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(54) A drive head assembly for a rotary scanner.

(57) A drive head assembly for a rotary scanner is provided including a first drive shaft (1) having one end (a) connectible to a rotary scanner platform for rotation thereof. First angular contact bearing means (2, 4) are provided for rotatably supporting the first drive shaft (1), first motor means (10) for supplying rotary drive to said first drive shaft (1), and a high resolution rotary position transducer operable to sense the angular position of the first drive shaft (1).

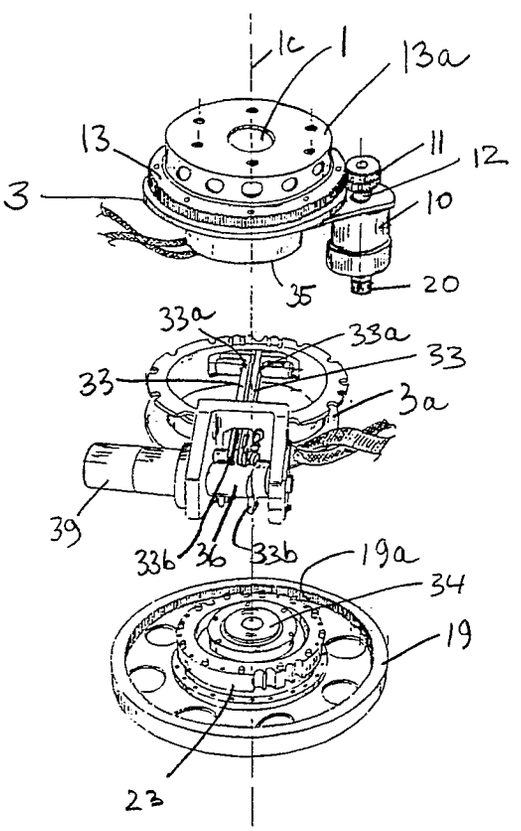

FIG 4

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A DRIVE HEAD ASSEMBLY FOR A ROTARY SCANNER

This invention relates to a drive head assembly for a rotary scanner, particularly, but not exclusively, suitable for use with a wide angle scanning system.

Wide angle scanning systems employing a rotary scanner require the use of a drive head mechanism for the rotary scanner. There is a need for such a drive head assembly to be capable of operating over a wide range of scan angles, have a long working life, the ability to handle rapid and complex scan patterns, be capable of rapid movement at high positional accuracy, have low mass and low power requirement. Preferably such a drive head assembly should be able, as an option, to afford full momentum compensation.

According to the present invention there is provided a drive head assembly for a rotary scanner, characterised by including a first drive shaft having one end connectible to a rotary scanner platform for rotation thereof, first angular contact bearing means for rotatably supporting the first drive shaft, first motor means for supplying rotary drive to said first drive shaft, and a high resolution rotary position transducer operable to sense the angular position of the first drive shaft.

Advantageously the first angular contact bearing means includes a first angular contact bearing unit located at or adjacent the end of the first drive shaft which is outermost with respect to the assembly, which first angular contact bearing unit is mounted in a housing of the assembly and is self aligning in operation.

Conveniently the first angular contact bearing unit has a part spherical, concave cross-section, bearing surface seat ring attached to the housing and a complementary co-operating part spherical convex cross-section outer bearing race ring forming part of a first ball or roller bearing whose inner race ring is secured to the first drive shaft at or adjacent the outermost end thereof for rotation therewith, the concave seat ring and convex outer race ring tapering inwardly towards the innermost other end of the first drive shaft and being relatively axially movable.

Preferably the first motor means is operable to transmit drive indirectly to the first drive shaft via a first gear fixedly attached to a first output shaft of the motor for rotation with the first output shaft and a gear wheel fixedly attached to the first drive shaft at or adjacent said outermost end thereof, with the gearwheel being in mesh with the first gear.

Advantageously the transducer includes two superimposed discs one of which forms a rotor and is attached to the first drive shaft to rotate therewith and the other of which forms a stator and is fixedly attached to the housing, the transducer being operable to give a varying output voltage indicative of the relative angular position of the first drive shaft, arising from the varying inductive transfer between the two discs.

Conveniently the assembly includes a momentum wheel mechanism having a momentum wheel rotatably attached to the housing at the innermost end of the first drive shaft for rotation about the same axis as the first drive shaft but in the opposite direction thereto to provide compensation for the momentum of the first drive shaft.

Preferably the momentum wheel is rotatably mounted on the housing via a second drive shaft to one end of which it is fixedly secured and a second angular contact bearing means.

Advantageously the assembly includes means for releasably off-loading the first and second angular contact bearing means to remove load therefrom.

Conveniently the off-loading means includes a pair of elongated levers each pivotally mounted at one end on the housing to extend side-by-side transversely across the coaxial longitudinal rotational axes of the first and second drive shafts between the facing innermost ends of the first and second drive shafts, said levers being displaceable between a rest position spaced from the adjacent facing innermost ends of the first and second drive shafts in which the first and second angular contact bearing means are loaded, and an operative position in which they are pivoted apart about the pivoted ends, one to displace the first drive shaft longitudinally along its rotational axis against the biasing force of the first diaphragm so that the first part spherical seat ring is displaced from load bearing contact with the first part spherical outer race ring to unload the first bearing mean, and the other to displace the second drive shaft longitudinally along its rotational axis against the biasing force of the second diaphragm so that the second part spherical seat ring is displaced from load bearing contact with the second part spherical outer race ring to unload the second bearing means.

