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(54) DESCENDING TYPE DOUBLE-SPAN MOVABLE SCAFFOLDING SYSTEM AND CONSTRUCTION METHOD

(57) The present invention discloses a double-span movable formwork of lower bearing type and a construction method. The formwork includes a main girder, a main bridging beam, a bracket, a propelling flat wagon, a cross beam, an outer shuttering, a front hanging beam and a rear hanging beam. Two main girders are provided, the main girders are connected through a plurality of pairs of cross beams, and the cross beams are in group in pairs with bottom ends thereof connected by bolts. The main bridging beam is fixedly connected to either end of the main girder, three pairs of brackets are provided at bottoms of the main girder and of the main bridging beam at either end of the main girder respectively, for supporting the main girder and the main bridging beam, each pair of brackets are connected through a connecting plate, and the propelling flat wagon is slidably connected to the top of the respective bracket. According to the present invention, through the arrangement of a close jointing apparatus, after the two parts of the outer shuttering are closed by the hydraulic device on the propelling flat wagon, the two cross beams of the same pair can be simultaneously fixed, and the top of the close jointing apparatus is embedded into the joint of the outer shuttering, so that a gap at the joint cannot be communicated up and down, preventing continuous leakage and improving safety.

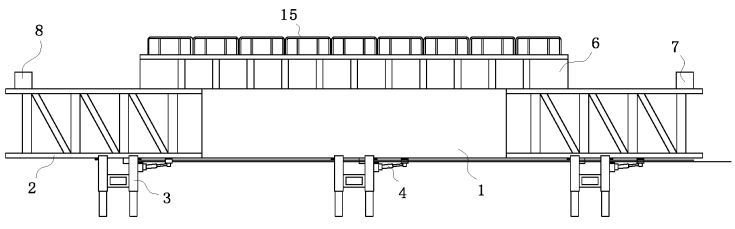

Fig.1

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Description

Technical field

[0001] The present invention belongs to the field of movable formwork technologies, and in particular, to a double-span movable formwork of lower bearing type and a construction method.

Technical background

[0002] A prestressed concrete box girder having a constant cross section by means of cast-in-place with movable formwork involves an advanced construction method for bridges in the world, which requires no formwork support under a bridge during construction, has the advantages of a simple construction process, a short construction cycle, and continuous construction, does not affect traffic requirements under the bridge during the construction, and has been widely used at home and abroad.

[0003] Since an existing movable formwork is required to be closed and a closing position is required to be fixed, the strength at this position determines the safety of the whole work. During the closing, cross beams are fixed by bolts, so the fixing is complicated. At the same time, a closing position of an outer shuttering is at the top of the cross beam. Since a gap here is communicated up and down, when leakage occurs, continuous leakage easily arises, affecting the safety of pouring.

[0004] Therefore, there is a need to provide a double-span movable formwork of lower bearing type and a construction method to solve the above problems, which can reduce the complexity of fixing during fixation of the cross beams and improve tightness at the closing position of the outer shuttering, thereby improving the safety of pouring.

Summary of the invention

[0005] In view of the above, the present invention provides a double-span movable formwork of lower bearing type and a construction method, so as to solve the problems raised in the Technical background.

[0006] In order to achieve the above objective, the present invention provides the following technical solution: a double-span movable formwork of lower bearing type, comprising a main girder, a main bridging beam, a bracket, a propelling flat wagon, a cross beam, an outer shuttering, a front hanging beam and a rear hanging beam, wherein two main girders are provided, the main girders are connected through a plurality of pairs of cross beams, and the cross beams are in group in pairs with bottom ends thereof connected by bolts; wherein the main bridging beam is fixedly connected to either end of the main girder, three pairs of brackets are provided at bottoms of the main girder and of the main bridging beam at either end of the main girder respectively, for supporting the main girder and the main bridging beam, each pair of brackets are connected through a connecting plate, the propelling flat wagon is slidably connected to the top of the respective bracket, and the front hanging beam and the rear hanging beam are located at top of the main bridging beam at either end of the main girder respectively, to connect two main bridging beams at a same end of the main girders; and wherein the outer shuttering is composed of two symmetrical parts, a close jointing apparatus is arranged at a position where the two parts are in contact, and the two parts of the outer shuttering are fixedly connected to the two main girders respectively.

[0007] Preferably, the close jointing apparatus includes a fitting plate, the fitting plate is embedded to the top of a joint of the two parts of the outer shuttering, a plurality of vertical rods are fixedly connected to the bottom of the fitting plate, a same horizontal rod is horizontally inserted and connected to bottom ends of the plurality of vertical rods, an outer side of the horizontal rod is sleeved with a plurality of oblique rods being connected, and top ends of the plurality of oblique rods are equally distributed and hinged to bottom surfaces of the two parts of the outer shuttering; wherein a movable rod is slidably inserted and connected to the bottom end of the respective vertical rod, and one end of the movable rod away from the vertical rod is double-headed, separately inserted into two cross beams of the same pair.

