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(54) Drive means for rotary members.

(57) Drive means for a member (2) such as the turret of a tank rotatably mounted on a support means such as the chassis of a tank comprises a substantially circular bearing rack (6) secured on the support means and a rotatable drive shaft (8) carrying a pinion (10) secured on, to be rotatable with, the rotatable member (2). The drive means further comprises a carrier member (12) mounted on the pinion shaft (8) to be pivotal about the shaft (8), the carrier member (12) carrying an idler pinion (18) reacting between the drive pinion (10) and the rack (6), and stop means (30) co-operating with the rack (6) to limit lateral movement of the idler pinion (18) relative to the rack (6) and thereby to maintain meshing engagement of the idler pinion (18) with the rack (6).

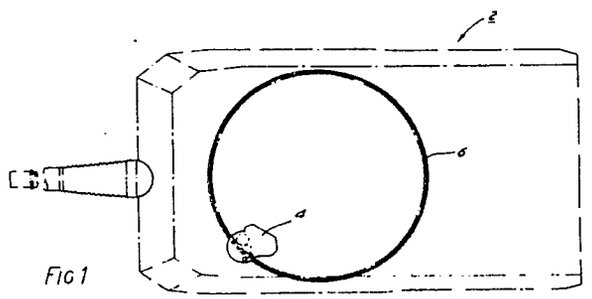

Fig 1

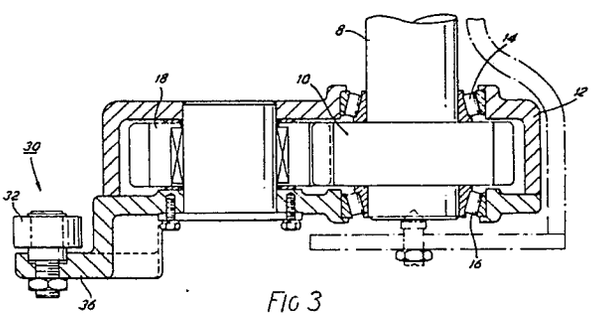

Fig 3

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DRIVE MEANS FOR ROTARY MEMBERS

This invention relates to drive means for rotary members and has particular, though not exclusive, application to drive means for the turrets of battle tanks.

Rotation of the turret of a battle tank is commonly achieved by means of a traverse gearbox mounted in, to be rotatable with, the turret and carrying a drive pinion which meshes with a circular bearing rack fixedly mounted on the tank chassis.

The fire control systems for the guns of modern battle tanks are designed to achieve extreme accuracy, typically within about 0.1 mil - i.e. to be able to hit a target 1 metre high at a range of 1000 metres. Consequentially, it is essential that the mechanical accuracy of the drive between the turret gearbox and the bearing rack is as high as possible, and in particular that the backlash between the drive pinion and the bearing rack is minimised.

The bearing racks are typically of 1.5 to 2.0 metres in diameter and are conveniently of aluminium. It is extremely difficult to produce a perfectly circular rack of such a size and material, while the fit of the bearing rack to the vehicle chassis requires some degree of clearance thus adding to the distortion - i.e. ovality -of the member.

Further, the loads imparted to the rack and pinion combination on firing of the gun, as well as the racking of the tank chassis when travelling at speed across country, tend to increase distortion of the bearing rack and therefore encourage the drive pinion to disengage from the rack.

Various proposals have been made to maintain meshing contact between the rack and pinion and to eliminate backlash between these components, but none has been entirely successful.

For example, it is known to insert shims between the gearbox and its mounting to the turret in such a manner as to maintain contact of the pinion with the rack at the regions of maximum distortion of the rack, but such an arrangement results in non-constant drive loads on the rack and can still result in the pinion coming out of mesh with the rack.

It has also been proposed to provide a pivotal mounting of the gearbox to the turret, a coil spring or like resilient means urging the pinion into mesh with the rack. However, on movement of the turret to rotate the gun quickly, the teeth of the pinion and the rack tend to move apart, and the resilient force required to maintain mesh is substantial. The application of such a high spring loading on the pinion, via the gearbox, results in an extremely high frictional force between the pinion and the rack which must be overcome to drive the turret, and consequentially results in rapid wear of the teeth and possible jamming thereof.

