Oct. 28, 1941. E. E. NEWTON ET AL 2,260,860

APPARATUS FOR HANDLING STRANDS

Original Filed May 21, 1938 3 Sheets-Sheet 1

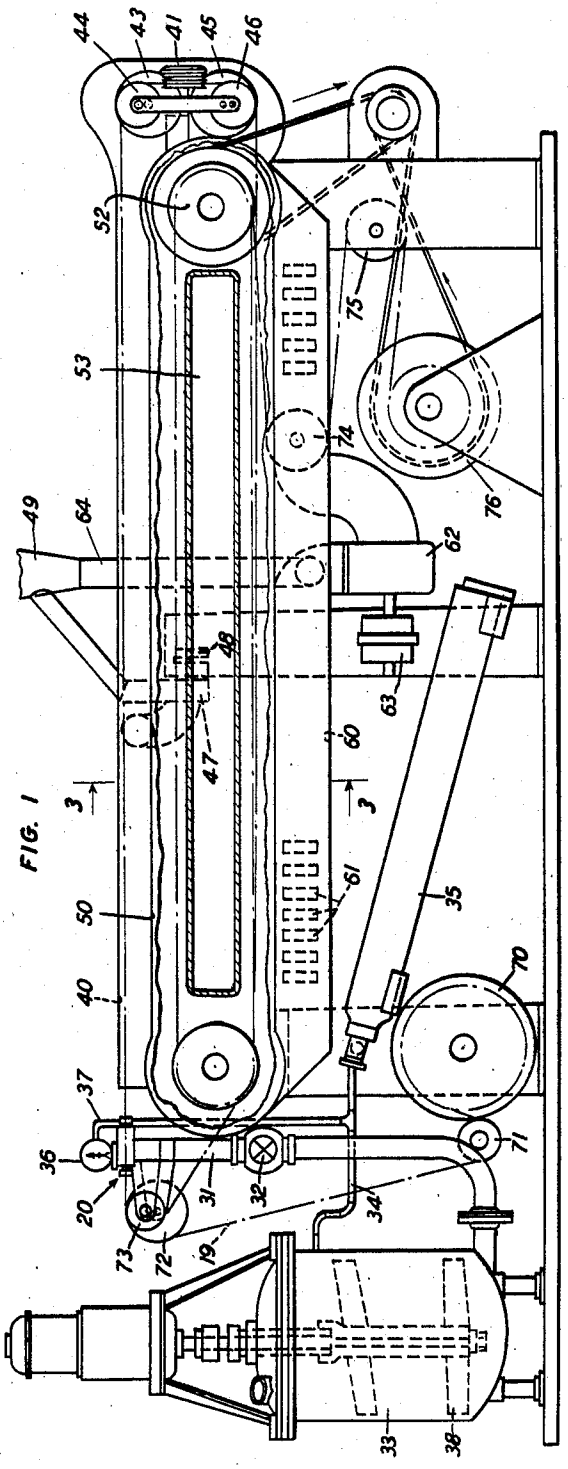


FIG. 1

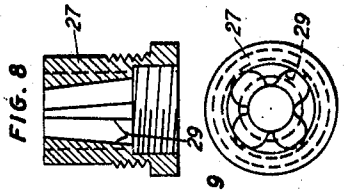


FIG. 8

FIG. 9

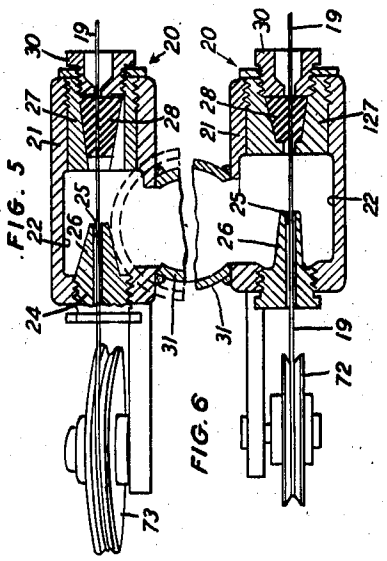


FIG. 5

FIG. 6

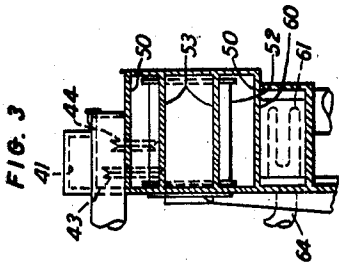


FIG. 3

INVENTORS
E. E. NEWTON
C. A. PEACHEY
F. R. REEVELY

BY E. R. Rowlan

ATTORNEY

Oct. 28, 1941. E. E. NEWTON ET AL 2,260,860

APPARATUS FOR HANDLING STRANDS

Original Filed May 21, 1938 3 Sheets-Sheet 2

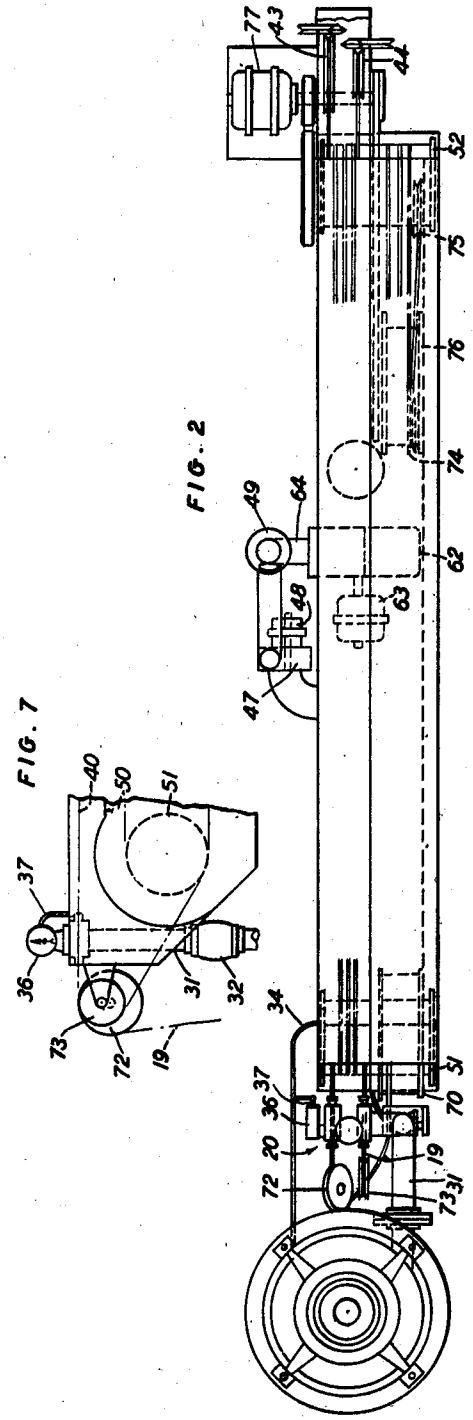


FIG. 2

