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GUTTA-PERCHA INSULATION MATERIAL

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This invention relates to gutta-percha insula-
tion materials and to methods of producing such
materials, and more particularly to improvements
in materials of this kind for use in long deep sea
cables especially designed for higher frequencies
than the usual cable telegraph signaling fre-
quencies.

It is an object of the invention to provide an
insulating material comprising gutta-percha
which has better electrical properties than gutta-
percha insulation hitherto employed in deep sea
cables and which is suitable for use in long cables
designed for telephone frequencies or even for
higher carrier current frequencies.

Another object of the invention is to provide an
improved gutta-percha as a compounding mate-
rial for deep sea cable insulation material which
has electrical properties as good as or better than
practically pure gutta-hydrocarbon.

Another object of the invention is to provide
an improved gutta-percha of this kind which be-
sides having satisfactory electrical properties has
improved mechanical properties.

Still another object is to provide a method of
treating gutta-percha whereby inferior grades
may be brought up to standard requirements as
to mechanical properties as well as to electrical
characteristics; or whereby such inferior gutta-
percha may be improved to have, besides the re-
quired mechanical properties, better electrical
characteristics than those usually required for
even high speed telegraph submarine cables.

Still another object is to provide a method of
producing such a material which is commercially
feasible.

For the purpose of the present specification,
and the claims appended thereto, the term gutta-
percha includes the various grades of balata.

In accordance with the invention gutta-percha
is treated in such a manner that it is deprived of
certain of its resinous constituents which have
been found to have unsatisfactory electrical
properties under certain sea bottom conditions,
and other resins, naturally present in the gutta-
percha or else obtained from other sources and
which have been found to have satisfactory elec-
trical properties, are utilized in the gutta-percha
product to add thermo-plastic characteristics
thereto, and possibly to afford a protective action,
as well as to improve its electrical characteristics.

The mechanical properties which in present
day practice are required of the compound com-
prising the main insulating body in deep sea ca-
bles include thermo-plasticity, ability to be ex-
truded in a uniform fashion around the conduc-
tor at the usual extrusion temperatures, limited
cold flow at room and sea bottom temperatures,
toughness and flexibility at room temperatures,
etc. The mechanical properties of the component
substances of the insulating compound may, of
course, differ somewhat from these standards, in-
asmuch as these substances usually are chosen
with regard to their ability to complement each
other in this respect.

An important electrical characteristic of the
insulating material is the leakance factor G/C ,
which is the ratio of leakance to capacity of a
sample. This factor is of greater importance as
the frequency of the applied current increases
and it should be kept low under sea bottom con-
ditions to insure a low attenuation of signals
over a long cable.

It has before been known that gutta-percha,
and therefore also balata, can be improved elec-
trically by the removal of resins therefrom. It
has therefore been concluded that the resins
themselves have less satisfactory electrical prop-
erties than has the gutta-hydrocarbon.

The resins of gutta-percha, including those of
balata, have before been separated and certain
of their physical and chemical characteristics
have been determined. They have been found
to fall into two main groups, termed fluavil and
albane, sometimes spelled alban. The albane
fraction is usually a white crystalline material
and may be further separated into a series of
fractions having different melting points. It is
soluble in hot alcohol and in petroleum naphtha,
but is nearly insoluble in cold alcohol. The
fluavil fraction is a yellow product melting at
low temperatures and soluble in cold alcohol
as well as in petroleum naphtha.

In an investigation conducted in an attempt
to determine how gutta-percha, and particularly
balata, may be improved for the purpose of deep
sea cable insulation, we have found that the less
satisfactory electrical properties may be ascribed
particularly to the resins included in the fluavil
group or to some constituent contained in or
intimately associated with the fluavil, whereas

those of the albane group have been found to have more satisfactory electrical characteristics.

We have furthermore found that the fluavil may be separated from the albane as well as from the gutta-hydrocarbon of a body of gutta-percha by solution, for example, in certain alcohols of the aliphatic series at ordinary room temperatures.

In carrying out the invention it is possible to proceed by different methods of removing the fluavil from the gutta-percha.

In accordance with one method, the whole resins are practically completely separated from the gutta-hydrocarbon by extraction; the fluavil is then extracted from the whole resin, and the albane residue restored to the gutta-hydrocarbon.

In accordance with another method, only the fluavil is removed by extraction, the albane remaining in the gutta-percha.

Another method may constitute a combination of these two methods.

