

June 10, 1969

P. BURNEL

3,449,235

APPARATUS FOR ELECTRODEPOSITION ON A TUBULAR FABRIC

Filed June 22, 1964

Sheet 1 of 2

Fig. 1

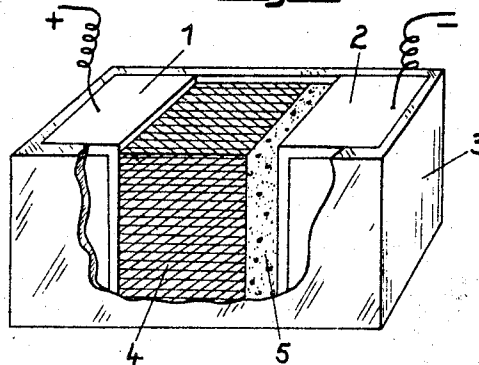


Fig. 2

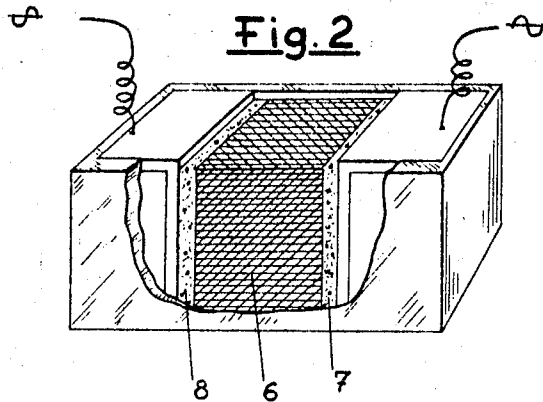


Fig. 3

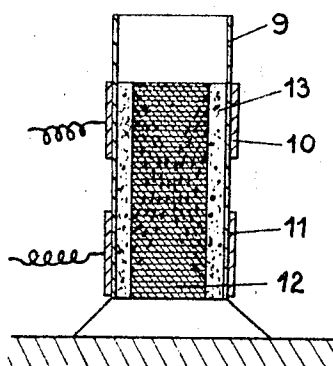
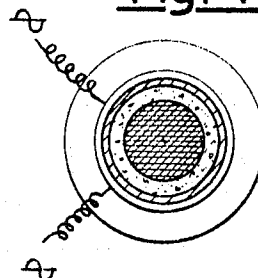


