

Dec. 21, 1948.

A. O. RYAN

2,456,650

METHOD OF COATING FILAMENTS

Filed Oct. 20, 1944

BARE FILAMENT

Fig. 1

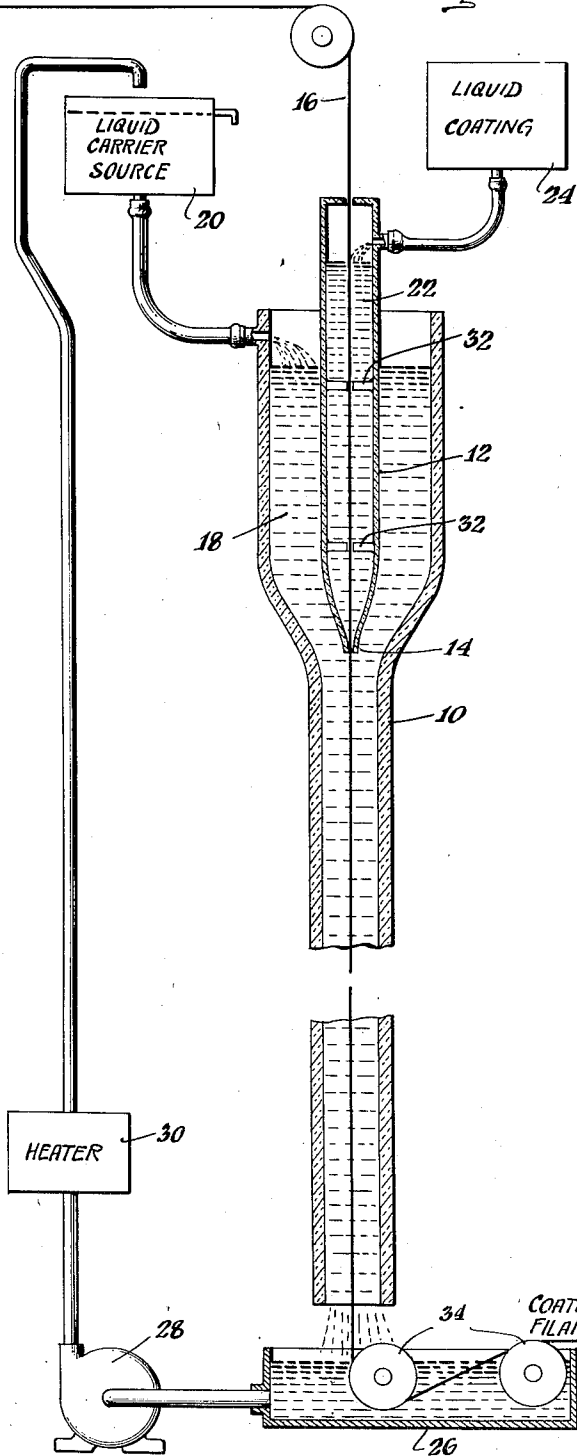
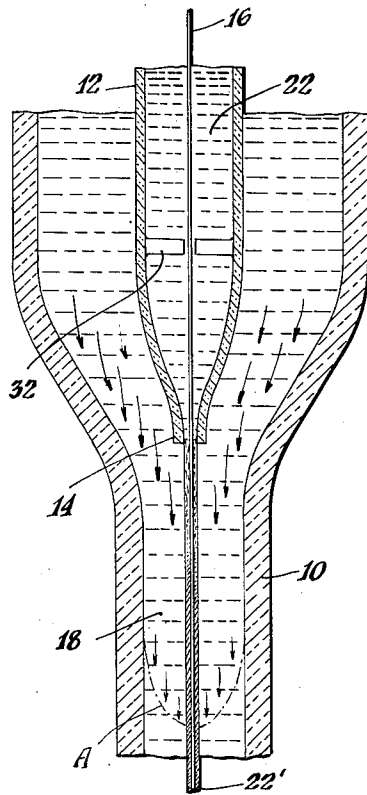


