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[54] **WINDING IMPREGNATION SYSTEM**

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[52] **U.S. Cl.** **118/58,** 118/56, 118/322

[51] **Int. Cl.** **B05b 13/02,** B05c 5/02

[58] **Field of Search** 118/64, 65, 66, 67, 118/322, 324, 426, 416, 423, 56, 58; 156/381, 499, 433; 117/113, 105.4

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[57] **ABSTRACT**

An endless conveyor chain is fitted with a plurality of longitudinally spaced fixtures which are adapted to carry electrical motor windings. The windings are carried by the conveyor chain from a load/unload station through a horizontal heating chamber for preheating the windings, then under an applicator station which applies a varnish coating to the windings, then through a heating chamber which is disposed in a generally upright plane adjacent to the applicator station, and then through a diagonal heating chamber which extends diagonally from the top of the upright heating chamber to the load/unload station. The upright heating chamber is long enough to allow the varnish to jell on the windings so that there will be no drippage in the diagonal heating chamber. A drip pan is positioned under the applicator station and under the bottom end of the upright heating chamber to catch any drippage in those two areas, the heating means in the upright chamber being at a side of the upwardly moving windings so as to be out of the path of drippage.

5 Claims, 5 Drawing Figures

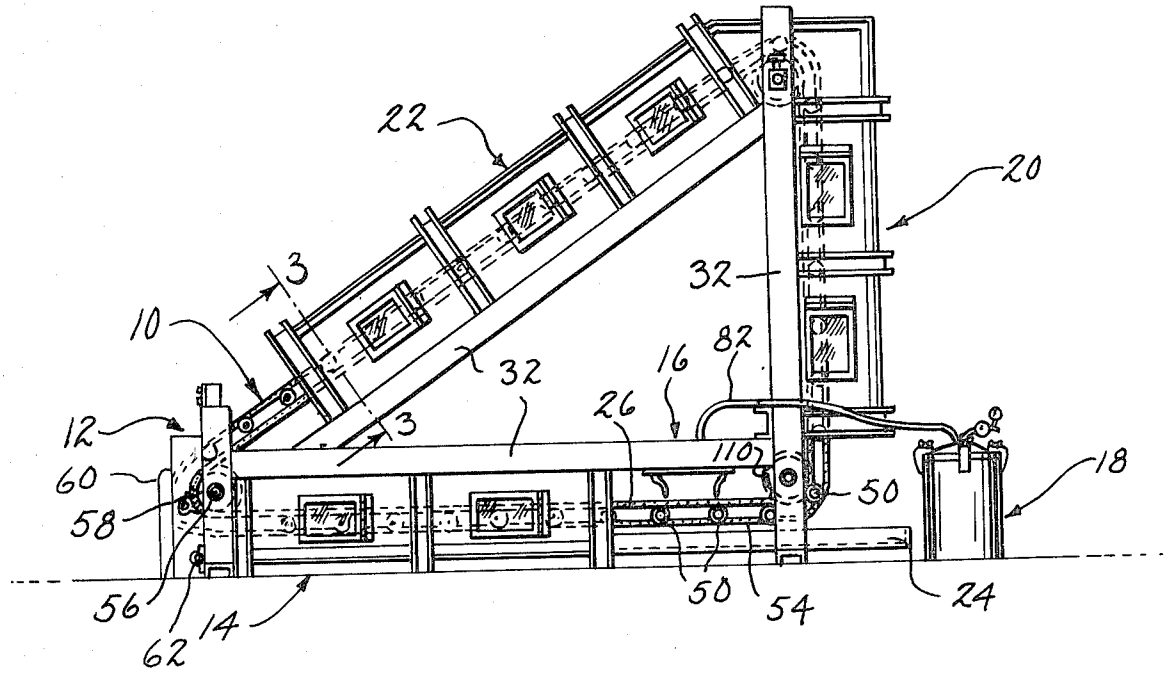


Fig. 1

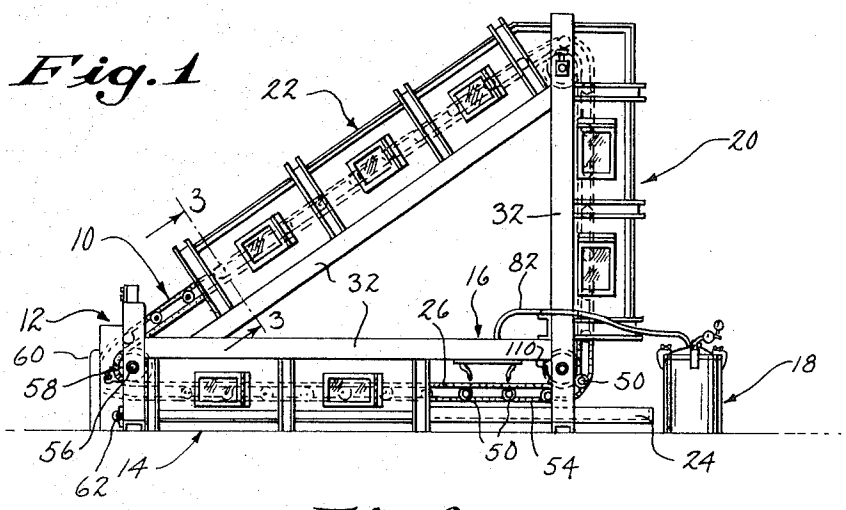


Fig. 3

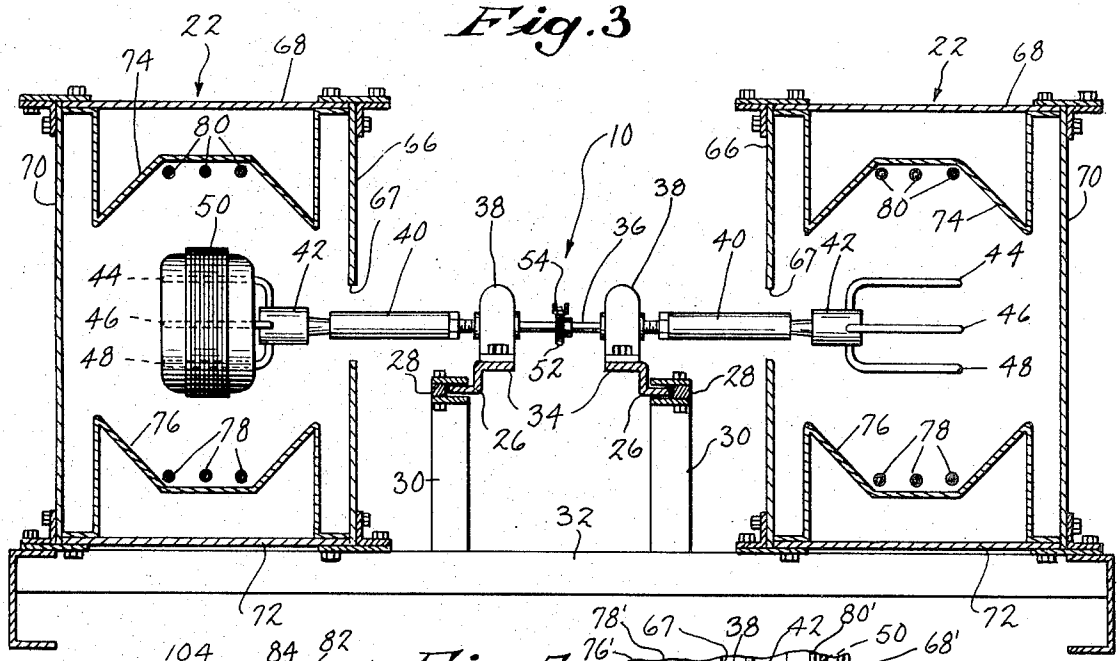


Fig. 5

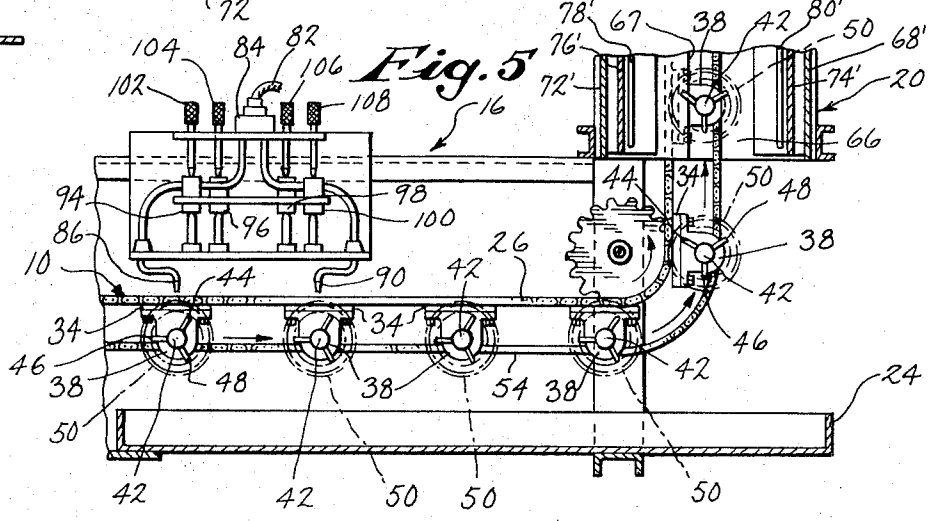
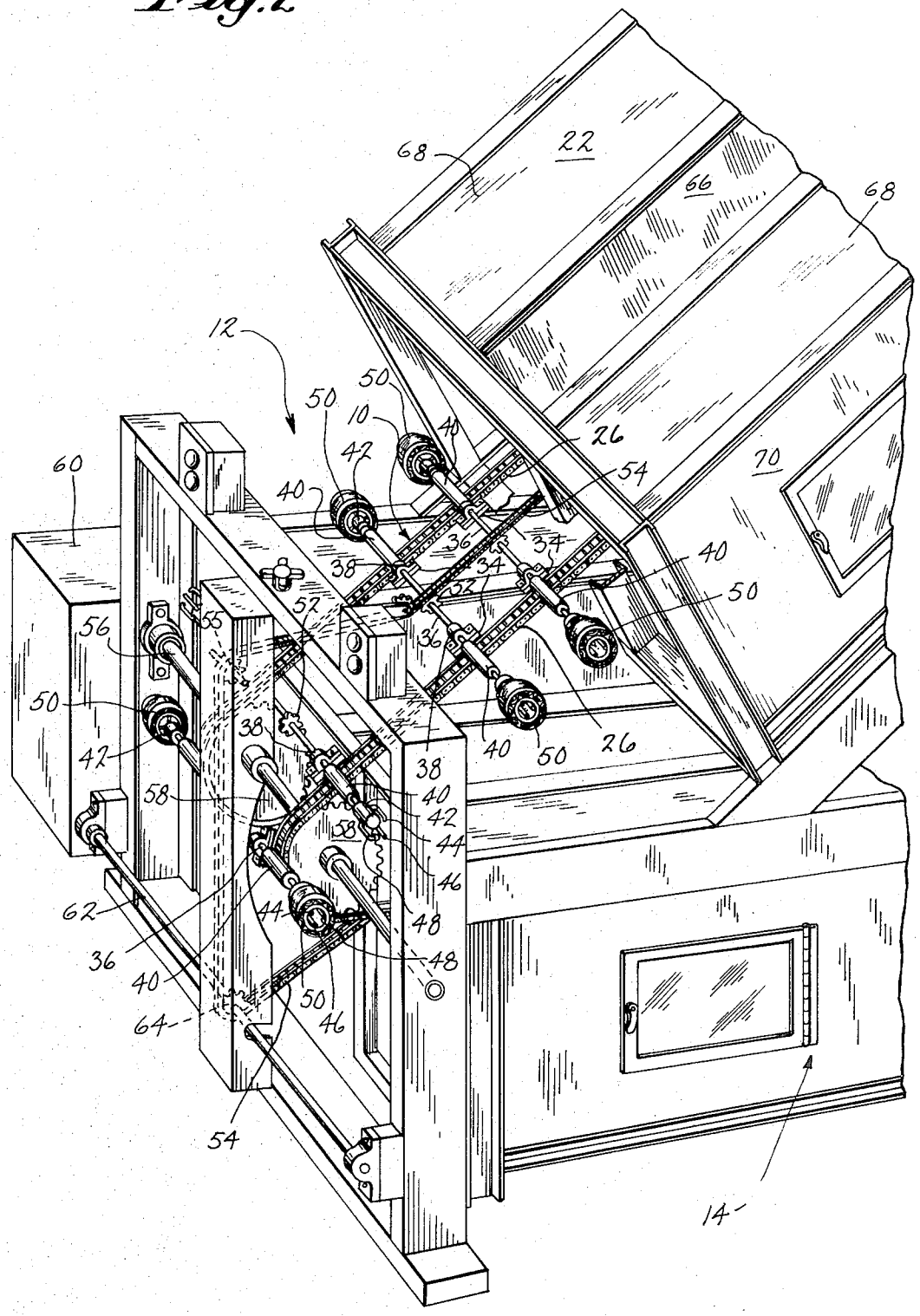


