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(54) **DEVICE FOR CONDITIONING INNER SURFACE OF CHEMICAL TANK BY GRINDING**

VORRICHTUNG ZUR KONDITIONIERUNG DER INNENFLÄCHE EINES CHEMISCHEN TANKS DURCH SCHLEIFEN

DISPOSITIF DE CONDITIONNEMENT PAR MEULAGE DE LA SURFACE INTERIEURE D'UN RESERVOIR DE PRODUITS CHIMIQUES

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Description

FIELD OF THE INVENTION

[0001] The invention is related to a device for conditioning the inner surface of a chemical tank by grinding (see for example SE-B-409301).

BACKGROUND OF THE INVENTION

[0002] With time, material residues are gathered on the inner surface of a chemical tank which material residues may be removed only with a more efficient cleaning of the surface, either chemical, mechanical or a combination thereof. Material residues may be produced especially as the same tank is used for transport of various chemicals. Despite of washing, the small amounts of chemicals remaining on surfaces may react with each other and form a layer of residues on a surface. Material residues are gathered also in tanks used for transport and storage of only one chemical, depending on the quality of a chemical, possible drying of a chemical on the walls of a discharging tank or efficiency of a normal cleaning.

[0003] Properties of the inner surface of a tank affect significantly the adhesion of chemicals and washability of the surface. Chemical tanks are normally made of acid-resistant steel, today normally of cold-rolled steel but earlier often also of hot-rolled steel. The microstructure of the surface is often unregularly granular and porous, and the surface of a hot-rolled steel is somewhat more porous than that of a cold-rolled steel. After manufacturing, surface roughness is typically of the order of 0.2 Ra. Chemicals adhere easily to this kind of surface, and it is not advantageous as cleaning is concerned. Therefore, conditioning of the surface is profitable also immediately after manufacturing of a tank before bringing it into use.

[0004] Use of grinding for cleaning and conditioning the inner surface is as such known. It is proved that suitable grinding to a roughness of 400 to 600, for example, is often an optimal method of conditioning. During washing, for example, the residues come out easier from a ground than polished surface, and by well-done grinding also good resistance against spot corrosion is achieved.

[0005] Grinding is often accomplished either wholly by hand or by means of various aids. This kind of work takes a lot of time and, in a tank into which the only access is through a manhole, is very inconvenient and dangerous and so expensive.

[0006] Various devices have also been developed for grinding cylinder surfaces, in which devices the frame of the device is supported to the cylindrical inner surface and a suitable grinding means is rotated on the frame. This kind of devices are known from the following documents: US 5111623, US 4327526, DE-A1-3446055 and FI-C-92563. However, the prior art devices have been developed for grinding cylindrical surfaces with open ends, e.g. grinding of the inner surface of a tube or like.

[0007] The applicant is not aware of such a device which would suit well for grinding the inner surface of a tank with closed ends. A prerequisite for this kind of device is that it may be rapidly installed in a tank through a manhole and that the tank may be ground essentially completely by means of the device. With conditioning by grinding, it is also important that as regular and uniform grinding finish is achieved, which is very difficult by grinding by hand or with normal aids.

[0008] An object of the invention is to present a device by which the grinding of the inner surface of a chemical tank may be started quickly and carried out rapidly and as completely as possible and by which a preferable grinding finish in view of keeping the surface clean is achieved.

SUMMARY OF THE INVENTION

[0009] For achieving these objects, the invention provides a device for conditioning the inner surface of a chemical tank by grinding as defined in claim 1. The dependent claims concern preferred embodiments of the invention.

[0010] The device according to the invention consists of only a few parts which may brought into a tank through a manhole. Mounting and dismounting of the device may be accomplished quickly. In a preferred ambodiment, the device according to the invention is provided with a programmable control so that it carries out the grinding steps inside a tank automatically, and the operation may be controlled from outside of the tank.

[0011] The device is compact, and thereby essentially the whole, also the ends, of the inner surface may be ground. A regular and uniform grinding finish may be achieved throughout the surface, the grinding finish having generally the direction of the cross-section of a tank. A suitable roughness of a ground surface may be of the order of 0.8 Ra or of the order of 0.3 Ra, for example.

[0012] At present, special attention is directed to the condition of the equipment used for storage and transport of chemicals. By means of the device according to the invention conditioning of the tanks may be carried out quickly and efficiently. Conditioning may be done after normal careful washing of a tank. The device makes easier to maintain classification of tanks. In comparison with chemical conditioning methods, the environmental drawbacks are small.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The invention and some embodiments thereof are described in further detail in the following with reference to the accompanying drawings, in which:

Fig. 1 presents a schematical front view of an embodiment of the device according to the invention;
Fig. 2 presents a side view of the device of Fig. 1 and shows schematically a possible way of carrying

out grinding with the device;

Fig. 3 presents schematically a grinding finish produced by a device according to the invention;

Fig. 4 presents a schematical front view of another embodiment of the device according to the invention;

Fig. 5 illustrates installation of the device according to the invention into a chemical tank to be conditioned; and

Fig. 6 illustrates accomplishment of grinding work with the device according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] The device of Figs. 1 and 2 is meant for cleaning and conditioning horizontal tanks, like transport tanks. In the centre of the device 4 there is a frame 5 from which telescopically adjustable legs 6, 7 and 6', 7' with the angle of 120 degrees therebetween extend. The frame and legs form a three-branched structure supporting itself on the wall 2 of the tank which structure may be set and adjusted so that the hub 12 of the structure stays on the central axis A1 of the cylindrical tank. The legs directed upwards in the figure include actuators 8 by means of which the legs may be shortened or lengthened as indicated by arrows L1 and L2 and pressed against the wall 2 of the tank 1. The third leg directed downwards is set to a proper length according to the radius of the tank. A roller is attached at the end of each leg, respectively, the rolling direction being the longitudinal direction (arrow R3 in Fig. 2). The rollers are rotated by corresponding drivers 10. The driver may be a squirrel-cage motor coupled to the roller by means of a chain with suitable transmission ratio, for example.

