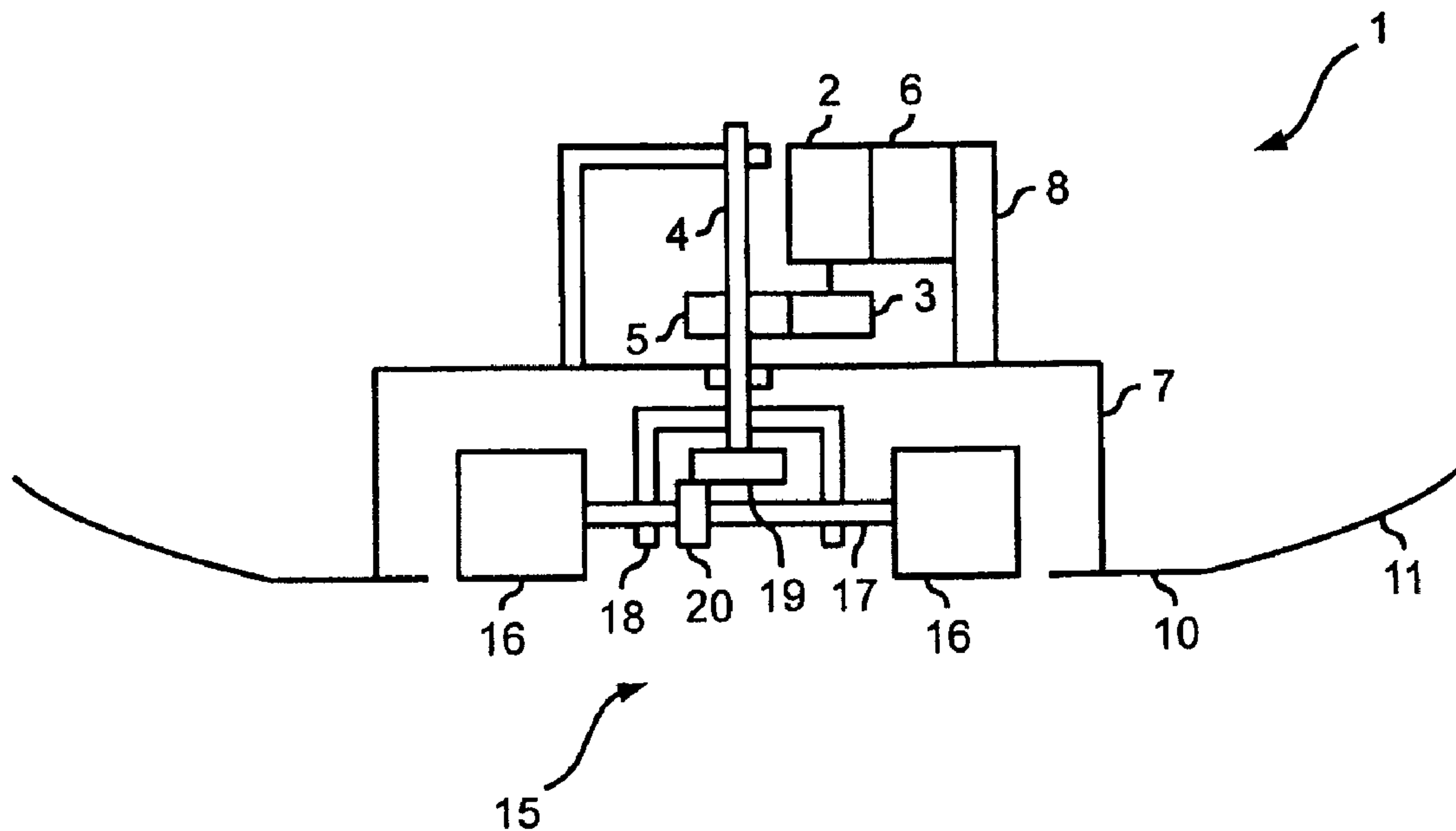




(86) Date de dépôt PCT/PCT Filing Date: 2011/08/23
 (87) Date publication PCT/PCT Publication Date: 2012/03/22
 (45) Date de délivrance/Issue Date: 2015/12/01
 (85) Entrée phase nationale/National Entry: 2013/03/12
 (86) N° demande PCT/PCT Application No.: EP 2011/004222
 (87) N° publication PCT/PCT Publication No.: 2012/034634
 (30) Priorité/Priority: 2010/09/13 (DE102010045096.0)

(51) Cl.Int./Int.Cl. *A47L 11/40* (2006.01),
A47L 11/10 (2006.01), *A47L 11/24* (2006.01),
A47L 5/30 (2006.01)
 (72) Inventeurs/Inventors:
 WEIS, NORBERT, DE;
 FLATH, JOHANNES, DE;
 GIBIS, KARL-LUDWIG, DE
 (73) Propriétaire/Owner:
 CARL FREUDENBERG KG, DE
 (74) Agent: BORDEN LADNER GERVAIS LLP