Fig. 2


22
66
68
68
12
50
50
10
40
42
26
54
70
60
40
36
34
38
32
40
50
56
55
57
50
38
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62
44
48
36
40
50
46
64
54
14

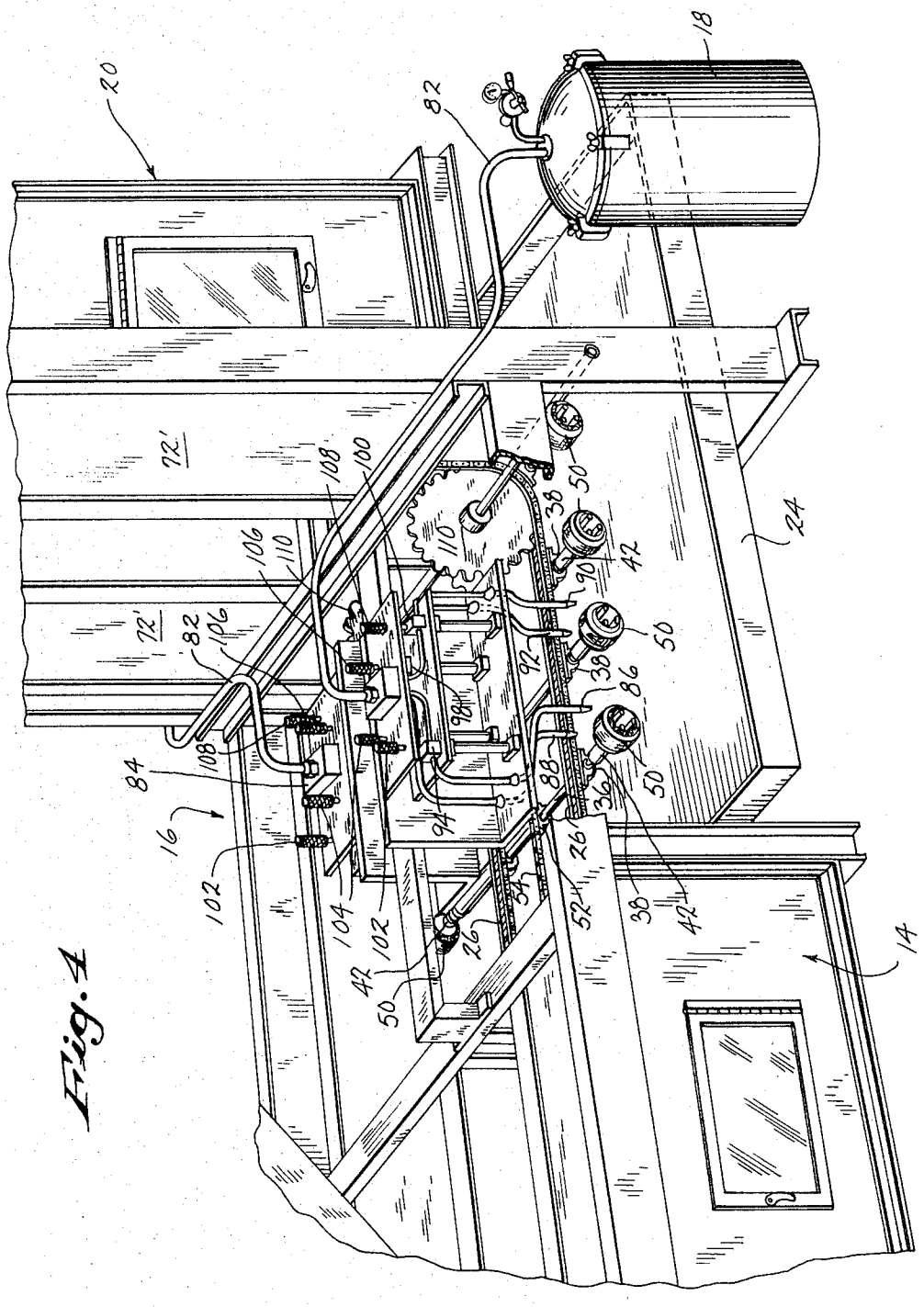

18
20
82
72'
72'
108
100
106
110
82
106
110
50
38
42
90
50
38
92
86
98
88
84
108
36
50
16
94
26
102
104
102
52
36
42
42
26
50
24
14

Fig. 4

WINDING IMPREGNATION SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to winding impregnation systems for impregnating electrical motor windings with varnish or the like and for heat-curing the impregnated varnish. In the past such winding impregnation systems have utilized horizontally disposed heating chambers which were equipped on their top and bottom sides with electrical heating elements. The motor windings were carried by a conveyor chain under an applicator station which applied a coating of varnish to each winding, then they were carried through the horizontally disposed heating chamber. These prior art impregnation systems had two notable drawbacks, however. In the first place, the horizontally disposed heating chambers took up an unduly large amount of floor space, and in the second place, while the varnish was still in its liquid form, it tended to drip off the windings and fall onto the bottom heating element of the heating chamber, thereby causing flash fires in the heating chamber.

Accordingly, one object of this invention is to provide a winding impregnation system which uses significantly smaller floor space than those heretofore known in the art.

Another object of the invention is to provide a winding impregnation system which avoids fire hazards by preventing drippage from falling onto heating elements.

A further object of this invention is to provide a winding impregnation system of the above-noted character which is sturdy in structure and reliable in operation.

SUMMARY OF THE INVENTION

In accordance with this invention, the above-noted objects are achieved by providing a winding impregnation system containing a conveyor chain which carries electrical motor windings or other workpieces under an applicator station which applies a varnish coating to the windings and then carries the windings through a heating chamber which is disposed in a generally upright plane adjacent to the applicator station. The heating chamber contains a heating element attached to at least one side of the chamber and the conveyor is spaced away from the heating element to avoid contact between the heating element and the varnish impregnated windings and to keep the heating element out of the path of drippage. The vertical heating chamber is long enough to allow the varnish to jell on the windings so that any drippage falls clear of the heating elements, out of the lower open end of the vertical heating chamber rather than onto a heating element. In the preferred embodiment, a drip pan is positioned under the applicator station and the lower open end of the vertical heating chamber to catch any drippage therefrom.