[0015] An arm 11 is connected pivotally, as indicated by arrow R1, to the hub 12 of the structure, grinding means 14 being attached at the end of the beam in such a way that a grinding wheel 15 is rotating in the direction of the tank's cross-section against the inner surface 3 of the tank. The arm 11 of the grinding means is driven by an actuator 13.

[0016] Fig. 2 illustrates at the same time an embodiment of the method of the invention. The grinding is carried out slice by slice or strip by strip, the slices or strips being indicated by broken line in Fig. 2. For achieving a uniform grinding finish, the grinding is carried out by means of a grinding wheel with a width of 4 centimeters, for example, so that the device is moved 2 centimeters at a time, whereby each point is ground twice. At the position of the device 4 indicated by broken line, strips n and n+1 are ground. Next, after moving the device, strips n+1 and n+2 are to be ground, and so on. At the position of the device 4 indicated by solid line, nineteen steps forward have been taken and strips n+19 and n+20 are now ground. The device is moved at a next strip to be ground by controlling rollers 9. The device is stopped at a strip which is then ground by rotating the grinding device around in a cross-sectional plane of the tank with a suitable speed. The grinding wheel is rotating in a cross-sectional plane. Working speed (rotating speed of the grinding wheel), rotating speed of the grinding wheel and grinding pressure are adjusted so that adequate grinding and good grinding finish are achieved by one run. As the quality of a surface to be conditioned may vary, values of these parameters possibly must be adjusted during grinding.

[0017] Fig. 3 presents a wall 3 the grinding of which is carried out from left to right. The ground strips and strips to be ground are indicated by broken line. The hatch on the ground strips 16i to 16q of the conditioned surface 3' at the left illustrates grinding finish. The grinding is going on at 17 to the direction of arrow M1. The second grinding of strip 16p and the first grinding of strip 16q are concerned. With the method of the invention, a ground surface is achieved in which the grinding finish is throughout regular and uniform and has the direction of the cross-section of the tank. In many cases, a suitable roughness of a conditioned surface is of the order of 0.8 Ra. The grinding may be made also to roughness value 0.3 Ra or even finer.

[0018] By a device according to Figs. 1 and 2, chemical transport tanks have been ground using a urethane body silicon carbide grinding wheel with the diameter of 150 millimeters and thickness, i.e. width of a strip to be ground, of 50 millimeters.

[0019] The device is advantageously easy to mount and dismount so that it may be brought as parts into a tank through a conventional manhole (e.g. with a diameter of 400 millimeters). For example, the parts may be: the frame, three legs with accessories and grinding unit. Advantageously, the device is also provided with a programmable control (not shown in Figs. 1 and 2) by means of which it may be got to carry out grinding automatically. Controlling is done from outside of a tank.

[0020] Figs. 4 and 5 present a further developed embodiment of the device according to the invention and installation of the device through a manhole 53 into a tank 1 to be conditioned. The device is brought into the tank as three parts which are: the leg 26 to be set against the bottom of the tank, the frame part 19 including also the other two legs, and the grinding unit 33 including the grinding arm 34 and the proper grinding device 40. Fig. 5 illustrates the installation of the device at the stage in which the support leg 26 is brought into the tank and the introduction of the frame part 19 through the manhole into the tank by means of a chain 52 connected to a crane is going on. The grinding unit 33 is still waiting outside the tank. The control unit 50 stays outside the tank, and necessary electric and pneumatic lines 51 are connected to the device in the tank.

[0021] The support leg 26 may be adjusted to a suitable length as indicated by arrow L so that the axle 32 of the device is placed at the centre of the tank. Therefore, the leg 26 is already provided with a scale according to the radius of a tank. The leg is provided with a linear guide arrangement, by means of which the part 30 is sliding telescopically in the body of the leg, and for locking e.g.

locking shoes are used by means of levers 31. At the upper end of the leg 26 there is a socket part 28 adapted to receive a corresponding part of the frame 19. For attachment, the frame includes threaded holes and the socket part of the leg includes screws 29 provided with levers for quick fastening.

[0022] Inside the branches 20a and 20b of the frame there are pneumatic cylinders, respectively, the rods 22 of which are visible in Fig. 4. Inside the frame, the cylinders are suspended to a base which is moved by a linear actuator. The parts 21 of support legs are moved by the linear actuators as indicated by arrows S and the rollers 23 are brought against the wall 3 of the tank. By means of the pneumatics, a suitable pressure P is directed to the rollers 23. The rollers 23 are made of a material providing good grip. Each roller 23 is driven by a corresponding e.g. pulse controlled electric motor 24 which is coupled to the roller with suitable gear and transmission means 25.

