Aug. 20, 1935. G. A. LOVETT 2,011,863

VALVE LASH ADJUSTING MECHANISM

Filed Nov. 25, 1929

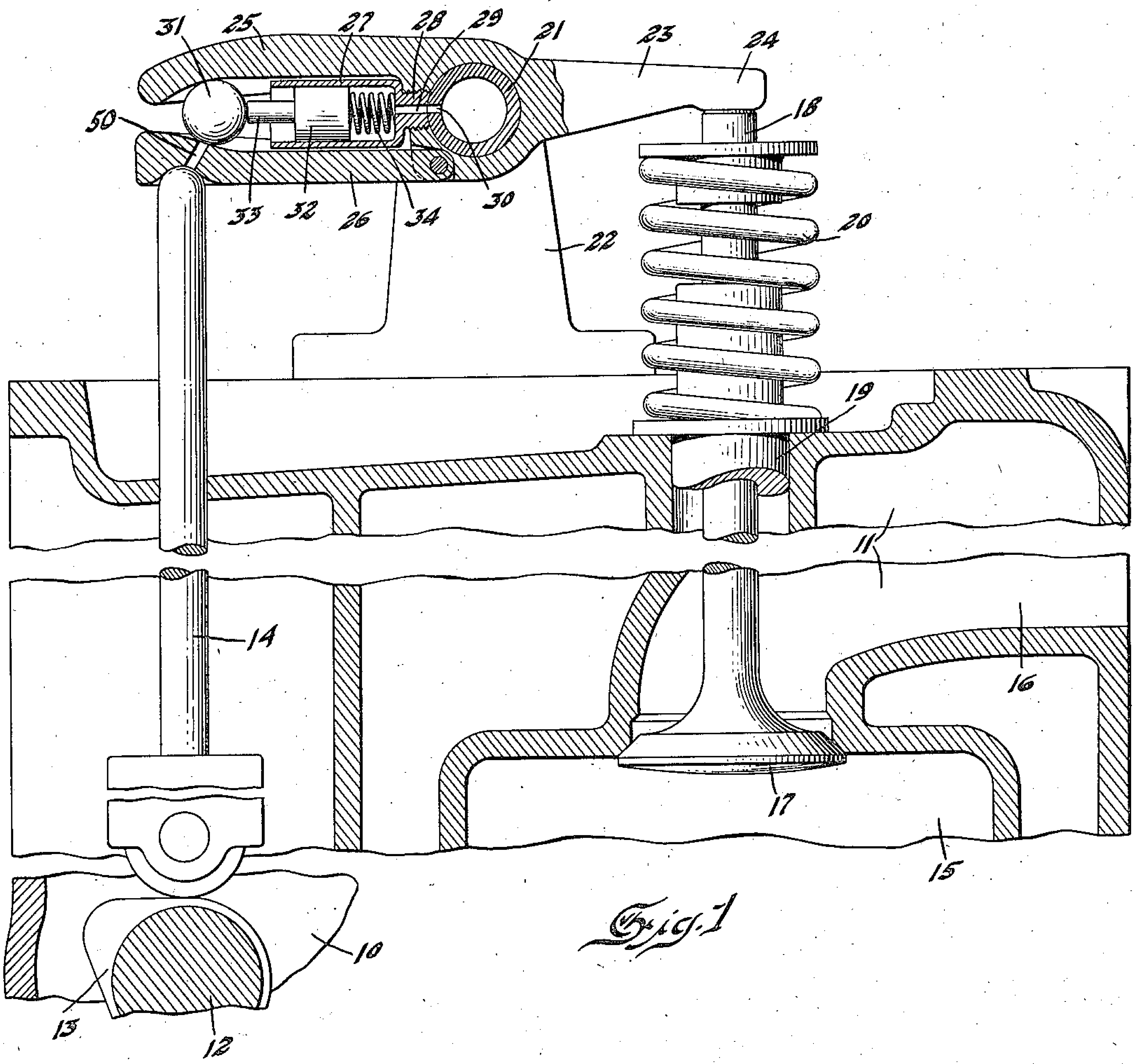

Fig. 1

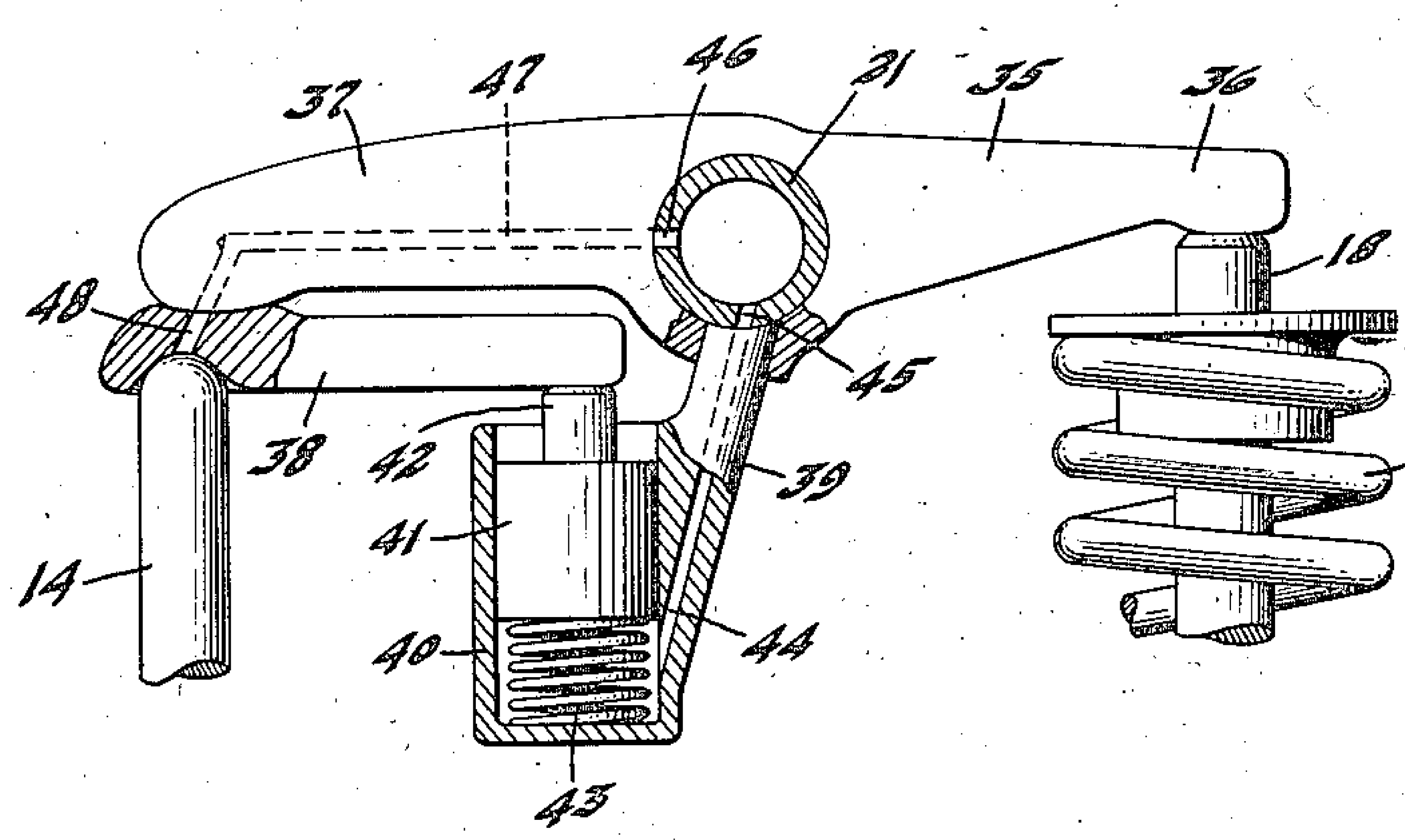

Fig. 2

Inventor

George A. Lovett

By Blackmore, Spencer & Flint

Attorneys

UNITED STATES PATENT OFFICE

2,011,863

VALVE LASH ADJUSTING MECHANISM

George A. Lovett, Detroit, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application November 25, 1929, Serial No. 409,582

8 Claims. (Cl. 123—90)

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 mechanism 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.

