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# (54) WEDGING SYSTEM FOR TRANSMITTING LOADS IN FORMWORK TO THE SURROUNDING EARTH

(57) The wedging system for transmitting loads from a formwork to the comprises a supporting member (3), a threaded bar (2) for the transmission of vertical load, a nut (11), and a base (1) that in turn comprises a plate (9) with a perforation (10), wherein the bar (2) for transmitting vertical load is secured to the supporting member (3), the supporting member (3) being affixed to a side wall of the formwork and the loads generated in the formwork being transmitted to the land, thereby preventing relative movement between the base (1) and the supporting member (3), by means of the insertion of the bar (2) for transmitting vertical load into the perforation (10) in the plate (9) of the base (1) and screwing the nut (11) into the upper end of the bar (2) for transmitting vertical load.

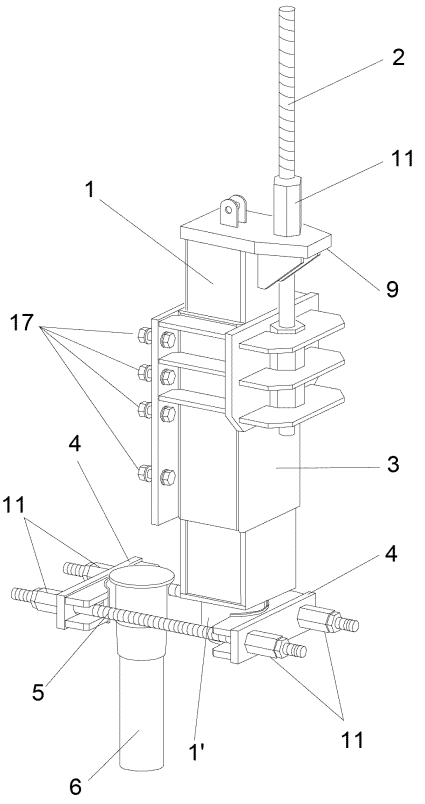


FIG. 2

EP 2 799 664 A1

## Description

### Object of the invention

**[0001]** The present invention relates to a wedging system for the base of a formwork. The wedging system is in charge of transmitting the loads generated during the concreting of a lining of bored tunnels or galleries to the base of a concreted section.

**[0002]** In general, the invention is applicable to the formwork of bored tunnels within the field of civil works, especially in the field of the execution of tunnels or galleries.

### Technical problem to be solved

**[0003]** Different phases are executed during the construction of a tunnel, which are well differentiated and are executed according to an order, such that certain phases are executed after certain others, the subsequent phases being supported by the works that were carried out before. The order of execution of the different phases is followed in a precise manner during the execution of the tunnel in order for the construction to be carried out safely and on time.

**[0004]** The first phase of the construction is the bench excavation of the section of the tunnel, with the execution of the lower part of the section (the inverted arch), in the first place, and then, in the second phase, the execution of the laterals (side walls) and the upper part (arch) of the section, which are executed together.

**[0005]** A formwork in charge of maintaining the shape of the section of the tunnel is used in order to execute the arch and the side walls, which, during the concreting of this section, must withstand the loads generated by the weight of the liquid concrete and transmit them to a part of the first phase having the capacity to withstand said loads.

**[0006]** Currently, there are many elements forming part of the formworks used for the execution of tunnels, which are in charge of the transmission of the loads generated by the concrete when poured. These elements that transmit load do so by resting on longitudinal elements, with complex systems that cannot adapt to irregularities of the earth or the footing.

**[0007]** The object of the invention is to propose a simple element that is easy to handle and place and that carries out point supports for the transmission of loads, this is why it can be adapted to irregularities of the earth or the footing where the loads are transmitted in said transmission.

### Description of the invention

**[0008]** In order to avoid the inconveniences indicated and achieve the objectives mentioned above, the invention consists of a wedging system for transmitting loads from formwork to the land, which rests on point supports and can be adapted to irregularities of the earth wherein it rests in order to modify the crown height of the formwork.

**[0009]** The element of the wedging system for transmitting loads in formwork to the surrounding earth comprises, in the transmission of vertical loads, a supporting member, a threaded bar for transmitting vertical load, a nut, and a base.

**[0010]** The base in turn comprises a plate with a perforation, and a change of section in the lower area.

**[0011]** In the transmission of vertical loads to the footing of the concrete section, the bar for transmitting vertical load is secured to the supporting member, the supporting member being affixed to a side wall of the formwork. The relative movement between the base and the supporting member is prevented by means of the insertion of the bar for transmitting vertical load into the perforation in the plate of the base and by screwing the nut into the upper end of the bar for transmitting vertical load, thereby achieving the transmission of the loads generated in the formwork to the land.

**[0012]** The lower area of the base changes its shape section, thereby having two different sections according to two embodiments of the object of the invention.

**[0013]** In the transmission of horizontal loads to the footing of the concrete section, according to a first embodiment where the lower area of the base has a circular section, the wedging system comprises two bars for transmitting horizontal load, parallel to each other, the lower area of the base itself with a circular section, two clamps, a perforated bar and at least two nuts for each bar for transmitting horizontal load.

**[0014]** The perforated bar is embedded in the base of the concrete section and a clamp is placed on the lower area of the base, clamping it from the outside, while the other clamp is placed on the perforated bar, the two clamps being joined by means of the bars for transmitting horizontal load and the nuts inserted into the ends of each bar for transmitting horizontal load.

**[0015]** In the transmission of horizontal loads to the footing of the concrete section according to a second embodiment wherein the lower area of the base has a hollow square section, the wedging system comprises a bar for transmitting horizontal load, a lower area of the base with a hollow square section inside with an indentation for the passage of the bar, a baseplate, a capped nut, a perforated bar with a through-hole, and a nut.

**[0016]** The lower area of the base, in this second embodiment and as mentioned above, has a hollow square section and there is an indentation of said section in two of its walls, through which the bar for transmitting horizontal load goes through.

**[0017]** The bar for transmitting horizontal load is inserted into the through-hole of the perforated bar and in the indentation of the lower area of the base. The baseplate is placed on the lower area of the base and the capped nut on the baseplate, such that the relative position of the lower area of the base is fixed with respect to the

perforated bar by means of the insertion of a nut into the end of the bar for transmitting horizontal load corresponding to the perforated bar and by inserting the capped nut into the baseplate on the other side of the bar for transmitting horizontal load.

