

Cable tray unit and cable tray system

This patent application claims the priority of the Chinese patent application No. 202311631874.2, titled “Cable tray unit and cable tray system” filed on December 1, 2023, the contents of which are incorporated by reference herein.

Technical Field

The present invention relates to the field of cable tray systems, and in particular to cable tray units and cable tray systems configured to accommodate high-voltage power transmission cables in cable tunnels.

Technical Background

In many countries and regions, including Singapore, China, Japan, South Korea, and etc., underground transmission cable tunnels have been built to provide power, freeing ground for road traffic and building space, and preventing dangerous accidental contact related to overhead power lines. For example, Singapore has strict requirements for electricity supply to meet industrial, commercial, and residential needs. Singapore has a vast underground tunnel network used to carry cables, pipelines, and other infrastructure. These tunnels are used for power transmission, water supply, sewage treatment, and communication, and underground power transmission cable tunnels can be located up to 60-80m below ground level. High voltage power cables are separated within cable trays in cable tunnels, and the cable trays must have the characteristics of quick installation and maintenance, as well as excellent fire and explosion safety.

The existing cable tray system is designed with the concept of elastic expansion to release pressure. The cable tray is designed with two U-shaped tray on top and bottom. During installation, the upper tray is covered on the lower tray and tied with elastic straps every 0.8m. A set of guide blocks is installed on both sides of the interface of the lower tray every 0.8m. When the cables inside the cable tray explode, the cable tray is pushed open, the guide

blocks are used to restrict the tray to maintain vertical upward movement when the upper tray is pushed open. When the cables installed in the cable tray explode, the impact force generated by the explosion will form a certain gap on the upper tray of the cable tray. Due to enough guide blocks and enough elastic straps installed on the lower tray, the explosive force will push the upper tray to open upwardly to create a large enough gap to release the pressure generated by the explosion (the size of the opened gap is related to the tightness of the straps and the magnitude of the explosive force), the explosive force generated by the explosion will be released from the gaps on both sides of the tray to both sides, after the internal pressure is completely released, the upper tray return to the installation position along the guide block of the lower tray under gravity and the tension of the straps, causing the upper tray and lower tray to close and reseal, the combustion inside the tray will automatically extinguish due to insufficient fresh air inside the cable tray to support combustion.

However, this elastic expansion release pressure type of cable tray system will directly release the shock wave, flame, pressure, high temperature, and harmful smoke generated by the explosion into the working area when the explosion pressure is released. During the pressure release, melted metal bodies, burning cables, and other PE materials will also spray out from this gap, if there are workers working near the explosion point at this time, the high-temperature splashes generated by the explosion and the accompanied shock wave will harm the surrounding personnel and equipment, which may cause irreversible and fatal injuries to personnel.

In addition, since the installation positions of the straps and the guide blocks of the cable tray are fixed, the cable tray needs to be installed on a bracket. The position of the bracket must be staggered from the position of the straps and the position of the interface between two trays of the cable tray. The method of staggered installation is achieved by ordering different lengths of cable trays. This requires inputting the installation path and bracket position of the entire cable tray into the computer during project ordering, and simulating on-site installation in the computer to determine the final order. This results in the design and installation of existing cable tray being relatively cumbersome.

In addition, since the interface design of the two trays of the cable tray is one piece pressed on the next piece, a special tray needs to be designed every

50m, which can disconnect the left and right trays of the cable tray. That is to say, if the cables inside the cable tray need to be repaired, the tray needs to be removed from the special tray all the way to the location that needs to be repaired, instead of directly opening the tray at the repair location. This will increase the workload of repairing the cable inside the cable tray.

Therefore, the present invention proposes a cable tray and cable tray system that meets the requirements of safe operation of electricity, which has better safety and can also have characteristics such as easy transportation, installation, and maintenance.

Summary

The object of the present invention is to provide a cable tray unit that meets the requirements for safe operation of electricity and can limit high-temperature and high-speed injected cable fragments, high-temperature harmful gases, and etc. generated during cable explosions to the interior of the tray.

To achieve the above object, the technical solution of the present invention is as follows:

A cable tray unit, comprising:

a bottom tray, which has a bottom and two lower sidewalls extending from opposite sides of the bottom towards a top direction;

a top tray, which has a top and two upper sidewalls extending from opposite sides of the top towards a bottom direction;

a locking assembly;

wherein the two lower sidewalls of the bottom tray and the two upper sidewalls of the top tray are disposed opposite respectively, and the locking assembly fixedly connects the lower sidewalls and the upper opposite sidewalls.

In an embodiment, the locking assembly comprises a fastener pair and a locking member, the fastener pair comprises two fastener units located on inner and outer sides of a junction of the lower sidewalls and the upper sidewalls respectively, the locking member is fixedly connected to the two fastener units.

In an embodiment, the lower sidewalls and the upper sidewalls both comprise inner flanges extending to insides of the corresponding sidewalls and outer flanges extending to outsides of the corresponding sidewalls, the fastener units are provided with a lower boss portion and an upper boss portion

corresponding to the inner flanges or outer flanges, the lower boss portion and the upper boss portion cooperate with the inner flanges or the outer flanges to prevent the separation of the bottom tray and the top tray.

