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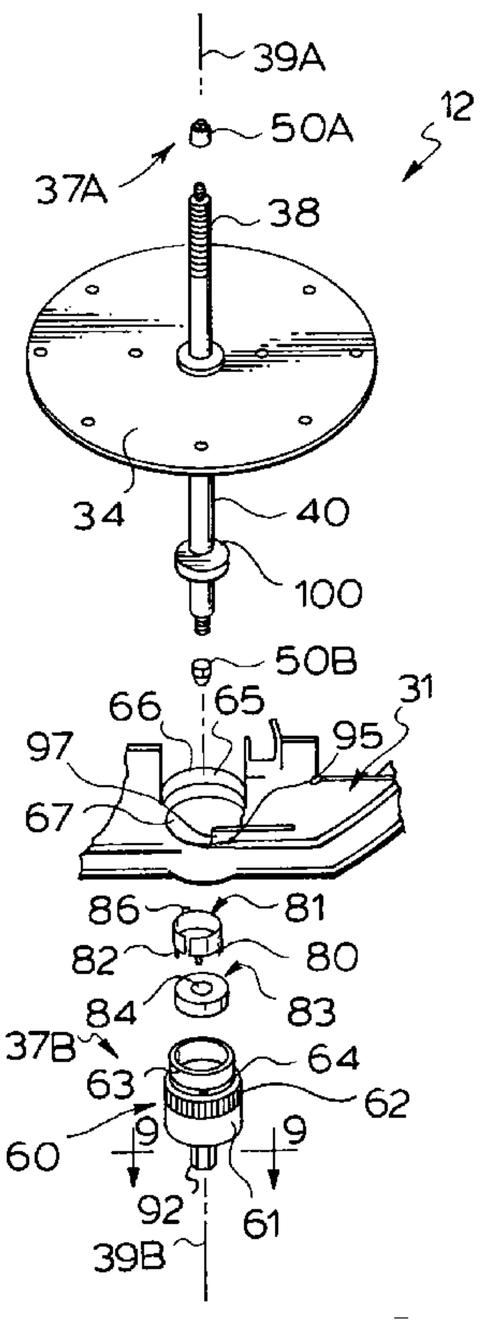
(54) **SYSTEME DE SUPPORT ET DE MONTAGE A DISQUES ROTATIFS POUR WATTHEURE-METRE A INDUCTION**

(54) **INDUCTION WATT HOUR METER ROTARY DISC MOUNTING AND BEARING SYSTEM**



(57) An electro-mechanical induction watt hour meter bearing system that includes end cap pilot bearings snap fit onto respective opposite ends of the shaft. The bearing system also includes a lower shaft support bearing selectively adjustable in increments for controlled adjustment.

Abstract

An electro-mechanical induction watt hour meter bearing system that includes end cap pilot bearings snap fit onto respective opposite ends of the shaft. The bearing system also includes a lower shaft support bearing selectively adjustable in increments for controlled adjustment.

Title of Invention

INDUCTION WATT HOUR METER ROTARY DISC MOUNTING AND BEARING SYSTEM

Field of Invention

This invention relates generally to induction watt hour meters and particularly to a bearing system for the rotor. The bearing system includes end cap pilot bearings secured respectively to opposite ends of the shaft and to controlled selective adjustment of the lower shaft support bearing.

Background of Invention

Watt hour meters most commonly used as electric energy billing meters are the simple induction electro-mechanical meters. These meters have proven to have a high degree of accuracy and reliability through many years of service under varying ambient operating conditions. The reliability of these meters is exemplified by the fact accrediting authorities in Canada require only sample testing from which a number of meters can be sealed for a period of twelve years and this can be extended for periods of up to eight years indefinitely depending upon the accuracy criteria.

The watt hour meter has a motor whose torque is proportional to the power flowing through it, a magnetic brake to retard the speed of the motor in such a way that it is proportional to power (by making the braking effect

proportional to the speed of the rotor), and a register to count the number of revolutions the motor makes.

The rotor portion of the meter motor is an electrical conductor in the form of a disc which is placed between the pole faces of the stator. Magnetic fluxes induce emf's in the disc which cause eddy currents that react with the alternating magnetic field, causing torque on the disc. The disc is free to turn, so it rotates. Since this torque tends to cause constant acceleration, brake magnets are placed around the disc. The strength of the magnet is chosen so that the retarding torque will balance the driving torque at a given speed.

In the existing art, the basic parts of the meter are assembled on a frame, mounted on a base, and then covered with a glass cover. The purpose of the frame is to hold in fixed relation the current stator, potential stator, disc, brake magnets and the register.

In order to support the shaft (spindle) on which the rotor is mounted bearings that give a minimum amount of friction are used. In existing meters there is an upper bearing and a lower bearing each slidably mounted in a bore on the frame and each slidable bearing is held by a set screw. This constructions is clearly illustrated in Figure 2 of U.S. Patent 3,881,070 issued November 14, 1989 to Burrowes et al. In each bearing is mounted a flexible guide pin (pintle) of a length which is non-resonant to any vibration frequencies encountered from no-load to maximum load. The upper and lower ends of the disc spindle are

Centered by graphite or polymide rings (pilot bearings) that are inserted into recesses in respective opposite ends of the shaft. These pilot bearings function as the bearing surface for the guide pivots.

