Coupling devices or clutches of the powder type are already known, in which the connection between a driving shaft and a driven shaft is obtained through the medium of a powder enclosed in a casing, generally circular in shape, which is integral with the driving shaft or the driven shaft, and in which a rotating member integral with the other part is adapted to rotate.

When the driving shaft is set in rotation, the powder is driven outwards inside the casing by centrifugal force and, after a certain period of slip, the powder binds the rotor to the casing, thus rotating the driven shaft.

The present invention has for its object to provide a clutch of this kind, which is simple to construct and by which it is possible to transmit substantial couples without slip.

The powder-type coupling device, in accordance with the invention has, in addition, the advantage that when stopped the powder automatically becomes decompressed, and, in consequence, the driving and driven shafts become freed the one from the other, whilst with the usual types of coupling devices, the powder, after the device has operated, often jams the rotor to a more or less great extent, so that when rotation has stopped, there is still a certain coupling between the two shafts.

The coupling device in accordance with the invention is essentially constituted by a casing, the interior of which is generally shaped like a lens, in which is arranged a rotor in the form of a disc or a ring provided with corrugations disposed radially, the depth of which increases from the interior towards the exterior of this ring.

During the putting into engagement of the clutch, there are formed, at the periphery of the rotor and towards the summits of the corrugations, small piles of powder which are wedged hard between the rotor and the casing and thus ensure the coupling between these two portions of the clutch.

In fact, by virtue of the lenticular shape of the casing, the centrifugal action of rotation on the powder causes the powder to be compressed in the region of the periphery of the casing. This effect of compression in the radial direction is accentuated by the tangential sense of the projecting portions of the rotor corrugations; and finally, the inclined faces, in the tangential sense, of the rotor corrugations also result in a compression of the piles of powder, this time in the tangential direction.

The powder situated at the summit of each of the corrugations is thus doubly compressed, in the radial direction and also in the tangential direction, in such a manner that there are obtained, at these points, even with metallic powders which have no inherent properties of cohesion and which behave almost like fluids, agglomerations or heaps of powder which ensure a non-slip coupling between the casing and the rotor.

By virtue of the multiple forces acting on the piles of powder, and which ensure their cohesion, these piles can present without any advantage, a fairly considerable thickness. In consequence, when the device is stopped and the forces acting on these piles vanish, the powder disintegrates and the heaps collapse spontaneously; the rotor and the casing are thus automatically de-coupled without any risk of permanent binding.

The uniform corrugations of the rotor give rise to equal thrusts on the two sides of the latter; these thrusts balance out and, in consequence, it is not necessary to reinforce the rotor specially and it may even be manufactured, for example, by simply pressing out a disc or a ring of sheet steel.

The description which follows below in respect of the attached drawings (which are given by way of example only and not in any sense by way of limitation) will make it quite clear how the invention may be carried into effect, the special features which are referred to either in the drawings or in the text, forming clearly a part of the said invention.

Fig. 1 is an axial cross-section of a powder-clutch constructed in accordance with the invention.

Fig. 2 is a section through II—II of Fig. 1.

Fig. 3 is an enlarged and developed cross section through III—III of Fig. 2.

Fig. 4 is an enlarged elevation of a segment of rotor intended to show the location of the wedged piles of powder.

Fig. 5 is a perspective view of the volume taken up by a pile of wedged powder.

Fig. 6 shows in axial semi-cross-section an alternative embodiment of the clutch in accordance with the invention.

The powder-type coupling device shown in Fig. 1 is intended to couple together in rotation two shafts 1 and 2 of which either one can be the driving and the other the driven shaft. The end plate 1a of the shaft 1 is integral with the lenticular casing 3 formed by two portions assembled together by bolts 4. One of the parts of the casing is fixed to the end plate 1a by bolts 5, whilst on the other a surface bearing 7 on which the casing rotates with respect to the shaft 2.

On the other side, this shaft 2, provided with an end plate 2a carries the rotor 9 which is fixed by means of a ring 22 and bolts 10.

The rotor 9 is a ring of steel sheet provided with corrugations 9a arranged radially, and the depth of which increases from the central portion towards the edge of this ring.

The casing contains a metallic powder 11 which can be introduced through a plug 12. In order that this powder shall not escape through the periphery of the casing, the internal faces of each of the parts of the casing, the end plate 2a and the ring 22 are provided with grooves 13 in which are housed felt rings 14.

When either the one or the other of the shafts 1 or 2 is rotated, the powder is forced outwards inside the casing by centrifugal force and thus spreads around the periphery of the latter. By virtue of the shape, approximately that of a wedge, of the radial section of this casing, the layers of powder at the periphery are pressed hard against each other by centrifugal force. This radial compression is still more marked with respect to the salient portions of the two faces of the rotor by reason of the inclination, in the radial direction, of these salient parts, which inclination is due to the increasing depth in the radial direction of the said corrugations. The edge of the ring 9 moves through the powder thus compressed at the periphery of the casing so long as the two shafts are not locked together whilst rotating.

