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PATENT SPECIFICATION

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(54) CLUTCH-MOTOR ASSEMBLY

(71) We, QUICK-ROTAN BECKER & NOTZ KG, a German KG, of 6100 Darmstadt, Gräfenhäuser Strasse 85, 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 a clutch-motor assembly and concerns a clutch-motor assembly comprising a clutch disc and a brake disc which are arranged side by side on the output shaft of the assembly and are co-rotatably coupled to the output shaft, with two electromagnets in a unit with the housing which are situated within an annular space between the clutch and brake discs, whereby it is possible to bring the clutch disc into engagement with a flywheel arranged on a motor drive shaft and the brake disc with a brake abutment, as well as means of generating at least one flow of cooling air ducted through the clutch/brake arrangement.

Clutch-motor assemblies of this kind are disclosed in the complete specifications of British Patents numbers 1,266,019 and 1,341,907 — Delmoran AG. In principle, they offer the advantage that the friction faces of the clutch and brake may be kept relatively large, whereas the axial space incorporating the clutch/brake system remains small. In addition short magnetic paths are obtained. In conjuction with the small axial air gaps required; it is thereby possible to obtain a magnetic system which responds rapidly whilst at the same time requires only a relatively small amount of electrical power. The small mechanical movements required of the clutch and brake discs enable the time required for transfer of the output shaft from the driven to the braked condition to be reduced, which thus enables rapid follow-up of the control parameter in the case of speed-controlled clutch-motor assemblies, and also allows of precise positioning of the output shaft.

As well as the heat radiated by the coils of the electromagnets in the case of clutch-motor assemblies, considerable heat is generated by friction since the speed of revolution of the output shaft is regulated by controlling the slip between the motor flywheel and the clutch disc, either by intermittent alternative activation of the clutch and brake or by simultaneous actuation of the clutch and brake. Apart from this, high calorific values are also produced briefly during the braking of the output shaft, since the entire kinetic energy present within the system is converted into heat. Since the durability of the clutch and brake linings, as the sole elements of the system subject to wear, is a function of the heat arising at the linings, the cooling of the clutch/brake system must be considered of prime importance in practice.

The invention is based on the problem inherent in reducing the thermal load by more effective cooling and thus in increasing the mechanical power transmissible to the output shaft by the motor despite extremely short periods of acceleration to rated speed and of braking.

In a clutch-motor assembly of the kind defined in the foregoing, this problem is resolved or reduced in accordance with the invention, in that the electromagnets are positioned with radial spacing between them and the flow of cooling air is ducted between the electromagnets. In this way, the cooling air may be brought into as close a proximity as possible to the source of heat generation.

The cooling action may be intensified complementarily, if the electromagnets are also staggered in the axial direction with respect to each other and the spaces thereby formed are exploited as ducting passages for cooling air.

The two electromagnets may be combined into a single structural unit with a supporting member integrally joined to the housing.

In accordance with another embodiment of the invention, the brake abutment is

situated within the annular space between the clutch and brake discs and thus in the area of the flow of cooling air traversing the clutch/brake system.

A substantially omnilateral flow envelopment of the principal heat generators is accomplished if, in a case of this nature, the flow of cooling air is initially ducted inwards radially behind the brake abutment, then in an axial direction between the two electromagnets, subsequently further inwards radially behind and past the clutch disc, then through the clutch disc in an axial direction, and finally radially outwards behind the portion of the flywheel coming into frictional engagement with the clutch disc.

The brake abutment may be installed either rotatably (see for example Figure 1 of British Patent Specification No. 1,341,907) or may be rigidly secured to the housing. In the latter case, the brake abutment is appropriately formed by the supporting element.

The supporting element may be fastened on an external bearing plate. The structural unit formed by the electromagnet and the supporting element is advantageously supported by means of a bearing on the output shaft of the assembly. A structurally uncomplicated, easily installed but nevertheless particularly stable arrangement may be obtained in this manner.

