

Nov. 11, 1924.

A. B. JOY

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PUSH ROD

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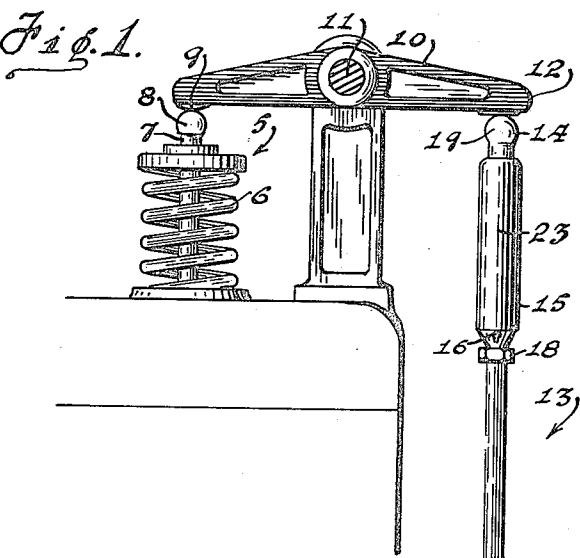
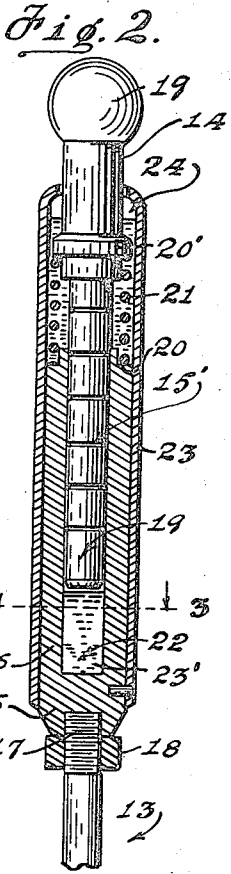


Fig. 4.

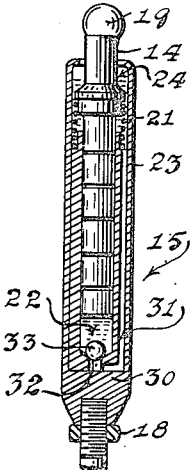
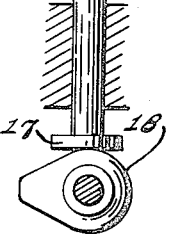


Fig. 3.

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UNITED STATES PATENT OFFICE.

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PUSH ROD.

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To all whom it may concern:

Be it known that I, Amos B. Joy, a citizen of the United States, and a resident of Redondo, in the county of Los Angeles and State of California, have invented new and useful Improvements in Push Rods, of which the following is a specification.

This invention relates to push rods and the like, and pertains more particularly to push rods for raising and lowering the valves in internal combustion engines.

The invention has for its principal object the provision of means for increasing the efficiency of internal combustion engine valve actions and the increasing of the efficiency of the motor itself by providing for more rapid opening and closing of the valve without increasing the forces set up in the mechanism by inertia and in fact by decreasing such forces.

Another object of the invention is the provision of means whereby all lost motion between the valve and the cam will be taken up to reduce noise, wear, vibration and the like, while permitting of accurate and uninterrupted seating of the valve.

Another object of the invention is to provide a valve push rod capable of being adjusted to take up substantially all lost motion in the valve mechanism, while precluding any slight high spots on the cam, intermediate of the regular "rise," tending to raise the valve from its seat.

Another object of the invention is the provision of a push rod that is relatively compressible, so that when subjected to excessive thrust, it will tend to compress slightly on the first application of the thrust.

It will be understood in the consideration of my invention that it is essential in practice to allow a slight clearance to exist at all times somewhere between the valve itself and the cam which drives it. One reason for this is to allow for expansion of the parts, and another reason is to preclude against the valve being unable to seat fully, and preclude the tendency of any slight irregularities in a cam to open the valve slightly at the wrong time. Internal combustion engine valves are generally forced open by a push rod, raised in turn by a cam, while a spring tends to hold them closed and quickly returns the valve to its seat when allowed to do so. To obtain maximum volumetric efficiency, and to reduce so called pumping losses to a minimum, it is essential

that the valves open very quickly. The rate at which they may be opened is limited largely by the inertia of the valve. Since the valve is returned to closed position by a spring, and should close as quickly as possible, it is advantageous to employ an extremely strong spring. Springs stronger than ordinarily employed would cause quicker return of the valve, but the shock to which the valve is subjected in closing, and the shock to which the push rod and cam are subjected in opening the valve, would be increased to an impracticable degree.

