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(54) METHOD AND ARRANGEMENT FOR ATTACHING A TOWER-LIKE STRUCTURE TO A FOUNDATION

VERFAHREN UND ANORDNUNG ZUM ANBRINGEN EINES TURMARTIGEN AUFBAUS AN EINEM FUNDAMENT

PROCÉDÉ ET AGENCEMENT POUR ATTACHER UNE STRUCTURE EN FORME DE TOUR À UNE FONDATION

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Description

[0001] The invention relates to a method for attaching a tower-like structure to a foundation, in which method a circular element is anchored to the concrete forming the foundation. The invention also relates to an arrangement for attaching a tower-like structure to a foundation.

[0002] Currently, tower-like structures are used in connection with a large variety of structures. As examples of structures, in connection with which tower-like structures are used, mention can be made of wind power plants, antenna masts, different kinds of mast structures used in radio and telephone technology, different kinds of columns, for example, in connection with the structures of bridge and electric transfer, etc. Such tower-like structures are usually produced from metal, for example, from steel, and they are joined to a foundation produced from reinforced concrete.

[0003] A typical solution according to known art is to form a flange at the bottom end of a tower-like structure. The flange has normally through holes, into which anchoring bolts are fitted. At the heads of the anchoring bolts are fitted nuts, with which the flange and, along with it, the tower-like structure is attached to the anchoring bolts. The anchoring bolts are generally attached to a circular anchoring element, which is fitted inside the concrete. The concrete surface of the foundation is often rough, so on the surface in question is normally fitted a soldering surface, on top of which the flange is fitted.

[0004] However, the disadvantage of the arrangement described above is that the base of the tower-like structure must be fitted onto the solder layer before the final curing of the solders. After installing the base of the tower-like structure, it is necessary to wait a given period of time, which is dependent on curing of the solder, before the next elements of the tower-like structure can be installed. Curing of the solder typically takes about a day. However, it must be noted that, under some conditions, curing of the solder may require even a considerably greater time. While the solder is curing, the installation work of the tower-like structure cannot be continued.

[0005] The base of the tower-like structure, i.e. that part, which is against the foundation, is often relatively large and heavy. For example, the base of the tower of a wind power plant can be approx. 10-20 m long. Thus, the part in question is transported in the horizontal position and, typically, two cranes are required to lift the part into the vertical position and fit it onto the solder. The cranes used in the installation are typically mobile cranes, which as such are very expensive and their operating costs are also high. Nonetheless, there is no use for the cranes while the solder is curing, and because use of the cranes is expensive, it is not desirable to leave them standing idle. As a whole, the situation is difficult, as installation sites of tower-like structures, for example, installation sites of wind power plants, are very often far from other settled areas. Thus, transporting the cranes in the meantime to other work is also expensive. Thus, in practise, the cranes quite often stand idle for that time while the solder cures, even though the costs of the waiting period are quite high.

[0006] Relating to the basic principle briefly described above, in the field different types of additional solutions have been developed.

[0007] As an example of such additional applications of basic technique mention can be made of the solution described in EP 1 849 920 A2. In above said known solution is described a type of middle section or adapter, which is fitted between the foundation and the base of the tower-like structure. Above said adapter is a relatively small part, so it can be transported in the vertical position to the installation site and lifted onto the solder formed on the foundation using one small crane.

[0008] The advantage of the solution according to EP 1 849 920 A2 is that the installation stage is managed using one crane that is smaller than previously required, wherein the costs from operation time and downtime can be decreased in comparison to the corresponding costs created by two larger cranes.

[0009] However, the problem with the solution according to EP 1 849 920 A2 is that the adapter described is quite an expensive solution. The structure is a uniform forged or welded structure, wherein the production costs are significantly high. Additionally, it must be noted that, for example, welding a web on the surface of a T-flange is a great risk factor, especially in dynamically loaded joints. The problem with the flange is further that it widens the structure, which, in turn, complicates transportation. In this connection, it must be noted that the structures to be transported are already over-wide, wherein even a slight increase in the width of the structure may create serious practical problems, which can lead, for example, to the use of long detour routes during transportation. However, although the adapter can, in principle, be smaller than the base of the tower-like structure, the reality is that the adapter is also a quite heavy element. The weight of the adapter can easily rise to the range of 10-20 tons, so that moving the adapter, in any event, requires special arrangements, which will create costs. The factor presented above is due to the fact that the adapter is installed on the worksite in connection with foundation casting, wherein there is normally not adequately heavy lifting equipment on the worksite. Thus, for the purpose of handling the adapter, it becomes necessary, in any event, to bring to the worksite an adequately heavy-duty crane, which increases total worksite costs. A similar solution is also known from US2009/044482A1, whereby fixing bolts of the adapter flange are liftable using nuts. The problem is that while installing the described adapter a separate installation frame is always required.

