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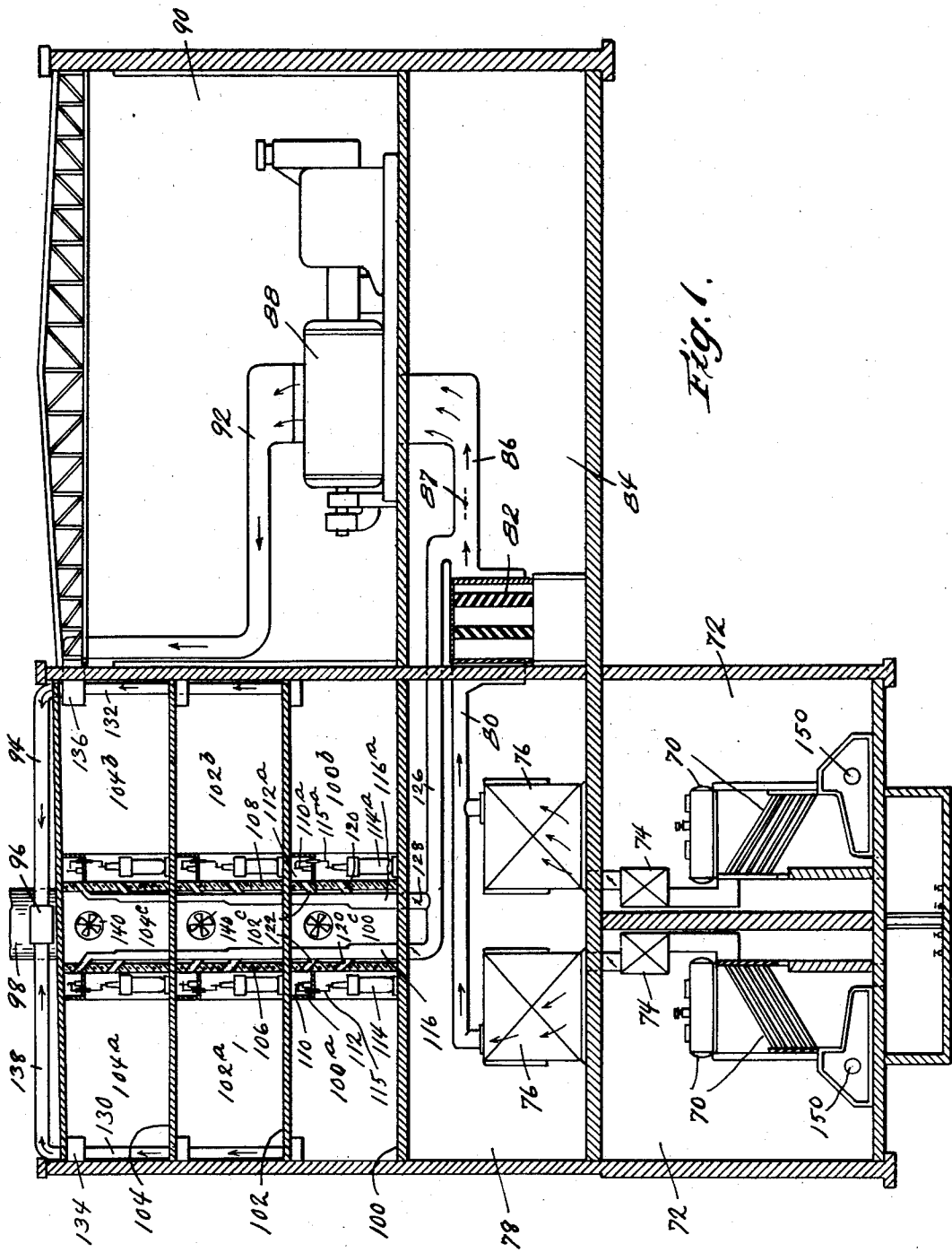
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ELECTRICAL GENERATING AND DISTRIBUTION SYSTEM AND APPARATUS THEREFOR

