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(54) **Tisztítóberendezés fotovoltaiikus szerkezetekhez**

Az európai szabadalom ellen, megadásának az Európai Szabadalmi Közlönyben való meghirdetésétől számított kilenc hónapon belül, felszólalást lehet benyújtani az Európai Szabadalmi Hivatalnál. (Európai Szabadalmi Egyezmény 99. cikk(1))

A fordítást a szabadalmat az 1995. évi XXXIII. törvény 84/H. §-a szerint nyújtotta be. A fordítás tartalmi helyességét a Szellemi Tulajdon Nemzeti Hivatala nem vizsgálta.

Cleaning Device for Photovoltaic Installations

The invention relates to a cleaning device for photovoltaic installations comprising a cleaning head with at least one disc brush having a bristle disc which is rotatable about an axis of rotation and on which cleaning bristles are arranged, and with a drive device comprising a rotatably mounted turbine wheel which can be subjected to pressurized cleaning liquid and which is coupled by a gearing to the bristle disc.

Such cleaning devices are known from DE 20 2009 008 001 U1. A photovoltaic installation can be cleaned by means of these. Such photovoltaic installations are often installed on the roofs of buildings and are permanently exposed to the effects of the weather and environment. This may lead to a soiling of the photovoltaic installations, on account of which their efficiency is impaired. DE 20 2009 008 001 U1 proposes cleaning the photovoltaic installations by means of a cleaning device which preferably comprises two disc brushes. The disc brushes each comprise a turbine wheel, which can be acted upon with pressurized cleaning liquid, and which is coupled to a bristle disc on which cleaning bristles are arranged. On the one hand, the cleaning liquid serves, to set the bristle discs of the disc brushes in rotation and, on the other hand, the surface of the photovoltaic installations can be cleaned by means of the cleaning liquid, with the surface being simultaneously worked on mechanically by means of the cleaning bristles.

In order to guide the bristle discs along the photovoltaic installations, a central carrying part, on which two wheels are rotatably mounted one behind the other, is used in the cleaning device known from DE 20 2009 008 001 U1. The two disc brushes are held on the central carrying part. In order to guide the cleaning device along the photovoltaic installation, the wheels arranged one behind the other can interact with guiding elements of the photovoltaic installation, for example, with grooves into which the wheels are inserted. It is thereby ensured that the cleaning device does not swerve to the side as it moves. A disadvantage of the cleaning device known from DE 20 2009 008 001 U1 is that it requires additional guiding elements of the photovoltaic installation for guiding it.

In the publication "Teleskopstangen für Ihre PV und Solarreinigung", dated 27 April 2012, use of a telescopic rod carrying a cleaning brush at its free end is proposed for cleaning a photovoltaic installation. The telescopic rod comprises retractable and extensible telescopic elements so that they can be changed in their length.

The object of the present invention is to further develop a cleaning device of the kind mentioned at the outset such that it can be more easily guided along a photovoltaic installation and has a high resistance to mechanical stress.

This object is accomplished by a cleaning device having the features of patent claim 1.

In the cleaning device in accordance with the invention, the cleaning head is held on a telescopic guiding device, i.e., on a guiding device which is changeable in its length. This enables the user to guide the cleaning head along the photovoltaic installation to be cleaned by means of the guiding device, and in doing so he can change the length of the guiding device. Additional guiding elements of the photovoltaic installation can, therefore, be dispensed with. The guiding device also serves to supply the at least one disc brush with the pressurized cleaning liquid, preferably water. The cleaning liquid can, for example, flow through the guiding device to the at least one disc brush and act upon its turbine wheel so that the turbine wheel and the bristle disc can be set in rotation by means of the cleaning liquid. An additional drive motor, in particular, an electric motor, for the cleaning head

can be dispensed with. This reduces the weight of the cleaning head and in combination with the telescopic guiding device facilitates the handling of the cleaning device.

As mentioned above, the cleaning head comprises at least one disc brush, which has a drive device. The bristle disc can be set in rotation about its axis of rotation by means of the drive device. In accordance with the invention, the at least one disc brush comprises a drive housing in which the turbine wheel is rotatably mounted, and the bristle disc is held on a holding part preferably of plate-shaped configuration, which is rotatably mounted on the drive housing by means of a roller bearing. Pressurized cleaning liquid can be supplied to the drive housing. The pressurized cleaning liquid can be directed at the turbine wheel rotatably mounted in the drive housing so that the turbine wheel can be set in rotation under the action of the pressurized cleaning liquid. The turbine wheel is coupled by a gearing to the holding part on which the bristle disc is rotationally fixedly held. Together with the bristle disc, the holding part can be set in rotation by the turbine wheel. The holding part is mounted on the drive housing by means of a roller bearing. The use of a roller bearing imparts a particularly high mechanical stability to the cleaning device and, in addition, has the advantage that frictional forces between the holding part and the drive housing can be kept low. Furthermore, use of a roller bearing has the advantage that manufacturing tolerances of the drive housing preferably made of one or more plastic materials as well as manufacturing tolerances of the holding part expediently also made of one or more plastic materials can be easily compensated.

The holding part comprises an internally toothed ring gear which meshes with a pinion of the gearing. The pinion is preferably rotatable about a gearing axis which is aligned parallel to the axis of rotation of the turbine wheel.

A particularly high resistance to mechanical stress of the cleaning device in accordance with the invention is achieved by the roller bearing surrounding the ring gear. The roller bearing can, therefore, have a relatively large diameter and thereby also transmit considerable tilting moments which may occur during use of the cleaning device reliably from the bristle disc by way of the holding part to the drive housing without the mounting of the bristle disc being thereby impaired.

In an advantageous embodiment of the invention, the guiding device comprises rigid guide rods which are insertable into one another. The guide rods form a rigid holder for the cleaning head. In addition, the pressurized cleaning liquid can be supplied to the cleaning head through the guide rods.

