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(54) **TWO-PART END ELEMENT FOR CONCRETE TUBULAR STRUCTURE**

(57) The present invention relates to an end element for the manufacture of a concrete tubular structure such as a culvert or sewage pipe.
According to the invention, the end part comprises a concrete first part formed in a first pouring pass. This first part comprises a lower wall, an upper wall and side walls, wherein the side walls extend between the lower wall and upper wall and wherein the side walls and the lower wall extend beyond the upper wall at a first end of the first part. The height of the parts of the side walls protruding beyond the upper wall decreases in a direction away from the upper wall.

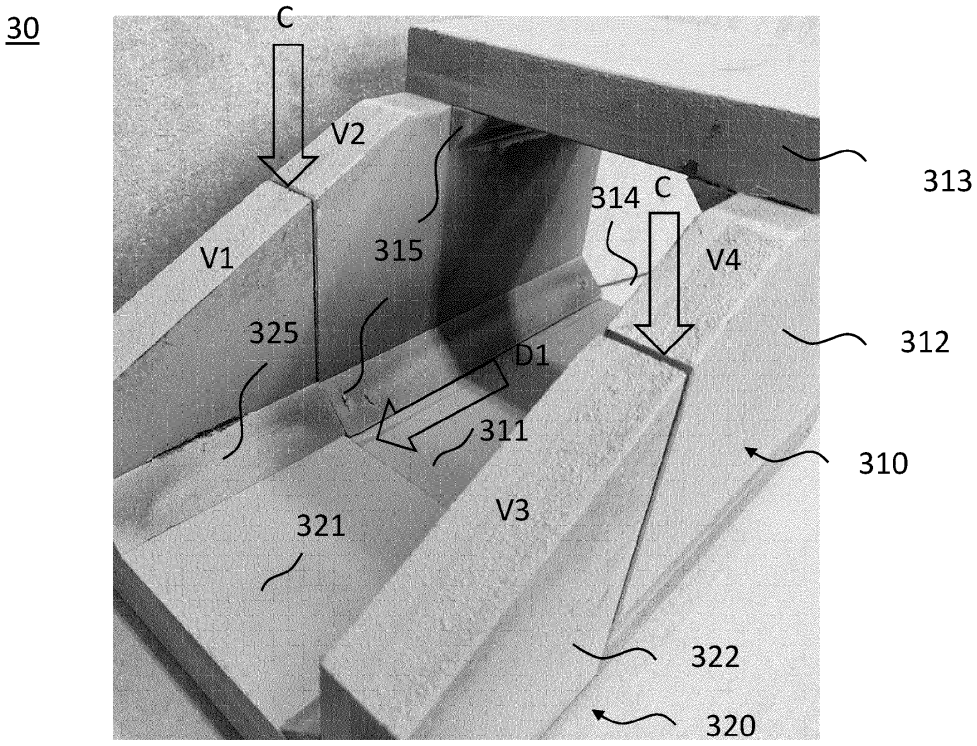


Fig. 4A

EP 4 219 834 A1

Description

[0001] The present invention relates to a mould assembly for forming an end element of a concrete tubular structure. The present invention further relates to a method for forming an end element and to a method for forming a concrete tubular structure. The present invention relates particularly to end elements for culverts and to culverts in which such an end element is incorporated.

[0002] Culverts are known civil engineering structures. A culvert usually has a tubular construction and lies beneath a road or in a waterway crossing. The culvert is often configured to mutually connect bodies of water and is made of concrete.

[0003] An example of a known concrete culvert is shown in figure 1. Concrete culvert 1 comprises a plurality of mutually coupled middle segments 2, these together forming a tubular structure which is closed on either side by an end element 3. End element 3 comprises here obliques side walls 4 and a lower wall 5. The height of side walls 4 decreases in a direction toward the end of culvert 1.

[0004] Culvert 1 is placed on a ground surface 6. Soil will here be deposited onto culvert 1. It is however also possible for culvert 1 to be placed directly in a dam or similar structure.

[0005] For a culvert, end element 3 is also referred to as culvert embankment. The length of such an element, measured in the longitudinal direction of the culvert, generally varies between 2.5 m and 5 m. The width and height of the element generally vary between 1 m and 3 m.

[0006] It is particularly the length of the element that poses limitations for the manner in which such an element can be manufactured. More particularly, it is very difficult in practice to manufacture end element 3 integrally in a single pouring run. This is because, if end element 3 is formed in the position shown in figure 1, it becomes very difficult or even impossible to remove the element from the mould after curing of the concrete. If the element is manufactured in upright position, i.e. with the opening oriented vertically, the length of the element, which can be up to 5 m, poses a problem. A hoisting device is needed to displace the element. At a length of 5 m, this would mean that the height of the hall in which the element is made would have to be considerable.

[0007] A known method for realizing end element 3 will be elucidated hereinbelow with reference to figures 2 and 3. It is noted here that end element 3 in figures 2 and 3 is not identical to the element shown in figure 1. The same manufacturing method can however be followed for both elements.

[0008] Figure 2 shows that side walls 4 are made separately in a mould 7, wherein side walls 4 are formed flat on the bottom of mould 7. Side walls 4 are provided with lift anchors 8 so that side walls 4 can be removed from mould 7 after pouring and curing of the concrete. Also visible is reinforcement 9, which is placed before concrete is poured into mould 7 and which protrudes from the concrete. After sufficient curing of the concrete, side walls 4 are placed upright. This is shown in both figure 2 and figure 3.

[0009] As shown in figure 3, end element 3 comprises a part 10 which is provided with a central opening 11 which, when placed in culvert 1, will connect to the central openings of middle segments 2. Figure 2 shows that part 10 is likewise provided with reinforcement 9 extending toward side walls 4. Reinforcement 9 in side walls 4 protrudes here toward further part 10.

[0010] Part 10 is manufactured in a separate mould, likewise flat on the bottom of the mould. The mould comprises here an inner mould and an outer mould. The walls of the inner mould and/or outer mould are hydraulically adjustable so that the part can be easily removed from the mould after curing of the concrete.

[0011] As shown in figure 3, two different side walls 4 are manufactured. These differ in respect of the direction along which reinforcement 9 protrudes on the underside. Figure 3 shows that the different side walls 4 are placed so that reinforcement 9 of the one side wall 4 extends to the other side wall 4.

[0012] As subsequent step in the manufacture of end element 3 formwork is placed around side walls 4 and further part 10. The lower wall of end element 3 will subsequently be poured as indicated by arrow A in figure 3. After sufficient curing, the connection between side walls 4 and part 10 will subsequently further be made by additional pouring at the position of reinforcement 9, as indicated by arrow B in figure 3. It is noted here that side wall 4 comprises a part 4A which prevents the liquid concrete from finding its way into an inner space of end part 4 during the second pouring run.

[0013] The above shows that the manufacture of an end element for a known culvert is a relatively labour-intensive process which can generally take up to 5 days. Different moulds and/or mould parts must further be used for the different components of the end element to be formed.

