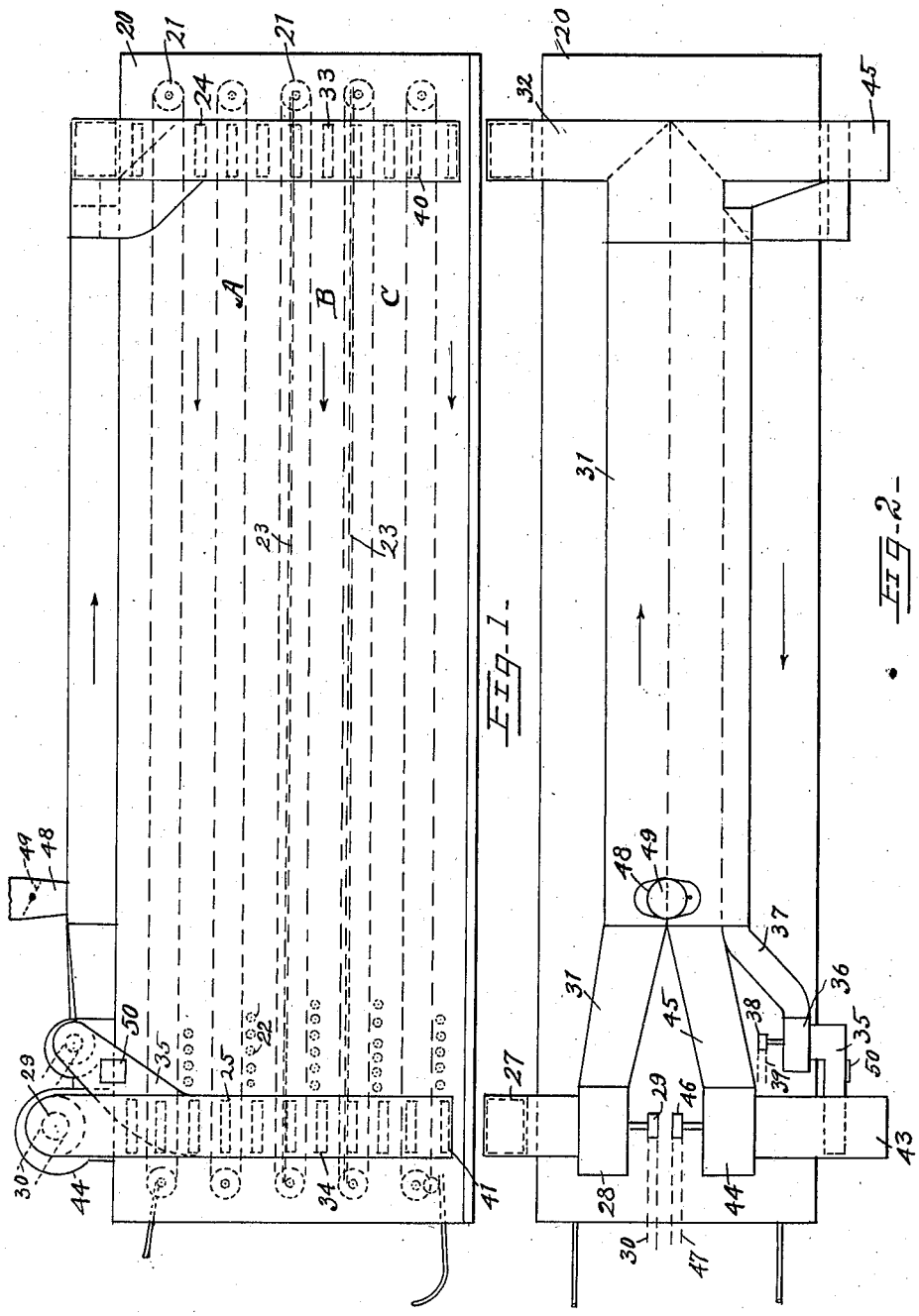
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DRIER

Filed July 29, 1932 8 Sheets-Sheet 1



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DRIER

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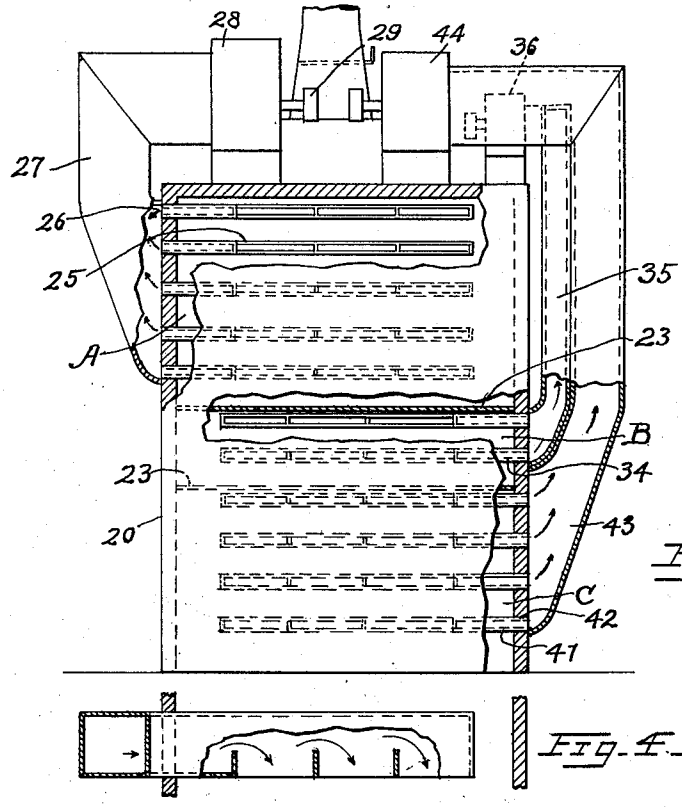


