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(54) **COMPACT ROBOTIC LOCALLY ADJUSTABLE LIGHTING OF WORKSPACE OF MEDICAL FACILITIES**

(57) Compact locally adjustable lighting (1) of workspace of medical facilities consists of a group of concentric rings (2) with inner arrangement of the positioning light chains (3) attached in the main arm (4) with an adjacent cover counterpart (5) on the central positioning column (6) continuing on the central positioning column with two degrees of freedom which is attached through a flanged ceiling segment (7) to the ceiling structure.

The main arm (4) is attached through a laterally located connecting block (18) in the segment (17) of main arm (4) of the central positioning column (6), when the connecting block (18) with its structure creates the inner space for central lighting (19), as well as camera, measuring and control system. Simultaneously, to the connecting block (18) there is attached a group of auxiliary ribs (20) which are linked spatially to the individual concentric rings (2) which are inserted into the round semi-circular recess (21) of inner part of the main arm (4) fixed through the installation of the cover counterpart (5) of the main arm (4).

The concentric rings (2) are formed by divided semicircles (32) which primary part forms the lower part (33) which is complemented to the circular cross section through a group of covers (34). The identical halves of the lower part (33) of the partial concentric ring (2) are connected via connector (35) with the second shaped recess (38) provided with a transparent cover (37), while on the opposite side they fit into the semicircular recess (21) formed by the main arm (4) with the cover counterpart (5).

The internal arrangement of the positioning light chains (3) consists of a group of interdependent dimen-

sionally identical driven cages (40) which are formed by a pair of dividedly interconnected lateral annular rings (41) with a central base (42) between which there is a connection element (43) of the lamp cap (44) located.

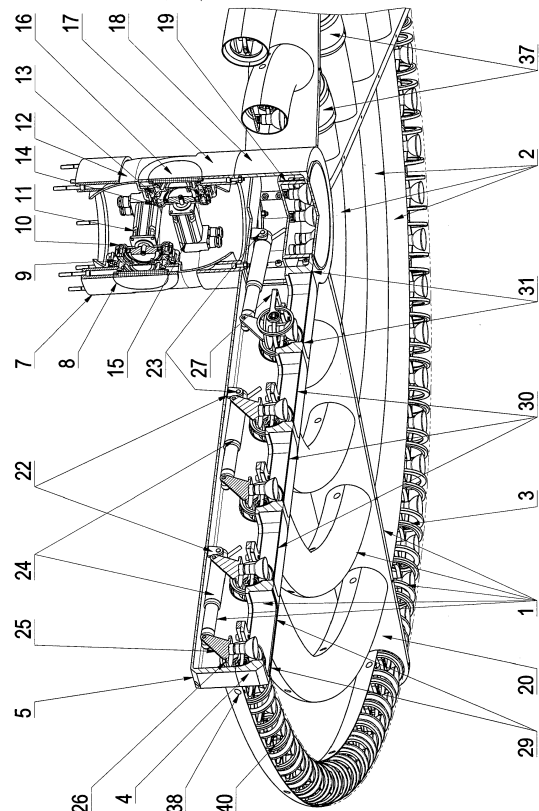


FIG. 1

EP 3 182 000 A1

Description

Technical field

[0001] The present invention relates to a robotic locally adjustable lighting of medical workplaces enabling controlled lighting of particular area of workplace characterized by particularly high efficiency and universality allowing use in a wide range of different types of medical rooms.

Description of the prior art

[0002] Currently, there exists a variety of solutions of workspace lighting of hospital and examination rooms. Most of them require the use of partial local lightings which need spatial manual setting and optimization of the luminous flux of the illuminated area.

[0003] The disadvantage of some current solutions is also the incidence of adverse turbulences of laminar flow of ventilation units, as well as complex configuration of external parts.

[0004] The above mentioned insufficiencies can be identified for example in the solutions of local lighting by STERIS (<http://www.steris-healthcare.com/products/surgical/xled-r-3>), or Dräger (http://www.draeger.com/sites/en_uk/Pages/Hospital/Video-options.aspx). The solutions by STERIS are described, for example in patent applications EP 2752 613 A1, WO 03/059235 A2, WO 2010/053882 A2; solutions by Dräger company are described in patent applications US 6,659,415 B2, US 8,050,547 B2, US 2012/0043915 A1, WO 2014/101994 A1.

[0005] These lights are only of local character with the necessity of supplementary lighting of the working area. Constructions allow the extension to dimensionally larger assemblies which may seem to be an advantage at first glance. However, the relevant assemblies form a dimensionally inadequate surface obstructing the appropriate flow which leads to the occurrence of undesirable turbulences of laminar flow of ventilation units. At the same time, they require direct contact of the operator with the structure in the process of alignment. The above mentioned solutions cannot be placed in any room - always there must be a "tailored" solution for a particular room.