The bearing may be situated on webs of the structural unit comprising the electromagnets and the supporting element, which webs form air slots so that a second flow of cooling air may be ducted through the part of the clutch/brake system which is situated radially inwards. Alternatively, or in addition, such air slots may be formed by webs of the output shaft on which the bearing is situated.

The electromagnets are appropriately joined to a supporting element by the shrinkage method. This ensures not only a high degree of mechanical strength, but also a particularly effective heat transmission between the magnets and the supporting element.

The positioning of the brake abutment between the clutch and brake discs or plates renders it possible to equip the brake plate with ventilator blades or vanes at the side facing away from the brake abutment, for generation of another flow of cooling air.

On the end facing towards the clutch plate, the flywheel preferably bears a flywheel annulus made of magnetically conductive material, which is arranged on webs of a flywheel element forming air slots for traversal by the flow of cooling air. This has the advantage that the principal ponderable proportion of the flywheel may be produced as a cheap casting and that the flow of cooling air may at the same time be brought up close to the source of frictional heat generation of the clutch.

Preferably at the extremity most distant from the flywheel, a vaned impeller may appropriately be secured on the motor shaft, and the airflow generated by this vaned impeller may be ducted in such manner that it passes across the ingress and egress openings of the airflow ducted through between the electromagnets. The ingress and egress opening of the airflow last cited are thereby screened off against dust penetration.

The clutch and brake plates may in each case comprise a hub fastened on the output shaft, which is joined by means of spring members, which leave open cooling air passages and for example consist of a slotted or perforated spring plate, to a magnetically conductive armature ring. A bistable behaviour of the clutch and brake plates may be obtained by application of spring members of this kind. After the coil current of an electromagnets is switched off, the corresponding clutch or brake plate immediately shifts back to a specified neutral position.

The armature rings are appropriately flanged by supporting elements of light metal or plastics material, which bear friction linings. It is thereby possible for the moment of inertia of the clutch and brake plates to be kept small despite a large friction surface and correspondingly low thrust per unit area and low rate of wear of the friction linings. For its part, this is of importance in obtaining short switching periods.

The supporting elements may be shrunk on to the armature rings. The supporting element of the clutch plate is moreover appropriately enflanked by a magnetically conductive ring. The armature ring of the clutch plate and the magnetically conductive ring flanking the supporting element may then be formed in such manner that the magnetic flux generated by the clutch magnet flows through three relatively radially spaced paths, of which one forms a common return path. Two mutually concentric friction linings may be installed between the magnetic conduction paths. The division of the magnetic flux has the advantage that the friction linings are thrust evenly against the flywheel and the risk of resilient yielding of the clutch plate thrust into contact is reduced.

In a further embodiment of the invention, the output shaft is axially displaceable with respect to the assembly housing. In conjunction with the feature

that the brake abutment is situated within the annular space between the clutch and brake plates, the axial gap between the clutch plate and the flywheel, as well as the axial gap between the brake plate and the brake abutment, may thereby be adjusted conjointly and equidirectionally. This renders it particularly easy to re-adjust the gaps after partial wear of the friction linings. The motor shaft is preferably also displaceable in the axial direction with respect to the motor housing. This makes it possible to set the clutch gap or clearance separately from the brake clearance, in particular for the purpose of initial setting. A screw-threaded bushing encircling the shaft, screwable into the bearing plate, and whereof the adjusting displacement in the axial direction may be imparted to the shaft, is appropriately incorporated for axial displacement of the shaft in question.

For the purpose of reducing attrition at the frictional surfaces, at least one element projecting in the axial direction and having lubricating properties, which consists of plastics material, is preferably inserted into the flywheel and/or the brake abutment at the side opposed to the clutch plate and brake plate respectively.

