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(54) COUPLING AND BRAKING APPARATUS FOR AN INTERMITTENTLY DRIVABLE MACHINE DRIVE SHAFT

(71) We, ORTLINGHAUS-WERKE GmbH, a body corporate organised and existing under the laws of the Federal Republic of Germany of Kenkhauser Strasse, 5678 Wermelskirchen, Federal Republic of Germany, 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 invention relates to coupling and braking apparatus for an intermittently drivable machine drive shaft.

The machine may be a press and the coupling and braking apparatus is of the kind which includes a drivably rotatable clutch plate, a stationary brake plate, an axially movable pressure plate mounted between the clutch plate and the brake plate secured against rotation with respect to the machine drive shaft and movable alternately into engagement with the clutch plate and the brake plate by a pressure medium and oppositely acting spring loading, and a respective opposed flange to be engaged by the faces of the clutch plate and brake plate opposite to the faces thereof which are engaged by the pressure plate, the opposed flanges being connected by torque-transmitting members to an associated support element secured against rotation with respect to the machine drive shaft.

In such apparatus where a quick action is required to effect a drive coupling or braking, considerable force is required to effect the axial movement of the pressure plate towards either the clutch plate or the brake plate. In shifting of the apparatus between the coupling and braking states such considerable force is provided by the pressure medium and by the spring loading.

A great disadvantage is that the changeover is accompanied by loud shifting noises, und these become louder the more rapidly and effectively the apparatus has to be transferred between its coupling and braking states. The impact forces involved shorten the lift of the components involved.

According to the invention there is provided coupling and braking apparatus for an intermittently drivable machine drive shaft, comprising a drivably rotatable clutch plate, non-rotatable brake plate, an axially movable pressure plate mounted between the clutch plate and the brake plate, secured against rotation with respect to the machine drive shaft and movable alternately into engagement with the clutch plate and the brake plate by a pressure medium and oppositely acting spring loading, and a respective opposed flange to be engaged by the faces of the clutch plate and the brake plate opposite to the faces thereof which are engaged by the pressure plate, the opposed flanges being each connected by torque-transmitting means to an associated support element secured against rotation with respect to the machine drive shaft, wherein one or each of the opposed flanges is axially movably mounted on its associated support element, and resilient members are disposed between the or each axially movable flange and its associated support element.

Thus at least one of the opposed flanges is resiliently mounted. In conjunction with the axial mobility of the clutch plate and brake plate for reasons of wear, the or each opposed flange can yield when the pressure plate is shifted. However, it is pressed against the opposite *i.e* axially outer, face of the clutch plate or brake plate with a correspondingly strong counter force by the interposed resilient members, resulting in rapid transfer of the torque with a driving or braking action. The impacts which occur when the pressure plate is shifted can be absorbed flexibly and resiliently without detracting from the effectiveness of the braking or coupling action. Tests have shown that this gives surprisingly strong damping of the noises which occur during the shift. In this way not only is the noise level lowered but the life of the components involved is lengthened.

Although a wide variety of resilient members could be used between the or each opposed flange and its associated support element, such as coiled compression springs or elastic blocks, the use of plate springs has proved successful, both in respect of the desired resilient properties and for reasons of good heat insulation between the opposed flange under stress and the associated support element connected to the shaft. In the simplest case the plate springs are fixed to the opposed flange by screws, while the screw head is sunk into a recess of adequate size in the support element. Although not so favourable for assembly reasons, the plate springs could conversely be fixed to the support element.

For the or each axially movable flange and its associated support element, the axial mobility, *i.e* drive connection permitting relative axial movement, of the opposed flange on the support element, is obtained in the simplest case by bolts which are fixed at one end in the opposed flange, while the other end of the bolt is guided axially movably in a corresponding recess in the support element. A converse disposition is obviously also possible. The bolts are arranged in the annular zone of the apparatus which contains the connecting screws provided to support the plate springs. The connecting screws alternate with the bolts within the annular zone.

