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(54) **Rotary device for the transfer of electric power.**

(57) In a device for the transfer of electric power between contact elements (7, 8, 9, 13, 14, 21, 22, 23, 25) which move relative to each other, such as the collector and brushes of an electric motor, wear and soiling generally present a problem. In the device in accordance with the invention an electrically conductive fluid (16, 27) is present between the contact elements (7, 8, 9, 13, 14, 21, 22, 23, 25), so that these problems are largely mitigated.

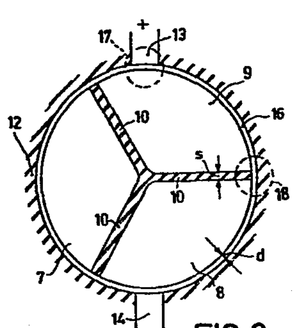

FIG.2

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"Device for the transfer of electric power"

TITLE MODIFIED
see front page

The invention relates to a device for the transfer of electric power, which device comprises a contact unit comprising a plurality of first contact elements which are insulated from each other, and a second contact element, the contact unit and the second contact element being movable relative to each other for the transfer of power between the second contact element and respective said first contact elements.

An example of such a device is the commutator of an electric motor, in which the second contact element is a brush spring which engages with the segments, or first contact elements, of a collector. The main disadvantages of this device are a limited lifetime as a result of wear of the contact elements and an impaired power transfer as a result of soiling.

The invention aims at mitigating these drawbacks and is characterized in that an electrically conductive fluid is present between the first and second contact elements.

A particular embodiment is characterized in that the contact unit is cylindrical and rotatable and is surrounded by a cylindrical film of the electrically conductive fluid.

The contact unit and the second contact element may form part of a bearing, in particular a spiral-groove bearing.

It is possible to use, for example a mixture of conductive particles in a non-conductive fluid as the conductive fluid.

Some embodiments of the invention will now be described in detail, by way of example, with reference to the Figures.

Fig. 1 is a longitudinal sectional view of an electric motor in which a device in accordance with the invention is used.

Fig. 2 is a sectional view taken on the line II-II in Fig. 1.

Fig. 3 is an axial cross-section of a shaft including the rotatable part of a different embodiment of the invention.

Fig. 4 is a sectional view taken on the line IV-IV in Fig. 3.

Fig. 5 is an axial cross-section of the non-rotatable part of the embodiment shown in Figures 3 and 4.

Fig. 6 is a sectional view taken on the line VI-VI in Fig. 5.

The electric motor shown in Fig. 1 comprises a housing 1, stators 2 and 3 of a permanent-magnetic material, and a rotor 4 on the shaft 5. The shaft also carries a contact unit 6 constructed as a collector. The collector comprises first contact elements 7, 8 and 9 (Fig. 2) in the form of segments of an electrically conductive material, which segments are separated by layers 10 of an insulating material. The contact elements 7, 8 and 9 are connected to the coils 11 of the rotor.

Around the contact unit 6 a ring 12 of an electrically insulating material is arranged. Second contact elements 13 and 14 are arranged in the ring 12 at two diametrically opposite locations. These contact elements 13, 14 can be connected to a voltage source via connecting lugs 15.

A cylindrical film 16 of an electrically conductive fluid is present between the contact unit 6 and the ring 12.

The contact unit 6 comprising the first contact elements 7, 8 and 9 and the ring 12 provided with the second contact elements 13 and 14 form a device for transferring electric power during rotation of the rotor relative to the housing 1. In the situation shown in

Figure 2 the electric current from the voltage source will flow through the contact element 13, the conductive fluid film 16, and the contact element 9 to a rotor coil 11 and will return to the voltage source <u>via</u> the contact element 8, the fluid film 16 and the contact element 14.

