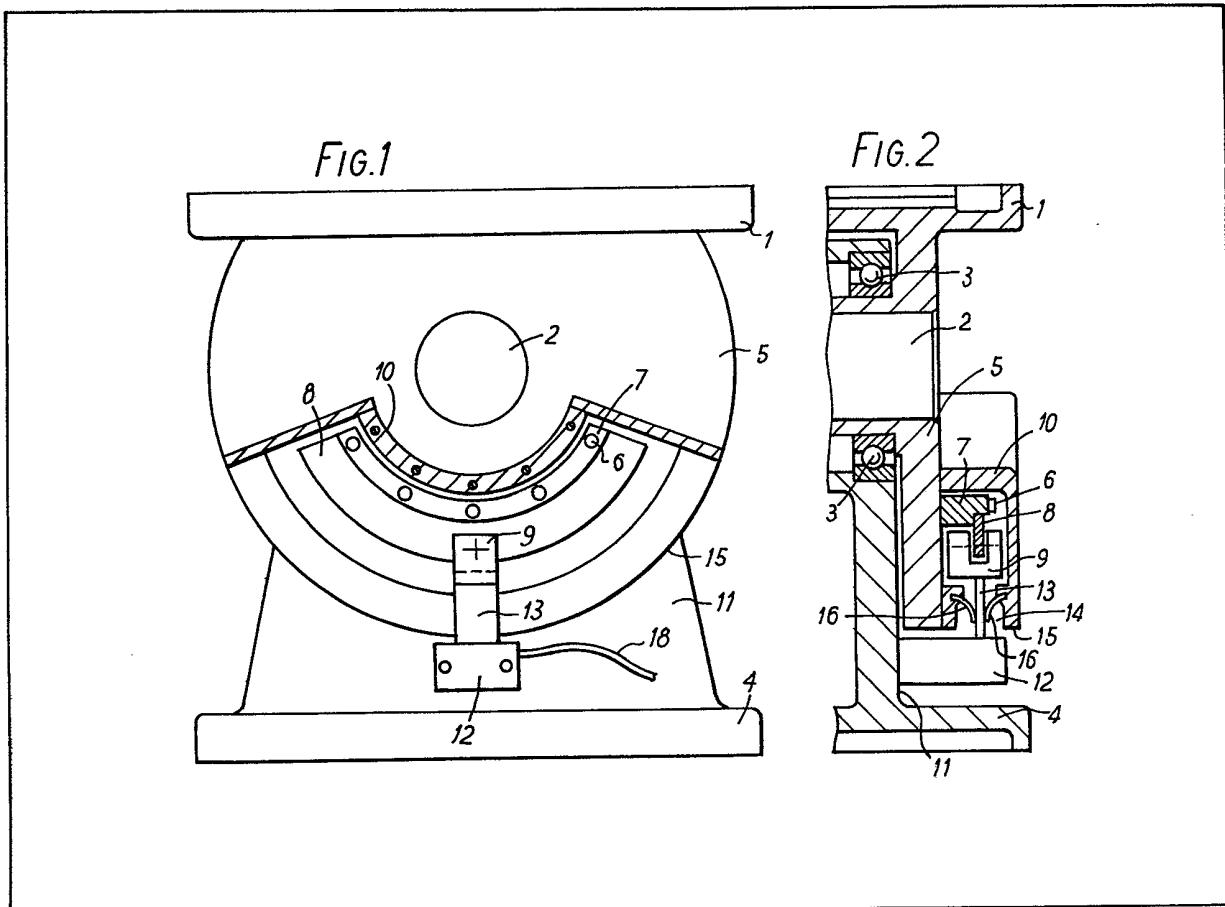


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(54) Enclosed angle measuring apparatus

(57) A tiltable table 1 comprises an angular scale 8 which tilts with the table about a spindle 2 over a scanner 9 which is mounted on a member 9 extending between flexible seals 16 of an arcuate housing 10.