The invention will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 shows a longitudinal cross-section of an embodiment of a clutch-motor assembly according to the invention;

Figure 2 shows an enlarged scale partial view of the clutch/brake system of the clutch-motor assembly according to Figure 1;

Figure 3 shows a partial view of the structural unit of the clutch-motor assembly according to Figures 1 and 2, consisting of the electromagnet housings and the supporting element;

Figure 4 shows an end view of the structural unit according to Figure 3, as seen from the left-hand side in Figure 3, and

Figure 5 shows a view analogous to Figure 2, for a modified form of embodiment of the clutch-motor assembly.

The clutch-motor assembly according to Figures 1 to 4 comprises a stator 1 and a rotor 2 which is rotatably coupled to a motor shaft 3 revolving at constant speed of revolution, for example 3000 r.p.m., during the operation of the motor. The motor shaft 3 is journalled in ball bearings 4, 5 and at the extremity which is at the left in Figure 1 carries a vaned impeller 6. The ball bearing 4 is situated in a bearing plate or bracket 7. A screw-threaded bushing 8 which is screwed into a tapped hole of the bearing plate from the end of the bearing plate 7, and which is concentric with the motor shaft 3, bears against the outer race of the ball bearing 4. A compression spring 9 bearing against the outer race of the ball bearing 5 exerts an axial prestressing force directed axially towards the left in Figure 1, on the motor shaft 3.

A flywheel 10 is keyed on the other extremity of the motor shaft 3. The flywheel 10 comprises a flywheel member 11, which may for example be produced as a casting, and a flywheel annulus 12 consisting of magnetically conductive material. The flywheel annulus 12 is affixed on webs 13 of the flywheel member which leave open air slots 14 for passage of a flow of cooling air depicted by arrow 15, at the end side of the flywheel facing away from the vaned impeller 6. The radially external extremities of the webs 13 form a ring of fan blades 16 for induction of the flow of cooling air 15.

The output shaft 18 of the clutch-motor assembly is journalled in ball bearings 19, 20. A clutch plate 21 and a brake plate 22 are situated on the output shaft 18. The clutch plate 21 comprises a hub 23 which is keyed on the extremity of the output shaft 18 confronting the flywheel 10, and is secured by means of a set screw 24. Situated co-axially with respect to the hub 23 is an armature ring 26 of magnetically conductive material, which is joined to the hub 23 by means of a spring annulus 27. In the area of the annular space remaining between the radially external parts of the peripheral surface of the hub 23 and the radially internal part of the armature ring 26, the spring annulus 27 is provided with slits or perforations as passages for the through-flow of the cooling airflow 15. The armature ring 26 has an annular groove in which a friction lining 29 is inserted, at the side facing towards the flywheel 10. A supporting element 30 in the form of an aluminium ring, which has a magnetically conductive ring 31 shrunk on to it, is shrunk on to the armature ring 26. The armature ring 26, the supporting element 30 and the ring 31 delimit an annular groove wherein is inserted another friction lining 32 which is arranged concentrically with respect to the friction lining 29 and is aligned with the same in the axial direction, at the end of the clutch plate 21 facing towards the flywheel 10.

In analogous manner, the brake plate 22 is equipped with a hub 34, which is keyed on to the output shaft 18 and secured by means of a set screw 35. A spring annulus 36 connects the hub 34 to an armature ring 37 of magnetically conductive material, on to which is shrunk a supporting element 38 which is preferably made of aluminium. At the end facing towards the flywheel 10, the supporting element 38 bears a friction lining 39. On the other end of the

supporting element 38 are situated ventilator blades 40 for generation of a cooling airflow 41 which enters through openings 43 and leaves through openings 44 in a bearing plate 42.

The bearing plate 42 comprises a hub 45 into which is screwed a screw-threaded bushing 46 which receives the ball bearing 20. Circlips 47 immobilise the ball bearing 20 in the axial direction within the screw-threaded bushing 46. Another circlip 48 holds the ball bearing 20 against a shoulder 49 of the output shaft 18. The screw-threaded bushing 46 may be immobilised with respect to the bearing plate 42, by means of a set screw 50.

