(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 130 992 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.12.2009 Bulletin 2009/50

(51) Int Cl.:
E04G 11/38 *(2006.01)* ***E04G 19/00*** *(2006.01)*

(21) Application number: **09161462.8**

(22) Date of filing: **29.05.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR

(30) Priority: **03.06.2008 IT UD20080132**

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(54) **Device, formwork, equipment and method for the production of horizontal flat structures, such as bearing floors, floors or similar**

(57) Device to make horizontal flat structures (11), comprising a formwork (12) having a molding surface (16) facing upward and on which a cast of concrete is made, on site, in order to define the horizontal flat structure (11), and a lifting equipment (13), able to be selectively constrained to the formwork (12) in order to lift the formwork (12) from a first position lower than the horizontal flat structure (11), to a second higher position resting on the horizontal flat structure (11) itself. The formwork (12) comprises first constraint elements (18) disposed in proximity both to the molding surface (16) and also to a barycentric zone thereof, and the lifting equipment (13) is conformed in such a manner as to define at least a lower segment (21) provided with second constraint elements (25) able to cooperate with the first constraint elements (18), in order to constrain from above the lifting equipment (13) to the formwork (12), and at least an upper segment (22) connected to the lower segment (21) and provided with connecting elements (26) with which it is able to be connected in a balanced manner to a lifting member.

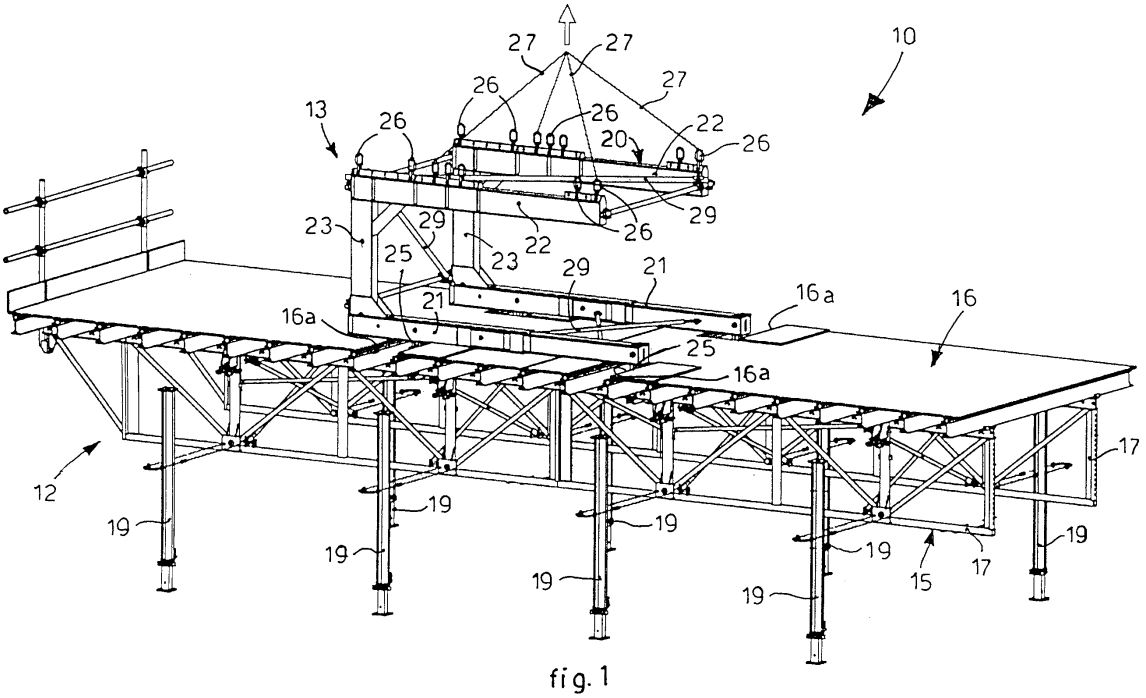

fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention concerns a device and method for the production of horizontal flat structures, such as bearing floors, floors or others, which make up the cover and the support of the intermediate floors of buildings. Moreover the present invention also concerns a mobile supporting formwork, or board, on which the flat structure is cast on site, and a lifting equipment for said mobile formwork.

BACKGROUND OF THE INVENTION

[0002] It is known that, in the building sector, in order to make horizontal flat structures such as bearing floors, floors, or others, devices are used provided with lower supporting formworks or boards, having a support frame and a molding surface, on which the cast of concrete is made on site in order to form the bearing floor.

[0003] This type of known boards has the support frame adjustable in height, so as to determine the height of the cast from the floor and, once the cast is consolidated, they are transported above the bearing floor which has just been made, so that they are ready to make a new bearing floor of a higher floor.

[0004] One of the main disadvantages in the state of the art is that it is necessary to transport the board from below to above the bearing floor, in a limited time, with operational simplicity and with limited risks for the operators.

[0005] It is known in the state of the art to make the board protrude from one side with respect to the bulk of the bearing floor made, in such a way as to be able to attach the board itself with a lifting device, for example a crane, to completely remove the board from the bulk of the bearing floor, to lift it with the crane and to position it above the bearing floor.

[0006] This first known method has considerable impediments and practical difficulties, above all during the steps when the board is attached to the crane and removed laterally from the bulk of the bearing floor.

[0007] Considering the length of the boards, which can be about 10 meters long or even more, it is very difficult to constrain the formwork to the crane in a balanced way, preventing uncontrollable pitching thereof.

[0008] With this known method, the risk of damaging the structures and of accidents for the workers is increased if such operations are carried out at about 10 - 20 meters from the ground.

[0009] It is also known, in order to limit the danger of pitching, to use a particular lifting equipment, called in slang fork or lifting device, which is constrained above the crane and, on the lower part, has one or more cross-pieces, or forks, which are positioned in cooperation with the support frame below the molding surface.

[0010] This known lifting equipment supports and lifts the formwork from below and, by means of the action of the crane, transports the board itself to above the bearing floor.

[0011] This second known method however, in order to maintain the balance, requires that the cross-pieces of the lifting equipment have substantially the same size as, or slightly lower than, the overall length of the board.

[0012] Thus, for long boards, the maneuvers to insert the cross-pieces of the lifting equipment below the support frame are particularly complex, with the risk of damaging the board itself, and with little maneuverability of the equipment.

[0013] Moreover, since it is necessary to provide cross-pieces that are correlated in size specifically to the length of the board, it is necessary to provide, on each occasion, a specific design and production of the lifting equipment.

[0014] This involves a considerable increase in times and costs of the operation, as well as a lot of stock in hand.

[0015] Purpose of the present invention is to allow to produce bearing floors with the possibility of transporting the board from below to above the bearing floor itself, in a limited time, with operative simplicity and with limited risks for the operators, without incurring the disadvantages of the state of the art.

[0016] The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0017] The present invention is set forth and characterized in the independent claims, while the dependent claims describe other characteristics of the invention or variants to the main inventive idea.

[0018] The present invention refers to a device, to a formwork, to a lifting equipment and to an method, for the production of horizontal flat structures.

[0019] In accordance with the above purpose, the present invention provides a formwork having a molding surface on which a cast of concrete is made on site, in order to define the horizontal flat structure, and a lifting equipment, able to be selectively constrained to the formwork, in order to lift the latter from a first position lower than the horizontal flat structure, to a second higher position resting on the horizontal flat structure.