[0006] Complex equipment with a partial solution of adjustable lighting of the hospital room is solved for example within the project "Optimus Integrated Surgical Environment"; however, the arrangement allows the location of the chosen concept only to selected dimensionally suitable spaces, eventually to newly constructed purpose-built facilities. The arrangement also works only in connection with an associated lighting of the whole room through built-in light panels.

[0007] The single block of adjustable lighting enables only to centralize partial luminous flux by positioning of specific number of illuminative cupolas (out of twelve) which are part of the ceiling structure.

Summary of the invention

[0008] The disadvantages are eliminated by the compact robotic locally adjustable lighting of workspace of medical facilities which principle can be found in that it is formed by a group of concentric rings with the internal arrangement of the positioning light chains mounted on the main arm with adjacent cover counterpart of the main arm continuing on the central positioning column with two degrees of freedom which is attached through a flanged ceiling segment to the ceiling structure, and which is formed by a flanged ceiling segment mounted on the ceiling and simultaneously by the opposite side with the first lateral grip which follows the first transmission block with a first reducing grip and a first actuator which is further fixed in the compact central segment to form a single degree of freedom;

while the compact central segment continues on an axially located second transmission block with a second reducing grip and a second actuator which on the exit further follows a second lateral grip of the main arm segment to which a complete set of lighting elements is attached;

while the main arm is through a laterally arranged connecting block attached in the main arm segment of the central positioning column, where the connecting block forms by its design an interior space into which is a central lighting inserted, as well as camera, measuring and control system, simultaneously on the connecting block there is a group of auxiliary ribs mounted which are spatially linked to the individual concentric rings which are inserted into the semicircular recesses of the inner part of the main arm while they are fixed there by installation of the cover counterpart of the main arm which has on the inner side a group of arranged connecting points with a pin of linear actuators following by the opposite side a rod of the swinging control cage of the compact locally adjustable lighting arranged in the space of the main arm, where the exact position of the control cage is set by the anchoring segment which one side via the round ending follows the shaped shoulder of the control cage, and it is anchored by the second side to the basic profile of the main arm;

while the main arm is on its bottom part provided with shaped recesses which are blinded by transparent covering with shaped adapted ergonomic area for assembly / disassembly of partial covers which continue fluently on the lateral shaped configuration of main arm construction;

while the concentric rings are formed by the divided semicircles which basic part is formed by the lower part that is filled to the compact circular cross section by a group of covers, identical halves of the lower part of the partial ring are connected via a coupling with shaped recess staffed by a transparent cover, and simultaneously on the opposite side they fit into a circular semicircular shoulder formed by the main arm with cover counterpart; while a group of covering of the upper part situated

around the circumference of the lower part of the tube is connected with the lower part by a mechanically deformable shaped recess for assembly / disassembly, while the zone of deformation drawing is located on the outer side of the covers;

while the inner arrangement of the positioning light chains is formed by a group of to each other via cardan joints dependent dimensionally identical controlled cages of the compact locally adjustable lighting which are formed by a pair dividedly connected lateral annular rings with central base between which a connection element of the lamp cap is located;

while the pair of lateral semicircles are fitted with shaped sliding element dimensionally defined by the radius of curvature of the tube comprising a lower part and a cover; while the controlled elements of the compact locally adjustable lighting follow the swinging control cage of the compact locally adjustable lighting in the place of anchoring of concentric rings and the main arm, where the shape and dimensional arrangement of cages in connection with a removable group of covering is structurally adapted for removing bulbs of any kind of positioning light chain.

[0009] The advantage of the proposed compact flexibly controllable room lighting is a unique possibility of controlled directional lighting of integrated workspace of hospitals and examination rooms.

[0010] Advantages of the proposed solution:

- it eliminates the need for partial local lamps requiring manual spatial settings and optimization of luminous flux of illumination area;
- it allows hygienically more appropriate contactless spatial settings with identically solved optimization of luminous flux;
- it features a symmetrical structure arrangement only with the appearance of an aerodynamically ideal cross-section of partial profiles which minimizes the possible occurrence of undesirable turbulences of laminar flow of the ventilation units;
- the selected compact profile eliminates the possible accumulation of dirt, which is achieved mainly by the absence of a complex configuration of external parts;
- it allows implementation of up to ten times of the light sources in comparison with conventional light;
- the structure can be equipped with measuring and sensing technology;
- possibility of any change of position and size of the illumination area allows placement in any room, mainly due to a wide variety of dimensional design of the basic concept, which depends on the size of the outer ring.

Description of Drawings

[0011] The attached sheets show figures and legend.

[0012] The figure for annotation shows the main basic spatial view of the compact locally adjustable lighting of

workspace with a cross-section of the main arm.