[0014] An object of the present invention is to provide an end element wherein the above stated problem does not occur, or hardly so.

[0015] This object is achieved with an end element which comprises a concrete first part formed in a first pouring run, wherein the end element is configured to be coupled with the first part to a middle segment of the one or more middle segments of the concrete tubular structure. The first part comprises here a lower wall, an upper wall and side walls, wherein the side walls extend between the lower wall and upper wall and wherein the side walls and the lower wall extend beyond the upper wall at a first end of the first part. The height of the parts of the side walls protruding beyond the upper wall decreases in a first direction away from the upper wall.

[0016] At the known end element shown in figure 2 side walls 4 and part 10 are components which are not formed in the same pouring run. The present invention proposes a different division, wherein part 10 and at least

a part of side walls 4 are formed integrally in a single pouring run. This has the advantage that a less complex process can be applied for longer culverts in that the remaining part of the side walls and lower wall can be placed separately as a second part, and thus requires no further pouring run.

[0017] The side walls of the first part can be provided with continuous openings which extend substantially parallel to the lower wall of the first part and in which post-tension cables are placed or can be placed. Such openings can be provided in the lower wall and/or the side walls and run parallel to a longitudinal axis of the tubular structure.

[0018] The end element can further be provided with a concrete second part formed in a second pouring run, wherein the second part comprises a lower wall and side walls, wherein the side walls extend from the lower wall. The first part is here configured to be arranged between said middle segment of the one or more middle segments and the second part and, after the second part has been arranged, the lower wall of the first part connects to the lower wall of the second part and the side walls of the first part connected to the side walls of the second part. The height of the side walls of the second part further decreases in the first direction. A side of the lower wall of the first part directed toward an inner side of the first part for instance lies in a plane with a side of the lower wall of the second part directed toward an inner side of the second part. Additionally or instead, upper surfaces of the side walls of the first part directed away from the lower wall of the first part can lie in a plane with upper surfaces of the side walls of the second part directed away from the lower wall of the second part.

[0019] The first part and the second part are preferably placeable separately of each other. More particularly, the first part is placed separately at the second part. Owing to the division of the end element into two parts, it is possible to make relatively large end elements, for instance with a length greater than 2.5 m, without additional requirements having to be made here of the height of the hall in which the end element is manufactured.

[0020] The side walls of the first part can each be provided with a first recess in an end surface thereof which is directed toward the second part. The side walls of the second part can also each be provided with a second recess in an end surface thereof which is directed toward the first part. The end element can here further comprise a sealing element which is placed in an opening formed by the first recess and second recess. The first recess and the second recess preferably extend over a whole height of the respective side walls. The sealing element is configured to prevent or impede sand or other contaminants from entering through the space between the first and second part and thus contaminating the inner space of the end element and/or causing the surrounding embankment to erode.

[0021] The first part can further comprise a chamfering or rounding which is formed in a corner between the side walls and lower wall of the first part and/or between the side walls and upper wall of the first part. Additionally or instead, the second part can further comprise a chamfering or rounding which is formed in a corner between the side walls and the lower wall of the second part.

[0022] The first part and/or the second part can be provided with reinforcement.

[0023] According to a second aspect, the present invention provides a concrete tubular structure such as a culvert or sewage pipe. This structure comprises one or more middle segments which form a middle part of the concrete tubular structure. The structure further comprises at least one end element as described above, the first part of which is coupled to a middle segment at an end of the middle part.

[0024] The first part can comprise a central opening which is surrounded by the side walls, lower wall and upper wall of the first part and which connects to a central opening formed in the one or more middle segments.

[0025] The one or more middle segments can each be provided with substantially continuous openings which connect to the above described continuous openings in the first part to form a combined opening, wherein the concrete tubular structure is provided with a post-tension cable which is placed in the combined opening and by which the first part and the one or more middle segments are pulled against each other.

[0026] According to a third aspect, the present invention provides a mould assembly for forming an end element as described above. This mould assembly comprises at least a first mould and optionally a second mould for forming respectively the first part and the second part of the end element. The first mould and, if applicable, the second mould comprises here an outer mould, an inner mould placed in the outer mould and a mould part placed in a space between the inner mould and an inner wall of the outer mould. The mould part comprises here mould walls which extend obliquely relative to a bottom of the outer mould and which extend between the inner wall of the outer mould and an outer wall of the inner mould for the purpose of forming the side walls of the first part or the side walls of the second part.

[0027] The outer mould of the first mould usually has a receptacle-like construction with a bottom and side walls. The side walls are here usually adjustable for the purpose of removing the poured first part after curing of the concrete. The outer mould of the second mould can be formed partially by the outer mould of the first mould. In the manufacture of a concrete tubular structure use is likewise made of an outer mould and an inner mould for the manufacture of the middle segments. It is the case here that the outer mould of the first mould and the outer mould of the second mould can be formed at least partially by such an outer mould. It is the case for all moulds that the inner mould is preferably placed on a bottom of the outer mould.

[0028] The mould part can comprise an elevated part which is placed on the bottom of the outer mould, and

wherein the obliquely extending mould walls extend from the elevated part.

[0029] The mould part of the first mould can comprise a transverse part which extends substantially perpendicularly relative to the obliquely extending mould walls, wherein the mould walls extend between the elevated part or the bottom of the outer mould and the transverse part.

[0030] The mould part can also comprise chamfering parts which lie against the transverse part and/or the obliquely extending mould walls for the purpose of forming the chamfering or rounding of the first part or second part of an end element as described above.

[0031] The mould assembly can comprise a reinforcement placed in a space between the outer mould and the inner mould of the first mould. Reinforcement can also be placed in a space between the outer mould and the inner mould of the second mould.

[0032] The outer mould of the second mould preferably surrounds the inner mould of the second mould on three sides. The outer mould of the first mould however preferably surrounds the inner mould of the first mould on four sides. This difference is caused by the fact that, in contrast to the second part, the first part has an upper wall.

[0033] The first mould can further comprise filler parts which extend perpendicularly relative to the bottom of the outer mould or elevated part of the first mould and which are configured to form continuous openings during the pouring of concrete for the purpose of throughfeed of post-tension cables. The filler parts, which are usually formed as tubular elements, prevent the space taken up by the filler parts from being filled up with concrete. This creates continuous openings in the first part, in which post-tension cables can be arranged later. These filler parts are preferably arranged on the obliquely extending mould walls, the elevated part and/or the transverse part.

[0034] For the first mould and/or the second mould a height over which the elevated part extends and/or an angle formed by the obliquely extending mould walls with the bottom of the outer mould or the elevated part and/or a position where the obliquely extending mould walls engage on the bottom of the outer mould or the elevated part can be adjustable. Such an adjustability can for instance be realized by means of hydraulics. The parts of the first mould and/or second mould can for instance be realized with metal such as steel, wherein hydraulic cylinders are used to change or set the relative position and/or orientation of the parts of the first and second mould.

