Sept. 27, 1938. W. M. GOODWIN 2,131,508

VALVE OPERATING MECHANISM

Filed Oct. 6, 1936

FIG. 1.

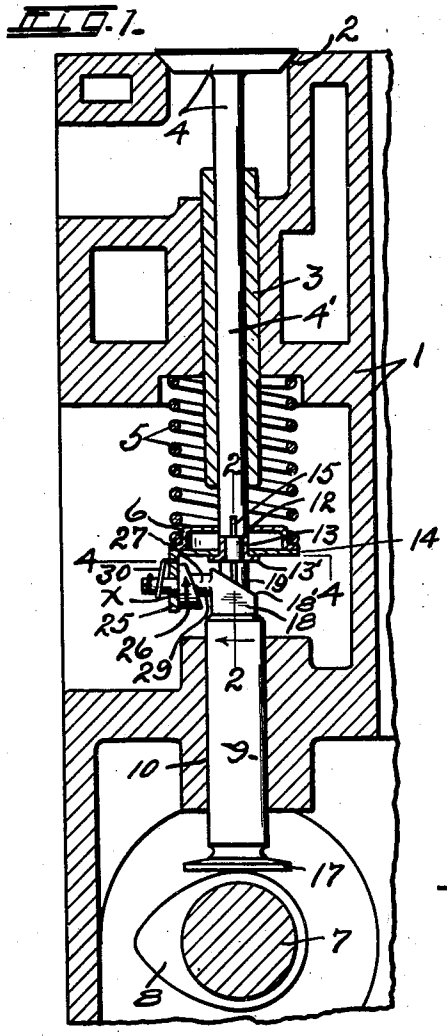


FIG. 2.

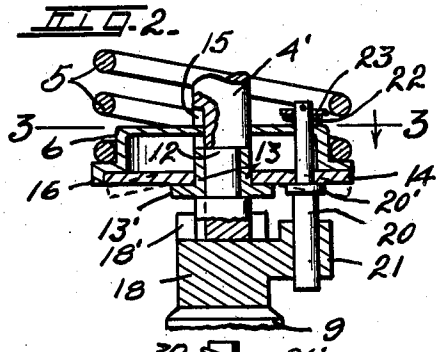


FIG. 3.

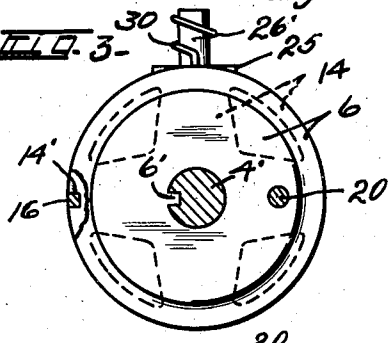


FIG. 4.

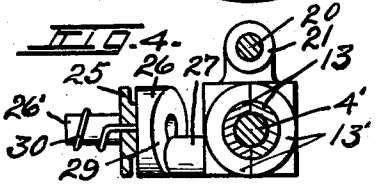


FIG. 5.

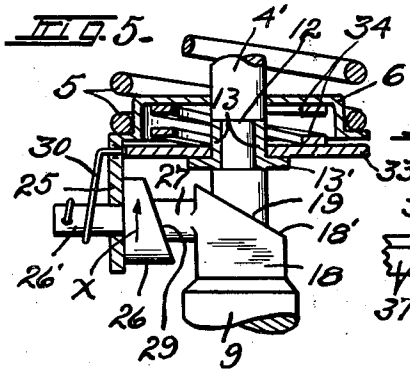


FIG. 6.

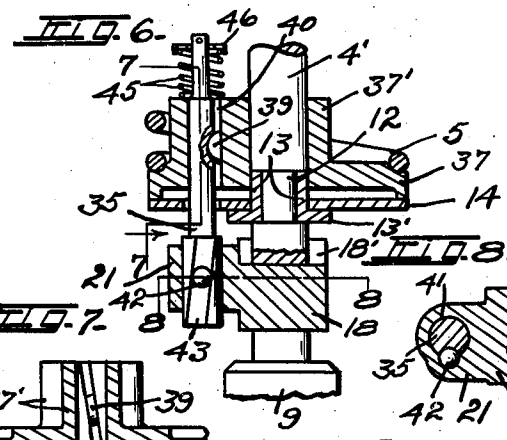


FIG. 7.