FIG. 7

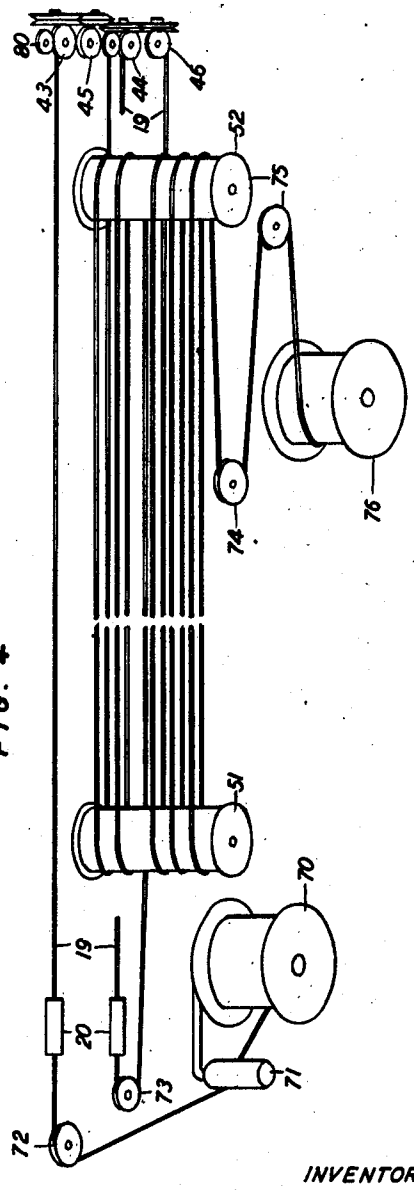


FIG. 4

INVENTORS
E. E. NEWTON
C. A. PEACHEY
F. R. REEVELY

BY E. R. Nowlan

ATTORNEY

Oct. 28, 1941. E. E. NEWTON ET AL 2,260,860

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FIG. 11

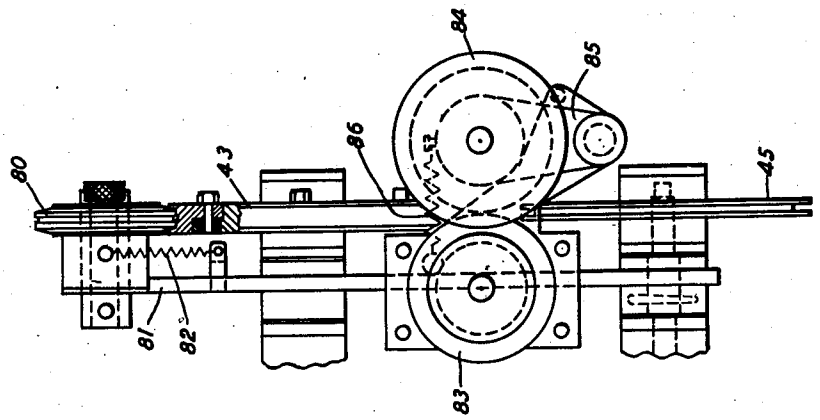


FIG. 10

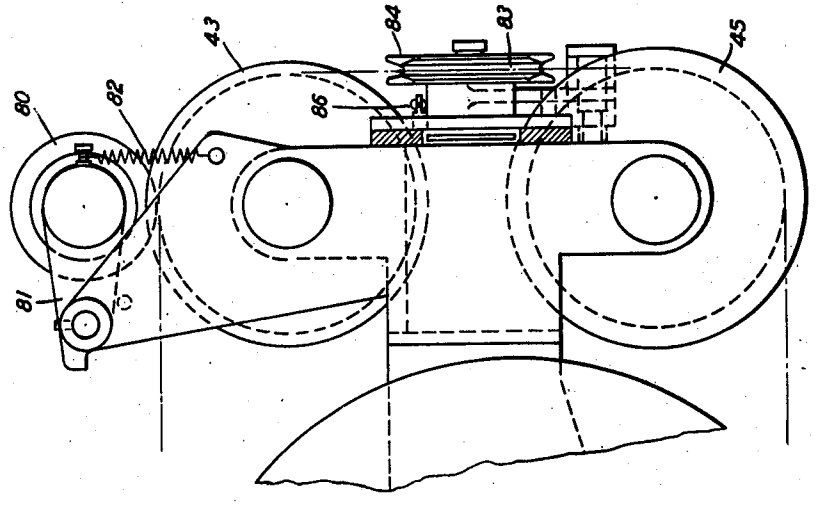


FIG. 12

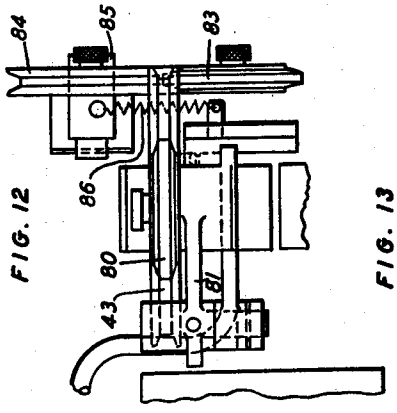
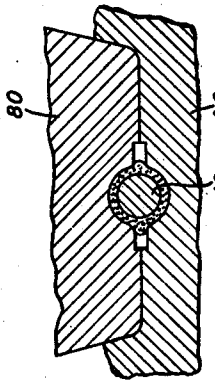


FIG. 13



INVENTORS
E.E. NEWTON
C.A. PEACHEY
F.R. REEVELY

BY E.R. Nowlan
ATTORNEY

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UNITED STATES PATENT OFFICE

2,260,860

APPARATUS FOR HANDLING STRANDS

Edwin E. Newton, Montreal, Quebec, Cyril A. Peachey, Ville La Salle, Quebec, and Frederick R. Reevely, St. Lambert, Quebec, Canada, assignors to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Original application May 21, 1938, Serial No. 209,396. Divided and this application September 15, 1939, Serial No. 295,024

4 Claims. (Cl. 91—55)

This invention relates to an apparatus for handling strands, and more particularly to an apparatus for coating strands, especially electrical conductors, with viscous liquid or plastically pasty materials.