My invention relates to adjusting mechanisms of the type described in the preceding paragraph and resides, particularly, in so constructing and arranging the elements of the adjusting mechanism as to eliminate therefrom certain defects which were prevalent in the mechanisms of the type described which were known prior to the time of my invention.

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 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 fragmentary view showing a modified embodiment of my invention applied to the same type of valve mechanism as is shown in Figure 1.

In Figure 1 of the drawing in which I have, as previously indicated, illustrated my invention applied to the valve-operating mechanism of internal combustion engine of the overhead valve type, the reference characters 10 and 11 indicate, respectively, the crank case and the cylinder head of an internal combustion engine of the overhead valve type. In the crankcase, there is journalled a cam shaft 12 on which is formed a cam 13 which engages the lower end of a push rod 14, which is slidably mounted in suitable guides (not shown) in the crankcase.

The reference character 15 indicates a combustion chamber into which opens a port 16 which is adapted to be opened and closed by a poppet valve 17 on which is provided a stem 18 which is slidably mounted in suitable guides 19 and extends through the cylinder head to a point thereabove. A coil spring 20, which surrounds a portion of the valve stem 18, constantly urges the valve 17 to position to close the port 16.

A rocker 23, on which there is provided an arm 24 which is seated on the upper end of the valve stem 18, and an arm 25 whose outer end is disposed vertically above the upper end of the push rod 14, is pivotally mounted on a hollow shaft 21 which is supported by suitable brackets 22 which are mounted on the cylinder head. Through a portion of the wall of the hollow shaft 21 which is surrounded by the rocker 23, there extends an opening 30, through which lubricant which is forced into the hollow shaft by a suitable pump may reach the bearing between the rocker and the shaft.

To the lower side of the hub portion of the rocker 23, there is pivotally connected a lever 26, which is coextensive in length with the arm 25. The juxtaposed sides of the arm 25 and the lever 26 are recessed to provide a space in which there is located a hollow cylindrical element 27 on which there is formed a nipple 28 which is threaded into the hub portion of the rocker. Through the nipple 28 and terminating in the cylinder 27, there extends a bore 29 which is adapted to register periodically with the bore 30 in the shaft 21 and through which lubricant is adapted to be conducted into the cylinder 27. In the lower side of the outer end of the lever 26, there is formed a recess in which the upper end of the push rod 14 is seated. There extends through the lever 26 a bore 50 through which lubricant which leaks out of the cylinder 27 into the recess in the upper side of the lever may be conducted to the bearing between the push rod and the lever.

In the outer end of the recess which is formed between the lever 26 and the arm 25 and whose walls adjacent the outer end of the arm and the lever are convergent, there is located a spherical element 31. In the cylinder 27, there is located a plunger 32 on which there is provided a reduced extension 33 which bears against the element 31. Within the cylinder 27 and located between the inner end thereof and the inner end of the plunger 32, there is provided a coil spring 34 which constantly urges the plunger and the element 31 outwardly.

When the engine is started, the lubricant pump forces lubricant into the hollow shaft 21 and, thence, through the opening 30 and the bore 29, into the portion of the cylinder 27 at the inner end of the plunger 32 and, as long as the engine is operating, maintains this portion of the cylinder filled with lubricant. During that portion of each cycle of the operation of the engine, during which 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 20 will maintain the valve 17 on its seat. However, when the rise portion of the cam comes into contact with the lower end of the push rod, the push rod will be lifted vertically and the valve will, through the intermediary of the lever 26, the element 31, the rocker 23 and the valve stem 18, be opened against the resistance of the spring 20, and when the drop portion of the cam comes into contact with the lower end of the push rod, the spring 20 will move the valve onto its seat and through the intermediary of the valve stem 18, the rocker 23, the element 31 and the lever 26, maintain the lower end of the push rod in contact with the cam.

