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(54) DRIVE ARRANGEMENT COMPRISING A DRIVING MOTOR AND AN ELECTROMAGNETIC CLUTCH AND BRAKE UNIT

(71) We, QUICK-ROTAN ELEKTROMOTOREN GMBH, a German Company, of Gräfenhäuser Strasse 85, 6100 Darmstadt, 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:—

This invention relates to a drive arrangement comprising a driving motor and an electromagnetic clutch and brake unit connecting the driven output side of the driving motor with a shaft to be driven.

A drive arrangement in accordance with the invention is intended more especially, but not exclusively, to operate in conjunction with a speed control system of the kind which forms the subject of British Patent Application No. 50816/77 (Serial No. 1,605,113) to provide a positioning drive.

The two main requirements which are demanded in such a positioning drive are, firstly a rapid action arresting characteristic, and secondly a high accuracy stopping characteristic, that is to say the driven output shaft must be brought down within the shortest possible time from the working speed to the stationary condition. The final stationary position thereby achieved is required to coincide as far as possible with the required reference position. In practice the simultaneous satisfaction of these two conflicting requirements encounters great difficulties, in particular when the driven load is subject to fluctuation. Problems of this type arise, for example, in the drives for industrial sewing machines, in winding machines, machine tools and the like.

It is an object of the present invention to provide a positioning drive having an electromagnetic clutch and brake unit of which the mechancial construction is such as to facilitate the achievement of the above-mentioned requirements, when used with an appropriate control system.

In accordance with the present invention there is provided a drive arrangement comprising a driving motor and an electromagnetic clutch and brake unit connecting the driven output side of the driving motor with a shaft to be driven, wherein the clutch and brake unit comprises clutch and brake plates displaceable in the axial direction of a driven output shaft and wherein the driven output shaft supports a guide member having axially parallel peripherally distributed apertures, each of said apertures containing a rolling action coupling member comprising an axially movable guide pin located within an external bearing sleeve and a plurality of rolling bearing elements engaging between said guide pin and said sleeve, alternate ones of said guide pins being connected respectively to said clutch and brake plate.

Preferably, each of the rolling action coupling members comprises a ball sleeve concentrically surrounding each guide pin and a plurality of freely rotatable balls supported between said ball sleeve and said guide pin.

Advantageously, the clutch and brake plates each consist of a light metal disc supporting a combination of magnet poles and friction linings. The light metal support disc of the clutch and/or the brake plate may have a peripheral arrangement of a plurality of separate cast-on magnet poles of arcuate sector shape. The frictional linings preferably project only a small distance beyond the corresponding magnet poles, and should also preferably be extremely thin and consist of a combination of cork, paraffin wax and/or organic or inorganic lubricating media.

The clutch and brake plates may be provided on all sides thereof with cooling air channels.

The invention will now be described more particularly with reference to preferred practical examples shown in the accompanying drawings, in which:—

Figure 1 is a longitudinal section through the clutch and brake unit of a drive arrangement according to the invention,

Figure 2 is an end view of the guide

member for the clutch and brake unit of Figure 1, and

Figure 3 is an end view of the pole pieces of the clutch plate cooperating disc before being cast on to the light metal support disc.

Referring to the drawings, in Figure 1 there is shown schematically the driven output end of the shaft 3 of an electric motor, usually a multiphase or single phase alternating current motor. When the arrangement is in operation this shaft rotates continuously at a constant speed, for example 3000 rpm. The motor shaft 3 carries a flywheel 4, preferably made of cast iron, which is rigidly connected, for example screwed, to a ring 5 of magnetic conducting material. The ring 5 is mounted upon webs 6 of the flywheel 4, whereby air slots 7 are left free for the access of a cooling air current 8. The radially outward ends of the webs 6 form a crown 9 for the blades of a fan for extraction of the cooling air current 8.

Coaxially with the motor shaft 3 is a driven output shaft 10 mounted in a ball bearing 11 and a bush 12, which are supported in a bearing shield 15 screwed to the motor housing 14. Upon that end of the output shaft 10 which is nearest to the motor shaft 3 there is keyed a guide member 16, in which, as seen in more detail in Figure 2, there is provided an arrangement of six axially parallel apertures 17 distributed in the peripheral direction, and an equal number of cooling air ports 18. The cooling air ports 18 are positioned more radially inward than the apertures 17, and intermediate the latter in the peripheral direction. In the apertures 17 there are accommodated rolling action coupling members 20, which are mounted in alternate sequence upon a hub body 21 of a clutch plate 22 and upon a hub body 23 of a brake plate 24. The hub bodies 21, 23 are made of magnetically conducting material. Each of the rolling action coupling members comprises a guide pin 25, which is mounted on the clutch plate, or on the brake plate, for example by means of a screw 26, and a ball sleeve 27 concentrically surrounding the guide pin. Within the ball sleeve there are freely supported a plurality of balls 28. The balls 28 are distributed about the shaft of the guide pin both in the axial direction and the peripheral direction, and make contact both with the outer surface of the guide pin and the inner surface of a bearing bush 29, which is forced into the respective apertures 17. The rolling action coupling members provide in this manner a positive connection, in the rotary sense, of the clutch plate 22 and the brake plate 24 with the output shaft 10, whilst simultaneously allowing a limited relative movement in the axial direction of the clutch plate and the brake plate with reference to the output shaft.

