Sept. 2, 1924. 1,507,053

C. B. FLORY ET AL

METHOD AND APPARATUS FOR EXTINGUISHING GENERATOR FIRES

Filed Oct. 5, 1921 3 Sheets-Sheet 1

Fig. 1.

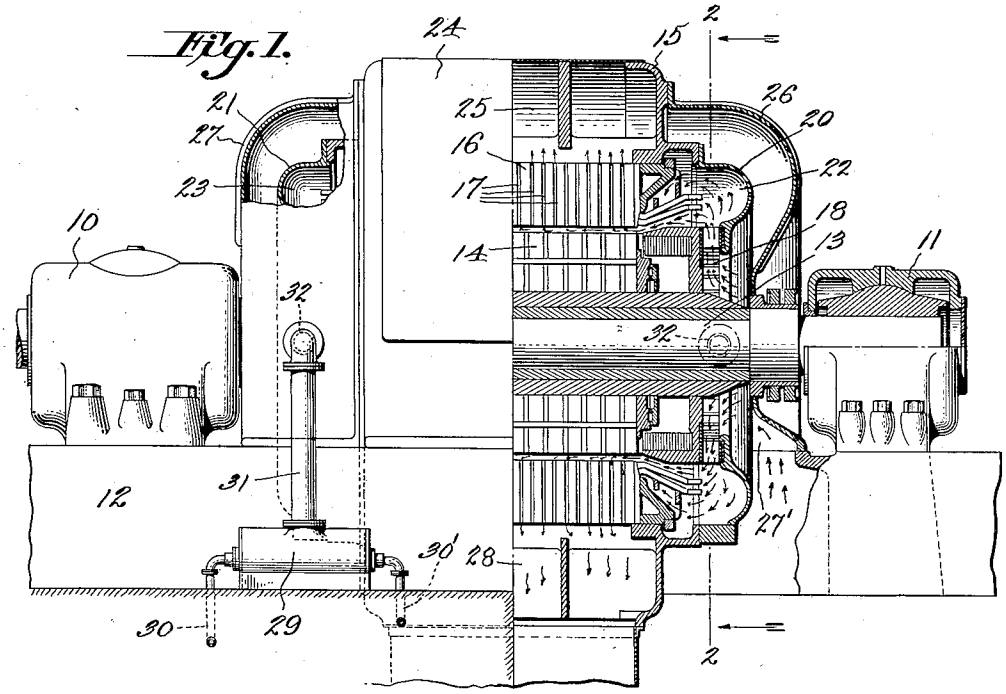
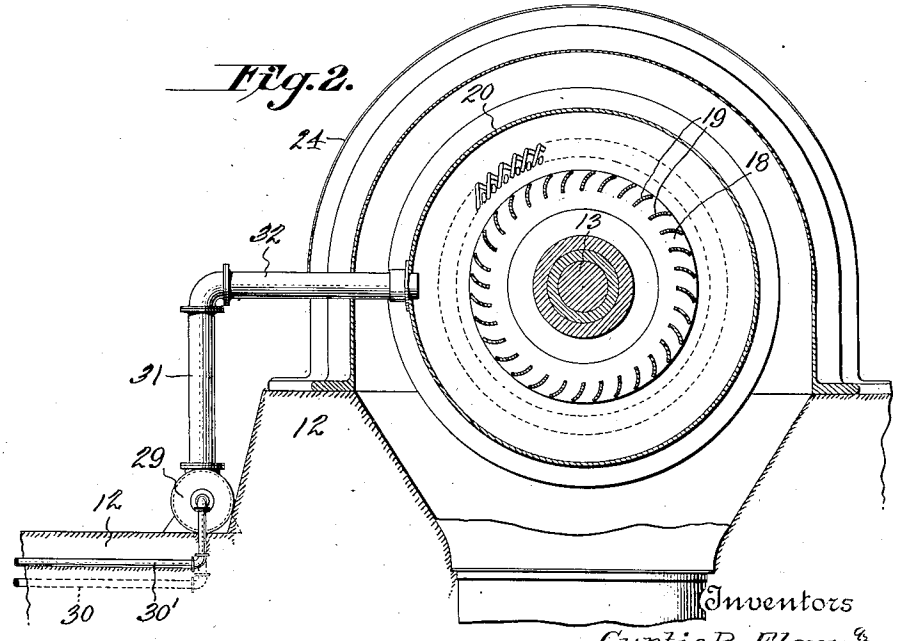


Fig. 2.