Fig-3-

Fig-4-

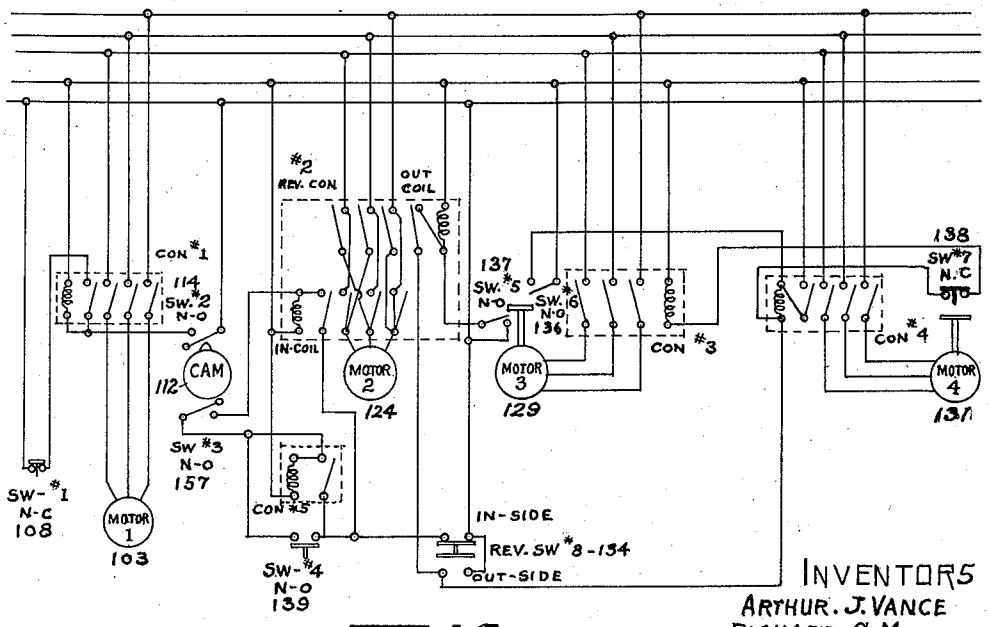


Fig-14-

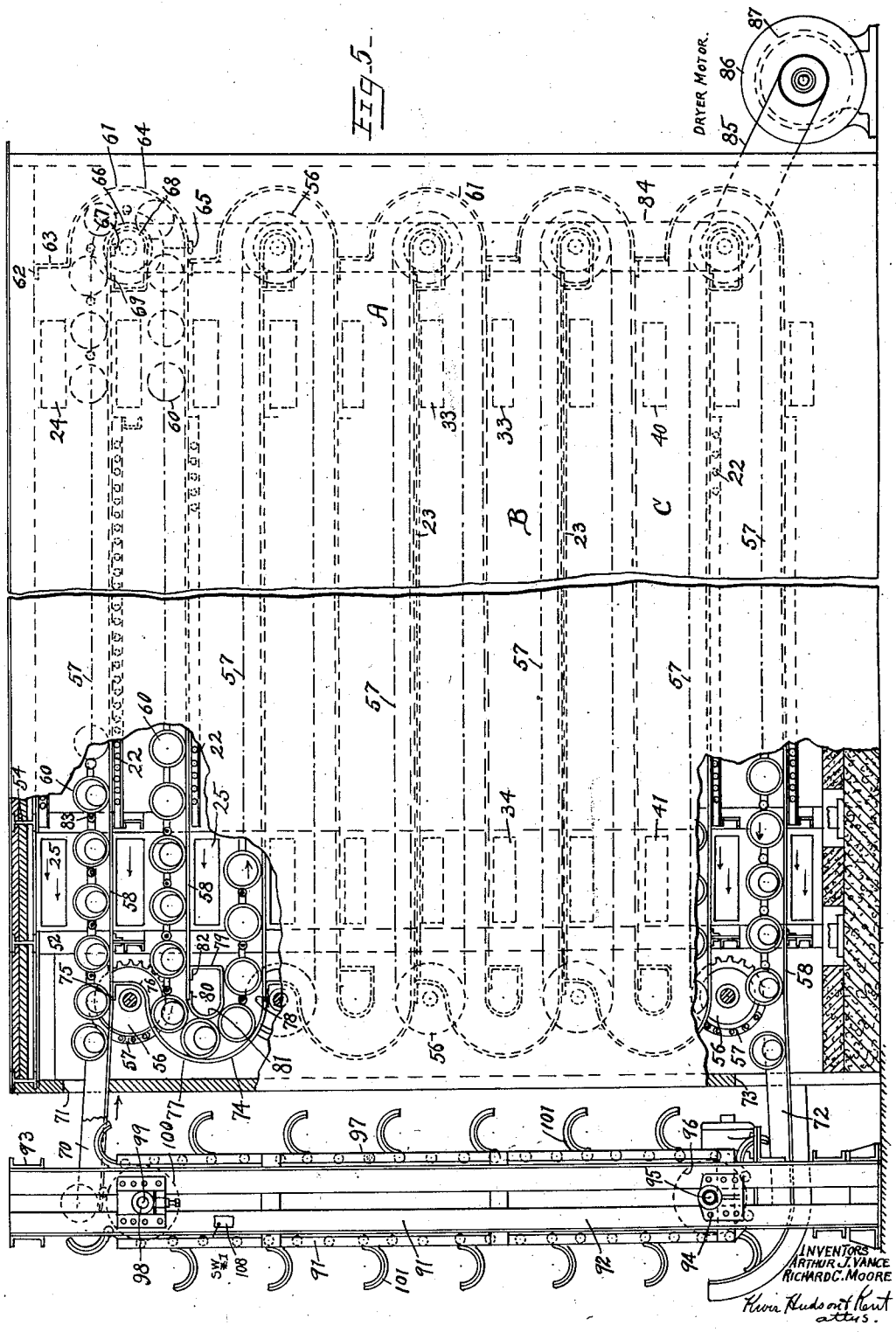
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DRIER

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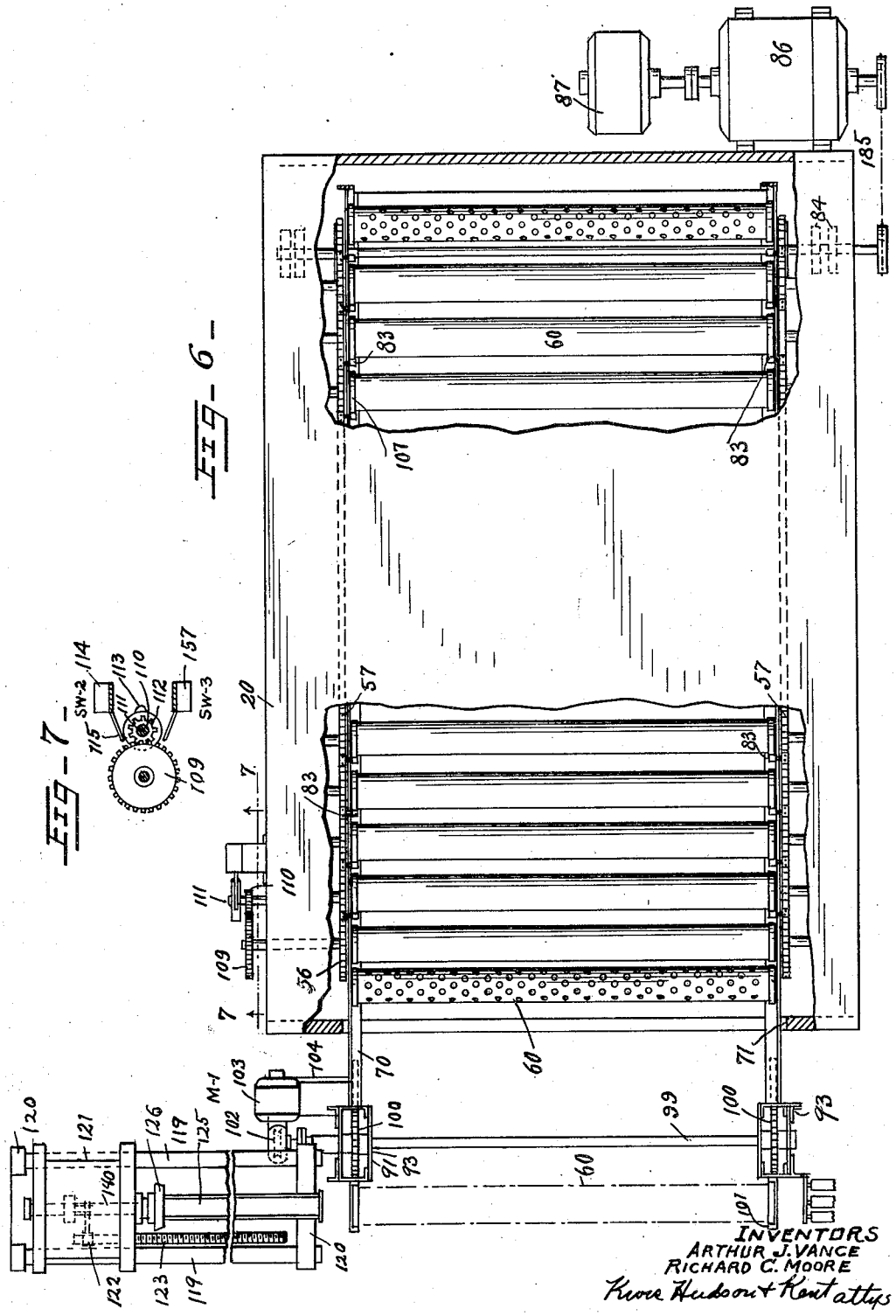
Fig. 5.