Fig. 2



INVENTOR.  
*Albert O. Ryan*  
BY *Dick and Remm*  
ATTORNEY

# UNITED STATES PATENT OFFICE

2,456,650

## METHOD OF COATING FILAMENTS

Albert O. Ryan, Oradell, N. J., assignor to Bedding Manufacturing Company, Inc., Norwalk, Conn., a corporation of Delaware

Application October 20, 1944, Serial No. 559,497

6 Claims. (Cl. 117-115)

1

This invention relates to improvements in method of coating filaments, and is more particularly directed to methods and means for covering wires and the like with insulation, and is a continuation-in-part of my co-pending application Serial Number 491,476, filed June 19, 1943, now Patent No. 2,402,846 granted June 25, 1946.

An object of this invention is to provide simple and improved methods for forming a continuous coating, such as insulation, about a filament, such as a wire.

Another object of this invention is to provide a method for coating wire, which assures a true centering of the wire within the coating so formed.

More specifically, my invention is directed to methods whereby a stream of coating material is discharged about the filament to be coated, into a second confining stream, which in some cases may function as a solidifying or coagulative material, moving with viscous flow in a restricted passage, so that as the filament, coating material, and confining material move along, the coating material gradually becomes solidified or coagulated and coats the enclosed filament.

Other objects and advantages of the present invention will appear from the following description of and examples thereof, illustrated in the accompanying drawings, in which:

Fig. 1 is a vertical cross-sectional diagrammatic view of a portion of apparatus adapted for use in carrying out my improved method, with other apparatus indicated diagrammatically, of a preferred form of arrangement in accordance with the present invention.

Fig. 2 is an enlarged vertical cross-sectional view of a portion of the apparatus illustrated in Fig. 1.

The apparatus for carrying out my method and shown by way of example in the drawings may consist of a hollow cylindrical tube 10 having a relatively long section of small internal diameter, and a short section on one end of relatively greater internal diameter. In the form of invention shown, this tube is preferably mounted vertically, with the larger section on top. Within the larger section of the tube 10 is mounted a second hollow tube 12 having a discharge nozzle 14 arranged at that portion of the tube 10 where the latter is changing to a smaller diameter. In actual practice the position of this nozzle may be at any point inside the smaller capillary tube, so long as the conditions suitable for viscous flow are attained. A filament to be coated passes through an opening in the top of the smaller tube 12, passes outwardly through the nozzle 14 and then downward-

2

ly through the smaller diameter section of the tube 10, and may be guided therefrom by means such as rollers 34. The liquid carrier 18 for the coating material is fed into the top of the tube 10, as from a source 20, and flows downwardly through the tube. The coating material 22 is fed into the inner tube 12 and passes downwardly, outwardly through the nozzle 14 about the filament 16. A source of coating material 24 will be connected to the tube 12.

The carrier liquid 18, after passing through the lower end of the tube 10, may be collected in a sump 26 for re-use. A pump 28 may be used to return this material to the source 20 and, if the action to be described in more detail later involves the use of a heated carrier liquid, a heater 30 may be interposed between the pump 28 and the source 20.

While the filament 16, to be coated, may be generally kept under suitable tension over the rollers, if this filament is a wire it is necessary that it be maintained free of bends or kinks, and it must be suitably centered. Within the tube 12 there may, therefore, be provided centering spiders 32 to effect this result.

The actual method followed in carrying out the present invention is substantially the same as that used and described in my co-pending application, previously identified. For example, if it is desired to coat the filament 16 with a coagulable material such as latex, liquid latex will be used as the coating material while heated glycerine may be used as the confining and carrying fluid. Both the latex and glycerine are fed into their respective tubes at such pressures that the discharge speed of the latex from the nozzle 14 is identical with the speed of flow of the glycerine in contact with the latex at this discharge point, and the speed of both of the materials at their interface is preferably identical with the speed of movement of the filament to be covered when the flow results from the hydraulic pressure above. The speeds are all so related to the viscosities of the materials used and the size of the filament, outer diameter of the latex and the inside diameter of the capillary tube 10 to bring about a condition known as streamline or viscous flow. Under all conditions the glycerine surrounding the latex will drag along the inner surface of the tube while at the interface of the glycerine and the latex the speed of each will be identical. When the speed of the filament is greater than the maximum speed in the latex due to hydraulic pressure, it produces a drag on the latex which will increase the rate of flow. The lineal speed of the filament must be limited by

