E. L. RUSSELL.

VALVE FOR INTERNAL COMBUSTION ENGINES AND DRIVING MEANS THEREFOR.

APPLICATION FILED DEC. 18, 1911.

1,166,939.

Patented Jan. 4, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

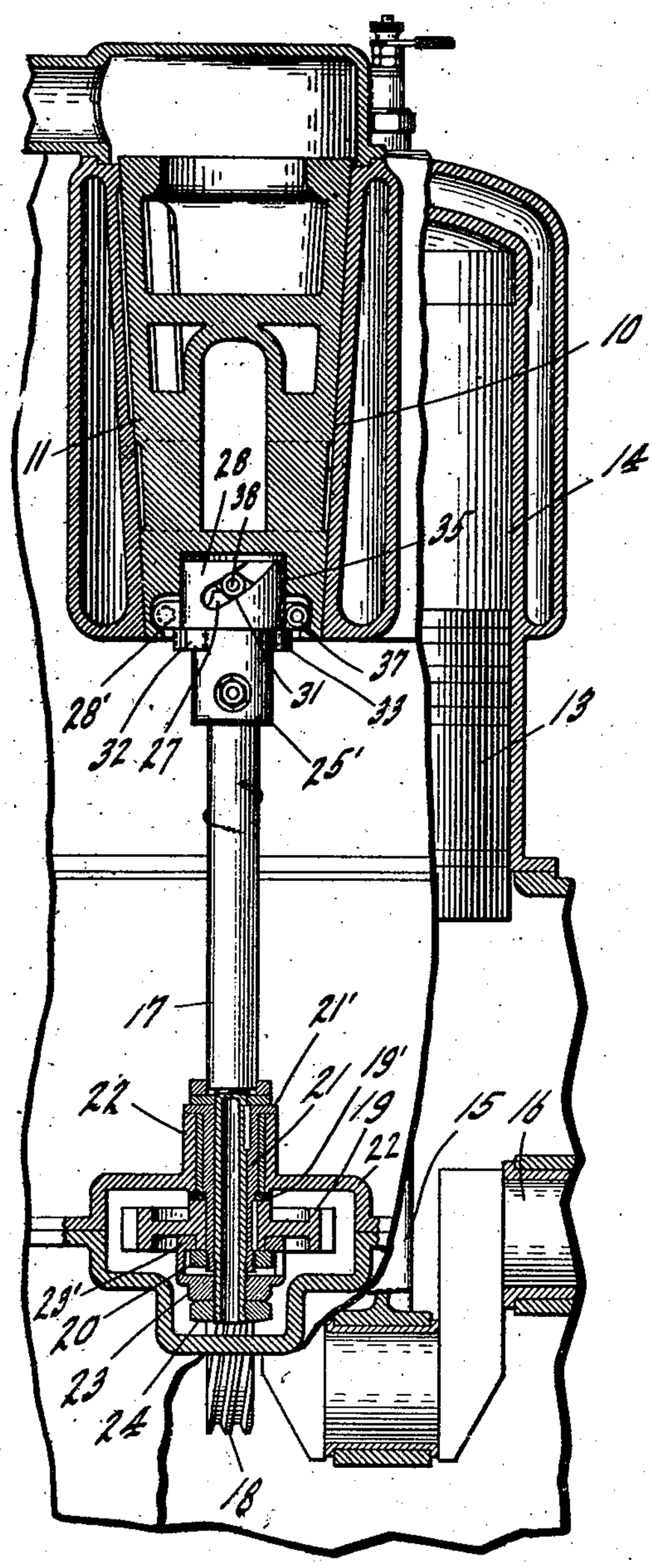
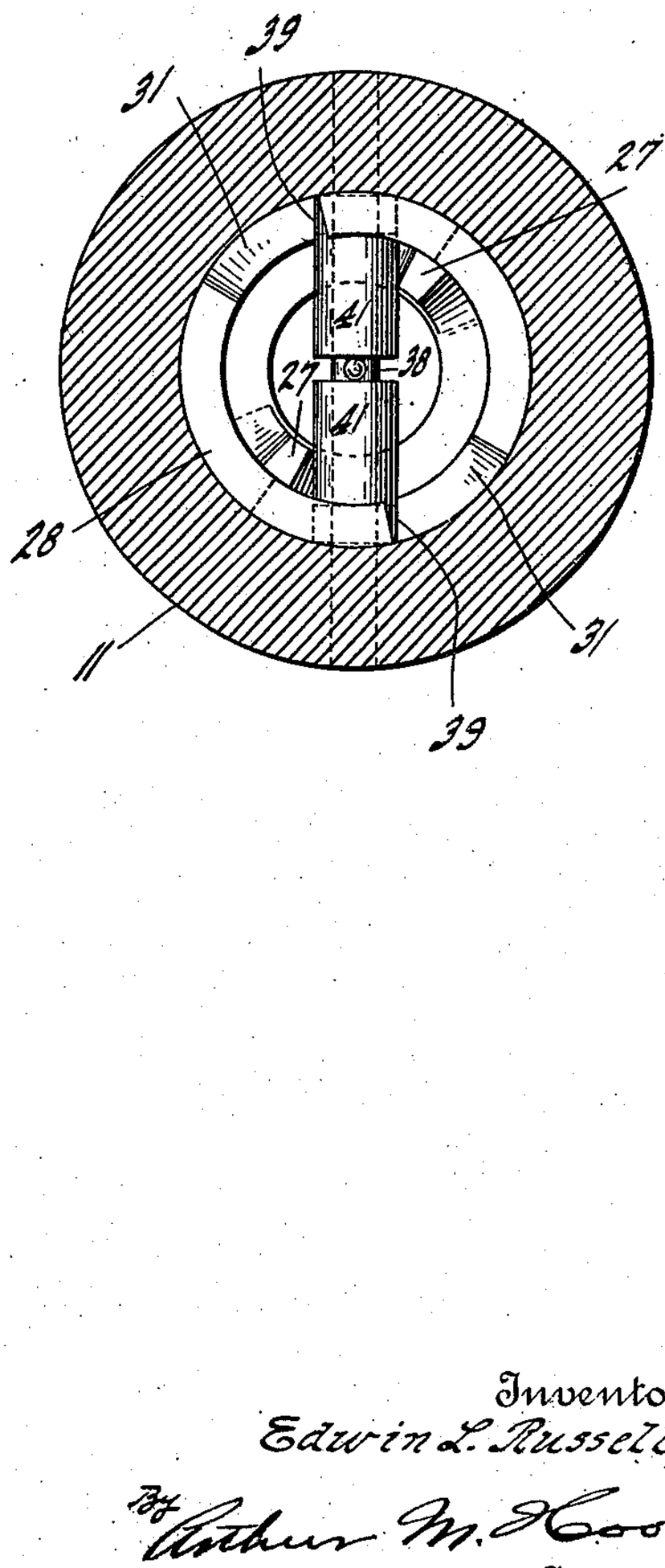