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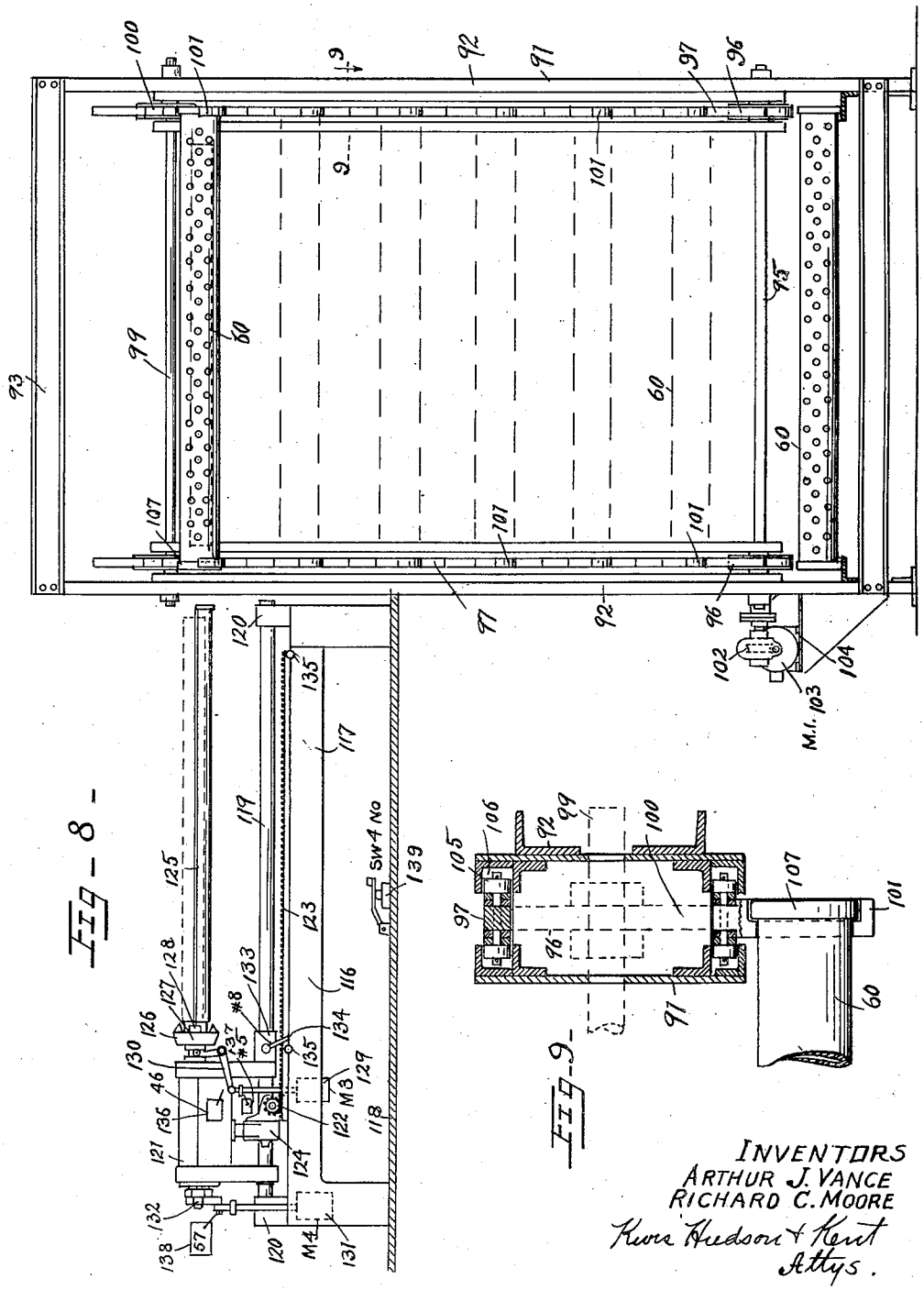


FIG - 8 -

FIG - 9 -

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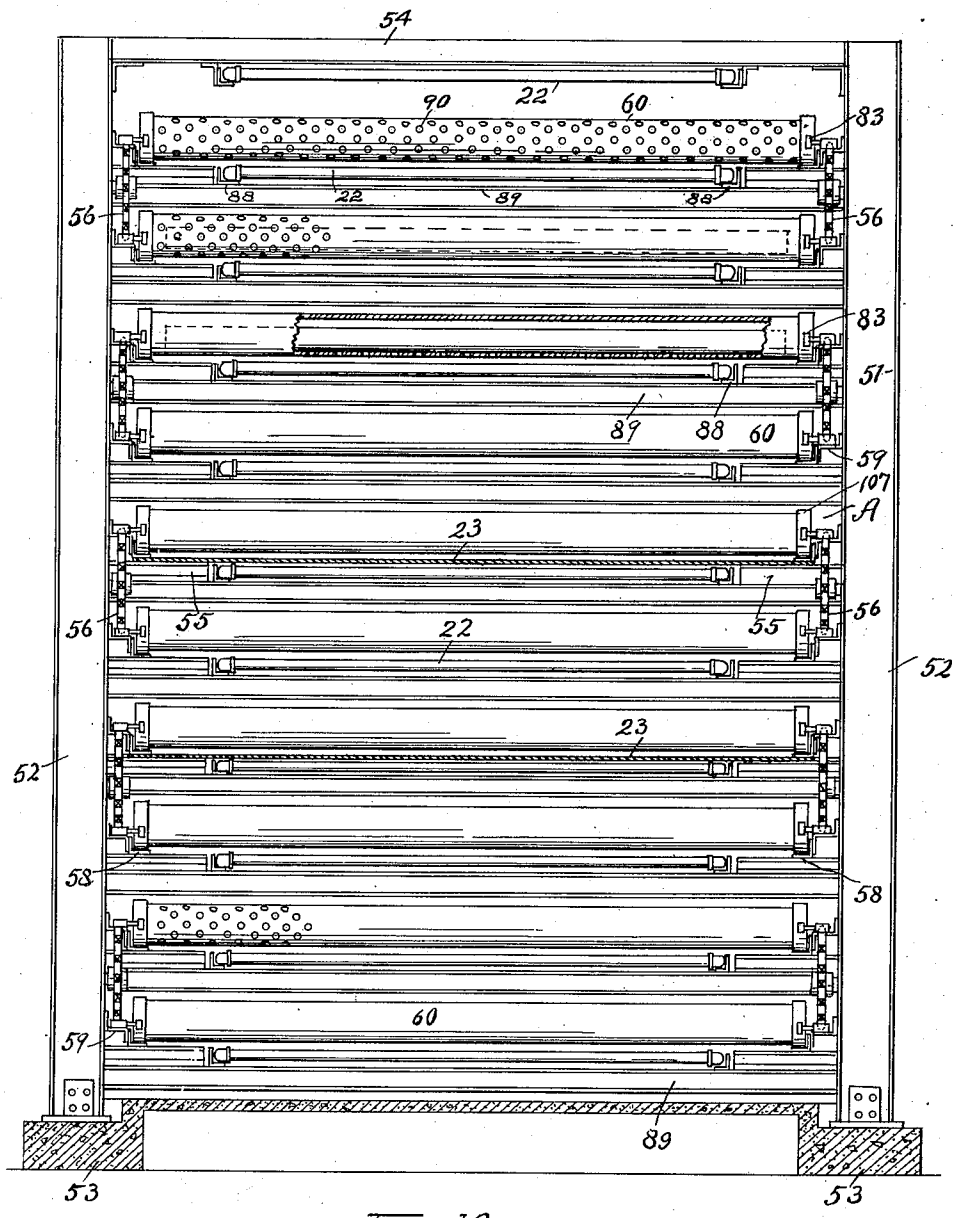


