PATENT SPECIFICATION

Application Date: May 16, 1938. No. 14504/38. **514,785**

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PROVISIONAL SPECIFICATION

Improved Rubber-like Compositions

We, THE CRAIGPARK ELECTRIC CABLE COMPANY LIMITED, a British Company, of 246, Flemington Street, Springburn, Glasgow, N., and JOHN RONALD MACFARLANE DUNCAN, a British Subject, of the Company's address do hereby declare the nature of this invention to be as follows :—

This invention is concerned with the production of a flexible and substantially non-hygroscopic rubber-like composition that possesses exceptionally good fire-resisting properties and is particularly suitable for use as a fire resistant covering for electric conductors. In accordance with the present invention such compositions are obtained by vulcanising mixtures which comprise from 30—50% by weight of polymerised chloro 2-substituted Butadiene (hereinafter referred to as Neoprene) and from 10—20% by weight of chlorinated diphenyl having a chlorine content of not less than 55% or of a mixture of such chlorinated diphenyl with certain other chlorinated organic compounds of the kind and in the proportions hereinafter specified, together with a filler and vulcanisation accessories for the Neoprene. The mixture of chlorinated organic bodies comprises from 45—55% by weight of chlorinated diphenyl having a chlorine content of not less than 55%, 22—32% by weight of chlorinated naphthalene having a chlorine content of not less than 55%, and 22—26% by weight of a chlorination product of polyvinyl chloride with a chlorine content of not less than 50%. Alternatively the mixture of chlorinated organic bodies comprises 40—60% by weight of chlorinated diphenyl having a chlorine content of not less than 55%, 15—25 parts by weight of chlorinated rubber having a chlorine content of not less than 60% and 15—30% by weight of chlorinated naphthalene having a chlorine content of not less than 55%. These mixtures of chlorinated bodies are made whilst the constituents are in a molten state and allowed to cool before being added to the Neoprene. An example of such a mixture of chlorinated diphenyl, chlorinated naphthalene and chlorinated polyvinyl chloride that is readily available is that sold under the trade name "Arubren."

Compositions obtained from mixtures of Neoprene and chlorinated bodies lying outside the range specified do not possess the desired combination of mechanical and fire-resistant properties. For instance, we have found that if the Neoprene content is lower than 30% the manufacturing processing and the mechanical properties of the composition are inferior whilst if the Neoprene content is raised beyond 50% there is a decrease in the fire-resistant properties of the composition, and that, on the other hand, if the proportion of highly chlorinated material exceeds 20% the processing and the mechanical properties of the product are inferior, while if it is reduced below 10% a decrease in the fire-resistant properties of the product results.

The following is an example of a mix in accordance with the invention :—

Neoprene – – –	40 parts by weight.
Arubren – – –	20 parts by weight.
Clay – – – –	36 parts by weight.
Zinc – – – –	2 parts by weight.
Magnesia – – –	2 parts by weight.

The clay referred to above is a China Clay or Kaolin, such as the clay sold under the Registered Trade Mark "Dixie," suitable for rubber compounding purposes and capable of stiffening and reinforcing the rubber. An indication of the fire-resisting properties of the vulcanisate of the above mix is given by the following tests carried out on an electric cable comprising a 3/.036" tinned copper conductor insulated with two layers of high grade vulcanised india rubber of a total radial thickness of 0.047", and having a single layer, 0.035" thick, of the above fire-resisting compound applied over the insulating covering and vulcanised thereto. A length of the cable was subjected to the flame of a No. 20 Barthel burner of the type described in B.S.S. No. 738—1937 and the following test results were obtained.

[Price 1/-]

Seconds in Flame.	Time of Burning after removal of flame.	Length burned.
60	0 seconds	4"

The application of a burner flame to the ends of the cable until the exposed rubber started to burn showed that, after removal of the flame, the burning did not continue along the cable.

With regard to the mechanical properties of the composite covering of rubber and fire-resistant composition the following figures show that these are very satisfactory being more than adequate for the purpose.

Normal tensile strength in lbs per square inch. 1600

Elongation % (at breaking load.) 450—500

Dated this 16th day of May, 1938.

R. L. CLEAVER.
Agent for the Applicants,
Cable Research House,
Silver Street,
W.C.1.

COMPLETE SPECIFICATION

Improved Rubber-like Compositions

We, THE CRAIGPARK ELECTRIC CABLE COMPANY LIMITED, a British Company, of 246, Flemington Street, Springburn, Glasgow, N., and JOHN RONALD MACFARLANE DUNCAN, a British Subject, of the Company's address, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