A supporting element 52 is inset into the side of the bearing plate 42 facing towards the flywheel 10. The supporting element 52 comprises radially extending webs 53 and axially extending webs 54, which delimit passage openings 55, 56 for the cooling airflow 15. The magnet housing 57 of the brake magnet 58 is shrunk into the supporting element 52, whereas the magnet housing 59 of the clutch magnet 60 is shrunk on to the webs 54. The magnet housings 57, 59 receive the brake coil 61 and the clutch coil 62, respectively. A clamping ring 63 is situated on the magnet housing 59. The supporting element 52, the magnet housings 57, 59 and the clamping ring 63 represent a structural unit in the installed condition (Figures 3 and 4) which, together with the bearing plate 42, is connected by means of screws 64 to a housing portion 65, and has arranged within it the ball bearing 19. The part of the end of the supporting element 52 which confronts the friction lining 39 of the brake plate 22, forms a brake abutment 66 rigidly joined to the housing. A projection 67 of the armature ring 26 protruding in the axial direction, engages in the magnet housing 59 whilst forming a radial air gap.

The sytem described operates as follows:

In the idle condition, there are axial clearances, of a width of a few tenths of a millimetre for example, between the friction linings 29, 32 of the clutch plate 21 and the flywheel annulus 12, as well as between the friction lining 39 of the brake plate 22 and the brake abutment 66. The annular springs 27 and 36 hold the clutch plate 21 and the brake plate 22, respectively, at a specified neutral position. The motor shaft 3 and the flywheel 10 are in rotation. The output shaft 18 is at rest. If the clutch coil 62 is energised, a magnetic flux is produced as indicated by a broken line 70 in Figure 2. This flux flows through three relatively radially spaced paths, of which one forms a common return path. The lines of force tend to diminish the gaps. The clutch plate 21 comprising the friction linings 29, 32 is thereby thrust against the flywheel annulus 12 revolving together with the flywheel member 11. The clutch plate 21 positively coupled to the output shaft 18 by means of the spring annulus 27 and the hub 23, is rotated by the flywheel 10 and in turn rotates the output shaft 18.

If current is fed to the brake coil 61, this generates a magnetic flux depicted by a broken line 71, by virtue whereof the brake plate 22 comprising the friction lining 39 is thrust against the brake abutment 66 to brake the output shaft 18.

The continuously revolving flywheel 10 draws in the cooling airflow 15 which flows through the structural unit formed by the supporting element 52 and the magnet housings 57, 59 through the passage openings 55, 56, initially flowing inwards radially, then between the magnet housings 57, 59 in the direction towards the clutch plate 21 and subsequently between the mutually opposed ends of the clutch plate 21 and magnet housing 59, and onwards in the direction towards the output shaft 18. The cooling airflow 15 then passes through the spring annulus 27 and the annulus space between the hub 23 and the armature ring 26, to pass into the air slots 14 between the flywheel member 11 and the flywheel annulus 12. Upon leaving the motor housing, the cooling airflow 15 is deflected by the housing portion 65.

For as long as the output shaft 18 is in rotation, the fan blades 40 of the brake plate 22 continue to deliver the cooling airflow 41 within the space between the brake plate 22 and the end of the bearing plate 42.

The vaned impeller 6 situated on the continuously revolving motor shaft 3 generates another airflow 73 which is driven in the direction towards the flywheel 10 through axial passages 74 of a motor housing portion 75 and upon emerging from the motor housing is guided in such manner that it flow across the ingress and egress openings for the cooling airflow 15 and thereby protects these against penetration by dust.

After releasing the set screw 50, the screw-threaded bushing 46 may be turned and may thereby be displaced in the axial direction with respect to the hub 45 of the bearing plate 42. The output shaft 18, the clutch plate 21 and the brake plate 22 are concomitantly entrained in the same direction by the ball bexring 20. The axial clearances for the clutch and brake may be adjusted at the same time, in this manner. Accordingly, it is easily possible to re-adjust these, when the friction linings 29, 32 and 39 wear down in the course of time. Moreover, and in particular for initial setting, the axial clearance of the clutch

may be adjusted separately, by turing the screw-threaded bushing 8 in the bearing plate 7.