Fig. 5.



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2 SHEETS—SHEET 2.

Fig. 2.

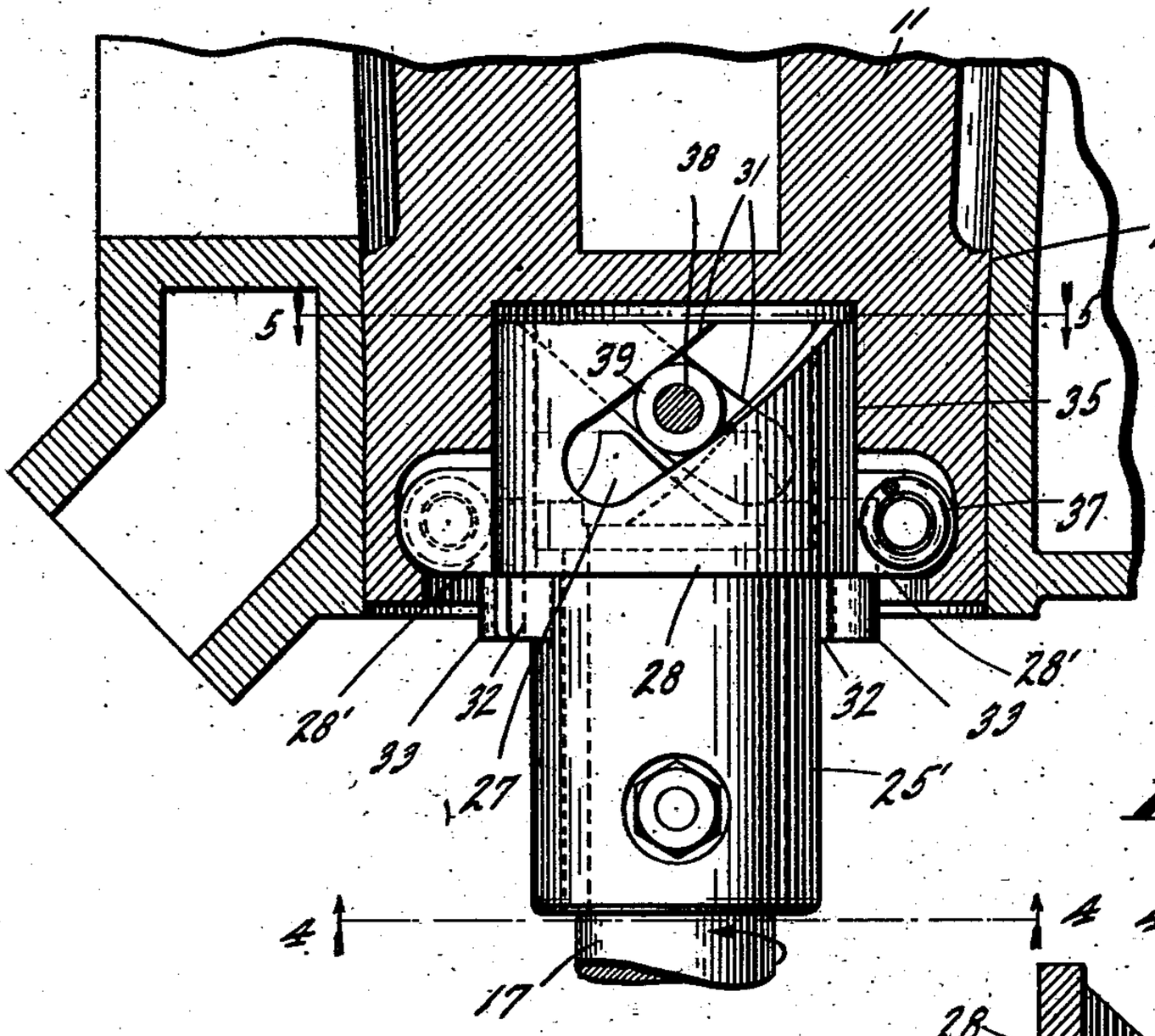


Fig. 3.

