Device with an array of magnets

The invention relates to a device for generating an alternating magnetic field, which interacts with a stationary magnetic field.
The interaction of a stationary magnetic field and an alternating magnetic field is used for some time, for example in the field of brushless DC motors, and magnetic levitation.
The invention has for its object to provide an improved apparatus for generating an alternating magnetic field, which interacts with a stationary magnetic field.
This object is achieved by a device having a rotor and a stator, which are arranged coaxially to a rotatably mounted shaft, the rotor, one or more first magnetic effects, and the stator comprises one or more second magnetic episodes, wherein the one or more first magnetic episodes each two or more arranged on a surface of a coaxial to the shaft oriented first circular cylinder dipole comprise whose dipole with a tangent to the circumference of the outer surface by a point at which the dipole pierce respectively the outer surface, enclosing a respective angle of inclination of in a range 14 degrees to 90 degrees, and the one or more second magnet sequences two or more arranged on a surface of a coaxial to the shaft oriented second circular cylinder dipole whose dipole with a tangent to the circumference of the outer surface by a point at which the dipole respectively the outer surface pierced, enclose respectively an angle of inclination, which is in a range of 14 degrees to 90 degrees, wherein the one or more first magnetic effects and the one or more second magnetic consequences in relation to a vertically arranged to a shaft axis of the shaft level each one slope angles, which lies in a range from 10 degrees to 80 degrees or 280 degrees to 350 degrees, and wherein the one or more first magnetic effects and the one or include more second magnet sequences one angle of attack, of the up in a range of 0 degrees 90 degrees.
The above-mentioned formulations "whose dipole with a tangent to the circumference of the outer surface by a point at which the dipole pierce respective lateral surface, each including an angle of inclination, which is in a range of 14 degrees to 90 degrees" are to be understood as that each of the dipole of the rotor and the stator may have a unique angle.
The only restriction on the respective individual inclination angle is that it is in a range of 14 degrees to 90 degrees.
This includes the case where two or more dipole having the same angle of inclination.
It is, for
Example also possible that all the dipole of the rotor and / or the stator have the same angle of inclination.
The above-mentioned expression "the one or more first magnetic effects and which have one or more second magnetic consequences in relation to a vertically arranged to a shaft axis of the shaft level each have a pitch angle in a range from 10 degrees to 80 degrees or 280 degrees to 350 degrees "is to be understood that each sequence of the magnet rotor and the stator may have an individual pitch angle.
The only limitation of the respective individual lead angle is that it is in a range from 10 degrees to 80 degrees or 280 degrees to 350 degrees.
This includes the case where two or more magnet sequences have the same pitch angle.
It is, for
Example also possible that all the magnetic effects of the rotor and / or the stator having the same pitch angle.
In the case where two magnetic effects on the rotor and / or the stator have different pitch angles, and the consequences of these magnetic associated angles are different.
Moreover, the above object is achieved by a device comprising a coaxially arranged to a rotatable shaft inside the stator, a coaxially arranged to the shaft rotor and arranged coaxially to the shaft outer stator, the rotor with respect to the inner stator, at least partially disposed radially outwardly on and fixedly connected to the shaft and the outer stator is in relation to the rotor, at least partially disposed radially further outwards, the inner stator having two or more arranged on a lateral surface

of a circular cylinder dipole which uniformly over the circular cylinder circumference distributed and in relation axially on a shaft axis of the shaft offset from each other are such that on the outer surface of the circular cylinder a stepped arrangement of the dipole gives and adjacent dipole in relation to the shaft axis overlap axially partially, wherein the rotor has two or more at a lateral surface of a circular cylinder extending rows, each with four or more evenly distributed on the circular cylinder circumferential dipole magnet, said dipole a number lying in a plane perpendicular to the shaft axis extending plane and the dipole magnets of adjacent rows are offset from one another alternately so that it axially to the shaft axis one above the form circular cylinder circumference uniform zigzag pattern, and the outer stator having two or more arranged on a lateral surface of a circular cylinder dipole magnets which are distributed uniformly on the lateral surface.
The formed by the special arrangement of the dipole of the rotor and the stator and the magnetic stators cause the rotor is kept free floating.
The inventive devices thus acts as a magnetic bearing.
Surprisingly, it has been shown that due to the special arrangement of the dipole of the rotor and the stator or the stators when the rotor rotates, an alternating magnetic field is generated, which allows a substantially loss-free rotation of the rotor relative to the stator or the stators.
This can be exploited for a variety of technical applications, for example for a very low-friction bearing of a preferably high-speed shaft.
In the following description, mathematical, especially geometric terms such
As parallel, perpendicular, plane, cylinder used, angles, etc., who register in technical drawings, but in practice, due to the manufacturing tolerances can never be completely fulfilled.
For the expert, it is therefore clear that this description is to be regarded only as an ideal description.
The description includes but implicitly also similar devices with generally accepted tolerances with.
The shaft extends in one axis, the so-called
The shaft axis, and is rotatable about this axis.
The shaft is preferably formed as a straight circular cylinder, the rotation axis of the circular cylinder is the shaft axis.
It is possible that within the first and / or second magnet sequences adjacent dipole magnets have the same polarity.
It is also possible that, within the first and / or second magnet sequences adjacent dipole magnets have a different polarity.
In a preferred embodiment, the polarity of the two or more dipole equal within one or more magnet sequences.
In relation to the shaft axis, this means that the north poles of all dipole show within one or more magnet sequences either to the shaft axis, or are turned away.
Said one or more magnetic effects are consequences of the solenoid, one or more first magnetic effects and / or magnetic effects of the one or more second magnetic effects.
It is also possible that the polarity of each dipole of the rotor or the stator is the same, that is, the north poles of the rotor or of all dipole magnets of the stator to the shaft axis either show or are turned away.
Polarity of a dipole magnet under the orientation of the magnetic North and South Poles of the dipole magnet is understood.
In another preferred embodiment, the polarity of the two or more
A dipole magnetic alternating sequence.
It is possible that within a magnetic dipole sequence adjacent a different polarity.
In this case, a magnetic dipole successive episode show, for example, the sequence ...
SNSN ...
(N = North Pole, S = south).
It is also possible that the change of the polarity is irregular, so that for example, the sequence ...
NNSNNS ... obtained.
Preferably run parallel to the dipole of the dipole of the vertically arranged to the shaft axis.
Preferably, the spacing between adjacent dipole magnets of the two or more dipole constant within

