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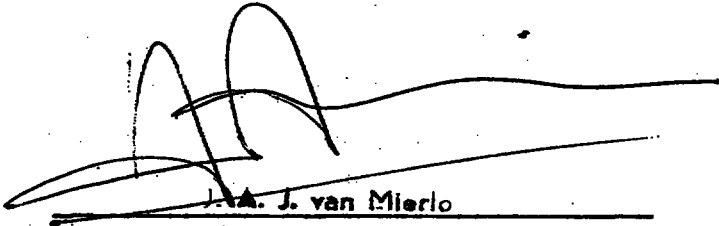
D E C L A R A T I O N
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I, the undersigned, J.A.J. van Mierlo,
Sworn Translator, of Prof. Holstlaan 6, Eindhoven, The
Netherlands, appointed by the Court of Bois-le-Duc,
The Netherlands, hereby declare:

- that I am conversant with the English and German languages
- that the attached translation into the English language is
a translation made by me of the published specification of
European patent No. 0142211
- that to the best of my knowledge and belief the said English
translation is a true translation of the said published
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Eindhoven, September 20, 1990.
The Netherlands.


J.A.J. van Mierlo
Sworn Translator
(name and signature)

"Electric motor with a damping device".

The invention relates to an electric motor with a damping device comprising a disc-shaped damping mass made at least partly of a magnetisable material and arranged to be axially movable and freely rotatable relative to the driven element, which mass is pressed against a stop under the influence of a magnetic force, said stop rotating with the driven element. Such an electric motor comprising a damping device, which is employed in known manner to improve the starting performance or to stabilise the operation of a motor, is known from US-PS 3,790,831, the magnetic force which urges the damping mass against a stop rotating with the driven element being provided by a permanent magnet embedded in the damping mass. However, the provision of such a permanent magnet is comparatively expensive and intricate. It is also known, as is disclosed in, for example, US-PS 3,197,659, to use a separate spring in order to urge the damping mass against a stop which rotates with the driven element, but this also involves additional cost, also in connection with the assembly of the entire device.

It is an object of the invention to provide an electric motor with a damping device having a very simple overall construction. For this purpose, according to the invention, the damping mass is arranged within the range of a magnetic stray field of the synchronous motor, which field is active at some distance adjacent the synchronous motor, and the stop is interposed between the rotor of the synchronous motor and the damping mass, the magnetic force which acts upon the damping mass being produced by a magnetic stray field of the synchronous motor. In this way it is not necessary to use a separate permanent magnet to produce the magnetic force which urges the damping mass against a stop rotating with the driven element, because this

magnetic force is constituted directly by a magnetic stray field of the motor. Thus, a magnetic stray field of the motor is utilised for a special purpose. In this respect it is to be noted that it is known per se to employ a magnetic stray field of a motor for other purposes not related to the present purpose; for example, US-PS 3,280,352 discloses a coupling and braking disc which can be actuated by a magnetic stray field of the motor when this motor is electrically energized and DE-OS 2,362,611 discloses the construction of a friction coupling between the rotor and the driven element of a motor, the coupling force being produced by the magnetic stray field of the permanent-magnet rotor.

It is found to be advantageous if the damping mass is arranged within the range of the magnetic stray field of the electrical excitation of the coils of the stator. Since the magnetic stray field of the electrical excitation of the motor is also active at some distance from the motor, the use of such a stray field to urge the damping mass against the stop rotating with the driven element does not impose any significant constructional limitations on the arrangement of the damping mass and on the stop on the driven element, which may be desirable for constructional reasons.

It is also found to be advantageous if in a motor having a permanent-magnet rotor the damping mass is arranged within the range of the magnetic stray field of the rotor. Since the damping mass can be arranged close to the rotor, this enables a highly compact construction to be obtained, as is often desirable.

In this respect it is found to be very advantageous if, in a motor having a cylindrically shaped rotor, the stop is formed by a radial surface of the rotor. This results in a very compact arrangement.

