July 9, 1963 H. M. DAVIDSON 3,096,749

ROCKER ARM AND METHOD OF MAKING THE SAME

Filed Nov. 25, 1960 2 Sheets-Sheet 1

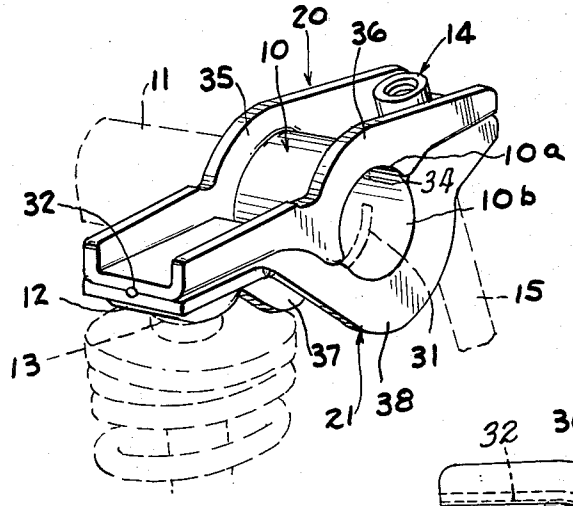


Fig. 1

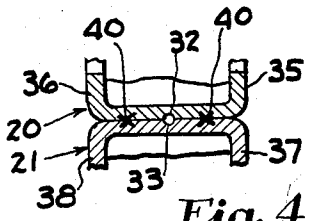


Fig. 4

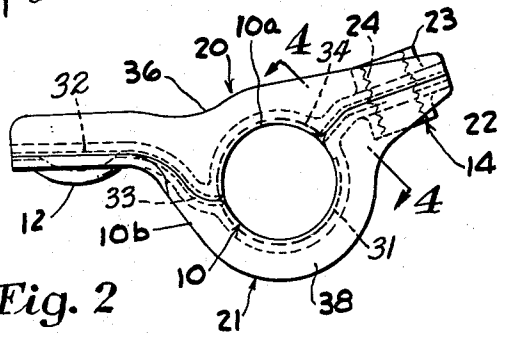


Fig. 2

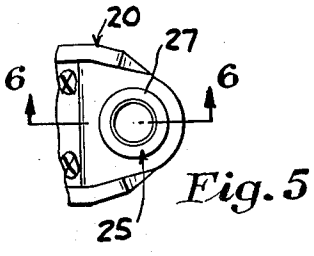


Fig. 5

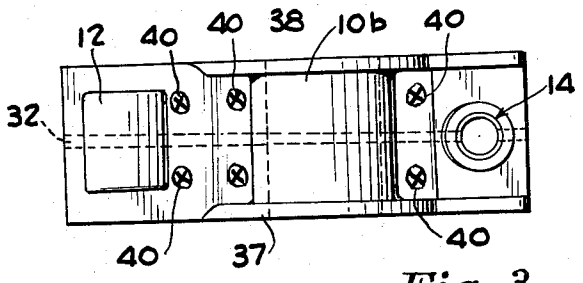


Fig. 3

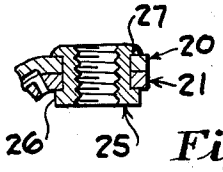


Fig. 6

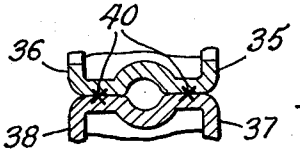


Fig. 4a

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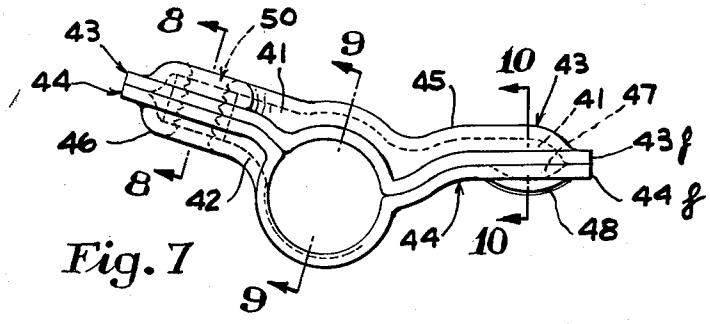


