

DESCRIPTION

The invention relates to an electric motor with disk brake according to the preamble of patent claim 1.

5 Such an electric motor is known from DE-A-1,951,892. The disk brake of this motor operates with a helical spring, surrounding the motor shaft at a distance, as device for generating the braking force and with an electromagnet as device for easing the brake, the
10 axially movable armature of the electromagnet forming the pressing part. The end of the helical spring facing away from the motor bears against a sleeve-shaped component surrounding the shaft with clearance, on the side of which component facing away from the spring the armature
15 is arranged. Helical spring and sleeve-shaped component are concentrically surrounded by the coil of the electromagnet. The brake disk comprises at its rim zone an annular brake disk part which forms the actual braking member and is connected via a membrane spring to a hub by
20 hollow rivets. This hub is seated on the motor shaft and has a threaded hole, which serves for receiving a clamping screw. The entire disk brake is covered by a housing cover, which is attached to the motor flange and on the inner end face of which a disk forming the fixed brake
25 part is secured by means of screws. Since the helical

spring and the mentioned sleeve-shaped component between this spring and the armature concentrically surround at only a small distance the motor shaft passing through the motor flange, the entire inner space of the housing cover
5 is filled virtually completely by the parts of the disk brake. Therefore, the bearing on the brake side for the motor shaft is also arranged in the form of a ballbearing on the inner side of the motor flange, that is next to the disk brake.

10 Another known electric motor with disk brake is known from EP-A 0,146,783 and is designed as a robot positioner with built-in resolver. This electric motor essentially comprises a first fixed housing part with a central hollow spindle, on which the stator is secured,
15 a second housing part, rotatable in relation to the first housing part, the rotor, which is mounted rotatably by a rotor ring on the hollow spindle, and a special reduction clutch installed between rotor and second housing part. The disk brake is located in the interior of this elec-
20 tric motor, in the annular space between the hollow spindle and a cylindrical sleeve belonging to the mentioned reduction clutch and is a spring-loaded brake which is eased by an electromagnet. The brake disk, consisting of flexible material, is secured to the end
25 of the rotor ring. The electromagnet has a cross-sectionally pot-shaped stator ring, which is secured next to the brake disk to the fixed housing part and is open towards the brake disk, a coil arranged inside this stator ring and an annular armature, forming the pressing part of the

brake. This armature surrounds the hollow spindle concentrically between stator ring and brake disk, is fixed against rotation but arranged axially displaceably and has a radially innerlying annular section, which
5 projects axially and is impinged by a spring which is fitted in the annular space between the hollow spindle and the inner periphery of the stator ring. When the electromagnet is not excited, the armature, under the effect of the spring, presses an annular rim zone of the
10 brake disk, with elastic deformation of the same, against the fixed brake part.

Disk brakes of this type are used in particular as standstill brakes, which assume their braking position when the magnet coil is currentless, in other words when
15 the electric motor is disconnected, by the armature being pressed against the brake disk by the spring. With excitation of the magnet coil, on the other hand, the brake is eased by the stronger magnetic force pulling the armature back from the brake disk against the action of
20 the spring. Such standstill brakes are necessary in particular on positioning motors, the rotor of which has to be blocked in its position if the motor is disconnected or there is a power failure.

The disk brake of the known electric motor
25 described above is accommodated completely in the interior of this motor and has a considerable space requirement, since it takes up quite a large annular space, extending radially outward from the hollow spindle.

Another disk brake intended for an electric motor is known from EP-A-0,078,944 and is likewise designed as an electromagnetically easable spring-loaded brake, which in turn can be used above all as a standstill brake. The
5 brake disk consists in this case, as in the case of numerous other known disk brakes as well, of a rigid, quite heavy and thick disk, to which a brake lining is secured, and is impinged on one side by the pressing part during the braking operation, said pressing part again
10 being the armature of the electromagnet, the pot-shaped magnet housing of which concentrically surrounds the motor shaft and carries an axially movable toroidal coil. This toroidal coil is pressed by springs in the direction of the armature, which is arranged axially movably
15 between coil and brake disk. The bearing bush for the motor shaft is seated in the central opening of the magnet housing, which therefore surrounds the motor shaft at only a small distance.

US-A-2,077,888 likewise discloses an electric
20 motor with electromagnetically easable disk brake in the form of a spring-loaded brake, in which a plurality of electromagnets, distributed along an outer peripheral region of the brake disk, are provided. In this case, the brake disk is clamped in the braking position by springs
25 between an axially displaceable pressure plate, carrying the armatures of the various electromagnets, and a plate forming an abutment, which is fitted on axially parallel pins, which for their part are secured to the side flange of the motor housing and project axially on the inner

side of the latter. In this case as well, the disk brake, installed completely in the interior of the motor housing, takes up a space filling the entire radial dimension of the motor.