The spindle assembly is supported by the mutual repulsion of two magnets one being attached to the shaft for rotation therewith and the other mounted in the lower bearing assembly. These are referred to as upper and lower magnets and there is a temperature compensator associated with the lower magnet. The only bearing pressures in this type of rotor support are slight side thrusts on the guide pins (pintles) since the shaft does not otherwise generally touch either the top or bottom supports.

In the existing meters the disc is centered between the brake magnets and stators by vertically moving the upper and lower bearings and using the set screws to lock the bearings in position. It is difficult and awkward to hold the bearing in the desired location while at the same time tightening the set screw and it is furthermore difficult to gage the distance the bearing and hence the disc has travelled in each adjustment. The adjustment becomes a trial and error tedious task with no predictability to repetitive adjustments.

Summary of Invention

The present invention provides an improved arrangement of the pilot bearing on the ends of the spindle facilitating construction and assembly of the same.

In accordance with one aspect of the present invention there is provided a rotor bearing system for an electro-mechanical induction watt hour meter comprising a rotor including a shaft having a disc secured thereto and a pair of end cap pilot bearings attached to respective opposite ends of the shaft. The end cap pilot bearings each having a pintle receiving aperture disposed in axial alignment with the axis of rotation of the shaft. The rotor bearings system has means for incrementally adjusting a location of the rotatable disc to one of a plurality of predetermined positions. This adjusting means comprises a bearing support housing for accepting and retaining one of said end cap pilot bearings. The bearing support housing includes a rotatable ratchet means and screw means, whereby when said screw means is rotated, the bearing support housing moves up or down and is retained in such position by said ratchet means. In one embodiment the end cap pilot bearings have outwardly flexing legs for snap fitting onto the shaft. In another embodiment, there is a magnetic bearing support means at a lower end of the shaft. The magnetic bearing support means has first and second permanent magnets secured respectively to said shaft and to the adjusting means to mutually repel each other. In accordance with a further aspect of the present invention there is provided a rotor support system for an electro-mechanical induction meter comprising a molded housing having an upper bearing guide and a lower bearing guide and lower bearing support means; a shaft having a disc secured thereto for reacting to induce flux fields of an electromagnetic

system that connects to an electrical supply line; a pair of end +cap pilot bearings secured respectively to each of opposite ends of said shaft and co-operating with said respective upper and lower guide means; said lower bearing support comprising a first permanent magnet secured to said shaft and a second permanent magnet positioned to repel said first permanent magnet; and controllably adjustable means on said housing supporting said second permanent magnet for selective incremental movement in a direction along the axis of rotation of said shaft. The second permanent magnet comprising an annular member receiving therein one of said end cap pilot bearings which is secured to said shaft and including a metal sleeve surrounding said second permanent magnet and holding said second permanent magnet captive on said adjustable bearing support means.

List of Drawings

The invention is illustrated by way of example in the accompanying drawings wherein:

Figure 1 is an exploded side elevational view illustrating the major components of the electro-mechanical induction watt hour meter;

Figure 2 is an oblique view of the rotor mounted on a housing support for the same and the register;

Figure 3 is an exploded view of the rotor and bearing support assemblies for the same;

Figure 4 is a partial sectional, part exploded, view of the rotor shaft and pilot bearings for the respective opposite ends thereof;

Figure 5 is an end view of one of the pilot bearings;

Figure 6 is an enlarged sectional view of an end

of the rotor shaft and pilot bearing secured thereto;

Figure 7 is an exploded view of the lower support bearing for the shaft;

Figure 8 is a sectional view taken essentially along line 8-8 of Figure 2; and

Figure 9 is a sectional view taken essentially along line 9-9 of Figure 3.

Description of Preferred Embodiments

Figure 1 is an exploded view illustrating applicant's electro-mechanical induction watt hour meter having a base 10, an electro magnetic unit 20 with a disc brake magnet mounted thereon, a register and rotor unit 30 and a glass cover 70.

The electro magnetic unit 20 has a core unit 21 with respective current and potential coils 22 and 23 mounted thereon. A magnetic brake 24 is carried by the unit 20 and has a gap 25 for receiving a portion of a rotor disc. The unit 20 securely attaches to the molded base 10 and has pairs of current terminals 11 and 12 projecting therefrom. There are two current coils and each has two terminals.

Base 10 may be molded conventionally from a hard plastics material i.e. thermoset plastics such as a phenolic resin (bakelite) or, and preferably, from a rigid thermoplastic resin. Applicant's preferred material is a polycarbonate material identified as #9417 Makrolon*

*Trade-Mark

polycarbonate available from Bayer Company of Germany. The polycarbonate is preferably glass reinforced (about 10% glass) and ultraviolet light stabilized.

