

1

3,359,959

WALKING BEAM ROCKER ARM

Frederick M. Rose, Sarasota, Fla., assignor to Chrysler Corporation, Highland Park, Mich., a corporation of Delaware

Filed Nov. 29, 1966, Ser. No. 597,681

10 Claims. (Cl. 123-90)

A concavo-convex spacer defined by eccentric spherical bearing surfaces spacing and cooperating respectively with mating bearing surfaces of a fixed support and an engine driven valve operating rocker arm to effect a double ball and socket articulated support for the rocker arm, whereby upon rocking of the rocker arm, predetermined translatory movement of the latter with respect to the center of curvature of the support is accomplished to enable guided rocker arm movement by means of an interengagement between the rocker arm and the conventionally guided axially reciprocable stem of the valve to be actuated.

This invention relates to valve operating rocker arms for a piston type automotive internal combustion engine and has for an important object the provision of an improved simplified and economically manufactured and installed rocker arm assembly, including the customary push rod actuator for the rocker arm and the latter's pivotal mounting, whereby the rocker arm is supported in predetermined alignment with the stem of the valve to be operated.

In a typical rocker arm installation for an overhead valve engine, a rocker arm is pivotally mounted between its ends on the cylinder head casting to engage at its opposite ends respectively an axially reciprocating push rod to be rocked thereby and the stem of the valve for reciprocating the latter in timed relationship with respect to the engine operation. Largely because of spatial limitation and the resultant angular relationships between the reciprocating parts involved, considerably difficulty has been experienced in maintaining the rocker arm in the desired alignment and in providing adequate bearing surface between the rocker arm and its supporting means, such that the desired alignment is not impaired by wearing of the parts and objectionable noise and inefficient engine operation are avoided.

For example, it has long been desirable to provide a stud-mounted rocker arm wherein a stud secured to the cylinder head cooperates with an intermediate base portion of the rocker arm to effect a ball-and-socket type articulated rocker arm mounting. The push rod and valve stem engage opposite ends of the rocker arm and either the rod or stem interengages the associated end of the rocker arm to prevent its rotation about the axis of the stud to a position out of engagement with either the rod or stem. Such structures have not been entirely satisfactory, largely because of the cost of providing suitable bearing means to withstand the resulting side or transverse loading on the rod or stem, resulting again in part from the spatial or dimensional requirements of the assembly, and also because of the costly design limitations that such structures impose on the rocker arm as well as on the rod and stem.

It is accordingly another object to provide a stud mounted rocker arm assembly of the above character including a particularly inexpensive and readily assembled stamped or coined rocker arm and mounting assembly adapted to be positively secured to the cylinder head by the same stud employed heretofore to mount the rocker arm. The mounting assembly in a preferred construction includes first and second arcuate bearing surfaces fixed with respect to the rocker arm and stud respectively. These bearing surfaces are spaced eccentrically from each

2

other by a concavo-convex spacer having eccentric concave and convex spherical surfaces cooperating with the first and second bearing surfaces to complete a scotch yoke type coupling comprising a double ball and socket articulation, whereby as the rocker arm rocks to actuate the valve, it also translates with respect to the center of curvature of the bearing surface that is fixed with respect to the stud, so as to maintain a ball and socket interengagement between the valve stem and rocker arm to guide the latter throughout the customary axial reciprocation of the valve stem.

By virtue of the foregoing structure, the push rod is not employed as the rocker arm restraint and the latter may be economically formed from tubular stock without a costly bearing surface. The valve stem is preferably mounted in a bushing for axial sliding movement in any event. The freedom of translatory movement achieved by the rocker arm mounting minimizes wear between the valve stem and its bushing, so that a shorter and more economical valve stem and also a more compact engine construction are achieved. Also a sloppy mounting for the valve stem after a minimum operating life is avoided, leakage of oil and exhaust gases are minimized and proper valve seating and the minimizing of valve noise are accomplished throughout a comparatively long operating life for the engine.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

FIGURE 1 is a vertical mid-sectional view through a rocker arm and mounting embodying the present invention, showing the rocker arm in the valve open position.

FIGURE 2 is a view similar to FIG. 1, showing the rocker arm in the valve closed position.

FIGURE 3 is a view similar to FIGURE 1, but showing a modification.

FIGURE 4 is a sectional view taken in the direction of the arrows substantially along the line 4-4 of FIG. 3.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein for the purpose of description and not of limitation.

