(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 029 234**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **80107059.0**

(22) Date of filing: **14.11.80**

(51) Int. Cl.³: **H 01 B 7/02**, H 01 B 3/44, B 32 B 27/08

(30) Priority: **15.11.79 IT 2729579**

(43) Date of publication of application: **27.05.81 Bulletin 81/21**

(84) Designated Contracting States: **AT CH DE FR GB LI NL SE**

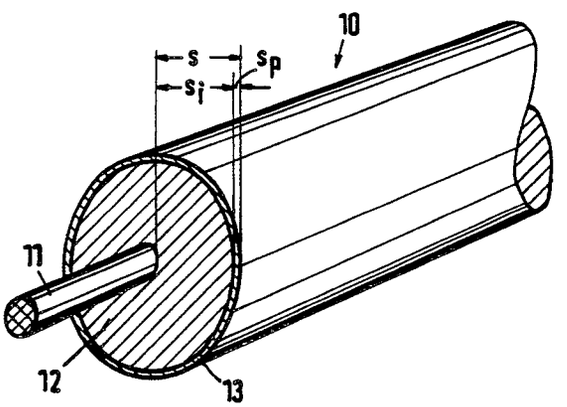
(71) Applicant: **INDUSTRIE PIRELLI S.p.A., Piazzale Cadorna, 5, I-20123 Milan (IT)**

(72) Inventor: **Beretta, Germano, Via Puglia 5, Monza (Milan) (IT)**

(74) Representative: **Dr. E. Wiegand Dipl.-Ing. Niemann Dr. M. Kohler, Dipl.-Ing. C. Gernhardt Dipl.-Ing. J. Glaeser Patentanwälte Herzog-Wilhelm-Strasse 16, D-8000 München 2 (DE)**

(54) **Low voltage cable provided with improved insulating layer.**

(57) Low voltage cable having a conductor (11) insulated with a compound of PVC containing a mineral filler in an amount of 40 to 500 parts by weight per 100 parts by weight of PVC. The insulating layer (12) is coated with a skin (13) obtained with a compound of PVC further containing at least a plasticizer.



EP 0 029 234 A1

0029234

LOW VOLTAGE CABLE PROVIDED WITH IMPROVED INSULATING LAYER

The present invention concerns an improvement to low voltage cables which comprise a single conductor and which are insulated with a compound based on polyvinylchloride (PVC), said cables being well known as wiring cables for civil appliances.

In the state of the art, these cables are generally realized taking into account especially very low costs yet compatibility with the electrical, mechanical and ageing characteristics, determined by standards in force.

It follows that the insulating layer of the wiring cables for civil appliances is always realized with compounds having a very high mineral filler content up to 30 parts by weight per 100 parts by weight of resin.

The insulating layer of low voltage cables used up to now had always a quite rough surface owing to the high content of mineral fillers. The high friction coefficient due to the roughness creates difficulties during drawing, and abrasions because of the contact with the inner surface of the conduits. Moreover, in spite of the presence of the mineral filler, the content of polyvinylchloride is always high with respect to said mineral filler. The polyvinylchloride is a thermoplastic material and in case of overheating it melts, exposing the conductor, with serious risk of short circuits.

The present invention aims to improve with the electrical characteristics being the same, any other properties of the wiring cables for civil appliances used up to now, eliminating the drawbacks, but retaining very low costs of the product.

The invention teaches a cable the insulating layer of which, even if it comprises a high mineral filler content, much higher than the presently used content,

has such a structure as to offer good mechanical characteristics, a very low friction coefficient, and a high fire resistance. Furthermore said insulating layer can be easily stripped and therefore easily applied and permits a high reliability in case of overheating.

More precisely, one object of the invention is a low voltage cable, having a conductor constituted by one or more wires stranded together and covered with an insulating layer realized with a compound based on polyvinylchloride, said compound containing also at least a mineral filler and a plasticizer, characterized by the fact that said mineral filler is contained in the compound in proportions from 40 to 500 parts by weight per 100 parts by weight of polyvinylchloride, said plasticizer being contained in the compound in proportions from 60 to 120 parts by weight per 100 parts by weight of polyvinylchloride, a skin is provided covering the surface of said insulating layer, said skin having a thickness from 5 to 30 % of the thickness of said insulating layer and being constituted by a compound based on polyvinylchloride and containing at least a plasticizer in the quantity of 10 to 40 parts by weight per 100 parts by weight of polyvinylchloride.

The enclosed drawing illustrates by way of a non-limiting example a prcatical embodiment of the invention:

- Figure 1 shows schematically a perspective view of a length of a cable according to the invention.
- Figure 2 shows a test path for wiring cables of civil appliances.

