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(54) IMPROVEMENTS IN OR RELATING TO FLEXIBLE COUPLINGS

(71) We, SOCIETE INDUSTRIELLE DE TRANSMISSIONS, a French Body Corporate, of 116, rue Danton, 92 Levallois Perret, France, do hereby declare the invention,

for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

The present invention relates to flexible couplings of the kind having a female element which is fitted with resilient radial inserts which are held by their ends in the hub and outer ring of the element, and a male element carrying spigots which fit between the resilient inserts. Hereinafter such couplings will be referred to as "of the kind described". Such couplings are intended to transmit torque between two shaft ends with a degree of flexibility which allows occasional irregularities in the transmitted torque to be taken up and also permits some misalignment between the shaft ends.

In known couplings of the kind referred to, the resilient inserts are formed by rubber blocks of rectangular section whose ends are set into recesses in the hub and outer ring of the female element and which, in operation, flex at the centre under the thrust from the spigots on the male plate. Because the resilient inserts operate in flexion in this way, there occur in service on the one hand fatigue to the rubber accompanied by gradual extrusion, chiefly near the edges of the recesses, and on the other hand abrasion wear resulting from the faces in contact of the inserts and spigots slipping relative to one another, in particular when the shafts are out of alignment. It may thus become necessary to replace the worn and distorted rubber inserts periodically. Therefore, such couplings, which are after all fairly simple and cheap, are generally reserved for ordinary applications in which the radial or angular misalignment permitted between the shafts is fairly small and in which the torsional elasticity allowed by the rubber inserts does not exceed approximately 5°. Such couplings are sometimes called semi-flexible by contrast with other tyres or coupling of greater flexibility.

The invention has as a general object to increase the performance of such couplings, and in particular the life of the rubber inserts so as to increase the interval between renewals, while at the same time retaining the intrinsic qualities of couplings of this kind, and particularly their simplicity, the ease with which they are fitted and removed, and their quietness in operation. The invention also has an object, by improving the way in which the rubber inserts operate, either to increase the level of torque which can be transmitted or to reduce the bulk of the couplings by endowing them with a more compact form.

The invention consists in a flexable coupling of the kind described wherein the corresponding lateral contact surfaces of the resilient inserts and the rigid spigots are substantially V-shaped having apices which are respectively concave and convex in the circumferential direction, and wherein the central part of each of the resilient inserts has a circumferential width at least equal to the remaining radial height of the inserts, this circumferential width increasing towards the parts of the inserts respectively held by the hub and the outer ring so that the inserts operate principally in combined compression and shear when transmitting torque in cooperation with said male element.

In order that the invention may be more clearly understood, reference will now be made to accompanying drawings which show some embodiments thereof

compared with prior art couplings, and in which:

Figs. 1 and 2 show a prior art device female and male element respectively,

Figs. 3, 4 and 5 show a first embodiment, with Fig. 3 being a perspective view of the two parts of the coupling in the separated position, Fig. 4 being an elevation view in axial section on line 4.4 of the two parts when assembled, and Fig. 5 being a sectional end-on view on 5.5,

Figs. 6 and 7 are detail views to an enlarged scale of a resilient insert for this coupling and the way in which it operates in the coupling when in use,

Figs. 8 and 9 are a side view in axial section along the line 8-8 of Fig. 9 and an end-on view in section along the line 9-9 of Figure 8, respectively, of another embodiment of the invention.

Referring now to the drawings, Figs 1 and 2 respectively show the female and male element of the prior art coupling hereinabove referred to in which the female element is shown at 1 fitted with with resilient radial inserts 2 held by their ends in the hub and outer ring of element 1, the male element being shown as a plate 3 carrying spigots 4 which are intended to fit between the resilient inserts 2 on the female element 1.

In a similar fashion, an embodiment of a coupling according to the invention consists of two main parts, namely a female element 10 fitted with resilient inserts and a male element in the form of a plate 11 having rigid drive spigots, these parts being attached to the extremities of respective ones of aligned shaft-ends 12, 13 by any suitable means such as keying, radial locking screws, expanding bosses, or flanges. The assembly is symmetrical about a diametral axis so as to be able to operate in both directions of rotation.

The resilient element 10 has a bored hub 14 and an outer ring 15 which is connected to the hub by a web 16, the hub and the outer ring forming between them a circular recess in which are mounted resilient radial inserts 17 of rubber which are spaced apart from one another. To this end, the facing cylindrical surfaces of the hub and outer ring contain longitudinal slots which face each other radially and in which are inset the ends of the resilient inserts 17. Between them the inserts leave openings 18.