Insulating sheathings on electrical conductors are made, at the present time, in a multitude of ways, some of which include the application to a bare or previously variously sheathed strand of hardenable materials applied in liquid, semi-liquid, or pasty form and subsequently hardened. Thus materials in the nature of paint, enamel, varnish, or waxes, asphalts, paraffins and the like dissolved in volatile vehicles, artificial resins hardenable by polymerization induced by heat, and other analogous materials are used for one or another specific purpose. In many such instances a solvent or vehicle is used which is volatilized to be subsequently recovered; and a considerable part of the cost of the coating operation may arise out of the volume of material to be recovered for subsequent re-use. Hence it is desirable and may be vitally important to apply the raw sheathing or sheath treating material in a condition approaching dryness as nearly as may be practicable, i. e. as a liquid of high viscosity or even a smoothly plastic paste, in order that the volume of vehicle or solvent circulated in the process, or perhaps wasted, may be kept low.

An object of the present invention is to provide an apparatus simple, rapid and reliable in operation, for forming and hardening a coating of material, such as described above, upon a strand, in which the material may be of a viscous or stiffly liquid nature or even a plastic paste, and in which the material may be applied thickly and yet hardened uniformly.

With the above and other objects in view, the invention in one form may be embodied in an apparatus comprising an applicator head with a chamber having a strand inlet member and a wiping die strand outlet member, and means to supply coating material in viscous or pasty form under pressure to the chamber, together with means to subject the coated strand emerging from the chamber to be preliminarily dried or hardened at room temperature and subsequently subjected to being dried at a suitable elevated temperature, thus to avoid formation at once upon the raw sheath of an outer skin which would retard or even prevent escape of vehicle from the inner layers.

Other objects and features of the invention will appear from the following detailed description of one embodiment thereof in an apparatus for applying a viscous mixture of cellulose acetate in an acetone vehicle to a textile covered electrical conductor strand, taken in connection with the accompanying drawings in which the same reference numerals are applied to identical parts in the several figures and in which—

Fig. 1 is a view in side elevation of the apparatus with a portion of one wall broken away;

Fig. 2 is a view of the apparatus in plan;

Fig. 3 is a sectional view on the line 3—3 of Fig. 1;

Fig. 4 is a diagram of the path of a strand through the apparatus;

Fig. 5 is an enlarged detached view partly in section of a preferred form of one of the twin material applicator heads;

Fig. 6 is a similar view of a modified form of applicator head;

Fig. 7 is a fragmentary view similar to Fig. 1 of a modified form of apparatus;

Fig. 8 is an enlarged detached view in section of the die of Fig. 5;

Fig. 9 is a similar end view thereof;

Fig. 10 is an enlarged view in side elevation of the pressure rolls at the right hand end of Fig. 1;

Fig. 11 is a similar view thereof in end elevation;

Fig. 12 is a similar view thereof in plan; and

Fig. 13 is a further enlarged, partial sectional view of the contact of two of the pressure rolls of Fig. 11.

The apparatus herein disclosed comprises, roughly, means to apply a viscous or pasty material to a strand combined with means to harden the applied material on the strand, the two being so constructed and arranged that the process of hardening begins immediately the coating is applied with a step of preliminarily hardening at room temperature and subsequent further treatment at an elevated temperature.

The heart of the paste applying means is a twin applicator device best shown in Fig. 5 and in a modified form in Fig. 6, and generally indicated by the numerals 20. Since this is a twin, a description of one side only will suffice for both. An individual applicator comprises a cylindrical body member 21 having a chamber 22 therein, through which passes a strand 19 to be coated. The strand enters the chamber through an axially bored plug 24 mounted in the rear wall of the chamber, the bore 25 of the plug being sufficiently large to pass the strand without harmful friction. The forward end of the plug ex-

tends taperingly into the chamber as at 26. Another plug 27 (Fig. 5) or 127 (Fig. 6) is mounted in the front wall of the chamber and has housed completely therein a wiper die member 28. This member 28 is a body of soft vulcanized rubber or similar material and is given any convenient shape. The particular member 28 illustrated is an ordinary soft rubber bottle stopper of suitable size. The plug 27 or 127 is recessed to receive and support member 28 which is held in place in the plug by any suitable means such as the removable retainer 30. The plug 27 or 127 and retainer 30 are axially bored to pass the strand 19 with liberal clearance for both the strand and its raw coating. The die member 28 is formed with an axial bore of such size as to pass the strand 19 bearing a raw coating of predetermined desired thickness; and the member 28 acts to wipe off any superfluous thickness of coating.