The low voltage cable 10 shown in figure 1 comprises a

conductor 11 constituted by a single wire, but it is understood that said conductor 11 could also comprise a plurality of wires stranded together.

The conductor 11 is covered with an insulating layer 12 extruded thereon.

The insulating layer 12 is constituted by a compound based on polyvinylchloride (PVC), containing at least a plasticizing mineral filler.

The mineral filler in the compound is present in a proportion from 40 to 500 parts by weight per 100 parts by weight of polyvinylchloride (PVC).

Among the substances which can be added to the compound as a mineral filler the following are preferable:

- calcium carbonate in a preferred proportion of 400 parts by weight per 100 parts by weight of PVC;
- magnesium carbonate in a preferred proportion of 400 parts by weight per 100 parts by weight of PVC;
- calcined kaolin in a preferred proportion of 300 parts by weight per 100 parts by weight of PVC.

The compound of the insulating layer further contains a plasticizer in a proportion from 60 to 120 parts by weight per 100 parts by weight of PVC.

In a preferred embodiment, the plasticizer is contained in a quantity of 100 parts by weight per 100 parts by weight of PVC.

The insulating layer 12 is covered on its surface with a skin 13 or thin layer which is constituted by a compound based on PVC and containing at least a plasticizer.

Preferably, the plasticizer is Di-2-(ethyl-hexyl)-phthalate (D.O.P.).

The content of plasticizer contained in the skin 13 is 10 to 40 parts by weight per 100 parts by weight of PVC. Its preferred content is 30 parts by weight per 100 parts by weight of PVC.

The thickness of the skin 13 is small with respect to the thickness of the insulating layer. The skin thickness might be comprised between 5 and 30 % of the insulating layer thickness and preferably is 15 % of the same.

Surprisingly it has been noted that, even if the compound of the insulating layer 12 is ultra-loaded, the structure of the cable 10 inclusive of skin 13 has a resistance to tensile stresses sufficient for the handling of the cable since the mechanical stresses occuring for example during the winding on the drum are taken up prevalently by the skin 13.

The electrical characteristics of said cable are good.

The outer surface of the cable 10 is moreover very smooth and very bright, owing to the prevalent presence of PVC in the skin 13, so that the cable 10 has a very low friction coefficient at its outer surface in respect to that of cables in use up to now. Said smoothness and brightness permit the drawing of the cable inside the conduits with easy, gentle and continuous sliding.

Another advantage offered by the cable 10 is the ease of stripping of the conductor 11, so that the insulating layer can easily and completely be removed from the conductor during the connecting and sealing operations.

In fact, it is sufficient to cut circularly the skin 13 and the insulating layer 12 down to the conductor 11 to remove a hollow pin comprising the skin 13 and the underlying insulating layer 12 to which the skin 13 adheres perfectly because it is constituted by a compound having the same base of PVC. The hollow pin cavity corresponds to the space previously occupied by the conductor 11.

In a cable according to the invention, in case of overheating, any melting of the PVC will never expose the conductor 11, owing to the presence of a high mineral filler content which filler remains compact, preventing the melted PVC from draining and on the contrary keeping the latter in place.

Moreover, the fact that a cable 10 according to the invention comprising an insulation with a high content of mineral filler has always a sufficiently high plasticizer-resin ratio, contributes to give the cable 10 itself a good cold flexibility.

A further property of cable 10 is a good behaviour to thermocompression because of the essentially "mineral" structure of the compound.

Said structure, shown by a compound with high mineral filler content, improves also the thermal conductivity of the cable 10 with respect to conventional compounds. It follows a more rapid cooling of the cable.

Moreover, in contrast to conventional wiring cables, the compound according to the invention does not include any colouring pigments, especially in the insulating layer, with a minimum risk, therefore, of decay of the insulating characteristics.

Moreover, the presence of a high mineral filler content

makes the cable 10 particularly resistant to flames since said high quantity of filler, besides being incombustible, improves the compatibility of PVC resin with chloroparaffins.

A cable 10 has a further advantage resulting from the good impermeability of skin 13, which lowers greatly the absorption of water of the assembly.

The advantages of the invention are still more evident from the results obtained with a cable having a conductor of 1,41 mm in diameter, coated with a covering having a thickness S = 7 mm, where $S = S_i + S_p$ = 0,6 mm + 0,1 mm, where S_i = insulating layer thickness and S_p = skin thickness.