one or more magnet sequences.
Said one or more magnetic effects are consequences of the solenoid, one or more first magnetic effects and / or magnetic effects of the one or more second magnetic effects.
It is possible that the spacing between adjacent dipole within the one or more first magnetic effects of the rotor and / or the stator is constant.
In this case it is possible that the distance between adjacent of the two or more dipole dipole within the one or more first magnetic effects of the distance between adjacent of the two or more dipole dipole within the one or more second magnetic episodes differs.
It is also possible that the spacing between adjacent dipole magnets of the two or more dipole within the one or more first magnetic effects coincide with the spacing between adjacent dipole magnets of the two or more dipole within the one or more second magnetic effects.
It is also possible that the inclination angle of the dipole within the one or more first magnetic effects and / or the one or more second magnet sequences is constant.
Preferably, this constant slope angle is in a range from 14 degrees to 90 degrees.
The pitch angle of a magnetic sequence specifies the angle of intersection between a tangent that touches a by the two or more dipole formed within the magnetic sequence curve, and a perpendicular to the shaft axis extending plane.
In general case, the pitch angle of a magnetic sequence change in the course of the magnetic sequence.
In a preferred embodiment the pitch angle of a magnetic sequence is constant, similar to the pitch of a thread.
In the case of a constant pitch angle of said two or more of the magnetic dipole in a winding sequence lie on a straight line.
It is preferred if the one or more first magnet sequences called the same pitch angle, first pitch angle having.
Furthermore, it is preferred if the one or more second magnet sequences called the same pitch angle, second pitch angles.
The angle between a first magnet sequence and a second magnet follower is in a winding of said first and second magnetic Follow the angle of intersection between a first tangent that touches one of the two or more dipole formed within the first magnet follower cam, and a second tangent, by a the two or more dipole formed within the second magnetic sequence curve touches on.
In the general case, the angle of incidence can change during the course of the magnetic effects.
In a preferred embodiment the angle between a first magnet and a second magnet sequence sequence is constant.
In this case the respective helix angle of the first magnet and the second magnet sequence sequence is constant.
In a particularly preferred embodiment, for all of the first and second magnet sequences exists a single, constant angle.
In this case, the one or more first magnetic effects on the same first pitch angle and have one or more second magnetic effects on the same second angle of inclination.
In a preferred embodiment, two or more first magnet sequences begin at a first perpendicular to the shaft axis is arranged on a second plane and terminate perpendicular to the shaft axis plane arranged.
In the same way, it is possible that two or more second magnet sequences begin at a first line perpendicular to the shaft axis and end at a second level which is arranged perpendicular to the shaft axis.
It is possible that all the magnetic effects of the rotor and / or start of the stator at a first axis oriented transversely to the shaft end surface of the rotor or the stator and terminating at a second axis oriented transversely to the shaft end surface of the rotor or the stator.
Preferably, the one or more first magnetic effects and / or the one or more second magnet sequences are arranged so that forming groups of two or more magnetic effects.
A group of two or more magnetic effects is characterized in that the distance of the magnetic effects

from one another is less than the distance to magnetic effects, which do not belong to the group.
In a preferred embodiment, an air gap between the rotor and the stator has a gap width of 0.1 mm to 50 mm.
It is particularly preferred if the gap width has a value of 1 mm to 5 mm.
In a preferred embodiment, the rotor and the stator in the line perpendicular to the shaft axis have a plane substantially circular cross section.
With the term "substantially circular" it is stated that the cross section due to the manufacturing tolerances are not met, the geometrically perfect circular shape, but it comes close.
Preferably, the outer surface of the first circular cylinder circumscribed to the outer circumference of the rotor and / or the inner circumference of the rotor inscribed.
The former, that the outer surface of the first circular cylinder the outer periphery of the rotor circumscribed, refers to the case that the rotor relative to the stator at least partially disposed radially inward.
The latter, that the outer surface of the first circular cylinder is inscribed to the inner circumference of the rotor refers to the case that the rotor is arranged with respect to the stator at least partially radially outwardly further.
Preferably, the outer surface of the second circular cylinder is circumscribed to the outer circumference of the stator, or the inner circumference of the stator inscribed.
The former, that the outer surface of the second circular cylinder is the outer circumference of the stator circumscribed, refers to the case that the rotor is arranged with respect to the stator at least partially radially outwardly further.
The latter, that the outer surface of the second circular cylinder is inscribed to the inner circumference of the stator, refers to the case that the rotor relative to the stator at least partially disposed radially inward.
In a preferred embodiment, the dipole of the rotor or the stator in each case so disposed on the outer surface of the first circular cylinder and the second circular cylinder, that the outer surface of the first circular cylinder and the second circular cylinder touches the dipole of the rotor or the stator in each case non-cutting .
The term "non-contact cutting" it is stated that the respective surface area touches the dipole magnets, but not its volume cuts.
This means that the respective outer surface, the dipole magnets only tangent touches ie superficial.
It is particularly advantageous, if the rotor and / or the stator comprising a support body of non-magnetic material with recesses for receiving the dipole magnets.
The support body is used to keep the dipole at a defined position.
The dipole magnets are fixed in the recesses provided to the support body.
In a preferred embodiment, the stator is constructed as an inner stator, the rotor in relation to the form of a stator inner stator is at least partially disposed radially outwardly on and fixedly connected to the shaft, and the apparatus includes a coaxial to the shaft outer stator , which is in relation to the rotor, at least partially disposed radially further outwards.
Also in this preferred embodiment, the dipole of the one or more second magnetic effects evenly distributed over the circumference of the second circular cylinder and in relation to the shaft axis axially mutually displaced so that on the outer surface of the second circular cylinder is a stair-like arrangement of the dipole magnets is and adjacent dipole with respect to the shaft axis axially overlap partially.
Moreover, in this preferred embodiment, the rotor magnet k first episodes, wherein k is an integer greater than or equal to four, and the two or more of the k first dipole magnet sequences are designed so that they are on two or more of
Lateral surface of the first circular cylinder extending rows, each with k uniformly distributed on the periphery of the first circular cylinder form dipole.
Moreover, in this preferred embodiment, the dipole of a number lying in a plane perpendicular to the shaft axis extending plane, and the dipole of adjacent rows are mutually alternately staggered such that they form axially to the shaft axis, a uniform over the circular cylinder circumferential

zigzag pattern.
To this preferred embodiment, the outer stator on two or more arranged on a the surface of a third circular cylinder dipole magnets which are distributed uniformly on the lateral surface.
In a preferred embodiment, the magnets of the inner stator, the rotor and the outer stator is at least partially overlap.
A partial overlap of two magnets is met when a plane perpendicular to the shaft extending exists which extends through each of the two magnets.
From a complete overlap of two magnets will be discussed, if for each point of one of the two magnets have a plane perpendicular to the shaft extending exists which extends through each of the two magnets.
A partial overlap of three magnets is satisfied when one plane perpendicular to the shaft extending exists which extends through each of the three magnets.
From a complete overlap of three magnets is then spoken, if, for each point of two of the three magnets exist perpendicular to the shaft extending plane passing through each of the three magnets.
There may be a degree of overlap can be defined in a degree of overlap of 0% overlap two / three magnets are not in a coverage ratio of 100%, two / three magnets completely cover.
In a particularly preferred embodiment of the apparatus, the inner stator and the rotor axially relative to the shaft axis and the magnets invariably of the inner stator and the rotor overlap completely.
Moreover, the outer stator is axially movable relative to the shaft axis, so that the
Degree of overlap of the magnets of the outer stator and the magnets of the rotor can be continuously changed in a range from 0% to 100%.
The magnets of the inner stator, the rotor and the outer stator each define an imaginary hollow cylinder with a common longitudinal axis (= the shaft axis), within the wall of the magnets are arranged.
In the case of a partial overlap of the three magnets of the three imaginary hollow cylinder are at least in a portion of the longitudinal axis radially superimposed.
This portion of the longitudinal axis of the imaginary longitudinal axis thus forms the cylinder cavity, the longitudinal axis is coaxial with the shaft.
In case of a complete coverage of the magnets of the three components (= inner stator, the rotor and the outer stator) two of the three imaginary hollow cylinder always lie radially above or below the third of the three imaginary hollow cylinder.
Preferably, the rotor has the shape of a drum or of a cup, that is, it comprises a hollow cylinder with a circular cross section or a pipe piece, whose one end is covered by a coaxial circular disk.
In the center of the circular disk, the rotor has a bore through which the shaft axis.
The circular disc can additionally carry a ring which is used to connect the rotor to the shaft, such Example by means of a screw which passes through a radial bore in the ring.
The rotor is connected with the shaft immovably, that is, the relative position of the rotor with respect to the shaft does not change during rotation of the shaft during the normal operation of the device.
Nevertheless, the screw which connects the rotor to the shaft, to be solved, such
As for maintenance, cleaning, replacement of defective parts, etc.
The hollow cylinder of the rotor, surrounding the outer surface of the cylindrical inner stator to form an annular air gap between the rotor and the inner stator.
It is also possible that the circular disc, which covers one end face of the rotor hollow cylinder having two or more dipole magnets arranged on a circumference in relation to the center of the circular disk.
The magnetic dipole axis of the dipole magnets is parallel to the shaft axis.
Under a magnetic dipole, or short dipole, a straight line is a dipole magnet understood that connects the south pole and the north pole of the dipole magnet.
Preferably, the dipole magnets are distributed uniformly on the circumference.
It is particularly advantageous if the outer stator of hollow cylindrical shape or a circular tube-

