Feb. 12, 1924. 1,483,839

G. A. BURNHAM

ELECTRIC SWITCH

Filed May 29, 1919 3 Sheets-Sheet 1

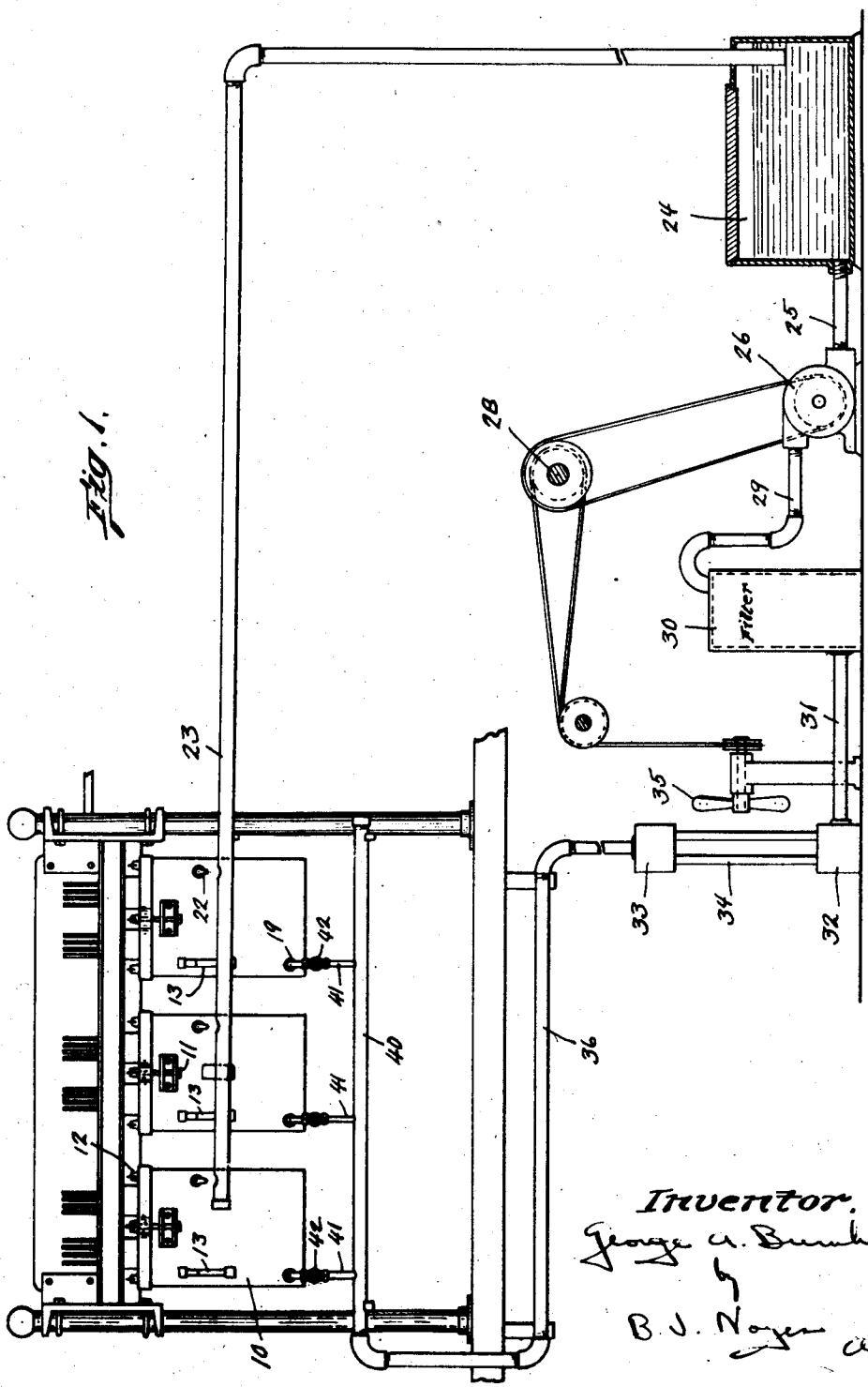


Fig. 1.