In a modified embodiment according to Figure 5, a magnet housing 77 is incorporated instead of the magnet housing 57. The housing 77 is equipped with a series of webs 78 directed towards the output shaft 18, which delimit air slots 79 and support the ball bearing 19. The bearing plate 80 is provided with air inlet openings 81. A complementary cooling airflow 82 is drawn in through these openings by the flywheel 10, and flows through the space between the brake plate 22 and the bearing plate 80, and openings in the spring annulus 36 and combines with the cooling airflow 15 after passing through the air slots 79. The fan blades 40 may be omitted in this form of embodiment. Alternatively, or in addition to the air slots 79, air slots (not shown) may be formed in the output shaft 18 by means of webs provided on the latter to support the bearing 19.

In the clutch-motor assemblies described, all the heat-generating surfaces within the clutch/brake system are positioned in the actual cooling airflow. The cooling air passages may perfectly well have a cross-section of such size that no air compression can occur. A robust two-point mounting is formed for the output shaft by application of the magnet unit as a bearing seat. The weights of the clutch and brake plates are small as compared to the friction linings of large surface area, by virtue of the light-weight supporting elements 30, 38. The electromagnets 58, 60 may be of relatively large size without any excessive fitting space being required for the clutch-motor assembly. Considerable forces are obtained in the axial air gaps, for this reason. The frictional surface area of the friction linings may be made particualy large in the arrangement of the electromagnets as disclosed, which leads to a lower thrust force per unit area on the friction linings, and thus to a lower rate of wear.

Several, for example six, plug-like elements 84 of plastics material having lubricating properties, preferably being polytetrafluoroethylene, are inserted into the flywheel annulus 12 with spacing in the peripheral direction. The elements 84 axially confront the end of the armature ring 26 which is not covered by the friction lining 29. The axial length of the elements 84 is so dimensioned that, after assembling the motor, the end of the elements 84 facing towards the armature ring 26 bears against the armature ring 26 when the clutch coil 62 is de-energised. During the initial operations of the assembly, the elements 84 are ground down on the armature ring 26. This has the result that a thin film of polytetrafluoroethylene is formed on the contact surfaces of the flywheel and of the clutch plate. A film of this nature, which in practice has a thickness of no more than a few thousandths of a millimetre, considerably reduces the wear on the frictional surfaces, i.e. in particular the attrition of the friction linings 29, 32. The clutch engagement operations are performed in particularly jolt-free manner. The film of plastics material is made up continuously in step with the wear of the friction linings by commensurate wearing down of the elements 84.

Analogous units 85 are inserted with spacing in the peripheral direction into bores of the brake abutment 66. They are in engagement with parts of the supporting element 38 which are not covered by the friction lining 39. The function of the elements 85 corresponds to that of the elements 84.

It is understood that plastics material elements corresponding in nature to the elements 84, 85 may also advantageously be incorporated in the embodiment corresponding to Figures 1 and 2.

WHAT WE CLAIM IS:—

1. A clutch-motor assembly comprising a clutch plate and a brake plate arranged side by side on an output shaft of the assembly and co-rotatably coupled to the output shaft, two electromagnets in a housing unit, which magnets are situated in an annular space between the clutch and brake plates, whereby the clutch plate may be brought into engagement with a flywheel on a motor drive shaft and the brake plate with a brake abutment, means for generating at least one cooling airflow ducted through the clutch/brake system, the electromagnets being arranged with radial spacing between them and the cooling airflow being ducted, in operation, between the electromagnets.

2. A clutch-motor assembly according to claim 1, in which the electromagnets are so staggered in the axial direction with respect to each other that spaces are formed therebetween, which spaces provide a cooling air duct between the electromagnets.