It would be desirable to be able to provide drive means between the gearbox pinion and the rack which was such as to accommodate any distortion of the rack and without encountering the disadvantages of the known arrangements.

According to the present invention there is provided drive means for a member, such as a turret, rotatably mounted on a support means, such as the chassis of a tank, the drive means comprising a substantially circular bearing rack fixedly mounted on the support means, and a rotatable drive pinion fixedly mounted on the rotatable member, the drive means further comprising a carrier member mounted on the pinion shaft to be pivotal thereabout, said carrier member carrying an idler pinion adapted to react between the drive pinion and the rack, and also carrying stop means adapted to co-operate with the rack to limit lateral movement of the idler pinion relative to the rack and thereby to maintain meshing engagement of said idler pinion with the rack.

It will thus be appreciated that, with such an arrangement, the idler pinion meshes with both the drive pinion and the rack, the constant co-operation between the stop means and the rack regardless of the precise configuration of the rack, together with the pivoting nature of the carrier member, ensuring that meshing contact between the idler pinion and the rack is maintained at all times.

Preferably the stop means are adjustably mounted relative to the carrier member whereby the maximum and minimum backlash between the idler pinion and the rack can be altered as required.

In a preferred arrangement, the rack includes an axially extending annular flange thereon, the stop means comprising a pair of rollers one adapted to engage with each of the radially inner and radially outer faces of said flange.

Conveniently each roller is eccentrically mounted on the carrier member such that the position of the central axis thereof relative to the carrier member can be altered.

Preferably the carrier member comprises a housing encasing the drive pinion and mounted to be pivotal about the pinion shaft on bearings above and below said drive pinion, the idler pinion being mounted to be rotatable in said housing and projecting therefrom to mesh with the rack. The stop means are conveniently secured to, to project from, the housing.

By way of example only, an embodiment of the invention will now be described in greater detail with reference to the accompanying drawings of which:

Fig. 1 is a plan view of the turret of a tank showing the location of the drive means according to the invention;

Fig 2 is a diagrammatic plan view from above showing the drive means of Fig. 1 in more detail, and partly cut-away, and

Figs. 3 to 5 are vertical sections on lines III-III, IV-IV and V-V respectively of Fig. 2.

Referring to Fig. 1 of the drawings, the turret of a battle tank is shown generally at 2, said turret 2 being rotatable on the chassis of the tank about a substantially circular bearing rack by drive means including a motor and gearbox 4 rigidly mounted to the turret 2 and co-operating with a substantially circular bearing rack 6 rigidly mounted on the vehicle chassis.

The drive means will now be described in more detail with reference to Figs. 2 to 5.

A drive shaft 8 extends vertically downwardly from the gearbox 4 and carries a drive pinion 10. A horizontally elongate housing 12 is mounted on the shaft 8 by means of tapered bearings 14,16 above and below the pinion 10, the housing 12 encasing the pinion 10 and being pivotal in a horizontal plane about the shaft 8.

Mounted within the housing 12 to be rotatable therein about a vertical axis is an idler pinion 18 meshing with the drive pinion 10 such that rotation of the drive pinion 10 results in rotation of the idler pinion 18. The sidewall of the housing 12 is apertured at 20, a segment 22 of the idler pinion 18 projecting from the housing 12 through said aperture 20, the idler pinion 18 being pivotal with the housing 12 about the shaft 8 to bring the segment 22 thereof into meshing engagement with the teeth of the rack 6.

Thus it will be appreciated that, with the idler pinion 18 pivoted about the shaft 8 into meshing engagement with the rack 6, the arrangement so far described enables rotation of the turret 2 on the tank chassis by appropriate powering of the drive pinion 10 by way of the motor and gearbox 4.

Continued meshing contact of the idler pinion 18 with the rack 6 irrespective of any deviation from circular of said rack 6 is achieved as follows.