The hub body 21 of the clutch plate 22 is surrounded by a light metal support disc 32, which carries a friction lining 33 at the side opposite to the ring 5. The peripheral surface of the support disc 32 is embraced by four magnetically conducting pole pieces 34, shown individually in Figure 3.

Preferably the clutch plate 22 may be prepared in the manner that the hub body 21, and the pole pieces 34 provided with holding projections 35, are inserted in a mould, into which then is cast the metal forming the support disc 32, for example aluminium. By the use of a plurality of separate pole pieces 34, stresses are avoided, which would otherwise be set up by the different coefficients of expansion of the materials used for the pole pieces and the support discs 32, in the case where instead of the pole pieces 34 an integral pole ring were to be provided.

The hub body 23 of the brake plate 24 is surrounded by a light metal support disc 36. At that side of the hub body 23 and of the support disc 36 remote from the clutch plate 22, there are applied concentric friction linings 37 and 38 respectively situated in a common radial plane.

The magnet housing 41 for a clutch coil 42 is shrunk on to a part 40 of the casing situated between the motor housing 14 and the bearing shield 14. The clutch coil 42 is in the form of an annular coil having a substantially rectangular cross-section, whose radial dimension is greater than its axial dimension. To the bearing shield 15 there is connected the magnet housing 43 of a brake coil 44, for example by screws. The brake coil 44 is likewise designed as a cylindrical coil. However, the greatest dimension of its cross-section lies in the axial direction. The current leads for the clutch coil and the brake coil are indicated at 45 and 46.

The magnet housing 43 is supported on the end wall 47 of the bearing shield 15 by means of webs 48, in such a manner as to leave radial cooling air channels 49 between the magnet housing and the bearing shield. Further cooling air channels 50 and 51 are situated radially within and radially outside the magnet housing 43. These channels communicate with a group of cooling air ports 52, 53 in the end wall 47. A further cooling air channel 54 is situated between the magnet housing 41 and the end face of the brake plate 24 facing the said magnet housing 41. The cooling air channel 54 is in communication both with the cooling air channels 50, 51 as well as with the ports 18, which themselves provide communication with the air slots 7. The arrangement in so far as above described operates as follows:

In the condition of rest, the friction linings 33, 37 and 38 are situated at a small axial spacing from the ring 5 of the flywheel 4

and the fixed magnet housing 43 of the brake magnet. The motor shaft 3 and the flywheel 4 rotate. The output driven shaft 10 remains stationary. If the clutch coil 42 is excited, a magnetic flux 57 is created, the lines of force of which tend to reduce the air gap between the ring 5 and the hub body 21 as well as the pole pieces 34. Thereby the friction lining 33 of the clutch plate is forced against the rotating ring 5 of the flywheel. The clutch plate 22, connected through the rolling action coupling members 20 for positive rotation with the output shaft, is driven by the flywheel 4 and itself drives the output shaft 10.

If the brake coil 44 is supplied with current, a magnetic flux 56 is established, as a result of which the friction linings 37, 38 of the brake plate 24 are forced against the magnet housing 43, which functions as a brake abutment. The driven output shaft 10 is thus retarded.

The continuously rotating flywheel 4 draws in cooling air through the ports 52, 53; this cooling air sweeps practically all around the heat producing parts of the clutch and brake unit, i.e. the clutch and brake coils as well as the friction linings and the cooperating counteracting surfaces. Finally the cooling air current 8 leaves the motor housing through suitable ports, not shown in detail in the drawing, whereby the air current is deflected in the direction of the arrow 58, in order also to sweep over the outer side of the clutch and brake unit.

WHAT WE CLAIM IS:—

1. A drive arrangement comprising a driving motor and an electromagnetic clutch and brake unit connecting the driven output side of the driving motor with a shaft to be driven, wherein the clutch and brake unit comprises clutch and brake plates displaceable in the axial direction of a driven output shaft and wherein the driven output shaft supports a guide member having axially parallel peripherally distributed apertures, each of said apertures containing a rolling action coupling member comprising an axially movable guide pin located within an external bearing sleeve and a plurality of rolling bearing elements engaging between said guide pin and said sleeve, alternate ones of said guide pins being connected respectively to said clutch and brake plate.

