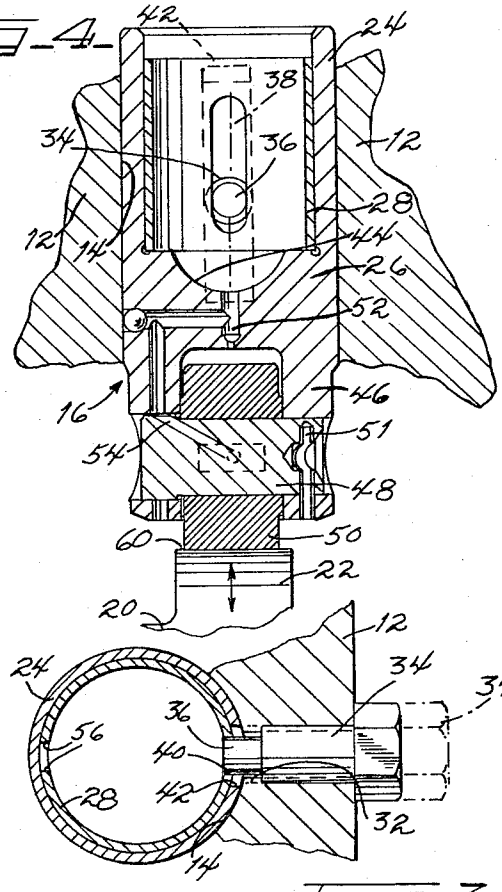
April 18, 1967 G. J. MAAT 3,314,303

NONROTATABLE CAMFOLLOWER

Filed June 28, 1965

FIG. 4



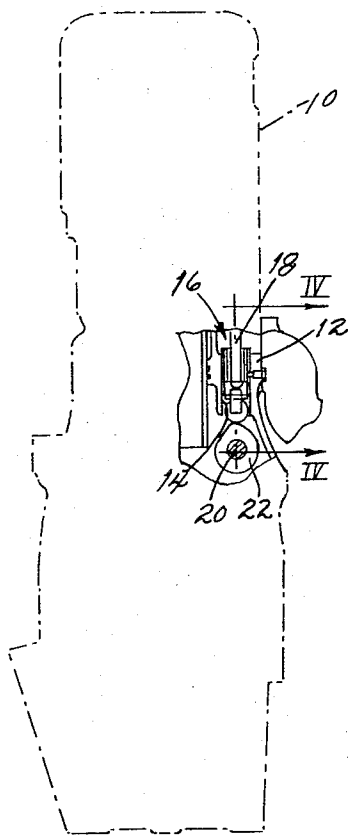


FIG. 1

FIG. 3

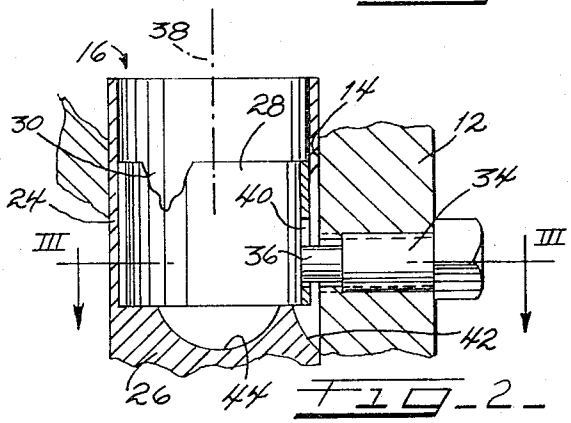


FIG. 2

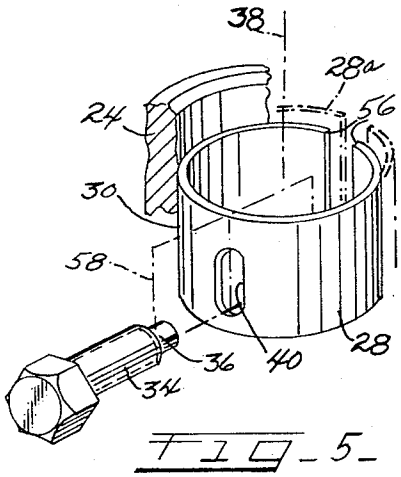


FIG. 5

INVENTOR
GEORGE J. MAAT
BY John W. Gaines
ATT'Y.

United States Patent Office 3,314,303 Patented Apr. 18, 1967

3,314,303

NONROTATABLE CAMFOLLOWER

George J. Maat, Batavia, Ill., assignor to International Harvester Company, Chicago, Ill., a corporation of Delaware

Filed June 28, 1965, Ser. No. 467,378
7 Claims. (Cl. 74—569)

This application relates to a nonrotatable camfollower. More particularly, it relates to a guide for a roller type camfollower, which camfollower is reciprocated in that guide in the plane established by the roller and which at the same time is prevented, by action of the guide, from allowing itself and the roller to be oscillated out of such plane.