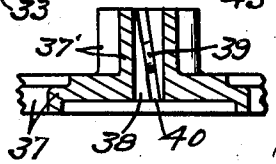


FIG. 8.

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VALVE OPERATING MECHANISM

William M. Goodwin, Central Square, N. Y.

Application October 6, 1936, Serial No. 104,247

9 Claims. (Cl. 123—90)

This invention relates to improvements in a valve operating mechanism for internal combustion engines of the class set forth in my Patents 1,577,965 issued March 23, 1926 and 1,609,711 issued December 7, 1926, in that a clearance take-up wedge is interposed between the stem of a poppet valve and the means or tappet for actuating said valve and wherein said wedge is rotatable about an axis parallel with and at one side of the axis of the valve.

The main object of this invention is to provide the mechanism for operatively connecting a poppet valve with an operating cam therefor with a simple and efficient clearance take-up means for automatically compensating for any variations in the overall length of the parts of said mechanism produced from any cause, as from expansion or contraction, whereby the valve may firmly engage its seat during each cycle of operation thereof and at the same time the spacing of said parts relative to each other and the noise resulting therefrom will be prevented from occurring.

Other objects of the invention reside in providing a valve operating mechanism of the above mentioned class with a clearance take-up apparatus which is compact, durable and relatively inexpensive to manufacture and that may be readily applied as an attachment to previously constructed engines having the conventional tappet valve operating mechanism as well as to new engines particularly built to accommodate my novel clearance take-up apparatus.

In carrying out the above mentioned objects I have provided a novel clearance take-up or slack adjusting apparatus for the operating mechanism of poppet valves whereby a slight slack or variation in the spacing of the parts is first effected in such mechanism and then such slack or spacing is compensated for during each cycle of operation of the mechanism.

Other objects and advantages relating to the specific parts of the mechanism will more fully appear from the following description taken in connection with the accompanying drawing in which:

Figure 1 is a fragmentary vertical sectional view of an internal combustion engine showing my invention applied thereto.

Figure 2 is an enlarged detail longitudinal sectional view taken substantially in the plane of the line 2—2 Figure 1 showing the means for rotatably supporting the wedge.

Figure 3 is a transverse sectional view taken on line 3—3 Figure 2.

Figure 4 is a transverse sectional view taken on line 4—4 Figure 1.

Figure 5 is a detail longitudinal sectional view partly in elevation of the adjacent ends of a valve stem and tappet or push rod therefor illustrating a slightly modified form of the structure shown in Figures 1 to 4, inclusive.

Figure 6 is a detail longitudinal sectional view similar to Figure 2 illustrating a modified form of the invention.

Figure 7 is a detail vertical sectional view through the spring seat taken substantially in the plane of the line 7—7 Figure 6 with the wedge actuating member removed and showing the helical groove for the actuating member associated with the spring seat.

Figure 8 is a sectional view partly in elevation taken on line 8—8 Figure 6.

Referring first to the structures shown in Figures 1 to 4, inclusive, a portion of an internal combustion engine cylinder block 1 is illustrated provided with the usual valve seat 2 and guide 3 for one of the valves 4. The valve 4 is yieldingly urged to the closed position in engagement with seat 2 by the usual spring 5 which has one end in contact with a portion of the cylinder block 1 and its other end in engagement with a seat 6 on the valve stem 4' of the valve 4. A cam shaft 7 is journaled in the cylinder block 1 some distance below the valve stem 4' and is provided with a cam 8 of usual construction for each valve 4. A tappet or push rod 9 is slidably mounted for longitudinal respective movement in a guide 10 provided in the cylinder block 1 for transmitting motion from the cam to the valve 4.