Fig. 7

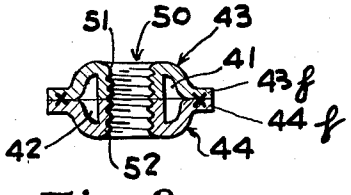


Fig. 8

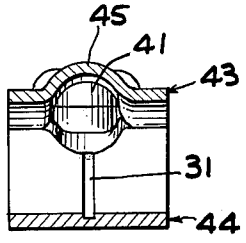


Fig. 9

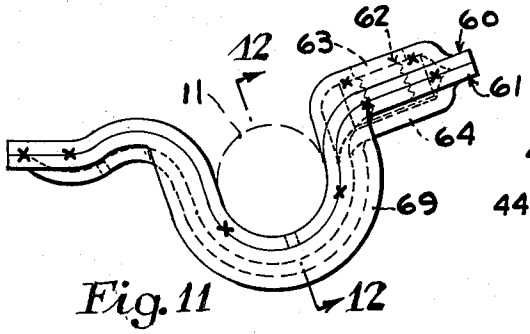


Fig. 11

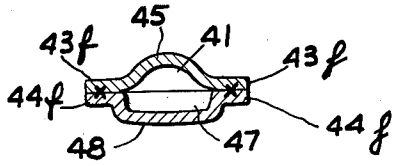


Fig. 10

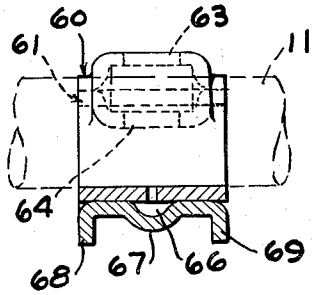


Fig. 12

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ROCKER ARM AND METHOD OF MAKING THE SAME

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Filed Nov. 25, 1960, Ser. No. 71,511
5 Claims. (Cl. 123—90)

This invention relates to internal combustion engines of the overhead type and more particularly to an improved rocker arm for such engines.

The valves of engines of the overhead valve type are actuated from the engine cam shaft with the aid of rocker arms which are, in fact, bell cranks hinged at their middles on a stationary shaft. Each rocker arm has one end operated upon by a pusher rod while its opposite end contacts the end of the valve stem for actuating such valve in a manner well known in the art. The pusher rod end of the rocker arm receives a threaded member in order to provide for necessary adjustment. The valve end of the rocker arm, which contacts the end of the valve stem, has a cam provided on it, with the surface of such cam made arcuate to produce rolling action of such cam on the valve stem and thus to eliminate friction and wear.

Originally, rocker arms were made primarily by forging as well as by casting them out of various materials. With the improvement of stamping methods such rocker arms have been largely made by stamping operations. With such methods the body of the rocker arm is usually made of one or more sheets or pieces of sheet metal, and a piece of tubing is used for the bearings. Assembling and securing such parts together is done by spot welding operations.

One of the successful and widely used constructions of rocker arms of such a nature is made by folding a piece of sheet metal upon itself to form a loop on one end in which a cylindrical recess is thus formed while the other end has the lower edges thereof upset to form the rolling cam surface. Two registering holes are provided in the piece with the material around the edges of such holes being extruded outwardly to provide flanges. The holes are so located that when the piece is so folded they are in registry and are disposed at the middle of the rocker arm. A piece of tubing is inserted through such flanged holes and spot welded to at least one of the flanges. With the rocker arm so constructed the connected sheet metal pieces extend in the planes substantially perpendicular to the axis of the bearing tube.

While such construction served satisfactorily, a number of serious disadvantages have been inherent in such construction, and such disadvantages created difficulties which have persisted in the art for many years. One of the difficulities is in the fact that the internally threaded cylindrical recess for the pusher rod threaded member has each thread interrupted because of the formation of the cylinder by folding the piece. Such interrupted threads have been a source of various problems. Similarly, the surface of the cam is also interrupted at the place of juncture of the two sheets, and is the result of upsetting rather than being a part of the original surface of the piece. There are also other difficulties and disadvantages inherent in the above construction, and they have not been solved satisfactorily.

One of the objects of the present invention is to provide an improved rocker arm whereby the above difficulties and disadvantages are overcome and largely eliminated without introducing other problems and without appreciably increasing the costs involved.