FIG. 1 the main basic spatial view of the compact locally adjustable lighting of workspace with a cross-section of the main arm

FIG. 2 a view of the system of concentric rings with positioning light chains

FIG. 3 a view of the driven and control cage of the compact adjustable lighting

FIG. 4 a view of the construction of the main arm for attachment of concentric rings with following central positioning column

An example of the invention version

[0013] A compact locally adjustable lighting 1 of workspace of medical facilities consists of a group of concentric rings 2 with inner arrangement of the positioning light chains 3 attached in the main arm 4 with an adjacent cover counterpart 5 of the main arm 4 continuing on the central positioning column 6 with two degrees of freedom which is attached through a flanged ceiling segment 7 to the ceiling structure.

[0014] The central positioning column 6 with two degrees of freedom is formed by the flanged ceiling segment 7 attached to the ceiling structure and simultaneously through the opposite side with a first lateral grip 8 it continues to a first transmission block 9 with a first reducing grip 10 and a first actuator 11 which is further attached to the compact central segment 12 which creates one degree of freedom. The compact central segment 12 further follows the normally located second transmission block 13 with a second reducing grip 14 and a second actuator 15 which on the output follows the second lateral grip 16 of the segment 17 of main arm to which a complete set of lighting elements is attached.

[0015] The main arm 4 is attached through a laterally located connecting block 18 in the segment 17 of main arm 4 of the central positioning column 6, the connecting block 18 forms with its dimensions the inner space into which a central lighting 19, camera, measuring or control system are inserted, to the connecting block 18 there is attached a group of auxiliary ribs 20 simultaneously, which are spatially linked to the concentric rings 2. Into the semicircular recess 21 of inner part of the main arm 4 there are inserted the concentric rings 2 which are fixed through the installation of the cover counterpart 5 of the main arm 4 which features on the inner side with a group of arranged connection points 22 with peg 23 of linear actuators 24 linked with the opposite side to the rod 25 of the swinging control cage 26 of the compact locally adjustable lighting 1 arranged on the space of the main arm 4; the exact position of swinging control cage 26 is defined by an anchoring segment 27 which one side follows through the round ending 28 the shaped shoulder 38 of the swinging control cage 26, and via the second side it is anchored in the basic profile of the main arm 4. The main arm 4 is on its lower part provided with first

shaped cutouts 29 which are blinded by transparent covering 30 with dimensionally adapted ergonomic zone 31 for assembling / disassembling of partial covers which are a fluent continuation of the side configuration of the structure of the main arm 4.

[0016] The concentric rings 2 are formed by divided semicircles 32 which primary part forms the lower part 33 which is complemented to the circular cross section through a group of covers 34, the identical halves of the lower part 33 of the partial concentric ring 2 are connected via connector 35 with a second shaped recess 36 provided with a transparent cover 37, and simultaneously on the opposite side they fit into the round semicircular recess 21 formed by the main arm 4 with the cover counterpart 5. A group of covers 34 of the upper area situated around the circumference of the lower part 33 of the tube is connected with the lower part 33 through the mechanically deformable shaped shoulder 38 for assembling / disassembling, while the zone of deformation drawing is located on the outer side of the covers 34.

[0017] The inner arrangement of the positioning light chains 3 consists of a group of interdependent through cardan joints 39 dimensionally identical driven cages 40 of the compact locally adjustable lighting 1 which comprises a pair of dividedly connected lateral annular rings 41 with central base 42 following the connection element 43 of the lamp cap 44. The pair of dividedly connected lateral annular rings 41 are provided with a shaped sliding element 45 defined by the radius of curvature of the tube formed by the lower part 33 and the cover 34. The driven cages 40 of the compact locally adjustable lighting 1 follow the sliding control cage 26 of the compact locally adjustable lighting 1 in the anchoring place of the concentric rings 2 and the main arm 4, shape and dimensional arrangement of the cages 26, 40 in connection with removable group of covers 34 allows to remove any bulb 46 of the positioning light chain 3.

Functions

[0018] The complex ceiling lighting technology with function of controlled lighting specific work areas of intervention hospital departments features a functional and shape arrangement that eliminates the negative impacts on the laminar flow of the ventilation units, particularly through the concentric rings 2 and the central positioning column 6 which smooth symmetrical profile and constant surface temperature do not create turbulences in the laminar flow.

[0019] The central positioning column 6 with two mutually orthogonal degrees of freedom, which allow to position the concentric rings 2, and thus to alter the position of the illuminated area, is to the ceiling construction attached through the flanged ceiling segment 7 that simultaneously follows the front interface of the first transmission block 9 through the oppositely disposed first lateral grip 8 thereby there occurs rotation of the given axis through the first actuator 11 mounted to the first reducing

grip 10 located on the opposite side of the first transmission block 9. The transmission block 9 is simultaneously mounted to the compact central segment 12 that forms with its inner space the compact enclosed space for the driving units 11, 15. Normally arranged second actuator 15 with the second reducing grip 14 following the second transmission block 13 anchored in the compact central segment 12 creates the second degree of freedom; while on the output interface of the second transmission block 13, there is the second lateral grip 16 of the segment 17 of the main arm arranged through which there is a controlled positioning of the entire assembly of the lighting elements.