In the illustrative example herein given, the roller-carrying camfollower of my invention is shown applied to a diesel engine having mechanical fuel injection. Specifically, the camfollower is moved in timed relation to the engine by a rotating, lobed cam and serves as the means of actuating the plunger in a fuel injector. The roller carried by the camfollower hereof does not oscillate out of plane with respect to the face of the cam lobe, and instead aligns itself with the cam face in a squarely confronting relation, so that it rides thereon in a manner maintaining line contact free from edge loading between the roller and cam face. Excessive contact stresses are thus eliminated at all angles of camlobe rotation because there is no wobbling.

In the present camfollower organization, I more particularly provide a cam-actuated tubular member having reciprocatory motion and having a slot formed in the side thereof parallel to the direction of reciprocation; means receiving the tubular member comprising guide pin means cooperatively arranged with a projecting pin in said slot and with clearance space at the sides of the projecting pin in excess of running clearance; and a generally C-shaped sleeve spring partially collapsed so as to fit tightly within and press outwardly against the tubular member in a relatively wide band of pressure contact; the spring having a pin receiving hole formed at an intermediate point on the spring spaced apart from each of the opposite ends and from each of the opposite circumferentially extending edges of the spring, and being slightly elongated in the direction of reciprocation of the tubular member; the pin at the sides being received in the hole with no more than running clearance with respect to the transverse dimension of the hole so that the pin and spring, respectively, prevent the spring and tubular member from turning movement, the pin fitting the hole in the long dimension thereof so as to provide a limit of relative sliding movement thereby preventing separation of the spring axially from the tubular member.

Further features, objects and advantages will either be specifically pointed out or become apparent when, for a better understanding of the invention, reference is made to the following written description taken in conjunction with the accompanying drawing, which shows a preferred embodiment thereof and in which:

FIGURE 1 is an end elevational view of an engine embodying the present invention, the engine shown being an inline engine;

FIGURE 2 shows a detail of FIGURE 1 to enlarged scale, and is likewise an end elevational view;

FIGURE 3 is a top plan view in transverse section taken along the section lines III—III of FIGURE 2;

FIGURE 4 is a side elevation of a detail to enlarged scale, taken along the section lines IV—IV of FIGURE 1; and

FIGURE 5 is an exploded isometric view of the invention, to indicate what the relation of parts will be as and when assembled.

More particularly in the drawing, a mechanical injection diesel engine **10** is shown having an in-line cylinder block **12**. Camfollower guide bores **14** in the block receive push rod lifters or tappets, one of which is shown at **16** and each of which transmits motion to reciprocate a push rod **18**. The push rods **18** are each connected to an individual plunger type fuel injector, not shown. A camshaft **20** which rotates in timed relation to the engine **10** carries individual cams **22** which, by cooperating with the tappets **16**, convert rotary motion to reciprocatory motion.

The body of the tappet **16** consists of a tubular camfollower member **24** which is closed at one end **26**. A C-shaped sleeve spring **28**, having a normally expanded diameter during its free-spring condition indicated by the broken lines **28***a* in FIGURE 5, is circumferentially collapsed sufficiently to be telescoped within, and to tightly fit inside of, the skirt of the tubular camfollower **24**. The coextensive inner surface of the camfollower with the spring **28** forms an essentially closed, wide band **30** of pressure contact which frictionally resists relative turning between the spring **28** and the camfollower **24**.

At essentially the nearest point on the outside surface of the block **12**, a drilled and tapped bore **32** is formed which intersects the bore **14**. A guide pin member **34** threaded in the tapped bore **32** projects inwardly therefrom into the bore **14**. The member **34** has a head at the outer end and is turned down smooth at the inner end to present a cylindrical pin **36** of reduced diameter.

The camfollower **24** and the spring **28** move as a unit and are guided along their longitudinal axis **38** as they reciprocate. They provide no more than running clearance at the sides of the pin **36** where it is received in a sleeve spring hole **40**, except for the fit between the pin **36** and a semicircular, milled slot **42** in the camfollower skirt which provides excessive clearance in all directions about the pin **36** therewithin.

The push rod **18** extends into the camfollower **24** through the open end and is received on the semicircular floor forming a lubricated socket **44** in the closed end **26** of the camfollower. The closed end **26** on its outer portion carries a depending wheel fork **46**, and an axle **48** is fixedly supported in the fork and supports a camfollower roller **50**.

The fork **46** carries a locking pin **51** which is staked to one end of the axle **48** and which prevents turning or sliding of the axle **48** in the fork bores. An oil passage intersecting the bottom of the socket **44** has a restricted branch **52** for externally lubricating the rim of the roller **50** and has another branch **54** for internally lubricating the hub so that the roller can freely rotate on the fixed axle **48**.

