Aug. 9, 1932. R. R. EVANS 1,870,990

INSULATION OF WIRE

Filed Feb. 24, 1930 2 Sheets-Sheet 1

Fig. 1.

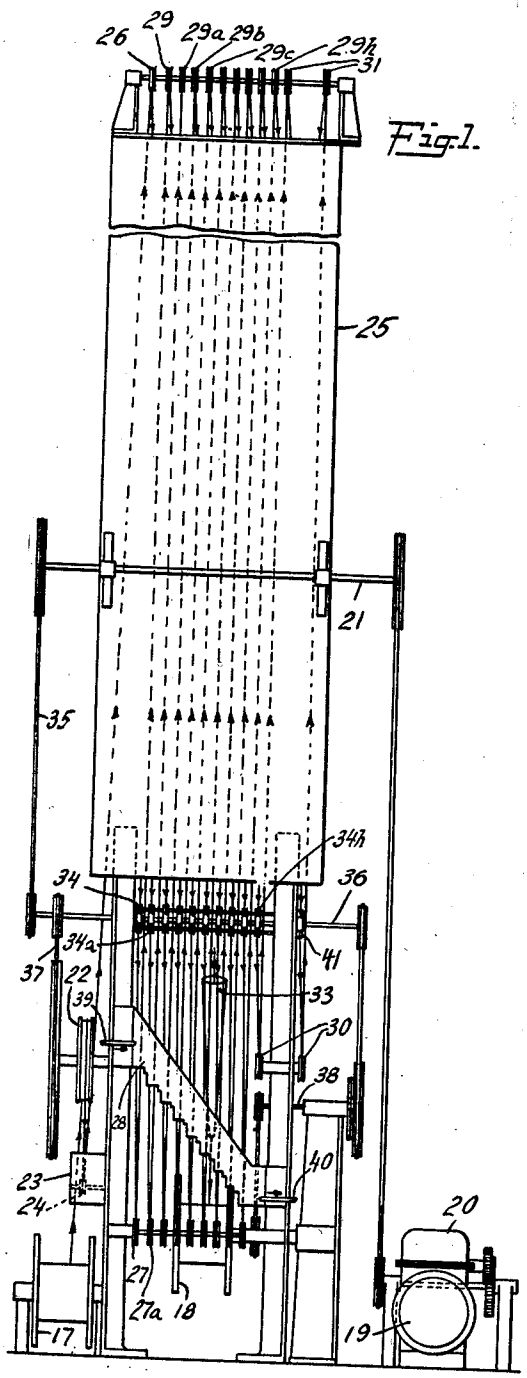
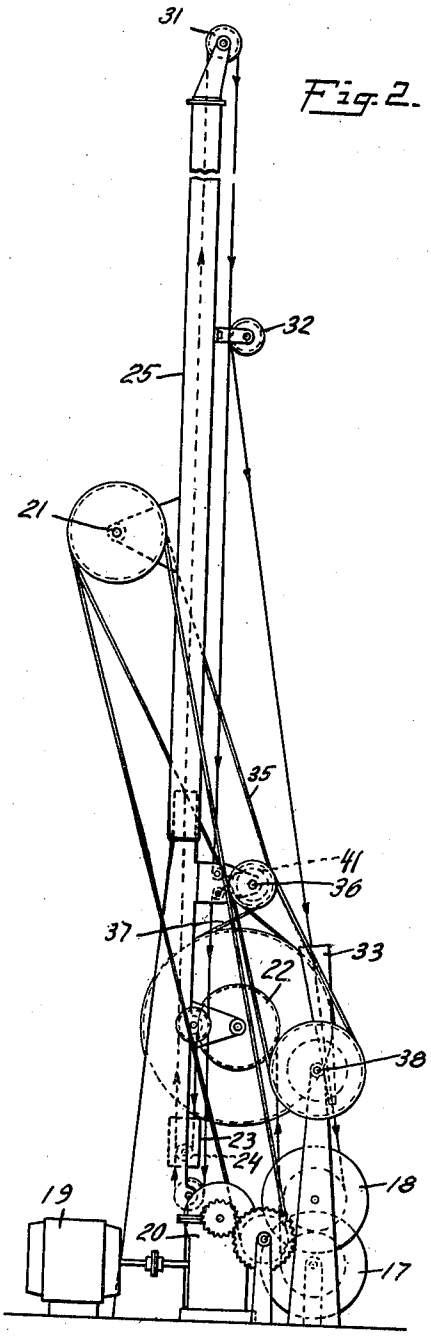


Fig. 2.



