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Ruget

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[54] **ELECTROMAGNETIC POWDER COUPLINGS**

[75] Inventor: **Gabriel Ruget**, Saint Etienne, Loire, France

[73] Assignee: **Creusot-Loire**, Paris, France

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[51] **Int. Cl.** **F16d 27/00**

[58] **Field of Search** 192/21.5; 335/217

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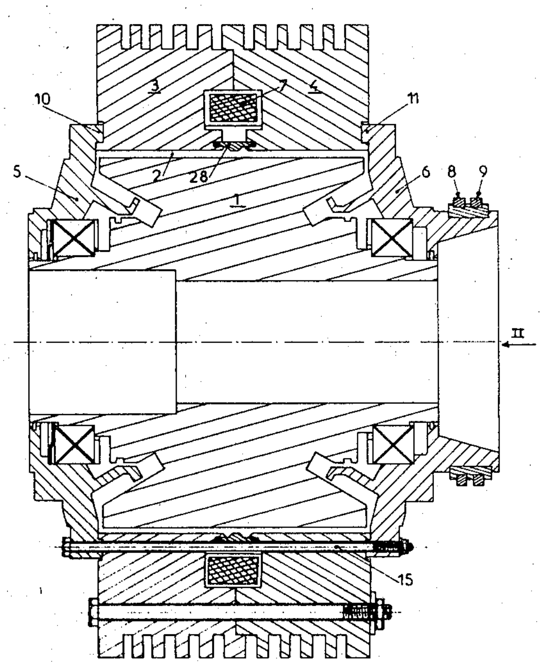
Primary Examiner—Benjamin W. Wyche
Assistant Examiner—Randall Heald
Attorney—Irving M. Weiner

[57] **ABSTRACT**

An electromagnetic powder coupling comprising an outer rotor formed by two pole piece halves centered on lateral cheeks of an amagnetic material, an excitation coil is housed between the two pole piece halves which define an air gap around an inner rotor, the centering of the pole piece halves being effected by a convex cylindrical face machined on each of these pole piece halves in the immediate vicinity of the air gap in order to fit on the cylindrical face opposite a peripheral ring provided for this purpose on the corresponding cheek, while, on the other hand, the connection of the two pole piece halves in the middle of the air gap is ensured, without direct contact between them, by an amagnetic axially-slidable coaxial sleeve which is separated from the coil by a free space.