In accordance with still other methods albanes may be taken from other bodies of gutta-percha to replace the total resin content of the body of gutta-percha which is to be improved, or to replace more or less of such portions of the resin content which has already been or is subsequently to be removed from the body of gutta-percha. Foreign albanes derived from other resinous materials such as chicle, may furthermore be incorporated in the gutta-percha for the present purpose.

Sample A.—In a specific instance, a quantity of balata of average quality was thoroughly washed in warm water for removal of dirt, dried in the masticator and formed into a sheet about one half millimeter in thickness. The resultant product was found to have the following

Moisture content..... Per cent by weight .92
Resinous content..... 51.5

Electrical tests at 0° C. gave the following results:

Applied frequency	Leakance factor	Dielectric constant
<i>f</i>	<i>G/C</i>	<i>K</i>
1000 c/s	107	3.13
2000 c/s	241	3.11
3000 c/s	398	3.09
10000 c/s	1815	3.03

Sample B.—A piece of Sample A, 400 grams in weight, was subjected to a single extraction for 24 hours at 24° C. in 2500 cm³ of methanol. It was then washed for the removal of the solvent and dried in the masticator after which it was found to have the following

Moisture content..... Per cent by weight .14
Resinous content..... 37.9

Electrical tests at 0° C. gave the following data:

<i>f</i>	<i>G/C</i>	<i>K</i>
1000 c/s	7.5	2.71
2000 c/s	30	2.71
3000 c/s	63	2.70
10000 c/s	445	2.70

Sample C.—Another piece of Sample A, 400 grams in weight, was subjected to a single extraction for 24 hours at 24° C. in 4000 cm³ of methanol. It was then washed for the removal of the solvent and dried in the masticator after which it was found to have the following

Moisture content..... Per cent by weight .75
Resinous content..... 36.7

Electrical tests at 0° C. gas the following data:

<i>f</i>	<i>G/C</i>	<i>K</i>
1000 c/s	14	2.71
3000 c/s	63	2.71
10000 c/s	400	2.71

Sample D.—Another piece of Sample A, 300 grams in weight was subjected to a single extraction for 24 hours at 24° C. in 1800 cm³ of ethanol. It was then washed for the removal of the solvent and dried in the masticator after which it was found to have the following

Moisture content..... Per cent by weight .95
Resinous content..... 35.1

Electrical tests at 0° C. gave the following data:

<i>f</i>	<i>G/C</i>	<i>K</i>
1000 c/s	7.8	2.63
2000 c/s	23.5	2.63
3000 c/s	46	2.63
10000 c/s	430	2.63

Sample E.—Another piece of Sample A, 300 grams in weight, was subjected to a single extraction for 24 hours at 24° C. in 3000 cm³ of ethanol. It was then washed for the removal of the solvent and dried in the masticator after which it was found to have the following

Moisture content..... Per cent by weight 1.03
Resinous content..... 30.5

Electrical tests at 0° C. gave the following data:

<i>f</i>	<i>G/C</i>	<i>K</i>
1000 c/s	5.3	2.89
2000 c/s	18.7	2.89
3000 c/s	32	2.89
10000 c/s	240	2.89

The Samples B to E are examples of partial extraction of the resins at low temperatures whereby mainly the fluavil is removed. The electrical data show that both the leakance factor *G/C* and the dielectric constant *K* have been greatly improved by the relatively limited extraction. The different products were found to have mechanical properties which make them suitable for submarine cable insulation both in regard to manufacturing and laying requirements and as to operating requirements. As a matter of fact the mechanical properties of these samples were greatly improved over those of the original balata of Sample A.

Sample F.—A piece of Sample A was subjected to two successive extractions each of 24 hours in petroleum naphtha at 10° C.; the gasoline was carefully removed and the product was washed in hot water and dried in the masticator and was found to have the following

Moisture content..... Per cent
by weight 1.34
Resinous content..... 4.1

5 Electrical tests at 0° C. gave the following data:

f	G/C	K
1000 c/s	39	2.75
3000 c/s	112	2.74
10000 c/s	360	2.72

10 Sample G.—A whole resin extracted from balata was subjected to electrical tests at 0° C. and gave the following data:

f	G/C	K
1000 c/s	53.9	3.26
2000 c/s	180.5	3.25
3000 c/s	367	3.24
10000 c/s	2540	3.17

20 Sample H.—75 grams of a whole balata resin was subjected to an extraction for 6 hours at room temperature in 900 cm³ of ethanol after which it was filtered and the residue washed in ethanol and the alcohol carefully removed.