**[0018]** The wedging system for transmitting loads in formwork to the surrounding earth, according to a third embodiment, comprises a wedge wherein the lower area of the base rests, said wedge being fastened to the footing of the concrete section, such that it transmits the horizontal loads to the footing.

**[0019]** The wedge of the wedging system for transmitting loads in formwork to the surrounding earth comprises two symmetrical pieces facing each other with a common face, said common face presenting a supporting area of the lower area of the base and a threaded bar, with a nut screwed into each end. In this third embodiment, by means of the screwing of the nuts, the geometry of the wedge is adapted until it enters into contact with the lower area of the base.

**[0020]** Both in the first embodiment and in the second embodiment, when the system is used for the layout of curved path tunnels in the transmission of horizontal load, a special piece is used in the outer part of the curve, which constitutes a third embodiment of the invention composed of two perforated bars, two metal profiles facing each other and secured to each other making up a beam, two clamps, two bars for transmitting horizontal load and two nuts; the two perforated bars, which have been embedded in the footing of the concrete section, are affixed to the beam formed by the two metal profiles; the beam incorporates, in one end, two clamps. One of the clamps slides through a segment of the beam and the other is joined to the first through the bars for transmitting horizontal load, limiting the relative movement between both clamps by means of nuts placed in the bars for transmitting horizontal load; the lower area of the base is inserted between said clamps, which in this embodiment has a circular section.

## Description of the figures

**[0021]** In order to complete the description and with the purpose of facilitating a better comprehension of the characteristics of the device, a set of figures is attached to this specification, which, in an illustrative rather than limitative manner, represents the following:

Figure 1 is a perspective view of a concrete section of a tunnel with a first embodiment of the wedging system object of the invention, located at the site of use.

Figure 2 is a perspective view of the wedging system of figure 1.

Figure 3 is a frontal view of the wedging system according to a first embodiment.

Figure 4 is a perspective exploded view of the wedging system of figure 1.

Figure 5 is a perspective view of a second embodiment of the wedging system object of the invention.

Figure 6 is a perspective exploded view of the wedging system of figure 5.

Figure 7 is a perspective view of the wedging system in the embodiment used for the transmission of horizontal loads in the outer part of the tunnel in curved sections.

Figure 8 shows an exploded view of the third embodiment of the wedging system object of the invention.

Figure 9 shows a lateral view of the embodiment of figure 8.

**[0022]** A list of the different elements represented in the figures making up the invention is provided below:

1.- base,
1'.- lower area of the base
2.- bar for transmitting vertical load,
3.- supporting member,
4.- clamp,
5.- bar for transmitting horizontal load,
6.- perforated bar,
7.- side wall,
8.- footing,
9.- plate,
10.- perforation,
11.- nut
13.- baseplate
14.- capped nut,
15.- indentation,
16.- through-hole,
17.- screw,
18.- metal profile,
19.- beam,
20.- inner wall,
21.- wedge,
22.- symmetrical pieces,
23.- supporting area,
24.- threaded bar.

## Detailed description of the invention

**[0023]** As shown in figure 1, the invention discloses a system placed at the base of the formwork of the lining of a tunnel executed under the bored tunnel procedure, which transmits the loads generated during the concreting of the second phase of the section of the tunnel to the first phase, which is already executed in the bored construction procedure.

**[0024]** The object of the invention comprises a telescopic base (1) in charge of the transmission of vertical loads to the footing (8), and, together with at least one bar for transmitting horizontal load (5) and one perforated bar (6), of the transmission of horizontal loads to the same footing (8).

**[0025]** The formwork of the second phase of the tunnel,

the one constituting the side walls (7), is formed by a series of ribs, joined at the inside, and at the outside by a smooth surface whereupon the concreting takes place.

**[0026]** The object of the invention has three alternative embodiments used for the construction of straight tunnel segments, and a fourth additional embodiment, compatible with the first two, used for the execution of curved tunnel segments.

**[0027]** In the straight segments, the transmission of loads is carried out through point supports, in individual pieces, and in the embodiment used for the execution of curved segments, the support for the transmission of loads is carried out in two points.

**[0028]** For the transmission of vertical loads, each individual piece has one supporting member (3) through which inside a base (1) with a square section moves, and which section varies in the lower area (1') of the base (1). The lower area (1') of the base (1) is the area of the base (1) wherein the support in the land or in the footing (8) of the concrete section takes place, and therefore, the one that transmits the vertical loads to said land or footing (8). The supporting member (3) incorporates a bar for transmitting vertical load (2) affixed to the supporting member (3). The bar for transmitting vertical load (2) is threaded at least in its upper part. Likewise, the base (1) has a plate (9) with a perforation (10) in its upper part. The bar for transmitting vertical load (2) affixed to the supporting member (3) is inserted into the perforation (10) of the plate (9), and a nut (11) is inserted into the threaded area of the aforementioned bar for transmitting vertical load (2), which prevents the movement of the base (1) with respect to the supporting member (3).

**[0029]** The invention is affixed to the ribs of the formwork of the side wall (7), either by means of screws (17) incorporated in the supporting member (3), or by means of a welded joint. Said joint limits the movement of the base (1) with respect to the supporting member (3), the vertical loads received by the supporting member (3) are transmitted to the base (1) through the bar for transmitting vertical load (2) and the base (1) transmits them to the concrete footing (8) of the section of the tunnel.

**[0030]** The invention has three different embodiments for transmitting horizontal loads, even though the operation is very similar in the three embodiments. In the lower area of the base (1'), an element for transmitting the horizontal load generated in the formwork of the side wall (7) of the tunnel is placed (two variations of the element transmitting the horizontal load generate two embodiments of the invention, which are exposed below). Said load is transmitted to a perforated bar (6), which has been previously embedded in the concrete footing (8) of the section of the tunnel.

**[0031]** In a first embodiment (shown in figures 3 and 4), the horizontal load is transmitted through two bars for transmitting horizontal load (5) placed in parallel on the two sides of the lower area of the base (1'), which in this embodiment has a circular section. At one of the ends of the bars for transmitting horizontal load (5) a clamp (4) is placed, which joins the two bars for transmitting horizontal load (5) and rests on the part of the base (1) with a circular section (1'), and at the other end of the bars for transmitting horizontal load (5), another clamp (4) is placed, which rests on the perforated bar (6) embedded in the concrete footing (8).