Fig. 4



Inventor

Philippe Burnel

By *Stevens, Davis, Miller & Mosher*

Attorneys

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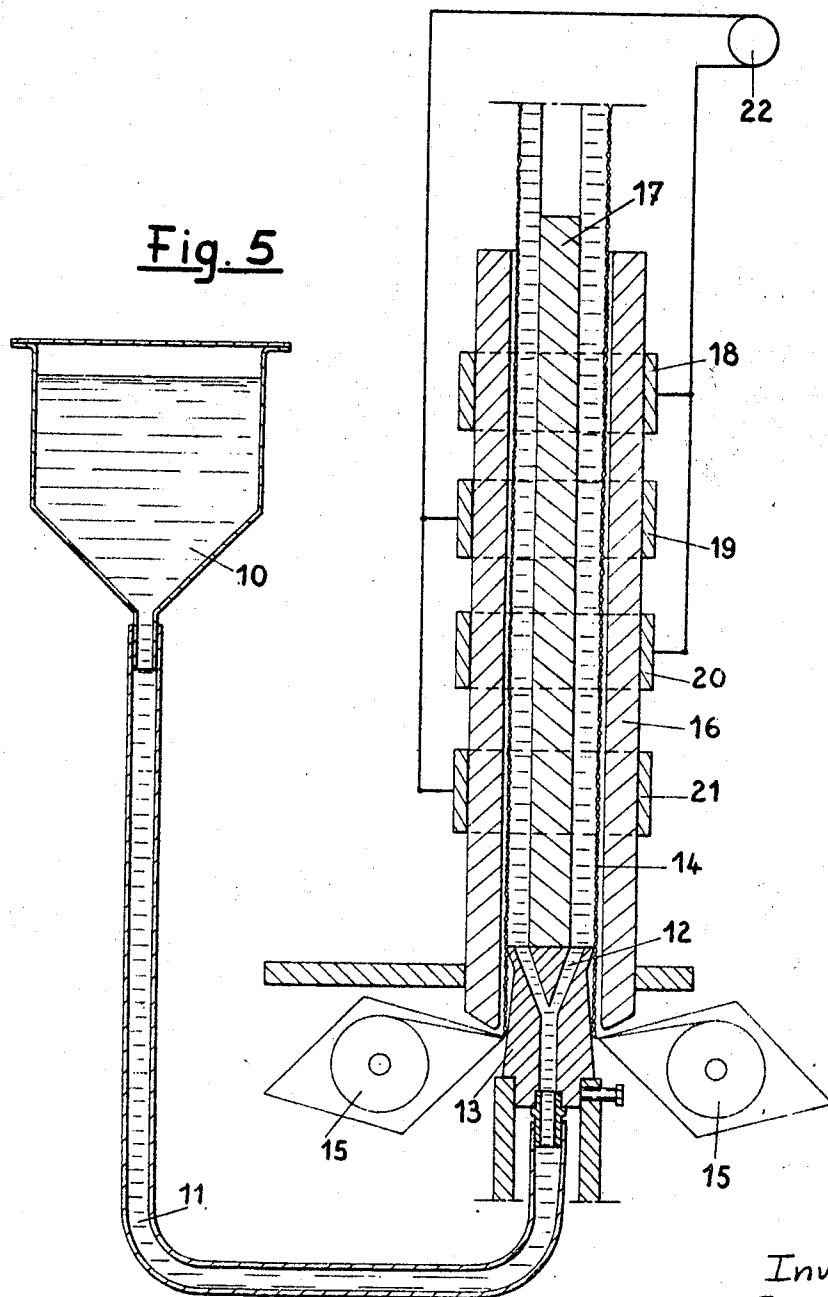
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Inventor
Philippe Burnel
By *Stevens, Davis, Miller & Mosher*
Attorneys

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3,449,235 APPARATUS FOR ELECTRODEPOSITION ON A TUBULAR FABRIC

Philippe Burnel, 1 bis Richard Wallace,
Neuilly-sur-Seine, France

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294,769

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2 Claims

ABSTRACT OF THE DISCLOSURE

A non-ionic colloid and a sensitizer are added to a rubber latex for the purpose of improving an electrophoretic deposition process. The electrodeposition may be effected onto a moving textile sheathing which may be in tubular form.

This invention relates to improvements in conjunction with natural or synthetic latex gels, particularly for the purpose of electrodeposition.

Expectations relating to the future of techniques applying the electrophoresis of latex have not been realised. The process appears to have been completely abandoned by industry and the reasons generally given for this setback are the following:

Local concentration of the particles near the anode;

Coagulation of the rubber particles by the positive ions emitted by the anode or originating from the anode compartment;

Partial dehydration of the deposit by endosmosis of the liquid.

The applicant has realised that these reasons were far from being the principal ones. On the other hand, he has realised that one of the main reasons for the setbacks was due to the fact that, because of insufficient analysis of the electrophoresis operation, the main factor, that is to say the constitution of the latex subjected to the electrophoresis, had been if not completely neglected, at least insufficiently and non-exhaustively taken into account.

It is very rare that producers of latex give precise information regarding the nature of the protective agents and stabilisers which they utilise for the purpose of preventing subsequent degradation of the latex and its coagulation during shipment and storage. The presence of these substances is a primordial cause of the setback.

According to the present invention, a non-ionic protective colloid is added to the latex, the function of which will be to coat the particles of latex and also the anionic agents introduced by the manufacturer into the latex. It must however be so selected that it will lose its own electrostatic identity under the action of electric fields and permit the action of the sensitising agent in the presence of which the operation is carried out.