The magnetic coil unit 20 attaches to the base in a convenient manner, for example, lugs projecting from the base which position and snap fit onto the unit 20.

The register and rotor 30 unit is a module that snap fits and locks onto the coil unit 20 and includes a molded plastics housing (preferably Ryton* PPS) 31 having a plurality of spacer lugs 32 projecting therefrom and attaching lugs 33 for precisely locating unit 30 relative to unit 20 and attaching unit 30 to the previously assembled together base 10 and a coil unit 20. The unit 30 has a register diagrammatically illustrated by its face designated 30A and a name plate 35 that attaches to and extends downwardly from the molded plastic housing 31. The locating lugs 32 position the unit 30 relative to unit 20 such that a rotatable disc 34 on the unit 30 projects into the coil gap 25 and lugs 33 snap fasten onto, as previously mentioned, the coil unit 20 and/or base unit 10.

The disc 34, which is caused to rotate by the electro magnetic unit 20 in a known manner, is mounted on a shaft or spindle 36 that is journalled on the housing 31 by respective upper and lower bearing assemblies 37 and 38. A pintle 39, associated with the upper bearing assembly 37, projects therefrom into a pintle receiving unit 39A on the molded plastic housing 31. The rotor shaft 36 has a worm

*T.M.

gear 36A on the upper end thereof that meshes with a drive gear, not shown, for the register unit which via dials visually indicates cumulatively the energy consumed.

The glass cover 70 has an outwardly directed flange 71 with a seat portion 72 that abuts against a seal forming rib 14 molded integral with the base 10. The outwardly directed flange 71 carries a metal ring 73 provided with lugs that engage tapered ramps on the flange 15 of the base forming a bayonet type of mount whereby the glass cover and base may be rotated relative to one another to detachably join them together with the rib 14 on the base being pressed against the seat 72 on the glass cover.

The present invention is particularly directed to the bearing system and various parts thereof for the rotor shaft 36 and incremental adjustment of the rotor shaft support bearing.

As previously mentioned there is an upper bearing assembly 37 and a lower bearing assembly 38, each of which include a pilot bearing 50 and a pintle (39, 39A). Each pilot bearing, in place of known graphite or polymide rings pressed into the end of the spindle as in the prior art, is a plastic bearing made of for example a polyphenylene sulfide compound (PPS) available from Phillips 66 Company under the Trade-Mark Ryton. Each pilot bearing is a cap type bearing that snap fits onto the end of the shaft 36. Each bearing 50 has a series of slits (or areas of reduced strength) 51 that provide a series of legs 52. The legs 52 of the pilot bearing 50 flex outwardly to snap onto an

enlargement or rib 36B machined onto a reduced end 36C of the shaft. The legs 52 have, on the inner surface, a knob or enlarged portion 53 securely anchoring the pilot bearing to the shaft. The shaft 36 has a shoulder 36D against which the pilot bearing abuts ensuring axial alignment of a hole 54 in the end of the bearing with the axis of rotation of the shaft. The end of the shaft 36E can serve as an abutment for the pintle 39 if need be but in normal operations there would be no engagement between the pintle and the end of the shaft. The upper end cap bearing 50 fits loosely into an opening provided by a lug 37A on the housing 31.

The upper pintle 39 projects into the pintle receiving unit 39A which is shown in cross-section in Figure 8. A lower pintle 39B, shown in Figure 3, projects into the bottom pilot bearing 50 and at the other end fits into a downwardly projecting stem portion on a lower bearing support portion 60. The pintle receiving portion of the lower bearing support is illustrated in cross-section in Figure 9 which is taken along essentially line 9-9 of Figure 3. The upper and lower pintle receiving members are designated respectively 39A and 39C. Each of these have three equally spaced triangular inwardly directed projections 39D with their apexes directed to a common center. Each apex has a concave area 39E on the end thereof partially to embrace the pintle which is press fit into the space 39F between the apex of the triangular projections.

The member 39C is a downwardly projecting portion of a molded plastic lower bearing support housing 60 that has a locating ring portion 61 below ratchet grooves 62 formed about the periphery centrally of the bearing housing. The bearing housing has a sleeve portion 63 with threads 64 formed on the outer surface. These threads mate with threads 65 on a semi-circular part 66 on the molded housing 31 (see Figure 3). The semi-circular part 66 is co-axially with an annular opening 67 that closely surrounds the bearing support portion 61. Between the bearing support portions 61 and 63 is a wall 68 having spaced apart openings 69 therein for receiving respective ones of a plurality of lugs 80 extending downwardly from a metal split sleeve member 81. The sleeve is split as at 82 so as to snugly receive therein an annular permanent magnet 83 having a central aperture 84. Magnet 83, tightly surrounded by sleeve 81, fits into the recess in the top end of the bearing support 60 and is firmly anchored in position by bending over the tabs 80 under the wall 68 accessible through access holes 85. The split sleeve member 81 has tabs 86 that are bent inwardly above the magnet holding the magnet captive in the top end of the bearing support.