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 lower end of the push rod is in contact with the rise and drop portions of the cam—the pressure exerted on the lever 26 by the push rod 14 will cause the former to swing in a clockwise direction about its pivot on the rocker and move the element 31 and the plunger 32 inwardly, forcing oil out of the inner part of the cylinder and into the hollow shaft 21, and thus reducing the stress in the valve operating mechanism. By reason of the fact that the push rod 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, even though the bore 29 be relatively large.

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 lower end of the push rod is in contact with the dwell portion of the cam—the force exerted by the lubricant plus the force exerted by the spring 34 on the plunger will push the plunger and the element 31 outwardly and cause the lever 26 to swing in a counterclockwise direction about its pivot on the rocker, thus increasing the stress in the valve operating mechanism. As the plunger moves outwardly in the cylinder, the lubricant pump will force more oil into the cylinder and thus maintain the cylinder 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 and/or to cause the valve 17 to remain open during the idle intervals, the distance through which the plunger 32 moves inwardly in the cylinder 27, during the working intervals, will be greater than the distance through which the plunger moves outwardly in the cylinder, during the succeeding idle intervals, and, consequently, the mean stress in the valve operating mechanism will be gradually decreased until the tendency of the parts of the valve operating mechanism to bind and/or the tendency of the valve 17 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 32 moves outwardly in the cylinder 27, during the idle intervals, will be greater than the distance through which the plunger moves inwardly 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 mechanism is eliminated. It will, of course, be understood that the force exerted by the lubricant plus the force exerted by the spring 34 on the lever 26 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 and/or to open the valve 17 against the resistance of the spring 20. When there is no tendency for the parts of the valve mechanism to bind or become slack and/or for the valve 17 to remain open during the idle intervals, the distance through which the plunger 32 moves outwardly in the cylinder 27, during the idle intervals, will be equal to the distance through which the plunger moves inwardly 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 32 moves in the cylinder 27 during any cycle 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.

In the embodiment of the invention which is illustrated in Figure 2 of the drawing, the reference characters 14, 18, 20 and 21, as in the preceding figure, indicate, respectively, the push rod, the valve stem, the valve spring and the rocker supporting shaft of valve operating mechanism of the type shown in the preceding figure. On the shaft 21, there is pivotally mounted a rocker 35 on which there is provided an arm 36 which bears against the upper end of the valve stem 18 and an arm 37 which terminates vertically above the upper end of the push rod 14. Located between the outer end of the arm 37 and the upper end of the push rod 14 is the outer end of a lever 38 which is fulcrumed on the arm 37 adjacent its extremity but inwardly of the axis of the push rod. In the the lower side of the lever 38, there is provided a recess in which the upper end of the push rod is seated.

There extends into and is secured to the hub portion of the rocker 35 an arm 39 which carries a cylinder 40 which is closed at its lower end and open at its upper end. In the cylinder, there is located a plunger 41 on which there is provided a reduced extension 42 which bears against the inner end of the lever 38. Within the cylinder, between the closed end thereof and the inner end of the plunger, there is located a coil spring 43 which urges the plunger 41 upwardly in the cylinder. Through the arm 39 and communicating at one end with the portion of the cylinder 40 below the plunger 41, there extends a bore 44, which is adapted to register periodically with a bore 45 which extends through the wall of the shaft 21 and through which lubricating oil is adapted to be conducted to the bearing between the shaft 21 and the rocker 35, and through which lubricant is adapted to be conducted into the cylinder 40.

