

Cable Rack Coupling

Background of the Invention

a) Field of the Invention

The present invention relates to a cable rack coupling destined for use to couple together frames of wire supporting racks called cable rack, cable ladder or the like (will generically be referred to as "cable rack" hereunder).

b) Explanation of the Related Art

Various types of cable racks are available and selectively used correspondingly to a number of cables to be supported. They are different in width from each other. For example, a wide cable rack is selected for supporting a large number of cables. When used to support cables, the cable racks are coupled longitudinally to each other with cable rack couplings. Figs. 17(I) and (II) schematically show typical examples of conventional cable rack couplings.

Fig. 17(I) shows a cable rack coupling 10 used to couple together cable racks whose frame is 70 mm wide, for example. The coupling 10 has four bolt holes 11 formed horizontally therein. Each bolt hole 11 is shaped to have a vertically oblong form. To couple adjacent cable racks to each other, two of the four bolt holes 11 in the coupling 10 are used to bolt the coupling 10 to one of the cable racks while the other two are used to bolt the same coupling 10 to the other cable rack.

Fig. 17(II) shows a cable rack coupling 20 used to couple together cable racks whose frame is 100 mm wide, for example. The coupling 20 has formed therein an upper row of four bolt holes 21 and a lower row of four bolts 21. Each bolt hole 21 is shaped to have a vertically oblong form. To couple adjacent cable racks to each other, four of the eight bolt holes 21 in the coupling 20 are used to bolt the coupling 20 to one of the cable racks while the other four are used to bolt the same coupling 20 to the other cable rack.

To couple two adjacent cable racks to each other using the 70 mm-wide coupling, the coupling is bolted at two of the bolt holes to each of the cable racks. Namely, to couple two adjacent cable racks to each other, four bolt holes are used to bolt the coupling to the cable racks. Two opposite cable racks form a pair. Therefore, for coupling two pairs each of two adjacent cable racks, the bolt fastening has to be done at eight bolt holes. To couple two adjacent cable racks to each other using the 100 mm-wide coupling, the coupling is bolted at four of the bolt holes to each of the cable racks. Namely, for coupling two pairs each of two adjacent cable racks, the bolt fastening has to be done at sixteen bolt holes. That is, to couple the cable racks to each other, a long time and much labor are required for bolting the couplings to the cable racks.

In addition, the cable racks are to be installed at a height in many cases and many bolts and nuts have to be used to fasten the couplings and cable racks. Inadvertent dropping of bolts or nuts from the height may possible happen in so many cases, which will be dangerous to their co-workers and nearby people at site.

The cable rack couplings of the above-mentioned types are required to have a sufficient strength to support cables even after they are used to couple together cable racks which supports many cables thereon. Namely, the desirable cable rack couplings are to be able to couple cable racks to each other in a simpler manner but not to be smaller in cable-supporting strength than the currently available cable rack couplings.

Summary of the Invention

The present invention has an object to overcome the above-mentioned drawbacks of the related art by providing a cable rack coupling which can couple cable racks together more simply and with an improved efficiency and has a greater cable-supporting strength than the conventional couplings.

- (1) The above object can be attained by providing a cable rack coupling for use to

couple together a plurality of cable racks forming together a cable way on which cables are to be laid, and including at least a parallel bar member disposed to support the cables, and a pair of rack frames disposed generally parallel to end faces of the parallel bar member to form a pair of side walls of the cable way, the cable rack coupling comprising :

a doubling plate portion which abuts on the outer surface of the rack frame of each of the two adjacent cable racks; and

a supporting portion inwardly bent at the lower end of the doubling plate portion to abut on a supporting panel portion inwardly bent at the lower end of the rack frame of each cable rack;

a pair of square coupling bolt holes being formed in the doubling plate portion at each of right and left ends of the latter.

Because of the above-mentioned construction of the cable rack coupling, the cable racks can be coupled to each other with a half of the coupling operations required when any conventional coupling is used, while maintaining a greater cable-supporting strength than that of the conventional coupling. That is, cable racks can be coupled to each other with a minimum necessary number of coupling bolts while being given the greater cable-supporting strength than that of the conventional coupling.