Fig. 10

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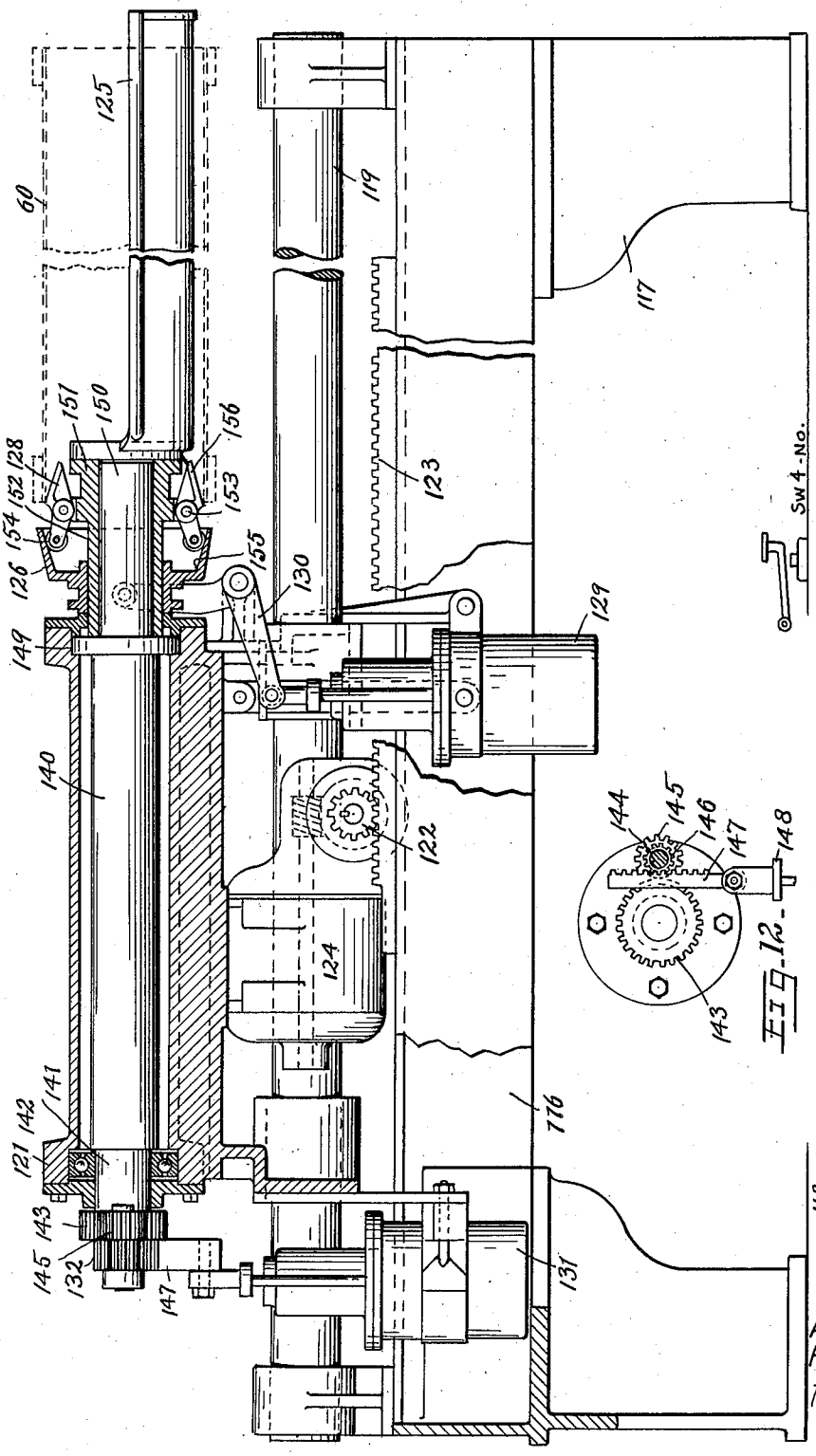


FIG. 11.

FIG. 12.

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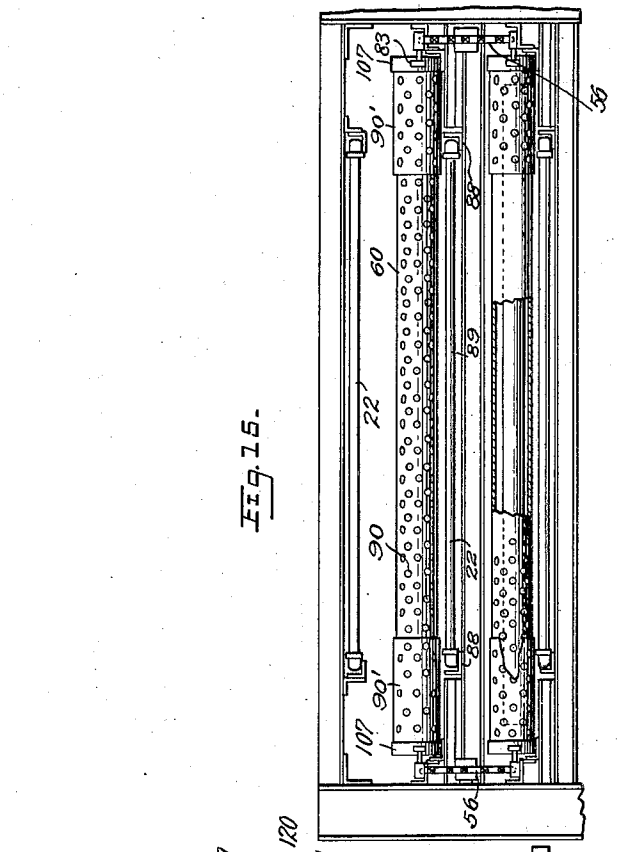


Fig. 15.

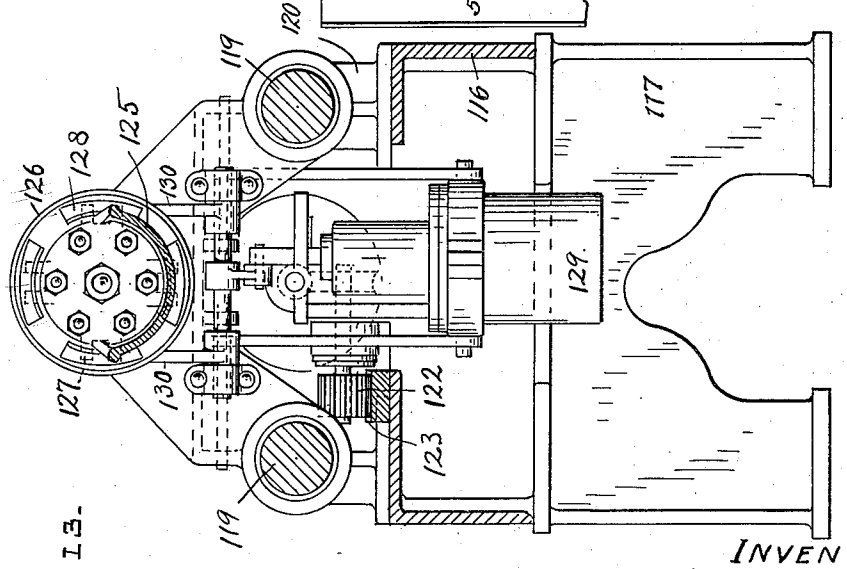


Fig. 13.

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Patented Apr. 28, 1936 2,039,129

UNITED STATES PATENT OFFICE

2,039,129

DRIER

Arthur J. Vance and Richard C. Moore, Painesville, Ohio, assignors to The Coe Manufacturing Company, Painesville, Ohio, a corporation of Ohio

Application July 29, 1932, Serial No. 625,758

6 Claims. (Cl. 34—12)

This invention relates to an apparatus for handling and drying wet fiber tubes in a manner more efficient than those now employed and with a considerable savings in the time required for complete treatment of the tubes.

So that the invention may be more readily understood, a brief explanation of the operations required in the forming of the wet fiber tubes, up to the point where they are ready to be received by the handling and drying apparatus will follow, together with the conditions necessarily resulting therefrom.

In the installation of electric and telephone cables underground, fiber tubes are used as forms or conduits which are imbedded in concrete, thus providing a continuous opening through which the cables can be drawn.

These fiber tubes are made on a wet machine of the usual type, similar to the way in which paper is made, and then have to be dried and, as they are very delicate, great care has to be used in drying them properly. After the tubes are dry they are boiled in pitch rendering them impregnable to moisture and take the appearance of cast iron pipe.

The tubes are of various sizes ranging from $1\frac{1}{8}$" to $4\frac{1}{2}$" inside diameter and are produced in 5' and 8' lengths. The tubes are formed upon mandrels by wrapping the wet sheet material around the mandrel until the proper thickness is obtained after which the operator slips them off the mandrels. The 5' lengths are stood on end upon trucks and placed in a drying room where they require several days to dry thoroughly, depending upon the sizes. The 8' lengths are too long to stand on end and so other means of drying are employed, such as roller driers. The 4" tube will weigh on an average about twenty or twenty-one pounds when wet and will dry down to less than five pounds when dry. They are so delicate that if a wet tube were laid on the floor before it was dry it would become flattened and therefore in drying the tubes in a horizontal position it is essential that they are continuously revolved.