The lower bearing support 60, with the lower support magnet 83 therein held captive by the temperature compensator sleeve 81, threads into the lower end of the housing 31, threads 64 mating with threads 65. This threaded engagement permits moving the lower bearing

support axially along the axis of rotation of the rotor by rotating the bearing housing. The lower pilot bearing 50 fits loosely into the opening 84 of the magnetic member 81 and lower magnet 83 is disposed closely adjacent an upper support magnet 90 secured to the spindle 36. Forces of magnets 83 and 90 opposing one another support the rotor.

The housing 31 has a finger 95 molded integrally therewith (or separately secured thereto) that has a free outer end portion 96 biased into the grooves 62 on the member 60. The finger 95 and grooves 62 provide a ratchet for incremental adjustments in rotating the bearing support housing 60 which, when rotated, moves axially along either up or down dependent upon clockwise or counterclockwise rotation so as to adjustably position the rotor assembly. The lower bearing assembly is readily rotated by turning the downwardly protruding head 39C on the bottom end of the housing 60.

It will be readily apparent to those skilled in the art the snap on end cap pilot bearings may be utilized without the adjustable lower bearing assembly and likewise the lower bearing adjustable assembly may be used with conventional pilot bearings that are inserted into the end of the shaft.

The register and rotor unit 30 disclosed herein has the register secured to the molded plastic housing 31 so as to be positively located relative to the worm drive gear 36A. This facilitates assembly with assurance of proper correlation in positioning between the worm drive

gear and the driven gear on the register. Raising and lowering of the rotor positions the disc 34 appropriately within the gap 25 in the electro magnetic unit 20.

The plastics for the molded housing, pilot bearings and meter base are engineering grade resins and preferably rigid thermoplastic materials such as those identified hereinbefore.

The Embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A rotor bearing system for an electro-mechanical induction watt-hour meter, comprising:

(a) a rotor including a shaft having a rotatable disc mounted thereon;

(b) a pair of end cap pilot bearings secured to respective opposite ends of the shaft, said end cap pilot bearings each having:

(1) a pintle receiving aperture disposed in axial alignment with the axis of rotation of the shaft; and

(2) outwardly flexing legs for snap fitting onto said shaft; and

(c) means for incrementally adjusting a location of said rotatable disc to one of a plurality of predetermined positions, said means for incrementally adjusting comprising a bearing support housing for accepting and retaining one of said end cap pilot bearings, said bearing support housing including a rotatable ratchet means and screw means, whereby when said screw means is rotated, said bearing support housing moves up or down and is retained in such position by said ratchet means.

2. The rotor bearing system of claim 1, wherein said shaft has an end portion of reduced thickness with an enlargement

thereon and wherein said end cap pilot bearings are snap fit onto said enlargement.

3. A rotor bearing system for an electro-mechanical induction watt-hour meter, comprising:

(a) a rotor including a rotatable disc secured to a shaft;

(b) a pair of end cap pilot bearings secured to a respective one of opposite ends of the shaft, said end cap pilot bearings each having a pintle receiving aperture disposed in axial alignment with the axis of rotation of the shaft;

(c) an adjustable support means for setting a location of the rotatable disc at one of a plurality of predetermined positions, said adjustable support means including screw means for adjusting the height of at least one of said end cap pilot bearings and ratchet means for retaining said height once it has been adjusted; and

(d) a magnetic bearing support means at a lower end of the shaft, said magnetic bearing support means comprising first and second permanent magnets secured respectively to said shaft and to the adjustable support means to mutually repel each other.

4. The rotor bearing system of claim 3, wherein said second permanent magnet has a central aperture therein loosely receiving an end cap pilot bearing on the lower end of the

shaft and wherein said adjustable support means comprises said second magnet mounted in a support housing threadingly mounted for adjustment in a direction back and forth along the axis of the shaft.

5. A rotor support system for an electro-mechanical induction meter comprising:

(a) a molded housing having an upper bearing guide and a lower bearing guide and lower bearing support means;

(b) a shaft having a disc secured thereto for reacting to induced flux fields of an electromagnetic system that connects to an electrical supply line;

(c) a pair of end cap bearings secured respectively one to each of opposite ends of said shaft and cooperating with said respective upper and lower guide means;

(d) said lower bearing support means comprising a first permanent magnet secured to said shaft for rotation therewith and a second permanent magnet positioned to repel said first permanent magnet; and

(e) controllably adjustable support means on said housing supporting said second permanent magnet for selective incremental movement in a direction along the axis of rotation of said shaft, said second permanent magnet including an annular member receiving therein one of said end cap pilot bearings which is secured to said shaft and including a metal sleeve surrounding said second permanent

magnet and holding said second permanent magnet captive on said adjustable bearing support means.

6. The rotor support system of claim 5 wherein said sleeve is a split sleeve tightly embracing said magnet associated therewith.

FIG. 1.