[0008] Preferably, an outer side of the movable rod is sleeved with a plurality of frustoconical caps, two adjacent frustoconical caps are mirrored about the respective cross beam, an inserting bar is fixedly connected to a big end of the frustoconical cap, an end portion of the inserting bar is capable of being inserted into the respective cross beam, a return spring is fixedly connected to a small end of the frustoconical cap, and an end portion of the return spring is fixedly connected to an outer surface of the movable rod.

[0009] Preferably, a baffle ring is rotatably connected to the small end of the frustoconical cap, a diameter of the baffle ring is larger than that of the small end of the frustoconical cap, and a surface of the baffle ring is provided with blade slots.

[0010] Preferably, a lifting rack is arranged at a top edge of the outer shuttering, and the lifting rack is of a grille-shaped (⊞-shaped) structure.

[0011] Preferably, the cross beams are arranged between two main girders and are each of a truss structure of profile steel beams, and the cross beam is divided into two parts at a position of a central axis, with two ends connected to the main girder by bolts respectively.

[0012] Preferably, the main bridging beam is divided into a front part and a rear part, connected to two ends of the main girder respectively, is of a triangular steel truss structure, and plays a guiding and longitudinal balancing role when a hole being longitudinally passed through.

[0013] The present invention also discloses a method for construction using the double-span movable formwork of lower bearing type described above, the method including the following steps:

step one: placing each pair of brackets on two sides of a bridge pier, and connecting the brackets through the connecting plate, so that the brackets are tightly attached to the bridge pier, and then hoisting and putting the propelling flat wagon on the top of the brackets and mounting the same;
step two: hoisting and putting the two main girders sequentially at the top of the propelling flat wagon, connecting three hydraulic parts, namely a horizontal part, a longitudinal part and a vertical part, on the propelling flat wagon to the main girders and the brackets, and then hoisting and putting each group of cross beams between the two main girders, subsequently hoisting and putting the outer shuttering onto the top of the cross beams, and fixing the outer shuttering to the top of the main girders;
step three: finally, connecting an end portion of the respective oblique rod to the bottom of the corresponding outer shuttering, closing the two parts of the outer shuttering through a hydraulic device on the propelling flat wagon, finally fixing the two cross beams by bolts, and pulling the movable rod, so that the double-headed end of the movable rod is separately inserted into the two cross beams of the same pair; and
step four: processing and bundling rebar in a rebar processing plant, then transporting and hoisting and putting the same onto the top of the outer shuttering, finally pouring concrete, and after the concrete is solidified, demoulding the outer shuttering through the propelling flat wagon, disassembling the cross beams and the outer shuttering, and transporting them to a next construction position through the propelling flat wagon, in which the outer shuttering can be re-closed and fixed.

[0014] The present invention has the following technical effects and advantages.

1. According to the present invention, through the arrangement of the close jointing apparatus, after the two parts of the outer shuttering are closed by the hydraulic device on the propelling flat wagon, the two cross beams of the same pair can be simultaneously fixed, and the top of the close jointing apparatus is embedded into the joint of the outer shuttering, so that a gap at the joint cannot be communicated up and down, preventing continuous leakage and improving safety.

2. According to the present invention, wind perpendicular to the horizontal rod will push all the frustoconical caps towards the respective cross beam, so the frustoconical caps may drive the inserting bar into the cross beam, thereby improving the stability of the movable rod. After the wind stops, the return spring drives the frustoconical caps back to their original positions automatically, without the need for subsequent moving out by manual work, which improves convenience. When the wind blows along a length direction of the horizontal rod, the corresponding frustoconical caps are enabled to move towards the respective cross beam so as to ensure the above effect.

3. According to the present invention, with the existence of the baffle ring, a larger contact area with the wind is ensured, so that the corresponding frustoconical caps move towards the respective cross beam. Moreover, in the case of high wind, the blade slots on its surface can play a role of wind guidance, which reduces a pushing effect of the wind on the baffle ring, and preventing an excessively large impact force between the inserting bar and the cross beam due to the high wind blowing the frustoconical caps.

Brief description of the drawings

[0015] In order to more clearly illustrate the technical solutions in embodiments of the present invention or the prior art, the accompanying drawings used in the description of the embodiments or the prior art will be briefly introduced below. It is apparent that, the accompanying drawings in the following description are only some embodiments of the present invention, and other drawings can be obtained by those of ordinary skill in the art from the provided drawings without creative efforts.

FIG. 1 is a schematic diagram of an overall structure of a movable formwork according to the present invention;

FIG. 2 is a side view of FIG. 1 according to the present invention;

FIG. 3 is an enlarged view of Part A in FIG. 2 according to the present invention;

FIG. 4 is a schematic diagram of positions of cross beam(s) and outer shuttering in FIG. 1 according to the present invention;

FIG. 5 is a side view of a baffle ring in FIG. 1 according to the present invention; and

FIG. 6 is a flowchart of a construction method according to the present invention.