9 Claims, 5 Drawing Figures



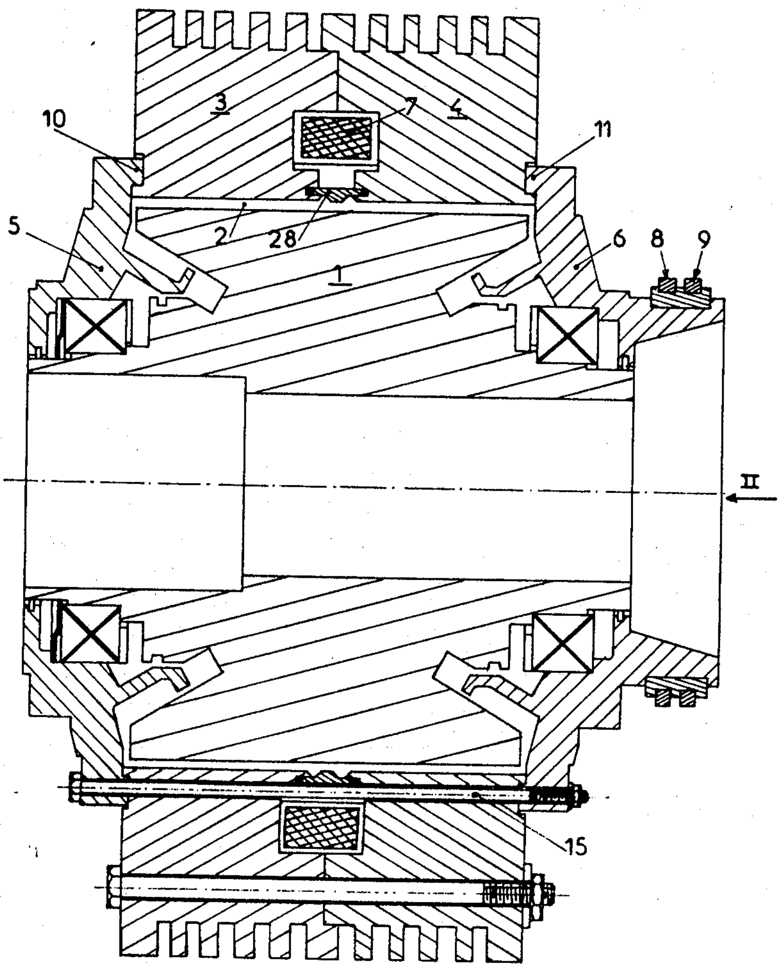


Fig. 1

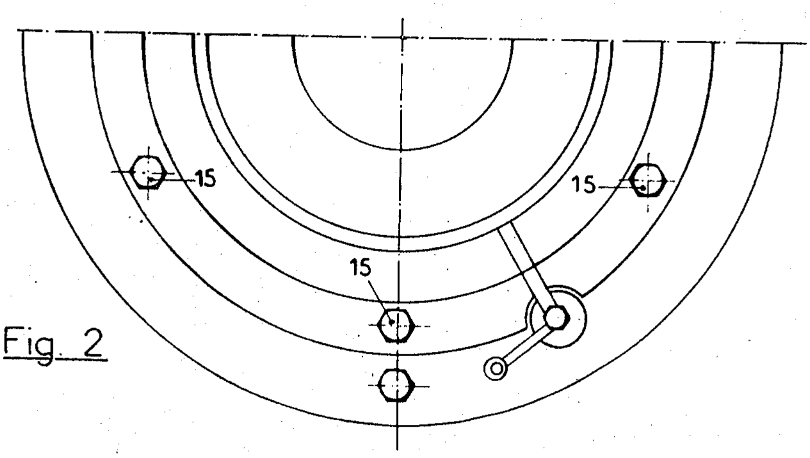


Fig. 2

INVENTOR
GABRIEL RUGET

BY Irving M. Weiner
ATTORNEY

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Fig. 3

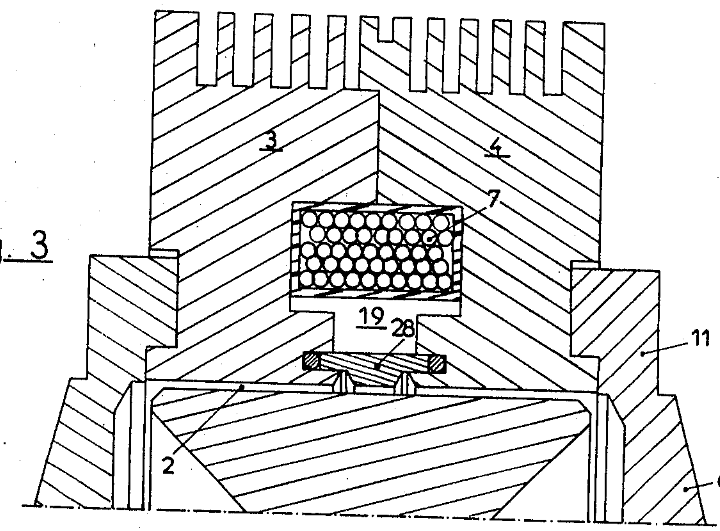


Fig. 4

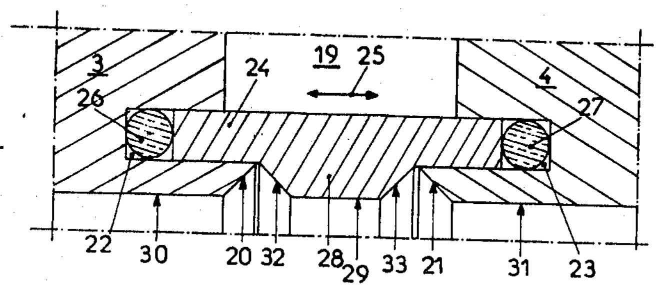
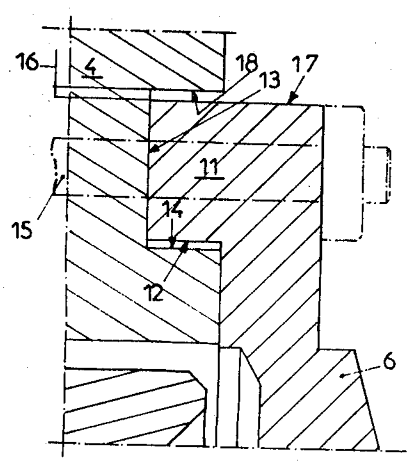


Fig. 5



INVENTOR
GABRIEL RUGET

BY Irving M. Weiner
ATTORNEY

ELECTROMAGNETIC POWDER COUPLINGS

This invention relates to an electromagnetic powder coupling having means for protecting it against the effect of thermal shocks.