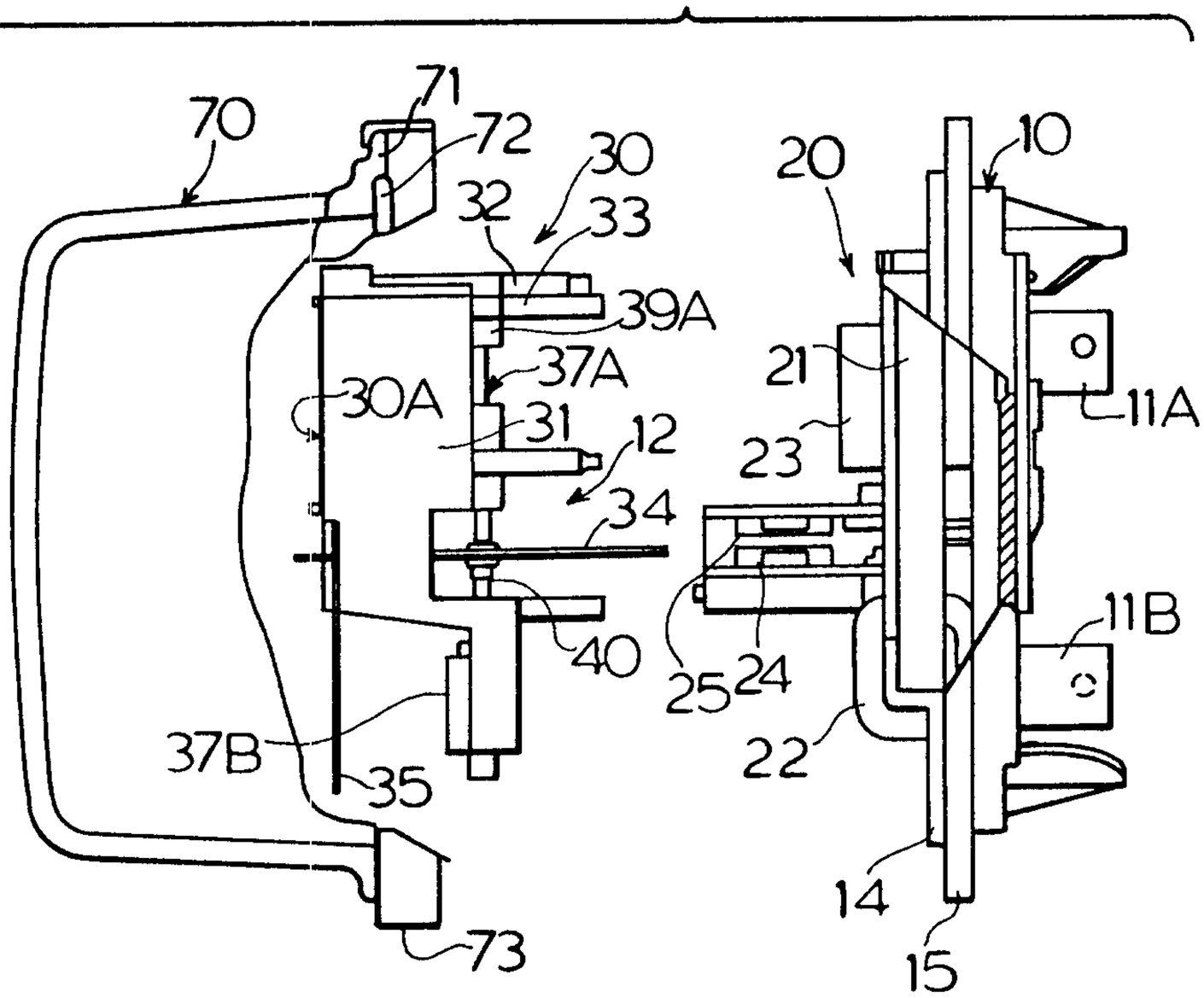
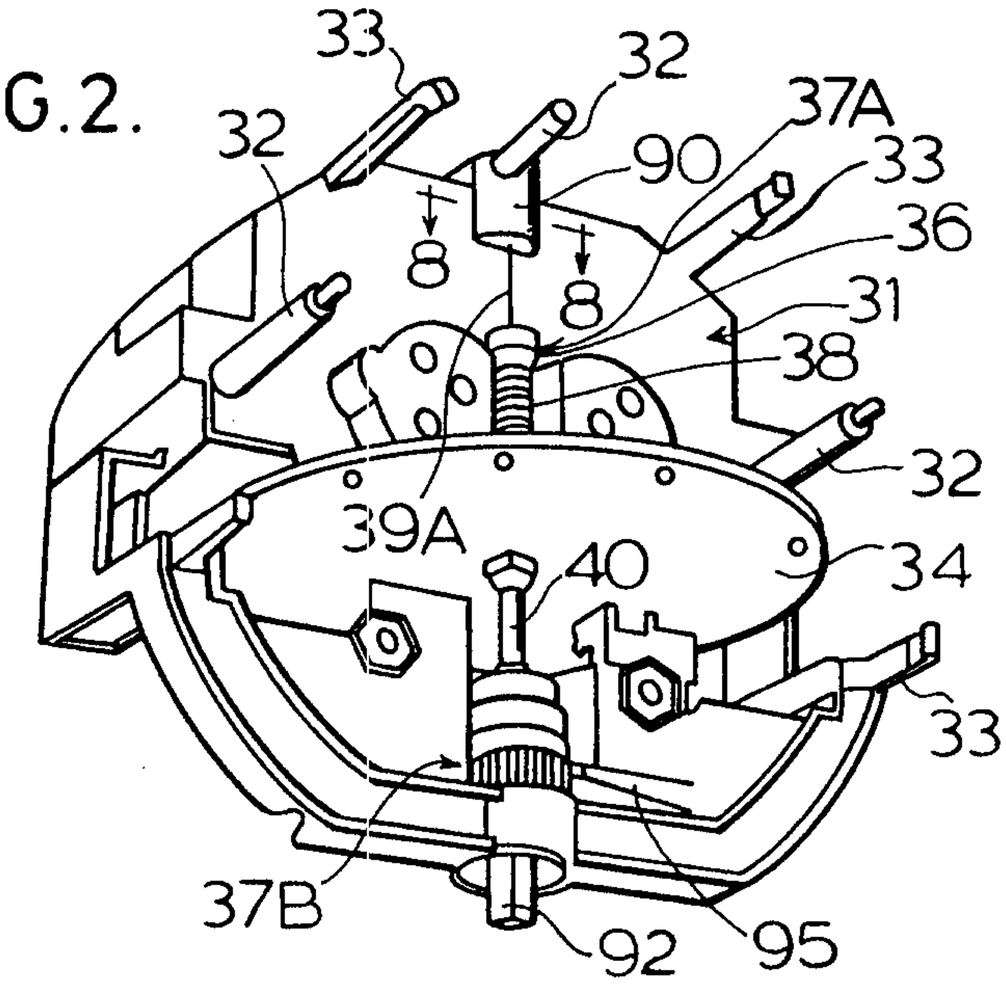


