July 4, 1939. J. H. FRIDÉN 2,164,768

APPARATUS FOR CONVEYING AND DRYING TUBES

Filed March 15, 1935 3 Sheets-Sheet 1

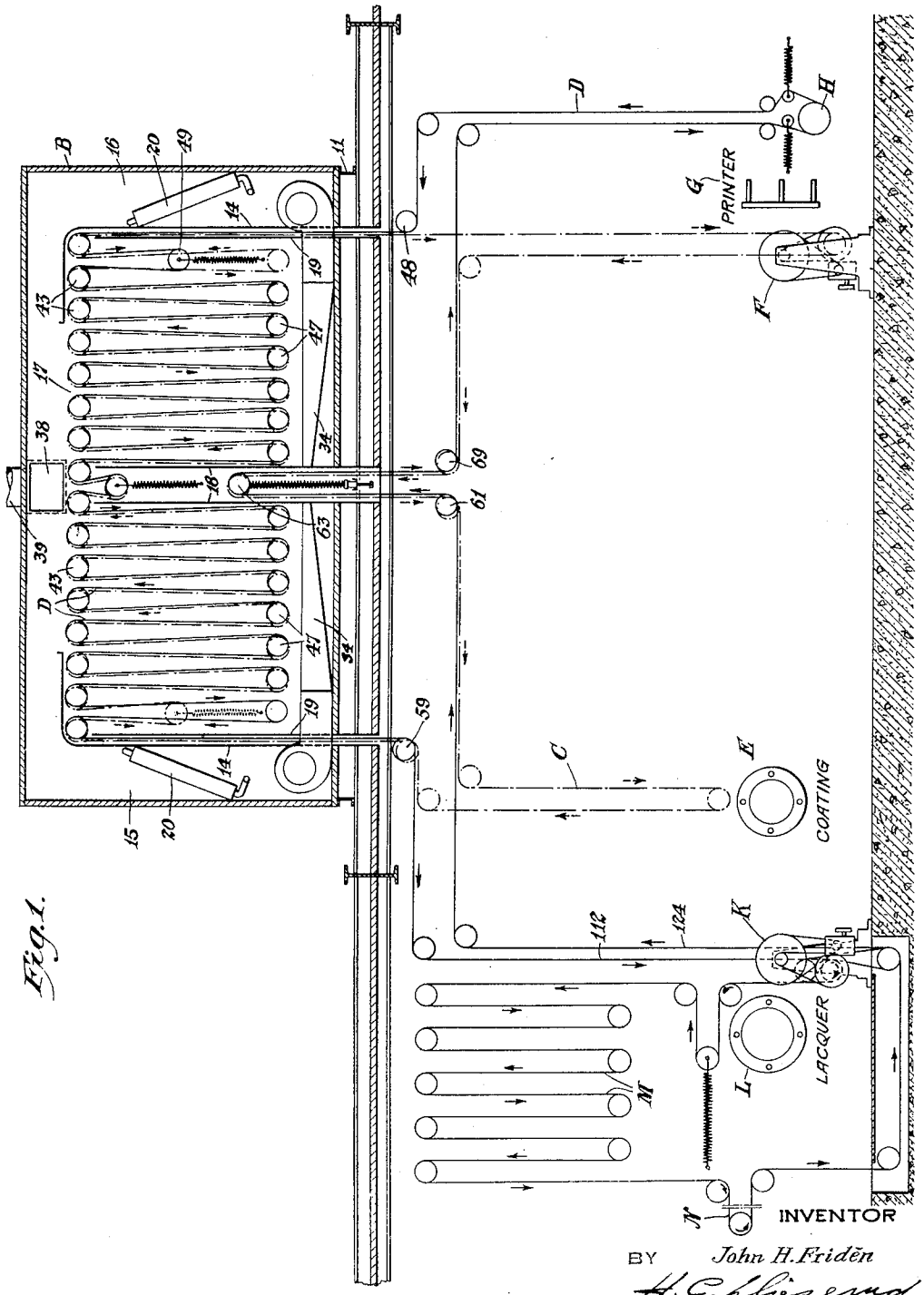
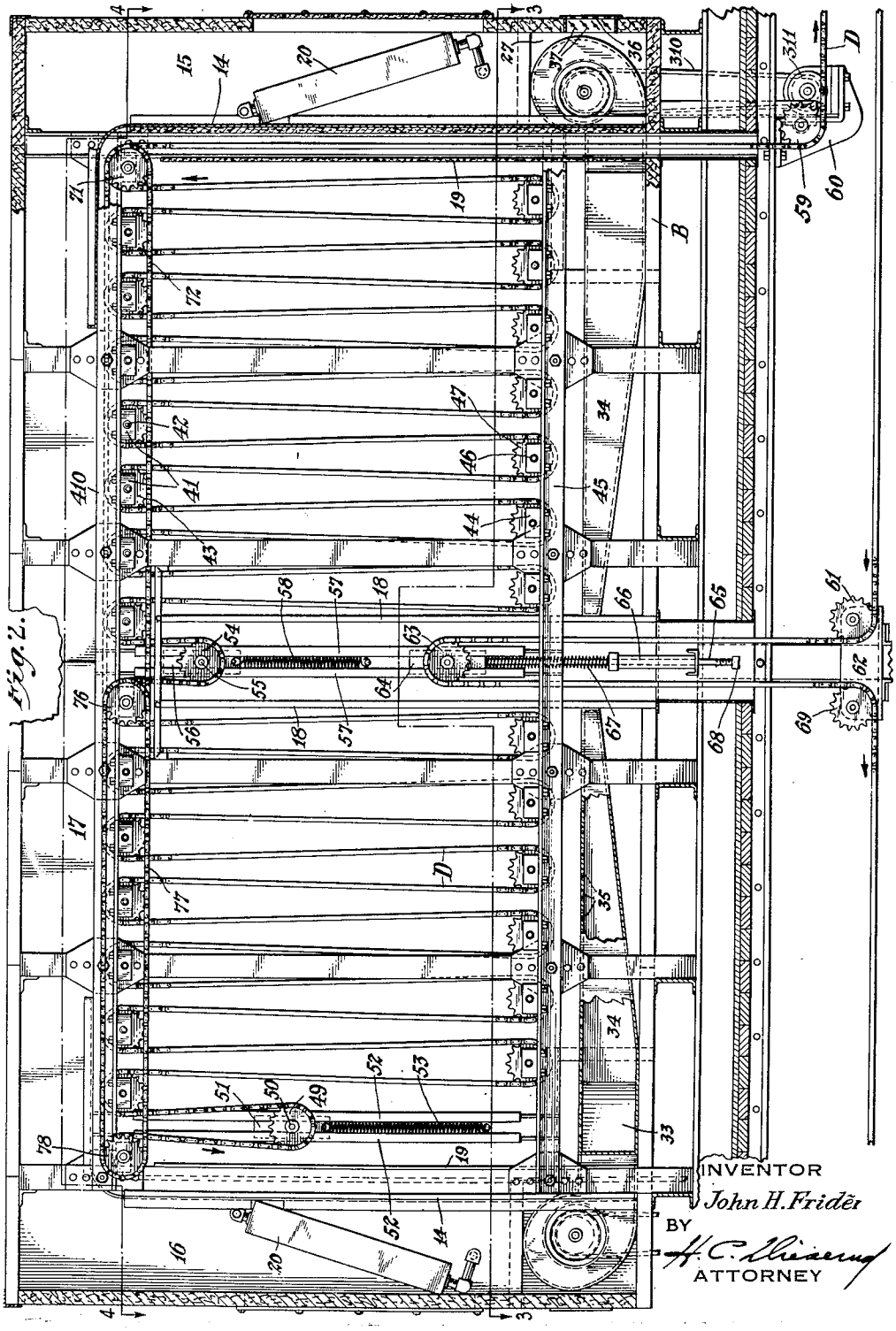