This invention is concerned with the production of a flexible and substantially non-hygroscopic rubber-like composition that possesses exceptionally good fire-resisting properties and is particularly suitable for use as a fire-resistant covering for electric conductors. In accordance with the present invention such compositions are obtained by vulcanising mixtures which comprise from 30—50% by weight of polymerised chloro 2-substituted butadiene (hereinafter referred to as Neoprene) and from 10—20% by weight of chlorinated diphenyl having a chlorine content of not less than 55%, together with a filler and vulcanisation accessories for the neoprene. According to a modified form of the invention from 10—20% of a mixture of such chlorinated diphenyl with other chlorinated organic compounds having an equally high or a higher chlorine content may be used in place of the aforesaid quantity of chlorinated diphenyl. Such a mixture of chlorinated bodies may comprise from 45—55% of chlorinated diphenyl having a chlorine content of not less than 55%, 22—32% by weight of chlorinated naphthalene having a chlorine content of not less than 55%, and 22—26% by weight of a polyvinyl chloride or of a chlorination product thereof. A second example of such a mixture of chlorinated organic bodies comprises from 40—60% by weight of chlorinated diphenyl having a chlorine content of not less than 55%, 15—25% by weight of chlorinated rubber having a chlorine content of not less than 60% and 15—30% by weight of chlorinated naphthalene having a chlorine content of not less than 55%. These two mixtures of chlorinated bodies may be made whilst the constituents are in a molten or plastic state and allowed to cool before being added to the neoprene, or the constituents thereof may be added to the neoprene in the unmixed condition. An example of a particular mixture of chlorinated diphenyl with other chlorinated organic bodies that has proved especially suitable is the mixture sold under the trade name "Arubren."

Compositions obtained from mixtures of neoprene and chlorinated bodies lying outside the range specified do not possess the desired combination of mechanical and fire-resistant properties. For instance, we have found that if the neoprene content is lower than 30% the manufacturing processing and the mechanical properties of the composition are inferior, whilst if the neoprene content is raised beyond 50% there is a decrease in the fire-resistant properties of the composition, and that, on the other hand, if the proportion of highly chlorinated material exceeds 20% the processing and the mechanical properties of the product are inferior, while if it is reduced below 10% a decrease in the fire-resistant properties of the product results.

The following are examples of mixes in accordance with the invention :—

EXAMPLE 1.

Neoprene	40	parts	by	weight
Arubren	20	,,	,,	,,
Clay	36	,,	,,	,,
Zinc oxide	2	,,	,,	,,
Magnesia	2	,,	,,	,,

EXAMPLE 2.

Neoprene	30	,,	,,	,,
Arubren	15	,,	,,	,,
French chalk	48	,,	,,	,,
Zinc oxide	1	,,	,,	,,
Magnesia	3	,,	,,	,,
Soft black	2	,,	,,	,,
Antioxidant	1	,,	,,	,,

EXAMPLE 3.

Neoprene	40	parts	by	weight
Chlorinated diphenyl	10	,,	,,	,,
Clay	46	,,	,,	,,
Zinc oxide	2	,,	,,	,,
Magnesia	2	,,	,,	,,

EXAMPLE 4.

Neoprene	40	,,	,,	,,
Chlorinated diphenyl	9	,,	,,	,,
Chlorinated rubber	5	,,	,,	,,
Chlorinated naphthalene	6	,,	,,	,,
Clay	36	,,	,,	,,
Zinc oxide	2	,,	,,	,,
Magnesia	2	,,	,,	,,

The clay referred to in Examples 1, 3 and 4 is a china clay or kaolin, suitable for rubber compounding purposes and capable of stiffening and reinforcing the rubber. In each case the mix is vulcanised for a period of 90 minutes at a temperature of 139° C. The resulting compositions are flexible, very fire-resistant and possess satisfactory mechanical properties.

The four examples of mixes given above are particularly suitable for use in the manufacture of insulated electric conductors of the kind described in the specification of British Patent Application No. 499,908, having a composite dielectric comprising an inner layer (or layers) of vulcanised india rubber and an outer layer (or layers) of a vulcanised neoprene composition. For this purpose the mix will be applied in the unvulcanised condition to the rubber coated conductor and the composite insulating layer subsequently vulcanised at a temperature of 139° C. for a period of 90 minutes. It will be appreciated that the composition of the underlying rubber mix will preferably be such that it requires the same vulcanising conditions as the neoprene mix.

An indication of the good fire-resistant properties of the improved neoprene compositions is given by subjecting specimen lengths of conductor insulated with an inner layer of vulcanised india rubber (which is of course combustible material) and an outer layer consisting of the vulcanisate of one of the four mixes given in Examples 1—4 to the flame of a No. 20 Barthel burner of the type described in B.S. 738—1937 for a period of 60 seconds, the specimens being held in a vertical position. The following results were obtained.