FIG. 2.



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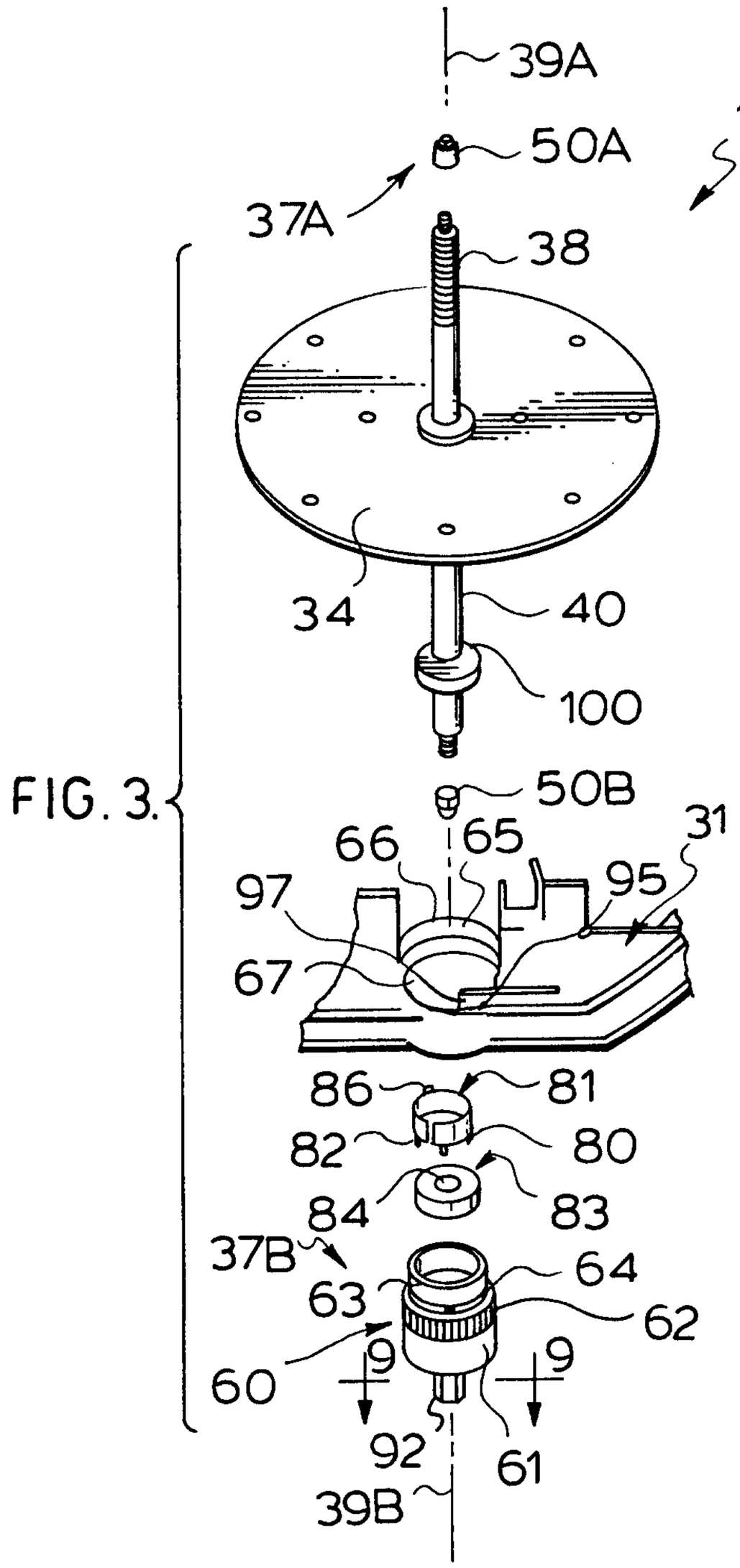