The preferred embodiment also includes a preheating chamber which extends in a horizontal plane from a load/unload station to the applicator station and includes a third heating chamber which extends from the top of the vertical heating chamber to the load/unload station, preferably in a diagonal direction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of one illustrative embodiment of the invention;

FIG. 2 is an enlarged perspective view of the load/unload station of the embodiment shown in FIG. 1;

FIG. 3 is a cross-sectional view taken on the line 3—3 of FIG. 1;

FIG. 4 is an enlarged perspective view of the applicator station of the embodiment shown in FIG. 1; and

FIG. 5 is a detailed sectional drawing showing the applicator station and the bottom of a vertical heating chamber.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, one illustrative embodiment of the invention includes an endless conveyor 10 which carries electric motor windings from a load/unload station 12 through a horizontal pre-heating chamber 14 and then under an applicator station 16 where liquid varnish is applied from a pressurized container 18 to the motor windings. After the varnish is applied at the applicator station 16, the conveyor 10 carries the varnish-coated windings through an upright heating chamber 20, preferably vertical as shown, and then through a return heating chamber 22, preferably diagonal, back to the load/unload stations 12.

As will be explained in detail later, the endless conveyor 10 is adapted to rotate the armatures at approximately thirty revolutions per minute so that the varnish is distributed evenly across the surface of the winding. The windings are pre-heated to a temperature of approximately 250° F. in the pre-heater 14 so that the varnish which is applied in the applicator station 16 will penetrate through the windings and also through any cores associated with the windings. In the vertical heating chamber 20, the temperature of the windings is raised from 250° to 350° F. which has the effect first of lowering the viscosity of the varnish so that it can penetrate throughoug the windings, and of then jelling the varnish so that there will be no problem of drippage when the windings pass through the diagonal heater 22. Drippage under the applicator station and from the open lower end of the heating chamber 20 is caught in a drip pan 24, which is mounted under the applicator station 16 and under the open end of the heating chamber 20, the drippage in the latter falling clear of the electrical heating elements so that there will be no flash fires.

Although only one side of the winding impregnation system is shown in FIG. 1, the system contains identical tandem units as shown in FIGS. 2, 3 and 4. Since these tandem units are identical with each other both in structure an in form, the same reference numerals will be used for identical parts of the tandem structure.

Referring to FIG. 3, the conveyor assembly comprises a pair of endless conveyor chains 26 which are constrained between a pair of chain guides 28. The chain guides 28 are supported by supporting members 30 which are rigidly attached to channel irons 32 which support the two tandm heating chambers 22.

The two conveyor chains 26 have outboard supporting members 34 attached thereto at regular intervals along the length of the chain for supporting the fixtures which hold the electrical windings. Each fixture includes a shaft 36 which is journalled in two pillow blocks 38. The pillow blocks 38 are attached to the two outboard support members 34 which are attached to and move along with conveyor chains 26.

Attached to the shaft 36 by means of screw threads are two fixture carriers 40. Each fixture carrier 40 is

threaded at one end to receive the shaft **36** and has a female taper in the other end to receive the male taper of a fixture **42** which has three fingers **44, 46** and **48** for supporting a winding assembly **50**. Each fixture **42** has a male taper on one end thereof for interacting with the female taper of a fixture carrier **40** to provide a friction fit.

In addition to providing the support and conveyance means for the winding assembly **50,** the conveyor must also provide a means for rotating the winding assembly **50** as it moves along so that the varnish applied thereto will be distributed evenly around the winding. Referring to FIG. **3,** this is accomplished by attaching a sprocket **52** to each shaft **36** and driving the sprockets **52** with a chain **54.**

The drive means for the chain **54,** and also for the chains **26,** is shown in FIG. **2.** The drive means for the chains **26** comprises a shaft **56** having two sprockets **58** attached thereto, the shaft being driven by an electric motor mounted within a housing **60.** Chain **54** is similarly driven by a drive shaft **62** and drive sprocket **64.** The drive shaft **62** is preferably driven by a separate variable speed motor. It will be noted that the chain **54** disengages from the sprockets **52** shortly before the fixtures reach the sprockets **58** and then re-engages the sprockets **52** immediately before the fixtures enter the pre-heating chamber **14.** The reason for disengaging the chain **54** in this area (the load/unload station) is to stop the fixtures from rotating in this area so that a winding assembly **50** can be easily removed from the fixtures and replaced with fresh windings at the entrance to the heating chamber **14.** The chain **54** is disengaged from the sprockets **52** by being passed around idler sprockets **53** and **55.**