Another arrangement which is simpler from the assembly point of view is for the desired drive connection, permitting relative axial movement between the or each axially movable flange and its associated support element, to be formed by complementary radial profiles between the opposed flange and the support element. Sets of teeth on the two components, engaging into one another would make suitable profiles. In the course of the axial movement the inter-engaged sets of teeth are moved longitudinally relative to one another. The resilient members such as plate springs always press the opposed flange back into its inital position relative to the associated support element, after absorbing the shock that occurs during shifting.

The opposed flange is thus not axially fixed to its support element. The degree of yielding of the opposed flange when the apparatus is shifted is determined by the compressibility of the interposed resilient members disposed between the stationary support element and the movable opposed flange. The maximum outward thrust of the flange from its support element is limited by appropriate stops on its axial connection, such as stopping shoulders or stopping collars or heads on the bolts.

The invention is diagrammatically illustrated by way of example in the accompanying drawings, in which:-

Figure 1 is a longitudinal section through half of one embodiment of coupling and braking apparatus according to the invention, the other half being generally symmetrical therewith;

Figure 2 is a front elevation of the inner part of the apparatus of Figure 1, and includes a line I-I on which the section of Figure 1 is taken;

Figure 3 is a fragmentary sectional view taken on line III-III of Figure 2; and

Figure 4 is a view corresponding to Figure 3 but showing a further embodiment of the invention.

Referring to the drawings, combined coupling and braking apparatus 10 comprises a clutch plate 11, which is connected to a rotable drive member 15, such as a fly wheel, so that it rotates with it, by bolts engaging through a ring of holes 13. In mirror image to this the apparatus also includes a brake plate 12 which is connected to a non-rotatable member 16 by bolts engaging through corresponding holes 14. The plates 11, 12 are provided with friction linings 17, 17' and 18, 18' respectively on both sides. In order to compensate for the wear on the linings both plates 11, 12 are arranged to be axially displaceably on the bolts.

A pressure plate 20 which affects control of the coupling and braking state is located between the two plates 11 and 12. Its two broadsides interact alternately with the linings 17 and 18 on the clutch plate 11 and brake plate 12, and it is movable axially between the two plates 11 and 12 by a combination of pressure medium and springs. For this purpose the pressure plate 20 is joined by a web 21 to an annular piston 22, which is guided in an annular cylinder 23 in a flange-like support element 24. The piston 22 is sealed within the cylinder 23 by grooved ring seals 25,26. The pressure medium, preferably compressed air, is supplied to the cylinder 23 through a passage 27. The passage 27 is disposed in a hub 19, which is secured on a machine drive shaft (not shown), and on which the radially inner ring seal 25 of the annular piston 22 of the pressure plate 20 also slides. Compression springs 28 are provided to oppose the axial shifting movement of the pressure plate 20 emanating from the pressure medium. The springs 28 each bear at one end on the outside of the piston 22 and load it, in the direction of insertion into the cylinder 23, against the pressure medium. The other end of each of the compression springs 28 bears against a flange-like support element 30 of the hub 19.

The support element 30 carries stay bolts 31 for guiding the individual compression springs 28, the stay bolts being moulded integrally onto a respective spring supporting plate 32. The stay bolts 31 are arranged in an annular array on the support element 30. Supply of pressure medium to the cylinder 23 presses the pressure plate 20 into engagement with the lining 17 on the clutch plate 11, in opposition to the force of the springs 28. When the cylinder 23 is exhausted to atmosphere, the compression springs 28 return the plate 20 into engagement with the friction lining 18 on the brake plate 12. The support element 30 carries guide bolts 33, in an annular array, for directing and carrying torque; the bolts 33 are received axially in recesses in a flange 29 on the pressure plate 20.