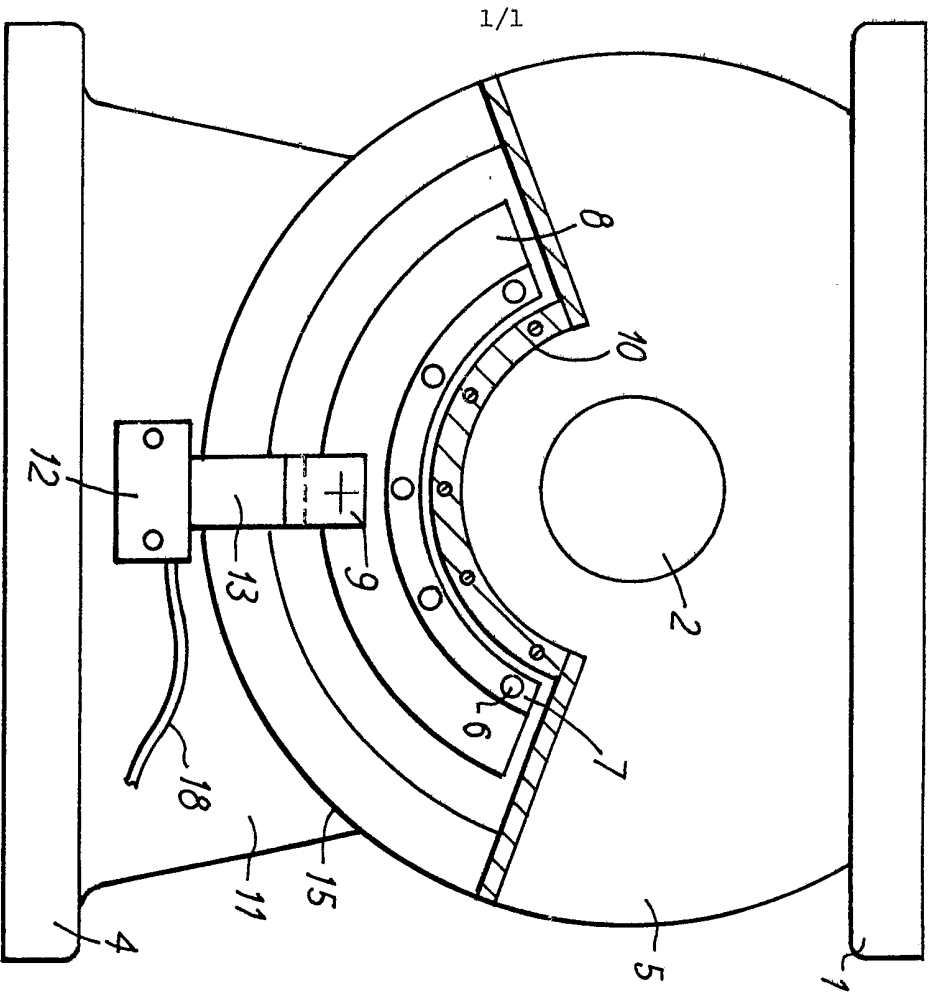


FIG. 1

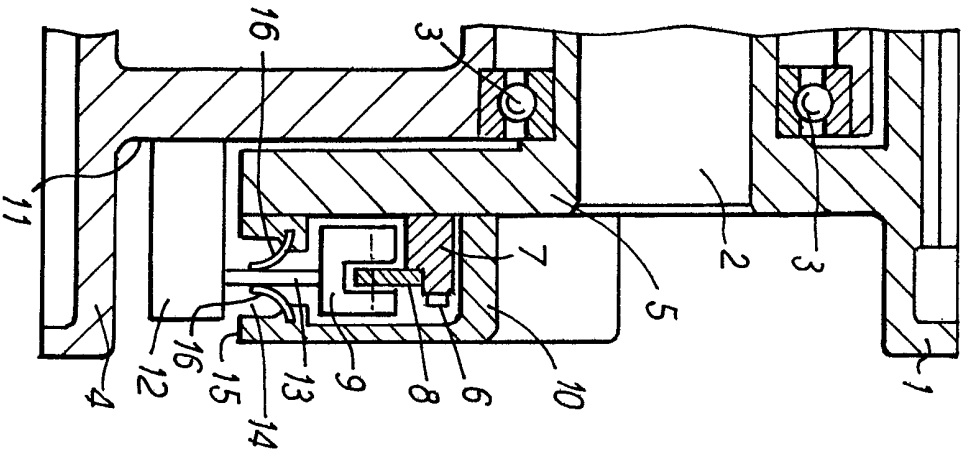


FIG. 2

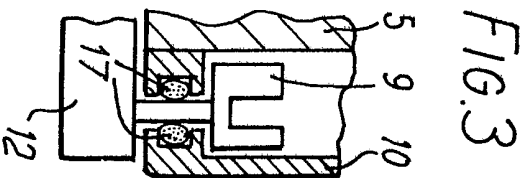


FIG. 3

SPECIFICATION

Enclosed angle measuring apparatus

5 The invention relates to enclosed angle measuring apparatus for measuring angles of rotation, especially, but not exclusively, in rotary or tilting tables whose range of rotation or tilt is less than 360°.

10 With such rotary and tilting tables, it is known, for exact angular positioning, to connect an attachable commercial rotary pick-up, such as is described, for example, in the publication: Incremental Rotary Pick-ups ROD Program 78/79, 66 d 5 8/78 1E, of Dr. Johannes Heidenhain GmbH.