[0035] The first mould can have first protruding edges for forming first recesses in end surfaces of the side walls of the first part which are directed toward the second part, and the second mould can have second protruding edges for forming second recesses in end surfaces of the side walls of the second part which are directed toward the first part.

[0036] According to a third aspect, the present invention provides a method for manufacturing an end element as described above. The method comprises the steps of providing the mould assembly as described above and of pouring concrete into the first mould in a first pouring run for the purpose of forming the first part of the end element.

[0037] The method can further comprise of pouring concrete into the second mould in a second pouring run for the purpose of forming the second part of the end element. The method can also comprise the step of placing the filler parts on the oblique mould wall, the elevated part, the bottom of the outer mould and/or the transverse part of the first mould prior to concrete being poured into the first mould for the purpose of forming continuous openings in the first part.

[0038] Reinforcement can be placed in a space between the inner mould and outer mould of the first mould and/or second mould.

[0039] According to a fourth aspect, the present invention provides a method for manufacturing a concrete tubular structure such as a culvert or sewage pipe. This method comprises the above described method for forming at least one end element, placing one or more concrete middle segments to form a middle part of the concrete tubular structure, placing the first part in the vicinity of a middle segment at an end of the middle part, and coupling this middle segment to the first part.

[0040] The middle segments and the first part can each have continuous openings. In this case the continuous openings of the middle segments can be aligned. Said coupling can further comprise of passing post-tension cables through the continuous openings of the middle part and continuous openings of the first part and tensioning them. The concrete tubular structure preferably comprises an end part on either side of the structure.

[0041] The method can further comprise the step of placing the second part in the vicinity of the first part. The second part can here be separate, i.e. not coupled, relative to the first part. If the first and second part are provided with the above described first and second recesses, the method can comprise the step of arranging sealing elements in the openings formed by the first and second recesses.

[0042] The present invention will be discussed in more detail hereinbelow with reference to the accompanying figures, in which:

Figure 1 shows a known culvert;

Figures 2 and 3 show different stages of a known method for forming an end element;

Figure 4A shows a schematic view of an end element according to the present invention and figure 4B shows a detail view of an end element in which a sealing element is arranged;

Figure 5 shows two views of the first mould for the manufacture of the first part of the end element of figure 4A; and

Figure 6 shows a second mould for the manufacture

of the second part of the end element of figure 4A. Figure 4A shows an example of an end element 30 according to the present invention. The example shown in figure 4A is a model and demonstrates merely the shape of end element 30. End element 30 is manufactured by means of two concrete pouring runs.

[0043] End element 30 comprises a first part 310 and a second part 320. First part 310 comprises a lower wall 311, a pair of side walls 312 and an upper wall 313. Lower wall 311 and side walls 312 extend beyond upper wall 313 in the direction toward second part 320. The height of side walls 312 further decreases in a first direction D1 away from upper wall 313.

[0044] Walls 311, 312, 313 surround a central opening 314. First part 310 further comprises a chamfering 315 which is formed at the corners between side walls 312 and upper wall 313 and at the corners between side walls 312 and lower wall 311. As stated above, figure 4A shows a model. In a final first part 310 walls 311, 312, 313 and chamfering 315 form a concrete element moulded integrally in a single pouring run.

[0045] Second part 320 comprises a lower wall 321 and a pair of side walls 322. Second part 320 further comprises a chamfering 325 which is formed at the corners between side walls 322 and lower wall 321. In a final second part 320 walls 321, 322 and chamfering 325 form a concrete element moulded integrally in a single pouring run and the height of side walls 322 decreases in the first direction D1.

[0046] During pouring of concrete, recesses can be realized in first part 310 second part 320 at the locations indicated by arrow C in figure 4A. In end element 30 the thus formed recesses co-act to form an opening. A sealing element, such as a plastic slat, can be introduced into this opening. Such an element prevents sand from entering through and/or eroding the opening between first part 310 and second part 320. A more detailed example of the formation of this recess is shown in figure 4B.

[0047] Figure 4B shows that side walls 312 of first part 310 are each provided with a first recess 317 in an end surface V6 thereof which is directed toward the second part 320. Side walls 322 of second part 320 are each provided with a second recess 327 in an end surface V5 thereof which is directed toward the first part 310. End element 30 comprises a sealing element 318 which is placed in an opening formed by the first recess 317 and second recess 327.

[0048] A continuous opening 316 can also be provided in surface V6. The middle segments of the final tubular structure can likewise be provided with such continuous openings. After first part 310 has been placed in line with these middle segments, the continuous openings form a single continuous opening. A post-tension cable can be passed through this opening in order to pull the middle segments and first part 310 against each other. It is noted here that a tubular structure usually has an end element at both outer ends. It is further noted that second part 320 is usually not provided with such continuous openings. Second part 320 is usually placed separately in front of first part 310.

[0049] Figure 5 shows two views of a first mould 100 for the manufacture of first part 310 of end element 30 of figure 4A. The first mould shown in figure 5 is a model and demonstrates merely the functionality of first mould 100. Components of first mould 100 are preferably made of metal parts, such as steel parts. It is also noted that first mould 100 comprises an outer mould (not shown) which is formed by a beam in which the components shown in figure 5 are placed.

[0050] Visible in the part-figure of figure 5 on the right are an inner mould 110 and a mould part 120. Inner mould 110 is here preferably a hollow structure with chamfered edges for forming chamfering 315.

[0051] Mould part 120, which extends in the space between the outer mould (not shown) and inner mould 110, comprises an elevated part 121, oblique walls 122 and a transverse part 123. Elevated part 121 comprises a platform 1211 from which oblique walls 122 extend to transverse part 123. Platform 1211 is supported by legs 1212 and transverse part 123 by legs 1232.

[0052] In an embodiment elevated part 121, oblique walls 122 and transverse part 123 are fixed, non-adjustable elements. Different types of this element can in this case be used for the manufacture of different end elements 30. In other embodiments the angle of oblique walls 122 relative to elevated part 121 is adjustable, for instance by means of hydraulic cylinders. The position of walls 122 relative to elevated part 121, indicated by arrows P1, could likewise be adjustable. Such an adjustability is also possible for adjusting the height positioning of platform 1211. Transverse part 123 is also adjustable to different heights by making use of legs 1232 with different lengths.

[0053] In order to realize a first part 310 of an end element 30 concrete is poured into the space between inner mould 110 and the outer mould from above. It runs up against mould part 120 here. Transverse part 123 defines here the position where upper wall 313 stops, platform 1211 defines the end of first part 30, and oblique walls 122 define side walls 312. Prior to the pouring, filler parts (not shown) can be placed on platform 1211, transverse part 123 and/or oblique walls 122 for the purpose of realizing continuous openings 316 in which post-tension cables are later arranged. Edge parts can also be placed on platform 1211, or on the bottom of the outer mould if platform 1211 is not used, for the purpose of forming recesses 317. Such an edge can however also form an integral part of platform 1211.