Specimen.	Size of Conductor.	Radial thickness of V.I.R. layer.	Radial thickness of Neoprene composition layer.	Neoprene composition used.	Time of burning after removal of flame.	Length affected.
1.	3/.036"	0.023"	0.015"	Example 1	0—5 secs.	3.0" to 3.5"
2.	3/.036"	0.034"	0.023"	Example 1	0—5 secs.	3.5" to 4.0"
3.	3/.036"	0.047"	0.035"	Example 1	0 secs.	4.0"
4.	3/.036"	0.023"	0.015"	Example 2	2—5 secs.	3.0" to 3.5"
5.	3/.036"	0.034"	0.023"	Example 2	15—20 secs.	3.5" to 4.5"
6.	3/.036"	0.023"	0.015"	Example 3	0—5 secs.	4.0" to 4.5"
7.	3/.036"	0.034"	0.023"	Example 3	45—55 secs.	4.5" to 5.0"
8.	3/.036"	0.023"	0.015"	Example 4	0—5 secs.	4.0" to 4.5"
9.	3/.036"	0.034"	0.023"	Example 4	18—30 secs.	3.5" to 4.25"

An indication of the very satisfactory mechanical properties of the composite dielectric of vulcanised india-rubber and the improved neoprene composition is given by the following results of tests taken on composite dielectric employed on Specimens 2, 5, 7 and 9.

Specimen.	Normal Tensile Strength. Lbs/Sq. inch.	Elongation % (at breaking load).
2	1500—1600	450—500
5	1450—1550	450—500
7	1500—1600	450—500
9	1500—1600	450—500

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is :—

1. A fire-resistant rubber-like composition obtained by vulcanising a mix comprising from 30—50% by weight of neoprene and from 10—20% of chlorinated diphenyl having a chlorine content of not less than 55%, together with a filler and vulcanisation accessories for the neoprene.

2. A fire-resistant rubber-like composition obtained by vulcanising a mix comprising from 30—50% by weight of neoprene and from 10—20% by weight

Specimen.	Size of Conductor.	Radial thickness of V.I.R. layer.	Radial thickness of Neoprene composition layer.	Neoprene composition used.	Time of burning after removal of flame.	Length affected.
1.	3/.036"	0.023"	0.015"	Example 1	0—5 secs.	3.0" to 3.5"
2.	3/.036"	0.034"	0.023"	Example 1	0—5 secs.	3.5" to 4.0"
3.	3/.036"	0.047"	0.035"	Example 1	0 secs.	4.0"
4.	3/.036"	0.023"	0.015"	Example 2	2—5 secs.	3.0" to 3.5"
5.	3/.036"	0.034"	0.023"	Example 2	15—20 secs.	3.5" to 4.5"
6.	3/.036"	0.023"	0.015"	Example 3	0—5 secs.	4.0" to 4.5"
7.	3/.036"	0.034"	0.023"	Example 3	45—55 secs.	4.5" to 5.0"
8.	3/.036"	0.023"	0.015"	Example 4	0—5 secs.	4.0" to 4.5"
9.	3/.036"	0.034"	0.023"	Example 4	18—30 secs.	3.5" to 4.25"

An indication of the very satisfactory mechanical properties of the composite dielectric of vulcanised india-rubber and the improved neoprene composition is given by the following results of tests taken on composite dielectric employed on Specimens 2, 5, 7 and 9.

Specimen.	Normal Tensile Strength. Lbs/Sq. inch.	Elongation % (at breaking load).
2	1500—1600	450—500
5	1450—1550	450—500
7	1500—1600	450—500
9	1500—1600	450—500

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is :—

1. A fire-resistant rubber-like composition obtained by vulcanising a mix comprising from 30—50% by weight of neoprene and from 10—20% of chlorinated diphenyl having a chlorine content of not less than 55%, together with a filler and vulcanisation accessories for the neoprene.

2. A fire-resistant rubber-like composition obtained by vulcanising a mix comprising from 30—50% by weight of neoprene and from 10—20% by weight

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of a mixture of chlorinated organic bodies comprising from 45—55% by weight of chlorinated diphenyl having a chlorine content of not less than 55%, 22—32% by weight of chlorinated naphthalene having a chlorine content of not less than 55% and 22—26% by weight of a polyvinyl chloride or of a chlorination product thereof, together with a filler and vulcanisation accessories for the neoprene.

3. A fire-resistant rubber-like composition obtained by vulcanising a mix comprising from 30—50% by weight of neoprene and from 10—20% by weight of a mixture of chlorinated organic bodies comprising from 40—60% by weight of chlorinated diphenyl having a chlorine content of not less than 55%, 15—25% by weight of chlorinated rubber having a chlorine content of not less than 60% and 15—30% by weight of chlorinated naphthalene having a chlorine content of not less than 55%, together with a filler and vulcanisation accessories for the neoprene.

4. A fire-resistant rubber-like composition obtained by vulcanising a mix comprising from 30—50% by weight of neoprene and ~~from~~ 10—20% by weight of the material sold under the trade name "Arubren." from

5. Fire-resistant rubber-like compositions substantially as described with reference to Examples 1—4 inclusive.

Dated this 5th day of May, 1939.
R. L. CLEAVER.
Agent for the Applicants,
Cable Research House,
Barter Street,
London, W.C.1.

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I certify this to be a true copy
2 MAY 1940
Acting for Comptroller.

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