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Filed Feb. 24, 1930 2 Sheets-Sheet 2

Fig. 4.

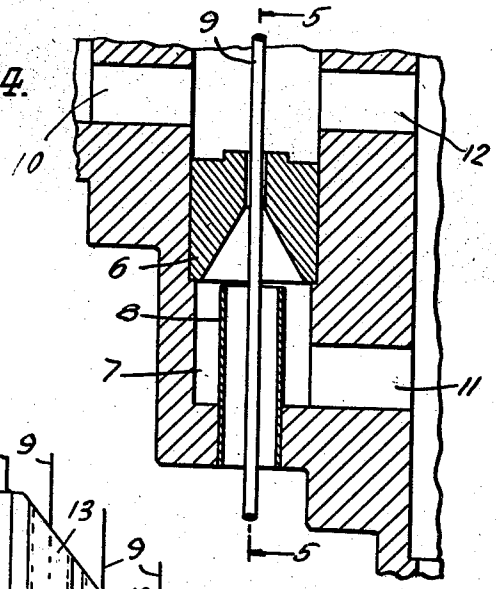


Fig. 5.

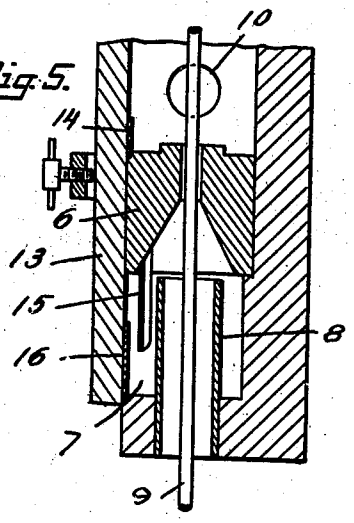
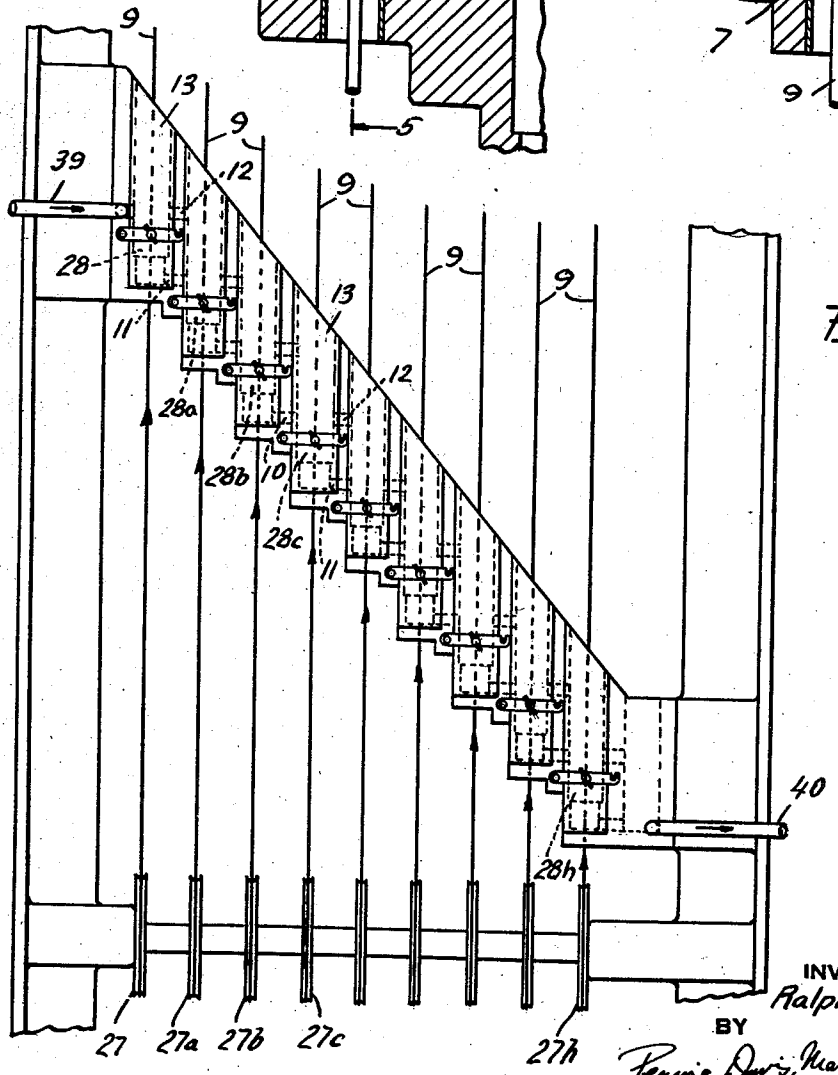


Fig. 3.



