Aug. 4, 1953 G. R. RICH 2,647,501

VALVE ASSEMBLY

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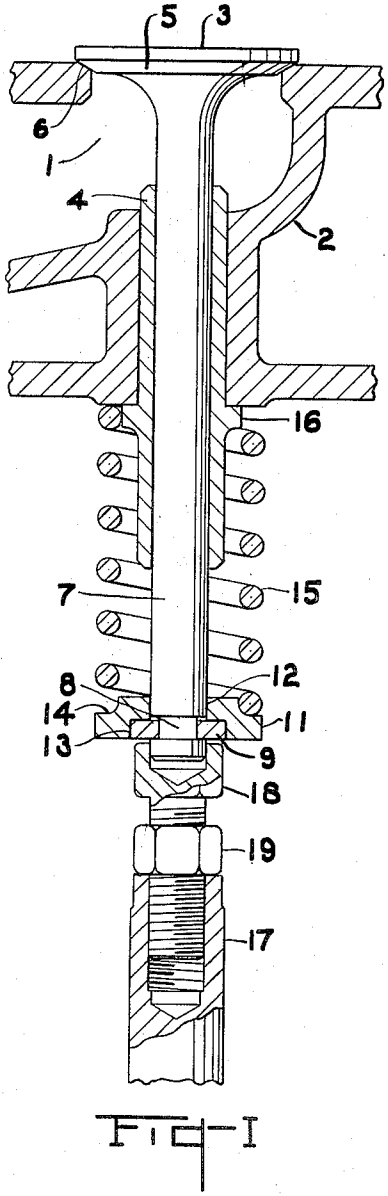


FIG-1

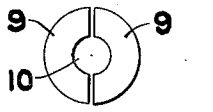


FIG-2

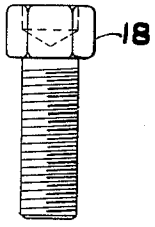


FIG-3

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VALVE ASSEMBLY

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1 Claim. (Cl. 123—90)

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The present invention relates broadly to a poppet valve assembly particularly suited for use in internal combustion engines, and in its specific phases to a special valve assembly wherein the valve is freely rotatable when lifted from its seat.

In accordance with present day practice which is commonly used in connection with poppet valves of internal combustion engines, such as automobile engines, the spring retainer cup at the lower end of the valve stem is rigidly gripped onto the valve stem by removable semi-circular elongated inserts which engage a groove or grooves in the stem, and have a tapered exterior which fits a like tapered socket in the spring retainer cup so as to cause a wedging action. With this type of construction, the friction of the ends of the compressed valve spring on the motor block and on the rigidly gripped spring retainer cup effectively locks the valve against rotation. This causes so-called "grunt grabbing," promotes uneven wear of the valve seat and block seat, tends to produce "hot spots" on the valve head and the spot building up of carbon and lead deposits on the seating area, and stem breakage directly under the valve head due to the fatigue caused by spring wind pressure.

The rigidly gripped parts of the valve assembly described above are seldom perfectly produced, and as a result the plane of the upper or spring supporting face of the rigidly gripped spring retainer cup is commonly out of true perpendicular to the axis of the valve stem. This, in combination with spring wind pressure and the rigid grip of the spring retainer cup on the stem, eccentrically loads the valve stem so that it almost invariably wears on one side at one end of the valve guide and on the other side at the opposite end of the valve guide. The friction on the valve stem in the valve guide caused by this eccentric loading also requires that the valve spring be heavier than otherwise necessary, with more operating power required, and after considerable wear, is commonly the cause of the valves not seating properly, as well as being out of alignment which promotes valve burning as well as building up carbon and lead in the seating area. It was a recognition of these as well as other problems and difficulties which lead to the conception and development of the present invention.

Accordingly among the objects of the present invention is the provision of a new type of valve assembly wherein the push rod actuates the valve by direct contact with the underface of a washer member which connects the spring retainer

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loosely to the valve through an annular groove near the lower end of the latter in manner promoting automatic free rotation or indexing of the valve in use, and in doing so (1) reduces one spot collection of carbon and lead deposits on the valve seating area, (2) keeps the valve seat and block seat round and even wearing, (3) materially reduces groove wear on the seat of the valve, (4) stops stem breakage directly under the valve head caused by the fatigue induced by spring wind pressure, (5) reduces valve burning, (6) permits moderately increased operation speeds above the current maximum, (7) substantially eliminates spot wear of the valve stem at the top and bottom of the valve guide, and (8) makes possible longer operation before valve grinding becomes necessary.