Referring to the drawings, a particular embodiment of the present invention is illustrated by way of example with a customary overhead valve type internal combustion automotive engine of conventional construction, a fragmentary portion of the cylinder head casting 10 being shown. A rocker arm 11 is associated with a valve comprising either the customary inlet or exhaust valve for one of the engine cylinders. In the present instance the rocker arm 11 may be of conventional construction and includes a central upwardly opening spherical socket portion 13 spaced from a ball head 14 of a stud 15 by means of a concavo-convex spacer 12 having a spherical convex bearing surface 12a seated against the mating surface 13, and a spherical concave bearing surface 12b seated against the mating surface 14, the surfaces 12a and 13 being centered at a and the surfaces 12b and 14 being centered at b. The stud 15 extends through oversize apertures 16 and 18 in the spacer 12 and in the base of the socket 13 for passage of an enlarged neck 17 of the stud 15. The latter is screwed tightly into an internally threaded boss 10a of the casting 10 to pivotally secure the rocker arm to the cylinder head 10 for universal rocking movement by virtue of the double ball and socket scotch yoke type articulation.

One end of the rocker arm 11 is provided with a downwardly opening spherical socket 19 engaged with the spherical ball end 20 of a tubular push rod 21. The latter extends freely through the bore of an oil return portion 10b of the casting 10 and engages a tappet 23 at its lower end by means of a ball and socket articulation similar to that illustrated at its upper end. The ball end 20 of the push rod 21 is provided with a diametrically extending oil passage which receives lubricating oil pumped upwardly through the tube 21 and discharges the oil into the socket 13 via an oil port 24 in the rocker arm. In this regard, a portion of the socket 19 is enlarged to provide an oil passage clearance between the oil ports in the ball 20 and socket 19 and also to provide lubrication for the ball and socket articulation 19, 20.

Oil flowing into the socket 13 via port 24 lubricates the ball and socket connections between members 12, 13 and 14 and overflows the opposite rounded valve stem engaging end of the rocker arm to lubricate the upper end of the valve stem 26 of an integral valve 27. The stem 26 comprises a smooth bearing shaft portion which extends in bearing and guided relationship through the bore of a valve guide portion 10c of the casting 10. The upper end of the stem 26 is provided with an integral spherical ball end 22 which seats within a spherical socket 25 of the rocker arm 11 to interengage the latter in guiding relationship as explained below. A lubrication port 28 through the base of socket 25 receives oil from the interior of the rocker arm 11 for lubricating the ball and socket articulation 22, 25. Also the upper end of stem 26 is provided with an annular groove 29 for interlocking engagement with a complementary pair of diametrically opposed dogs 30 having conically tapered outer surfaces mating with a similarly tapered inner opening of an annular spring retainer 31. This latter structure is conventional and is maintained in assembled relationship by means of a valve closing spring 32 seated coaxially around the stem 26 under compression between the retainer 31 and a portion of the casting 10 near the upper end of the valve guide 10c.

The spring 32 urges the valve and valve stem engaging socket 25 of the rocker arm upwardly and normally maintains the valve 27 in its closed position. Similarly the push rod 21 is maintained in contact with the push rod engaging socket 19 of the rocker arm with a reacting force opposing the spring 32 to cooperate with the latter in urging the rocker arm 11 upwardly to the upper portion of the neck 17 to clamp the spacer 12 therebetween and the spherical mounting portion 14 of the stud 15, thereby to maintain the double pivotal ball and socket relationship. Preferably the ball head 14 is integral with the stud 15, and a washer 33 spaces the neck 17 from the casting boss 10a.

It is apparent in accordance with the foregoing that upon axial reciprocation of the push rod 21, the rocker arm 11 will be rocked about a generally horizontal axis to effect corresponding reciprocation of the valve 27 in accordance with conventional engine operation. A line through the centers of the ball elements 20 and 22 is preferably located above the center *a* to achieve mechanical stability for the system. Also, by virtue of the eccentricity of the spherical surfaces 12 and 12b, a limited translational movement of the rocker arm 11 will take place sufficient to maintain the ball and socket interengagement 22, 25 as the valve stem 26 reciprocates axially in the closely confined movement determined by the bearing 10c, thereby to maintain the desired alignment between the rocker arm 11 and valve stem 26. The clearance between the tubular portion 10b and the push rod 21 is adequate to enable the limited movement of the push rod 21 transversely of its axis as required by the translatory or walking movement of the arm 11 during its valve operating rocking movement. The ball and

socket connections at the opposite ends of the push rod 21 cooperate to enable this transverse movement.

