United States Patent

[11] 3,617,356

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[54] **A METHOD FOR APPLYING LATEX COATINGS TO THE INNER SURFACES OF TUBULAR ARTICLES OF WOVEN CLOTH**
5 Claims, 11 Drawing Figs.

[52] **U.S. Cl.** **117/95,** 118/408, 138/145
[51] **Int. Cl.** **B44d 1/09**
[50] **Field of Search** ..... 118/408, DIG. 12, DIG. 10; 117/95; 138/145

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Attorney—Waters, Roditi, Schwartz & Nissen

ABSTRACT: A latex coating is formed on the inner surface of a tubular article by winding the article in the form of a helix on a rotatable drum and successively feeding the article with chemical components which are to form the coating. The chemical components are admitted to the tubular article via a valve means and controlled by a distributor and the spent chemical components are discharged from the outlet of the tubular article and fed to receiving containers. The chemical components are advanced inside the tubular article by rotation thereof caused by the rotation of the drum.

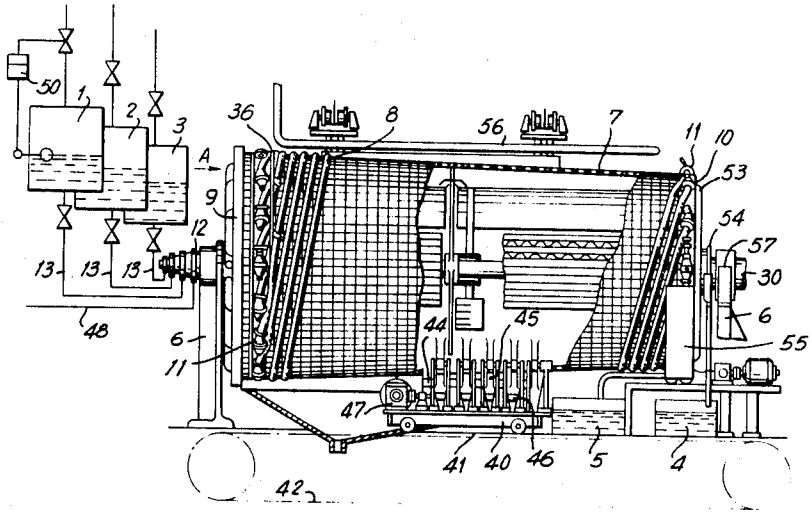

FIG. 1

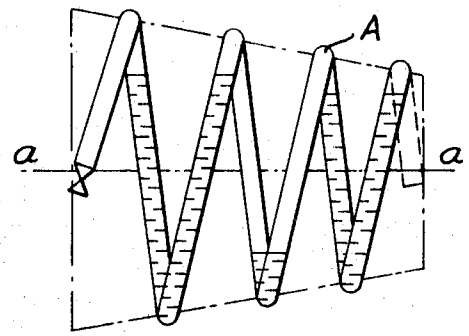

FIG. 2

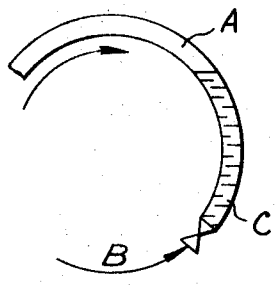

FIG. 3

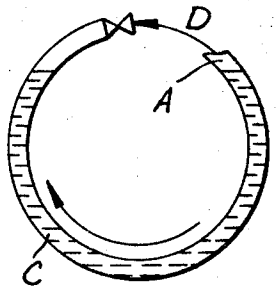

FIG. 4

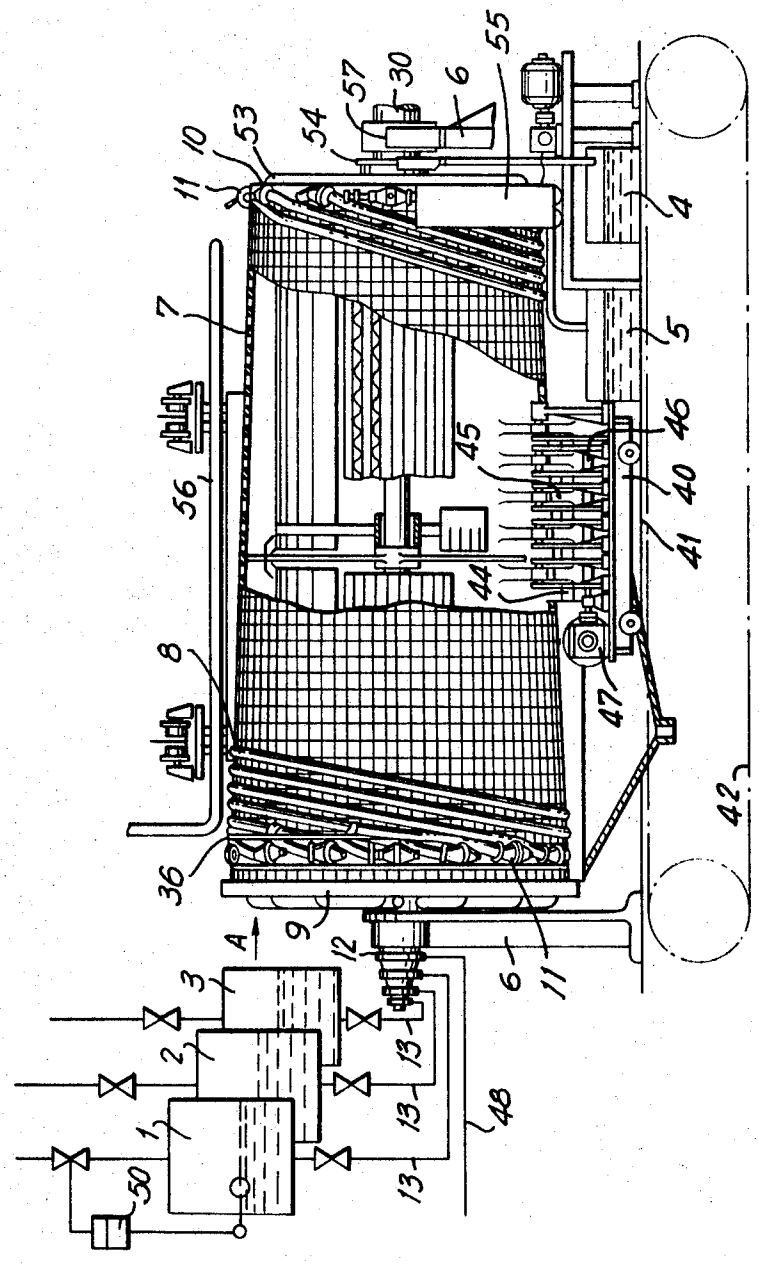
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FIG. 5