In assembly, the walls of sleeve spring **28** are collapsed inwardly from free state and are introduced through the open end of the tubular camfollower **24** so as to rest on the floor in surrounding relation to the socket **44**. The free ends **56** of the spring **28** are in closely spaced adjacency when the spring is assembled, and it is essential that there be a small gap in the circumference therebetween. The hole **40**, the opening of which is elongated in the direction of reciprocation, and the semicircular slot **42**, the opening of which is elongated in the direction of reciprocation, are brought into approximate alignment on center with one another by relatively rotating the camfollower **24** and spring **28** until such openings register.

The assembly is then rotated until the registered openings are approximately aligned with the tapped bore **32**, whereupon the guide pin member **34** is advanced in the threads from its initial position, indicated by the broken lines **34***a*, into its seated position indicated by solid lines in which the pin **36** is received in the registering openings.

Then the push rod **18** is introduced down inside of, and radially spaced apart from the spring **28**, so as to seat in the lubricated socket **44**.

In practice, the drilling of the bore **32** so that it intersects the bore **14**, cannot be performed on the engine block **12** with sufficient accuracy or uniformity that the two bore axes precisely intersect. In the usual case, the common vertical plane **58** of the pin **36** and the hole **40** in the spring **28** will, when extended, miss the longitudinal axis **38** of the assembly, passing, for example, to the right thereof as viewed in FIGURE 5. However, the stick-slip joint along the band **30** defined by the sleeve spring and camfollower affords relative turning therebetween sufficient to accommodate to the arc of misalignment.

In one physically constructed embodiment of the invention, the frictional resistance to relative circumferential sliding due to the band of circular contact **30** between the camfollower and spring was from three to five foot-pounds of torque. In operation, when the cam **22** starts rotating, the pressure angle between the roller **50** and the face **60** of the camflank and camlobe produces an initial squaring force that overcomes the three to five foot-pounds of friction torque, precisely aligning the roller surface and the cam surface so as to bring the unopposed moments into balance. The oversized milled slot **42** is ineffective to allow the camfollower to oscillate on the cam **22**, because of the close running fit between the minor dimension of the elongated hole **40** and the sides of the pin **36** fitting therein.

It is preferable, if not essential, to use an aperture such as the hole **40** machined in the spring **28** rather than to attempt use of the wide, circumferential interruption or gap between the ends **56** to receive the pin **36**. In the latter case, the close clearance would be too difficult to maintain for the running fit necessary and the spring sleeve **28** would be free to ride out of, and escape from, the open end of the camfollower, which could happen if a gap open at the sides were used to receive the pin **36**.

As herein disclosed, the invention is shown embodied in tappet structure for lifting the push rods **18** of a mechanical fuel injection system. It is evident that the principles of the invention are equally applicable to various cam actuated lifters wherein a push rod or other reciprocating device is driven and wherein oscillation of the roller **50** and the camfollower out of the plane of the actuating cam is a problem. The coextensive surface of the interconnecting sleeve with the camfollower skirt prevents wobbling of the camfollower on the cam, and the coextensive running clearance fit of the apertured interconnecting sleeve with the guide pin prevents axial separation between the sleeve and camfollower.

What is claimed is:

1. In a camfollower,

a cam actuated tubular member having reciprocatory motion and having a longitudinally extending slot in the side thereof;

means receiving the tubular member comprising guide pin means cooperatively arranged with a projecting pin in said slot and with clearance space at the sides of the projecting pin in excess of running clearance; and

interconnecting means having no more than a running fit with the pin and having a tight frictional fit with the tubular member, for preventing turning of the interconnecting means and tubular member relative to one another and to the pin, and for preventing relative sliding movement sufficient to separate said means axially from the tubular member.

2 In a camfollower,

a cam actuated tubular member reciprocable in a longitudinal direction and having a slot formed in the skirt thereof parallel to said direction;

longitudinal guide means receiving the tubular member

and having a transversely projecting pin arranged in said slot and with clearance space, in excess of running clearance, at the opposed sides of the projecting pin adjacent the skirt; and

interconnecting means having no more than a running clearance fit with the pin and having a tight frictional fit inside of, and with, the skirt of the tubular member, for preventing turning of the interconnecting means and tubular member relative to one another and to the pin.

3. In a camfollower,

a cam actuated tubular member having reciprocatory motion and having a slot formed in the side thereof parallel to the direction of reciprocation;

means receiving the tubular member comprising guide pin means cooperatively arranged with a projecting pin therefrom in said slot and with clearance space at the sides of the projecting pin in excess of running clearance; and

interconnecting means having pin-receiving hole means establishing no more than a running fit with the pin at the sides of the latter, and being within the tubular member and having a spring biased area of which the coextensive surface with said tubular member establishes a tight frictional fit, for preventing turning of the interconnecting means and tubular member relative to one another and to the pin, and for preventing relative sliding movement sufficient to separate said means axially from the tubular member.