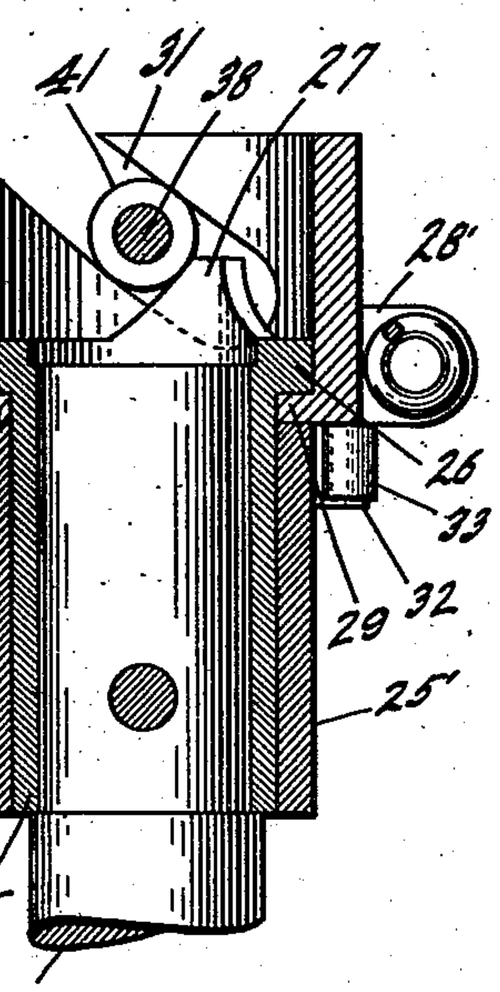
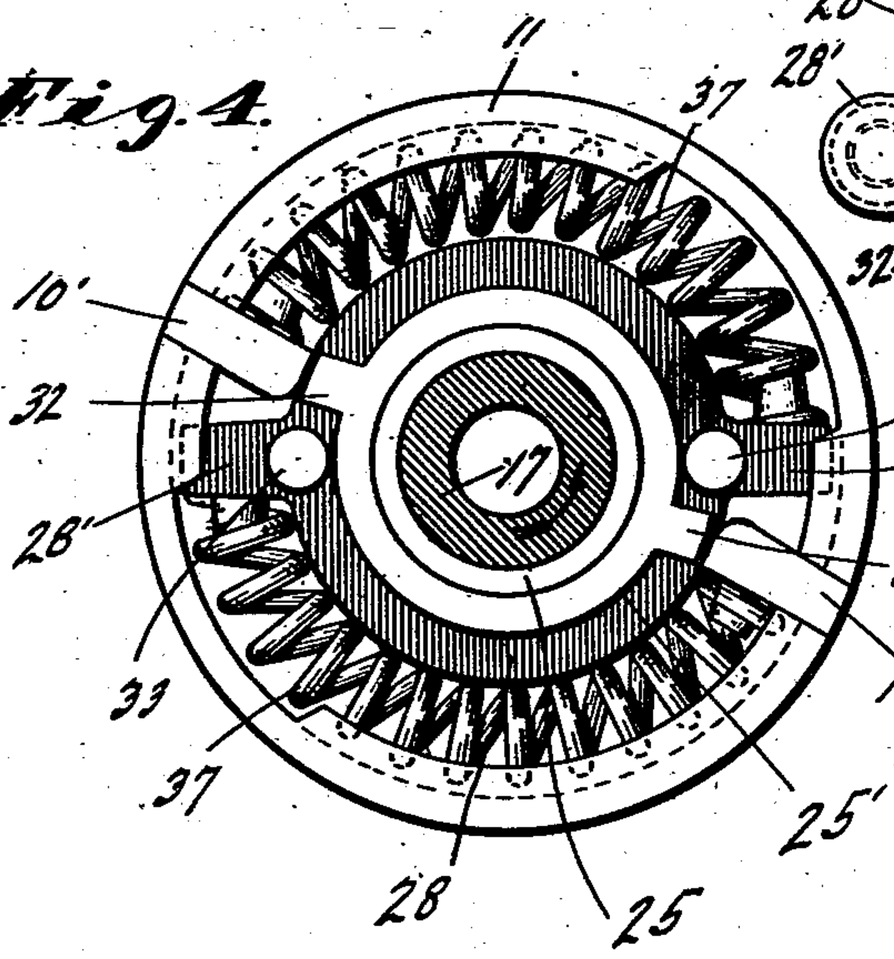


Fig. 4.



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UNITED STATES PATENT OFFICE.

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VALVE FOR INTERNAL-COMBUSTION ENGINES AND DRIVING MEANS THEREFOR.

1,166,939. Specification of Letters Patent. Patented Jan. 4, 1916.

Application filed December 18, 1911. Serial No. 666,477.

To all whom it may concern:

Be it known that I, EDWIN L. RUSSELL, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a new and useful Valve for Internal-Combustion Engines and Driving Means Therefor, of which the following is a specification.

The object of my invention is to provide, for use in internal combustion engines, and elsewhere, a rotary valve and driving means therefor of such character that the valve cannot stick but will always be properly correlated with its seat; such that proper compensation for wear may be readily made by unskilled hands; and such that backward movement of the driving member, due to backward movement of the engine when it is stopped, or otherwise, may not operate objectionably on the valve.

The accompanying drawings illustrate my invention.