3. A clutch-motor assembly according to claim 1 or 2, in which both electromagnets are combined into a structural unit with a supporting element which is rigidly connected to the housing.

4. A clutch-motor assembly according to any one of the preceding claims, in which the brake abutment is housed within the annular space between the clutch and brake plates.

5. A clutch-motor assembly according to claim 4, in which the cooling air is arranged

may be adjusted separately, by turing the screw-threaded bushing 8 in the bearing plate 7.

In a modified embodiment according to Figure 5, a magnet housing 77 is incorporated instead of the magnet housing 57. The housing 77 is equipped with a series of webs 78 directed towards the output shaft 18, which delimit air slots 79 and support the ball bearing 19. The bearing plate 80 is provided with air inlet openings 81. A complementary cooling airflow 82 is drawn in through these openings by the flywheel 10, and flows through the space between the brake plate 22 and the bearing plate 80, and openings in the spring annulus 36 and combines with the cooling airflow 15 after passing through the air slots 79. The fan blades 40 may be omitted in this form of embodiment. Alternatively, or in addition to the air slots 79, air slots (not shown) may be formed in the output shaft 18 by means of webs provided on the latter to support the bearing 19.

In the clutch-motor assemblies described, all the heat-generating surfaces within the clutch/brake system are positioned in the actual cooling airflow. The cooling air passages may perfectly well have a cross-section of such size that no air compression can occur. A robust two-point mounting is formed for the output shaft by application of the magnet unit as a bearing seat. The weights of the clutch and brake plates are small as compared to the friction linings of large surface area, by virtue of the light-weight supporting elements 30, 38. The electromagnets 58, 60 may be of relatively large size without any excessive fitting space being required for the clutch-motor assembly. Considerable forces are obtained in the axial air gaps, for this reason. The frictional surface area of the friction linings may be made particualy large in the arrangement of the electromagnets as disclosed, which leads to a lower thrust force per unit area on the friction linings, and thus to a lower rate of wear.

Several, for example six, plug-like elements 84 of plastics material having lubricating properties, preferably being polytetrafluoroethylene, are inserted into the flywheel annulus 12 with spacing in the peripheral direction. The elements 84 axially confront the end of the armature ring 26 which is not covered by the friction lining 29. The axial length of the elements 84 is so dimensioned that, after assembling the motor, the end of the elements 84 facing towards the armature ring 26 bears against the armature ring 26 when the clutch coil 62 is de-energised. During the initial operations of the assembly, the elements 84 are ground down on the armature ring 26. This has the result that a thin film of polytetrafluoroethylene is formed on the contact surfaces of the flywheel and of the clutch plate. A film of this nature, which in practice has a thickness of no more than a few thousandths of a millimetre, considerably reduces the wear on the frictional surfaces, i.e. in particular the attrition of the friction linings 29, 32. The clutch engagement operations are performed in particularly jolt-free manner. The film of plastics material is made up continuously in step with the wear of the friction linings by commensurate wearing down of the elements 84.

Analogous units 85 are inserted with spacing in the peripheral direction into bores of the brake abutment 66. They are in engagement with parts of the supporting element 38 which are not covered by the friction lining 39. The function of the elements 85 corresponds to that of the elements 84.

It is understood that plastics material elements corresponding in nature to the elements 84, 85 may also advantageously be incorporated in the embodiment corresponding to Figures 1 and 2.

WHAT WE CLAIM IS:—

1. A clutch-motor assembly comprising a clutch plate and a brake plate arranged side by side on an output shaft of the assembly and co-rotatably coupled to the output shaft, two electromagnets in a housing unit, which magnets are situated in an annular space between the clutch and brake plates, whereby the clutch plate may be brought into engagement with a flywheel on a motor drive shaft and the brake plate with a brake abutment, means for generating at least one cooling airflow ducted through the clutch/brake system, the electromagnets being arranged with radial spacing between them and the cooling airflow being ducted, in operation, between the electromagnets.

