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HYDRAULIC VALVE LASH ADJUSTING MECHANISM

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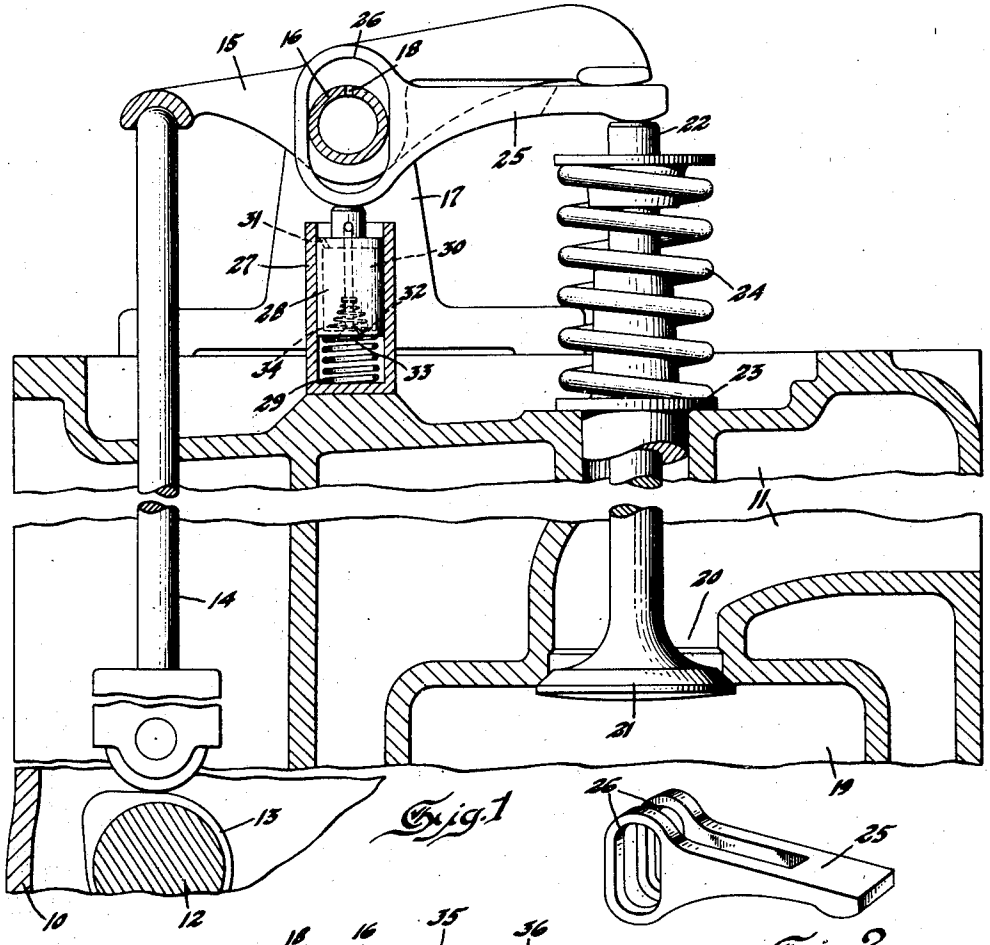


