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F. M. CLARK

1,935,595

LIQUID COMPOSITION AND ELECTRICAL APPARATUS CONTAINING SAME

Filed Feb. 8, 1933

Fig. 1.

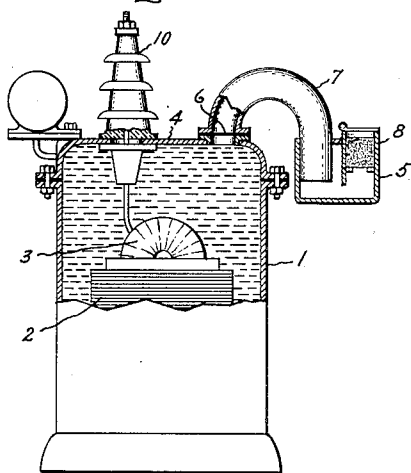


Fig. 2.

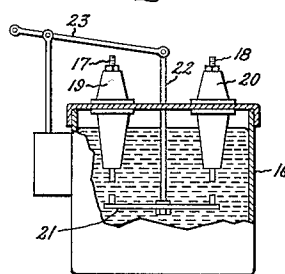


Fig. 3.

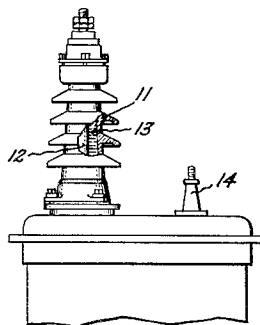


Fig. 4.

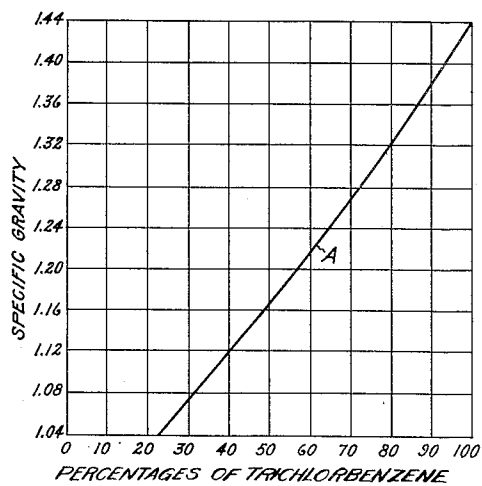
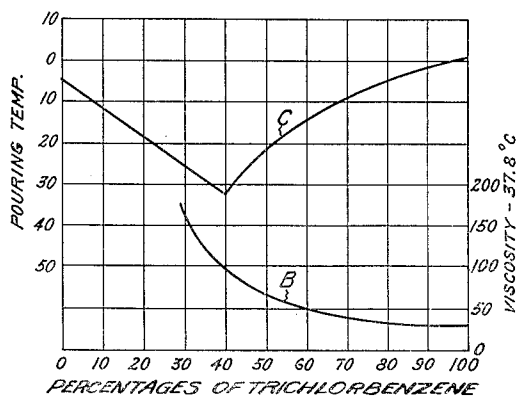


Fig. 5.



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UNITED STATES PATENT OFFICE

1,935,595

LIQUID COMPOSITION AND ELECTRICAL
APPARATUS CONTAINING SAMEFrank M. Clark, Pittsfield, Mass., assignor to
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Application February 8, 1933. Serial No. 655,785

8 Claims. (Cl. 175—361)

The present invention comprises a liquid composition for use as a cooling and insulating medium for electrical apparatus.

Mineral hydrocarbon oils, both of the naphthene base and of the paraffin base, have long been in general use for dielectric purposes although it has been generally recognized that their inflammability was a serious disadvantage. Vegetable oils, such as castor oil, while used to a lesser extent also have this disadvantage. The fact that such oils have a specific gravity less than water, and hence water will sink to the bottom in oil and may collect at regions in electric devices where eventually electrical breakdown may occur, is a further disadvantage to their use which is especially marked in certain high voltage devices.

The present application relates in particular to a composition consisting essentially of a mixture of either mineral or vegetable oil or both and liquid trichlor benzene which possesses various advantages over ordinary oil as an insulating medium. For example, such mixtures solidify at lower temperatures than the oil component and are substantially non-flammable.

I have discovered that an insulating composition comprising petroleum or vegetable oils and containing trichlor benzene in substantial amounts remains liquid at temperatures substantially as low as any of those encountered in northern winter climates, and far lower than the solidifying temperatures of these two ingredients, the solidifying point (pour point) depending somewhat on the ratio of the ingredients. These compositions possess in addition various favorable properties for dielectric purposes, namely, chemical stability, high dielectric constant, non-inflammability, a specific gravity which is greater than water, and a lesser tendency to form sludge than does mineral oil.