In an embodiment, back surfaces of the inner flanges and the outer flanges facing the corresponding lower boss portion or upper boss portion are first inclined surfaces, and the first inclined surfaces are inclined towards the top direction of the lower or upper sidewalls connected thereto, surfaces of the lower boss portion, upper boss portion facing the upper boss portion or the lower boss portion are second inclined surfaces, the second inclined surfaces are substantially parallel to the first inclined surfaces.

In an embodiment, the locking member comprises a screw and a nut, a rod portion of the screw passes through the two fastening units of the same fastening pair, and the two fastening units are locked by the nut.

In an embodiment, the locking member further comprises a limiting block, and the rod portion of the screw passes through the limiting block.

In an embodiment, the locking member further comprises an elastic member, and the rod portion of the screw passes through the elastic member.

In an embodiment, the fastener units are further provided with a middle boss portion located between the upper boss portion and the lower boss portion.

In an embodiment, there is a height difference between the two lower sidewalls of the bottom tray, and there is also a height difference between the two upper sidewalls of the top tray.

In an embodiment, the top tray comprises a variable radial size segment.

In an embodiment, the cable tray unit further comprises a support member fixed to the bottom tray.

In an embodiment, ribs are provided on inner sides of the two lower sidewalls of the bottom tray, and the ribs and the lower sidewalls form grooves for fixing the support member.

In an embodiment, both ends of the bottom tray have inward contracted portions without the ribs.

In an embodiment, the cable tray unit further comprises an extending side plate, which is provided between the lower sidewalls of the bottom tray and the upper sidewalls of the top tray, the locking assembly is fixedly connected to the lower sidewalls and the extending side plate, and the locking assembly is

fixedly connected to the upper sidewalls and the extending side plate.

The present invention also provides a cable tray unit, comprising:

a bottom tray, which has a bottom and two lower sidewalls extending from opposite sides of the bottom towards a top direction, an upper end of each of the lower sidewalls is provided with a lower fixing portion;

a top tray, which has a top and two upper sidewalls extending from opposite sides of the top towards a bottom direction, a lower end of each of the upper sidewalls is provided with an upper fixing portion;

a locking assembly;

wherein the locking assembly is fixedly connected to the upper fixing portion and the lower fixing portion to form a complete tray with the bottom tray and the top tray and limit a generated explosive force to an interior of the tray when cables inside the tray explode.

In an embodiment, the lower fixing portion is a lower hook-shaped groove provided on outer edges of the lower sidewalls, and the upper fixing portion is a lower hook-shaped groove provided on outer edges of the lower sidewalls, the lower hook-shaped groove is open towards the bottom, and the upper hook-shaped groove is open towards the top, the lower hook-shaped groove and the upper hook-shaped groove are hooked to each other, the locking assembly restricts the lower hook-shaped groove and the upper hook-shaped groove from separating.

In an embodiment, the lower fixing portion and the upper fixing portion are one and the other of a slot and an inserting portion, respectively, the inserting portion is located in the slot, and the locking assembly restricts the inserting portion from being released from the slot.

In an embodiment, the lower fixing portion is a lower fixing plate extending outwardly from the lower sidewalls, and the upper fixing portion is an upper fixing plate extending outwardly from the upper sidewalls, the locking assembly is fixedly connected to the lower fixing plate and the upper fixing plate.

In an embodiment, the locking assembly further comprises a tray strap, which is located on outer sides of the bottom tray and the top tray and fixes the bottom tray and the top tray.

A cable tray system comprising a tray unit and an inner lining, the inner

lining is located at a junction of the adjacent tray units, and multiple tray units are connected to each other through the inner lining, wherein the tray unit comprises the cable tray unit as described above.

The present invention adopts the above-mentioned technical solution, which has the following beneficial effects:

the tray structure of the cable tray unit provided by the present invention achieves a fully sealed and non-pressure relief cable tray design by means of a completely coupling connection between the top tray and the bottom tray, when the cables inside the cable tray explode, the high-temperature fragments generated by the explosion are completely confined within the cable tray under the action of high pressure, and will not splash to the surrounding to harm personnel and equipment. In addition, the number of components of the cable tray of the present invention is less, easy to install, and when it is necessary to inspect the cables at the designated position inside the tray, only the top tray at the designated position needs to be removed.

Description of drawings

Fig.1 shows a perspective view of a first tray unit.

Fig.2 shows a cross-section view of the first tray unit.

Fig. 3 shows a perspective view of a first bottom tray.

Fig. 4 shows a perspective view of a first top tray.

Fig. 5 shows a schematic diagram of an inner lining.

Fig. 6 shows a schematic diagram of a fastener pair.

Fig. 7 shows a schematic diagram of a locking assembly.

Fig. 8 shows a partially enlarged view of the junction between the first bottom tray and the first top tray.

Fig. 9 shows a cross-section view of the fastener pair.

Fig. 10 shows a partial enlarged view of the locking assembly when locked at the junction of the first bottom tray and the first top tray.

Fig. 11 shows a cross-section view of the first bottom tray, the first top tray, and the inner lining.

Fig. 12 shows a perspective view of a second tray unit.

Fig. 13 shows a cross-section view of the second bottom tray, second top tray, and inner lining.

Fig. 14 shows a perspective view of a third tray unit.

Fig. 15 shows a schematic diagram of a cable tray system composed of different tray units.

Fig. 16 shows a schematic diagram of a non linear cable tray system composed of tray units.

