PUSH ROD STRUCTURE


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4 Claims. (Cl. 123—90)

The push rod of this invention may be used to interconnect a large variety of movable members in various kinds of machines especially where one or more of the members has a rotary component of motion. An exemplary use of the invention is a push rod for operably connecting a valve lifter with a valve operating rocker arm in an internal combustion engine.

An object of the invention is to provide a simple, light weight, inexpensive push rod structure having improved operating characteristics. The invention generally contemplates a push rod formed by securing a ball to each open end of a length of tube. A further object of the invention is to provide a method of making such a push rod which generally comprises attaching the balls by fused metal connections to seats formed by the open ends of the tube. The advantages of this type of push rod and its method of manufacture appear in the detailed description. One form of the invention is illustrated in the accompanying drawings:

FIG. 1 is a view partly in elevation and partly in section illustrating a push rod according to this invention in use.

FIG. 2 is an enlarged fragmentary view of one end of the push rod with a portion broken away to illustrate structure.

FIG. 3 is an elevational view of a modified form of the invention.

FIG. 4 is a fragmentary view generally similar to FIG. 1 on a somewhat larger scale showing the modified form of push rod in use.

Shown in FIG. 1 is a push rod 10 according to this invention operably interconnecting a valve lifter 11 and a valve rocker arm 12. Lifter 11 is raised and lowered by a cam 13 on a cam shaft 14 and the lifter moves in a guide 15 which may be formed in an engine block 16. Rocker arm 12 is rockably mounted on a shaft 18 with one arm 19 operably engageable with a valve (not shown) and with another arm or projection 20 on the opposite side of shaft 18 engaged with the push rod. Rocker arm 12 may be spring biased in a conventional way for engagement against the push rod. Extension 21 of the rocker arm and the upper portion 21 of lifter 11 are recessed as at 22 and 23 respectively for receiving end pieces 24 of push rod 10.

Push rod 10 is formed of a length of tube 26 which may be hollow throughout its entire extent and which has open ends prior to the time when end pieces 24 are secured thereto. The tube may be of any cross sectional shape although the round shape illustrated is suitable for most purposes and facilitates economic manufacture. The tube may be of any suitable substantially rigid type, such as an extruded seamless tube or a rolled single or plural ply tube, and may be made of any suitable material, such as a ferrous metal, which will give it the requisite rigidity. An example of suitable tube is single ply rolled steel tube having a butt welded longitudinal seam.

An end piece 24 is secured to each open end of the tube by a fused metal connection. The end piece is shaped as required to seat on the open tube end and the externally projecting portions 25 of the end piece are formed as required for use in a particular machine or engine. In some cases these external portions provide the bearing surfaces which engage movable parts of a machine or engine. In the form of the invention illustrated in FIGS. 1 and 2, end pieces 24 comprise metal balls. Each ball has a diameter larger than the open end of the tube on which it seats and it engages the tube end on a circumferential area.

The fused metal connection of the ball to the tube end may advantageously be accomplished by resistance welding. In this method of construction an electrode (not shown) is connected to ball 24 and another electrode (not shown) is connected to tube 26 preferably adjacent its end portion 27. The ball is pressed against the seat formed by the open tube end and electric current passed through the ball and tube end to effect a continuous circumferential weld at the seat area 28 in which the ball and tube end interengage.

The end portions 26 of the tube are shown as being somewhat flared out radially as a result of the combined heat and axial pressure of ball 25 on the end of the tube during the welding. The outward flaring 26 increases the area of seat 28 and increases the width of the weld to provide a very sturdy joint between the ball and tube end. Fillets 29 are formed during the welding which further increases the strength of the joint. If desired, the edge 30 of the outwardly flared portion may be reduced by grinding.

In some cases the balls may be secured to the tube ends by other types of fused metal connections, such as by soldering or brazing.

In use, the push rod is mounted for operably engaging two movable parts of an engine or machine, such as valve lifter 21 and rocker arm 12. Outwardly projecting portions 25 of balls 24 may provide the bearing surfaces at the end of the push rod. Where the end pieces are shaped as balls, as illustrated, they are admirably adapted for use with elements such as projection 20 of rocker arm 12 which have a rotary component of motion. In some applications it is desirable to prevent any flow of fluid through the tube interior and in this situation the circumferential fused metal connections between the end pieces and the tube ends is made continuous to provide seals so that no fluid will pass through the tube ends.

The modified form of the invention illustrated in FIGS. 3 and 4 is similar to the principal form except that push rod 35 comprises a tube 36 having its end portions 37 formed radially inwardly to provide a seat for an end piece or ball 38 having a relatively smaller diameter than that of the tube. Seat 39, where the ball and tube end are welded together, has a width approximating the thickness of the wall of tube 36 as illustrated in FIG. 4 and fillets 40 are formed as a result of the heat and pressure applied during welding, thus providing a very sturdy joint between the ball and tube end. Use of push rod 35 is similar to the use of push rod 10 except that in some applications the inwardly rounded end portions 37 of the tube may provide bearing surfaces for contact with the machine or engine parts as illustrated in FIG. 5 whereas rocker arm 26a has an opening 41 into which ball 38 projects and has a bearing recess 22a engaged against portions 37. Ball 38, being relatively small, does not obstruct access to portions 37 by bearing surface 22a.

The invention thus provides a push rod which is formed of a hollow tube and which, therefore, relatively light weight so that the weight of an engine or machine in which the push rod is used and the efficiency thereof will be increased. The push rod has ready made bearing surfaces thus obviating the necessity of expensive subsequent machining operations. The invention also facili-
tates inexpensive manufacture since the open ends of the tubular body provide ready made seats for receiving the balls or end pieces so that no special machining or other preparation of the push rod body is necessary to provide the seats.

I claim:

1. A push rod comprising, a tube having an end portion, said end portion being formed radially inwardly to provide a curved surface exposed at the tube exterior, said surface forming a bearing surface adapted for engagement with a part of a mechanism with which said push rod is adapted to be used, the extreme end of said end portion forming an annular seat having a diameter smaller than the diameter of said bearing surface, a ball having surface portions engaged against said seat, and a fused metal connection directly connecting said ball surface portions to said seat so that said ball forms a closure for the tube end, said ball having a diameter smaller than the diameter of said bearing surface to facilitate unobstructed access to the said bearing surface.

2. The combination defined in claim 1 wherein said fused metal connection is fluid tight.

3. The method of making a push rod which comprises, providing a tube having an open end, fashioning a portion of said tube adjacent said end radially inwardly and thereby providing said portion with a rounded surface on the tube exterior forming a bearing surface adapted for engagement with a part of a mechanism with which said push rod is adapted to be used, providing at said open end an annular seat having a diameter smaller than that of said bearing surface, providing a ball having a diameter smaller than the diameter of said bearing surface but larger than the diameter of said seat, engaging portions of said ball against said seat, applying force to said ball and tube to urge them toward each other, and while applying said force, applying heat to the interengaged portions of said ball and seat to form a fused metal connection securing said ball and tube together so that said ball forms a closure for the tube end.

4. The method defined in claim 3 wherein said portions of said ball and seat are interengaged in a substantially continuous annular region so that said fused metal connection forms a fluid-tight joint.

References Cited in the file of this patent

UNITED STATES PATENTS

2,223,730 Ledig
2,386,317 Jenny et al.
2,434,080 Rosa
2,719,315 Archangeli

Dec. 3, 1940
Oct. 9, 1945
Jan. 6, 1948
Oct. 4, 1955