Another object of the present invention is to provide a rocker arm of an improved construction susceptible of

being manufactured by stamping and spot welding operations and in which the various functional elements, such as the bearing for the rocker arm shaft and the rolling cam, are formed from the sheet metal body pieces and in such a manner that the working surfaces of such elements are the original surfaces of the rolled sheet metal stock merely bent to a proper configuration.

Another object of the present invention is to provide an improved rocker arm made of sheet metal in which the threaded cylinder is formed by extruding the metal of its body pieces and thus producing a cylinder which can be threaded without having each and every thread interrupted, or which can receive a threaded cylindrical insert with the extruded metal supporting such inserts without being interrupted anywhere around its periphery, as is the case when a cylinder is formed by folding with the place of juncture extending longitudinally of the cylinder.

A still further object of the present invention is to provide an improved rocker arm in which oil conducting grooves or conduits operate also as reinforcements for the structure of the rocker arm.

A still further object of the present invention is to provide an improved rocker arm which may be made of only two pieces of sheet metal without the necessity of using tubing for the bearing or connecting such tubing by spot welding to the shoulders of the rocker arm flanges, and in which no upsetting operations are necessary to form the rolling cam shaft.

It is an added object of the present invention to provide an improved rocker arm which is simple in construction, dependable in operation and which is simple and less expensive to manufacture both with respect to the tools necessary for manufacturing as well as with respect to the cost of the operations themselves.

In one of its aspects the present invention contemplates an improved method of manufacturing rocker arms by stamping operations.

Further objects and advantages of this invention will be apparent from 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.

FIG. 1 is a perspective view showing a rocker arm embodying the present invention, the rocker arm shaft, the valve stem, and the pusher rod being indicated with the aid of dotted lines in their proper space relationships to the rocker arm.

FIG. 2 is a side view of the rocker arm of FIG. 1, the observer being presumed to look on the right hand end of the rocker arm shaft.

FIG. 3 is a bottom view of the rocker arm of FIG. 1.

FIG. 4 is a sectional view taken in the direction of the arrows on the section plane passing through section line 4—4 of FIG. 2.

FIG. 4*a* is a sectional view similar in part to FIG. 4 but showing the raised bead type oil groove in a channel type rocker arm.

FIG. 5 is a fragmentary top view of the end of the rocker arm showing a modified construction of the internally threaded cylinder.

FIG. 6 is a fragmentary sectional view taken in the direction of the arrows on the section plane passing through the line 6—6 of FIG. 5.

FIG. 7 is a side view of a rocker arm of modified construction embodying the present invention.

FIG. 8 is a sectional view taken in the direction of the arrows on the section plane passing through the line 8—8 of FIG. 7.

FIG. 9 is a sectional view taken in the direction of the

arrows on the section plane passing through the line 9—9 of FIG. 7.

FIG. 10 is a sectional view taken in the direction of the arrows on the section plane passing through the line 10—10 of FIG. 7.

FIG. 11 is a side view similar in part to FIGS. 2 and 7 but showing a still further modification.

FIG. 12 is a sectional view taken in the direction of the arrows on the section plane passing through the section line 12—12 of FIG. 11.

It is to be understood that the invention is not limited in its application to the details of construcion 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 and terminology employed herein is for the purpose of description and not of limitation.

Referring to the drawings, there is shown therein, by way of example three rocker arms embodying my invention. Referring particularly to FIGS. 1–4, the construction illustrated therein comprises, generally, for the purposes of performing its intended functions, an elongated body with a cylindrical bearing 10 formed in the manner described above in the middle portion of said body and adapted to receive a rocker arm shaft such as indicated in dotted lines at 11. A rolling cam 12 is provided on one end of said body to engage the end 13 of a valve stem for the purposes of actuating such valve in a manner well known in the art. On the opposite end of the body there is provided an internally threaded cylinder 14 adapted to receive an adjusting screw of the pusher rod 15 and thus provide a connection with the pusher rod 15 for actuating the rocker arm in a manner well known in the art.

The bearing, the cam, and the internally threaded cylinder are elements common to many types of conventional rocker arms. The present invention resides in the advantageous manner in which the entire arm and each of the above elements are formed from sheet metal with a number of important advantages produced in the construction of each of said elements.