[0023] The grinding arm 34 is attached by member 36 at the end of the axle 32. These parts are provided with corresponding quick-locking members by means of which firm and reliable fastening is obtained (conventional technique which is not described here in detail). The arm is rotated as indicated by arrow R (Fig. 4) by an electric motor 54 located at the other side of the frame (Fig. 6). Connections of the electric and pneumatic lines (connectors 39) to the arm and other parts of the device restrict rotation so that it is limited to 1.5 to 3 turns depending on the solution used for connections. Inside the arm there are a conventional guide and screw which are indicated by reference sign 35 but are not described here in further detail. The grinding device 40 is by means of the arm 42 coupled with an as well conventional mechanism 41 to be moved on the screw and guide. The screw is driven by an electric motor 37 placed at the other end of the arm 34 by means of suitable transmission means 38, e.g. a chain.

[0024] The grinding wheel 46 is rotated by a controlled electric motor 44, and the pressure with which it is set against the wall is determined by a controlled pneumatic cylinder 45. The pneumatics are provided with a feedback in which the current of the motor is measured and the pressure is adjusted accordingly.

[0025] Fig. 6 presents a side view of the accomplishment of grinding with the device of Figs. 4 and 5. The branch 20b of the frame is presented in section. The device is set perpendicular to the axis of a tank on the legs and rollers 23. With each step, each roller is driven the same distance forward or backward. The device is provided with a detector which is reset during installation (a tank may be in an inclined position) and which detects tilting of the device from the initial position thereof and switces the device automatically off if the tilting for any reason goes over a certain limit.

[0026] Fig. 6 illustrates quite well how small a longitudinal space the device needs in operation and how the jacket up to the ends and also the end surfaces can be ground. At the left in Fig. 6, the device is grinding in the way described above with reference to Fig. 2, for example. The grinding device 40 is on the arm 42 and joint 43 in the straight position, and the axis of the grinding wheel 46 is parallel to the axis of the tank. In the middle in Fig. 6, the grinding is advanced close to the end 55 of the tank. The grinding device is rotated at the joint 43 so that the axis of the grinding wheel is directed crosswise in relation to the axis of the tank, and at the same time the grinding device is tilted at the joint so that the end surface can be ground. At the right in the figure, the grinding of the end surface is advanced closer to the centre thereof and the grinding device is tilted more so that it extends approximately perpendicularly to the surface. Therefore, suitable parameter values must be set separately for the end surface grinding and often it is also prefereable to use another type of grinding wheel than with grinding the jacket. The grinding device may be turned to this position also during grinding the jacket.

[0027] The term "roller" means here a roller, wheel or corresponding device which may be installed at the end of a support leg and be provided with a controlled actuator.

[0028] The invention may vary within the scope of the accompanying claims.

Claims

1. A device for conditioning the inner surface of a chemical tank by grinding, which device includes:

a frame;
means for supporting the frame on the wall of the tank (1);
rotatable grinding means attached to the frame; and
means for moving the device along the jacket (2, 3) of the tank (1); wherein said means for supporting the frame (5, 19) and means for moving the device essentially consist of three support legs (6, 7; 6', 7'; 26, 30; 20a, 21; 20b, 21) at the end of which a roller (9; 23) is attached, which is provided with a controlled motor drive (10; 24, 25) for moving the device according to control;

characterized in that at the centre of the frame there is an axle (32) for attachment and rotation of grinding means (33), and that the grinding means are attached to the axle extending from the frame in close vicinity to the frame; and
that the grinding means include an arm (34) attached to said axle (32) and a grinding device (40) movable longitudinally on the arm.

2. A device according to claim 1, **characterized in that** the frame and the supporting and moving means are

divided to a few parts for quick mounting and dismounting of the device and the parts are accomplished to go into a chemical tank through a conventional manhole.

3. A device according to claim 2, **characterized in that** the frame and the supporting and moving means are divided to two parts one including one support leg with the accessories (26) and the other including the frame and the other two supporting legs with the accessories (19, 20, 21, 22, 23, 24, 25, 32, 54).

4. A device according to claim 1, **characterized in that** the motor (54) for rotating the grinding means is attached at the opposite side of the frame (19) in relation to the grinding means (33).

5. A device according to claim 1, **characterized in that** the grinding device (40) is provided with an attachment (23) pivotal around an axis parallel to the arm (34).

6. A device according to claim 1, **characterized in that** the grinding device (40) is provided with an attachment (23) pivotal around an axis transverse to the arm (34).