Inventor.
George A. Burnham
B. J. Noyes Atty

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G. A. BURNHAM

ELECTRIC SWITCH

Filed May 29, 1919 3 Sheets-Sheet 2

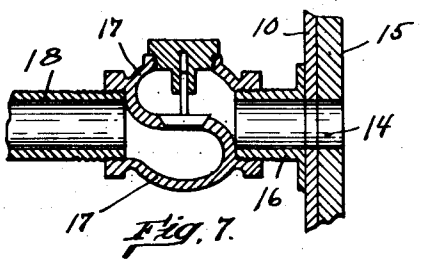


Fig. 7.

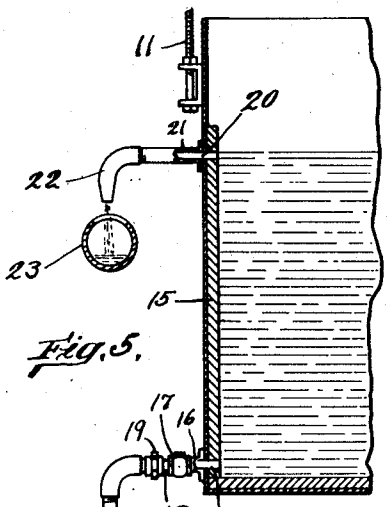


Fig. 5.

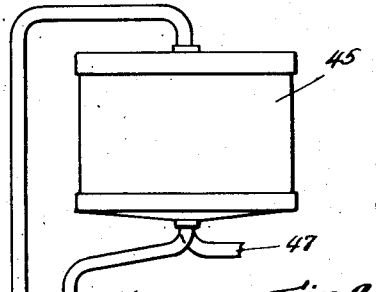
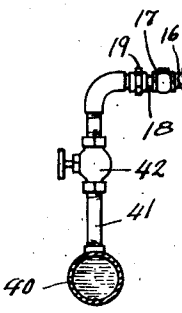


Fig. 2.



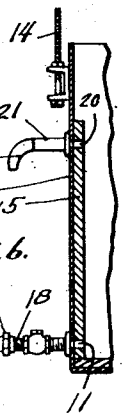
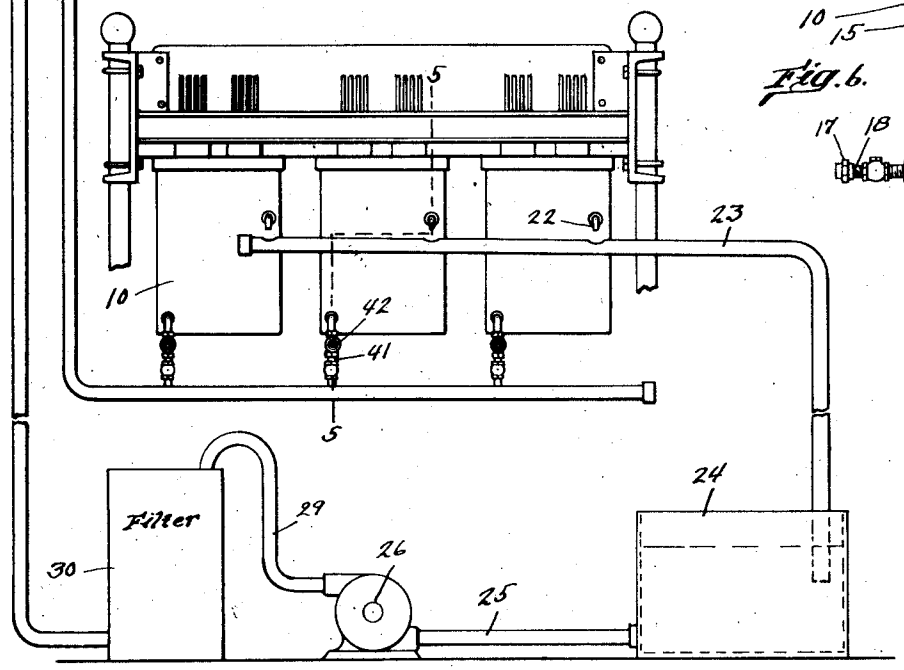


Fig. 6.