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Fig. 3.

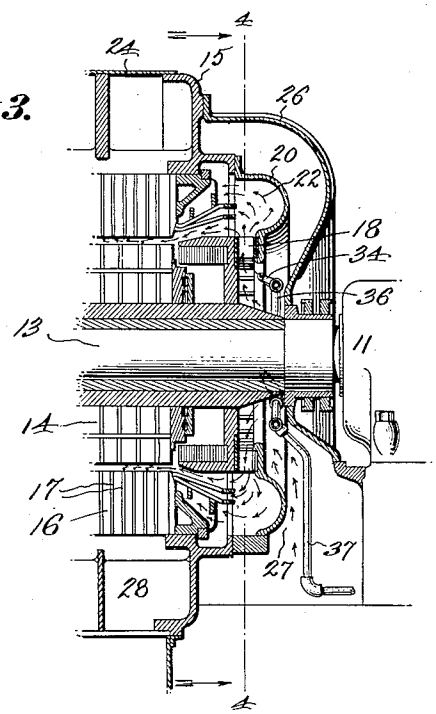
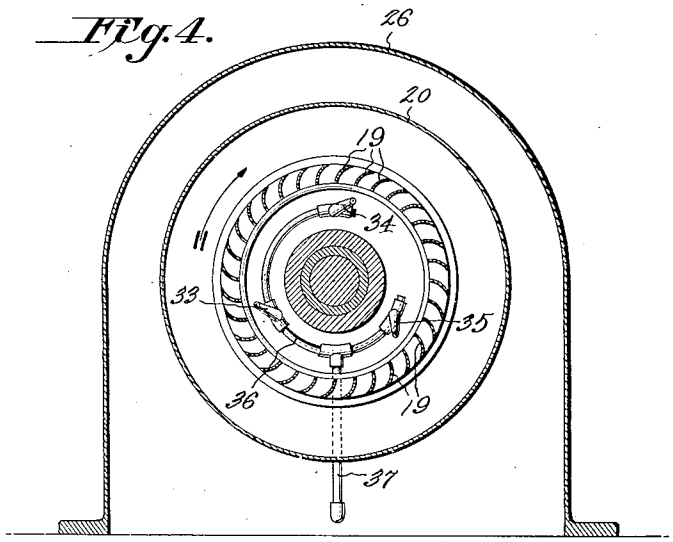


Fig. 4.



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Fig. 5.