Another object is to provide a new form of valve assembly wherein spring wind is relieved and the valve is freely rotatable when lifted from its seat under normal operating conditions, both being facilitated by direct lifting of the assembly through the washer means which is automatically lubricated.

Another object is to provide a valve assembly wherein the valve stem is annularly grooved for a pair of loose fitting semi-circular washers which are slightly thinner than the length of the groove and adapted to fit the counterbore in the underface of the spring retainer cup.

Another object is to provide a valve assembly wherein the valve is only loaded by the valve spring when the valve is in its closed position and the valve spring at its minimum operating pressure.

Another object is to provide a hollow head stud mounted on the push rod for actuating the valve, said hollow in the stud head being a little larger than the diameter of the valve stem and a little deeper than the length of the end of the valve stem extending beyond the washer carried in the valve stem groove, and adapted to only contact the underface of said washer for the actuation of the assembly, whereby the washer takes all of the actuating thrust and leaves the valve free to rotate.

A further object is to provide a valve assembly wherein the washers and stud are made to very close tolerances, hardened, and ground for accurate operation and long wear.

A further object is to provide a valve assembly which is self-aligning and self-centering and which holds its seating and alignment better than usual even after considerable wear, and due to its freeness of action does not require as heavy a

spring as is now commonly used on like size valve assemblies, with resultant increase in the engine's power.

A further object is to provide a valve assembly which is free from "grunt and grab" when seating, is simple, efficient, easy to manufacture, may be readily installed and removed, and yet permits free rotation of the valve when lifted from its seat due to actuation of the tappet.

Still further objects and advantages of the invention will become apparent as the description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, consists of the means hereinafter fully described and particularly pointed out in the claim, the annexed drawing and the following description setting forth in detail certain means for carrying out the invention, such disclosed means illustrating, however, but one of various ways in which the principle of the invention may be used.

In the annexed drawing:

Figure 1 shows a partially sectioned assembly view of a preferred form of the present invention.

Figure 2 shows a top view of a pair of split washers adapted for use in the assembly illustrated in Figure 1.

Figure 3 shows a special stud forming part of the present invention.

Referring more particularly to Figure 1 of the drawing, valve port 1 of the motor block 2 is shown with the head of valve 3 closing same. This valve is of the type adapted to be reciprocated endwise through valve guide 4 in conventional manner with seat 5 of the valve engaging with block seat 6 when the valve is in closed position as shown.

Adjacent the lower end of valve stem 7 is provided an accurately machined annular groove 8, the upper and lower edges of which are in parallel planes perpendicular to the axis of the valve stem. Assembled in this groove are a pair of split washers 9, Figure 2, which are accurately machined to uniform thickness and hardened and ground. The opening 10 between these washers is preferably adapted to be a free but close fit on the inner diameter of annular groove 8 in the valve stem. A preferred thickness for these washers is .125" while the length of groove 8 is preferably .003" to .005" longer than the washer thickness to provide a safety clearance under conditions of use.

Mounted on the lower end of valve 3 is a spring retainer cup 11 which has a center bore 12 slightly larger than the diameter of valve stem 7 to avoid binding thereon. The lower face of the spring retainer cup is provided with a counterbore 13 which is coaxial with bore 12 and closely fits but is slightly larger than the outside diameter of the pair of split washers 9, the inner face of said counterbore being in a plane perpendicular to the axis of said center bore. Spring retainer cup 11 is provided in its upper face with a shoulder groove 14 of suitable size to support and center the lower end of valve spring 15, said groove also being in a plane perpendicular to the axis of said center bore. The upper end of valve spring 15 may be held in suitable position by shoulder 16 on valve guide 4.