Inventor.
George A. Burnham
by
B. J. Noyes. atty

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ELECTRIC SWITCH

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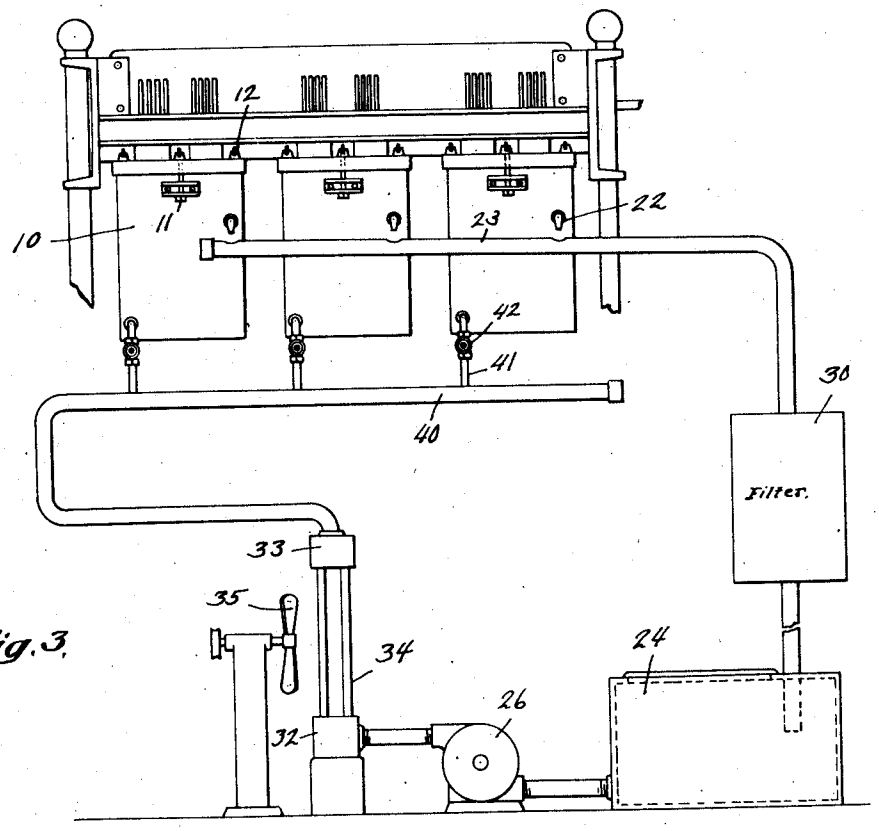


Fig. 3.

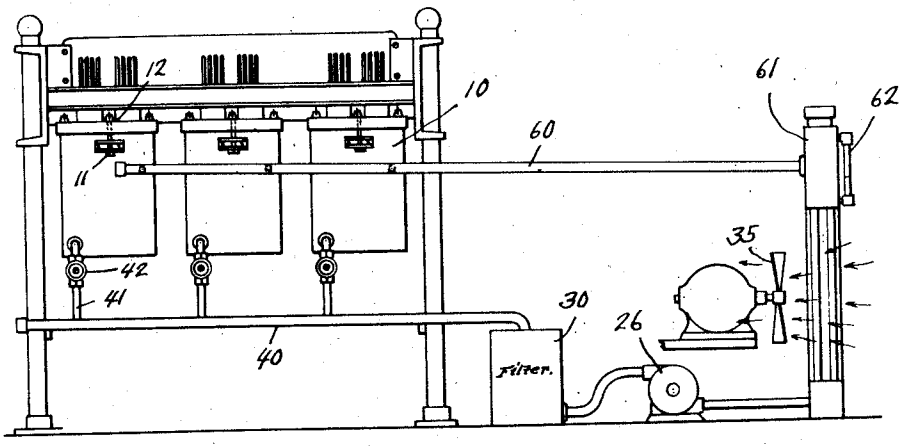


Fig. 4.