The rack 6 is provided with a depending annular flange 24 having axially flat inner and outer surfaces 26,28 respectively. Stop means indicated generally at 30 for co-operation with the annular flange 24 are mounted on the end of the housing 12 remote from the drive pinion 10.

More particularly, the stop means 30 comprise a pair of rollers 32,34 each mounted on an extension piece 36 forming part of the housing 12, the rollers 32,34 being positioned one to each side of the flange 24 as best seen in Fig. 5 and engaging with the inner and outer faces 26,28 of said flange 24 respectively in such a manner as to locate the idler pinion 18 in meshing contact with the rack 6.

Conveniently the two rollers 32,43 are each eccentrically mounted about their axes of rotations as best seen in Fig. 5, whereby the distance between the central axis of each roller 32,34 and the associated inner and outer face 26,28 of the flange 24 can be varied. The precise locations of the rollers 32,34 relative to the flange 24 determine the minimum and maximum backlash respectively between the idler pinion 18 and the rack 6, which backlash may be set to vary between, typically, 0.05mm and 0.25mm by appropriate adjustment of said rollers 32,34 on the faces 26,28. It will be appreciated that these backlash settings will remain constant despite any ovality of the rack 6 because the rollers 32,34, which determine the backlash, follow the rail regardless of its configuration, any ovality thereof resulting in the housing 12, and therefore the idler pinion 18, pivoting about the shaft 8 to maintain meshing engagement of the idler pinion 18 with the rack 6.

Thus there is provided drive means for rotating the turret of a tank which is such as to be able to accommodate any distortion from circular of the bearing rack without any variation in the backlash or free play between the drive means and the rack. Further, the motor and gearbox 4 can be rigidly bolted in position on the turret, there being no need to shim the gearbox mounting face as in the traditional method of setting the backlash.

It will be appreciated that the precise configuration of the drive means may vary from that shown and in particlar the stop means may comprise other than the rollers 32,34 providing the idler pinion 18 is arranged to follow closely the path of the rack 6.

Although described in relation to the turrets of battle tanks, the invention has application in other fields where high pointing accuracy of a rotatable member is required, such as with an astronomical telescope.

Claims

1. Drive means for a member (2) rotatably mounted on a support means and comprising a substantially circular bearing rack (6) fixedly mounted on the support means and a rotatable drive pinion (10) carried on a shaft (8) and fixedly mounted on the rotatable member (2), characterised in that the drive means further comprises a carrier member (12) mounted on the pinion shaft (8) to

be pivotal thereabout, said carrier member (12) carrying an idler pinion (18) adapted to react between the drive pinion (10) and the rack (6), and also carrying stop means (30) adapted to co-operate with the rack (6) to limit lateral movement of the idler pinion (18) relative to the rack (6) and thereby to maintain meshing engagement of said idler pinion (18) with the rack (6).

2. Drive means as claimed in claim 1 in which the stop means (30) are adjustably mounted relative to the carrier member (12) whereby the maximum and minimum backlash between the idler pinion (18) and the rack (6) can be altered as required.

3. Drive means as claimed in claim 2 in which the rack (6) includes an axially extending annular flange (24) thereon, the stop means (30) comprising a pair of rollers (32,34) one adapted to engage with each of the radially inner and radially outer faces (26,28) of said flange (24).

4. Drive means as claimed in claim 3 in which each roller (32,34) is eccentrically mounted on the carrier member (12) such that the position of the central axis thereof relative to the carrier member (12) can be altered.

5. Drive means as claimed in any one of claims 1 to 4 in which the carrier member comprises a housing (12) encasing the drive pinion (10) and mounted to be pivotal about the pinion shaft (8) on bearings (14,16) above and below said drive pinion (10), the idler pinion (18) being mounted to be rotatable in said housing (12) and projecting therefrom to mesh with the rack (6).

