Jan. 28, 1941. P. NOWAK ET AL 2,229,985

ELECTRICALLY INSULATING COMPOSITION

Filed Nov. 16, 1937

Fig. 1.

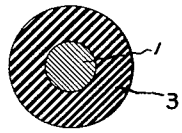


Fig. 2.

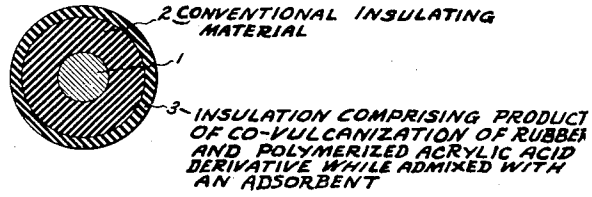
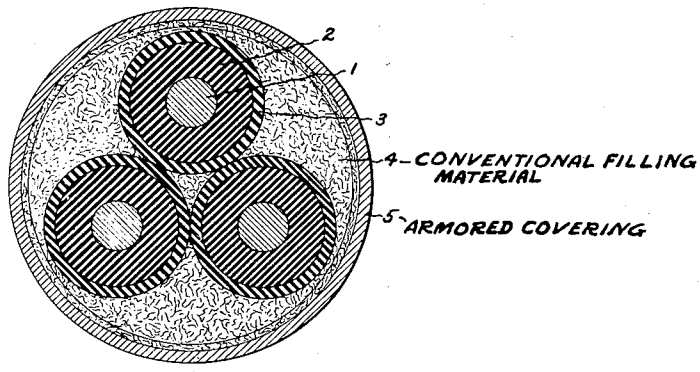


Fig. 3.



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ELECTRICALLY INSULATING COMPOSITION

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Application November 16, 1937, Serial No. 174,889
In Germany November 21, 1936

6 Claims. (Cl. 260—3)

The present invention relates to electrical cables. It is more particularly concerned with cables comprising a conductor insulated with a composition comprising vulcanized polymerized acrylic acid or its homologues, or vulcanized polymerized derivatives of acrylic acid or homologues thereof. Compositions and cables of this kind are described in the copending applications of Paul Nowak, Serial No. 749,476, filed October 22, 1934, now Patent No. 2,105,361, issued January 11, 1938, and of Paul Nowak and Hermann Hofmeier, Serial No. 33,898, filed July 30, 1935, now Patent No. 2,105,362, also issued on January 11, 1938, both of which patents are assigned to the same assignee as the present invention. In the following description of the invention and in the appended claims, the class of polymers above mentioned is designated, generally, as "polymerized acrylic acid derivative."

For certain cable purposes it is desirable to provide an electrically insulating composition which retains more elastic properties over a wide temperature range than is possessed by compositions of the kind described in the aforementioned applications. It has been found in practice that in many cases an absolute resistance of the insulating or sheathing composition to oil is not required. Under such circumstances addition materials, which in themselves have relatively little or inferior resistance to oil, may be incorporated in the compositions.

In accordance with the present invention compositions comprising vulcanized polymerized acrylic acid derivatives are made more resistant to the effect of cold on their flexibility, and are given improved elastic properties at elevated temperatures, by incorporating therewith a small amount, for example, about 2 to 10 per cent by weight of the whole of new (unused) or reclaimed (used) rubber.

In the accompanying drawing Figs. 1 and 2 represent cross-sectional views of single-conductor cables enclosed in a sheath of our improved insulating composition; and Fig. 3 shows a similar view of a multi-conductor cable comprising three single-conductor cables insulated as shown in Fig. 2.

The reference numeral 1 designates the metallic conductor; 2 conventional electrically insulating material such, for example, as paper, rubber, asbestos, spun glass, varnished cambric, etc.; 3 the insulating composition of the present invention; 4 conventional filling material, such as jute, asbestos or the like, for bringing a multiconductor cable to uniform cross-section; and 5 an armored covering. Like numerals designate like parts in all figures.