The best results will be obtained by using a sufficient quantity of non-ionic protective colloids to ensure complete coating of the particles, and a quantity of sensitizer (coagulant) permitting quantitative gelling into rubber.

In order to determine these quantities, having regard to the diversity of the latices and particularly the uncertainty of some of their constituents, on the one hand, and on the other hand the influence of fillers and vulcanization products, it will be necessary to operate by successive tests, to which reference will be made below.

It is found that for determined conditions of pH and temperature, the relative proportions are contained within a very narrow range.

The clearest results were obtained by utilising, as non-ionic protective colloid, ethers of aromatic polyglycols

amongst which mention may be made as a typical product of that known under the trade name "Emulvine," which is used in the form of a 20% aqueous solution.

A water soluble methylpolyvinyl ether will be used with this protective agent as sensitising agent; the product known under the trademark "Lutonal M40" will be mentioned as typical.

Referring now to the drawing, FIGURE 1 is a perspective view of apparatus including a direct current source for carrying out the invention.

FIGURE 2 is a perspective view of apparatus of an embodiment employing alternating current.

FIGURE 3 is a vertical sectional view of another embodiment of the invention.

FIGURE 4 is a horizontal sectional view of the apparatus of FIGURE 3.

FIGURE 5 is a somewhat diagrammatic vertical sectional view through apparatus for effecting the electrodeposition onto an annular textile sheathing.

With these two typical additives referred to above, one of the two following tests may be carried out, which can and should be repeated, equivalent results being obtained, if it is desired to study and seek protective colloids and/or sensitising agents other than those indicated.

FIRST TEST (FIGURE 1)

Two metal electrodes 1, 2 having a side length of one centimetre are situated against the opposite walls of a container 3 of insulating material of one cubic centimetre.

This container is filled with the latex formula. A direct current voltage of 24 volts is applied to the terminals of the electrode. The resistivity of this cubic centimetre of latex is adjusted at 7,000 ohms. The current circulating between the electrodes is therefore $24/7,000=0.0034$ ampere.

The liquid phase passes to the solid phase of the latex in three seconds. In addition, a very considerable concentration of all the solid particles is observed visually at 4 on the positive electrode side, with expulsion of the liquid phase at 5 on the negative electrode side.

The amplitude and speed of the phenomenon are such that on the negative side (expulsion of the liquid phase) there is found at 5 the formation of a space having a thickness of 2 mm. which is filled exclusively with water expressed by the gel, whereas on the positive electrode side there is a homogeneous block of rubber 4 which immediately has mechanical properties.

The very high speed of concentration of the particles under the action of electric fields does not permit the time required for the formation of a sheath of hydrogen on the anode.

The local concentration on the anode of a sheath of hydrogen generates an electromotive force which is opposite to that applied to produce the electrophoresis, which is accordingly reduced. This has the result that the current is reduced and practically cancelled out (polarisation phenomenon). This consequently results in a limitation of the thicknesses of coagulated latex, this group of phenomena being tied to the time factor.

The invention therefore eliminates one cause of the setback which hitherto does not appear to have been elucidated. Consequently, considerable thickness can be obtained, and it becomes possible to produce industrially coatings of a thickness of several millimetres on metal, textile, and other frameworks.

SECOND TEST (FIGURE 2)

With the same container, provided with the same electrodes, a similar experiment is carried out, but with a voltage of 24 volts alternating current 50 cycles per second applied to the electrodes.

The gel is formed substantially at the same speed but the particles having been attracted to both electrodes, because the latter alternately become positive and negative 50 times per second, the solid gel is uniformly distributed at 6 in the middle portion between the electrodes, and the same is true of the liquid phase which is interposed at 7 and 8 between the walls of the electrodes and the solid block of rubber thus formed.

The experimental results which it is desired to obtain being known from the above data, successive tests will be carried out until these results are actually achieved, and, as has been stated, it will be found that these results are obtained only for quantities of the two substances which vary within very narrow limits, for a given temperature of operation and a given pH.