In a preferred configuration, provision is made for a supply line for pressurized cleaning liquid, preferably a supply hose, to be led through the guiding device. A high-pressure hose, which is connected to the pressure outlet of a high-pressure cleaning appliance, and by of which the at least one disc brush of the cleaning head can be supplied with pressurized cleaning liquid, is preferably used as supply line.

In a particularly preferred configuration of the invention, a brush holder, on which the at least one disc brush is -- preferably releasably -- held, is arranged between the guiding device and the cleaning head.

The brush holder can, for example, be constructed in the form of a pipeline section which is in flow communication, on the one hand, with the end of the guiding device facing the cleaning head and, on the other hand, with the at least one disc brush of the cleaning head.

It is particularly advantageous for the brush holder to comprise a line assembly with an inlet to which a supply line for pressurized cleaning liquid, for example, a supply hose, is connectable, and with at least one outlet to

which a disc brush is connectable, the at least one outlet being pivotable relative to the inlet about a pivot axis aligned perpendicularly to a longitudinal axis of the guiding device. This results in a further simplification of the handling of the cleaning device for on account of the pivotability of the at least one outlet relative to the inlet of the brush holder, the alignment of the at least one disc brush relative to a longitudinal axis of the guiding device can be changed. It can thus be ensured in a simple way that all of the cleaning bristles of the disc brush also contact the surface of the photovoltaic installation when the alignment of the guiding device relative to the surface of the photovoltaic installation is changed. If the cleaning head is moved back and forth on the photovoltaic installation by the user by means of the guiding device, he can change the alignment of the guiding device relative to the surface of the photovoltaic installation without the cleaning bristles thereby losing their contact with the surface of the photovoltaic installation.

It is advantageous for the at least one outlet of the brush holder to be pivotable from a first end position only in one pivotal direction about the pivot axis. In the first end position, the at least one outlet is preferably substantially parallel to or in alignment with the longitudinal axis of the guiding device. In such a configuration, the at least one outlet of the brush holder is pivotable from its first end position only in one pivotal direction about the pivot axis. It can thereby be ensured that while moving the cleaning head back and forth along the photovoltaic installation, the guiding device will not unintentionally touch and possibly damage the surface of the photovoltaic installation. If the cleaning bristles of the least one disc brush are lying on the photovoltaic installation, the guiding device, in such a configuration of the invention, starting from a position in which with its longitudinal axis it is substantially in alignment with the at least one outlet of the brush holder, can only be pivoted in the direction facing away from the photovoltaic installation about the pivot axis of the brush holder. Damage to the photovoltaic installation by the guiding device is thus reliably avoided. It is expedient for the at least one outlet to be pivotable from the first end position about the pivot axis through an angle of at most 90°, in particular, through an angle of at most 50°, for example, through an angle of approximately 45°.

In an advantageous embodiment, the brush holder comprises a liquid-tight joint by means of which the inlet is in flow communication with the at least one outlet. The joint allows in a constructionally simple way the at least one outlet to be pivoted relative to the inlet about the pivot axis. In addition, the joint serves to supply cleaning liquid from the inlet to the at least one outlet. For this purpose, the joint is of liquid-tight configuration and forms a flow path so that the pressurized cleaning liquid can flow through the joint.

The holding part in a preferred configuration of the invention is rotatable about the axis of rotation of the turbine wheel.

The roller bearing is expediently configured as ball bearing.

It is particularly advantageous for the roller bearing to be constructed as axial bearing. This makes it possible to transmit axial forces occurring while the cleaning device is in use from the bristle disc by way of the holding part and the axial bearing to the drive housing. This imparts a particularly high mechanical stability to the cleaning device.

It is expedient for the pinion meshing with the internal toothing of the ring gear to be rotationally fixedly connected to a gear wheel, which is rotatably mounted in the drive housing, and which meshes with a pinion rotationally fixedly connected to the turbine wheel.

The pinion connected to the turbine wheel is expediently connected in one piece to a turbine wheel disc on which a plurality of turbine blades are arranged, which can be acted upon with pressurized cleaning liquid.

A further simplification of the handling of the cleaning device is achieved in a preferred configuration of the invention by the cleaning head comprising two disc brushes, the bristle discs of which are rotatable in opposite directions. The bristle discs are thus counter-rotatable. This facilitates moving the cleaning device along a photovoltaic installation to be cleaned for owing to the counter-rotating movement of the two bristle discs, the risk is reduced that the cleaning device will execute an unintentional sideways movement.

The two disc brushes are expediently of substantially identical construction and differ only in that the respective turbine wheel is acted upon with pressurized cleaning liquid at different sides in relation to the respective axis of rotation. Owing to being acted upon differently with liquid, the turbine wheels execute a rotational movement in opposite directions, which is transmitted by way of the respective gearing to the bristle disc so that the latter are also rotated in opposite directions owing to the turbine wheels being acted upon differently with liquid.

The following description of a preferred embodiment of the invention will serve in conjunction with the drawings for further explanation. There are shown in:

- Figure 1: a schematic representation of a cleaning device in accordance with the invention during the cleaning of a photovoltaic installation arranged on the roof of a building;
- Figure 2: a schematic plan view of a cleaning head of the photovoltaic installation from Figure 1;
- Figure 3: a sectional view of a disc brush of the cleaning head taken along line 3-3 in Figure 2;
- Figure 4: a sectional view of the disc brush taken along line 4-4 in Figure 3;
- Figure 5: a sectional view of the disc brush taken along line 5-5 in Figure 3;
- Figure 6: a sectional view of a brush holder taken along line 6-6 in Figure 7; and
- Figure 7: a sectional view of the brush holder taken along line 7-7 in Figure 6.