Filed Aug. 12, 1926

2 Sheets-Sheet 1



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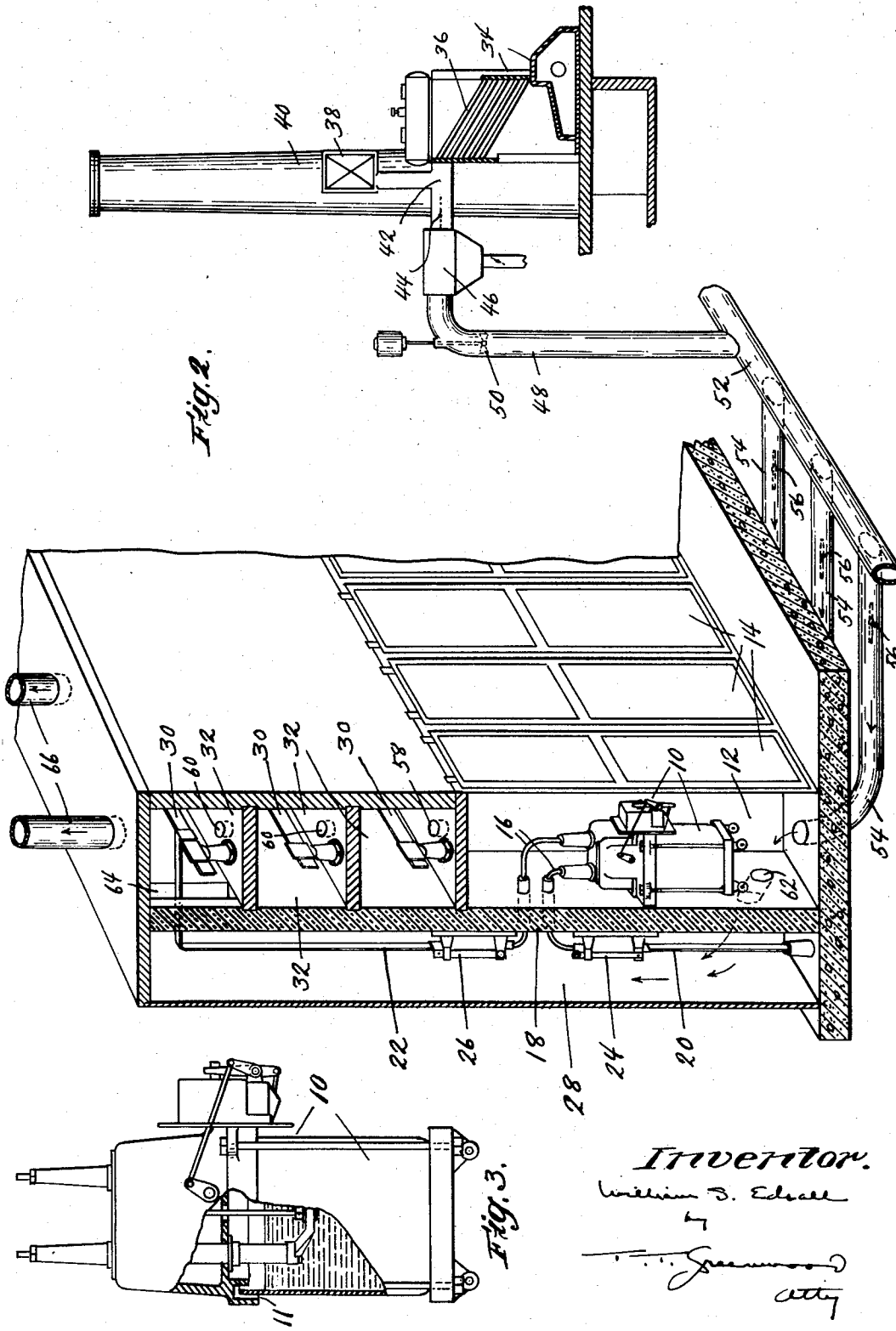
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UNITED STATES PATENT OFFICE

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ELECTRICAL GENERATING AND DISTRIBUTION SYSTEM AND APPARATUS THEREFOR

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21 Claims. (Cl. 175—298)

This invention relates to electrical generating and distributing systems and apparatus and to houses containing the apparatus.