It is known that an electromagnetic powder coupling comprises an outer rotor and an inner rotor separated by an air gap in which is located metal, for example, steel powder. The outer rotor comprises two pole piece halves between which is housed an electromagnetic coil which is supplied from outside by rotating contacts. Two lateral cheeks are attached to the sides of the pole piece halves in order to ensure the centering of the outer rotor on the inner rotor.

It is known to place the two pole piece halves in contact with each other by means of an annular lip of slight thickness placed around the central region of the air gap, in order to produce, without any significant magnetic leakage, a magnetic shunt capable of closing the residual field at the time of cutting the excitation current to the coil, in order to obtain an immediate disconnection of the two rotors. It is known that if the speed of heating-up of the coupling, when operating, reaches a certain level, the metal of the two pole piece halves expands and exceeds its elastic limit at the level of the two lips in contact which form the magnetic shunt. The metal is compressed in this region and, when the coupling cools, the contraction causes a clearance which results from the thermal stresses. The magnetic powder tends to pack into this gap, such that during the next heating-up, the phenomenon is increased and so on. Gradually, the assembly of the outer rotor becomes deformed due to buckling, the air gap reduces in the centre, and the powder tends to accumulate in the coil housing by passing through the gap between the two pole piece halves of the outer rotor, such that there is little left in the air gap. In the course of time, the performance of the coupling deteriorates, its operating temperature increases and this phenomenon can increase until the coupling is destroyed.

Another important point in the heating of known electromagnetic powder couplings is constituted by the centering of the outer rotor on the lateral cheeks. Traditionally, this centering is ensured by shoulders, machined in the lateral faces of the two pole piece halves and which abut against the outer peripheral face of the cheeks. The latter are made from an amagnetic material, and they have a coefficient of expansion greater by almost 60 percent than that of the extra soft steel which forms the pole piece halves. The mounting of the cheeks in the pole piece halves is effected without clearance when cold. Consequently, when the coupling heats up during operation, the lateral cheeks tend to expand more than the pole piece halves which fasten them together, such that here too there is a risk of causing thermal stresses in the case of exaggerated heating. After cooling and contraction, the pole piece halves of the outer rotor are no longer correctly centred on the cheeks. This causes unbalances and gives the air gap an irregular shape which is harmful to the proper operation of the coupling.

Finally, the performances of an electromagnetic, powder coupling of known type are limited by the consequences of heating, on the one hand, at the level of the magnetic shunt which connects the two pole piece halves of the outer rotor, and, on the other hand, in the region where these pole piece halves are centred on the lateral cheeks.

An object of the present invention is to obviate or mitigate these disadvantages and to push back this upper limit due to heating, in order to improve the performance of the coupling.

An electromagnetic powder coupling according to the invention comprises an outer rotor formed by two pole piece halves of extra soft steel centred on the lateral cheeks of amagnetic material, while an excitation coil is housed between the two pole piece halves which define an air gap around an air gap around an inner rotor, and it is characterized in that, on the one hand, the centering of the pole piece halves is effected by a convex, cylindrical face machined on each of these pole piece halves in order to fit over the inner cylindrical face of a peripheral ring provided for this purpose on the corresponding cheek, whilst, on the other hand, the connection of the two pole piece halves in the middle of the air gap is ensured, without direct contact between them, by an amagnetic coaxial sleeve fitted, with the possibility of axial sliding in two grooves cut opposite each other in the pole piece halves. Preferably, this sleeve has in its centre a rib projecting inwardly, and the inner diameter of which is equal to the inner diameter of the two adjacent pole piece halves which define the air gap around the inner rotor. In addition, the lip of each pole piece half which is located between this sleeve and the air gap of the coupling is preferably bevelled.