(2) Also, the above object can be attained by providing a cable rack coupling for use to couple together a plurality of cable racks forming together a cable way on which cables are to be laid, and including at least a parallel bar member disposed to support the cables, and a pair of rack frames forming together a pair of side walls of the cable way, each rack frame consisting of a side panel portion disposed generally parallel to end faces of the parallel bar member, a supporting panel portion inwardly bent in a generally L form at the lower end of the side panel portion, and a bent panel portion outwardly bent in a generally L form at the upper end of the side panel portion, the cable rack coupling comprising:

a doubling plate portion which abuts on the outer surface of a side panel portion of the rack frame of each the two adjacent cable racks;

a supporting portion inwardly bent at the lower end of the doubling plate portion to abut on the lower surface of a supporting panel portion of the rack frame of each cable rack; and

a reinforcing portion outwardly bent at to the upper end of the doubling plate portion to abut on the lower surface of a bent panel portion of the rack frame of each cable rack;

a pair of square coupling bolt holes being formed in the doubling plate portion at each of right and left ends of the latter.

By forming the supporting portion and reinforcing portion at the bottom and top, respectively, of the doubling plate portion, it is possible to assure a greater cable-supporting strength.

In the above-mentioned cable rack couplings (1) and (2), a pair of auxiliary bolt holes should preferably be formed between the pair of coupling bolt holes in the doubling plate portion and also each auxiliary bolt hole should preferably be shaped square.

Also, in the cable rack couplings (1) and (2), the doubling plate portion should be shaped to have an oblong form of 180 mm in length and 70 mm in width or of 180 mm in length and 100 mm in width, and square coupling bolt holes of 10 mm in side length should preferably be formed in the doubling plate portion in positions of 60 to 70 mm longitudinally apart from the center of the latter.

In addition to the square coupling bolt holes of 10 mm in side length, square auxiliary bolt holes of 10 mm in side length should preferably be formed in the doubling plate portion in positions 17 to 27 mm longitudinally apart from the center of the latter.

The above-mentioned cable rack couplings (1) and (2) are suitably usable to couple together cable racks each including a rack frame formed by bending a metal sheet of 1.6 to 2 mm in thickness and which includes a side panel portion of 70 to 100 mm in width,

supporting panel portion bent inwardly of the rack frame at the lower end of the side panel portion, and a bent panel portion bent outwardly of the rack frame at the upper end of the side panel portion to have a generally L section.

These objects and other objects, features, and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiments of the present invention when taken in conjunction with the accompanying drawings. It should be noted that the present invention is not limited to the embodiments but can freely be modified without departing from the scope and spirit thereof set forth in the claims given later.

Brief Description of the Drawings

Fig. 1 is an exploded perspective view of a first embodiment of the cable rack coupling according to the present invention.

Fig. 2 is a perspective view of the cable rack coupling in Fig. 1, showing the cable rack coupling used to couple cable racks to each other.

Fig. 3 is a cross-sectional view of the cable rack coupling used as in Fig. 2.

Fig. 4 is a cross-sectional view of a variant of a doubling plate portion of the first embodiment of the cable rack coupling according to the present invention.

Fig. 5 is a front view of the cable rack coupling in Fig. 1, showing locations of coupling bolt holes formed in the cable rack coupling.

Fig. 6 is an exploded perspective view of a second embodiment of the cable rack coupling according to the present invention.

Fig. 7 is a cross-sectional view of the cable rack coupling in Fig. 6, showing the cable rack coupling used to couple cable racks to each other.

Fig. 8 is a cross-sectional view of a variant of a doubling plate portion of the second embodiment of the cable rack coupling according to the present invention.

Fig. 9 is a front view of the cable rack coupling in Fig. 6, showing locations of coupling bolt holes formed in the cable rack coupling.

Fig. 10 is an exploded perspective view of a third embodiment of the cable rack coupling according to the present invention.

Fig. 11 is a cross-sectional view of the cable rack coupling in Fig. 10, showing the cable rack coupling used to couple cable racks to each other.

Fig. 12 is a cross-sectional view of a variant of a doubling plate portion of the third embodiment of the cable rack coupling according to the present invention.

Fig. 13 is a front view of the cable rack coupling in Fig. 10, showing locations of coupling bolt holes formed in the cable rack coupling.

Fig. 14 schematically illustrates the method of testing the cable rack coupling for the cable-supporting strength.

Fig. 15 shows results of the cable-supporting strength test made on the first embodiment of the cable rack coupling according to the present invention.

Fig. 16 shows results of the cable-supporting strength test made on the second and third embodiments of the cable rack coupling according to the present invention.

Fig. 17 is a front view of the conventional cable rack couplings.

Detailed Description of the Preferred Embodiments

Some embodiments of the cable rack coupling according to the present invention will be described herebelow with reference to the accompanying drawings.