(54) Titre : SYSTEME D'ENTRAINEMENT POUR UN APPAREIL DE NETTOYAGE ET APPAREIL DE NETTOYAGE
 (54) Title: DRIVE SYSTEM FOR A CLEANING UNIT, AND CLEANING UNIT



(57) **Abrégé/Abstract:**

The invention relates to a drive system (1) for driving an automatic cleaning unit, comprising: - a carrier unit (7, 10); - a drive motor (2), which is fastened on the carrier unit (7, 10); - a driveshaft (4), which is arranged in a rotatable manner on the carrier unit (7, 10) and can be driven by the drive motor (2); - an advancement device (15), which is arranged on the driveshaft (4) and can be rotated about the driveshaft, wherein the advancement device (15) is coupled to the driveshaft (4) in order to generate advancement transversely to the extent of the driveshaft (4) and in order, when advancement is stopped, to cause the advancement device (15) to rotate in relation to the carrier unit.

Abstract

The invention relates to a drive system (1) for driving an automatic cleaning unit, comprising: - a carrier unit (7, 10); - a drive motor (2), which is fastened on the carrier unit (7, 10); - a driveshaft (4), which is arranged in a rotatable manner on the carrier unit (7, 10) and can be driven by the drive motor (2); - an advancement device (15), which is arranged on the driveshaft (4) and can be rotated about the driveshaft, wherein the advancement device (15) is coupled to the driveshaft (4) in order to generate advancement transversely to the extent of the driveshaft (4) and in order, when advancement is stopped, to cause the advancement device (15) to rotate in relation to the carrier unit.

DRIVE SYSTEM FOR A CLEANING UNIT, AND CLEANING UNIT

Technical Field

The invention relates to drive systems for automatic cleaning apparatus as well as cleaning apparatus in which by sweeping over a surface driven over by the cleaning apparatus a cleaning of the surface is achieved.

Background Art

Cleaning apparatus for the cleaning of floors are generally known. Thus generally include a rotating roller, for example with a brush attachment, which in addition to movement of the cleaning apparatus across a floor surface by way of a rotation carries out a sweeping of a floor surface with the cleaning attachment. Such cleaning apparatus are often moved manually. With improvements in battery technologies, it is increasingly possible to manufacture automated cleaning apparatus which drive across a floor surface in random movements and thereby clean the floor surface.

Automatic cleaning apparatus generally drive in a straight line over a region of the floor surface until they encounter an obstruction. A change in direction is then carried out at the obstruction which is in general random and moves the cleaning apparatus in the changed direction.

A battery operated vacuum is known, for example from US 4,173,809, the drive unit of which has spheres rotatable in random directions, which can arbitrarily change their direction of movement.

A floor cleaning apparatus with its own drive is further known from US 6,571,415 B2 in which a drive unit includes a hollow sphere which is generally freely moveably positioned within a frame. A motor is positioned with the hollow sphere which is not at the center of gravity and by which the hollow sphere is moved in a random movement. The cleaning apparatus is thereby moved in random movements across the floor and the floor surface is cleaned.

The above drive units for the cleaning apparatus, because of their spherical drive elements have only one or few points of contact with the floor surface, whereby the transfer of propulsion energy for the propulsion of the cleaning apparatus is limited. This is especially disadvantageous when the cleaning apparatus for the cleaning includes a

cleaning cloth or a cleaning brush which is to be in flat contact with the floor surface to be cleaned so that a high propulsion force is required in order to generate movement of the cleaning apparatus.

It is furthermore desired that in addition to the drive force for the movement of the cleaning apparatus across the floor surface an additional movement, for example a rotational movement of a cleaning element sweeping across the floor surface is created in order to improve the cleaning effect.

It is therefore an object of the present invention to provide a drive system for a cleaning apparatus as well as a cleaning apparatus in which a sufficient propulsion force can be transferred onto the floor surface to move a cleaning element for the cleaning of soiled floors. It is furthermore an object of the present invention to carry out a movement of the cleaning element in addition to the propulsion in order to improve the cleaning effect.

Description of the Invention

These objects are achieved by the drive system for a cleaning apparatus according to claim 1 as well as by the cleaning apparatus according to the secondary claim.

Further preferred embodiments are the subject of the dependent claims.

In accordance with a first aspect, a drive system for the driving of an automated cleaning apparatus is provided. The drive system includes:

- a carrier unit;
- a drive motor fastened on the carrier unit;
- a driveshaft which is rotatably positioned on the carrier unit and can be driven by the drive motor; and
- a propulsion device positioned on the driveshaft and rotatable about the driveshaft, whereby the propulsion device is coupled with the driveshaft in order to generate a propulsion transverse to the direction of the driveshaft and in order to create a rotation of the propulsion device relative to the carrier unit upon blocking of the propulsion.