4. In a camfollower,

a cam actuated tubular member having longitudinal reciprocatory movement and having a longitudinally extending slot in the side thereof;

means receiving the tubular member comprising guide pin means having a projecting pin thereon arranged in said slot and with clearance space at the sides of the projecting pin in excess of running clearance; and

a generally C-shaped sleeve spring partially collapsed so as to fit tightly within and press outwardly against the tubular member, said spring having a pin receiving hole formed at an intermediate point on the spring spaced apart from each of the opposite ends and being slightly elongated in the direction of longitudinal reciprocation of the tubular member;

said pin being received in the hole with no more than running clearance at the sides so that the pin and spring, respectively, prevent the spring and tubular member from turning movement, said pin preventing relative sliding movement sufficient to separate the spring axially from the tubular member.

5. In a camfollower arrangement, the combination of:

a tubular supporting member;

a roller supported thereby for rolling against a cam; said tubular member having a longitudinally extending slot in the side thereof;

guide bore means guiding the tubular member for longitudinal reciprocation of the latter, comprising guide pin means cooperatively arranged with a projecting pin in said slot and with clearance space at the sides of the projecting pin in excess of running clearance; and

a generally C-shaped sleeve spring partially collapsed so as to be compressed within and to press outwardly against the tubular member;

said spring having a pin receiving hole formed at an intermediate point on the spring spaced apart from each of the opposite ends and from each of its opposite circumferentially extending edges, and being slightly elongated in the direction of longitudinal reciprocation of the tubular member;

said sleeve having the hole thereof engaging the pin at the sides with no less than a running fit and having a spring biased area of which the coextensive surface with the tubular member establishes a tight frictional fit for preventing turning of the roller and the

sleeve spring relative to one another and to the pin, and for preventing relative sliding movement sufficient to separate the sleeve axially from the tubular member.

6. Cam mechanism comprising:

a cam;

a tubular follower member operatively arranged in the plane of rotation of the cam;

a roller riding the cam in the plane thereof and carried by the tubular follower member, said tubular member having reciprocatory motion as it carries the roller and having a slot extending in the side thereof in the direction of reciprocatory motion;

means supporting the tubular member and cam in the operative arrangement described including tubular member guide means comprising guide pin means cooperatively arranged with a projecting pin in said slot and with clearance space at the sides of the projecting pin in excess of running clearance; and

a generally C-shaped sleeve spring partially collapsed within and pressing outwardly against the tubular member in a relatively wide band of pressure contact;

said spring having a pin receiving hole formed at an intermediate point on the spring spaced apart from each of the opposite ends and from each of its opposite circumferentially extending edges, and being slightly elongated in the direction of reciprocatory motion of the tubular member;

said sleeve spring having the pin receiving hole thereof engaging the pin at the sides of the latter with no less than a running fit and having said relatively wide band of pressure contact establishing a tight frictional fit with the tubular member for preventing turning of the tubular member and sleeve spring relative to one another, and preventing turning of the roller and sleeve spring relative to one another and relative to the cam and pin, said pin preventing relative sliding movement sufficient to separate the sleeve spring axially from the tubular member.

7. Cam mechanism comprising:

a cam;

a follower operatively arranged in the plane of rotation of the cam;

a roller riding the cam in the plane thereof and carried by the follower at an end of the latter opposite an open end;

said follower having a socket exposed at the open end of the follower and a tubular structure surrounding the socket, said follower having guided movement of reciprocation and a slot in the tubular structure extending in the direction of reciprocation of the follower;

guide bore means receiving the following comprising pin means therein cooperatively arranged with a projecting pin in said slot and with clearance space at the sides of the projecting pin in excess of running clearance; and

a generally C-shaped spring partially collapsed so as to be within and press outwardly against the tubular structure in a substantially closed band of pressure contact;

said spring having a pin receiving hole formed at an intermediate point on the spring spaced apart from each of the opposite ends and from each of its opposite circumferentially extending edges, said spring hole being slightly elongated in the direction of reciprocation;

said spring arranged with the hole engaging the pin at the sides with no less than a running fit and arranged about the push rod with said relatively wide band of pressure contact establishing a tight frictional fit with the tubular structure for preventing turning of the roller and the spring relative to one another, and to the cam and the pin, said pin preventing relative sliding movement, due to reciprocation, of the sleeve along the push rod axis sufficient to separate the sleeve axially from the tubular structure of the follower.

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FRED C. MATTERN, JR., *Primary Examiner.*

W. S. RATLIFF, *Assistant Examiner.*