As may be seen in Fig. 3, each of the crests of the corrugations, on the two faces of the ring, pushes before it, in a way, in the direction of its movement, a certain
quantity of powder already compressed and this pushing effect is a maximum in the neighborhood of the parts 21 of the rotor, where the space between the casing and the rotor is most reduced and where the powder is relatively most compressed. There is thus very rapidly produced a jamming effect between the ring 9 on the one hand and the small piles of powder 15 in the neighborhood of the parts 21 on the other hand.

By reason of the lenticular shape of the casing and also the increasing depth of the corrugations towards the periphery of the rotor, these piles of powder assume the shape of small prisms 15, approximately triangular, the bases of which, on the rotor and on the casing, are oblique with respect to the edges (Figs. 4 and 5).

By virtue of the shape of the rotor and the casing, these small prisms are, in a way, shaped three ways to the form of a wedge; on the one hand in two ways in the radial direction, and on the other hand in the tangential direction, their face 18 being considered as of nearly constant height.

When the rotary movement is stopped, the powder is no longer compressed and loses its cohesion so that each of the prisms disintegrates progressively, on the one hand in the radial direction (arrow 16), that is to say from the center towards the periphery and on the other hand in the tangential sense (arrow 17), that is to say from the bottom of one corrugation towards the summit of the same corrugation. It is, in fact, along the face 18 that the height of the prisms of powder is the greatest and that, in consequence, these piles are the least stable.

Because of the double direction, both in the case of the binding action and the disintegration of the piles of powder, the binding action of the piles is very efficient on the one hand, even if the thickness of the piles is fairly considerable, whilst, on the other hand, the binding action totally disappears, in practice, as soon as the rotation is stopped.

The arrangement of the rotor and of the casing in accordance with the invention thus provides not only a very efficient means of ensuring the binding of the powder, but also a means of disintegration of the piles of powder as soon as rotation stops.

The torque transmitted may be very high, since the quantity of powder jammed may be considerable; the number of the piles wedged against the rotor is considerable and, in addition, the connection between the casing and the rotor is essentially obtained at the extreme periphery of the latter. A complementary advantage results from this: such a coupling device constitutes an efficient power limiting arrangement. In fact, if the torque transmitted tends to increase in an abnormal manner, the prisms 15 are destroyed and the binding of the rotor in the casing can no longer take place.

In the alternative embodiment shown in Fig. 6, the casing 3, which is integral with the shaft 1, comprises an internal partition 19 which divides the casing into two symmetrical portions, each of which is almost lenticular in shape. In these two casings are located two rings 9 which are integrally mounted on the shaft 2 by means of bolts 10 and a stay ring 20. Other things being equal, the torque which can be transmitted by a clutch of this type is twice that which can be transmitted by the coupling device shown in Fig. 1.

It will be clearly understood that modifications may be made to the methods of embodiment which have just been described, in particular as concerns the use of equivalent technical means, without thereby departing from the scope or from the spirit of the present invention.

This application is a continuation-in-part of my co-pending application Serial No. 217,927, filed March 28, 1951, now Patent No. 2,771,170, granted November 20, 1956.

I claim:

1. A mechanical coupling device of the type employing a subdivided solid material as a fluid coupling medium comprising a substantially circular casing formed of two interconnected portions, each of said portions having an inner surface, said inner surfaces defining a cavity within said casing for containing said medium, said inner surfaces tapering toward one another in a radially outward direction of the casing and being disposed in adjacent relationship at the outermost portion of said cavity, said medium being adapted to be disposed by centrifugal action packingly in the outermost portion in said cavity when the casing is rotated about its axis, a support hub extending coaxially within said housing and being of substantially less diameter than said cavity whereby the support hub is unsubmerged in the medium when the same is packingly disposed in the outermost portion of the cavity, said hub having a radially extending portion, said support hub and casing being rotatable with respect to one another, and a substantially annular coupling member comprising a sheet metal blade, said radially extending portion having at least one substantially radially extending surface, means for securing said blade to said last mentioned surface, the outermost portion of said blade being disposed adjacent the outermost portion of said cavity and disposed adjacent the inwardly tapered portion of the inner surfaces of the casing portions, the outer portions of said blade having formed therein a plurality of substantially radially extending corrugations the width and depth of which increase toward the outermost portion of said blade, whereby under the influence of centrifugal force during rotation of the apparatus, said corrugations and adjacent tapered surfaces of the casing cooperate to form substantially wedge-shaped piles of said fluid coupling medium which ensure a non-slip coupling between said coupling member and the casing, and yet which ensures substantially instantaneous collapse of the piles upon cessation of rotation of the apparatus thereby automatically decoupling the coupling member from the casing without any risk of permanent binding.

2. Apparatus as defined in claim 1, wherein said securing means comprises at least one bolt threadedly mounted in said radially extending portion.

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