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ELECTRIC HIGH POWER SWITCHING DEVICE

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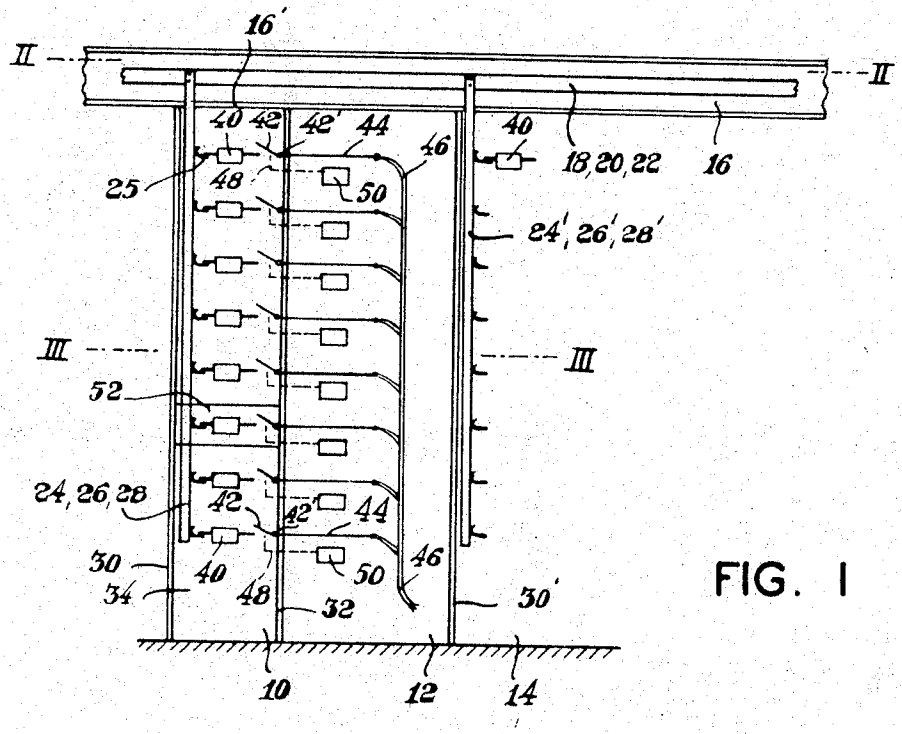
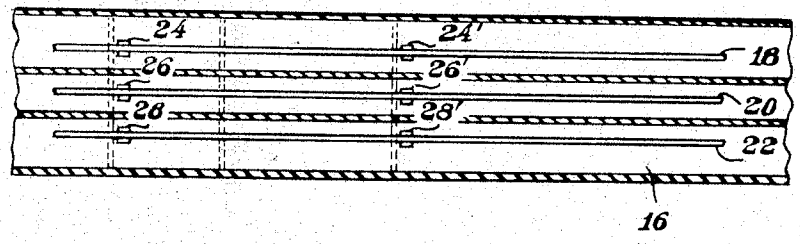


FIG. 1

FIG. 2



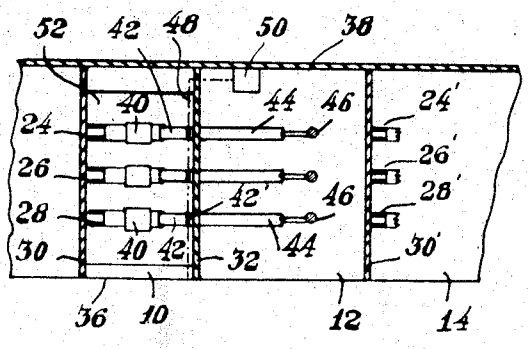


FIG. 3

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ELECTRIC HIGH POWER SWITCHING DEVICE

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This invention relates to an electrical high power switching device.

Prior art switches do not satisfy certain requirements, namely, they are not completely safe in operation and servicing, they do not prevent damage in the case of short circuits and they do not provide complete personal safety for the operators. Furthermore, it is desirable that a switching apparatus of this type should have the smallest possible dimensions without detrimentally affecting thereby the electrical safety, facility of inspection and convenient handling.

An object of the present invention is the provision of an electrical switching apparatus which will avoid the drawbacks of prior art devices and satisfy the above-mentioned requirements.

Other objects will become apparent in the course of the following specification.

The present invention is concerned with an electrical high power switching device having compartments located one next to the other and a common channel for a trunk conduit located above or below the compartments; side conduits extend from the channel in a plane perpendicular to the longitudinal direction of the compartments and of the channel either downwardly or upwardly, namely, toward the bottom or toward the upper wall of the compartments, whereby high power devices, such as load switches, are located in vertical rows and are connected to the side conduits.