15 Frequency, however, the use of such a rotary pick-up is not possible for reasons of space or construction, for example when the tilting or rotary table has a hollow shaft.

20 According to the present invention, there is provided enclosed angle measuring apparatus for measuring angles of rotation between two bodies, of less than 360°, the apparatus including an angle scale located on a scale carrier and scanned by a scanning unit, wherein, the angle scale is applied to an arcuate scale carrier which is connected to one of the said bodies and is located, together with the scanning unit scanning the angle scale, in the interior of an arcuate housing having an arcuate slot which is sealed by correspondingly formed sealing elements and through which there extends an intermediate part connecting the scanning unit to the other of the said bodies, the intermediate part having a cross-section corresponding to the shape of the cross-section of a two-edged sword.

35 The invention will now be described in more detail, solely by way of example, with reference to the accompanying drawings, in which:

40 Figure 1 is a side view of a tilting table with enclosed angle measuring apparatus embodying the invention;

Figure 2 is a view in cross-section of a portion of the tilting table of Figure 1; and

Figure 3 is a cross-sectional view of a detail of another embodiment of the invention.

45 The tilting table shown in Figures 1 and 2 has a plane table plate 1 which can be tilted in an angular range of less than 180° about a horizontal hollow shaft 2 mounted by means of ball bearings 3 in a base body 4.

50 For exact angular adjustment of the table plate 1, a front plate 5 in the form of part of a circle and connected perpendicularly to the plane table plate 1 has fixed to it by means of screw connections 6 a body 7 in the form of part of a circular ring and on which there is mounted a carrier 8 in the form of part of a circular ring and bearing an angle scale which is scanned in manner known *per se* by a scanning unit 9. For protection from mechanical damage, the carrier 8 and the scanning unit 9 are surrounded by a housing 10 in the form of part of a circular hollow ring, preferably of aluminium, and fixed in any desired manner to the front plate 5.

65 Fixed to a vertical surface 11 of the base body 4 in any desired manner below the housing 10 is a mounting foot 12 with intermediate part 13, having a cross-section corresponding to that of a two edged sword, which extends through a slot 14 in the circularly curved bottom face 15 of the housing 10 and is connected to the scanning unit 9. In order to prevent contaminants penetrating into the interior of the housing 10, the slot 14 is closed by means of flexible sealing lips 16 in the form of parts of circular rings and in roof-shaped arrangement in cross-section as can be seen from Figure 2. In another embodiment according to Figure 3, the sealing of the slot 14 is produced by means of sealing strips 17 in the form of parts of circular rings.

70 The electrical signals obtained in the scanning unit 9 for determining the angle of inclination of the table plate 1 are supplied through an electric cable 18 to an evaluating and indicating unit (not shown).

80 In another embodiment, in a manner not shown in the drawings, the body bearing the carrier, and the housing, can be fixed to the vertical surface of the base body and the mounting foot bearing the sword-shaped intermediate part can be fixed to the turnable front plate.

85 The incorporation of the angle measuring apparatus in the tilting table results in a considerable saving of space, since the use of an attachable precision rotary pick-up, which requires a large amount of space, can be dispensed with. Likewise, the apparatus can be used in those devices or kinds of apparatus in which, for reasons of construction or design, the use of an attachable rotary pick-up is not possible. Since the radius of the angle scale of the angle measuring apparatus is generally larger than that of the angle scale of a commercial rotary pick-up, a higher angular resolution is achieved in addition.

90 Embodiments of the invention can employ photoelectric, optical, inductive, capacitive, or magnetic, an absolute (i.e. from a datum), or incremental, angle measuring techniques.

105 CLAIMS

1. Enclosed angle measuring apparatus for measuring angles of rotation between two bodies, of less than 360°, the apparatus including an angle scale located on a scale carrier and scanned by a scanning unit, wherein the angle scale is applied to an arcuate scale carrier which is connected to one of the said bodies and is located, together with the scanning unit scanning the angle scale, in the interior of an arcuate housing having an arcuate slot which is sealed by correspondingly formed sealing elements and through which there extends an intermediate part connecting the scanning unit to the other of the said bodies, the intermediate part having a cross-section corresponding to the shape of the cross-section of a two-edged sword.

2. Enclosed measuring apparatus according to claim 1, wherein the sealing elements consist of two arcuate flexible sealing lips inclined towards one another in cross-section.

3. Enclosed angle measuring apparatus according to claim 1, wherein the sealing elements consist of two arcuate flexible sealing strips.

5 4. Enclosed angle measuring apparatus, substantially as described hereinbefore with reference to Figures 1 and 2, or to Figure 3, of the accompanying drawings.

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