Inventor,
George A. Burnham
by
B. J. Noyes Atty

Patented Feb. 12, 1924. 1,483,839

UNITED STATES PATENT OFFICE.

GEORGE A. BURNHAM, OF SAUGUS, MASSACHUSETTS, ASSIGNOR TO SEARS B. CONDIT, JR., OF BROOKLINE, MASSACHUSETTS.

ELECTRIC SWITCH.

Application filed May 29, 1919. Serial No. 300,557.

To all whom it may concern:

Be it known that I, GEORGE A. BURNHAM, a citizen of the United States, residing at Saugus, in the county of Essex and State of Massachusetts, have invented an Improvement in Electric Switches, of which the following is a specification.

My present invention relates to artificially cooled oil immersed electric switches of the type set forth in my copending application Serial No. 286,353, filed March 31, 1919; and my patents No. 1,409,997, dated March 21, 1922, and No. 1,337,995, dated April 27, 1920.

The object of this invention is in the provision of an electric switching apparatus including an oil immersed switch that has a high current carrying capacity and is simple, inexpensive, and efficient in operation.

I accomplish this object by circulating the oil in which switch components are immersed and cooled through a circulatory and conditioning system external the switch and in and by which the oil is cooled and filtered, and the conditioned oil returned from the system to the switch.

Fig. 1 is a diagrammatic representation of an electric switch and an oil circulatory and conditioning system embodying my invention.

Fig. 2 is a modification of Fig. 1 in which cold oil is supplied to the switch from an elevated oil reservoir.

Fig. 3 is a further modification of Fig. 1 illustrating the oil filter disposed in that portion of the oil circulatory and conditioning system adapted to contain hot oil.

Fig. 4 is a further modification of Fig. 1.

Fig. 5 is a sectional detail of the oil receptacle of an electric switch along lines 5—5 of Fig. 2.

Fig. 6 is a detail of an oil receptacle constructed for the performance of my invention and as adapted to be applied to an electric switch.

Fig. 7 is an enlarged detail of the check valve of Fig. 6.

I have chosen for the purpose of illustrating my invention the electric oil immersed switch set forth in my application Serial No. 240,317, filed June 17, 1918, as being well adapted for the purpose but it is also obvious that other oil immersed switches may be employed with satisfactory results.

The switching apparatus here shown is adapted for the control of a three-phase circuit and comprises three independent oil immersed switches, each having the oil receptacles 10 adapted to contain oil normally under atmospheric pressure in which the stationary and movable switch members are immersed. Said oil receptacles 10 are provided with bolts 11 and wing-nuts 12 by means of which the receptacles are removably secured to the switch frame 12^a. Said receptacles are preferably provided with thermometers 13 by means of which the temperature of the oil within the receptacles may be known.

In the performance of my invention I circulate the oil in which the switch members are immersed from the oil receptacle through an external oil circulatory and conditioning system and return it in treated condition to the switch. For this purpose I provide the receptacle with an inlet for treated or conditioned oil from the system at or near the bottom of the receptacle and an outlet for the discharge of heated oil from the receptacle to the system at the surface of the oil within the receptacle; and the surface of the oil in the receptacle is preferably a substantial distance below the switch frame to provide a substantial gas expansion space under the switch frame and above the oil, as is common practice in the type of switch chosen to illustrate the invention.

Near the bottom of the receptacle an opening 14 is formed through the wall thereof and a registering opening is formed through the insulating lining 15 when such lining is employed, and a pipe 16 is secured to the wall of said receptacle by welding or other suitable means in register with the opening 14 therethrough. A check valve 17 is included in said pipe 16 for the purpose of preventing the draining of the receptacle at such times as the forcing means included in the oil circulatory system has ceased to function whereby oil may be continually contained in the receptacle. A short nipple 18 is secured in the other end of said check valve and a coupling 19 is arranged thereon forming means whereby the tank may be removably connected to that portion of the circulatory

and conditioning system containing cold and filtered, or otherwise conditioned, oil.