2. A clutch-motor assembly according to claim 1, in which the electromagnets are so staggered in the axial direction with respect to each other that spaces are formed therebetween, which spaces provide a cooling air duct between the electromagnets.

3. A clutch-motor assembly according to claim 1 or 2, in which both electromagnets are combined into a structural unit with a supporting element which is rigidly connected to the housing.

4. A clutch-motor assembly according to any one of the preceding claims, in which the brake abutment is housed within the annular space between the clutch and brake plates.

5. A clutch-motor assembly according to claim 4, in which the cooling air is arranged

to flow, in operation, initially radially inwardly behind the brake abutment, then in the axial direction between the two electromagnets, then further radially inwardly behind and past the clutch plate, then through the clutch plate in axial direction and finally radially outwardly behind the part of the flywheel coming into frictional contact with the clutch plate.

6. A clutch-motor assembly according to any one of claims 3 to 5, in which the brake abutment is rigidly connected to the housing and is formed by the supporting element.

7. A clutch-motor assembly according to any one of claims 3 to 6, in which the supporting element is fastened to an external bearing plate.

8. A clutch-motor assembly according to any one of claims 3 to 7, in which the structural unit formed by the electromagnets and the supporting element is borne by means of a bearing on the output shaft of the motor.

9. A clutch-motor assembly according to claim 8, in which the bearing is on webs of the structural unit comprising the electromagnets and the supporting element, and/or on webs of the output shaft, which webs form air slots.

10. A clutch-motor assembly according to any one of claims 3 to 9, in which the electromagnets are joined to the supporting element by the shrinkage method.

11. A clutch-motor assembly according to any one of claims 4 to 10, in which, on the side facing away from the brake abutment, the brake plate has fan blades for generating a cooling airflow.

12. A clutch-motor assembly according to any one of the preceding claims, in which, on the end facing towards the clutch plate, the flywheel carries a flywheel annulus of magnetically conductive material, which is affixed on webs of a flywheel element, said webs forming air slots for traversal by the cooling airflow.

13. A clutch-motor assembly according to any one of the preceding claims, in which a vaned impeller is fastened on the motor shaft and the airflow generated by this vaned impeller is ducted in such manner that it sweeps across the ingress and egress openings of the airflow ducted between the electromagnets.

14. A clutch-motor assembly according to any one of the preceding claims, in which the clutch and brake plates in each case have a hub secured on the output shaft, said hub being connected to a magnetically conductive armature ring, by means of spring elements which leave open passages for cooling air.

15. A clutch-motor assembly according to claim 14, in which the armature rings are enflanked by supporting elements of light metal or plastics material, which bear friction linings.

16. A clutch-motor assembly according to claim 15, in which the supporting elements are shrunk on to the armature rings.

17. A clutch-motor assembly according to claim 15 or 16, in which the supporting element of the clutch plate is enflanked by a magnetically conductive ring.

18. A clutch-motor assembly according to claim 17, in which the armature ring of the clutch plate and the magnetically conductive ring enflanking the supporting element are constructed in such manner that the magnetic flux generated by the clutch magnet flows through three relatively radially spaced paths of which one forms a common return path.

19. A clutch-motor assembly according to any one of claims 4 to 18, in which the output shaft is displaceable in the axial direction with respect to the motor housing and the axial clearance at the clutch side as well as at the brake side may be adjusted at the same time by such a displacement.

20. A clutch-motor assembly according to any one of the preceding claims, in which the motor shaft is displaceable in the axial direction with respect to the motor housing.

21. A clutch-motor assembly according to claim 19 or 20, comprising a screw-threaded bushing for each shaft, in which each bushing is screwable into a corresponding bearing plate whereby a setting displacement in the axial direction may be imparted to its associated shaft.

22. A clutch-motor assembly according to any one of the preceding claims, in which at least one member of plastics material

having lubricating properties is inserted into the flywheel and/or into the brake abutment at the side confronting the clutch plate and the brake plate, respectively and projects in the axial direction.

23. A clutch-motor assembly substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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