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UNITED STATES PATENT OFFICE

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INSULATION OF WIRE

Application filed February 24, 1930. Serial No. 430,725.

This invention relates to improvements in the application of liquid dispersions of insulating materials to wire in the manufacture of insulated wire and cable. The invention includes improvements in process and in apparatus.

The invention is of special value in the application of aqueous dispersions including vulcanized but substantially uncoagulated rubber, such for example as are described in United States Letters Patent Number 1,433,149 and 1,682,857, issued January 23rd, 1923, and September 4th, 1928, respectively, to wire. In one aspect, this invention provides improvements of special value in carrying out the process and in making the product described in an application filed November 7th, 1928, by Charles R. Boggs, Serial Number 317,883.

Liquid dispersions, such as the aqueous dispersions of vulcanized but substantially uncoagulated rubber just mentioned, frequently become unstable when subjected directly to friction, local pressure or agitation produced by the coaction of mechanical elements within the liquid dispersions. For example, in attempted application of such liquid dispersions to wire by passing the wire beneath a sheave positioned in a bath of the liquid dispersion, the common method of applying liquid coating materials to wire, difficulties are frequently encountered due to the formation of coagulated lumps or strings of the dispersed material in the bath, involving the production of a nonuniform and consequently unsatisfactory product. This tendency seems to be due to the coaction between the wire and the sheave or between the sheave and its mounting within the bath.

In endeavoring to eliminate these difficulties, I have devised a number of processes and various apparatus. For example, I have been able to apply such liquid dispersions to wire by passing the wire while suspended as a free loop through a bath of the liquid dispersion. Again for example, I have been able to apply such liquid dispersions to wire by arranging sheaves or other guides for the wire within a bath of mercury and floating a bath of the liquid dispersion upon that part of this bath of mercury through which the wire emerges. These schemes, however, have not been free from some difficulties. The free loop scheme is subject to difficulties with respect to regulation, and the mercury bath scheme is expensive, involves the handling of a poisonous material and is subject to difficulties with respect to entrainment of mercury on the wire or in the applied coating.

In my study of this problem, however, I have found that such liquid dispersions tend to flow more readily over a surface previously wetted by the liquid dispersion than over a surface previously unwetted by the liquid dispersion, and I have embodied this principle in the process and apparatus of my present invention to secure a number of important practical advantages.

In carrying out the process of my present invention, I pass the wire, then unwetted by the liquid dispersion, upwardly through an aperture in a die somewhat larger than the wire and then through a pool of the liquid dispersion maintained on the upper face of the die without permitting the wire to contact with the die, and I prevent the liquid dispersion from flowing downwardly along the approaching unwetted wire below the die by dimensioning the aperture through the die so that it is smallest in section above its lower end and flares outwardly below this smallest section. I thus provide, in effect, for the entry of the wire into the lower part of the bath of the liquid dispersion, to be passed upwardly therethrough, without the use of stuffing-boxes or sheaves or other mechanical elements coacting with each other or with the wire within the liquid dispersion. Part of the liquid dispersion flows downwardly through the aperture, through the space around the wire, but, unless the aperture through the die is so much larger than the wire as to permit this flow to be very rapid, this part of the liquid dispersion follows the surface of the die away from the approaching unwetted wire below the point at which the aperture through the die is smallest in section and is collected in an appropriate trap.

In the apparatus of my present invention,

I position the die, having a vertical aperture therethrough smallest in section above its lower end and flaring outwardly below said smallest section, above and in alignment with a trap having a vertical aperture therethrough, the aperture through the trap being at least as large in section as the smallest section of the aperture through the die and being smaller in section at its upper end than the lower end of the aperture through the die, and I position guides, sheaves for example, above the die and below the trap so that a wire moving upwardly through the trap and the die over these guides is prevented from contacting with the die.