The compounds used for realizing the skin 13 and the insulating layer 12, respectively, are described hereinbelow:

Skin:	Parts by weight:
Polyvinylchloride	100
Di-2-(ethyl-hexyl)-phthalate	36
Tribasic lead sulphate	7
Calcined kaolin	7
Bibasic lead stearate	0,5
Insulating layer:	
Polyvinylchloride	100
Chlorinated paraffinic plasticizer	100
Magnesium carbonate	400
Calcium stearate	10

Tests conducted on said cable gave the following results:

- electrical characteristics: insulation resistance of 0,2 MΩ/km, measured under water at 70°C;
- flame resistance: "oxigen index" of 28. The test was conducted with the ASTM D 2863-70 method, on the

cable after having removed the conductor;

- cold flexibility: the tests were conducted according to standards CEI 20-11 Quality R issue 1968. This latter test was chosen since it is one of the most severe among the standardized tests;
- very low friction coefficient: it had been measured the force F necessary to draw a bundle of three cables along a conventional corrugated PVC tube, for a path (see figure 2) $l = l_1 + l_2 + l_3 + l_4 \geq 6$ m presenting three angles, α, β, γ, where $\alpha = \beta = 90^\circ$ and $\gamma = 135^\circ$. α is the angle comprised between l_1 and l_2, β is the angle between l_2 and l_3 and γ the angle between l_3 and l_4. The angles α and β were radiused according to an arc of circle having radius r = 10 cm. Each of the three cables had the following dimensional characteristics:
  - conductor diameter = 1,41 mm
  - insulating layer plus skin thickness = 0,7 mm (insulating layer thickness = 0,6 mm, skin thickness = 0,1 mm).

  The force necessary for the drawing is F = 2,5 kg. The advantage is considerable if it is considered that to draw a bundle of cables, with dimensions equal to those of the bundle on which the experimental tests have been conducted, but realized with two cables of conventional type, it is necessary to apply a drawing force of 9 kg.
- absorption: the said cable was kept under water at 100° during 24 hours. At the end of this period it had been found an absorption of 10 mg/cm^2, a value to be considered extremely satisfactory for a cable having such a high content of mineral filler in its insulation.

The particulars of practical realization of the invention can change according to needs, but all will be included in the scope of the invention.

What is claimed is:

1. Low voltage cable having a conductor constituted by one wire or more wires stranded together and covered with an insulating layer realized with a compound based on polyvinylchloride, said compound containing also at least a mineral filler and a plasticizer, characterized by the fact that said mineral filler is contained in the compound in a proportion from 40 to 500 parts by weight per 100 parts by weight of polyvinylchloride, said plasticizer is contained in the compound in a proportion from 60 to 120 parts by weight per 100 parts by weight of polyvinylchloride, a skin (13) is provided covering the surface of said insulating layer (12), said skin having a thickness from 5 to 30 % of the thickness of said insulating layer and being constituted by a compound based on polyvinylchloride and containing at least a plasticizer in the quantity from 10 to 40 parts by weight per 100 parts by weight of polyvinylchloride.

2. Low voltage cable according to claim 1, characterized by the fact that said mineral filler is calcium carbonate.

3. Low voltage cable according to claim 2, characterized by the fact that said calcium carbonate is added in a preferred proportion of 400 parts by weight per 100 parts bei weight of polyvinylchloride.

4. Low voltage cable according to claim 1, characterized by the fact that said mineral filler is magnesium carbonate.

5. Low voltage cable according to claim 4, characterized by the fact that said magnesium carbonate is added in a preferred proportion of 400 parts by weight per 100 parts by weight of polyvinylchloride.

6. Low voltage cable according to any one of the preceding claims,
characterized by the fact that the plasticizer in said compound of said insulating layer is contained in a quantity of 100 parts by weight per 100 parts by weight of polyvinylchloride.

7. Low voltage cable according to any one of claims 1 to 6,
characterized by the fact that said plasticizer is Di-2-(ethyl-hexyl)-phthalate.

8. Low voltage cable according to any one of the preceding claims,
characterized by the fact that in the compound constituting said skin the plasticizer is comprised in a quantity of 30 parts by weight per 100 parts by weight of polyvinylchloride.

9. Low voltage cable according to claim 8,
characterized by the fact that said plasticizer is Di-2-(ethyl-hexyl)-phthalate.

10. Low voltage cable according to any one of the preceding claims,
characterized by the fact that the thickness of said skin is 15 % of the insulating layer thickness.