6. Drive means as claimed in claim 5 in which the stop means (30) are secured to, to project from, the housing (12).

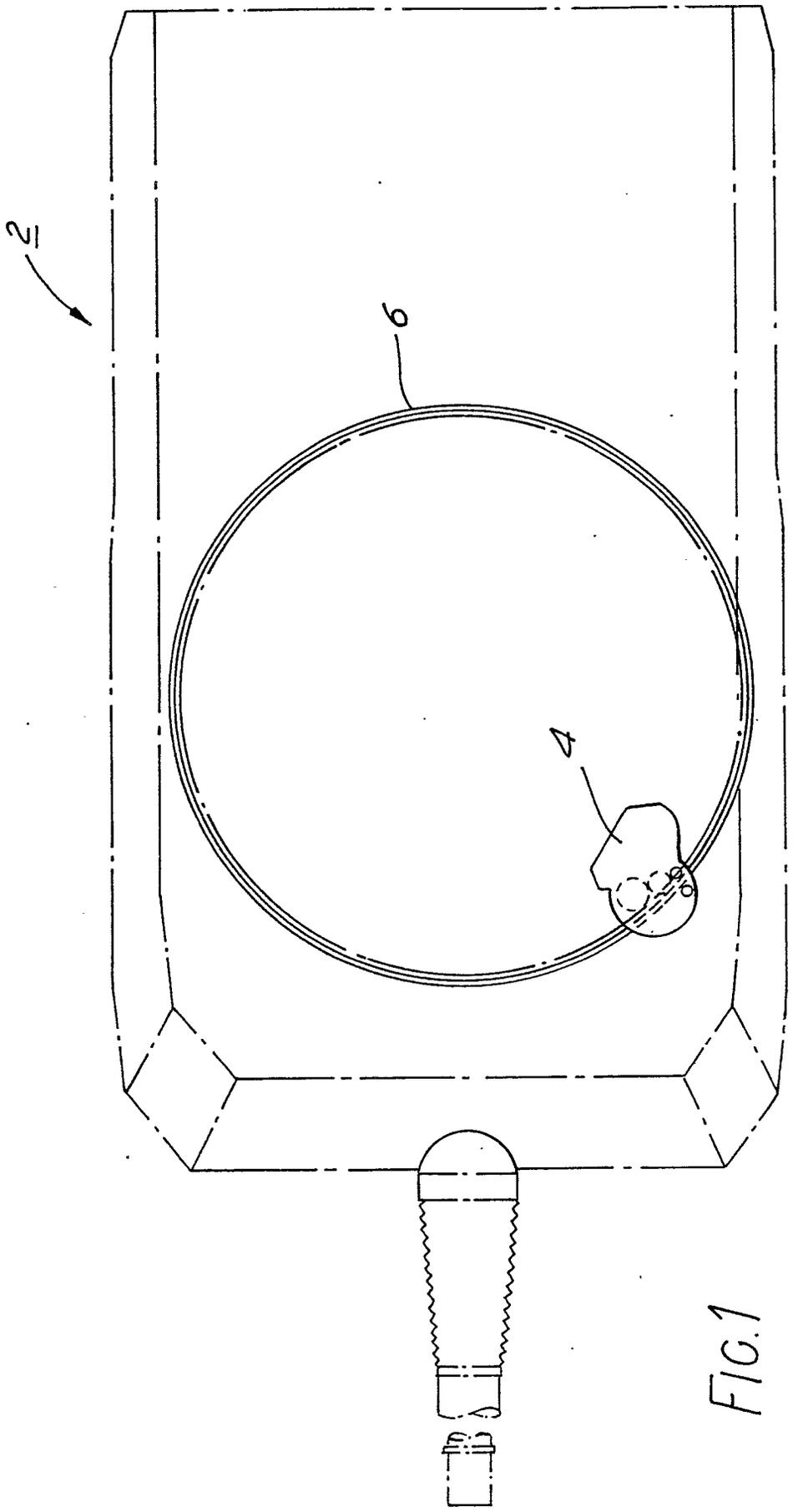

FIG.1

