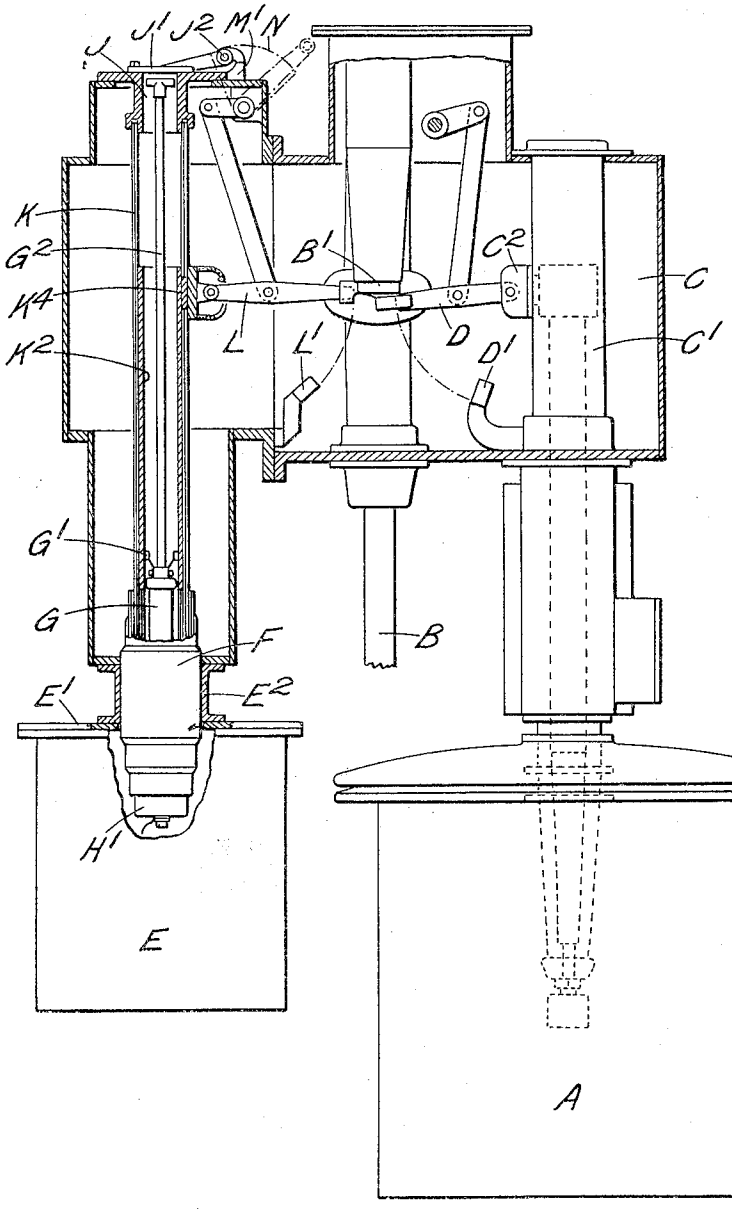
April 18, 1933. J. CHRISTIE ET AL 1,903,956

HIGH VOLTAGE ELECTRIC SWITCH GEAR

Filed March 14, 1932 3 Sheets-Sheet 1

FIG. 1.



