Aug. 4, 1959 E. E. ETZLER 2,897,805

TUBULAR PUSH ROD AND METHOD OF MAKING SAME

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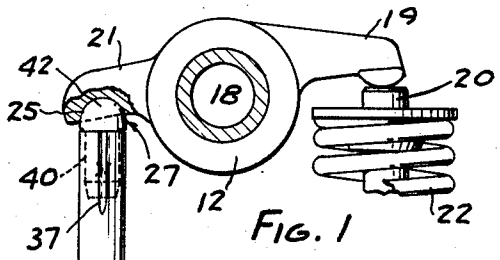


FIG. 1

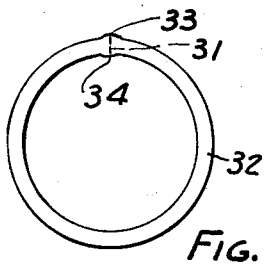


FIG. 3

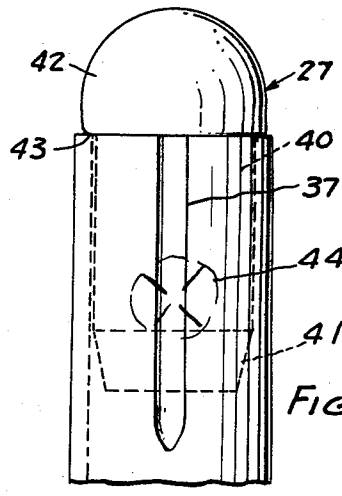


FIG. 2

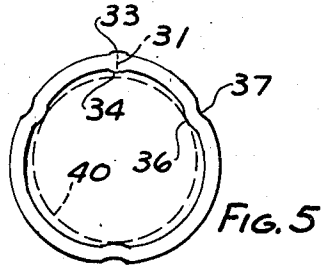


FIG. 5

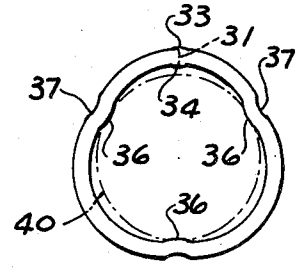
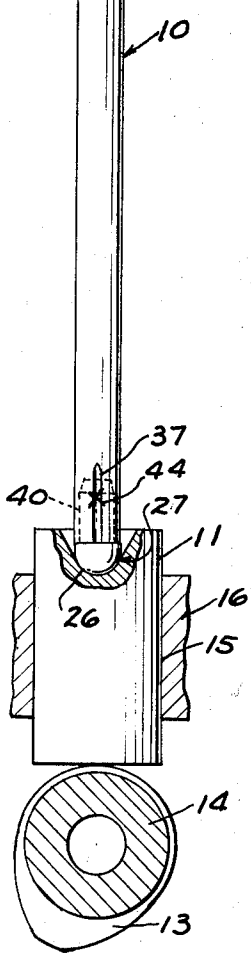


FIG. 4



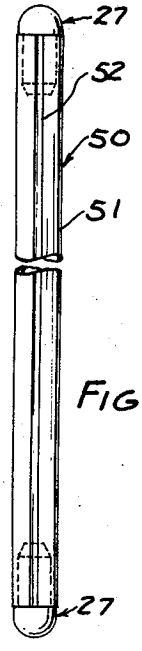


FIG. 7

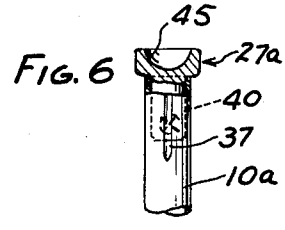


FIG. 6

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TUBULAR PUSH ROD AND METHOD OF MAKING SAME

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12 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. A good example of a use of the invention is a push rod for operatively connecting a valve lifter with a valve operating rocker arm in an internal combustion engine.