One idea of the above drive system consists in that a drive motor is provided which is positioned on a carrier unit that is rotatable about a driveshaft relative to the propulsion device. The drive motor is coupled with the driveshaft in order to rotate the latter. The

driveshaft is further connected, for example through a transmission, with one or more drive rollers, the drive axis of which is oriented perpendicular to the driveshaft and which generate the propulsion, whereby the drive axis moves with the driveshaft.

A propulsion by way of the drive system occurs when a resistance counteracts a rotation of the carrier unit, as is generally the case when it carries, for example, a cleaning element that rests against the floor surface to be cleaned and thereby creates a frictional contact. One or more drive rollers are thereby driven, for example, and move the cleaning apparatus in a translational movement across the floor surface. Since the frictional resistance caused by the contact of the cleaning element with the floor surface also counteracts the propulsion device, the carrier unit coupled with the driveshaft is rotated about the driveshaft and the cleaning element is therefore moved in a rotational movement across the floor surface to be cleaned.

When the translational movement across the floor surface is impeded or blocked, this results in a turning of the propulsion device with respect to the carrier unit, whereby the direction of propulsion movement is changed and the cleaning device driven with the drive system is further moved in another, random direction.

The use of such a drive system for a cleaning apparatus achieves a significantly stronger cleaning effect because of the higher permissible friction of the cleaning element with the floor surface than is known from the prior art. Furthermore, the navigation around obstructions is significantly softer, whereby the total cleaning surface covered during a specific time period is enlarged. It is achieved with the coupled drive system in which the rotation and the propulsion movement are coupled with one another through a drive system that the cleaning apparatus nestles up closer to obstructions and edges and drives along them for a longer time. This improves the cleaning especially in these critical regions of the floor surface.

The carrier unit can further include a fastening element surrounding the propulsion device on which a cleaning element, especially a cleaning cloth and/or a cleaning brush, can be mounted.

The carrier unit can be constructed for rotating the cleaning element about the propulsion device when the propulsion device generates propulsion.

In particular, the propulsion device can be coupled with the driveshaft in such a way that upon retardation of the propulsion beyond a threshold value, the rotation of the propulsion device is initiated.

The driveshaft can be coupled with a damping element, whereby the damping element provides a dampening for the adjustment of a preselected distribution of the drive energy produced by the drive motor between a rotation of the carrier unit and the propulsion.

It can be provided that the propulsion device includes at least one drive roller which is placed on a drive axis coupled with the driveshaft, whereby the drive axis extends transverse to the driveshaft and is coupled with the latter by way of a transmission.

The propulsion device can further include at least one auxiliary roller which is placed laterally offset to the drive axis on the base part, whereby the axis of rotation of the auxiliary roller is essentially parallel to the drive axis. This achieves a more stable straight ahead drive and an increase of the friction of the propulsion device against a turning out of position, so that the provision of the auxiliary roller provides for a possible adjustment of the drive system with respect to a distribution of the drive energy between propulsion and rotation of the carrier unit.

According to a further aspect, a cleaning device is provided with the above drive system. The drive system can be surrounded by a housing which is especially resiliently connected with the drive system in direction of the driveshaft. The resilient suspension avoids that upon a loading of the housing from above the load acts directly on the propulsion device. It is rather achieved that the force is absorbed by the housing especially when the housing comes to rest on the floor surface before the range of elastic deflection is exhausted.

The housing can furthermore have a non-round shape with respect to a plane parallel to the plane of the propulsion of the propulsion device. It can be reliably guaranteed thereby that a rotation of the housing is blocked when the cleaning apparatus drives against an obstruction so that the rotation of the propulsion device is immediately initiated.

The carrier unit can be provided with the fastening element, especially a holding ring, which is positioned parallel to the plane of the propulsion device.

The holding element can be provided with a device for the fastening of a cleaning element, especially for the generation of a hook and loop connection with the cleaning element.

The fastening element can furthermore be surrounded by a loading element in order to press an attached cleaning element onto the floor surface.

According to one embodiment, the carrier unit is constructed to be rotatable about the housing.

A cleaning apparatus can further be provided with a control unit for the controlling of a direction of rotation of the drive motor. The control unit can be constructed to switch the drive motor at control times or through a manual operation. This can result on the one hand in a better coverage of the cleaning in complex rooms and on the other hand in a better release from points of constriction or a better disentanglement from obstructions.

According to one embodiment, the control unit can be constructed to reverse the direction of rotation of the drive motor when a complete blockage of the translational and rotational movement of the propulsion device is detected. Blockade situations can be resolved in an improved manner with this approach.

Brief Description of the Drawings

Preferred embodiments are further described in the following by reference to the attached drawings.

Fig. 1 shows a schematic illustration of the drive system for a cleaning apparatus;

Fig. 2 shows a cross-section through one embodiment of a cleaning apparatus for the mopping of a floor surface; and

Fig. 3 shows a perspective illustration of an underside of the cleaning apparatus of Fig. 2.

Embodiment of the Invention

Fig. 1 shows a schematic illustration of a drive system 1 for the operation of a cleaning apparatus. The drive system 1 includes a drive unit 2 which is constructed, for example, as an electric motor. The electric motor 2 is supplied with electric energy from an energy storage 6 in order to drive the drive unit 2.