shaped surrounding the rotor.
It is possible, for example that the outer stator and the shape of a hollow cylinder
Circular tube having a central axis coincident with the central axis of the rotor.
The hollow cylinder of the outer stator surrounding the outer surface of the hollow cylindrical rotor to form an annular air gap between the outer stator and the rotor.
In a preferred embodiment have the dipole magnets of the outer stator on a rod-shaped geometry and run with their Stabbzw.
Longitudinal axis parallel to the longitudinal axis of the circular tube, ie parallel to the axis of the shaft (= shaft axis).
It is preferable if they are of the outer stator dipole extending substantially over the entire length of the shape of a circular tube formed in the outer stator.
Mean "substantially" may be that the outer stator having at its end faces have an edge or a cover plate, forming at which the dipole magnets.
The magnetic dipole of the dipole magnets of the outer stator is preferably in a plane which is perpendicular to the longitudinal axis of the dipole magnets.
It is also possible that the rod-shaped, preferably of the outer stator dipole magnets in the form of one or more rings along the circumference of the outer stator are arranged.
Each of the rings is formed from the dipole in a plane perpendicular to the shaft axis.
Forming a ring dipole magnets are separated from each other by webs of non-magnetic material from one another.
Between each group formed by the dipole rings extend along the periphery of the outer stator annular webs of non-magnetic material.
Preferably the axis of the shaft is oriented toward the inner side of the dipole magnets are located on a lateral surface of a circular hollow cylinder.
It is preferable that the dipole rings are evenly distributed over the entire height of the outer stator.
In a preferred embodiment of the invention, the inner stator and the outer stator are arranged to be stationary.
The inner stator and the outer stator can be by using fastening devices and / or guide means can not be rotated in a mechanical housing for receiving the device is arranged.
In a preferred embodiment, the shaft penetrates the inner stator, but rather is only connected to the rotor.
The rotor is held by the magnetic fields of the device in balance.
Therefore, an additional mechanical mounting of the rotor by means of a bearing is not necessary.
The shaft is in this case formed by a pin which is disposed to the outside of the circular disc at the end face of the rotor on the rotor projecting.
In an alternative embodiment of the device, the shaft extending over the entire length of the device.
While the shaft extends along the central axis of the inner stator, and serves as an additional guide element of the mechanical rotor.
In this case, the inner stator preferably has a bearing, for
B. Rolling one, on, in which the shaft is rotatably mounted.
It is also possible that the rotor and the outer stator each consist of two halves.
Preferably, these halves are each formed symmetrically, with respect to a plane of symmetry perpendicular to the shaft axis.
This plane of symmetry passes through the same time the inner stator, which is split in this way in two equal halves imaginary.
In the field of
Plane of symmetry is arranged a fixing device by means of the inner stator is fixedly secured to the mechanical housing.
Preferably separates these fastening means, the two halves of the rotor and the two halves of the outer stator, forming air gaps.
It is also possible that the two halves of the outer stator with respect to the shaft axis are movable.
In a preferred embodiment, the two halves of the outer stator are arranged symmetrically to the

plane of symmetry be displaced in that the degree of overlap of the magnets of the rotor continuously through the magnets of the outer stator in a range from zero percent to one hundred percent is adjustable.
This is for
Example be realized by means of a threaded shaft with two opposite threads, to which the two halves of the outer stator are disposed in the opposite threaded portions.
Depending on a direction of rotation of the threaded shaft, the two halves of the outer stator toward each other or away from each other.
An angle [alpha] is defined as the angle between the dipole one dipole magnet of the inner stator and a tangent to the circumference of the inner stator, wherein the tangent line passing through a point on the circumference, in which the dipole axis penetrates the circumference.
An angle ss was defined as the angle between the dipole axis of the rotor and one dipole magnet of a tangent to the circumference of the rotor, wherein the tangent line passing through a point on the circumference, in which the dipole axis penetrates the circumference.
An angle Y is defined as the angle between the dipole one dipole magnet of the outer stator and a tangent to the circumference of the outer stator, the tangent passing through a point on the circumference, in which the dipole axis penetrates the circumference.
In a preferred embodiment of the invention, the angles are [alpha], [deg.] Ss and y is in a range of 14 <[alpha], ss, y <= 90 [deg.].
It is possible that the one dipole dipole magnet in a plane perpendicular to the shaft axis, which angle [alpha], ss, Y corresponds to 90 [deg.].
In the case that said tangent parallel to the circumference of the inner stator to the tangent to the circumference of the outer surface of the second circular cylinder corresponds to the angle [alpha] to the inclination angle.
In the case that said tangent to the circumference of the rotor parallel to the tangent to the circumference of the outer surface of the first circular cylinder, corresponds to the angle ss to the inclination angle.
It is particularly advantageous if the dipole magnets of the inner stator and / or of the outer stator in a sectional plane perpendicular to the shaft axis have a rectangular or trapezoidal cross-section.
Furthermore, it is particularly advantageous if the dipole magnets of the rotor in a section plane perpendicular to the magnetic dipole axis of the dipole magnets one point-symmetrical, preferably a circular, cross-section.
There are also other, non-point-symmetric cross sections are possible, such
As trapezoidal, triangular, or irregularly shaped cross sections.
In a further preferred embodiment, the dipole of the inner stator and / or the outer stator point parallel to the shaft axis to the largest extent.
This means that the dipole of the inner stator and / or the outer stator having a rod-shaped geometry.
The dimension parallel to the dipole is smaller than the dimension parallel to the shaft axis.
It is possible that all the dipole magnets of the inner stator a same outer shape, that is, the same geometry.
It is also possible that all of the outer stator, a dipole same external shape, ie, the same geometry.
It is also possible that all the dipole of the rotor an identical outer shape, that is, the same geometry.
With external form or
Geometry are merely meant the external dimensions and the magnetic orientation, ie, the position of the magnetic north pole and the magnetic south pole is independently thereof and can individually vary from magnet to magnet.
In a preferred arrangement of the magnet device, the magnets of the inner stator, the rotor and the outer stator each have the same orientation, so that they repel each other at any angle of the rotor.
For example, has at all dipole on the inner stator, the north pole to the outside, with all dipole magnet on the rotor, the north pole and the south pole to the inside to the outside, and all on the outer stator of the dipole magnet south pole to the inside.
Further features, details and advantages of the invention will become apparent from the following