[0054] Also visible in the figure on the right are filler parts 124 which, as shown in figure 4A, prevent chamfering 315 from running beyond upper wall 313 at the position of upper wall 313. The figure on the left in figure 5 shows an example of a side view of a first part 310 formed with first mould 100. Side wall 312 of first part

310 is visible here.

[0055] Figure 6 shows a view of a second mould 200 for the manufacture of second part 320 of end element 30 of figure 4A. The second mould shown in figure 6 is a model and demonstrates merely the functionality of second mould 200. Components of second mould 200 are preferably made of metal parts, such as steel parts. It is also noted that second mould 200 comprises an outer mould (not shown) which is formed by a number of walls which define a space in which the components shown in figure 6 are placed.

[0056] Second mould 200 comprises an inner mould 210 with rounded corners for forming chamfering 325. Second mould 200 further comprises a mould part 220 which is placed in a space between inner mould 210 and the outer mould. Mould part 220 comprises here an elevated part 221 which comprises a platform 2211 supported by legs 2212. The height positioning of platform 2211 determines the length of second part 320. Mould part 220 also comprises side walls 222.

[0057] In figure 6 the angle of side walls 222 can be adjusted by placing support 2213 in a different position. Such a function can be implemented by a steel wall which can be pivoted relative to the outer mould by means of a hydraulic cylinder. Such a function can also be implemented as shown in figure 6. Side wall 222 comprises here a number of recesses 2214 which are arranged in side wall 222 at several positions. It is noted here that figure 6 shows only a single recess 2214. Support 2213 engages on a single recess and rests on a step of stair part 2215. Side wall 222 can now be adjusted by selecting a different recess 2214 and a different step of stair part 2215.

[0058] The angle formed by side walls 222 must correspond with the angle formed by oblique walls 122. The position of side walls 222 relative to platform 2211, indicated by arrows P2, can further be varied.

[0059] At the position indicated by arrows D edge-shaping elements can be pressed into the concrete immediately after it is poured for the purpose of forming recesses 327.

[0060] Reinforcement can be placed in both first mould 100 and second mould 200. Lift anchors, with which the concrete first part 310 and second part 320 can be removed from the respective moulds after sufficient curing, can also be cast in.

[0061] End element 30 can be coupled to known middle segments 2. First part 310 is here placed against a middle segment 2 which is arranged at the end of the row of middle segments 2. Opening 314 is here aligned with the openings of middle segments 2. First part 310 is then coupled to the adjacent middle segment 2. Use can be made here of a socket-spigot joint, wherein a socket is formed in or at middle segment 2 or end element 30 and a spigot is formed in or at end element 30 or middle segment 2.

[0062] In other embodiments middle segments 2 are provided with continuous openings, which are likewise present in first part 310. Post-tension cables can be arranged through these openings. Use can be made here of cone-shaped parts which are arranged at the end of the openings in first part 310 during pouring. The tensioned post-tension cables can be anchored in these parts.

[0063] If necessary, for instance if end element 30 has a great length, second part 320 can be placed adjacently of first part 310. Lower walls 311, 321 and side walls 312, 322 are here aligned so that it seems as if first part 310 and second part 320 form an integral part. It is preferred here for upper surfaces V1, V2 shown in figure 4A to lie in the same plane. The same applies to upper surfaces V3, V4 and lower walls 311, 321.

[0064] The above described outer moulds and inner moulds can be embodied by means of metal walls, such as steel walls, which are hydraulically adjustable. Adjustment enables first part 310 or second part 320 to be easily removed from the mould after sufficient curing. Mould part 120 can here be placeable as a single element. Filler parts 124 can optionally be placed separately from the rest of mould part 120. Mould part 220 can similarly be placeable as a single element.

[0065] The present invention is described on the basis of embodiments. The invention is however not limited to these embodiments. Various modifications are possible without departing from the scope of protection of the present invention as defined by the appended claims and equivalents thereof.

Claims

1. Mould assembly for forming an end element (30) of a concrete tubular structure such as a culvert (1) or sewage pipe, comprising a first mould (100) and a second mould (200) for forming respectively a first part (310) and a second part (320) of the end element (30), wherein the first mould (100) and the second mould (200) each comprise:

    an outer mould;
    an inner mould (110; 210) placed in the outer mould;
    a mould part (120; 220) placed in a space between the inner mould (110; 210) and an inner wall of the outer mould, wherein the mould part (120; 220) comprises mould walls (122; 222) which extend obliquely relative to a bottom of the outer mould and which extend between the inner wall of the outer mould and an outer wall of the inner mould (110; 210) for the purpose of forming the side walls (312) of the first part (310) or the side walls (322) of the second part (320);
    wherein the mould part (120; 220) comprises an elevated part (121; 221) which is placed on the bottom of the outer mould, and wherein the obliquely extending mould walls (122; 222) extend

from the elevated part (121; 221);
wherein, for the first mould (100) and/or the second mould (200), a height over which the elevated part (121; 221) extends and/or an angle formed by the obliquely extending mould walls (122; 222) with the bottom of the outer mould or the elevated part (121; 221) and/or a position where the obliquely extending mould walls (122; 222) engage on the bottom of the outer mould or the elevated part (121; 221) is adjustable.

2. Mould assembly according to claim 1, wherein the mould part (120) of the first mould (100) comprises a transverse part (123) which extends substantially perpendicularly relative to the obliquely extending mould walls (122), wherein the mould walls (122) extend between the elevated part (121) or the bottom of the outer mould and the transverse part (123).

3. Mould assembly according to any one of the foregoing claims, wherein the mould part (120; 220) further comprises chamfering parts (124) which lie against the transverse part (123) and/or the obliquely extending mould walls (122; 222) for the purpose of forming a chamfering (315; 325) or rounding of the first part (310) or second part (320) of the end element (30), wherein the mould assembly is configured to form the chamfering (315) or rounding in a corner between the side walls (312) and lower wall (311) of the first part (310), and/or between the side walls (322) and the upper wall (313) of the first part (310), and/or in a corner between the side walls (322) and the lower wall (321) of the second part (320).

4. Mould assembly according to any one of the foregoing claims, further comprising reinforcement placed in a space between the outer mould and the inner mould (110) of the first mould (100) and reinforcement placed in a space between the outer mould and the inner mould (210) of the second mould (200).

5. Mould assembly according to any one of the foregoing claims, wherein the outer mould of the second mould (200) surrounds the inner mould (210) of the second mould (200) on three sides.

6. Mould assembly according to any one of the foregoing claims, wherein the outer mould of the first mould (100) surrounds the inner mould (110) of the first mould (100) on four sides.

7. Mould assembly according to any one of the foregoing claims, wherein the first mould (100) further comprises filler parts which extend perpendicularly relative to the bottom of the outer mould or elevated part (121) of the first mould (100) and which are configured to form continuous openings during the pouring of concrete for the purpose of throughfeed of post-tension cables.

8. Mould assembly according to claim 7, wherein the filler parts are arranged on the obliquely extending mould walls (122), the elevated part (121) and/or the transverse part (123).