The resistance R_1 of the film of fluid between the contact elements 13 and 9 at the location 17 and the resistance R_2 of the film of fluid between the contact elements 8 and 9 at the location 18 are given approximately by the following formulae:

$$R_1 = \rho \frac{d}{lb}$$

$$R_2 = \rho \frac{s}{db}$$

where:

ρ = specific resistance of the fluid, for example 10 cm

d = thickness of the fluid film, for example 15 μm

l = width of contact elements 13 and 14, for example 1.5 mm

b = width of the ring 12, for example 12 mm

s = thickness of insulating layer 10, for example 0.5 mm.

When the above values, which are given by way of example, are inserted into the formulas for the resistance values, these yield:

$$R_1 = 0.08\,\Omega$$

$$R_2 = 280\,\Omega.$$

In practice the resistance values of the rotor coils lie in the range 1-10 Ω so that, in view of the value of the leakage resistance R_2 relative to the value of the rotor-coil resistance and the resistance R_1, the loss of power as a result of the direct electric current through the fluid film at the location 18 between the contact elements 8 and 9 may be ignored.

In the embodiment shown in Figures 3 to 6 the power-transfer device is constructed as a bearing comprising a shaft 19 and a bearing bush 20, the electrically conductive fluid also serving as a lubricant.

Suitably, the bearing is constructed as a spiral-groove bearing, because as a result of the self-centring properties of such a bearing a very small clearance between the shaft and the bearing bush, corresponding to a very small thickness d of the fluid film, may be used, whilst as a result of the pumping action of the spiral-groove bearing it is achieved in a simple manner that an electrically conductive fluid is always present at the location of the contact elements and over the entire circumference of the shaft.

On the shaft 19 (Figures 3 and 4) first contact elements 21, 22 and 23 are arranged, which elements are insulated from each other and from the shaft by an insulating layer 24. The shaft 19 is rotatably journalled in the bearing bush 20 which is provided with second contact elements 25 (Figs. 5 and 6). The bearing bush is formed with V-shaped grooves 26, so that a spiral-groove bearing is formed. Between the shaft 19 and the bush 20 an electrically conductive fluid 27 is present for the transfer of electric power between the first and second contact elements, in the same way as in the embodiment shown in Figures 1 and 2.

As is shown in Fig. 5 a second bearing bush 28 is arranged adjacent the bearing bush 20, which second bush is also constructed as a spiral-groove bearing having grooves 29. The portion of the bearing bush 28 adjacent the bearing bush 20 has an annular chamber 30 provided with an inlet duct 31. A lubricant, which also serves as an electrically conductive fluid, can be fed to the bearing bushes 20 and 28 via this duct 31 and the chamber 30. As a result of the pumping action to which the fluid is subjected during rotation of the shaft 19, which is journalled in the bushes 20 and 28, fluid will be fed to the central zones 32 and 33 of the bearing bushes 20 and 28 respectively, whilst leakage of fluid from the bearing is minimized. Thus, the zone 32 where the second contact elements 25 are located always receives an adequate amount of electrically conductive fluid.

Obviously, it is possible to omit the additional bearing bush 28. The shaft 19 is then journalled in the single bearing bush 20 and fluid is fed to the space between the shaft and the bearing bush, for example <u>via</u> an additional radial duct formed in the bearing bush.

To preclude the leakage of fluid from the devices shown in Figures 1 to 6 also conventional means such as oil-sealing rings, labyrinth-seals and the like.

It is possible to use mercury as the electrically conductive fluid. Also a mixture of conductive particles and a non-conductive fluid, for example silver particles and ethyleneglycol can be used.

CLAIMS

1. A device for the transfer of electric power, which device comprises a contact unit comprising a plurality of first contact elements which are insulated from each other, and a second contact element, the contact unit and the second contact element being movable relative to each other for the transfer of power between the second contact element and respective said first contact elements, characterized in that an electrically conductive fluid is present between the first and second contact elements.

2. A device for the transfer of electric power, as claimed in Claim 1, comprising a cylindrical rotatable contact unit having a plurality of said first contact elements on its circumference, and a said second contact element situated adjacent the circumference, characterized in that the cylindrical rotatable unit is surrounded by a cylindrical film of the electrically conductive fluid.