description of several embodiments of inventive devices based on the drawings.
Shown
1a, 1b cross sections of a stator with a magnetic string;
2a, 2b show cross sections of stators with multiple-magnetic effects;
Figures 3a, 3b handling from outer surfaces of stators;
FIG
4 handling from outer surfaces of a stator and a rotor;
5a - 5c is a side view and cross sections of a stator;
6a - 6f views, cross sections and a longitudinal section of a rotor; 7a - 7d views and a cross section of a stator;
8a - 8d and a cross-sectional views of a stator;
9a - 9h schemes to illustrate the pitch angle;
10 is a diagram showing the relationship between
Magnet sequences and series of magnets of the rotor;
11 shows a schematic representation of an inventive apparatus having a rotor and two stators;
12a is a perspective view of the inner stator of the apparatus of Figure 11 without magnets (= stator);
Figure 12b is a schematic representation of the inner stator of the apparatus of Figure 11, perpendicular to the shaft axis;
13 is a development of the magnet assembly on the inner stator of the apparatus of FIG
11;
14 shows a section through the inner stator of the apparatus of Figure 11, along the line AA shown in Figure 12b;
Figure 15a shows a view of the fastening device of the apparatus of FIG 11, perpendicular to the shaft axis;
Figure 15b is a view of the fastening means of the device according to FIG 11, in the direction of the shaft axis;
16 is a perspective view of the rotor of the apparatus of FIG
11;
17a is a schematic view of the inner stator and the rotor of the apparatus of FIG
11, 17b is a diagram of possible tilt angle of the dipole magnets of the rotor of the apparatus of FIG 11;
Figure 18a is a development of the magnet assembly of the rotor of the apparatus of FIG 11, XY along the direction indicated in Figure 16;
Figure 18b shows a detailed view of the settlement according to 18a;
Figure 19a is a longitudinal section through a mechanical housing for the apparatus of FIG
11;
Figure 19b shows a section through the outer stator of the apparatus shown in FIG 11, perpendicular to the shaft axis;
20 shows an oblique view of the outer stator and the mechanical
Housing for receiving the device according to FIG
11;
21 shows a diagram of the magnet assembly on the stators and the rotor of the apparatus of Figure 11, shown as a section taken along the
Shaft axis;
22 shows a diagram of the magnet assembly on the stators and the rotor of the
The apparatus of Figure 11, shown as a section along the line BB shown in Figure 11;
Figure 23a is a schematic illustration of a dipole magnet of the outer stator of the apparatus shown in FIG
11;
Figure 23b is a schematic illustration of a dipole magnet of the inner stator of the apparatus of Figure 11, and

Figure 23c is a schematic illustration of a dipole magnet of the rotor of the apparatus of FIG
11th 1a shows a cross section of a stator 2, wherein the sectional plane orthogonal to the shaft axis 50.
The stator 2 has a circular cross-section.
The stator 2 comprises a magnetic dipole magnet sequence of 8th
The magnetic dipole axis of one of these 80 dipole 8 is located in the section plane.
The dipole magnet 8 is arranged on a circumferential surface coaxial to the shaft axis one M2 50 oriented first circular cylinder.
On the outer surface extending in the M2-sectional plane tangent 81 is laid, which touches the circumferential surface M2 at the point at which the dipole axis 80 penetrates the outer surface.
The angle between the dipole axis 80 and the tangent 81 is the angle of inclination a, which in this example is 90 degrees.
Fig.1 b 1a shows a detail of FIG.
The dipole magnet 8 touches the dotted surface M2 in the contact points P1, P2.
The drawn with a continuous line the circumference U of the stator 2 follows the planar
End surface of the dipole magnet 8 and therefore differs from the region of the dipole magnet 8 of the cylindrical surface M2.
2a shows a cross section of a stator 2 with a first and a second magnetic sequence.
The stator 2 comprises two dipole magnets 8, which are arranged side by side.
The magnetic dipole 80 of the two dipole magnets 8 are in the cutting plane and parallel.
The left part of the first dipole magnet is 8 sequence of the stator 2, the right part of the second dipole magnet 8 is a result of the magnetic stator 2
2b shows a cross section of a stator 2 with a first and a second magnetic sequence.
The stator 2 comprises two dipole magnets 8, which are arranged side by side.
The magnetic dipole 80 of the two dipole magnets 8 are in the sectional plane, the shaft axis 50 and cut include an angle [lambda].
The left part of the first dipole magnet is 8 sequence of the stator 2, the right part of the second dipole magnet 8 is a result of the magnetic stator 2
3a shows a development of a surface M2 of a cylindrical stator with a magnet sequence F2.
The orientation of the surface M2 is defined by the specification of the shaft 5 and the shaft axis 50.
The magnetic sequence F2 starts at the left side of the outer surface and ends M2 on the right side of the lateral surface M2.
The dipole magnets 8 of the magnet sequence F2 lie on a straight line.
The arrangement of the magnet sequence F2 on the outer surface is defined by a pitch angle M2 b of the straight line defined.
The pitch angle b is the angle of intersection between the straight line of the magnet and a sequence F2 perpendicular to the shaft axis 50 extending plane.
The magnetic sequence F2 describes in their course along the shaft axis 50, a whole turn (= 360 degrees) around the shaft axis 50
3b shows - in line 3a - a development of a surface M2 of a cylindrical stator with a magnet sequence F2.
In comparison to the one shown in Figure 3a, the pitch angle is magnet sequence shown in Figure 3b magnet sequence F2 b greater.
Therefore the magnetic sequence F2 describes in their course along the shaft axis 50, only a half-turn (= 180 degrees) around the shaft axis 50
4 shows a development of a surface M2 with a stator magnet sequences F2 and a development of a surface M1 of a stator associated with rotor magnet sequences F1.
The dipole magnets of the magnet sequences F1, F2 lie on straight lines.
The stator and the associated line the rotor associated straight divorced at an angle c.
5a shows a plan view of a stator 2
The stator 2 has the shape of a cylinder whose axis of rotation in the image plane and coincides with the shaft axis 50.