Where desired, the ball and socket mounting for the rocker arm 11 could be readily reversed, such that the spacer 12 would engage the exterior spherical undersurface of the rocker arm 13 and be clamped between the latter surface and a fixed spherical socket integral with the stud 15 in the manner of and in lieu of ball portion 14. Also as illustrated in FIGS. 3 and 4, the various articulated members could be cylindrical instead of spherical. In the modification shown, the ball element 14 is replaced by a cylindrical element 14' of circular section spaced from a circularly cylindrical base surface 13' of the rocker arm by a cylindrical concavo-convex spacer 12' comparable in function to the spacer 12. The concave and convex cylindrical surfaces of the spacer 12' will be eccentric with respect to each other and centered about axes *a'* and *b'*, which may be located above the line of centers between the ball portions 20 and 22. This latter is true because the axial extent of the cylindrical portions of the double articulated support will prevent rotation of the rocker arm about any horizontal axis parallel to the plane of the drawing in FIGURE 3.

The cylinders 12' and 13' are provided with over-size openings 16' and 18' respectively for passage of the spacer 17', which is comparable to the neck or spacer 17 of FIGURES 1 and 2. The supporting cylinder 14' and spacer 17' need not be integral portions of the stud 15, so that the cylinder 14' is clamped to the spacer 17' by the head of the stud 15. In all other respects, the structure and mode of operation of the device illustrated in FIGURES 3 and 4 is substantially the same as that described with regard to FIGURES 1 and 2.

Having thus described my invention, I claim:

1. In a valve operating assembly for use with an automobile engine,

(A) a valve operating rocker arm having

- (1) a first arcuate bearing surface,
- (2) a valve operating portion for operatively coupling with a valve to operate the latter upon rocking of said arm, and
- (3) an actuator engaging portion for operatively coupling with a reciprocating actuator to rock said arm,

(B) mounting means having

- (1) a second arcuate bearing surface spaced from said first bearing surface,

(C) means cooperating with said first and second bearing surfaces to complete a scotch yoke type articulation therebetween comprising

- (1) a spacer between said first and second bearing surfaces and having

- (a) a third arcuate bearing surface conforming to and seated against said first bearing surface in rocking sliding relationship, and
- (b) a fourth arcuate bearing surface conforming to and seated against said second bearing surface in rocking sliding relationship,
- (c) the centers of curvature of said third and fourth bearing surfaces being eccentric with respect to each other to effect translatory movement of said rocker arm with respect to the center of curvature of said fourth bearing surface upon rocking of said rocker arm on said third surface.

2. In the combination according to claim 1, said mounting means including a stud fixed with respect to the center of curvature of said second bearing surface and extending through aligned oversize holes in said spacer and rocker arm for attachment with a fixed portion of said engine.

3. In the combination according to claim 1, an axially reciprocable valve operating stem, means cooperating with said valve operating portion and stem to com-

5

plete an articulated connection therebetween for reciprocating said stem upon said rocking of said rocker arm and for maintaining the latter in predetermined guided relationship with respect to said stem, and bearing means for closely supporting and guiding the axial reciprocation of said shaft along a fixed axis.

4. In the combination according to claim 3, said articulated connection comprising ball and socket elements of said valve operating portion and stem in rocking and sliding interengagement for maintaining said rocker arm in said predetermined guided relationship with respect to said stem.

5. In the combination according to claim 4, said third and fourth arcuate surfaces of said spacer comprising concavo-convex cylindrical surfaces.

6. In the combination according to claim 4, said third and fourth arcuate surfaces of said spacer comprising concavo-convex spherical surfaces.

7. In the combination according to claim 4, actuator means for rocking said rocker arm including a reciprocating push rod having means at one end for articulated coupling with engine driven means for reciprocating said push rod, and means at the other end of said push rod cooperable with said actuator engaging portion of said

6

rocker arm for completing an articulated coupling therebetween.

8. In the combination according to claim 7, said mounting means including a stud fixed with respect to the center of curvature of said second bearing surface and extending through aligned oversize holes in said spacer and rocker arm for attachment with a fixed portion of said engine.

9. In the combination according to claim 1, said third and fourth arcuate surfaces of said spacer comprising concavo-convex cylindrical surfaces.

10. In the combination according to claim 1, said third and fourth arcuate surfaces of said spacer comprising concavo-convex spherical surfaces.

References Cited

UNITED STATES PATENTS

1,198,155	9/1916	Schenker	123—90
1,246,343	11/1917	Snadecki	123—90
1,497,451	6/1924	Kytlica	74—519
3,087,478	4/1963	Fairchild	123—90
3,096,750	7/1963	Bouvy et al.	123—90
3,254,637	6/1966	Durham	123—90

AL LAWRENCE SMITH, *Primary Examiner*.