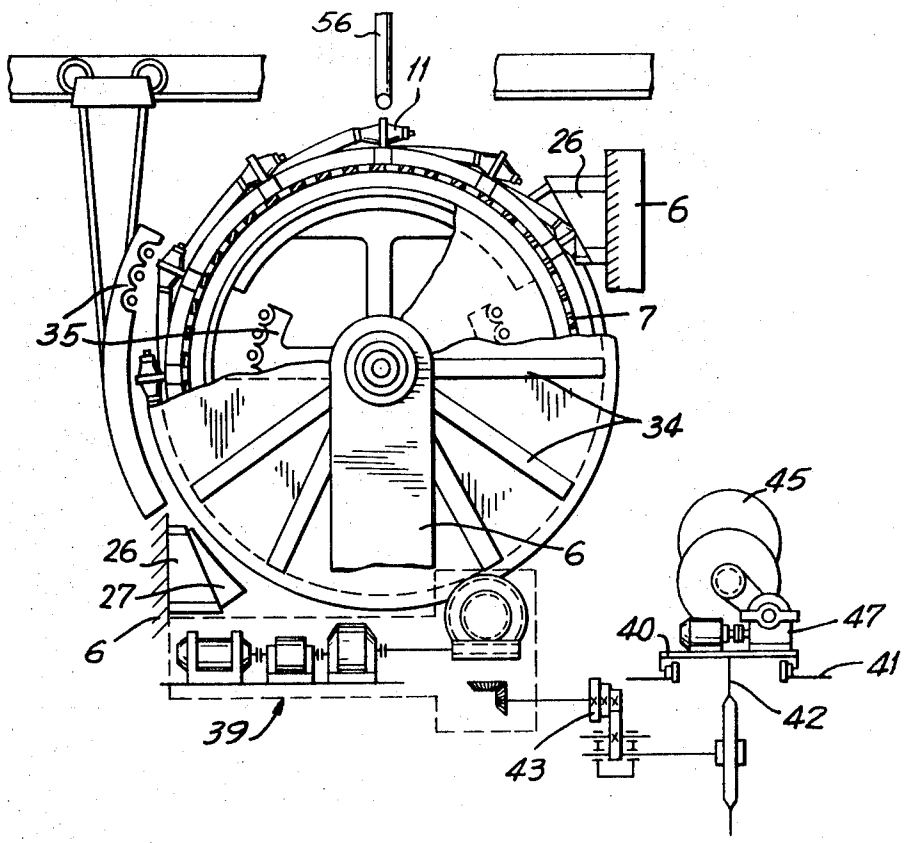


FIG. 6

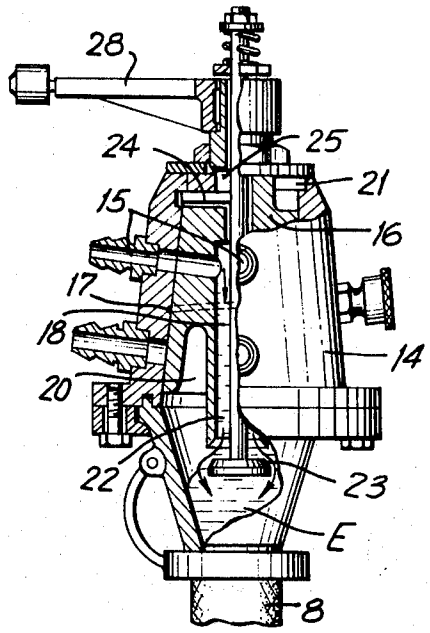


FIG. 7

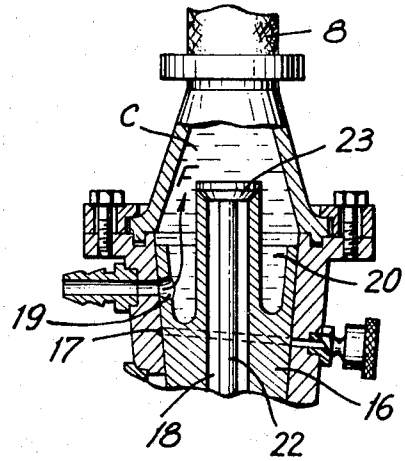


FIG. 8

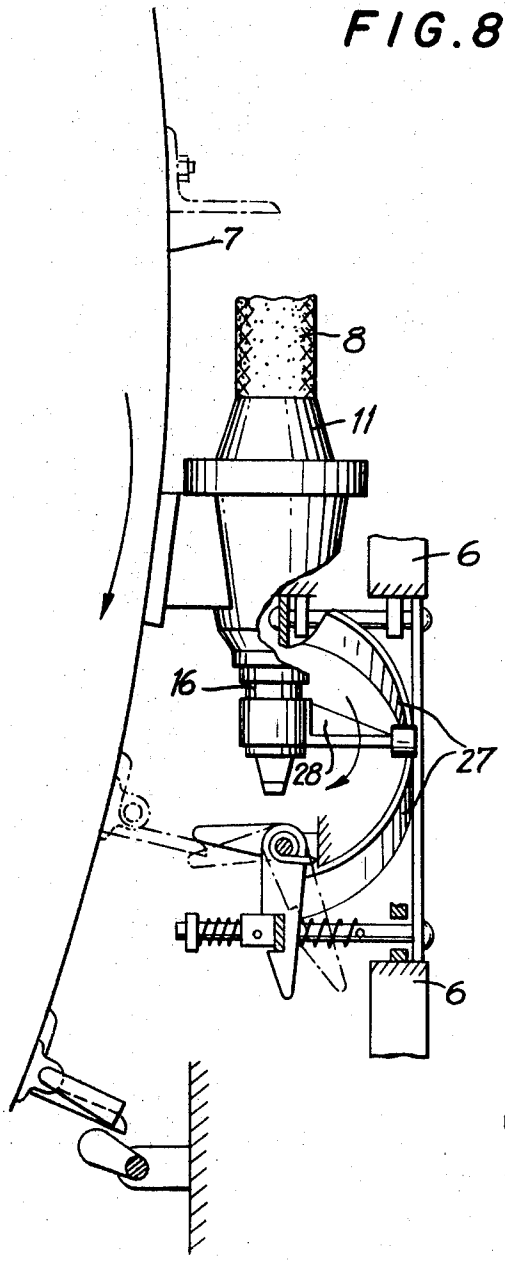


FIG. 10

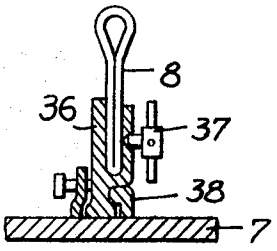
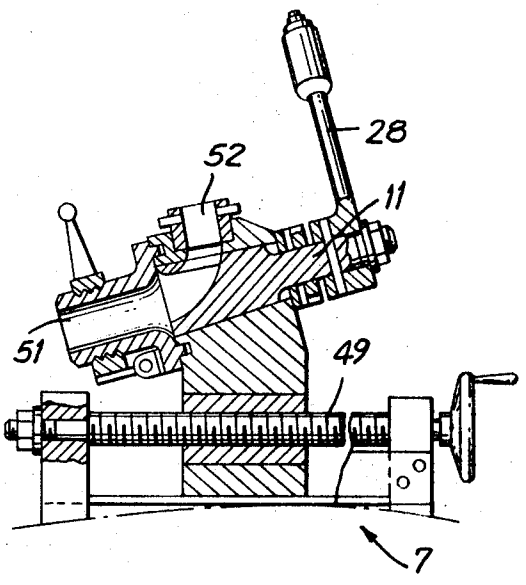


FIG. 11



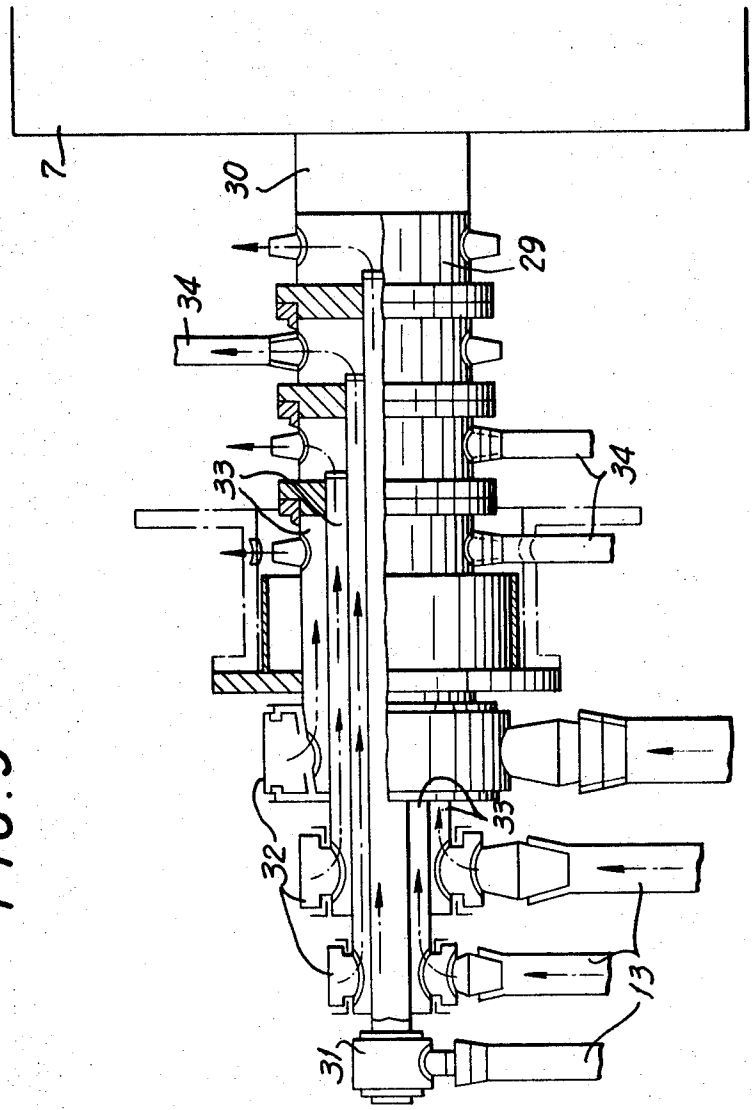


FIG. 9

A METHOD FOR APPLYING LATEX COATINGS TO THE INNER SURFACES OF TUBULAR ARTICLES OF WOVEN CLOTH

The present invention relates to methods for applying coatings on the inner surfaces of tubular articles and more particularly to methods for applying latex coatings on the inner surfaces of tubular articles constituted in part of woven cloth, such as fire hoses.

Known in the art are methods for applying latex coatings on the inner surface of tubular articles made of woven cloth, for examples fire hoses, by successively advancing the components being applied along the inner surface of a fire hose.

To apply a latex coating by resorting to the conventional method a fire hose with a length not exceeding twenty meters is made fast on an inclined table and its cavity is successively filled with chemical components, each chemical component being fed into and drained from the cavity of the inclined hose through its lower end.

To provide for a uniform coating of the inner surface of the hose the latter is inclined towards the other side and the same chemical component is applied for a second time.

The conventional method permits a latex coating to be applied by resorting to the ion deposition method when artificial latex is employed, and only by dipping in case of natural latex.