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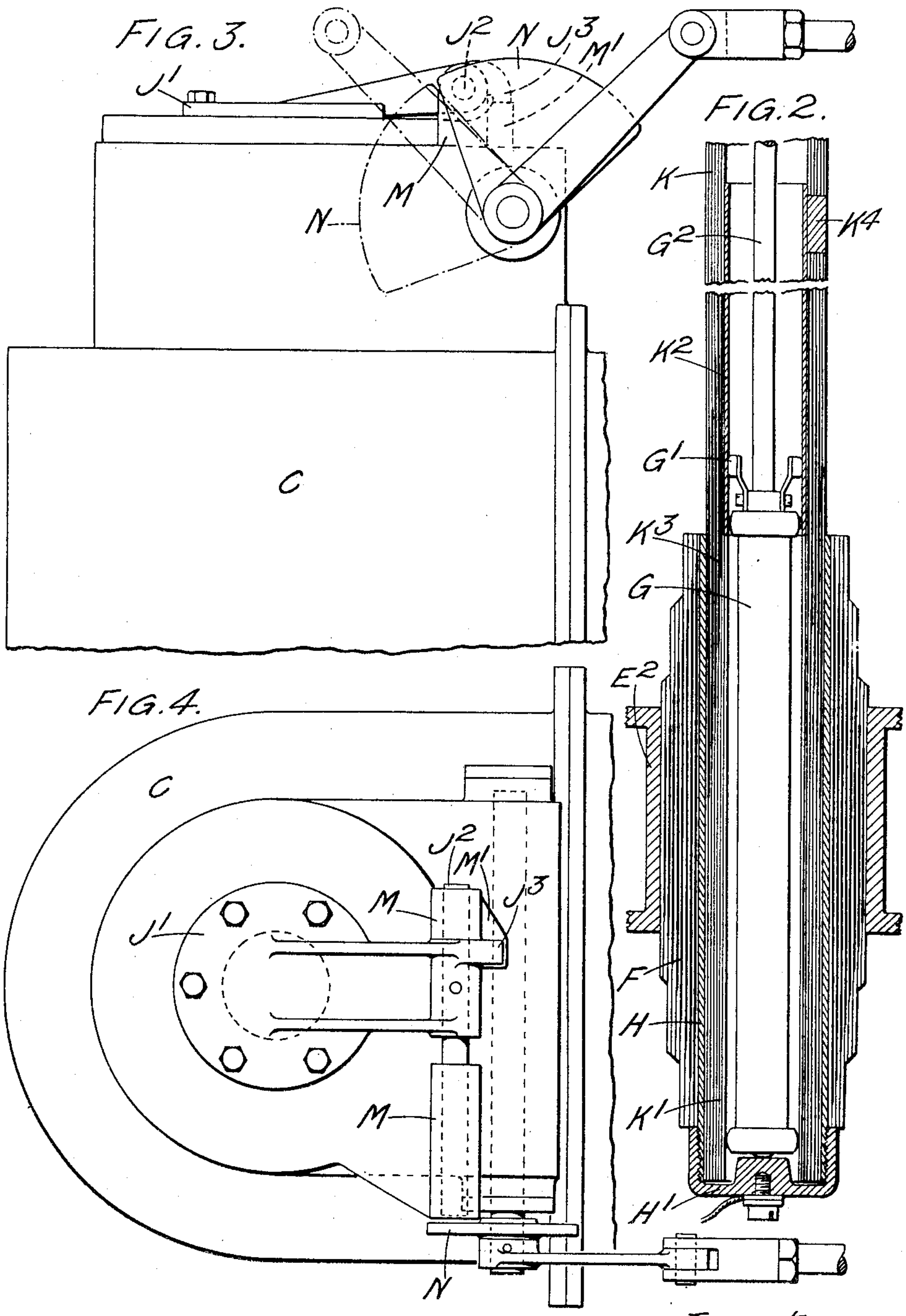
HIGH VOLTAGE ELECTRIC SWITCH GEAR

Filed March 14, 1932 3 Sheets-Sheet 2



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HIGH VOLTAGE ELECTRIC SWITCH GEAR