[0016] Reference numerals in the drawings: main girder 1, main bridging beam 2, bracket 3, propelling flat wag-

on 4, cross beam 5, outer shuttering 6, front hanging beam 7, rear hanging beam 8, close jointing apparatus 9, fitting plate 91, vertical rod 92, horizontal rod 93, oblique rod 94, movable rod 95, frustoconical cap 10, inserting bar 11, return spring 12, baffle ring 13, blade slot 14, lifting rack 15.

Detailed description of the embodiments

[0017] In order to make the objectives, technical solutions and advantages of the embodiments of the present invention clearer, the technical solutions in the embodiments of the present invention will be clearly and fully described below with reference to the drawings in the embodiments of the present invention. Apparently, the embodiments described are only some rather than all of the embodiments of the present invention. All other embodiments acquired by those skilled in the art without creative efforts based on the embodiments of the present invention shall fall within the protection scope of the present application.

[0018] In the description of the present invention, it is to be understood that the orientation **or position relationship indicated by the terms "length", "width", "upper", "lower",** "front", "back", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer", etc. are based on the orientation or position relationship shown in the accompanying drawings and are intended to facilitate the description of the present invention and simplify the description only, rather than indicating or implying that the apparatus or element referred to must have a particular orientation or be constructed and operated in a particular orientation, and therefore are not to be interpreted as limiting the present invention. In addition, in the description of the present invention, "a **plurality of' means two or more than two, unless specifically stated otherwise.**

[0019] The present invention provides a double-span movable formwork of lower bearing type as shown in FIG. 1 to FIG. 2, including a main girder 1, a main bridging beam 2, a bracket 3, a propelling flat wagon 4, a cross beam 5, an outer shuttering 6, a front hanging beam 7 and a rear hanging beam 8. Two main girders 1 are provided, the main girders 1 are connected through a plurality of pairs of cross beams 5, and the cross beams 5 are in group in pairs with bottom ends thereof connected by bolts. The main bridging beam 2 is fixedly connected to either end of the main girder 1, three pairs of brackets 3 are provided at bottoms of the main girder 1 and of the main bridging beam 2 at either end of the main girder 1 respectively, for supporting the main girder 1 and the main bridging beam 2, each pair of brackets 3 are connected through a connecting plate, the propelling flat wagon 4 is slidably connected to the top of the respective bracket 3, and the front hanging beam 7 and the rear hanging beam 8 are located at top of the main bridging beam 2 at either end of the main girder 1 respectively, to connect two main bridging beams 2 at a same end of the main girders 1. The outer shuttering 6 is composed of two symmetrical parts, a close jointing apparatus 9 is arranged at a position where the two parts are in contact, and the two parts of the outer shuttering 6 are fixedly connected to the two main girders 1 respectively.

[0020] Referring to FIG. 2 to FIG. 4 of the specification, the close jointing apparatus 9 includes a fitting plate 91, the fitting plate 91 is embedded to the top of a joint of the two parts of the outer shuttering 6, a plurality of vertical rods 92 are fixedly connected to the bottom of the fitting plate 91, a same horizontal rod 93 is horizontally inserted and connected to bottom ends of the plurality of vertical rods 92, an outer side of the horizontal rod 93 is sleeved with a plurality of oblique rods 94 being connected, and top ends of the plurality of oblique rods 94 are equally distributed and hinged to bottom surfaces of the two parts of the outer shuttering 6. A movable rod 95 is slidably inserted and connected to the bottom end of the respective vertical rod 92, and one end of the movable rod 95 away from the vertical rod 92 is double-headed, separately inserted into two cross beams 5 of the same pair. A thickness of the fitting plate 91 is nearly half of a thickness of the outer shuttering 6, so the fitting plate 91 can block the closing position of the outer shuttering 6 to prevent up-down communication at a seam of the outer shuttering 6. A gap at which two sides of the fitting plate 91 are in contact with the outer shuttering 6 may not be communicated up and down, so downward leakage of concrete may not occur. Moreover, after the outer shuttering 6 is closed, the double-headed end of the movable rod 95 is separately inserted into two cross beams 5 of the same pair. In this case, the outer shuttering 6, the close jointing apparatus 9 and the cross beams 5 are fully locked, which improves the overall connection stability and eliminates the need to fix the cross beams 5 by bolts. At the same time, in the case of disassembly, the movable rod 95 is pulled out from the inside of the cross beams 5, and then the cross beams 5 are driven to be separated from each other by the propelling flat wagon 4. Under the separation of the two parts of the outer shuttering 6, the top of the fitting plate 91 may move upwards and then move to a next station to be closed again. During the closing of the outer shuttering 6, the fitting plate 91 can automatically move down and fit the outer shuttering 6, which is convenient to use.