The above description of the applicator applies equally to the showing of either Fig. 5 or Fig. 6 and is completely descriptive of the structure disclosed in Fig. 6, in which the recess of the plug 127 is of the same shape as the member 28. The plug 27 in Fig. 5 is originally made identically like the plug 127, but the walls of the recess therein are modified by having flutings or grooves 29 formed longitudinally therein.

The structure and function of these applicators per se and apart from their general combination in the structure and function of the apparatus as a whole are no part of the present invention, being disclosed and claimed in copending application Serial No. 209,395, filed May 21, 1938, by one of the present inventors. Also the process for the carrying on of which the present invention was made, is no part of the present invention, being disclosed and claimed in copending application Serial No. 209,396, filed May 21, 1938, by the present inventors and of which application the present application is a division.

An object of this arrangement is to permit the coating material under pressure to have access to the exterior of the soft member 28 to insure a uniform wiping effect.

The twin applicators 20 may conveniently be supported, as shown, upon the upper end of a vertical feed pipe 31 which serves to bring coating material to the chambers 22 as well as to support the twin applicators. A valve 32 mounted in the feed pipe serves to control the flow of coating material from a supply tank 33 through the pipe to the applicators. A supply of some inert gas, nitrogen, carbon dioxide or other similar gas according to the nature of the coating material, under pressure is fed into the upper part of the tank 33, preferably above the level of the coating material therein, through a pipe 34 from a suitable supply 35 of the compressed gas. If desired an indicating pressure gage 36 may be mounted at any convenient place and connected by a pipe 37 to the pipe 34. For many materials, coating material supply means as thus far described is satisfactory. For others it may be desirable to provide agitating means such as a stirrer 38. As such devices are familiar in many suitable forms and their structure and operation are irrelevant to the present invention, no further description is deemed necessary here. Such an arrangement will also enable the material to be compounded directly in the tank 33 if desired.

Immediately behind the pipe 31 and its supported applicators 20 is the entrance to the sheath hardening section of the apparatus. This comprises fundamentally a series of three horizontal, elongated chambers, positioned for convenience one above the other. The first, uppermost chamber 40 opens at its forward end directly opposite to and immediately behind the outlets of the two wiper dies 28 and their retainers 30. The rear end of the chamber 40 opens into a short vertical passageway 41 within which are mounted two coaxially spaced guide sheaves 43 and 44, over which coated strand from the applicators 20 after passing through the chamber 40 passes down and around another pair of guide sheaves 45 and 46 located in the lower portion of the passage 41. The chamber 40 is laterally completely enclosed, but its forward end is open to the outer air, and its rear end is completely open into the passageway 41 and so to the open air, since the passageway 41 has no wall on the side toward the beholder in Fig. 1. Air is drawn from the chamber 40, at some point between its ends, by a blower 47 driven by a motor 48 and is exhausted through a pipe 49, preferably to some solvent recovery means not shown. Fresh air at room temperature then enters the chamber through its open ends.

The second, intermediate chamber 50, may be located most conveniently immediately below and parallel to the chamber 40. The chamber 50 is preferably substantially completely enclosed on all four sides and both ends, except for apertures in its floor near each end communicating with the chamber 60 below. As these apertures are merely means for air to be circulated as later described from the heated chamber 60 through the chamber 50, and hence their size and shape are not material, there appears to be no need to describe them more in detail. The rear end wall next to the sheaves 45 and 46 is provided with small apertures, preferably barely large enough to allow strand from the sheaves 45 and 46 to pass through without harmful friction and enter the chamber 50.

Multi-grooved strand guide rollers 51 and 52 are positioned transversely across the chamber 50 near its respective ends, and strand entering the chamber from the sheaves 45 and 46 passes in a plurality of continuous loops over these rollers as hereinafter described. The forward end wall of the chamber 50 has a small aperture to allow the strand, at one point in its travel, to pass out of the chamber and over a guide sheave 73 into one of the applicators 20. The floor of the chamber 50 is also perforated at one place to allow the strand to pass out of the chamber there and to a take-up mechanism to be described later.

A long baffle 53, running lengthwise of the chamber 50 from near the rear side of the roller 51 to near the forward side of the roller 52, divides the chamber over most of its length into parallel, upper and lower passageways through which the coated strand may pass to and fro between the rollers 51 and 52.