The necessity to feed one and the same chemical component twice into the cavity of a hose with a change in its incline requires considerable time for the following operations: filling the hose with latex and its subsequent draining, hose refastening when supplying other components, removal of superfluous latex left in the lower portion of the hose cavity.

Apart from this, to apply a latex coating by the conventional method the following cannot be dispensed with: a complicated and bulky device to change the inclination of the hose fastened thereon, large stores of chemical components, powerful pumps, and creation of high pressures to fill the entire hose cavity with latex.

The primary object of the present invention is to provide such a method of and a device for applying latex coating on the inner surface of tubular articles made of woven cloth which would make it possible to apply latex coating both by dipping and by the ion deposition method with high efficiency and for an unlimited length of a fire hose, as well as to provide for uniflow latex coating with insignificant loss of latex.

With these and other objects in view a method of applying latex coating on the inner surface of tubular articles made of woven cloth is characterized in that, according to the invention, a tubular article is coiled into a helix with its geometrical axis arranged horizontally or substantially in a horizontal position and the successively fed components are propelled inside the article by rotating the latter round the geometrical axis of the coil.

To provide for a uniform latex deposition on the inner surface of a hose it is necessary either to reduce the rotational speed of the coil as the portion of component fed into the hose is consumed, or coil the hose into a conical helix.

Since latex coating is applied to fire hoses of unlimited length, the film formed in advancing the chemical components is reasonably to be dried by air pressure-fed into the article which is preheated externally.

To carry the proposed method into effect, a device is provided with a rotating drum for the tubular articles to be coiled thereon which is installed horizontally on a frame and whose end faces accommodate at least one multiway cock fastened thereon, said cock being connected to the ends of the tubular articles, and a means for distributing chemical components which is connected both to containers intended for feeding and draining the chemical components and the multiway cock.

To provide a uniform latex coating and reducing the speed of movement of chemical components, it is advantageous that the drum for winding tubular articles be constituted in the shape of a cone.

For a more rapid drying of the film formed, the drum may be of the mesh type and heat radiators should be provided both from outside of and inside the drum.

To reduce the stress in a hose in the process of drying due to shrinkage thereof it is advantageous that the drum be fitted with a swivel ring provided with clamps to receive the ends of tubular articles, said ring being prevented from axial displacement through the use of guides.

To dispense with refastening of tubular articles when feeding next portions of chemical components the means for distributing said components may be essentially a multipassage journal fastened on the rotating axle of the drum and a stationary multipassage ring embracing said journal whose channels communicating with containers through the ring channels are provided with pipe unions which are connected to the inlet channels of the multiway cock.

The multiway cock may have a body with the holes located in steps, a tapered plug with an endwise channel capable of communicating with the holes of the upper step of the cock body and an end face channel capable of communicating with the holes of the lower step of the cock body. The endwise channel accommodates a spring-loaded rod of a plate-type valve which separates the plug channels with the help of a lever fastened on the rod with an eccentric slot provided in the cock body.

To provide for automatic feed of chemical components the multiway cock is made controllable and is equipped with a control means which is essentially a plurality of bow-shaped master forms fastened on the frame of the drum and arranged on the circumference thereof on the path of the movement of the cocks, said master forms interacting with a lever rigidly connected to the cock plug.

It is preferable to accomplish the winding onto and the removal from the drum of tubular articles by employing a carriage capable of travelling along the rotating drum and being operatively associated therewith, and provided with split coils.

The proposed method allows for applying a latex coating not only on the inner surface of fire hoses but on any hoses employed in chemical, metallurgical industries, foundry etc. The device is more compact as compared with existing equipment and enables the floor space to be diminished from four to five times.

Concurrent uniflow applying of a latex coating on a number of fire hoses of an unlimited length, as well as automatic feeding and draining of chemical components increases the productivity 5 to 6 times compared to existing equipment. Moreover, partial feeding of chemical components into the article cavity obviates the necessity to store large amounts of said components as their consumption is reduced 6 to 8 times, leads to reduction in power of pumping units and provides for a uniform coating which fact improves quality of coating and reduces latex consumption.

Other objects and advantages of the present invention will become apparent from a consideration of an exemplary embodiment with due reference to the accompanying drawings, wherein:

FIG. 1 shows a coiled tubular article, according to the invention;

FIG. 2 shows a tubular article being filled with latex, according to the invention;

FIG. 3 shows a tubular article with air being supplied to its first coil thereof, according to the invention;

FIG. 4 is a side elevational view, partly broken away, of a device for applying a latex coating on the inner surface of tubular articles made of woven cloth, according to the invention;

FIG. 5 shows the device as viewed in the direction of the arrow A of FIG. 4;

FIG. 6 is a cutaway view of a multiway cock of the device, according to the invention;

FIG. 7 shows the cock as in FIG. 6, turned through 180°;

FIG. 8 shows a means for controlling the multiway cocks in the device, according to the invention;

FIG. 9 shows a multipassage journal of the device, according to the invention;

FIG. 10 shows a swivel ring of the device, according to the invention; and

FIG. 11 shows a screw fastening of multiway cocks in the device which are designed for draining chemical components, according to the invention.