The fire hazard in houses containing electric generating, transforming and switching apparatus and handling large amounts of power is very great. Fire frequently develops in electric generators due to overloads or flash overs. Transformers and electric switches are immersed in oil for the purpose of providing superior insulation, and in the case of the circuit breakers to facilitate the quenching of the circuit interrupting arc. Under certain cases, the break down of insulation in a transformer or the opening of a circuit breaker under a heavy overload subjects the enclosing casings of the apparatus to high or explosion pressures and hot or burning oil may be thrown out of the casings and onto the adjacent apparatus or structures. Current conductors sometimes flash over due to potential surges on them and the flash-over arc may start a conflagration. Various means have been proposed to minimize the fire hazard and to maintain as far as possible the continuity of service. To this end, the transformers and switches are placed in separate and isolated compartments. The current carrying conductors are also mechanically isolated from each other and from associated apparatus. The generators are cooled by artificially produced blasts of air to keep down the temperature thereof. Regardless of these precautions, much damage has been done by generator fires and fires produced by the expulsion of burning oil and vapors from transformers and switch casings. In some instances, the hot gases have been sufficiently conducting to cause the flash over of remotely disposed circuit conductors with which it came in contact, thereby disabling the entire system.

It is an object of this invention to provide an electric generating and distributing system wherein the essential apparatus of the system is immersed in a medium which excludes air from the apparatus and which ordinarily is incapable of supporting combustion within it, whereby to prevent the possibility of disastrous fires.

A further object is to maintain the apparatus constantly immersed in an inert atmosphere, which atmosphere, preferably, is continually renewed and serves to withdraw from the vicinity of the apparatus any ordinarily combustible gases and vapors and which also assists in the cooling of the apparatus and improves the electrical insulation of the apparatus.

It has been proposed heretofore to maintain

an inert atmosphere within the casings of certain oil-immersed electrical apparatus as in the casings of oil immersed transformers and switches, usually by providing gas tight casings and connecting the casings with a source of gas stored under pressure. Regardless of the difficulties inherent in maintaining a pressure tight casing that will not have an excessive loss of gases therefrom and regardless of the expense of constantly renewing the charges of inert gas in the gas containers and the danger of loss of gas supply unknowingly, the arrangement is a step in the right direction, but does not provide complete protection from fire hazard. While the maintenance of an inert gas above the oil in an oil immersed apparatus serves to prevent explosions within the casing, it can not prevent a fire outside of the casing. When an electric switch, for instance, interrupts its circuit under heavy load, and oil is thrown from the casing into the chamber containing it, the oil may not be burning when expelled from the switch by reason of the presence of inert gases within the casing, yet the gas may be at a very high temperature due to the heat of the circuit-interrupting arc. When the hot oil and especially the hot vapors expelled from the switch casing come in contact with the air around the casing, the hot oil and vapors may burst into flame immediately and the flame may do great damage.

It is an object of this invention to provide an inert atmosphere surrounding the casings of apparatus so that any oil or oil vapors expelled therefrom are received in the inert atmosphere and so can not burn; and it is a further object to maintain the hot oil vapors and hot oil in the inert atmosphere at least until they have cooled below their ignition point in air.

It is a further object of the invention to maintain an oil immersed electrical apparatus in a compartment containing an inert gas, and to vent the casing of the electrical apparatus into the compartment whereby not only to surround the casing with the inert gas but to provide for the occupation of the casing with inert gas.

As has been previously set forth, one of the great difficulties experienced is the provision of a supply of relatively inexpensive inert gas. Every coal burning electric power generating system is also a generator of abundant volumes of inert gas in that the products of combustion of fuel in the boiler furnace are inert gases, consisting mainly of nitrogen and carbon dioxide with so little amounts of free oxygen and carbon monoxide as to be negligible; and it is an object of

this invention to utilize the waste products of combustion which are ultimately discharged into the atmosphere, as the supply of inert gas to satisfy the requirements of this invention. The

5 supply of waste products of combustion is ample for the requirements of this invention and the supply is continuous for so long as power is being generated and therefore for so long as protection is needed for the essential apparatus of the system. In those systems and apparatus where-
10 in the waste products of combustion resulting from the generation of steam for power purposes is not available, I propose as a further object of the invention to generate my supply of
15 inert gas by an especially provided fuel burning furnace and I may or may not, as the case may be, utilize the heat resulting from the burning of fuel for any particular purpose.