It is therefore a further object of the invention to provide a push rod which will positively open a spring pressed valve while dissipating any inertia shocks, and which upon having accomplished the opening of the valve and being allowed to return to normal position, will permit of the valve seating freely, and which will for a brief lapse of time after the valve is seated provide for a slight clearance to insure seating of the valve; which clearance it will subsequently reduce to a practical minimum preparatory to its next actuation.

Still another object of the invention is the provision of a push rod which may be adjusted to at all times carry out the foregoing objects, and which will continue to function in accordance therewith, even should the push rod parts expand or contract due to temperature changes.

I have illustrated by the accompanying drawings a preferred embodiment of my invention and a modification thereof, and it is understood that numerous other modifications will suggest themselves to the minds of those skilled in the art, and therefore, I do not limit myself to any construction or arrangement of parts, except within the appended claims.

In the said drawings,

Figure 1 is a view in elevation of an internal combustion engine valve mechanism in which the push rod employed is constructed in conformance with my invention.

Figure 2 is an enlarged view in vertical section of a part of the push rod.

Figure 3 is a view in section seen on line 3-3 of Fig. 2 and

Figure 4 is a view in vertical section of a modification of the invention.

More specifically, 5 indicates a valve common to internal combustion engines and

normally held in closed position by a spring 6. Said valve includes a valve stem 7, terminating in a rounded end 8, which is abutted by an end 9 of a rocker arm 10. The rocker arm is oscillatably mounted as at 11, so that when its other end 12 is raised, end 11 is depressed, and the valve stem is forced downward to raise the valve from its seat (not shown). The above described arrangement of parts is common to valve-in-head engines, and it will be apparent hereinafter that my invention is equally applicable to other types of valve mechanisms, and in fact to any machine or mechanism in which a push rod is employed.

The salient feature of my invention resides in certain features, which I am about to describe, embodied in a push rod 13. Said push rod, as will be apparent particularly by reference to Fig. 2, is divided into substantially two aligned sections 14 and 15, respectively. Section 15 terminates in an enlarged lower end 17, abutting a cam 18, which, acts to raise and lower the valve, through the medium of the push rod, as it is rotated.

Section 14 of the push rod is provided with a rounded end 19, which abuts the rocker arm, and it will be apparent that with the respective sections maintaining the same positions with respect to one another, the cam acting to raise the push rod as a whole will cause the valve to be opened.

Section 14 of the rod is constructed similarly to a plunger and in conformance with its purpose, apparent hereinafter, oil grooves 15' are provided therein. Section 15 of the rod terminates in a cylinder member 16, which for purposes of adjustment and practicability of manufacture is formed as a separate unit adjustably mounted on a threaded end 17 of the rod by a jam nut 18. The cylinder is formed with a bore 19 in which the plunger end of the other section is reciprocable. Section 14 is formed with an annular enlargement 20' corresponding to a shoulder 20 provided on the cylinder, so that a spring 21 tends to hold the cylinder and plunger sufficiently apart to maintain a space 22 in the lower end of the cylinder.

Encompassing the cylinder member and extending upwardly to encompass the major portion of section 14, an annular shield 23 is provided which forms an overflow space 24.

This overflow space and space 22 are filled with a suitable fluid 23', such as lubricating oil or glycerine. It will be apparent that any force acting to press the plunger downward into the bore of the cylinder would act to displace oil from the space 22 into the overflow space, although it would be necessary to set up considerable pressure in the oil to accomplish this.

Upon filling the overflow space and space

22 with oil, the spring will act to raise the plunger until the spring is fully expanded. This spring is not of any appreciable strength, and it is not intended that it shall appreciably counteract the valve spring. Spring 21 is capable of tending to create an appreciable vacuum in the cylinder and as it tends to raise, it causes a reduction of pressure therein, with the result that the pressure of the atmosphere acting on the oil in the overflow space will cause the oil to flow into the space and allow the plunger to gradually rise. In practice I have found that a practically negligible clearance between plunger and cylinder is ample for the purpose, and therefore I have shown no visible space existing between said parts.

The operation of the device shown in Figs. 1, 2 and 3 is as follows: The respective parts of the valve mechanism are adjusted so that with the valve closed, spring 21 is subject to a slight compression by the valve spring, while the plunger end is still sufficiently above the end of the cylinder bore to leave an appreciable amount of oil in the cylinder. When the engine is in operation the valve illustrated will of course be under motion during only one stroke of the usual four strokes of the engine. When the cam "rise" first strikes the push rod to force it upward, the thrust will be imparted to the upper section of the rod, due to the incompressibility of the oil in space 22. The first portion of the thrust is extremely great, due to the inertia of the valve, and this thrust, while it lasts, will place the oil under high pressure. A small portion of the oil will escape, since the interval is very slight, but by this escape of the oil some of the thrust is dissipated while the valve is opened as quickly, or even more rapidly by virtue of the absence of lost motion, than ordinarily in the case of a valve mechanism adjusted to provide lost motion. During the interval that the valve is opened, after its inertia has been overcome, the valve spring will continue to depress the plunger and may displace more oil, but any displacement effected by the spring alone will be negligible as compared to that originally displaced, since the pressure of oil set up by the inertia of the valve is many times greater than the normal pressure set up by the spring.