Fig. 1.

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APPARATUS FOR CONVEYING AND DRYING TUBES

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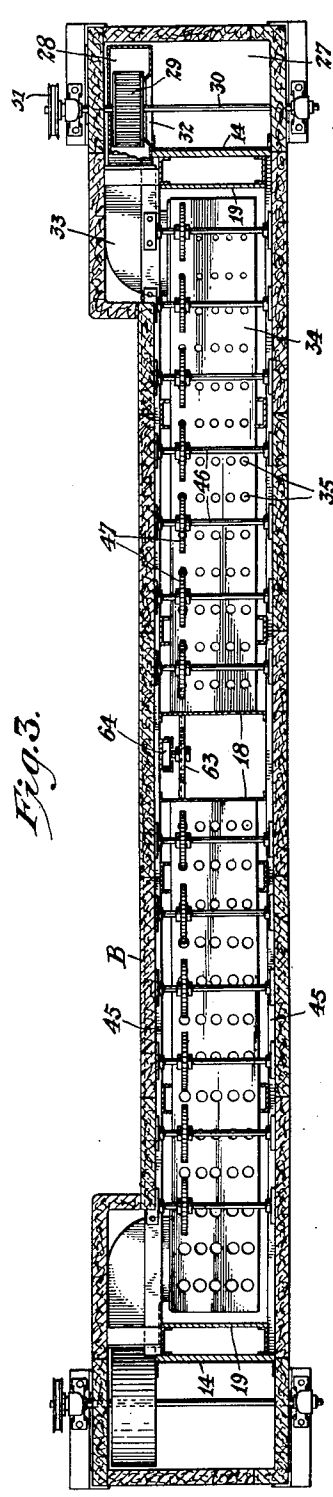


Fig. 3.

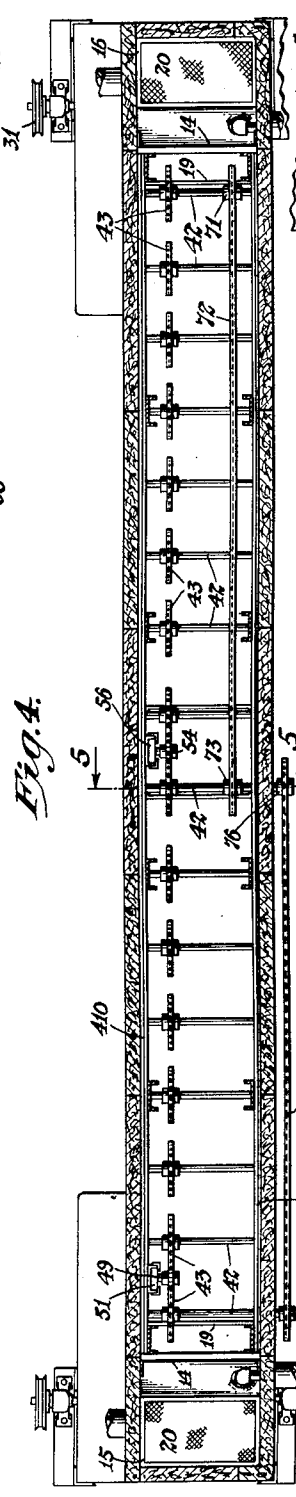


Fig. 4.

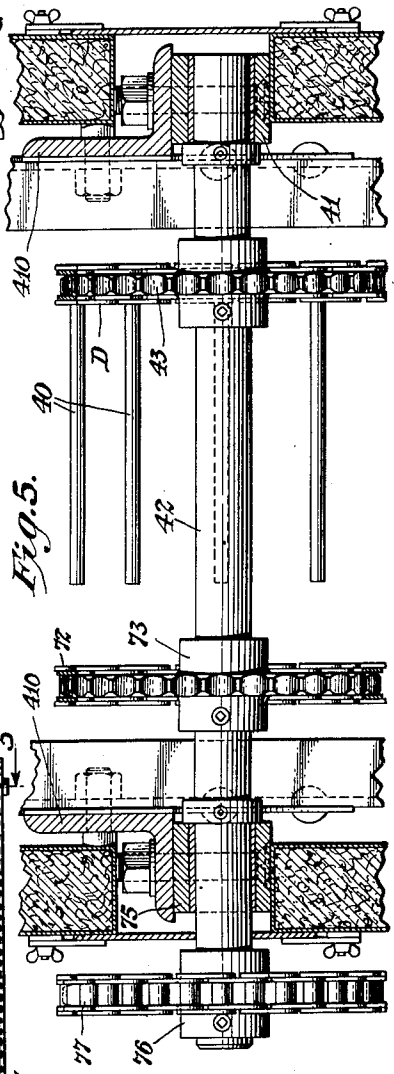


Fig. 5.