[0020] According to a characteristic feature of the present invention, the formwork comprises first constraint means disposed in proximity both to its molding surface and also to a barycentric zone of the formwork itself.

[0021] According to the invention, the lifting equipment is conformed in such a way as to define at least a lower segment provided with second constraint means able to cooperate with the first constraint means, in order to define the attachment from above of the lifting equipment to the formwork. Moreover, the equipment comprises at

least an upper segment connected to the lower segment and provided with connecting means with which it is able to be connected in a balanced way to a lifting member.

[0022] The connecting means is disposed on the upper segment in such a way that, with respect to the conformation of the lifting equipment, the lifting action applied on this upper segment by the lifting member is substantially balanced, that is, sufficiently compensated, with respect to the action of downward traction applied by the weight of the formwork on the lower arm.

[0023] In this way, the attachment of the lifting equipment to the formwork is achieved in a substantially balanced way, thus avoiding uncontrolled pitching and unbalancing in the movement phases of the formwork.

[0024] Moreover, the attachment from above of the lifting equipment to the formwork allows to simplify and standardize the conformation of the lifting equipment, guaranteeing an efficient and rapid lifting of the formwork itself.

[0025] Indeed, the connection from above with respect to the first constraint means, disposed in proximity to a barycentric zone of the formwork, allows a standardized lateral extraction of the formwork with respect to the bulk of the horizontal flat structure.

[0026] This lateral extraction of the formwork can be carried out in safety until the barycentric zone of the formwork is at a determined distance, irrespective of the length of the formwork, with respect to the lateral edge of the flat structure.

[0027] In this way, the lower segment of the lifting equipment can be partly inserted between the flat structure and the molding surface of the formwork, until reaching the first constraint means. The entity of this insertion is directly proportionate to the distance of the barycentric zone from the edge of the structure.

[0028] Therefore, the size of the lower segment can be standardized depending on the entity of the distance and not of the sizes of the formwork.

[0029] Therefore with the present invention there is a substantial reduction in times and costs of making the lifting equipment, and also a reduction in the stock in hand.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is an overall three-dimensional view of a device for producing horizontal flat structures according to the present invention;
- fig. 2 is a lateral view of an operative step of the method according to the present invention;
- fig. 3 is a lateral view of an operative step subsequent to fig. 2, of the method according to the present invention;
- fig. 4 is a lateral view of an operative step subsequent to fig. 3, of the method according to the present invention;
- fig. 5 is a lateral view of an operative step subsequent to fig. 4, of the method according to the present invention;
- fig. 6 is a lateral view of an operative step subsequent to fig. 5, of the method according to the present invention;
- fig. 7 is a lateral view of an operative step subsequent to fig. 6, of the method according to the present invention;
- fig. 8 is a lateral view of an operative step subsequent to fig. 7, of the method according to the present invention;
- fig. 9 is a lateral view of an operative step subsequent to fig. 8, of the method according to the present invention;
- fig. 10 is a lateral view of an operative step subsequent to fig. 9, of the method according to the present invention;
- fig. 11 is a lateral view of an operative step subsequent to fig. 10, of the method according to the present invention;
- fig. 12 is a lateral view of an operative step subsequent to fig. 11, of the method according to the present invention.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT

[0031] With reference to the attached drawings, a device 10 according to the present invention is applied to make one or more concrete bearing floors 11, or other horizontal flat structure, of a building having several stories.

[0032] In particular, the device 10 substantially comprises a mobile formwork, or board 12, and a lifting equipment 13 which, assisted by a crane or other lifting device, selectively moves the board 12 between a first position lower than the bearing floor 11 and a second position resting above the bearing floor 11, in order to make a new bearing floor 11 of a higher story.

[0033] The board 12 comprises a lower support frame 15 and an upper molding surface 16, substantially flat, on which concrete is directly cast on site in order to make the bearing floor 11.

[0034] The support frame 15 comprises a pair of reticular beams 17 to support the molding surface 16, and a plurality of supporting legs 19, in this case eight, made telescopically to allow to regulate the board 12 in height.

[0035] Moreover, on each reticular beam 17, two constraint pins 18 are provided, which are disposed on one side or the other with respect to a barycentric zone, in this case a median zone, of the board 12, and in proximity to the molding surface 16.

[0036] The molding surface 16 comprises a plurality

of openings 16a, re-closable, made in correspondence with each constraint pin 18, in such a way as to allow selective access from above to the latter.

[0037] The lifting equipment 13 comprises a frame 20 shaped like a double "C" and provided with two lower segments 21, two upper segments 22 substantially parallel to the two lower segments 21, and two connecting segments 23 which connect with each other one end of each lower segment 21 with respective ends of each upper segment 22.

[0038] Each lower segment 21 is advantageously shaped in a telescopic way, to be able to be selectively lengthened and shortened, and at the lower part comprises two constraint brackets 25 able to be inserted from above, through the openings 16a, to cooperate with the constraint pins 18.

[0039] The telescopic conformation of the lower segments 21 allows to make uniform, or to correct, the interaxis of the constraint brackets 25 with respect to that of the constraint pins 18, thus guaranteeing an optimal coupling of the lifting equipment 13 to the board 12.

[0040] Each upper segment 22 comprises at the upper part a plurality of connecting ringbolts 26, distributed in various positions along the length of the upper segment 22, to allow different connecting conditions.

[0041] The connecting ringbolts 26 allow to connect, through relative drawing cables 27, the lifting equipment 13 to a lifting crane, of the traditional type and not shown here.

[0042] Both the two lower segments 21 and the two upper segments 22 and the two connecting segments 23 are connected to each other by means of stiffening crosspieces 29.

[0043] The method to make bearing floors 11 with the device 10 according to the present invention is as follows.

[0044] Initially the board 12 is set up, regulating the supporting legs 19, in order to dispose the relative molding surface 16 substantially horizontal and at a desired height from the floor.

[0045] The cast of concrete is then made to make the bearing floor 11.

[0046] Once the concrete has set, the molding surface 16 is slightly detached from the bearing floor 11 formed (fig. 2).

[0047] Then four of the eight supporting legs 19 are lifted, preferably the external ones (fig. 3), so that respective hydraulic jacks 30 can be associated with these lifted legs 19 in order to support the board 12.

[0048] The four central supporting legs 19 are then also lifted, and respective revolving wheels 31 are associated with each of these (fig. 5).

[0049] Once the revolving wheels 31 have been mounted, the jacks are released (fig. 6) in order to rest the board 12 on the ground by means of the wheels 31, and to define a space between the molding surface 16 and the bearing floor 11.

[0050] A safety catch 32 is disposed on the floor, and is advantageously, but not exclusively, applied when the above and subsequent operations are carried out at a certain height.

[0051] The board 12 is then thrust on the wheels 31 until it protrudes laterally with respect to the bearing floor 11 (fig. 7). The entity of the movement given to the board 12 is such as to take the barycentric zone of the latter into proximity with the outside edge of the bearing floor 11. Advantageously, the movement is such as to take the barycentric zone of the board 12 to a determined standardized distance from the outside edge of the bearing floor 11.

[0052] Once the desired position of the board 12 is reached, the lifting equipment 13 is lowered, associated in advance with a crane by means of the connecting ringbolts 26.