One form of composition comprising my invention is of particular value as a dielectric material for fluid-quenched electric switches as there is less tendency encountered in its use of carbon separation when subjected to contact with an arc than in halogenated products unassociated with oil. The composition of my invention, however, is capable of general usage in electric devices such for example as transformers, capacitors, cables, bushings, and the like.

The accompanying drawing shows a simple outline in Fig. 1 a transformer, in Fig. 2 a switch and in Fig. 3 a bushing as illustrative of some of the forms of electric devices in combination with which such compositions are adapted for

use; Fig. 4 is a graph showing the specific gravity of different mixtures of a petroleum or mineral oil and trichlor benzene; while Fig. 5 shows graphs of the pour points and viscosities of different mixtures of a mineral oil with various percentages of trichlor benzene.

I prefer to use a mixture of isomers of trichlor benzene which has the following characteristics: a viscosity of about 35 seconds Saybolt Universal at 37.8° C., a specific gravity of 1.44 (referred to water at 15.5° C.), a pour point of solidifying temperature at 2° C., and a boiling point of about 210 to 215° C. The pour point of a mixture is the lowest temperature at which the liquid will flow. It is determined by the standard method test of the A. S. T. M., Designation D—87—30, described in the American Society for Testing Materials, Part II, Pages 481—487, of 1930.

It will be understood that my invention is not limited to chemically pure trichlor benzene. Various mixtures of the isomers of trichlor benzene and mixtures having substantially the properties of trichlor benzene but containing compounds of lower or higher chlorine content than the trichlor product come within the scope of my invention. It will be understood by those skilled in the art that other halogens such as iodine, bromine or fluorine can be substituted for chlorine in the trichlor benzene. Compounds of this type are also included in my invention. In my copending application, Serial No. 614,196, filed May 28, 1932, I have described and claimed a dielectric material comprising liquid chlorinated benzene.

One example of a liquid insulating composition which is well adapted for use in capacitors and cables, is made up of about 60 parts by weight of a relatively heavy mineral oil mixed with 40 parts by weight of trichlor benzene. These ingredients form a mixture having a viscosity at 100° C. of about 100 seconds Saybolt.

A heavy mineral oil suitable for making up this mixture may be one having the following characteristics: Viscosity at 100° C. of 100 seconds Saybolt Universal, specific gravity at 15.5° C. of .935 (referred to water at the same temperature), fire or burn point of 274° C., pour point or solidifying temperature of minus 5° C.

The graph A of Fig. 4 shows the specific gravity of different mixtures of heavy mineral oil and trichlor benzene. Mixtures containing above 20% trichlor benzene have specific gravities greater than water and therefore water will rise to the surface in such mixtures where it will evaporate.

As shown by graph B in Fig. 5 the viscosity of heavy mineral oil is lowered by the addition of trichlor benzene, thus promoting circulation and heat dissipation in devices employing such mixtures. For example, in a mixture containing about 30% trichlor benzene the viscosity of heavy mineral oil is lowered at 37.8° C. from about 1200 to 1300 seconds to 160 seconds Saybolt Universal.

Graph C of Fig. 5 shows the pour points of different proportions of a heavy mineral oil and trichlor benzene. The pour point of the heavy naphthenic base mineral hydrocarbon oil which was chosen is about minus 5° C. The progressive addition of trichlor benzene progressively lowers the pour point, although this material itself has a pour point of about plus 2° C., until with a content of about 40 per cent by weight of trichlor benzene a pour point of minus 32° C. is reached. At 20 per cent of trichlor benzene content the pour point is minus 18° C. and at 50 per cent trichlor benzene content the pour point is minus 20° C.

I may use a medium mineral oil having the following characteristics: Viscosity at 37.8° C. of 102 seconds Saybolt Universal, specific gravity at 15.5° C. of .907 (referred to water at the same temperature), fire or burn point of 175° C. and a pour point or solidifying temperature of about minus 40° C.

The addition of trichlor benzene will lower the pouring temperature of this oil when added in the proportion of about 20 to 40 per cent by weight of the mixture.

A medium paraffin base oil having a viscosity at 37.8° C. of about 69 seconds Saybolt, a specific gravity of .860, a pour point of minus 5° C. and a burn point of 175° C. may be mixed with trichlor benzene to produce a product of lower pour point and higher specific gravity.

Vegetable oils may be used with trichlor benzene in place of or in combination with mineral oil.

