Aug. 20, 1963 S. GONDEK 3,101,402

PUSH ROD STRUCTURE AND METHOD OF MANUFACTURE

Original Filed Feb. 12, 1960 2 Sheets-Sheet 1

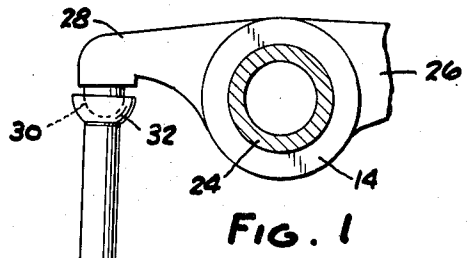
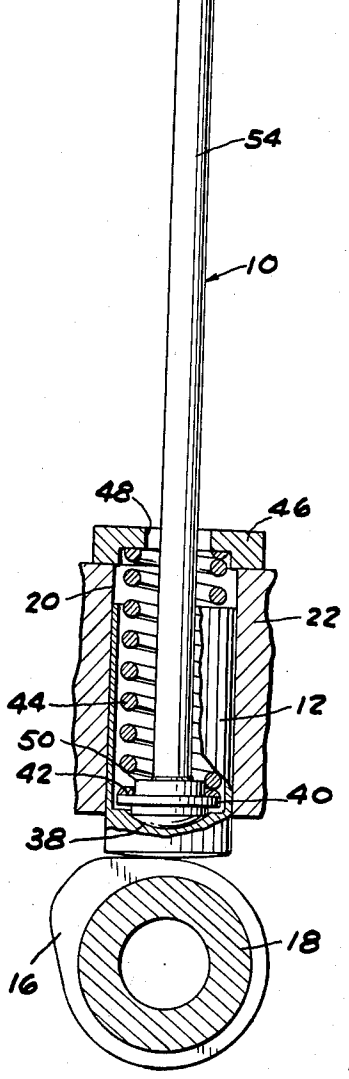


FIG. 1



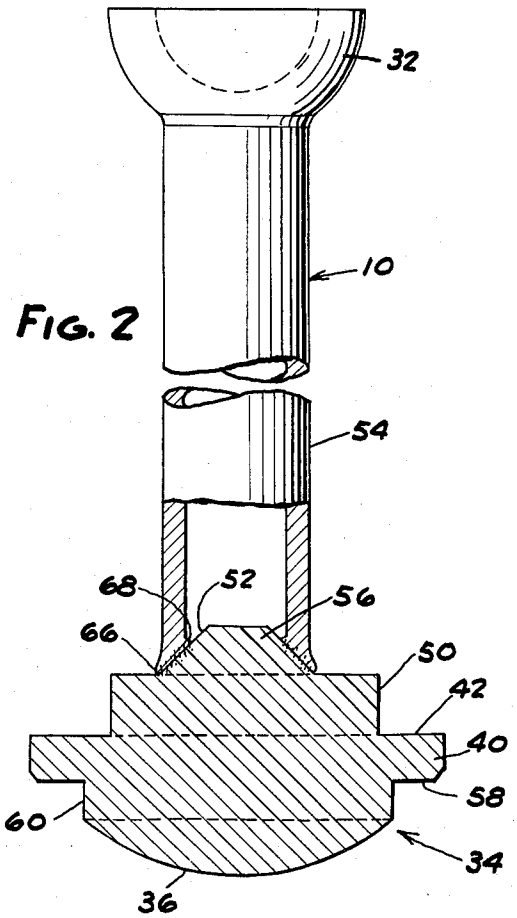


FIG. 2

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PUSH ROD STRUCTURE AND METHOD OF MANUFACTURE

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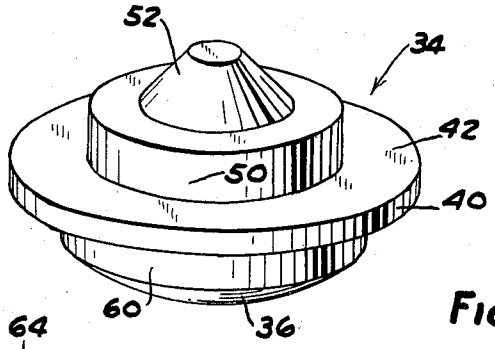


