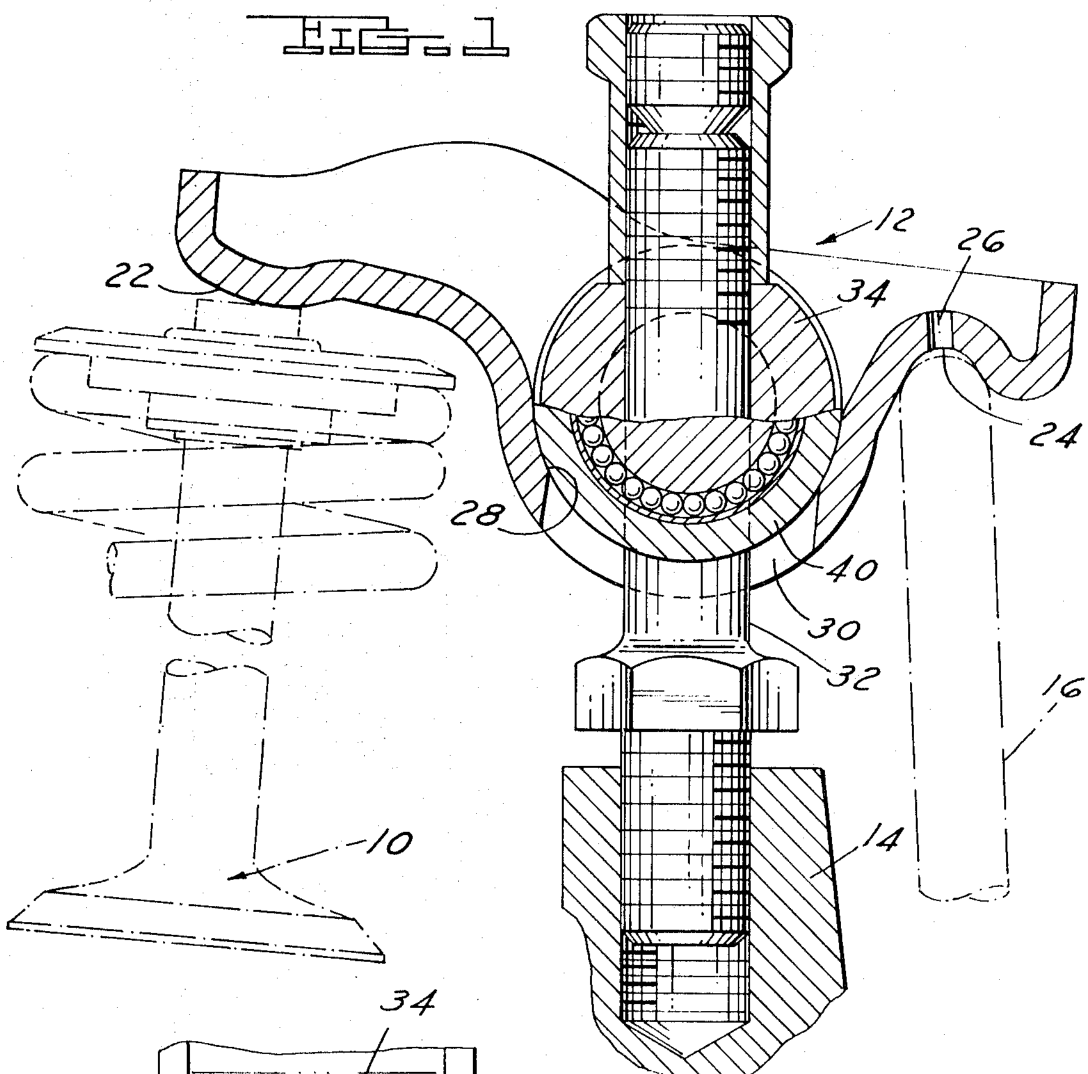
Nov. 23, 1971 J. LOMBARDI 3,621,823

FRICTIONLESS ROCKER ARM FULCRUM ASSEMBLY

Filed Aug. 27, 1969 2 Sheets-Sheet 1

FIG. 1



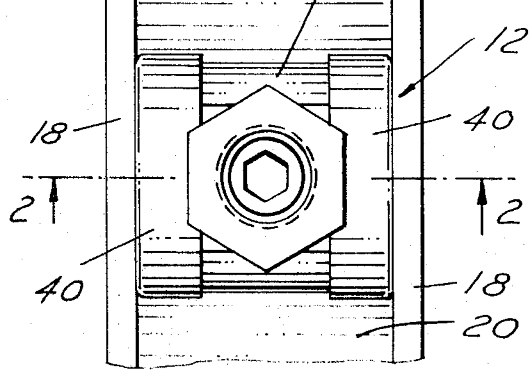


FIG. 3

INVENTOR
JOHN LOMBARDI
BY
John R. Faulkner
Robert E. Mc Collum
ATTORNEYS

Nov. 23, 1971 J. LOMBARDI 3,621,823

FRICTIONLESS ROCKER ARM FULCRUM ASSEMBLY

Filed Aug. 27, 1969 2 Sheets-Sheet 2

FIG. 4b

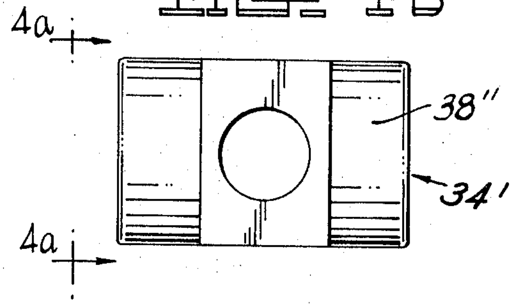


FIG. 2

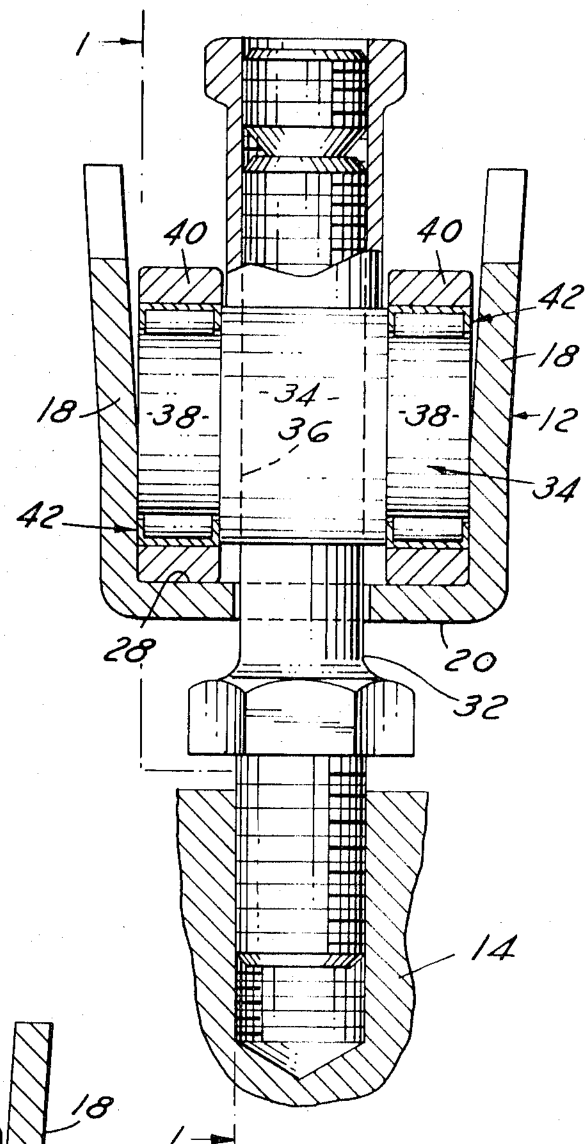


FIG. 4a

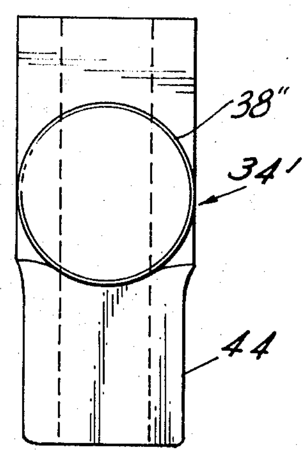
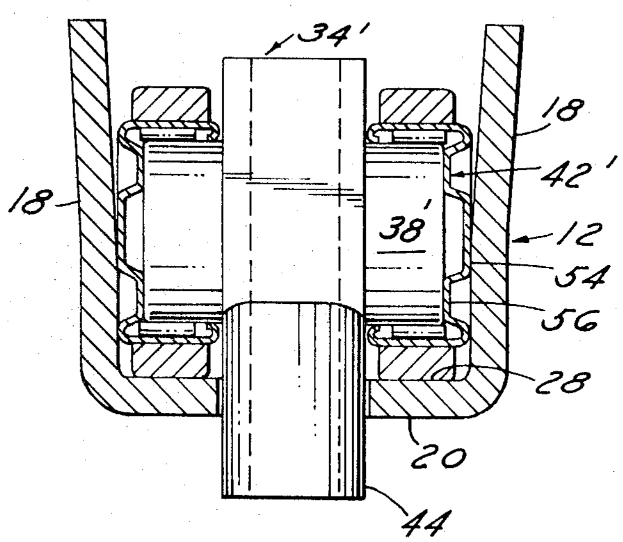


FIG. 5



INVENTOR
JOHN LOMBARDI
BY
John R. Faulkner
Robert E. Mc Collum
ATTORNEYS

3,621,823

FRICTIONLESS ROCKER ARM FULCRUM ASSEMBLY

John Lombardi, Detroit, Mich., assignor to Ford Motor Company, Dearborn, Mich.

Filed Aug. 27, 1969, Ser. No. 853,349
Int. Cl. F01l 1/18
U.S. Cl. 123—90.42 2 Claims

ABSTRACT OF THE DISCLOSURE

A one-piece rocker arm with straight side walls and a semi-cylinder bottom bearing surface is mounted on a fulcrum having cylindrical stub shafts on which are mounted needle bearings and bearing housings; the rocker arm bearing surface has