Figure 1 is an axial section of my improved valve and driving mechanism in an internal combustion engine structure; Fig. 2 an enlarged detail of the connection between the valve and its driver; Fig. 3 an axial section of the two cam members of the driver; Fig. 4 a section on line 4—4 of Fig. 2 looking in the direction indicated by the arrows; and Fig. 5 a section on line 5—5 of Fig. 2 looking in the direction indicated by the arrows.

In the drawings, 10 indicates a valve seat upon or in which the valve 11 is mounted said valve being movable on its seat from open to closed position and from closed to open position, and being also movable toward and from seated position. In the present drawings I have shown the seat and valve as axially tapered, as is common with ordinary plug valves, such form being probably the most practical commercially, although it is to be understood that my present invention is by no means limited to this precise form.

The valve 11 is, in the instance illustrated, intended to be constantly driven in one direction as a result of the reciprocation of the piston 13 in the internal combustion cylinder 14, the piston being connected by pitman 15 with crank-shaft 16, and for that purpose I provide a driving shaft 17 connected to shaft 16 by means of the two spiral gears 18 and 19 connected to said shafts respectively.

Splined upon shaft 17, near its lower end, is a sleeve 21 which, at its upper end, is provided with a radially extending flange 21′ adapted to engage the upper end of casing 22 in which the sleeve is journaled. Splined upon the lower end of sleeve 21 is a gear 19 which is held in place by a nut 20, the arrangement being such that the gear 19 may be held against a thrust collar 19′ arranged between gear 19 and casing 22 and acting upon the casing 22 in a direction toward the valve 11 and therefore in a direction opposite to the direction of action of flange 21′ upon casing 22. Threaded upon the lower end of shaft 17, which projects down below the lower end of sleeve 21, is a nut 23 which is provided with an inwardly projecting flange 23′, which surrounds a portion of the lower end of the hub of the gear 19 and may have a thrust engagement with said gear and also with the nut 20. For this purpose nut 23 is conveniently made hollow so as to receive the nut 20. Nut 23 is held in position upon the lower end of shaft 17 by a check nut 24. It will be noticed that any downward pressure upon the shaft 17 will be transmitted as a pull upon the nut 23 which will, in turn, pull upon nut 20 and thus pull upon sleeve 21, and that this pull will be resisted by the action of flange 21′ upon the upper end of casing 22. By means of this arrangement shaft 17 does not come into direct thrust upon sleeve 21 or casing 22 and consequently may have a freedom of axial adjustment relative to the sleeve 21, this adjustment being varied by variation of position of nut 23 upon the shaft.

Secured to the upper end of shaft 17 is a sleeve 25 provided with a circumferential flange 26 and a pair of upwardly projecting cams 27 having helical active faces. Sleeved over sleeve 25 is a tubular head 28 having an internal flange 29 lying beneath flange 26 and held axially in place by a tube 25′ which is fixedly secured to sleeve 25. The axial flange or main body of head 28 has formed within it a pair of diametrically-opposed similarly-extending helical slots, or screw threads, 31 forming both upper and lower active edges or cam surfaces, and preferably having the same pitch as cam 27 but opposite thereto. Tube 25′ of sleeve 25 carries a pair of diametrically-opposed, radially-extending lugs 32 arranged to engage, in one direction, with downwardly projecting pins 33 carried by head 28, the arrangement being such that

there may be considerable freedom of rotation of sleeve 25 in one direction relative to head 28.

Head 28 is projected into a socket 35 formed in the lower end of valve 11, there being freedom of relative movement both axially and rotatively. Projecting radially from head 28 are two diametrically opposed lugs 28′ between which and abutment 10′ of valve 11 are arranged compression springs 37. Projecting diametrically across socket 35 is a pin 38 upon which are mounted two pairs of rollers, the rollers 39, 39 being within slots 31 and the rollers 41, 41 in position to be acted on by cams 27.

The springs 37 constantly tend to drive the valve 11 forwardly relative to the driving shaft 16 and, as such relative movement shifts the slots 31 relative to pins 38 the valve is under the constant tendency of the springs to be drawn down into the seat, the shaft 17 being axially fixed.

In initially setting the parts nut 23 will be screwed up on shaft 17 until springs 37 are under desired tension and in that position of the parts there may be a slight play of lugs 32 from pins 33 before cams 27 come into engagement with rollers 41, as indicated in Fig. 4.