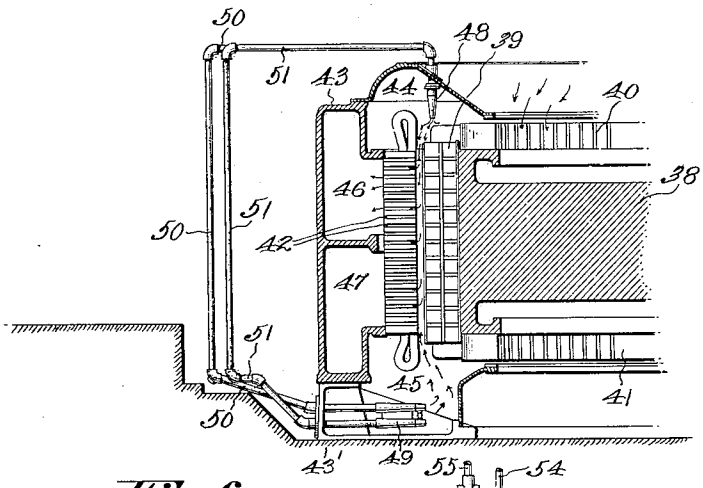
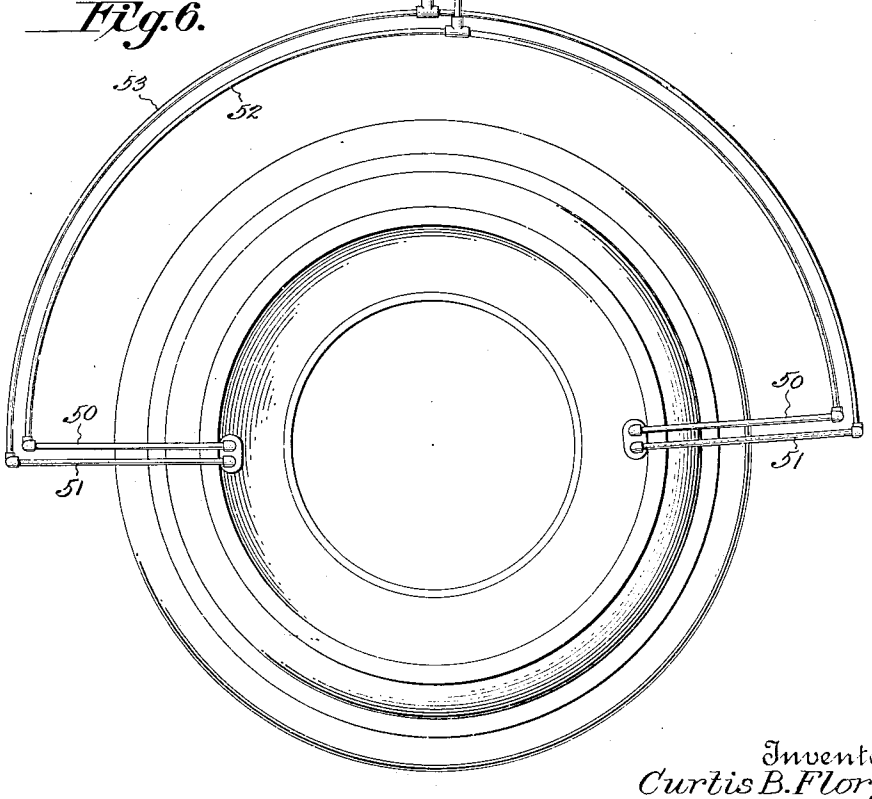


Fig. 6.



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Patented Sept. 2, 1924. 1,507,053

UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR EXTINGUISHING GENERATOR FIRES.

Application filed October 5, 1921. Serial No. 505,587.

To all whom it may concern:

Be it known that we, CURTIS B. FLORY and FRANK A. EPPS, citizens of the United States, and residents, respectively, of Forest Hills and New York city, in the counties of Queens and New York, respectively, and State of New York, have invented certain new and useful Improvements in Methods and Apparatus for Extinguishing Generator Fires, of which the following is a specification.

This invention relates to a fire extinguishing method and apparatus and more particularly to a method and apparatus for extinguishing fires occurring in electric generators and has special reference to the provision of a fire extinguishing apparatus in which a foam compound produced by the comixture of chemical component solutions may be introduced or injected into the generator and carried through the windings thereof for quickly smothering the fires therein.

The occurrence of fires in electric generators of, for example, the turbo-generator type (now being extensively used in hydro-electric plants) has been attended with serious losses resulting, for example, from destruction of the generator windings and the enforced idleness of the plant due to the time consumed for making the necessary rewinding repairs. Fires in these generators have been known to be caused by such factors as heavy overloads, short circuits and line surges. The immense size of some of these generators coupled with the fact that many of these generators are semi-enclosed or completely enclosed by housings, removal of which is difficult and time consuming and therefore out of the question in time of fire when it is essential to immediately protect the windings from destruction, has made the fighting of generator fires a problem difficult to cope with. In order to quickly protect the windings it is paramount to rapidly obtain a fire extinguishing agent and to introduce the same into all the interior and normally inaccessible parts of the generator, it being required not only to save the windings and insulation from destruction by fire, but to save them against the chemical and physical attack by the fire extinguishing agent itself, so that the generator may be capable of being put back into service without undue loss of time.