30 Electrical tests at 0° C. gave the following data:

f	G/C	K
1000 c/s	11.6	2.2
2000 c/s	21.3	2.2
3000 c/s	50	2.2
10000 c/s	69.3	2.2

40 The Sample H, which constituted the undissolved residue from the cold alcohol extraction of balata resins, was a white crystalline material having the characteristics of the albanes with a melting point range of 165° C. to 195° C.

45 By adding the albane Sample H to the substantially resin free gutta-hydrocarbon Sample F in proportions determined by the requirements, an insulating material may be obtained which combines electrical properties better than those of the original product represented by Sample A and in some respects better than those of the deresinated balata of Sample F with mechanical properties satisfactory for deep sea cable insulation.

55 Though the various samples described had all been taken from balata, similar treatments may be given to any other type of gutta-percha with corresponding results. It is furthermore possible to extract and separate the albanes from any one or more gutta-percha varieties and use them in the desired proportions as plasticizing agents for any one variety or combination of varieties of gutta-percha. Again, other natural albanes or albane rich substances may be incorporated by well known mixing processes as a plasticizing agent in any of these instances, such as chicle or the albanes of chicle.

65 It is obvious that the temperatures at which the fluavil extraction from gutta-percha is made may be somewhat different from room temperatures depending upon the solvent used, the time allowed for the extraction and upon the degree of extraction desired. Thus a very quick extraction may be made with methanol at temperatures as high as 60–65° C. Besides the preferred solvents, methanol and ethanol, a number of other solvents may be used such as propyl alcohol, acetone,

methylethyl ketone, as well as mixtures of some of these. By the proper choice of the three factors mentioned above, it is possible to extract more or less of the fluavil constituent and also certain of the albanes from the albane constituent of the gutta-percha.

Various methods described as examples of this invention have involved the removal of fluavil from the gutta-percha. It is possible that the poor electrical properties of fluavil are not inherent to the main bulk of the fluavil but are due to smaller quantities of substances which are more closely associated with the fluavil than with the albane and which may be less easily separated therefrom. Thus the fluavil extractions have been found to contain small quantities of free acids and still smaller quantities of free alcohol. These quantities appear, however, to be sufficient to justify the assumption that one or both of these substances are the cause of the degradation in the electrical properties of gutta-percha.

It should be understood that the mechanical properties of any particular body of gutta-percha which is suitable for incorporation in a cable insulating material are not necessarily identical with the mechanical properties required for such insulating material. By the methods forming part of this invention any quality of gutta-percha, which in present practice is considered suitable for use in admixture with other qualities of gutta-percha or with other compounding materials may have its electrical properties improved and at the same time may retain its mechanical properties or even have these somewhat improved.

It is within the scope of this invention to admix with the above described gutta-hydrocarbon and albane composition such materials as: natural rubber of all sorts treated or untreated to remove objectionable constituents, such as soluble salts and proteins; synthetic rubber prepared by polymerizing any of the known conjugated dienes; waxes which are derived from natural sources or prepared synthetically; antioxidants such as phenyl alpha naphthylamine or phenylbeta-naphthylamine or any other product which may act to modify the properties of the gutta-hydrocarbon and albane composition in the direction to attain the desired product.

What is claimed is:

1. A gutta-percha product comprising resin poor gutta-percha in which albane has been incorporated as a plasticizing agent.

2. A gutta-percha product comprising a greatly deresinated gutta-percha and as a plasticizing agent a foreign albane, such as chicle albane.

3. A gutta-percha product in which resins having better electrical properties have replaced natural resin constituents having poorer electrical properties.

4. A method of improving the electrical properties of gutta-percha which comprises extracting at least a portion of the resins therefrom, separating from the extracted resins at least a portion of those constituents which have the poorer electrical properties and restoring a portion of the remaining constituents to the gutta-percha.

5. A method of treating gutta-percha which comprises extracting a portion of the resins therefrom, separating the albanes from the extract and incorporating said separated albanes in the gutta-percha from which resin was removed.

6. A method of improving the mechanical properties of at least partially deresinated gutta-

percha by mixing a quantity of albanes therewith.

7. A method of improving the electrical properties of gutta-percha which has been considerably deresinated which comprises mixing a foreign substance therewith, the main natural constituent of which is albane.

8. A method of improving the electrical and mechanical properties of gutta-hydrocarbon by mixing therewith an albane rich substance such as chicle.

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