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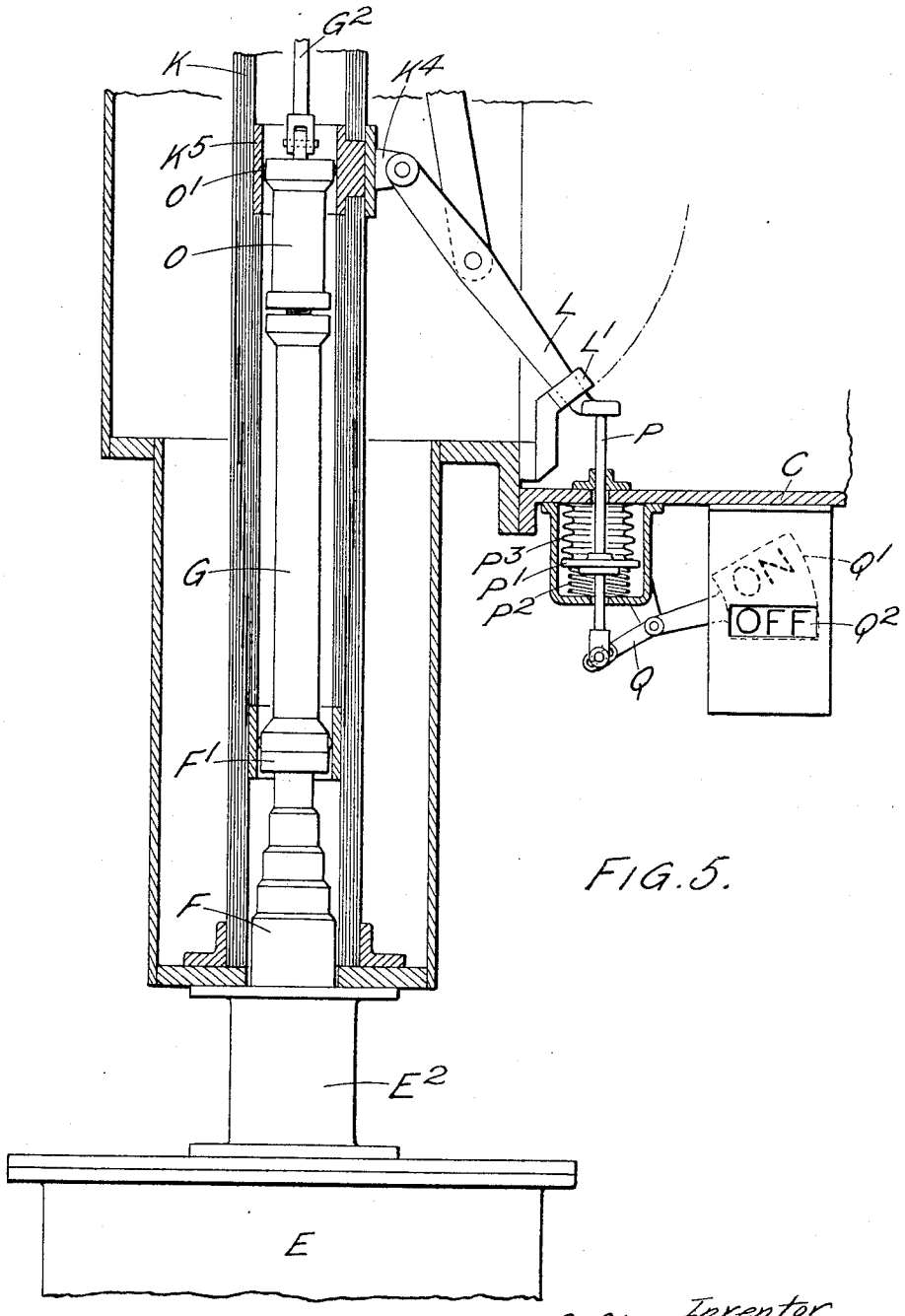

FIG. 5.

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UNITED STATES PATENT OFFICE

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HIGH VOLTAGE ELECTRIC SWITCH GEAR

Application filed March 14, 1932, Serial No. 598,836, and in Great Britain April 17, 1931.

This invention relates to high voltage electric switch gear and has particular reference to the mounting of potential transformer fuses in such gear. As is well known such fuses are employed to protect the primary circuits of the potential transformer, and it is customary to mount the fuses in separate oil filled tanks into which the connections from the potential transformer are led through plug and socket isolating contacts. In some instances isolation has also been effected by withdrawing the fuse from its mounting.

The present invention has for its object to provide an improved mounting for a potential transformer fuse which renders unnecessary the provision of a special tank for the fuse and thereby enables considerable economy to be effected both in space and in cost.

A convenient practical arrangement of fuse mounting according to the invention, as applied to A. C. switchgear wherein a single-phase potential transformer is provided in each phase in association with an oil-immersed circuit-breaker for connecting a feeder circuit to a busbar, is illustrated by way of example in the accompanying drawings, in which

Figure 1 shows a general view of a portion of the switch gear partly in section to show the mechanism between the circuit-breaker and the potential transformer,

Figure 2 shows the potential transformer fuse and its mounting in vertical section on a larger scale,

Figures 3 and 4 also on a larger scale show respectively in side elevation and in plan part of the mechanism at the top of the fuse mounting, and

Figure 5 is a view similar to part of Figure 1 illustrating a modified form of fuse mounting according to the invention.

In the arrangement of Figures 1–4 two oil-filled chambers are provided above the circuit-breaker tank A, into which the busbar and the feeder B are respectively introduced. The busbar chamber is not shown in the drawings since it forms no part of the present invention, but may be arranged for example in the manner described in the present applicants' prior U. S. patent application Serial No. 508,988, wherein the busbar is connected to one of the main circuit-breaker contacts through an isolating switch in the busbar chamber and through an insulated conductor normally projecting into the circuit-breaker tank but withdrawably mounted in an insulating tube passing through the busbar chamber. The other main circuit-breaker contact is similarly connected through a withdrawable conductor to a contact on an insulating tube C^1 passing through the feeder chamber C. This contact is connected to a metal lug C^2 to which an isolating switch blade D is pivoted. This isolating switch blade D cooperates with a contact member B^1 connected to the feeder B and also with an earthed contact D^1.

The feeder chamber C extends over the potential transformer tank E, which is disposed by the side of the circuit-breaker tank A, and has an orifice in its bottom wall vertically above a corresponding orifice in the cover plate E^1 of the potential transformer tank E. The two orifices are connected by a short trunk E^2, within which is mounted a condenser type bushing insulator F of usual construction, the length of the bushing being approximately the same as that of the potential transformer fuse G itself. The outermost layer of the bushing F is connected to earth through the metal wall of the trunk E^2, and the innermost layer is formed by a metal tube H whose lower end projects a short distance beyond the bushing and carries a metal cap H^1 to which the primary winding of the potential transformer is connected.

Closely fitting within the tube H and extending from the metal cap H^1 right up to an orifice J in the top of the feeder chamber C is an insulating tube K formed of layers of impregnated paper. This tube K is lined in its lower part with further layers K^1 of paper insulation extending approximately to the same height as the surrounding metal tube H, and in its upper part with a second metal tube K^2 resting on top of such paper insulation K^1 and extending nearly to the top of the insulating tube K. Metal conducting layers K^3 are interleaved with the paper lay-

ers of the insulating tube in the neighbourhood of the upper end of the outer metal tube H and the lower end of the second metal tube K^2.

The potential transformer fuse G itself is of the high resistance dust-filled type and is inserted within these tubes so that in its operative position its lower metal base rests on the metal cap H^1 and is thus electrically connected to the potential transformer primary winding and to the metal tube H forming the innermost layer of the bushing F, whilst its upper terminal is provided with spring contacts G^1 or spring pressed plungers engaging with the second metal tube K^2. The fuse is carried on an insulating handle G^2 extending to the top of the insulating tube K, so that the fuse can be readily withdrawn by the handle from its mounting. The upper end of the insulating tube K is normally closed by a metal cap J^1 which may press on the upper end of the handle G^2 and thus hold the fuse securely in place. The space within the tube K surrounding the fuse G is preferably oil-filled.

The second metal tube K^2 near its upper end is connected through the wall of the insulating tube K to a metal lug K^4 to which is pivoted an isolating switch blade L. This blade L cooperates with the contact member B^1 connected to the feeder B and also with an earthed contact L^1 mounted in a suitable position in the feeder chamber C. This arrangement enables the second metal tube K^2 and therefore also the fuse G to be earthed so that the fuse can be withdrawn, when desired, with absolute safety. In order that the operator may readily see that the isolating switch L is in its earthed position before withdrawing the fuse, an indicator may be provided outside the wall of the feeder chamber. This indicator may conveniently be actuated by a flexible bellows in the wall of the chamber, this bellows being operated by movement of the isolating switch blade L into the earthed position. Such an indicating arrangement is incorporated in the modified form of fuse mounting shown in Figure 5 and will be described later with reference to that figure.

If desired, the metal cap J^1 closing the top of the insulating tube K may be mechanically interlocked with the operating mechanism for the isolating switch L, whereby removal of the cap is prevented unless the isolating switch is in its earthed position. Thus in one convenient arrangement the metal cap J^1 is mounted at one side on a pivot pin J^2 which is carried in suitable bearings M on the top of the feeder chamber C so that it can rotate therein and can also slide longitudinally for a short distance. In the normal position with the cap J^1 closed, a projection J^3 on the side of the pivot pin J^2 abuts closely against a stop M^1 on the top of the chamber so that it is impossible to rotate the pin J^2 to open the cap J^1 without first sliding the pin longitudinally until the projection J^3 is clear of the stop M^1. The operating mechanism for the isolating switch L is provided with a segmental plate N which, when the isolating switch is closed, lies beyond the end of the pivot pin J^2 and prevents longitudinal movement thereof. Movement of the isolating switch into its earthed position causes the segmental plate N to move out of the path of the pivot pin. Thus the metal cap J^1 cannot be opened, when the isolating switch L is closed, but when the switch is earthed the cap can be opened by sliding and then rotating the pivot pin J^2. The cap J^1 is preferably bolted in its normal position, the bolts having first to be removed before the cap can be opened. It will be noted that when the cap is open, the pivot pin J^2 lies in the path of the segmental plate N and thus prevents movement of the isolating switch L into the closed position.

Thus the fuse G when in its operative position constitutes part of the connection from the potential transformer primary winding through the isolating switch L to the feeder B and is directly mounted within the terminal bushing F of the potential transformer. The use of a condenser type bushing prevents corona discharge from the thin wire of the fuse and the insulating tube K serves to prevent the two ends of the fuse from being virtually short-circuited, as they would otherwise be, by the innermost layer of the condenser bushing. The condenser layers K^3 act to grade the stress set up when the fuse blows between the lower end of the metal tube K^2 and the upper end of the metal tube H which is at the potential of the lower end of the fuse.

An alternative form of mounting for the fuse is illustrated in Figure 5, which shows only those parts of the arrangement which differ from the arrangement of Figures 1–4. In this modification the fuse G is as before mounted within an insulating tube K which extends through the feeder chamber C coaxially with the condenser bushing F in the trunk E^2 connecting the feeder chamber with the potential transformer tank E, but in this instance the condenser bushing F is of the usual construction with a central rod-like conductor terminating at its upper end in a metal cap F^1 on which the lower end of the fuse G rests, the insulating tube K at its lower end surrounding the upper part of the condenser bushing F instead of being mounted within it. The upper end of the insulating tube K is arranged in the same manner as in the arrangement of Figures 1–4.

When the fuse G is of the liquid-filled type, a limiting resistance O is mounted on top of the fuse with its lower end attached to the upper terminal of the fuse, so that the limiting resistance is in series with the fuse. The

resistance O and the fuse G thus together constitute a unit which can be withdrawn as a whole through the upper end of the tube K by means of the insulating handle G^2 as in the arrangement of Figures 1–4. The limiting resistance O may be omitted when the fuse is of the high resistance dust-filled type.

The upper end of the limiting resistance O (or of the fuse G as the case may be) is provided with spring contacts or spring-pressed plungers O^1 engaging with a conducting member K^5 connected through the wall of the insulating tube K to a metal lug K^4, which serves as in Figure 1 to carry the isolating switch blade L. This blade L co-operates with the feeder contact member B^1 (see Figure 1) and also with the earthed contact L^1, whereby the fuse G can be earthed so that it can be withdrawn, when desired, with absolute safety. When the switch blade L is moved into its earthed position, it engages with a rod P passing through the wall of the chamber C and carrying a plate P^1 pressed by a spring P^2 towards the chamber wall, an oil-tight joint being ensured by the provision of a flexible bellows P^3 connecting the plate P^1 to the chamber wall. The outer end of the rod P^1 is connected to a lever Q which serves to actuate an indicator of suitable construction whereby the operator can readily see whether or not the fuse is earthed before withdrawing the fuse. In the example illustrated the lever Q carries a plate Q^1 bearing suitable legends such as On and Off which are selectively exposed to view through a window Q^2 in accordance with the position of the isolating switch blade L.

The insulating tube K is formed of layers of impregnated paper and, as in the previous arrangement, metal conducting layers of short length are interleaved with the paper layers to grade the stress set up when the fuse blows between conducting members connected to the upper and lower ends of the fuse. In this instance the conducting layers K^6 surround the fuse G itself, the innermost layer being disposed around the lower end of the fuse and the outermost layer around the upper end of the fuse, whilst the intervening layers overlap one another in a step-like formation. These layers thus grade the stress between the conducting member K^5 connected to the isolating switch contact and the metal cap F^1 on the central conductor within the condenser bushing F, and thereby eliminate or minimize risk of a flash-over between these conducting members. Although the potential transformer primary winding may be earthed in the usual manner so that the metal cap F^1 at the lower end of the fuse is at earth potential, it may sometimes be preferable to operate the transformer without earthing one of its windings.

It will be seen that either of the above arrangements provides a convenient and compact mounting for the fuse, without the necessity for a separate containing tank, and is adequately safeguarded against disruptive discharges.

The arrangements described have been given by way of example only and may be modified in various ways within the scope of the invention. Thus for instance the fuse in the arrangement of Figures 1–4 may be of the liquid-filled type, in which case a limiting resistance would be mounted in series with and on top of the fuse in the manner described with reference to Figure 5.

What we claim as our invention and desire to secure by Letters Patent is:—

1. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer tank, a condenser-type bushing insulator which supports the fuse mounting in the wall of the tank, a metal tube constituting the innermost layer of the bushing insulator, a potential transformer fuse disposed within the bushing insulator, and an insulating tube surrounding the fuse and surrounded by the metal tube.

2. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer tank, a condenser-type bushing insulator which supports the fuse mounting in the wall of the tank, a metal tube constituting the innermost layer of the bushing insulator, a potential transformer fuse disposed within the bushing insulator, an insulating tube surrounding the fuse and surrounded by the metal tube, and an electrical connection between the lower end of the fuse within the transformer tank and the metal tube.

3. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer tank, a condenser-type bushing insulator which supports the fuse mounting in the wall of the tank, a metal tube constituting the innermost layer of the bushing insulator, a potential transformer fuse disposed within the bushing insulator, an insulating tube surrounding the fuse and surrounded by the metal tube, and means whereby the fuse can be withdrawn through the upper end of the insulating tube for isolating purposes.

4. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer tank, a condenser-type bushing insulator which supports the fuse mounting in the wall of the tank, a metal tube constituting the innermost layer of the bushing insulator, a potential transformer fuse disposed within the bushing insulator, an insulating tube surrounding the fuse and surrounded by the metal tube, a second metal tube mounted

within the insulating tube and electrically connected at its lower end to the upper end of the fuse, and an external electric circuit to which the second metal tube is connected.

5. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer tank, a condenser-type bushing insulator which supports the fuse mounting in the wall of the tank, a metal tube constituting the innermost layer of the bushing insulator, a potential transformer fuse disposed within the bushing insulator, an insulating tube surrounding the fuse and surrounded by the metal tube, a second metal tube mounted within the insulating tube and electrically connected at its lower end to the upper end of the fuse, a contact formed on the second metal tube constituting a terminal for connection to an external electric circuit, and an electrical connection between the lower end of the fuse within the transformer tank and the first metal tube, the fuse being so mounted as to be withdrawable through the top of the insulating tube for isolating purposes.

6. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer tank, a condenser-type bushing insulator which supports the fuse mounting in the wall of the tank, a metal tube constituting the innermost layer of the bushing insulator, a potential transformer fuse disposed within the bushing insulator, an insulating tube surrounding the fuse and surrounded by the metal tube, such insulating tube being formed of layers of insulating material, an electrical connection between the lower end of the fuse within the transformer tank and the metal tube, and conducting layers interleaved with the insulating layers of the insulating tube between the upper ends of the fuse and of the metal tube.

7. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer tank a condenser-type bushing insulator which supports the fuse mounting in the wall of the tank, a metal tube constituting the innermost layer of the bushing insulator, a potential transformer fuse disposed within the bushing insulator, an insulating tube surrounding the fuse and surrounded by the metal tube, such insulating tube being formed of layers of insulating material, a second metal tube mounted within the insulating tube with its lower end in electrical connection with the upper end of the fuse, an external electric circuit to which the second metal tube is connected, an electrical connection between the lower end of the fuse within the transformer tank and the first metal tube, and overlapping conducting layers of short length interleaved with the insulating layers of the insulating tube between the lower end of the second metal tube and the upper end of the first metal tube.

8. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer tank, a condenser-type bushing insulator in the wall thereof, a conductor within the bushing inslator connected to the potential transformer primary winding, an insulating tube formed of layers of insulating material and disposed coaxially with the bushing insulator, a potential transformer fuse mounted within such insulating tube, and overlapping conducting layers of short length interleaved with the insulating layers of such tube and acting to grade the stress set up when the fuse has blown between conducting members connected to the two ends of the fuse.

9. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer fuse, an insulating tube formed of layers of insulating material surrounding the potential transformer fuse, overlapping conducting layers of short length interleaved with the insulating layers of such tube and acting to grade the stress set up when the fuse has blown between conducting members connected to the two ends of the fuse, and means whereby the fuse can be withdrawn through the upper end of the insulating tube for isolating purposes.

10. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer tank, a condenser-type bushing insulator which supports the fuse mounting in the wall of the tank, a metal tube constituting the innermost layer of the bushing insulator, a potential transformer fuse disposed within the bushing insulator, an insulating tube surrounding the fuse and surrounded by the metal tube, a limiting resistance connected in series with the fuse and mounted on the upper end thereof, and means whereby the fuse can be withdrawn together with the limiting resistance through the upper end of the insulating tube for isolating purposes.

11. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer tank, a condenser-type bushing insulator in the wall thereof, a conductor within the bushing insulator connected to the potential transformer primary winding, an insulating tube formed of layers of insulating material and disposed coaxially with the bushing insulator, a potential transformer fuse mounted within such insulating tube with its lower end connected to the upper end of the conductor within the bushing insulator, a contact on the insulating tube constituting a terminal for connection to an external circuit, a limiting resistance mounted with its upper end connected to such contact and its lower end in contact with the up-

per end of the fuse, means whereby the fuse can be withdrawn together with the limiting resistance through the upper end of the insulating tube for isolating purposes, and overlapping conducting layers of short length interleaved with the insulating layers of the insulating tube and acting to grade the stress set up when the fuse has blown between the lower end of the fuse and the contact on the tube.

12. The combination with the features set forth in claim 1, of a chamber which is disposed above the potential transformer tank and through which the insulating tube passes, a contact on the insulating tube to which the upper end of the fuse is connected, a contact in the chamber connected to an external electric circuit, a contact in the chamber connected to earth, and an isolating switch in the chamber which can be moved to connect the contact on the insulating tube either to the circuit contact or to the earthed contact.

13. The combination with the features set forth in claim 1, of a circuit-breaker tank disposed by the side of the potential transformer tank, a circuit-breaker immersed in oil therein, a chamber which is disposed above the two tanks and through which the insulating tube passes, a conductor leading from one of the contacts of the circuit-breaker into the chamber, a contact in the chamber connected to an external circuit, an isolating switch controlling the connection between such contact and the conductor leading to the circuit-breaker, a contact on the insulating tube to which the upper end of the fuse is connected, and a second isolating switch in the chamber controlling the connection between such contact and the contact connected to the external circuit.

14. The combination with the features set forth in claim 5, of a chamber which is disposed above the potential transformer tank and through which the insulating tube passes, a contact in the chamber connected to the external electric circuit, a contact in the chamber connected to earth, and an isolating switch in the chamber which can be moved to connect the contact on the second metal tube either to the circuit contact or to the earthed contact.

15. The combination with the features set forth in claim 8, of a chamber which is disposed above the potential transformer tank and through which the insulating tube passes, a contact on the insulating tube to which the upper end of the fuse is connected, a contact in the chamber connected to an external electric circuit, a contact in the chamber connected to earth, and an isolating switch in the chamber which can be moved to connect the contact on the insulating tube either to the circuit contact or to the earthed contact.

16. The combination with the features set forth in claim 11, of a chamber which is disposed above the potential transformer tank and through which the insulating tube passes, a contact in the chamber connected to the external electric circuit, a contact in the chamber connected to earth, and an isolating switch in the chamber which can be moved to connect the contact on the second metal tube either to the circuit contact or to the earthed contact.

17. The combination with the features set forth in claim 3, of a chamber which is disposed above the potential transformer tank and through which the insulating tube passes, a contact on the insulating tube to which the upper end of fuse is connected, a contact in the chamber connected to an external electric circuit, a contact in the chamber connected to earth, an isolating switch in the chamber which can be moved to connect the contact on the insulating tube either to the circuit contact or to the earthed contact, a cover for the upper end of the insulating tube, and means for preventing removal of the cover to permit the fuse to be withdrawn unless the isolating switch is in its earthed position.

18. The combination with the features set forth in claim 8, of a chamber which is disposed above the potential transformer tank and through which the insulating tube passes, a contact on the insulating tube to which the upper end of the fuse is connected, a contact in the chamber connected to an external electric circuit, a contact in the chamber connected to earth, an isolating switch in the chamber which can be moved to connect the contact on the insulating tube either to the circuit contact or to the earthed contact, a cover for the upper end of the insulating tube, means whereby the fuse can be withdrawn through the upper end of the insulating tube when the cover is removed, and means for preventing removal of the cover unless the isolating switch is in its earthed position.

19. A potential transformer fuse mounting for high voltage electric switchgear, comprising a potential transformer tank, a condenser-type bushing insulator in the wall thereof, a conductor within the bushing insulator connected to the potential transformer primary winding, an insulating tube formed of layers of insulating material and disposed coaxially with the bushing insulator, a potential transformer fuse mounted within such insulating tube with its lower end connected to the upper end of the conductor within the bushing insulator, overlapping conducting layers of short length interleaved with the insulating layers of the insulating tube and acting to grade the stress set up between the two ends of the fuse when the fuse has blown, a circuit-breaker tank disposed by the side of the potential transformer tank, a circuit-breaker im-

mersed in oil therein, a chamber which is disposed above the two tanks and through which the insulating tube passes, a conductor leading from one of the contacts of the circuit-breaker into the chamber, a contact in the chamber connected to an external circuit, an isolating switch controlling the connection between such contact and the conductor leading to the circuit-breaker, a contact on the insulating tube to which the upper end of the fuse is connected, and a second isolating switch in the chamber controlling the connection between such contact and the contact connected to the external circuit.

In testimony whereof we have signed our names to this specification.

JOHN CHRISTIE.
DONALD FOSTER AMER.