**[0032]** In each bar for transmitting horizontal load (5), two nuts (12) are inserted into the outside of the clamps (4), on per end, such that the clamps affix the base (1) and the perforated bar (6), and, through the bars for transmitting horizontal load (5), the horizontal load generated in the side wall (7) of the tunnel is transmitted to the perforated bar (6) located in the concrete footing (8) of the section of the tunnel.

**[0033]** In a second embodiment (shown in figures 5 and 6), the horizontal load is transmitted through a single bar for transmitting horizontal load (5) passing through the centre of the lower area (1') of the base (1') through an indentation (15) and through the perforated bar (6), there being a through-hole (16) in the aforementioned perforated bar (6). The lower area of the base (1') in this embodiment has a hollow square section.

**[0034]** A nut (11) is inserted Into one end of the bar for transmitting horizontal load (5), specifically in the end corresponding to the perforated bar (6), said nut (11) rests on the perforated bar (6), and into the other end, which corresponds to the base (1), a baseplate (13) and a capped nut (14) are inserted, such that the baseplate (13) rests on the aforementioned base (1).

**[0035]** The curved shape of the capped nut (14) and of its place in the cavity of the plate (13) allows small misalignments between the bar for transmitting horizontal load (5) and the perpendicular of the baseplate (13). The first embodiment also allows misalignments due to the round section of the lower area of the base (1'), the perforated bar (6), and the clamps (4).

**[0036]** In the execution of tunnels with a section presenting a step or an inner wall (20), and another outer wall forming part of the footing (8), a third embodiment of the invention has been developed (shown in figures 8 and 9). In the third embodiment, the horizontal load is transmitted by means of the support of the lower area of the base (1') on a wedge (21), said wedge (21) resting on the inner wall (20) of the section of the tunnel.

**[0037]** The wedge (21) is formed by two symmetrical pieces (22) facing each other by a common face, which in turn presents a supporting area (23) of the lower area of the base (1'). A threaded bar (24) passes through the inside of the two symmetrical pieces (22) with a nut (25) being screwed into each end, thereby adapting the geometry of the wedge (21) until it enters into contact with the lower area of the base (1').

**[0038]** These elements, described above in three different embodiments, are aligned for the execution of straight segments of the tunnel.

**[0039]** For the execution of curved segments, there is a fourth embodiment (shown in figure 7), which is placed in the outer side of the curve to be executed. The inven-

tion is formed by two perforated bars (6), joined to each other by means of two metal profiles (18). The two metal profiles (18) face each other and are affixed to each other by forming a hollow beam (19). In one end of the beam (19) formed by the metal profiles (18) there is a first sliding clamp (4) in a segment between the metal profiles (18). Facing the first clamp (4) there is a second clamp (4), joined to the first through two bars for transmitting horizontal load (5), the relative movement between the clamps (4) being limited by means of two nuts (12) placed in the end of the bars for transmitting horizontal load (5). The lower area (1') of the base (1) is inserted between the two clamps (4), which in this embodiment has a circular section.

**[0040]** The invention should not be limited to the particular embodiment described in this document. Experts in the art can develop other embodiments based on the description made herein. In consequence, the scope of the invention is defined by the following claims.

## Claims

1. Wedging system for transmitting loads from a formwork to the land, **characterized in that,** in the transmission of vertical loads to the surrounding earth, the system comprises:

   - a supporting member (3),
   - a threaded bar for transmitting vertical load (2),
   - a nut (11)
   - a base (1), which in turn comprises a plate (9) having a perforation (10),

   wherein the bar for transmitting vertical load (2) is fixed to the supporting member (3), the supporting member (3) being affixed to a side wall of the formwork, and transmitting the loads generated in the formwork to the land, thereby preventing the relative movement between the base (1) and the supporting member (3) by inserting the bar for transmitting vertical load (2) into the perforation (10) in the plate (9) of the base (1) and by screwing the nut (11) into the upper end of the bar for transmitting vertical load (2).

2. Wedging system for transmitting loads from a formwork to the land according to claim 1, **characterized in that** in a lower area (1') of the base (1) there is a change of the cross section in the base (1), the section of the lower area (1') being circular.

3. Wedging system for transmitting loads from a formwork to the land according to claims 1 and 2, **characterized in that,** in the transmission of horizontal loads, the system comprises:

   - two bars for transmitting horizontal load (5), parallel to each other,
   - the lower area of the base (1'),
   - two clamps (4),
   - a perforated bar (6), and
   - at least two nuts (12), one per bar for transmitting horizontal load (5),

   such that the perforated bar (6) is embedded in a footing (8) of the concrete section and a clamp (4) is placed on the lower area of the base (1'), clamping it from the outside, while the other clamp (4) is placed on the perforated bar (6), the two clamps (4) being joined by the bars for transmitting horizontal load (5) and the nuts (12) inserted into the ends of each bar for transmitting horizontal load (5).

4. Wedging system for transmitting loads from a formwork to the land according to claim 2, **characterized in that** the lower area (1') of the base (1) comprises a hollow square section with an indentation (15).

5. Wedging system for transmitting loads from a formwork to the land according to claims 1 and 4, **characterized in that,** in the transmission of horizontal loads, the system comprises:

   - a bar for transmitting horizontal load (5),
   - the lower area of the base (1'),
   - a baseplate (13),
   - a capped nut (14),
   - a perforated bar (6), with a through-hole (16), and
   - a nut (11),

   such that the bar for transmitting horizontal load (5) is inserted into the through-hole (16) of the perforated bar (6) and into the indentation (15) of the lower area (1') of the base (1), and the baseplate (13) is placed on the lower area (1') of the base (1) and the capped nut (14) rests on the baseplate (13), such that the relative position of the lower area (1') of the base (1) is fixed with respect to the perforated bar (6) by means of the insertion of a nut (11) into the end of the bar for transmitting horizontal load (5) corresponding to the perforated bar (6) and by inserting the capped nut (14) into the other side of the bar for transmitting horizontal load (5).