[0053] The lifting equipment 14 is disposed with its lower segment 21 in the space between the bearing floor 11 and the molding surface 16, in such a position that the constraint brackets 25 are in correspondence with the constraint pins 18 (fig. 8).

[0054] The openings 16a are opened to allow the coupling from above of the constraint brackets 25 and the relative constraint pins 18.

[0055] Once the coupling from above of the lifting equipment 13 and the board 12 is consolidated, the lifting and the lateral movement of the lifting equipment 13 is commanded (fig. 9), in order to completely extract the board 12 sideways with respect to the bearing floor 11.

[0056] The board 12 is positioned on the upper surface of the bearing floor 11 which has been previously made (figs. 10 and 11), in order to prepare it for making a new bearing floor 11.

[0057] Once the board 12 has been correctly positioned, the constraint brackets 25 are detached from the relative constraint pins 18, the openings 16a are reclosed and the lifting equipment 13 is discharged (fig. 12).

[0058] It is clear, however, that modifications and/or additions of parts may be made to the device 10, the formwork or board 12, the lifting equipment 13 and the method as described heretofore, without departing from the field and scope of the present invention.

[0059] For example, it comes within the field of the present invention to provide that the lifting equipment 13 can have a different shape than that of the double "C" as shown here, for example a "Z", an upside down "T", an "I", or others which in any case guarantee, on the one hand, the insertion of the lower segment 21 in the space between the bearing floor 11 and the board 12 and, on the other hand, a sufficient compensation and balance of the forces exerted by the crane and the board 12 during the lifting.

[0060] It also comes within the field of the present invention to provide parapets or other safety structures able to be selectively positioned in order to make the work area safe for the workers.

[0061] It is also clear that, although the present invention has been described with reference to specific examples, a person of skill in the art shall certainly be able to

achieve many other equivalent forms of device, formwork, equipment and method to make horizontal flat structures, such as bearing floors, floors or suchlike, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

Claims

1. Device to make horizontal flat structures (11), comprising a formwork (12) having a molding surface (16) facing upward and on which a cast of concrete is made, on site, in order to define said horizontal flat structure (11), and a lifting equipment (13), able to be selectively constrained to said formwork (12) in order to lift said formwork (12) from a first position lower than the horizontal flat structure (11), to a second higher position resting on said horizontal flat structure (11), **characterized in that** said formwork (12) comprises first constraint means (18) disposed in proximity both to said molding surface (16) and also to a barycentric zone thereof, and **in that** said lifting equipment (13) is conformed in such a manner as to define at least a lower segment (21) provided with second constraint means (25) able to cooperate with said first constraint means (18), in order to constrain from above said lifting equipment (13) to said formwork (12), and at least an upper segment (22) connected to said lower segment (21) and provided with connecting means (26) with which it is able to be connected in a balanced manner to a lifting member.

2. Device as in claim 1, **characterized in that** said connecting means (26) is disposed on said upper segment (22) in such a way that, with respect to the conformation of said lifting equipment (13), the lifting action applied on said upper segment (22) by the lifting member is substantially balanced, or sufficiently compensated, with respect to the action of downward traction applied by the weight of said formwork (12) on said lower arm (21).

3. Formwork for the production of horizontal flat structures (11), having a molding surface (16) facing upward, on which a cast of concrete is made on site in order to define said horizontal flat structure (11), said formwork (12) being able to be selectively constrained to a lifting equipment (13) to be lifted from a first position lower than said horizontal flat structure (11), to a second higher position and resting on said horizontal flat structure (11), **characterized in that** said formwork (12) comprises first constraint means (18) disposed in proximity with both said molding surface (16), and also with a barycentric zone thereof, and able to cooperate with said lifting equipment (13) in order to achieve the constraint from above of said lifting equipment (13) to said formwork (12).

4. Formwork as in claim 3, **characterized in that** it comprises a support frame (15) lower than said molding surface (16).

5. Formwork as in claim 4, **characterized in that** said support frame (15) comprises a pair of reticular beams (17) to support said molding surface (16), and a plurality of telescopic supporting legs (19) able to allow to regulate the height of said formwork (12).

6. Formwork as in claim 5, **characterized in that** said first constraint means comprises at least a pair of constraint pins (18) provided on each of said reticular beams (17), and disposed on one side and the other with respect to said barycentric zone of the formwork (12).

7. Formwork as in any claim from 3 to 6, **characterized in that** said molding surface (16) comprises a plurality of openings (16a), re-closable, made in correspondence with each constraint pin (18), in order to allow selective access from above to said constraint pins (18).

8. Lifting equipment for the production of horizontal flat structures (11), able to be selectively constrained to a formwork (12) having a molding surface (16) facing upward, on which a cast of concrete is made on site in order to define said horizontal flat structure (11), said lifting equipment being able to lift said formwork (12) from a first position lower than said horizontal flat structure (11), and a second higher position and resting on said horizontal flat structure (11), **characterized in that** it is conformed so as to define at least a lower segment (21) provided with second constraint means (25) able to cooperate with coordinated first constraint means (18) of said formwork (12), in order to achieve the constraint from above of said lifting equipment (13) to said formwork (12), and at least an upper segment (22) connected to said lower segment (21) and provided with connecting means (26) with which it is able to be connected in a balanced way to a lifting member.

9. Lifting equipment as in claim 8, **characterized in that** said connecting means (26) is disposed on said upper segment (22) in such a way that, with respect to the conformation of said lifting equipment (13), the lifting action applied on said upper segment (22) by the lifting member is substantially balanced, or sufficiently compensated, with respect to the action of downward traction applied by the weight of said formwork (12) on said lower arm (21).

10. Lifting equipment as in claim 8 or 9, **characterized in that** it comprises a frame (20) shaped like a double "C" and provided with two lower segments (21), two upper segments (22) substantially parallel to said

two lower segments (21), and two connecting segments (23) able to connect to each other one end of each lower segment (21) with respective ends of each upper segment (22).

11. Lifting equipment as in any claim from 8 to 10, **characterized in that** each lower segment (21) is conformed telescopically, so as to be selectively lengthened or shortened.

12. Lifting equipment as in any claim from 8 to 11, **characterized in that** said second constraint means comprises at least two constraint brackets (25) made on a lower surface of each of said lower segments (21).

13. Lifting equipment as in any claim from 8 to 12, **characterized in that** said connecting means comprises a plurality of connecting ringbolts (26) disposed in different positions on the length of each of said upper segments (22), so as to allow different connecting conditions.

14. Lifting equipment as in any claim from 10 to 13, **characterized in that** both the two lower segments (21), and also the two upper segments (22), and also the two connecting segments (23) are connected to each other by means of stiffening cross-pieces (29).

15. Method for the production of horizontal flat structures (11), by means of a device comprising a formwork (12) having a molding surface (16) facing upward and on which, in a first shaping step of said method, a cast of concrete is made on site in order to define said horizontal flat structure (11), and a lifting equipment (13), able to be selectively constrained to said formwork (12) which, in a second lifting step of said method, lifts said formwork (12) from a first position lower than said horizontal flat structure (11), to a second higher position and resting on said horizontal flat structure (11), **characterized in that** in said second lifting step said lifting equipment (13) is constrained both from above to said formwork (12), by means of the cooperation between first constraint means (18) disposed in proximity both with said molding surface (16) and also with a barycentric zone of said formwork (12), and second constraint means (25) provided on a lower segment (21) of said lifting equipment (13), and also connected in a balanced way to a lifting member by means of connecting means (26) provided on an upper segment (22) of said lifting equipment (13).

