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(71) Applicant
Uni-Cardan Aktiengesellschaft

(Incorporated in FR Germany)

Alte Lohmarer Strasse 59, D-5200 Siegburg, Federal Republic of Germany

(72) Inventor
Herbert Taureg

(74) Agent and/or Address for Service
B C Robertson B Thorpe G M Dodd
GKN plc, Group Patents & Licensing Dept,
P O Box 55, Ipsley House, Ipsley Church Lane,
Redditch, Worcestershire, B98 0TL

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(54) Viscous shear coupling

(57) A viscous shear coupling comprises an inner coupling part and an outer coupling part supported on the inner coupling part to define a sealed annular space wherein are disposed annular plates rotationally fast with the inner coupling part interleaved with annular plates rotationally fast with the outer coupling part, the space being partially filled with a viscous liquid and the remainder of the space occupied by a gas. The plates are provided with perforations (2, 3) whose total volume is greater than the volume of gas contained in the coupling under atmospheric pressure, so that in use gas bubbles (5) in the viscous liquid tend to lodge in the perforations in the plates (upper Fig. 2) rather than between opposed surfaces of the plates (lower Fig. 2), thereby improving the torque transmitting ability of the viscous coupling.

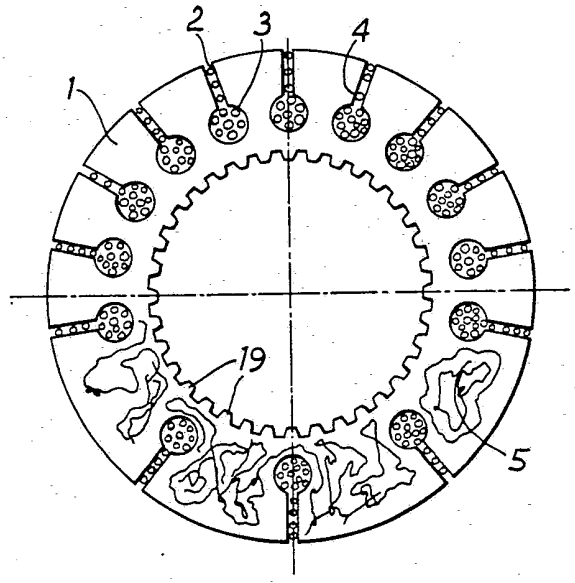

Fig. 2

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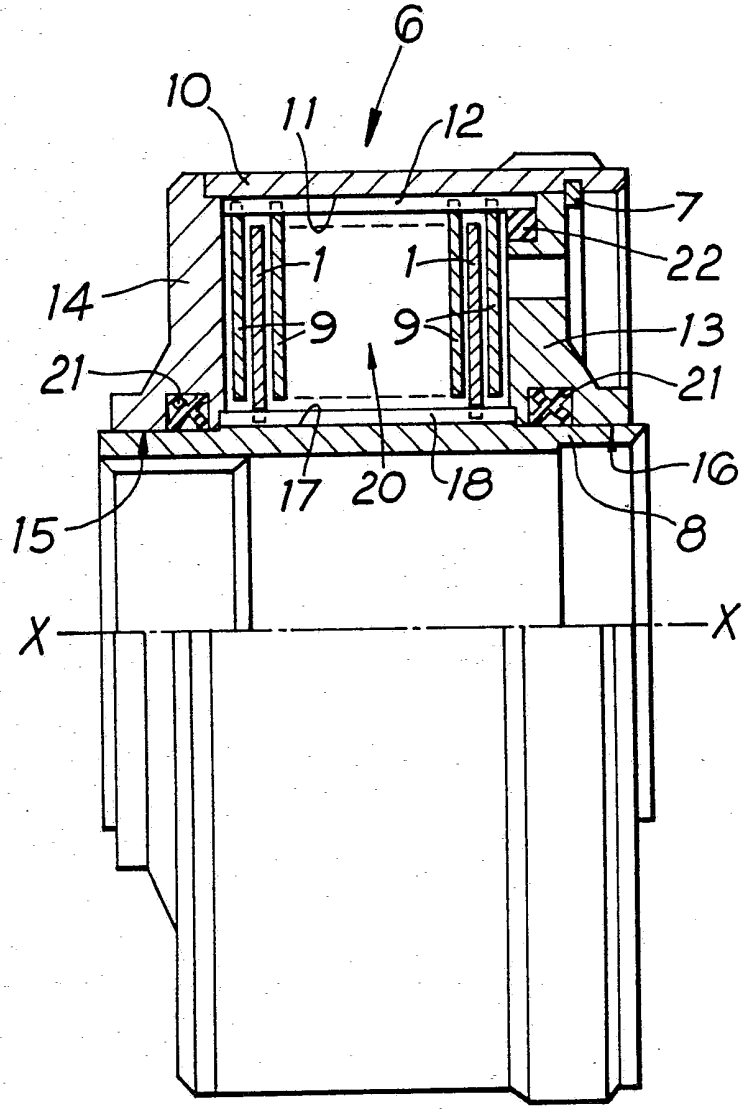