The third, lowest chamber 60 is substantially completely enclosed except at its ends which communicate directly with the chamber 50 through the above mentioned apertures in the common wall of the two chambers. A series of heating elements 61 of any approved and familiar construction, e. g. steam pipes, electric resistance elements or the like, fed from some convenient source not shown, is located in this chamber to heat a current of air or other drying medium passing thereover through the chamber

60. Air may be drawn into the chamber 60 at one end from the chamber 50 and forced into the chamber 50 at its other end by any suitable means such as a blower fan 62 driven by a motor 63. This circulating air is then warmed by the elements 61. A proportion of the air thus circulated may be bled off through a pipe 64, which may conveniently communicate with the pipe 49. In the apparatus disclosed the air thus lost is replaced by leakage into the chamber through the various small apertures noted and also through the unsealed joints of its walls, although, if desired, an appropriate aperture may be provided for this purpose.

Strand to be coated is drawn from a supply reel 70 over a tensioning roller 71 and a guide sheave 72 and passes thence through the farther (Fig. 1) of the twin applicators 20. In the chamber 22 of the applicator, the strand passes through a mass of viscously liquid or plastically pasty coating material supplied to the chamber from the tank 33 under pressure provided by the compressed gas in the supply 35. The pressure of the material in the chamber 22 is controlled by the valve 32. How far the process of coating by which the strand emerges from the applicator with a sheath of raw coating material, may be termed an extrusion process or how far it is merely a matter of adhesion of the coating material to the strand it is difficult to say. The pressure is ordinarily held at such a point that, in spite of the form of the nose 26 and of the drag of the strand through the bore 25, a certain amount of the coating material is forced out through the bore 25 and accumulates on the front face of the plug 24, to be periodically removed. At the same time the pressure is held below the point at which the coating material would be forced through the bore of the member 28 in excess of the amount desired as a coating on the strand.

The raw coated strand leaving this first applicator 20 passes, without contact with any solid object until it reaches the sheave 43, through the cool drying or hardening chamber 40. During this passage a considerable proportion of the volatile vehicle or solvent in the raw coat is removed by evaporation at the relatively low temperature in this chamber, without the formation on the coat of a relatively dry superficial skin to retard subsequent removal of residual volatile matter. By the time the strand reaches the sheave 43, the partly dried sheath has become hard enough throughout its thickness to endure being carried around the sheave without damage.

Because of the fact that the coating material is thus applied as a relatively thick paste with no great volume of solvent or vehicle, this first coat may be applied in a thickness several times as great as is practicable where the strand is simply passed through a relatively thin liquid bath of raw material. Also it becomes practicable to give this relatively thick coating sufficient hardness to endure contact with a guide sheave in the cold preliminary chamber 40 within a reasonable and practicable distance between the applicator and the sheave 43. At the same time, since this is done at relatively low temperature, solvent or vehicle is removed from the raw sheath substantially throughout its thickness and without the formation of a dry, tough and impervious skin over a still soft interior, which might slip, tear and wrinkle on the strand if it were passed over a sheave, capstan or the like, as would be the case if an equally or equivalently thick coating of the customary thin liquid preparation were used and it were attempted to harden it to the same consistency by heated air.

From the sheave 43, the strand passes under the sheave 45 and thence into the chamber 50 through which it passes without contact with any solid object until it passes up over the roller 51. Thence it travels to and fro in the chamber 50 around the rollers 51 and 52 such a number of times as is found to be necessary or desirable to harden the coating to the intended degree. The strand then passes out of the chamber 50 at its front end, over the sheave 73 and through the second applicator 20 (the nearest one in Fig. 1) where a second coating of pasty material is applied.

In passing around the rollers 51 and 52 as described, the partly dried or hardened coat has its remaining volatile matter driven out and removed by the hot air circulated through the drying chamber 50 and the heating chamber 60 by the blower 62. The air thus circulated ordinarily carries a considerable proportion of its capacity for volatilized solvent, so that, while the solvent or vehicle is ultimately substantially completely removed, the removal is effected relatively slowly and evenly throughout the thickness of the sheath, and again without the production of a thin impervious dried skin over a still moist interior. Hence when the strand emerges from the chamber 50 it has a relatively thick uniform sheath which is substantially dry of solvent throughout its thickness.