3. A device for the transfer of electric power, as claimed in Claim 1 or 2, characterized in that the contact unit and the second contact element form part of a bearing.

4. A device as claimed in Claim 3, characterized in that the bearing is a spiral-groove bearing.

5. A device as claimed in any of the preceding Claims, characterized in that the electrically conductive fluid is a mixture of conductive particles and a non-conductive fluid.

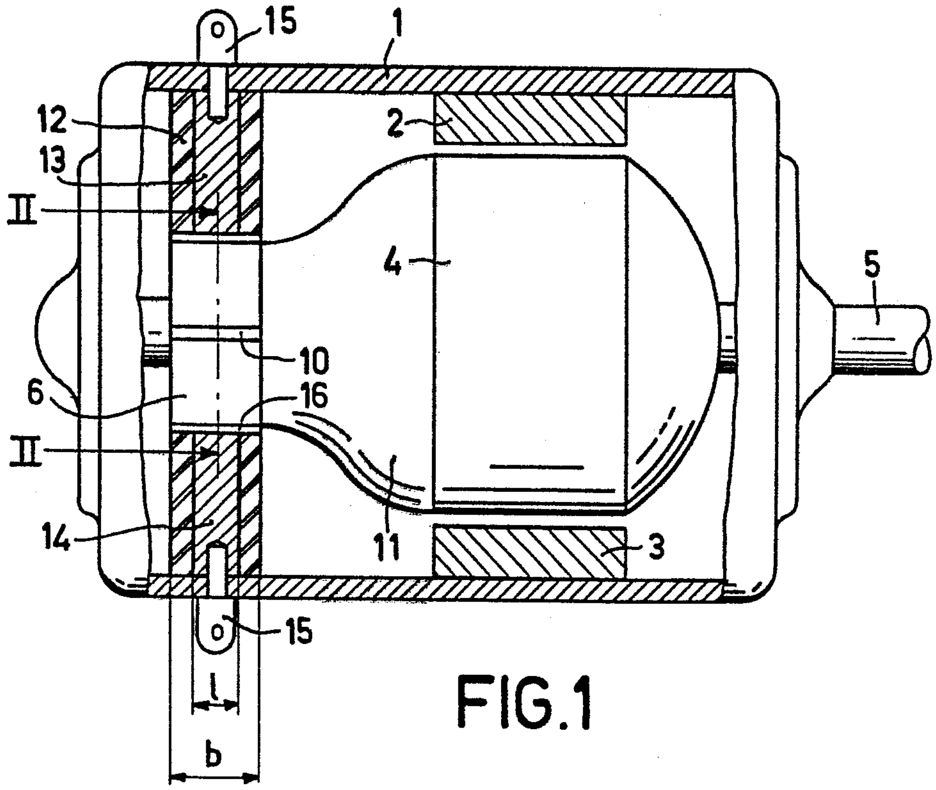
15
1
12
2
13
II
4
5
10
6
16
II
11
14
3
15
l
b

FIG.1

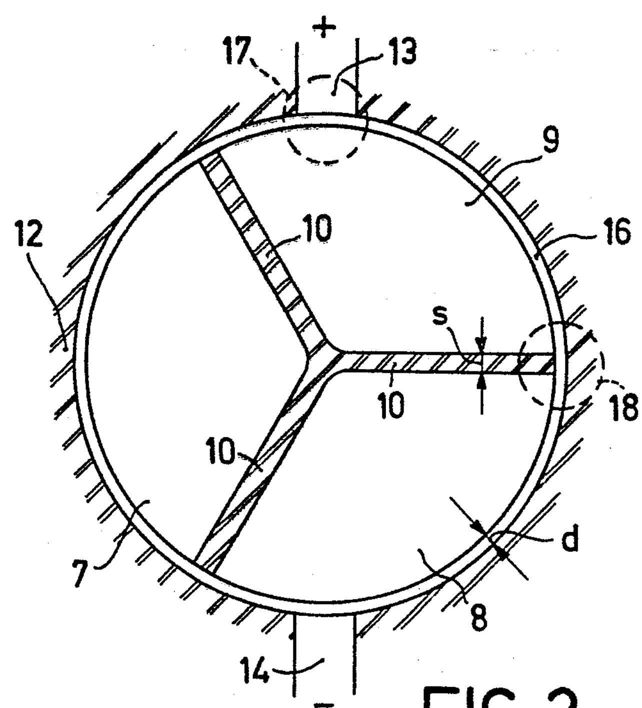
+
17
13
9
12
10
16
s
10
18
10
7
d
8
14
-