[0020] The main arm 4 is attached through the laterally located connecting block 18 in the segment 17 of the main arm 4 of the central positioning column 6, the connecting block 18 creates an inner space suitable for installation of additional central lighting 19, camera, measuring or control system, simultaneously to the connecting block 18 there is attached a group of auxiliary ribs 20 transferring the local load thus eliminating deformations created by mass of the concentric rings 2. The concentric rings 2 are inserted centrally in the semicircular recess 21 of the inner part of main arm 4; while they are further fixed through the clamp connection formed via installation of the cover counterpart 5 that features on the inner side with a group of connection points 22 to which are through pegs 23 mounted the linear actuators 24 creating the desired compression and tensile strength to position the sliding control cages 26 through the following rod 25 of the partial concentric rings 2; the defined spatial position of the sliding control cage 26 is set by the anchoring segment 27 which round ending 28 fits into the shaped recess of the sliding control cage 26, and via the opposite side it is anchored through the screwed joint in the profile of the main arm 4. The main arm 4 is on its lower part provided with first shaped cutouts 29 with transparent covering 30 that does not limit the homogeneous chain of the luminous flux of the source, and simultaneously it is in the peripheral part formed by the ergonomic zone 31 designed to assembly / disassembly partial covers caused by reversible deformation drawn from the action of external forces in the area.

[0021] The concentric rings 2 are in terms of transport and handling formed by divided semicircles 32 which primary part forms the lower part 33 which is complemented to the circular cross section through a group of covers 34, the identical halves of the divided semicircles 32 of the lower part 33 of the concentric rings 2 are mutually connected via the shiftable connector 35 with mechanical anchor and the second shaped recess 36 fitted with the transparent cover 37 that does not limit the luminous flux of the source. Covering through covers 34 also allows through the circumferentially arranged shaped shoulder 38 the flexible dismantling of selected section of the covering through cover 34. The concentric rings 2 fit into the clamping semicircular recess 21 of the main arm 4 with the cover counterpart 5 simultaneously on the opposite

side.

[0022] The lower part 33 of the concentric rings 2 is in the place of cutouts of the upper area complemented by a group of covers 34 which are connected to the lower part 33 through the mechanically deformable shaped shoulder 38 via which the covers 34 in the area may be dismantled by external force.

[0023] The internal arrangement of concentric rings 2 consists of the positioning light chain 3 that comprises dimensionally identical driven cages 40 which are mutually connected through the cardan joint 39; the linear actuator 24 sets the default direction and value of swing through the rod 25 and the swinging control cage 26 of the compact locally adjustable lighting 1 which follows the positioning light chain 3 in the place of the main arm 4. The driven cages 40 are formed by a pair of dividedly connected lateral annular rings 41 with central bases 42 to which a connection element 43 of the lamp cap 44 is mounted. The pair of the lateral annular rings 41 is equipped by the shaped sliding element 45 which ensures low friction swinging controlled cages 40 thanks to spot contact of the contact surfaces. Level of values of rotation of the control and driven cages 26, 40 in connection with the shaped arrangement and removable covering through covers 34 enables removing any bulb 46 or other light source of the positioning light chain 3.

Industrial Use

[0024] Device of the complex lighting technology is usable, due to variably optional arrangement of dimensions of the concentric rings, in existing and newly built hospital halls and surgery rooms requiring the function of controlled lighting of specific areas of workspace.

[0025] Industrial applicability of the complex lighting technology with the function of controlled lighting of workspace is given by a wide range of optional light intensity of illumination area while maintaining an identical outer shape ideal for maintaining the laminar flow of air units.

List of the positions used

[0026]

1. Compact locally adjustable lighting
2. Concentric rings
3. Positioning light chains
4. Main arm
5. Cover counterpart
6. Central positioning column
7. Flanged ceiling segment
8. First lateral grip
9. First transmission block
10. First reducing grip
11. First actuator
12. Compact central segment
13. Second transmission block
14. Second reducing grip

15. Second actuator
16. Second lateral grip
17. Segment of main arm
18. Connecting block
- 5 19. Central lighting
20. Auxiliary ribs
21. Semicircular recess
22. Connection points
23. Peg
- 10 24. Linear actuators
25. Rod
26. Swinging control cage
27. Anchoring segment
28. Round ending
- 15 29. First shape recess
30. Transparent covering
31. Ergonomic zone
32. Divided semicircles
33. Lower part
- 20 34. Covers
35. Connector
36. Second shaped recess
37. Transparent cover
38. Shaped shoulder
- 25 39. Cardan joint
40. Driven cage
41. Lateral annular ring
42. Central base
43. Connection element
- 30 44. Lamp cap
45. Sliding element
46. Bulb