Opposite the outer friction linings 17' and 18' of the two plates 11, 12 are opposed flanges 34, 40 respectively. In the coupling and braking state these interact with the axially outer faces of the clutch plate 11 and brake plates 12 respectively, *i.e* the opposite faces to those acted on by the pressure plate 20. Although the opposed flange 34 could be arranged in the special way described below, in the embodiment shown it is fixed to the support element 30 in the conventional way, here by being made integrally with it. For this purpose ribs 35 are provided on the support element 30 and have not only a mechanical reinforcing fuction but also a cooling fuction since they act as fan blades. Apertures 36 are provided radially inwardly of the opposed flange 34 to ventilate the interior of the apparatus. Radial apertures 37 in the pressure plate 20 are provided for the same purpose.

The opposed flange 40 carries comparable fan blades 38. However, the flange 40 is mounted on the flange like support element 24 with a special axially movable bearing 41, Figure 3. Resilient members, in the present case plate springs 42, are disposed between the opposed flange 40 and the support element 24. They are attached to the axially outer face of the opposed flange 40 by screws 43 engaged in tapped holes 44 in the flange 40. Behind the plate springs are compensating plates 45 on which they bear at one side. The support element 24 contains recesses 46 large enough to receive the heads 47 of the individual screws 43. The screw heads are not normally used to absorb torque during braking, since other components (shown in Figure 3) are provided for this purpose. Shoud these be inadequate, however, it is possible in an emergency for the flange 40 to be supported against being entrained for relative rotary movement with respect to the support element 24 by means of the screw heads 47.

Said other components shown in Figure 3 are as can be seen from Figure 2, disposed in the same annular zone 39 as that in which the plate springs 42 with their retaining screws 43 are provided. Said other components comprise three guide bolts 50 which extend in an axial direction with one end of each bolt 50 fixed in the opposed flange 40 and with the free end 52 engaged in a respective aperture 48 in the support element 24. The bolts 50 are axially displaceable in the apertures 48 when the plate springs 42 are resiliently compressed in the braking state of the apparatus. The pressure of the plate 20 against the axially movable brake plate 12, exerted by the springs 28, deforms the resilient members 42 and produces a buffer-like, yielding backward movement of the opposed flange 40, whereby the initial impact is absorbed and the noise damped. When the impact has been absorbed the plate springs 42 resume their original form, leading to a corresponding return movement of the flange 40. A stop washer 53, retained on the respective bolt 50 by a retaining member passing through the bolt, is disposed at each free end 52 to limit the return movement caused by the plate springs 42, to prevent the bolts 50 from becoming disengaged from the support element 24. In the case of the axial movement indicated by the double arrow 55 in Figure 3, a radially surface 56 of the annular opposed flange 40 slides over a corresponding shoulder 57 on the outside of the cylinder wall 49 of the cylinder 23, of the support element 24. Reinforcing ribs 58 are provided on the support element 24 in this region. The support element 24 is secured by bolts (not shown) to the hub 19, which engages about the machine shaft (not shown). Instead of the stop discs 53, screw on shoulders or heads could produce a stopping action to limit the movement of the guide bolts 50 in the support element 24.

In the example shown in Figure 4 a different kind of axial bearing 60 is provided so that when braking occurs relative rotation between the opposed flange 40 and the support element 24 is prevented. The resilient members are again in the form of plate springs 42; as far as they are concerned the operation is the same as in the embodiment of Figures 1 to 3. However in the embodiment of Figure 4, external toothing 61 is provided on the outside of the cylinder wall 49 to engage complementary internal toothing 62 on the radial inner edge of the opposed flange 40. There is a similar axial movement, indicated by a double arrow 63 in Figure 4, when the flange 40 moves back resiliently by virtue of the elastic yielding nature of the plate springs 42, when force is exerted by the pressure plate 20. To limit the extent of return movement a stop 59 is provided at the end of one set of toothing 61, so as to prevent any further axial movement of the internal toothing 62 along the outer toothing 61.