FIG. 3

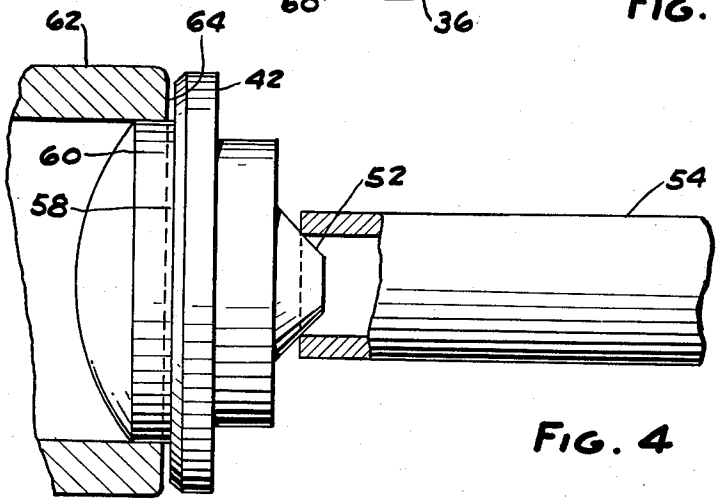


FIG. 4

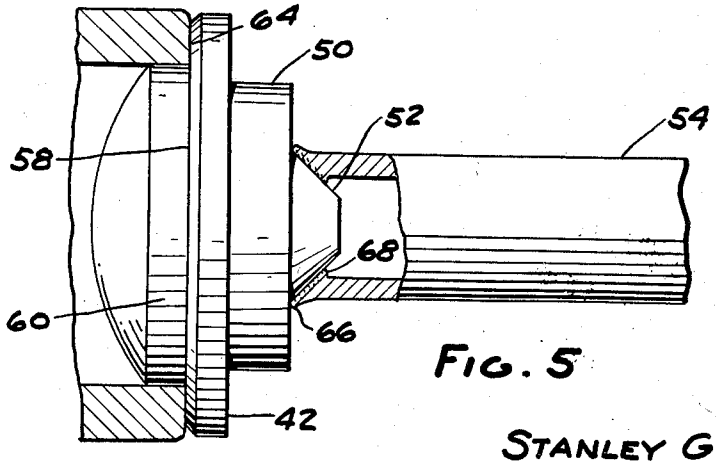


FIG. 5

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PUSH ROD STRUCTURE AND METHOD OF MANUFACTURE

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Original application Feb. 12, 1960, Ser. No. 8,331, now Patent No. 3,050,045, dated Aug. 21, 1962. Divided and this application Feb. 28, 1961, Ser. No. 92,279
3 Claims. (Cl. 219—107)

This invention involves push rods of the type having a rounded bearing surface adjacent one end, and having a generally radial flange which provides a seat for a coil spring utilized to hold the bearing surface in operative engagement with a rocker arm, cam follower, or other part in a mechanical train. Selected for illustration of the invention is a push rod in the valve train of an internal combustion engine.

This application is a division of my co-pending application Serial No. 8,331, filed February 12, 1960, now Patent No. 3,050,045, and entitled "Push Rod Structure and Method of Manufacture."

The object of the invention is to provide a light weight, inexpensive push rod structure of improved operating characteristics and a rapid, relatively inexpensive, improved method of its manufacture.

Generally the invention contemplates a tubular push rod body having an end forming a seat to which a curved surface on an end piece is welded. The end piece has a curved bearing surface disposed exteriorly of the tube and has a flange, one face of which forms an abutment for an electrode to facilitate welding, and the other face of which forms the seat for a coil spring in the valve train. One form of the invention is shown 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 view of the push rod with portions broken away at one end to illustrate structure.

