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ABSTRACT

The invention is a method of building a multi-compartment electrical enclosure for low-voltage applications in a cost-effective manner. In this process, a metal box (10) having improved ingress protection characteristics is modified and fixed together in a particular manner to build multi-compartments. The resulting enclosure has compartments in which each box enclosure (12) has a mounting plate. The mounting plates are used to mount electrical equipment and devices inside the compartment. The gland holes (19) in the resulting enclosure facilitate inter-compartment wiring. It is comprised of a plinth at the bottom and a canopy on the top. The resulting enclosure can either be built-up on the plinth or mounted to the wall depending on its weight and height. It has provisions for expansion of the enclosure by adding compartments whenever required.
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COMPLETE SPECIFICATION
INNOVATION PATENT

METHOD OF BUILDING COST-EFFECTIVE MULTI-COMPARTMENT ELECTRICAL ENCLOSURE
TITLE OF INVENTION
Method of building cost-effective multi-compartment electrical enclosure

TECHNICAL FIELD
The present invention is a method of building a multi-compartment electrical enclosure for low-voltage applications in a cost-effective manner.

BACKGROUND ART
For low-voltage electrical applications, electrical enclosures having a frame structure covered with doors and covers, are generally used. Their metal frame structures are built by assembling many standard components. These electrical enclosures consist compartments to install electrical equipment and device as required by the application for which they are used. The compartments in such electrical enclosures are made by separating their internal space with frame members and separation plates fixed to frame members. Busbar systems are installed in such electrical enclosures to distribute power to the compartments. The strength and the structure of the electrical enclosures vary according to the requirements of the application for which they are used and the equipment installed in compartments.

SUMMARY OF INVENTION
Technical Problem
Some electrical applications do not require electrical enclosure with heavy metal structures and internal separations. The use of an electrical enclosure with metal structure in-turn increases the cost of the enclosure. The cost is further increased when the number of compartments increases. The standard electrical enclosures are assembled using many components. As result, it often requires considerable number of skilled man-hours to build the enclosure and the involves complex assembling processes. The electrical enclosure builders and electrical
installation contractors find it less cost-effective to use standard electrical enclosures for non-mission critical applications.

Solution to Problem
The invention is a method of building a multi-compartment electrical enclosure for low-voltage applications in a cost-effective manner. In this process, a metal box having improved ingress protection characteristics is modified and joined together in a particular manner to build multi-compartments. The resulting enclosure has compartments in which each metal box is used as a compartment for installation of electrical equipment and devices. It is comprised of a plinth at the bottom and a canopy on the top.

Advantageous Effects
In the present invention, a metal box with improved ingress protection characteristics is used to make the multi-compartment electrical enclosure in which each metal box that builds-up the enclosure is used as a compartment in the resulting enclosure. It eliminates the requirement of a frame structure and separation plates to separate compartments. Thus, the cost of building this enclosure is reduced. The resulting enclosure has facilities to extend it with new compartments or remove or relocate existing compartments whenever required. In the absence of a metal frame structure, there is no requirement of following a complex assembling process to build-up the enclosure. On the other hand, the assembling process of the resulting enclosure is simple, which in turn reduces the labour cost and assembling time.
BRIEF DESCRIPTION OF DRAWINGS

The drawings shown in figures are not drawn in accordance with a scale and contains only the features which are required to describe the invention.

Fig. 1 shows a metal box with improved ingress protection characteristics.
Fig. 2A shows the metal box with its door opened and an enlarged view of the collar profile.
Fig. 2B shows an enlarged cross-sectional view of the collar when the door is closed.
Fig. 3A and 3B show the front view and isometric exploded view of box enclosure without the door and mounting plate.
Fig. 4 shows the box enclosure with gland holes, fixing holes, gland plates and gland bolts.
Fig. 5A shows two adjoining box enclosures with gland holes intended for inter-compartment wiring.
Fig. 5B shows an enclosure built using two metal boxes with doors fixed to different sides.
Fig. 6 shows an enclosure built using four metal boxes and gland holes intended for inter-compartment wiring.
Fig. 7 shows an enclosure built using two metal boxes with doors, plinth and canopy.
Fig. 8 shows a metal box/compartment separated by an optional internal separation.
DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS OF THE INVENTION

[001] The invention is a method of building a multi-compartment electrical enclosure for low-voltage applications in a cost-effective manner. The outcome of this method builds a multi-compartment enclosure. This method can be used to build multi-compartment enclosures of any dimensions. The basic building block of such multi-compartment enclosures is a metal box with improved ingress protection characteristics as described below and each metal box used to build the electrical enclosure will be a compartment of the resulting electrical enclosure. Hence, the terms metal box and compartment may be used inter-changeably.