0029234

Fig.1

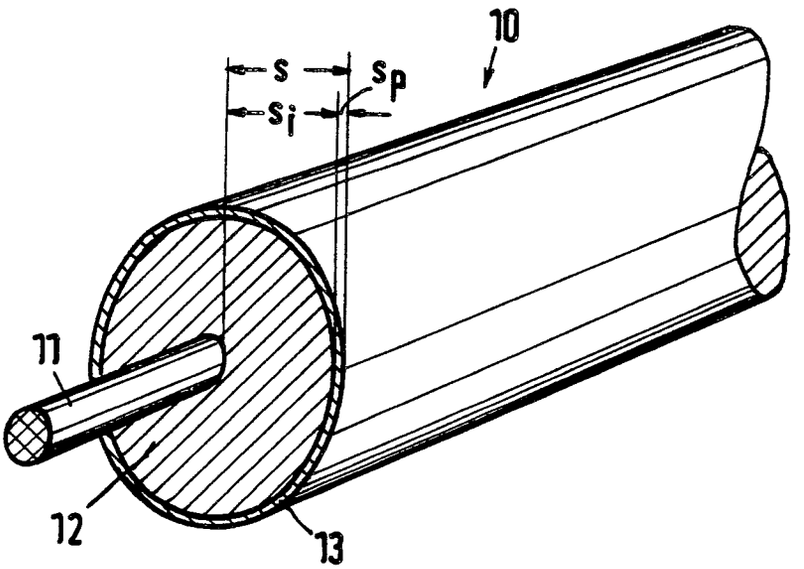
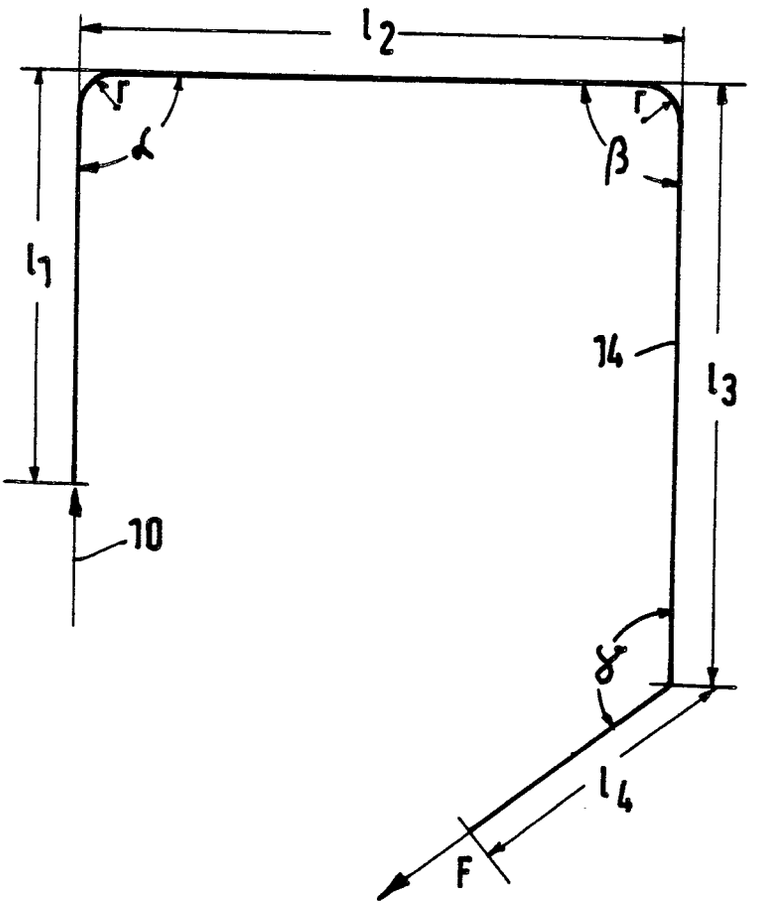


Fig.2



European Patent Office

EUROPEAN SEARCH REPORT

0029234
Application number

EP 80107059.0

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	JP - A2 - 53-50 484 (HITACHI DENSEN) + Pages 6,7; fig. + PATENT ABSTRACTS OF JAPAN, unexamined applications, E-Section, Vol. 2, No. 86, July 14, 1978 The Patent Office Japanese Government, page 3750 E 78 + Kokai-No. 53-50 484 + --	1,2,4
A	HELMUT GRAMM, WERNER SOMMER "Lösungsmittel und Weichmachungsmittel", 7th edition, 1958 WISSENSCHAFTLICHE VERLAGSGESELLSCHAFTmbH, Stuttgart, page 653 + Page 653, line 11 to end of page + --	7,9
A	US - A - 4 166 881 (WESTERN ELECTRIC) + Totality + --	1,7,9, 10
A	DE - B2 - 2 051 192 (PIRELLI) + Totality + --	1,2,4
A	DE - B2 - 2 114 369 (GUTEHOFFNUNGSHÜTTE) + Totality + ----	1,2,4

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

H 01 B 7/02
H 01 B 3/44
B 32 B 27/08

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

H 01 B 7/00
H 01 B 3/00
H 01 B 9/00
B 32 B 27/00
C 08 L 27/00
C 08 K 3/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	02-02-1981	KUTZELNIGG

EPO Form 1503.1 06.78