To apply a latex coating on the inner surface of fire hoses made of woven cloth the latter is coiled into a spiral A (FIG. 1) with respect to a geometric axis *a–a* arranged horizontally or substantially horizontally. This spiral A may be either tapered or cylindrical (not shown in the drawing).

The spiral A is then rotated.

With the spiral A rotating, its coil COIL is fed with a definite amount of latex C which is fed in the direction of arrow B (FIG. 2) upwards along the coil, the feed rate being equal to the rotational speed of the spiral, which keeps latex from foaming.

The amount of latex required to fill the coil depends upon the fire hose length and the desired film thickness. When feeding of latex C into the fire hose cavity is cut off, the latter is supplied with air in the direction of arrow D (FIG. 3).

During the next turn of the spiral A it is fed according to the technological sequence with other chemical components, the procedure being analogous to that described hereinabove.

The rotation of the spiral A through its geometrical axis *a–a* results in the fact that chemical components subsequently fed into the article cavity and separated by air gaps are gradually advanced along the inner surface, moisten it and form a film.

For a uniform deposition of latex C on the inner surface of a fire hose the rotational speed of a cylindrical spiral (not shown in the drawing) is reduced as the fed portion of chemical components is consumed, the reduction in speed being directly proportional to the amount of the chemical components left in the coil.

In the case the fire hose is coiled into a tapered spiral A (FIG. 1) the uniformity of deposition of latex C on the inner surface of the hose with uniform rotation of the surface is achieved due to gradual shortening of spiral coils.

The film formed in applying a coating in the hose cavity is dried by air pressure-fed inside the article with simultaneous external heating of the hose.

The device for applying latex coating on the inner surfaces of fire hoses comprises: containers **1**, **2** and **3** (FIG. 4) for feeding chemical components; containers **4** and **5** for draining chemical components and a rotating tapered drum **7** installed horizontally on a frame **6** for winding fire hoses **8** onto it.

End faces **9** and **10** are provided with multiway cocks **11** fastened thereon, the number of said cocks corresponding to that of fire hose **8** wound onto the drum **7**.

The outlet channel of each multiway cock **11** fastened on the end face **9** is connected to the end of the fire hose **8**, whereas the inlet channels of said cock are connected to means **12** for distributing chemical components which is coupled through piping **13** with the containers **1**, **2** and **3** for feeding the chemical components.

Each multiway cock **11** has a body **14** (FIG. 6) with stepped holes which form inlet channels **15**, and a tapered plug **16**. The channels **15** are arranged in pairs and are separated by a groove **17** intended for lubricating or greasing.

Each pair of the channels **15** is fed with chemical components nonreacting in respect to one another, whereas chemical component reacting is respect to one another are fed between said pairs, for example, one upper channel **15** is supplied with water and the other with calcium chloride, whereas the lower pair of the channels **15** is supplied with latex and air. Such an arrangement of the channels **15** precludes contacting of chemical components reacting in respect to one another which are washed away when the plug **16** is turned and, consequently, precludes clogging of the inlet channels **15** of the cock.

The tapered plug **16** is provided with an endwise channel **18**, whereas the plug body is provided with holes **19** (FIG. 7) which, when the plug **16** is turned, coincide only with one of the channels **15** of the body of the cock **11**.

The lower portion of the plug **16** is provided with an end face channel **20** which is essentially an outlet channel of the cock **11** and communicates with the channels **15** of the lower step.

The upper portion of the body **14** of the cock **11** is provided with an eccentric slot **21** (FIG. 6).

The endwise channel **18** of the plug **16** accommodates a spring loaded rod **22** of a plate-type valve **23**. The rod **22** accommodates a projecting pin **24** which passes through an orifice **25** of the end piece of the plug **16** and enters the eccentric slot **21** of the cock body **14**. When the plug **16** is turned the pin **24** interacts with the slot **21** and shifts the rod **22** endwise thus entraining the plate-type valve **23**. When the rod **22** moves upwards, the valve **23** shuts off the endwise channel **18** and separates the upper and lower steps of the channels **15**.

The prevention of film-forming in the end face channel **20** is accomplished by changing the position of the cock **11** depending on the chemical components being fed.