I will describe my invention in more detail in connection with the accompanying drawings which illustrate, somewhat diagrammatically and conventionally, apparatus embodying my invention and adapted for carrying out my invention. It is intended and will be understood that the accompanying drawings and the following more detailed description are for the purpose of exemplification; my invention can be carried out in apparatus other than that shown, and the apparatus can be changed and modified in many respects without departing from the spirit of my invention. In the accompanying drawings;

Fig. 1 is a front elevation of a machine embodying my invention and adapted for carrying out my invention,

Fig. 2 is a side elevation of the same machine,

Fig. 3 is an enlarged fragmentary view of the series of die chambers shown diagrammatically in Figs. 1 and 2,

Fig. 4 is a section of a die chamber, and

Fig. 5 is a section on line 5—5 of Fig. 4.

The more important elements of the apparatus illustrated in the accompanying drawings are shown in detail in Figs. 4 and 5. The die 6 has a vertical aperture therethrough which is smallest in section above its lower end and which flares outwardly below this smallest section to a substantially larger section at its lower end. The trap 7, formed by the extension of the annulus 8 within the lower end of the die chamber, has a vertical aperture therethrough, aligned with the aperture through the die 6, at least as large in section throughout as the smallest section of the aperture through the die 6 and smaller in section at its upper end than the lower end of the aperture through the die 6. Liquid flowing downwardly through the aperture through the die 6, following the enlargement of the aperture, drops into the trap 7. The liquid dispersion to be applied to the wire 9, passed upwardly through the die 6, is supplied through inlet 10 at a rate fast enough to maintain a pool of the liquid dispersion on the upper face of the die 6, that part of the liquid dispersion flowing through the aperture in the die 6 being discharged from the trap 7 through outlet 11 and any excess being discharged from the pool through outlet 12. It will be apparent that the pool of liquid maintained on the upper face of the die 6 is controlled by regulating the rate at which the liquid dispersion is supplied through inlet 10 and either or both the rate at which the dispersion is discharged through outlet 12 or the position of outlet 12. A door 13 is provided to afford access to the die chamber and, to avoid discharge of the liquid dispersion through this door, guards 14 and 15 are provided on the die and guard 16 is provided in the trap.

The carrying out of my invention in this particular apparatus may be illustrated by the following example: To apply an aqueous dispersion of vulcanized but substantially uncoagulated rubber having a viscosity of from 5 to 100 times the viscosity of water to wire up to 0.090 inches in diameter, the smallest section of the aperture through the die 6 may be 0.160 inches in diameter and the wire may be passed through the die at a rate approximating 8 feet per minute.

After the wire has passed through the bath of the liquid dispersion of insulating material to be applied to the wire, it is carried upwardly for a distance great enough to afford the time necessary for drying of the applied coating before the coated wire is brought into contact with the guide above the die or any other mechanical element. This, of course, is conventional practice in the application of various coating materials to wire.

The liquid dispersion discharged through the outlets 11 and 12 may be returned to the reservoir from which the liquid dispersion is supplied through inlet 10 or this discharged liquid dispersion may be supplied to the next die chamber of a series of die chambers. A single application of the liquid dispersion may be sufficient in some cases or, to build up a thicker layer of the insulating material, several successive applications of the liquid dispersion may be necessary. The machine illustrated in Figs. 1, 2 and 3 is arranged to subject the wire to 9 successive applications of the liquid dispersion of insulating material.

Referring more particularly to Figs. 1, 2 and 3, the wire to be coated is supplied from a reel 17 and the coated wire is taken off on a reel 18. Power is supplied by the motor 19 through reduction gears and a change gear set 20 to the counter shaft 21. The wire from the supply reel 17 passes around the capstan 22, through the tank 23 beneath the sheave 24, upwardly through the heater-drier 25 and over the sheave 26, downwardly and over the first lower guide sheave 27, upwardly from this guide sheave 27 through the first die chamber 28 and