Patentansprüche

1. Eine Vorrichtung zur Behandlung der Innenfläche eines Chemikalientanks dutrch Schleifen, wobei die Vorrichtung folgendes umfasst:

    - einen Rahmen,
    - Mittel zur Halterung des Rahmens an der Wand des Tanks (1),
    - Am Rahmen befestigte drehbare Schleifmittel, und
    - Mittel zur Bewegung der Vorrichtung entlang dem Mantel (2, 3) des Tanks (1),

    worin die besagten Mittel zur Halterung des Rahmens (5, 19) und Mittel zur Bewegung der Vorrichtung aus im wesentlichen drei Halterungsbeinen (6, 7; 6', 7'; 26, 30; 20a, 21; 20b, 21) bestehen, an deren Enden eine Rolle (9; 23) befestigt ist, die mit einem gesteuerten Motorantrieb (10; 24, 25) zur Bewegung der Vorrichtung entsprechend der Steuerung versehen ist;
    dadurch gekennzeichnet, dass sich im Zentrum des Rahmens eine Welle (32) zur Befestigung und Drehung von Schleifmitteln (33) befindet und dass die Schleifmittel an der sich vom Rahmen in die Nachbarschaft des Rahmens erstreckenden Welle befestigt sind, und dass die Schleifmittel einen an der besagten Welle (32) befestigten Arm (34) und eine in Längsrichtung auf dem Arm bewegliche Schleifvorrichtung (40) umfassen.

2. Eine Vorrichtung nach Patentanspruch 1, **dadurch gekennzeichnet, dass** der Rahmen und die Halterungs - und Bewegungsmittel zur schnellen Montierung und Demontierung der Vorrichtung in wenige Teile unterteilt sind, und dass die Teile so ausgeführt sind, dass sie in den Chemikalientank durch ein herkömmliches Einsteigloch eingeführt werden können.

3. Eine Vorrichtung nach Patentanspruch 2, **dadurch gekennzeichnet, dass** der Rahmen und die Halterungs- und Bewegungsmittel in zwei Teile unterteilt sind, wobei eines ein Halterungsbein mit Zubehör (26) und das andere zwei Halterungsbeine mit Zubehör (19, 20, 21, 22, 23, 24, 25, 32, 54) umfasst.

4. Eine Vorrichtung nach Patentanspruch 1, **dadurch gekennzeichnet, dass** der Motor (54) zum Drehen der Schleifmittel an der in Bezug auf die Schleifmittel (33) entgegengestzten Seite des Rahmens (19) befestigt ist.

5. Eine Vorrichtung nach Patentanspruch 1, **dadurch gekennzeichnet, dass** die Schleifvorrichtung (40) mit einer Befestigung (23) versehen ist, die um eine Welle drehbar ist, die parallel zum Arm (34) verläuft.

6. Eine Vorrichtung nach Patentanspruch 1, **dadurch gekennzeichnet, dass** die Schleifvorrichtung (40) mit einer Befestigung (23) versehen ist, die um eine Welle drehbar ist, die quer zum Arm (34) verläuft.

Revendications

1. Un dispositif pour le traitement de la surface intérieure d'un réservoir pour produits chimiques par ponçage, lequel dispositif comprend :

    un cadre ;
    des moyens pour soutenir le cadre au mur du réservoir (1) :

        des moyens de ponçage susceptibles de tourner fixés au cadre ; et
        des moyens pour bouger le dispositif le long de l'enveloppe (2,3) du réservoir (3) ; lesdits moyens pour soutenir le cadre (5, 19) et les moyens pour déplacer le dispositif étant constitués essentiellement de trois jambes de support (6,7 ; 6', 7' ; 26, 30 ; 20a, 21 ; 20b, 21) à l'extrémité desquelles jambes on a fixé un rouleau (9 ; 23) pourvu d'un entraînement à moteur commandé (10 ; 24, 25) pour déplacer le dispositif selon les commandes, **caractérisé en ce qu'**au centre du cadre il existe un axe (32) pour la

fixation et la rotation des moyens de ponçage (33), et **en ce que** les moyens de ponçage sont fixés à l'axe s'étendant à partir du cadre tout près du cadre ; et **en ce que** les moyens de ponçage comprennent un bras (34) fixé audit axe (32) et un dispositif de ponçage (40) susceptible d'être bougé de façon longitudinale sur le bras.

2. Un dispositif selon la revendication 1, **caractérisé en ce que** le cadre et les moyens de soutien et de déplacement sont divisés en deux parties pour un montage et un démontage rapide du dispositif et les parties sont réalisées afin de s'insérer dans un tank chimique à travers un trou d'entrée conventionnel.

3. Un dispositif selon la revendication 2, **caractérisé en ce que** le cadre et les moyens de soutien et de déplacement sont divisés en deux parties, l'une comprenant une jambe de soutien avec les accessoires (26) et l'autre comprenant le cadre et les deux autres jambes de soutien avec les accessoires (19, 20, 21, 22, 23, 24, 25, 32, 54).

4. Un dispositif selon la revendication 1, **caractérisé en ce que** le moteur (54) destiné à tourner les moyens de ponçage est fixé sur le côté opposé du cadre (19) par rapport aux moyens de ponçage (33).

5. Un dispositif selon la revendication 1, **caractérisé en ce que** le dispositif (40) de ponçage est pourvu d'une fixation (23) pivotant autour d'un axe parallèle au bras (34).

6. Un dispositif selon la revendication 1, **caractérisé en ce que** le dispositif de ponçage (40) est pourvu d'une fixation (23) pivotant autour d'un axe transversal au bras (34).