3

conditions to insure that viscous flow results. Under all the above conditions the glycerine will support and confine the latex to a definite size and shape by acting as a lubricating, mobile, confining wall and on moving downward through the tube 10, the latex will gradually become coagulated about the filament, forming the coating 22' indicated in Fig. 2. The coated filament is then drawn off over the rollers 34 and subjected to any further necessary treatment, while the glycerine, discharged into the sump 26, may be pumped back for re-use.

Instead of using glycerine to coagulate the latex by the combined action of temperature and dehydration, the latex may be coagulated chemically by discharging a stream of alkaline-stabilized latex into a stream of an aqueous external fluid of low pH. The external stream could be a solution containing buffer salts such as magnesium sulphate, zinc-ammonium sulphate, and the like, or an acid solution such as acetic acid, formic acid, and the like. In all cases, however, the shape of the coating to be formed is maintained by the equilibrium forces of the viscous flow.

It is to be pointed out that the invention is applicable to the coating of a wide variety of filaments with a wide variety of material. For example, the filament may be a single or multiple strand of metallic wire, a single or multiple thread of any suitable textile material, a single or multiple thread of natural or synthetic rubber, resins, plastics or fiberglass, or, in fact, any filamentary substance which can be used with a minimum of tension.

If, for example, the invention is used to coat a solid or stranded copper wire, the coagulable or solidifiable coating material may be emulsions or dispersions of plasticized vinyl-acetate-vinyl chloride copolymers, plasticized polystyrene, polyethylene or other mixtures. The confining liquid carrier in such cases will be material used to destabilize the emulsion, or to change the liquid coating into a solid coating by any suitable chemical or physical change required.

The invention is equally applicable to the coating of threads or cords with natural or synthetic rubber, natural or synthetic resin, cellulose derivatives, waxes, or any other mixtures. Likewise, the original filament may be a copper wire which may then be coated with suitable asphaltic materials, waxes, paints or lacquers.

Another use for the present invention, involving the principles outlined above, is in the formation of small hollow filaments. This merely involves the coating, by the aforescribed method, of a central filament with, however, a material which does not adhere to this filament. After the coating has been applied in any one of the manners described above, the core may then be removed, leaving a hollow filamentary structure.

Accordingly, while I have, for the purposes of illustration, described one particular form of apparatus for carrying out my invention, I have indicated several examples of the manner in which the principles according to this invention are applicable, it is to be understood that the invention is not limited to the examples given, but only as set forth in the objects and the claims which follow. In the claims, the term "solidifying" or "solidifiable" is also intended to broadly cover any hardening operation or coagulating process.

I claim:

1. The method of forming a coated filament

4

which comprises causing a stream of a confining and supporting liquid to flow through a confining space at such a speed that the liquid flows through said space under conditions of viscous flow, discharging under pressure a continuous annular stream of a solidifiable liquid coating material about a continuous axially moving filament, introducing the moving filament and surrounding liquid coating material into the center of said viscously flowing confining liquid stream at substantially the same speed and in the same direction as the center of said stream, continuing the movement of said filament and surrounding coating liquid along with said stream of viscously flowing confining liquid at substantially the same speed while causing the coating material to solidify, whereby said stream of viscously flowing confining liquid supports and holds the liquid coating material in shape during movement thereof through said space, and then withdrawing the filament and the surrounding solidified coating material from said confining liquid in the form of a coated filament.

2. The method of forming a coated filament which comprises causing a stream of a solidifying liquid to flow through a relatively small tube at such a speed that the liquid flows through the tube under the conditions of viscous flow, discharging under pressure a continuous annular liquid stream of a solidifiable coating material about a continuous axially moving filament, introducing the moving filament and surrounding liquid coating material into the center of said stream of solidifying viscously flowing liquid at substantially the same speed and in the same direction as the center of said stream of solidifying liquid, continuing the movement of said filament and surrounding coating liquid along with said stream of viscously flowing confining liquid at substantially the same speed while causing the coating material to solidify, whereby said stream of viscously flowing confining liquid supports and holds the coating material in shape during solidifying thereof, and then withdrawing the filament and the surrounding solidified coating material from said solidifying liquid in the form of a coated filament.