9. Mould assembly according to any one of the foregoing claims, wherein the first mould (100) has first protruding edges for forming first recesses (317) in end surfaces (V6) of the side walls (312) of the first part (310) which are directed toward the second part (320), and wherein the second mould (200) has second protruding edges for forming second recesses (327) in end surfaces (V5) of the side walls (322) of the second part (320) which are directed toward the first part (310).

10. Method for manufacturing an end element (30), comprising of:

providing the mould assembly according to any one of the foregoing claims;
pouring concrete into the first mould (100) in a first pouring run for the purpose of forming the first part (310) of the end element (30); and
pouring concrete into the second mould (200) in a second pouring run for the purpose of forming the second part (320) of the end element (30).

11. Method according to claim 10, to the extent dependent on claim 7, further comprising of placing the filler parts on the oblique mould walls (122), the elevated part (121), the bottom of the outer mould and/or the transverse part (123) of the first mould (100) prior to concrete being poured into the first mould (100) for the purpose of forming continuous openings in the first part (100).

12. Method according to any one of the claims 10-11, further comprising of placing reinforcement in a space between the inner mould (110; 210) and outer mould of the first mould (100) and/or second mould (200).

13. Method for manufacturing a concrete tubular structure such as a culvert or sewage pipe, comprising of:

the method according to any one of the claims 10-12 for forming at least one end element (30);
placing one or more concrete middle segments (2) to form a middle part of the concrete tubular structure;
placing the first part (310) in the vicinity of a middle segment (2) at an end of the middle part and coupling this middle segment (2) to the first part (310).

14. Method according to claim 13, to the extent dependent on claim 11, wherein the middle segments (2) each have continuous openings, wherein the continuous openings of the middle segments (2) are aligned, and wherein said coupling comprises of passing post-tension cables through the continuous openings of the middle part (2) and continuous openings of the first part (310) and tensioning them.

15. Method according to claim 13 or 14, further comprising of placing the second part (320) in the vicinity of the first part (310) and, to the extent dependent on claim 9, further comprising of arranging sealing elements (318) in the openings formed by the first and second recesses (317; 327).