Valve tappet 17 is actuated in conventional manner (not shown) and the upper end of same is bored and threaded for the reception of a stud 18 which preferably has a hexagon head, to facilitate adjustment, and has mounted thereon

a lock nut 19 for holding stud 18 after adjustment to desired operating position. The head of this stud, which is coaxial with valve stem 7 and moves in alignment with same, is slightly smaller in its maximum end dimension than the diameter of counterbore 13, and the head of the stud is concentrically drilled a little larger than the diameter of valve stem 7 and a little deeper than the length of the end of said stem below groove 8 to insure that the upper end of stud 18 will exert valve lifting pressure only on the under face of split washers 9. If desired washers 9 may be made a little thicker than the depth of counterbore 13, and in that case the outside size of the head of stud 18 can be larger than the diameter of washers 9 without interfering with operation according to the principles of the present invention. Stud 18 is suitably hardened and its upper face accurately ground in a plane perpendicular to its axis for direct engagement with the hardened and ground lower face of split washers 9.

Under conditions of use, the operating clearance of the valve is set by adjusting the space between the end of stud 18 and the lower face of washers 9 and then checking same with a feeler. The actual clearance between the washers and the ends of groove 8 is normally taken into consideration in determining the final setting of the valve.

With the valve in its seated position, as shown in Figure 1, the valve spring 15 will exert downward pressure on the upper face of spring retainer cup 11 and in turn the latter will hold washers 9 in contact with the lower face of groove 8 in valve stem 7. In this position the minimum operating valve spring pressure is exerted in holding the valve seated on block seat 6. After valve tappet 17 starts to rise, the hardened and ground upper end of stud 18 will move upward into contact with the lower face of the hardened and ground washers 9. Then as the tappet continues to move upward, washers 9 will leave the lower face of groove 8 and move up to the upper face of same, during which time valve 3 will hang free. Further movement of the tappet in upward direction will cause washers 9 to engage the upper edge of valve stem groove 8 and carry the valve upward to the top of its travel, during which time the valve will freely rest on the upper face of washers 9 and will not be affected by the increasing spring pressure caused by the compression of valve spring 15. Valve tappet 17 then starts moving downward and the spring continues to hold washers 9 in contact with the upper end of stud 18, the valve still remaining free to rotate. When the valve reaches the lower end of its travel and the spring is holding washers 9 against the lower edge of valve stem groove 8, tappet 17 will move away from washers 9 to the extent of the preset clearance therebetween, thus allowing the spring tension to once more clamp the valve in seated position. The valve thus throughout the entire cycle, except when same is seated and split washers 9 are held in contact with the lower face of valve stem groove 8, is entirely free of valve spring pressure. This, it has been found, eliminates "grunt grabbing," eliminates grooving of the valve stem on diametrically opposite sides at the top and bottom of the valve guide, permits exceeding the 4600 R. P. M. of the valve containing motor, which has been the practical limit in the past due to the valve head breaking from the

valve stem on account of spring wind pressure. It has been found by actual experience that the valve, when assembled as described, gradually rotates under conditions of operation so as to wear uniformly and almost completely avoid building up of carbon on the valve seat and the valve burning encountered in the past, while permitting as much as several thousand hours extra operation before valve grinding becomes necessary.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by the following claim or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

A valve assembly comprising a poppet valve with head and stem, said stem having an external annular groove adjacent its end remote from said head, a substantially flat faced washer means closely but freely and rotatably fitting said groove, said washer means being slightly thinner than the width of said groove to facilitate free rotation of said valve while positively controlling its endwise movement, a freely reciprocable spring retainer cup in which said washers freely fit, said retainer cup having a central opening of slightly larger diameter than and freely clearing the major diameter of said stem and having a coaxial counterbore adapted to freely receive said washer means, a valve spring mounted on said valve stem and occupying part of the space extending from said retainer cup toward said valve head and adapted to force the bottom of the counterbore of said retainer cup against said washer means and said washer means against the bottom of said groove for seating said valve, and valve opening means adapted to solely engage said washer means on the side of same opposite to that in contact with said valve spring retainer and being the sole means for actuating said valve, said valve opening means first moving said washer from contact with the bottom of said groove and upon further movement forcing the washer against the upper part of said groove to lift said valve, said valve then being free for longitudinal vibration and rotation with respect to said washer.

GEORGE R. RICH.

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