Fig. 17 shows a perspective view of a fourth tray unit.

Fig. 18 shows a cross-section view of the fourth tray unit.

Fig. 19 shows a cross-section view of a fourth bottom tray, a fourth top tray, and an extended side plate.

Fig. 20 shows a cross-section view of the fifth tray unit.

Fig. 21 shows a cross-section view of a fifth bottom tray, a fifth top tray, and an fifth locking assembly.

Fig. 22 shows a cross-section view of the sixth tray unit.

Fig. 23 shows a cross-section view of a sixth bottom tray, a sixth top tray, and an sixth locking assembly.

Fig. 24 shows a cross-section view of the seventh tray unit.

Fig. 25 shows a cross-section view of a seventh bottom tray, a seventh top tray, and an seventh locking assembly.

Embodiments

The embodiments of this invention will be described in detail with reference to the accompanying drawings, so that the purposes, the characteristics and the advantages of the invention can be more clearly understood. It should be understood that the embodiments shown in the figures are not intended to limit the scope of this invention, but illustrate the essential spirit of the technical solution of this invention.

In the following description, certain specific details are set forth for purposes of illustrating the various disclosed embodiments to provide a thorough understanding of the various disclosed embodiments. However, Those skilled in the art will recognize that embodiments may be practiced without one or more of these specific details. In other instances, well-known devices, structures, and techniques associated with the present application may not be shown or described in detail to avoid unnecessarily obscuring the description of the embodiments.

Unless otherwise desired by context, throughout the specification and claims, the terms "comprising" and variations thereof, such as "including" and "having", are to be construed as non-exclusive, i.e., to be construed as "including, but not limited to".

Throughout the specification "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. Therefore, the presence of "in one embodiment" or "in an embodiment" at various locations throughout the specification need not all refer to the same embodiment. Additionally, particular features, structures, or features may be combined in any manner in one or more embodiments.

The singular forms "a" and "the" as used in the specification and appended claims include plural references unless the context clearly dictates otherwise. The term "or" be used in its usual sense including "and/or" unless the context clearly dictates otherwise.

In the following description, for clarity of illustration of the structure and mode of operation of the present invention, various directional terms will be used to describe the present invention, but words such as "front", "rear", "left", "right", "outer", "inner", "outward", "inward", "upper", "lower", and the like, should be understood as convenient terms and should not be construed as limiting terms.

In addition, the terms "horizontal", "vertical", "overhang" and other terms do not mean that the component is required to be absolutely horizontal or overhanging, but can be slightly tilted. If "horizontal" only refers to its direction being more horizontal compared to "vertical", it does not mean that the structure must be completely horizontal, but can be slightly tilted.

In the description of this application, it should also be noted that unless otherwise specified and limited, the terms "provide", "install", "connect to each other", and "connect" should be broadly understood, for example, they may be fixedly connected, detachably connected, or integrally connected; it may be a mechanical connection or an electrical connection; they may be directly connected, or indirectly connected through an intermediate medium, or it may be an internal connection between two components. For those skilled in this art, they can understand the specific meanings of the above terms in this application

based on specific circumstances.

The present invention provides a cable tray system comprising multiple substantially rectangular tray units, which are connected to each other through connecting inner lining to form a slender body with a cavity for accommodating cables and related equipment (such as cooling pipelines), for protecting cables inside the tray and personnel and facilities outside the tray.

As shown in Figs. 1-10, a cable tray of a conventional segment is shown, which includes multiple substantially rectangular first tray units 10, multiple first tray units 10 can be connected to each other through a first inner lining 12 to form a elongate cable tray that accommodates cables and related equipments.

Referring to Figs. 3 and 4, the first tray unit 10 includes a first tray 11 and a first locking assembly 13, wherein the first tray 11 is composed of a first bottom tray 111 and a first top tray 112. The first bottom tray 111 is a U-shaped tray, which is installed on a bracket in the cable tunnel. The first top tray 112 is an inverted U-shaped tray, installed on the top of the first bottom tray 111, and matched with the first bottom tray 111 to form a substantially rectangular cavity, which is used to accommodate cables and related facilities. In order to achieve fire and explosion resistance, both the first bottom tray 111 and the first top tray 112 are made of flame-retardant materials, such as flame-retardant fiber-reinforced plastic (FR-FRP), which have sufficient strength, high flame retardancy, and fire resistance, and can effectively slow down the spread of fire.

Referring to Figs. 1 and 5, the first inner lining 12 is fixed or fastened to the junction of two adjacent first tray units 10, connecting the two adjacent first tray units 10 to form a sealed or substantially sealed connection. The first inner lining 12 in this embodiment includes a U-shaped bottom lining member 121 that matches the first bottom tray 111, and a U-shaped top lining member 122 that matches the first top tray 112. During installation, the bottom lining member 121 is connected to two adjacent first bottom trays 111 through bolts, and the top lining member 122 is connected to two adjacent first top trays 112 through bolts. The first inner lining 12 can be made of the same flame retardant material as the trays, such as flame retardant fiber-reinforced plastic (FR-FRP), which has sufficient strength, high flame retardancy and fire resistance, and can effectively slow down the spread of fire.

