Feb. 19, 1963 J. J. BUSH 3,077,874

ROTATABLE POPPET VALVE

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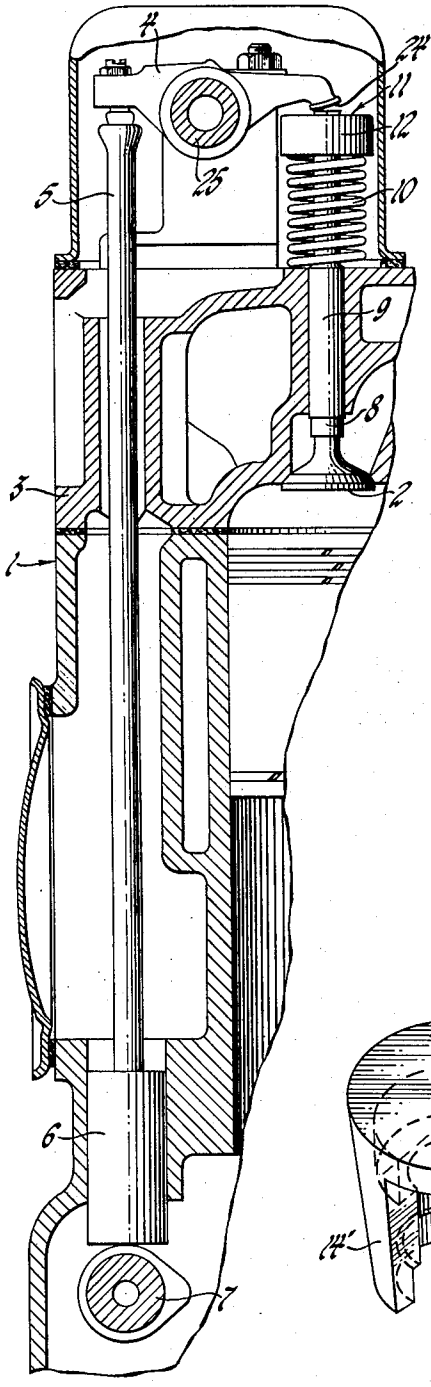

Fig. 1

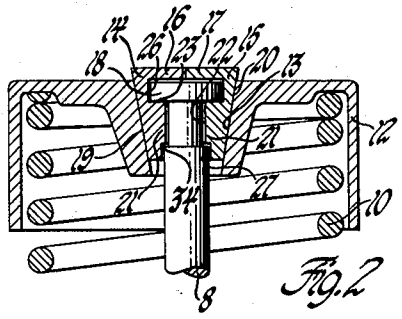

Fig. 2

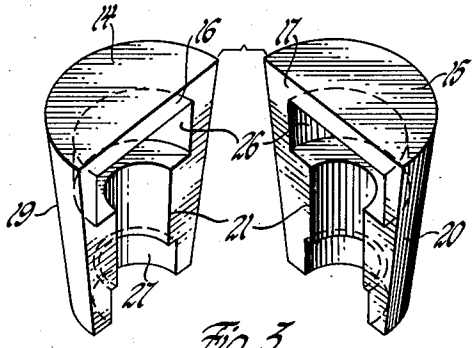

Fig. 3

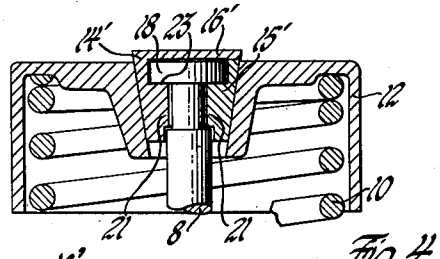

Fig. 4

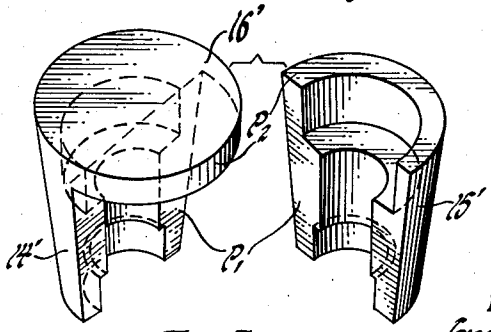

Fig. 5

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ROTATABLE POPPET VALVE

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The invention relates to internal combustion engines and like devices having slidably guided and spring opposed poppet valves, and particularly to improved means for connecting such a valve to its spring so as to accommodate rotation of the valve during reciprocation.

In such engines employing rockers or other valve actuating means having a substantial component of lateral movement relative to the direction of valve reciprocation, the conventional spring-to-valve stem connection transmits lateral force to the valve as the result of such lateral movement of the rocker or other actuator, creating friction between the valve and its guide and between the valve and the parts connecting it to the spring. This friction prevents rotation of the valve, with resulting ovalizing wear of its guide and accumulation of carbon deposits on the valve seating surface in the engine. Also, the increased friction between the valve stem and its guide tends to create the objectionable valve "squawk" noise as explained in U.S. Patent 2,851,022 to Andon et al.