When shaft 17 is rotated in the direction indicated by the arrows in Figs. 1 and 4, lugs 32 engage pins 33 and the valve 10 will be rotated by the combined action of springs 37 and the interaction of the lower edges of slots 31 and the rollers 39. If the resistance of the valve to movement is too great the springs will yield, slots 31 will slide under rollers 39 and the valve will be moved axially from its seat but the upper edges of the slots will prevent too great an axial movement and will, of course, prevent any axial movement of the valve due to any gaseous pressure applied to it. Immediately that the valve is released from its seat it starts forward both because of the circumferential component of the interaction of slots 31 and rollers 39 and also because of the increased tension of springs 37 so that the valve is properly advanced and at all times held to its seat with sufficient force to maintain a tight joint and yet under such yielding conditions that it may at all times be driven as desired.

When the engine stops it is quite possible that there may be a final backward movement of shaft 17 and therefore lugs 32 will be withdrawn from pins 33 and cams 27 will slide under rollers 41 so as to catch the valve 11 (by pins 38, and rollers 39 and 41) in the crotches between cams 27 and slots 31 so as to shift the valve 11 backwardly without danger of the upper edges of slots 31 sliding over rollers 39 and serving to draw the valve more tightly into its seat without driving it backwardly. Indeed, if the valve should tend to stick in its seat during the backward rotation of the shaft 17, the cams 27 will slide under rollers 41 enough to lift the valve 11 so as to release it from its seat and permit its free movement.

It will be seen that, by this construction, I am enabled to drive my valve in either direction on its seat and, under either direction of driving force, to properly release the valve and at all times maintain a proper seating thereof. It will be noticed that an axial adjustment of shaft 17, if the shaft be held against rotation, will result in a rotation of the valve in one direction or the other, so that the valve may thus be brought accurately into time with the crank shaft, by the axial adjustment of the shaft 17.

I claim as my invention:

1. In an internal combustion engine, having a driven shaft capable of rotation in either direction, of a valve structure comprising a seat member and a seated member movable toward and from the seat member and also movable along the seat member, and a driving connection between said shaft and the seated member, said driving connection comprising a spring connection between the driver and the seated member, interengaging members carried by the seated member and driver whereby movement of the driver in either direction will cause corresponding movement of the seated member, said connection permitting movement of the driver in either direction relative to the seated member and consequent movement of the seated member away from its seat.

2. In an internal combustion engine having a driven shaft capable of rotation in either direction, of a valve structure comprising a seat member and a seated member movable toward and from the seat member and also movable along the seat member, and a driving connection between said shaft and the seated member, said driving connection comprising a torque-applying spring connecting the seated member and the shaft, interengaging members carried by the shaft and the seated member and interacting under normal stress of the spring to drive the seated member toward its seat and, under resistance of the seated member to movement on its seat by the shaft, to drive the seated member initially from its seat upon movement of the shaft in either direction.

3. In an internal combustion engine having a driven shaft capable of rotation in either direction, of an axially tapered valve seat, an axially tapered rotatable valve seated therein, a torque-applying spring connecting the said shaft and valve, a helical double-acting cam-connection between the shaft and valve, and a second oppositely acting helical cam-connection between the shaft and valve, one of said cam-connections hav-

ing a limited range of movement relative to the shaft.

4. The combination of an axially tapered seat, an axially tapered member seated in the seat and both rotatably and axially movable, a driver, a torque-applying spring connecting the driver and seated member, a helical double-acting cam-connection between the shaft and valve, and a second oppositely acting helical cam-connection between the driver and valve, one of said cam-connections having a limited range of movement relative to the driver, and the other being directly carried by the driver.

5. The combination of an axially tapered seat, an axially tapered member seated in the seat and both rotatably and axially movable, a driver, a torque-applying spring connecting the driver and seated member, a helical double-acting cam-connection between the shaft and valve, and a second oppositely acting helical cam-connection between the driver and valve, one of said cam-connections having a limited range of movement relative to the driver.