35 Claims

1. Compact locally adjustable lighting (1) of workspace of medical facilities **characterized in that** it consists of a group of concentric rings (2) with inner arrangement of the positioning light chains (3) attached in the main arm (4) with an adjacent cover counterpart (5) of the main arm (4) continuing on the central positioning column (6) which is attached through the flanged ceiling segment (7) to the ceiling structure, and which comprises flanged ceiling segment (7) mounted to the ceiling structure and also the opposite side with a first lateral grip (8) that continues to a first transmission block (9) with a first reducing grip (10) and a first actuator (11) which is further mounted to the compact central segment (12) to create one degree of freedom; while the compact central segment (12) further follows the normally arranged second transmission block (13) with the second reducing grip (14) and the second actuator (15) which on the output follows the second lateral grip (16) of the segment (17) of the main arm to which a complete set of lighting elements is attached; while the main arm (4) is attached through a laterally

located connecting block (18) in the segment (17) of main arm (4) of the central positioning column (6) where the connecting block (18) forms with its dimensions the inner space into which a central lighting (19) is inserted, to the connecting block (18) there is attached a group of auxiliary ribs (20) simultaneously which are spatially linked to the concentric rings (2) which are inserted into the semicircular recess (21) of inner part of the main arm (4) which features on the inner side with a group of arranged connection points (22) with peg (23) of linear actuators (24) linked with the opposite side to the rod (25) of the swinging control cage (26) of the compact locally adjustable lighting (1) arranged in the space of the main arm (4), where the exact position of swinging control cage (26) is defined by an anchoring segment (27) which one side follows through the round ending (28) the shaped shoulder (38) of the swinging control cage (26), and via the second side it is anchored in the basic profile of the main arm (4); while the main arm (4) is on its lower part provided with first shaped cutouts (29) which are blinded by transparent covering (30) with dimensionally adapted ergonomic zone (31) for assembling / disassembling of partial covers which are a fluent continuation of the side configuration of the structure of the main arm (4);

while the concentric rings (2) are formed by divided semicircles (32) which primary part forms the lower part (33) which is complemented to the circular cross section through a group of covers (34), the identical halves of the lower part (33) of the partial concentric ring (2) are connected via connector (35) with the second shaped recess (36) provided with the transparent cover (37) and simultaneously on the opposite side they fit in the into the round semicircular recess (21) formed by the main arm (4) and cover counterpart (5);

while the group of covers (34) of the upper area situated around the circumference of the lower part (33) he tube is connected with the lower part (33) through the mechanically deformable shaped shoulder (38) for assembling / disassembling; while the zone of deformation drawing is located on the outer side of the covers (34);

while the inner arrangement of the positioning light chains (3) consists of a group of interdependent through cardan joints (39) dimensionally identical driven cages (40) of the compact locally adjustable lighting (1) which comprises a pair of dividedly connected lateral annular rings (41) with central base (42) between which the connection element (43) of the lamp cap (44) is located;

while the pair of connected lateral annular rings (41) are provided with the shaped sliding element (45) dimensionally defined by the radius of curvature of the tube formed by the lower part (33) and the cover (34);

while the driven cages (40) of the compact locally adjustable lighting (1) follow the sliding control cage (26) of the compact locally adjustable lighting (1) in the anchoring place of the concentric rings (2) and the main arm (4), where the shape and dimensional arrangement of the cages (26, 40) in connection with the removable group of covers (34) is structurally adapted for removing of a bulb (46) of the positioning light chain (3).

2. Compact locally adjustable lighting (1) of workspace of medical facilities according to the claim 1 **characterized in that** the central positioning column (6) features two degrees of freedom.
3. Compact locally adjustable lighting (1) of workspace of medical facilities according to the claim 1 **characterized in that** it is equipped with camera system, measuring system and control system.