The valve stem 4' has the lower end thereof normally spaced from the tappet 9 and is provided with a circular recess 12 in the periphery thereof formed in spaced relation to said lower end. A split collar 13 is mounted in the recess 12, said collar having an outwardly extending flange 13' adapted to carry a supporting member 14 for the spring seat 6. This support 14 as shown in Figures 1, 2 and 3 is a resilient member preferably formed of spring steel for yieldingly supporting the spring seat 6 and spring 5. The tension of the support 14 relative to the spring 5 is such that when the valve is in its closed position in engagement with the seat 2 and the spring 5 is in its normal extended position said support will extend outwardly from the collar 13 and valve stem 4' in a plane substantially normal to the axis of said valve stem. However when the valve is moved upwardly to the open position the increased tension of the spring 5 produced thereby

during the collapsing of said spring will overcome the normal tension of the support 14 and effect a slight flexing of the outer marginal portion of the support, as illustrated by broken lines in Figure 2, whereby the spring seat will have a limited axial movement relative to the valve stem toward the tappet 9 and cam 8.

In order that the valve stem 4', spring seat 6 and the supporting member 14, may rotate in unison the valve stem is provided with a key slot 15 formed in one side thereof adjacent recess 12 and the spring seat 6 is provided with an extension 6' adapted to engage in said slot. Furthermore, the support 14 is provided with a slot 14' in the marginal edge thereof in which is positioned a pendant lug or detent 16 formed integral with the spring seat 6 as shown in Figures 2 and 3.

In the construction shown the tappet or push rod 9 is of usual construction having a head 17 adapted to be engaged by the cam 8 in the usual manner for raising the tappet while the upper end of the tappet is formed substantially normal to the axis thereof. Mounted upon the upper end of the tappet 9 is a wedge 18 having a flat lower surface adapted to slidably engage the upper end of the tappet while the upper face of the wedge is inclined relative to the axes of the tappet and valve stem 4' to form a cam face 18' adapted to contact with the lower end of the valve stem which is similarly tapered or inclined as at 19. The wedge 18 is rotatably supported to swing about an axis at one side of and parallel to the axis of the valve stem 4' by means of a pintle or pivot pin 20. This pintle 20 as shown in Figure 2 has the upper end portion thereof extending through aligned openings formed in the spring seat 6 and the support 14 therefor. The lower end portion of the pintle is rotatably received in a suitable aperture formed in an outwardly extending boss 21 made integral with the wedge 18 at one side thereof. The pintle 20 is provided with an annular flange 20' intermediate the ends thereof which contacts with the lower face of the support 14 while a light spring 22 is mounted upon the upper end of the pintle between a washer 23 secured to said pintle and the adjacent portion of the spring seat 6 and which co-acts with the flange 20' for yieldingly maintaining the pintle in its operative position.

As shown more particularly in Figure 1 the supporting member 14 is provided with a pendant arm or plate 25 secured to or formed integral with one side thereof. This plate 25 extends substantially paralled with the axis of the valve stem 4' in outwardly spaced relation to the wedge 18 and has rotatably mounted therein a cam member 26 to operatively engage a lateral projection or shoulder 27, connected to one side of the wedge, said projection 27 being extended outwardly from said wedge substantially at right angles to the vertical plane passing through the axis of the valve stem 4' and pivot pin 20. The cam member 26 is provided with a reduced bearing portion or shank 26' arranged to extend outwardly therefrom co-axially thereto. This shank 26' extends through a suitable opening provided in the plate 25 arranged in a plane at one side of the shoulder 27 so that the cam 26 will be in eccentric relation with said shoulder.

The adjacent surfaces 29 of the cam 26 and shoulder 27 are tapered or inclined as shown so that when the cam is rotated in the direction of arrow X Figure 1, the wedge 18 will be moved about the pivot 20 as an axis in the direction of its smaller end for taking up slack between the tappet 9 and the valve stem 4'. The cam 26 is yieldingly urged to rotate in the direction of the arrow X by means of a spring 30 coiled about the outer end of the shank 26' and which has one end thereof secured to said shank and the other end secured to the plate 25. The inclined or cam surface 18' of the wedge 18 and the inclined lower end 19 of the valve stem 4' are in such angular relation to the axes of movement of the valve stem 4' and tappet 9 that during the upward movement of the tappet 9 and valve stem 4' for opening the valve 4, the resistance to the upward movement of the wedge offered by the spring 5 through the valve stem 4' will tend to produce movement of the wedge 18 in the direction of its larger end with sufficient force to overcome the friction between the surfaces 19 and 18' and between the wedge 18 and tappet 9 and thereby produce a slight movement of the wedge about the pivot pin 20 toward the cam 26.