Referring to Figs. 1 and 2, the first bottom tray 111 is also equipped with a

support member 14, which is used to support cooling pipelines and other equipments. After the cables are laid into the tray, multiple support members 14 are assembled in the tray at a certain distance, and the cooling pipelines are placed on the support members 14, so that the cooling pipelines are located above the cables, which can cool the power cables during the power transmission. If the cables are not cooled, it may cause a rated power of the cable to reduce due to high temperature. The support member 14 can also provide a certain isolation or spacing between the cable and the cooling pipe.

In this embodiment, there are ribs 1112 extending along the length direction of the tray on the opposite inner sidewalls of the first bottom tray 111. The cross-section of the rib 1112 is substantially L-shaped, and its bottom is connected to the first bottom tray 111, and forms a groove for supporting and accommodating the bottom of the support member 14 with the inner sidewalls of the first bottom tray 111, thereby allowing the support member to be fixed on the first bottom tray 111. Preferably, the ribs 1112 cut off at both ends of the first bottom tray 111, forming an inward contracted portion that avoids the bottom lining member 121, this not only does not affect the assembly of the bottom lining member 121, but also plays a positioning and limiting role in the installation of the bottom lining member 121.

The first locking assembly 13 fixedly connects the first bottom tray 111 and the first top tray 112 into a sealed whole, when the cable installed in the cable tray experiences a short circuit explosion, the connection structure of the first locking assembly 13 can withstand the explosive force generated by the cable explosion, and the impact force, various high-temperature fragments, harmful smoke, and etc. generated by the explosion are confined within the tray, and will not spray out from the inside of the cable tray to harm workers and equipment, improving the safety of the cable tray system. In addition, the number of members of the tray in this embodiment is less, only including the bottom tray, the top tray, and the locking assembly. Not only is it easy to install on site, but when it is necessary to inspect the cables at the designated position inside the tray, only one top tray at the designated position needs to be removed.

Referring to Figs. 6-7, the first locking assembly 13 in this embodiment includes a fastener pair 131 and a locking member 132, the fastener pair 131 is

composed of two fastener units 1310 located on the inner and outer sides of the tray, respectively, the locking member 132 locks the fastener pair 131 to fixedly connect the first bottom tray 111 and the first top tray 112 into a sealed whole.

Preferably, refer to Figs. 3-4 and 6-10, the sidewalls on both sides of the first bottom tray 111 are provided with first lower flange portions 1111 at the top ends respectively, the sidewalls on both sides of the first top tray 112 are provided with first upper flange portions 1121 at the top ends respectively, the first lower flange portion 1111 and the first upper flange portion 1121 both include an inner flange extending to the inner side of the tray and an outer flange extending to the outer side of the tray, forming a structure with a substantially T-shaped cross-section with the first lower flange portion 1111 and the first upper flange portion 1121 and their respective sidewalls.

Top surfaces of the first lower flange portion 1111 and the first upper flange portion 1121 facing each other are all flat surfaces, back surfaces of the inner and outer flanges of the first lower flange portion 1111 and the first upper flange portion 1121 opposite to the top surfaces are all inclined surfaces, which are inclinedly arranged in a direction from the outer edges of the respective flange portions to the middles, that is, the inclined surfaces gradually reduce the thickness of the flange portions in a direction from the outer edge to the middle, the inclined surfaces can be matched with the fastener pair 131 to better fix the first bottom tray 111 and the first top tray 112, when the cables inside the cable tray experience a short circuit explosion, the first tray unit 10 can withstand the explosive force generated by the cable explosion, and the impact force, various high-temperature fragments, harmful smoke, and etc. generated by the explosion are confined within the tray.

The two fastening units 1310 of the fastener pair 131 are mirror structures, including a main body portion 1311 extending along the length direction of the tray, a lower boss portion 1312 and an upper boss portion 1313 protruding from the main body portion 1311 to the same side, and a middle boss portion 1314 located between the lower boss portion 1312 and the upper boss portion 1313. The main body portion 1311, the lower boss portion 1312, the upper boss portion 1313 and the middle boss portion 1314 form a structure with a substantially E-shaped cross-section. The lower boss portion 1312 and the middle boss portion 1314 form a space for accommodating the inner or outer

flange corresponding to the first lower flange portion 1111, and an surface of the lower boss portion 1312 facing the inner or outer flange of the corresponding first lower flange portion 1111 is a inclined surface substantially parallel to the inclined surface of the inner or outer flange. Similarly, the upper boss portion 1313 and the middle boss portion 1314 form a space for accommodating the inner or outer flange of the corresponding first upper flange portion 1121, and an surface of the lower boss portion 1312 facing the inner or outer flange of the corresponding first upper flange portion 1121 is a inclined surface substantially parallel to the inclined surface of the inner or outer flange. When the cables inside the cable tray experience a short circuit explosion, the cooperation between the fastener pair 131 and the inclined surfaces of the inner and outer flanges of the first lower flange portion 1111 and the first upper flange portion 1121 can effectively prevent the vertical detachment of the first lower flange portion 1111 and the first upper flange portion 1121, enhance the structural strength of the entire tray, and thus withstand the explosive force during the explosion.