To conduct lubricant from the hollow shaft 21 to the bearing between the rocker 35 and the lever 38 and to the bearing between the lever 38 and the push rod 14, there are provided a bore 46 which extends through the wall of the shaft 21, a bore 47 which extends through the arm 37 of the rocker, whose inner end is adapted to register periodically with the bore 46 and which terminates at its outer end in the bearing between the arm 37 of the rocker and the lever 38, and a bore 48 whose upper end registers with the outer end of the bore 47 and which terminates at its lower end in the bearing between the lever 38 and the push rod 14.

When the engine is started, the lubricant pump forces lubricant into the hollow shaft 21 and, thence, through the opening 45 and the bore 44, into the portion of the cylinder 40 below the plunger 41 and, so long as the engine is operating, maintains the portion of the cylinder below the plunger filled with lubricant. Further than to note that, since the cylinder 40 is rigidly fixed to the rocker 35, the oscillatory movements of the rocker will not cause the lever 38 to move with respect to the rocker, and that the angular position of the lever 38 with respect to the rocker 35 determines the stress in the valve operating mechanism, it is thought that no description of the operation of the apparatus illustrated in Figure 2 is necessary.

It will, of course, be understood that there may be substituted for the mechanisms shown in drawing through which the dash-pot mechanisms operate at a mechanical advantage, other similarly functioning mechanisms.

I claim:

1. In internal combustion engine valve operating mechanism which includes a rocker, a member associated with the rocker, a lever on the rocker and in engagement with the member, and an hydraulically damped spring device carried by the rocker and operating on the lever to eliminate slack in and binding of the valve operating mechanism.

2. In power or motion transmitting mechanism which includes a pair of power or motion transmitting elements, means to eliminate slack in and prevent binding of the mechanism, including a motion modifying element which engages one and is carried by the other of the power or motion transmitting elements, and an hydraulically damped spring device carried by one of the power or motion transmitting elements and engaging the motion modifying element.

3. In power or motion transmitting mechanism which includes a pair of power or motion transmitting elements, means to eliminate slack in and prevent binding of the mechanism, including a lever which engages one and is carried by the other of the power or motion transmitting elements, and an hydraulically damped spring device carried by one of the power or motion transmitting elements and engaging the lever.

4. Valve operating mechanism which includes a rocker, a hollow rocker shaft, an hydraulically damped spring device carried by the rocker and having a channel for connecting it to the rocker shaft for fluid supply, and a lever engaging the hydraulically damped spring device, the rocker and another element of the valve operating mechanism.

5. A rocker which includes a body portion and an element pivotally connected thereto, a wedging element located between the body of the rocker and the first-mentioned element, means adapted to move the wedging element in one direction, and means to damp movement of the wedging element, the two last-mentioned means including an hydraulically damped spring device which is located between the body of the rocker and the first-mentioned element and engages the wedging element.

6. In internal combustion engine valve operating mechanism which includes a rocker and a hollow rocker shaft, a member associated with the rocker, a lever pivoted to the rocker and in engagement with the member, an hydraulically damped spring device carried by the rocker, a channel connecting the rocker shaft with the hydraulic cylinder of the spring device, and means operated by the spring device and bearing on the lever to eliminate slack in and binding of the valve mechanism.

7. In internal combustion engine valve operating mechanism which includes a rocker and a hollow rocker shaft, a member operating the rocker, a lever pivoted to the rocker and contacting the operating member, the lever and one arm of the rocker forming a U-shaped opening, an hydraulically damped spring device secured to the rocker within the U-shaped opening, a channel for fluid leading from the spring device to the rocker shaft, and means operated by the spring device tending to spread the arm and lever apart to eliminate slack in and binding of the valve mechanism.

8. In an internal combustion engine valve operating mechanism which includes a rocker and a hollow rocker shaft, a member operating the rocker, an hydraulically damped spring device secured to the rocker, a channel for fluid connecting the device with the hollow rocker shaft, an independent arm carried between the end of the rocker arm and the operating member and having its opposite end bearing upon the spring device to eliminate slack in and binding of the valve mechanism.

GEORGE A. LOVETT.