Let us assume now that the point is reached at which the cam begins to allow the valve to be closed by the valve spring. The push rod is slightly less in effective length than at the outset of the opening of the valve. Said valve spring causes the rocker arm and push rod, and in fact impels it, to keep up with the decreasing diameter of the cam. Finally the valve closes and of course the upper end of the valve stem stops in its original position. The push rod having become slightly shortened

in effective length results in the rounded end of section 14 continuing on a short distance beyond original position. Thus a clearance exists between it and the rocker arm, and the possibility of the valve not being absolutely free to seat is precluded.

The existence of a clearance makes the position of the parts the same now as in usual practice. Should this clearance remain there would be no advantage accomplished.

It should be explained here that the forces acting to displace the oil are those innumera- ted hereinbefore, while the force which acts to return the oil to the space 22, is the pres- sure corresponding to the vacuum set up in the cylinder by spring 21. Since the flow of a fluid increases only inversely with the square of the pressure difference accelerat- ing it, and since the time during which the oil has to return to the cylinder is three times (about) longer than the period during which it is displaced, it is evident that the area of the plunger, in any given instance, should be great enough to prevent the oil being subjected to a pressure more than ap- proximately nine times in excess of the suc- tion pressure acting to return the oil.

When the valve is seated and the said clearance exists, the spring is free to tend to raise the plunger, and therefore a reduction of pressure is effected in the cylinder. Now the pressure of the atmosphere forces the oil back into the cylinder as the plunger rises, and before another impulse is given the push rod all clearance will have been taken up. When the next impulse is im- parted by the cam to push the rod, the latter acts instantly on the valve stem as herein- before explained.

In some instances I have found that it would be impracticable to have the plunger sufficiently large in diameter, therefore to meet such conditions I provide the embod- iment shown in Fig. 4, in which embodiment the parts corresponding to those previously described are correspondingly numbered. In this form of the invention the shield is formed with a bottom closure 30, and a pas- sage 31 is formed in the cylinder so that oil may flow from the overflow space to the space 22 through this groove more freely than it escaped between the walls of the cylinder and plunger. Communication is had from the groove to the space in the cyl- inder through a vertical passage 32, which is closed against reverse flow by a ball- check 33.

The operation of this form of the inven- tion is substantially similar to the other form, in that during the interval in which the rod is subject to thrust, oil may escape slowly past the plunger into the overflow space. When the end of the plunger is clear of contact with the rocker arm, the spring

is capable of returning the rod to its full effective length, inasmuch as oil may return freely by way of the passage 32; the ball being raised from its seat by the return flow of oil. With this form of the invention the push rod may regain its original length in the short interval of time, merely by atmos- pheric pressure returning the oil, even though the oil was displaced from the cyl- inder by a relatively high pressure.

It will be apparent now that I have pro- vided a push rod capable of taking up all clearance automatically, and of tending to resist instant compression while capable of being slowly compressed to decrease its effective length for the purpose set forth.

I claim:

1. A device for reducing shocks and tak- ing up lost motion in push rods and the like, including a fluid filled cylinder, a plunger in said cylinder devoid of packing or the like whereby a slight leakage at high pressure will result, an annular shield extending above the upper end of said cylinder, and means interposed between said plunger and cylinder yieldably tending to raise said plunger in said cylinder, and means between said cylinder and said shield whereby oil may flow freely from said shield to said cylinder while being checked from reverse flow.

2. In a device of the character described, a cylinder provided with a bore and an overflow space; one end of the bore being in direct communication with the overflow space, and the other end of the bore being in communication with the overflow space through a separate passage, and a check valve for permitting oil to flow from the overflow space through said passage to the bore while checking return flow.

3. In a device of the character described, two concentric members; the inner member provided with a coaxial bore and the outer member being of annular form and fitted over the inner member and extending above the inner member to provide an overflow space coaxial with and communicating with said bore, a plunger fitted in said bore and elongated to extend through said overflow space and protrude from the upper end of said annular member, an enlargement to said plunger disposed to come within said overflow space when the parts are assem- bled, a spring interposed between the upper end of said member and said enlargement, a fluid course between said members connect- ing the overflow space with the lower end of the bore, and a check valve disposed to permit flow of oil from the overflow space to the bore through said course while check- ing return flow.

AMOS B. JOY.