6. Wedging system for transmitting loads from a formwork to the land according to claims 1 and 2, **characterized in that,** in the transmission of horizontal loads in curved segments, the system comprises:

   - two perforated bars (6),
   - two metal profiles (18), facing each other and fixed to each other, configuring a beam (19),
   - two clamps (4),
   - two bars for transmitting horizontal load (5),

- two nuts (12),

such that the two metal profiles (18) make up a beam (19), the two perforated bars (6) being affixed to said beam (19); the beam (19) incorporating in one end a clamp (4) that slides through a segment of the beam (19), the other clamp (4) being joined to the first clamp (4) through the bars for transmitting horizontal load (5), thereby limiting the relative movement between both clamps (4) by means of nuts (12) placed in the bars for transmitting horizontal load (5).

**7.** Wedging system for transmitting loads from a formwork to the land according to claims 1 and 2, **characterized in that,** in the transmission of horizontal loads, the system comprises a wedge (21), wherein the lower area of the base (1') rests, said wedge (21) being fastened to the footing (8) of the concrete section.

**8.** Wedging system for transmitting loads from a formwork to the land according to claim 7, **characterized in that** the wedge (21) comprises:

- two symmetrical pieces (22) facing each other by a common face, said common face having a supporting area (23) of the lower area of the base (1'), and
- a threaded bar (24), with a nut (25) screwed into each end,

such that by screwing the nuts (25), the geometry of the wedge (21) is adapted until it contacts the lower area of the base (1').