It will now be understood that inasmuch as the marginal portion of the supporting member 14 is flexed downwardly slightly relatively to the valve stem 4' and therefore toward the wedge 18 by the action of the spring 5 during the opening of the valve 4 the cam 26 will be carried downwardly thereby relative to the wedge 18 and shoulder 27 with the result that the action of the tapered surface 19 of the valve stem upon the surface 18' of the wedge 18 will cause the wedge to move toward the cam 26 and thereby effect a decrease in the distance between the adjacent ends of the valve stem 4' and tappet 9. As the valve 4 again returns to its closed position in engagement with its seat 2 it will be obvious that there will be a slight clearance formed between the wedge 18 and the valve stem 4' depending upon the degree of outward movement of the wedge during the opening of the valve providing of course there is no increase in the overall length of either the tappet 9 or the valve stem 4 or of both. If there is no change in the overall length of the valve stem and a clearance occurs between the wedge and the valve stem the spring 30 will effect rotation of the cam 26 in the direction of the arrow X and thereby cause the wedge 18 to rock about the pivot pin 20 in the direction of its smaller end to take up this clearance.

If on the other hand the movement of the wedge in the direction of its larger end toward the cam 26 produced during the opening of the valve 4 is insufficient to provide enough spacing between the lower end of the valve stem 4' and the tappet 9 to permit the valve 4 to engage its seat then of course the wedge 18 will not be moved by the action of the cam 26 in the direction of its smaller end during the inoperative portion of the cycle of movement of the cam 8. In this case the valve will be held slightly off its seat 2 until the next action of the cam 8 upon the tappet 9 for opening the valve 4 at which time the downward flexing of the support 14 will again provide a slight clearance between the cam 26 and wedge 18 so that the wedge may again be moved outwardly in the direction of its larger end to bring the adjacent ends of the valve stem 4 and tappet 9 into closed relationship with each other. This outward adjustment of the wedge 18 will continue during each opening of the valve 4 until such time as the valve 4 will engage its seat 2 when in the closed position. When the valve is thus properly seated the spring 30 will function in the manner hereinbefore described for rotating the cam 26 to produce a limited

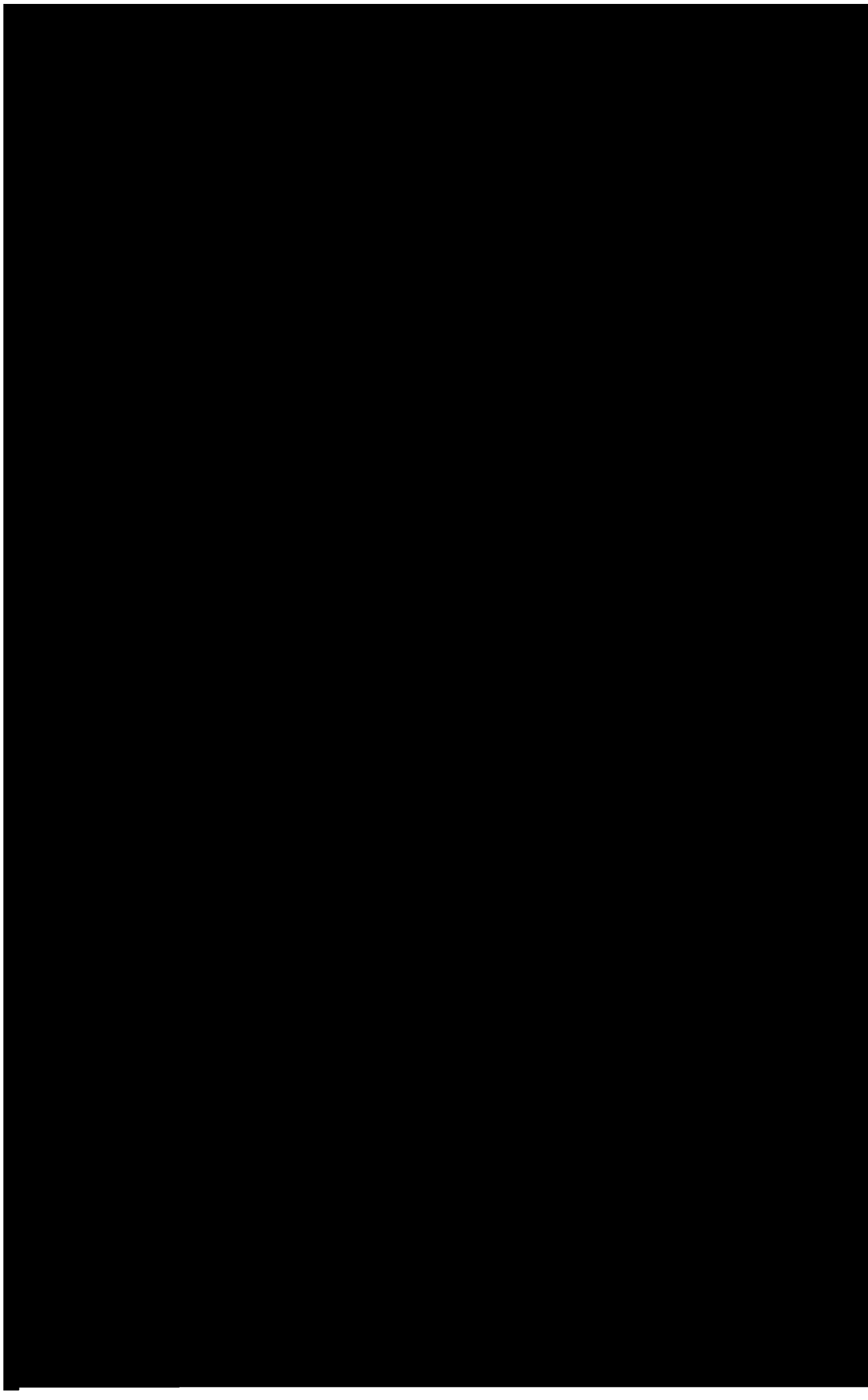
swinging movement of the wedge 18 in the direction of its smaller end for taking up any clearance which may occur between the valve stem 4 and tappet 9.