For a better understanding of the present invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a vertical sectional view through a drive head assembly according to a first embodiment of the present invention,

Figure 2 is a vertical sectional view, similar to that of Figure 1, through a drive head assembly according to a second embodiment of the present invention,

Figure 3 is a view from above of the assembly of Figure 2 and

Figure 4 is an exploded perspective view of the assembly of Figures 2 and 3.

A drive head assembly of the invention is intended for operation with a rotary scanner and will be described hereinafter in terms of such an assembly for use with a satellite scanning system as a support for a microwave antenna useful for a wide range of scientific Earth observation uses, such as for meteorology. It is, however, to be understood that the drive head assembly of the invention can be used for many other forms of rotary scanner applications for land, sea or air use.

A drive head assembly according to a first embodiment of the invention as shown in Figure 1 of the accompanying drawings includes a first drive shaft 1 having one end 1a connectible to a rotary scanner platform (not shown) for rotation thereof. The assembly also includes first angular contact bearing means for rotatably supporting the drive shaft 1, first motor means for supplying rotary drive to the drive shaft 1 and a high resolution rotary position transducer operable to sense the angular position of the drive shaft 1.

The first angular contact bearing means includes a first angular contact bearing unit 2 located at or adjacent the end 1a of shaft 1 which is outermost with respect to the assembly. The bearing unit 2 is mounted in a housing 3 of generally drumlike configuration and is self aligning in operation. The first angular contact bearing means also includes a further bearing unit 4 located at or adjacent the other end 1b of the shaft 1, which other end 1b is innermost with respect to the assembly.

the bearing unit 4 is also mounted in the housing 3. The bearing unit 4 has a part spherical, concave-cross section bearing surface seat ring 5 fixedly attached to the housing 3 and a complementary cooperating part spherical, convex cross section, outer bearing race ring 6 forming part of a first ball or roller bearing 7 whose inner race ring 8 is secured to the shaft 1 at or adjacent the outermost end 1a thereof for rotation therewith. The seat ring 5 and race ring 6 taper inwardly towards the innermost other end 1b of the shaft 1 and are relatively axially movable. Preferably the taper is approximately 30° to the longitudinal rotational axis 1c through the shaft 1.

Each bearing unit 2 and 4 includes a ball or roller bearing incorporating an at least part spherical seating for the rollers or balls 9. The bearing units 2 and 4 with their particular bearings are dry lubricated preferably by having lead ion plated races and lead bronze race rings or cages. Such dry lubrication affords a long life particularly under hard vacuum conditions in space.

The first motor means is an electric brushless DC torque motor 10 operable to transmit drive directly or indirectly to the shaft 1. In the illustrated embodiment the motor 10 transmits drive indirectly to the shaft 1 via a first gear 11 fixedly attached to a first output shaft 12 of the motor 10 for rotation with the first output shaft 12. Conveniently the gear 11 is attached to the shaft 12 for limited axial displacement relative thereto.

The gear 11 is externally peripherally toothed and is in mesh with a gear wheel 13 which is externally peripherally toothed and fixedly attached to the shaft 1 at or adjacent the outermost end 1a thereof. To this end the gear wheel 13 is in the form of a shallow dish secured in any convenient manner to the shaft 1. The gear 11 and gearwheel 13 are also dry lubricated and form an anti-backlash gear train for the shaft 1. To this end the gear 11 and gearwheel 13 are made of molybdenum disulphide impregnated polyimide. In operation a rotary scanner platform may be connected directly to the upper dish portion 13a of the gear 13.

The transducer is a high resolution inductive position transducer including two superimposed discs one of which forms a rotor 14 attached to the shaft 1 to rotate therewith and the other of which forms a stator 15 fixedly attached to the housing 3. The transducer is operable to give a varying output voltage indicative of the relative angular position of the shaft 1 arising from the varying inductive transfer between the rotor 14 and stator 15. To this end the rotor 14 and stator 15 may have various windings provided thereon on their facing cooperating surfaces and are axially apertured with the innermost end portion 1b of the shaft 1 being formed as a reduced diameter nose portion 16 which projects through the rotor and stator apertures.

The assembly also includes a first annular flexible diaphragm 17 fixedly connected at or adjacent its outer periphery to the housing 3 and fixedly connected at or adjacent its inner periphery to the outer race ring 18 of the bearing unit 4. This diaphragm 17 is flexible transversely to preload the bearing unit 2 in a manner such as to urge the seat ring 5 and outer race ring 6 towards and into engagement with one another, whilst permitting movement of the bearing units 2 and 4, and hence of the shaft 1 to which the units 2 and 4 are attached, in the direction of the longitudinal axis 1c. To this end the diaphragm 17 is a spirally slotted disc of aluminium alloy or of titanium.

The assembly of the invention preferably also includes a momentum wheel mechanism having a momentum wheel 19 rotatably attached to the housing 3 at the innermost end 1b of the shaft 1 for rotation about the same axis 1c as the shaft 1 but in the opposite direction thereto to provide compensation for the momentum of the shaft 1. The

momentum wheel 19 has internal teeth 19a which mesh with external teeth on a second output gear 20 provided on a second output shaft 21 of the motor 10. the shaft 21 is coaxial with the shaft 12 and extends in the opposite direction thereto.

The momentum wheel 19 is rotatably mounted on the housing 3 via a second drive shaft 22 to one end 22a of which it is fixedly secured and a second angular contact bearing means.

The second angular contact bearing means includes a second angular contact bearing unit 23 located at or adjacent the end 22a of the shaft 22 which is outermost with respect to the assembly. The bearing unit 23 is mounted in the housing 3 and is self aligning in operation.