FIG. 3.

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FIG.4.

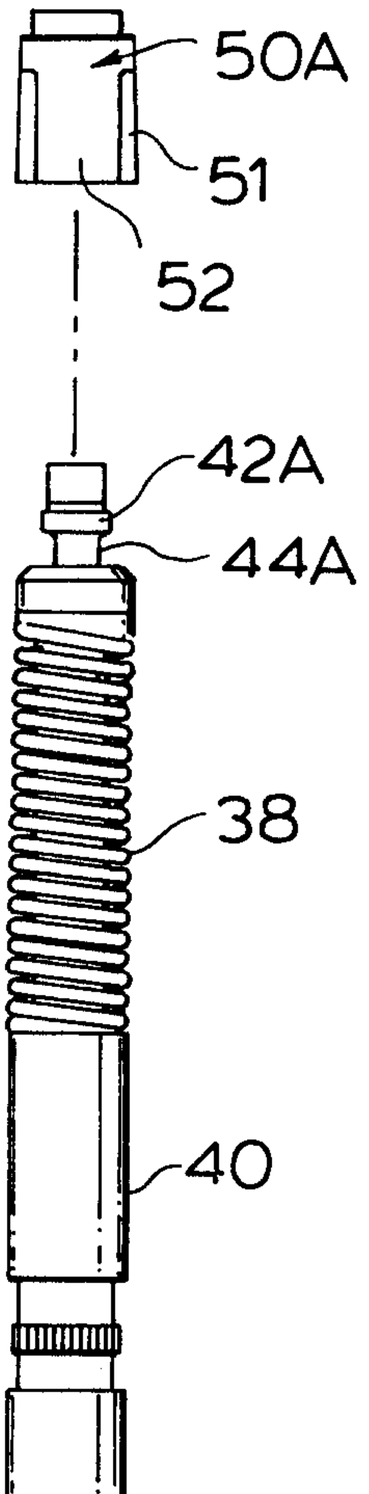

FIG.5.

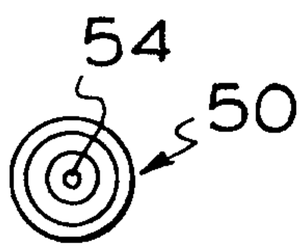

FIG.6.

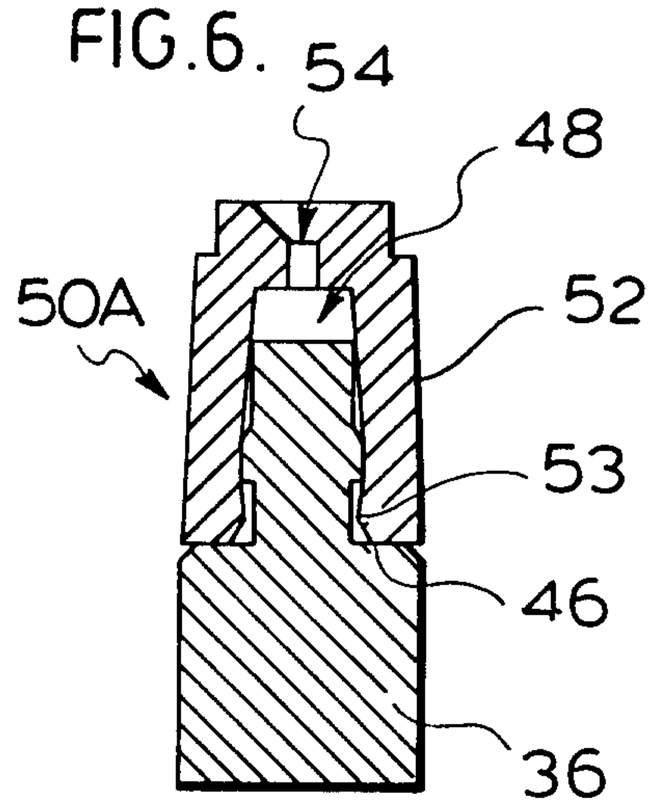

FIG.7.