[0021] Referring to FIG. 4 of the specification, an outer side of the movable rod 95 is sleeved with a plurality of frustoconical caps 10, two adjacent frustoconical caps 10 are mirrored about the respective cross beam 5, an inserting bar 11 is fixedly connected to a big end of the frustoconical cap 10, an end portion of the inserting bar 11 is capable of being inserted into the respective cross beam 5, a return spring 12 is fixedly connected to a small end of the frustoconical cap 10, and an end portion of the return spring 12 is fixedly connected to an outer surface of the movable rod 95. When high wind is blown vertically on cylindrical surfaces of the frustoconical caps 10, all the frustoconical caps 10 may be pushed towards

the respective cross beam 5. Therefore, the frustoconical caps 10 may drive the inserting bar 11 to be inserted into the cross beam 5, thereby improving the stability of the movable rod 95. After the wind stops, the return spring 12 drives the frustoconical caps 10 back to their original positions automatically, without the need for subsequent moving out by manual work, which improves convenience. When the wind blows along a length direction of the horizontal rod 93, the corresponding frustoconical caps 10 are enabled to move towards the respective cross beam 5 so as to ensure the above effect.

[0022] Referring to FIG. 4 and FIG. 5 of the specification, a baffle ring 13 is rotatably connected to the small end of the frustoconical cap 10, a diameter of the baffle ring 13 is larger than that of the small end of the frustoconical cap 10, and a surface of the baffle ring 13 is provided with blade slots 14. When the wind blows against the small end of the frustoconical cap 10, with the existence of the baffle ring 13, a larger contact area with the wind is ensured, so that the corresponding frustoconical cap 10 moves towards the respective cross beam 5. Moreover, in the case of high wind, the blade slots 14 on its surface can play a role of wind guidance, which reduces a pushing effect of the wind on the baffle ring 13, and preventing an excessively large impact force between the inserting bar 11 and the cross beam 5 due to the high wind blowing the frustoconical cap 10.

[0023] Referring to FIG. 1 of the specification, a lifting rack 15 is arranged at a top edge of the outer shuttering 6, and the lifting rack 15 is of a grille-shaped structure. In rainy weather, waterproof cloth can be draped over the lifting rack 15.

[0024] Referring to FIG. 1 and FIG. 2 of the specification, the cross beams 5 are arranged between two main girders 1 and are each of a truss structure of profile steel beams, and the cross beam 5 is divided into two parts at a position of a central axis, with two ends connected to the main girder 1 by bolts respectively.

[0025] Referring to FIG. 1 of the specification, the main bridging beam 2 is divided into a front part and a rear part, connected to two ends of the main girder 1 respectively, is of a triangular steel truss structure, and plays a guiding and longitudinal balancing role when a hole being longitudinally passed through.

[0026] Referring to FIG. 6 of the specification, the present invention also discloses a method for construction using the double-span movable formwork of lower bearing type described above. The method includes the following steps.

[0027] In step one, each pair of brackets 3 are placed on two sides of a bridge pier, and are connected through the connecting plate, so that the brackets 3 are tightly attached to the bridge pier, and then the propelling flat wagon 4 is hoisted and put on the top of the brackets 3 and mounted.

[0028] In step two, the two main girders 1 are sequentially hoisted and put at the top of the propelling flat wagon 4, three hydraulic parts, namely a horizontal part, a longitudinal part and a vertical part, on the propelling flat wagon 4 are connected to the main girders 1 and the brackets 3, and then each group of cross beams 5 are hoisted and put between the two main girders 1, the outer shuttering 6 is subsequently hoisted and put onto the top of the cross beams 5, and the outer shuttering 6 is fixed to the top of the main girders 1.

[0029] In step three, finally, an end portion of the respective oblique rod 94 is connected to the bottom of the corresponding outer shuttering 6, the two parts of the outer shuttering 6 are closed through a hydraulic device on the propelling flat wagon 4, the two cross beams 5 are finally fixed by bolts, and the movable rod 95 are pulled, so that the double-headed end of the movable rod 95 is separately inserted into the two cross beams 5 of the same pair.

[0030] In step four, rebar is processed and bundled in a rebar processing plant and then transported and hoisted and put onto the top of the outer shuttering 6, finally concrete is poured, and after the concrete is solidified, the outer shuttering 6 is demoulded through the propelling flat wagon 4, the cross beams 5 and the outer shuttering 6 are disassembled, and they are transported to a next construction position through the propelling flat wagon 4, in which the outer shuttering 6 can be re-closed and fixed.