The strand then passes through the second applicator, as already described, and the new sheath is dried in the same manner as the first one, the strand passing through the chamber 40, around the sheaves 44 and 46, into the chamber 50 and back and forth around the rollers 51 and 52. This time the strand emerges from the chamber 50 through the perforation or aperture in its floor, noted above and in which is positioned a guide sheave 74. From this latter sheave the strand passes over a tension roller 75 and thence to a take-up reel 76.

The take-up reel 76 and the roller 52 are both driven by any suitable means, such as the belts indicated in Figs. 1 and 2, from a motor 77.

The roller 52, being driven as described, acts as a capstan to assist in advancing the strand through the apparatus in addition to the effect of the take-up reel 76. For this reason, the diameter of the roller 52 may preferably be made sufficiently smaller where the first passes of the strand run than where the later passes run to compensate for the sometimes unavoidable elongation of the strand due to the tension needed to advance the strand. For the same reason it may be preferable also to taper the roller 51 correspondingly or even in some cases to replace the roller 51 by a plurality of independently rotatable guide sheaves.

The drying effectiveness of the chamber 40 is dependent partly upon the room temperature and relative humidity of the air and partly upon the rapidity with which the room air is drawn through the chamber by the blower 47. It is apparently important that this drying effect be carefully controlled by adjustment of the blower speed. In some cases it may be desirable and even necessary to close even the small gap between the applicators 20 and the open end of the chamber 40 as shown in Fig. 7, where the

chamber 40 is extended to substantially enclose and contain the twin applicators.

While the apparatus and procedure as thus far described may be substantially entirely satisfactory with some materials and for some purposes, in some instances it may be desirable to effect a greater degree of compactness and smoothness in the applied coating, especially where a porous sheath, e. g. of textile or paper pulp material, on the strand is to be both impregnated and coated. In such a case, means are provided at the end of the first pass of the strand, through the chamber 40, to compact and smooth the coating.

As herein disclosed, particularly in Figs. 10 to 13 inclusive, such means may comprise a pressure sheave or roller 80 mounted to ride on top of the strand passing over the top of the sheave 43. This roller 80 is mounted to be freely rotatable in a freely pivotable arm 81 supported in any suitable manner on the frame of the apparatus. A helical tension spring 82 will cause the roller 80 to press down on the strand with the requisite pressure. The roller 80 and the sheave 43 will then be grooved as best shown in Fig. 13 to form the coating over most of the circumference of the strand and leave room over small portions for excess material.

A forming sheave or roller 83 is mounted to be freely rotatable in a fixed position a little below sheave 43, with its periphery tangent to the path of the strand 19 from the sheave 42 to the sheave 45, and with its plane at right angles to the common plane of the sheaves 42 and 45. A coacting pressure sheave or roller 84 is mounted, on the other side of the strand 19, to be freely rotatable in a freely pivotable arm 85 supported in any suitable manner on the apparatus, and a tension spring 86. The peripheries of the sheaves 83 and 84 are grooved in the same manner as those of the sheaves 80 and 43 as the latter are shown in Fig. 13. Since the contact line of the sheaves 80 and 43 passes through the axis of the strand in a diretcion at right angles to that of the contact line of the sheaves 83 and 84, the strand is formed and compacted over the entire circumference of the applied coating by passing successively through the two pairs of coacting rollers.

If it be found desirable, a second set of forming rollers may be similarly associated with the sheaves 44 and 46.

Substantially the same process and apparatus may also be used where the coating material is a preparation in the raw or more or less unpolymerized state of one of the polymerizable oils or artificial resins, e. g. comprising China-wood oil either raw or partly polymerized or one of the many forms of an aldehyde polymerized or condensed with a phenol type compound. In such a case the hardening of the material results primarily from an atomic or molecular rearrangement of the substance of the material.

It is found, in some instances of such products, that what may be termed an aging step of allowing the material, after being applied and before being heated to induce hardening, to rest at room temperature in its finally desired physical conformation, may conduce materially to the satisfactorily uniform character of the finished product.

Hence it may be highly desirable, in some cases, to employ substantially the same steps and to use apparatus analogous if not identically like that described, for such materials, wherein a heat hardenable coating material having no volatilizable material is applied to a strand, is then aged for a predetermined time at room temperature, and is then hardened at an elevated temperature.

Many such materials in the raw state comprise ammonia or substance which gives off ammonia. In such cases the air circulating and supplying means of the apparatus as disclosed may be a practical necessity.