It is also found to be advantageous if the damping mass is formed by two juxtaposed discs, of which the first disc adjacent to the stop is made of a non-

magnetisable material and the other, second disc is made of a magnetisable material. This enables the two discs to be dimensioned more or less independently of one another, the force for pressing the damping mass against the stop being provided by the second disc only. As an example, the first disc may then be made of brass and the second of iron. Since brass has a higher density than iron, the damping mass can then be dimensioned very favourably.

In this respect it is found to be very advantageous if the second disc takes the form of a disc which is at least ten times as thin as the first disc, which mainly constitutes the damping mass. In that case the first disc alone practically determines the actual damping mass.

It is likewise found to be advantageous if the second disc is clear of the driven element. In this way it is achieved that said second disc does not give rise to any frictional losses relative to the driven element and is used only to press the first disc against the stop which rotates with the driven element. For this purpose the second disc may be mounted, for example, on a cylindrical step on the first disc or affixed to the first disc by means of an adhesive.

If desired, a disc having predetermined anti-friction properties may be interposed between the stop and the damping mass to enable the frictional conditions between the damping mass and the stop to be influenced, as is also set forth in US-PS 3,790,831 referred to in the introductory part. In this respect it is also found to be very advantageous if the facing sides of the stop and the damping mass are provided with a lubricant. This enables the frictional conditions between the damping mass and the stop to be influenced so as to promote slipping of the damping mass, without the need to provide an additional disc. For this purpose lubricants of a wide variety of compositions in the form of

commercially available greases or oils may be employed.

The invention will now be described in more detail with reference to the drawings, which show two exemplary embodiments of the invention but to which the invention is not limited.

Fig. 1 is a sectional view of a grinding apparatus in which a damping mass is arranged within the range of the magnetic stray field of the electrical excitation of the motor of the apparatus.

Fig. 2 is a sectional view taken on line II-II in Fig. 1 and showing the pattern of the lines of force of the magnetic stray field of the electrical excitation of the motor.

Fig. 3 shows an electric motor having a permanent-magnet rotor in which a damping mass is arranged within the range of the magnetic stray field of the rotor.

The grinding apparatus shown in Figs. 1 and 2, with which, for example, knives or scissors can be sharpened, has a grinding wheel 2 arranged inside its housing 1, said housing having slots 3 and 4 for insertion of the objects to be ground so as to apply them to a radial surface of the grinding wheel. The grinding wheel 2 is mounted on a shaft 5 which is journaled to be rotatable and axially movable in a bearing 6 of the apparatus. Two collars 7 and 8 are arranged on the shaft 5 and each cooperate with a portion, 9 and 10, respectively, of a leaf spring, which spring portions act in opposition to each other to position the drive shaft 5 and the grinding wheel 2 relative to each other. This enables the grinding wheel 2 together with shaft 5 to move under the influence of a lateral grinding pressure from either of the two spring portions 9 and 10, thereby limiting the pressure exerted on the grinding wheel by an object to be ground.

To drive the grinding wheel 2 the apparatus has an electric motor 11, in the present case a self-

starting single-phase synchronous motor. Such motors are frequently employed to drive small domestic appliances. This motor has a U-shaped stator 12 whose limbs each carry an exciter winding 13. The free ends of the two stator limbs enclose a rotor 14 formed by a diametrically magnetised permanent magnet, which rotor is arranged on a support 15 which is rotatably journalled in bearing shields 16 and 17 and from which a motor shaft 18 projects, which in turn carries a pinion 19 which engages in a corresponding internally toothed axial bore 20 in the shaft 5, to establish the drive connection with the axially movable shaft 5.