[0031] An operating principle of the present invention is as follows. Since an existing movable formwork is required to be closed and a closing position is required to be fixed, the strength here determines the safety of the whole work. During the closing, the cross beams 5 are fixed by bolts, so the fixing is complicated. At the same time, the closing position of the outer shuttering 6 is at the top of the cross beams 5. Since a gap here is communicated up and down, when leakage occurs, continuous leakage easily arises, affecting the safety of pouring. Thus, the present invention mainly solves the problem of how to reduce the complexity of fixing during fixation of the cross beams 5 and improve tightness at the closing position of the outer shuttering 6, thereby improving the safety of pouring. Specific measures and a use process are as follows. Each pair of brackets 3 are placed on two sides of a bridge pier, and are connected through the connecting plate, so that the brackets 3 are tightly attached to the bridge pier, and then the propelling flat wagon 4 is hoisted and put on the top of the brackets 3 and mounted. The two main girders 1 are sequentially hoisted and put at the top of the propelling flat wagon 4, three hydraulic parts, namely a horizontal part, a longitudinal part and a vertical part, on the propelling flat wagon 4 are connected to the main girders 1 and the brackets 3, and then each group of cross beams 5 are hoisted and put between the two main girders 1, the outer shuttering 6 is subsequently hoisted and put onto the top of the cross beams 5, and the outer shuttering 6 is fixed to the top of the main girders 1. Through the arrangement of the close jointing apparatus 9, after the two parts of the outer shuttering 6 are closed by the hydraulic device on the pro-

pelling flat wagon 4, the two cross beams 5 of the same pair can be fixed simultaneously, and the top of the close jointing apparatus 9 is embedded into the joint of the outer shuttering 6, so that a gap at the joint cannot be communicated up and down, preventing continuous leakage and improving safety. After completion of the assembly, rebar is processed and bundled in a rebar processing plant and then transported and hoisted and put onto the top of the outer shuttering 6, finally concrete is poured, and after the concrete is solidified, the outer shuttering 6 is demoulded through the propelling flat wagon 4, the cross beams 5 and the outer shuttering 6 are disassembled, and they are transported to a next construction position through the propelling flat wagon 4, in which the outer shuttering 6 can be re-closed and fixed.

[0032] Although the present invention is described in detail with reference to the foregoing embodiments, those of ordinary skill in the art should understand that they may still make modifications to the technical solutions described in the foregoing embodiments or make equivalent replacements to some technical features thereof. Such modifications or replacements do not cause the essence of the corresponding technical solutions to depart from the spirit and scope of the technical solutions of the embodiments of the present invention.

Claims

1. A double-span movable formwork of lower bearing type, comprising a main girder (1), a main bridging beam (2), a bracket (3), a propelling flat wagon (4), a cross beam (5), an outer shuttering (6), a front hanging beam (7) and a rear hanging beam (8), **characterized in that** two main girders (1) are provided, the main girders (1) are connected through a plurality of pairs of cross beams (5), and the cross beams (5) are in group in pairs with bottom ends thereof connected by bolts; wherein the main bridging beam (2) is fixedly connected to either end of the main girder (1), three pairs of brackets (3) are provided at bottoms of the main girder (1) and of the main bridging beam (2) at either end of the main girder (1) respectively, for supporting the main girder (1) and the main bridging beam (2), each pair of brackets (3) are connected through a connecting plate, the propelling flat wagon (4) is slidably connected to the top of the respective bracket (3), and the front hanging beam (7) and the rear hanging beam (8) are located at top of the main bridging beam (2) at either end of the main girder (1) respectively, to connect two main bridging beams (2) at a same end of the main girders (1); and wherein the outer shuttering (6) is composed of two symmetrical parts, a close jointing apparatus (9) is arranged at a position where the two parts are in contact, and the two parts of the outer shuttering (6) are fixedly connected to the two main girders (1) respectively.

2. The double-span movable formwork of lower bearing type according to claim 1, **characterized in that** the close jointing apparatus (9) comprises a fitting plate (91), the fitting plate (91) is embedded to the top of a joint of the two parts of the outer shuttering (6), wherein a plurality of vertical rods (92) are fixedly connected to the bottom of the fitting plate (91), a same horizontal rod (93) is horizontally inserted and connected to bottom ends of the plurality of vertical rods (92), an outer side of the horizontal rod (93) is sleeved with a plurality of oblique rods (94) being connected, and top ends of the plurality of oblique rods (94) are equally distributed and hinged to bottom surfaces of the two parts of the outer shuttering (6); a movable rod (95) is slidably inserted and connected to the bottom end of the respective vertical rod (92), and one end of the movable rod (95) away from the vertical rod (92) is double-headed, separately inserted into two cross beams (5) of the same pair.

3. The double-span movable formwork of lower bearing type according to claim 2, **characterized in that** an outer side of the movable rod (95) is sleeved with a plurality of frustoconical caps (10), two adjacent frustoconical caps (10) are mirrored about the respective cross beam (5), wherein an inserting bar (11) is fixedly connected to a big end of the frustoconical cap (10), an end portion of the inserting bar (11) is capable of being inserted into the respective cross beam (5), a return spring (12) is fixedly connected to a small end of the frustoconical cap (10), and an end portion of the return spring (12) is fixedly connected to an outer surface of the movable rod (95).

4. The double-span movable formwork of lower bearing type according to claim 3, **characterized in that** a baffle ring (13) is rotatably connected to the small end of the frustoconical cap (10), wherein a diameter of the baffle ring (13) is larger than that of the small end of the frustoconical cap (10), and a surface of the baffle ring (13) is provided with blade slots (14).