[002] As shown in Fig. 1, the metal box (10) has a front door (11) fixed to box enclosure (12) with two or more hinges. There are one or more locks (13) fixed to the door (11) to securely close the door (11) of the metal box (10).

[003] As shown in Fig. 2A, the door (11), which is fixed to the box enclosure (12) with two or more hinges, consists of a gasket (14) around perimeter of the rear side of the door (11). The front opening (15) of the box enclosure (12) is designed with a collar (16) which runs around front opening (15).

[004] As shown in Fig. 2A, the collar (16) is raised from the level of the front opening (15) and flanged outwards. The edge (17) of the collar (16) is folded outwards. The collar (16) is made seamlessly by bending the same sheet of metal used to make the box enclosure (12), i.e. the collar (16) is not separately bended from a sheet of metal and welded to the box enclosure (12). As shown in Fig. 2B, the design of the collar (16) prevents entering foreign objects or particles entering into the box enclosure (12) when its door (11) is fully closed. The gasket (14) seats with the edge (17) of the collar (16) in an air-tight manner when the door (11) is fully closed by locks (13). Thus, the metal box (10) has enhanced features of ingress protection against foreign objects. The metal box (10) has been fully type tested as per IEC 62208:2011 standard and
certified by Test Report No. 2217145.101 and 2217145.102 issued by DEKRA independent testing laboratory in Arnhem, The Netherlands.

[005] As shown in Fig. 2A, two earth studs (24) are provided on the door (11) and the side wall of the box enclosure (12) in order to connect the two earth studs (24) with a wire (25) to establish earth continuity. The metal box (10) has a set of mounting brackets (26) which are used to fix it against a wall.

[006] As shown in Fig.s 3A and 3B, a mounting plate (18) is fixed inside the box enclosure (12). The mounting plate (18) has fixing cutouts (27) and fixing holes (28) to fix the mounting plate (18) on the welded bolts (29) provided at the rear wall of the box enclosure (12). The mounting plate (18) is used to mount electrical accessories, equipment or devices by making necessary hole configurations on it. Thus, the mounting plate (18) can be used to mount any electrical accessory, equipment or device once the corresponding hole configuration is made on it (18). When the height of the mounting plate (18) increases, the number of fixing holes (28) on the vertical edges of the mounting plate (18) are increased. As shown in Fig. 3B, the metal box (10), by default, has a gland hole (19) covered with a gland plate on its bottom wall.

[007] Since the above described metal boxes (10) are used to build the multi-compartment enclosure, the number of required compartments and dimensions of each compartment become decisive factors. Therefore, such factors are decided first in building the multi-compartment enclosure. Depending of the required dimensions of each compartment, the metal boxes (10) with similar or equivalent dimensions are selected. The number of metal boxes (10) required may equivalent to the number of compartments in the resulting multi-compartment enclosure. The multi-compartment enclosure may require compartments with different heights and widths. Thus, the resulting multi-compartment enclosure may include metal boxes (10) with varying dimensions.
One advantage of building a multi-compartment enclosure is cost-effective inter-compartment wiring, which is basically achieved by joining plurality of metal boxes (10) as described under this detailed description. When it comes to inter-compartment wiring, the openings in each adjoining box enclosure (12) through which the wires are passed through should be matching and aligned. Gland holes are used for such inter-compartment wiring. A gland hole of a box enclosure (12) should be coincide with the corresponding gland hole of the adjoining box enclosure (12). Therefore, the locations of corresponding coinciding gland holes are marked, as required, on the walls of adjoining box enclosures (12). After marking the gland hole locations, the gland holes are created.