In Fig. 1 the new insulating material is shown as being superposed directly on a metallic conducting core. In Fig. 2 conventional insulating material is shown as being superposed directly on the conductor and the composition of this invention constitutes the external sheath. Fig. 3 shows three individual conductors insulated as shown in Fig. 2, and the whole surrounded by an armored covering, with filling material in the intervening space between the individual conductors and the armored covering.

The following specific examples illustrate how the new electrically insulating compositions of this invention may be prepared:

Example 1

	Parts by weight
Polymerized ethyl ester of acrylic acid	500
Powdered adsorbent (surface-active) material	200
Powdered, inert (non-active that is, substantially free from surface activity), inorganic filling material	280
Sulfur	5
Rubber	20 to 100

Preferably the polymerized ethyl acrylate is plasticized prior to mixing with the other ingredients, for example, by incorporating therewith a suitable amount of dibutyl phthalate. The specified components may be kneaded together at about 80° to 90° C. in a suitable mixing apparatus, for example, a Banbury mixer, followed by working on heated mixing rolls. A small amount, for instance about 15 parts by weight, of an antioxidant such as beta-naphthol may be incorporated in the above-described mass during the kneading operation. In the foregoing formula active magnesium silicate is the preferred adsorbent, although other adsorbents also may be used, for example, active carbon, silica gel, activated alumina, fuller's earth, activated bleaching clays, activated bauxite, and the like. Talcum, French chalk or other powdered filling materials may be used. The rubber may be crude rubber of commerce, but mainly for purpose of economy the use of plasticized reclaimed rubber is preferred. If desired, the polyacrylate, adsorbent and filler, with or without the sulfur, may be separately mixed, after which the rubber or the rubber and the sulfur (if the sulfur was not previously added) may be incorporated with the said mixed or reacted components. Under certain conditions it may be preferred to

mix first the polyacrylate and rubber, and then to incorporate therewith the adsorbent, inert filler and sulfur. When crude natural rubber is used and to effect complete vulcanization of the rubber, then sometimes it may be necessary to employ a little more sulfur than that specified in the formula.

Example 2

	Parts by weight
Polymerized ethyl ester of acrylic acid	318
Powdered adsorbent (surface-active) material	195
Powdered, inert (non-active), inorganic filling material	467
Sulfur	2
Rubber	20 to 100

The powdered adsorbent in the foregoing formula preferably is active carbon (for example, active gas soot). A small amount, for instance about 18 parts by weight, of an anti-oxidant such as beta-naphthol may be incorporated with the other components during the mixing operation. The description given under Example 1 with respect to plasticizing the polyacrylate, to methods and temperatures of combining or mixing the components, and to the rubber, adsorbent material, filling material and sulfur employed, is also applicable to this example.

Example 3

	Parts by weight
Polymerized ethyl ester of acrylic acid	30.50
Reclaimed rubber composition (70 per cent natural rubber)	9.00
Powdered talc	36.00
Active carbon	23.00
Anti-oxidant (for example, beta-naphthol)	0.70
Plasticizer (for example, stearic acid)	0.80

The description given under Example 1 with respect to plasticizing the polyacrylate, and to methods and temperatures of mixing or combining the components, also applies to this example. Other adsorbents, inert filling materials, anti-oxidants and plasticizers than those mentioned by way of example may be employed.

Compositions produced in a manner such as described under the foregoing illustrative examples are soft and yielding, and after the mixing operation readily may be extruded upon a metallic conducting core (for example, solid or stranded copper wire) at an elevated temperature, for instance at about 100° to 120° C. The insulated conductor ordinarily is given a vulcanizing heat treatment in order to effect or to complete vulcanization of the applied insulating composition and particularly vulcanization of the polymerized acrylic acid derivative in the composition. The advantage of vulcanizing polymerized acrylic acid derivative in the presence of surface active materials (adsorbents), as is done in making the compositions of this invention, is fully described in the aforementioned Nowak application Serial No. 749,476, now Patent No. 2,105,361.