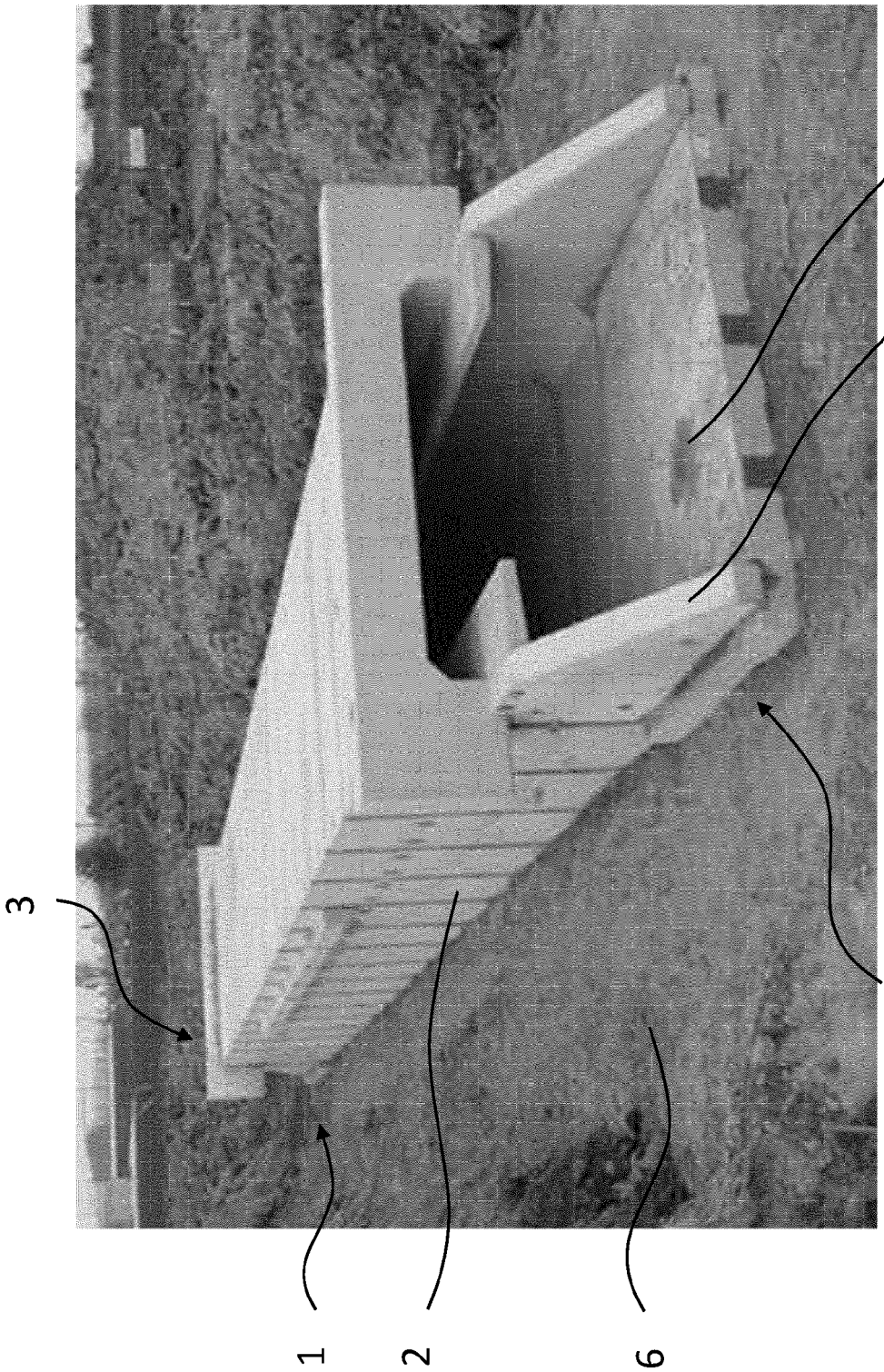


Fig. 1

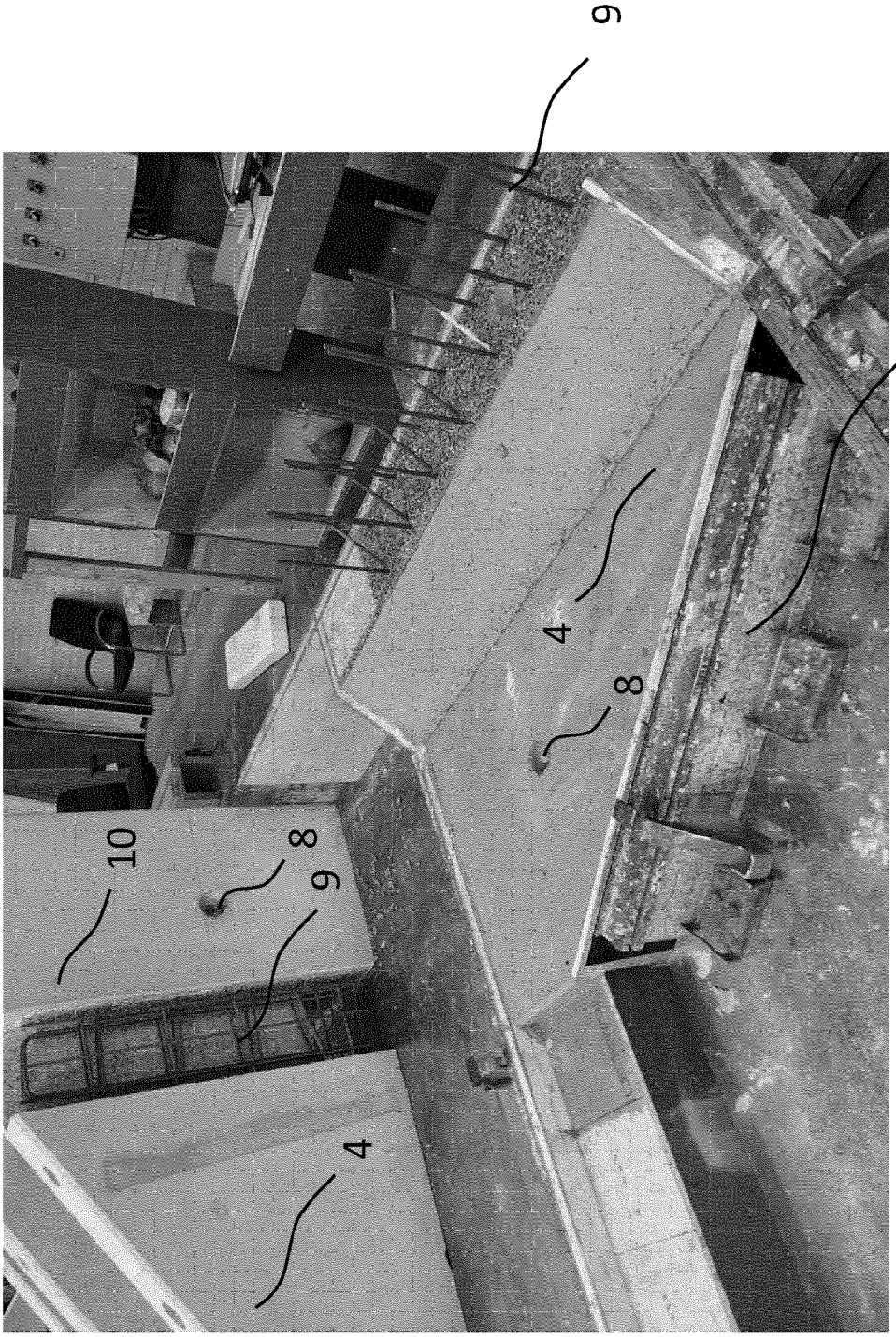


Fig. 2

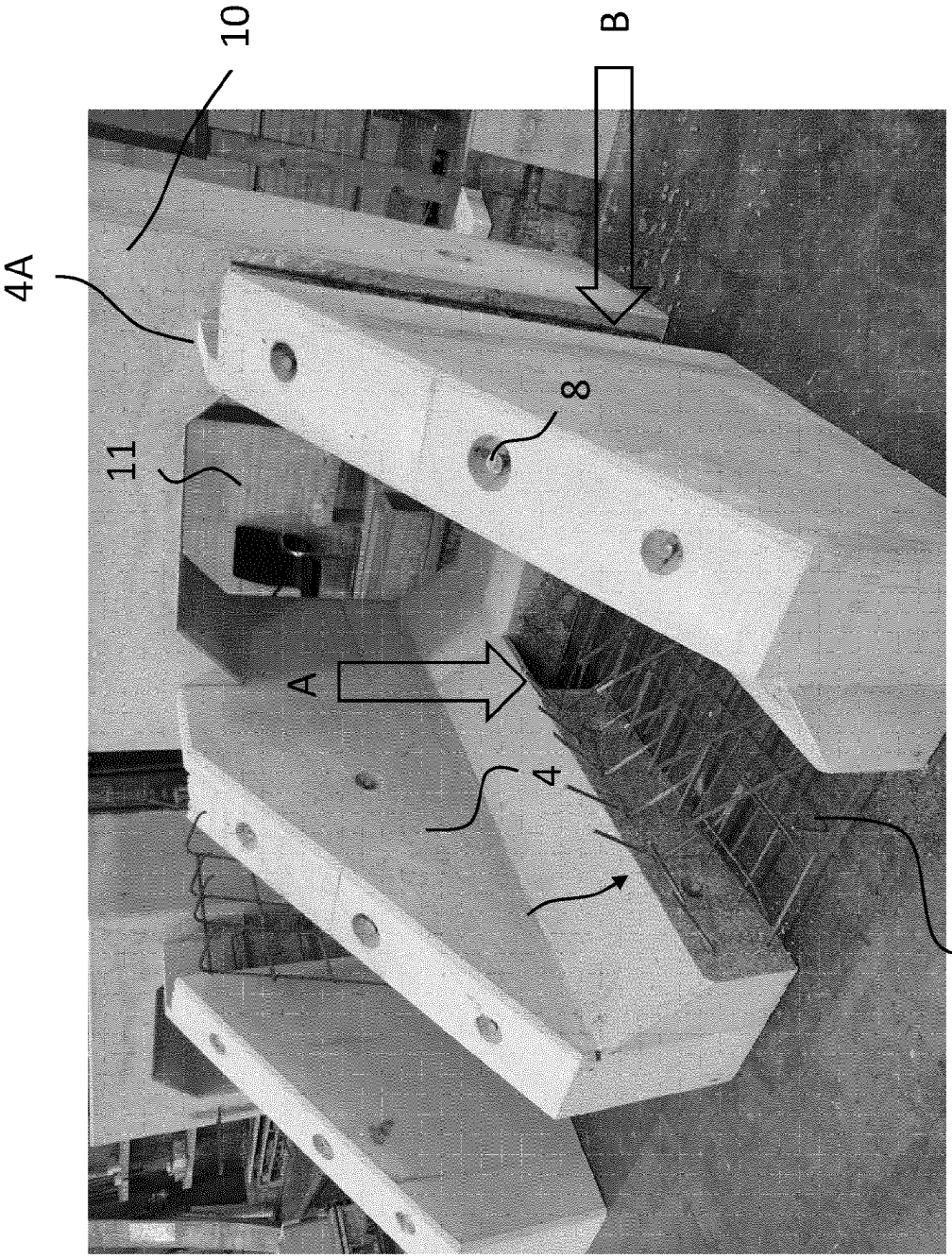