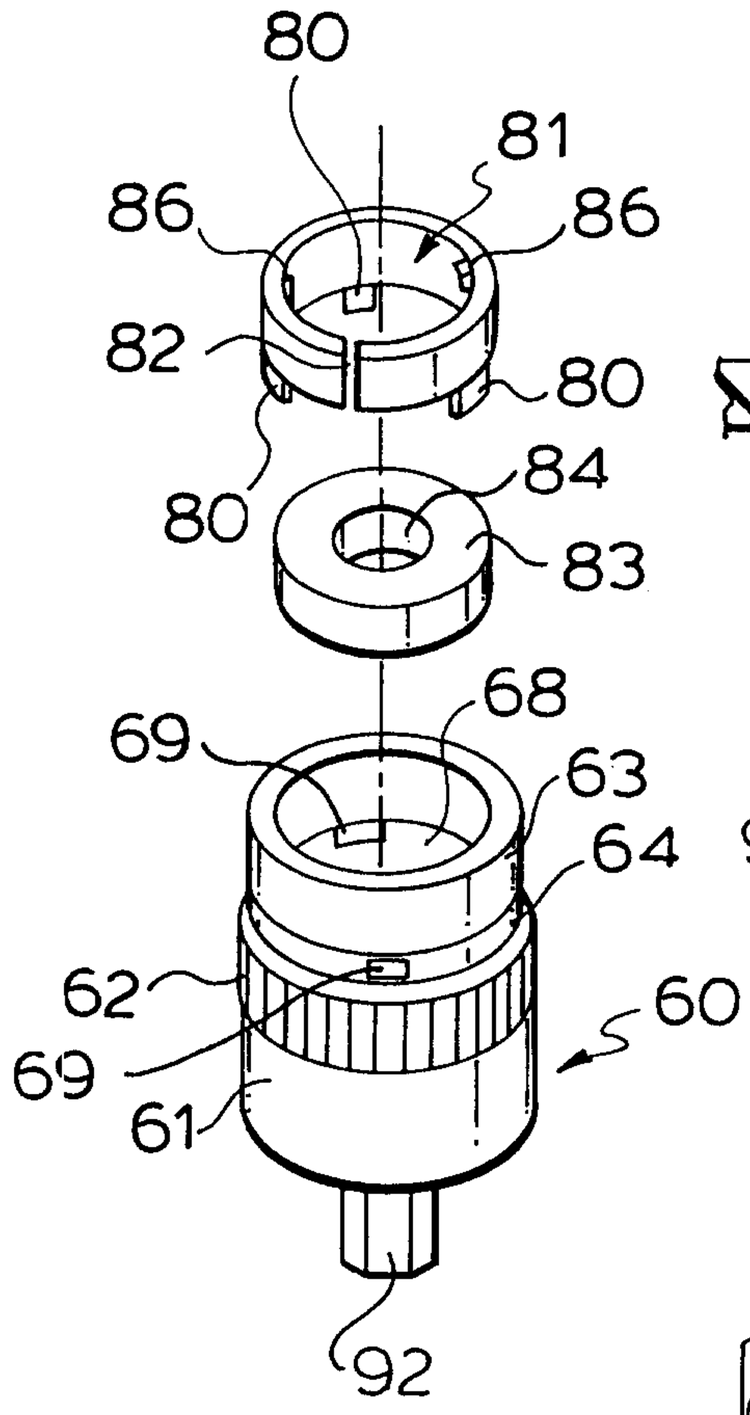

FIG.8.

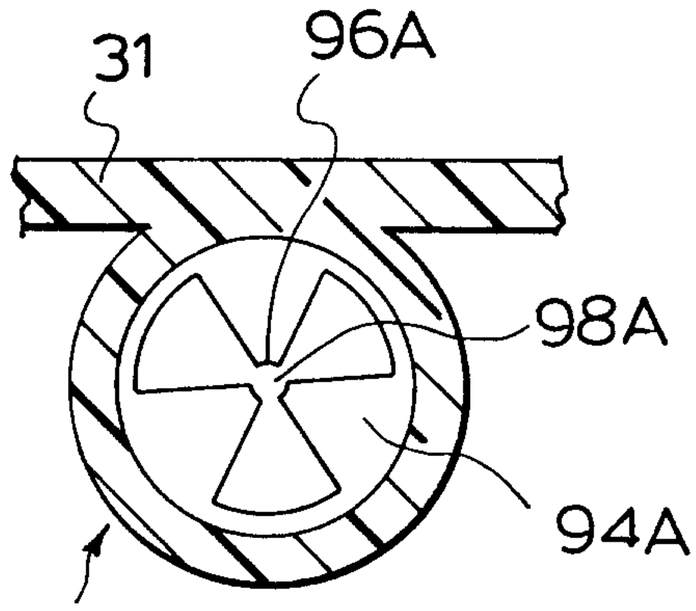

FIG.9.