The compositions used in making the insulated conductors or cables of the present invention preferably comprise vulcanized polymerized acrylic acid ethyl ester and new or reclaimed rubber in an amount by weight corresponding to from about 5 to 35 per cent that of such ester.

Specific examples of acrylic compounds that may be employed in practicing this invention are, for instance, polymerized acrylic acid, polymerized methyl, ethyl, propyl, butyl and higher alkyl esters of acrylic and methacrylic acids, polymerized acrylonitrile, or mixtures of two or more such substances.

The insulating compositions of this invention are elastic over a wide temperature range, and have adequate flexibility at temperatures as low as minus 15° C. They also show a greater resistance to flow (less tendency to soften) at elevated temperatures than compositions comprising vulcanized polymerized acrylic acid derivatives which have not been modified as herein described. These improvements in the physical properties of such polymerized acrylic acid derivatives are all the more surprising in that they are effected by the addition of such relatively small proportions of rubber, more particularly (as hereinbefore pointed out) from 2 to 10 per cent by weight of the whole. Further, these ends are attained without materially affecting the resistance of such compounds to water, ozone, aging and inflammability.

Compositions comprising polymerized acrylic acid derivative. polymerized vinyl ether, and addition agents of the kind herein described with reference to polyacrylate compositions similarly are improved in their physical characteristics by incorporating rubber therewith as hereinbefore set forth.

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. An electrically insulating composition comprising polymerized ethyl ester of acrylic acid, plasticized used rubber in an amount by weight corresponding to from about 5 to 35 per cent that of the said ester, sulfur, a filler substantially free from surface activity and an adsorbent, said rubber constituting from 2 to 10 per cent by weight of the whole, the said ester and rubber being conjointly reacted with the sulfur in the presence of the adsorbent, and the said composition being water-, ozone- and age-resisting, flexible and elastic at temperatures as low as minus 15° C., and having a greater resistance to flow at elevated temperatures than a composition containing no rubber component but with all other components and proportions thereof substantially the same.

2. An electrically insulating composition comprising a filler substantially free from surface activity and the reaction product of a vulcanizing agent with a mixture containing rubber, polymerized acrylic acid derivative and polymerized vinyl ether in the presence of an adsorbent, said rubber constituting from 2 to 10 per cent by weight of the whole.

3. An insulating material adapted for insulating an electric cable, said material being water-, ozone- and age-resisting and comprising a filler and the product of co-vulcanization of rubber and polymerized acrylic acid derivative with a vulcanizing agent in the presence of an adsorbent, said rubber constituting from 2 to 10 per cent by weight of the whole and increasing substantially the flexibility and elasticity of said composition at temperatures as low as minus 15° C. and, also, the resistance to flow of the composition at elevated temperatures.

4. An insulating material adapted for insulating an electric cable, said material being water-, ozone- and age-resisting and comprising a filler, plasticized used rubber and polymerized acrylic acid derivative coreacted with sulfur in the presence of an adsorbent, said

rubber constituting from 2 to 10 per cent by weight of the whole and increasing substantially the flexibility and elasticity of said composition at temperatures as low as minus 15° C. and, also, the resistance to flow of the composition at elevated temperatures.

5. An electrically insulating composition comprising a filler substantially free from surface activity and the product of co-vulcanization of rubber and polymerized ester of acrylic acid with a vulcanizing agent in the presence of an adsorbent, said rubber constituting from 2 to 10 per cent by weight of the whole and increasing substantially the flexibility and elasticity of said composition at temperatures as low as minus 15° C. and, also, the resistance to flow of the composition at elevated temperatures.

6. A water-, ozone- and age-resisting composition comprising the product of vulcanization of a mixture containing approximately

	Parts by weight
Polymerized ethyl ester of acrylic acid	500
Powdered adsorbent material	200
Powdered inert inorganic filling material	280
Sulfur	5
Rubber	20 to 100

said composition being flexible at temperatures as low as minus 15° C. and having a greater resistance to flow at elevated temperatures than a composition containing no rubber component but with all other components and proportions thereof substantially the same.

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