The electric motor 2 is coupled by way of a transmission with the driveshaft 4 in order to drive the latter. When used in a cleaning apparatus, the driveshaft 4 is supported essentially perpendicular to the floor surface to be cleaned by the cleaning apparatus. In particular, the electric motor 2 can therefor include a driveshaft which carries a pinion 3 by which the driveshaft 4 is driven. In order to transfer the drive torque onto the driveshaft 4, the driveshaft 4 can be provided with a gear 5 which meshes with the pinion 3.

The drive system further includes a base part 7 on which the electric motor 2 and the energy storage 6 are mounted, for example by a mount 8. The base part 7 further serves to support the driveshaft 4 in an essentially vertical position so that the driveshaft 4 is rotational positioned relative to the base part 7. The driveshaft 4 is preferably supported at two mutually spaced apart bearing points.

The base part 7 is rigidly connected with a supporting ring 10 as carrier unit which is positioned during use of the cleaning apparatus in the vicinity of the floor and essentially parallel to the floor surface. The supporting ring 10 serves for the support of a cleaning cloth, a cleaning brush and the like as cleaning element. The cleaning element can be preferably removably connected with the supporting ring 10, for example by way of a hook and loop connection and is therefore exchangeable. When a cleaning cloth is used, a flexible loading element 11 can be provided at the outer circumference of the supporting ring 10 which surrounds the supporting ring essentially as an annulus in order to ensure the contact of the cleaning cloth with the floor surface over the largest possible area.

The cleaning cloth fastened to the supporting ring 10 is preferably also annular in shape and can have an outer diameter which is the same or larger than the outer diameter of the supporting element 10 and an inner diameter which essentially corresponds with the inner diameter of the supporting ring 10. In the condition of contact with the floor surface, the cleaning cloth then lies flat against the floor surface and is pressed against the floor surface at its inner edge by the supporting ring 10 and further outward by the loading element 11.

In the inner region surrounded by the supporting ring 10, a propulsion device 15 with two drive rollers 16 is provided which are rigidly connected with one another by way of a drive axle 17. The drive rollers 16 are preferably cylindrically shaped and made of a material, for example rubber, which provides a high friction with common floor surfaces

to be cleaned. The drive rollers can be furthermore provided with grooves extending transverse to the circumferential direction in order to further increase the friction. The drive axle 17 is held by an axle mount 18 in horizontal position or essentially perpendicular to the driveshaft 4. The axle mount 18 is therefor positioned on the driveshaft 4 in such a way that the driveshaft can rotate independently from the axle mount 18 but that the axle mount 18 fixes the axle 17 in a perpendicular orientation to the driveshaft 4.

A ring gear 19 is provided at the end of the driveshaft 4 directed towards the propulsion device 15, which meshes with a gear 20 that is rigidly positioned on the drive axle 17. In this manner, a rotation of the driveshaft 4 can be translated into a rotation of the drive axle 17. A rotation of draft shaft 4 thereby leads to a rotation of the drive axle 17 and as a result to propulsion by way of the drive rollers 16.

By way of the above described drive system 1, the drive energy made available by the electric motor 2 is distributed by way of the driveshaft 4 on the one hand to the propulsion by way of the drive rollers 16 and on the other hand to a rotational movement of the base part 7 over the floor surface on which the drive system rests with the drive rollers 16. In this manner, a cleaning element positioned on the supporting ring 10 can be rotated about the propulsion device 15.

In the balanced condition, in which for example, the cleaning element is a cleaning cloth which is used to clean a smooth surface such as parquet, laminate, tiles or stone, the use of the above drive system results in a propulsion movement by rotation of the drive rollers 16 and at the same time in a rotation of the supporting ring 10 about the propulsion device 15 so that a cleaning cloth connected therewith rotates about the driveshaft 4.

If a cleaning apparatus operated with such a drive system 1 encounters an obstruction, the rotation of the base part 7 with the supporting ring 10 is initially retarded or blocked and the drive energy which was previously transmitted by way of the driveshaft 4 onto the supporting ring 10 is now completely transferred to the propulsion device 15. When a rotation of the drive rollers 16 which preferably have a high friction with the floor surface is also locked by the obstruction, the drive energy on the driveshaft 4 is translated against the friction of the drive axel 17 on the floor surface into a rotational movement of the propulsion device 15 about the driveshaft 4. The necessary force for this rotational movement of the propulsion device 15 is high, since during the rotational movement at

least one of the drive rollers 16 is moved over the floor surface against the friction so that a rotation of the propulsion device 15 occurs preferably only when both the propulsion movement as well as the rotational movement of the base part 7 with the supporting ring 10 thereon is blocked.