In the case of Figs. 3 to 5, the other part 11 also has a bored hub 19, which is secured to a cirular flange which carries, on one face, rigid spigots 20 parallel to its axis. These spigots are laid out on a pitch circle whose diameter corresponds to that of the circular recess in the female element and are spaced apart by a distance corresponding to the width of the openings 18 so that they can fit into the latter when the coupling is in the assembled state. The axial length of the spigots is equal to or slightly greater than that of the resilient inserts fitted into element 10. In operation, one of the lateral faces of the spigots 20 comes into contact with the corresponding lateral face of the inserts 17 to transmit the torque.

Figs. 6 and 7 are enlarged scale views showing the shape of the resilient inserts 17 and of the parts of the coupling which directly co-operate with these inserts. Instead of being in the shape of a block of uniform rectangular section as is normal in known couplings, each insert 17 has lateral contact faces 21 which form between them a V whose included angle is 90° and whose point is rounded off with a wide radius, so that the circumferential width of the insert is at a minimum (E) in its central portion situated in the plane of its pitch circle and increases towards the ends which are inset into the slots in the hub and outer ring. This minimum circumferential width E of the insert is at least equal or slightly greater than the radial height H of the recess separating the hub 14 from the outer ring 15 of element 10 and this height is also the remaining radial height of the inserts as it excludes those parts of the inserts which are held in the hub and outer ring respectively. The ends of the lateral faces 21 join up with the inset ends of the inserts at longitudinal shoulders 22 which rest against the cylindrical surfaces of the hub and outer ring near the seating slots. Finally, the inset ends of the insert have oblique and convergent lateral bearing faces 23 which in operation form an angle of 15 to 20° with their respective opposing contact faces 21. These lateral faces 23 connect up with the bearing faces of the edges 22 via radiused corners. The slots into which the ends of the inserts are inset will obviously have faces whose configurations correspond to those just described for the inserts, the dimensions being such as to ensure that the inserts are gripped in the slots when fitted.

The spigots 20 on the male plate 11 of the coupling have lateral contact faces 25 in the shape of a V with a rounded point corresponding to the V shape of the lateral contact faces 21 of the inserts 17. The width of the spigots in the circumferential direction is slightly less than the circumferential width of each of the openings 18 so that the spigots fit between the inserts 17 with a slight clearance. Their radial height is slightly less than the radial height H of the recess in the female element so as to allow a clearance corresponding to the permitted amount of radial and/or

angular misalignment between the shafts to be coupled and to allow for manufacturing tolerances.

Fig. 7 shows the shape of a resilient insert when at rest in broken lines and the form which it assumes in operation together with the position of the drive spigots 20, in solid lines. It can be seen that the V-shaped working part of the spigot fits into the central part of the insert and deforms it in the direction of rotation. In the course of this deformation, a considerable part of the rubber of the inserts lying between the V-shaped contacting faces 21 and 25 and the opposing oblique bearing faces 23 is essentially in compression and shear combined when it acts to transmit the torque between parts 10 and 11, while the rest of the central part of the insert is mainly in flexion. The flexing operation of the insert is thus reduced and does not constitute the main proportion of its operation when driving. Its driving effect is derived more from the combined shear and compression operation of the rubber (illustrated by the broken lines of force) which, for the same volume of rubber, enables a higher torque to be transmitted, or alternatively a smaller volume of rubber to be used in the inserts 17 to transmit torque of the same level, thus allowing the size and bulk of the coupling to be reduced. A particularly substantial gain in respect of bulk may be achieved in the radial direction by reducing the radial dimension h to which the ends of the inserts are inset to approximately 0.3 to 0.5 of the free, remaining radial height H of the inserts.

The way in which the inserts operate by compression/shear of the rubber is mainly the result of the V shape given to the contacting faces 21 and 25 of the inserts and spigots, and also of the obliquity of the bearing faces 23 of the inserts in the slots in which they are inset. Also, the effect of the angle 15 to 20° between the contacting faces 21 and 25 and the bearing faces 23 is that, while the rubber is operating in compression, it is thrust towards the end faces 24 of the seatings and resists being extruded into the passage of height H. By making the angle A between the V faces 21 and 25 approximately 80 to 100°, it is ensured that the share which compression has in the combined compression and shear stresses is a maximum one, and better resistance to fatigue and to cold-flow deformation by the rubber is also obtained. The interengagement of the V surfaces and the rounded shapes given to the edges resist or reduce relative slipping between the surfaces in contact and reduce the abrasion wear on the inserts, particularly in misaligned operation. The overall effect is thus to assist in increasing the life of the reslient inserts and in lengthening the intervals between renewal.