As shown in Fig. 4, gland holes (19) are created on the top and bottom walls and side walls of the box enclosure (12). The gland holes (19) can be in varying sizes and shapes. These gland holes (19) are used to pass through wires from one box enclosure (12) to another when they are joined together. Thus, inter-compartment wiring is achieved. Once all gland holes are created, there are two types of gland holes (19), i.e. the gland holes (19) intended for inter-compartment wiring and the gland holes (19) intended for extension which facilitates addition of new compartments or gland holes (19) not being used for inter-compartment wiring. The gland holes intended for inter-compartment wiring are kept opened. The gland holes (19) intended for future extensions or not being used for inter-compartment wiring at present, are closed with gland plates (20).Irrespective of whether the gland holes (19) are kept opened or closed, a set of fixing holes (30) are created around each gland holes (19). Gland plates (20) are created for gland holes intended for extension of compartments or not being used for inter-compartment wiring. The gland bolts (21) are welded to rear surface of each gland plate (20) at matching positions corresponding to fixing holes (30) around the relevant gland hole (19). The gland plates (20) are tightly fixed with the walls of the box enclosure (12) by inserting gland bolts (21) into corresponding fixing holes (30) and fastening the gland bolts (21) with nuts to securely cover the gland holes (19) when they are not used.
As shown in Fig.s 5A and 5B, two box enclosures (12) are joined together side-by-side by placing the relevant walls of the two box enclosures (12) together, coinciding the matching gland holes (19) intended for inter-compartment wiring, fixing the two box enclosures (12) together by bolts inserted from one box enclosure (12) through selected coinciding fixing holes (30) located around gland holes (19) and fastening the bolts with their nuts from the adjoining box enclosure (12). The location and the number of fixing holes (30) used to join a box enclosure (12) to another box enclosure (12) are selected depending on the dimensions of each box enclosure (12). It is important to note in the invention that the same fixing holes (30) which are used to fix the gland plates (20) are used when joining two box enclosures (12) together. Two box enclosures (12) placed on top of the other are joined together in the same above described manner. Alternatively, the two box enclosures (12) can be joined together by drilling coinciding joining holes (22) preferably closer to each corner on the relevant walls of the two adjoining box enclosures (12) and fixing the them with bolts inserted from one box enclosure (12) through drilled coinciding joining holes (22) and fastening the bolts with their nuts from the adjoining box enclosure (12). The doors (11) of each metal box (10) can be either fixed to left or right-side collar (16) of the box enclosure (12) depending on the requirement of the application or as the space allows.

The Fig. 6 shows another arrangement of metal boxes (10) where four box enclosures (12) are joined together side-by-side and on top of the other. In this arrangement, the top gland holes (19) of the two box enclosures (12) in the lower row are kept opened and the bottom gland plates (20) of the upper row box enclosures (12) are removed; the gland holes (19) on adjoining side walls are kept opened; the two rows of box enclosures (12) are fixed together using bolts inserted through coinciding fixing holes (30) around the gland holes (19) on top and bottom and adjoining side walls of relevant box enclosures (12). Alternatively, the two rows of box enclosures (12) can be joined together by drilling joining holes (22) on top wall of the lower row, closer to each corner, of box enclosures (12); on the bottom wall of the upper row, closer to each corner, of box enclosures (12); on the adjoining side walls of the two box enclosures (12); and fixing them with bolts and nuts. The doors (11) of each metal box (10) can be either
fixed to left-side or right-side collar (16) of the box enclosure (12) depending on the requirement of the application or as the space allows. The resulting enclosure is built-up on a plinth (31). The bottom most row of box enclosures (12) are fixed using bolts and nuts to the plinth (31). The plinth (31) provides a strong base that can hold the weight of the resulting enclosure. As shown in Fig. 7, a canopy (32) is fixed on the top wall of the top-most row box enclosures (12) in the resulting enclosure.

[0012] When the resulting enclosure is intended to be floor standing, considerably heavy in weight or long in height, the box enclosures (12) in the lowest row are joined together and their bottom walls are fixed to plinth (31) using bolts inserted through holes drilled on the bottom wall, closer to the four corners, of each box enclosure (12). When the resulting enclosure is intended to be wall mounted, considerably light in weight and short in height, the box enclosures (12) are joined together row by row and the resulting enclosure is mounted against wall using mounting brackets (26);

[0013] The compartments can be added to the resulting enclosure whenever required. The resulting enclosure is expanded by joining metal boxes (10) to the existing compartments using gland holes (19) intended for extension. When it is required to expand the enclosure, the relevant gland plates covering the gland holes intended for expanding the enclosure are removed and a matching box enclosure (12) is joined as described in Paragraphs [0010] and [0011].

[0014] The compartments can be reduced or relocated from the resulting enclosure whenever required. When it is required to reduce or relocate a compartment from the resulting enclosure, the relevant box enclosure is removed from the resulting enclosure and any unnecessary gland holes left opened are covered with gland plates as described in Paragraph [0009]; and if required the removed compartment is joined to a different compartment as described in Paragraphs [0010] and [0011].
[0015] A compartment can be equipped with different optional accessories such as internal doors and internal separations to further separate the space inside a compartment itself. An internal door is used as an intermediate door which blocks the direct access to equipment and devices mounted on the mounting plate (18). The Fig. 8 shows an optional internal horizontal separation (33) fixed in a compartment to further compartmentalization.