As has previously been stated, dynamo electric machines, as generators, are artificially cooled by circulating air through the generator casings. It is a further object of this invention to circulate a cool inert gaseous fluid through the generator casing and to utilize the inert
20 gas to cool the generator in addition to its function in preventing disastrous fires within the casings since combustion can not be maintained in the inert gas. It is also an object of this invention to circulate the inert gases formed
25 by the combustion of fuel through the casings of electric generators. The specific heat of the products of combustion is somewhat greater than the specific heat of air and consequently the cooling effect of the products of combustion on the electrical apparatus is somewhat greater than
30 that of the air.

The spacing between the exposed high-tension electric conductors of the system, and between the conductors and ground depends upon the potentials of the conductors and the dielectric strength of air. For high potential conductors the spacing or distances between the conductors and adjacent objects must be relatively great and, consequently, the house enclosing the conductors and associated apparatus must have substantial
35 dimensions and be correspondingly expensive in construction.

It is an object of this invention to increase the factor of safety of the insulation of high tension conductors in control houses and to reduce the dimensions and consequently expense of construction of such houses by maintaining the high tension conductors in a gaseous fluid having a substantially higher dielectric strength than air and, specifically, in a gaseous fluid composed
40 mainly of combustion gas, which has a high dielectric strength and is inert so that danger from fires is minimized. Combustion gas is composed mainly of nitrogen and carbon dioxide and has a dielectric strength which is about sixteen percent greater than air, both being at atmospheric pressure. By the use of combustion gas the factor of safety of the gaseous insulation of the conductors is increased by this material
45 extent, thereby reducing very materially the possibility of flash over due to potential surges on the conductors, or reducing by this amount the spacing between the conductors and grounded objects, as partition walls, thereby permitting a material reduction in the dimensions and consequently expense of construction of the houses enclosing the conductors.

By the provision of the circulation of the products of combustion from the furnaces of steam generating boilers through and about the

essential apparatus of an electric generating system, I am enabled to provide a unique design for the arrangement of the apparatus of the system and for the house containing the apparatus and this constitutes a yet further object of the invention. 80

A still further object of the invention is generally to improve the construction and arrangement of electric generating systems and apparatus and the houses containing them. 85

Fig. 1 is a transverse sectional elevation, diagrammatically illustrated, through a generating and distributing station provided for the performance of this invention.

Fig. 2 is a perspective diagrammatic detail
90 generally in section of a somewhat modified arrangement for conducting the inert gases formed of the waste products of combustion of fuel in the furnace of the steam boiler through the compartments containing translating apparatus and current conductors. 95

Fig. 3 is a sectional elevation through one of the switches illustrated in Figs. 1 and 2.

In Fig. 2 the invention is illustrated as associated with oil immersed electric switches and the station bus bars of a three phase generating and distributing system. The electric switches
100 one being here shown are of the oil immersed type wherein the movable and stationary contacts are immersed in oil contained in an enclosing casing. The switches are contained within enclosing cells 12, the front openings of which may be closed by doors 14. The doors may be of any suitable type and are adapted to make an approximately gas tight seal with the cell structure when closed so that large amounts of gas will not escape from or leak into the cell. It is not vital, however, to have these doors form an absolutely gas tight seal with the cell structure since the invention provides for such an abundant supply of inert gas that a small amount of leakage will not nullify the invention. The electric switches 10 may be of any suitable type, for instance as shown in Fig. 3, and may be adapted to vent into their enclosing cells through
105 vent passages 11 so that the atmosphere of the cell is also the atmosphere within the switch casing. The terminals of the switch are connected to conductors 16 which extend through openings in the rear wall 18 of the cell and connect with line conductors 20 and 22 through disconnecting switches 24 and 26, which conductors 20 and 22 and switches are disposed on the rear wall 18 of the enclosing cell and within a compartment 28 the walls of which may be more or less gas tight. The buses 30 of the distribution system are disposed in separate superimposed compartments 32 which are located above the switch cells, and the upper line conductors 20 are arranged for electrical connection with said buses in any usual manner. 115 120 125 130 135