Referring to Figs. 7 and 10, the locking member 132 comprises a screw 1321 and a nut 1322 matched with the screw 1321. Preferably, the locking member 132 further comprises a limiting block 1323 and elastic members 1324. The rod of screw 1321 is integrated with the E-shaped fastener unit 1310 inside the tray, so that when the E-shaped fastener unit 1310 inside the tray is installed, the screw 1321 passes through the limiting block 1323, which serves as a support to fix the E-shaped fastener unit 1310 inside the tray and prevent it from falling into the interior of the tray. After the screw 1321 of the internal E-shaped fastener passes through the external fastener unit 1310, the two fastener units 1310 are locked by the nut 1322, thereby fixedly connecting the first bottom tray 111 and the first top tray 112 into a sealed whole. The screw 1321 passes through the limiting block 1323, when two fastener units 1310 is locked by the locking member 132, the limiting block 1323 is located between the middle boss portion 1314 of the two fastener units 1310, the limiting block 1323 abuts with the middle boss portion 1314 of the fastener unit 1310, which can prevent the locking force being too high to cause deformation of the fastener unit 1310, and also serve to fix the internal E-shaped fastener unit 1310. There are two elastic members 1324, both sleeved on the screw 1321 and

located on both sides of the limit block 1323, the elastic members 1324 can play a buffering role to a certain extent, preventing the nut from loosening due to vibration.

Referring to Fig. 10, the height of the sidewalls on the left and right sides of the first bottom tray 111 is different. In the figure, the height of the left sidewall of the first bottom tray 111 is greater than that of the right sidewall. Of course, in practical applications, the height of the right sidewall can also be greater than that of the left sidewall. It can better adapt to various on-site installation spaces with such a non equal height design. For example, in some space limited situations, the sidewall with lower height is located on the side where the construction personnel are located, which can make the placing of cables and related equipment more convenient.

Referring to Figs. 12-13, a cable tray of joint well segment is shown, which includes at least one second tray unit 20 with a substantially rectangular shape and a second inner lining 22, the structure of the second tray unit 20 is substantially the same as that of the first tray unit 10, including a second tray 21 and a second locking assembly 23.

Wherein, the second tray 21 is composed of a second bottom tray 211 and a second top tray 212. The second inner lining 22 is fixed or fastened to the joint of two adjacent second tray units 20, connecting the two adjacent second tray units 20 to form a sealed or substantially sealed connection. The second locking assembly 23 fixedly connects the second bottom tray 211 and the second top tray 212 into a sealed whole, when the cable installed in the cable tray experiences a short circuit explosion, the connection structure of the second locking assembly 23 can withstand the explosive force generated by the cable explosion, the impact force, various high-temperature fragments, harmful smoke, and etc. generated by the explosion are confined within the tray and will not spray out from the inside of the cable tray to harm workers and equipment, improving the safety of the cable tray system.

Since the structure of the second tray 21 is substantially the same as that of the first tray 11, the parts with the same structure will not be repeated here. Referring to Figs. 11 and 13, the main difference between the second tray 21 and the first tray 11 is that the height difference $\Delta H2$ of the sidewalls on both sides of the second bottom tray 211 is larger than the height difference $\Delta H1$ of

the sidewalls on both sides of the first bottom tray 111, i.e. $\Delta H_2 > \Delta H_1$. Due to the reduction of obstruction on one sidewall of the cable tray, it can be more convenient for construction personnel to carry out the construction at the cable joints. Due to changes in the height of the sidewalls on both sides of the second bottom tray 211, the height of the sidewalls on both sides of the second top tray 212 also changes accordingly to adapt to the second bottom tray 211. Similarly, the height of the sidewalls of the second inner lining 22 also changes accordingly.

Referring to Fig. 14, a variable radial size cable tray is also shown, comprising at least one substantially elongate third tray unit 30 and a third inner lining 32. The third tray unit 30 comprises a third tray 31 and a third locking assembly 33.

Wherein, the third tray 31 is composed of the third bottom tray 311 and the third top tray 312. The third inner lining 32 is fixed or fastened to the joint of two adjacent third tray units 30, connecting the two adjacent tray units to form a sealed or substantially sealed connection. The third locking assembly 33 fixedly connects the third bottom tray 311 and the third top tray 312 into a sealed whole. When the cable installed in the cable tray experiences a short circuit explosion, the connection structure of the third locking assembly 33 can withstand the explosive force generated by the cable explosion, the impact force, various high-temperature fragments, harmful smoke, and etc. generated by the explosion are confined within the tray and will not spray out from the inside of the cable tray to harm workers and equipment, improving the safety of the cable tray system.

Since the structure of the third tray 31 is substantially the same as that of the first tray 11, the parts with the same structure will not be repeated here. Referring to Fig. 13, the main difference between the third tray 31 and the first tray 11 is that the third top tray 312 further has a variable radial size segment 3121, which makes the sizes at the joints on both sides of the third tray 31 different, and can be connected to trays of different radial sizes. Due to the different radial sizes at the joints on both sides of the third tray 31, the radial size of the third inner lining 32 also changes accordingly.

Referring to Fig. 15, which shows a schematic diagram of a cable tray system is formed by at least one of the first tray unit 10, second tray unit 20,

and third tray unit 30 mentioned above, a of Fig. 15 shows a schematic diagram of a connecting a small radial size tray to a large radial size tray through a variable radial size tray; b shows a schematic diagram of the connection between equal radial size trays; c shows a schematic diagram of connecting a large-size tray to a small radial size tray through a variable radial size tray; d shows a schematic diagram of two small radial size trays connected by a variable radial size tray.