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APPARATUS FOR CONVEYING AND DRYING TUBES

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5 Claims. (Cl. 198—203)

The present invention contemplates a continuously operated conveyor system coordinated with suitable drying devices by means of which the various drying operations may be effectively and efficiently carried out within a minimum of time. The construction is such that a relatively small amount of space is required and the operation is continuous so that completed tubes having a dry outer protecting coating are constantly being delivered at a packing station where they can conveniently and efficiently be packed for shipment. Furthermore the arrangement is such that the tubes are conveniently presented for the various operations preceding the several drying stages.

It will be understood, of course, that while the invention is particularly well suited for the handling of collapsible tubes its use is not limited to this field and most, if not all, of its features are capable of quite general application.

With the foregoing features and advantages in view an illustrative form of the invention will now be described in detail in conjunction with the accompanying drawings in which:

Figure 1 is a diagrammatic view, partly in section illustrating in elevation the general arrangement of the complete system that is shown in greater detail in the remaining views. The dot and dash lines indicate a conveyor chain in a different vertical plane from that shown in full lines and cooperating with a different drying chamber similar to the one shown.

Figure 2 is an enlarged view, partly in rear elevation and partly in section, of one of the drying chambers, showing the conveyor slings therein.

Figure 3 is a horizontal section along the line 3—3 of Figure 2.

Figure 4 is a horizontal section along the line 4—4 of Figure 2.

Figure 5 is an enlarged detail in vertical section along the line 5—5 of Figure 4.

Referring now to the drawings, and particularly to Figure 1, the apparatus preferably includes one or more drying chambers or ovens B. The oven B has associated with it a conveyor chain D while an oven behind the oven B has similarly associated with it a conveyor chain C. A loop or sling is provided in the chain C adjacent suitable coating equipment E, indicated schematically in Figure 1. The chain C travels in the direction indicated by the arrows. As will be more fully explained hereinafter, the chain is provided with a series of pegs or pins, each adapted to support one of the tubes or similar hollow articles intended to be handled. In the continuous movement of the chain C, empty pegs are brought in the vicinity of the coating devices and at this point the coated tubes are transferred either manually or mechanically to the pegs. The ascending portion of the chain passes into the drying or baking chamber and is caused to follow a tortuous path through the chamber formed by the series of slings indicated in Figure 1. The speed of travel of the chain is such that when the coated articles leave the chamber, they are properly baked or at least sufficiently dry for the performance of the next operation.

The tubes are now carried down to the driving mechanism F which supplies the power for moving the conveyor chain throughout its winding course. Upon leaving the driving mechanism the chain is again passed upwardly into the drying chamber, but only around a single loop, and is then returned to the starting point at the coating mechanism E.

Adjacent the driving mechanism F there is conveniently located any suitable form of printer G. The arrangement is such that the coated and dried tubes may be readily transferred either manually or automatically from the descending portion of the chain C to suitable spindles on the printer. Here the printing operation involving the application of a second coating to at least portions of the outer surface of the tubes takes place and they are then removed either manually or automatically and transferred to the pegs of the chain D, which is of a construction similar to the chain C. To enable the printed tubes to be readily applied to the chain D without danger of injury, an intermittent motion mechanism H is provided adjacent the printer so that while the major portion of the chain is shifted continuously, a portion adjacent the point H is given an intermittent motion. A similar intermittent motion device may be employed at other points also, if desired, or it may be omitted altogether. Upon leaving this mechanism the printed tubes are carried into the drying chamber B and through the same along the tortuous path provided by the series of slings. Descending from the opposite end of the chamber B the tubes are carried to the driving mechanism K which supplies the power for the movement of the chain D. Adjacent the power source there is located any suitable form of lacquering equipment L to which the tubes may be transferred either manually or automatically and from which they may again be returned in coated condition to the

empty pegs on the same chain. If desired the lacquering equipment may be arranged to act upon the tubes as they remain upon the conveyor pegs and if so an intermittent motion mechanism similar to H may be employed at this point. The lacquered tubes are then carried along a series of slings M, which may simply be suspended in the air and need not be supplied with additional heat inasmuch as the lacquer dries rather readily. Upon leaving the slings M the tubes are conveyed to a point adjacent a packing table N, where they are removed and placed in suitable cartons or cases, either manually or automatically. The empty pegs on the chain D are then carried back around the driving mechanism K, into the chamber B where a single loop is provided, and finally to the starting point at H.