It can also be seen from Figs. 3 to 5 that the ends of the spigots on plate 11 may be thinned down by a bevelled cut-away (see 26 in Fig. 4) to lighten them and reduce stresses of centrifugal origin at high speeds of rotation.

Two of the spigots 20_1 and 20_2 in diametrically opposed positions have safety ribs 27 on the outside which are intended to butt against steps 28 in the outer ring of the element 10 to provide the rotary drive in the event of the resilient inserts 17 failing. Similar ribs and steps may be provided on all the spigots 20 on plate 11 and in all the openings 18 in element 10.

In another embodiment, which is illustrated in Figs. 8 and 9, the female element 10 has two additional longitudinally directed spigots 35 which are arranged 180° apart, between the recess which accepts the inserts and the bore in hub 14. The plate 11 likewise has two additional longitudinal spigots 36 180° part which are positioned at the same radius between the spigots 20 and the bore in hub 19. When the assembly is fitted together axially there is thus formed a safety dog-clutch.

In this case the hub 19 of the male plate may contain recesses 24′, which may for example be four in number arranged 90° apart and such that they are positioned between successive spigots 35, 36 of the dog-clutch on a separate spigot-bearing ring 30. These recesses enable the resilient inserts 17 to be extracted from the female element by sliding them out axially when they have to be replaced, having previously removed the rug 30.

In the couplings described above, the resilient inserts 17 are made of a vulcanised rubbery mixture based on a suitable elastomer such as natural rubber, nitrile rubber, chloroprene, an ethylene - propylene-diene terpolymer, or polyurethane, as dictated by the applications and conditions of operation anticipated for the couplings. The vulcanised rubbery mixture preferably has a fairly high Shore A hardness, of the order of approximately 80 to 85. Since the inserts are of constant section throughout their length they may be produced by extrusion through a die to give the appropriate cross-section and by cutting up the extrusion, or again by moulding.

Attention is directed to claim 1 of our co-pending Application No. 33752/79, divided herefrom serial no. 1 580 552.

WHAT WE CLAIM IS:—

1. A flexible coupling of the kind described wherein the corresponding lateral contact surfaces of the resilient inserts and the rigid spigots are substantially V-shaped

having apices which are respectively concave and convex in the circumferential direction, and wherein the central part of each of the resilient inserts has a circumferential width at least equal to the remaining radial height of the inserts, this circumferential width increasing towards the parts of the inserts respectively held by the hub and the outer ring so that the inserts operate principally in combined compression and shear when transmitting torque in cooperation with said male element.

2. A coupling as claimed in claim 1, wherein the V-shaped engaging surfaces of the inserts and the spigots form an angle of the order 80 to 100°.

3. A coupling as claimed in claim 1, wherein the inserts are held in slots in the hub and outer ring respectively and the co-operating bearing faces of the inserts and of the slots are oblique and convergent.

4. A coupling as claimed in claim 3, wherein the parts of the inserts held in the slots are connected to the remaining parts by shoulders which bear against the surfaces of the hub or outer ring respectively on either side of said slots.

5. A coupling as claimed in claim 1, 2, 3 or 4, wherein the radial height of the inset parts of the resilient inserts is between 0.3 and 0.5 times the remaining radial height of the inserts.

6. A coupling as claimed in any of the preceding claims, wherein the resilient inserts are made of a vulcanised rubbery mixture which has Shore A hardness of the order of 80 to 85.

7. A coupling as claimed in any of the preceding claims, wherein the spigots are thinned down at the ends.

8. A coupling as claimed in any of the preceding claims, wherein one or more spigots have a safety rib which may abut against corresponding steps in the openings against corersponding steps in the openings in the resilient element in the event of the resilient inserts failing.

9. A coupling as claimed in any of the preceding claims, wherein the male plate and the female element each have longitudinally directed spigots which are laid out at the same radius and which insert themselves between one another to form a safety dog-clutch.

10. A lexible coupling substantially as hereinbefore described with reference to Figs. 3 to 7 of the accompanying drawings.

11. A flexible coupling substantially as hereinbefore described with reference to Figs. 8 and 9 of the accompanying drawings.