The rotational movement of the propulsion device 15 continues as long as the blocking of the propulsion movement remains. As soon as the blocking of the cleaning apparatus stops, because of the changed direction of propulsion and the drive rollers 16 of the propulsion device 15 once again generate a propulsion of the drive system 1, the rotation of the propulsion device 15 stops. In other words, the rotation of the propulsion device 15 continues until a portion of the drive energy leads to either a rotational movement of the base part 7 and the cleaning element fastened thereonto and/or in a propulsion movement by way of the drive rollers 16. As soon as a certain minimum portion of the drive energy is again translated into propulsion or a rotation of the cleaning element, the drive energy is no longer sufficient for a rotation of the propulsion device 15 on the floor surface and rotation of the propulsion device 15 on the floor surface stops because of the high friction of the drive rollers 16. Thereafter, the drive system 1 moves the cleaning apparatus essentially linear in a new direction which is determined by the orientation of the propulsion device 15 at the point in time where the rotation of the propulsion device 15 stopped.

Fig. 2 shows a cross-section of a cleaning apparatus with the drive system 1 along the perpendicularly oriented driveshaft 4. Apparent is the positioning of the drive unit 1 in a housing 25 surrounding drive unit 1.

The housing 25 is essentially resiliently connected with the drive unit 1 so that a pressure on the exterior of the housing 25 leads to a contact of the housing 25 with the floor surface without exertion of the pressure directly onto the drive rollers by way of the drive unit. The drive unit 1 can thereby be protected against detrimental effects on the housing. The housing is therefor connected with the drive unit 1 by at least one spring 26.

The housing 25 is also coupled with the base part 7 in such a way that a rotation of the base part 7 on the floor surface is correspondingly carried out by the housing 25, which means the housing is carried along by the base part 7 of the drive system 1. As illustrated in the perspective view of the underside of the cleaning apparatus 24, the housing 25 has a non-circular shape so that on encounter of an obstruction the rotational movement of the

housing 25 and thereby of the base part 7 connected therewith is blocked and a rubbing of an outer rim of the housing 25 on the blocked object is avoided as much as possible. The instant blocking of the rotational movement of the housing 25 then leads to a rotation of the drive axle 17 between the two drive rollers 16 so that the cleaning apparatus 24 changes direction as result until it impacts with the next obstruction.

The illustration of Fig. 3 shows the underside of the cleaning apparatus 24 with a supporting ring 10 on which the cleaning element for example in the form of a cleaning cloth or the like is positioned. The positioning can be achieved, for example by hook and loop connections, whereby in the illustrated embodiment sectional hook and loop connectors 27 are positioned on the supporting ring 10.

The propulsion device 15 of the cleaning apparatus shown in Fig. 3 can further include one or more auxiliary wheels 28 which are positioned at a distance from the drive rollers 16 and in a direction perpendicular to the drive axle 17 and have an axis of rotation which is parallel to the one of the drive rollers 16. The auxiliary wheels 28 are essentially positioned with respect to the drive rollers 16 in such a way that their contact surface is positioned in about the same plane as the contact surface of the drive rollers 16.

The auxiliary wheels 28 are used to improve straight-ahead travel of the propulsion device 15 and to improve the resistance of the propulsion device 15 against rotation so that a larger portion of the rotational energy is transmitted onto the base part 7 or the housing 25. Upon rotation of the propulsion device, the one or more auxiliary wheels 28 are moved transverse to their direction of travel over the floor surface. The auxiliary wheels 28 can however also be biased against the floor surface by way of a biasing spring, whereby the spring force can be adjusted to adjust the behaviour of the cleaning apparatus 24 on impact with an obstruction.

Alternatively, or additionally, the rotatability of the propulsion device can also be adjusted by way of the selection of the materials of the drive rollers 16 and/or by selection of the size of the contact surfaces of the drive rollers 16 which determines the friction of the driver rollers 16 on the floor surface. The resistance of the propulsion unit against a rotational movement can thereby be set.

According to a further embodiment, a damping element can be provided between the propulsion device 15 and the base part 7 in order to influence the portion of the drive energy which is translated into a rotation of the base part 7. The damping element 29 can,

for example, be variable with respect to the relative angle of the propulsion device 15 to the base part 7 so that preferred directions of the propulsion device 15 in relation to the housing 25 and the rotational speed of the rotation of the base part can be adjusted.

In an alternate embodiment, the housing 25 is constructed to be rotatable about the base part of the drive system 1. In that case, the cleaning element is not rotated during the movement of the cleaning apparatus.

The cleaning apparatus 24 can be further provided with a control unit for the control of a rotational direction of the drive motor 2. The control unit can be constructed to switch the drive motor 2 on the basis of time or manual operation. On the one hand, an improved coverage of the cleaning of complex rooms can thereby be achieved and on the other hand an improved liberation of the cleaning apparatus 24 from impasses or disentanglement from obstructions.

Furthermore, if a complete blockage of the translational or rotational movement of the propulsion device 15, the rotational direction of the drive motor 2 can be switched in order to resolve blockade situations. The detection of the complete blocking of the translational and rotational movement can be carried out for example by monitoring of a motor current or by way of suitable movement sensors.