In order to stabilise the operation of single-phase synchronous motors and to ensure a reliable starting performance of these motors it is known to couple a disc-shaped damping mass frictionally to the driven element of such motors, which mass is arranged to be freely rotatable and axially movable in relation to the driven element and under the influence of a force is urged against a stop which rotates with the driven element. When the motor is started or in the case of load fluctuations the damping mass slips in relation to the stop and rotates in synchronism with the driven element during stable operation. The frictional load during slipping of the damping mass provides the stabilising action in known manner and can also provide an improved power output of the motor. In order to generate the force needed to press the damping mass against the stop which rotates with the driven element the damping mass, which is made at least partly of a magnetisable material, is arranged within the range of a magnetic stray field of the motor and the stop is arranged between the rotor of the motor and the damping mass. The magnetic force exerted on the damping mass by the magnetic stray field then causes the damping mass to be pressed against the stop in that it pulls the damping mass towards the stop.

In the present exemplary embodiment the disc-shaped damping mass 21, which is made of iron, is mounted on the shaft 5 so as to be freely rotatable and axially movable on the shaft, and the stop which rotates with the driven element is formed by a disc 22 which is fixedly mounted on the shaft 5 between the rotor 14 of the motor and the damping mass 21. The position of the damping mass 21 on the shaft 5 is selected in such manner that the damping mass 21 is situated within the range of the magnetic stray field of the electrical excitation of the motor. In Fig. 2 the magnetic lines of force of the magnetic stray field of the electrical excitation of the motor are shown in broken lines 23. This magnetic stray field of the electrical excitation of the motor is produced as soon as the exciter windings 13 of the motor are connected to the supply voltage, whereupon a magnetic main field is formed which is closed via the two stator limbs and the rotor 14 of the motor, the magnetic stray field being closed externally around the stator limbs. This stray field traverses the damping mass 21 of a magnetisable material, said mass being pulled towards and pressed against the stop 22. Thus, when the motor is connected to its supply voltage the damping mass 21 comes into operation, enabling it to perform its damping and stabilising function. After the motor has been disconnected from the supply voltage, the damping mass 21 is again freely rotatable and axially movable on the shaft 5.

Thus, as can be seen, no additional steps are necessary in order to urge the damping mass 21 against the stop 22 which rotates with the driven element, because this is effected directly by the magnetic force generated by the magnetic stray field of the motor, resulting in a very simple construction and also a very simple assembly.

Fig. 3 shows separately a self-starting single-phase synchronous motor 11 such as can be used,

for example, to drive an electric shaver. In this case a gearwheel 24, which forms part of the driven element of the motor, is formed directly on the support 15 for the cylindrical rotor 14. In the present exemplary
5 embodiment the damping mass 21 is formed by two juxtaposed discs 25 and 26. The disc 25 is arranged to be freely rotatable and axially movable on a shaft portion 27 of the support 15, which shaft portion is disposed directly adjacent a radial surface of the
10 rotor 14, which surface here acts as a stop rotating with the driven element. The second disc 26 is also arranged to be freely rotatable and axially movable on a cylindrical projection on the side of disc 25 which is remote from the rotor 14, so that disc 26 is clear of
15 the shaft portion 27 and thus of the driven element and therefore does not give rise to any frictional losses relative to the shaft portion 27 or the driven element. In principle, however, it would also be possible to mount the disc 26 on the shaft portion 27 itself. The
20 first disc 25 is then made of a non-magnetisable material whereas the other, second disc 26 is made of a magnetisable material. The actual damping mass is then formed essentially by the first disc 25. The other, second disc 26 is made substantially thinner than the
25 disc 25, namely at least ten times as thin, and is used to provide the force needed to press the disc 25 against the radial surface 28 of rotor 14. This two-part construction of the damping mass 21 in the form of the discs 25 and 26 means that a heavier material such as
30 brass, for example, which is not magnetisable, can be used for the disc 25, whereas the magnetisable disc 26 can be made of iron. This enables the entire damping mass 21 to be dimensioned in a very favourable manner.

In the present exemplary embodiment the damping mass 21 is located within the range of the magnetic
35 stray field of the rotor 14, which comprises a diametrically magnetised permanent magnet, whose direction

of magnetisation is indicated by the arrow 30. The magnetic stray field of the rotor 14 closes round the rotor as indicated by the broken lines 31 in Fig. 3. This magnetic stray field of the permanent magnet rotor 14 constantly attracts the second disc 26 of a magnetisable material towards the radial surface 28 of the rotor so that the interposed disc 25 is constantly urged against the radial surface 28 constituting the stop which rotates with the driven element. Thus, the damping mass 21 can again damp and stabilise the rotor motion.