BARON & WARREN,
16, Kensington Square,
London, W8 5HL.
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1580551 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1

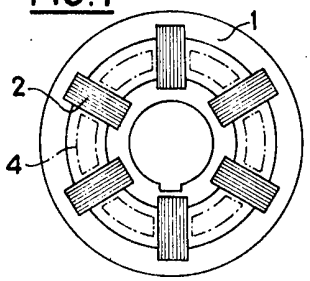


FIG. 2

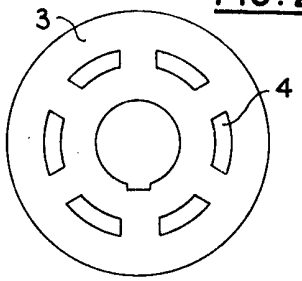


FIG. 3

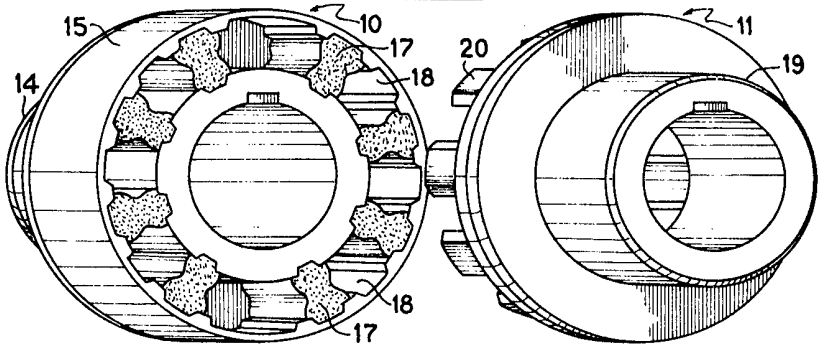


FIG. 4

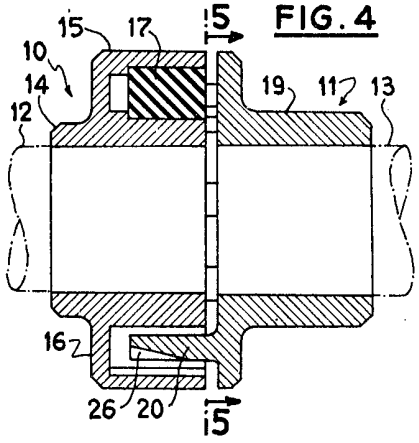


FIG. 5

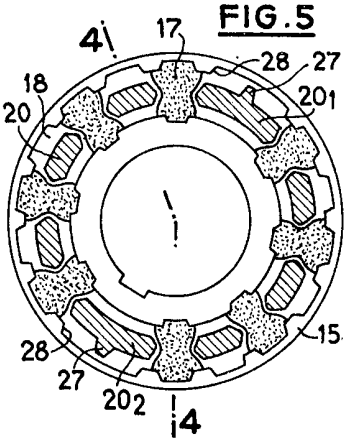


FIG. 6

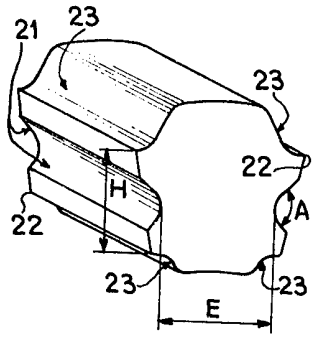
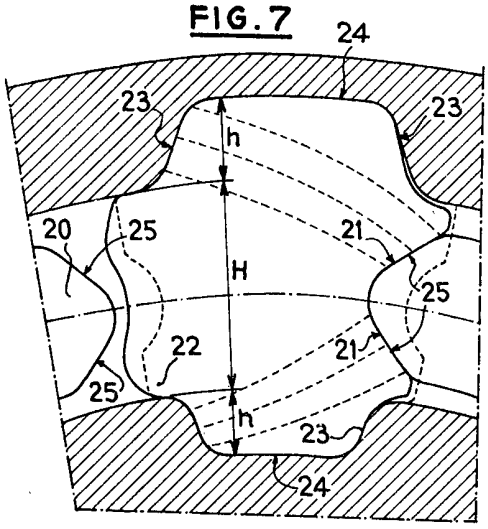


FIG. 7



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Sheet 3

FIG.8

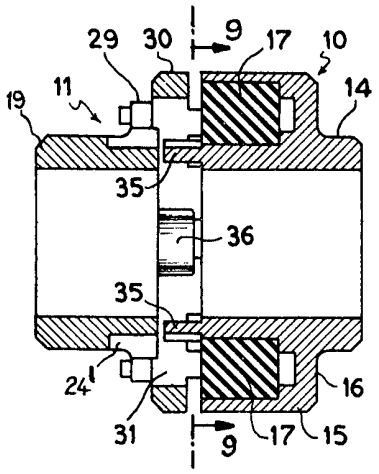

FIG.9