Fig. 1

Fig. 2

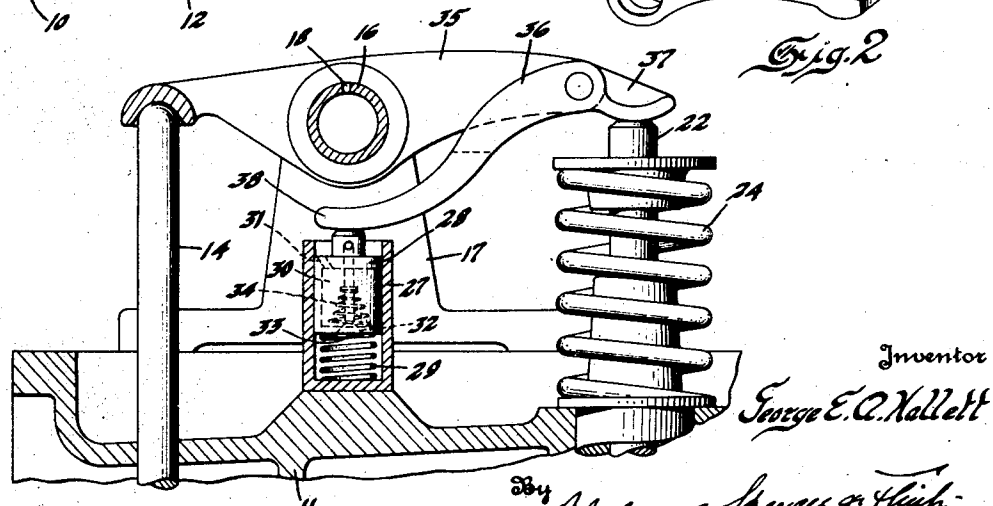


Fig. 3

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HYDRAULIC VALVE LASH ADJUSTING MECHANISM

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The principal object of this invention is to provide means for automatically preventing binding of the parts of, or an undesirable amount of slack in, intermittently actuated power or motion transmitting mechanisms, such as the valve operating mechanisms of internal combustion engines.

It has, heretofore, been proposed to attain the end outlined above, by providing means for automatically adjusting a part of the power or motion transmitting mechanism so as to maintain in the mechanism, during the idle intervals in its cycles of operation, stress sufficient to eliminate slack therein but insufficient to cause binding of the parts thereof, and to maintain the stress in the mechanism, during the working intervals in its cycles of operation, less than that which would cause binding of the parts thereof. Of the several means of this type which have been suggested, those which have been most successful are those which consist of a hydraulically damped spring device arranged to take up slack in the mechanism and to yield when the stress in the mechanism reaches a predetermined limit so as to prevent binding of the parts of the mechanism. However, for the reason that they were generally applied to the power or motion transmitting mechanism in such a manner as to introduce sufficient friction to hinder the proper operation of the adjusting mechanism or of the power or motion transmitting mechanism, adjusting means of the type described have not functioned entirely satisfactorily in practice.

My invention resides in the provision of adjusting means of the type described which is so arranged in the power or motion transmitting mechanism that no friction, which will hinder the proper operation of the adjusting mechanisms or the power or motion transmitting mechanisms, will be introduced into the system.

For a better understanding of the nature and objects of the present invention, reference is made to the following specification in which are described the embodiments of my invention which are illustrated in the accompanying drawing.

In the accompanying drawing:

Figure 1 is a fragmentary transverse cross-section through an internal combustion engine of the overhead valve type, in which one embodiment of my invention is applied to the valve operating mechanism.

Figure 2 is a perspective view of the adjusting lever shown in Figure 1.

Figure 3 is a fragmentary transverse cross-section through an internal combustion engine of the overhead valve type, in which a second embodiment of my invention is applied to the valve operating mechanism.

In Figures 1 and 2 of the drawing, in which, as has been hereinbefore stated, I have shown my invention applied to the valve operating mechanism of an overhead valve type of internal combustion engine, the reference characters 10 and 11 indicate, respectively, the crankcase and the cylinder head of an internal combustion engine of the overhead valve type. In the crankcase, there is journalled a camshaft 12, on which is formed a cam 13 which engages the lower end of a push rod 14 which is mounted to reciprocate vertically in suitable guides (not shown) in the crankcase. The upper end of the push rod 14 engages the lower side of one arm of a rocker 15, which is pivotally mounted on a hollow shaft 16 which is supported in suitable brackets 17 which are mounted on the cylinder head 11. There extends into the central bore in the shaft 16, adjacent the rocker 15, a bore 18, through which lubricating oil, which is forced into the central bore in the shaft by a suitable pump, is led to the bearing of the rocker on the shaft.

The reference character 19 indicates a combustion chamber, into which opens a port 20, which is adapted to be opened and closed by a poppet valve 21, on which is provided a stem 22 which is slidably mounted in suitable guides 23 and which extends to a point adjacent and vertically beneath the arm of the rocker 15, opposite that which is engaged by the push rod 14. A coil spring 24 surrounds a portion of the valve stem 22, and constantly urges the valve to position to close the port 20.