For the discharge of hot oil from the oil receptacle an opening 20 is formed therein at the surface of the oil and a registering opening may also be formed in the insulating lining 15 arranged within the oil receptacle when such lining is present. A nipple 21 is secured to the wall of the oil receptacle in register with the opening 20 therein and a discharge nozzle 22 is secured thereon and extended downwardly to discharge the heated oil into a trough or other oil conductor 23 associated with the external circulatory and conditioning system. The nozzle 22 is spaced above the trough whereby the flow of oil therefrom is visible and the rate of flow may be estimated, and thereby the cooling effect of the oil, by observing the characteristics of the discharged stream of oil.

The circulatory and conditioning system here shown comprises means to cool the hot oil, means to filter the oil, and means to forcibly circulate the oil through the cooling system and return it in proper condition to the switch, and the necessary fluid conductors and appurtenances to conduct and direct and act upon, or to be acted upon by, the oil in its circulation.

The cooling means for the oil comprises a fluid receptacle in which a sufficient mass of the oil is presented for cooling that the temperature of the oil, as a whole is reduced to a suitable value.

The filtering means for the oil comprises a device by which the carbon and other solid particles formed by repeated switch operation and the presence of which in the oil impairs the insulating value thereof is separated from the oil. The device may also operate to separate from the oil any moisture therein, the presence of which also impairs the insulating value of the oil.

The forcing means for the oil comprises a pump or it may include such an arrangement and disposition of the apparatus that the force of gravity is utilized to effect the circulation of oil in a part of the circulatory and conditioning system.

In the switching apparatus illustrated in Fig. 1 the hot oil issues from the nozzles 22 of the oil receptacles of the switches into the trough 23 from which it flows by gravity to an oil reservoir or sump 24 which may be located in any convenient position in the station in which the switching arrangement is installed. The oil sump may have an oil capacity sufficient for but one switching apparatus or it may have a capacity sufficient for a number of switching apparatus and other oil utilizing apparatus.

The sump may have such a heat radiating capacity that it in itself is sufficient to adequately cool the oil without the necessity for the employment of additional oil cooling means or its heat dissipating capacity may be inadequate and additional cooling means may be necessary. In many instances, however, cooling means having a definite heat dissipating ability is desirable and such a cooling means is here shown.

A pipe 25 extends from the bottom of the oil sump to the inlet end of a fluid pump 26 of any suitable type which is driven through belting from the source of power 28. A pipe 29 extends from the discharge end of the pump to a filter 30 through which the hot oil discharged from the switch is forced and the carbon and other solid particles formed in the oil due to repeated switch operation, and also moisture collected in the oil is separated from the bulk of oil whereby only clean oil is returned to the switch.

A pipe 31 extends from the filter to the heat radiator which comprises an inlet manifold 32, an exhaust manifold 33 and a plurality of pipes or oil conductors 34 having large heat dissipating surface and in which the hot oil is cooled connecting said manifolds. The heat dissipating surface of said pipes or conductors 34 may be so great that the natural circulation of air thereabout is sufficient for the adequate cooling of the oil or it may be that a forced air circulation is necessary and such forced circulation is here provided by the fan or blower 35 which is driven from the same source of power 28 that operates the oil pump. The blower is adapted to force a relatively large volume of air over the cooling surfaces of the radiator, or around the pipes or conductors 34 thereof to abstract heat from and thereby cool the oil.

A pipe 36 is in communication with the discharge manifold 33 of the radiator and the cooled oil is forced therethrough by the pump to the cold oil distributing manifold 40 extended the length of the switches. Separate pipes 41 for cold oil rise from said manifold 40 and are connected through regulating valves 42 with the unions 19 of the oil receptacles whereby cold oil may be forced into the receptacles from the system. The capacity of the individual switches may be independently governed by varying the extent of opening of the regulating valves 42 to thereby govern the rate of flow of cold oil into the receptacles and consequently govern the abstraction of heat from the heated components of the switches.

In the operation of the system shown in Fig. 1 oil is pumped from the sump 24 into the receptacle in which it is heated and the heated oil is discharged from the receptacle and returned by gravity to the sump. A bath of oil is constantly maintained in the oil receptacles by the provision of the check valves 17 in the inlet conductors to the oil

receptacle whereby the switches may operate effectively even when the oil pump has ceased to operate.