It will now be readily understood that during each cycle of operation of the valve operating mechanism a slight slack is introduced in the mechanism due to the movement of the wedge 18 in the direction of its larger end toward the cam 26 as the valve 4 is moved to the open position and that the slack thus produced is again taken up as the valve again returns to its closed position by the flexing of the support 14 back to its normal position or by the rotation of the cam 26 produced by the action of the spring 30 thereupon or by both of these movements providing no change occurs in the overall length of the valve stem 4' or of the tappet 9 or of both of these members. It thus follows that as a result of this introduction of slack in the valve operating mechanism during each cycle of operation thereof, the seating of the valve is assured and it is not possible for the valve to be maintained off its seat for any extended period of time during the operation of the engine.

The structure shown in Figure 5 functions in the same manner as that shown in Figures 1 to 4, inclusive. The main difference in these two devices resides in the supporting member as 33 for the spring seat 6 which in this instance instead of being a flexible spring member is a rigid member of sufficient strength to overcome the action of the spring 5 during the opening of the valve without flexing axially of the valve stem 4'. In order that the cam 26 may be moved in a direction parallel with the axis of the valve stem and tappet 9 during each opening operation of the valve a relatively short strong spring 34 is interposed between the support 33 and the spring seat 6 which is adapted when the valve is in its closed position and spring 5 is in its normal extended position to maintain the seat in slightly spaced relation to the support 33 as illustrated in Figure 5. This spring 34 however is so tensioned relative to the tension of the spring 5 that when said spring 5 is contracted during the opening of the valve the increased tension of the latter spring will overcome the tension of the spring 34 and cause a slight downward movement of the spring seat 6 toward the support 33, the extent of this downward movement of the spring seat being limited by said seat contacting with the support 33. Furthermore in order that this slight axial movement of the spring seat 6 relative to the valve stem 4' and support 33 may produce a corresponding movement of the cam 26 relative to the wedge 18 the plate or bearing member 25 for the cam is secured to or made integral with the spring seat 6 instead of with the supporting member as is the case in the structures shown in Figures 1, 2 and 3.