[0010] The object of the invention is to provide a solution, with which the disadvantages of prior known art are eliminated. This is achieved with a method according to claim 1 and an arrangement according to claim 4. An advantage of the invention is that welding joints are not used at all, wherein the disadvantages of known art cre-

ated by welding joints are eliminated. The advantage of the invention is further that the solution can be implemented from separate parts, wherein the parts can be delivered as a normal shipment. The weight of the parts to be lifted, in this case, forms as relatively small. The weights for the parts are in the range of 1-4 tons and for the whole 4-12 tons. An advantage is also that a solution according to the invention is attached with a joint formed by an ordinary P-flange. In addition, the advantage of the invention is that, in connection with installation, no installation frame is required, as the structure can also be used as an installation frame.

[0011] In the following, the invention is described in greater detail by means of an exemplary embodiment depicted in the accompanying drawings, wherein

Fig. 1 shows an arrangement according to the invention viewed from above in cross-section,
Fig. 2 shows an arrangement according to the invention as a perspective view,
Fig. 3 shows an arrangement according to the invention as a principle cross-section viewed from the side when installed on the foundation and
Fig. 4 shows a detail of Fig. 3 viewed on a larger scale.

[0012] Figs. 1-4 show in principle an exemplary embodiment of an arrangement according to the invention.

[0013] In the figures, the foundation is marked by reference number 1. The foundation is formed from concrete having steel reinforcements. By reference number 2 is marked the circular element, which is anchored to the foundation 1. Anchoring can take place, for example, with anchoring bolts 4 and the circular anchoring element 3. The circular anchoring element 3 is placed in the foundation such that it remains inside the concrete. The circular element 2 is fitted on the surface of the foundation 1 such that the circular element 2 remains partially inside the concrete. The circular element 2 can be formed from one or several parts.

[0014] The lowest part 7 of the tower-like structure is attached by a screw connection 5 to the circular element. In the example of the figures, the circular element 2 is produced from a sheet-like material. The circular element 2 can, naturally, be produced also from another kind of material, for example, from a square-profile shaped material. It is essential that above the upper surface of the concrete is formed an even surface for attachment of the lowest part of the tower-like structure, as is shown in the figures. Above said facts are clearly visible in Fig. 3.

[0015] In the example of the figures, the lowest part 7 of the tower-like structure is attached to the circular element 2 by an interior flange connection (P-flange). The interior flange connection is shown by reference number 6.

[0016] In the example of the figures, the lowest part 7 of the tower-like structure is preferably a part having a circular-cylindrical shape. However, the invention is in no way limited to a circular-cylindrical shape, rather the shape of the lowest part 7 of the tower-like structure can vary in accordance with each respective need, i.e. the cross-section of the tower part of the tower-like structure to be built can also be other than round. The foundation 1 is, naturally, fitted to be supported by the soil.

[0017] In the figures is shown only the lowest part of the tower-like structure. The tower-like structure is formed in a normal manner by installing the parts of the tower-like structure on top of each other and attaching the parts together successively at their ends.

[0018] As stated above, the circular element is fitted on the surface of the foundation 1 such that the circular element remains partially inside the concrete of the foundation 1, wherein the upper surface of the circular element 2 remains slightly above the upper surface of the concrete. Above said fact is clearly visible in Fig. 3. The upper surface of the circular element 2 remains visible on the upper surface of the concrete, wherein the lowest part 7 of the tower-like structure can be attached to it. The circular element 2 is arranged partially inside the concrete of the foundation such that the circular element 2 is anchored to the foundation with anchoring bolts 4. The anchoring bolts 4 come through the circular element 2 and are tightened with nuts on the upper surface of the circular element 2 or in its vicinity. Thus, at the upper end of the anchoring bolts 4, there is a circular element 2, through which the anchoring bolts 4 go and above which circular element 2 the anchoring bolts 4 are attached with nuts or other corresponding attachment organs. At the bottom end of the anchoring bolts 4, there is preferably a circular anchoring element 3, which is preferably completely within the foundation. Thus, the circular element 2 can be anchored to the foundation with the anchoring bolts 4.