Referring now to Figs. 1 to 5, there is schematically illustrated the first embodiment of the cable rack coupling according to the present invention.

As shown in Fig. 1, each of cable racks P to be coupled together by couplings 30 according to the present invention to form together a cable way on which cables are to be laid includes a plurality of parallel bar members P2 (only one of them is shown for the simplicity

of the illustration and explanation) disposed at predetermined intervals to support the cables, and a pair of rack frames P1 disposed generally parallel to end faces of the parallel bar member P2 to form a pair of side walls of the cable way.

Each rack frame P1 consists of a generally vertical side panel portion P1a, a supporting panel portion P1b inwardly bent at a right angle at the lower end of the side panel portion P1a, and a bent panel portion P1c outwardly bent at a right angle at the upper end of the supporting panel portion P1b and further bent downward in a generally L form. The side panel portion P1a has formed therein horizontally elongated openings P1d through which coupling bolts Q which will be described later are to be introduced.

Each of the parallel bar members P2 is fixed, by welding or any other suitable technique, to the supporting panel portion P1b of the rack frame P1 with the lower end surface thereof being in contact with the upper surface of the supporting panel portion of each of two rack frames P1 laid parallel to each other.

The cable rack P should preferably be formed by bending a metal sheet of 1.6 to 2 mm in thickness, and the rack frame P1 should also preferably be formed from a side panel portion P1a of 70 to 100 mm in thickness, a supporting panel portion P1b bent inwardly of the rack frame P1 at the lower end of the side panel portion P1a, and a bent panel portion P1c bent outwardly of the rack frame P1 in a generally L form at the upper end of the side panel portion P1a.

The cable rack coupling 30 according to the present invention is formed to fit the cable rack P of the above structure. That is, the cable rack coupling 30 consists of an oblong doubling plate portion 1 which is to abut on the outer surface of the side panel portion P1a of the rack frame P1 of each of the adjacent cable racks P, a supporting portion 2 inwardly bent generally at a right angle at the lower end of the doubling plate portion 1 to abut on the lower surface of the supporting panel portion P1b of the rack frame P1 of each cable rack P, and a

reinforcing portion 4 outwardly bent generally at a right angle at the upper end of the doubling plate portion 1 to abut the lower surface of the bent panel portion P1c of the rack frame P1 of each cable rack P. Further, the doubling plate portion 1 of each coupling 30 has formed nearly at either end thereof square coupling bolt holes 3 corresponding to the openings P1d formed in the rack frames P1 of the two adjacent cable racks P.

For securing the above coupling 30 to the two adjacent cable racks P, it is put in contact with the side panel portions P1a of the rack frames P1 of the cable racks P, the coupling bolt holes 3 in the coupling 30 are centered with the openings P1d in the rack frames P1, coupling bolts Q are penetrated through the coupling bolt holes 3 and openings P1d from inside the rack frames P1, nuts Q1 are put on the coupling bolts Q with washers Q2 placed inside the nuts Q1, respectively, from outside the rack frames P1, and then the nuts Q1 are turned to fasten the coupling bolts Q.

The coupling bolt Q penetrated through the coupling bolt hole 3 may be an ordinary bolt, but it should desirably be a cup square neck bolt for an improved supporting strength of the doubling plate portion 1.

In this embodiment, the opening P1d formed in the side panel portion P1a of the cable rack P is a horizontally elongated one. However, the opening P1d should desirably have a height a little larger than one side of the square-pole portion of the cup square neck bolt which is penetrated through the opening.

Note that in this embodiment, the doubling plate portion 1 has the reinforcing portion 4 outwardly bent at the upper end of the doubling plate portion 1 to abut on the lower surface of the bent panel portion P1c of the rack frame P1 to improve the supporting strength of the doubling plate portion 1 but the reinforcing portion 4 may not be provided on the doubling plate portion 1 as shown in Fig. 4.

Fig. 5 shows the doubling plate portion 1 having an oblong form of 180 mm in length

(A) and 70 mm in width (B), and square coupling bolt holes 3 of 10 mm in side length (X) formed therein in positions (C) of 60 to 70 mm longitudinally apart from the center thereof.

Figs. 6 to 9 show together a second embodiment of the cable rack coupling according to the present invention.

This second embodiment is generally identical in basic construction to the first embodiment provided that the doubling plate portion 1 has a somewhat larger width and auxiliary bolt holes 5 in addition to the coupling bolt holes 3.