The invention generally contemplates making push rods by inserting an end piece into each end of a tube and securing it in place with a portion of the end piece projecting out of the end of the tube to engage a cam follower, rocker arm or other mechanism. It is desirable to use tubing which is formed by transversely rolling strip stock to tubular form and welding or brazing the interfacing portions of the stock together.

This kind of tubing is relatively inexpensive as compared to seamless tubing, and it has the necessary structural strength. Heretofore, it has not been economically advantageous to use this kind of tubing because the usual internal irregularities at the longitudinal seam area of the tubing prevent centering the insert in the tube with the accuracy required in push rod construction. Reducing or removing the seam irregularities such as by scarfing, reaming, or mandrel drawing the tubing and the necessity of subsequently internally gauging the tubing increases its cost objectionably.

An object of this invention is to provide an improved economical method of making tubular push rods of the type described.

The invention is carried out generally by deforming the end portions of the tube to provide at three or more circumferentially spaced locations protrusions which project generally radially into the tube, a distance greater than the inward extent of any irregularities at the seam area. The protrusions engage the insert and center it within the tube end. One form of the invention is shown in the accompanying drawings:

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

Figure 2 is an enlarged fragmentary view of one end of the push rod with parts shown in phantom to illustrate structure.

Figure 3 is an enlarged view of an end of a piece of tubing before it is conditioned for receiving an insert.

Figure 4 is a view similar to Figure 3 illustrating the end of a piece of tube after it is conditioned for receiving an insert.

Figure 5 is a view similar to Figure 4 illustrating the end of the tube after an insert has been inserted therein.

Figure 6 is a fragmentary view of an end portion of a piece of tubing having a different type of insert.

Figure 7 is a view of a modified piece of tubing.

Shown in Figure 1 is a push rod 10, according to this invention, operably interconnecting a valve lifter 11 and a valve-actuating rocker 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 12 is rockably mounted on a shaft 18 with

one arm 19 operably engaged with a valve 20 and with another arm 21 on the opposite side of shaft 18 engaged by the push rod. Valve 20 is shown as being spring returned by a spring 22. Arm 21 of rocker 12 and the upper portion of lifter 11 are recessed as at 25 and 26 for receiving end pieces 27 of the push rod.

Push rod 10 is formed of a length of tube 30 which is formed by rolling flat strip stock transversely to tubular form, and securing the interfacing portions of the stock together by a fused metal connection such as brazing or welding. The tube thus has a longitudinal seam. The tube may have a single wall thickness and the interfacing portions of the stock forming the tube may be butt welded as illustrated diagrammatically at 31 in Figures 3 and 4. The welding may be accomplished by any suitable means such as by electric resistance welding or arc welding. In some instances the joint may be brazed. Suitable tubing may also be provided by transversely rolling the strip stock through about 720° to form plural wall tubing with the interfaces brazed together as disclosed for example in Woeller 2,292,810, dated Aug. 11, 1942 and entitled "Method and Apparatus for Making Tube."

For purposes of illustration, it may be assumed that the tubular stock 32, Figure 3, from which the push rod of this invention is made, has a single wall thickness and that the side edges are butt welded by electric resistance. External and internal beads or flashing formed by the welding are illustrated at 33 and 34. The end portions of tubing 32 are conditioned for receiving end pieces 27 by deforming the walls of the end portions radially inwardly at at least three circumferentially spaced locations to provide inward projections 36 which are shown in somewhat exaggerated form. These projections may be conveniently provided by fluting the tubing as at 37 along axially extending lines by dies which are secured in a press and advanced axially over the end of the tube. Where the flutes are formed without supporting the tube interiorly by means of a mandrel, the tube may be somewhat flattened in the vicinity of the flutes as illustrated in Figure 4.