Whereas in Fig. 1 I have illustrated a system in which the oil is adapted to be forcibly circulated from the heat radiator to the switch, in Fig. 2 I show an arrangement in which the heat radiator in the form of an oil reservoir is disposed in elevated position above the switch, and flows by gravity to the switch. The radiator may comprise a relatively large tank 45 adapted to receive oil and having a surface sufficiently great to adequately cool the oil or it may be so constructed that it is especially adapted for the radiation of heat. The hot oil in this arrangement is adapted to be forced from the oil sump through the filter and into the elevated tank from which it is adapted to flow by gravity through the pipe 46 into the oil receptacle of the switches. This arrangement is particularly adapted to supply a plurality of separate switches with conditioned oil from a common conditioning system, and a second conductor 47 may supply conditioned oil to a second switch, now shown.

I prefer to insert the filter in the path of the hot oil as the filter is more efficient in separating carbon from the heated oil than from cooled oil and in Fig. 3 I have illustrated the filter as being directly in the discharge pipe 23 for the hot oil as it issues from the switches and before it passes to the oil sump in which it may be partially cooled.

In Fig. 4 I have illustrated a circulatory and cooling system in which the use of an oil sump is obviated, and the oil conditioning system is adapted to be at all times filled with oil.

A discharge pipe 60 for the heated oil extends from independent oil receptacles 10 of the multi-phase switching unit to the radiator 61. Said radiator is adapted to be such a height relative to the switches that when the oil pump is at rest, oil will be contained in the system and in the oil receptacles at the proper level for efficient switch operation. This height may be indicated by an oil gauge 62 associated with the radiator.

A fan or blower 35 is employed to create and force the circulation of air through the radiator.

The pump 26 forces cold oil from the radiator 61 to the filter 30 and thence to the intake manifold 40 from which it is distributed to the risers 41 through the regulating valves 42 into the oil receptacles of the switches.

In this arrangement oil flows from oil receptacles at the same rate as it is supplied thereto and consequently the level of oil in said receptacle and in the circulatory system remains constant. Whereas, in the type of switch having no provision for circulation of oil therethrough, oil may be thrown therefrom at each switch operation, and the oil level may thereby be so lowered as to permit the separation of the switch members in air, in the arrangement above set forth, oil expelled from the switch is immediately replaced from the circulatory system so that the oil level is restored to its predetermined height whereby the switch is in condition to interrupt its circuit indefinitely without damage to the switch.

It is obvious that other combinations and arrangements of apparatus for the conditioning and circulation of oil through the oil receptacles may be formed, by which the switch is cooled and maintained in efficient operation and this invention is not limited to any particular combination and arrangement.

I claim—

1. An electric switching apparatus comprising an electric switch having an oil receptacle adapted to contain oil in which switch components are immersed, and a circulatory and conditioning system for the oil including means to cool the oil, and means to forcibly circulate the oil through said cooling means and subsequently return it to the receptacle.

2. An electric switching apparatus comprising an electric switch having an oil receptacle adapted to contain oil in which switch components are immersed, and a circulatory and conditioning system for the oil including means to filter the oil, means to cool the oil and means to forcibly circulate the oil through said filtering and cooling means and subsequently return it cooled and filtered to the receptacle.

3. An electric switching apparatus comprising an electric switch having an oil receptacle adapted to contain oil in which switch components are immersed, and a circulatory and conditioning system for the oil including means to filter the oil, means to cool the oil, and means to forcibly circulate the oil through said filtering and cooling means in the order named and subsequently return it to the receptacle.

4. An attachment for electric switches comprising an oil receptacle adapted to contain oil in which switch components are immersed, having an outlet conduit in communication with the interior of the receptacle near the top thereof for the outflow of hot oil from the receptacle and an inlet conduit in communication with the interior of the receptacle near the bottom thereof for the inflow of cold oil to the receptacle and means removably to secure the receptacle to an electric switch.