In the structures shown in Figures 6, 7 and 8 the supporting member 14 is formed in the same manner as in the structures shown in the Figures 1, 2 and 3 with the exception that the bearing plate 25 is eliminated and in place of the pivot pin 20 I have substituted an actuating member 35 for producing rotation of the wedge 18 in a direction to first introduce slack or clearance between the valve stem 4' and tappet 9 and then to take up said slack or clearance. In order that the actuating member may thus operate the wedge 18, I have shown a slightly modified form of seat 37 for the spring 5 in that it is provided with a hub 37' which receives the stem 4' therethrough. This hub 37' is provided with an opening 38 extending therethrough at one side of the valve stem in parallel relation with the axis of said stem for slidably receiving the upper end portion of the actuating member 35. This actuating member is in the form of a rod or stud having a key 39 carried in the intermediate portion of the upper portion thereof to extend outwardly therefrom into a helical groove 40 formed in the opening 38 as shown in Figure 7. The lower end of the rod or stud 35 extends into a suitable opening 41 formed in the extension 21 of the wedge 18. This opening 41 is of sufficient size to permit the adjacent end of the rod to freely slide therethrough while a ball 42 is fitted in the boss 21 to extend into the opening 41 and into a helical groove 43 provided in the lower end portion of the rod 35. The grooves 40 and 43 are each provided with a relatively steep pitch, as shown in Figures 6 and 7, to permit rod 35 to be readily moved axially with respect to members 18 and 37. Furthermore, the pitch of groove 43 is slightly less than that of groove 40 whereby wedge 18 will be moved about rod 35 as an axis with respect to spring seat 37 during axial movement of the rod 35 relative to wedge 18 and spring seat 37. The upper end of the rod 35 extends a short distance above the hub 37 and has a relatively light coil spring 45 mounted thereon between a washer 46 and the upper end of the hub for yieldingly urging the rod upwardly relative to the spring seat and to the wedge 18.

It will now be observed that the action of the clearance take-up mechanism shown in Figures 6, 7 and 8 is similar to that shown in the remaining figures with the exception that the wedge is positively moved in the direction of its larger end during each opening operation of the valve. This latter action of the wedge is effected during each downward flexing of the seat support 14 and the resultant axial movement of the spring seat 37 relative to the valve stem 4' and wedge 18 in the following manner. Considering first that as the spring seat 37 is thus moved axially relative to the valve stem toward the wedge 18 as the valve is being opened and that the actuating member 35 moves with said seat it will then be observed that the screw or helical groove 43 will produce rotary movement of the wedge 18 in the direction of its larger end due to the engagement thereof with the ball 42. If on the other hand the actuating member 35 remains stationary relative to the wedge 18 during the downward axial movement of the spring seat 37 relative to the stem 4', the spring seat will then obviously move relative to the actuating member and said actuating member will be rotated by the action of the helical groove 40 on the key member 39. The angle of inclination of the helical groove 40 is such that the rotation of the actuating member 35 produced by the downward movement of member 39 will be in a direction to move the wedge 18 in the direction of its larger end for introducing slack between the valve stem and tappet 9. Likewise, if the actuating member 35 moves axially relative to both the spring seat 37 and wedge 18 during the flexing of the support 14 it follows that the combined action of the grooves 40 and 43 and the respective members 39 and 42 associated therewith will effect swinging movement of the wedge 18 in the same manner and to substantially the same extent as when the actuating member remains stationary with the spring seat or with



opening and closing operation of the valve for swinging said wedge in the direction of its larger end.

6. A structure as set forth in claim 5 having separate means for yieldingly urging the wedge in the direction of its smaller end.

7. A clearance take-up mechanism for a valve of an internal combustion engine or the like comprising, in combination, a valve, a cam, means operated by the cam for intermittently opening the valve including two reciprocating members, a wedge interposed between said members, a spring for closing the valve, resilient supporting means for the spring connected with one of the reciprocating members to move therewith and adapted to be moved axially relative to the latter member to a limited degree by the action of the spring during the opening of the valve, and means operatively connected with the wedge and with the supporting means coacting with said cam and including a control mechanism adapted to be actuated by the said relative axial movement of the supporting means and member for effecting movement of the wedge in the direction of its larger end.

8. A device as in claim 7 wherein said control mechanism includes a cam and a spring member acting to rotate said cam in a direction to move the wedge in the direction of its smaller end.

9. A device as in claim 7 wherein said control mechanism includes an actuating member having a screw connection with the wedge and with the supporting means, and a spring connected with the actuating member adapted to effect movement of said member in a direction to move the wedge in the direction of its smaller end.

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