Refer to Fig. 16, which shows a schematic diagram of a cable tray system is formed by at least one of the first tray unit 10, second tray unit 20, and third tray unit 30 mentioned above, wherein the joint between adjacent tray units can be a inclined surface, thus forming a non linear extending cable tray system, two different bending forms are shown in a and b of Fig. 16. During actual installation, the cable tray system can select the corresponding first tray unit 10, second tray unit 20, and third tray unit 30 according to actual needs to form the required cable tray.

Referring to Fig.s 17-19, a cable tray with adjustable tray height is also shown, which includes at least one fourth tray unit 40 with a substantially rectangular shape and a fourth inner lining 42, the structure of the fourth tray unit 40 is substantially the same as that of the first tray unit 10, including a fourth tray 41 and a fourth locking assembly 43.

The fourth tray 41 consists of a fourth bottom tray 411, a fourth top tray 412, and a pair of extending side plates 413. Wherein the structures of the fourth bottom tray 411 and the fourth top tray 412 is substantially the same as those of the first bottom tray 111 and the first top tray 112, and the difference is that there is also a pair of extending side plates 413 between the opposite sidewalls of the first bottom tray 111 and the first top tray 112, by selecting the extending side plates 413 with different height, the height of the fourth tray 41 can be adjusted, and the height of the tray can be flexibly adjusted according to the on-site installation space. The extending side plate 413 and the first bottom tray 111 and the extending side plate 413 and the first top tray 112 fixedly connect the fourth bottom tray 411, the fourth top tray 412, and the extending side plate 413 as a sealed whole through a fourth locking assembly 43. When cables installed in the cable tray experience a short circuit explosion, the connection structure of the fourth locking assembly 43 can withstand the explosive force

generated by the cable explosion, the impact force, various high-temperature fragments, harmful smoke, and etc. generated by the explosion are confined within the tray and will not spray out from the inside of the tray to harm workers and equipment, improving the safety of the cable tray system.

Since the structure of the fourth locking assembly 43 is the same as that of the first locking assembly 13, its specific structure will not be described repeatedly. It can be understood that in order to match the structure of the fourth locking assembly 43, the ends of the extending side plate 413 opposite to the top of the fourth bottom tray 411 and the fourth top tray 412 is provided with flange portions that match the upper and lower boss portions of the fourth locking assembly 43, to achieve stable locking of the fourth bottom tray 411, the fourth top tray 412, and the extending side plate 413 through the fourth locking assembly 43, thus when the cables inside the tray experience a short circuit explosion, the fourth locking assembly 43 can effectively avoid the detaching between the fourth bottom tray 411, the fourth top tray 412, and the extending side plate 413, so as to withstand the explosive force during the explosion. The structural design of the flange portion of the extending side plate 413 is the same as that of the first lower flange portion 1111 of the first bottom tray 111 and that of the first upper flange portion 1121 of the first top tray 112, so the specific structure will not be described repeatedly.

Referring to Figs. 20 to 21, a fifth tray unit 50 is shown, the difference between the fifth tray unit 50 and the first tray unit is that different fixed connection structures are used between the bottom tray and the top tray. Specifically, the fifth tray unit 50 includes a fifth tray 51 and a fifth locking assembly 53, multiple fifth tray units 50 may be connected to each other through a fifth inner lining 52 to form a slender cable tray that accommodates cables and related equipment.

Wherein, the fifth tray 51 is composed of the fifth bottom tray 511 and the fifth top tray 512. The fifth inner lining 52 is fixed or fastened to the joint of two adjacent fifth tray units 50, connecting the adjacent two tray units to form a sealed or substantially sealed connection. The fifth locking assembly 53 fixedly connects the fifth bottom tray 511 and the fifth top tray 512 into a sealed or roughly sealed whole. When the cables installed in the cable tray experience a short circuit explosion, the connection structure of the fifth locking assembly

53 can withstand the explosive force generated by the cable explosion, the impact force, various high-temperature fragments, harmful smoke, and etc. generated by the explosion are confined within the tray and will not spray out from the inside of the tray to harm workers and equipment, improving the safety of the cable tray system.

Since the structure of the fifth tray 51 is substantially the same as that of the first tray 11, the parts with the same structure will not be repeated here. Referring to Figs 20 and 21, the main difference between the fifth tray 51 and the first tray 11 is that the connection structure between the fifth bottom tray 511 and the fifth top tray 512 is different. The outer edge of the lower sidewall of the fifth bottom tray 511 is provided with a lower hook-shaped groove 5111, which forms a substantially U-shaped structure with the lower sidewall of the fifth bottom tray 511, and the U-shaped opening of the lower hook-shaped groove 5111 faces the bottom of the fifth bottom tray 511. The outer edge of the upper sidewall of the fifth top tray 512 is provided with an upper hook-shaped groove 5121, which form a substantially U-shaped structure with the upper sidewall of the fifth top tray 512, and the U-shaped opening of the upper hook-shaped groove 5121 faces the top of the fifth top tray 512. During assembly, the upper hook-shaped groove 5121 and the lower hook-shaped groove 5111 are hooked with each other to form an anti detachment structure in the vertical direction. The fifth locking assembly 53 includes bolts 531. Upper hook-shaped groove 5121 and lower hook-shaped groove 5111 are provided with screw holes for installing the bolts (not shown in the figures). The bolts are locked in the corresponding screw holes to prevent detachment between the upper hook-shaped groove 5121 and the lower hook-shaped groove 5111, thereby locking the fifth bottom tray 511 and the fifth top tray 512 together.