Fig. 1

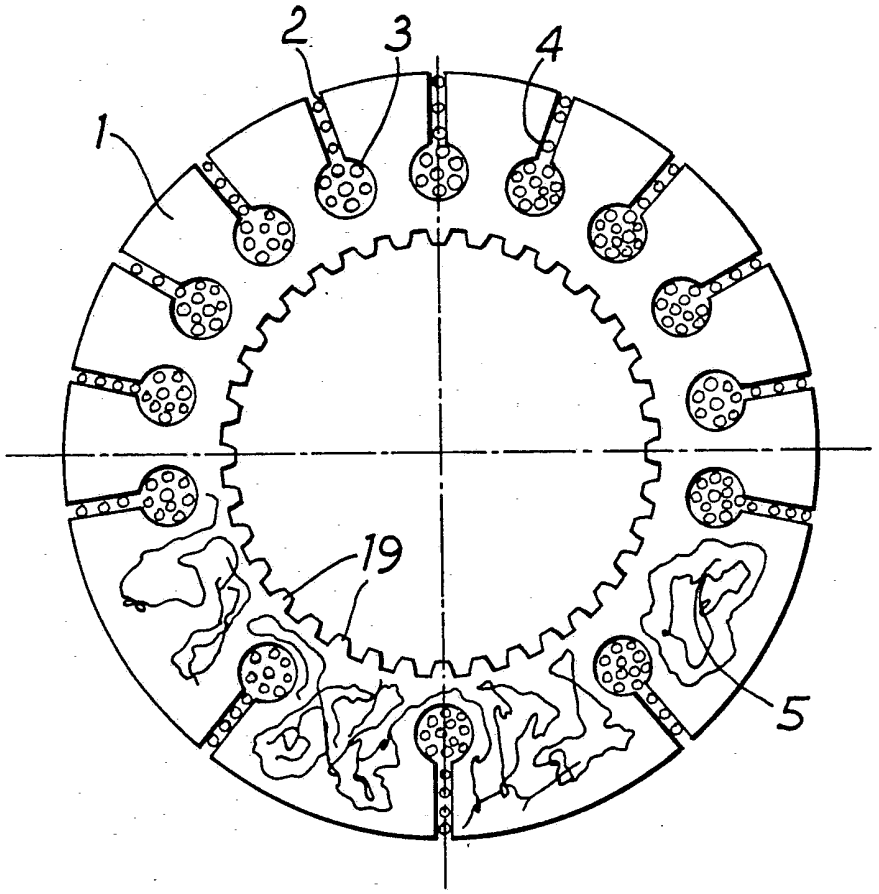

Fig. 2

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VISCOUS COUPLING

This invention relates to a viscous coupling comprising a first coupling part and a second coupling part in the form of a housing rotatably supported on the first coupling part to define a sealed annular space therewith, and a plurality of annular plates disposed between the first and second coupling parts in said space, the plates comprising plates which are rotationally fast with the first coupling part interleaved with plates which are rotationally fast with the second coupling part, the annular space wherein the plates are disposed being partially filled with a viscous liquid and the remainder of the space being occupied by a gaseous medium. The plates are provided with perforations, which may be closed apertures in the plates, or shaped slots extending generally radially therein, or a combination of both. Such a viscous coupling will hereafter be referred to as a viscous coupling of the kind specified.

To provide the plates in a viscous coupling with perforations is known from DE-OS 2607353. The provision of such perforations permits an improvement in the torque transmitting ability of the viscous coupling. However, such disclosure is purely qualitative and does not give any information as to any relationship between the nature of the perforations and the torque transmitting behaviour of a viscous coupling.

It is the object of the present invention to improve the torque transmitting characteristics of a viscous coupling by optimising the arrangement of the perforations in the plates thereof.

According to the present invention, we provide a viscous coupling of the kind specified wherein the ratio of the total volume of the perforations in the plates to the volume of the enclosed gaseous medium under atmospheric pressure is greater than one.