The second angular contact bearing means includes an additional bearing unit 24 located at or adjacent the other end 22b of the shaft 22 which end 22b is innermost with respect to the assembly. The additional bearing unit 24 is also mounted on the housing 3.

The second angular contact bearing unit 23 also has a part spherical, concave cross section, bearing surface seat ring 25 attached to the housing 3 and a complementary co-operating part-spherical, convex cross section, outer bearing race ring 26 forming part of a second ball or roller bearing 27 whose inner race ring 28 is secured to the shaft 22 at or adjacent the outermost end 22a thereof for rotation therewith. The seat ring 25 and outer race ring 26 taper inwardly at an angle of about 30° to the rotational axes 1c, towards the innermost end 22b of the shaft 22 and are relatively axially movable.

Each bearing unit 23 and 24 also includes a ball or roller bearing incorporating an at least part spherical seating for the rollers or balls 29. The bearing units 23 and 24 and bearings are also dry lubricated particularly by having lead ion plated races and lead bronze race rings or cages.

Additionally the assembly includes a second annular flexible diaphragm 30 fixedly connected at or adjacent its outer periphery to the housing 3 and fixedly connected at or adjacent its inner periphery to the outer race ring 31 of the bearing unit 24. This diaphragm 30 is also flexible transversely to preload the second angular contact bearing unit 23 in a manner such as to urge the seat ring 25 and outer race ring 26 towards and into engagement with one another whilst permitting movement of the bearing units 23 and 24, and hence the shaft 22 to which the units are attached, in the direction of the rotational axis 1c of the drive shafts 1 and 22 to the extent allowed by movement of the outer race ring 26 relative to the seat ring 25. Again the diaphragm 30 is a spirally slotted disc of aluminium alloy or titanium.

As shown in Figure 1 spring finger means 32 are connected between the housing 3 and the outer ends of the bearing units 7 and 27 to urge the respective seat rings 5 and 25 and outer race rings 6 and 26 towards engagement.

The second embodiment to the invention illustrated in Figures 2 to 4 of the accompanying drawings basically is similar to that of Figure 1 and like features have been given like reference numerals and will not be further described in detail. The basic difference between the second and first embodiments is the presence in the second embodiment of means for releasably offloading the first and second angular contact bearing means to remove load therefrom. This is particularly useful where the assembly of the invention is intended for the use of, for example, a relatively large reflector for a satellite or spacecraft application. By use of such offloading means the launch loads can be made to bypass the bearings of both the shafts 1 and 22 thus providing a very rigid and robust structural configuration during the launch phase. As the offloading means is releasable and thereby reversible it is suitable for use on spacecraft which are intended to return to Earth.

To this end the offloading means includes a pair of elongated levers 33 each pivotally mounted at one end 33a on the housing 3 or a modular part 3a thereof, to extend side by side transversely across the coaxial longitudinal rotational axes 1c of the shafts 1 and 22 between the facing innermost ends 1b and 22b of the shafts 1 and 22. In the illustrated embodiment the shaft 22 is provided with a facing plate 34 and the shaft 1 is provided with a facing plate 35.

The levers 33 are displaceable between a rest position, as shown in Figure 2, spaced from the adjacent facing innermost ends or plates 34 and 35 of the drive shafts 1 and 22 at an operative position. In the operative position the levers 33 are pivoted apart about the pivoted ends 33a, one to displace the first drive shaft 1 longitudinally along its rotational axis against the biasing force of the diaphragm 17 so that the seat ring 5 is displaced from load bearing contact with the outer race ring 6 to unload the first bearing means. In this operative position the other lever 33 displaces the second drive shaft 22 longitudinally along its rotational axis 1c against the biasing force of the second diaphragm 30 so that the second seat ring 25 is displaced from load bearing contact with the second outer race ring 26 to unload the second bearing means.

The other ends 33b of the levers 33 are offset from the longitudinal axes of the levers 33 so that the offset end 33b of one lever is located on one side and spaced from the longitudinal axes of the levers and the offset end 33b of the other lever is located on the opposite side of and from the lon-

gitudinal axes of the levers as can be seen from Figure 2. Also forming part of the offloading means is a cam 36 pivotally mounted between the offset ends 33b of the levers 33 and actuable by pivotal movement, about an axis extending transverse to the lever longitudinal axes, in one or the other direction to displace the offset ends 33b apart. In this way the levers 33 are urged into the operative position to displace the drive shafts 1 and 22 axially for offloading purposes or to allow the offset ends 33b, and thereby the levers 33, to return to the rest position for loading purposes. To ensure that the race rings 6 and 26 are not displaced too far axially away from their respective seat rings 5 and 25, spring finger means 37 are provided between the housing 3 and the outer ends of the first and second angular contact bearing means. Additionally stop means such as cooperating hooks 38 and 38a are provided between the housing and the first and second angular contact bearing means for limiting the maximum axial displacement of the shafts 1 and 22. The stop means hooks are shown in the embodiment of Figure 2 but have been omitted for clarity from the embodiment of Figure 1. However they may also be present in the embodiment of Figure 1 in the manner shown in the embodiment of Figure 2.

The offloading means further includes a second motor 39, preferably a D.C. brushed electric motor, for reversably pivotally rotating the cam 36.