Referring to Fig. 20 again, the fifth locking assembly 53 also comprises a tray strap 532, which is located on the outer side of the fifth bottom tray 511 and the fifth top tray 512 and binds the fifth bottom tray 511 and the fifth top tray 512, the tray is formed as a whole by cooperating the tray strap 532 with the bolt 531 and can withstand the explosive force generated by a short circuit explosion inside the tray.

Referring to Figs. 22-23, a sixth tray unit 60 is shown, the difference between the sixth tray unit 60 and the first tray unit is that different fixed

connection structures are used between the bottom tray and the top tray. Specifically, the sixth tray unit 60 comprises a sixth tray 61 and a sixth locking assembly 63, multiple sixth tray units 60 may be connected to each other through a sixth inner lining 62 to form a slender cable tray that accommodates cables and related equipment.

Wherein, the sixth tray 61 is composed of the sixth bottom tray 611 and the sixth top tray 612. The sixth inner lining 62 is fixed or fastened to the joint of two adjacent sixth tray units 60, connecting the adjacent two tray units to form a sealed or substantially sealed connection. The sixth locking assembly 63 fixedly connects the sixth bottom tray 611 and the sixth top tray 612 into a sealed or substantially sealed whole. When the cables installed in the cable tray experience a short circuit explosion, the connection structure of the sixth locking assembly 63 can withstand the explosive force generated by the cable explosion, the impact force, various high-temperature fragments, harmful smoke, and etc. generated by the explosion are confined within the tray, and will not spray out from the inside of the cable tray to harm workers and equipment, improving the safety of the cable tray system.

Since the structure of the sixth tray 61 is substantially the same as that of the first tray 11, the parts with the same structure will not be repeated here. Referring to Figs. 22 and 23, the main difference between the sixth tray 61 and the first tray 11 is that the connection structure between the sixth bottom tray 611 and the sixth top tray 612 is different. The top of the lower wall of the sixth bottom tray 611 is provided with a U-shaped slot 6111, and an opening of slot 6111 faces the top of the sixth top tray 612. The end of the upper sidewall of the sixth top tray 612 is inserted into the slot 6111 as an inserting portion 6121. The sixth locking assembly 63 includes a locking bolt pair 631 composed of bolts and nuts. The slot 6111 and the inserting portion 6121 are provided with screw holes matching with each other. The locking bolt pair 631 passes through the corresponding screw holes to lock the inserting portion 6121 in the slot 6111, thereby locking the sixth bottom tray 611 and the sixth top tray 612 to each other.

Similarly, the sixth locking assembly 63 may also include a tray strap 632 that binds the sixth bottom tray 611 and the sixth top tray 612, allowing the tray to withstand the explosive force generated by a short circuit explosion inside

the tray.

Referring to Figs 24-25, a seventh tray unit 70 is shown, the difference between the seventh tray unit 70 and the first tray unit is that different fixed connection structures are used between the bottom tray and the top tray. Specifically, the seventh tray unit 70 comprises a seventh tray 71 and a seventh locking assembly 73, multiple seventh tray units 70 may be connected to each other through a seventh inner lining 72 to form a slender cable tray box that accommodates cables and related equipments.

Wherein, the seventh tray 71 is composed of the seventh bottom tray 711 and the seventh top tray 712. The seventh lining 72 is fixed or fastened to the joint of two adjacent seventh tray units 70, connecting the adjacent two tray units to form a sealed or substantially sealed connection. The seventh locking assembly 73 fixedly connects the seventh bottom tray 711 and the seventh top tray 712 into a sealed or substantially sealed whole. When cables installed in the cable tray experience a short circuit explosion, the connection structure of the seventh locking assembly 73 can withstand the explosive force generated by the cable explosion, the impact force, various high-temperature fragments, harmful smoke, and etc. generated by the explosion are confined within the tray, and will not spray out from the inside of the tray to harm workers and equipment, improving the safety of the cable tray system.

Since the structure of the seventh tray 71 is substantially the same as that of the first tray 11, the parts with the same structure will not be repeated here. Referring to Figs. 24 and 25, the main difference between the seventh tray 71 and the first tray 11 is that the connection structure between the seventh bottom tray 711 and the seventh top tray 612 is different. The lower sidewall of the seventh bottom tray 711 has a lower fixing plate 7111 that extends outwardly, and the upper sidewall of the seventh top tray 712 has an upper fixing plate 7121 that extends outwardly, the lower fixing plate 7111 and the upper fixing plate 7121 are provided with screw holes matching with each other. The seventh locking assembly 73 comprises bolts and nuts that match the corresponding screw holes, the bolts and nuts lock the lower fixing plate 7111 and the upper fixing plate 7121, thereby locking the seventh bottom tray 711 and the seventh top tray 712 together.

Similarly, the seventh locking assembly 73 may also comprises a tray strap

731 that binds the seventh bottom tray 711 and the seventh top tray 712, allowing the tray to withstand the explosive force generated by a short circuit explosion inside the tray.

The preferred embodiments of the present invention have been described in detail above, but it should be understood that after reading the above teachings of the present invention, various changes or modifications to the present invention can be made by those skilled in the art. These equivalent forms also fall within the scope defined by the claims appended hereto.