End pieces 27 may be applied to the fluted tube ends by inserting a cylindrical portion 40 into the tube so that it is engaged by inward projections 36 formed by the flutes. Cylindrical insert may have a taper end 41 to facilitate its entry into the tube end. End piece 27 has a rounded end portion 42 which projects out of the tube to provide a bearing surface for engagement with other mechanism such as rocker arm 21 or lifter 11. Between insert 40 and end portion 42 is a shoulder 43 which seats on the end face of the tube, Figure 2, to properly position portion 42 longitudinally of the tube. Projections 36 extend toward the tube interior radially a substantially equal distance and engage cylindrical insert portion 40 snugly for centering the insert and end portion 42 relatively to the tubing. Projections 36 extend inwardly a distance greater than flash 34 at the seam area so that the insert is out of contact with the flash. Thus the presence of flash 34 does not affect centering of insert 40 or end portion 42 and it is unnecessary to remove or reduce the size of the flash.

The radially inward extent of projections 36 need not be closely controlled since the only requirement is that they project inwardly far enough to engage cylindrical portion 40 snugly and hold it spaced from flash 34. If during the fluting process projections 36 should be pressed further inwardly than necessary, the metal of the tube end will be merely expanded back out when cylindrical insert 40 is driven into the tube end, compare Figures 4 and 5. After cylindrical insert 40 has been positioned within the tube end, it may be permanently secured into place such as by spot welding 44 at a location where

projection 36 engages the insert. The push rod is now complete.

End pieces 27 are properly centered and longitudinally positioned so that outwardly projecting portions 42 are located for engaging rocker arm 21 and valve lifter 11. Inner flash 34 at the seam area need not be reduced or removed. Since projections 36 need not extend into the tubing to any accurately controlled extent, no gauging of the tube interior is necessary during manufacture. Thus the process of mounting end pieces 27 on the tube to complete the push rod is rapid, economical and effective.

Figure 6 illustrates a push rod 10*a* similar to push rod 10 except that a different type of end piece 27*a* is illustrated having a recess 45 at its outwardly projecting end rather than a ball 42 for engaging adjacent mechanism.

Figure 7 illustrates a modified form of push rod 50 similar to the form shown in Figure 1 except that tube 51 has flutes 52 extending through its entire length rather than just a short distance from its ends. This modification enables the tube manufacturer to provide fluted tubular stock in relatively long lengths. The push rod manufacturer may cut the tube to various desired shorter lengths for completion by addition thereto of end pieces 27, as described.

I claim:

1. The method of making a push rod which comprises, conditioning an end portion of an open-ended tubular element for receiving an insert in substantially centered relation on a predetermined center therein by deforming the wall of said tubular element to provide said end portion with generally axially inwardly extending projections at at least three circumferentially spaced locations, and securing an insert in the conditioned end portion of the tubular element so that said insert is centeringly engaged by said projections and so that the apposed portions of the tube interior and insert exterior extending circumferentially between said projections are spaced apart, while leaving a part of said insert projecting out of said end portion for operative engagement with other mechanism.

2. The method of making a push rod which comprises, conditioning an end portion of an open-ended tubular element for receiving an insert in substantially centered relation therein by deforming the wall of said tubular element to provide said end portion with axially elongate, generally radially equally inwardly extending projections at at least three circumferentially spaced locations, securing a generally cylindrical portion of an insert in the conditioned end portion of the tubular element so that said cylindrical portion is centeringly engaged by said projections and so that the apposed portions of the tube interior and insert exterior extending circumferentially between said projections are spaced apart, while leaving a part of said insert projecting out of said end portion for operative engagement with other mechanism.

3. The method defined in claim 2 wherein said elongate projections extend axially from an extreme end of the tubular element through a distance which is small relative to the length of said tubular element.

4. The method defined in claim 2 wherein said elongate projections extend through substantially the entire length of said tubular element.

5. The method of making a push rod which comprises providing an open-ended tube having a longitudinal seam, conditioning an end portion of said tube for receiving an insert by deforming the wall of said tube to provide inwardly extending projections at at least three circumferentially spaced locations with said projections extending inwardly a distance greater than the inward extent of irregularities at said seam, providing an end piece having one end portion forming an insert and having another end portion forming a bearing surface adapted for operative engagement with other mechanism, and securing said insert in said conditioned end portion of the tube so that said insert is centeringly engaged by said projections and so that the portions of said insert extending circumferentially between said projections are spaced from the tube interior and clear said irregularities, while leaving said bearing surface projecting out of said end portion of the tube.