In accordance with the invention, the rocker arm is formed of two pieces of sheet steel, the upper sheet designated in the drawing by the numeral 20 and the lower piece by the numeral 21, both of them extending generally in the planes substantially parallel to the axis of the shaft 11. The piece 20 is formed to provide a portion 10*a* of the bearing, while the complementary portion 10*b* is provided by correspondingly forming the piece 21. Portions 10*a* and 10*b* when disposed in registry with each other form a hollow cylinder. It will be noted that the lower portion 10*b* forms more than half of the cylindrical surface of the bearing 10, while the upper portion 10*a* forms less than half of said surface. Such an arrangement does not interfere with the insertion of the shaft 11 through the rocker arm, and has the advantage of providing a larger uninterrupted bearing surface in the location of application of the prevailing load.

One end of the lower piece 21 is formed to provide the rolling cam 12. By virtue of such a construction a strong and rigid cam portion is formed having an ample and uninterrupted working surface. It is of importance that the places of juncture of the two pieces forming the rocker arm are on the sides thereof and not on the working face of the cam as is the case with rocker arms formed by two pieces extending in vertical planes, i.e. planes normal or substantially normal to the axis of the shaft.

The opposite ends of the pieces 20 and 21 are provided with two holes which come in registry with each other when the pieces 20 and 21 are assembled and secured together as explained in detail below. In providing the holes in the pieces 20 and 21, the metal at the edges of said holes is extruded downwardly in the piece 21 and upwardly in the piece 20 to form cyclindrical shoulders 22 and 23, respectively, which, in the position of registry, form, in effect, a cylinder extending perpendicularly to the axis of the shaft but without intersecting the same.

The cylinder so formed is tapped to provide an internal thread as indicated at 24. If desired, said cylinder may be drilled and/or reamed prior to tapping. By virtue of such a construction the rocker arm is adapted to receive an adjusting screw for the pusher rod. The important improvement resides in the fact that the thread 24 is not interrupted at each thread throughout the entire length of the cylinder, as is the case with rocker arms formed by two pieces extending in vertical planes, i.e. planes normal or substantially normal to the axis of the shaft.

FIGS. 5 and 6 illustrate a tapped cylinder for receiving the adjusting screw, with such cylinder having a modified construction. In the construction of said FIGS. 5 and 6, the holes provided in the ends of the pieces 20 and 21 do not have metal at their edges extruded, as in the construction of FIGS. 1–4, but have square edges. In the position of registry, said holes are adapted to receive an internally threaded cylindrical insert 25 having a shoulder 26 provided around its lower edges. The insert 25 is secured in place in any suitable manner, such as by upsetting the metal at its top edges downwardly over the edges of the upper piece 20 at the hole, as indicated at 27.

Oil passages or conduits are formed by providing on the pieces 20 and 21 in any suitable manner, such as by coining or embossing, grooves 34 and 31 extending in a desired manner over the inner surfaces of the bearing portions 10*a* and 10*b* thereof, and grooves 32 and 33 extending through the contacting surfaces of the horizontal portions of the pieces 20 and 21, respectively, as is best shown in FIGS. 1 and 4. In the assembled position of the pieces 20 and 21, the grooves 32 and 33 come into registry and form enclosed oil conduits extending from the bearing 10 to the ends of the rocker arm to serve for the purposes of lubrication in a manner well known in the art. Upstanding flanges 35 and 36 are provided along the side edges of the upper piece 20, and downwardly depending flanges 37 and 38 are provided along the side edges of the lower piece 20, to impart requisite strength and rigidity to the construction.

The pieces 20 and 21 are secured together in any suitable manner, preferably by spot or projection welding as indicated at 40.

It will now be seen, in view of the foregoing, that by virtue of such construction there is provided a rocker arm which is greatly superior in its strength and rigidity to conventional rocker arms made of stamped sheet steel, and in which objectionable features in the construction of functional elements, such as the bearing, the cam, and the internally threaded cylinder found in such conventional rocker arms, are eliminated.

FIGS. 7–10 show a modified construction in which the same improvements in functional advantages and strength are obtained in a different manner. One of the important features of difference between this construction and the construction of FIGS. 1–4 is in the fact that side flanges such as 35, 36 and 37, 38 are eliminated and their function of strengthening the construction is performed by the enlarged oil grooves 41 and 42 formed in the horizontally extending pieces 43 and 44 of stamped sheet metal. The provision of such enlarged oil grooves causes formation of corresponding beads such as 45 and 46 on the pieces 43 and 44, respectively. The groove 41 and the bead 45 extend substantially through the entire length of the upper piece 43, while the groove 42 and the bead 46 extend only through the threaded end of the lower pieces 44. A depression 47 is provided in the opposite end of the lower piece 44 to form the rolling cam 48.