CLAIMS:

1. A drive system for the driving of an automated cleaning apparatus, comprising:
 - a carrier unit;
 - a drive motor mounted on the carrier unit;
 - a driveshaft which is rotatably positioned on the carrier unit and can be driven by the drive motor; and
 - a propulsion device positioned on the driveshaft and rotatable about the driveshaft, wherein the propulsion device is coupled with the driveshaft in order to generate a propulsion transverse to the extension of the driveshaft and in order to create a rotation of the propulsion device relative to the carrier unit upon blocking of the propulsion, wherein the carrier unit carries a fastening element surrounding the propulsion device, to which a cleaning element is connectable, and wherein the carrier unit is constructed for rotating the cleaning element about the propulsion device, when the propulsion device generates a propulsive force.
2. The drive system of claim 1, wherein the cleaning element is a cleaning cloth and/or a cleaning brush.
3. The drive system according to claim 1 or 2, wherein the propulsion device is coupled with the driveshaft such that a retardation of the propulsion beyond a threshold value triggers rotation of the propulsion device.
4. The drive system according to any one of claims 1 to 3, wherein the driveshaft is coupled with a dampening element, wherein the dampening element provides a dampening for adjusting a preselected proportioning of the drive energy provided by the drive motor between a rotation of the carrier unit and the propulsion.

5. The drive system according to any one of claims 1 to 4, wherein the propulsion device includes at least one drive roller which is positioned on a drive axle coupled with the driveshaft, wherein the drive axle extends transverse to the driveshaft and is coupled therewith by a gearing.
6. The drive system according to any one of claims 1 to 5, wherein the propulsion device includes at least one auxiliary roller, which is positioned laterally offset relative to the drive axle, wherein the axis of rotation of the auxiliary roller extends essentially parallel to the driveshaft.
7. A cleaning apparatus comprising the drive system according to any one of claims 1 to 6.
8. The cleaning apparatus according to claim 7, wherein the drive system is surrounded by a housing which is connected with the drive system.
9. The cleaning apparatus of claim 8, wherein the housing is resiliently connected with the drive system in direction of the driveshaft.
10. The cleaning apparatus according to any one of claims 7 to 9, wherein the housing has a non-round shape relative to a plane parallel to the plane of the propulsion device.
11. The cleaning apparatus according to any one of claims 7 to 10, wherein the carrier unit is provided with a fastening element which is positioned parallel to the plane of propulsion of the propulsion device.
12. The cleaning apparatus of claim 11, wherein the fastening element is a fastening ring.
13. The cleaning apparatus according to claim 11 or 12, wherein the fastening element is provided with a device for the fastening of a cleaning element.

14. The cleaning apparatus of claim 13, wherein the device for fastening is a device for generating a hook and loop connection with the cleaning element.
15. The cleaning apparatus according to any one of claims 10 to 12, wherein the fastening element is surrounded by a loading element for pushing a fastened cleaning element against the floor surface.
16. The cleaning apparatus according to any one of claims 7 to 15, wherein the carrier unit is rotatable about the housing.
17. The cleaning apparatus according to any one of claims 7 to 16, further comprising a control unit for controlling a direction of rotation of the drive motor, wherein the control unit is constructed for switching the drive motor on the basis of time or manual operation.
18. The cleaning apparatus according to any one of claims 7 to 17, wherein the control unit is constructed for switching the direction of rotation of the drive motor upon detection of a complete blockage of the translational and rotational movement of the propulsion device.