Extinguishing of fires in these generators has further been attended with the difficulties resulting from the utilization of air drafts or currents forced into the generator in the normal operation of the same for air cooling purposes. These generators running at great speeds and heated to dangerous temperatures are usually equipped with a fan or blower mounted on the shaft of the rotor thereof, the fan or blower causing a volume of air which may amount to thousands of cubic feet per minute to flow at high velocities through the generator and its windings. In time of fire, the fire in the generator shows a great tendency to spread rapidly through the generator windings, the fire being carried and fanned by the air inducted into and forced through the generator windings. In some generators, in order to shut off the air supply, inlet and outlet dampers which are closed in time of fire have been provided, but these dampers are attended with leakage troubles, it being furthermore necessary to give these dampers constant care and attention in the maintenance of the same in order to keep the dampers in proper operating condition.

In prior methods and apparatus for extinguishing fires occurring in these types of generators it has been practically impossible to fulfill the desired ends of rapidly reaching all parts of the generator, efficiently extinguishing the fires therein, protecting the windings and insulation from the quick spread of the fire fanned by the high velocity air currents and protecting the same against the destroying influence of the fire extinguishing agent so that the generator may be in condition for service soon after the fire has been extinguished and our present invention comprehends the provision of a method and apparatus in which these sought for ends are obtained in a practical and successful manner.

The principal objects of our invention may therefore be said to include, besides the provision of a method and apparatus for extinguishing generator fires in which a fire extinguishing agent may be rapidly produced and introduced into the generator for quickly smothering the fires therein, the pro-

vision of a method and apparatus of the nature referred to in which chemical component solutions are intermixed to produce a fire extinguishing foam which is introduced into the generator and forced through the windings for covering same with an extinguishing and protecting blanket of foam; the further provision of a fire extinguishing method and apparatus in which the insulation and windings are free from physical and chemical attack by the fire extinguishing agent, the generator being capable of immediate service in most instances after the fire has been extinguished; the provision of such a method and apparatus in which the air currents inducted into and forced through the generator are utilized in carrying the foam bubbles to all inaccessible parts of the generator and in which the filling up of the air ducts by the foam bubbles acts as an automatic damper means and the general provision of a method and apparatus of the nature referred to which is simple of construction and which is capable of rapid and facile operation.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, our invention consists in the elements and their relation one to the other, as hereinafter particularly described and sought to be defined in the claims, reference being had to the accompanying drawings which show preferred embodiments of our invention, and in which:

Figure 1 is an elevational view of a generator with parts shown in section and disclosing one form of our invention applied thereto,

Figure 2 is a cross sectional view taken on the line 2—2, Figure 1,

Figure 3 is a cross sectional elevational view of the generator showing a second form of our invention applied thereto,

Figure 4 is a cross sectional view taken on the line 4—4, Figure 3,

Figure 5 is an elevational view of a different form of generator shown in cross section with a third form of our invention applied thereto, and

Figure 6 is a plan view of the same.