5. An attachment for electric switches comprising an oil receptacle adapted to con-

tain oil in which switch components are immersed, an oil discharge pipe communicating with the oil space of the receptacle near the top thereof through which hot oil is adapted to flow from the receptacle, an inlet pipe communicating with the oil space of the receptacle near the bottom thereof through which cold oil is adapted to flow to the receptacle, and a check valve in said inlet pipe arranged to prevent flow of oil out of said receptacle through said inlet pipe.

6. An attachment for electric switches comprising an oil receptacle adapted to contain oil in which switch components are immersed, an oil discharge pipe communicating with the oil space of the receptacle near the top thereof through which hot oil is adapted to flow from the receptacle, an inlet pipe communicating with the oil space of the receptacle near the bottom thereof through which cold oil is adapted to flow into the receptacle, a check valve in said inlet pipe, and a control valve in said inlet pipe to govern the flow of oil therethrough.

7. An attachment for electric switches comprising an oil receptacle adapted to contain oil in which switch components are immersed having an inlet for the inflow of cold oil near the bottom thereof and an outlet for the discharge of hot oil near the top thereof, means permitting the flow of oil through the receptacle to be estimated, means to regulate the flow of oil, and means to measure the temperature of the hot oil.

8. An attachment for electric switches comprising an oil receptacle adapted to contain oil in which switch components are immersed, an oil discharge pipe communicating with the oil space of the receptacle near the top thereof through which hot oil is adapted to flow from the receptacle, an inlet pipe communicating with the oil space of the receptacle near the bottom thereof through which cold oil is adapted to flow to the receptacle, a check valve in said inlet pipe arranged to prevent flow of oil out of said receptacle through said inlet pipe, and means to removably secure the attachment to an electric switch.

9. An attachment for electric switches comprising an oil receptacle adapted to contain oil in which switch components are immersed, an oil discharge pipe communicating with the oil space of the receptacle near the top thereof through which hot oil is adapted to flow from the receptacle, an inlet pipe communicating with the oil space of the receptacle near the bottom thereof through which cold oil is adapted to flow to the receptacle, a check valve in said inlet pipe, a valve in said inlet pipe to govern the flow of oil therethrough, and means to removably secure the attachment to an electric switch.

10. An attachment for electric switches comprising an oil receptacle adapted to contain oil in which switch components are immersed having an inlet for the inflow of cold oil near the bottom thereof and an outlet for the discharge of hot oil near the top thereof, means permitting the flow of oil through the receptacle to be estimated, means to regulate the flow of oil, means to measure the temperature of the hot oil, and means to removably secure the attachment to an electric switch.

11. An electric switching apparatus comprising an electric switch having an oil receptacle adapted to contain oil in which switch components are immersed, a circulatory and cooling system for the oil including means to cool the oil, means to circulate the oil through the cooling means and subsequently return it to the receptacle, means permitting the rate of circulation of oil to be estimated, means to regulate the circulation of oil, and means to indicate the temperature of oil in the switch.

12. An electric switching apparatus including the combination of an oil receptacle, switch members contained in the oil in said receptacle, and means to govern the capacity of said switch comprising a circulatory and cooling system for the oil including cooling means for the oil, and means to direct the hot oil from the receptacle into and through the cooling means and return the oil in cooled condition to the receptacle, means to determine the temperature of the oil within the receptacle and means to regulate the rate of circulation of oil between the receptacle and cooling means.

13. An electric switching apparatus comprising an electric switch having an oil receptacle adapted to contain oil in which switch components are immersed, and a circulatory and conditioning system for the oil including an oil reservoir arranged to receive hot oil from the switch, a heat radiator, and a pump to force oil from said reservoir through said cooling means and thence to the switch.

14. An electric switching apparatus comprising an electric switch having an oil receptacle adapted to contain oil in which switch components are arranged, and a circulatory and conditioning system for the oil including an oil reservoir into which hot oil is adapted to flow by gravity from the switch, a heat radiator elevated above the switch, and a pump to force oil from said low reservoir to said elevated radiator from which it flows by gravity to the switch.