While the latter patented construction accomplishes its intended objective, I have found that the desired results can be obtained more simply and economically by a novel construction of the so-called "keepers" or split "locks" which conventionally secure the valve stem to its spring retaining washer. Among the more important advantages of my invention are that the desired freedom of the valve to rotate and the elimination of the aforementioned noise during operation are accomplished without extensive modification of existing valve mechanisms, and the number of parts required is reduced from that proposed in the Andon et al. patent. In accordance with the invention, the keeper members are constructed in such a way that they are forced against each other by their engagement with the spring retainer washer, instead of being forced against the valve stem, and the interengageable portions of the keeper and the valve stem have sufficient freedom of relative movement that the lateral component of motion of the valve rocker or other actuator is not transmitted to the valve. Also one or both of the keeper parts has a portion overlying the end of the valve stem, isolating it from frictional engagement with the actuating member.

The invention will be more clearly understood from the following description, having reference to the drawing wherein:

FIGURE 1 is a transverse view, partly in section and partly in elevation, through a portion of an internal combustion engine having a poppet valve operating mechanism incorporating one preferred form of the invention.

FIGURE 2 is an enlarged fragmentary view, similar to FIGURE 1 but showing the spring retainer washer and the parts connecting it to the valve stem in longitudinal section.

FIGURE 3 is a further enlarged view in perspective of the keeper parts per se.

FIGURE 4 is a view similar to FIGURE 2 but showing a slightly different form of the invention.

FIGURE 5 is a view similar to FIGURE 3 but showing the modified form of the keeper parts illustrated in FIGURE 4.

Referring now in detail to the drawing, and first to FIGURES 1, 2 and 3 thereof, the numeral 1 designates generally an internal combustion engine having a poppet valve 2 reciprocably mounted in the engine cylinder head

3 and operated by a valve gear including an actuator in the form of a rocker 4, a push rod 5, tappet 6 and engine driven cam 7, all of conventional design. The valve has a stem 8 slidably guided by a bushing 9 fixed in the cylinder head 3, and biasing the valve to its closed position (shown) is a coiled return spring 10 embracing the valve stem and reacting at one end against the cylinder head.

Means generally designated by the numeral 11 forms a connection between the other end of the spring 10, the valve stem 8 and the valve end face 24 of the rocker 4. This means, as best shown in FIGURE 2, serves both to isolate the valve stem from any movements laterally thereof on the part of the rocker 4 or spring 10, and to substantially relieve the valve stem of all forces tending to restrain its axial rotation during reciprocation, and particularly during the valve opening stroke. As shown, a washer 12, of conventional design having a tapered bore 13, embraces the valve stem and provides a seat for the upper end of the spring 10. Seated in the tapered bore 13 of this washer are a pair of split locks or keeper members 14 and 15, which when assembled in abutting relation as shown define a generally cup-shaped member having end portions or walls 16, 17 overlying the end 18 of the valve stem, and side walls with externally tapered surfaces 19, 20 conforming to the tapered bore 13 in the washer. Projecting inwardly from the side wall of each keeper member is an internal rib 21 which is spaced from its corresponding end wall portion 16, 17. These rib portions 21 extend into the externally relieved area or groove 22, which is conventionally provided on the valve stem to provide a shoulder 23 under the end 18 of the valve stem. A second shoulder 34 may additionally be formed at the juncture of the groove 22 and the main portion of the stem below it, although this is not necessary to my invention. In any event, the rib portion 21 of each keeper part is spaced a somewhat greater distance from its end wall portion 16, 17 than is the spacing of the shoulder 23 from the upper face of the valve stem end 18, and the depth of the stem groove 22 is sufficient to prevent bottoming therein of the rib portions 21 throughout the range of lateral movement of the rocker surface 24 as the rocker oscillates about its shaft 25. Also, the internal side wall surfaces 26 and 27 of the keepers, above and below the rib portions 21, likewise have ample lateral spacing from the valve stem to accommodate such lateral movement of the keepers with the washer during rocker oscillation.

In the form of the invention shown in FIGURES 4 and 5, the keeper parts 14′ and 15′ are not made identical, but rather one of them (14′) has its end wall portion 16′ overlying completely the end 18 of the valve stem and the side wall of the cooperating keeper part 15′. Thus in defining a cup-shaped member the two keeper parts are separable on a first parting plane P_1 extending diametrically upward from the lower end, and a second parting plane P_2 extending transversely from one side, the two parting planes terminating at their intersection. This construction has the advantage of avoiding a split line between the two keeper parts in the end wall section engaged by the valve rocker surface 24, but the structure and function of the parts are otherwise unchanged from that of the embodiment first described.

In the case of each embodiment, during operation, downward movement of the valve rocker pad end surface is transmitted first to the keepers and thence by them to the washer 12, which causes the spring 10 to compress with increased valve opening in the usual manner. Because of the greater spacing between the end wall portions 16, 17 (16′ in the case of FIGURES 4 and 5) and the rib portions 21 relative to the spacing of the shoulder 23 from the end of the stem, the valve stem is allowed

to more or less "float" between the two keeper members during movement of the washer in the valve opening direction. Thus, the only frictional resistance imposed on the stem through its connection to the washer and valve spring tending to restrain rotation of the valve stem is that resulting from contact between the upper end face of the stem and the end wall portions of the keeper members. Furthermore, as previously described, the keeper members have full freedom for lateral movement relative to the valve stem throughout the range of the lateral component of motion of the rocker. As the result, the valve stem is not forced against the sides of its valve guide 9 as would tend to cause the objectionable valve "squawk" noise, and ovalizing of the valve stem or its guide is eliminated.