Referring to Figures 1 and 2 of the drawings, we show one form of generator to which our invention may be applied, the said generator being of the horizontal shaft type. Mounted in the opposed journal boxes 10 and 11 located on a suitable foundation such as 12 is the horizontal shaft 13 of the generator. Fixedly mounted on the shaft 13 is the generator rotor comprising a series of windings shown diagrammatically and designated generally as 14. Surrounding the stator windings 14 is a fixed frame 15 suitably anchored to the foundation 12 and to the said frame 15 is fixed the stator 16, the stator comprising the usual coils or windings. The stator windings are so constructed as to provide a plurality of air ducts 17 for a purpose that will appear hereinafter. Mounted on the rotor shaft 13 and at opposite ends of the stator windings 14 are provided blower means for causing a draft or flow of cooling air to move into the generator and circulate through the parts thereof, the said blower means being generally designated as 18 and comprising a series of spaced fan blades 19 clearly shown in Figure 2 of the drawings. Enclosing the rotor and stator windings at opposite ends thereof are provided the inner bells 20 and 21, the said bells being spaced from the stator and rotor and defining inner chambers 22 and 23. Enclosing the rotor and stator of the generator and running longitudinally of the same is provided the housing 24 suitably connected to the foundation 12, the said housing defining an annular space or chamber 25 between the housing and the stator coils 16. In the generators of the type in which the parts are completely enclosed there is further provided an outer bell structure comprising the bell portions 26 and 27 arranged on opposite ends of the generator, the said outer bells, in conjunction with the cylindrical housing 24, completely enclosing the stator and rotor of the generator. In this type of generator the space between an inner bell 20 and an outer bell 26 forms an open ended compartment 27', the bottom or open end of this compartment defining an air inlet used for ventilating purposes, as will appear presently. The chamber 25 provided by the housing 24 is also open ended at the bottom of the generator as at 28, the said open end 28 defining an outlet for the ventilating air. In the normal operation of this generator a supply of cooling air is inducted into the chambers 22 and 23 by means of the blower 18, the air currents having entry through the inlet 27', the inducted air being forced by blower action into the generator and through the ducts 17 provided in the generator windings, the air moving into the annular space or chamber 25 and having exit at the air outlet 28, the said air effecting a cooling of the generator to prevent the same from rising to dangerous temperatures in the normal operation thereof.

For the purpose of rapidly producing a fire extinguishing compound or agent and for quickly introducing the same into all parts of the generator, our invention contemplates the production of a foam compound and the introduction of the same into the generator and more particularly into the paths of the air currents in the generator to permit the air currents to carry the foam bubbles into all the interior and normally inaccessible parts of the generator. To

accomplish these ends we provide a foam producing unit associated and combined with the generator, one form of our foam producing unit being shown in Figures 1 and 2 under consideration. In this form of our invention we provide preferably a plurality of spaced mixing chambers 29 suitably supported on the foundation 12, a plurality of solution lines 30 and 30' being connected in opposed relation to each of the mixing chambers 29, the solution lines being adapted for independently conducting to the chambers 29 the acid and basic chemical component solutions which may have a composition as disclosed, for example, in the patent to Walker, No. 1,259,813, dated March 19, 1918. Connected to the mixing chambers 29 preferably to the central portions thereof and rising therefrom are the foam conducting lines 31, the said lines being connected to horizontal piping 32, the latter being, in turn, connected for open communication to the chambers 22 and 23 provided by the inner bells 20 and 21 respectively, the connection to the chamber 22 being fully shown in Figure 2 of the drawings. In time of fire the chemical component solutions are conducted, preferably under pressure, through the lines 30 and 30' and into opposing intermixing relationship in the mixing chamber 29, resulting in the production of a foam compound which quickly rises in the foam lines 31 and moves through the foam piping 32 and into the chambers 22 and 23 of the generator, the air forced by the blower means 18 through these chambers being effective for carrying the foam bubbles in all the directions of the air paths as indicated by the arrows, the bubbles being carried consequently through the generator windings, through the ducts 17 and out to the annular chamber 25. The foam compound is rapidly produced by means of the foam generating unit, the foam bubbles being quickly conducted and distributed to the fire exposed regions. The foam bubbles being of low specific gravity are easily picked up by the air currents and rapidly carried thereby to all the interior parts of the generator. The bubbles moving through the generator windings cover the latter with a blanket of fire extinguishing foam resulting not only in extinguishing the fire therein, but in protecting the same against a reflash. The filling of the generator and the plurality of air ducts therein with the fire extinguishing foam compound acts automatically as a damper against the further inrush or inflow of air, the air pressure being insufficient to remove the tenacious foam bubbles which attach themselves to all the interior surfaces or walls over which they move. The foam compound used does not attack the windings or insulation either physically or chemically, damage to these parts being thus obviated. After the fire has been extinguished and the generator allowed to cool, the foam bubbles when dried may be blown out by currents of air, the generator being then in condition for use.