In order to make the assembly of the invention more easily assemblable and to enable the rapid modification of the assembly for different uses the housing 3 preferably is of modular unit construction. In this way the housing portion relating to the shaft 1 and its associated first angular contact bearing means and diaphragm can be made separate from and attachable to the housing portion containing the transducer rotor 14 and stator 15 and separate from the housing portion containing the drive shaft 22 and associated second angular contact bearing means and the housing portion containing the levers 33. In this way it is possible easily to replace portions of the assembly or to make up different assemblies from the same basic housing portions and components. For example the embodiment of Figure 2 may be formed from the embodiment of Figure 1 simply by putting the housing portion containing the levers 33 in between the housing portion containing the rotor 14 and stator 15 and the housing portion containing the second drive shaft 22. Similarly if the momentum wheel is not required on either the embodiment of Figure 1 or Figure 2 it can be simply omitted and if required can be equally simply bolted back onto the respective end face of the adjacent housing portion.

The assembly of the invention preferably includes a closed loop position control system for controlling the angular position of the first drive shaft 1, which is operable to vary the angular position of the shaft 1 as a function of the position thereof sensed by the transducer. The control system employs a digital controller which in combination with the high resolution rotary transducer provides high scanning accuracy.

Claims

1. A drive head assembly for a rotary scanner, characterised by including a first drive shaft (1) having one end (1a) connectible to a rotary scanner platform for rotation thereof, first angular contact bearing means for rotatably supporting the first drive shaft (1), first motor means for supplying rotary drive to said first drive shaft (1), and a high resolution rotary position transducer operable to sense the angular position of the first drive shaft (1).

2. An assembly according to claim 1, wherein the first angular contact bearing means includes a first angular contact bearing unit (2) located at or adjacent the end (1a) of the first drive shaft (1) which is outermost with respect to the assembly, which first angular contact bearing unit (2) is mounted in a housing (3) of the assembly and is self aligning in operation.

3. An assembly according to claim 2, wherein the first angular contact bearing means includes a further bearing unit (4) located at or adjacent the other end (1b) of the first drive shaft (1), which other end (1b) is innermost with respect to the assembly, and which further bearing unit (4) is mounted in the assembly housing (3).

4. An assembly according to claim 3, wherein the first angular contact bearing unit (2) has a part spherical, concave cross-section, bearing surface seat ring (5) attached to the housing (3) and a complementary co-operating part spherical convex cross-section outer bearing race ring (6) forming part of a first ball or roller bearing (7) whose inner race ring (8) is secured to the first drive shaft (1) at or adjacent the outermost end (1a) thereof for rotation therewith, the concave seat ring (5) and convex outer race ring (6) tapering inwardly towards the innermost other end (1b) of the first drive shaft (1) and being relatively axlally movable.

5. An assembly according to claim 3 or claim 4, wherein each bearing unit (2,4) includes a ball or roller bearing incorporating an at least part spherical seating for the balls or rollers (9).

6. An assembly according to any one of claims 3 to 5, wherein the bearing units (2,4) and bearings are dry lubricated.

7. An assembly according to claim 6, wherein the

bearing units (2,4) and bearings have lead ion plated races and lead bronze race rings or cages.

8. An assembly according to any one of claims 2 to 7, wherein the first motor means is an electric brushless DC torque motor (10).

9. An assembly according to claim 8, wherein the first motor means is operable to transmit drive directly to the first drive shaft (1).

10. An assembly according to claim 8, wherein the first motor means is operable to transmit drive indirectly to the first drive shaft (1) via a first gear (11) fixedly attached to a first output shaft (12) of the motor (10) for rotation with the first output shaft (12) and a gear wheel (13) fixedly attached to the first drive shaft (1) at or adjacent said outermost end (1a) thereof, with the gear wheel (13) being in mesh with the first gear (11).

11. An assembly according to claim 10, wherein the gear wheel (13) is externally peripherally toothed.

12. An assembly according to claim 10 or claim 11, wherein the first gear (11) and gear wheel (13) are dry lubricated and form an anti-backlash gear tram for the first drive shaft (1).

13. An assembly according to claim 12, wherein the first gear (11) and gear wheel (13) are made of molybdenum disulphide impregnated polyimide.

14. An assembly according to any one of claims 3 to 13, wherein the transducer includes two superimposed discs one of which forms a rotor (14) and is attached to the first drive shaft (1) to rotate therewith and the other of which forms a stator (15) and is fixedly attached to the housing (3), the transducer being operable to give a varying output voltage indicative of the relative angular position of the first drive shaft (1), arising from the varying inductive transfer between the two discs.

15. An assembly according to claim 14, wherein the rotor and stator discs (14,15) are axially apertured and wherein the innermost end portion (1b) of the first drive shaft (1) is formed as a reduced diameter nose portion (16) which projects through the rotor and stator apertures.

16. An assembly according to claim 4, including a first annular flexible diaphragm (17) fixediy connectible at or adjacent its outer periphery to the housing (3) and fixedly connectible at or adjacent its inner periphery to the outer race ring (18) of the further bearing unit (4), the first diaphragm (17) being flexible transversely to preload the first angular contact bearing unit (2) in a manner such as to urge the part spherical seat ring (5) and outer ring (6) towards and into engagement with one another, whilst permitting movement of the first and further bearing units (2,4), and hence of the first drive shaft (1) to which said units (2,4) are attached, in the direction of the rotational axis (1c) of the first drive shaft (1) to the extent allowed by movement of the part spherical outer race ring (6) relative to the part spherical seat ring (5).

17. An assembly according to claim 16, wherein the first diaphragm (17) is a spirally slotted disc of aluminium alloy or titanium.