The use of a cleaning device 10 in accordance with the invention, the constructional design of which is apparent, in particular, from Figures 2 to 6, is schematically represented in Figure 1. A photovoltaic installation 16, for example, mounted on a roof 12 of a building 14 can be cleaned by means of the cleaning device 10. The cleaning device 10 comprises a cleaning head 18 which is held by way of a brush holder 20 on a telescopic guiding device 22. The latter comprises several rigid guide rods 24, 25, 26, 27 insertable into one another and can comprise at its end facing away from the cleaning head 18 a holding device which can be grasped by a user 29. The user 29 can, for example, assume a position on an aerial work platform 30 and can move the cleaning head 18 by means of the guiding device 22 back and forth along the photovoltaic installation 16. A supply line in the form of a supply hose 32 is led through the guide rods 24, 25, 26, 27 of the guiding device 22. The supply hose 32 is connected at its end facing the cleaning head 18 to the brush holder 20 and at its end, not shown in the drawings, facing away from the cleaning head 18, for example, to the pressure outlet of a high-pressure cleaning appliance, known per se, and, therefore, likewise not shown in the drawings in order to achieve a better overview. The cleaning head 18 can be supplied with pressurized liquid by way of the supply hose 32 and the brush holder 20. As will be explained in greater detail hereinbelow, on the one hand, the pressurized cleaning liquid serves to rotate the bristle discs of two disc brushes of the cleaning head 18 in opposite directions, and, on the other hand, the cleaning liquid serves to clean the photovoltaic installation 10 in that it can be applied by way of the disc brushes practically without any pressure to the photovoltaic installation.

The cleaning head 18 is shown schematically in Figure 2. It comprises a first disc brush 34 and a second disc brush 36. The second disc brush 36 is practically identical in configuration to the first disc brush 34. In order to avoid repetitions, only the first disc brush 34 will be explained in detail hereinbelow with reference to Figures 3, 4 and 5. The corresponding explanations do, however, also apply in the same way to the second disc brush 36.

The two disc brushes 34, 36 are connected to the brush holder 20. The brush holder 20 forms a line assembly, by way of which the disc brushes 34, 36 can be supplied with pressurized cleaning liquid. The brush holder 20 is schematically shown in Figures 6 and 7. It comprises an inlet 38 to which the free end of the supply hose 32 led through the guide rods 24 to 27 can be connected, and a first outlet 40 to which the first disc brush 34 is connected, and a second outlet 42 to which the second disc brush 36 is connected.

The two disc brushes 34, 36 each comprise a drive housing 44 with an upper housing part 46 constructed in the manner of a hood, and with a lower housing part 48 forming a bottom plate 50. The drive housing 44 surrounds a drive chamber 52 into which a connection pipe 54 opens and in which a turbine wheel 56 is mounted for rotation about an axis of rotation 58. The turbine wheel 56 comprises a turbine disc 60 having arranged on its underside facing the bottom plate 50 several turbine blades 62. The connection pipe 54 of the first disc brush 34 can be connected to the first outlet 40 of the brush holder 20. In the same way, the connection pipe 54 of the second disc brush 36 can be connected to the second outlet 42 of the brush holder 20. By way of the connection pipe 54, the turbine blades 62 of the turbine wheel 56 can be acted upon with pressurized cleaning liquid, so that the turbine wheel 56 is set in rotation about the axis of rotation 58. Owing to corresponding alignment of the connection pipes 54 of the two disc brushes 34 and 36, the direction of rotation of the turbine wheel 56 of the first disc brush 34 is opposite to the direction of rotation of the turbine wheel 56 of the second disc brush 36.

The turbine wheel 56 is coupled by means of a gearing 64 to a holding part in the form of a drive disc 66, which is mounted for rotation about the axis of rotation 58 on the underside of the bottom plate 50 facing away from the drive chamber 52. The drive disc is mounted by means of a roller bearing in the form of a ball bearing 68, which forms an axial bearing. A bristle disc 70 is releasably and rotationally fixedly held on the underside of the drive disc 66 facing away from the drive housing. The bristle disc 70 is rotatable together with the drive disc 66 about the axis of rotation 58 and carries a multiplicity of cleaning bristles 72 on its underside facing away from the drive housing 44.

The gearing 64 comprises a first pinion 74, which is aligned coaxially with the turbine wheel 56 and is rotationally fixedly connected to it, and which meshes with a gear wheel 76 which is rotationally fixedly held on a shaft 78 mounted in the drive housing 54 for rotation about a gearing axis 80 aligned parallel to the axis of rotation 58. The shaft 78 passes through an opening in the bottom plate 50 and protrudes from the drive chamber 52. In its area protruding from the drive chamber 52, the shaft 78 carries a second pinion 82 which meshes with an internal toothing 84 of a ring gear 86. The ring gear 86 is rotationally fixedly connected and preferably in one piece to the drive disc 66 and is surrounded by the ball bearing 68. The ball bearing 68, in turn, is surrounded by a collar 88 which protrudes from the underside of the bottom plate 50 facing away from the drive chamber 52.

The bottom plate 50 like the drive disc 66 and the bristle disc 70 comprises several liquid openings 90 by way of which the cleaning liquid applied under pressure to the turbine blades 62 of the turbine wheel 56 can flow practically without any pressure out of the drive chamber 52 into the area of the cleaning bristles 72. The

photovoltaic installation 16 can be effectively cleaned by means of the cleaning liquid flowing out and under the mechanical action of the cleaning bristles 72 rotating about the axis of rotation 58.

As indicated above, the bristle discs 70 of the two disc brushes 34 and 36 rotate in opposite directions. This results in a stabilization of the cleaning head 18 so that there is practically no risk of the cleaning head 18 executing an unintentional sideways movement perpendicularly to the longitudinal axis 92 of the guiding device 22 while being guided along the photovoltaic installation 16.