[0019] Thus, the arrangement according to the invention is installed in place during the stage of reinforcing the foundation, wherein, after casting the concrete, the circular element 2 is on the surface of the concrete partially inside the concrete, as is shown in Fig. 3.

[0020] Due to the screw connection, the parts of the arrangement can be transported to the installation site as separate parts, wherein transportation is significantly easier than using prior known art. A solution according to the invention is also cost-effective and technically inexpensive, as the expensive structures produced by forging, used in prior known art, are not used and the problems of welding joints are also eliminated.

[0021] The holes 8 in the circular element 2 for the anchoring bolts 4 are through holes. The holes 8 are visible in Fig. 4. Tightening of the anchoring bolts takes place by turning the nuts on the ends of the anchoring rods. The nuts 9 are visible in Fig. 4. The holes 10 of the screw connection 5 in the circular element 2 are, in turn, threaded holes.

[0022] An arrangement according to the invention, more specifically stated, the circular element 2 can also be used as an installation frame. The element in question

is cast in the concrete, as presented above.

[0023] If above said circular element is, after casting, at the correct position and height, then nothing need be done to the structure, rather the installation work of the tower-like structure may continue.

[0024] If above said circular element is, in turn, at the wrong height, for example, skewed and/or at the wrong height, then, in that case, the screws are turned the required amount into the inner screw holes 10 of the screw connection. The screws are turned through the circular element 2 such that they press against the surface of the concrete. In this case, the circular element 2 begins to rise under the influence of the force created by the screws and rises to the correct position and/or height. Next, the gap created between the concrete and the circular element 2 is soldered shut. After the solder has cured, the structure transfers the compression directly from the circular element 2 to the concrete.

[0025] The lowest part 7 of the tower-like structure is tightened directly against the circular element 2 with the screws of the screw connection 5. In this case, the force transfers as compression directly from the tower-like structure to the circular element 2 and further to the concrete of the foundation 1. In a tensile situation, force is transferred through the screws of the screw connection 5 from the P-flange further to the circular element 2. The circular element is anchored to the concrete of the foundation with anchoring bolts, as is disclosed above.

[0026] The invention is, for example, not limited in any way to the forms and dimensions/proportions shown in the figures, rather the forms and dimensions/proportions of the different parts can vary according to each respective situation as defined in the appended claims.

Claims

1. A method for attaching a tower-like structure to a foundation (1), in which method a circular element is anchored to the concrete forming the foundation (1), the circular element (2) is fitted on the surface of the foundation (1) such that the circular element (2) remains partially inside the concrete such that the circular element (2) is anchored to the foundation with anchoring bolts (4), and that the lowest part (7) of the tower-like structure is attached by a screw connection (5) to the circular element (2), **characterized in that** the circular element (2) is placed to the correct position by turning screws in threaded holes (10) of the screw connection (5) to the required points, and the screws are tightened against the concrete surface to lift the circular element (2) from the surface of the concrete into the correct position, and the gap between the concrete and the circular element (2) is soldered shut, when the circular element (2) is in the correct position.

2. A method according to claim 1, **characterized in that** the circular element (2) is formed from one or several parts.

3. A method according to claim 1, **characterized in that** the lowest part (7) of the tower-like structure is attached to the circular element (2) by an internal flange connection (P-flange) (6).

4. An arrangement for attaching a tower-like structure to a foundation, which arrangement comprises a circular element, which is fitted to be anchored to the concrete forming the foundation (1), wherein the circular element (2) is fitted to be located partially inside the concrete of the foundation (1) such that the circular element (2) is to be anchored to the foundation (1) with the anchoring bolts (4), and that the circular element (2) is provided with means for providing a screw connection between the lowest part (7) of the tower-like structure and the circular element (2), **characterized in that** the means for providing a screw connection (5) comprise threaded holes (10) and screws, and the threaded holes (10) formed to the circular element for the screw connection are fitted to function as means, with which the circular element (2) can be moved into the correct position by turning said screws in the threaded holes (10) to the required points and tightening the screws against the surface of the concrete.

5. An arrangement according to claim 4, **characterized in that** circular element (2) is formed from one or several parts.

6. An arrangement according to claim 4, **characterized in that** means for providing a screw connection are fitted to enable a connection formed by means of an interior flange (P-flange) (6).