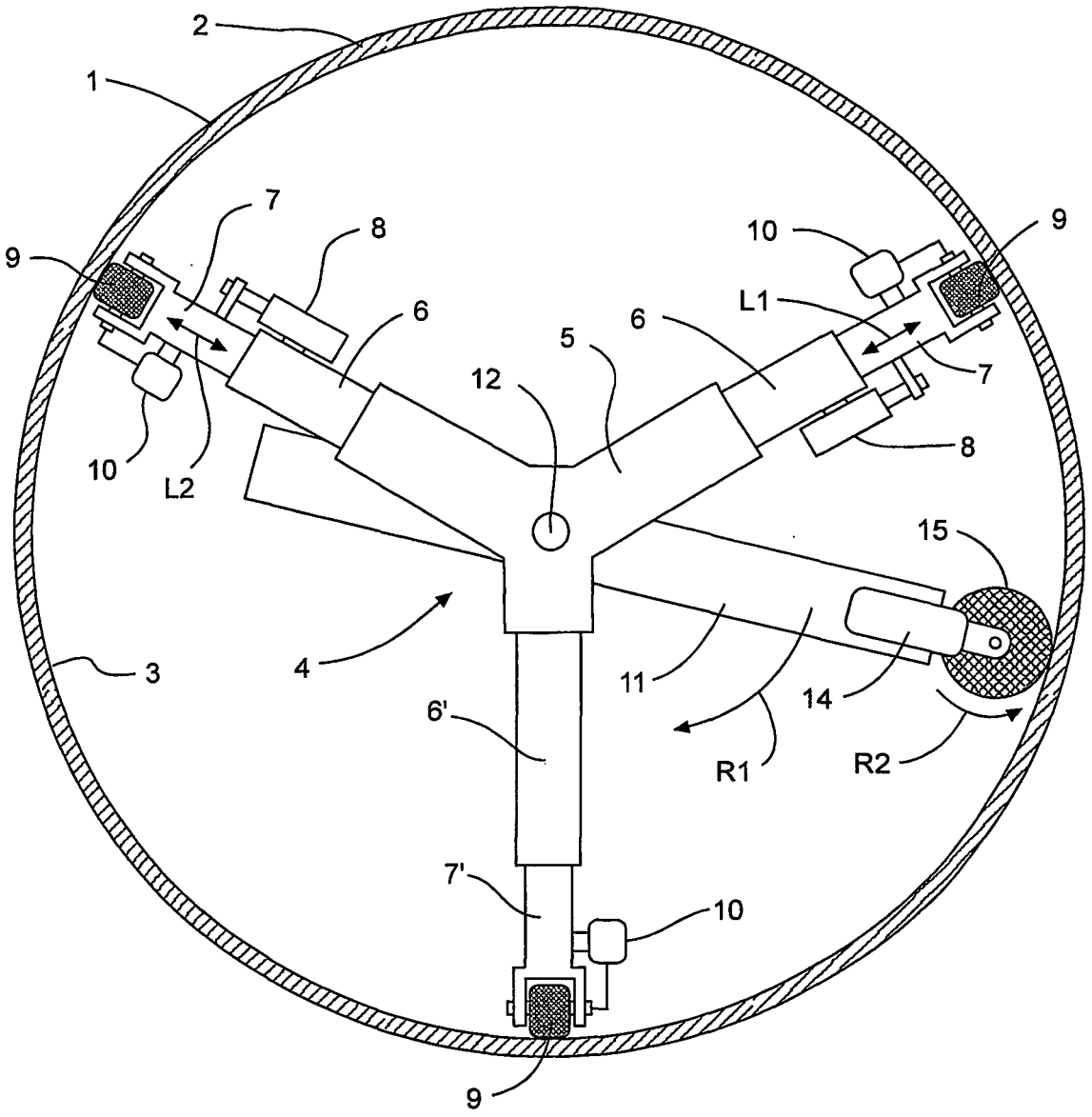
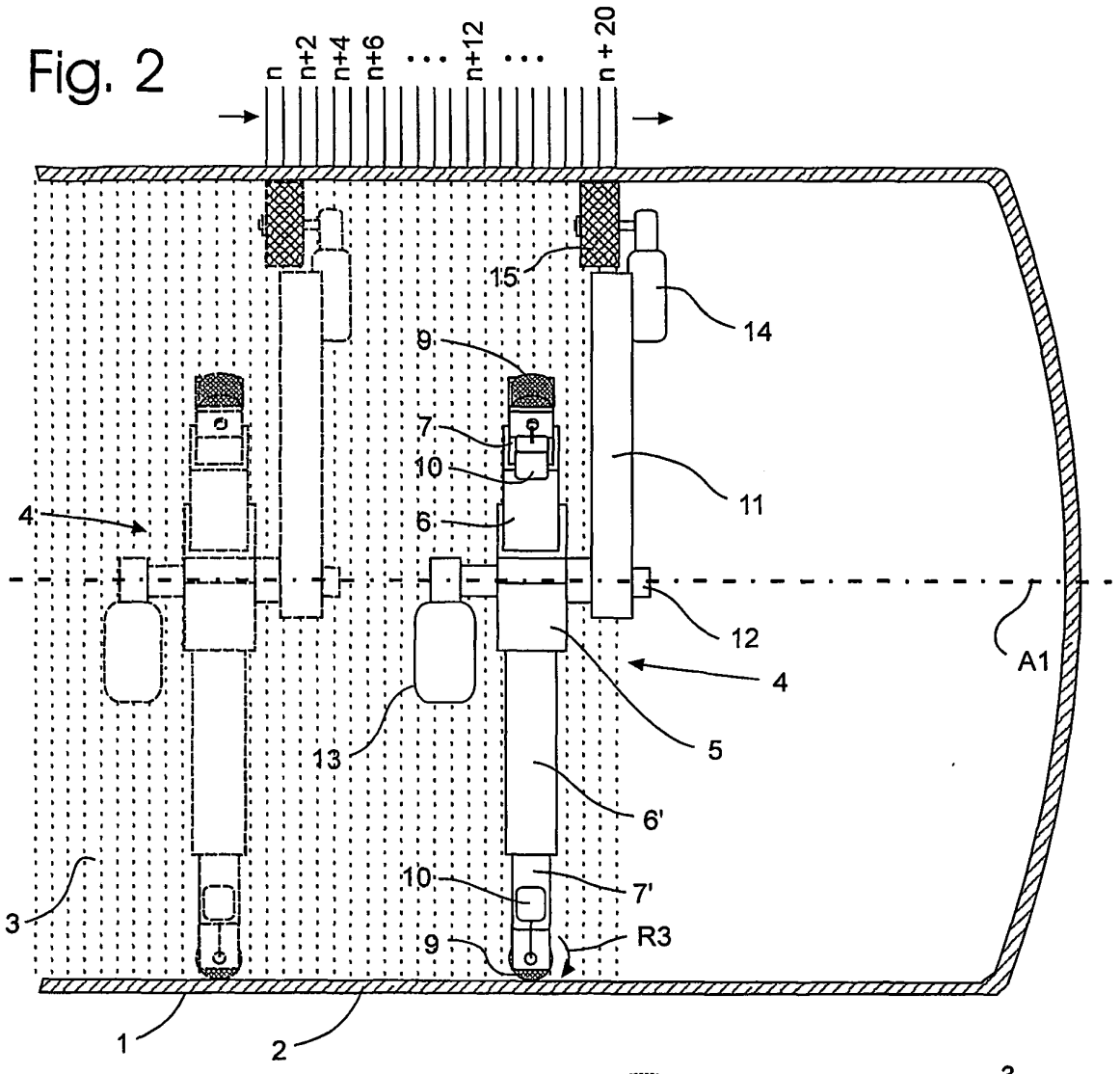


