WHAT IS CLAIMED IS:

1. A lower-trolley system, in which a conventional quay crane girder is upgraded into a double-trapezoid four-track girder (1), and inner-side tracks (16) of the double-trapezoid four-track girder (1) are configured for an upper trolley (2) to travel on, wherein the lower-trolley system comprises a lower trolley (3), a lower-trolley hoisting system, and a lower-trolley travelling system, and the lower trolley (3), the lower-trolley hoisting system and the lower-trolley travelling system are all arranged on a quay crane; the lower-trolley hoisting system is configured to drive a hoist (14) of the lower trolley (3) to rise and fall, and the lower-trolley travelling system is configured to pull the lower trolley (3) to travel along the direction of the double-trapezoid four-track girder (1) of the quay crane; and the lower trolley (3) is suspended upside down on outer-side tracks (15) of the double-trapezoid four-track girder (1), and a container (12) hoisted by the upper trolley (2) is able to pass through the lower trolley (3);

wherein the lower-trolley hoisting system comprises a lower-trolley hoisting mechanism (27) and a lower-trolley hoisting winding system, the lower-trolley hoisting mechanism (27) is configured to drive the hoist (14) of the lower trolley (3) to rise and fall through the lower-trolley hoisting winding system, the lower-trolley hoisting mechanism (27) comprises a lower-trolley hoisting mechanism part-A (29), a lower-trolley hoisting mechanism part-B (30) and a floating coupling (31), the lower-trolley hoisting mechanism part-A (29) is connected to the lower-trolley hoisting mechanism part-B (30) via the floating coupling (31);

the lower-trolley hoisting mechanism (27) is arranged in a quay crane machine room (24), wherein the floating coupling (31) is horizontally arranged behind an upper-trolley hoisting mechanism (32), and the lower-trolley hoisting mechanism part-A (29) and the lower-trolley hoisting mechanism part-B (30) are respectively arranged on left and right sides of the upper-trolley hoisting mechanism (32); and

the lower-trolley hoisting winding system comprises a lower-trolley hoisting winding group-A (33) and a lower-trolley hoisting winding group-B (34), the lower-trolley hoisting mechanism part-A (29) is configured to drive the hoist (14) of the lower trolley (3) to rise and fall through the lower-trolley hoisting winding group-A (33), and meanwhile, the lower-trolley hoisting mechanism part-B (30) is configured to drive the hoist (14) of the lower trolley (3) to rise and fall through the lower-trolley hoisting winding group-B (34).

2. The lower-trolley system of claim 1, wherein the lower trolley (3) comprises a recessed frame (5), a movable trolley (6) and wheels (13), wherein the wheels (13) are arranged on two sides of

the top of the recessed frame (5) and are configured to roll on the outer-side tracks (15) of the double-trapezoid four-track girder (1), the movable trolley (6) is arranged on the bottom of the recessed frame (5), and the hoist (14) is connected below the movable trolley (6).

3. The lower-trolley system of claim 2, wherein a movable trolley track is laid on the bottom of the recessed frame (5), the movable trolley (6) comprises a trolley body (10) and travelling wheels (17), and the travelling wheels (17) are mounted on two sides of the bottom of the trolley body (10) and are configured to roll on the movable trolley track.

4. The lower-trolley system of claim 3, wherein the recessed frame (5) comprises a horizontal frame (4), a first vertical frame group (8), and a second vertical frame group (9), wherein one end of the horizontal frame (4) is connected with an end of the first vertical frame group (8), the other end of the horizontal frame (4) is connected with an end of the second vertical frame group (9), and structures of the first vertical frame group (8) and the second vertical frame group (9) are symmetrically disposed relative to the middle of the horizontal frame (4); the first vertical frame group (8) comprises a first vertical rod (19) and a second vertical rod (20); the second vertical frame group (9) further comprises a first vertical rod (19) and a second vertical rod (20); and the wheels (13) are arranged on top ends of the first vertical rods (19), the other ends of the first vertical rods (19) are connected with ends of the second vertical rods (20), and the other ends, away from the first vertical rods (19), of the second vertical rods (20) are connected with the horizontal frame (4).