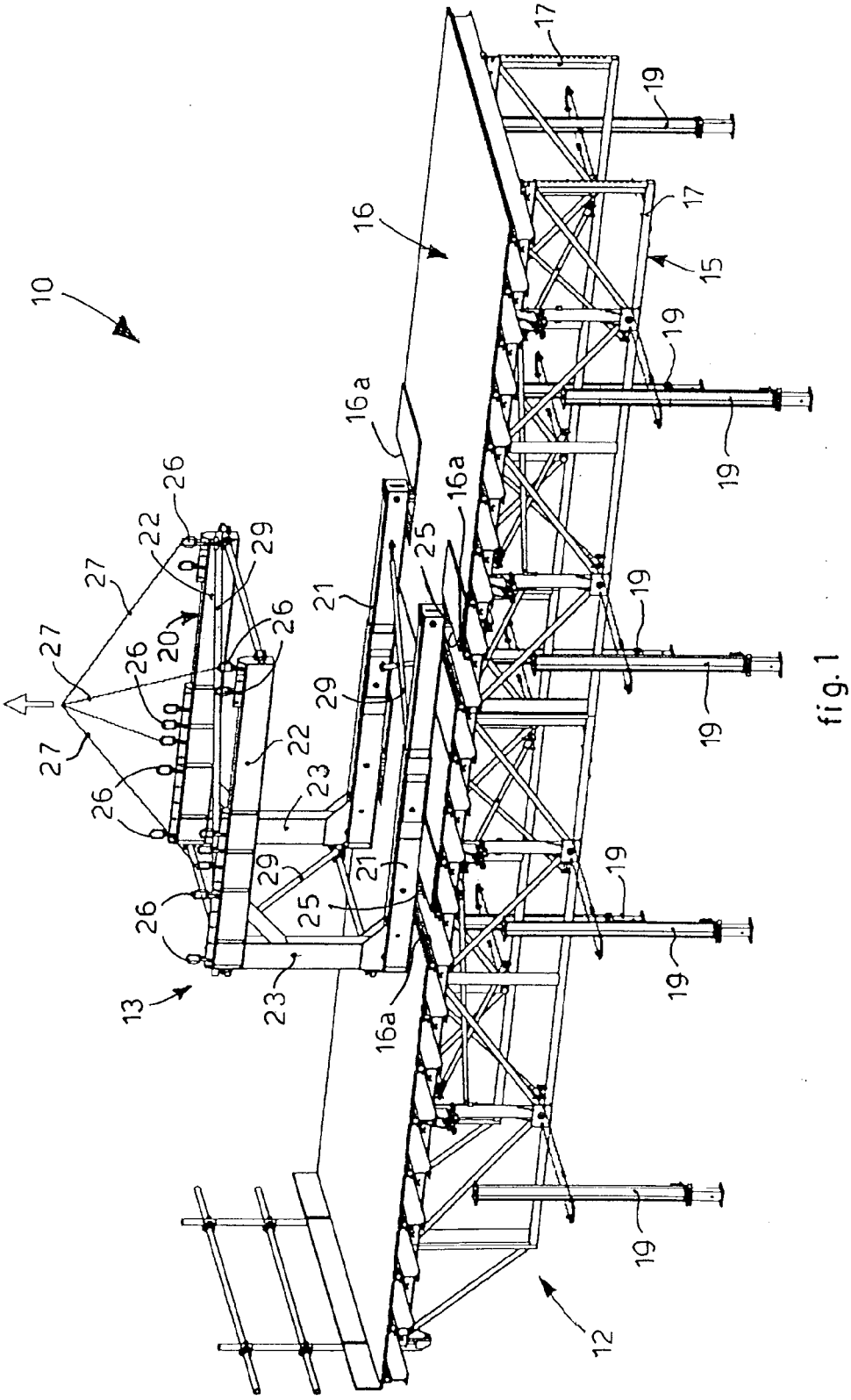

fig.1

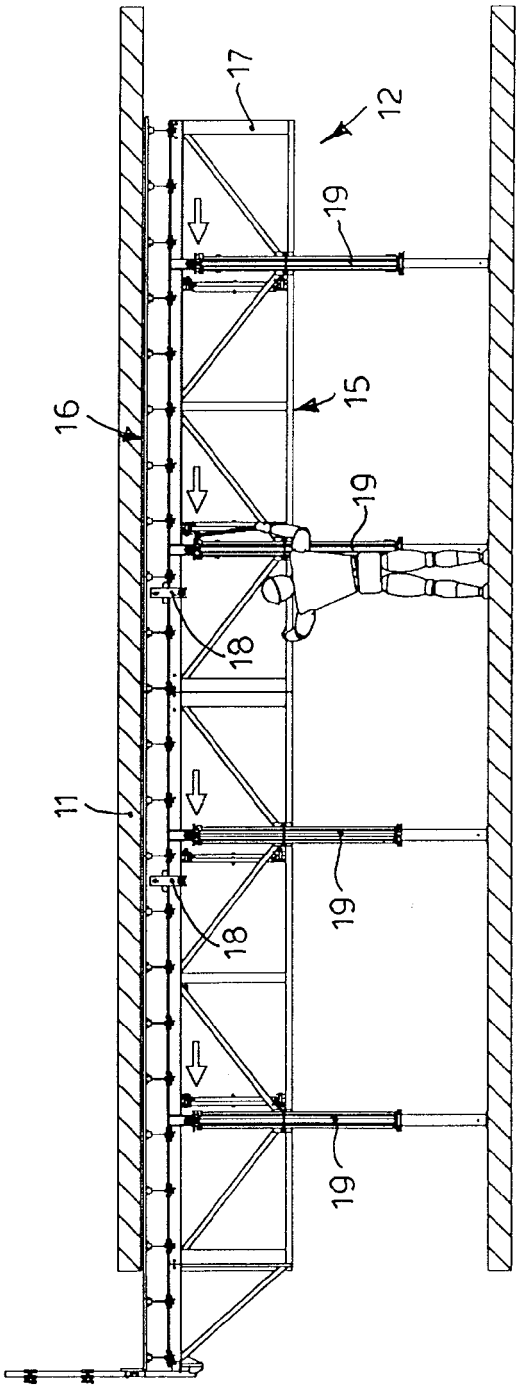

fig. 2

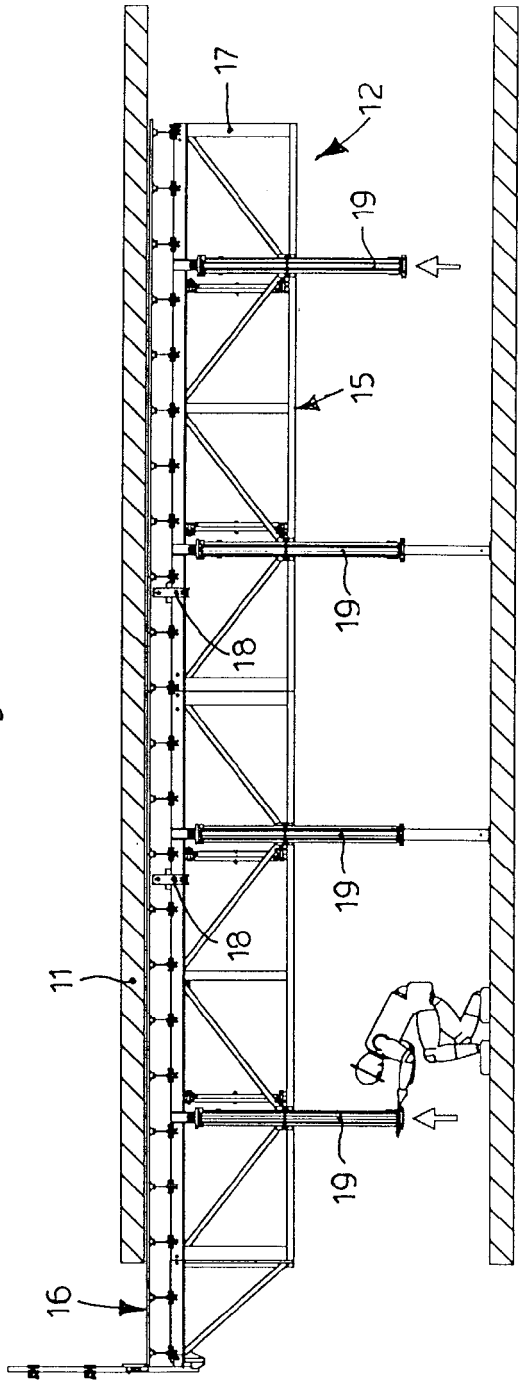

fig. 3

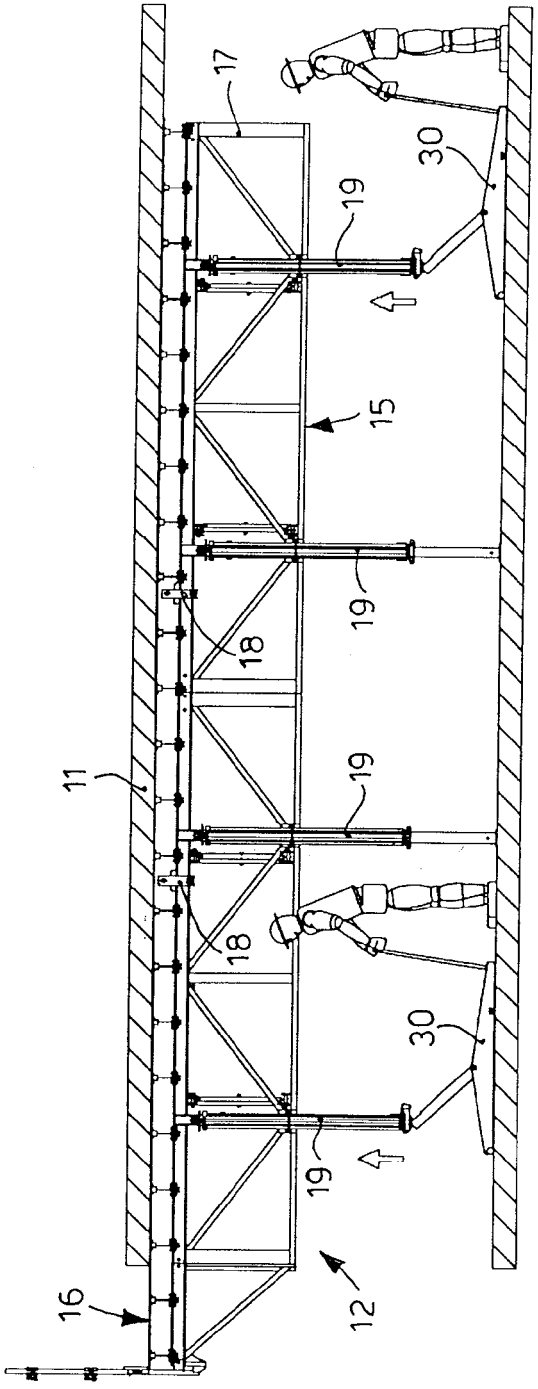