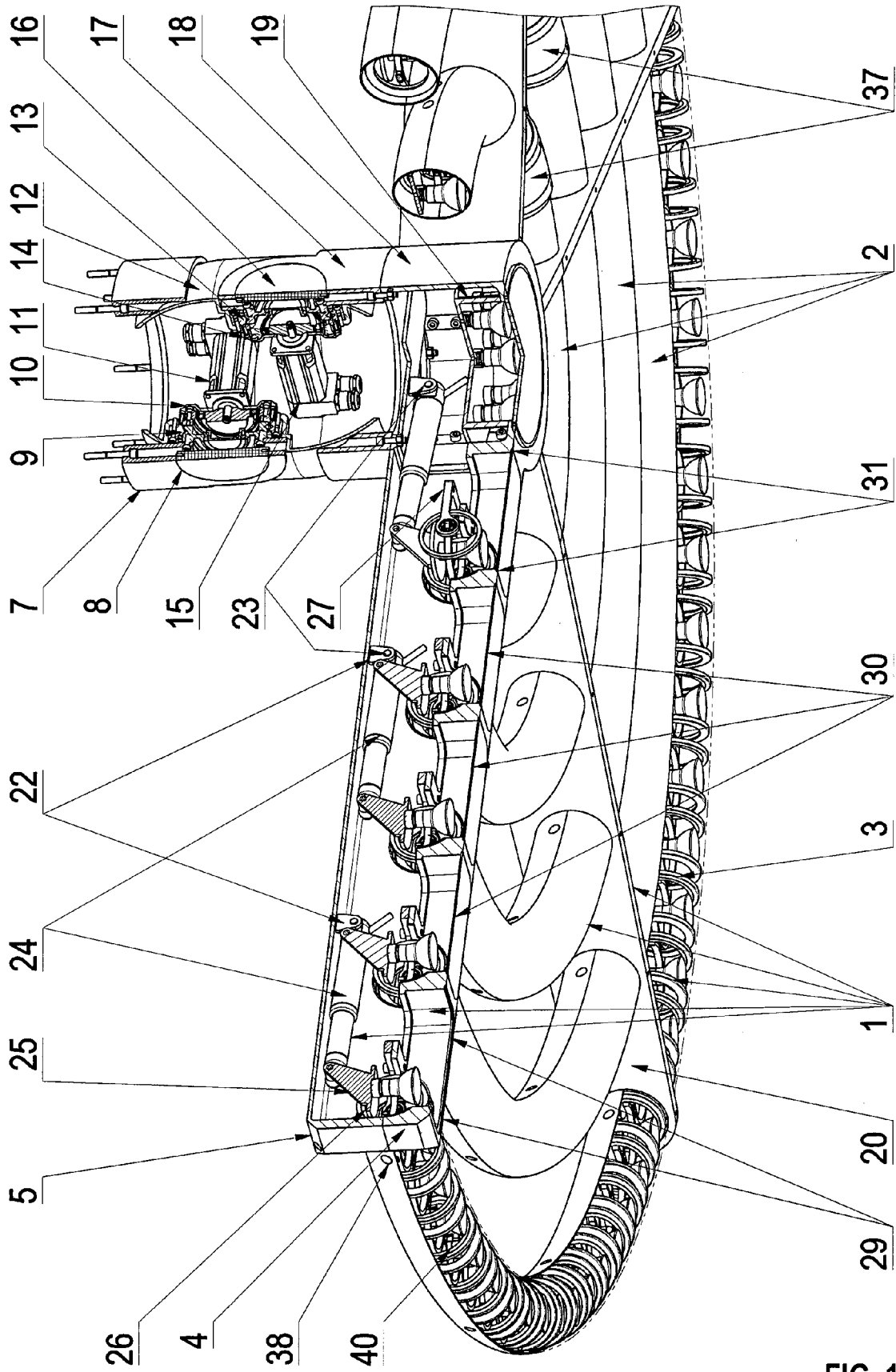


FIG. 1

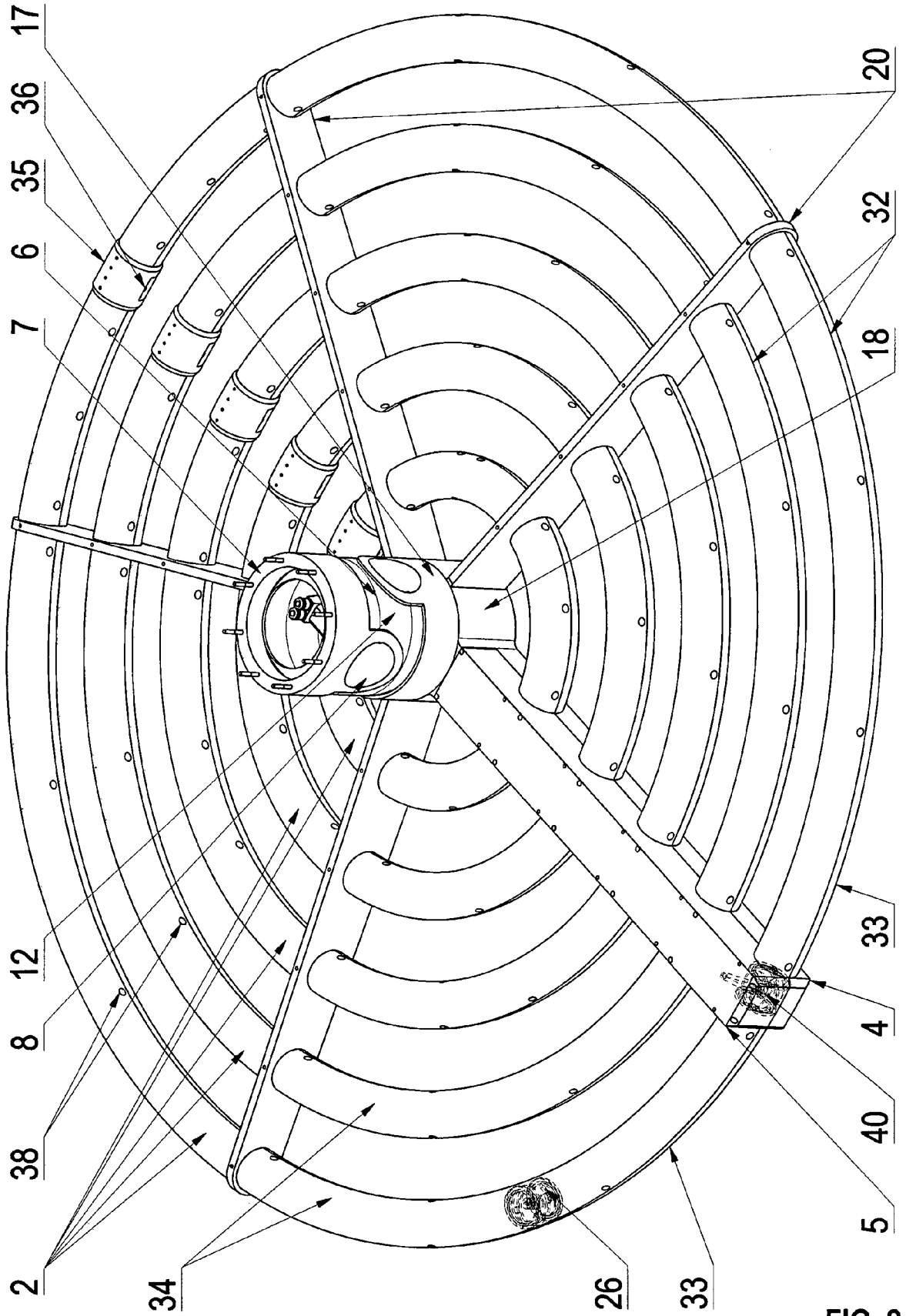


FIG. 2

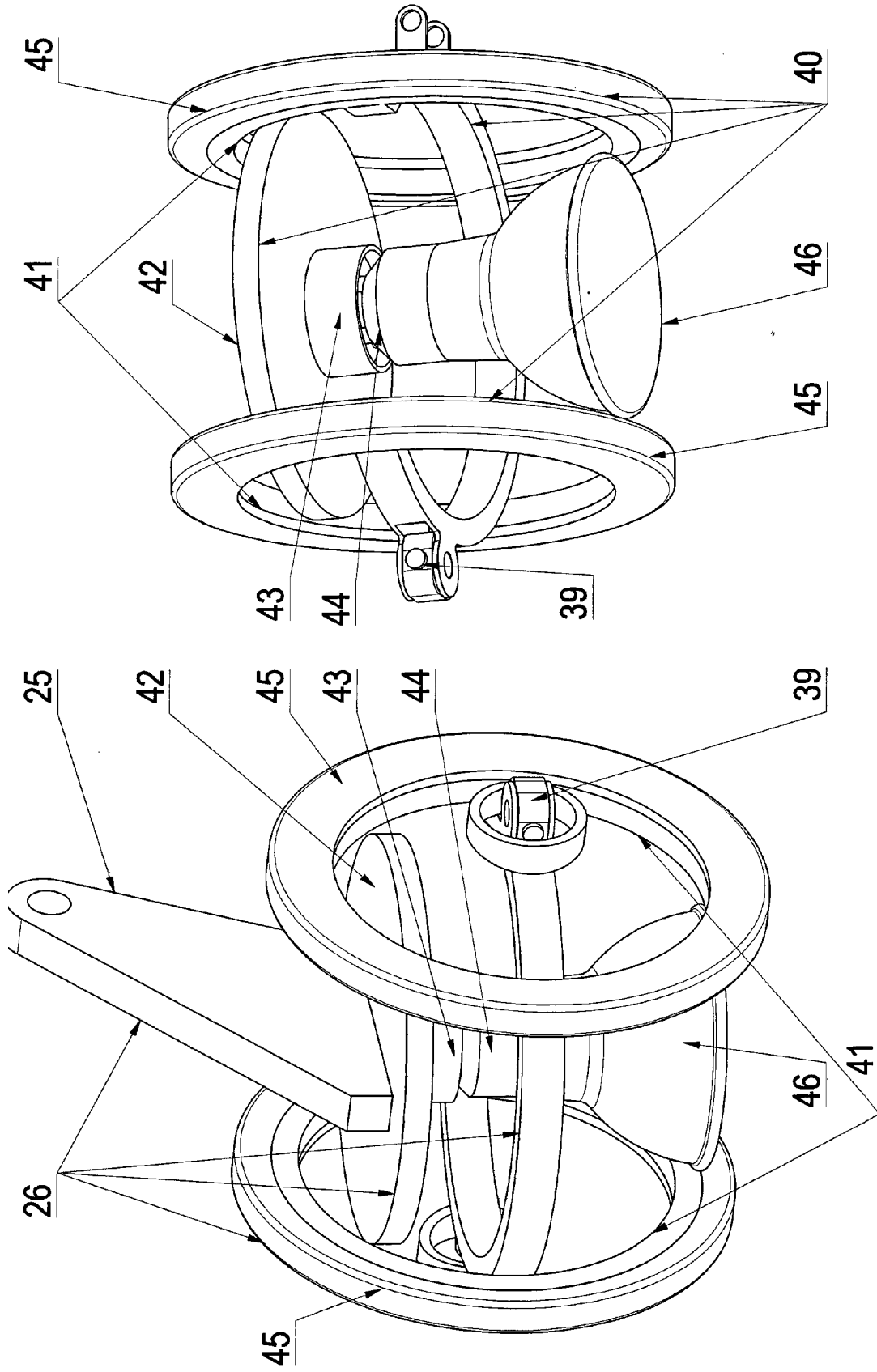


FIG. 3

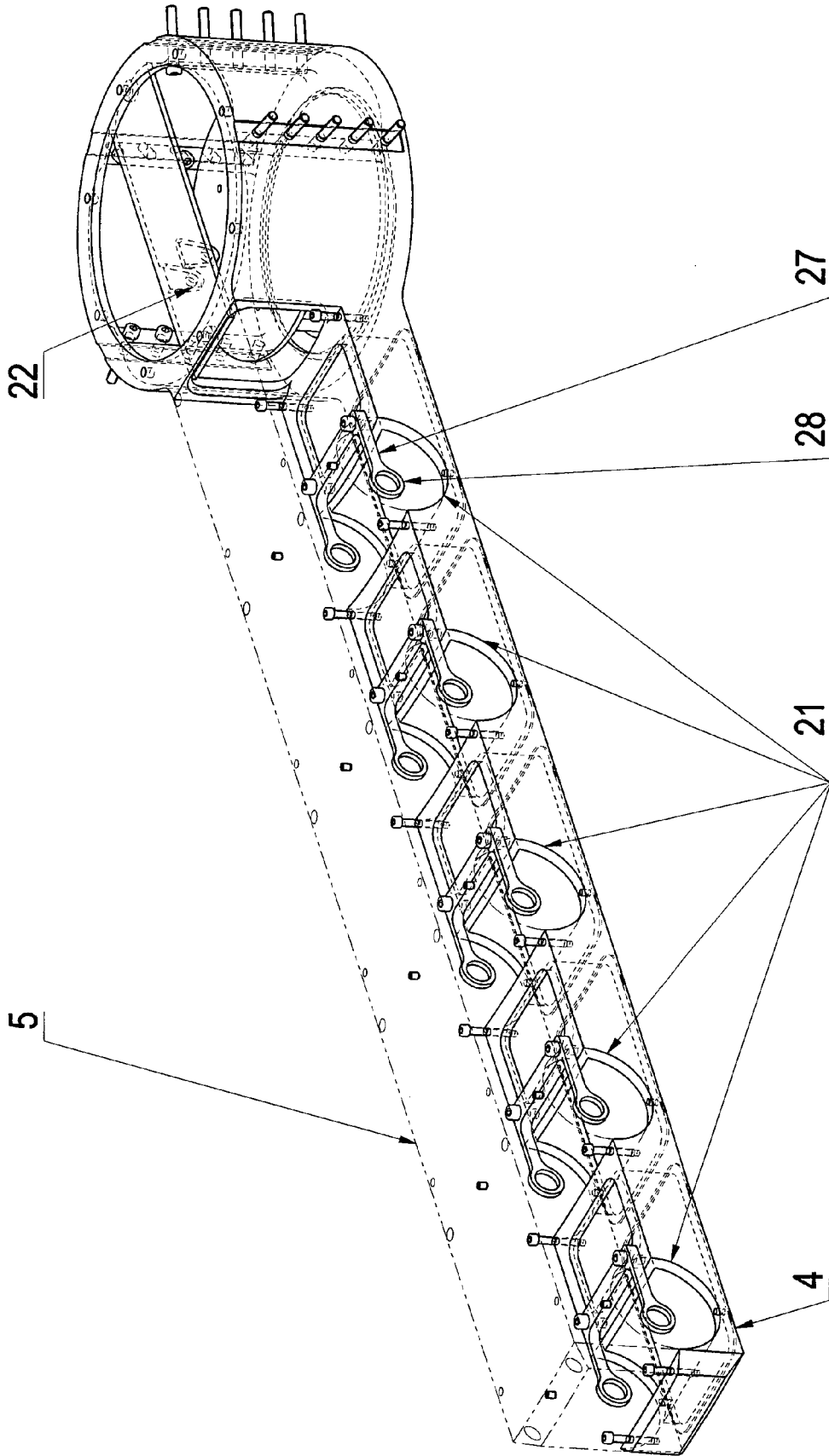


FIG. 4



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Place of search		Date of completion of the search	Examiner
The Hague		6 May 2016	Thibaut, Arthur
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EUROPEAN SEARCH REPORT

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ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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