Fig. 3

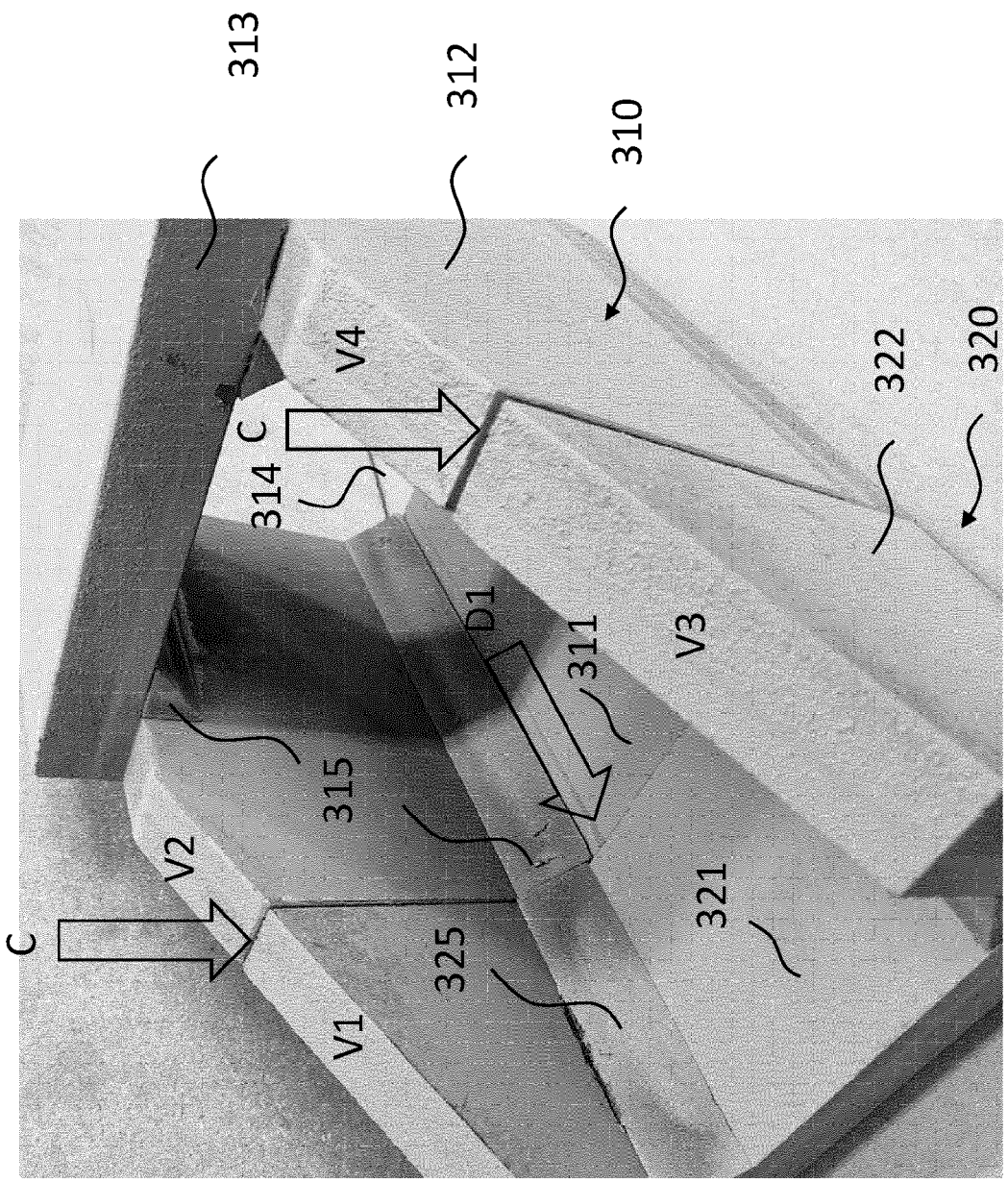


Fig. 4A

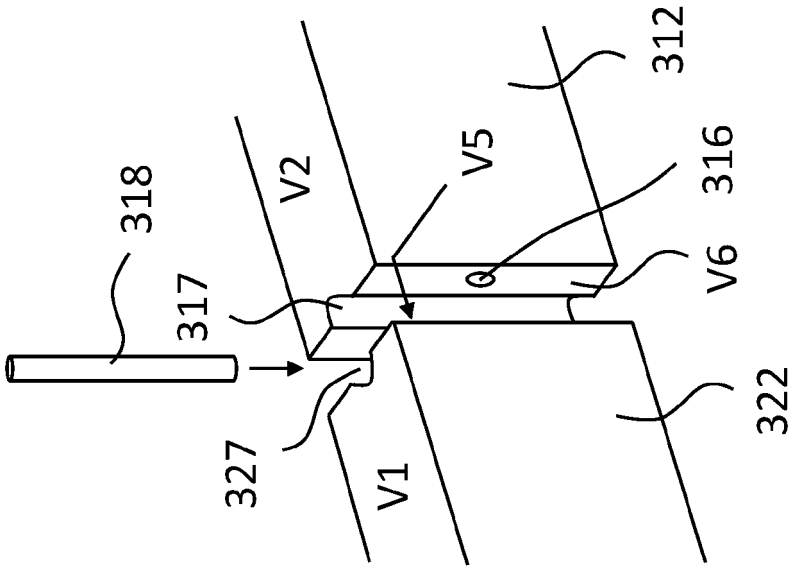
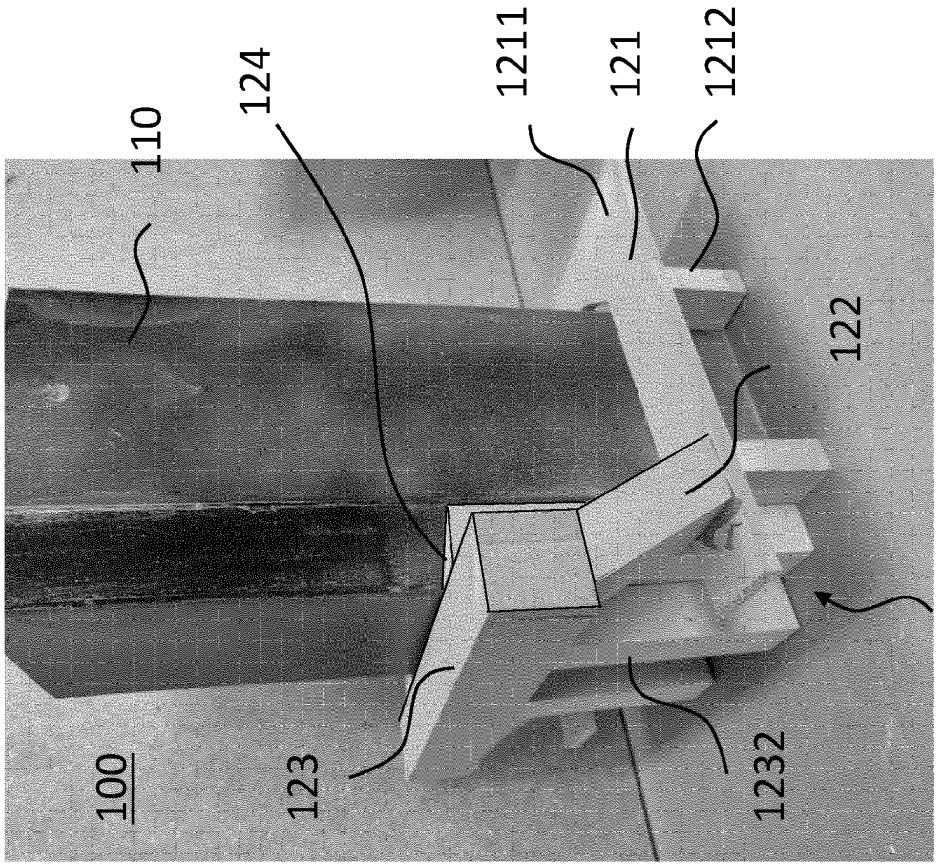