18. An assembly according to claim 1 or claim 10, including a momentum wheel mechanism having a momentum wheel (19) rotatably attached to the housing (3) at the innermost end (1b) of the first drive shaft (1) for rotation about the same axis (1c) as the first drive shaft (1) but in the opposite direction thereto to provide compensation for the momentum of the first drive shaft (1).

19. An assembly according to claim 18, wherein the momentum wheel (19) has internal teeth (19a) which mesh with external teeth on a second output gear (20) provided on a second output shaft (21) of the first motor means motor (10), which second output shaft (21) is coaxial with the first output shaft (12) and extends in the opposite direction thereto.

20. An assembly according to claim 19, wherein the momentum wheel (19) is rotatably mounted on the housing (3) via a second drive shaft (22) to one end (22a) of which it is fixedly secured and a second angular contact bearing means.

21. An assembly according to claim 20, wherein the second angular contact bearing means includes a second angular contact bearing unit (23) located at or adjacent the end (22a) of the second drive shaft (22) which is outermost with respect to the assembly, which second angular contact bearing unit (23) is mounted in the housing (3) and is self-aligning in operation.

22. An assembly according to claim 21, wherein the second angular contact bearing means includes an additional bearing unit (24) located at or adjacent the other end (22b) of the second drive shaft (22), which other end (22b) is innermost with respect to the assembly, and which additional bearing unit (24) is mounted in the housing (3).

23. An assembly according to claim 22, wherein the second angular contact bearing unit (23) has a part spherical, concave cross-section, bearing surface seat ring (25) attached to the housing (3) and a complementary cooperating part spherical, convex cross-section, outer bearing race ring (26) forming part of a second ball or roller bearing (27) whose inner race ring (28) is secured to the second drive shaft (22) at or adjacent the outermost end (22a) thereof for rotation therewith, the concave seat ring (25) and convex outer race ring (26) tapering inwardly towards the innermost other end (22b) of the second drive shaft (22) and being relatively axially movable.

24. An assembly according to claim 23, wherein each bearing unit (23,24) includes a ball or roller bearing incorporating an at least part spherical seating for the balls or rollers (29).

25. An assembly according to claim 24, wherein the bearing units (23,24) and bearings are dry lubricated.

26. An assembly according to claim 25, wherein the bearing units (23,24) and bearings have lead ion plated races and lead bronze race rings or cages.

27. An assembly according to any one of claims 23 to 26, including a second annular flexible diaphragm (30) fixedly connectible at or adjacent its outer periphery to the housing (3) and fixedly connectible at or adjacent its inner periphery to the outer race ring (31) of the additional bearing unit (24), the second diaphragm (30) being flexible transversely to preload the second angular contact bearing unit (23) in a manner such as to urge the part spherical seat ring (25) and outer ring (26) towards and into engagement with one another, whilst permitting movement of the second and additional bearing units (23, 24), and hence of the second drive shaft (22) to which said units are attached, in the direction of the rotational axis (1c) of the second drive shaft (22) to the extent allowed by movement of the part spherical outer race ring (26) relative to the part spherical seat ring (25).

28. An assembly according to claim 27, wherein the second diaphragm (30) is a spirally slotted disc of aluminium alloy or titanium.

29. An assembly according to claim 28, including spring finger means (32) connected between the housing (3) and the outer ends of the first and second angular contact bearing means (7,27) to urge the respective concave seat ring (5,25) and convex outer race ring (6,26) towards engagement.

30. An assembly according to claim 28, including means for releasably off-loading the first and second angular contact bearing means to remove load therefrom.

31. An assembly according to claim 30, wherein the off-loading means includes a pair of elongated levers (33) each pivotally mounted at one end (33a) on the housing (3,3a) to extend side-by-side transversely across the coaxial longitudinal rotational axes (1c) of the first and second drive shafts (1,22) between the facing innermost ends (1b, 22b) of the first and second drive shafts (1,22), said levers (33) being displaceable between a rest position spaced from the adjacent facing innermost ends (34,35) of the first and second drive shafts (1,22) in which the first and second angular contact bearing means are loaded, and an operative position in which they are pivoted apart about the pivoted ends (33a), one to displace the first drive shaft (1) longitudinally along its rotational axis against the biasing force of the first diaphragm (17) so that the first part spherical seat ring (5) is displaced from load bearing contact with the first part spherical outer race ring (6) to unload the first bearing means, and the other to displace the second drive shaft (22) longitudinal along its rotational axis against the biasing force of the second diaphragm (30) so that the second part spherical seat ring (25) is displaced from load bearing contact with the second part spherical outer race ring (26) to unload the second bearing means.

32. An assembly according to claim 31, wherein the other ends (33b) of the levers (33) are offset from the longitudinal axes of the levers (33) so that the offset end (33b) of one lever is located on one side of and spaced from the longitudinal axes of the levers and the offset end (33b) of the other lever is located on the opposite side of and spaced from the longitudinal axes of the levers.

33. A assembly according to claim 32, wherein the off loading means includes a cam (36) pivotally mounted between the offset ends (33b) of the levers (33) and actuable by pivotal movement, about an axis extending transverse to the lever longitudinal axes, in one or the other direction to displace the offset ends (33b) apart and thereby urge the levers (33) into the operative position to displace the first and second drive shafts (1,22) for off-loading purposes or to allow the offset ends (33b) and thereby the levers (33) to return to the rest position for loading purposes.

34. An assembly according to claim 33, including spring finger means (37) connected between the housing (3) and the outer ends of the first and second angular contact bearing means to urge the respective concave seat ring (6) and convex outer race ring (26) towards engagement.