5. The lower-trolley system of claim 4, further comprising a first redirecting pulley block (101), a second redirecting pulley block (102), a third redirecting pulley block (103), a fourth redirecting pulley block (104), a fifth redirecting pulley block (105), a sixth redirecting pulley block (106), a seventh redirecting pulley block (107), and an eighth redirecting pulley block (108), wherein the first redirecting pulley block (101) is mounted on the top of the first vertical rod (19) of the first vertical frame group (8), the second redirecting pulley block (102) is mounted on an intersection of the first vertical rod (19) of the first vertical frame group (8) and the second vertical rod (20) of the first vertical frame group (8), the horizontal frame (4) is sequentially provided with the third redirecting pulley block (103), the fourth redirecting pulley block (104), the fifth redirecting pulley block (105), and the sixth redirecting pulley block (106) from left to right, the seventh redirecting pulley block (107) is mounted on an intersection of the first vertical rod (19) of the second vertical frame group (9) and the second vertical rod (20) of the second vertical frame group (9), and the eighth redirecting pulley block (108) is mounted on the top of the first vertical rod (19) of the second vertical frame group (9).

6. The lower-trolley system of claim 5, wherein the lower-trolley hoisting winding group-A (33) comprises a first quay crane redirecting pulley block (36) mounted on the quay crane, further comprises the first redirecting pulley block (101), the second redirecting pulley block (102), the third redirecting pulley block (103), and the fourth redirecting pulley block (104), further comprises a hoist pulley-A (40) mounted on the hoist (14) of the lower trolley (3), and further comprises a quay crane pulley-A (38) mounted on the double-trapezoid four-track girder (1) of the quay crane;

the lower-trolley hoisting winding group-B (34) comprises a hoist rope (35), further comprises a second quay crane redirecting pulley block (37) mounted on the quay crane, further comprises the fifth redirecting pulley block (105), the sixth redirecting pulley block (106), the seventh redirecting pulley block (107), and the eighth redirecting pulley block (108), further comprises a hoist pulley-B (41) mounted on the hoist (14) of the lower trolley (3), and further comprises a quay crane pulley-B (39) mounted on the double-trapezoid four-track girder (1) of the quay crane; and

one end of the hoist rope (35) is wound on the lower-trolley hoisting mechanism part-B (30), and the other end of the hoist rope (35), after firstly being wound through a lower side of the second quay crane redirecting pulley block (37) and then being wound through the eighth redirecting pulley block (108), the seventh redirecting pulley block (107), the sixth redirecting pulley block (106), the fifth redirecting pulley block (105), and the hoist pulley-B (41), is wound on the quay crane pulley-B (39), and, after being wound through the quay crane pulley-A (38) and then being wound through the first redirecting pulley block (101), the second redirecting pulley block (102), the third redirecting pulley block (103), the fourth redirecting pulley block (104), and the hoist pulley-A (40), is wound on the first quay crane redirecting pulley block (36), and is finally wound on the lower-trolley hoisting mechanism part-A (29).

7. The lower-trolley system of claim 6, wherein an included angle between each of the first vertical rods (19) and a vertical central line of a corresponding one of the outer-side tracks (15) is an acute angle, an included angle between each of the first vertical rods (19) and a corresponding one of the second vertical rods (20) is a blunt angle, and an included angle between each of the second vertical rods (20) and the horizontal frame (4) is an acute angle or a right angle.

8. The lower-trolley system of claim 7, wherein horizontal guide wheel groups (7) are further mounted on the top of the recessed frame (5) and are arranged on outer sides of the wheels (13); and each of the horizontal guide wheel groups (7) comprises a horizontal wheel (18) and a

rotation shaft (21), and the horizontal wheel (18) is coaxially sleeved on the rotation shaft (21) and is able to rotate around the rotation shaft (21).

9. The lower-trolley system of claim 8, wherein the horizontal wheel (18) has a shape of an inverted horn.