Claims

1. A cable tray unit, comprising:

a bottom tray, which has a bottom and two lower sidewalls extending from opposite sides of the bottom towards a top direction;

a top tray, which has a top and two upper sidewalls extending from opposite sides of the top towards a bottom direction;

a locking assembly;

wherein the two lower sidewalls of the bottom tray and the two upper sidewalls of the top tray are disposed opposite respectively, and the locking assembly fixedly connects the lower sidewalls and the upper opposite sidewalls.

2. The cable tray unit according to claim 1, wherein the locking assembly comprises a fastener pair and a locking member, the fastener pair comprises two fastener units located on inner and outer sides of a junction of the lower sidewalls and the upper sidewalls respectively, the locking member is fixedly connected to the two fastener units.

3. The cable tray unit according to claim 2, wherein the lower sidewalls and the upper sidewalls both comprise inner flanges extending to insides of the corresponding sidewalls and outer flanges extending to outsides of the corresponding sidewalls, the fastener units are provided with a lower boss portion and an upper boss portion corresponding to the inner flanges or outer flanges, the lower boss portion and the upper boss portion cooperate with the inner flanges or the outer flanges to prevent the separation of the bottom tray and the top tray.

4. The cable tray unit according to claim 3, wherein back surfaces of the inner flanges and the outer flanges facing the corresponding lower boss portion or upper boss portion are first inclined surfaces, and the first inclined surfaces are inclined towards the top direction of the lower or upper sidewalls connected thereto, surfaces of the lower boss portion, upper boss portion facing the upper boss portion or the lower boss portion are second inclined surfaces, the second inclined surfaces are substantially parallel to the first inclined surfaces.

5. The cable tray unit according to claim 3, wherein the locking member comprises a screw and a nut, a rod portion of the screw passes through the two fastening units of the same fastening pair, and the two fastening units are locked by the nut.

6. The cable tray unit according to claim 5, wherein the locking member further comprises a limiting block, and the rod portion of the screw passes through the limiting block.

7. The cable tray unit according to claim 6, wherein the locking member further comprises an elastic member, and the rod portion of the screw passes through the elastic member.

8. The cable tray unit according to claim 3, wherein the fastener units are further provided with a middle boss portion located between the upper boss portion and the lower boss portion.

9. The cable tray unit according to claim 1, wherein there is a height difference between the two lower sidewalls of the bottom tray, and there is also a height difference between the two upper sidewalls of the top tray.

10. The cable tray unit according to claim 1, wherein the top tray comprises a variable radial size segment.

11. The cable tray unit according to claim 1, wherein the cable tray unit further comprises a support member fixed to the bottom tray.

12. The cable tray unit according to claim 11, wherein ribs are provided on the inner sides of the two lower sidewalls of the bottom tray, and the ribs and the lower sidewalls form grooves for fixing the support member.

13. The cable tray unit according to claim 12, wherein both ends of the bottom tray have inward contracted portions without the ribs.

14. The cable tray unit according to claim 1, wherein the cable tray unit further comprises extending side plates, which are provided between the lower sidewalls of the bottom tray and the upper sidewalls of the top tray, the locking assembly is fixedly connected to the lower sidewalls and the opposite extending side plates, and the locking assembly is fixedly connected to the upper sidewalls and the opposite extending side plates.

15. A cable tray unit, comprising:

a bottom tray, which has a bottom and two lower sidewalls extending from opposite sides of the bottom towards a top direction, an upper end of each of the lower sidewalls is provided with a lower fixing portion;

a top tray, which has a top and two upper sidewalls extending from opposite sides of the top towards a bottom direction, a lower end of each of the upper sidewalls is provided with an upper fixing portion;

a locking assembly;

wherein the locking assembly is fixedly connected to the upper fixing portion and the lower fixing portion to form a complete tray with the bottom tray and the top tray and limit a generated explosive force to an interior of the tray when cables inside the tray explode.

16. The cable tray unit according to claim 15, wherein the lower fixing portion is a lower hook-shaped groove provided on outer edges of the lower sidewalls, and the upper fixing portion is a lower hook-shaped groove provided on outer edges of the lower sidewalls, the lower hook-shaped groove is open towards to the bottom, and the upper hook-shaped groove is open towards to the top, the lower hook-shaped groove and the upper hook-shaped groove are hooked to each other, the locking assembly restricts the lower hook-shaped groove and the upper hook-shaped groove from separating.

17. The cable tray unit according to claim 15, wherein the lower fixing portion and the upper fixing portion are one and the other of a slot and a inserting portion, respectively, the inserting portion is located in the slot, and the locking assembly restricts the inserting portion from being released from the slot.

18. The cable tray unit according to claim 15, wherein the lower fixing portion is a lower fixing plate extending outwardly from the lower sidewalls, and the upper fixing portion is a upper fixing plate extending outwardly from the upper sidewalls, the locking assembly is fixedly connected to the lower fixing plate and the upper fixing plate.

19. The cable tray unit according to claim 16, 17 or 18, wherein the locking assembly further comprises a tray strap, which is located on outer sides of the bottom tray and the top tray and fixes the bottom tray and the top tray.

20. A cable tray system comprising a tray unit and an inner lining, the inner lining is located at a junction of adjacent tray units, and multiple tray units are connected to each other through the inner lining, wherein the tray unit comprises the cable tray unit according to any one of claims 1 to 19.