5. The double-span movable formwork of lower bearing type according to claim 1, **characterized in that** a lifting rack (15) is arranged at a top edge of the outer shuttering (6), and the lifting rack (15) is of a grille-shaped structure.

6. The double-span movable formwork of lower bearing type according to claim 1, **characterized in that** the cross beams (5) are arranged between two main girders (1) and are each of a truss structure of profile steel beams, and the cross beam (5) is divided into two parts at a position of a central axis, with two ends connected to the main girder (1) by bolts respectively.

7. The double-span movable formwork of lower bearing type according to claim 1, **characterized in that** the main bridging beam (2) is divided into a front part and a rear part, connected to two ends of the main girder (1) respectively, is of a triangular steel truss structure, and plays a guiding and longitudinal balancing role when a hole being longitudinally passed through.

8. A method for construction using the double-span movable formwork of lower bearing type according to any one of claims 1 to 7, **characterized in that** the method comprises the following steps:

step one: placing each pair of brackets (3) on two sides of a bridge pier, and connecting the brackets through the connecting plate, so that the brackets (3) are tightly attached to the bridge pier, and then hoisting and putting the propelling flat wagon (4) on the top of the brackets (3) and mounting the same;
step two: hoisting and putting the two main girders (1) sequentially at the top of the propelling flat wagon (4), connecting three hydraulic parts, namely a horizontal part, a longitudinal part and a vertical part, on the propelling flat wagon (4) to the main girders (1) and the brackets (3), and then hoisting and putting each group of cross beams (5) between the two main girders (1), subsequently hoisting and putting the outer shuttering (6) onto the top of the cross beams (5), and fixing the outer shuttering (6) to the top of the main girders (1);
step three: finally, connecting an end portion of the respective oblique rod (94) to the bottom of the corresponding outer shuttering (6), closing the two parts of the outer shuttering (6) through a hydraulic device on the propelling flat wagon (4), finally fixing the two cross beams (5) by bolts, and pulling the movable rod (95), so that the double-headed end of the movable rod (95) is separately inserted into the two cross beams (5) of the same pair; and
step four: processing and bundling rebar in a rebar processing plant, then transporting and hoisting and putting the same onto the top of the outer shuttering (6), finally pouring concrete, and after the concrete is solidified, demoulding the outer shuttering (6) through the propelling flat wagon (4), disassembling the cross beams (5) and the outer shuttering (6), and transporting them to a next construction position through the propelling flat wagon (4), in which the outer shuttering (6) can be re-closed and fixed.