It is possible, with this apparatus and by the process described, to apply in one operation a coating several or even many times as thick as that which may be applied where the raw coating material is in the frequently customary form of a relatively thin and liquid solution. In some instances a satisfactory coating may be produced with a single applicator, the strand being brought out over the sheave 74 after its first drying instead of being brought out over the sheave 73 to the second applicator, and such coating, in the case of cellulose acetate with an acetone vehicle, may be as thick as one requiring six or more several applications of a truly liquid solution.

It may be noted here that it may be desirable in some instances to use an inert gas, e. g. nitrogen, carbon dioxide, helium or the like as a volatilizing agent. In such case the several chambers, modified as shown in Fig. 6, will be made substantially gas tight, and gas to replace that bled off or carried off through the pipe 64 will be replaced by gas supplied from the solvent recovery means or any suitable source and introduced into the rear end of the chamber 40 and into the intake casing of the blower 62.

In some instances it may be desired to leave a predetermined proportion of the vehicle in the sheath to provide a degree of residual plasticity for further manufacturing operations. The extent to which the removal of the vehicle approaches complete dryness may be controlled by the temperature in the chamber 50 produced by the heating elements 61 or by the total length of the path of the strand inside the chamber 50 or by both.

Since it is possible by this method and by such apparatus to employ a thick plastic paste instead of a relatively thin liquid form for the coating material, it is evident that the invention has the further important practical advantage of producing a markedly smaller volume of volatilized vehicle vapors to be treated to recover the vehicle for re-use.

The embodiment of the invention disclosed may clearly be modified and departed from in various ways without departing from the spirit and scope of the invention as defined in and limited solely by the appended claims.

What is claimed is:

1. An apparatus for coating strands which apparatus comprises an applicator having a chamber through which a strand to be coated may pass, means to supply highly viscous pasty coating material, comprising a solid and a solvent, to the chamber and to maintain the material in the chamber under pressure, means in the chamber to control the thickness of the coating of material on the strand emerging from the chamber, in combination with coating treating means having a first treating chamber through which the raw coated strand passes from the applicator chamber, said treating chamber being of sufficient length to evaporate a major portion of the solvent, means to pass a gaseous treating

medium through the first treating chamber at room temperature, a second treating chamber through which the coated strand passes from the first treating chamber, and means to pass a gaseous treating medium through the second treating chamber at a raised temperature, the said second treating chamber being of sufficient length to harden the coating.

2. An apparatus for coating strands which apparatus comprises an applicator having a chamber through which a strand to be coated may pass, means to supply highly viscous pasty coating material, comprising a solid and a solvent, to the chamber and to maintain the material in the chamber under pressure, means in the chamber to control the thickness of the coating of material on the strand emerging from the chamber, in combination with coating treating means having a first treating chamber through which the raw coated strand passes from the applicator chamber, said treating chamber being of sufficient length to evaporate a major portion of the solvent, means to pass a gaseous treating medium through the first treating chamber at room temperature, means to receive the treated strand from the first treating chamber and to compact the coating by pressure, a second treating chamber through which the coated strand passes from the compacting means, and means to pass a gaseous treating medium through the second treating chamber at a raised temperature, the said second treating chamber being of sufficient length to harden the coating.

3. In an apparatus for coating strands with highly viscous plastic material, comprising a solid and a solvent, and having means to apply a relatively thick coating of such material to a strand, coating treating means having a first treating chamber through which the raw coated strand passes from the applicator means, said treating chamber being of sufficient length to evaporate a major portion of the solvent, means to pass a gaseous treating medium through the first treating chamber at room temperature, a second treating chamber through which the coated strand passes from the first treating chamber, and means to pass a gaseous treating medium through the second treating chamber at a raised temperature, the said second treating chamber being of sufficient length to harden the coating.

4. In an apparatus for coating strands with highly viscous plastic material, comprising a solid and a solvent, and having means to apply a relatively thick coating of such material to a strand, coating treating means having a first treating chamber through which the raw coated strand passes from the applicator means, said treating chamber being of sufficient length to evaporate a major portion of the solvent, means to pass a gaseous treating medium through the first treating chamber at room temperature, means to receive the treated strand from the first treating chamber and to compact the coating by pressure, a second treating chamber through which the coated strand passes from the compacting means, and means to pass a gaseous treating medium through the second treating chamber at a raised temperature, the said second treating chamber being of sufficient length to harden the coating.

EDWIN E. NEWTON.
CYRIL A. PEACHEY.
FREDERICK R. REEVELY.