All of such advantages of a freely rotatable valve are obtained without the requirement of any additional parts over that of a conventional valve-to-spring connection. Furthermore, the only modification required of existing parts in a conventional valve assembly to accomplish the advantages of the invention is the substitution of the novel keeper parts in place of those which are wedged against the valve stem by the tapered bore of the washer.

While only two preferred embodiments of the invention have been disclosed, it is appreciated that numerous minor changes in the construction and arrangement of the parts may be made without departing from the spirit and scope of the invention as defined in the following claims.

I claim:

1. In combination with a poppet valve and a valve operating rocker, means for isolating the valve from substantially all lateral thrust transmission from the rocker during valve reciprocation, said means including a member in operative thrust transmitting engagement between the rocker and the valve, said member having a portion extending between the valve and the rocker and a second portion underlying a portion of the valve and spaced from said first named portion, said first named and second portions having freedom for lateral movement relative to the valve throughout the range of rocker movement laterally of the valve.

2. In combination with a poppet valve and a rocker and spring respectively operative to alternately open and close the valve, means drivably connecting the rocker to the spring and to the valve while isolating substantially all lateral thrust transmission from the rocker to the valve, said means including a washer thrustably engaging the spring, a member thrustably engaging said washer and having spaced portions respectively extending between the valve and rocker and underlying a portion of the valve adjacent the rocker, said spaced portions having freedom for lateral movement of the member relative to the valve throughout the range of rocker movement laterally of the valve.

3. In a poppet valve operating mechanism, a valve stem, a guide slidably supporting the stem, stem reciprocating means including a return spring, an arm having a surface movable toward and with the spring about a fixed axis, and thrust transmitting means between said arm surface, spring and stem effective to substantially isolate the stem from movements of the spring and arm in directions laterally of the stem, said thrust transmitting means including a washer surrounding the stem and thrustably engaging the spring, a member thrustably spacing the washer from said arm surface and secured against lateral movement relative to the washer, said member having spaced portions overlying and underlying a portion of the valve adjacent the rocker with freedom for lateral movement relative to the valve throughout the range of rocker movement laterally of the valve, said portion overlying the valve being in direct engagement with said arm surface.

4. In a device for transmitting spring opposed movement to a poppet valve from a valve actuator whose operative motion has a substantial component laterally of the direction of valve opening movement, a valve stem, a spring retaining washer having a tapered bore encircling and spaced from the valve stem, and radially abutting keeper members having tapered external side surfaces seated in said washer bore, said stem having an end facing the valve actuator and an externally relieved area defining a shoulder longitudinally spaced from and facing oppositely from said end, at least one of said keeper members having an end portion overlying said valve stem end and drivably engaging the valve actuator directly, and having a rib spaced from said portion and underlying said stem shoulder within said relieved area, the spacing between said portion and rib being greater than the spacing of said shoulder from said stem end and the depth of said relieved area being sufficient to preclude bottoming of said rib therein throughout the component of lateral motion of the actuator relative to the valve.

5. In a device for transmitting spring opposed movement to a poppet valve from a valve actuator whose operative motion has a substantial component laterally of the direction of valve operation, a valve stem having an end facing the actuator and an annular external groove spaced from said end, a spring retaining washer having a tapered bore encircling and spaced from the valve stem, and a diametrically split generally cup-shaped member having tapered external side surfaces seated in said washer bore, each half of said member having an end wall disposed between the actuator and said stem end and an internal rib spaced from said end wall and extending into said groove, said end wall directly engaging said actuator, the spacing of said rib from said end wall being greater than the spacing of said groove from said stem end and the depth of said groove being sufficient to accommodate lateral movements of the member with the actuator throughout the valve operating stroke without bottoming of said rib therein.

6. In a device for transmitting spring opposed movement to a poppet valve from a valve actuator whose operative motion has a substantial component laterally of the direction of valve operation, a valve stem having an end facing the actuator and an annular external groove spaced from said end, a spring retaining washer having a tapered bore encircling and spaced from the valve stem, and a generally cup-shaped member having its end wall overlying the full extent of said stem end and an internal annular rib spaced from said end wall and extending into said groove, said end wall directly engaging said actuator, the spacing of said rib from the end wall being greater than the spacing of the groove from said stem end and the depth of said groove being sufficient to accommodate lateral movements of the member with the actuator throughout the valve operating stroke without bottoming of said rib therein, said member having two parting planes dividing it into two separable portions for assembly and disassembly with the valve stem, one of said parting planes extending diametrically thereof and toward said end wall from the opposite end of the member and terminating with the other of said parting planes, said other parting plane extending transversely from one side of the member between said rib and end wall and terminating with said one parting plane.

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