Patentansprüche

1. Verfahren zum Befestigen einer turmartigen Struktur an einem Fundament (1), wobei in diesem Verfahren ein kreisrundes Element am das Fundament (1) bildenden Beton verankert wird, das kreisrunde Element (2) an der Oberfläche des Fundaments (1) so montiert wird, dass das kreisrunde Element (2) teilweise im Beton verbleibt, so dass das kreisrunde Element (2) mit Ankerschrauben (4) im Fundament verankert wird, und dass der unterste Teil (7) der turmartigen Struktur durch eine Schraubverbindung (5) am kreisrunden Element (2) befestigt wird, **dadurch gekennzeichnet, dass** das kreisrunde Element (2) in die korrekte Position gebracht wird, indem Schrauben in Gewindelöchern (10) der Schraubverbindung (5) zu den erforderlichen Punkten gedreht werden, und die Schrauben gegen die Betonoberfläche festgezogen werden, um das kreis-

runde Element (2) ausgehend von der Oberfläche des Betons in die korrekte Position zu heben, und der Zwischenraum zwischen dem Beton und dem kreisrunden Element (2) zugelötet wird, wenn das kreisrunde Element (2) in der korrekten Position ist.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das kreisrunde Element (2) aus einem oder mehreren Teilen gebildet ist.

3. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** der unterste Teil (7) der turmartigen Struktur durch eine Innenflanschverbindung (P-Flansch) (6) am kreisrunden Element (2) befestigt wird.

4. Anordnung zum Befestigen einer turmartigen Struktur an einem Fundament, wobei die Anordnung ein kreisrundes Element umfasst, das so montiert wird, dass es am das Fundament (1) bildenden Beton verankert wird, wobei das kreisrunde Element (2) so montiert wird, dass es sich teilweise im Beton des Fundaments (1) befindet, so dass das kreisrunde Element (2) mit den Verankerungsbolzen (4) im Fundament (1) zu verankern ist, und dass das kreisrunde Element (2) mit Mitteln zum Bereitstellen einer Schraubverbindung zwischen dem untersten Teil (7) der turmartigen Struktur und dem kreisrunden Element (2) versehen ist, **dadurch gekennzeichnet, dass** die Mittel zum Bereitstellen einer Schraubverbindung (5) Gewindelöcher (10) und Schrauben umfassen und die am kreisrunden Element ausgebildeten Gewindelöcher (10) für die Schraubverbindung so montiert sind, dass sie als Mittel operieren, mit denen das kreisrunde Element (2) in die korrekte Position bewegt werden kann, indem die Schrauben in den Gewindelöchern (10) zu den erforderlichen Punkten gedreht werden und die Schrauben gegen die Oberfläche des Betons festgezogen werden.

5. Anordnung nach Anspruch 4, **dadurch gekennzeichnet, dass** das kreisrunde Element (2) aus einem oder mehreren Teilen gebildet ist.

6. Anordnung nach Anspruch 4, **dadurch gekennzeichnet, dass** die Mittel zum Bereitstellen einer Schraubverbindung so montiert sind, dass sie eine mittels eines Innenflansches (P-Flansches) (6) gebildete Verbindung ermöglichen.

Revendications

1. Procédé de fixation d'une structure assimilable à une tour sur une fondation (1), dans lequel un élément circulaire est ancré sur le béton formant la fondation (1), ledit élément circulaire (2) étant monté sur la surface de la fondation (1) de manière que l'élément circulaire (2) reste partiellement dans le béton de sorte que l'élément circulaire (2) soit ancré sur la fondation avec des boulons d'ancrage (4) et que la partie la plus basse (7) de la structure assimilable à une tour soit fixée à l'élément circulaire (2) par un raccordement vissé (5), **caractérisé en ce que** l'on place l'élément circulaire (2) dans la position correcte en tournant des vis jusqu'aux points requis dans des trous taraudés (10) du raccordement vissé (5), et que les vis sont serrées contre la surface du béton pour soulever l'élément circulaire (2) à partir de la surface du béton jusqu'à la position correcte, et l'espacement entre le béton et l'élément circulaire (2) est fermé à la brasure quand l'élément circulaire (2) est dans la position correcte.

2. Procédé selon la revendication 1, **caractérisé en ce que** l'élément circulaire (2) est fait d'une ou de plusieurs parties.

3. Procédé selon la revendication 1, **caractérisé en ce que** la partie la plus basse (7) de la structure assimilable à une tour est fixée à l'élément circulaire (2) par un raccordement à bride interne (bride P) (6).