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fig. 4

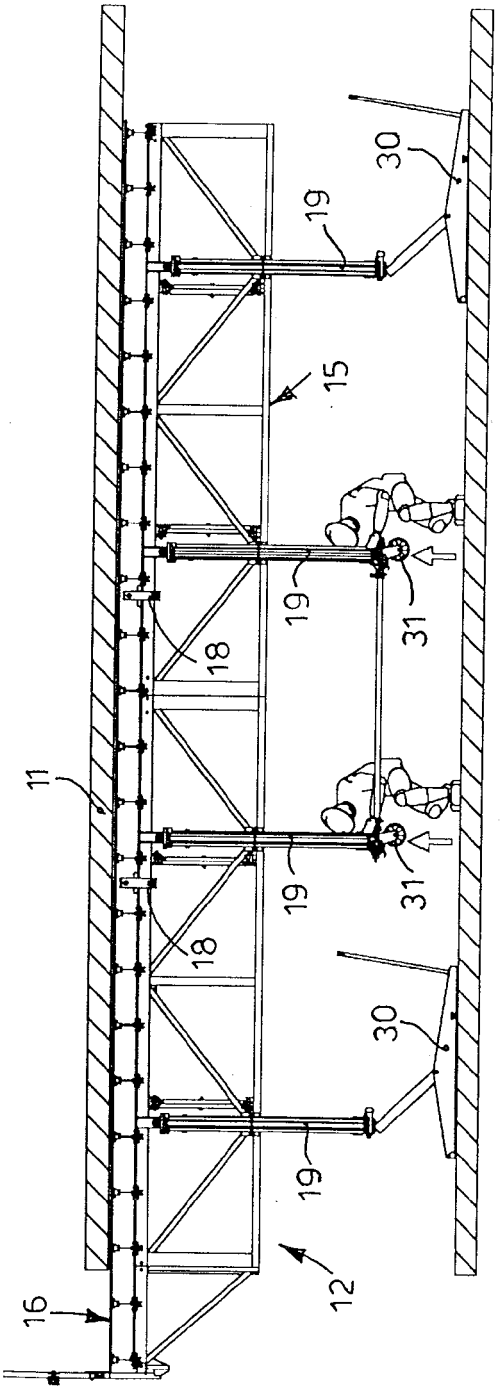
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fig. 5