The internally threaded cylinder 50 is formed by extruding inwardly the metal round the edges of two registering holes provided in the pieces 43 and 44, as is best shown in FIG. 8 and indicated therein at 51 and 52.

The pieces 43 and 44 are secured together at their flat marginal flanges 43*f* and 44*f* by spot or projection weld-

ing, as is best shown in FIGS. 8 and 10, to provide a unitary structure.

FIGS. 11 and 12 shows a still further modification. In the construction of FIGS. 11 and 12 both the upper piece **60** and the lower piece **61** extend under the shaft **11** and, therefore, the upper portion of the shaft is open. Such an arrangement does not interfere with the proper functioning of the rocker arm since the load on such rocker arm at the shaft **11** is always directed downwardly. The second feature of difference resides in the fact that instead of extruding the metal inwardly for the provision of the threaded cylinder **50**, a nut **62** is spot or projection welded in place between the pieces **60** and **61**, as shown, with holes **63** and **64** being provided in the pieces **60** and **61**, respectively, in registry with the threaded hole in said nut **62**. An oil conduit **66** is provided in the lower piece **61**, and its extends substantially through the entire length of the piece. Such conduit may be of a greater width and depth than the groove **33** of the construction of FIGS. 1–4, and, therefore, its provision causes formation of a raised bead **67** on the under surface of the piece **61**, thus contributing materially to the strength and rigidity of the rocker arm. However, for the purposes of increasing still further the strength and rigidity of the arm as may be required for some engines, side flanges, such as those indicated at **68** and **69**, may also be provided on said piece **61**. With respect to other features of construction, the construction of FIGS. 11 and 12 is substantially similar to that of the construction of FIGS. 7–10.

By virtue of the above described constructions, there are thus provided improved rocker arms whereby the objects of the present invention and numerous additional advantages are attained.

I claim:

1. A rocker arm for an internal combustion engine having a rocker arm shaft, said rocker arm comprising an elongated body, a bearing provided in the middle of the body, a rolling cam provided on one end of said body with the axis of curvature of the cam being in the plane parallel to the axis of the bearing, and an internally threaded cylinder on its other end with the axis of the cylinder being perpendicular to but not intersecting a plane passing through the axis of the bearing; said body, bearing, and the rolling cam being formed of a plurality of laminations of sheet metal, with the inner surfaces of the laminations being in direct contact with the rocker arm shaft surfaces, said laminations having channel cross sections and extending in planes parallel to the axis of the bearing, and with said internally threaded cylinder extending perpendicular to said laminations and being integral therewith.

2. A rocker arm for an internal combustion engine having a rocker arm shaft, said rocker arm comprising an elongated body, a bearing provided in the middle of the body, a rolling cam provided on one end of said body with the axis of curvature of the cam being in the plane parallel to the axis of the bearing, and an internally threaded cylinder on its other end with the axis of the cylinder being perpendicular to but not intersecting a plane passing through the axis of the bearing; said body, bearing and the rolling cam being formed of two pieces of sheet metal generally extending in the planes parallel to the axis of the bearing and having channel cross sections, with the lower piece being formed to provide the lower portion of the bearing and the rolling cam, and the upper piece being formed to provide the upper portion of the bearing, the inner surfaces of said lower and upper pieces being in direct bearing contact with the rocker arm shaft surfaces.

3. The invention defined in claim 2, with an oil groove being provided at least on one of said pieces on the surface contacting the other piece, with the surface of such other piece covering said groove for forming an oil conduit, with such oil groove having an inlet opening and an outlet opening for circulation of oil therethrough.

4. The invention defined in claim 2, with oil grooves being provided at least on one of the contacting surfaces of said pieces by forming the metal thereof to provide an elongated depression and a raised bead on the opposite surface thereof to form a reinforcement for said piece, with said oil grooves having inlet and outlet openings for circulation of oil therethrough.

5. The invention defined in claim 2 with the edges of said pieces being bent away from the surfaces of contact to form reinforcements and to provide a channel cross section throughout the entire length of the upper piece and a portion of the length of the lower piece.

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