Considerable difficulty is encountered in the making of 8' lengths of tubes and apparently the trouble lies in the drying. The commercial lengths are about 7' and are shortened to this extent as a result of so called splits. Splits occur at the ends of the tube as a result of inefficient and irregular drying. The end of the tubes have a tendency to dry first while the central portion dries last. In order, therefore, to sufficiently dry the central portion of the tubes results in the application of excessive heat at the ends of the tubes which causes the ends to dry too rapidly and usually causes cracks to appear. The split or cracked ends must then be cut back and the result is a shortened tube which is not commercially desirable.

It is, therefore, an object of the present invention to provide an apparatus for handling and drying wet tubes of the type referred to which is capable of handling the various sizes of tubes, more efficiently dry the tubes, and in general to eliminate the objections heretofore existing in methods at present employed.

Another object of the invention is to provide a drier for the wet tubes having zones through which the tubes are conveyed and therein subjected to different treatments so as to more efficiently equalize the removal of moisture from the tubes.

Another object of the invention is to provide a conveyor for the tubes through the drier which will operate at a constant speed irrespective of whether tubes are disposed thereon.

Another object of the invention is to provide means whereby the sizes of the respective zones may be changed to suit the different drying requirements.

Another object of the invention is to apply heat to the tubes in such a manner as to effect substantially equal or uniform drying thereof, so as not to injure the tubes.

Another object of the invention resides in providing a heat transmitting roll to receive the tube and having apertures therethrough to admit the heated drying medium into contact with the tube to assist in the drying thereof.

Another object of the invention resides in maintaining a rolling contact between the roll and its associated tube.

Another object of the invention is to provide an automatic feeder for handling the wet tubes as they come from the wet tube forming machine.

Another object of the present invention is to provide an automatic conveyor or elevator for receiving and discharging the rolls from and into the drier, the operation of which is synchronized with respect to the drier operation.

With the objects above indicated and other objects hereinafter explained in view the invention resides in the construction of the apparatus and the method accomplished thereby, as hereinafter described and claimed.

Referring to the drawings:

Figure 1 is a side elevational view of a drier embodying the invention and showing more clearly

the arrangement of the drying medium circulating systems for the various zones;

Fig. 2 is a top plan view of the drier shown in Fig. 1;

Fig. 3 is an end elevational view of the drier shown in Fig. 1 with portions broken away to better illustrate the arrangement of the zones and their respective circulating systems.

Fig. 4 is a top plan view of one of the discharge nozzles employed in the drier, a portion being broken away to more clearly show the construction;

Fig. 5 is a side elevational view on an enlarged scale of the elevator and the drier with portions of the latter broken away to more clearly illustrate the construction of the roll conveying mechanism;

Fig. 6 is a top plan view of that shown in Fig. 5 and also showing the relative position of the feeding apparatus;

Fig. 7 is a sectional view taken on line 7—7 of Fig. 6 and showing the mechanism for synchronizing the operation of the drier with the feeding apparatus;

Fig. 8 is an end elevational view of that shown in Figs. 5 and 7 and more clearly illustrating the control mechanism for the feeding apparatus;

Fig. 9 is a fragmentary sectional view on an enlarged scale taken on line 9—9 of Fig. 8 and showing a detail of the elevator;

Fig. 10 is a vertical cross-sectional view of the drier on an enlarged scale showing more clearly the details of construction;

Fig. 11 is a side elevational view of the feeding apparatus on an enlarged scale with portions broken away to more clearly illustrate the details of construction;

Fig. 12 is an end view of the cradle revolving mechanism;

Fig. 13 is an end elevational view of that shown in Fig. 11 with portions broken away to more clearly illustrate the details of construction;

Fig. 14 is a wiring diagram of the electrical circuit employed for operating the feeding apparatus, elevator and drier.

Fig. 15 is a partial vertical sectional view on the order of Fig. 10 but showing a modified form of article carrying roll.

In the drawings, referring particularly to Figs. 1 to 3, inclusive, there is illustrated a drier which forms a part of the present apparatus and discloses the drying medium circulating systems for the respective zones into which the drying chamber is divided. The drying chamber is indicated by the numeral **20** and may consist of the usual type of insulated housing of sufficient size to accommodate the number of tubes which it is desired to handle. A plurality of superimposed conveyors **21** are arranged within the drying chamber and are adapted to convey the rolls containing the wet tubes back and forth through the drying chamber, the details of which will be later more fully described. Heating means **22** in the form of coils extend along the path of movement of the conveyors **21** and transversely of the drier or longitudinally of the rolls.

The drying chamber **20** is divided into a plurality of zones by adjustable partitions **23**, two of which are herein shown, and extend in parallel relation longitudinally and in superimposed relation vertically. These partitions **23** may be located in any desired manner within the drying chamber, depending upon the drying requirements, and the heating coils in each of the respective zones are independently controlled by any suitable means familiar to those skilled in the art.

Drying medium circulating systems are also provided for the respective zones and the independently controlled so as to obtain the proper drying conditions necessary to efficiently dry the wet tubes as they are conveyed through the zones successively. The upper zone A, which is located above the upper partition **23**, is supplied with any suitable drying medium such as air, through a plurality of transversely extending and horizontally disposed nozzles **24** located at one end of the drying chamber and preferably the right-hand end, as shown in Fig. 1, there being a nozzle disposed between the respective conveyors and which nozzles will be termed inlet nozzles. At the opposite end of the drying chamber a plurality of similar nozzles **25** are provided through which the drying medium is withdrawn from zone A of the drying chamber, the arrangement of which is more clearly shown in Fig. 3. While Fig. 3 illustrates the position of the outlet nozzles in the respective zones, the arrangement and construction is identical with respect to the inlet nozzles **24**. The outlet nozzles **25** have one of their ends secured within suitable openings **26** provided in the housing of the drying chamber and a duct **27** has one end secured to the outer side of the housing and over the openings **26**, while the opposite end is connected to a fan housing **28** suitably supported upon the top of the drying chamber. The usual type of suction fan is mounted within the housing **28** and has a shaft extending outwardly through the housing to which a pulley **29** is secured. The fan is rotated by means of a belt **30** which engages the pulley **29** and is connected to any suitable source of power. The outlet of the fan is connected by a duct **31**, which has one end connected to the housing **28**, and extends along the top of the drying chamber and upon the outside thereof where it connects with a transversely extending duct **32** having its lower end extending downwardly along the side of the drying chamber and connected with the inlet nozzles **24** in a manner similar to the nozzles **25**.

The zone B is supplied with drying medium in a similar manner having inlet nozzles **33** and exhaust nozzles **34**. The exhaust nozzles are supported within openings provided in the side of the housing of the drying chamber and communicate with a duct **35** which has its lower end secured to the housing and extending over the openings provided for the nozzles **34**. The upper end of the duct **35** connects with the inlet side of a fan housing **36**, while the outlet side of the fan housing is connected to one end of a duct **37** extending along the top and upon the outer side of the housing of the drying chamber. The opposite end of the duct **37** extends downwardly along the side of the housing in a manner similar to the duct **35** and is connected to the housing so as to extend over the openings provided therein for receiving the ends of the inlet nozzles **33**. The fan, not shown, within the housing **36** has a shaft which extends therethrough and to which is secured a pulley **38** adapted to be engaged by a belt **39** connected to any suitable source of power for rotating the fan.