The objects of the present invention are attained by providing novel component parts of an apparatus of this type and by arranging them in a manner which combines exceptional operational safety with a clear and easily operable arrangement of devices belonging to one group.

The apparatus of the present invention is essentially characterized by a construction wherein current transmitting conduits of the high power switching devices are located in a chamber which contains only these conduits, and extend in a horizontal plane toward side conduits which are mounted at a distance from and parallel to side walls of their respective compartments, said side walls consisting of a nonmagnetic material with an exceptionally high dielectric disruptive strength, whereby the interior of the compartments is substantially free of magnetic materials which could affect the passage of the current.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawing showing, by way of example only, a preferred embodiment of the inventive idea.

In the drawing;

FIGURE 1 is a diagrammatic front view of a switching apparatus constructed in accordance with the present invention, some parts being shown in section.

FIGURE 2 is a horizontal section along the line II—II of FIG. 1 through the chamber for the trunk conduits.

FIGURE 3 is a horizontal section along the line III—III of FIG. 1.

The drawing illustrates a cross switching apparatus for high power energy distribution. The apparatus comprises a number of compartments **10**, **12**, **14** etc. and a conduit chamber **16** common to all compartments.

Electrical current is supplied through three trunk conduits **18**, **20**, **22** which extend through the chamber **16**; each of these conduits is hermetically enclosed in its own channel consisting of an insulating material. In the case of three phase current the three conduits **18**, **20**, **22** correspond to the three phase conduits.

The compartments of the apparatus include side walls **30**, **32** and **30'**, a rear wall **38** and upper wall **16'**. These walls consist of an insulating material having an exceptionally high dielectric disruptive strength, such as a specific composition of wood fibers enclosed in gypsum plates and cured in a plastic material, the composition being known in the trade under the trademark "Gibogi."

Side conduits **24**, **26**, **28** and **24'**, **26'**, **28'** have the shape of double rails and extend close to the walls **30** and **30'**, respectively. As will be explained in detail hereinafter, it is of utmost importance that these walls be made of said insulating material.

The side conduits **24**, **26**, **28** are connected at their upper end to the trunk conduits **18**, **20**, **22**, respectively, and extend downwardly through the compartment **10**, being connected to the distributing units **52**. The side conduits **24'**, **26'**, **28'** are similarly arranged in the adjacent compartment **14**.

Each of the distributing units **52** includes three fuses **40**, three high power switches **42** and three connecting conduits **44**. The connecting conduits **44** extend through the wall **32** of the compartment **10** and are connected to distributing cables **46**.

As shown in the drawing, the paths for the flow of electrical current, which are formed by the fuses **40**, the switches **42** and the connecting conduits **44** extend substantially in a horizontal plane.

It is desirable to mount the pivots **42'** of the movable switch arms upon the side wall **32**.

It is also possible to connect the movable switch arm to a flexible conduit, such as a plaited wire braid, which is fixed directly upon the connecting conduit **44** extending through the wall **32**.

The outer end of the movable switch arm cooperates with one of the two terminals of the fuse **40**, while the other terminal of the fuse engages an immovable contact **25** connected to one of the side conduits **24**, **26**, **28**.

The compartment **10** contains a large number of these distributing units **52** which have the shape of frames and are mounted one over the other, each in its own story or vertical section, and which can be easily individually removed and replaced.

The three fuses **40** of each distributing unit **52** consist of commercially available normalized fuses of the melting wire type for a maximum current of 600 amp.; the three fuses of each unit **52** are located in a slider (not shown) by means of which all three fuses can be simultaneously inserted into a distributing unit **52**, or removed therefrom.

In operation, the switches **42** may be actuated remotely by compressed air from containers **50** located in the compartment **12** and connected with the switches by driving means **48** consisting of mechanical coupling elements made of non-magnetic material.

However, it is also possible to operate the switches **42** by hand through the use of a lever (not shown), or by electromagnets, or an electromotor.

The front wall **36** of the compartments extends upwardly to the chamber **16**; for reasons of safety the wall **36** consists, in the usual manner, of steel sheets. With the exception of members interconnecting the compartment walls, this wall is the only large component part of the compartments which consists of magnetizable material. Due to its magnetic properties the wall **36** should be arranged at a distance and as far as possible from the electric current paths.