The bight of a bifurcated lever 25, whose legs straddle a portion of the rocker 15 and through the extremities of which extend vertically elongated openings 26, through which extends the shaft 16, is shaped to provide a flat upper surface which is fulcrumed on a suitable cam surface formed on the lower side of the arm of the rocker adjacent the valve stem, and a cam-shaped lower surface against which the upper end of the valve stem 22 bears at a point between the fulcrum point and the end of the lever. Directly beneath the shaft 16 and the inner end of the lever 25, there is secured to the cylinder head 11 a hollow cylinder 27 which is open at its upper end and closed at its lower end. In the cylinder 27, there is slidably mounted a plunger 28, which is urged by a coil spring 29 into engagement with the lower side of the inner end of one of the legs of the lever 25, which is shaped like the arc of a circle whose center is in the axis of the openings

26. In the interior of the plunger 28, there is provided a recess 30 into which extends, from the upper side of the plunger, an opening 31, and into which extends, from the lower side of the plunger, an opening 32. The last mentioned opening (32) is controlled by a valve 33 which is constantly urged to position to close the opening by a coil spring 34.

Before the engine is started, the part of the cylinder 27 below the plunger 28 is filled with a suitable liquid, preferably engine lubricating oil. During that portion of each cycle of the operation of the engine, during which the tappet, which is secured to the lower end of the push rod 14, is in contact with the dwell portion of the cam 13, there will be no movement of the push rod and the spring 24 will maintain the valve 21 on its seat. However, when the rise portion of the cam comes into contact with the tappet, the push rod will be lifted vertically and the valve will, through the intermediary of the rocker 15, the lever 25 and the valve stem 22, be opened against the resistance of the spring 24; and when the drop portion of the cam comes into contact with the tappet, the spring 24 will move the valve onto its seat and, through the intermediary of the valve stem 22, the lever 25, the rocker 15 and the push rod 14, maintain the tappet in contact with the cam. It will be obvious that since the portion of the lever 25 which is engaged by the plunger 28, is shaped like the arc of a circle, whose center is substantially at the center of rotation of the rocker 15, the oscillatory movement of the rocker 15 will cause no movement of the lever 25 with respect to the rocker.

During the working intervals in the cycles of operation of the valve operating mechanism—i. e., during those portions of the cycles of operation during which the tappet is in contact with the rise and drop portions of the cam—the pressure exerted on the lever 25, by the valve stem 22, will cause the former to rock about its fulcrum on the rocker 15 and move the plunger downwardly in the cylinder 27, forcing oil out of the lower part of the cylinder between the cylinder and the plunger, and reducing the stress in the valve operating mechanism. By reason of the fact that the valve stem is working at a mechanical disadvantage, it will not apply sufficient force to the plunger to cause more than a very small volume of the lubricant to be discharged from the cylinder during each working interval.

During the idle intervals in the cycles of operation of the valve operating mechanism—i. e., during those portions of the cycles of operation during which the tappet is in contact with the dwell portion of the cam—the spring 29 will push the plunger 28 upwardly in the cylinder 27 and cause the lever 25 to rock about its fulcrum on the rocker arm, thus increasing the stress in the valve operating mechanism. As the plunger moves upwardly in the cylinder, oil, which drips off the bearing between the rocker 15 and the shaft 16, into the upper end of the cylinder will pass through the opening 31, the recess 30 and the opening 32 into the lower end of the cylinder which will thus be kept filled with oil.