The invention is based on the discovery that in use of the viscous coupling bubbles of air can tend to occur between adjacent plates and, where such bubbles form, the affected parts of the plates cannot participate in torque transmission by shear in the fluid between the plates.

It is necessary to provide a certain quantity of gas, normally air, in a viscous coupling in order to permit the volume of the viscous liquid to increase as its temperature rises. According to the invention, by providing the plates with perforations whose total volume is greater than that of the volume of gas in the coupling under atmospheric pressure, it is ensured that when the coupling is in use and adjacent plates rotate relative to one another, the gas which becomes distributed in the viscous liquid in the form of small bubbles is able to settle in the perforations in the plates. Hence the viscous liquid which transmits torque between the plates is free or substantially free from gas bubbles.

The invention will now be described by way of example with reference to the accompanying drawings, wherein:-

Figure 1 is a partly sectioned elevation of a viscous coupling to which the invention may be applied;

Figure 2 is an axial view of a plate for the viscous coupling, with the lower half showing a plate according to the state of the art and the upper half showing a plate according to the invention.

Referring firstly to Figure 1 of the drawings, the viscous coupling there shown comprises a first, inner, part 8 and a second, outer, part 6. The part 8 is in the form of an internally splined sleeve to be received on a shaft rotatable about axis X-X. The outer part 6 of the coupling forms a housing, and comprises a tubular part 10 which at its one end is welded to an annular end piece 14 and at its other end is able to receive a removable annular closure member 13 held in place by a spring ring 7. An annular seal 22 ensures fluid tightness between the closure member 13 and the tubular member 10. End portions of the external surface 17 of the inner coupling part 8 are formed as bearing surfaces, and the end piece 14 and closure member 13 have bores 15, 16 respectively which are received on such surface parts so that the outer part of the coupling is rotatably received on the inner part 8 thereof. Seals 21 provide for fluid tightness at such rotary support.

In its central region between its end parts on which the parts 14, 13 are received, the inner part 8 of the coupling is provided with external circumferentially spaced axially extending teeth 18. The tubular member 10 is provided in its interior 11 with similar internal teeth 12. A plurality of annular plates occupy the space between the parts 8, 10, and these plates comprise plates 1 which are internally toothed so as to be rotationally fast with the inner coupling part 8, interleaved with plates 9 which are externally toothed so as to be rotationally fast with the outer part of the coupling.

The internal space 20 of the viscous coupling which is not occupied by the plates 1, 9 is partially filled with a viscous liquid, usually a silicone oil, the remainder of such space being occupied by a gaseous medium, usually air.

Referring now to Figure 2 of the drawings, there is shown a plate of the visous coupling. It is one of the plates 1, provided with internal teeth 19 to engage the teeth 18 on the inner coupling part 8. The plate is provided with perforations, which in the particular example shown comprise radial slots 2 extending into circular perforations 3.

As has been above described, it is known to provide the plates in a viscous coupling with perforations. However, it has been found that in use the gas contained in the viscous coupling can form thin laminar gas bubbles as indicated at 5, between the unperforated parts of adjacent plates.

According to the invention, the plates in a viscous coupling are provided, as shown in the upper half of Figure 2, with a greater number of perforations 2, 3 such that their total volume is greater than the volume of gas in the viscous coupling under atmospheric pressure. In use, the gas which becomes entrained in the viscous liquid is deposited as spherical bubbles 4 in the perforations 2, 3, and the tendency for laminar bubbles 5 to form between the unperforated parts of the plates is reduced or eliminated. The faces of the plates between which shearing forces in the viscous liquid is effective for torque transmission are free or substantially free from gas bubbles, so that their entire area can contribute towards torque transmission.

The form of the perforations 2, 3 which has been illustrated above is exemplary only, and other configurations of perforation could be utilised. Further, although only one of the plates 1 has been illustrated, it will be appreciated that the plates 9 are also analogously provided with perforations. For each plate, the volume of its perforations comprises the surface area of the perforations as the plate is viewed axially as in Figure 2, multiplied by the thickness of the plate. According to the invention, it is the ratio of the total volume of the perforations in all the plates to the volume of the gas enclosed in the viscous coupling, under atmospheric pressure, which is greater than one.

CLAIMS

1. A viscous coupling of the kind specified wherein the ratio of the total volume of the perforations in the plates to the volume of the enclosed gaseous medium under atmospheric pressure is greater than one.

2. A viscous coupling substantially as hereinbefore described with reference to the accompanying drawings.

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