The compartment **10** has an empty space **34** located below the lowermost distributing unit **52**. The space **34** constitutes a spark chamber should there be a short circuit between the side conduits **24, 26, 28**. An electric arc produced by such short circuit travels with great speed from the upper conduits in the chamber **16** between the side conduits downwardly to their lower ends and switches and is directed by them into the space **34**, as will be described in detail hereinafter. It should be noted that such short circuit taking place during operation between the side conduits **24, 26, 28**, subjects them to very high mechanical and thermal strains. However, experiments with the apparatus of the present invention have shown that side conduits having a cross-section of 50×5 mm. can sustain short circuit currents up to 100 ka. at 525 v. without becoming deformed.

Experiments have been also carried out to determine the capacity of the apparatus of the present invention to limit any damage which may arise to the location where it has arisen.

It should be noted that in prior art switching devices electrodynamic and electromagnetic forces cause the creation of a three-phase electric arc between each phase conduit and ground. However, in the apparatus of the present invention, only two electric arcs can be formed between the three conduits extending in one plane, namely, between the central conduit and the two outer conduits, while there can be no parallel arc between the two outer conduits; furthermore, the formation of the arc is that the possibilities of producing electric arcs are diminished from three in prior art devices located adjacent a ground surface, to two between the conduits **24, 26, 28** of the apparatus of the present invention, said conduits being located in front of a non-magnetic and insulating surface **30**, diminishes the electric arc power to the extent of 33%. As an example, it may be indicated that in the case of prior art conduits located adjacent a ground surface, an electric arc was measured having a power of 10 mw., while under the same conditions but in case of conduits located in front of a non-magnetic and insulating surface the power measured was about 6 mw.

As already stated, an electric arc produced by a short circuit between the conduits **24, 26, 28** travels along the conduits downwardly with a very high speed. By way of example, this speed can reach up to 4000 m./s. in the case of a short circuit current of 100 ka. and a distance of a few millimeters between the circuits. When the electric arc has reached the lower end of the side conduits **24, 26, 28** it is further driven and extended by electrodynamic forces, so that it continues in the form of an expanding arc below under the conduits in the empty space **34** and is blown out. This effect of self-extinction may be compared with the extinction of the arc which takes place in the known horn dischargers. It is important in this connection that the electric arc should not be securely established in the space **34** by finding a tracing point and continuing to burn and that, therefore, the side conduits should extend straight downwards without deviations, since otherwise the electric arc can be ignited all over again and will run around circularly in the compartment; furthermore the distance between the side conduits should be as little as possible so as to maintain low the power of the electric arc and to keep its travel speed high.

It is apparent that the example described above has been given solely by way of illustration and not by way of limitation and that it is subject to many variations and modifications within the scope of the present invention. All such variations and modifications are to be included within the scope of the present invention.

What is claimed is:

1. An electric high power switching device, comprising, in combination, at least one trunk conduit, means forming a horizontal chamber enclosing said trunk conduit, a plurality of side conduits connected with said trunk conduit and extending substantially perpendicularly and downwardly thereto, at least three spaced side walls in parallel to each other and consisting of an insulating material with high dielectric disruptive strength extending close and parallel to said side conduits, said walls forming at least two compartments receiving said side conduits and extending substantially perpendicularly to said chamber, and a plurality of distributing units located one over the other in one of said compartments, each of said distributing units comprising at least one switch secured to the middle one of said three walls and a melting wire fuse cooperating with said switch and connecting said switch with one of said side conduits, said fuse together with said switch providing a horizontal path for an electrical current between said one side conduit, said fuse, said switch and a distributing cable, the interior of said compartment being substantially free of magnetic material.

2. A device in accordance with claim **1**, comprising a fixed contact connected to said one side conduit and receiving one terminal of said melting wire fuse, the other terminal of said fuse being adapted to be engaged by said switch when the switch is closed.

3. A device in accordance with claim **1**, wherein said side conduits extend along straight lines and have ends located at substantially equal distances from said trunk conduit, said compartment having an empty space adjacent said ends for extinguishing electric arcs.

4. A device in accordance with claim **1**, wherein one of said side walls extends close and parallel to said side conduits, said device further comprising means connecting said switch with said distributing cable and extending through the middle wall of said side walls.

5. A device in accordance with claim **1**, further comprising a rear wall enclosing said compartment and consisting of the same material as said side walls.

6. A device in accordance with claim **1**, wherein each switch comprises a swingable arm and a pivot carrying said arm and located on said middle wall.

7. A device in accordance with claim **1**, comprising means located in the other of said compartments and actuating said switches.

8. A device in accordance with claim **7**, wherein the last-mentioned means comprise mechanical coupling elements consisting of a non-magnetic material.

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