a no-lash engagement with the bottom portion of the bearing housing which rotates with the rocker arm as a unit during a loaded condition of the valve train but rotates relative to the rocker arm during the unloaded valve train condition due to vibrations of the engine and inertia of the parts to provide even wear of the parts. The fulcrum is provided with an integral sleeve shaft of rectangular or square cross-section which extends through the rocker arm bearing surface and into a slotted recess or groove in the engine cylinder head. A bolt which passes axially through the sleeve shaft secures the fulcrum to the cylinder head.

This invention relates, in general, to a valve train for an internal combustion engine. More particularly, it relates to a rocker arm assembly for an over-head valve, push rod type actuated valve train providing minimum frictional resistance to relative rotation between the parts. It will be clear, however, that it is within the scope of the invention to utilize the assembly to be described in connection with overhead cam shaft type actuated valve train rocker arm assemblies as well.

Conventional passenger car type engine valve trains generally are unsatisfactory for use in so-called race engines for a number of reasons. A standard or conventional valve train rocker arm assembly generally is designed to be lubricated adequately at the top valve train speeds it must endure. These top speeds, however, are considerably less than those attained by a so-called race engine valve train, in which the valve train r.p.m. is increased by as much as several thousand. In the latter case, if a conventional valve train rocker arm assembly were used, the lubrication system would be inadequate and considerable heat due to frictional resistance would be generated. Ultimately, parts failure would occur. For example, an unsatisfactorily lubricated valve train assembly produces increase friction and heat as a result of increased load on the bearing surface. This can result in the push rod wearing through the rocker arm bearing surface. Also, during sustained high speed driving, such as is prevalent in a race type engine valve train, the bearing portions tend to wear faster than in a conventional type valve train rocker arm assembly because the load tends to be concentrated in a few of the bearing areas.

For the above reasons, a race type engine valve train usually requires a specially constructed or non-production type rocker arm assembly that can withstand the high loads prevalent and also will reduce friction to a minimum so as to reduce the heat and reduce wear of the parts, thereby minimizing fatigue or failure.

The conventional engine valve train rocker arm assemblies that use pedestal mounted rocker arms generally have a spherical or part cylindrical fulcrum that provides

an essentially large bearing area. This also provides a large area for frictional resistance and heat build-up if not adequately lubricated. Race engines, on the other hand, in order to avoid or minimize friction, generally utilize roller bearing assemblies mounted on stub shafts secured to a fulcrum and extending through side wall openings in the rocker arm. The rocker arm, in this case, generally has a considerably thicker side wall than that used in conventional street type engine valve trains since the needle bearing assembly generally is pressed into a hole in the side wall of the rocker arm.

From the foregoing, therefore, it will be seen that race engine type valve trains generally are far more expensive and complex than the conventional street type engine valve trains, and accordingly, would be unsatisfactory from a production standpoint for so-called street engines. A further disadvantage of the pressed needle bearing assembly rocker arm type construction is that during sustained high speed driving, the wear tends to concentrate at the lower portion of the roller bearing assembly; i.e., uneven wear occurs, causing fatigue of one part of the needle bearing assembly while the other portions show essentially no wear whatsoever.

The invention provides a high-speed essentially frictionless rocker arm assembly that meets all of the requirements necessary to provide high speed sustained operation without fatigue or failure, and yet is considerably more economical to manufacture and less complex to assemble than the conventional high speed engine valve train. This is because it combines a conventional one piece type rocker arm with a fulcrum assembly constructed according to the invention including a needle bearing assembly. That is, the invention utilizes a needle bearing fulcrum assembly that is easily insertable into a conventional production type rocker arm. The conventional so-called street engine valve train rocker arm assembly can become a high speed race engine valve train rocker assembly simply by replacing the pedestal mounting spherical or part cylindrical fulcrum assembly with one to be described.

It is an object of the invention, therefore, to provide an engine valve train rocker arm assembly that is essentially frictionless in operation, is easy to assemble and disassemble, and is economical to manufacture.

Another object of the invention is to convert a known type of one piece rocker arm, medium speed, valve train into a high speed valve train by replacing the rocker arm fulcrum with a needle bearing, cylindrical fulcrum type assembly.

A still further object of the invention is to provide a valve train rocker arm assembly in which relative rotation betwen the bearing portions is permitted due to engine vibration and inertia forces of the parts, thereby effecting more even wear of the parts and longer life thereto.

Other objects, features and advantages of the invention will become more apparent upon reference to the succeeding detailed description thereof, and to the drawings illustrating the preferred embodiments thereof, wherein;

FIG. 1 is a cross sectional view of a portion of an internal combustion engine valve train embodying the invention taken on a plane indicated by and viewed in the direction of the arrows **1—1** of FIG. 2;

FIG. 2 is a cross sectional view of the rocker arm assembly of FIG. 1 taken on a plane indicated by and viewed in the direction of the arrows **2—2** of FIG. 3;

FIG. 3 is a top view of a portion of a valve train embodying the invention;

FIGS. 4*a* and 4*b* are cross sectional views corresponding to FIGS. 1 and 2 and illustrating modifications of the invention; and

FIG. 5 is a cross sectional view similar to FIG. 2

illustrating a further embodiment or modification of the invention.

FIG. 1 illustrates a portion of the valve train for an internal combustion engine in which over-head valves are used. In this particular instance, each spring closed engine valve **10**, indicated in phantom, is adapted to be actuated by pivotal movement of a rocker arm **12**. The latter is individually or pedestal mounted on a boss **14** projecting from a cylinder head (not shown) of the engine. In this case, the opposite end portion of the rocker arm is adapted to be actuated by a push rod **16**, also shown in phantom, reciprocated by a conventional tapper means (not shown).

Rocker arm **12** in this case is essentially of conventional form and shape. It comprises a stamped or alternately cast one-piece member **12** that has essentially a square U-shape in cross section, as seen in FIG. 2, with essentially straight upstanding side walls **18** joined by a flat bottom wall **20**. The side wall portions **18** are continuous from end to end so as to provide rigidity to the construction. As will appear more clearly later, the unbroken side walls also laterally locate the rocker arm with respect to the fulcrum assembly and stationary supporting means.

Bottom wall **20** is arcuately formed along its longitudinal length, as best seen in FIG. 1, to provide a valve stem seating and actuating portion **22** at one end and a concave push rod end receiving portion **24** at the opposite end. A lubricating slot **26** cooperates with a lubricant containing bore (not shown) in the push rod for lubrication of the rocker arm mounting means and bearing surfaces in a known manner.

Bottom wall **20** also is formed with a concavity providing a semi-cylindrical internal bearing surface **28**. The latter surface has an essentially rectangular aperture **30** that extends arcuately over a major extent of the longitudinal length of cylindrical surface **28** to accommodate pivotal movement of the rocker arm **12** about the stationary supporting means to be described, in a known manner.

As stated previously, each rocker arm is adapted to be individually supported upon a cylinder head boss **14**. In this case, a bolt **32**, screwed into the cylinder head as indicated in FIG. 2, receives over it a fulcrum body **34** having an aperture **36** corresponding approximately to the diameter of the bolt. The fulcrum has a stub shaft **38** projecting laterally from each side, and in this case, extending axially essentially into abutting relationship with the side wall **18** of rocker arm **12**. The rocker arm thus is laterally or axially located thereby. Surrounding each of the stub shafts **38** and journaled thereon is an annular bearing housing **40** that is spaced from the shaft and journaled thereon by a needle bearing assembly **42**.

When the valve train is assembled, the upwardly directed forces exerted by the valve stem and the push rod on opposite ends of the rocker arm lightly force the bottom wall **20** of the rocker arm against the bearing housings **40**. The face of the bearing housings then mate with the semi-cylindrical bearing surface **28** of the rocker arm, as shown in FIGS. 1 and 2. As thus far described, therefore, it will be seen that in the assembled condition, the rocker arm is both laterally and vertically located by the needle bearing type fulcrum assembly.

It is important to note at this point that the rocker arm is mounted to rotate with respect to the bearing housings at times and at other times to be non-rotatable therewith depending upon the frictional resistance between, so that during the latter time, both the arm and bearing housings rotate as a unit about the fulcrum. More specifically, when the engine in which the described valve train is installed is operating so that the cam (not shown) on the cam shaft (also not shown) is forcing the push rod upwardly to load the rocker arm against the lower portion of the bearing housing, the frictional resistance to relative rotation between the bearing housing and rocker arm will be greater at this time than the frictional resistance between the fulcrum shafts and the needle bearing assembly. Therefore, both the rocker arm and bearing housing rotate as a unit about the fulcrum shafts **38** with a minimum of friction, minimizing heat build-up and parts wear. On the other hand, when the cam on the cam shaft has moved away from the tappet surface (also not shown), the push rod will exert essentially no force against the rocker arm at this time.

Accordingly, there is essentially no force between the bottom wall **20** of the rocker arm and the bearing housing **40**; i.e., the rocker is unloaded from the bearing housing; and accordingly, the bearing housing now can rotate relative to the rocker arm about the fulcrum shaft due to engine vibrations and the inertia forces of the housing at this time.

It will be seen, therefore, that, in the unloaded condition, the bearing housing rotation will cause other portions of the bearing housing surface to come in contact with the rocker arm semi-cylindrical bearing surface **28**, thereby equally distributing the wear on the bearing housing. However, when the rocker arm again becomes loaded when the cam begins raising the tappet, the rocker arm and bearing housing again have a non-relative rotational relationship, thereby reducing friction and wear.

FIGS. *4a* and *4b* illustrate a modification. The fulcrum **34'** has a central hole through which is received the bolt **32** of FIG. 1 to secure the fulcrum to the engine cylinder head. The main body of fulcrum **34'** has a depending portion **44** that extends through the rocker arm opening **30** and has a rectangular or square shank shape in cross section. The latter would extend into a slotted recess or groove (not shown) in the cylinder head boss **14** to prevent relative rotation between the fulcrum and cylinder head.

In FIG. 1, the push rod **16** could be guided by means (not shown) to prevent lateral cocking or rotation of the rocker arm about the cylinder head boss **14**. FIGS. *4a* and *4b* show an alternate arrangement. A still further alternative would be to extend a metal bracket between several, such as four, valves to laterally align the rocker arms. With the use of such a bracket, the depending extension **44** of the fulcrum means **34'** could be cylindrical.

FIG. 5 illustrates a further modification. In this case, each needle bearing assembly **42'** includes a cage **54** that has a radially corrugated portion **56** serving as a spacer between the rocker arm side wall **18** and the end of the stub shaft **38'**. The spacer thus locates laterally the rocker arm in the same manner that the extended shafts **38** do in FIG. 1. In all other respects, the operation of the FIGS. *4a* and *4b* and 5 constructions are essentially the same as that already described in connection with the embodiment shown in FIGS. 1 and 2.

From the foregoing, therefore, it will be seen that the invention provides an internal combustion engine valve train rocker arm assembly that minimizes friction between the parts to permit high speed operation with minimum heat build-up due to frictional forces; and also effects an even wear of the parts by permitting relative rotation therebetween during different phases of operation of the valve train, in contrast to conventional constructions. It will also be seen that the invention provides an economically constructed high speed valve train rocker arm assembly, by utilizing a conventional one piece pedestal type rocker arm and replacing the low speed valve train rocker arm fulcrum means with a needle bearing assembly type fulcrum means constructed according to the invention.

While the invention has been illustrated in its preferred embodiments, it will be clear to those skilled in the arts to which it pertains that many changes and modifications may be made thereto without departing from the scope of the invention. For example, it will be clear, that while the rocker arm has been indicated as mounted in this case to the cylinder boss by headed bolt members, it will be equally within the scope of the invention to provide other mounting means such as studs, for example.

I claim:

1. An engine valve train rocker arm assembly comprising, a one piece hollow rocker arm having essentially a U-shape in cross section with essentially straight side walls and a bottom wall essentially at right angles thereto, the latter formed to provide a semi-cylindrical concave internal bearing surface thereon, an aperture in said surface adapted to receive loosely therethrough a fulcrum supporting means, a fulcrum means receivable within said arm between said side walls and having an aperture adapted to receive said supporting means therein to locate said fulcrum means, and means rotatably mounting said arm semi-clindrical surface on said fulcrum means, said latter means comprising annular housing means rotatably mounted on said fulcrum means within said arm between said side walls and relatively rotatably engageable with said arm at said arm internal bearing surface only so as to effect unitary movement of said arm and housing means at times relative to said fulcrum means and relative rotation between said housing and arm at other times, said unitary or relative rotation varying as a function of the loading of said arm against said housing during normal oscillatory operation of the engine valve train, said engine including a cylinder head, means securing said supporting means to said head, said fulcrum means including means integral therewith and depending therefrom into engagement with said cylinder head, and means on said head cooperating with said integral means to prevent rotation of the fulcrum depending means relative to said head.

2. An assembly as in claim 1, said integral means comprising a sleeve shaft surrounding said supporting means and extending through said arm aperture, said means on said head engaging a portion of said sleeve shaft to prevent rotation thereof.

References Cited

UNITED STATES PATENTS

1,352,897	9/1920	Holmes	123—90
1,693,832	12/1928	Vincent	123—90
1,752,055	3/1930	Angle	123—90
3,082,755	3/1963	Gropp	123—90
3,112,740	12/1963	Sampietro	123—90
3,198,183	8/1965	Ball	123—90
3,251,350	5/1966	Thompson	123—90
3,401,678	9/1968	Rose	123—90

AL LAWRENCE SMITH, Primary Examiner

U.S. Cl. X.R.

74—519