through the heater-drier 25 and over the first upper guide sheave 29, downwardly and over the second lower guide sheave 27*a*, upwardly from this guide sheave 27*a* through the second die chamber 28*a* and through the heater-drier 25 and over the second upper guide sheave 29*a*, and so on through each of the successive die chambers in the series, from the last die chamber 28*h* upwardly through the heater-drier 25 and over the last upper guide sheave 29*h*, twice more through the heater-drier 25 over the lower sheaves 30 and the upper sheaves 31, and then to the take-off reel 18 over the guide sheave 32 through the chalk hopper 33. The wire is carried through the machine by the capstan 22 and by a series of friction drives 34, 34*a*, etc., 34*h*, and 41, picking up the wire each time as it passes downwardly from the upper sheaves 26, 29, 29*a*, etc., and the sheaves 31, to the lower sheaves 27, 27*a*, etc., and 30. The series of friction drives 34, etc., and 41, are driven from the counter shaft by means of belt 35, the capstan 22 is driven from the friction drive shaft 36 through belt 37, and the take-off reel 18 is driven from the friction drive shaft 36 through traverse shaft 38. The liquid dispersions of insulating material are supplied to the inlet of the first die chamber 28 through connection 39, overflows and is discharged from the first die chamber 28 to the second die chamber 28*a* and so on to the last die chamber 28*h* and overflows and is discharged from the last die chamber 28*h* through connection 40.

To the extent that the die chambers extend upwardly above the surface of the pools of the liquid dispersion maintained on the upper face of the dies therein, an atmosphere of any volatile components of the liquid dispersion of insulating material is maintained, partially confined, above the pools of the liquid dispersion inhibiting evaporation of such volatile components from the liquid dispersion. If desirable for any reason, the die chambers can be elongated to secure this result in increasing measure.

The wire may be subjected to treatment with any desired treating or conditioning agents or preliminary coating materials in the tank 23. For example, a paste may be applied to the wire as it passes through tank 23 to smooth out surface irregularities, or a paste may be applied to a twisted pair or parallel pair of wires to fill interstices. Such pretreatment is not part of my present invention.

My invention is useful in the application of liquid dispersions of insulating materials to bare wire and to wire previously covered with other insulation or protection, for example, to enamelled wire or to wire covered with cotton. My invention is also useful in the application of liquid dispersions of insulating materials to multi-conductor wire and cable as primary insulation or as a jacket over other insulation, to individual conducting elements or to groups of conducting elements. My invention is useful in the application of liquid dispersions of various insulating materials including, for example, rubber, gutta percha, balata, vulcanized or unvulcanized, without or together with other compounding materials commonly used in insulation. My invention is, however, of special value in connection with the application of dispersions including vulcanized but substantially uncoagulated rubber, as noted above.

I claim:

1. In the application of coagulable liquid dispersions of insulating material to wire, the improvement which comprises passing the wire, then unwetted by the liquid dispersion, upwardly through an aperture substantially larger than the wire in a die and then through a mechanically undisturbed pool of the liquid dispersion maintained on the upper face of the die without permitting the wire to contact with the die, and causing the liquid dispersion flowing downwardly through the aperture to be carried away from the approaching unwetted wire below said die.

2. In the application of coagulable aqueous dispersions of vulcanized but substantially uncoagulated rubber to wire, the improvement which comprises passing the wire, then unwetted by the aqueous dispersion of vulcanized but substantially uncoagulated rubber, upwardly through an aperture substantially larger than the wire in a die and then through a mechanically undisturbed pool of the aqueous dispersion of vulcanized but substantially uncoagulated rubber maintained on the upper face of the die without permitting the wire to contact with the die, and causing the aqueous dispersion of vulcanized but substantially uncoagulated rubber flowing downwardly through the aperture to be carried away from the approaching unwetted wire below said die.

3. Apparatus for applying liquid dispersions of insulating material to wire, comprising a die having a vertical aperture therethrough, said aperture being smallest in section above its lower end and flaring outwardly below said smallest section, a trap having a vertical aperture therethrough in alignment with said first-mentioned aperture positioned beneath said die, said second-mentioned aperture being at least as large in section throughout as said smallest section of said first-mentioned aperture, the upper end of said second-mentioned aperture being in section smaller than the lower end of said first-mentioned aperture, guides positioned above said die and below said trap adapted to position a wire moving upwardly through said trap and said die over said guides to avoid contact between said wire and said die, means for

maintaining a pool of the liquid dispersion of insulating material on the upper face of said die and means for discharging such liquid dispersion from said trap away from said wire.

In testimony whereof I affix my signature.

RALPH RUSSELL EVANS.