Except for orientation and positioning, the three heating chambers **14, 20,** and **22** are identical in construction and the cross-sectional view of the heating chamber shown in FIG. **3** serves as an illustration of the internal structure for all three of the heating chambers **14, 20,** and **22,** it being understood that the heating elements are at the top and bottom of the chambers **14** and **22** but at the front and back of the chamber **20.** Referring to FIG. **3,** the heating chambers comprise four walls **66, 68, 70,** and **72,** all of which are made of asbestos. The four asbestos walls are held together by means of an iron framework made of channel irons and angle irons which are shown in the drawings but which will not be described in detail because they are well-known prior art structural configurations. The inner walls **66** of the heating chambers are slotted at **67** to admit the fixture holders **40.** Mounted in the interior of the heating chambers **22** are two metal reflectors **74** and **76** which reflect the heat from electrical heating elements **78** and **80** onto the winding assemblies **50** as they pass through the interior of a heating chamber.

FIGS. **4** and **5** show the applicator station **16** at which the winding assemblies **50** receive a coating of varnish after emerging from the pre-heating chamber **14.** Referring to FIGS. **4** and **5,** the varnish is contained in a pressurized can **18** and is delivered from the pressurized can **18** to the nozzle assembly by means of a hose **82.** The hose **82** delivers the varnish to a junction block **84** which divides the varnish flow into four different branches to feed four different nozzles **86, 88, 90** and **92.** The amount of the fluid flow from the nozzles **86–92** is controlled by means of valves **94, 96, 98,** and **100** (FIG. **5**). The valves **94–100** have corresponding manual adjustments **102, 104, 106,** and **108.** In addition to these manual adjustments, the valves **94–100** also have "off-on" solenoid actuating members which are not visible in the drawings for switching the valves on when a winding assembly is underneath the corresponding nozzles, and switching the valves off when no winding assembly is underneath the corresponding nozzles.

As the winding assemblies **50** are carried under the nozzles **86–92,** they receive trickles of varnish from the nozzles and the varnish tends immediately to permeate or impregnate the winding due to the face that the winding has been pre-heated to a temperature of approximately 250° F. in the pre-heating chamber **14,** and also due to the fact that the armatures are being spun at approximately 30 revolutions per minute. Because of the spinning of the armatures, there is a tendency for the varnish to spread itself evenly around the winding but if any drippage occurs it is caught in the drip pan **24,** which is mounted below the applicator station **16** and also below the open end of the upright heating chamber **20.** After carrying the winding assemblies **50** underneath the nozzles **86–92** the conveyor chains **26** pass beneath and around idler sprockets **110** which lead the conveyor into the bottom of the vertically oriented heating chamber **20.** The novel arrangement of the heating chamber **20** is a particularly important feature of the invention because in the past, when the freshly varnished winding assemblies were passed through the customarily horizontal heating chamber for curing, drippage from the winding assemblies would fall down onto the heating elements and the bottom of the chamber and cause flash fires within the heating chamber. In accordance with this invention, however, any drippage from the winding assemblies **50** while they are in the vertical heating chamber **20** falls parallel to the heating elements, and in locations spaced therefrom by a significant distance as can be seen in FIG. **3.** Accordingly, there is no fire hazard in the winding impregnation system of this invention.