6. The combination of an axially tapered seat, an axially tapered member seated in the seat and both rotatably and axially movable, a driving shaft substantially coaxial with the seated member, means for holding and adjusting said shaft axially, a helical, double-acting cam-connection between the shaft and valve, and an oppositely acting helical cam-connection between the shaft and valve, one of said cam-connections having a limited range of rotation relative to the driver.

7. The combination of an axially tapered seat, an axially tapered member seated in the seat and both rotatably and axially movable, a driving shaft substantially coaxial with the seated member, means for holding said shaft axially, a helical, double-acting cam-connection between the shaft and valve, and an oppositely acting helical cam-connection between the shaft and valve, one of said cam-connections having a limited range of rotation relative to the driver.

8. The combination of a seat member, a seated member associated therewith and movable both along and away from the seat member, a driver, a double-acting cam-connection between the driver and the seated member, a second cam-connection between the driver and seated member, one of said cam-connections having a limited range of movement relative to the driver, a torque-applying spring arranged between the driver and seated member, the said cam-connection between the driver and seated member being such that movement of the driver relative to the seated member in either direction will move the seated member from the seat member.

9. The combination of a seat member, a seated member associated therewith and movable both along and away from the seat member, a driver, a double-acting cam-connection between the driver and seated member, a second cam-connection between the driver and seated member, one of said cam-connections having a limited range of movement relative to the driver, the said cam-connections between the driver and seated member being such that movement of the driver relative to the seated member in either direction will move the seated member from the seat member.

10. The combination of a seat member, a rotatable seated member associated therewith, a driving shaft, means for axially holding said driving shaft and for axially adjusting the same, a double-acting cam-connection between the shaft and seated member serving to rotate the seated member by shaft rotation and also serving to axially shift the seated member upon rotation of the shaft relative to the seated member, a second cam-connection between the shaft and the seated member also serving to rotate the seated member upon rotation of the shaft in one direction and serving to shift the seated member away from the seat member upon rotation of the shaft relative to the seated member in the active direction of said last mentioned cam-connection, one of said cam-connections having a limited range of movement relative to the driver, and a torque-applying spring connection between the driver and seated member.

11. The combination of a seat member, a rotatable seated member associated therewith, a driving shaft, means for axially holding said driving shaft and for axially adjusting the same, a double-acting cam-connection between the shaft and seated member serving to rotate the seated member by shaft rotation and also serving to axially shift the seated member upon rotation of the shaft relative to the seated member, and a second cam-connection between the shaft and the seated member also serving to rotate the seated member upon rotation of the shaft in one direction and serving to shift the seated member away from the seat member upon rotation of the shaft relative to the seated member in the active direction of said last mentioned cam-connection, one of said cam-connections having a limited range of movement relative to the driver.

12. The combination of a seat member, a rotatable seated member associated therewith, a driving shaft, means for axially holding said driving shaft and for axially adjusting the same, a double-acting cam-connection between the shaft and seated member serving to axially shift the seated member upon rotation of the shaft relative to the seated member, a second cam-connection between the shaft and the seated mem-

ber also serving to shift the seated member away from the seat member upon rotation of the shaft relative to the seated member in the active direction of said last mentioned cam-connection, one of said cam-connections having a limited range of movement relative to the driver, and a torque-applying spring connection between the driver and seated member.

13. The combination of a seat member, a rotatable seated member associated therewith and also movable axially, a driver, a cam-connection between the driver and seated member controlling axial movement in both directions of the seated member by relative rotative movement between the driver and seated member, a second cam-connection between the seated member and driver producing axial movement of the seated member in one direction by relative rotative movement between the driver and seated member, one of said cam-connections having a limited range of rotative movement relative to the driver, and yielding torque-applying means acting upon the seated member tending to produce rotation thereof relative to the driver and thereby tending to drive the seated member axially toward its seat.

14. The combination of a seat member, a rotatable seated member associated therewith and also movable axially, a driver, a cam-connection between the driver and seated member controlling axial movement in both directions of the seated member by relative rotative movement between the driver and seated member, a second cam-connection between the seated member and driver producing axial movement of the seated member in one direction by relative rotative movement between the driver and seated member, one of said cam-connections having a limited range of rotative movement relative to the driver, and yielding means acting upon the seated member tending to produce rotation thereof relative to the driver and thereby tending to drive the seated member axially toward its seat.