35. An assembly according to claim 29 or claim 34, including stop means (38,38a) for limiting the maximum axial displacement of the first and second drive shafts (1,22).

36. An assembly according to claim 34, wherein the off loading means includes a second motor (39) for reversibly pivotally rotating the cam (36).

37. An assembly according to claim 36, wherein the second motor (39) is a D.C. brushed electric motor.

38. An assembly according to any one of claims 2 to 37, wherein the housing (3) is of modular unit construction.

39. An assembly according to any one of claims 1 to 38, including a closed loop position control system for controlling the angular position of the first drive shaft (1) operable to vary the angular position of the first drive shaft (1) as a function of the position sensed by the transducer.

40. A scanner according to claim 39, including antenna means carried by a rotary scanner platform attached to said one end of the first drive shaft (1).

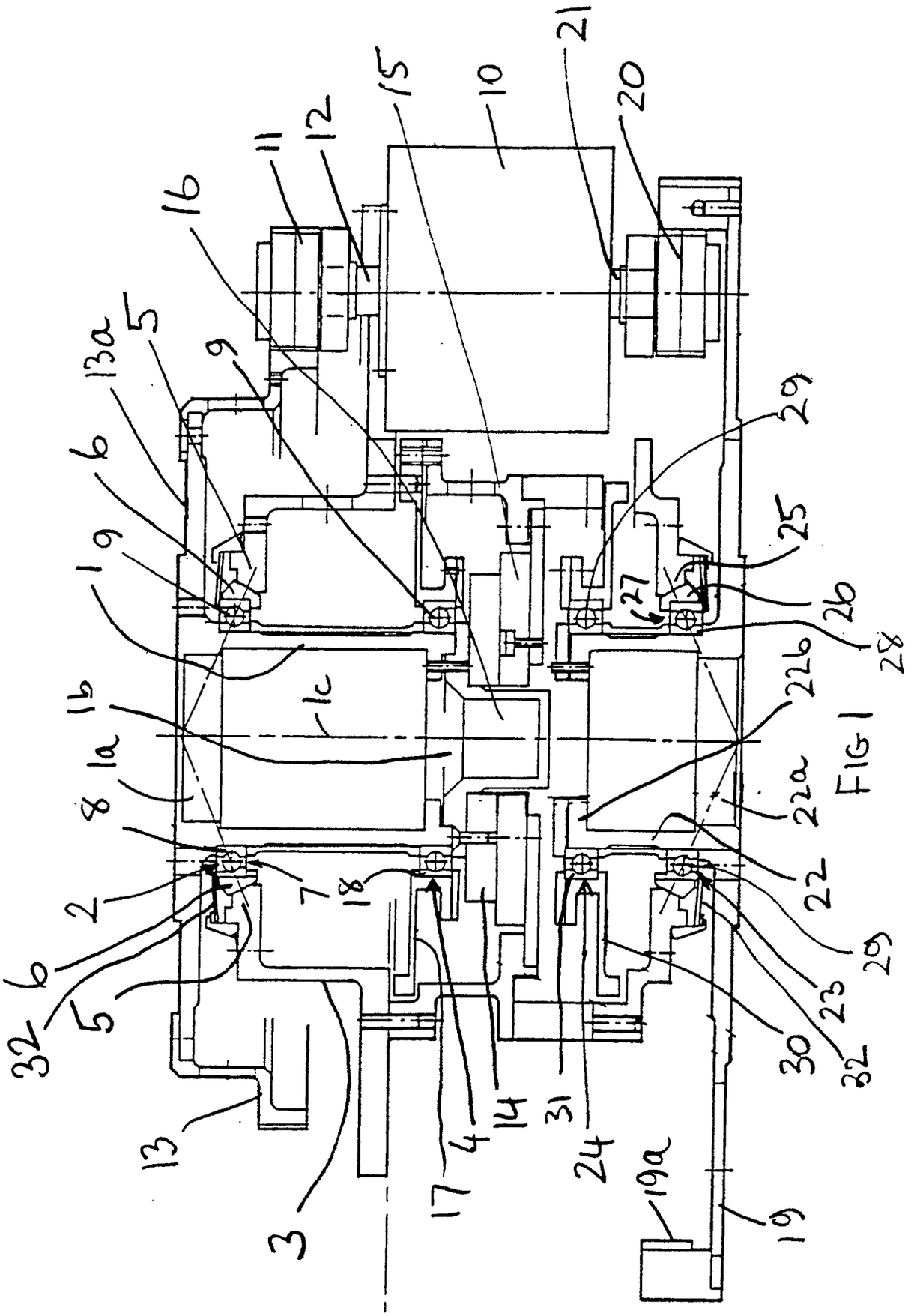
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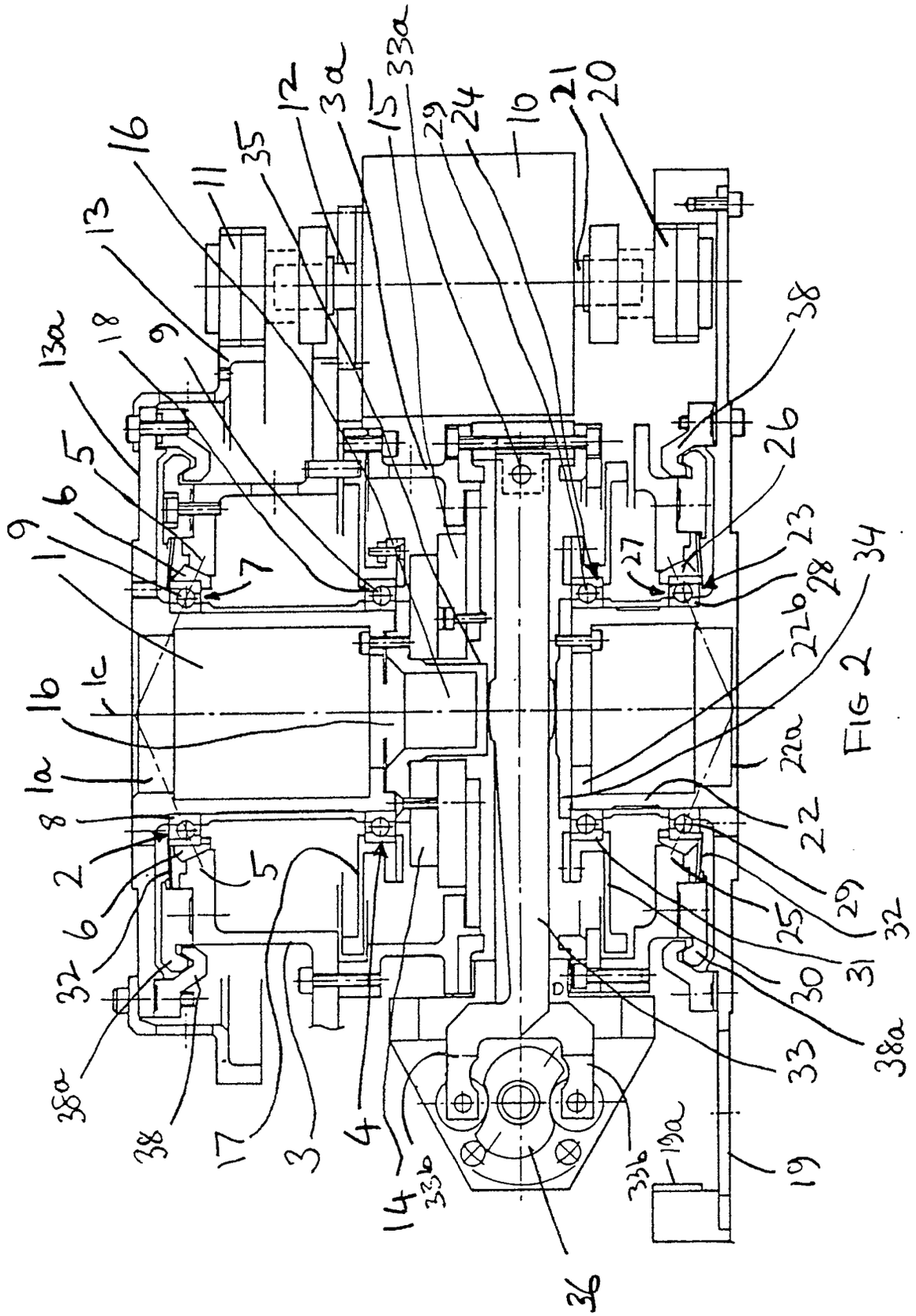
FIG 1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36
FIG 2