In accordance with this invention, provision is made for filling or flooding the switch enclosing cells, and also the conductor and bus compartments and for circulating therethrough and maintaining therein an inert gaseous fluid as a gas which is not combustible with air or with the oil and oil vapors of the switch. In accordance with this invention the inert gas comprises the waste products of combustion formed in the furnace 34 of the steam generating boiler 36 which may supply steam to drive the electric generators, the circuits of which may be controlled by said switches 10. The waste products of combustion from the furnace may pass from the boiler head- 140 145 150

er 38 into the stack 40 under usual conditions. In accordance with this invention, waste products of combustion are taken from the header 38 through a pipe 42. Said pipe may be provided with a valve 44 therein to control the amount of waste products of combustion taken to maintain an inert atmosphere around the essential apparatus of the system. Preferably, the waste products of combustion are passed through a dust separating and gas cooling apparatus 46 from which the gases pass into the pipe 48 in a practically dust-free and cool state. A blower as the fan 50 may be located at any suitable place in the gas supply system as in the pipe 48 to move the waste products of combustion positively through the system. The pipe 48 communicates with a header 52 which may be extended in parallel relation with and disposed adjacent the row of switch cells. Individual ducts 54 are preferably extended from said header 52 and terminate in the bottoms of the individual switch cells whereby to deliver the cooled products of combustion into the cells. Said ducts 54 may each be provided with a valve 56 by which the supply of inert gases to each cell may be suitably regulated. The cells 12 may be in communication through the top openings 58 with the bottom of the lowermost bus compartment 32 and the bus compartments may be in gas communication with each other through similar openings 60 formed in their bottom walls. Inert gas may be caused to pass from the bottom of the switch cells through openings 62 in the rear wall thereof into the bottom of the conductor compartment 28. The upper portion of said wall 18 may be provided with openings 64 therein which communicate with the bus compartments 32 thereby providing for a flow of inert gas upwardly through said conductor compartment 28. The uppermost bus compartment may be in communication with outgoing ducts or stacks 66 which discharge the waste inert gases into the atmosphere. The particular manner in which the inert gases are caused to circulate through the various switch and conductor and bus compartment is herein of no particular consequence so long as the compartments are maintained filled with inert gas in sufficient quantities to render atmosphere therein permanently incapable of supporting combustion or at least for during such periods as the possibility of fires would otherwise be present. It is not essential that the various compartments be completely gas tight as the supply of inert gas is abundant. Preferably the inert atmosphere in the various compartments is at least at atmospheric pressure and preferably slightly thereabove whereby to prevent leakage of air into the compartments in quantities to dilute the inert atmosphere sufficiently to render it combustible. By reason of the inert atmosphere surrounding the electric switches and current carrying components of the system, the danger of a disastrous fire is practically eliminated. Since the oil immersed electric switches are surrounded by an inert atmosphere and breathe in the inert atmosphere explosions of the oil gases or vapors above the oil within the switch is prevented. While hot oil and oil vapors may be expelled from the switch under severe conditions of circuit interruption the hot oil and vapors cannot take fire as they issue from the switch since they are discharged into an inert atmosphere in which combustion can not be supported. Disastrous results of flash overs between the adjacent current carrying con-

ductors is minimized due to the superior insulation provided by the inert gases and also since there can be no flame to form hot gases that might bridge and thereby electrically connect current carrying conductors at different potentials.

The continual circulation of cool inert gases through the system serves to cool the apparatus of the system and thereby enables it to carry a greater load than is possible without provision for circulation of the atmosphere surrounding the apparatus. The circulation of the inert gases also serves to carry away the gases and vapors formed in the oil immersed apparatus during circuit interruption and to cool them below the ignition point before they are finally liberated into the atmosphere. The supply of inert gases is abundant and continuous for so long as the steam boilers are in operation and when the boilers are not in operation there is no need for a supply of inert gases since there is no electric energy to be controlled by the system. In the case of substations and other locations wherein steam boilers are not involved in the generation of electric energy, I propose to generate an abundant supply of waste products of combustion by burning fuel in a fuel burning furnace especially installed for the purpose and I may utilize the heat resulting from the burning of the fuel in any suitable or desirable manner.

