Feb. 22, 1949. J. K. WEBB 2,462,149

PROCESS FOR TREATMENT OF CABLE INSULATED WITH THERMOPLASTIC MATERIAL

Filed Dec. 19, 1945

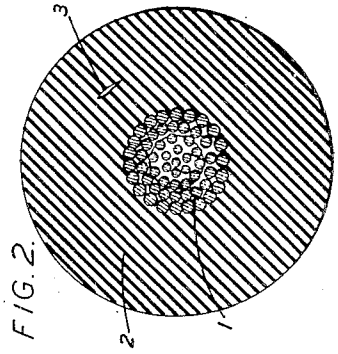

FIG. 2.

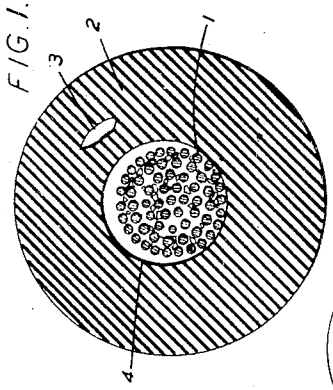

FIG. 1.

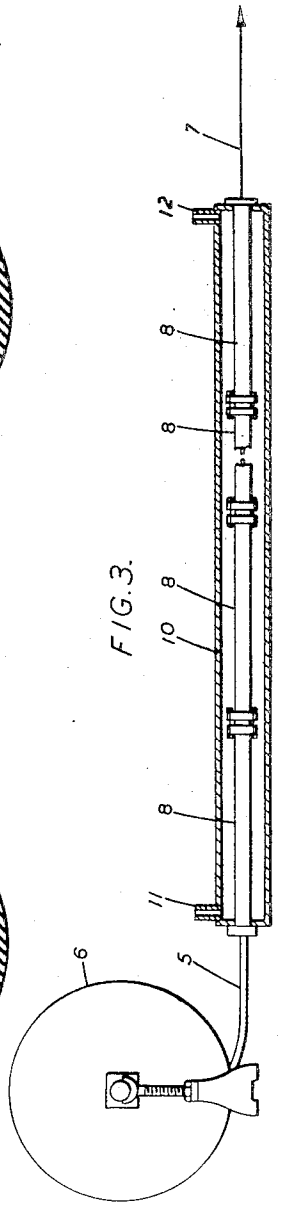

FIG. 3.

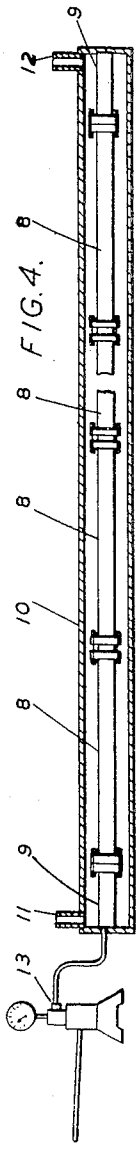

FIG. 4.

INVENTOR
John Krauss Webb
BY
Robert Harding Jr.
ATTORNEY

Patented Feb. 22, 1949

2,462,149

UNITED STATES PATENT OFFICE

2,462,149

PROCESS FOR TREATMENT OF CABLE INSULATED WITH THERMOPLASTIC MATERIAL

John Krauss Webb, London, England, assignor, by mesne assignments, to International Standard Electric Corporation, New York, N. Y., a corporation of Delaware

Application December 19, 1945, Serial No. 636,022
In Great Britain December 22, 1944

1 Claim. (Cl. 18—48)

1

This invention relates to treatment of electric cables and more particularly of cables in which the conductor is insulated with a covering of thermoplastic material.

With such cables voids are apt to occur in the body of the insulation and along the boundary between the conductor or conductors and the insulation. Some of the voids may initially be vacuous but in course of time the gas pressure in them increases owing to air diffusing through the insulation. Voids are particularly liable to occur along the boundary between the conductor and its surrounding insulation in the case of insulation composed of certain thermoplastic materials that either do not adhere to metal at all or do not satisfactorily or easily adhere thereto. This is particularly the case with solid polymers of ethylene, known as polythene, since these substances will not at all adhere to metal unless some special precautions are taken.

It is the object of the present invention to eliminate the voids referred to above.

According to the present invention a method of manufacturing an electric cable the conductor of which is insulated with a covering of thermoplastic material comprises heating the insulated conductor and subjecting it to pressure whilst hot and during subsequent cooling.

The time during which the heat and pressure are maintained depends upon the temperature, the higher the temperature the less the time required so that it is preferable to heat to a temperature only a little below the melting point. The insulated conductor should not of course be raised to such a temperature that the insulating material melts.

By this means the voids in the insulation and between the insulation and the conductor are substantially reduced as may be determined by visual inspection and by measurements of the minimum voltage at which ionisation occurs. As an example, in a conductor of a diameter 0.030 inch covered with a solid polymer of ethylene to an outside diameter 0.287 inch the minimum voltage at which ionisation occurred was increased from about 2 kv. to over 6 kv. by the application of the method set out above.