Any other inter-engaging radial profiles which allow the necessary axial movement and nvertheless provide a connection to prevent relative rotation of the opposed flange 40 and its support element 24 may be provided instead of the toothing 61, 62. Different, known, resilient members such as coiled compression springs may be employed instead of the plate springs 42. For the purpose of mounting the above-mentioned screws 43 for holding the plate springs 42, the heads of the screws may be provided with a recessed hexagon 64. These can be seen from the front elevation in Figure 2 and are easily accessible to an appropriate implement. The implement can be inserted from outside through the holes 46 in the support 24.

As well as absorbing the impact occurring on the braking side when the apparatus is shifted, thereby to damp the impact and reduce noise, it is of course possible to use the same or a similar arrangement to connect the opposed flange 34 on the clutch side so that it is axially movably with respect to its support element 30 with resilient members interposed. Thus both opposed flanges could be mounted resiliently on their associated support elements 30,24. Conversely, instead of the braking side, only the clutch side could if desired be provided with an axially movable, resiliently yielding opposed flange. Both opposed flanges 34, 40 act, sometimes during coupling and at other times during braking, as abutments to absort the shifting forces which arise.

WHAT WE CLAIM IS:-

1. Coupling and braking apparatus for an intermittently drivable machine drive shaft, comprising a drivably rotatable clutch plate, a non-rotatable brake plate, an axially movable pressure plate mounted between the clutch plate and the brake plate, secured against rotation with respect to the machine drive shaft and movable alternately into engagement with the clutch plate and the brake plate by a pressure medium and oppositely acting spring loading, and a respecitve opposed flange to be engaged by the faces of the clutch plate and the brake plate opposite to the faces thereof which are engaged by the pressure plate, the opposed flanges being each connected by torque-transmitting means to an associated support element secured against rotation with respect to the machine drive shaft, wherein one or each of the opposed flanges is axially movably mounted on its associated support element, and resilient members are disposed between the or each axially movable flange and its associated support element.

2. Apparatus according to claim 1, in which, for the or each axially movable flange and its associated support element, the resilient members comprise plate springs arranged in a gap between the opposed flange and the support element and the plate springs are mounted on screws engaged in one of the opposed flange and the support element with the heads of the screws recessed into the other of the opposed flange and the support element.

3. Apparatus according to claim 1 or claim 2, in which, for the or each axially movable flange and its associated support element, a drive connection permitting relative axial movement between the opposed flange and the support element is provided by at least one bolt engaged at one of its ends in one of the opposed flange and the support element and having the other of its ends engaged in an aperture in the other of the opposed flange and the support element.

4. Apparatus according to claim 1 or claim 2, in which, for the or each axially movable flange and its associated support element, a drive connection permitting relative axial movement between the opposed flange and the support element is provided by radial profiles of interengaging complementary shape on the opposed flange and the support element, such as inter-engaging teeth.

5. Apparaturs according to claim 3 or claim 4, including stops to limit the extent of relative axial movement of the opposed flange and the support element.

6. Coupling and braking apparatus for an intermittently drivable machine drive shaft substantially as hereinbefore described and illustrated with reference to Figure 1 to 3 or Figure 4 of the accompanying drawings.

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1575763 COMPLETE SPECIFICATION