Fig. 1

Fig. 2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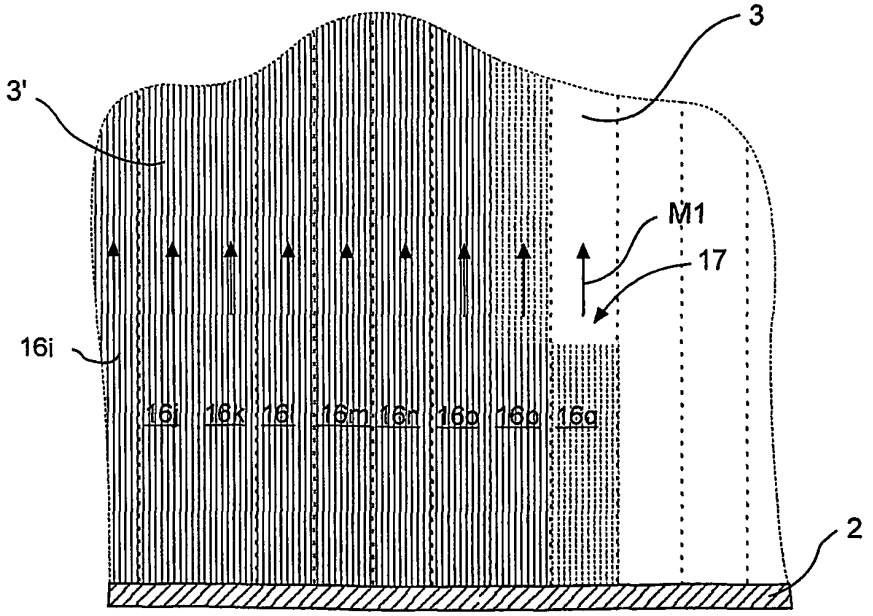
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Fig. 3