In this embodiment, the doubling plate portion 1 has an oblong form of 180 mm in length (A) and 100 mm in width (B), square coupling bolt holes 3 of 10 mm in side length (X) formed therein in positions (C) of 60 to 70 mm longitudinally apart from the center thereof, and square auxiliary bolt holes 5 of 10 mm in side length (X) formed therein in positions (D) of 17 to 27 mm longitudinally apart from the center thereof.

As shown in Fig. 6, the rack frame P1 of the cable rack P is as wide (100 mm) as the doubling plate portion 1 of the coupling 30, and has two through-holes P1d formed in each of upper and lower portions thereof. The rack frame P has formed therein coupling bolt holes 3 and auxiliary bolt holes 5 correspondingly to the lower through-holes P1d in the doubling plate portion 1 of the coupling 30.

As shown in Fig. 7, the doubling plate portion 1 of the coupling 30 has a reinforcing portion 4 outwardly bent at the upper end of the doubling plate portion 1 to abut on the lower surface of the bent panel portion P1c of the rack frame P1. The reinforcing portion 4 further improves the supporting strength of the doubling plate portion 1. Also, the doubling plate portion 1 may not include such a reinforcing portion 4 as shown in Fig. 8.

Figs. 10 to 13 show together a third embodiment of the cable rack coupling according to the present invention.

In this embodiment, the doubling plate portion 1 has an oblong form of 180 mm in

length (A) and 100 mm in width (B), square coupling bolt holes 3 of 10 mm in side length (X) formed therein in positions (C) of 60 to 70 mm longitudinally apart from the center thereof, and square auxiliary bolt holes 5 of 10 mm in side length (X) formed therein in positions (D) 17 to 27 mm longitudinally apart from the center thereof, as shown in Fig. 10.

The third embodiment is different from the second embodiment in locations of the coupling bolt holes 3 and auxiliary bolt holes 5. More particularly, the third embodiment is similar to the second embodiment in that the rack frame P1 of the cable rack P is 100 mm width and has two through-holes P1d formed in each of upper and lower portions thereof, but different from the second embodiment in that the doubling plate portion 1 of the coupling 30 has the coupling bolt holes 3 formed in positions where they will be aligned with the upper through-holes P1d and the auxiliary bolt holes 5 formed in positions where they will be aligned with the lower through-holes P1d. The longitudinal distance from the center of the doubling plate portion 1 to the coupling bolt hole 3 to the auxiliary bolt hole 5 is similar to those in the second embodiment.

As shown in Fig. 11, therein a reinforcing portion 4 outwardly bent at the upper end of the doubling plate portion 1 to abut on the lower surface of the bent panel portion P1c of the rack frame P1, as in the second embodiment. Also, the doubling plate portion 1 may not include such a reinforcing portion 4 as shown in Fig. 12.

The aforementioned first, second and third embodiments of the cable rack coupling according to the present invention were tested for their strength as shown in Fig. 14. In this test, the deflection of the cable rack couplings was determined. The test results are as shown in Figs. 15 and 16.

Note that in this test, the rack frames P1 of the cable racks P were coupled together by the coupling, a predetermined weight (P) was applied at the joint between the cable racks P and a deflection (mm) of the coupling at the joint was measured by the use of a dial gauge R.

The coupled cable racks P were supported at right and left points S separated 500 mm from each other. The coupling bolts Q used were cup square neck bolts.

Fig. 15 shows the comparison in supporting strength between the first embodiment of the cable rack coupling according to the present invention and the conventional cable rack coupling shown in Fig. 17(I). In Fig. 15, the "A type" indicates the result of the test on the coupling with the reinforcing portion 4 as shown in Fig. 3, while the "B type" indicates the result of the test on the coupling without the reinforcing portion 4 as shown in Fig. 4.

Fig. 16 shows the comparison in supporting strength between the second and third embodiments of the cable rack coupling according to the present invention and the conventional cable rack coupling shown in Fig. 17(II). In Fig. 16, the "C type" and "E type" indicate the results of the test on the second embodiment of the coupling, while the "D type" and "F type" indicate the results of the test on the third embodiment of the coupling.

That is, the "C type" is the result of the test made on the coupling shown in Fig. 9, "E type" is the result of the test made on the coupling without the reinforcing portion 4 as shown in Fig. 8, "D type" is the result of the test made on the coupling shown in Fig. 13, and the "F type" is the result of the test made on the coupling shown in Fig. 12.

The test results show that all the cable rack couplings of the "A" to "F" types according to the present invention show smaller deflection and larger supporting force than the conventional coupling.