Due to this arrangement, the tendency of the powder to pack between the pole piece halves and the sleeve is avoided, whilst reducing the significance of the magnetic shunt formed by the powder between the two pole piece halves.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1, is an axial section of an electromagnetic powder coupling according to the invention;

FIG. 2, is a partial end view in the direction of the arrow II in FIG. 1;

FIG. 3, is a partial section showing, on a larger scale, a detail of FIG. 1;

FIG. 4, illustrates, on a still larger scale, a detail of FIG. 3; and

FIG. 5, shows the operation of the coupling for centering a cheek when the coupling operates hot.

There is shown in the drawings, an electromagnetic powder coupling which comprises an inner rotor **1** separated from the outer rotor by an air gap **2** where the steel powder is located. The outer rotor is formed by two pole piece halves **3** and **4** of soft steel provided with lateral cheeks **5** and **6** of amagnetic material. Between the two pole piece halves **3** and **4** is housed an excitation coil **7** which is supplied externally by means of rotating contacts **8** and **9**.

Each cheek **5** or **6** is provided with a centering ring **10** or **11** which projects in the direction of the coupling pole piece half **3** or **4**. The following description relates to the ring **11** of the cheek **6** and its mounting on the pole piece half **4**, but it is understood that the mounting is similar for the ring **10** of the cheek **5** fixed on the pole piece half **3**.

The ring **11** has a concave cylindrical face **12** (FIG. 5) and it is on this inner cylindrical face that the centering of the pole piece half **4** is effected when cold. For this a first annular groove **13** is cut on the side of the pole piece half **4**, so as to define a convex cylindrical face **14** which, when cold, is mounted contiguously without play against the inner face **12** of the ring **11**. The fixation is ensured by pins or tie-bolts **15** which pass entirely through the assembly **10, 3, 4, 11.**

Finally, a radial clearance **16** is provided between the outer cylindrical face **17** of the ring **11** and the inner cylindrical face **18** of the groove **13.**

The coefficient of expansion of the material of the cheeks **5** and **6** is clearly greater than that of the soft steel of the pole piece halves **3** and **4,** and therefore it will be understood that when the coupling heats up while operating, the centering rings **10** and **11** tend to move away from the convex cylindrical faces **14** of the pole piece halves. The peripheral gap **16** (FIG.**5**) is thus reduced, but at no time is the free expansion of the rings **10** or **11** hindered by the pole piece halves **3** and **4.** When hot, the rigorous centering of the pole piece halves **3** and **4** on the cheeks **5** and **6** is no longer ensured by the rings **10** and **11.** It is produced automatically under the action of the powder contained in the air gap **2,** this powder thus being made compact by the action of the magnetic field.

When cooling, the centering is again guaranteed by the inner faces such as **12** of the rings **10** and **11** which reassume contact with the convex cylindrical faces such as **14** or the pole piece halves **3** and **4.**

There is provided between the pole piece halves **3** and **4,** a free space **19** (FIG. **4**) which extends until it opens into the air gap **2.** Each pole piece half opens into the air gap by a bevel **20** or **21.**

Above this bevel there is cut a second annular groove, indicated by the reference numeral **22** for the pole piece half **3** and by the reference **23** for the pole piece half **4** (FIG.**4**). These two grooves **22** and **23** are coaxial and open out opposite each other. The edges of a cylindrical sleeve **24** made of an amagnetic material such as stainless steel, bronze, brass or a light alloy are engaged in these grooves. It can slide in axial direction (double arrow **25**) and its air-tightness is ensured by two annular seals **26** and **27** located at the base of the grooves **22** and **23.**

These seals are made of a deformable material able to resist heat, i.e., a synthetic resin polymer such as a product known under the trade name "TEFLON."