[0016] As result of building electrical enclosures following the above method, electrical enclosures with different dimensions can be built. The height, width and depth of the resulting multi-compartment enclosure are determined by the height, width and depth of each metal box (10) used to build the enclosure. It is more convenient to use metal boxes (10) with equal dimensions in a row.
1. A method of building a multi-compartment electrical enclosure in a cost-effective manner for low-voltage applications, comprising steps:
   a. Considering the requirements of electrical application, the number of compartments which should be required in the resulting enclosure and the dimensions of each compartment are determined;
   b. Considering the dimensions of each compartment, metal box with improved ingress protection characteristics, which has equivalent or similar dimensions of each compartment, is selected and the number of metal boxes required to build up the resulting enclosure is determined;
   c. Locations of coinciding and matching gland holes are marked on the top, bottom, left or right walls of each box enclosure, as required, and those gland holes are created;
   d. Corresponding fixing holes are created around each gland hole;
   e. If required the gland plate fixed, by default, to the gland hole on the bottom wall of box enclosure is removed to keep that gland hole opened;
   f. Gland plates are created for gland holes intended for extension of compartments or not being used for inter-compartment wiring;
   g. Gland holes intended for extension of compartments or not being used for inter-compartment wiring, are covered with gland plates by tightly fixing the gland plates with the wall of the box enclosure by inserting gland bolts into respective fixing holes and fastening the gland bolts with nuts;
   h. Gland holes intended for inter-compartment wiring are kept opened;
   i. The location and the number of fixing holes used to join a box enclosure to another box enclosure are selected depending on the dimensions of each box enclosure;
   j. Each box enclosure is joined to another box enclosure by placing them side-by-side or on top of the other, coinciding the matching gland holes intended for inter-compartment wiring and fixing them together by bolts inserted from one box
enclosure through selected coinciding fixing holes and fastening the bolts with their nuts from the adjoining box enclosure;

k. When the fixing holes of two adjoining box enclosures are not coinciding to each other for any reason, corresponding joining holes are drilled alternatively on the relevant walls and the two box enclosures are joined together by inserting bolts from one box enclosure through drilled coinciding joining holes and tightening the bolts with their nuts from the other box enclosure;

l. When the resulting enclosure is intended to be floor standing, considerably heavy in weight or long in height, box enclosures in the lowest row are joined together following the above steps from ‘c.’ to ‘k.’ and their bottom walls are fixed to plinth using bolts inserted through holes drilled on the bottom wall, closer to the four corners, of each box enclosure in the lowest row;

m. When the resulting enclosure is intended to be wall mounted, considerably light in weight and short in height, box enclosures are joined together row by row following the above steps from ‘c.’ to ‘k.’ and the resulting enclosure is mounted against wall using mounting brackets;

n. Above steps from ‘c.’ to ‘k.’ are repeated until the required enclosure is built up;

o. Canopy is fixed optionally on the top wall of each compartment on the top-most row of the resulting enclosure;

p. After creating required hole configuration on mounting plate of each box enclosure, the mounting plate is fixed using fixing cutouts and fixing holes to the welded bolts provided at the rear wall of the box enclosure;

q. After considering the door opening side, a door is fixed to each compartment;

r. Earth stud on the door and on the side wall of each compartment are connected with a wire;

s. Equipment and devices are fixed on the mounting plates in each compartment and are wired through gland holes kept opened, to make necessary inter-connections;
t. When it is required to expand the resulting enclosure, the relevant gland plates covering the gland holes intended for expanding the resulting enclosure are removed and another box enclosure is joined as stated in steps ‘c.’ to ‘m.’; and
u. When it is required to reduce or relocate a compartment from the resulting enclosure, the relevant box enclosure is removed from the resulting enclosure and any unnecessary gland holes left opened are covered with gland plates as stated in step ‘g.’ and follow steps from ‘c.’ to ‘k’.

2. The method of building a multi-compartment electrical enclosure in a cost-effective manner for low-voltage applications according to Claim 1, wherein each box enclosure in the resulting enclosure is joined to another box enclosure at least from one side wall or from top or bottom wall and the resulting enclosure can be built on a plinth and mounted against a wall using mounting brackets.

3. The method of building a multi-compartment electrical enclosure in a cost-effective manner for low-voltage applications according to Claim 1 wherein, the resulting enclosure is built up using varying dimensions of box enclosures of which the top-most box enclosures are fixed with canopies.

4. A metal box with improved ingress protection characteristics adapted for installing electrical components inside, used for building multi-compartment electrical enclosure in accordance with Claim 1, wherein a collar of its box enclosure runs around front opening is raised from the level of the front opening and is flanged outwards and the outwardly bent edge is folded outwards; a mounting plate with fixing cutouts and fixing holes is fixed on welded bolts provided at the rear wall of the box enclosure and has a set of mounting brackets.

5. A multi-compartment electrical enclosure adapted for installing electrical components built in accordance with the method in Claim 1, wherein such resulting enclosure comprises multiple compartments of which front openings are covered with doors having a gasket around
perimeter on the rear side of the doors; internal separations; internal doors; two earth studs on
door and on side wall of each compartment are connected with a wire; gland holes intended for
inter-compartment wiring and gland holes intended for extending the enclosure with new
compartments are covered with gland plates.
Fig. 1

DRAWINGS: