Sept. 28, 1943. K. DANNENBERG 2,330,690

CARTRIDGE FUSE AND SWITCHGEAR INCORPORATING THE FUSE

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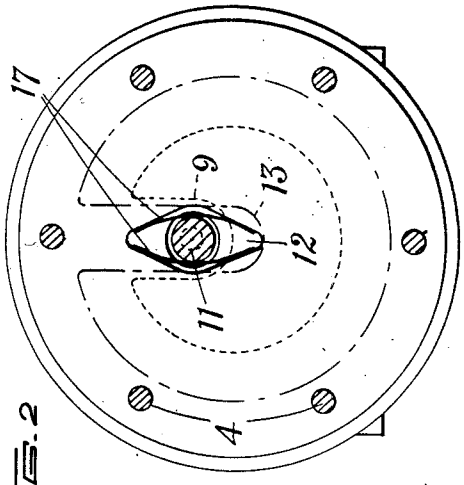

FIG. 2

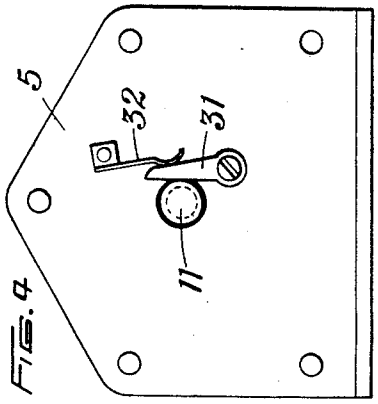

FIG. 4

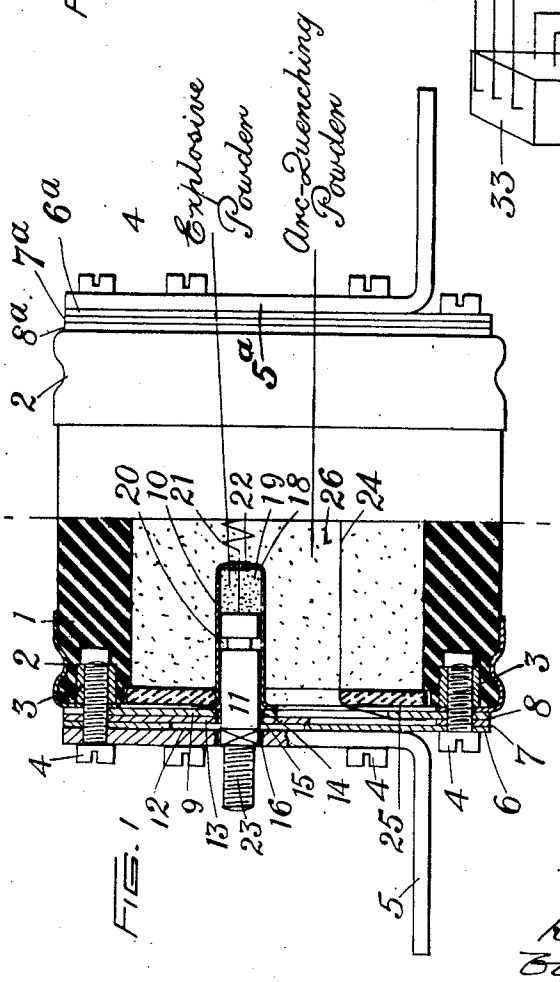

FIG. 1

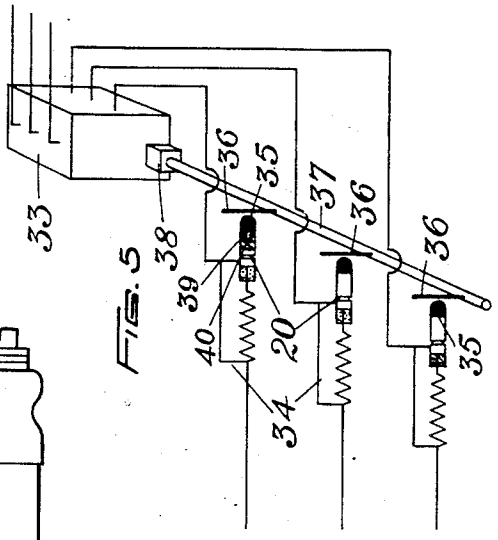

FIG. 5

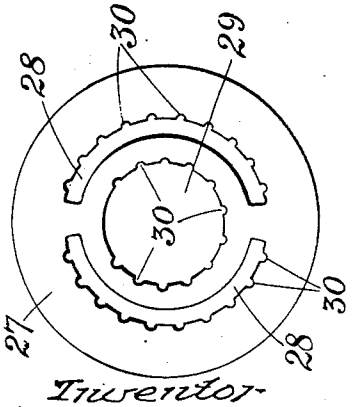

FIG. 3

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CARTRIDGE FUSE AND SWITCHGEAR INCORPORATING THE FUSE

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25 Claims. (Cl. 200—131)

This invention has reference to improvements in and relating to cartridge fuses, i. e., fuses in the form of hermetically closed, powder filled sheaths containing fusible elements, for high, low and medium voltages.

According to one feature of the invention a trip hammer which is arranged to be displaced with sufficient force to cause it mechanically to open an electric switch is held against return movement by a locking device arranged to engage with it after it has been so displaced. The hammer has a part which is permanently exposed (i. e., exposed even when the fuse is not blown and is in service condition) to permit of easy access to the hammer.

Another feature of the invention comprises switchgear having a three-phase switch and fuses in accordance with the foregoing in series with the phases of the switch with their hammers, which act as strikers, commonly associated with the opening member of the switch so that operation of any fuse opens all switch phases and prevents closing of the switch until such time as an intact fuse (i. e., a fuse fit for service) replaces the operated fuse in the switchgear.

One form of fuse, a detail in connection with the mounting of fusible elements therein, an alternative form of hammer locking device and a three-phase switch according to the invention will now be described with reference to the accompanying drawing wherein:

Fig. 1 is a side elevation of a medium voltage fuse with that end thereof having the trip hammer shown in section;

Fig. 2 is a view of the trip hammer end of the fuse after removal of the connecting tag at this end;

Fig. 3 is a face view of a notched ring for supporting a number of fusible elements;

Fig. 4 is an end view of a connecting tag on which a spring-driven locking bit is mounted; and

Fig. 5 is a diagrammatically shown switchgear comprising a three-phase switch and three fuses with permanently accessible trip hammers.

The fuse illustrated in Figs. 1 and 2 comprises the usual refractory, insulating sheath 1 with internally flanged caps 2 secured to it at its ends. Screw-threaded sockets 3 are sunk into the ends of the sheath to take fixing screws 4 which secure the connecting tags 5 and 5a, discs 6 and 6a and intermediate rings 7, 7a and 8, 8a to the sheath. The elements 6, 7 and 8, and 6a, 7a, 8a, are of metal and each set thereof is firmly clamped between its adjacent connecting tag and end of the sheath by the screws 4.

The ring 8 has an inwardly directed tongue 9 to which a cylinder 10 for the trip hammer 11 is welded near the inner end of the tongue, the cylinder 10 extending inwardly of the sheath 1.

The disc 6 has a diamond-shaped slot 12, the centre of which coincides with the axis of the trip hammer 11; and the ring 7 has an inwardly directed tongue 13 which lies against one side of the slot. The corresponding connecting tag 5 lies against the other side of the said slot. In this manner a shallow chamber is provided.

The outer end of the trip hammer extends through holes 14 and 15 in the tongues 9 and 13, respectively, through the middle portion of the said chamber and through a hole 16 in the tag 5.

Within the said chamber are two bowed wire springs 17 which tend normally to close towards each other but are prevented from doing so by contact with the sides of the hammer 11.

The cylinder 10 extends well beyond the inner end of the hammer 11 to provide a chamber 18 for explosive powder (e. g. gunpowder) 19.

The hammer is annularly grooved at 20 near its inner end and one end of the fusible element 21 is connected to the hammer, said element passing through an insulating bush 22 on the closed end of the cylinder 10 and through the explosive chamber 18.

When the element 21 fuses it ignites the powder 19 and the hammer 11 is ejected until the groove 20 comes into register with the springs 17 whereupon the said springs close into the groove and lock the hammer against both forward and backward movement.

The outer end of the hammer has a screw-threaded shank 23 enabling it to be connected to or associated with a switch; and that portion of the hammer 11 normally within the hole 16 is squared and the said hole is of corresponding shape to prevent rotation of the hammer when a connecting body is applied to the shank.

The element 21 is of coil form to enable the requisite length of wire to be arranged in the sheath having the length shown, in spite of the cylinder 10 projecting well into the sheath. The coil and the cylinder are substantially aligned.

A second fusible element 24 electrically parallel with 21 is located within the sheath; its ends are connected to the rings 8 and it is stretched between the inner peripheries of two ceramic rings or supports 25 let into recesses at the ends of the sheath.

The fuse is filled with powder indicated by 26

and the sealing provided by the members screwed to the ends of the sheath is such as to be hermetic or nearly so.

The element 21, which is the main interruption element, preferably consists of tungsten and is so graded with respect to the explosive charge that approximately $\frac{1}{10}$ sec. time is required for the hammer to complete its ejection stroke. Thus, the said element dissipates inside the fuse before the hammer fully operates.

When it is desired to provide a fuse of high current rating the rings 25 are replaced by rings as 27 illustrated in Fig. 3. The rings 27 have arcuate slots 28 around the bore 29 and the inner peripheral portions of the slots and of the bore are recessed at 30. Elements additional to the coil 21 and electrically parallel therewith have their ends secured to the rings 8 and stretch from ring to ring with those portions contacting with the rings lying in the recesses 30.

Instead of employing springs 17 to lock the hammer 11 I may use the spring-driven bit 31, Fig. 4. This is mounted on the tag 5 and it normally presses against the outer end of the hammer and, when the fuse operates, enters the groove 20, owing to the action of the blade spring 32.

The switchgear illustrated in Fig. 5 comprises the three-phase switch 33 and three fuses 34 having permanently accessible hammers. Each fuse is in series with a phase of the switch and the hammers have insulated ends 35 adjacent to arms 36 rigid with the operating rod 37 of the trip 38 of the switch. Thus, operation of any one fuse causes its hammer partially to turn the shaft 37 and this upsets the trip to cause all phases of the switch to be opened. When the switch is so opened the trip is held in the upset position owing to the locking of the operated hammer and cannot be reset until such time as an intact fuse is substituted for the one that has operated. The switch 33 and its trip may be of any suitable known kind. Alternatively, the switch may be of the type which is directly opened by the turning of a shaft.

Part of one of the hammers in Fig. 5 is in section. The hammer has a screw-threaded bore 39 into which a metal shank 40 on the insulating end 35 fits.

What I claim is:

1. A cartridge fuse comprising a refractory, insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch, and a locking device adapted to hold said hammer against return movement after it has been so displaced.

2. A cartridge fuse comprising a refractory, insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, said hammer having a part which is permanently exposed to permit of easy access to it even when the fuse is not blown and is in service condition, means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch, and a locking device adapted to hold said hammer against return movement after it has been so displaced.

3. A cartridge fuse comprising a refractory, insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, a shank extending from said hammer, said shank being exposed to permit of easy access to it even when the fuse is not blown and is in service condition, means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch, and a locking device adapted to hold said hammer against return movement after it has been so displaced.

4. A cartridge fuse comprising a refractory, insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, said hammer having a screw-threaded bore which is permanently exposed to permit of easy access to it even when the fuse is not blown and is in service condition, means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch, and a locking device adapted to hold said hammer against return movement after it has been so displaced.

5. A cartridge fuse comprising a refractory, insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, said hammer having a groove, means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch, and a spring locking device adapted to engage with said groove to hold the hammer against return movement after it has been so displaced.

6. A cartridge fuse comprising a refractory, insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, said hammer having a groove, means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch, a flat body at one end of said sheath, a second flat body lying against said first body and a third flat body lying against said second body, the second body having a slot and the first and third bodies having openings of smaller size than the slot whereby a chamber is provided, and a spring locking device in said chamber, the trip hammer extending through said openings and said chamber and said spring device being arranged to engage with the groove in the trip hammer to hold said hammer against return movement after it has been displaced subsequently to fusing of the fusible element.

7. A cartridge fuse comprising a refractory, insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, said hammer having a groove, means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch, connecting tags at the ends of the fuse and a spring locking device mounted on one of

said tags arranged to engage with the groove in the trip hammer to hold said hammer against return movement after it has been displaced subsequently to fusing of the fusible element.

8. A cartridge fuse comprising a refractory, insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, said hammer and said fusible element being in series electrically, means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch, and a locking device adapted to hold said hammer against return movement after it has been so displaced.

9. A cartridge fuse comprising a refractory, insulating sheath, an helically coiled fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a cylinder located at one of said ends coaxially of the coiled fusible element, said cylinder extending into the sheath, a trip hammer located in said cylinder and connected in series electrically with said fusible element, means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch, and a locking device adapted to hold said hammer against return movement after it has been so displaced.

10. A cartridge fuse comprising a refractory, insulating sheath, an helically coiled fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a cylinder located at one of said ends coaxially of the coiled fusible element, said cylinder extending into the sheath, an explosive powder in the cylinder traversed by the fusible element, and a trip hammer in the cylinder, ignition of the powder as a result of the element fusing effecting displacement of the trip hammer with a force sufficient to cause it mechanically to open an electric switch, and a locking device adapted to hold said hammer against return movement after it has been so displaced.

11. In a cartridge fuse according to claim 9, insulating rings near the ends of the cartridge, said rings having longitudinal openings in them at different distances from their centers, the openings in one ring corresponding with those in the other and said rings surrounding the axis of the coiled fusible element and being parallel with the ends of the cartridge, terminal rings adjacent to said insulating rings, said terminal rings surrounding the axis of the coiled fusible element, and main service elements, said main service elements being electrically parallel with each other and with said coiled fusible element and stretching from openings in one insulating ring to corresponding openings in the other ring and connected at their ends to said terminal rings whereby said main service elements are of different length owing to the position of the holes in the insulating rings with relation to the terminal rings and, therefore, said elements of different length dissipate in steps when the fuse effects an electrical interruption.

12. In a cartridge fuse according to claim 9, insulating rings near the ends of the cartridge, said rings having longitudinal openings in them at different distances from their centers, the openings in one ring corresponding with those in the other and the sides of said openings having notches in them and said rings surrounding the axis of the coiled fusible element and being parallel with the ends of the cartridge, terminal rings adjacent to said insulating rings, said terminal rings surrounding the axis of the coiled fusible element, and main service elements, said main service elements being electrically parallel with each other and with said coiled fusible element and stretching from openings in one insulating ring to corresponding openings in the other insulating ring and lying in said notches and connected at their ends to said terminal rings whereby said main service elements are of different length owing to the position of the holes in the insulating rings with relation to the terminal rings and, therefore, said elements of different length dissipate in steps when the fuse effects an electrical interruption.

13. A cartridge fuse, comprising a refractory insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, said hammer having a part which is permanently exposed to permit of easy access to it even when the fuse is not blown and is in service condition, and means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch.

14. A cartridge fuse, comprising a refractory insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, a shank extending from said hammer, said shank being exposed to permit of easy access to it even when the fuse is not blown and is in service condition, and means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch.

15. A cartridge fuse comprising a refractory insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, said hammer having a screw threaded bore which is permanently exposed to permit of easy access to it even when the fuse is not blown and is in service condition, and means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch.

16. A cartridge fuse, comprising a refractory insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, said hammer and said fusible element being in series electrically, and means activated by the fusing of the fusible element adapted to displace the trip hammer with a force sufficient to cause it mechanically to open an electric switch.

17. A cartridge fuse, comprising a refractory insulating sheath, an helically coiled fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a cylinder located at one of said ends coaxially of the coiled fusible element, said cylinder extending into the sheath, a trip hammer located in said cylinder and connected in series electrically with said fusible element, and means activated by the fusing of the fusible element adapted to displace the trip hammer with

a force sufficient to cause it mechanically to open an electric switch.

18. A cartridge fuse, comprising a refractory insulating sheath, an helically coiled fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a cylinder located at one of said ends coaxially of the coiled fusible element, said cylinder extending into the sheath, an explosive powder in the cylinder traversed by the fusible element, and a trip hammer in the cylinder, ignition of the powder as a result of the element fusing effecting displacement of the trip hammer with a force sufficient to cause it mechanically to open an electric switch.