By the utilization of the waste gaseous products of combustion of steam-operated electric-generating systems for the purpose of flooding the electrical apparatus of the system with inert gases, I am enabled to design a steam-operated electrical-generating and distributing system with specific regard to the circulation of the waste products of combustion about the electrical apparatus of the system and Fig. 1 illustrates a steam operated electrical generating and distribution station arranged in accordance with this invention. As illustrated in Fig. 1 steam boilers 70 may be arranged in parallel rows in the lowermost room 72 of the station and the waste products of combustion from the boilers are adapted to pass into headers 74 located in the upper part of the boiler rooms. Economizers or feed water heaters 76 are located in an economizer room 78 immediately above the boiler rooms and said heaters are connected to said headers through conduits 80. The hot furnace gases are adapted to heat the boiler feed water and the hot gases are thereby cooled to about the temperature of the feed water. The partially cooled gases are passed from the economizers into a horizontally disposed conduit 80 and thence into a gas cooler and washer 82 located in a washer room 84 at one side of and at the same elevation as the economizer room 78. Said washer 82 is adapted to remove objectionable amounts of solid particles, as dust, in the gases and to cool the gases in any suitable manner as by water sprays or screens so that the gases emerging from the washer are practically free from dust and are cold. The cold and dust free gases pass from the washer into a duct 86 which is in communication with the casing of the turbine-driven electric generator 88 disposed in the generator room 90 located immediately above the washer room 84. The cold and inert gases are adapted to flood the generator casing and thereby prevent the maintenance of any fires that may occur in the generator for any cause since the inert gases can not support combustion. The cold inert gases also provide adequate cooling means

for the generator. Inasmuch as the specific heat of the composite mixture of gases passing through the generator is somewhat greater than the specific heat of the circulating air ordinarily employed in cooling the generator, the generator can deliver a greater output than would be the case if air alone were circulated through the generator under the same conditions. The heated inert gases are conducted from the outlet of the generator casing into a conduit 92 which is extended to the upper part of the generator room 90 and is placed in communication with a conduit 94. Preferably each generator in the room is provided with separate inlet and outlet conduits. Said conduit 94 may be located above the roof of the generating station and may connect with a header 96 which header extends along the roof and is in communication with the stack 98. The inert gases are ultimately discharged from the upper end of said stack into the atmosphere.

The switching equipment is arranged for vertical isolated phase protection and is disposed on three vertical floors 100, 102, and 104 which are disposed one above the other above the economizer room 78 and at the side of the generator room 90. A double bus system is herein shown so that rooms 100a, 100b; 102a and 102b; 104a, and 104b are provided by the vertical walls 106 and 108, which walls are spaced apart in the middle of the floors to form compartments or galleries 100c, 102c, and 104c in which compartments the switch mechanisms are disposed and which are of sufficient size to permit free working room for attendants. Buses 110 and 110a, corresponding to one phase of the three phase system, are disposed in said compartments 100a and 100b respectively, in the upper portions thereof adjacent said walls 106 and 108 respectively and are located in enclosures 112 and 112a. Switches 114 and 114a are disposed in said compartment 100a and 100b respectively beneath said buses and are electrically connected therewith. Line conductors 115 and 115a are connected with the respective phase conductors and switches and are extended transversely along said walls 106 and 108. Similar buses, bus compartments and switches are disposed in the upper compartments 102a, and 102b; 104a, and 104b for the remaining phases of the three phase system. Said compartments 100a and 100b; 102a and 102b; 104a and 104b; may extend longitudinally of the station and each compartment may contain a plurality of switches which are connected with the common bus in said compartments. Each switch may be shielded from neighboring switches by walls 105, in the usual manner.

Said isolated phase compartments 100a and 100b, 102a and 102b, 104a and 104b, and the bus compartments 112 and 112a, are adapted to be flooded with the cold furnace gases. To this end, a plurality of conduits 116 and 116a are disposed in said mechanism compartments 100c, 102c, and 104c adjacent said walls 106 and 108 and are provided with ducts 120 which extend through said walls and into said phase compartments. Other ducts 122 communicate with said conduits and with the bus compartments 112 and 112a. Said bus compartments may be provided with apertures, not shown, by which the gases in said bus compartments are ultimately discharged into said phase compartments. Said conduits 116 and 116a are extended downwardly into the economizer room 78 and are in communication with a conduit 126 disposed therein.