FIG.2

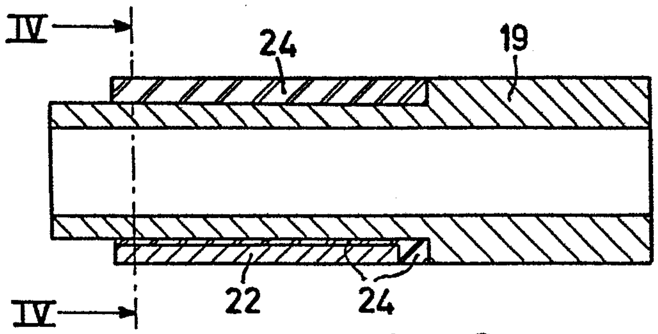

FIG.3

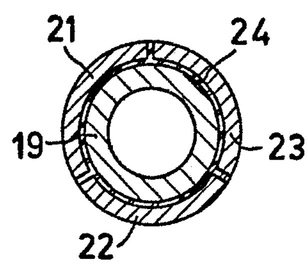

FIG.4

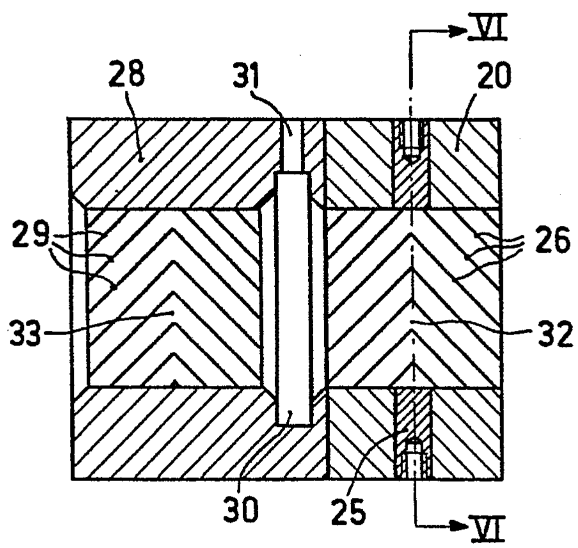

FIG.5

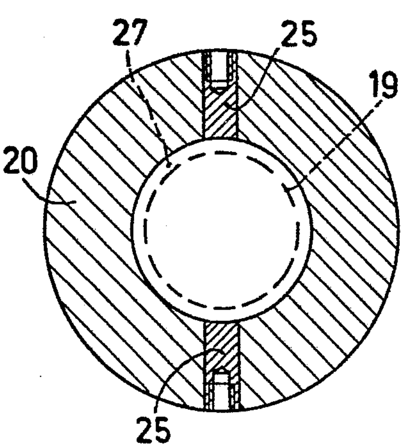

FIG.6

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EUROPEAN SEARCH REPORT

0089725
Application number

EP 83 20 0377

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X,Y	GB-A- 621 108 (CARBONE-LORRAINE) * Whole document * ---	1,2	H 01 R 39/30
X,Y	GB-A-2 019 107 (MABUCHI MOTOR CO.) * Whole document * ---	1,2,5	
Y	GB-A- 777 335 (ASSOCIATED ELECTRICAL INDUSTRIES) * Page 1, lines 85-90; page 2, lines 91-95 * ---	3,4	
Y	US-A-3 523 079 (WESTINGHOUSE ELECTRIC) * Whole document * -----	3,5	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
			H 01 R 39/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25-05-1983	MOBOUCK G.C.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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