5 Owing to their relatively large weight and therefore large moment of inertia, the rigid, heavy brake disks used in the case of the known electric motors just described, are frequently unfavorable, namely when they are used as standstill brakes for positioning motors
10 which have to be switched on and off frequently and in particular have to be accelerated and braked rapidly. If the motor also has to operate at high speeds as well, a large moment of inertia of the brake disk is especially unfavorable. In addition, the necessary perfect balancing
15 of the heavy brake disk is laborious and time-consuming. Furthermore, the space requirement necessary for accommodation of the brake is frequently unfavorable, above all if the motor has to be equipped with further attaching parts, for example a tachometer generator and/or a
20 phase-angle sensor.

Setting out from an electric motor with disk brake of the type described in the preamble of claim 1, the invention is based on the object of accommodating the
25 disk brake in such a space-saving way that it does not disturb the installation of attaching parts and, in particular, allows a compact design without great space requirement in the axial direction and that at the same

time the advantage of a brake disk with only low moment of inertia is utilized without adversely affecting the braking power. Such a disk brake is advantageous in particular as a standstill brake for positioning motors.

5 This object is achieved according to the invention by the features specified in the characterizing part of patent claim 1.

 In this way, the advantage is obtained that the free annular space within the housing body of the brake
10 is available in a space-saving way for accommodating a further attaching part, in particular a tachometer generator and/or a phase-angle sensor, or else a ball-bearing for the motor shaft. At the same time, use is made of the advantage of the flexible brake disk known
15 per se, which can be designed to be especially thin, whereby its weight and its moment of inertia can be kept very small and its balancing is facilitated. Since the braking force becomes effective through the annular pressing part on the outer rim of the brake disk, a
20 maximum braking moment is obtained.

 The invention will be described in more detail with reference to the drawings by describing an exemplary embodiment of an electric motor with an electromagnetically operable spring-loaded brake, which acts as standstill brake.

Figure 1 shows a side view of the motor with an axial cross-section through the brake in eased state and

Figure 2 shows the same axial cross-section in the
5 braked state.

The disk brake is mounted on the side of a flange 1a of an electric motor 1 (indicated only diagrammatically) and consists of an electromagnet concentrically surrounding the shaft 2 of the motor 1 at a distance and
10 with an armature 8, which forms the pressing part, a brake disk 12, which is immovably secured on the shaft 2 by a press fit, and a stationary brake part 13 forming the outer brake housing.

15 The electromagnet has an annular housing frame 4 which forms the stator, is secured on the motor flange 1a and is pot-shaped, the annular recess 5 on the side facing away from the motor 1 being open. An annular coil 6 with its coil element 6a is borne axially displaceable in the
20 recess 5 and is subject to the effect of springs 7 in the form of helical springs. These are compression springs, which lie in the recess 5, distributed evenly along the periphery of the stator 4, and are supported on the one hand against the bottom of this recess 5 and on the other
25 hand against the inside of the coil element 6a of the coil 6. Borne rotatably fixed, but axially displaceable between the stator 4 with its coil 6 and the brake disk 12,

is the annular armature 8, which forms the pressing part and surrounds the shaft 2 at a distance. To prevent a rotation of the armature 8, a number of axially directed pins 10 are secured on it, distributed around its periphery, which pins engage freely displaceably in corresponding openings 11 of the stator 4. The stationary brake part 13, which forms a brake housing covering the brake with its electromagnet, is secured by means of screws 15 on the motor flange 1a.

On their sides facing the brake disk 12, the armature 8 and the stationary brake part 13 carry annular brake linings 9 and 14, which are opposite an annular rim zone 12a of the brake disk 12. The brake disk 12 consists of elastically flexible spring steel and has a thickness of only, for example, 0.15 to 0.30 mm, preferably of about 0.20 mm. Its diameter is matched to the motor size and, in the example considered, is approximately 16 cm. Up to an outside diameter of about 20 cm, the brake disk 12 may have the preferred thickness mentioned of about 0.2 mm; at diameters of 20 cm to 30 cm and above, this thickness may be chosen correspondingly greater and be, for example, approximately 0.3 mm.

The air gaps between the brake disk 12 and the brake lining 9 of the armature 8, on the one hand, and the brake lining 14 of the brake part 13, on the other hand, are, in the eased state, in each case about 0.2 mm, so that the border zone 12a of the brake disk 12 is dis-

placed by about 0.2 mm during braking.

With regard to the thickness of the brake disk 12 and the air gaps mentioned, which have been shown as exaggeratedly large in Figures 1 and 2 for reasons of clarity of the representation, Figures 1 and 2 are not true to scale.