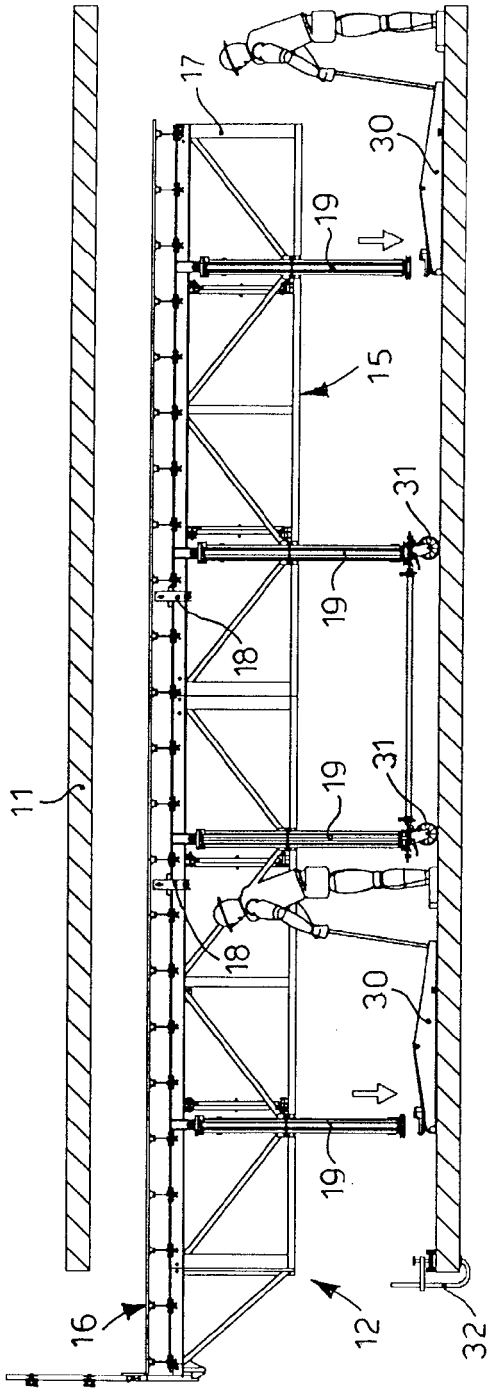

fig.6

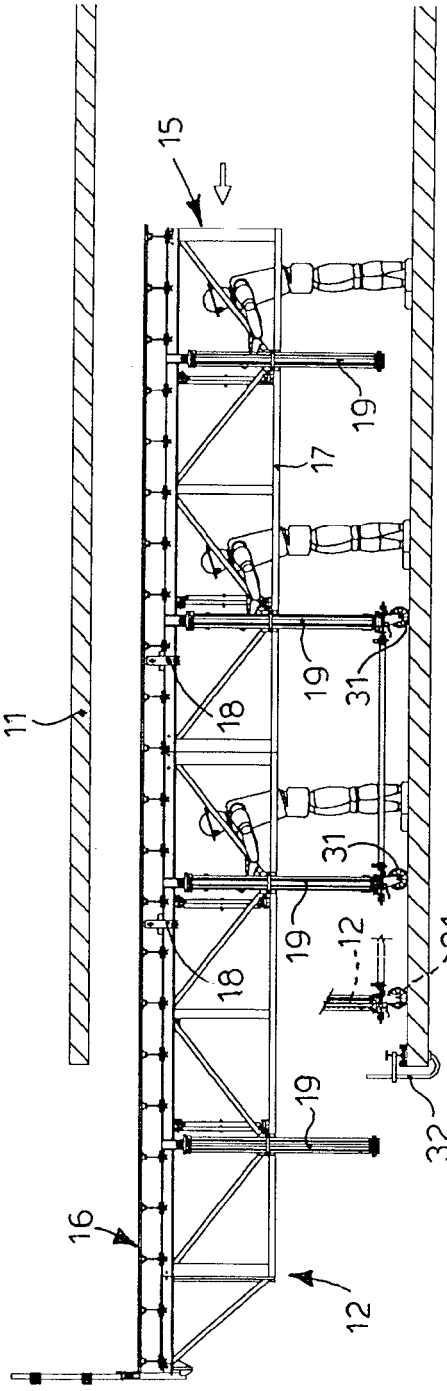

fig. 7

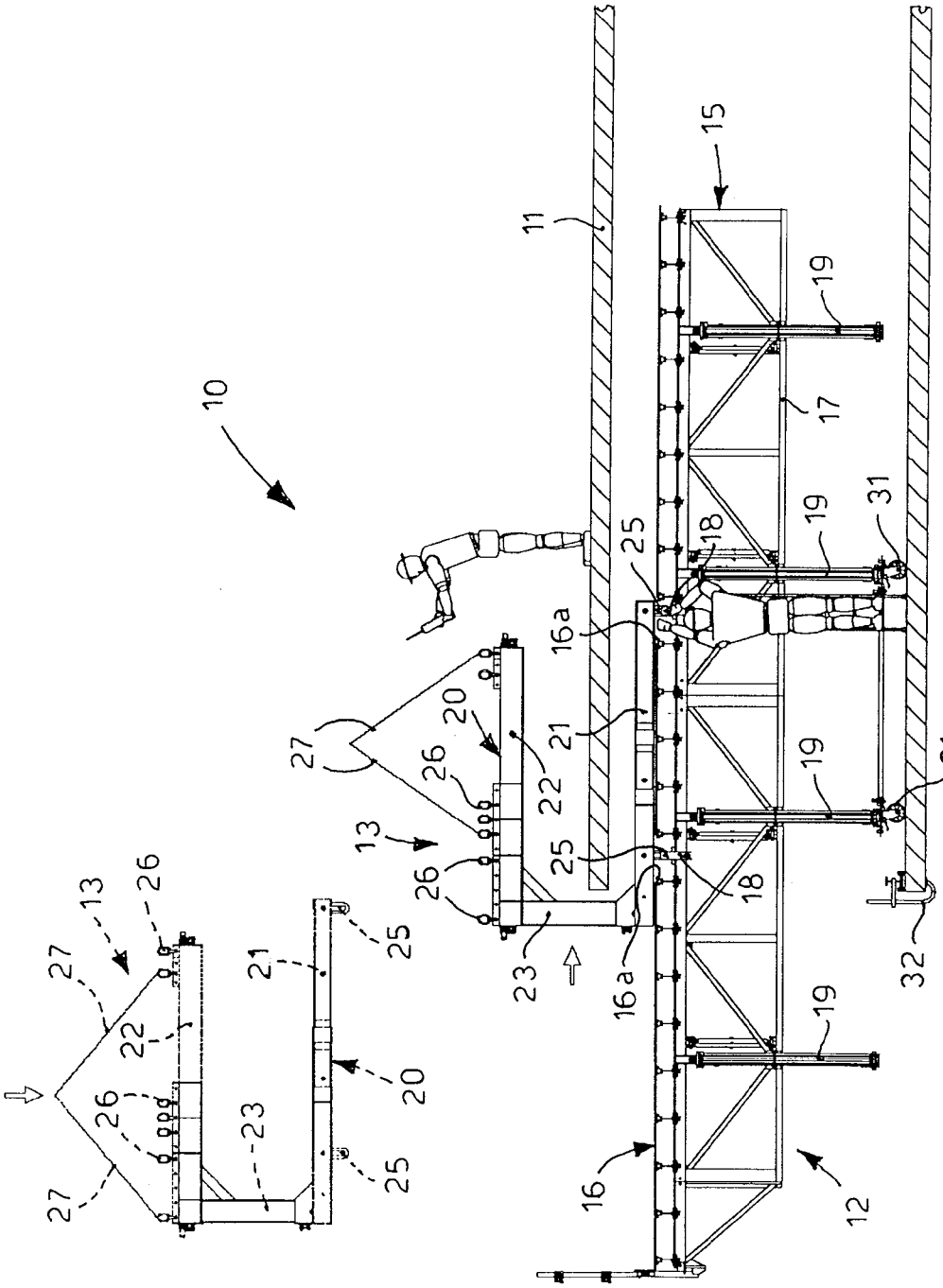