Fig. 4B



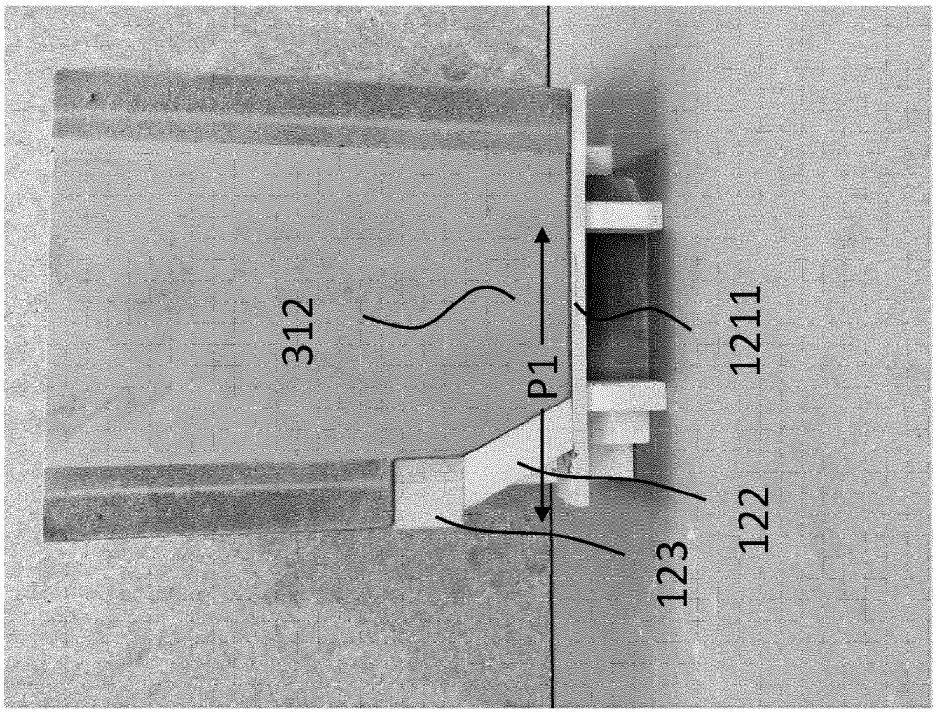


Fig. 5

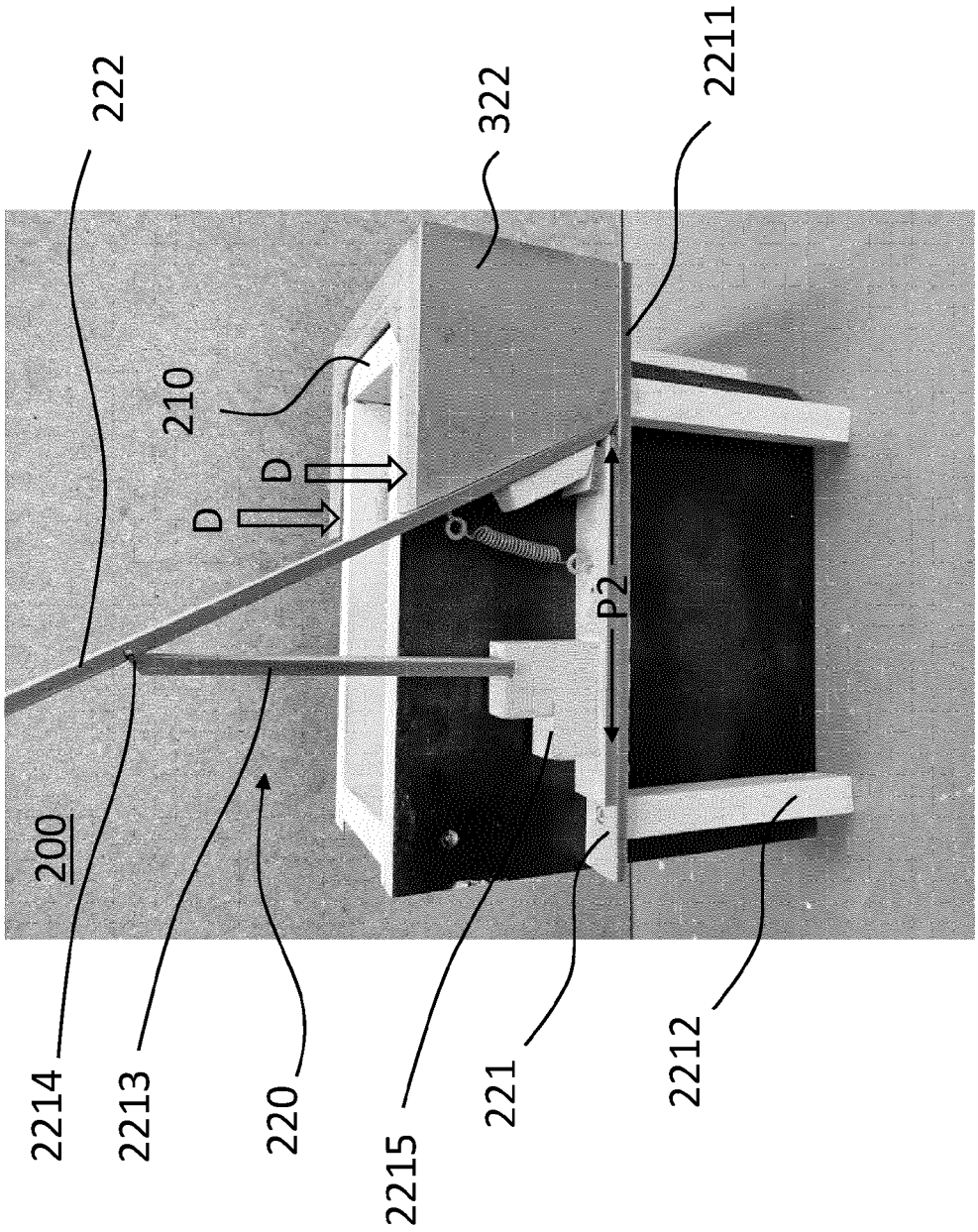


Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 23 15 4008

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 May 2023	Schouten, Adri

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