FIG. 3 is an enlarged perspective view of an end piece separate from the tube.

FIG. 4 is a fragmentary partially sectional view illustrating a step in manufacture of the push rod.

FIG. 5 is a view similar to FIG. 4 illustrating a subsequent step in manufacture of the push rod.

Shown in FIG. 1 is a push rod **10** according to this invention operably interconnecting a cup-shaped valve lifter **12** and a valve operating rocker **14**. Lifter **12** is raised and lowered by a cam **16** on a cam shaft **18** and the lifter moves in a guide **20** formed in an engine block **22**. Rocker **14** is rockably mounted on a shaft **24** with one arm **26** operably engaged with a valve (not shown) and with another arm **28** on the opposite side of shaft **24** engaged with the push rod. Arm **28** has a projection with a spherical surface **30** engaged within a complementary spherical concavity in a cup-shaped end piece **32** at one end of the push rod.

The other end of the push rod is provided with an end piece **34** having a spherical end surface **36** bearing against a complementary spherical concave surface **38** in the bottom of cup-shaped valve lifter **12**. End piece **34** has a radial flange **40**, one face **42** of which forms a seat for engagement by an end of a coil spring **44** which is compressed to bias bearing surface **36** against seat **38**. Spring **44** reacts against a retainer **46** secured by suitable means not shown to engine block **22** and having a central opening **48** through which the push rod extends.

End piece **34** has a cylindrical portion **50** extending longitudinally away from face **42** and serving as a pilot or positioning means for centering the end of coil spring **44** with respect to face **42**. End piece **34** has adjacent one end a curved surface **52** which is secured to an end

portion of the tubular body **54** of the rod in a manner to be described. In the form of the invention illustrated, surface **52** is convex and is provided by a conical projection **56**. Flange **40** has a surface **58** which faces in a direction opposite from surface **42**, and extending longitudinally from surface **58** is a cylindrical projection **60** serving a purpose to be described. End piece **34** is preferably formed of a relatively hard material such as a case hardened steel and may conveniently be formed by cold forging. By this means exposed surface **36** provides a hard smooth bearing surface for engagement with seat **38** on valve lifter **12**. Surface **36** is free of any machining marks and requires minimal treatment subsequent to being forged and prior to use. End piece **34** is secured to an of tube **54** by a fused metal connection such as by soldering, brazing or welding.

Cup-shaped end piece **32** preferably comprises a case hardened stamped part secured to the other end of tube **54** by a fused metal connection as disclosed in copending application Serial No. 770,496, filed October 29, 1958, now Patent No. 2,960,080, by Edward O. Burnard and Raymond T. Read entitled "Push Rod and Method of Its Manufacture."

The tubular push rod body **54** has open ends prior to the time when end pieces **32** and **34** are secured thereto. The tube many have 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 rigid type, such as an extruded seamless tube or a rolled plural or single ply tube and may be made of any suitable material such as ferrous metal which will give it the requisite rigidity. An example of a suitable tube is a single ply rolled steel tube having a butt welded longitudinal seam.

In the form of the invention illustrated, end piece **34** has been fastened to tube **54** by resistance welding. Conical surface **52** is engaged against the seat formed at an open end portion of the tube so that surface **52** and the seat engage in a generally annular region of contact. A suitable electrode, not shown, is connected to tubular body **54**. Another electrode **62** having a tubular end is engaged around cylindrical portion **60** of end piece **32** as illustrated in FIG. 4, thereby assisting in centering end piece **34** relative to the end of tube **54**.

Electrode **62** and tube **54** are then advanced toward each other. End face **64** of electrode **62** engages face **58** on flange **40** and urges conical surface **52** firmly against the end of tube **54**. A welding current is then passed through end piece **34** and the tube to effect the welding. During the welding, the walls defining the end of the tube are softened and end piece **34** and tube **54** move toward each other to the general condition illustrated in FIG. 5. During this process, the walls adjacent the end of the tube are flared somewhat in a radial direction, thus increasing the width of the weld and providing a very sturdy joint between the end piece and tube. Fillets formed during the welding are illustrated at **66** and **68**.

In the form of the invention illustrated, the various surfaces of end piece **34** are substantially concentric around the longitudinal center line or axis of the end piece and the axis of the end piece coincides substantially with the longitudinal axis of tube **54**. Also in the structure illustrated, cylindrical portions **50** and **60** of the end piece have different axial dimensions to facilitate hopper feeding of the end piece to a position for engagement between electrode **62** and tube **54**.

In use, spherical bearing surface **36** is engaged within spherical seat **38** on valve lifter **12** and spherical projection **30** on rocker arm **28** is engaged within the complementary concavity in cup-shaped end piece **32**. Since these interengaged surfaces are spherical, push rod **10** may have random rotative orientation about its longitudinal

axis. The push rod generally in admirably adapted for interconnecting machine parts having rotary components of motion such as in the case of rocker arm **28**.

Flange **40** not only provides a face **42** forming a seat for coil spring **44** but also provides a surface **58** for abutment by electrode **62** during the welding process. End piece **34** has a ready-made bearing surface **36** obviating the necessity of expensive machining operations after its attachment to tube **54**. The invention facilitates inexpensive manufacture since the tubing and end piece **34** are relatively inexpensive and since the open end of the tube provides a seat for engagement with end piece **34** so that special machining or other preparation of the tube is minimized or obviated in providing the seat. The invention provides a push rod which is formed of a hollow tube and which is relatively light weight so that the efficiency of an engine or machine in which the push rod is used will be increased.

I claim:

1. The method of forming a push rod having a flange adjacent one end to provide a seat for a coil spring which comprises, providing a tube having an end portion forming a seat, providing an element having portions lying generally on a cylindrical surface and extending between a bearing surface at one end of the element and a fixed flange, one face of said flange forming said spring seat and the opposite face thereof forming a pressure seat, said element having a curved surface adjacent the end opposite said bearing surface, providing a hollow electrode having an end face, engaging said hollow electrode around said portions of said element while leaving said bearing surface free of contact with said electrode, aligning said hollow electrode substantially co-axially with the tube seat, utilizing said hollow electrode as a holder for said element and thereby aligning said element substantially co-axially with said tube seat, engaging said curved surface against said tube seat and while leaving said bearing surface free of contact with said hollow electrode and while continuing to use said hollow electrode as an aligning holder for said element, forcibly engaging said end face of said hollow electrode substantially axially against said pressure seat on said flange and thereby applying longitudinal force urging said curved surface against said tube seat, and while continuing to supply said force, heating the interengaged seat and curved surface to form a fused metal connection therebetween.

2. The method defined in claim 1 and including in addition the steps of providing said curved surface with a generally conical conformation dimensioned to enter at least partially within said tube seat and utilizing the interengagement of said conical conformation and tube seat to assist in aligning said tube seat and element in substantially co-axial relation.

3. The method of providing a bearing surface and a seat for a coil spring on one end of a push rod having an open tubular end forming said seat comprising, providing a blank, performing work on said blank to provide an element having portions lying generally on a cylindrical surface extending between a bearing surface at one end of the element and an integral flange, said flange having one face which forms said spring seat and an opposite face forming a pressure seat, said element having a curved surface adjacent the end opposite said bearing surface, providing a hollow electrode having an end face, engaging said hollow electrode around said portions of said element while leaving said bearing surface free of contact with said electrode, aligning said hollow electrode substantially co-axially with the tube seat, utilizing said hollow electrode as a holder for said element and thereby aligning said element substantially co-axially with said tube seat, engaging said curved surface against said tube seat and while leaving said bearing surface free of contact with said hollow electrode and while continuing to use said hollow electrode as an aligning holder for said element, forcibly engaging said end face of said hollow electrode substantially axially against said pressure seat on said flange and thereby applying longitudinal force urging said curved surface against said tube seat, and while continuing to apply said force, heating the interengaged seat and curved surface to form a fused metal connection therebetween.

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