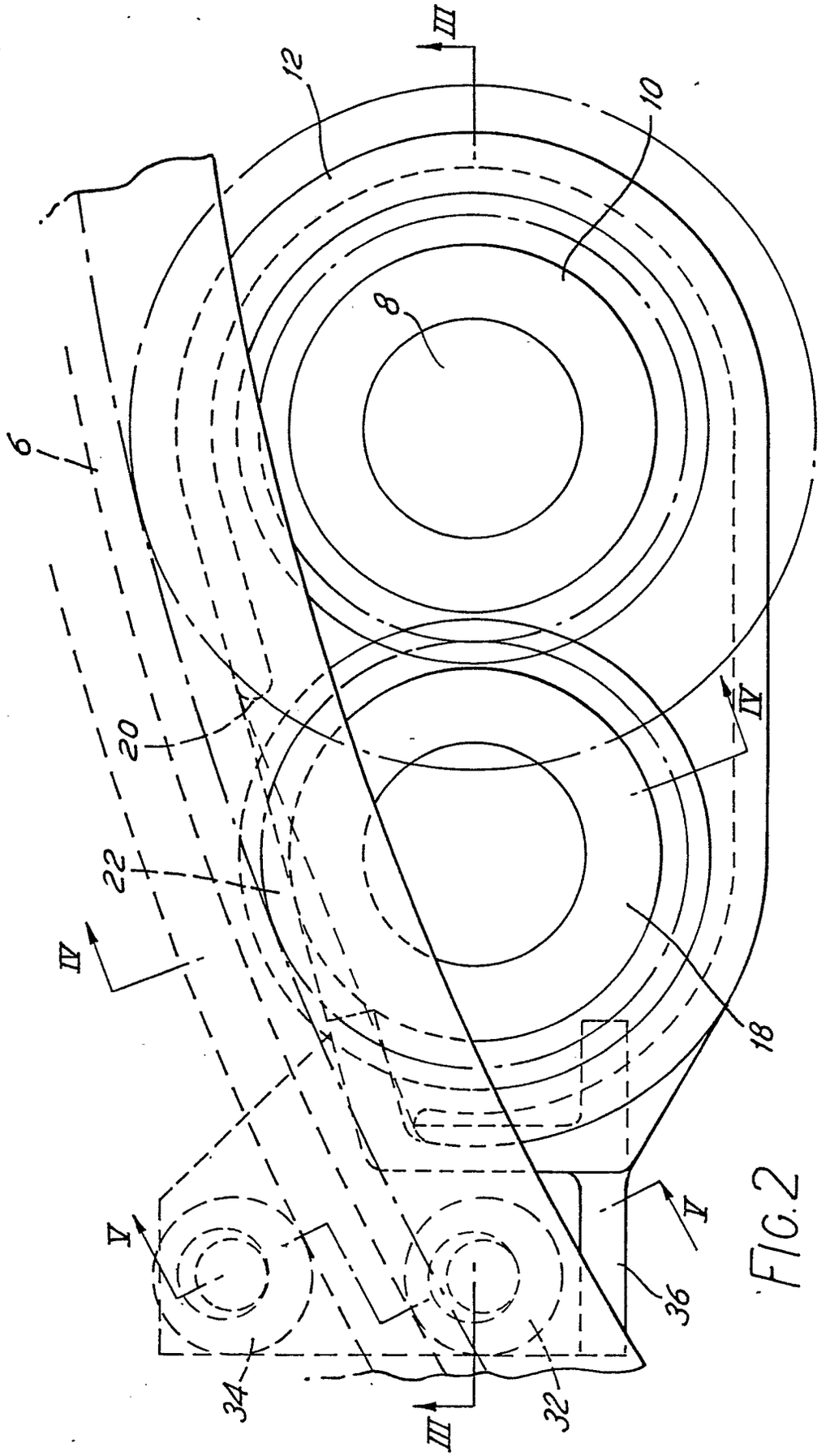

FIG.2

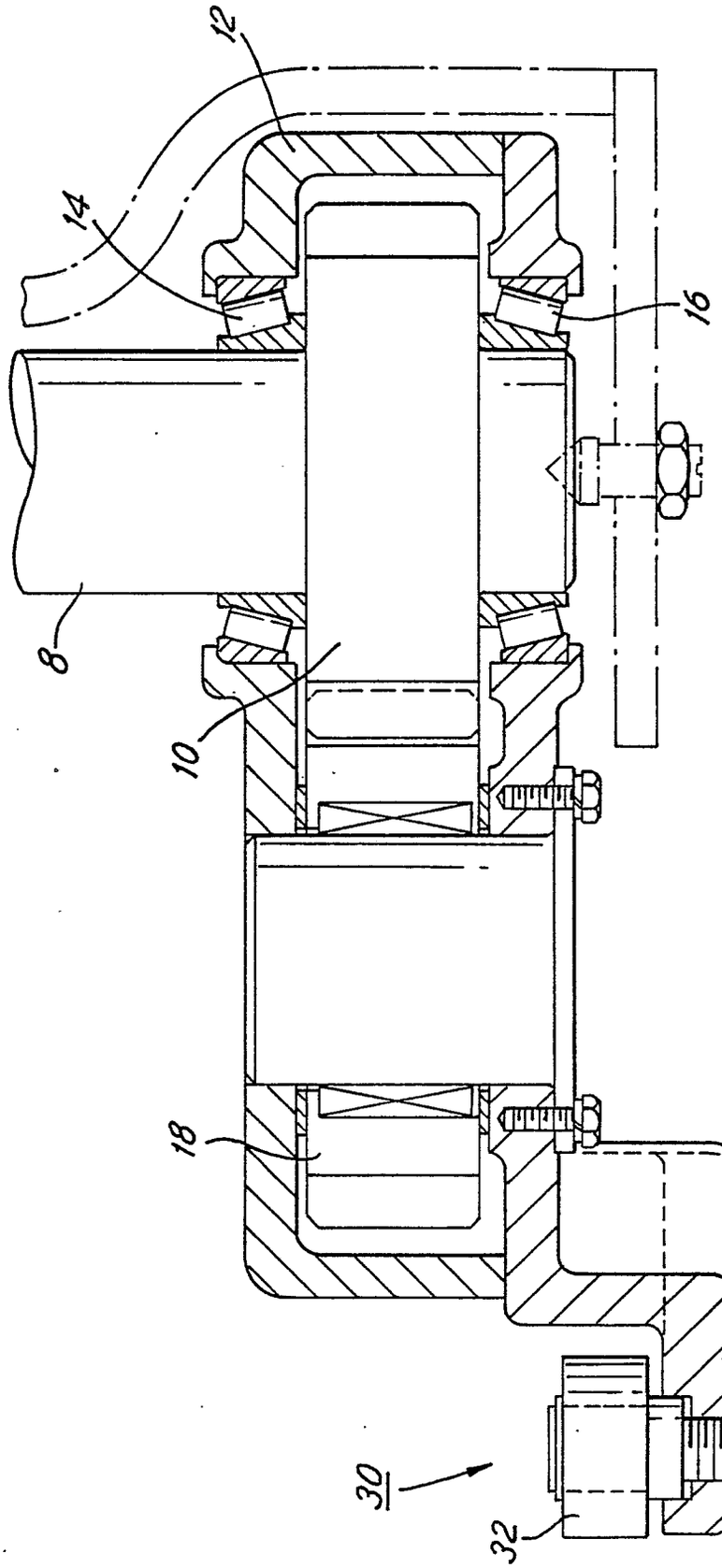

FIG. 3