fig.8

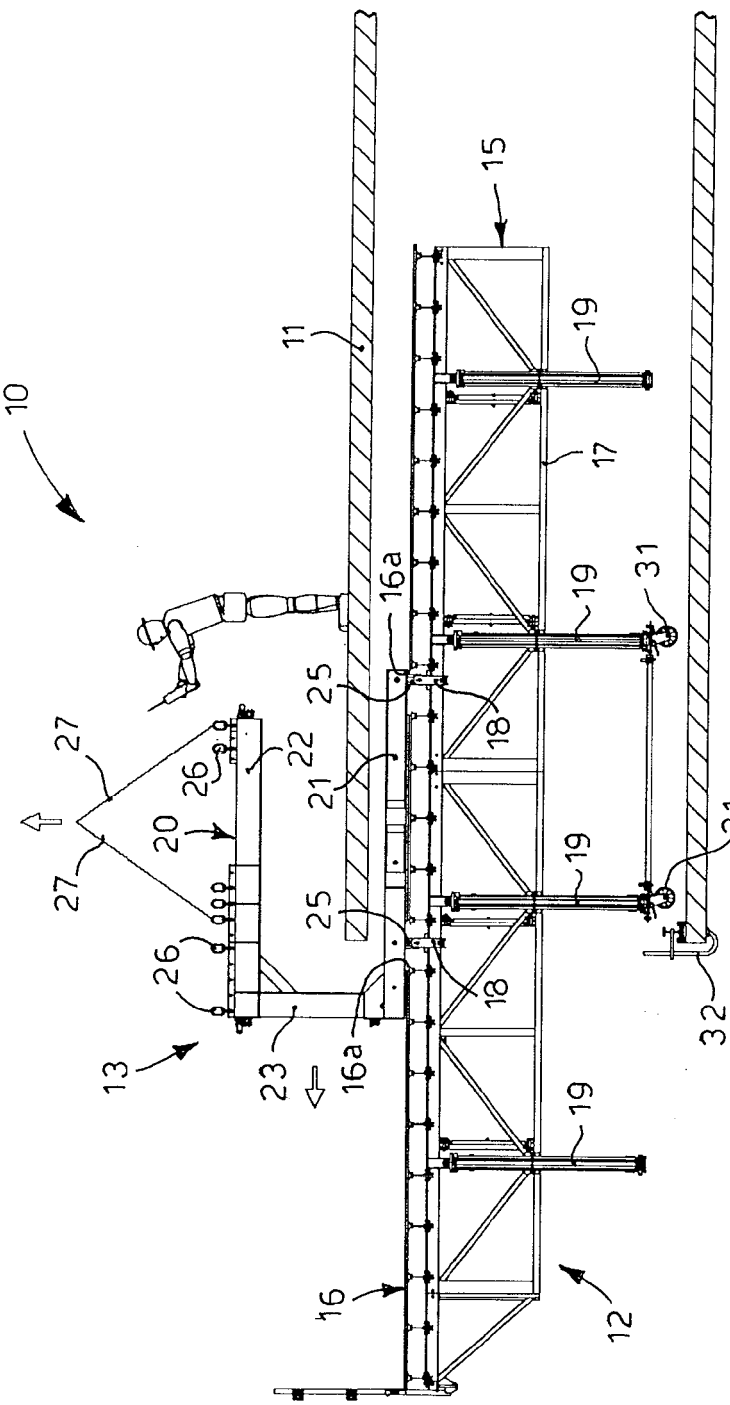

fig. 9

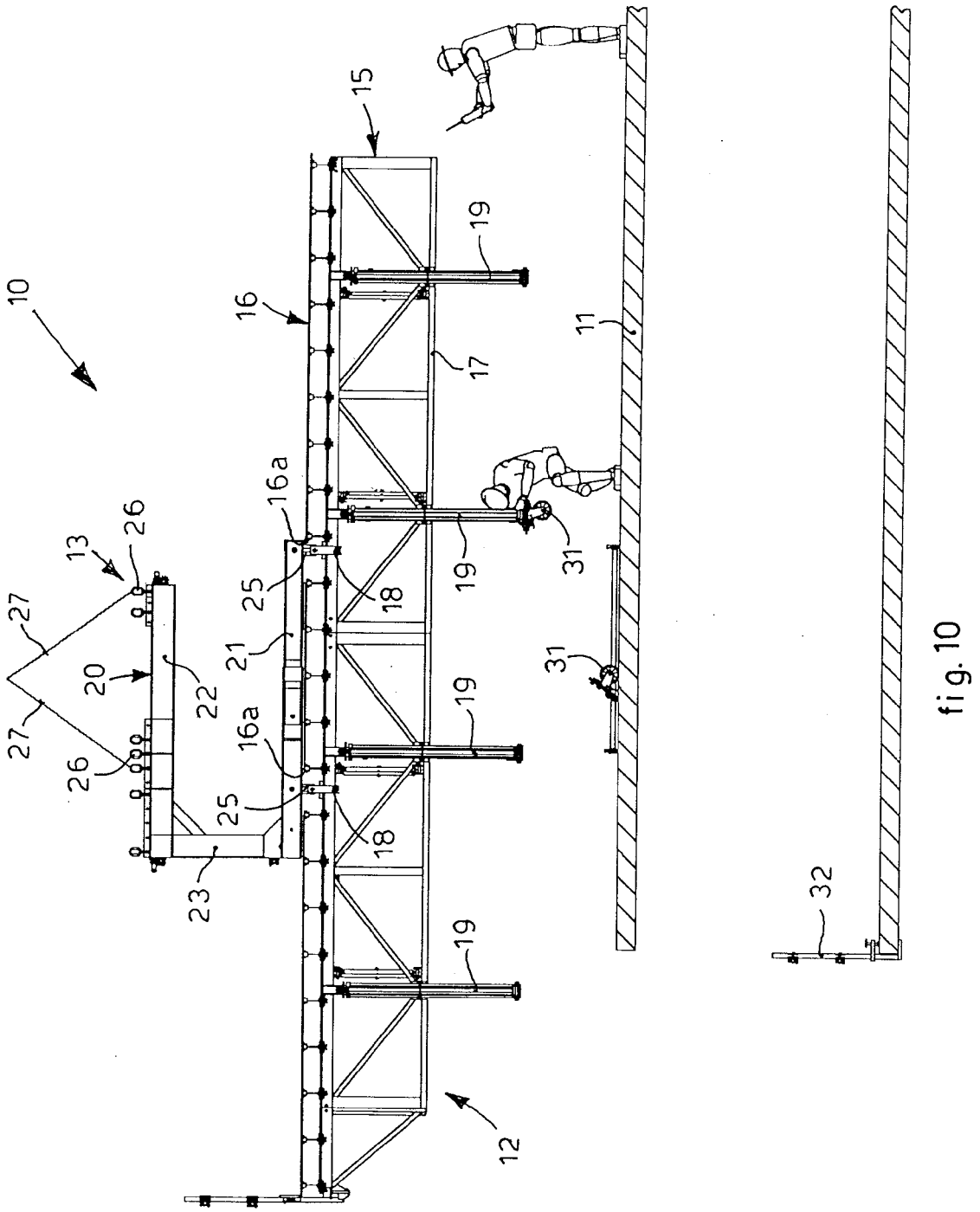

fig.10