Referring to Figures 3 and 4 of the drawings, where similar reference characters denote similar parts, we provide a modified form of foam distributing means, the said distributing means comprising a plurality of foam nozzles 33, 34 and 35 spacedly arranged circumferentially of the rotor shaft 13 and in advance of the blower provisions 18, the said foam nozzles being connected preferably to a substantially semi-circular pipe section 36, the said pipe section being connected to a main foam conducting line 37. The foam nozzles 33 to 35 are arranged as shown, for example, in Figure 4 of the drawings, to the end that the foam is ejected therefrom in the direction of rotation of the fan blades 19, as indicated by the arrow in Figure 4 of the drawings. With this construction the fan blades will pick up the bubbles ejected with a considerable velocity from the nozzles without causing foam breakdown, the foam being inducted by the fan blades and forced into the chamber such as 22 with the foam issuing from the fan blades in a circular or annular stream, this effecting a quick distribution of the foam into all parts of the generator.

In Figures 5 and 6 is illustrated a third form of our invention as applied to a vertical shaft generator. In this generator the rotor 38 is mounted for rotation about a vertical axis, the said rotor being provided with the rotor windings 39 and with the oppositely mounted fan provisions 40 and 41. The stator windings 42 are stationarily mounted on the frame 43 supported on the foundation 43' in a manner similar to the generators shown in Figures 1 to 4 of the drawings. The air paths in this type of generator may be traced from the blower provisions 40 or 41 into the annular chambers 44 and 45, through the stator windings 42 and into the outer annular chambers 46 and 47. Mounted spacedly in the chambers 44 and 45 we provide a plurality of mixing chambers, preferably of the type shown in the patent to Meigs and Epps, No. 1,261,422 of April 2, 1918, the said mixing chambers being generally designated in Figure 5 as 48 and 49. Connected to these mixing chambers are a plurality of solution lines 50 and 51, the said solution lines independently conducting the chemical component solutions for intermixture in the mixing chambers 49, the foam being produced in this form of our invention in the annular chambers 44 and 45 of the generator. The mixing chambers 48 and 49 are spacedly arranged horizontally and vertically of the generator,

the former arrangement being shown in Figure 6 and the latter in Figure 5 of the drawings. For conducting the solutions to all the lines 50 and 51 we may provide the semi-circular arranged conduits 52 and 53 connected respectively to the lines 50 and 51, the said conduits being in turn connected to main supply lines 54 and 55.

The operation of our novel fire extinguishing apparatus will, in the main, be apparent from the above description thereof. Upon the occurrence of a fire a fire extinguishing foam is generated in the different forms of our invention and the foam is introduced either directly into the air chambers of the generator as shown in Figures 1, 2, 5 and 6, or introduced in advance of the fan blades as shown in Figures 3 and 4 of the drawings, the foam being introduced in all forms of our invention in the paths of the air currents, the latter being effective for carrying the foam into all the interior parts of the generator for quickly smothering the fire therein.

From the above it will be apparent that we have provided a fire extinguishing method and apparatus for extinguishing fires occurring in generators in which the generators may be substantially protected against fires occurring therein and causing burn-outs of the generator coils, damaging or destroying the insulation thereof, such fires having hitherto necessitated replacement of coils and at times total rewinding thereof, the generator unit having hitherto been incapable of service for weeks or months after the occurrence of a fire. It will be further apparent that with our method and apparatus fires may be quickly smothered at low cost with the use of a small quantity of fire extinguishing medium, the fire extinguishing medium being quickly carried to all interior portions of the generator for extinguishing and protecting purposes, the fire extinguishing medium used subjecting the generator to a minimum of damage, the generator being capable of efficient service soon after the fire has been extinguished.

While we have shown our device in the preferred form, it will be obvious that many changes and modifications may be made in the structure disclosed without departing from the spirit of the invention, defined in the following claims.