The free annular space limited by the stator 4 of the electromagnet is relatively large as, after all, the diameter of the annular stator 4 may be chosen only a little smaller than the diameter of the electric motor and its radial dimension relatively small. Therefore, this inner annular space, the diameter of which is preferably at least as large as half the motor diameter, may be utilized for accommodation of a further attaching part 3 installed on the motor flange 1a, for example a tachometer generator and/or a phase-angle sensor, whereby an especially space-saving, compact design is achieved. However, in this annular space may also be mounted a bearing, in particular a ball bearing, arranged outside the flange 1a, for the shaft 2 of the motor 1, whereby the axial distance between the two bearings carrying the shaft 2 is increased and thus the stability of the motor rotor is improved.

Figure 1 shows the disk brake in the eased state, which it assumes when the motor is switched on and thus the coil 6 is excited. In this state, the magnetic force, which overcomes the force of the springs 7, pulls

the armature 8 back as far as the stop on the stator 4, the axially movable coil 6 being pressed into the recess 5 by its coil element 6a against the effect of the springs 7, and the brake disk 12 being released. In this unimpinged and undeformed state, the brake disk 12 is at an axial distance both from the brake lining 9 on the armature 8 and from the brake lining 14 on the inside of the stationary brake part 13 and can turn freely with the shaft 2.

Figure 2 shows the braking state of the brake which it assumes when the motor is disconnected or the power fails and thus the coil 6 is currentless. In this state, the springs 7 press the coil 6 by its coil element 6a axially outward against the armature 8, which presses the annular rim zone 12a of the brake disk 12, with elastic deformation of this brake disk, against the stationary brake part 13, whereby the brake disk is thus clamped by its rim zone 12a firmly between the two brake linings 9 and 14. Owing to this two-sided impingement of the brake disk 12 and the circumstance that the braking force acts on the outer rim of the brake disk 12, a maximum braking moment is achieved. As soon as the brake disk is released upon easing of the brake, it resumes its undeformed shape, shown in Figure 1, owing to its natural elasticity.

Owing to its only small moment of inertia, its acceleration and its braking do not require any substantial additional motor forces, so that the disk brake

according to the invention is suitable in particular for positioning motors switched on and off frequently. As it is seated axially immovably on the shaft 2, a clearance-free blocking of the motor shaft at a standstill is also
5 guaranteed.

The invention is not restricted to the embodiment described, but, in view of its structural design, permits manifold variants; in particular, instead of an annular coil 6, several separate coils evenly distributed along
10 the periphery of the stator 4 may be provided, for example three coils.

Furthermore, the braking force and/or the force for easing of the brake may be generated in a different way than by springs or by electromagnetic forces, for example by pressure medium-operated cylinder-piston units.
15 In this case, in the recesses 5 of the housing frame 4, for example, instead of the springs and coils, pneumatically or hydraulically operated, double-acting pistons are accommodated, which act on a pressing part corresponding
20 to the armature 8 and are, for example, hinged to it.



PATENT CLAIMS

1. An electric motor with disk brake mounted on the side of a motor flange (1a) and consisting of an elastically flexible brake disk (12) immovably secured on the motor shaft (2), an annular pressing part (8) opposite the brake disk (12) on the side facing the motor, and arranged rotationally fixed but axially movable, a stationary brake part (13) fitted on the side of the brake disk (12) facing away from the pressing part (8), a device (7) for generation of the braking force, by which the pressing part (8) presses an annular rim zone (12a) of the brake disk (12), with elastic deformation of the same, against the stationary brake part (13), and a device (6) for easing of the brake, by which the pressing part (8) is moved away from the brake disk (12), the devices (6, 7) for generation of the braking force and for easing of the brake, and the pressing part (8) concentrically surrounding the motor shaft (2) which traverses the motor flange (1a), characterized in that said devices (6, 7) for generation of the braking force and for easing of the brake are accommodated in an annular housing frame (4), in that this housing frame (4) and the pressing part (8) form around the motor shaft (2) a free annular space, the diameter of which is at least as large as half the diameter of the electric motor (1) and which offers room for a further attaching part (3), in particular a tachometer generator and/or a phase-angle sensor, or for a bearing, in particular a ball bearing, carrying the motor shaft (2), and in that the



brake disk (12) is made in one piece.

2. An electric motor according to claim 1, characterized in that the brake disk (12) consists of spring steel and has a thickness between 0,15 and 0,30 mm, preferably of 0,20 mm.

3. An electric motor according to one of claims 1 or 2, with attached disk brake in the form of a spring-loaded brake which can be eased by an electromagnet, wherein the housing frame (4) forms the stator of the electromagnet, characterized in that the electromagnet has several separate coils (6) distributed along the periphery of the stator (4).

4. An electric motor according to one of claims 1 to 3, characterized in that the stationary brake part (13) is formed by a pot-shaped housing part covering the brake disk (12) and the devices (6, 7) for generation of the brake force and for easing of the brake.