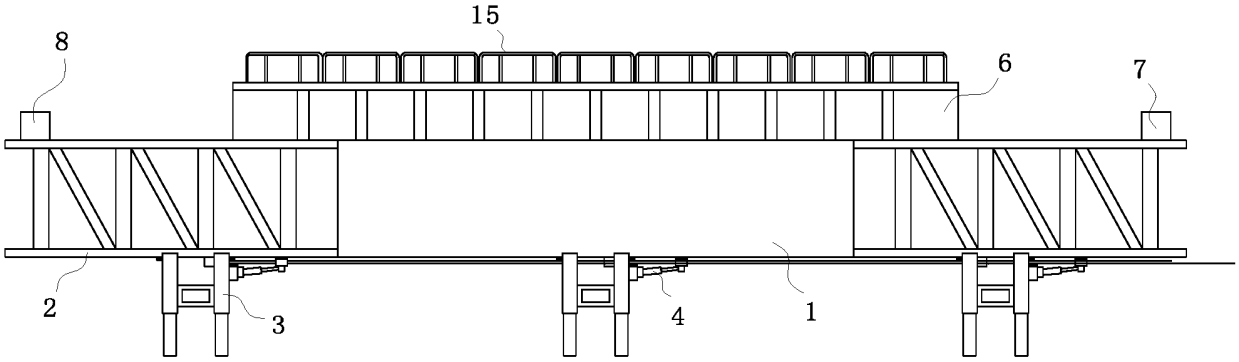

Fig.1

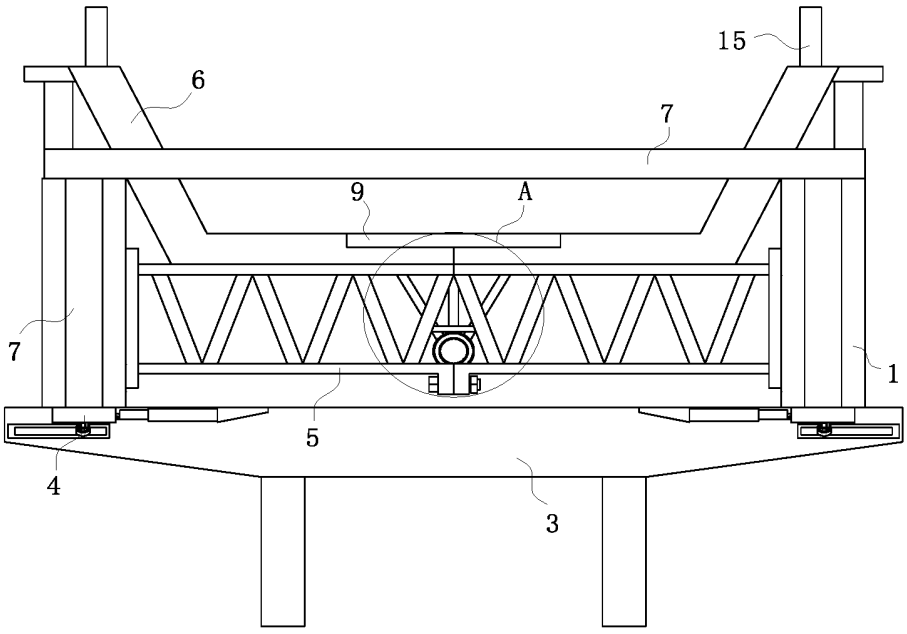

Fig.2

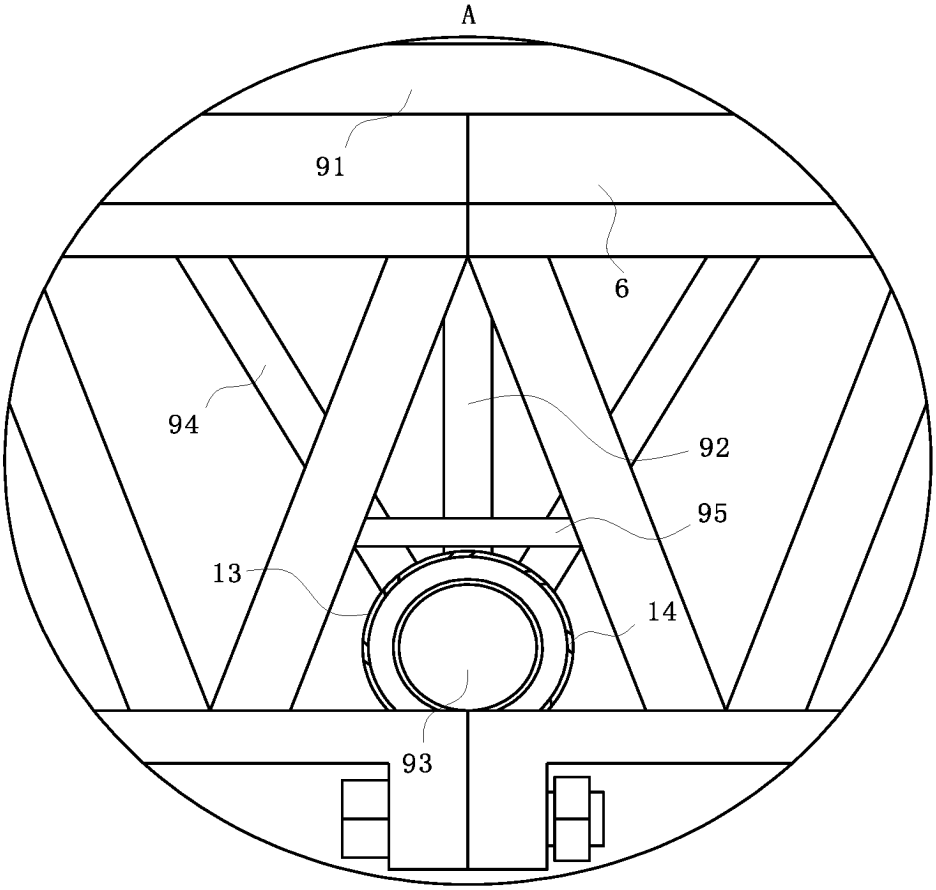

Fig.3

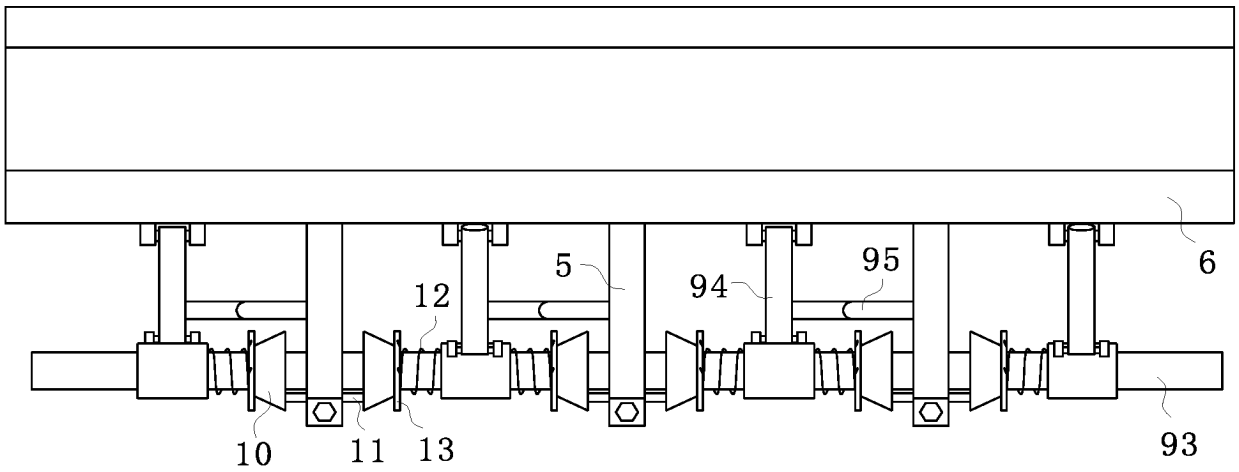

Fig.4

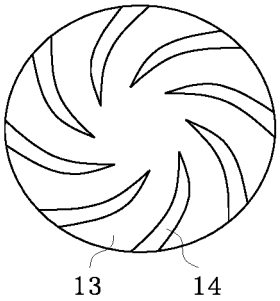

Fig.5

Step one: Place each pair of brackets 3 on two sides of a bridge pier, and connect the brackets through the connecting plate, so that the brackets 3 are tightly attached to the bridge pier, and then hoist and put the propelling flat wagon 4 on the top of the brackets 3 and mount the same

Step two: Hoist and put the two main girders 1 sequentially at the top of the propelling flat wagon 4, connect three hydraulic parts, namely a horizontal part, a longitudinal part and a vertical part, on the propelling flat wagon 4 to the main girders 1 and the brackets 3, and then hoist and put each group of cross beams 5 between the two main girders 1, subsequently hoist and put the outer shuttering 6 onto the top of the cross beams 5, and fix the outer shuttering 6 to the top of the main girders 1

Step three: Finally, connect an end portion of the respective oblique rod 94 to the bottom of the corresponding outer shuttering 6, close the two parts of the outer shuttering 6 through a hydraulic device on the propelling flat wagon 4, finally fix the two cross beams 5 by bolts, and pull the movable rod 95, so that the double-headed end of the movable rod 95 is separately inserted into the two cross beams 5 of the same pair

Step four: Process and bundle rebar in a rebar processing plant, then transport and hoist and put the same onto the top of the outer shuttering 6, finally pour concrete, and after the concrete is solidified, demould the outer shuttering 6 through the propelling flat wagon 4, disassemble the cross beams 5 and the outer shuttering 6, and transport them to a next construction position through the propelling flat wagon 4, in which the outer shuttering 6 can be re-closed and fixed

Fig.6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/134664