15. An electric switching apparatus comprising an electric switch having an oil receptacle adapted to contain oil in which switch components are immersed, and a circulatory and conditioning system for the oil including an oil sump into which hot

oil is adapted to flow by gravity from the switch, an oil tank elevated above the switch and from which oil is adapted to flow by gravity to the switch, said tank serving as a heat radiator to cool the oil, and a pump to force oil from said sump to said elevated tank.

16. The combination of a plurality of independent electric switches each having an independent oil receptacle adapted to contain oil in which switch components are immersed, and a common circulatory and cooling system for the oil in said independent switches.

17. The combination of a plurality of independent electric switches each having an independent oil receptacle adapted to contain oil in which switch components are immersed, a common circulatory and cooling system for the oil in said switches, and means to independently govern the rate of circulation of conditioned oil through the switches.

18. In combination with an electric switch having an oil receptacle adapted to contain oil in which switch components are immersed, an oil sump, a fluid conductor extended between the oil receptacle to said sump for the flow by gravity of hot oil from the receptacle to said sump, a fluid conductor extended between said sump and the oil receptacle, a heat radiator comprising a component of said conductor, and a pump comprising a component of said conductor to force hot oil from said sump through said radiator to be cooled and thence into the oil receptacle of the switch.

19. An electric switching apparatus comprising an electric switch having an oil receptacle adapted to contain oil, switch components immersed in the oil in the receptacle, a circulatory and cooling system for the oil by which oil is supplied to and withdrawn from the receptacle, and means to constantly maintain a supply of oil in the receptacle about said switch components.

20. In an electric switch, an oil receptacle adapted to contain oil in which switch components are immersed having an inlet for the flow of cold oil into the receptacle, and an unrestricted outlet for hot oil from the receptacle, and means to govern the inflow of cold oil into the receptacle.

21. An attachment for electric switches comprising an oil receptacle adapted to contain oil in which switch components are immersed having an inlet for the flow of cold oil thereinto, an unrestricted outlet for the discharge of hot oil therefrom, means to govern the flow of cold oil into the receptacle, and means to secure the attachment to an electric switch.

22. An attachment for electric switches comprising an oil receptacle adapted to contain oil in which switch components are immersed having an inlet for the flow of cold oil thereinto, an outlet for the visible discharge of hot oil therefrom, means to govern the flow of cold oil into the receptacle and means to secure the attachment to an electric switch.

23. An electric switch having an oil receptacle normally under atmospheric pressure and adapted to contain oil to a predetermined level and overflow when the oil is above said level and means to maintain the predetermined level of oil in said receptacle comprising means continually to force oil into said oil receptacle to cause it to overflow.

24. An electric switch having an oil receptacle normally under atmospheric pressure and adapted to contain oil to a predetermined level and overflow when the oil is above said level and means to maintain the predetermined level of oil in said receptacle comprising means continually to force oil into said oil receptacle to cause it to overflow and means to catch the overflowing oil.

25. An electric switch having an oil receptacle normally under atmospheric pressure and adapted to contain oil to a predetermined level and overflow when the oil is above said level and means to maintain the predetermined level of oil in said receptacle comprising means continually to force oil into said oil receptacle to cause it to overflow, and means to catch the overflowing oil and return it to said forcing means.

26. An electric switch having an oil receptacle normally under atmospheric pressure and adapted to contain oil to a predetermined level and overflow when the oil is above said level and means to maintain the predetermined level of oil in said receptacle comprising an oil circulatory system for the oil in said receptacle having means adapted continually to force oil into said oil receptacle to cause it to overflow and means to catch the overflowing oil and conduct it to the forcing means to be returned to the switch.

27. An electric switch comprising a switch frame, a receptacle disposed beneath said frame adapted to contain oil normally under atmospheric pressure, switch members immersed in the oil in said receptacle, said switch having a passage through which oil may escape from the receptacle, and means to add oil to the receptacle to keep constant the oil level therein.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

GEORGE A. BURNHAM.

Witnesses:
T. T. GREENWOOD,
H. B. DAVIS.