The stator has eight magnet sequences F2.
A supporting body of the stator 2 surrounds the pole faces of the magnetic cylindrical dipole magnet 7 episodes F2, which are located in recesses of the support body.
5b shows a cross section of the stator 2 shown in Figure 5a along a section plane AA, as shown in FIG 5a.
Average equally distributed around the circumference of the stator 2 recesses 22 are visible for the dipole magnets.
Each of the recesses 22 in the visible section is a separate magnet sequence F2 assigned.
Relative to the shaft axis of the stator 2, the recess 22 of a magnet is rotated sequence F2 by the angle [delta] with respect to the recess 22 of an adjacent magnet sequence F2.
In the present embodiment, the angle [delta] = 45 degrees.
The radius R2 of the cylindrical stator 2 is in the present embodiment 45 mm.
The depth T22 of the cylindrical recesses 22 in the present embodiment is 22.22 mm, the diameter D22 has such
Example, a value of 10 mm.
5c shows a cross-section of the stator 2 shown in Figure 5a along a section plane BB, as shown in FIG 5a.
Compared to the illustrated section in FIG 5b the recesses are twisted at an angle [Delta] to the shaft axis 50.
Within a magnet sequence F2 adjacent dipole magnets 8 are therefore with respect to the shaft axis 50 rotated by an angle [Delta] to today.
In the present embodiment, the angle [delta] = 12 degrees.
6a shows a plan view of a rotor 1
The rotor 1 is in the form of a hollow cylinder having a height H. The height H is such
B. 235 mm.
The wall of the rotor 1 has the wall penetrating through holes that serve as recesses 15 for receiving the dipole magnets.
The magnetic effects of the rotor 1 starts at a distance E from the end face of the rotor 1 and terminate in the first distance E from the opposite end of the rotor
In the present embodiment, the distance D 35 mm.
The D15 diameter of the cylindrical recesses 15 is, for
B. 10 mm.
Each recess 15 is associated with a holding device for fixing the inserted into the recesses 15 dipole magnet seventh
The holding device consists of a threaded hole 150 and a threaded pin, which is screwed into the threaded hole and for fixing of the dipole magnet 7 serves.
6b shows a view of the links shown in Figure 6a rotor 1
The outer diameter of the rotor 1 is, for D1A
Example 143 mm, its inner diameter D1 for I
B. 93 mm.
The rotor 1 has at its end face evenly distributed over the circumference on M6 threaded holes, which are mounted at a distance from the outer circumference DM6.
The threaded holes M6 for example, one metric ISO thread with a nominal diameter M6 have (International Organisation for Standardisation).
The distance is, for DM6
B. 10 mm.
These threaded holes M6 used to attach a cover to the face of the rotor 1, on which the rotor 1 is connected to the shaft 5.
At each end, the rotor 1 has a circumferential groove 16, the outer diameter D16, for
B. is 97 mm.
This groove 16 receives a corresponding circular projection of the lid.
6c shows a three dimensional view of the rotor shown in FIG 6a first

6d shows a longitudinal section of the shown in Figure 6a along the rotor 1 shown in Figure 6a-sectional plane AA. The depth of the TM6 mounted in the ends holes M6 has a value of, for B. 20 mm on.
The depth T16 of the arranged at the ends, circumferential grooves 16 is, for
Example 2 mm and its width has a value of, for example B16
As 2 mm.
In Figure 6d in different recesses 15 threaded holes 150 can be seen, which open into the recesses 15.
Adjacent recesses 15 of a point in the direction of the magnet follower shaft axis 50 to a distance DF1, which, for
Example is 11 mm.
6e shows a cross-section of the shown in Figure 6a along the rotor 1 shown in Figure 6d sectional plane BB. Average equally distributed around the circumference of the rotor 1 recesses 15 are visible for the dipole magnets.
Each of the recesses 15 in the visible section is a separate magnet sequence F1 assigned.
Relative to the shaft axis 50 of the rotor 1, the recess 15 of a magnet is rotated sequence F1 by the angle [delta] 1 over the recess 15 of an adjacent magnet sequence F1.
In the present embodiment, the angle [delta] = 20 degrees.
A dipole axis of a first recess 15 and a central longitudinal axis of a threaded hole 150, which in one of the first recess 15 opens adjacent recess 15 to close, an angle [delta] 2, which in the present embodiment is 25 degrees.
Figure 6f shows a cross-section of the shown in Figure 6a along the rotor 1 shown in Figure 6d section plane CC. Opposite the section shown in Figure 6e, the recesses 15 are rotated by an angle [Delta] 1 around the shaft axis 50.
Within a magnetic sequence F1 adjacent dipole magnets 8 are so twisted with respect to the shaft axis 50 by an angle [Delta] 1 to today.
In the present embodiment, the angle [delta] 1 = 12 degrees.
7a shows a plan view of a stator 2 with group arranged like magnet sequences F2.
Three magnet sequences F2 each form a group G.
7b shows a view of the links shown in Figure 7a stator 2
7c shows a cross-section of the type shown in Figure 7a along the stator 2 shown in Figure 7a-sectional plane AA. The recesses 22 for receiving the cylindrical dipole magnets 8 are formed so that, the longitudinal central axes of the recesses 22, which are the one group G forming magnet sequences F2 allocated and arranged in a direction perpendicular to the shaft axis 50 intersecting plane parallel to the cutting plane and to each other parallel.
Extending in the plane of section line intersecting the shaft axis 50 and pass through the points in which the longitudinal central axes of the recesses pierce 22 one the periphery of the stator 2 circumscribed cylinder close, wherein adjacent recesses of a group of magnetic effects an angle [xi].
In the present embodiment, the angle [xi] has a value of 14.24 degrees.
The outer edges of immediately adjacent recesses 22 have a minimum distance 23, which, for
As can be 1 mm.
7d shows a three dimensional view of the second stator in Figure 7a illustrated
8a shows a top view of a stator 2 with group arranged like magnet sequences F2.
Three magnet sequences F2 each form a group G. In contrast to the example shown in Figure 7a in which the stator 2 shown in Figure 2, the stator 8, a group G forming magnet sequences F2 a greater distance from each other.
8b shows a view of the links shown in Figure 8a stator 2
8c shows a cross section of the type shown in Figure 8a along the stator 2 shown in Figure 8a-sectional plane AA. The recesses 22 for receiving the cylindrical dipole magnets 8 are formed so that, the longitudinal central axes of the recesses 22, which are the one group G forming magnet sequences F2 allocated and arranged in a direction perpendicular to the shaft axis 50 intersecting plane parallel to the cutting plane and to each other an angle [phi] 1 include.