Mixtures embodying my invention but containing mineral oil of low viscosity also exhibit the unexpected advantages above noted in connection with a heavy or medium viscosity oil although in lesser degree. For example, a mixture by weight of 75 parts of a light mineral oil having a pour point of minus 56° C. and 25 parts of trichlor benzene (having a pour point varying according to composition from 0 to plus 5° C.) has a pour point of approximately minus 65° C. My invention, however, is not limited to a mixture containing an oil of such viscosity and pour point that the addition of trichlor benzene renders the mixture less viscous and solidifying at a lower temperature than the oil itself.

An oil mixture containing as much as about twenty per cent of trichlor benzene is not inflammable. Under some special conditions a transitory flame may be produced but the resulting volatilization of trichlor benzene will act as a snuffer to put out the flame. However, the trichlor benzene will not be removed by volatilization from the mixture under ordinary conditions. Even after heating the mixture for three weeks at 100° C. which might be expected to tend to remove the trichlor benzene the product still is non-inflammable.

The drawing shows in Figures 1, 2 and 3 electrical devices as illustrative of the kind of service for which the new dielectric material comprising my invention has peculiar advantages. Fig. 1 shows a transformer comprising a casing or tank 1 in which are located the usual magnetic

core 2 and electrical windings, one of which is indicated at 3. As indicated by the dotted lines, the tank is filled with a liquid material which in this case comprises a mixture of mineral hydrocarbon oil and trichlor benzene. Fixed to the cover 4 of the transformer tank is a gas absorber 5. Should any considerable quantities of gas be liberated from the liquid dielectric material by arcing between members of the transformer or any other reason the diaphragm 6 consisting of glass plate of definite bursting strength usually about 10 pounds gauge pressure is ruptured and the gas passes through the conduit 7 into the absorbing chamber 5 in which is located a quantity of soda lime, or other suitable basic absorbing material as indicated at 8.

The transformer is also shown as provided with a high tension bushing as indicated at 10. As shown in greater detail in Fig. 3 this high tension bushing comprises a casing 11 through which passes a conductor 12 which is surrounded by a liquid dielectric material 13 made up in accordance with my invention regardless whether or not such a mixture is used to insulate the transformer coils. The fact that this material has a specific gravity greater than water is of particular utility in the bushing as the water can not collect at the bottom of the high tension terminal where it would produce trouble. The low tension terminal of the transformer is indicated conventionally at 14.

Because of its advantageous property of sustaining arcing without undue separation of carbon my new dielectric material is well suited for use in fluid quenched switches such as shown conventionally in Fig. 2. This switch comprises a tank 16 filled with a fluid dielectric material as indicated by dotted lines. High tension terminals 17, 18 are led through the cover of the tank suitably insulated therefrom by bushings 19, 20. A contact making member 21 attached to a rod 22 serves to make and break the circuit between the terminal conductors 17, 18. The rod 22 is connected to a lever 23 and from thence to an operating mechanism not shown in detail whereby the circuit is completed and broken in the well understood manner.

Although I have illustrated and explained my invention with particular reference to chlorine substitution products of benzene, other halogens may be similarly used in conjunction with oil. For example, benzo-trifluoride and chlorinated benzotrifluoride may be employed in admixture with oil in accordance with my invention.

What I claim as new and desire to secure by Letters Patent in the United States is:

1. A liquid composition of matter comprising a substantial proportion of oil of the class including mineral and vegetable oils in combination with a substantial proportion of trichlor benzene.

2. A liquid composition of matter comprising at least about twenty parts by weight of trichlor benzene, the balance of said composition being mineral hydrocarbon oil.

3. A composition of matter which is liquid at temperatures as low as minus 18 to minus 32° C. comprising about 80 to 50 parts of mineral hydrocarbon oil and 20 to 50 parts of liquid trichlor benzene.

4. An electric apparatus comprising electric conductors spaced apart and charged during operation at different electric potentials and a medium insulating said conductors comprising mineral hydrocarbon oil and trichlor benzene in substantial proportions.

5. An electric apparatus comprising a conductive sheath, a conductor located therein and spaced apart therefrom and a liquid medium in said sheath for insulating said conductor comprising mineral hydrocarbon oil and trichlor benzene in substantial proportions.

7. A composition of matter comprising a substantial proportion of both mineral and vegetable oil in combination with a substantial proportion of trichlor benzene.

8. A composition of matter comprising a major proportion of oil of the class including mineral and vegetable oils in combination with a minor but substantial proportion of trichlor benzene.

FRANK M. CLARK.

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CERTIFICATE OF CORRECTION.

Patent No. 1,935,595.

November 14, 1933.

FRANK M. CLARK.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 66, for "of" read or; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of December, A. D. 1933.

(Seal)

F. M. Hopkins
Acting Commissioner of Patents.

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