The drying chamber is in the form of a completely enclosed, box-like structure, whose walls are preferably formed in sections of heat insulating material which may conveniently include an outer metallic shell filled with any suitable insulating substance or may merely be slabs of a heat insulating composition. As will be apparent from the drawings and from the description which follows, the walls of the heating chamber surround a supporting structure formed by a series of angle members and channel members by which the walls are carried in any suitable and convenient way. The chambers are mounted upon a series of I beams 11 which are in turn supported in any suitable way at or adjacent the ceiling of the shop in which the equipment is installed. Adjacent each end of the chamber, as best shown in Fig. 1, there is provided a partition member 14 extending upwardly from the bottom of the chamber to a point near the top, at which it is bent through an arc of 90 degrees to provide a short, horizontal extension. These partitions serve to divide the chamber into three major portions or compartments, these being a narrow portion 15 at one end and a similar portion 16 at the opposite end and a large, intermediate portion 17. This intermediate portion is further divided by a pair of partitions 18 rising upwardly from the bottom of the chamber to a point near the top for the purpose of providing a well at the center of the chamber. Similar partitions 19, spaced a slight distance from each of the partitions 14, serve to form narrow wells or passages adjacent the ends of the portion 17 of the chamber through which the conveyor chain is passed upon entering and leaving the chamber.

In each of the compartments 15 and 16 there is provided a suitable heat exchange unit 20, preferably extending completely across the passageway at an angle. These heat exchangers may conveniently be in the form of steam radiators of suitable construction, arranged to present a relatively large surface of contact to the air as the latter passes through them. They may, if desired be formed simply by a series of steam pipes having radiating fins arranged to provide a tortuous passage from one side to the other of the heat exchangers.

At the bottom of each of the compartments 15 and 16 there is formed a small chamber 27 arranged to receive a blower 28 of suitable construction. This may conveniently be of the centrifugal type, having a rotor 29 mounted upon a shaft 30 extending through the walls of the chamber and supported in suitable bearings on the outside. One end of the shaft is extended and provided with a pulley 31 through which the rotor may be driven by means of a belt 310 connected at its other end with a pulley on a motor 311. The blower has its intake 32 arranged to draw air from the chamber 27 beneath the radiator 20. The discharge side of each blower is connected through a duct 33 with a distributor 34 extending along the bottom of the chamber to a point adjacent the middle. As will be seen, each distributor 34 is preferably tapered in vertical cross section. Each distributor has in its upper surface a series of openings 35 which are preferably graduated in size. As best shown in Figure 3, the openings in the left-hand distributor preferably decrease in size from the point nearest the blower to the most remote point while the openings for the right-hand distributor increase in size from the blower toward the far end of the distributor. Furthermore, the largest openings of the right-hand distributor are of the same size as, or slightly smaller than, the smallest openings of the left-hand distributor. This arrangement provides for a maximum flow of warm air adjacent the left end of the chamber and a gradual decrease in the rate of flow or circulation toward the right end. The purpose of this is to provide maximum drying effect at the end of the chamber at which the coated tubes are first introduced and a gradual tapering off in the drying effect and temperature toward the end at which the tubes leave the chamber. As will be apparent, a considerably greater amount of heat will be required to maintain a desired temperature at the point where a relatively great amount of evaporation of the coating liquid takes place. Furthermore, it is desirable to taper off the temperature in the chamber from one end to the other so that a sudden change in temperature, that would adversely affect the coating, is not met with as the tubes are carried out of the chamber. The temperature at the left end of the chamber may be maintained around 300° F., if desired, while that at the right end may be below 100° F. These desired effects can be accomplished both by regulating the volume of circulation, through the graduation of the distributor openings and control of the blowers, and by regulating the amount of heat supplied to the air at the heat exchangers. While this is the preferred construction and mode of operation for the purposes disclosed, a more even distribution of the air may be effected if desired by graduating the openings slightly in both distributors from smaller ones adjacent the blowers to larger ones adjacent the center of the chamber.