Latex C is kept from foaming (FIG. 7) at high feed rates involved by feeding it upwards in the direction of arrow F. Smoothly filling the end face channel **20**, latex C moves upwards with valve **23** shutting off the channel **18** and fills the fire hose **8**.

The feeding of calcium chloride E (FIG. 6), conversely, is accomplished by pouring it out from the end face channel **18** with the respective position of the cock. Calcium chloride E, encountering the valve **23**, streamlines the latter, changes its direction and forms a fluid ballon which moistens the cock lower portion and the hose cavity, bypassing the end face channel **20**, which prevents calcium chloride E and latex C from contacting one another. Draining calcium chloride E directly from the channel **18** into the cavity of the hose **8** and gradual feeding of latex C upwards prevents said two fluids from contacting one another and prevents a film from being formed in the cock outlet channel.

To automatically turn the plugs **16** of the multiway cocks **11** and to admit the required chemical component a means **26** capable of controlling the cocks is fitted on the frame **6** (FIG. 5).

The means **26** is made as a plurality of bow-shaped master forms **27** (FIG. 8) the number of which corresponds to that of the technological procedures involved. The bow-shaped master forms **27** are arranged in a helix on the path of the travel the cocks **11** and interact with levers **28** rigidly connected to the end pieces of the plugs **16** of the cocks **11**.

The means **12** (FIG. 4) capable of distributing chemical components is essentially a multipassage journal **29** (FIG. 9) which in turn is the continuation of an axle **30** of the drum **7**, said journal being embraced by stationary multipassage rings **31**.

Annular channels **32** of the rings **31** communicate with the respective tubular channels **33** of the journal **29** and through the pipelines **13** with containers for feeding chemical components.

The tubular channels **33** of the journal **29** terminate in pipe unions **34** which are respectively connected to the outlet channels of the cocks **11**, the number of the pipe unions **34** of each channel of the journal **29** corresponding to that of the cocks **11**.

To provide for more rapid drying of the film formed on the inner surface of the fire hoses **8** the drum **7** (FIG. 4) is made of wire mesh, and heat radiators **35** are (FIG. 5) are located outside and inside the drum.

The drum **7** (FIG. 10) on the side of its larger diameter is fitted with a ring **36** with clamps **37**, said ring receiving the ends of the fire hoses **8** when the latter are being dried. Turning of the ring **36** reduces the stress of the hose due to shrinkage thereof, said ring being prevented from endwise movement by means of guides mounted on the drum **7**.

The drum **7** is imparted with rotation from a drive **39** (FIG. 5).

Winding onto and removal of fire hoses **8** from the drum **7** is accomplished through the use of a carriage **40** capable of traversing on rails **41** along the drum **7**.

The carriage 40 through an infinite chain 42 is connected to the drive 39 via a gear box 43 with a gearing, said gearbox enabling the speed of the carriage 40 to be varied.

The platform of the carriage 40 is provided with horizontal supports 44 (FIG. 4) to mount split coils 45 each of which is connected to a transmission shaft 46 of an independent drive 47 of the carriage 40, said connection being accomplished first through a chain drive and then through a friction gearing.

The drive 47 is used to rotate the coils 45 while winding off finished articles, the fire hoses, from the drum 7.

The procedure of applying latex coating on the inner surface of fire hoses is as follows.

The lot of the fire hoses 8 of equal length from 14 to 100 meters and more which are preliminarily smeared with thickened latex are coiled and then fitted on the core of the split coils 45.

The ends of fire hoses 8 are fastened to the outlet channels of the cocks 11 fitted on the end face 9 of the drum 7.

The engagement of the drive 39 (FIG. 5) capable of rotating the drum 7 acts to simultaneously move the carriage 40 (FIG. 4) through the gearing and the endless chain 42.

While rotating, the drum 7 winds and enwraps onto itself the fire hoses 8 synchronously with movement of the carriage 40, which fact provides for a uniform winding of the hoses.

The compressed air for straightening the hoses is delivered into the hose 8 from an air duct 48 via the cocks 11.

When the carriage 40 reaches the rear end face 10 of the drum 7 the hose ends are fastened to the cocks 11 mounted on said end face of the drum by virtue of a screw fastening 49 (FIG. 11) which is required due to possible length inequality of the fire hoses 8 and their nonuniform winding onto the drum 7.

Depending upon the length of the hoses involved, the angle of winding of said hoses onto the drum is made variable by varying the speed of the carriage 40 (FIG. 5) through the use of the gearbox 43.