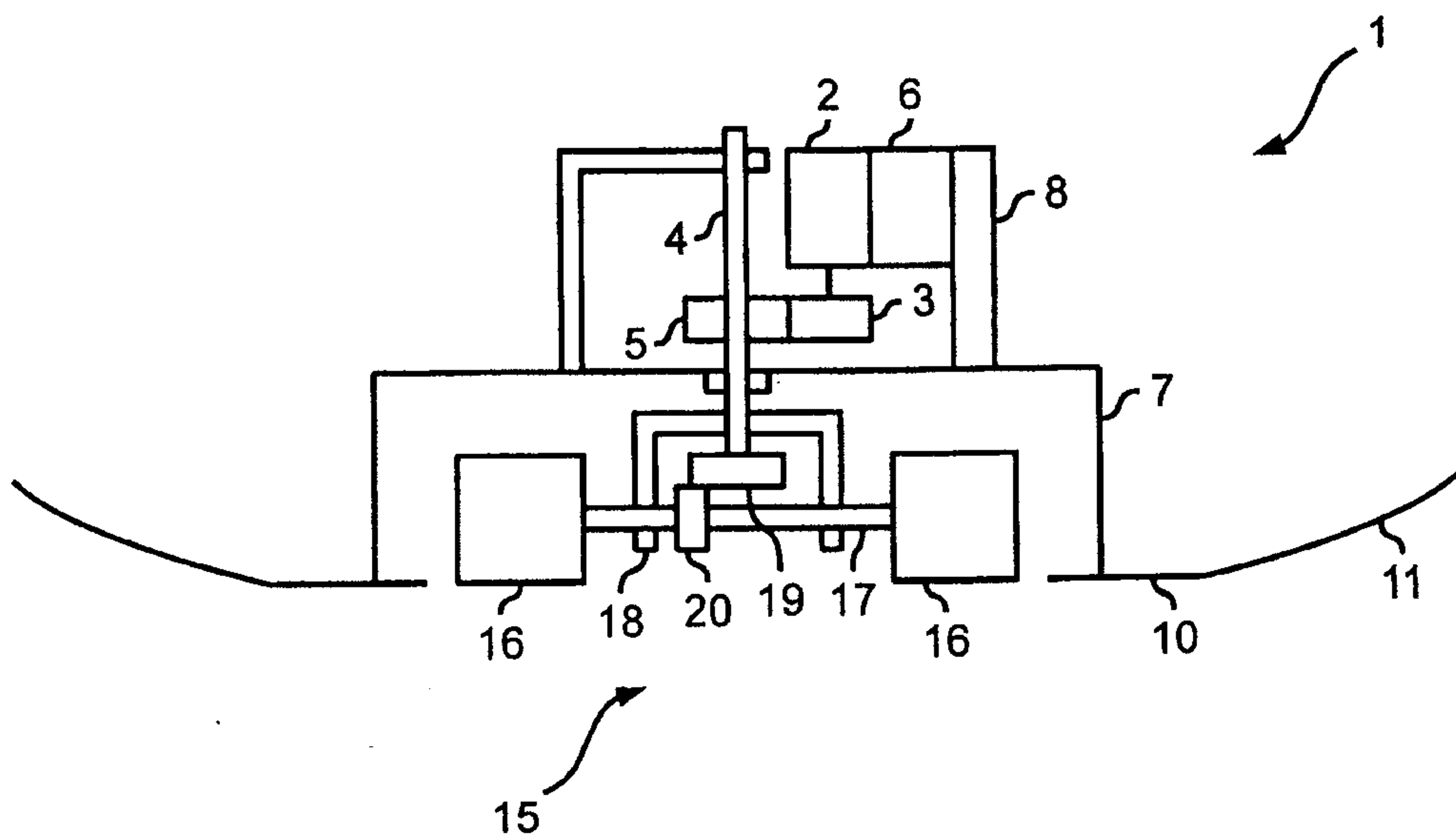


Fig. 1

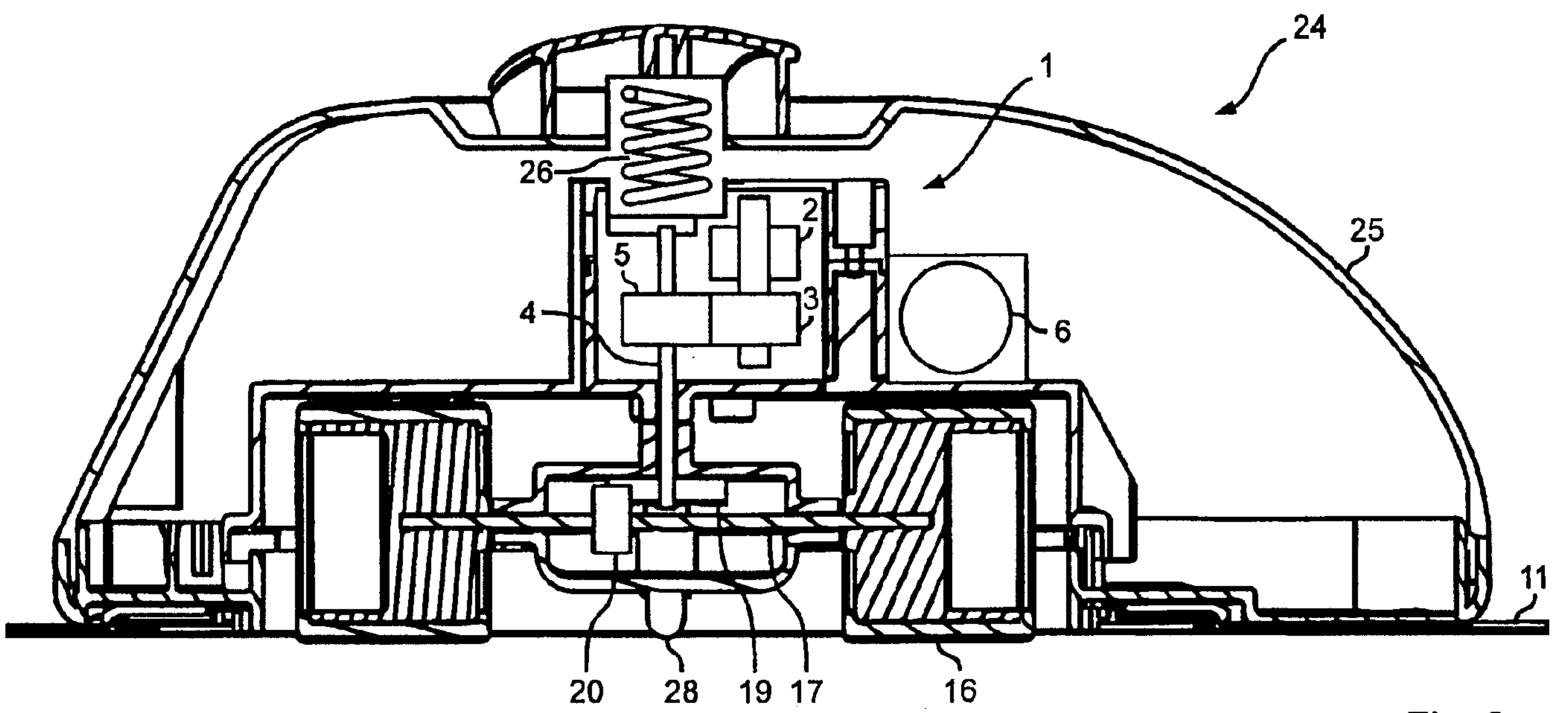