The air handled by each blower is drawn partly through the heat exchanger and partly from the room outside of the chamber through a register 36 (Figure 2) directly at the end of the chamber in line with the blower. To regulate the amount of fresh air so introduced into the chamber, a series of dampers or louvers 37 may be provided at the register. That portion of the air handled by the blower which passes through the heat exchanger is recirculated from the compartment 17. After passage upwardly through the compartment 17, in which the heated air passes around the articles to be dried, it is deflected toward the center of the chamber by the horizontally extending portion of the partition member 14. An opening 38 is provided in one wall of the chamber adjacent the top and midway between the ends. This opening communicates with a stack 39 through which a slight draft is continually maintained. Accordingly it will be seen that a part of the air, after passing over the

articles to be dried, will be discharged from the system and will be replaced by the fresh air drawn into the system through the register 36. In this way the relative humidity of the air at the temperature at which it is maintained within the chamber is kept quite low so as to provide for a maximum drying effect without raising the temperature of the air excessively. It has been found that if the drying of coated tubes is effected at too high a temperature, there is a tendency to discolor the coating and to otherwise bring about imperfections in the coated surface. These difficulties, however, are eliminated by the present arrangement since the temperature may very readily be regulated and need never be carried above the point at which harm is done to the coating.

Conveyor means

The means for supporting and advancing the articles through the drying chamber will now be described. As previously explained, an endless conveyor chain is associated with each of the drying chambers for this purpose. Inasmuch as the chain D associated with the chamber B has all of the features of the chain C, and in addition is subjected to special operations, a detailed description of this chain will suffice for both.

A series of sprocket wheels, to be hereinafter described in further detail, is appropriately positioned to guide and support the chain throughout its movement. As best shown in Fig. 5, a series of elongated pegs 40 is arranged to extend at right angles from the face of the chain. These pegs are of suitable length to support the tubes or other articles to be conveyed, being preferably longer than the articles themselves, and are spaced at a convenient distance to hold the articles in spaced relation and permit them to be applied to and removed from the pegs without scraping one upon the other. As indicated, the pegs may be conveniently provided as extensions of every third or fourth pivot pin for the links.

Within the compartment 17 of the drying chamber there is provided a series of bearing blocks 41 secured to an angle member 410 extending longitudinaly of the compartment 17 adjacent the top and at one of the walls of the compartment. A similar series of bearings is provided in a similar way at the opposite wall of the chamber. A series of shafts 42, each journaled in one of the bearing blocks at each side of the chamber, serves to support a series of sprocket wheels 43. These, as best shown in Fig. 4, are arranged in the same plane and are spaced a suitable distance to permit the free passage of the looped portions of the conveyor chain in the manner to be explained. Adjacent the bottom of the chamber a series of bearing blocks 44 is provided in each wall, these being carried by longitudinally extending angle bars 45. A series of shafts 46 extending between the bearings 44 at the opposite walls of the chamber serve to support sprocket wheels 47, best shown in Fig. 3, arranged in the same plane as the sprocket wheels 43.

Beginning at the right in Fig. 1, or the left in Fig. 5, the chain, prior to entering the chamber, is passed around a sprocket wheel 48, which places the chain in vertical alinement with the passage formed between the partition members 14 and 19. After traversing this passage, the chain is looped around the first of the series of sprockets 43 and is then passed downwardly to and around a shiftable sprocket 49. The latter is arranged about midway between the top and bottom of the chamber and is carried by a stub shaft 50 journaled in a slidable bearing member 51. This bearing member is held between two vertically disposed guides 52 and is drawn downwardly between these guides by means of a spring 53, attached at one end to the bearing member and at its opposite end to a portion of the frame. As will be apparent, this provides for a take-up of the slack in the chain.

Continuing, the chain is now alternately passed around a series of the sprockets 43 and a corresponding series of the sprockets 47. This forms the chain into a series of loops or slings extending in the plane of the sprockets from substantially the top to the bottom of the compartment 17. The slings or loops are continued in this way toward the vertical center line of the chamber, at which point another slack take-up device is provided. This comprises a sprocket wheel 54 carried by a stub shaft 55 mounted in a slidable bearing member 56 held between a pair of guides 57 and drawn downwardly as far as the chain will permit by a spring 58. The chain is looped around the sprocket 54 and is then formed into another series of elongated loops or slings by passing it alternately around the remaining sprockets 43 and 47. Upon leaving the last sprocket 43 the chain passes downwardly through the passage formed between the partitions 14 and 19 at the right end of the chamber (Fig. 2) and then around a sprocket 59 suitably supported by a bracket 60 secured to the bottom of the chamber in any convenient way. It will be understood that the sprocket 48, previously mentioned, may conveniently be supported in the same manner.