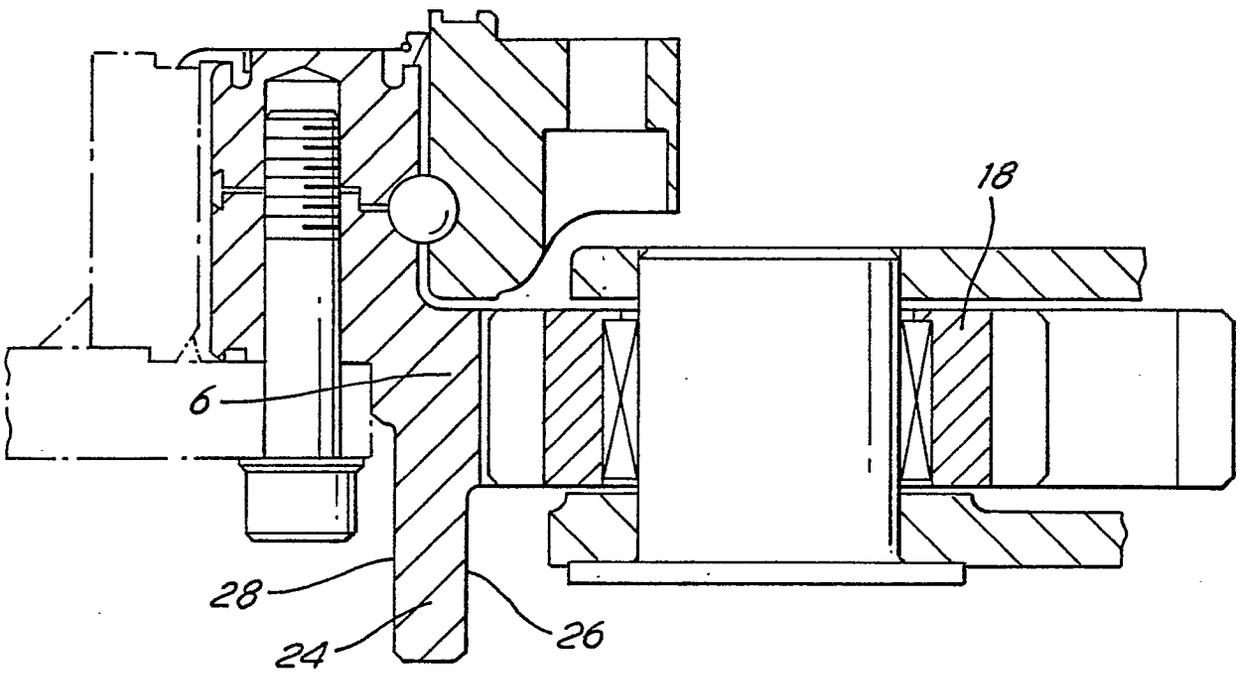

FIG. 4

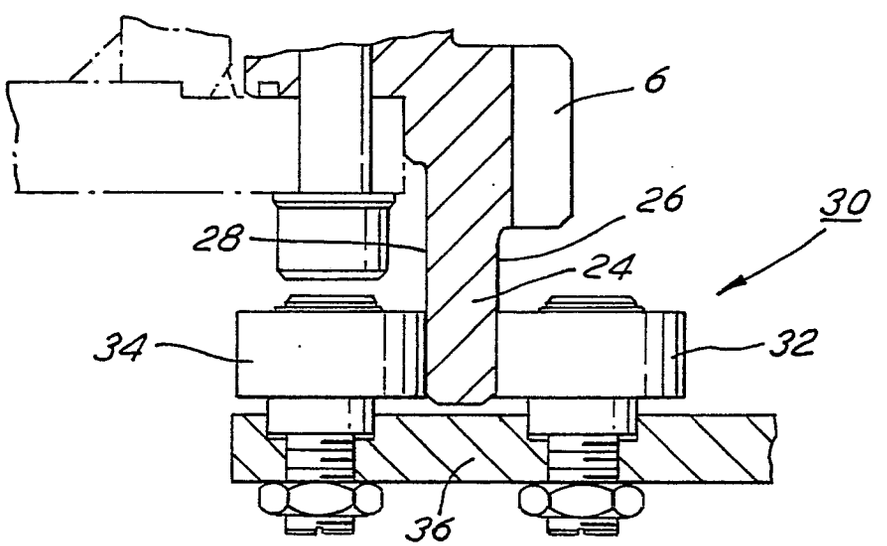

FIG. 5