The zone C is also provided with an independent circulating system and has a plurality of inlet nozzles **40** secured within suitable openings in the side of the housing in the drying chamber and with exhaust nozzles **41** having their ends se-

cured within openings 42 provided in the housing of the drying chamber, as clearly shown in Fig. 3. A duct 43 has its lower end secured to the housing and extends over the openings 42, while the upper end is connected with the inlet side of a fan housing 44 secured to the top of the housing of the drying chamber. The outlet side of the fan housing is connected with one end of a duct 45 which extends along the top of the housing and has its opposite end extending downwardly in a manner similar to the duct 43, being connected to the outside of the housing and extending over the openings therein provided for the inlet nozzles 40. A fan is provided within the housing 36 and has a shaft extending outwardly therethrough to which is secured a pulley 46 with which a belt 47 engages and is connected with any suitable source of power for rotating the fan. Upon the top of the ducts 31 and 45 an exhaust 48 is connected and communicates with the interior of the ducts, so that a portion of the drying medium may be exhausted to atmosphere therethrough, the quantity of exhausted medium being controlled by a valve 49 secured within the exhaust 48. A louvre damper 50 is provided in the duct 35 for exhausting, if desired, a portion of the circulating medium passing through the duct 37. Inasmuch as each of the drying medium circulating systems is independently controlled, variation in the rate of flow may be obtained.

In Figs. 5 and 10, the interior construction of the drying chamber is illustrated in detail. Frames 51, such as shown in Fig. 10, are provided at the forward and rear ends of the drying chamber to provide a suitable support for the conveyor and consist of spaced uprights 52 having their lower ends secured to a suitable foundation 53 and their upper ends held in spaced relation by transversely extending members 54, all joined together to provide a rigid structure. The partitions 23, which divide the drying chamber into independent zones, are also shown and are removably supported upon inwardly extending members 55, which have their outer ends connected to the uprights 52. These members 55 extend inwardly at spaced intervals vertically and are adapted to support the partitions 23 so that the size of the zones may be varied to suit the drying requirements. Upon the inner sides of the end uprights 52 are rotatably secured a plurality of sprocket wheels 56 disposed one above the other in vertical alignment and at both the forward and rear ends of the drying chamber, as clearly shown in Fig. 5. Longitudinally extending sprocket chains 57 engage the sprocket wheels 56 at the forward and rear ends of the drying chamber, so as to provide a plurality of horizontally extending superimposed conveyors in parallel relation.

Adjacent the inner sides of the uprights 52 are a plurality of longitudinally extending angles 58, spaced one above the other in vertical alignment, and which have their inwardly extending legs secured upon the members 55, while the upwardly extending legs are disposed adjacent the sprocket wheels 56 and are connected by Z-bars 59 with the uprights 52. These angle members 58 extend longitudinally from adjacent the axes of the sprocket wheels 56 and act as a guide track and support for the opposite ends of a plurality of independent hollow rolls 60. At one end, preferably the right-hand end, as shown in Fig. 5, guide plates 61 are provided for guiding the rolls 60 and consist of substantially a flat metal strap having a flange 62 for attaching the same to the housing, a depending portion 63 and an arcuate portion 64 extending concentrically with respect to the axis of the sprocket wheel adjacent thereto, the lower end being provided with an offset flange 65 for attachment with the under side of the angle 58. As all of the connections at this end are identical, the explanation of the construction of one will suffice. Connected to the under side of the uppermost angles 58 are second guide members 66 which consist of a flat metal strap having an offset flange 67 for attachment to the under side of the angle 58 and an arcuate portion 68 concentric with respect to the arcuate portion 64 of the member 61 and its opposite end bent upwardly and inwardly to provide a flange 69 for attachment with the under side of the angle 58. These guide members 61 and 66 are spaced apart a sufficient distance to permit the rolls 60 to pass therebetween and are secured to the angle members on both sides of the drying chamber.

At the opposite end of the drying chamber, or the left hand end, as viewed in Fig. 5, the free ends of the uppermost angles 58 are connected with one end of a pair of spaced angles 70 which extend through an opening 71 provided in the adjacent end of the housing of the drying chamber, the opening being of sufficient size to permit the rolls 60 to pass therethrough without interference. The lowermost angles 58 are similarly connected to one end of a pair of spaced angles 72, forming a continuation of the angle guide rails 58, and extend through a suitable opening 73 adjacent the lower portion of the end wall of the drying chamber to permit, likewise, the unrestricted passage of the rolls 60 through which they are discharged from the drying chamber. Guide plates 74 in the form of flat metal straps are provided for guiding the rolls in their movement between adjacent conveyors and consist of a flange 75 for attachment with the under side of the angle 58, a depending portion 76, to clear the shaft of the sprocket wheel 56, an arcuate portion 77 and an offset flange 78 for attachment with the underside of the alternate angle 58. A guide plate 79 in the form of a flat metal strap has an offset flange 80 for attachment with the underside of the intermediate angle 58, an arcuate portion 81 concentric with the arcuate portion 77 of the plate 74, a flat horizontal portion, an upwardly extending portion and a lateral flange 82 for attachment with the under side of the intermediate angle 58. These guiding plates are spaced apart a sufficient distance to permit the rolls 60 to pass freely therebetween and the construction at the opposite end of the drier is such as to provide a continuous conveying system for the rolls 60, the path of movement being backward and forward through the drying chamber from the upper portion of the drying chamber, at which the rolls are charged, to the lower portion of the chamber at which the rolls are discharged. It is further to be noted that the rolls 60 are charged into the drier and discharged from the drier at the same end. As the construction of the conveyor is identical with respect to the various decks, the description of one connection is believed to be sufficient.

The hollow rolls 60 are fed into the drier through the opening 71 and are supported at their opposite ends upon the angle members 58. The sprocket chains 57 have a plurality of inwardly extending rollers 83 secured thereto and are spaced at intervals therealong, so as to engage the opposite ends of a single roll and propel the

same along the angles or guide rails 58. As the rolls 60 reach the end of the upper travel of the sprocket chain 57 they pass around between the guide plates 61 and 66 and are propelled in the opposite direction by the return travel of the sprocket chain, the rolls 60 being compelled to rotate due to the frictional contact with the angles or guide rails 58. As the rolls reach the forward end of the drying chamber they pass between the guide plates 74 and 79 and, due to gravity, move downwardly into the succeeding angles or guide rails 58 where they are again propelled in a like manner by the conveyor directly beneath. The sprocket chain conveyors of each deck are connected by a sprocket chain 84, so as to operate in unison, and the lowermost conveyor may be driven by a sprocket chain 85 connected with a variable speed device 86, which in turn is driven by an electric motor 87. Any suitable means for controlling the operation of the motor may be employed, as well as the motor being driven by any suitable source of current supply.

Heating coils 22, as already explained, extend transversely of the drier and are disposed immediately beneath the path of movement of the rolls 60, as clearly shown in Fig. 10. The outer ends of the coils terminate inwardly from the outer ends of the rolls 60 and are supported upon longitudinally extending angles 88, which in turn are supported upon transversely extending channel members 89, the opposite ends of which are connected to the uprights 52 at a point adjacent the inlet openings and exhaust openings for the drying medium. These heating coils may be supplied with any heating medium such as steam and are supplied from any suitable source and controlled in any well known manner. The heating coils in the respective zones are independently controlled so that different drying conditions may be obtained in the respective zones to more efficiently dry the wet tubes which the rolls 60 are adapted to carry in their passage through the drier. One of the important features of the arrangement of the heating coils is their termination short of the ends of the rolls 60 in order to apply a greater amount of heat adjacent the central portion of the roll than at the ends. This construction, to a great extent, prevents the formation of splits at the ends of the tubes as they are being dried with the result that a longer commercial tube may be produced. The rolls 60 are preferably made of heat conducting material, so that the heat will be transmitted directly to the tube within the roll with which it is in contact and perforations 90 are provided in the wall of the rolls to permit the heat to pass therethrough into direct contact with the wet tube. If it is found that the ends of the tubes are drying more rapidly than is desirable the perforations adjacent the ends of the rolls 60 may be eliminated or, as shown in Fig. 15, sleeves 90' may be provided which are slidably mounted upon the ends of the rolls to wholly or partially cover the perforations until the proper drying condition is obtained. It will be further noted that the wet tube is adapted to have a rolling engagement with the inner surface of the roll, which results in maintaining the tube in its cylindrical shape during the drying operation.

