Dec. 3, 1935. S. RUBEN 2,022,827

INSULATED WIRE

Filed Sept. 29, 1932

Fig. 1.

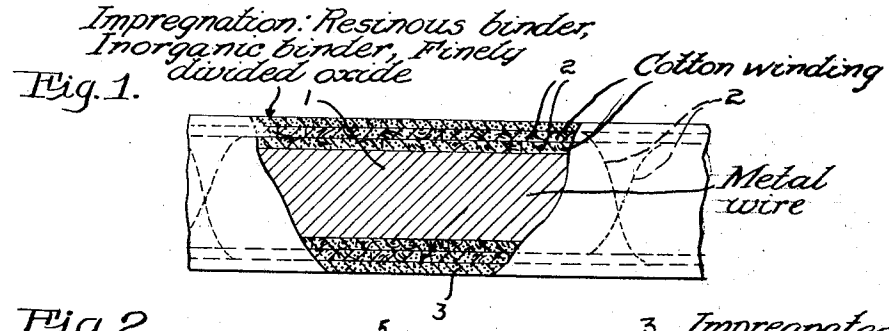


Fig. 2.

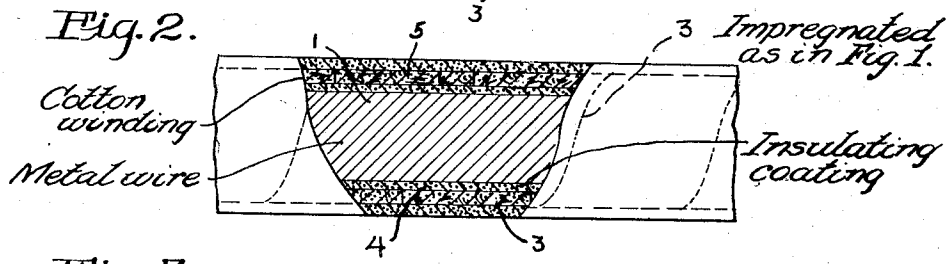


Fig. 3.

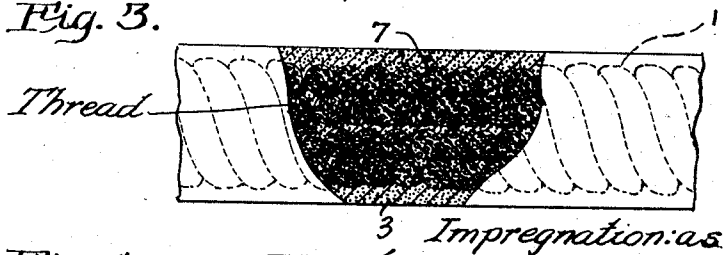


Fig. 4.

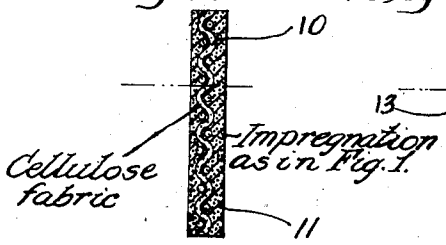
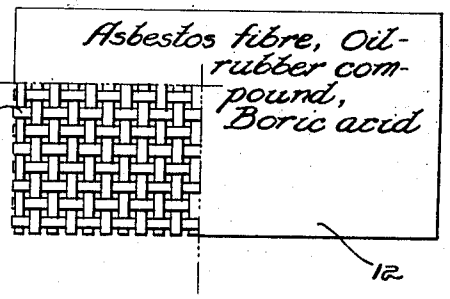


Fig. 5.



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Patented Dec. 3, 1935 2,022,827

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2,022,827

INSULATED WIRE

Samuel Ruben, New Rochelle, N. Y., assignor to Vega Manufacturing Corporation, Wilmington, Del., a corporation of Delaware

Application September 29, 1932, Serial No. 635,304

6 Claims. (Cl. 173—264)

This invention relates to metallic bodies having coverings of impregnated fabric textile or fibrous material. It also relates to impregnated textile or fibrous material as such.

An object of the invention is to produce an impregnated textile covered metallic body in which the impregnated textile has high dielectric and heat resistant properties, due, in a large degree to the impregnation.

Another object is to produce an impregnated textile or fibrous sheet and winding material for electrical insulation, having high dielectric and heat resistant properties and long life, due, in a large degree, to the impregnation.

A specific object is to produce an impregnated textile covered wire.

Further objects will be apparent from the disclosure.

In the accompanying drawing Fig. 1 is a view partly in section, of an impregnated fabric covered wire;

Figs. 2 and 3 are similar views of a modification of the invention;

Fig. 4 shows an impregnated cellulose fabric; and

Fig. 5 illustrates an impregnated heat fabric.

In my issued Patents #1,896,041, #1,896,042, and #1,896,043 and co-pending applications, Serial No. 580,531 of 12th December, 1931; 619,019 of 9th July, 1932 and 631,654 of 3rd September, 1932; I described an insulating compound for electrical conductors, comprising a finely divided inorganic refractory material, such as an oxide and a water-insoluble resinous binder, such as an oleoresinous varnish. Where high heat resistance was a factor, the compound contained an inorganic binder, such as boric acid or other boron compounds, effective at elevated temperatures.