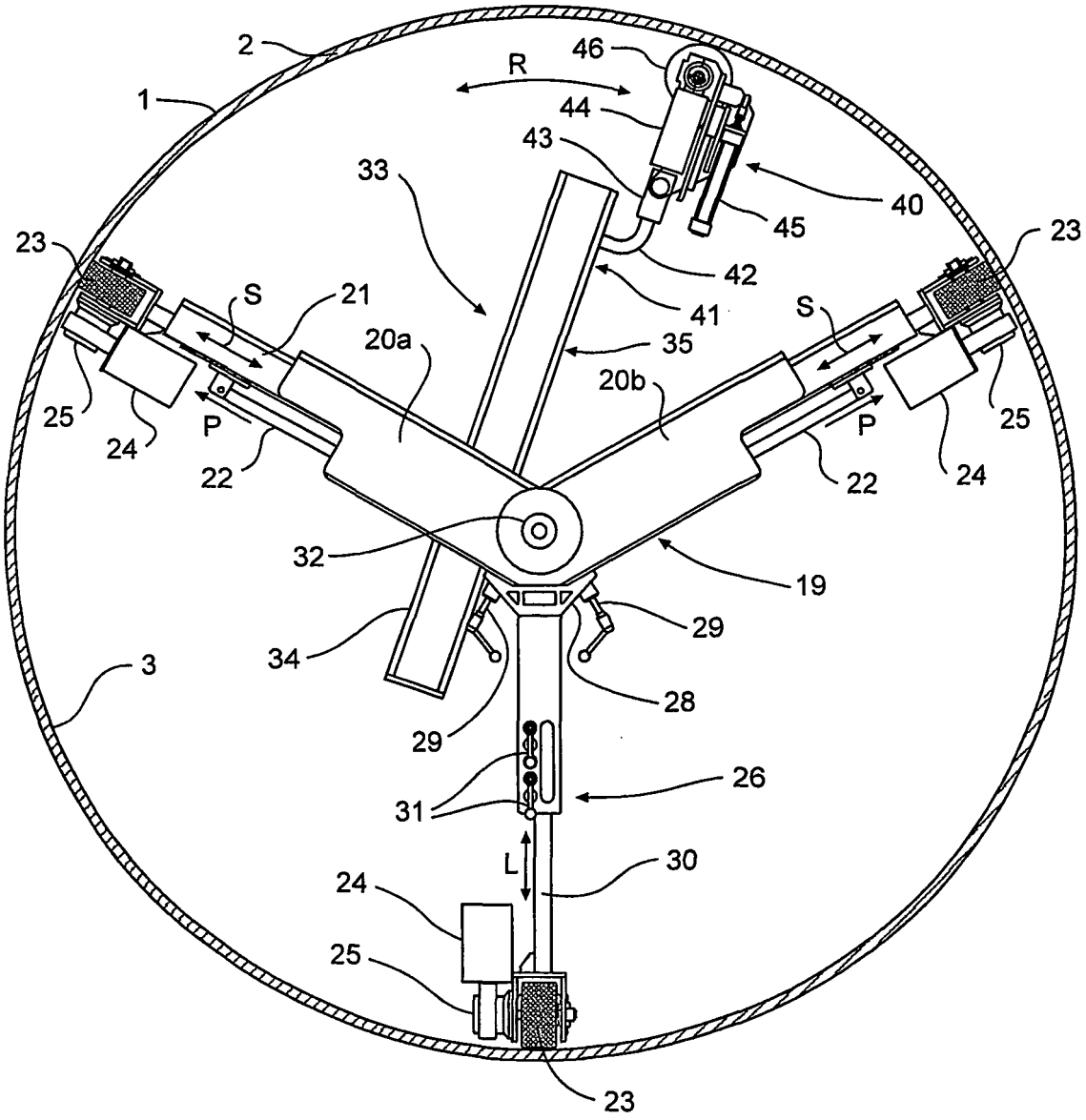
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Fig. 4