The heating chamber **20** has a front side **72'** (see FIG. **5**) which supports heating elements **78'** and a reflector **76',** and said chamber has a back side **68'** which supports heating elements **80'** and a reflector **74'.** These parts are identical in function to the correspondingly numbered parts (with unprimed numbers) shown in cross-sectional view of FIG. **3.** The conveyor chain **26** is oriented in such position as to place the winding assemblies **50** approximately in the center of the space separating the two groups of heating elements **78'** and **80'** so that the heating elements will not be in the path of drippage and so that there will be no possibility of direct contact between the winding assemblies **50** and the heating elements **78'** and **80'.**

In the heating chamber **20,** the temperature of the windings **50** is raised from 250° F. to 350° F. Initially, the effect of the higher temperature is to lower the viscosity of the varnish and allow it to penetrate into every part of the windings and to the cores upon which the windings are wound. The next effect of the increased heat is to cause the varnish to jell and to cure. The heating chamber **20** is sufficiently high that, with the given amount of heat supplied to the heating chamber **20,** the varnish will jell before the windings leave the vertical heating chamber **20** and enter the diagonal heating chamber **22.** This is to eliminate any drippage in the diagonal heating chamber **22** since drippage here would

fall onto the heating element 78 and cause flash fires.

From the foregoing description it will be apparent that this invention provides a winding impregnation system which requires significantly smaller floor space than those heretofore known in the art and which avoids fire hazards by preventing varnish drippage from falling onto heating elements thereof. And although this invention has been described in connection with one specific embodiment thereof, it should be understood that the invention is by no means limited to the disclosed embodiment since many modifications can be made in the disclosed structure without departing from the basic concepts of this invention. Accordingly, this invention includes all such modifications as may fall within the scope of the following claims.

What is claimed is:

1. Winding impregnation apparatus comprising an endless conveyor having means for supporting workpieces; means supporting said conveyor for movement in a triangular course, said triangular course including a horizontal base section, an upright section at one end of said base section, and an oblique section connecting the upright end of said upright section with the other end of said base section; means for causing the endless conveyor to travel in such a direction that the workpieces travel first through the horizontal section, then upwardly through the upright section, and then obliquely downwardly through the oblique section; preheating chambers for said base section through which said workpieces travel; an applicator chamber for said base section for applying thermosetting liquid coating material to said pre-heated workpieces, said applicator section being located between the pre-heating chambers and the lower end of said upright section; a heatcuring chamber for said upright section through which the coated workpieces are conveyed upwardly; heating means in said last-mentioned chamber positioned so that the workpieces are laterally-spaced from said heating means whereby any drippings fall downwardly in a path clear of the heating means while the workpieces are traveling upwardly through said heat curing chamber, said heat-curing chamber for the upright section being sufficiently high that jelling of the thermosetting material takes place before the workpieces leave the chamber for said oblique section; an additional heatcuring chamber for workpieces passing along said oblique section, which chamber terminates short of the lower end of said oblique section, said endless conveyor moving the workpieces through said oblique heatcuring chamber and the chamber being of sufficient length as to provide for proper curing of the coating material on the workpieces before they leave said last-mentioned heat-curing chamber; and an exposed loading-unloading station at the lower end of the oblique section.

2. Winding impregnation apparatus as claimed in claim 1 in which there is heating means on opposite sides of the heatcuring chamber for the upright section, with the workpieces conveyed in a path which is spaced from both of said heating means.

3. Winding impregnation apparatus as claimed in claim 2 in which the endless conveyor is supported for movement in a right-triangular course, with the horizontal base section being one of the legs of the right triangle, with the upright section being another leg of the right triangle, and with the oblique section being the hypotenuse.

4. Winding impregnation apparatus as claimed in claim 1 in which the thermosetting liquid coating material is varnish, and in which the heating means in the pre-heating chamber is designed to raise the temperature of the workpieces to a predetermined point, and in which the heating means in the heating chamber for the upright section is designed to raise the temperature of the workpieces to a predetermined higher point, with said upright chamber being high enough with respect to the temperature in said chamber to cause the varnish to jell before it leaves said upright section.

5. Winding impregnation apparatus as claimed in claim 1, including means for causing rotation of the workpieces as they are being conveyed, and means for eliminating said rotation during passage through the loading-unloading station.

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