4. Agencement pour fixer à une fondation une structure assimilable à une tour, ledit agencement comprenant un élément circulaire qui est monté de manière à être ancré dans le béton formant la fondation (1), ledit élément circulaire (2) étant monté de manière à être partiellement situé dans le béton de la fondation (1) de sorte que l'élément circulaire (2) soit destiné à être ancré à la fondation (1) avec les boulons d'ancrage (4), et que l'élément circulaire (2) soit pourvu de moyens destinés à prévoir un raccordement vissé entre la partie la plus basse (7) de la structure assimilable à une tour et l'élément circulaire (2), **caractérisé en ce que** les moyens destinés à prévoir un raccordement vissé (5) comprennent des trous taraudés (10) et des vis et que les trous taraudés (10) pratiqués dans l'élément circulaire pour le raccordement vissé sont montés pour fonctionner comme des moyens avec lesquels on peut déplacer l'élément circulaire (2) jusqu'à la position correcte en tournant les vis dans les trous taraudés (10) jusqu'aux points requis et en serrant les vis contre la surface du béton.

5. Agencement selon la revendication 4, **caractérisé en ce que** l'élément circulaire (2) est fait d'une ou de plusieurs parties.

6. Agencement selon la revendication 4, **caractérisé en ce que** les moyens destinés à prévoir un raccordement vissé sont montés de manière à autoriser un raccordement formé au moyen d'une bride interne (bride P) (6).