A. CLASSIFICATION OF SUBJECT MATTER

E01D 21/00(2006.01)i; E01D 2/04(2006.01)i

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)

E01D

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)

CNTXT; WPABS; DWPI; CNABS; CNKI: 主梁, 鼻梁, 牛腿, 横梁, 模板, 吊, 导梁, 导向梁, 圆台帽, 杆, 弹簧, 帽, 模架, 梁, 插, girder?, beam?, wind, spring?, guid+, nose, die?, mould?, mold?, pattern

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 113047152 A (CHINA TIESIJU CIVIL ENG GROUP CO., LTD. et al.) 29 June 2021 (2021-06-29) claims 1-8	1-8
Y	CN 201704630 U (THE THIRD ENGINEERING CO., LTD. OF CHINA RAILWAY NO.18 BUREAU) 12 January 2011 (2011-01-12) description, paragraphs [0004]-[0013], and figures 1-2	1-2, 5-8
Y	CN 202466423 U (CHINA RAILWAY FIRST BUREAU GROUP CO., LTD.) 03 October 2012 (2012-10-03) description, paragraphs [0051]-[0104], and figures 1-7	1-2, 5-8
A	KR 20090055063 A (CORE ENC CO., LTD.) 02 June 2009 (2009-06-02) entire document	1-8
A	CN 101806038 A (SHANDONG LUQIAO GROUP CO., LTD.) 18 August 2010 (2010-08-18) entire document	1-8
A	CN 111455852 A (CCCC ROAD AND BRIDGE SOUTH CHINA ENGINEERING CO., LTD.) 28 July 2020 (2020-07-28) entire document	1-8

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

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 February 2022	**02 March 2022**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

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PCT/CN2021/134664

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 201648971 U (SHANDONG LUQIAO GROUP CO., LTD.) 24 November 2010 (2010-11-24) entire document	1-8

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/134664

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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CN 201704630 U	12 January 2011	None	
CN 202466423 U	03 October 2012	None	
KR 20090055063 A	02 June 2009	KR 100949585 B1	25 March 2010
CN 101806038 A	18 August 2010	None	
CN 111455852 A	28 July 2020	None	
CN 201648971 U	24 November 2010	None	

Form PCT/ISA/210 (patent family annex) (January 2015)