Valves or dampers 128 are disposed in said conduits 116 and 116a whereby to regulate the flow of furnace gases therethrough. Said conduit 126 is extended into the washer room 84 and communicates with the conduit 86 therein between said washer 82 and the damper 87 which regulates the flow of furnace gases into the housing of the generator 98. A plurality of conduits 130 and 132 are extended vertically in said phase compartments 100a and 100b, 102a and 102b, 104a and 104b and are provided with inlet openings in the upper regions of said compartments whereby to provide for a circulation of the furnace gases entirely through said phase compartments. Said conduits 130 and 132 may be connected with headers 134 and 136 which extend longitudinally through the uppermost rooms 104a and 104b. Said headers are connected with ducts 138 and 94 which conduct the gases into the common header 96 and thence into the stack 98. As thus arranged, the phase rooms and the electrical equipment therein is completely flooded with inert gases and consequently combustion cannot be maintained in said rooms.

The switches in said rooms are in venting communication therewith and consequently are filled with inert gas so that the oil of the switches cannot burn in the switch casings and neither can the hot oil or vapor burn if it is expelled from the casings into the rooms. Consequently, the station appears to be entirely immune from danger of disastrous fires.

The mechanism compartments 100c and 102c and 104c are free from the inert gas and contain atmospheric air only. Ventilators 140 may be located in said mechanism rooms to maintain the rooms substantially clear of any furnace gases which may leak therein so that attendants may occupy the rooms without interference. If it is necessary for an attendant to enter one of the phase compartments, the flow of furnace gases therein may be stopped by closing one of the valves 128 and permitting the compartment to clear itself from the gases, either by the natural draft of the stack or by suitable ventilating means not shown. The system may be operated on the natural draft provided by the stack 98 or it may be operated on forced draft provided by the usual blowers which furnish air under pressure to conduits 150 connected with the boiler furnaces. Preferably the system is operated under forced draft so that the gases in the various parts of the station and apparatus is under a pressure somewhat greater than that of the atmosphere so that atmospheric air cannot leak in and dilute the inert gases to any deleterious extent. However, the supply of inert gases is so abundant that the amount of air that can leak in through the usual crevices of the station structure is so small in proportion to the amount of inert gases present that there is no danger of having an atmosphere present that will support combustion.

Since the apparatus of the separate phases of a multi-phase circuit are isolated from each other by bodies of inert gases, and since the inert gases have a dielectric strength that is materially greater than that of air, danger of trouble on one phase communicating to an adjacent phase is minimized and, as a consequence, the apparatus of the separate phases can be installed in close relation without danger, thereby permitting a material reduction in the size of the switch house; or the factor of safety of the insulation is materially increased.

I have not herein shown the invention applied specifically to transformers, reactors and other electrical apparatus as the application of the invention thereto will be the same as to the electric switches and generators herein illustrated so that any additional showing is considered unnecessary.

While the showing of Fig. 1 illustrates an isolated phase system and that of Fig. 2 illustrates a grouped phase system, the application of the broad principle of my invention is not restricted to any particular arrangement of the system and of the apparatus thereof.

I claim:

1. The combination of an electric switch having an oil-containing casing in which the separable switch members are contained, said casing having a vent passage therethrough, and means to normally maintain an inert gaseous atmosphere about said casing and the outlet of said vent passage.

2. The combination of an electric switch having an oil-containing casing in which the separable switch members are contained, said casing having a vent passage therethrough, and means to normally maintain an inert gaseous atmosphere of combustion gas about said casing and the outlet of said vent passage.

3. The combination of an electric switch having an oil-containing casing in which the separable switch members are contained, said casing having a vent passage therethrough, and means to normally maintain an inert circulatory gaseous atmosphere about said casing and the outlet of said vent passage.

4. The combination of an electrical apparatus having an oil-containing casing provided with a vent passage therethrough, and a compartment containing an inert gaseous atmosphere which is in communication with the outlet of said vent passage.

5. The combination of an electrical apparatus having an oil-containing casing provided with a vent passage therethrough, and means to normally maintain an inert gaseous atmosphere within said casing including means providing an inert atmosphere about said casing in communication with the interior thereof through said passage.