It will be understood, of course, that under the ordinary circumstances the rolls 60 are not to be removed from the conveying system and that the drier is designed to accommodate a given number of rolls, each roll being adapted to receive a single wet tube and to convey the same through the drying chamber. A charging and discharging device is therefore provided for receiving the rolls as they are discharged from the drying chamber and conveying them to the point at which they are charged into the drying chamber. In the present instance, an elevator 91 is provided and consists of a frame having spaced uprights 92, the lower ends of which rest upon and are secured to a suitable foundation, preferably the same as that which supports the drying chamber. The upper ends of the uprights are held in spaced relation by transversely extending channel members 93 which have their ends secured to the uprights in such a manner as to provide a rigid structure. At the lower end of the frame bearings 94 are secured to the uprights and rotatably support a transverse shaft 95. A pair of sprocket wheels 96 are keyed or otherwise secured to the opposite ends of the shaft 95, but within the upright members 92, as clearly shown in Fig. 8 and engage a pair of upwardly extending sprocket chains 97. At the upper end of the frame adjustable bearing members 98 are secured to the uprights 92 and rotatably support a transversely extending shaft 99, which has a pair of sprocket wheels 100 keyed or otherwise secured to the opposite ends of the shaft and likewise inside of the uprights 92. These sprocket wheels receive and support the sprocket chains 97 and in effect provide an endless conveyor. The sprocket chains 97 have arcuate fingers or projections 101 extending outwardly therefrom which are adapted to receive the opposite ends of the rolls 60. These fingers are spaced apart along the conveyor chains 97 at any desired distances, but preferably should be spaced apart a distance corresponding to the spacing of the adjacent rolls 60, so, as the rolls 60 are discharged from the drying chamber through the opening 73, the fingers 101 will engage the rolls in succession and convey the same upwardly to the point where they are charged through the openings 71 into the drying chamber.

One end of the shaft 95 extends beyond the adjacent upright member 92 and is connected through a suitable worm drive 102 with an electric driving motor 103, the same being supported upon a plate 104 connected with the upright, as clearly shown in Fig. 8.

Details of the sprocket chain 97 are more clearly shown in Fig. 9 and include rollers 105 rotatably carried by the sprocket chain and running within guides 106, so as to provide an anti-friction construction for the sprocket chain. As the rolls 60 are provided with flanged ends 107 of enlarged diameter, the fingers 101 are cut away to correspond with the shape of the ends of the rolls so that there is little chance for the rolls to become disengaged during their travel upon the elevator. A switch 108 is secured to one of the uprights and has its operating member in line with the rollers 105, so as to be operated thereby for a purpose to be later described.

The operation of the elevator is intermittent with respect to the operation of the drier conveyor, which, under normal operating conditions, is continuous. It is necessary that the elevator be stopped in its travel in order that a wet tube may be loaded into the rolls and the dry tubes discharged from the rolls. The intermittent operation of the elevator, however, has no effect upon the continuity of the operation of the drier conveyor and consequently whether a wet tube is

within a roll has no effect upon the drying of the wet tubes which are within other rolls. However, the operation of the elevator must be synchronized with respect to the operation of the drier conveyor and, therefore, the operation of the elevator motor 103 is controlled by the operation of the drier conveyor. In Figs. 6 and 7 a detail of the control means is shown, although any other means may be employed. The shaft from one of the sprocket wheels 56 of the drier conveyor extends through the housing of the drier and has secured thereto an external gear 109. A pinion 110 is secured upon a shaft 111 rotatably journaled in the housing and is in constant mesh with the external gear 109, any suitable ratio between the meshing gears being maintained. The shaft 111 also has secured thereto a disc 112 having an offset 113 provided thereon. A switch 114 is secured to the drier housing and has an operating arm 115 disposed in the path of movement of the offset 113. The switch 114 is suitably connected in the circuit with the motor 103, as will be later more fully described, and, consequently, as the offset 113 makes one revolution the motor circuit 103 is momentarily closed with the result that the elevator is moved a distance corresponding to the space between the fingers 101.

As it is impractical to handle the wet tubes after they are formed, due to the fact that the tubes may become marked or otherwise exteriorly damaged, an automatic means is provided by which the wet tubes may be safely handled and expeditiously loaded into the rolls 60 upon the elevator. Inasmuch as the elevator 91 is intermittently operated, the loading of the wet tubes into the rolls 60 is also intermittent and the loading operation is controlled by the movement of the elevator 91. The loader 116 comprises a base or standard 117 adapted to be supported upon a suitable foundation 118 at a substantially higher elevation than the foundation upon which the elevator 91 is supported, for a reason as will be more apparent as the description proceeds. This base 117 has secured thereto a pair of spaced rods 119 which extend longitudinally and are secured in brackets 120 attached to the upper surface of the base 117. A member 121 is slidably mounted upon the rods 119 and is reciprocably movable thereon by means of a pinion 122 which engages with a rack 123 secured to the upper side of the base 117. The pinion 122 is driven through a worm drive connection by a motor 124 secured to the member 121, the current for the motor being supplied from any suitable source, as will later be more fully described.

A substantially U-shaped cradle 125 is rotatably supported within the member 121 and is normally in alignment with one of the rolls 60 which is to be loaded with the wet tube. The relationship of the cradle, with respect to the roll upon the elevator, is clearly illustrated in Figs. 6 and 8. It is important in discharging a wet tube from the cradle into the roll 60 that practically no relative movement between the wet tube and the roll be permitted, otherwise a scarring of the tube will result. A roll engaging clutch 126 is, therefore, provided and is mounted at the rear end of the cradle 125. This clutch 126 comprises a cam member 127 which is slidable upon its support and is adapted to engage a plurality of pivoted fingers 128, the outer ends of which are adapted to engage the inner surface of the roll 60, so as to rigidly hold the tube for rotation as the cradle 125 is rotated. The construction of the clutch is more clearly illustrated in Figs. 11 and 13 and will be more fully described. A motor 129 is mounted upon the slidable member 121 and has an actuating member which is connected to suitable linkage 130 for moving the clutch into and out of clutching engagement. A motor 131 is also mounted upon the slidable member 121 and has an actuating member for rotating the cradle 125 about its longitudinal axis through a suitable rack and pinion connection 132. A limit switch 133 is mounted upon the slidable member 121 and has an actuating arm 134 engageable with pins 135 positioned at the limit of travel of the member 121 for controlling the operation of the motor 124 and limiting the movement of the slidable member 121. A switch 136 is mounted upon the member 121 and has an actuating arm in the path of movement of the actuating member upon the motor 129 which controls the operation of the motor 129. A switch 137, also carried by the slidable member 121, has an actuating member which is likewise in the path of movement of the actuating member of the motor 129 and is adapted to be operated upon the reverse movement only of the motor 129. A switch 138 is mounted in any suitable manner upon the sliding member 121 and has an actuating member in the path of movement of the actuating member of the motor 131 for controlling the operation of the said motor. A manually operable switch 139 is supported upon the floor or foundation 118 in a position convenient to the operator and controls the operation of the intermittently operated elevator 91, so that the elevator will be operated only at such time as a wet tube is to be loaded within the roll 60.

In Figs. 11, 12 and 13 a detail of the loading device 116 is shown. The motors 129 and 131 are preferably of the commercial type known as operators or thrusters and are selected by reason of their special adaptation to this device. A motor is provided in the upper portion of the housing which operates a centrifugal piston for raising the actuating member. The movement is rectilinear and any motor which is capable of producing rectilinear motion can be used in place of the motors herein shown. The cradle 125 is mounted for rotary movement about its longitudinal axis upon a shaft 140, which has a reduced end 141 journaled in ball bearings 142 secured in the end of the member 121. The end of the shaft 141 extends beyond the end of the housing and has secured thereto an external gear 143, better shown in Fig. 12. The housing also carries a stud 144 upon which is rotatably mounted a pinion 145 which is in constant mesh with the gear 143. The pinion 145 also has formed integral therewith a pinion 146 of smaller pitch diameter which meshes with a rack 147 secured to the actuating member 148 of the motor 131. The ratio of the gear connection is such as to rotate the cradle a sufficient distance to discharge the wet tube from the cradle into the roll.