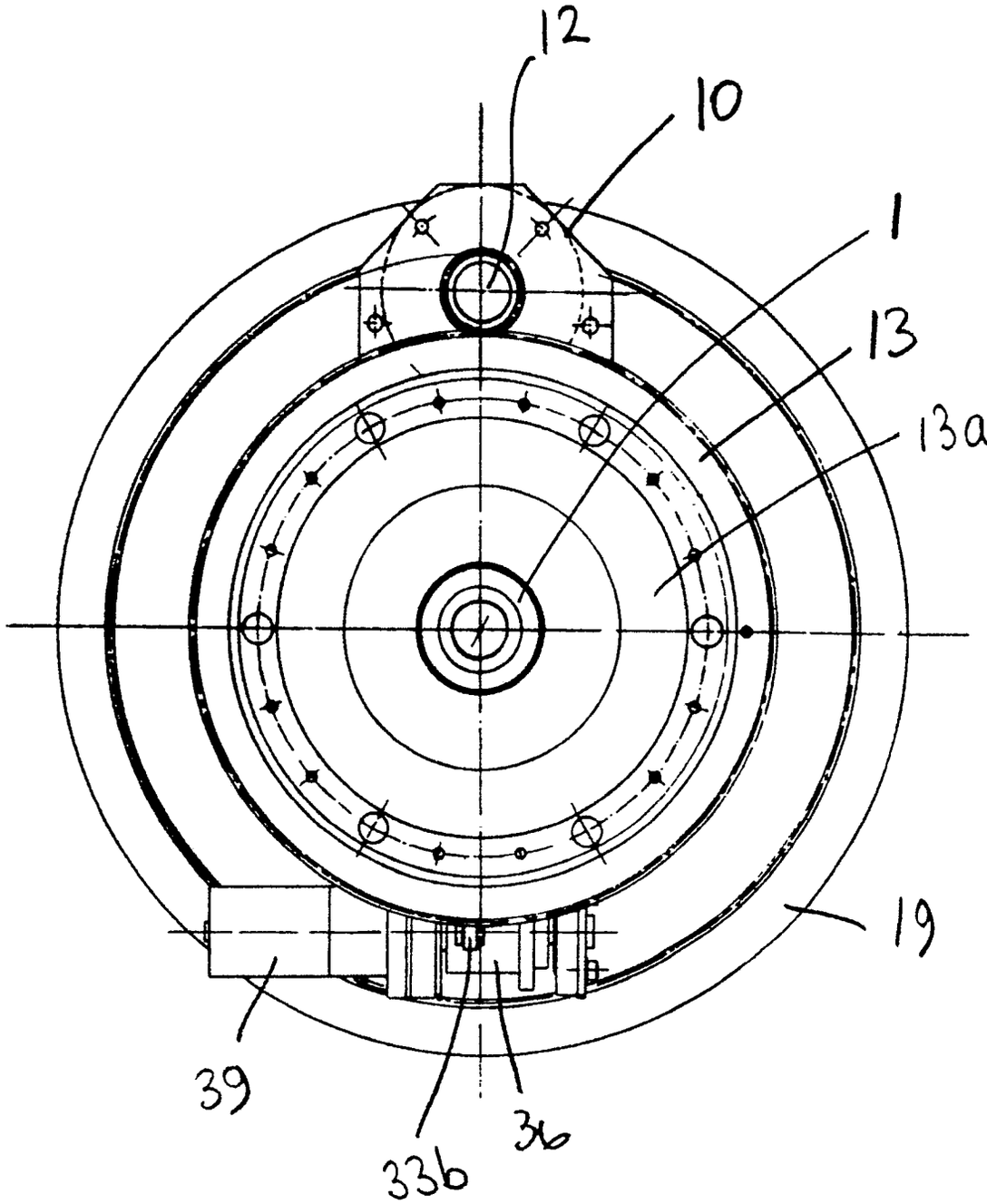

FIG 3

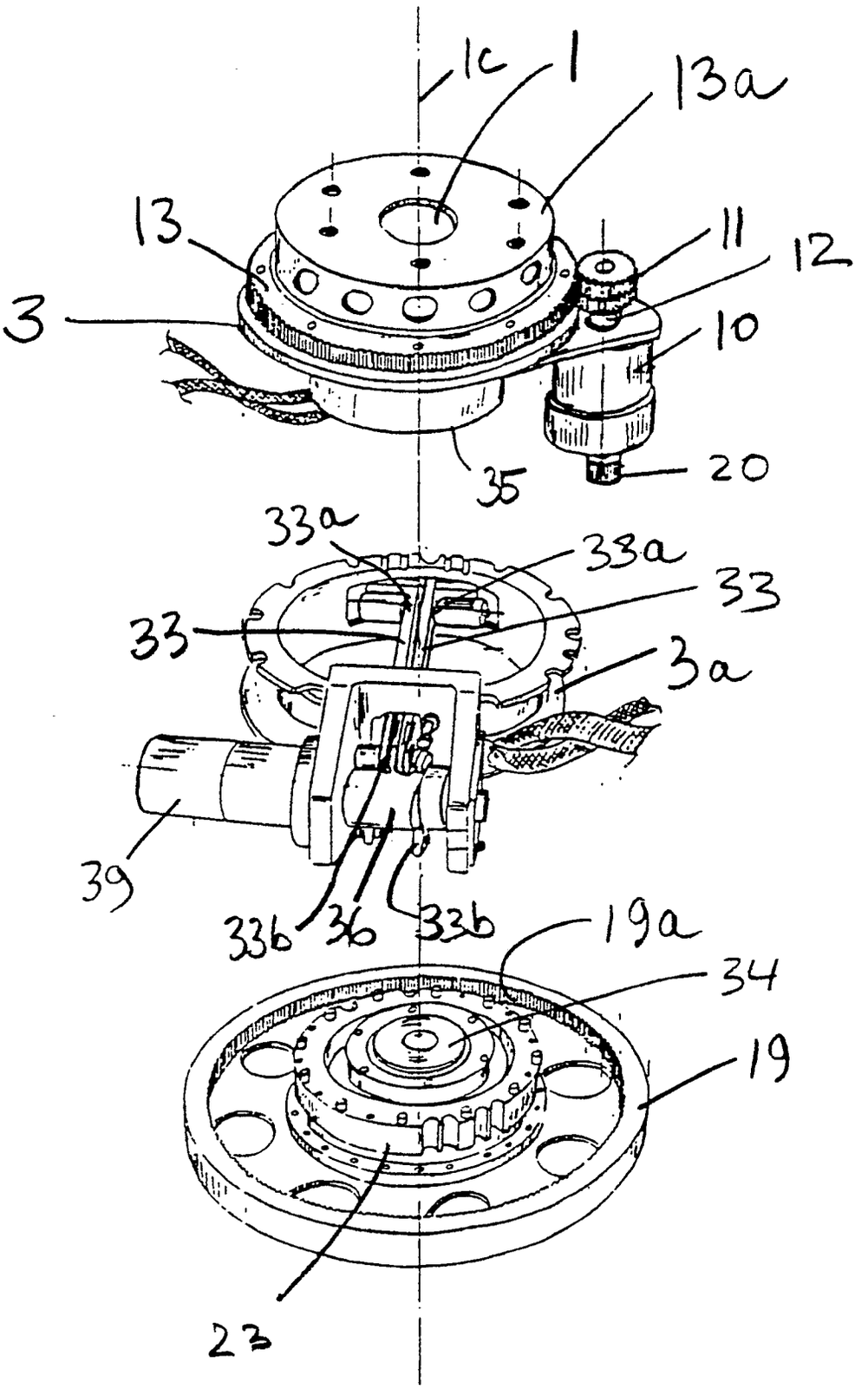
1c
1
13a
13
11
12
3
10
35
20
33a
33a
33
33
3a
39
33b
36
33b
19a
34
19
23

FIG 4