15. The combination of a seat member, a rotatable seated member associated therewith and also movable axially away from the seated member, a rotatable driver, a helical connection between the driver and seated member controlling movement of the seated member in both directions axially by relative rotation between the driver and seated member, a second helical connection between the driver and seated member producing axial movement of the seated member in one direction upon relative rotation of said last mentioned helical connection in one direction, one of said helical connections having a limited range of rotation relative to the driver, and yielding torque-applying means acting upon the seated member to produce, in conjunction with said helical connections, a combined axial and rotative movement of the seated member toward the seat.

16. The combination of a seat member, a rotatable seated member associated therewith and also movable axially away from the seated member, a rotatable driver, a helical connection between the driver and seated member controlling movement of the seated member in both directions axially by relative rotation between the driver and seated member, a second helical connection between the driver and seated member producing axial movement of the seated member in one direction upon relative rotation of said last mentioned helical connection in one direction, one of said helical connections having a limited range of rotation relative to the driver, and yielding means acting upon the seated member to produce, in conjunction with said helical connections, a combined axial and rotative movement of the seated member toward its seat.

17. In an internal combustion engine, the combination with the cylinder, piston and crank shaft, of a valve seat communicating with the cylinder, a rotatable valve associated with said seat, a driving shaft drivingly connected with the crank shaft and arranged axially of the valve, a helical driving connection between said last mentioned shaft and the valve, acting to control the angular position of the valve relative to its seat by variation of axial position of the shaft, a second helical connection between the driving shaft and valve acting upon said valve in the direction opposite to the action of the first helical connection, and one of said helical connections being rotatable relative to the shaft, means for normally holding the driving shaft axially relative to the valve and for adjusting said shaft axially to vary the angular relation of the valve relative to the shaft, and a spring acting circumferentially upon the valve and one of the helical connections tending to shift the valve axially and angularly relative to the shaft.

18. In an internal combustion engine, the combination with the cylinder, piston and crank shaft, of a valve seat communicating with the cylinder, a rotatable valve associated with said seat, a driving shaft drivingly connected with the crank shaft and arranged axially of the valve, a helical driving connection between said last mentioned shaft and the valve, acting to control the angular position of the valve relative to its seat by variation of axial position of the shaft a second helical connection between the driving shaft and valve acting upon said valve in the direction opposite to the action of the first helical connection, and one of said helical connections being rotatable rela-

tive to the shaft, means for normally holding the driving shaft axially relative to the valve and for adjusting said shaft axially to vary the angular relation of the valve relative to the shaft, and a spring acting upon the valve and one of the helical connections tending to shift the valve axially and angularly relative to the shaft.

19. In an internal combustion engine, the combination with the cylinder, piston and crank shaft, of a valve seat communicating with the cylinder, a rotatable valve associated with said seat, a driving shaft drivingly connected with the crank shaft and arranged axially of the valve, a helical driving connection between said last mentioned shaft and the valve, acting to control the angular position of the valve relative to its seat by variation of axial position of the shaft, a second helical connection between the driving shaft and valve acting upon said valve in the direction opposite to the action of the first helical connection, and one of said helical connections being rotatable relative to the shaft, and means for normally holding the driving shaft axially relative to the valve and for adjusting said shaft axially to vary the angular relation of the valve relative to the shaft.

20. In an internal combustion engine, the combination with the cylinder, piston and crank shaft, of a valve seat communicating with the cylinder, a rotatable valve associated with said seat, a driving shaft drivingly connected with the crank shaft and arranged axially of the valve, a helical driving connection between said last mentioned shaft and the valve, acting to control the angular position of the valve relative to its seat by variation of axial position of the shaft, and means for normally holding the driving shaft axially to vary the angular relation of the valve relative to the shaft.

In witness whereof, I have hereunto set my hand and seal at Indianapolis, Indiana, this 11th day of December, A. D. one thousand nine hundred and eleven.

EDWIN L. RUSSELL. [L. S.]

Witnesses:
ARTHUR M. HOOD,
FRANK A. FAHLE.