6. The method of making a push rod which comprises, forming a tube by rolling a strip of metal transversely to tubular form and bringing edge portions thereof together at a longitudinal seam area, joining interfacing portions of the metal strip by a fused metal connection, conditioning an end portion of the tube for receiving an insert by deforming the wall of said tube to provide inwardly extending projections at at least three circumferentially spaced locations with said projections extending inwardly a distance greater than the inward extent of irregularities at the longitudinal seam, providing an end piece having one end portion forming an insert and another end portion forming a bearing surface adapted for operative engagement with other mechanism, and securing said insert in said conditioned end portion of the tube so that said insert is centeringly engaged by said projections and so that the portions of said insert extending circumferentially between said projections are spaced from the tube interior and clear said irregularities, while leaving said bearing surface projecting out of said end portion of the tube.

7. The method of making push rod which comprises, rolling metal strip stock transversely to tubular form with its edge portions in apposed relation, welding said edge portions together in a longitudinal seam, conditioning an end portion of the tube thus formed for receiving an insert by deforming the wall of said tube to provide inwardly extending projections at at least three circumferentially spaced locations with said projections extending inwardly a distance greater than the inward extent of interior flash formed incidental to the welding of said seam, providing an end piece having one end portion forming an insert and having another end portion forming a bearing surface adapted for operative engagement with other mechanism, and, without otherwise conditioning the interior of said tube, securing said insert in said conditioned end portion of the tube so that said insert is centeringly engaged by said projections and so that the portions of said insert extending circumferentially between said projections are spaced from the tube interior and clear said interior flash, while leaving said bearing surface projecting out of said end portion of the tube.

8. A tubular push rod comprising, a length of tube having open end portions, each end portion having at least three generally radially inward projections at circumferentially spaced locations, a member disposed within each of said end portions and being engaged by said projections so that said member is substantially centered on a predetermined center within said end portion, the apposed portions of said member and the tube interior extending circumferentially between said projections being spaced apart in a radial direction, said members projecting out of said end portions and being formed for operative engagement with other mechanism.

9. A tubular push rod comprising, a length of tube having a longitudinal seam and having open end portions, each end portion having at least three generally radially inward projections at circumferentially spaced locations, said projections extending inwardly a distance greater than the inward extent of irregularities in the seam area, a member disposed within each of said end portions, said member being engaged and substantially centered within said end portion by said projections, the apposed portions of said member and the tube interior extending circumferentially between said projections being spaced apart in a radial direction so that said member clears the irregularities at the seam area of said tube, said members projecting out of said end portions and being formed for operative engagement with other mechanism.

10. A tubular push rod comprising a length of tube having a longitudinal seam and having open end portions, each end portion having at least three axially elongate, generally radially inward projections at circumferentially spaced locations, said projections extending inwardly a distance greater than the inward extent of irregularities at the seam area of said tube, a generally cylindrical member disposed within each of said end portions and being engaged by said projections so that said member is substantially centered within said end portion, the apposed portions of said member and tube interior extending circumferentially between said projections being spaced apart in a radial direction so that said member clears the irregularities at the seam area of said tube, said members having portions projecting out of said end portions of said tube and being formed for operative engagement with other mechanism.

11. The push rod defined in claim 10 wherein the axial extent of said projections is relatively smaller than the length of said tube.

12. The push rod defined in claim 10 wherein said projections extend through substantially the entire length of said tube.

References Cited in the file of this patent

UNITED STATES PATENTS

1,375,852	Linendoll	Apr. 26, 1921
2,386,317	Jenny et al.	Oct. 9, 1945
2,708,246	Dunn	May 10, 1955