A still further improvement may be effected by placing the insulated conductor in vacuo prior to heat and pressure being applied, the insulated conductor being allowed to remain in vacuo for a sufficient period to enable any air therein to diffuse away. As however the pressure difference assisting the diffusion of the air is not greater than 15 lb./sq. inch, the period required for the

2

air to diffuse away may be inconveniently long. It may, however, be lessened by first compressing the insulated conductor and then releasing the pressure and storing the cable for a while at atmospheric pressure or in vacuo. Any entrapped air is thus raised to a higher pressure and tends to diffuse more quickly through the insulation whilst the insulated conductor is maintained at atmospheric pressure or below. The time required is still further reduced if the insulated conductor is heated whilst under pressure so that the preferred method is to heat the insulated conductor whilst subjecting it to pressure, allow it to cool whilst the pressure is maintained, evacuate the container in which the cable is placed, allow the insulated conductor to remain in vacuo for a time and then to repeat the heat and compression.

The invention although particularly applicable to and hereinafter described in connection with a cable in which the conductor is insulated with polythene, is not confined thereto but is applicable to cables the conductors of which are insulated with other thermoplastic materials.

In the drawings:

Fig. 1 shows in cross section a stranded conductor insulated with an extruded covering of polythene immediately after extrusion;

Fig. 2 shows, also in cross section the same insulated conductor after the method of the invention has been applied thereto;

Fig. 3 shows one form of apparatus for treating a cable of comparatively large diameter according to the invention.

Referring to the drawings, Fig. 1 shows a stranded conductor 1 over which has been extruded a covering of polythene 2. Owing to such factors as air bubbles in the extruded polythene and contraction upon cooling voids such as 3 may be formed, and there may also be a space 4 between a portion of the periphery of the conductor and the surrounding polythene. These features have been shown in exaggerated form for the sake of clearness. The polythene does not adhere to the wires of the stranded conductor 1.

In order to reduce these voids the cable is placed in a chamber which is provided with means for heating it and for evacuating it or filling it with a pressure fluid as desired. Figs. 3 and 4 show such an apparatus adapted for a cable of large diameter such as the power cable shown in cross-section in Fig. 1.

In Fig. 3 the cable 5 is unwound from a drum 6 and pulled by means of a steel hawser 7 fixed to its end into a steel tube which consists of sev-

eral sections 8 of heavy steel pipe jointed together. The ends of the cable are sealed by means of metal caps bound with rubber tape. Suitable end pieces 9 are then bolted on the end sections 8. The steel tube composed of the sections 8 and end pieces 9 is then evacuated of air and filled with water.

The steel tube is enclosed within an outer jacket 10 provided with inlet and outlet pipes 11 and 12 and steam under pressure is circulated through the jacket 10, thus heating the water within the inner steel tube. When the water has been heated to a temperature of 105° C. its pressure is increased by means of a suitable pump 13 to about 2 tons per square inch. After remaining at this temperature and pressure for some hours the steam is shut off and the cable allowed to cool slowly with the pressure still maintained. After room temperature is attained the pressure is released and the steel tube emptied of water.

The steel tube may then be evacuated and the cable left in vacuo for some hours or even days. Or the end caps 9 may be removed and the cable pulled out of the steel tube, rewound on a drum and stored for some days or weeks, and then redrawn into the steel tube and the end caps 9 replaced.

In either case the steel tube is again filled with water and the heat, pressure and cooling cycle repeated.

It will be understood that cables of small diameter can conveniently be wound upon a former and that the chamber for carrying out the cycle of operations above described can therefore conveniently be of different form than that described.

The result of the operations described on the cable of Fig. 1 is shown in Fig. 2. The void 3

has been reduced to a smaller size whilst the polythene 2 has been forced into the interstices between the strands of conductor 1 thus eliminating the space 4. The only spaces left, are those in the centre of the conductor 1. If the void 3 in Fig. 2 contains air, such air will be highly compressed and in the course of further storage at atmospheric pressure the air will diffuse away thus completely eliminating this void 3.

What is claimed is:

Process for treating a thermo-plastic insulated cable that comprises placing the finished cable in a pressure chamber, applying pressure to the cable within the chamber and maintaining the cable at a temperature such as to cause softening without melting of the insulation whereby the insulation is compressed and gas within voids in such insulation is subjected to increased pressure causing reduction in the size of such voids, thereafter reducing the temperature while maintaining the pressure whereby the insulating material becomes solid, then storing the cable at sub-atmospheric pressure whereby gas in the voids diffuses through the insulating material into the surrounding atmosphere.

JOHN KRAUSS WEBB.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,501,791	Marshall	July 15, 1924
2,035,190	Renfrew	Mar. 24, 1936
2,245,640	Beattie	June 17, 1941
2,273,188	Graves	Feb. 17, 1942
2,384,224	Williams	Sept. 4, 1945