3. The method of forming a coated filament which comprises causing a stream of a solidifying liquid to flow through a relatively small tube at such a speed that the liquid flows through the tube under the conditions of viscous flow, creating a temperature difference between said solidifying liquid and a temperature-solidifiable liquid coating material, discharging a continuous annular liquid stream of said coating material about a continuous axially moving filament, introducing the moving filament and surrounding coating material into the center of said stream of solidifying viscously flowing liquid at substantially the same speed and in the same direction as the center of said stream of solidifying liquid, continuing the movement of said filament and surrounding coating material along with said stream of viscously flowing confining liquid at substantially the same speed while said coating material solidifies, whereby said stream of viscously flowing confining liquid supports and holds the coating material in shape during solidifying thereof, and then withdrawing the filament and the surrounding solidified coating material from said solidifying liquid in the form of a coated filament.

4. The method of forming a coated filament which comprises causing a stream of a solidifying liquid heated to a temperature sufficient to

5

solidify a coating material to flow through a relatively small tube at such a speed that the liquid flows in the tube with viscous flow, discharging a continuous annular liquid stream of a thermosetting coating material about a continuous axially moving filament, introducing the moving filament and surrounding coating material into the center of the stream of heated solidifying liquid at substantially the same speed and in the same direction as said solidifying liquid, whereby said stream of solidifying liquid supports and holds said coating material in shape during movement thereof through said tube, and said coated material is hardened while supported by the heated solidifying liquid and then withdrawing the filament and the surrounding hardened coating material from said liquid in the form of a coated filament.

5. The method of forming a latex coated filament which comprises causing a stream of glycerine heated to a temperature sufficient to coagulate a latex coating material to flow through a relatively small tube at such a speed that the glycerine flows in the tube with viscous flow, discharging a continuous annular liquid stream of latex coating material about a continuous axially moving filament, introducing the moving filament and surrounding liquid latex into the center of the stream of glycerine and at substantially the same speed and in the same direction as the center of said stream of glycerine, whereby said stream of glycerine supports and holds the coating of liquid latex in shape during movement thereof through said tube, and the latex is coagulated while so supported, and then withdrawing the filament and the surrounding coating of coagulated latex from the glycerine in the form of a coated filament.

6. The method of forming a latex coated fila-

6

ment which comprises causing a stream of a buffer solution having a pH sufficiently low to agglomerate latex to flow through a relatively small tube at such a speed that the solution flows in the tube with viscous flow, discharging a continuous annular stream of alkaline liquid latex about a continuous axially moving filament, introducing the moving filament and surrounding liquid latex into the center of the stream of buffer solution and at substantially the same speed and in the same direction of flow as the center of said stream, whereby said stream of buffer solution supports and holds the latex coating material in shape during movement thereof through said tube and said latex is agglomerated by the buffer solution while so supported, and then withdrawing the filament and the surrounding agglomerated latex from said buffer solution in the form of a coated filament.

ALBERT O. RYAN.

#### REFERENCES CITED

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

#### UNITED STATES PATENTS

Number	Name	Date
827,434	Friedrich .....	July 31, 1906
1,590,608	Taylor .....	June 29, 1926
1,654,253	Henderson .....	Dec. 27, 1927
2,062,389	Bleibler .....	Dec. 1, 1936
2,127,413	Leguillon .....	Aug. 16, 1938
2,155,403	Cook .....	Apr. 25, 1939
2,283,621	Arber .....	May 19, 1942
2,288,982	Waterman et al. ....	July 7, 1942
2,327,638	Harrison .....	Aug. 24, 1943
2,330,370	Miller .....	Sept. 28, 1943
2,402,846	Ryan .....	June 25, 1946