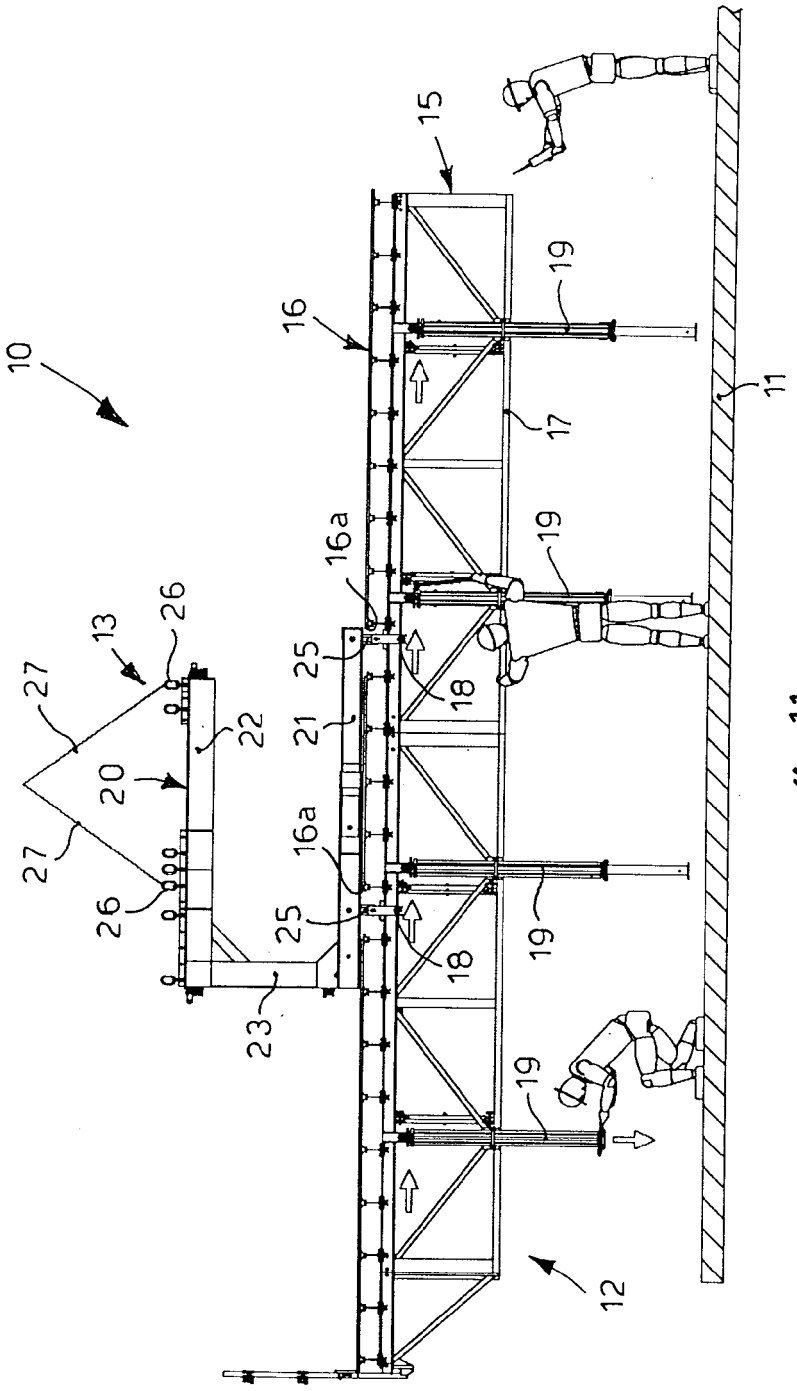
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fig. 11

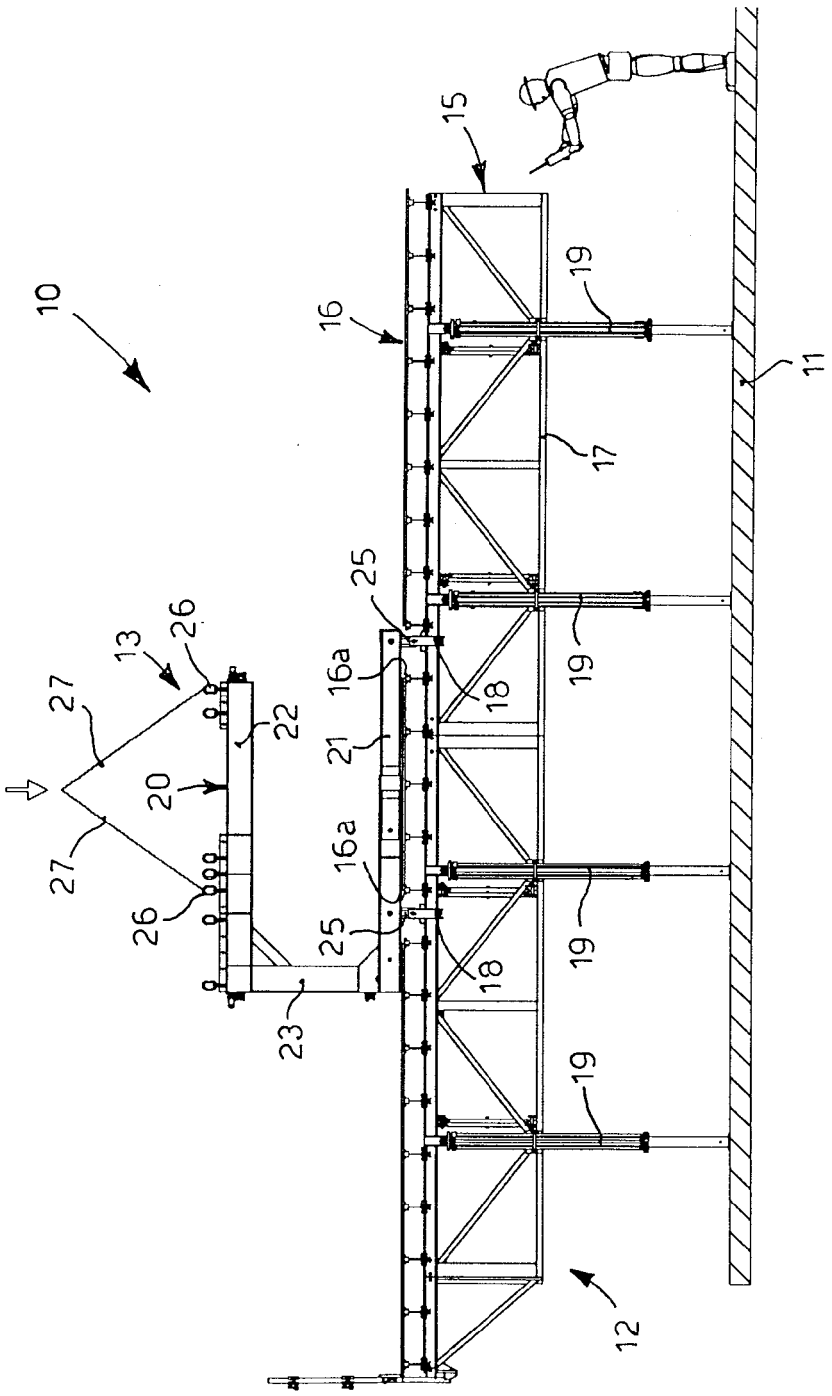

fig.12