As will be clear from Figures 6 and 7, the brush holder 20 comprises a liquid-tight joint 94 by means of which the two outlets 40, 42 can be pivoted relative to the inlet 38 of the brush holder 20 about a pivot axis 96 aligned perpendicularly to the longitudinal axis 92 of the guiding device 22. The joint 94 comprises a first joint part 98 and a second joint part 100 as well as a joint bolt 102 which passes through the two joint parts 98, 100. The first joint part 98 is rotationally fixedly held on the joint bolt 102, whereas the second joint part 100 is mounted on the joint bolt 102 for rotation about the pivot axis 96. The first joint part 98 comprises the inlet 38 of the brush holder 20. The second joint part 100 comprises a first outlet 104 to which an L-shaped first outlet pipe 106 is connected, and a second outlet 108 to which an L-shaped second outlet pipe 110 is connected. The two outlet pipes 106 and 110 are of identical configuration and are rigidly connected to each other by a cross bar 112. The first outlet pipe 106 forms with its end that faces away from the joint 94 the first outlet 40 of the brush holder 20, and the second outlet pipe 110 forms with its end that faces away from the joint 94 the second outlet 42 of the brush holder 20.

The two joint parts 98, 100 as well as the joint bolt 102 have a plurality of bore holes by way of which the cleaning liquid can flow through the joint parts 98, 100 and the joint bolt 102.

The pivotability of the second joint part 100 relative to the first joint part 98 is limited to a pivot angle range of approximately 45°. For this purpose, the first joint part 98 has on its outer side opposite the inlet 38 a recess 114, which is delimited in the pivoting direction of the second joint part 100 by a first stop element 116 and a second stop element 118, and into which a projection 120 of the second joint part 100 extends. Starting from a first end position shown in Figure 7, in which the two outlets 40, 42 are aligned substantially parallel to the longitudinal axis 92 of the guiding device 22, the second joint part 100 can be pivoted through at most approximately 45° in a pivoting direction as far as a second end position. In the first end position, the projection 120 lies against the first stop element 116, and in the second end position, which is not shown in the drawings, the projection 120 lies against the second stop element 118.

Use of the joint 94 enables the alignment of the guiding device 22 relative to the photovoltaic installation 16 to be changed without the lying of the cleaning bristles 72 of the two disc brushes 34, 36 against the photovoltaic installation 16 being thereby impaired. This simplifies the moving back and forth of the cleaning head 18 along the photovoltaic installation 16 by means of the guiding device 22.

The length of the telescopic guiding device 22 can be changed and so the user 29 can, as required, adopt a lesser or greater distance from the photovoltaic installation 16. The changeable length of the guiding device also enables photovoltaic installations 16 of different extent to be effectively cleaned in the same way.

TISZTÍTÓBERENDEZÉS FOTOVOLTAIKUS SZERKEZETEKHEZ
SZABADALMI IGÉNYPONTOK

1. Tisztítóberendezés fotovoltaiikus szerkezetekhez, ami tartalmaz egy tisztítófejet (18) legalább egy olyan tárcsakefével (34, 36) ami egy forgástengely (58) körül forgatható sörtetárcsát (70) tartalmaz, amin tisztító sörték (72) vannak elrendezve, és egy meghajtószerkezetet, ami egy forgathatóan ágyazott turbinakerékkel (56) van ellátva, ami nyomás alatti tisztítófolyadékkal táplálható, és ami egy meghajtáson (64) keresztül van a sörtetárcsával (70) összekapcsolva, **azzal jellemezve, hogy** a tisztítóberendezés (10) a tisztítófej (18) mozgására egy teleszkópos tartószerkezettel (22) van ellátva, ahol a nyomás alatti tisztítófolyadék a tartószerkezeten (22) keresztül a legalább egy olyan tárcsakeféhez (34, 36) vezethető, és hogy a legalább egy olyan tárcsakefe (34, 36) egy meghajtó házzal (44) van ellátva, amiben a turbinakerék (56) van forgathatóan ágyazva, és hogy a sörtetárcsa (70) egy olyan tartóelemen (66) van rögzítve, ami a meghajtó házban (44) van egy gördülőcsapággal forgathatóan ágyazva, ahol a tartóelem (66) tartalmaz egy belsőfogazású fogaskereket (86), ami a meghajtás (64) egy kiskerekével kapcsolódik, és ahol a csapág a fogaskereket (86) körülveszi.
2. Az 1. igénypont szerinti tisztítóberendezés, **azzal jellemezve, hogy** a tartószerkezet (22) merev, egymásba illeszthető vezetőrudakat (24, 25, 26, 27) tartalmaz.
3. Az 1. vagy 2. igénypont szerinti tisztítóberendezés, **azzal jellemezve, hogy** a tartószerkezeten (22) a nyomás alatti tisztítófolyadék számára egy vezeték van átvezetve.
4. Az előző igénypontok bármelyike szerinti tisztítóberendezés, **azzal jellemezve, hogy** a tartószerkezet (22) és tisztítófej (18) között egy kefetartó (20) van elrendezve, ami legalább egy tárcsakefét (34, 36) tart.
5. A 4. igénypont szerinti tisztítóberendezés, **azzal jellemezve, hogy** a kefetartó (20) egy vezeték elrendezést tartalmaz, aminek van egy bevezetése (38), amihez a nyomás alatti tisztítófolyadék vezeték csatlakoztatható, és legalább egy kivezetése (40, 42), amire egy tárcsakefe (34, 36) csatlakoztatható, ahol a legalább egy kivezetés (40, 42) a bevezetéshez (38) képest egy, a tartószerkezet (22) hossz tengelyére merőlegesen elrendezett billenő tengely (96) körül billenthető.
6. Az 5. igénypont szerinti tisztítóberendezés, **azzal jellemezve, hogy** a legalább egy kivezetés (40, 42) egy első végállásból kiindulva a billenő tengely (96) körül csak egy irányba billenthető.
7. A 6. igénypont szerinti tisztítóberendezés, **azzal jellemezve, hogy** a legalább egy kivezetés (40, 42) egy első végállásból kiindulva a billenő tengely (96) körül legfeljebb 90 fokban billenthető.
8. Az 5 – 7. igénypontok bármelyike szerinti tisztítóberendezés, **azzal jellemezve, hogy** a kefetartó (20) egy folyadékzáró csuklóval (94) van ellátva, amik keresztül a bevezetése (38) a legalább egy kivezetéssel (40, 42) van áramlási kapcsolatban.
9. Az előző igénypontok bármelyike szerinti tisztítóberendezés, **azzal jellemezve, hogy** a tartóelem (66) a turbinakerék (56) forgástengelye (58) körül forgatható.