In the present embodiment, the angle [phi] 1 has a value of 28 degrees.
Immediate neighbors within the recesses 22, which are assigned to the same group G are, by a web of the supporting body of the stator 22 separately from each other.
The web has on the circumference of the stator 2 has a width J, as sketched in Figure 8c.
In the present embodiment, the width Y has a value of 11, 94 mm.
The longitudinal central axes of the recesses 22, the different groups G are associated with one another to close at least an angle [phi] 2.
In the present embodiment, the angle [phi] 2 has a value of 64 degrees.
8d shows a three dimensional view of the stator shown in FIG 8a second
9a to 9h, respectively, show a development of the lateral surface of M1, M2 and a rotor 1
Stator 2
A magnetic order is symbolized by an arrow.
By the direction of the arrow a direction of a magnetic sequence is defined.
A direction of a magnetic sequence is of importance when the dipole of the magnet having a characteristic sequence polarity sequence, which is dependent on the direction.
For example, it may be of importance for the present invention, whether a row with three dipole magnet having the polarity or the polarity SNN NNS.
The orientation of the surface M1, M2 is defined by the specification of the shaft axis 50.
9a shows a pitch angle of b = 10 degrees of a magnetic sequence which starts at the left side of the casing surface.
9b shows a gradient angle of b = 80 degrees of a magnetic sequence which starts at the left side of the casing surface.
9c shows a pitch angle of 280 degrees b = a magnetic sequence which starts at the right side of the lateral surface.
9d shows a gradient angle of b = 350 degrees of a magnetic sequence which starts at the right side of the lateral surface.
9e shows a gradient angle of b = 10 degrees of a magnetic sequence which starts at the left side of the casing surface.
Figure 9f shows a gradient angle of b = 80 degrees of a magnetic sequence which starts at the left side of the casing surface.
Figure 9g illustrates a pitch angle of 280 degrees b = a magnetic sequence which starts at the right side of the lateral surface.
Figure 9h shows a gradient angle of b = 350 degrees of a magnetic sequence which starts at the right side of the lateral surface.
Figure 10 serves to illustrate the relationship between the magnet and magnet rows sequences F1 701-707 a rotor first
10 shows a surface M1 of a coaxial to a shaft 5 oriented first circular cylinder Z1.
The rotor 1 is arranged coaxially with the shaft 5.
The rotor 1 comprises twenty-eight dipole magnets 7, which are arranged on the lateral surface M1.
The dipole magnets 7 of the rotor 1 are arranged in four magnet sequences F1, each with seven dipole 7th
To better distinguish the four magnet sequences are numbered F1 with the subscripts 1 to 4 as F1i to FI4.
The dipole magnets 7 of the magnet sequences F1 i to FI4 are so arranged or designed that it comprises seven extending on the outer surface M1 rows 701-707 form with four evenly distributed on the periphery of the first circular cylinder Z1 dipole 7th
The dipole magnets 7 a row 701-707 are located in a plane perpendicular to the shaft 5 50 Wellennachse extending plane.
The dipole magnets 7 of adjacent rows are offset relative to one another alternately so that they are axially to the shaft axis 50 form a circle around the circumference of cylinder Z1 uniform zigzag pattern.
As an example, the uniform zigzag pattern that form the dipole magnets 7 of the adjacent rows 703

and 704, as indicated in Figure 10 with a bold line.
11 shows a schematic representation of a device of the invention, having an inner stator 2, a rotor 1 and an outer stator 3, which are arranged coaxially to a shaft axis 50 of a rotatable, rod-shaped shaft 5.
The cylindrical inner stator 2 has at its two ends in each case a circular disc-shaped end cap 13, each with a ball bearing 11.
By means of these ball bearings 11, the inner stator 2 is mounted coaxially on the shaft 5.
The shaft is in a typical embodiment of non-magnetic material, such
As plastic, steel and has a diameter of 10 to 40 mm and a length of 100 to 400 mm.
The inner stator 2 comprises an inner stator 12 and out along the outer surface of the inner stator 2 arranged magnets 8.
The inner stator 2 is positioned by means of screw 10, with an attachment means 4, which in a mechanical housing (not shown) for receiving the device, and is held firmly fixed in this way.
The rotor 1, consisting of two mirror-image construction rotor drums each with a pipe section and a circular disc, is by means of screw 10 is connected immovably with the shaft 5.
Each of the rotor drums has magnets 7th
There are seven dipole whose magnetic dipole extending in perpendicular to the shaft 5 which is arranged planes.
Each of the rotor drums are separated by a hollow cylindrical air gap of the radially arranged within the rotor drums inner stator 2 and by an annular air gap of the mounting plate 4, which is a plane of symmetry with respect to the two rotor drums of the rotor 1.
In a typical embodiment, the annular air gap, and have the hollow cylindrical air gap each have a width of 3 to 50 mm.
In the circular disk on the front sides of the rotor drums also dipole magnets 700 are arranged.
The mass of the rotor 1 and the associated shaft 5 is distributed rotationally symmetrical, so that during a rotation about the shaft axis 50 there is no imbalance.
The outer stator 3 is composed of two separate halves of annular
(= Stator), 6 each with frame 9, magnet 6 and hardware for attachment of the magnets
Each of the frame consists of a hollow cylinder, at the two end faces of an annular disk is arranged.
In this way each of the stator is provided on its outer surface and on its two faces of one of the frame 9 and to the shaft axis covers 50 out without a frame, that is open.
Within the frame 9 are provided between the fixing parts, the magnets 6th
Each of the two stator rings is associated with one of the two rotor drums of the rotor 1.
Each of the stator are separated by an annular air gap with a width of 3 to 50 mm from the radially arranged within the stator rotor drums of the rotor 1.
Which are arranged on the inside of the stator 6 and the magnets are arranged on the outer side of the rotor 1 magnets 8 are thus directly opposite, separated only by the annular air gap.
Each of the stator can be moved parallel to the shaft axis 50.
This means that the relative position of the outer stator 3, and thus the covering of the rotor 1 by the outer stator during operation of the device can be changed and adjusted.
The magnets 6, 7, 8 are dipole magnets.
In a preferred embodiment of the dipole magnets 6, 7, 8 are designed as permanent magnets, such
As consisting of the materials and SmCo / NdFeB or formed.
However, it is also possible that one or more of the dipole magnets 6, 7, 8 is formed as electromagnets.
The magnetic flux density of the magnets 6, 7, 8 is preferably in a range of 0.4 to 1, 4 Tesla.
The frame is preferably made of non-magnetic material, such
As aluminum, steel and has a wall thickness of 2 to 10 mm.
Figure 12a shows a (non-magnetic material, for
As aluminum, copper, 2) existing inner stator core 12 of the inner stator
The core 12 has a circular cylinder 120, on the outer surface or webs
Ribs 121 are arranged in the form of a beam flange.

Each of the ribs 121 extends along the central axis of the circular cylinder 120 of the base of the cylinder 120 to its top surface.
The ribs 121 extend in relation to the central axis of the circular cylinder 120 are distributed radially and uniformly distributed over the cylinder circumference.
In this way between the ribs or grooves 121 result
Grooves 122nd
The circular cylinder 120 has along its central axis to a circular hole for receiving the shaft 5.
Both in the base and in the top surface of the cylinder 120 is in each case a disk-shaped recess in the respective one of the ball bearing 11 is arranged in part.
The diameter of the stator core 12 is 50 to 500 mm, its height is 100 to 300 mm.
The width of the ribs 121 is <= 100 mm and about
20 percent of the width of the grooves 122nd
Figure 12b shows a schematic representation of the inner stator 2
The inner stator 2 includes the inner stator 12, the magnets 8 and the end caps 13th
The same length, magnets 8, the length dimension is selected to be lower than that of the stator core 12 are inserted into the at the outer surface of the circular cylinder 120 along grooves 122nd
Considered over the cylinder circumference of the inner stator 2 is the arrangement of the magnets 8 such that a first magnet is 8-1 inserted flush with the base of the cylinder 120 finally, and the remaining magnets 8 with an axial offset V with respect to the shaft axis 50 are arranged are such that on the outer surface of the inner stator 2, a uniform pattern is stairs.
V is the axial offset evenly divided so over the length of the inner stator 2, that a final magnet 8-10 closes on its front side with the top surface of the cylinder 120th
During the transition from the last to the first solenoid magnet 8-10 8-1 exists a large stage W, whose length corresponds to the (n)-fold of the displacement V, where n is the number of magnets 8 indicates.
Both on the top surface and on the base of the cylinder 120, the inner stator 2 each have a disk-shaped end cap 13, the central axis is in each case one of the ball bearing 11.
The end caps 13 have a diameter of 50 to 500 mm and a height of 5 to 20 mm.
A typical length of the magnets 8, measured in the direction of the shaft axis 50 is 100 mm.
The axial displacement V is variable depending on the number of magnets.
In a typical arrangement V is about
5 percent of the length of the magnets eighth
Extend between the magnets 8, the outer sides of the ribs 121 of the inner stator 12th
The dimensions of the magnets 8 and the inner stator 12 are coordinated so that the inner stator 2 having a substantially uniform outer surface.
13 shows a development of the outer surface of the inner stator 2
On the lateral surface ten magnets 8 are arranged, each having the same geometry.
The magnets are in the direction of the shaft axis 50 is shorter than the measured surface area.
8-1 is a first magnet with one of its end surfaces are flush with the bottom surface 125 of the inner stator 12 are arranged on the lateral surface conclusively.
The remaining nine magnets 8 are now in the direction of the shaft axis 50 at a uniform offset V arranged that the last magnet terminates flush with 8-10 his right front side with the top surface 126 of the inner stator 12th
In this way, as illustrated in FIG 13 stepped arrangement of the magnets will be 8
14 shows a section through the inner stator 2, along the direction indicated in the Figure 12b Section AA. The inner stator 12 has a hollow cylinder 120, along the central axis of the shaft 5 extends to the outer surface and extending along the fins 121st
The hollow cylinder 120 has a diameter of 100 mm and a length of 170 mm.
Into the space formed between the ribs 121 grooves magnets 8 are used, which in the cutting plane AA have a trapezoidal cross-section.
The dipole magnets 8 are arranged so that their magnetic dipole axis 80 extends within the illustrated section plane AA.