Particularly, the deflection of the first embodiment is about a half of that of the conventional coupling as will be seen from Fig. 15. That is, although the number of coupling bolts Q used in the first embodiment is a half of that in the conventional coupling, the supporting strength of the first embodiment can be more than twice larger than that of the conventional coupling (when a weight of 400 kgf is applied).

As having been described in the foregoing, the cable rack coupling permits to couple

cable racks P to each other with a half of the coupling operations required when any conventional coupling is used, and to assure a greater cable-supporting strength than that of the conventional coupling. That is, cable racks P can be coupled to each other with a minimum necessary number of coupling bolts Q while maintaining the greater cable-supporting strength than that of the conventional coupling. Particularly, when the coupling bolt holes 3 are shaped square and cup square neck bolts are used as the coupling bolts Q, a higher supporting strength can be assured.

Also, the reinforcing portion 4 is outwardly bent at the upper end of the doubling plate portion 1 to abut on the lower surface of the bent panel portion P1c of the rack frame P1, which can further improve the supporting strength of the doubling plate portion 1.

Further, the cable rack couplings according to the present invention are most suitably usable to couple together cable racks each including a rack frame P1 including a side panel portion P1a of 70 to 100 mm in width, supporting panel portion P1b bent inwardly of the rack frame P1 at the lower end of the side panel portion, and a bent panel portion P1c bent outwardly of the rack frame P1 to have a generally L section at the upper end of the side panel portion P1a. The cable rack couplings according to the present invention permit to couple cable racks to each other more simply and with an improved efficiency of coupling and has a higher supporting strength of the cable racks than the conventional couplings.

Claims:

1. A plurality of cable racks coupled together by a cable rack coupling to form a cable way on which cables are to be laid, wherein
 - each cable rack comprises at least a parallel bar member disposed to support the cables, and a pair of rack frames disposed generally parallel to end faces of the parallel bar member to form a pair of side walls of the cable way; and
 - the cable rack coupling comprises:
 - a doubling plate portion which abuts on the outer surface of the rack frame of each of the two adjacent cable racks;
 - a supporting portion inwardly bent at the lower end of the doubling plate portion to abut on a supporting panel portion inwardly bent at the lower end of the rack frame of each cable rack; and
 - a pair of square coupling bolt holes being formed in the doubling plate portion at each of right and left ends of the latter.
2. A plurality of cable racks coupled together by a cable rack coupling to form a cable way on which cables are to be laid; wherein
 - each cable rack comprises at least a parallel bar member disposed to support the cables and a pair of rack frames forming together a pair of side walls of the cable way, each rack frame consisting of a side panel portion disposed generally parallel to end faces of the parallel bar member, a supporting panel portion inwardly bent in a generally L form at the lower end of the side panel portion, and a bent panel portion outwardly bent in a generally L form at the upper end of the side panel portion; and
 - the cable rack coupling comprises:
 - a doubling plate portion which abuts on the outer surface of a side panel portion of the rack frame of each the two adjacent cable racks;
 - a supporting portion inwardly bent at the lower end of the doubling plate portion to abut on the lower surface of a supporting panel portion of the rack frame of each cable rack;
 - a reinforcing portion outwardly bent at to the upper end of the doubling plate portion to abut on the lower surface of a bent panel portion of the rack

frame of each cable rack; and

a pair of square coupling bolt holes being formed in the doubling plate portion at each of right and left ends of the latter.

3. The cable rack coupling of claim 1 or 2, wherein the doubling plate portion has a pair of auxiliary bolt holes formed therein in addition to the pair of coupling bolt holes.

4. The cable rack coupling of claim 3, wherein one or both auxiliary bolt hole is shaped to have a square form.

5. The cable rack coupling according to any one of the preceding claims, wherein the doubling plate has an oblong form of 180 mm in length and 70 mm in width, and square coupling bolt holes of 10 mm in side length are formed in the doubling plate portion in positions 60 to 70 mm longitudinally apart from the center of the latter.

6. The cable rack coupling of claim 1, 2, 3 or 4, wherein the doubling plate portion has an oblong form of 180 mm in length and 100 mm in width, square coupling bolt holes of 10 mm in side length are formed in the doubling plate portion in positions 60 to 70 mm longitudinally apart from the center of the latter, and square auxiliary bolt holes of 10 mm in side length are formed in the doubling plate portion in positions of 17 to 27 mm longitudinally apart from the center of the latter.