Fig. 2

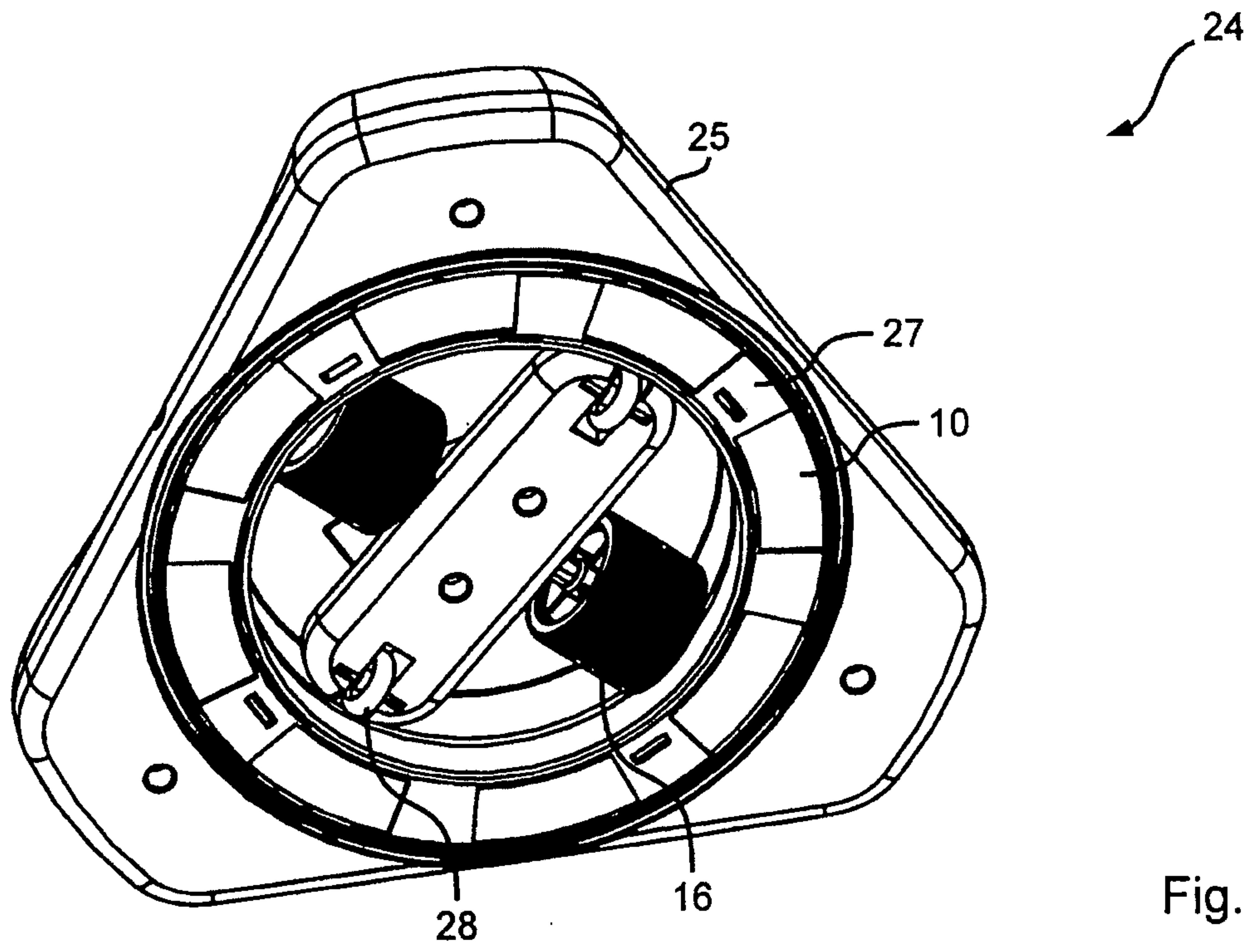


Fig. 3