2. A drive arrangement according to Claim 1, wherein said bearing sleeve and said bearing elements of each of the rolling action coupling members respectively comprise a ball sleeve concentrically surrounding each guide pin and a plurality of freely rotatable balls supported between said ball sleeve and said guide pin.

3. A drive arrangement according to Claim 1 or 2, wherein the clutch and brake plates each consist of a light metal disc supporting a combination of magnet poles and friction linings.

4. A drive arrangement according to Claim 3, wherein the light metal support disc of the clutch and/or the brake plate has a peripheral arrangement of a plurality of separate cast-on magnet poles of arcuate sector shape.

5. A drive arrangement according to Claim 3 or 4, wherein the frictional linings project only a small distance beyond the corresponding magnet poles.

6. A drive arrangement according to any one of Claims 3 to 5, wherein the friction linings are extremely thin and consist of a combination of cork, paraffin wax and/or organic or inorganic lubricating media.

7. A drive arrangement according to any one of Claims 3 to 6, wherein the clutch and brake plates are provided on all sides thereof with cooling air channels.

8. A drive arrangement incorporating a clutch-brake assembly substantially as described herein with reference to Figures 1 to 3 of the accompanying drawings.

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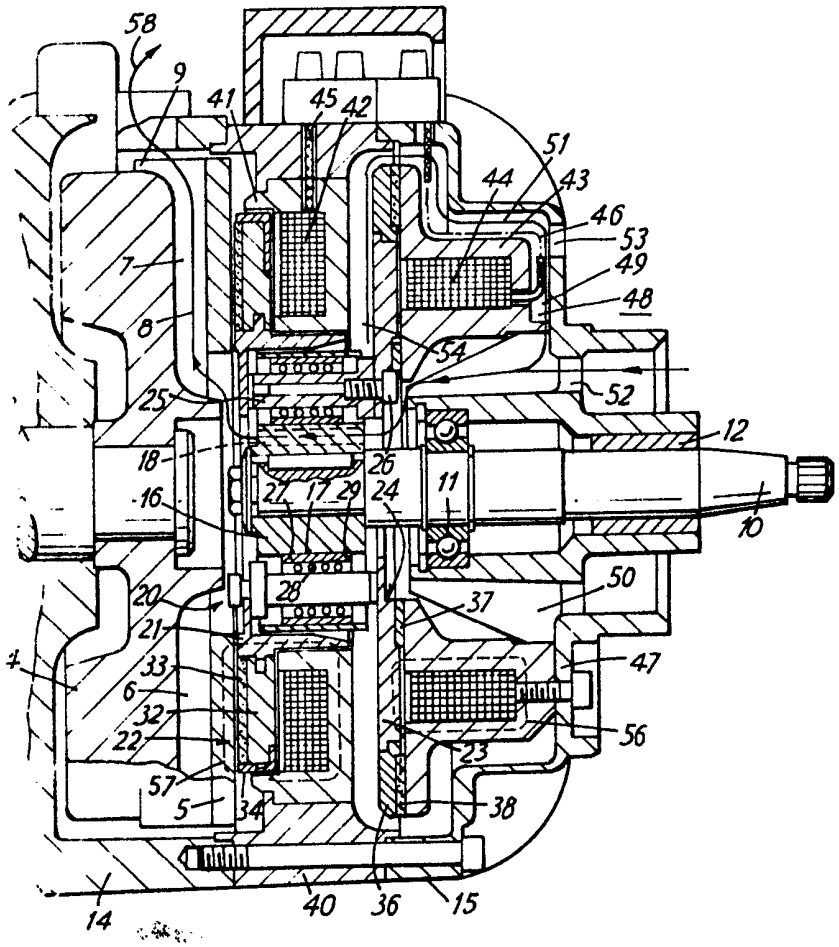
Sheet 1

FIG. 1



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Sheet 2

FIG. 2

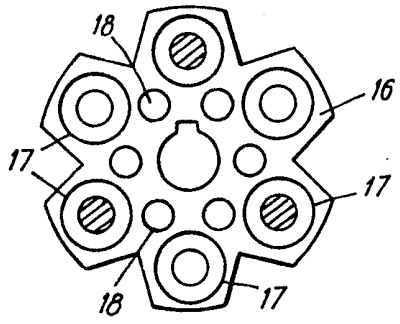

FIG. 3