We claim:

1. The method of extinguishing fires in electric generators of the type in which a draft or current of air is forced through the generator and through the windings thereof in the normal operation of the same which consists in introducing a fire extinguishing foam compound into the generator in time of fire and introducing the said foam compound into the path of the air current, whereby the foam is carried by the air current through the generator and the windings for extinguishing the fire therein.

2. The method of extinguishing fires in electric generators of the type in which a draft or current of air is forced through the generator and through the windings thereof in the normal operation of the same which consists in conducting component chemical solutions into intermixing relationship in time of fire for the production of a foam compound and in introducing the foam compound into the generator and into the path of the air current, whereby the foam is carried by the air current through the generator and the windings for extinguishing the fire therein.

3. The method of extinguishing fires in electric generators of the type in which the rotor and stator windings are enclosed by a housing and in which a draft or current of air is forced into the chamber defined by the housing and caused to flow through the generator windings, which consists in introducing a fire extinguishing foam compound into the said chamber for filling the same whereby the foam will be carried by the air current in the chamber through the generator windings for extinguishing the fire therein.

4. The method of extinguishing fires in electric generators of the type in which the rotor and stator windings are enclosed by a housing and in which a draft or current of air is forced into the chamber defined by the housing and caused to flow through the generator windings, which consists in conducting chemical component solutions into intermixing relationship in time of fire for the production of a foam compound and in introducing the foam compound into the said chamber for filling the same, whereby the foam will be carried by the air current in the chamber through the generator windings for extinguishing the fire therein.

5. A fire extinguishing apparatus, in combination with an electric generator having a rotor and stator and having a blower or fan mounted on the rotor for forcing a current of air through the generator and its windings, means for introducing a fire extinguishing foam compound into the generator in time of fire, the said means comprising elements associated with the blower or fan to permit the air current produced by the latter to carry the foam through the generator and its windings.

6. A fire extinguishing apparatus, in combination with an electric generator having a rotor and stator and having a blower or fan mounted on the rotor for forcing a current of air through the generator and its windings, provisions for conducting chemical component solutions into intermixing relationship in time of fire to produce a fire extinguishing foam compound and means for

introducing the said foam compound into the generator, the said means comprising elements associated with the blower or fan to permit the air current produced by the latter to carry the foam through the generator and its windings.

7. A fire extinguishing apparatus, in combination with an electric generator having a rotor and stator and a housing or bell enclosing the same and defining a chamber, the rotor being provided with a blower or fan for producing an air current in the chamber, the air current moving through the generator windings and means for introducing a fire extinguishing foam compound into the said chamber in time of fire, the said means comprising elements associated with the blower or fan to permit the air current produced by the latter to carry the foam through the generator and its windings.

8. A fire extinguishing apparatus, in combination with an electric generator having a rotor and stator and a housing or bell enclosing the same and defining a chamber, the rotor being provided with a blower or fan for producing an air current in the chamber, the air current moving through the generator windings and means for introducing a fire extinguishing foam compound into the said chamber in time of fire, the said means comprising a plurality of nozzles arranged about and in advance of the fan or blower with the nozzles turned in the direction of fan rotation.

9. A fire extinguishing apparatus, in combination with an electric generator having a rotor and stator and a housing or bell enclosing the same and defining a chamber, the rotor being provided with a blower or fan for producing an air current in the chamber, the air current moving through the generator windings and means for introducing a fire extinguishing foam compound into the said chamber in time of fire, the said means comprising a mixing chamber, a plurality of solution lines connected to the mixing chamber and a foam line connecting the mixing chamber with the said chamber defined by the generator bell or housing.

10. A fire extinguishing apparatus, in combination with an electric generator having a rotor and stator and a housing or bell enclosing the same and defining a chamber, the rotor being provided with a blower or fan for producing an air current in the chamber, the air current moving through the generator windings and means for introducing a fire extinguishing foam compound into the said chamber in time of fire, the said means comprising spaced mixing chambers located in the chamber defined by the enclosing bell and a plurality of solution lines connected to said mixing chambers.

Signed at New York in the county of New York and State of New York, this 4th day of October, A. D. 1921.

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