10. Az előző igénypontok bármelyike szerinti tisztítóberendezés, azzal jellemezve, hogy a golyócsapágy kúpcsapágy (68).
11. Az előző igénypontok bármelyike szerinti tisztítóberendezés, azzal jellemezve, hogy a golyócsapágy axiális csapágy.
12. Az előző igénypontok bármelyike szerinti tisztítóberendezés, azzal jellemezve, hogy a tisztítófej (18) két tárcsakefét (34, 36) tartalmaz, amik sörtetárcsái (70) egymással szemben forognak.

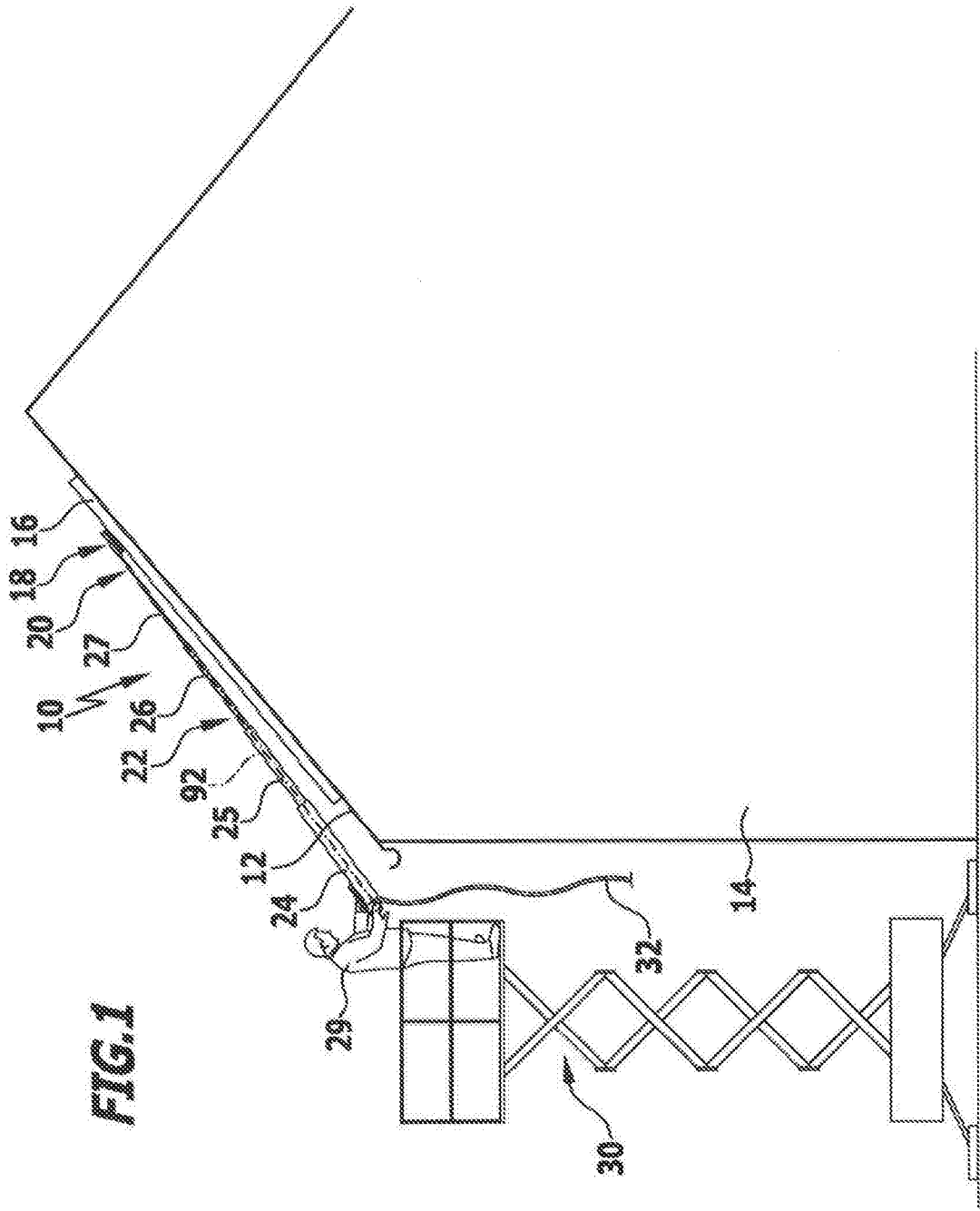


FIG. 1



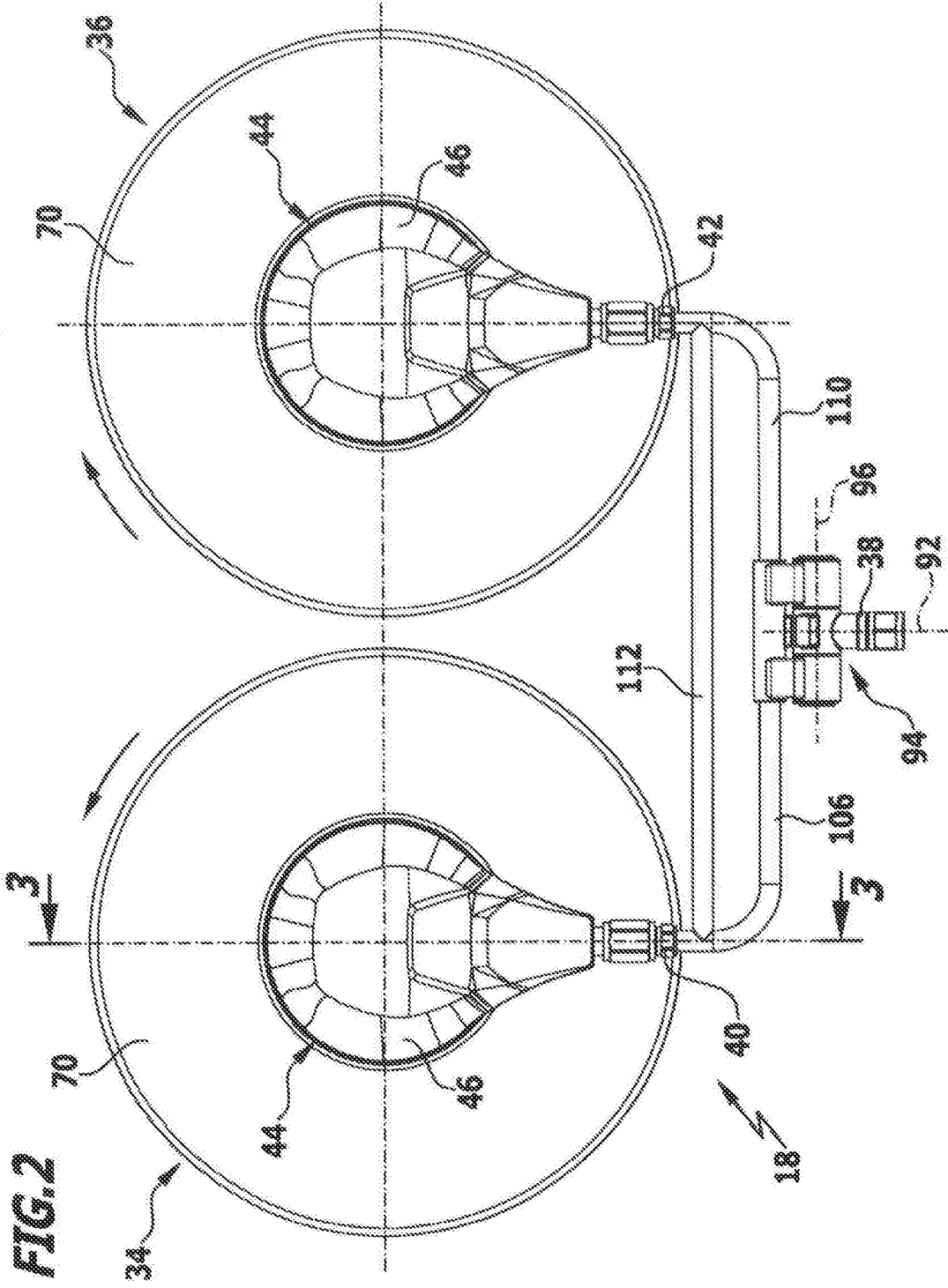


FIG.3