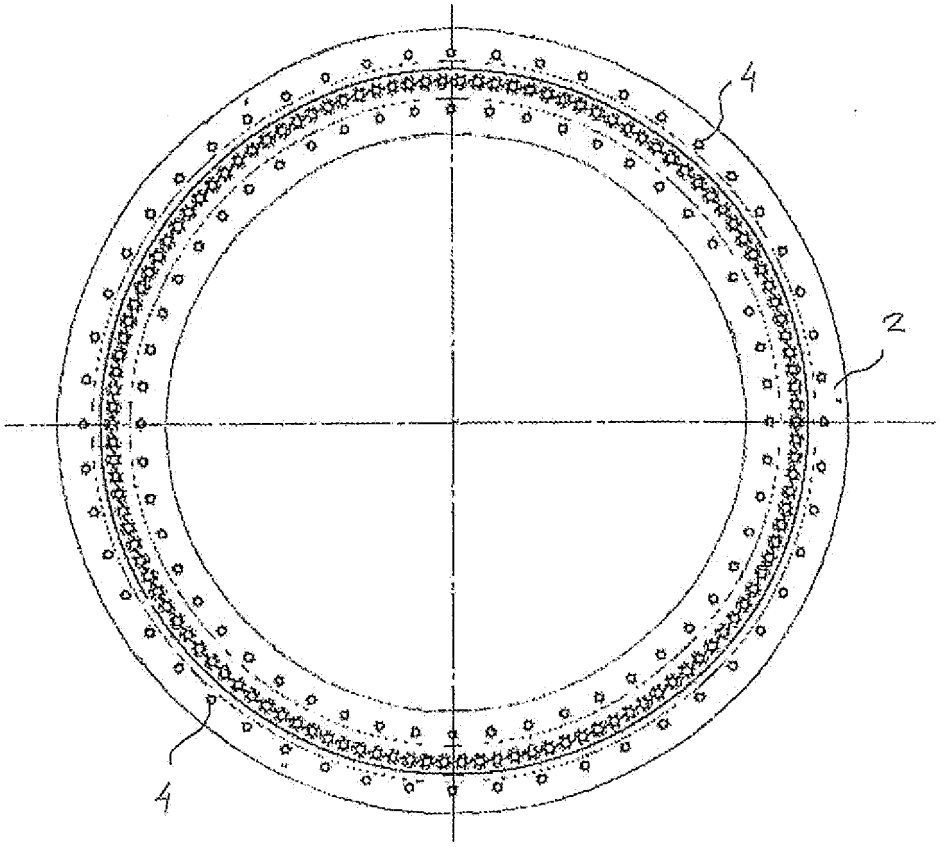

Fig. 1

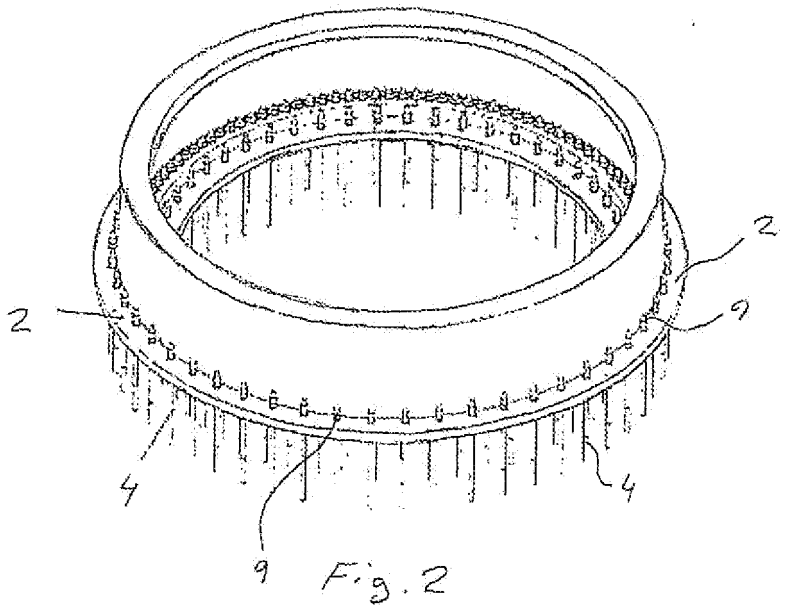

Fig. 2

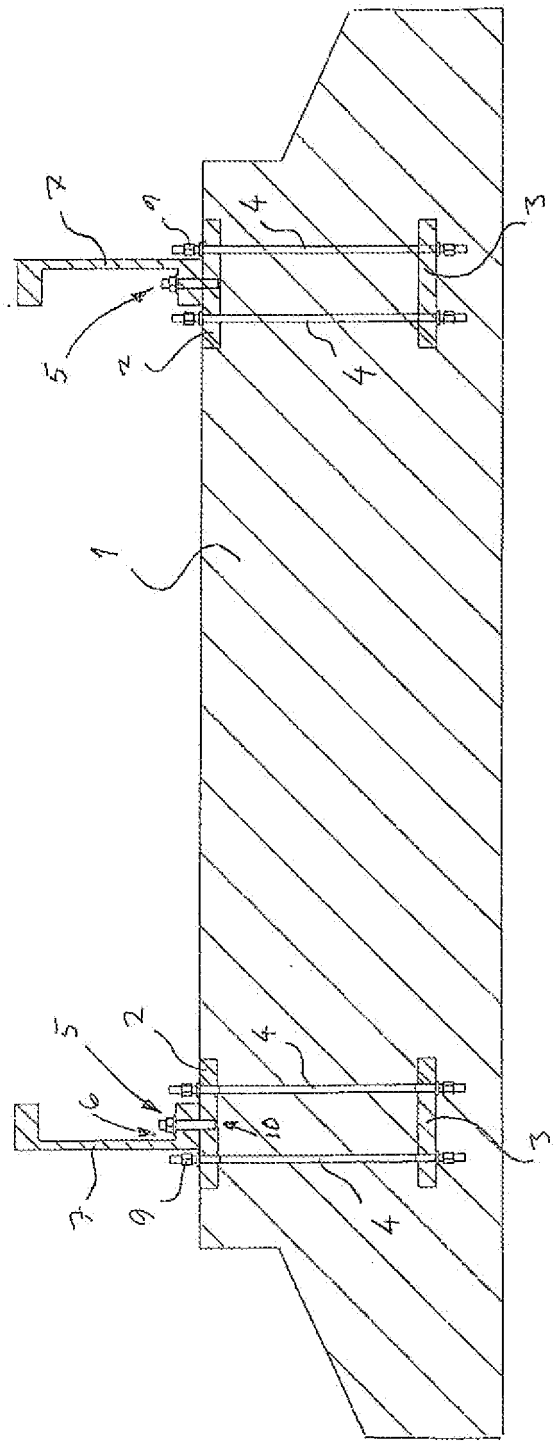

Fig. 3

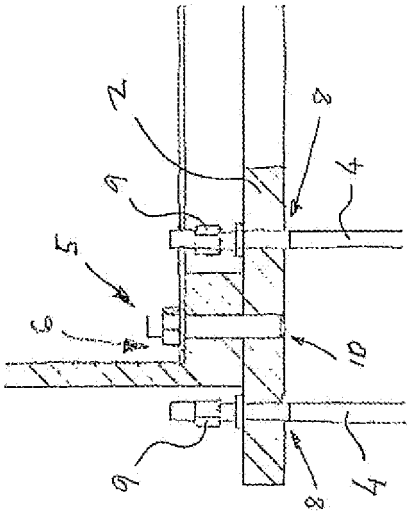

Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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- US 2009044482 A1 **[0009]**