19. In a cartridge fuse according to claim 9, wherein the trip hammer is provided with a permanently accessible part, and wherein there is provided insulating rings near the ends of the cartridge, said rings having longitudinal openings in them at different distances from their centers, the openings in one ring corresponding with those in the other and said rings surrounding the axis of the coiled fusible element and being parallel with the ends of the cartridge, terminal rings adjacent to said insulating rings, said terminal rings surrounding the axis of the coiled fusible element, and main service elements, said main service elements being electrically parallel with each other and with said coiled fusible element and stretching from openings in one insulating ring to corresponding openings in the other ring and connected at their ends to said terminal rings, whereby said main service elements are of different length owing to the position of the holes in the insulating rings with relation to the terminal rings, and therefore said elements of different length dissipate in steps when the fuse effects an electrical interruption.

20. In a cartridge fuse according to claim 9, wherein the trip hammer is provided with a permanently accessible part, and wherein there is provided insulating rings near the ends of the cartridge, said rings having longitudinal openings in them at different distances from their centers, the openings in one ring corresponding with those in the other and the sides of said openings having notches in them and said rings surrounding the axis of the coiled fusible element and being parallel with the ends of the cartridge, terminal rings adjacent to said insulating rings, said terminal rings surrounding the axis of the coiled fusible element, and main service elements, said main service elements being electrically parallel with each other and with said coiled fusible element and stretching from openings in one insulating ring to corresponding openings in the other insulating ring and lying in said notches and connected at their ends to said terminal rings, whereby said main service elements are of different length owing to the position of the holes in the insulating rings with relation to the terminal rings, and therefore said elements of different length dissipate in steps when the fuse effects an electrical interruption.

21. A cartridge fuse, comprising a refractory insulating sheath, a main service fusible element in said sheath and a main interruption element in said sheath, an arc-extinguishing powder filling in said sheath, said main service and main interruption elements being embedded in said powder filling, an explosive container in said sheath, an explosive in said container, said main interruption element entering said container to make igniting relationship with said explosive upon cut-out operation of the fuse, and a trip hammer mounted on said fuse, said trip hammer being located between said explosive and atmosphere and said explosive being present in sufficient quantity to ensure that when the main interruption element ignites it the trip hammer is displaced with a force sufficient to enable it mechanically to open an electric switch, and a locking device to hold said hammer against return movement after it has been displaced by the explosive charge.

22. A construction as defined in claim 21, wherein the trip hammer is provided with a permanently accessible part.

23. A cartridge fuse, comprising a refractory insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, said hammer having a part which is permanently exposed to permit of easy access to it even when the fuse is not blown and is in service condition and said hammer and said fusible element being in series electrically and being mechanically continuous with each other, means adapted to hold said trip hammer against rotation with respect to said cartridge fuse, and means activated by the fusing of the fusible element adapted to displace the trip hammer forcibly.

24. A cartridge fuse, comprising a refractory insulating sheath, a fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a trip hammer mounted on said fuse, said hammer having a part which is permanently exposed to permit of easy access to it even when the fuse is not blown and is in service condition and said hammer and said fusible element being in series electrically and being mechanically continuous with each other, means adapted to hold said trip hammer against rotation with respect to said cartridge fuse, means activated by the fusing of the fusible element adapted to displace the trip hammer forcibly, and a locking device adapted to hold said hammer against return movement after it has been so displaced.

25. A cartridge fuse, comprising a refractory insulating sheath, an helically coiled fusible element in said sheath, an arc-extinguishing powder filling in said sheath, hermetic closures at the ends of the sheath, a cylinder located at one of said ends coaxially of the coiled fusible element, said cylinder extending into the sheath, an explosive powder in the cylinder traversed by the fusible element, a trip hammer in the cylinder, said trip hammer having a part which is permanently exposed to permit of easy access to it even when the fuse is not blown and is in service condition and said fusible element and said trip hammer being in series electrically and being mechanically continuous, ignition of the powder as a result of the element fusing effecting forcible displacement of the trip hammer, and means preventing rotation of said trip hammer with respect to said fusible element.

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