The forward end of the shaft 140 is mounted in a plain bearing 149 and has an extension 150 which is connected with the cradle 125. A sleeve 151 is secured to the extension 150 so that it will rotate therewith and has a cylindrical surface 152 upon which the clutch member 126 is reciprocably and rotatably mounted. A plurality of fingers 128 are pivotally mounted at 153 upon the forward end of the sleeve 151 and have rearwardly extending portions supporting rollers 154 which are adapted to engage with the cammed inner surface 155 of the clutch 126. The forward ends of the fingers 128 have surfaces 156 which are

adapted to engage with the inner surface of the roll 60, the roll being herein shown in dotted lines to show the relationship between the fingers and roll just prior to the clutching engagement.

In the description of the operation of the device, reference should be made to the wiring diagram shown in Fig. 14. The drying of fiber tubes is accomplished by placing the wet tubes within hollow rolls 60 made of perforated metal which are then caused to roll through successive decks of the drier 20. The rolls 60 are introduced at the top deck of the drier and are discharged at the bottom deck of the drier at the same end. The rolls 60 are moved through the drier by chain conveyors and it is one of the features of the drier that, regardless of whether a roll 60 contains a wet tube, the length of time required for a roll to make a round trip is always constant. In other words, the movement of the rolls is constant regardless of whether they are loaded with wet tubes. The feeder consists of two main units, the elevator and the loader. The elevator is arranged to lift the rolls 60, after they have been discharged from the drier, up to the top deck of the drier where they roll into engagement with the drier chain of the drier. The action of the elevator is intermittent as each roll 60 must be stopped in its upward travel for unloading and loading. The loader is a cradle arranged to receive a wet tube, so mounted that it may be inserted into a roll rotated 180° and withdrawn. To prevent possible scuffing of the tube, the cradle is provided with a clutch mechanism which grips the roll during rotation, so that cradle, tube and roll are turned simultaneously. The unloading of the dry tubes may be done by hand as the rolls emerge from the drier, or the dry tubes may be pushed from the rolls by the leading edge of the loading cradle.

The operation of the automatic feeder may be described as follows:

The timing of the roll feeding is accomplished by a cam 112 driven from the chain drive of the drier proper. The cam makes one revolution as the drier chain advances one pitch, or one roll space. Each revolution switch 114 is momentarily closed which energizes contactor No. 1 controlling the elevator motor 103. The contactor is held closed through switch 108, which is opened by a cam on the elevator chain, thus stopping the elevator when a roll has reached loading position. It might be explained that normally about one roll per minute is fed into the drier and that the elevator cycle consumes only about ten seconds, thus leaving the roll at rest in the loading position for about fifty seconds.

The cycle of the loading operation is controlled by switch 157 which is closed momentarily each revolution of the timing cam 112. The circuit is so arranged, however, that the loader will not respond to the closing of switch 157 unless switch 139 has previously been momentarily closed by the manual operation of the operator. The reason for this is that the production of wet tubes is variable and sometimes intermittent and it is desired that the operator, placing tubes on the loader, be relieved of the attention which would be required if the loader operated every cam revolution. Switch 139 is connected with a foot board in front of the loader, so that it may be closed automatically by the operator as he steps upon the foot board while placing a tube in the cradle.

When the operator places a tube on the loader he closes switch 139. This closes contactor No. 5 which then holds closed through reversing switch 134, then in its normal "in" position, as shown. The "in" side of reversing contactor No. 2 controlling the motor driving the loader cradle into the roll is now ready to respond to an impulse from cam switch 157. When contact is made on No. 3 the "in" contact on No. 2 contactor closes starting motor 124 which drives the cradle into the roll, which then must be in proper position for loading through the relation of cam switches 114 and 157.

Movement of the cradle into the roll is arrested when reversing switch 134 strikes a limit pin 135, as this switch is then snapped to the then "out" position, thus stopping motor 124. As soon as switch 134 is thrown to "out" position contactor No. 3 is closed starting clutch thruster motor 129. This motor drives the hydraulic rig which causes the clutch on the motor to grip the roll. At the end of its travel, after the clutch has gripped the roll, the clutch thruster closes switch 136 which energizes contactor No. 4, which in turn causes the cradle revolving thruster motor 131 to operate thus revolving the cradle and roll 180°. At the end of revolving thruster travel, switch 138 is opened which deenergizes contactor No. 3 causing clutch to release through the thruster resuming its normal position, contactor No. 4 meanwhile remaining closed and the cradle therefore inverted, through its holding circuit through switch 134. The clutch thruster on its down stroke momentarily closes switch 137 energizing the out circuit on contactor No. 2, which holds closed through "out" side of switch 134. Thus the cradle is withdrawn from the roll by motor 124 until reversing switch 134 strikes a limit pin 135 which snaps it to "in" position again. The breaking of the "out" circuit of switch 134, stops motor 124, deenergizes contactor No. 5 and also deenergizes contactor No. 4 which stops motor 131 and allows the cradle to resume its normal loading position.

While we have described the preferred embodiment of the invention, it is to be understood that we are not to be limited thereto inasmuch as changes and modifications may be resorted to without departing from the spirit of the invention as defined by the appended claims.

Having thus described our invention, we claim:

1. In an apparatus of the character described, a drying chamber divided into a plurality of longitudinally extending zones, a conveyor extending back and forth through said zones, a plurality of independent hollow perforated rolls adapted to be propelled by said conveyor and to receive tubular articles to be dried, independently controlled heating means in said zones, and a circulating system for creating a flow of medium longitudinally within said zones, the perforations of said hollow rolls being such that the passage of drying medium therethrough is controlled and the rate of drying of end and intermediate portions of the tubular articles is regulated.

2. In an apparatus of the character described, a drying chamber divided into a plurality of longitudinally extending zones, a conveyor extending back and forth through said zones, a plurality of independent hollow perforated rolls adapted to be propelled by said conveyor and to receive tubular articles to be dried, independently controlled heating means in said zones and extending along the path of movement of said conveyor, and independently controlled circulating systems for creating flows of medium longi-

tudinally within said zones, the perforations of said hollow rolls being such that the passage of drying medium therethrough is controlled and the rate of drying of end and intermediate portions of the tubular articles is regulated.

3. In drying apparatus the combination of a chamber, means for causing a flow of drying medium longitudinally within said chamber, a plurality of elongated hollow rolls adapted to receive elongated tubular articles to be dried, stationary means in said chamber for supporting and guiding said hollow rolls and with which portions of the latter have rolling contact, and means operable in said chamber for propelling said hollow rolls along said supporting and guiding means, said hollow rolls being provided with perforations arranged such that the passage of drying medium therethrough is controlled and the rate of drying of end and intermediate portions of the tubular articles is regulated.

4. In drying apparatus the combination of a chamber, means for causing a flow of drying medium longitudinally within said chamber, a plurality of elongated hollow rolls adapted to receive elongated tubular articles to be dried, stationary means in said chamber forming a supporting track upon which said hollow rolls are adapted to roll, and a conveyor operable in said chamber for propelling said hollow rolls and causing the same to roll along said track, said hollow rolls being provided with perforations adapted to so regulate the passage of drying medium that end and intermediate portions of the tubular articles are dried at substantially the same rate.

5. In drying appparatus the combination of a chamber, means for supplying drying medium thereto, a plurality of elongated hollow rolls adapted to receive elongated tubular articles to be dried, conveyor means for moving said rolls along said chamber, said rolls being provided with perforations for the passage of drying medium, and means cooperating with the perforations adjacent the ends of the rolls to control the passage of drying medium and thereby regulate the rate of drying for the end portions of the tubular articles.

6. In drying apparatus the combination of a chamber, means for supplying drying medium thereto, a plurality of elongated hollow rolls adapted to receive elongated tubular articles to be dried, conveyor means for moving said rolls along said chamber, said rolls being provided with perforations for the passage of drying medium, and slidable sleeves on the end portions of the rolls to control the perforations of such end portions and thereby regulate the rate of drying for the end portions of the tubular articles.

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