Since in the present exemplary embodiment the damping mass 21 is arranged directly adjacent a radial surface of rotor 14 a very compact construction is obtained. Obviously, it is in principle also possible to provide a separate stop for the damping mass 21, as in the embodiment shown in Figs. 1 and 2.

Moreover, it is to be noted that the second disc 26 need not be freely rotatable and axially movable but may also be fixedly connected to the disc 25, for example by means of an adhesive. It is obvious that also in this embodiment, in the same way as in the embodiment shown in Figs. 1 and 2, a single disc of a magnetisable material may be used as the damping mass. However, in the present case the arrangement of the non-magnetisable disc 25 between the rotor 14 and the magnetisable disc 26 has the additional advantage that the disc 25 creates a certain distance between the disc 26 and the rotor 14, so that the magnetic shunt formed by the disc 26 in relation to the permanent-magnet rotor 14 is smaller. Another possibility is to include in a disc of a non-magnetisable material parts of a magnetisable material which under the influence of the magnetic stray field of the motor perform the function of pressing the disc against the stop rotating with the driven element.

It is also found to be very effective if the facing sides of the stop and the damping mass are

provided with a lubricant so that the friction between these parts can be influenced so as to enhance slipping of the damping mass. For this lubricant a wide variety of commercially available greases or oils may be used, for example "Alania Grease R2" or "Precision Fluid 78".

5 It will be appreciated that numerous modifications of the exemplary embodiments described hereinbefore are possible without departing from the scope of the invention. This applies in particular to
10 the construction and arrangement of the damping mass as such and also to its cooperation with the stop which rotates with the driven element and against which said mass is pressed under the influence of a magnetic stray field. It is obvious that the steps in accordance with
15 the invention can be applied not only to a self-starting single-phase synchronous motor but to all motors whose operation can be stabilised or whose starting performance can be improved by means of a damping mass, for example also in stepping motors.

CLAIMS:

1. An electric motor with a damping device comprising a disc-shaped damping mass (21) made at least partly of a magnetisable material and arranged to be axially movable and freely rotatable relative to the driven element, which mass is pressed against a stop (22) under the influence of a magnetic force, said stop rotating with the driven element, characterized in that the motor is a single-phase synchronous motor (11) comprising a two-pole permanent-magnet rotor (14) and a stator (12) with coils (13),
 - the damping mass being arranged within the range of a magnetic stray field of the synchronous motor, which field is active at some distance adjacent the synchronous motor,
 - the stop being interposed between the rotor of the synchronous motor and the damping mass, and
 - the magnetic force which acts upon the damping mass being produced by the magnetic stray field of the synchronous motor.
2. A motor as claimed in Claim 1, characterized in that the damping mass (21) is arranged within the range of the magnetic stray field of the electrical excitation of the coils (13) of the stator (12).
3. A motor as claimed in Claim 1, characterized in that the damping mass (21) is arranged within the range of the magnetic stray field of the rotor (14).
4. A motor as claimed in Claim 3, characterized in that in a motor having a cylindrically shaped rotor the stop (22) is formed by a radial surface (28) of the rotor (14).
5. A motor as claimed in any of the preceding Claims, characterized in that the damping mass is formed



by two juxtaposed discs (25, 26), of which the first disc (25) adjacent the stop is made of a non-magnetisable material and the other, second disc (26) is made of a magnetisable material.

5 6. A motor as claimed in Claim 5, characterized in that the second disc (26) takes the form of a disc which is at least ten times as thin as the first disc (25), which mainly constitutes the damping mass.

7. A motor as claimed in Claim 5 or 6,
10 characterized in that the second disc (26) is clear of the driven element.

8. A motor as claimed in any of the preceding Claims, characterized in that the facing radial surfaces of the stop (22) and the damping mass (21) are provided
15 with a lubricant.