6. A control house having a room, an electrical apparatus contained therein, said apparatus having exposed electrical conductors and means to maintain a constant circulatory inert atmosphere having a dielectric strength greater than that of air in said room about said conductors to prevent flash-over therebetween.

7. In a control house, a plurality of compartments containing electrical apparatus, and means to maintain said compartments flooded with an inert atmosphere having a dielectric strength greater than that of air.

8. In a control house for electrical apparatus, an enclosing compartment, an electrical apparatus contained therein, and means to maintain in said compartment a combustion-gas under a pressure which is elevated above that of the atmosphere.

9. In a control house for electrical apparatus, an enclosing compartment, an electrical apparatus contained therein, and means to normally maintain in said compartment an inert gaseous atmosphere having a dielectric strength greater than that of air and under a pressure which excludes the entrance into the compartment of deleterious amounts of atmospheric air.

10. In a control house for electrical apparatus, a compartment having a wall, a bus located in the upper portion of said compartment adjacent said wall, an electric switch connected with and disposed beneath said bus adjacent said wall, and means to normally maintain an inert gaseous atmosphere having a dielectric strength greater than that of air within said compartment to surround said bus and switch.

11. The combination of a fuel burning furnace, a stack for the gaseous products of combustion of said furnace, a switch house having a room containing an electrical apparatus, and means to conduct gaseous products of combustion from said furnace into said room and out of said room into said stack.

12. The combination of a fuel burning furnace, a stack for the gaseous products of combustion of said furnace, a switch house having a plurality of compartments containing electrical apparatus, separate means to conduct gaseous products of combustion from said furnace into said compartments and out of said compartments into said stack, and means to regulate the flow of gas through each compartment.

13. In a switch house, an isolated switch room, and a gallery extended along side said room, said gallery having an atmosphere of air in it, and said switch room having an atmosphere of inert gas in it.

14. The method of preventing fires in the vicinity of oil-immersed electric apparatus which consists in circulating a cool inert gaseous fluid about the apparatus to receive hot combustible oil or oil vapors discharged from the apparatus, and discharging the gaseous fluid and the combustible oil or oil vapors into the atmosphere only after the oil or oil vapors has cooled below its ignition point with the atmosphere.

15. An electric generating plant comprising an electric generator, exposed conductors, an oil switch for controlling the circuit through said generator and conductors, means for generating gaseous combustion products necessary for the production of power to operate said generator, and means for circulating said combustion products to cool and insulate the generator, to insulate said conductors and to provide a non-combustion supporting atmosphere externally about said switch.

16. An electrical distribution system comprising conductors of substantial length, an oil switch connected thereto, means for generating gaseous combustion products, and means for circulating said gases externally about the oil switch to provide an inert non-combustion supporting atmosphere for preventing combustion of hot oil expelled from the switch and for circulating said gases about said conductors whereby to improve their insulation.

17. The combination of an electric switch having an oil-containing casing in which the separable switch members are contained and means to maintain an atmosphere of combustion-gas within and about said casing.

18. The method of preventing the combustion of hot oil and gases ejected from an oil switch casing which comprises circulating an inert gaseous atmosphere externally about said casing in the vicinity thereof whereby hot oil and gases ejected from said casing come in contact with said inert gaseous atmosphere.

19. In combination, a compartment, an oil switch comprising an oil filled casing within said compartment, and means to normally maintain

an inert gas within said compartment about said switch casing in the vicinity thereof whereby hot oil and gases ejected from said casing come in contact with said inert gaseous atmosphere.

- 5 20. The combination of an electric switch having an oil-containing casing in which the separable switch members are contained, said switch having exposed terminals on the exterior of said casing, and means to normally maintain an inert
10 gaseous atmosphere having a dielectric strength greater than that of air externally about said casing, so that any heated oil or oil vapor discharged from said casing into said atmosphere is pre-

vented from burning and causing a flash-over between said terminals.

21. The combination of an electric switch having an oil-containing casing in which the separable switch members are contained, said switch
80 having exposed terminals on the exterior of said casing, and means to normally maintain an inert circulatory gaseous atmosphere having a dielectric strength greater than that of air about said casing and said exposed terminals to prevent
85 flash-over therebetween.

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