An angle [alpha] formed at the intersection of the magnetic dipole axis 80 of a magnet 8 and a tangent 81 to the inner stator 2 in the area of the magnet 8, values of 14 to [deg.] Have one to 90 [deg.].
In the illustrated case, the angle in Figure 14 [alpha] = 90 is [deg.].
Figure 15a shows the fastening device 4 in a view perpendicular to the
Shaft axis 50
The fastening means 4 has an inner hollow cylinder 40 with a smaller radius and an outer mounting ring plate 41 with a larger radius.
The inner hollow cylinder 40 and the outer mounting ring plate 41 are firmly connected.
The hollow cylinder 40 serves for receiving and securing of the inner stator 2 by means of screw connections 10th
The fixing washer 41 is connected to a mechanical housing (not shown) for receiving the device firmly.
The fastening annular disk 41 has on its outer periphery threaded 10th
Figure 15b, the fastening device 4 is a view in the direction of the shaft axis 50
The fastening annular disc 41 has on its periphery on four screw 10 for attachment to the mechanical housing, the hollow cylinder 40 has on its periphery a plurality of screw connections 10 to the fastening of the inner stator 2.
16 shows a view of the rotor 1, which is arranged on the shaft 5 by means of screw immovably 10th
The rotor 1 consists of two separate rotor arranged drums, in the outer surface circular bores are mounted, which serve to accommodate the magnets 7th
The rotor 1 is made of non-magnetic material (such
As Al, Cu).
The distance of the rotor drums to each other is 15 mm.
The rotor drums have an outer diameter of 165 mm, a height of 70 mm and a wall thickness of 26 mm.
Each of the rotor drums has a ring-shaped top surface 102 in which two or more evenly distributed on a circumference in relation to the center of the top surface 102 are disposed dipole 700th
The magnetic dipole axis of the dipole magnets 700 is parallel to the shaft axis 50
Figure 17a shows a schematic view of one of the rotor drums of the rotor 1 and the inner stator 2, which view is perpendicular to the shaft axis 50.
The rotor 1 is connected to the shaft 5 by means of screw immovably 10th
The shaft 5 is rotatably supported by a ball bearing in the inner stator 2.
1, the rotor surrounds the inner stator 2 trommelbzw. bell-shaped.
The rotor 1 comprises a hollow cylinder 101, which is terminated on a side facing away from the inner side of the stator 2 by the top surface 102.
Because the inner stator 2 by the fastening means 4 is fixed (= not rotatable) held, the rotor 1 rotates with its hollow cylinder 101 to the inner stator 2
The hollow cylinder 101 of the rotor 1 is separated from the inner stator 2 by an annular air gap G1.
The hollow cylinder 101 of the rotor 1 has holes are inserted into the magnet seventh
The top surface 102 of the rotor 1 also comprises holes 700 are used in the magnets.
Figure 17b shows a schematic representation of the possible orientations of the dipole magnets 7 of the rotor 1, in a viewing direction parallel to the shaft axis 50th
The magnetic dipole axis 70 of the rotor magnets 7 extends in a plane that is perpendicular to the shaft axis 50, ie, within the imaging plane.
The angle ss between the magnetic dipole axis 70 and a tangent 71 to the outer circumference of the hollow cylinder 101 of the rotor 1 through the point at which the dipole axis pierces 70 the outer circumference of the hollow cylinder 101 may be, [deg.] Values of 14 to 90 [deg.] exhibit.
Figure 18a shows one implementation of the circumferential surfaces of the two drum halves of the rotor 1 along the direction indicated in Figure 16 XY. Figure 18a shows the left half of the left and right of the right-hand drum drum half which are mutually symmetrical.
Settlement extends along the X-Y direction, as indicated in Figure 16.

In perpendicular to the shaft axis 50 vertical levels extending from 701 to 708 rows of magnets 7th
Each of the rows 701-708 is slightly offset to an adjacent row, so that in the direction of the shaft axis 50, a zigzag-shaped arrangement of the magnets 7 results.
Figure 18b shows a magnified section of the processing shown in Figure 18a of the magnets 7th
The midpoints of the magnets 7 within the rows 705, 706 are located at a constant distance f from each other.
The distance between two adjacent rows 705, 706 is chosen so large that the assembly is shown in Figure 18b with a constant magnetic distance d.
Two magnets 7051, 7052 in the row 705 are arranged with respect to an associated therewith solenoid 7061 in the adjacent row 706, so that the center points of the three magnets 7051, 7052, 7061 an isosceles triangle with legs of length d and a third side (base spanning the length) f.
This relationship applies to all magnets 7 in all ranks from 701 to 708th
7, the magnets may not only have shown, has a circular cross-section, but also other shapes, such as square or hexagonal.
The distance d is in a range of about 3 mm to 50 mm.
Particularly preferred is a spacing of 5 mm.
The distance f is in a range of about 10 mm to 70 mm.
Figure 19a shows a longitudinal section through the mechanical housing for receiving the device, ie, a section parallel to the shaft axis 50
The mechanical housing, the fastening means 4 for accommodating the inner stator 2, guide means 19 for guiding the movable halves of the outer stator 3, and a rotatable means of a crank gear shaft 14 to the displacement of the halves of the outer stator 3 with respect to the rotor and inner stator.
The transmission shaft 14 has two threaded rods which have mutually opposing thread (legal and left thread).
This allows the two halves of the outer stator 3 are in a symmetrical manner opposite to each other uniformly or moved apart.
The
Guide means 19 seated on the transmission shaft 14 and are in this way moved in relation to the fastening means 4 outwards or inwards.
The frame 9 of the outer stator 3 are connected to the guide means 19 are connected firmly.
The mechanical housing has a height of 400 to 600 mm, a width of 400 mm, and a depth of 530 mm.
Figure 19b shows a section through the outer stator 3, wherein the section plane is perpendicular to the shaft axis 50.
The outer stator 3 has annularly arranged on a non-magnetic fastening members 18, between which magnets 6 are arranged.
For reasons of clarity, only by way of example some of the magnets 6 are shown.
The skilled person will appreciate that the magnets 6 are arranged over the entire periphery of the outer stator 3.
The magnets 6 and the non-magnetic fastening members 18 are dimensioned so that in the assembled state of a hollow cylinder whose central axis extends in the direction of the shaft axis 50, result.
The magnetic dipole 60, the magnets 6 are located in planes which are perpendicular to the shaft axis 50.
An angle y between the magnetic dipole axis 60 and a tangent 61 to the outer circumference of the hollow cylindrical outer stator 3 through the point where the magnetic dipole axis pierces 60 the outer periphery is in a range of 14 [deg.] To 90 [deg.] .
The outer stator 3 is connected to the guide means 19, which in turn are slidably mounted on mounting columns 20th
20 shows an oblique view of the mechanical housing for receiving the device.
The mechanical housing has at both ends a respective housing plate 21a, 21b, which are connected together by four fastening columns 20th

