under a condition of false valve motion at high engine speeds when a valve bounce occurs the tendency of this tappet construction was to follow the end of the valve stem up, even in the extremely short time interval such action took place. Now then, if the annular washer element 25, or other equivalent means having a dashpot action, restricts the upward movement of the plunger 16, by regulating escape of hydraulic fluid from the tappet body, the plunger cannot move upward very quickly under such conditions as exist in the extremely short time interval of a valve bounce. It will be apparent downward movement of the plunger relative to the separate cylinder is not retarded by the dashpot element. Accordingly, while the rate or speed of compensation at such high speeds is slowed down, the range of compensation is in no way affected and automatic self-compensation takes place in the usual manner without any objectionable "pump-up."

From the foregoing disclosure, which represents one concrete embodiment of the present invention concerning altering the rate of compensation of a hydraulic tappet in one direction of travel in an internal combustion engine it will be apparent the generic concept of the invention is equally applicable to other hydraulic self-compensating automatic tappet structures provided with a predetermined fluid escapement, as will be obvious to those skilled in the art to which this invention is related.

Formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the invention, the scope of which is commensurate with the following claims.

What I claim is:

1. The combination with an internal combustion engine having a valve which may assume an unnatural valve bounce period at certain engine speeds, and including a hydraulic self-compensating tappet interposed in the valve train to effect zero clearance between the parts thereof; of means comprising an element operable in dashpot fashion to automatically retard the rate of self-compensation of said tappets during said valve bounce period and otherwise afford normal self-compensation by said tappets.

2. A hydraulic self-compensating tappet construction for use in the valve train of an internal combustion engine comprising in combination, means for automatically effecting zero clearances in the valve train during normal operation thereof, and means comprising a dashpot element associated with each of said tappets operable during a condition of valve bounce in said valve train to provide normal rate of elongation and a retarded rate of compensation in the opposite direction of movement.

3. A hydraulic self-compensating tappet construction for use in the valve train of a variable speed internal combustion engine which may have normal and abnormal valve action at various engine speeds comprising in combination, means in said tappets affording predetermined fluid escapement for automatically effecting zero clearance in the valve train during normal speeds and operation thereof, and means comprising an element operable in dashpot fashion to restrict the normal rate of elongation.

4. A hydraulic self-compensating tappet construction for use in the valve train of a variable

speed internal combustion engine which may have normal and abnormal valve action at various engine speeds comprising in combination, means in said tappets affording predetermined fluid escapement for automatically effecting zero clearance in the valve train during normal speeds and operation thereof, and means comprising an element in said tappet automatically operable in dashpot fashion to restrict the normal rate of elongation.

5. A hydraulic valve tappet comprising in combination, a tappet body having a longitudinal bore closed at its lower end and open at the upper end and adapted to receive operating liquid, the lower part of said body including a liquid reservoir, a hydraulic mechanism receivable in the open upper end of said bore, valve means in the hydraulic mechanism regulating flow of operating fluid from the reservoir thereinto, plunger means in the hydraulic mechanism regulating a predetermined escapement of operating fluid from the open upper end of said bore, and means associated with said plunger operable in dashpot fashion to retard the normal rate of elongation of said tappets.

6. A hydraulic valve tappet comprising in combination, a tappet body having a longitudinal bore adapted to receive a hydraulic compensating mechanism therein, a liquid reservoir in the tappet bore, valve means for regulation of liquid into the hydraulic mechanism, and means acted upon by liquid escapement from the hydraulic mechanism to retard the normal rate of elongation of said tappet.

7. A hydraulic valve tappet comprising in combinatoin, a tappet body having a longitudinal bore adapted to receive a hydraulic compensating mechanism therein, a liquid reservoir in the tappet bore, valve means for regulation of liquid into the hydraulic mechanism, and means comprising an annular washer element pressed into the hydraulic compensating mechanism and acted upon by liquid escapement from the hydraulic mechanism to retard the rate of compensation thereof in one direction without affecting the range of compensation.

8. A hydraulic valve tappet comprising in combination, a tappet body having a longitudinal bore adapted to receive a hydraulic compensating mechanism therein, a plunger in said hydraulic mechanism having a reduced neck portion in an open upper end of the tappet body bore, a liquid reservoir in the tappet bore, valve means for regulation of liquid into the hydraulic mechanism, and means comprising an annular washer element pressed into the hydraulic mechanism with predetermined clearance around the reduced neck portion of the plunger thereof to be acted upon by liquid escapement from the hydraulic mechanism to retard the rate of compensation thereof in one direction without affecting the range of compensation.

9. In a valve tappet of the hydraulic type having a predetermined range of self-compensation for adjustment of clearance dimensions in the valve train of a variable speed internal combustion engine which may induce false valve action at certain engine speeds; said tappet having a tappet body with a longitudinal bore adapted to receive a hydraulic compensating mechanism, a liquid reservoir in the tappet bore, valve means for regulation of movement of operating liquid into the hydraulic mechanism to effect the necessary range of compensated length of said tappet, and means associated with said mechanism to be acted upon by a predetermined amount of escapement of operating fluid to affect the normal rate of elongation thereof during said false valve motion without affecting the range of compensation thereof during normal valve action.

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