I have found that if a textile covered wire, such as the conventional silk or cotton covered magnet wire, is impregnated with a compound such as described, that the heat resistance, dielectric strength and life of the insulation are greatly increased. This is due in a great measure to the to the fact that the finely divided inorganic materials filter through the textile winding to the wire and also into the textile itself. When an inorganic binder, such as a borate is present, the heat and flame resistance is very high.

If the textile covered wire has first had an initial coat of the refractory oxide-resinous binder insulation over which the textile has been wound, the refractory ability of the insulation is still further increased by impregnation.

If the textile covered wire has first had an initial coat of conventional varnish enamel or rubber over which the textile has been wound, the refractory ability of the insulation is much increased.

The fabric textile to be impregnated may be in sheet or tape form and unattached to metal at the time of impregnation.

I may select as a suitable impregnating compound, one of the insulating compounds mentioned in the copending applications referred to, which include as resinous or water-insoluble organic binding materials, spirit varnishes of the shellac type, oleoresinous varnishes, phenol varnishes, rubber varnishes, oil-rubber varnishes or alkyd resin lacquers, to any one or more of which is added the finely divided insulating compound which may consist of one or more of the oxides of such elements, as iron, chromium, titanium, beryllium, magnesium, aluminum, silicon, tantalum, vanadium, manganese, cobalt, nickel, copper, zinc, molybdenum, tungsten, lead, thorium, zirconium. Where the borates, silicates, hydroxides or hydrates of these elements form insulating compounds, these may be used. Mixtures containing more than one compound, for example beryl, chromite, rutile or mica, may also be used in combination or otherwise.

Finely divided aluminum may in some cases be substituted for one of the refractory materials, as aluminum in a finely divided state is not conductive, probably due to the thin film of oxide which seems to naturally form upon its surface. If desirable, the thickness of this insulating film can be materially increased by chemical treatment, as for instance, by immersion in nitric acid.

In a number of cases it will be found desirable to add to the mixture of refractory material and organic binder, an inorganic binding and reacting agent. The choice of this material is governed to some degree by the temperature which the insulating compound will be called upon to withstand, one of the objects in using a compond of this nature being to provide a binding action after the organic materials have lost their ability to hold the refractory material in place. Another reason is that these compounds usually increase heat and fire resistance of the organic materials with which they are mixed or come in contact with or impregnate and tend to preserve them from deterioration. It is well known that organic insulations definitely deteriorate with age and in time become conductive, due to carbonization. This effect is rapidly accelerated by heat, such as would be inherent in motors, etc. (see

article by Steinmetz and Lamme, volume 32, pages 79 to 89, Journal of A. I. E. E.). The presence of the inorganic binding material, will definitely increase the life of the organic materials, by preventing early carbonization. The most satisfactory materials for this use are the boron compounds such as boric acid, sodium borate, lead borate, etc., boric acid being in most instances preferred. So-called "solvent oxides" such as antimony oxide, zinc oxide, and the phosphates such as ammonium phosphate are also heat resisting inorganic binder compounds which may be used. These inorganic binders may be added separately or in the form of a compound or mixture with any of the other components and should be ground to the same fine dimension. Preferably, they should have a melting or flowing point lower than the carbonization temperature of the organic materials used.

The following illustrates typical mixtures: first, as to the organic binding material; (1) 100 grams flake shellac and 100 grams of Venice turpentine dissolved in 400 cc. alcohol; (2) oleoresinous varnish consisting of ester and kauri gums, China wood and linseed oil, turpentine and mineral thinner in proper proportions, heated to about 500° F.; (3) a phenol resinous varnish made up with proportions of #2 above and a compound consisting of China wood oil, fish oil and phenol formaldehyde resin heated together to about 450° F. thinned out with toluol or xylol; (4) an oil-rubber varnish consisting of varying amounts of rubber, such as from 25% to 50% rubber dissolved in an oil resinous compound. Various other types of varnish and lacquers are described in my copending applications, for instance, glycerol-phathalate resin varnish, etc.

To 400 cc. of a properly thinned out compound, such as one of the types described, I add 200 grams of one of the finely divided inorganic insulating materials hereinbefore mentioned and grind these together until the solid matter has been reduced to a very fine dimension. If it is desired to add an inorganic binder, flame or heat resistant compound such as boric acid, this is preferably put in and ground with the mixture. It may be added in amounts from 2% of the amount of the insulating material up to 75%. The amount of insulating material, such as the oxide, may be determined by its specific gravity, bulking and wetting qualities and by the degree of refractoriness desired. For instance, if finely divided aluminum were used, only a small proportionate weight compared with heavy oxide would be necessary.

The size of the solid inorganic materials should be not greater than will allow them to pass through a 200 mesh screen and much better results are obtained if they are small enough to pass through a 300, 350 or 400 mesh screen.