These tests, which have been confirmed at the industrial stage, show that the speed of electrodeposition is increased to a considerable extent, but the qualities of the deposit are also increased because a clear separation is achieved between the liquid phase and the solid phase.

In addition, a new method and a new apparatus result from these tests, and are achieved through the following experiment:

EXPERIMENT (FIGURES 3-4)

A graduated glass test tube 9 of circular shape will serve as container. Two copper electrodes of circular shape and a width of 5 mm. are applied against the outside of the glass wall of this test tube and insulated from one another by a space of about 5 mm. The power applied to the electrodes will be a high frequency voltage produced by a high frequency generator of the electronic type. All ranges of frequency from 20 kilocycles to 100 megacycles per second have been applied with the same success. Coagulation in the form of a solid, compact, irreversible gel is obtained in one second with one cc. of liquid latex. The characteristics of this cycle are the same as for test No. 2 at 50 cycles per second.

In this experiment the electrodes are insulated from the liquid latex by the glass wall of the test tube.

The high frequency power travels through the dielectric constituted by this glass and the latex particles are attracted inside the insulated space at 12 between the two electrodes in the identical manner to the previously described experiments with the formation at 13 of a liquid phase of about 2 mm. thickness.

The apparatus which is described in the U.S. Patent No. 3,156,600, Fontaine, and U.S. application Ser. No. 260,002 dated Feb. 2, 1963 now abandoned may be conveniently adapted for carrying out the present invention.

FIGURE 5 illustrates diagrammatically the apparatus to which the invention is applied.

The machine is fed from the tank 10 with a latex prepared as described above. This latex enters through the pipe 11 and the passage 12 in the sleeve 13 to the interior of the textile sheathing (framework) designated by 14, which is formed around the sleeve 13 by a circular loom represented diagrammatically at 15. The sheathing 14 passes to the interior of the cylindrical sleeve 16, which is

made of dielectric material for example glass. The sleeve 16 contains in its interior a rod or mandrel 17 which determines the inside diameter of the pipe.

The sheathing 14 is drawn continuously upwards by any device used in normal techniques, not illustrated. Four circular electrodes 18, 19, 20 and 21 are disposed around and outside the sleeve 16 and are connected two by two and alternately to a source of high frequency current, represented diagrammatically by 22.

Annular electrodes are disposed along the entire length of the glass sleeve, against the outside wall, and are alternately connected to the terminals of a high frequency source, the frequencies selected being preferably within the range of 20 to 35 megacycles per second, these frequencies being the most effective for the application of the process according to the invention.

Operation is as follows: as the finished pipe is drawn continuously upwards, the electrodeposition is effected regularly and extremely quickly in the field of the electrodes.

Depending on the texture of the sheathing which is passed through the sleeve, there will be obtained an internal coating of the sheathing, a sheathing intensely impregnated with the deposited latex, or a sheathing embedded in the mass of the layer deposited.

What I claim is:

1. In apparatus for lining a tubular fabric by means of a liquid lining compound, comprising a vertical elongated sleeve having an internal diameter substantially equal to the external diameter of the tubular fabric, and means for continuously pulling said tubular fabric through said sleeve, wherein the improvement comprises means to promote a high frequency electric field through said sleeve.

2. Apparatus as set forth in claim 1, in which said field promoting means include annular electrodes disposed outside and along the length of said sleeve, said electrodes being alternately connected to the terminals of a high frequency electric source.

References Cited

UNITED STATES PATENTS

1,723,083	8/1924	Sheppard et al.	204—182
1,867,970	7/1932	Hailwood et al.	204—182
3,156,600	10/1964	Fontaine	156—393
3,066,720	12/1962	Fontaine	156—393

FOREIGN PATENTS

284,736	2/1928	Great Britain.
316,924	8/1929	Great Britain.
331,563	7/1930	Great Britain.

JOHN H. MACK, *Primary Examiner.*

E. ZAGARELLA, JR., *Assistant Examiner.*

U.S. Cl. X.R.

156—393; 204—181, 182, 183