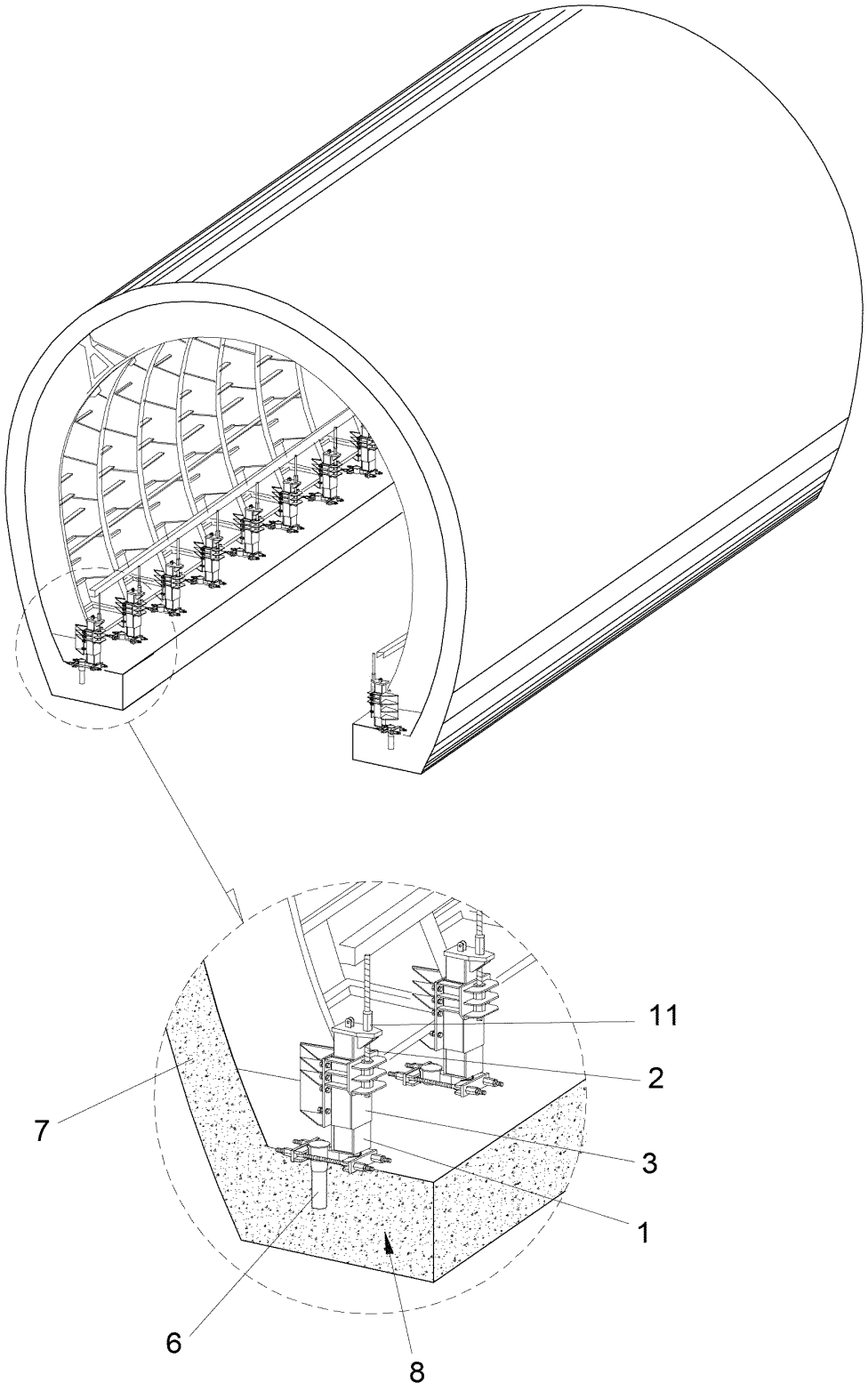


FIG. 1

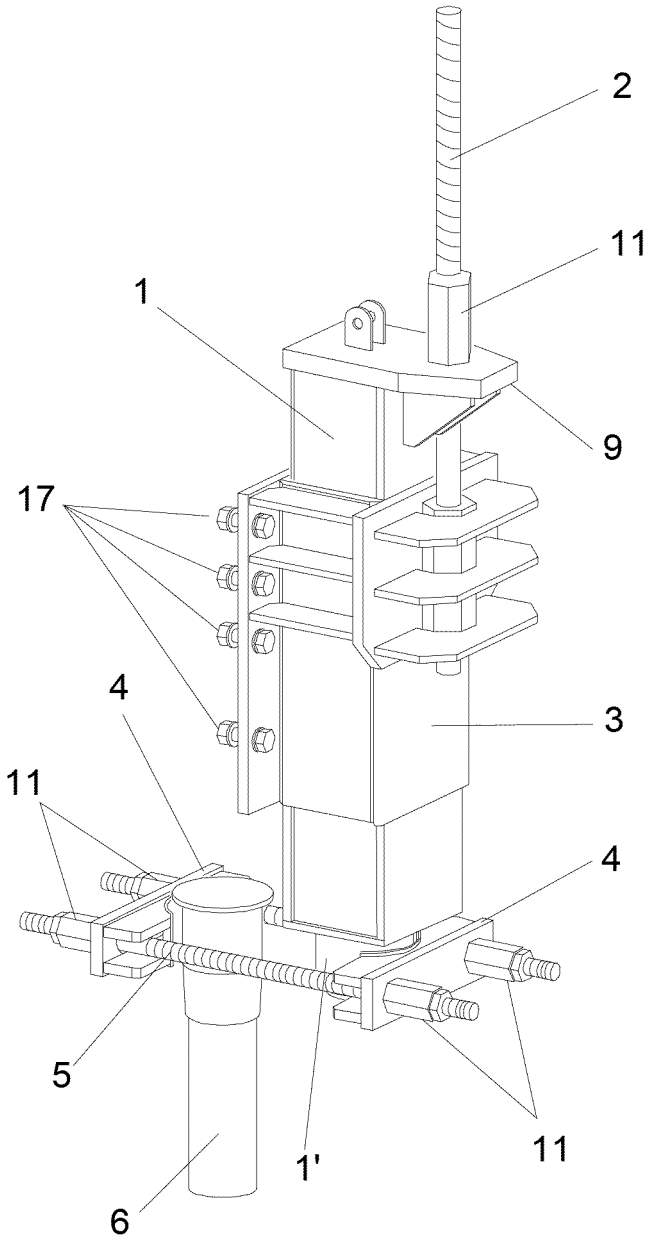


FIG. 2

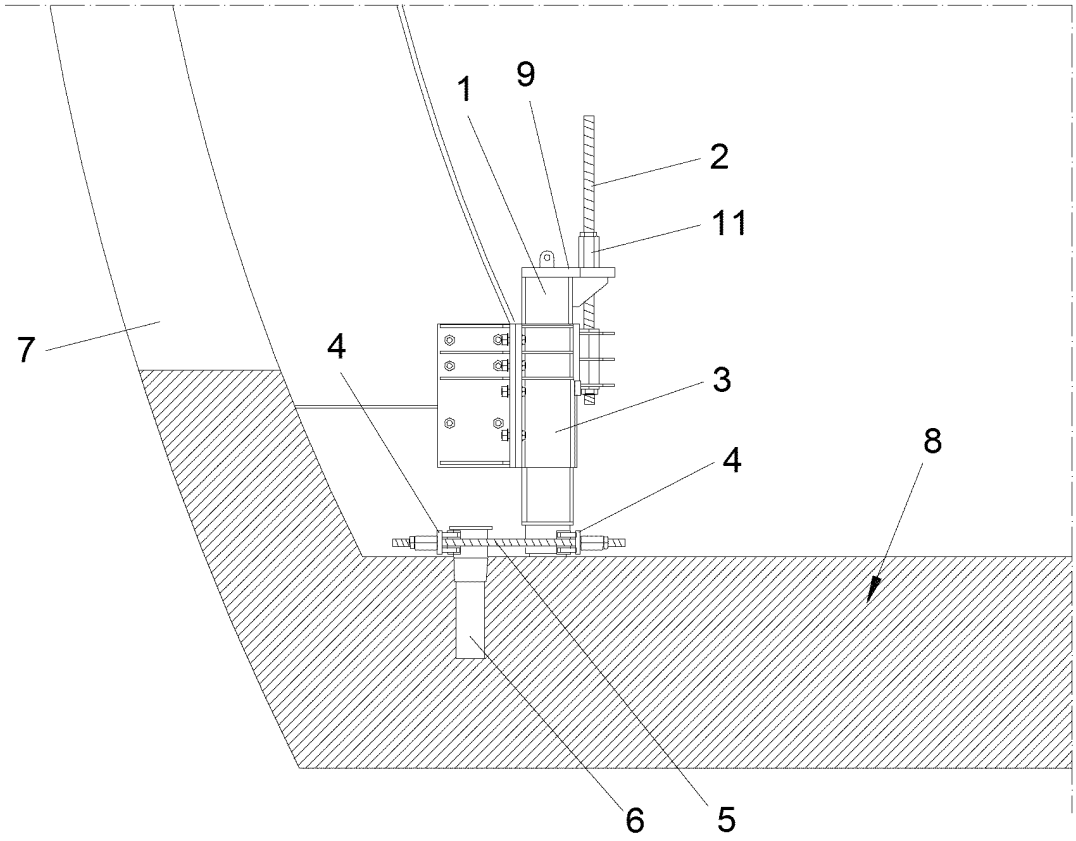


FIG. 3

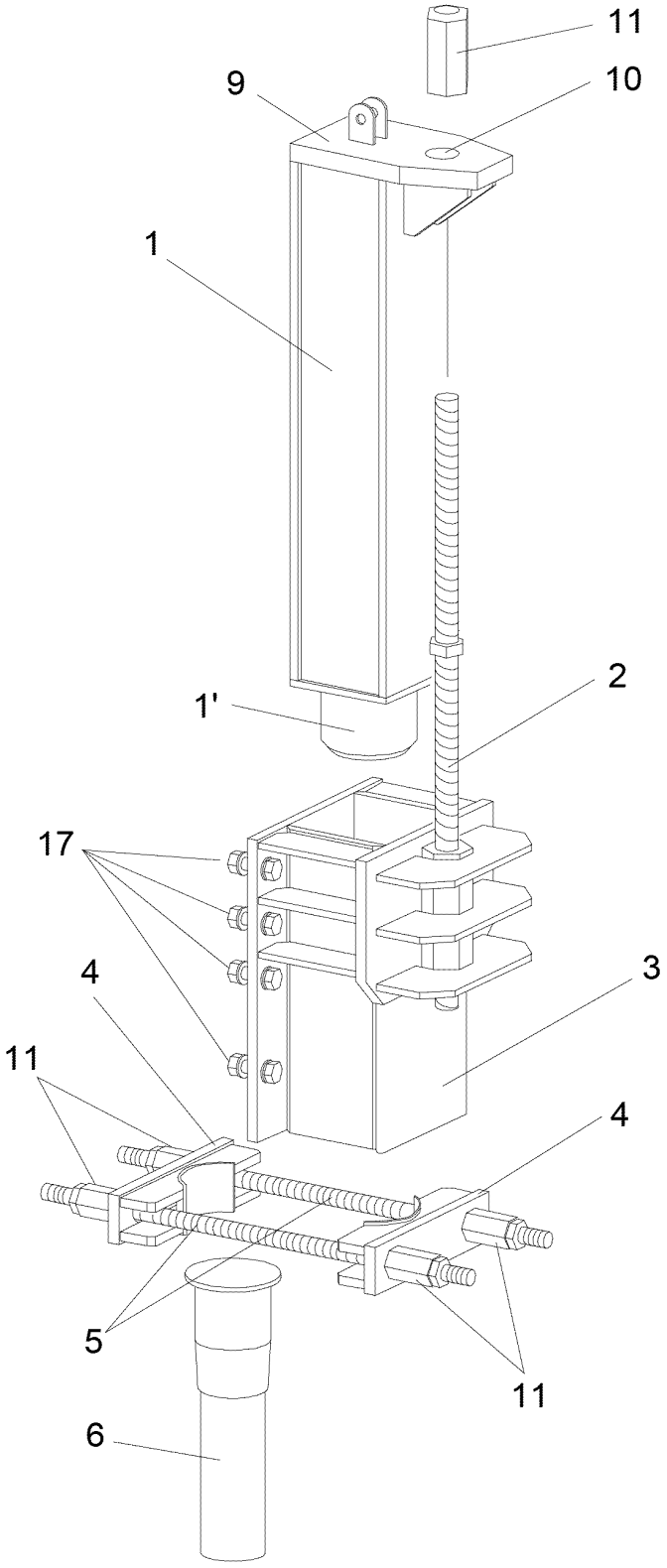


FIG. 4

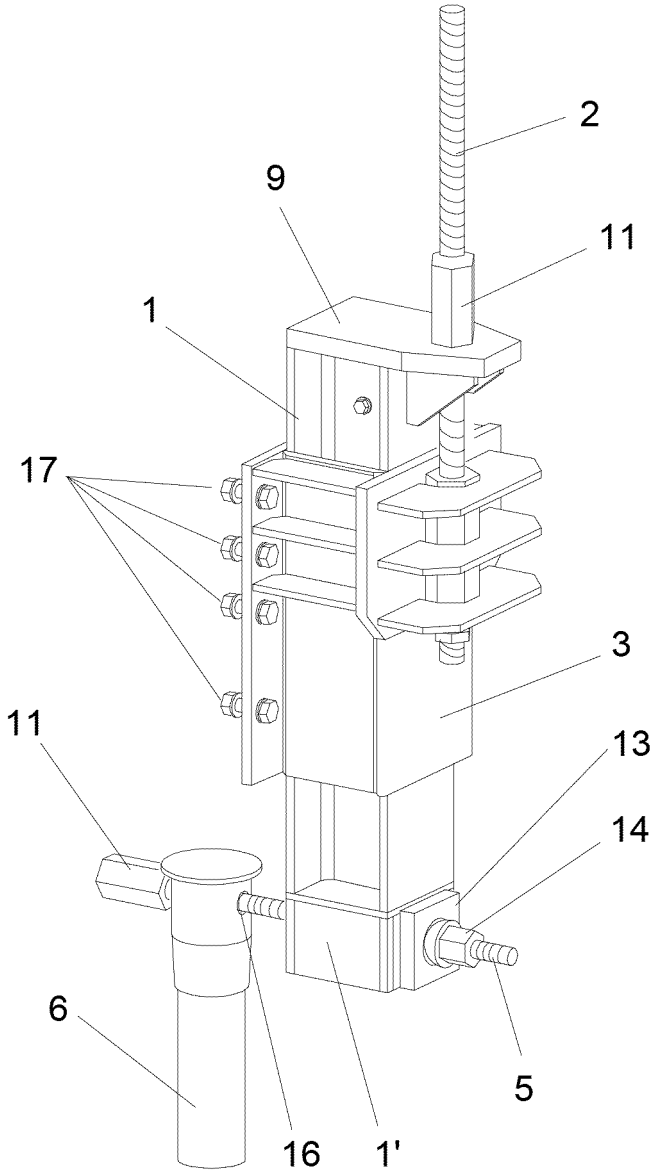


FIG. 5

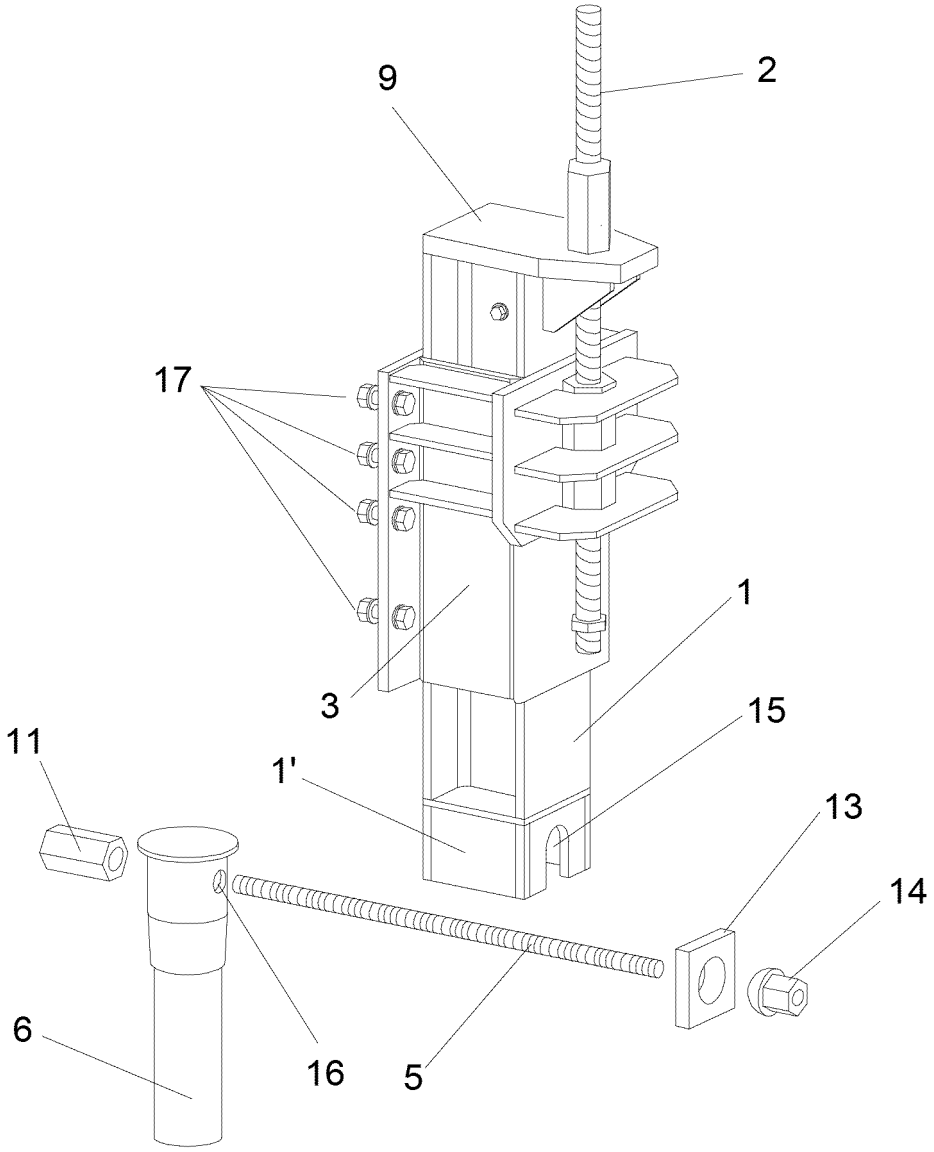


FIG. 6

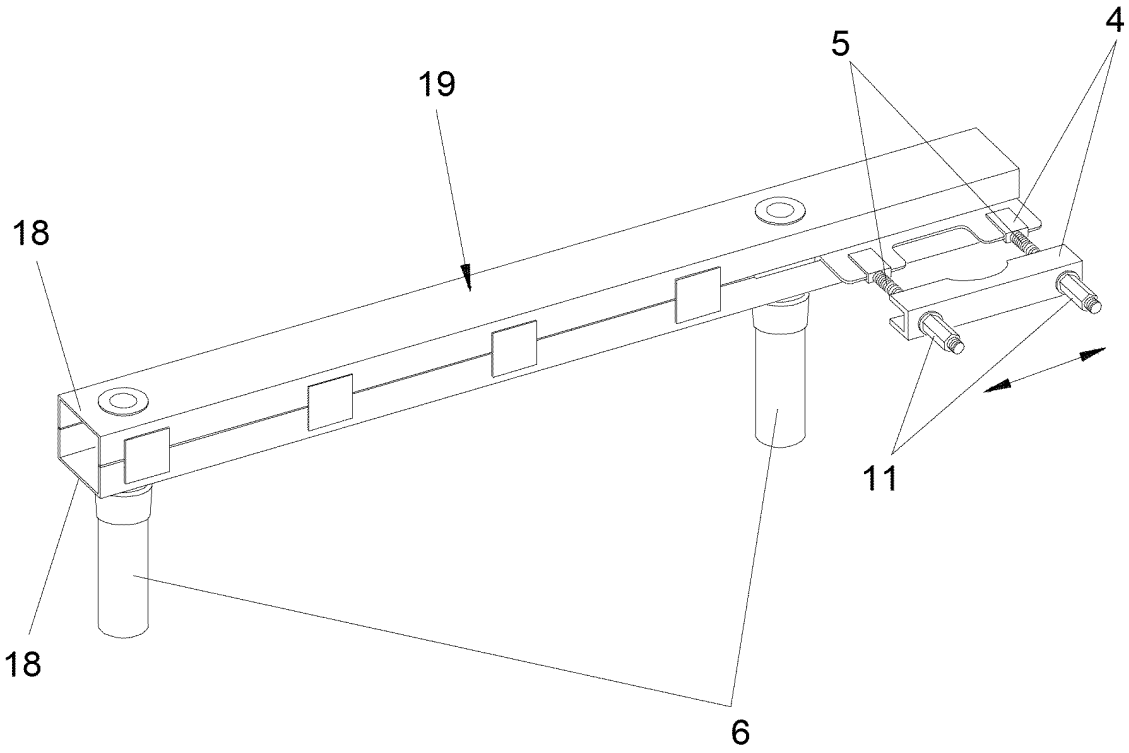


FIG. 7

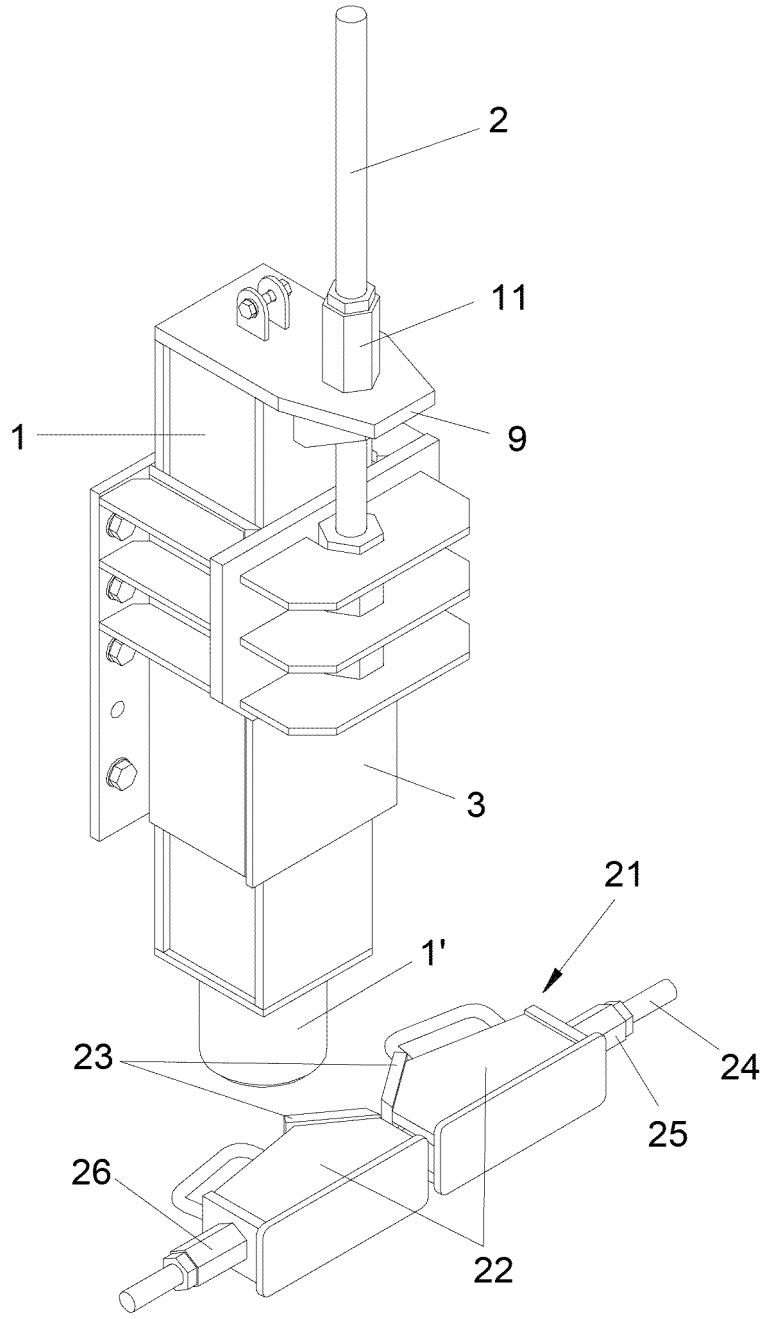


FIG. 8

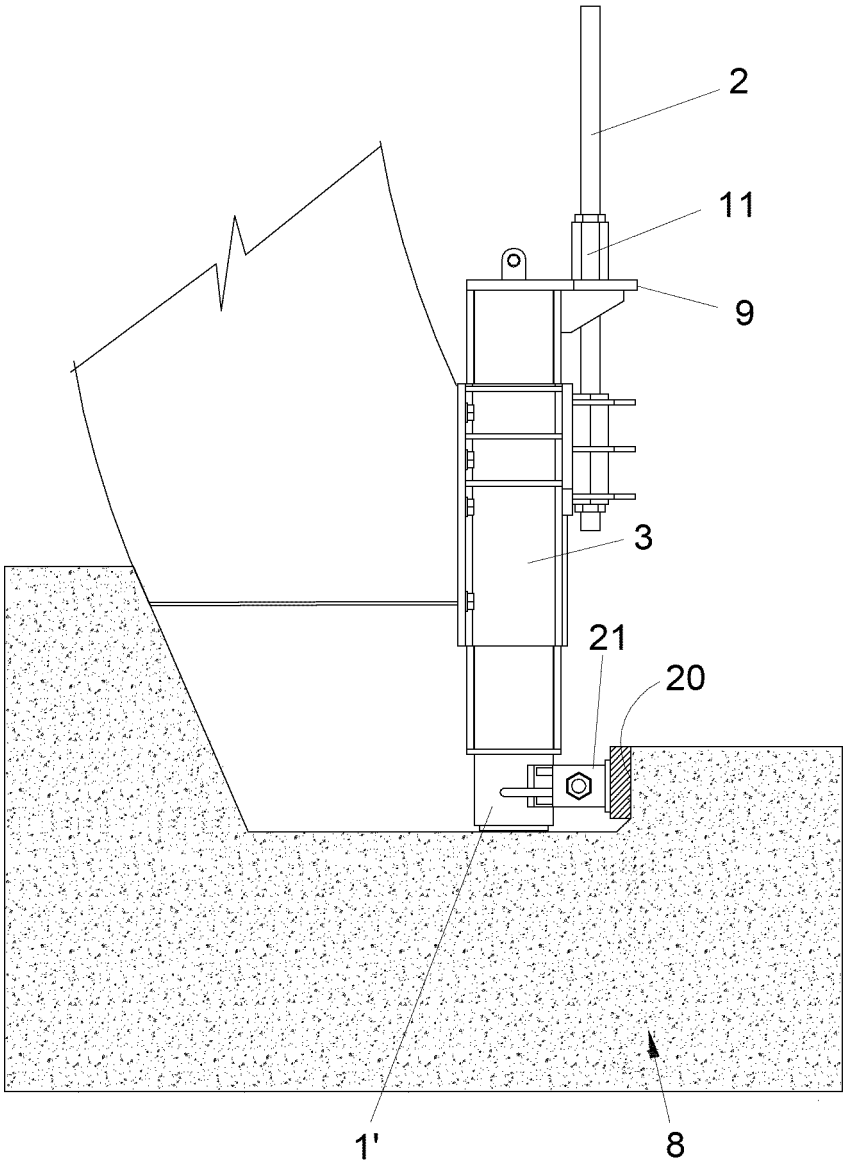


FIG. 9

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2012/070756

A. CLASSIFICATION OF SUBJECT MATTER

***E21D11/10*** (2006.01)
***E04G17/14*** (2006.01)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E21D, E04G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | FR 2691204 A1 (AL CANT COFFRAGES) 19/11/1993, page 6, paragraph 2 - page 8, line 2; figures. | 1 |
| A | US 4315701 A (IVANOV VALENTIN A ET AL.) 16/02/1982, column 3, line 34 - column 4, line 27; figures. | 1 |
| A | FR 1502024 A (DEBURAUX GUY EDOUARD EDMOND) 18/11/1967, page 1, paragraph 15 - page 2, line 13; figures. | 1 |
| A | GB 1487138 A (KENNY P ET AL.) 28/09/1977, the whole the document. | 2-5 |
| A | US 4450666 A (TRUMBULL JAMES L ET AL.) 29/05/1984, column 2, lines 10 - 62; figures 1-2. | 1 |

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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| Date of the actual completion of the international search | Date of mailing of the international search report |
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| 08/02/2013 | **(11/02/2013)** |
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Form PCT/ISA/210 (second sheet) (July 2009)

## INTERNATIONAL SEARCH REPORT

International application No.
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| Category * | Citation of documents, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
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