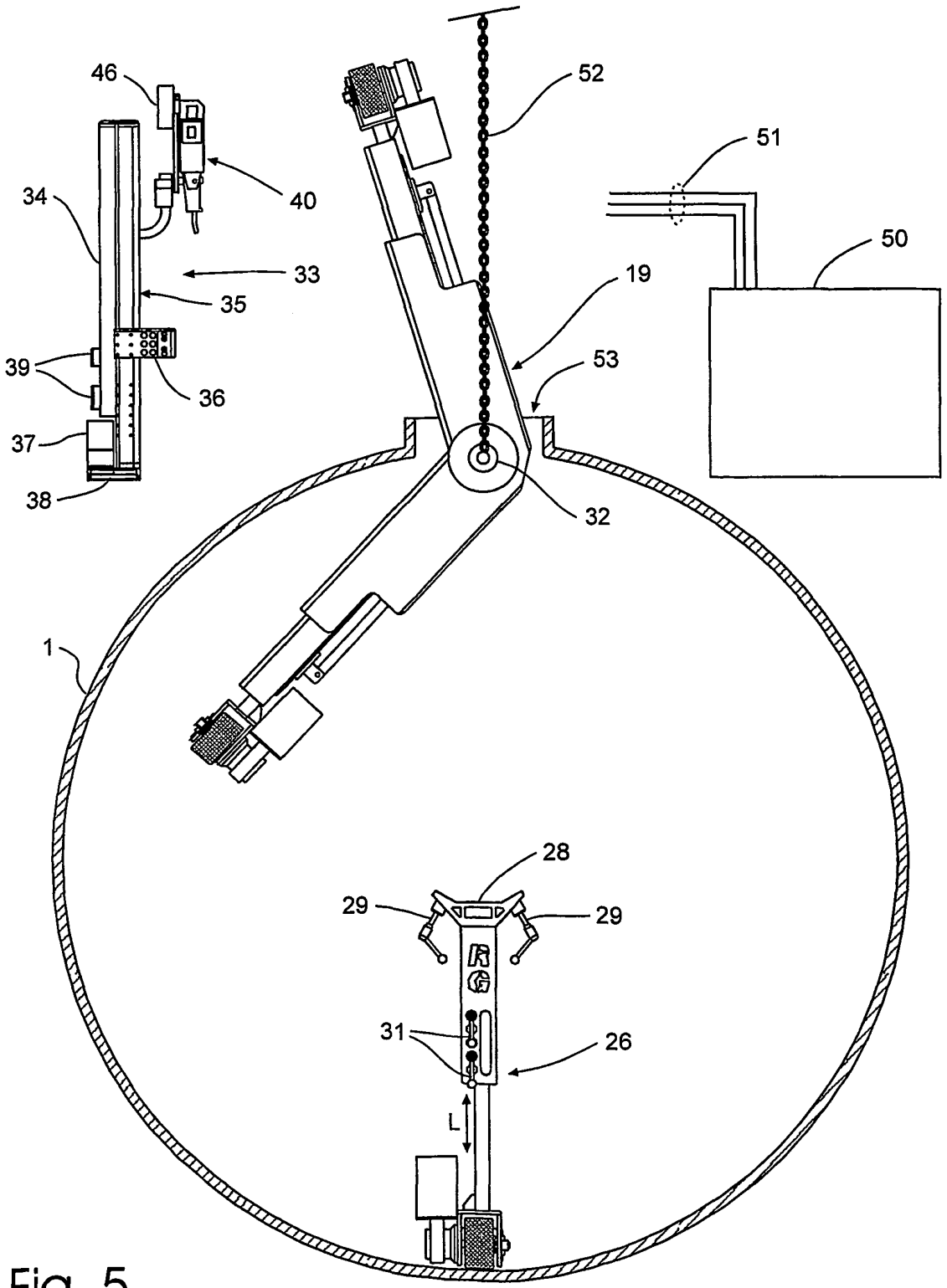
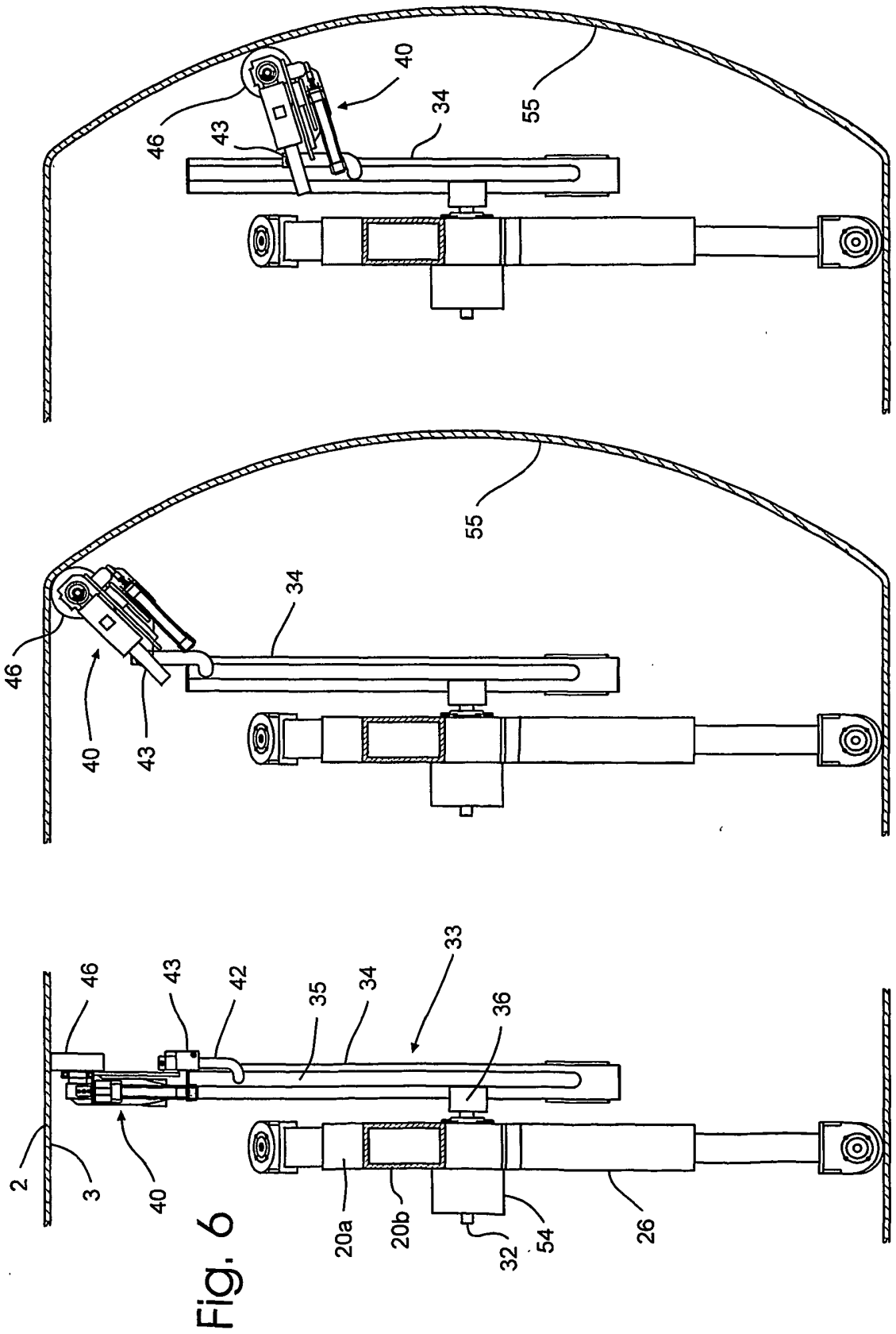


Fig. 5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20b
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Fig. 6