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

Sheet 1

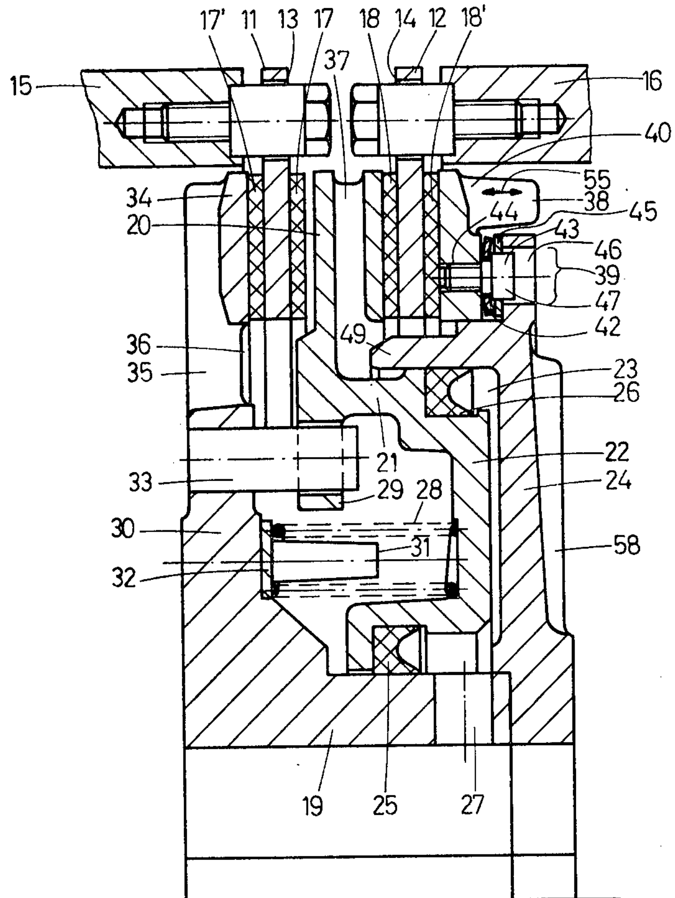

FIG.1

1575763 COMPLETE SPECIFICATION
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Sheet 2

FIG. 3

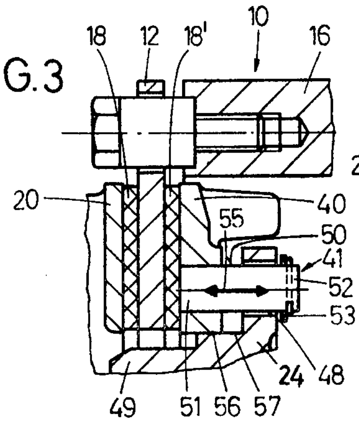
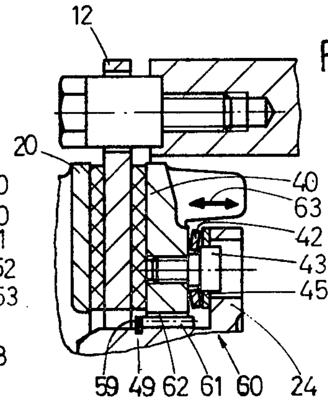


FIG. 4



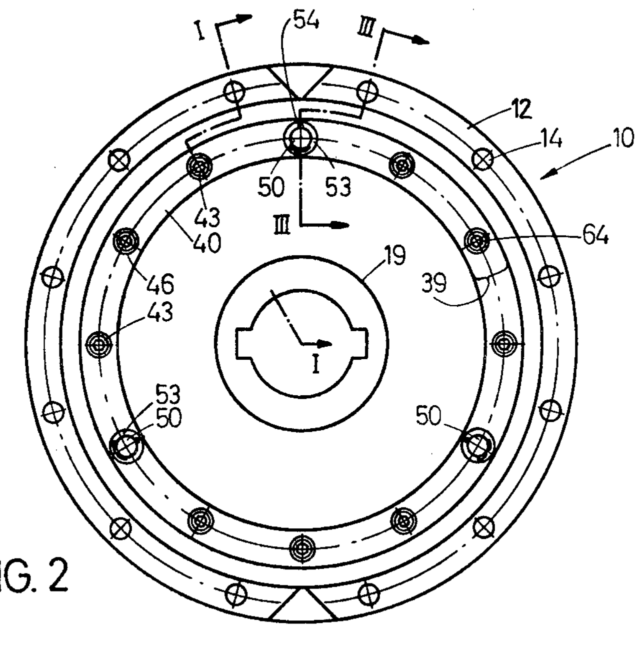


FIG. 2