In the central plane between the two housing plates 21a, 21b, the fastening disc is 4 for accommodating the inner stator 2
In the mid-points of the housing plates 21a, 21b is a bore for the implementation of the shaft 5
On the four mounting columns 20, the guide means 19, in which the halves of the outer stator 3 are fastened, arranged.
Also between the two housing plates 21a and 21b, the threaded shaft 14 extends (not shown) for the symmetrical
Displacement of the guide means 19, and thus the mounted thereon stator halves of the external third
21 shows a diagram representing the relative arrangement of the magnets 6 of the outer stator 3, the magnets of the rotor 1 and 7 of the magnets 8 of the inner stator 2 in a preferred embodiment.
The arrangement relates to a constellation in which the two halves of the outer stator 3 shifted as far as possible to each other.
In this situation there is a complete coverage of the three levels described magnet.
The north pole of the dipole magnets 6, 7, 8 is indicated by the letter N, the South Pole with the letter S.
The air gap G1 between the outer circumference of the inner stator 2 and the inner circumference of the rotor 1, and the air gap G2 between the outer circumference of the rotor 1 and the inner periphery of the outer stator 3 can be in any range selected with a width of 3 to 50 mm.
22 shows a schematic arrangement of the three magnetic layers 6, 7, 8 specified in a section plane perpendicular to the shaft axis 50 BB, as shown in Figure 11.
In a preferred embodiment are located evenly on the inner stator 2 on the outer circumference of the inner stator 2 distributed ten magnets eighth
The magnets 6 are in the section plane BB, ie, perpendicular to the shaft axis 50, a trapezoidal cross-section.
Each of the two rotor halves each has four rows of sixteen magnets 7, which comprises in a sectional plane perpendicular to their magnetic dipole axis a circular cross-section.
The outer stator 3 has on each of its two halves each eighteen magnets 6, which are distributed uniformly over the periphery of each of the two stator halves.
The magnets 6 are in the section plane BB in a trapezoidal cross-section.
In Figure 22 is a preferred orientation of the dipole magnets 6, 7, 8 is located.
The north pole of the dipole magnets 6, 7, 8 is indicated by the letter N, the South Pole with the letter S.
The ratio of the number of the magnets 8 of the inner stator 2, the number of rows of magnets on the two rotor drums of the rotor 1 and the number of magnets 6 on the two stator halves of the outer stator 3 is preferably selected as indicated in Table I below.

Table I
Figure 23 is again particularly advantageous dimensions of the magnets used.
Figure 23a shows a preferred dimension of a magnet 6 of the outer stator 3
The magnet 6 has, in the direction of the shaft axis 50 to a length of 75 mm, the height of the trapezoidal cross-section is 50 mm.
The base of the trapezium has a length of 25 mm and that of the base line on the opposite side has a length of 20 mm.
Figure 23b shows a preferred dimension of a magnet 8 of the inner stator 2
The magnet 8 points in the direction of the shaft axis 50 to a length of 100 mm, the height of the trapezoidal cross-section is 25 mm.
The base of the trapezium has a length of 25 mm and that of the base line on the opposite side has a length of 10 mm.
Figure 23c shows a preferred embodiment of a magnet of the rotor 1 7
The magnet 7 has a circular-cylindrical geometry,. The magnetic dipole axis 70 with the Mittelbzw

Longitudinal axis of the circular cylinder is coincident.
The cylinder has a height of 20 mm and a diameter of 20 mm.
With respect to the dimensions of the magnets is to be noted that, in other advantageous embodiments of the indicated length information may vary in a range of plus / minus 50 percent. There is, however, embodiments are possible in which the dimensions of the magnets are outside this range.

REFERENCE LIST

1 Rotor
2 stator, stator inner
3 outer stator
4 mounting device, disc
5 Shaft
6 dipole magnets of the outer stator 3
Dipole magnets 7 of the rotor 1
8 dipole magnets of the (inner) stator 2
9 frame
10 screw
11 ball bearings
12 Core of the inner stator 2 (= inner stator)
13 cap
14 Gear Shaft
Recesses of the rotor 15 one
16 groove
18 Fasteners
19 guiding device
20 mounting pillars
21a, 21b housing plates
Recesses 22 of the stator 2
23 spacing of the recesses 22
40 hollow cylinder
41 fixing washer
50 shaft axis
51 plane, perpendicular to the shaft axis 50
60 magnetic dipole axes of the dipole magnets 6
61 Tangent
70 magnetic dipole axes of the dipole magnets 7
71 Tangent
80 magnetic dipole dipole magnets of 8
81 Tangent 101 hollow cylinders of the rotor 1
102 top surface of the rotor 1
120 circular cylinder of the inner stator core 12
Ribs 121 of the inner stator 122 of the inner grooves 12 stator core 12
125 base surface of the inner stator 12
126 top surface of the stator core inner threaded hole 12 150
511 first plane perpendicular to the shaft axis 50 512 second plane perpendicular to the shaft axis 50
700 dipole magnets
701-708 rows of magnets 7
a tilt angle of inclination b b1 first pitch angle b2 second pitch angle
B16 width of the groove 16 c angle d spacing
D1A outer diameter of the rotor 1
D11 inner diameter of the rotor 1
DM6 distance

D15 diameter of the recesses 15 D16 outer diameter of the groove 16
D22 distance
E distance f distance
F1 first magnet sequences F2 second magnet sequences
G group of first magnet sequences F1 and second magnet sequences F2
G1 air gap
G2 airgap
H Height Width J k number of the first magnet sequences F1
M1 lateral surface of the first circular cylinder Z1
M2 surface area of the first circular cylinder Z2
M3 lateral surface of the first circular cylinder Z3
M6 threaded hole
N North Pole
P1, P2, contact points
Radius R2
S South Pole
TM6 depth of the threaded hole M6
T16 depth of the groove 16
T22 depth
U scope
V offset
Z1 first circular cylinder
Z2 second circular cylinder
Z3 third circular cylinder [alpha], ss, [gamma], [delta], [delta] 1, [delta] 2, [Delta] [Delta] 1, [lambda], [xi], [phi] angle