The containers 1, 2 and 3 (FIG. 4) for feeding chemical components are arranged on different levels depending upon the height assigned for filling the spiral coil with chemical components. This provides for the step-by-step technological operations time or duration of washing of the coil in liquid. The specified level of chemical components in containers 1, 2 and 3 is maintained by means of an automatic regulator 50.

Chemical components are fed under pressure to the pipelines 13 from the containers 1, 2 and 3 into the channels 33 (FIG. 9) of the journal 29, wherefrom via pipe unions 34 said components are fed into the respective inlet channels 15 (FIG. 6) of the cocks 11.

With the drum 7 rotating, the levers 28 rigidly connected to the plug 16 of the cocks 11 encounter bow-shaped master forms 27 (FIG. 8) arranged in a helix, roll over them and turn the plug 16, opening one of the cock channels for separate feeding the first coils of the hoses with chemical components according to the sequence of technological operations.

After each turn of the drum 7 chemical components moving along the inner cavity of the coils moisten it thereby forming a latex film.

The latex is allowed to enter when the cocks 11 pass the top admission level gradual filling of the coil at the speed of rotation and it is stopped when coming out of the filling zone. The subsequent admission of water starts a little below the top admission level for creating an excess pressure in the hose said pressure preventing sticking of the film. The feeding in of calcium chloride E (FIG. 6) is accomplished after the cock passes the filling zone, i.e. a little above said zone, by pouring the calcium chloride from the axial channel 18 thereby forming a liquid ballon which uniformly washes the inner cavity of the hose 8.

Draining the residues of the chemical components is accomplished separately at the rear end face 10 (FIG. 4) of the drum 7 in the succession according to which said components had been fed into the hose via the cocks 11 fastened at said end face. Said cocks 11 are also automatically opened having encountered similar bow-shaped master forms 27 releasing the liquid into the corresponding containers 4 or 5. The cocks 11 slightly differ in design as compared to the cocks fastened at the end face 9. The cocks 11 are provided with one inlet channel 51 (FIG. 11) and two outlet channels 52 arranged at 135° (not shown in the drawing).

One of the channels 52 is designed for draining calcium chloride and water and for expelling the air, whereas the other channel is used for latex, said channel through a hose 53 (FIG. 4) being connected to a drain funnel through a damper 54.

The damper 54 is designed to prevent spattering of drained latex and running it into the container 4 and consists of two cupped rings (not shown in the drawing) joined by a bushing.

The calcium chloride is drained into a movable pan 55 and wherefrom into the container 5.

After draining the chemical components the hoses are filled with water delivered from the container 2 through the cock 11 and the calcium chloride seeped onto the surface of the hoses 8 is simultaneously washed off through jets 56 located under the drum 7.

After termination of the synersis and draining of water the front ends of the hose 8 are disconnected from the cocks 11, flattened and bent and fixed by the clamps 37 (FIG. 10) to the swivel ring 36 which turns under the influence of hose shrinkage and protects them from bursting.

Through a hollow journal 57 (FIG. 4) fixed to the axle 30 at the end face 10, and the cocks 11 compressed air is delivered which inflates the hoses and being warmed by the bilateral action of the heat radiators 35, accelerates the drying of the hoses, and passes out from the other end.

After the drying of the hoses is completed talc is blown thereinto through the journal 57 to protect the hoses from sticking and then the hoses are removed from the drum by unrolling them in coils with return movement of the carriage 40. Preliminarily the ends of the hoses are clamped in the slot of the core coil 45 which is forced to rotate from the drive 47 of the carriage 40 with compensation of ununiformity of winding and regulation of its packing by means of a friction drive.

What we claim is:

1. A method of applying a latex coating on inner surface of tubular articles constituted at least in part of woven cloth, said method comprising coiling a tubular article into a helix conically tapering between the ends thereof with its geometrical axis arranged substantially horizontal, successively feeding the cavity of the coiled tubular article with the chemical components necessary to form said latex coating; and advancing said chemical components inside the tubular article by rotating said helix about its geometrical axis, said chemical components advancing from the large diameter end of the helix to the small diameter end of the helix.

2. A method as claimed in claim 1 wherein the rotational speed of the helix is reduced as the portion of chemical components fed therein is consumed.

3. A method as claimed in claim 1 including coiling a plurality of tubular articles into respective helices conically tapering between the respective ends thereof along a common geometrical axis, and rotating said helices about the common geometrical axis in unison.

4. A method as claimed in claim 3 including terminating the inlet ends of said helices in a common plane and the outlet ends of the said helices in a further common plane.

5. A method as claimed in claim 4 including feeding each of said helices simultaneously with the chemical components at the respective inlet ends.

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