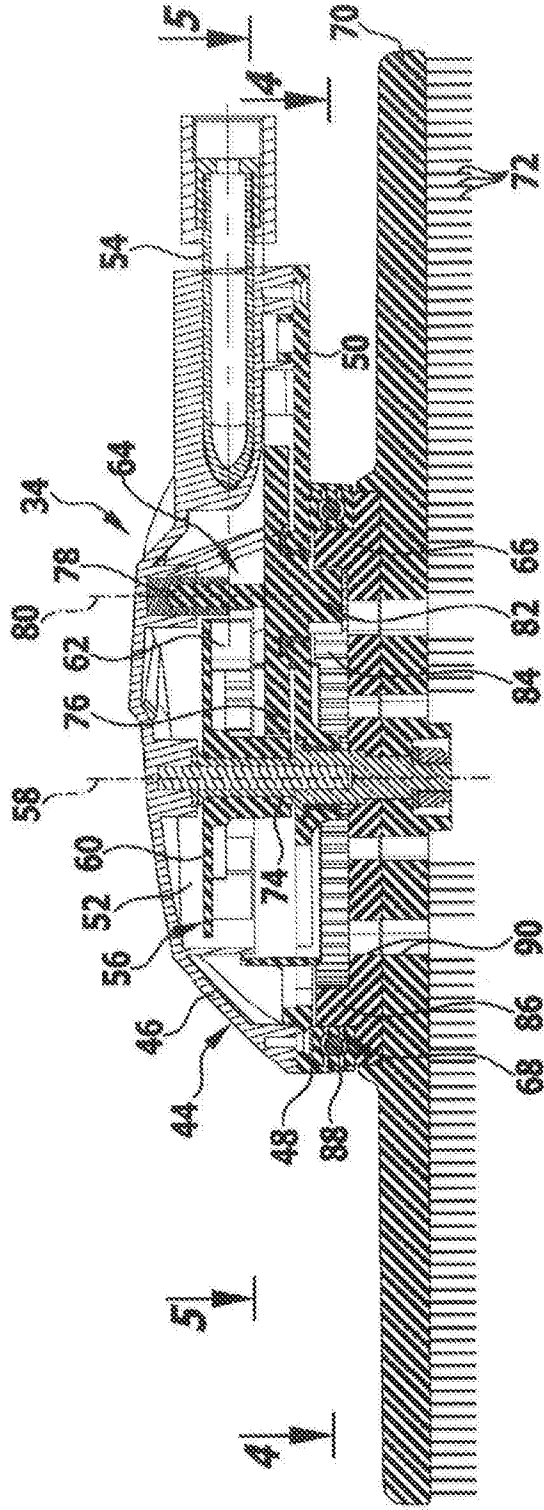


FIG.4

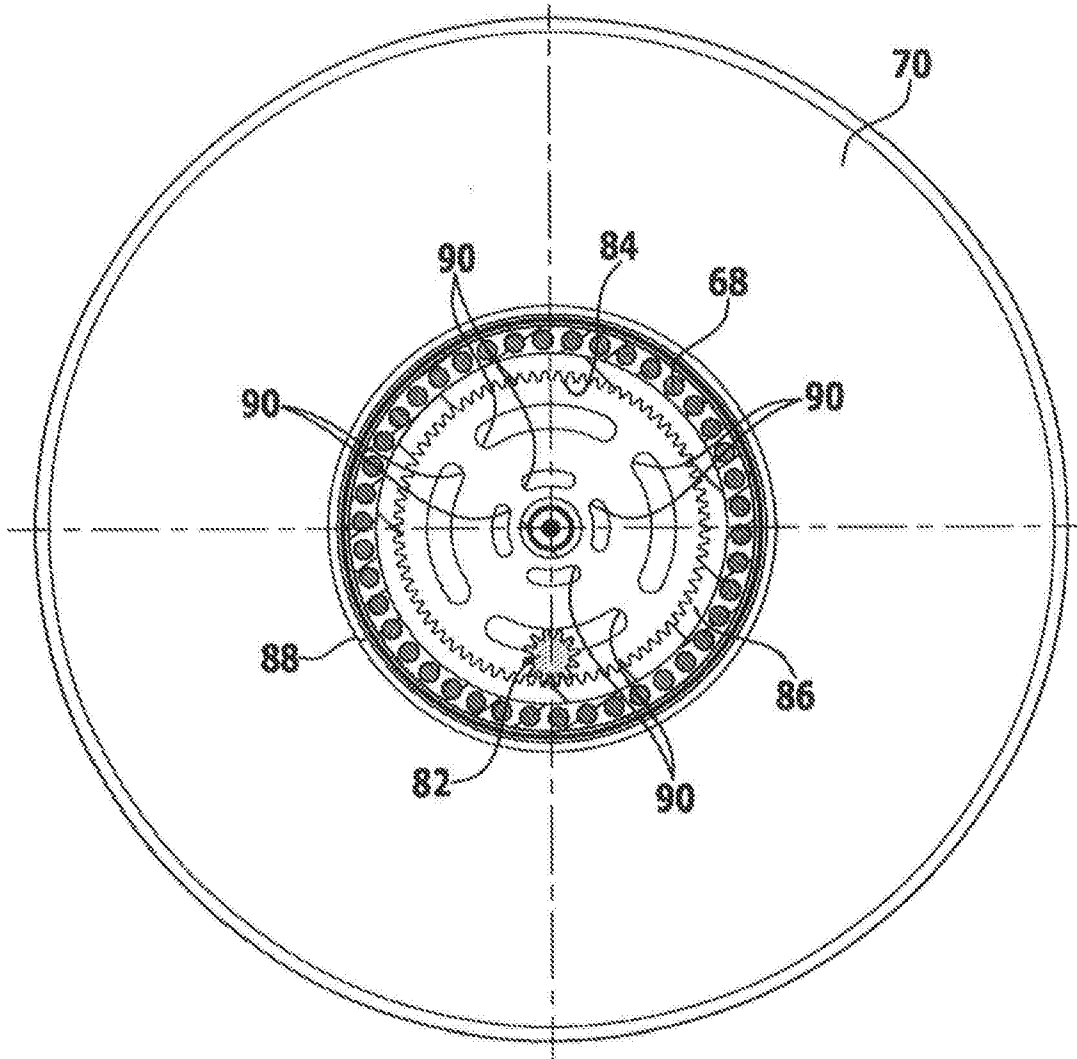


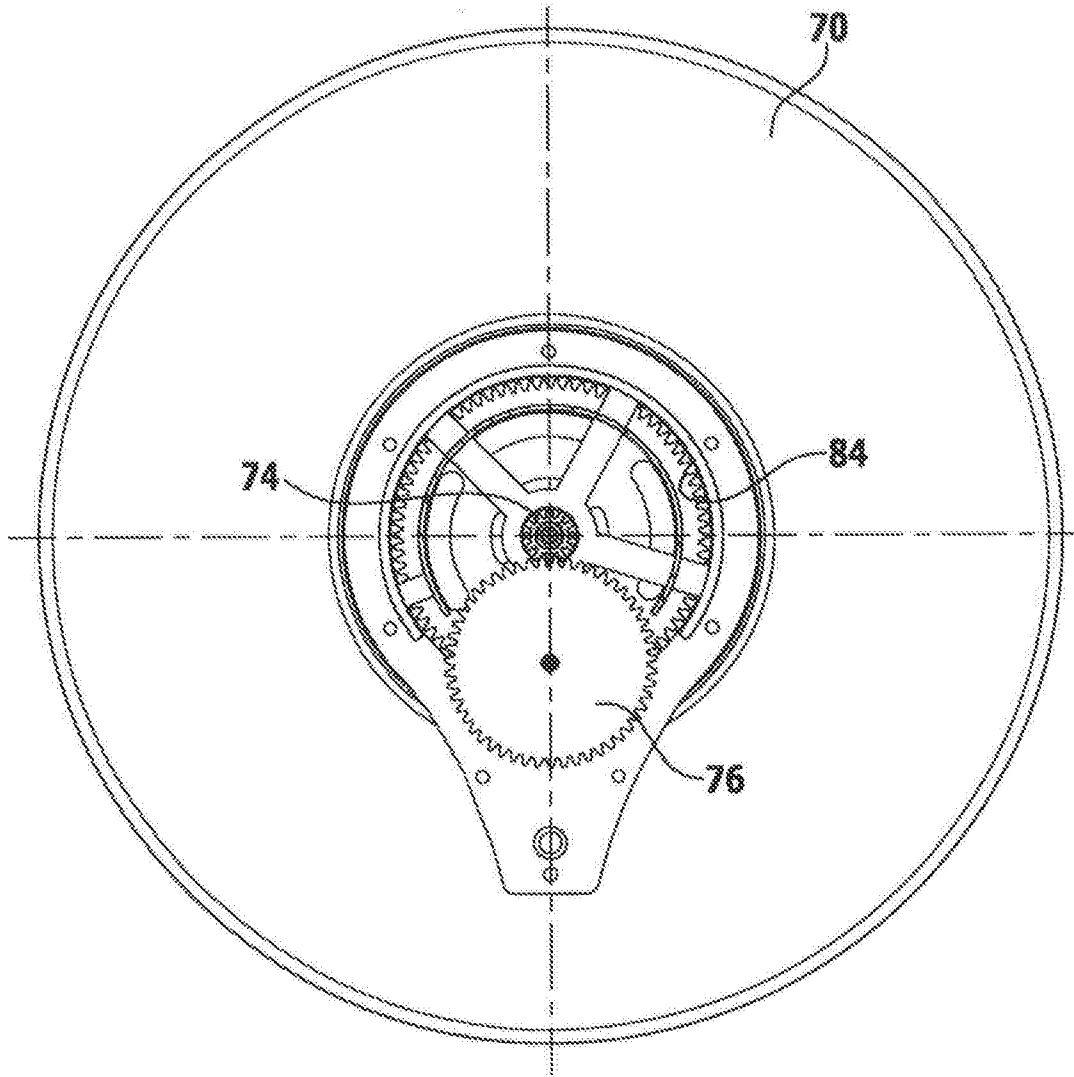
FIG. 5

FIG. 6

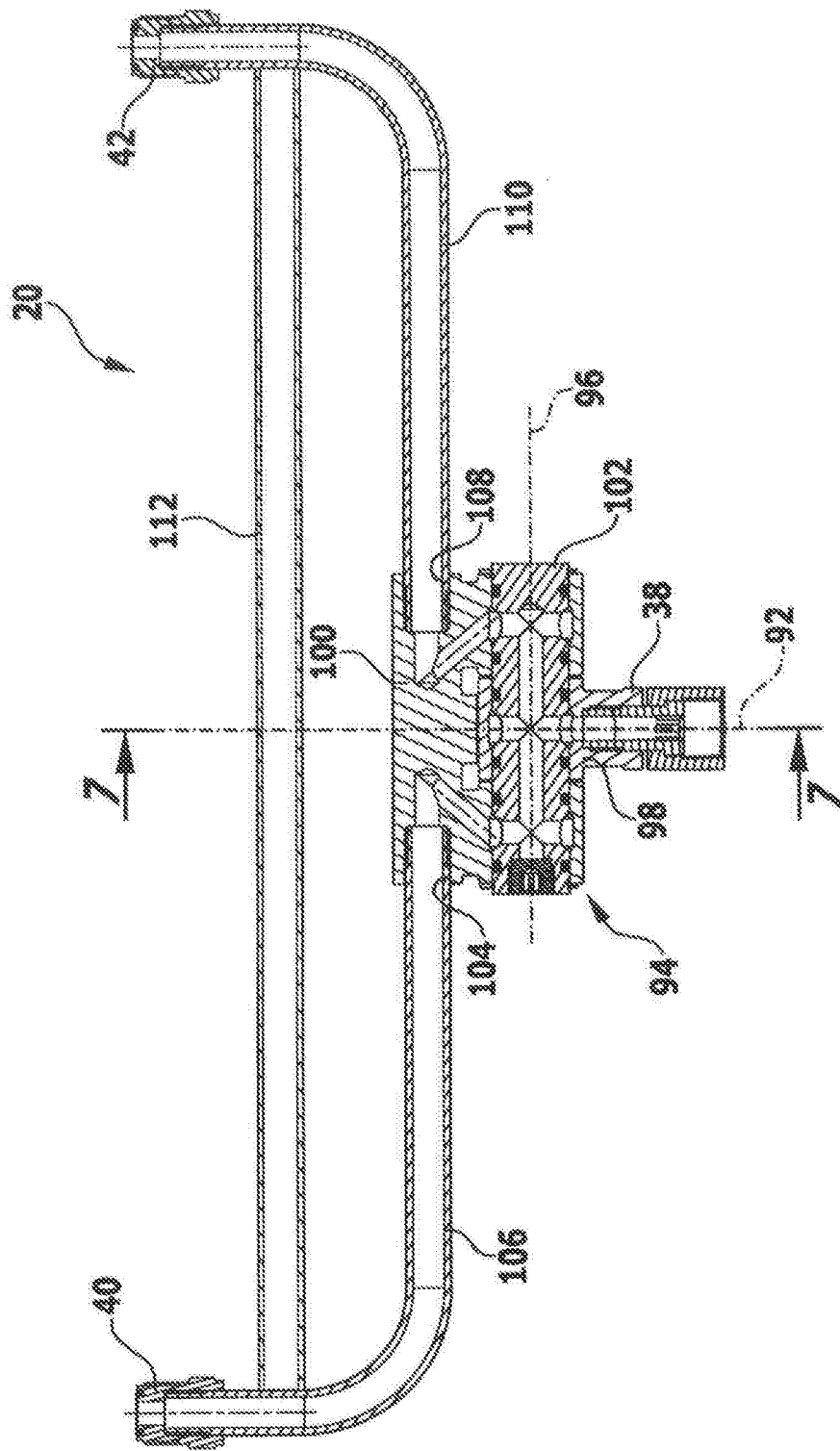


FIG.7