In its center, the sliding sleeve **24** comprises an annular boss **28** which projects radially inwardly toward the air space **2** and the inner face **29** of which has the same diameter as the inner wall **30** or **31** of the pole piece halves **3** and **4.**

It is understood that, even if the components of the coupling are subjected to a sudden heating which causes a high gradient of temperature in the vicinity of the air gap **2,** the metal of the pole piece halves **3** and **4** can expand freely on either side of the sleeve **24** without risking causing any thermal stresses. On the other hand, the presence of the sleeve **24** prevents the powder from leaving the air gap **2** to enter the free space **19.**

The free sliding of the sleeve **24** is facilitated by preventing powder from packing between its annular boss **28** and the pole piece halves **3** and **4.** For this, the inlets **20** and **21** of the pole piece halves **3** and **4** are bevelled, and the boss **29** is also provided with bevelled lateral faces **32** and **33.**

Due to the presence of this boss **28,** the thickness of the layer of powder under the sleeve **24** is not greater than in the rest of the air gap **2.** Thus, the magnetic leakage through the shunt formed by the layer of powder is not increased.

What is claimed is:

1. An electromagnetic powder coupling, comprising:

an inner rotor;

an outer rotor formed by two pole pieces disposed around and spaced apart from said inner rotor;

an air space defined by said inner rotor and said outer rotor adopted to contain a powdered metal therein;

means defining a first annular groove formed in an end of each of said pole pieces comprising a convex cylindrical face and an inner cylindrical face;

two lateral cheek pieces disposed at opposite ends of said outer rotor adopted to center said pole pieces comprising said outer rotor with said inner rotor to produce a uniform symmetric air space therebetween each of said cheek pieces having a centering ring disposed thereon defining a concave cylindrical face and an outer cylindrical face, said concave cylindrical face being adopted to mate contiguously when cold against said convex cylindrical face of said annular groove in said pole pieces;

a radial clearance defined by said outer cylindrical face of said centering ring of each of said cheek pieces and said inner cylindrical face of each of said annular grooves in said pole pieces when they are cold to allow for thermal expansion of said centering rings and said cheek pieces as they become hot;

an excitation coil located partially in each of said pole pieces at an interface between said pole pieces, the face of each of said pole pieces comprising said interface being opposite said ends thereof which contain said first annular grooves;

means defining a free space in each of said pole pieces at said interface between said pole pieces, said free spaces being disposed coaxially with each other and extending radially from said excitation coil to said air space;

means defining a second annular groove in each of said pole pieces at said interface between said pole pieces, said second annular grooves being disposed coaxially with each other and radially located between said excitation coil and said air space;

an amagnetic sleeve partially disposed in each of said annular grooves in said pole pieces coaxially therewith and adopted to be axially-slidable therein to allow said pole pieces to expand freely independently of each other, and to prevent powdered metal from passing from said air space to said excitation coil; and

an annular seal located in each of said second annular grooves, each disposed between the base of a different one of said grooves and said amagnetic sleeve to provide an air tight fit between each of said grooves and said sleeve.

2. A coupling as defined in claim **1,** further characterized in that:

said coaxial sleeve has a radially inwardly projecting annular boss having inclined lateral faces; and

a portion of each of said pole pieces located between said coaxial sleeve and said air space having bevelled lips adjacent said inclined faces of said boss of said sleeve sloping in a generally opposite direction to that of said inclined lateral faces of said sleeve,

said inclined faces of said boss and said opposite bevelled faces of said pole pieces adjacent said boss prevent powdered metal from packing between said sleeve and said annular boss.

3. A coupling as defined in claim **2**, further characterized in that said radially inwardly projecting annular boss has an inner face of the same diameter as an inner wall of said pole pieces such that a portion of said air space located between said inner rotor and said boss is substantially the same as the thickness of the portion of said air gap between said inner rotor and said outer rotor,

thus preventing an increase in the magnetic leakage through the magnetic shunt formed by the layer of metal powder contained in said air space.

4. A coupling as defined in claim **1** further characterized in that said annular seals are fabricated of a deformable material able to resist heat.

5. A coupling as defined in claim **4** further characterized in that said seal is fabricated of a synthetic resin polymer.

6. A coupling as defined in claim **5** further characterized in that said synthetic resin polymer is TEFLON.

7. A coupling as defined in claim **1** further characterized in that said cheek pieces are fabricated of a material having a greater coefficient of expansion than that of said pole pieces.

8. A coupling as defined in claim **7** further characterized in that:

said cheek pieces are fabricated of an amagnetic material; and

said pole pieces are fabricated of soft steel.

9. A coupling as defined in claim **1**, further characterized in that said coupling is fastened together by a plurality of fasteners which pass entirely through both of said cheek pieces and both of said pole pieces.

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