If, during the operation of the engine, parts of the valve operating mechanism become expanded by heat, or by any other means, to such an extent as would tend to cause them to bind or to cause the valve 21 to remain open during the idle intervals, the distance through which the plunger 28 moves downwardly in the cylinder 27, during the working intervals will be greater than the distance through which the plunger moves upwardly in the cylinder, during the succeeding idle intervals, and, consequently, the stress in the valve operating mechanism will be gradually decreased until the tendency of the parts of the valve operating mechanism to bind or the tendency of the valve 21 to remain open during the idle intervals is eliminated. On the other hand, if, for any reason, during the operation of the engine, the valve operating mechanism tends to become slack, the distance through which the plunger 28 moves upwardly in the cylinder 27, during the idle intervals, will be greater than the distance through which the plunger moves downwardly in the cylinder, during the succeeding working intervals, and, consequently, the mean stress in the valve operating mechanism will be gradually increased until the slack in the valve mechanism is eliminated. It will, of course, be understood that the force exerted by the spring 29 on the lever 35 is sufficient to eliminate slack in the valve operating mechanism, but, although it is working at a mechanical advantage, is not sufficient to introduce into the valve operating mechanism, sufficient stress to cause binding of the parts thereof or to open the valve 21 against the resistance of the spring 24. When there is no tendency for the parts of the valve operating mechanism to bind or to become slack or for the valve 21 to remain open during the idle intervals, the distance through which the plunger 28 moves upwardly in the cylinder 27, during the idle intervals, will be equal to the distance through which the plunger moves downwardly in the cylinder, during the succeeding working intervals, and, consequently, the mean stress in the valve operating mechanism will remain constant.

The distance through which the plunger 28 moves in the cylinder 27, during any cycle of operation of the valve operating mechanism, is very small, since the period is very short and the oil in the cylinder prevents rapid movement of the plunger, and, consequently, no such movement of the adjusting mechanism as would, in itself, cause noisy and faulty operation of the valve operating mechanism will occur.

The embodiment of the invention, which is illustrated in Figure 3 of the drawing, differs from that which is illustrated in Figures 1 and 2 only in that the arm of the rocker 35 opposite that which contacts the push rod 14 terminates inwardly of the valve stem 22, and in that there is pivoted to this extremity of the rocker a lever 36, on which is provided an arm 37 which bears against the upper end of the valve stem, and another arm 38 whose lower surface, which is shaped like the arc of a circle whose radius is equal to the distance from the axis of the shaft 16 to the upper surface of the plunger 28 when the parts of the valve operating mechanism are in their normal operating positions, bears against the upper end of the plunger 28. To the parts of the structure which are shown in Figure 3 and not mentioned specifically above and which are similar to the corresponding parts of the structure, shown in Figures 1 and 2, the same reference characters have been applied. It is thought the operation of the apparatus shown in Figure 3 will be apparent from the description of the operation of the apparatus shown in Figures 1 and 2.

It will, of course, be understood that there may be substituted for the lever mechanisms which

are shown in the drawing and through which the dash-pot mechanisms operate at a mechanical advantage, other mechanically equivalent mechanisms.

I claim:

1. In internal combustion engine valve operating mechanism which includes a shaft, a rocker pivotally mounted on the shaft, a member operating or adapted to be operated by the rocker, a lever fulcrumed on the rocker and through which the rocker engages the member, a cylinder, a plunger in the cylinder engaging the lever, a spring device urging the plunger outwardly in the cylinder, and means to damp the action of the spring.

2. In internal combustion engine valve operating mechanism which includes a shaft, a rocker pivotally mounted on the shaft, a member operating or adapted to be operated by the rocker, a lever fulcrumed on the rocker and through which the rocker engages the member, means including a spring device acting on the lever to prevent binding and undue slack in the mechanism, and means to damp the action of the spring device.

3. In internal combustion engine valve operating mechanism which includes a shaft, a rocker pivotally mounted on the shaft, a member operating or adapted to be operated by the rocker, a lever fulcrumed on the rocker and through which the rocker engages the member, a cylinder mounted independently of the previously mentioned elements, a plunger in the cylinder engaging the lever, a spring device urging the plunger outwardly in the cylinder, and means to damp the action of the spring device.

4. In power or motion transmitting mechanism which includes a shaft, a rocker pivotally mounted on the shaft, a member operating or adapted to be operated by the rocker, a lever fulcrumed on the rocker and through which the rocker engages the member, means including a spring device acting on the lever to prevent binding and undue slack in the mechanism, and means to damp the action of the spring device.

5. In power or motion transmitting mechanism which includes a pair of power or motion transmitting elements, means to eliminate slack in and binding of the mechanism including a lever which is carried by one and engages the other of the elements, a cylinder, a plunger in the cylinder engaging the lever, a spring urging the plunger against the lever, and a volume of liquid in the cylinder to damp the action of the spring device.

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