It will be recognized, of course, that the figures given and the composition of the insulating compound may be varied within wide limits according to the use to which the compound is to be put and the amount of heat to be encountered. That is to say, in the formula given above, twice the amount of oxide may be used or only $\frac{1}{5}$ as much and the boric acid might be 2% of the amount of oxide or 100%. The organic binder or carrier should be of proper consistency in relation to the specific gravity of the solid materials used so that these materials do not deposit too rapidly. A typical coating mixture might comprise 400 cc. of a compound consisting of one part of rubber dissolved in three parts of an oil-resinous compound, 200 grams finely divided iron oxide and 25 grams of boric acid, ground together. Such a mixture would also be suitable as an impregnating compound.

After the wire has been coated the textile winding such as cotton or silk is wound on by machine in a manner well known in the art. For some applications the textile may be wound directly on the bare wire without surface insulation. Also other cellulosic materials, such as paper or certain forms of regenerated sheet cellulose, may be used.

In impregnating an insulated wire for instance, of the textile covered type above referred to, it is desirable to use a continuous process. The wire is passed through cups or baths containing the impregnating compound and is then dried and preferably heated in ovens located between the cups. The amount of heat applied should be such as will not seriously injure the textile covering. In this connection, the use of a heat or fire resistant material such as boric acid in the impregnating compound is highly useful. After the wire is impregnated and dried, it may be rolled up into spools.

If sheet or tape fabric material is to be impregnated, this may be passed through the impregnating compound, either continuously or otherwise as may be found best and then dried and/or baked.

Drying and baking schedules are determined in a large degree by the amount of and quality of the solvents used with the organic binder and by the nature of the binder base. For instance, a shellac-alcohol mixture will give a rapid drying while an oil-resinous naptha thinner type varnish will dry much slower.

For some applications, it is desirable to incorporate the impregnating material as an initial component of the fabric or sheet material, for instance, in the production of sheet laminating material for insulation to replace fish paper, etc. This may be accomplished by taking fibrous material such as asbestos or cotton or silk, and mixing it with one of the types of impregnating compounds described; preferably of the oil-rubber oxide type and then rolling into sheets which can be dried and baked. A highly useful and relatively thin sheet material composed of low priced asbestos fibres, a 50/50 oil-rubber compound and preferably containing a small amount of a boron compound, such as boric acid, can be obtained.

In order to illustrate the invention, reference is made to the accompanying drawing.

In Fig. 1, the wire (1) has a cotton winding (2) and the wound wire has been impregnated with compound (3) consisting of a resinous binder, a finely divided oxide and an inorganic binder serving as a heat and fire resistant material.

In Fig. 2, the wire (1) has an insulating coating (4) of the enamel or oxide-resin or rubber type over which is cotton winding (5) and the wire as such has been impregnated with compound (3), similar to compound (3) of Fig. 1.

In Fig. 3, is shown a piece of thread (7) impregnated with impregnating compound (3), similar to compound (3) of Fig. 1. It will be observed that the impregnating material not only covers the whole thread but has filtered through and between the smaller constituent threads.

In Fig. 4, is shown a piece of cellulose fabric (10) such as cotton or silk or "rayon" which has been impregnated with compound (11), similar to compound (3) of Fig. 1.

The fabric (1) shown in Fig. 3, might also consist in whole or in part of non-cellulosic materials such as asbestos.

In Fig. 5, is shown a sheet lamination (12) consisting of a mixture (13) of asbestos fibre, an oil-rubber compound and boric acid.

I claim:

1. A wire having a surface insulation comprising a mixture of finely divided oxide, a resinous binder and a boron compound, and having a textile winding over said insulation, said textile being impregnated with a mixture of finely divided oxide, a resinous binder and a boron compound.

2. A wire having a surface insulation comprising a mixture of finely divided oxide, a resinous binder and a boron compound, and having a textile winding over said insulation, said textile being impregnated with a mixture of finely divided oxide, a resinous binder and a boron compound.

3. A wire having a surface insulation comprising a mixture of finely divided oxide, a resinous binder and a heat resistant inorganic binder, and having a textile winding over said insulation, said textile being impregnated with a mixture of finely divided chromium oxide, a resinous binder and a boron compound.

4. A wire having a surface insulation comprising a mixture of finely divided chromium oxide, a resinous binder and a boron compound, and having a textile winding over said insulation, said textile being impregnated with a mixture of finely divided chromium oxide, a resinous binder and a boron compound.

5. A wire having a surface insulation comprising a mixture of 200 grams finely divided chromium oxide, 25 grams of boric acid and 400 cc. of a compound consisting of one part of rubber dissolved in three parts of an oil resinous binder, a textile fabric winding over said insulation, and an impregnant of finely divided oxide, a resinous binder and a boron compound within said fabric.

6. A wire having a surface insulation comprising a mixture of finely divided oxide, a resinous binder and a heat resistant organic binder, a textile fabric over said insulation, and an impregnant identical in composition to that of the insulation, in said fabric.

SAMUEL RUBEN.

CERTIFICATE OF CORRECTION.

Patent No. 2,022,827. December 3, 1935.

SAMUEL RUBEN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 20, claim 6, for the word "organic" read inorganic; 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 21st day of September, A. D. 1937.

Henry Van Arsdale

(Seal) Acting Commissioner of Patents.

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