Upon leaving the sprocket 59 the chain is passed to the driving mechanism K and to other portions of the circuit, which will be later described. After completing these exterior portions of its course, the chain is returned to the chamber, being passed into the chamber between the centrally located partitions 18. Here it is again provided with a slack take-up device consisting of a sprocket wheel 63 carried by a slidable bearing 64 mounted between the guides 57. To the bottom of the bearing 64 is attached a rod 65 which passes through a sleeve 66 carried by a portion of the frame structure. A spring 67 surrounding the rod and having its opposite ends engaged with the bearing and the top of the sleeve 66 urges the bearing upwardly to tension the chain. A nut 68 provided at the end of the rod 65 serves to limit the upward movement of the bearing. After looping around the slack take-up wheel 63, the chain is passed downwardly again in the well formed between the partitions 18 and is passed around another sprocket 69 mounted on the bracket 62 beneath the chamber. From this point the chain is passed to the mechanism H, indicated at the lower right corner of Fig. 1, which imparts an intermittent motion to a small section of the chain, and it is then returned to the sprocket 48 to repeat the same circuit.

As previously explained and as will be more fully explained hereinafter, the chain is driven by the mechanism indicated at K in Fig. 1, which serves to pull the chain around the sprocket wheel 59. It would be practically impossible to move the chain through its entire tortuous path by a single pulling force applied to it as it passes around the driving sprocket. The force required to draw the chain around the various sprockets increases very rapidly as additional slings or loops are provided. Accordingly a point is rapidly reached at which

the force required to draw the chain around the series of sprockets is greater than the chain will stand. Furthermore, it will be apparent that the cost of operation of the device would be excessive if sufficient power were required to draw the chain around the entire series of sprockets by a force applied at a single point.

To overcome these objections, I provide for an application of a pulling force to the chain at several intermediate points. In this way the force applied at any given point need only be sufficient to pull the chain around the sprockets between that point and the next at which power is applied. This is accomplished, however, in the present construction without the provision of a number of sources of power and without multiple connections from a source of power to the points at which the pull is to be applied to the chain. Referring to Fig. 4, the shaft **42** at the right-hand end of the series has secured to it, in addition to the sprocket **43**, another sprocket **71**, adjacent the opposite wall of the chamber, connected by means of a chain **72** with a sprocket **73** secured to the shaft **42** which is just to the left of the center of the chamber (Fig. 4). This shaft **42** differs from most of the others in that it extends through a bearing **75** mounted in the forward wall of the chamber and is provided adjacent its outer end with a sprocket wheel **76**. A chain **77** connects the sprocket **76** with a sprocket **78** secured to the shaft **42** at the extreme left of Figure 4 which also has secured to it the last sprocket **43** at the left end of the series of these sprockets. As indicated in Figure 4 it may be desirable to form the shafts **42** upon which the sprockets **71**, **73** and **78** are mounted of somewhat larger diameter than the remaining shafts **42** in view of the extra load imposed upon them. It will be apparent that the pull transmitted through the chain to the first sprocket wheel at the right end of Figs. 2 and 4 will be transmitted through the chain **72** directly to the shaft upon which sprocket **73** is mounted to apply a pulling force to the chain at this point. Similarly, the chain **77** passes the power directly to the shaft upon which sprocket **78** is mounted to exert a pulling force upon the chain just as it enters the chamber. This overcomes the excessive increase in the pulling force which would otherwise be required to move the chain around the entire series of sprockets. The advantage is probably due, in some measure at least, to the fact that the chain is being fed to a particular group of slings as rapidly as it is being drawn away. If desired, the force required could be further reduced by providing additional sprockets on some of the other shafts **42** to cooperate with the chains **72** and **77** so that a pulling force might be imparted to the conveyor chain at this points as well.

As has been explained at length in the general description, the mechanism for advancing the chains C and D is such that power for the movement of the chains will be supplied at a number of points. This is accomplished in part by the special construction of the driving mechanism K and in part by the provision of special power transmitting chains, such as **72** and **77**, within the drying chambers. In this way the provision of a relatively large number of slings within the drying chambers is made possible without placing an excessive load upon the chain. The construction and arrangement of the devices for providing circulation of warm, relatively dry air through the drying chambers, in a manner to produce best results, has been described in such detail in the foregoing that further explanation at this point is deemed unnecessary.

While an illustrative embodiment of the invention has been set forth in considerable detail it will be understood that numerous changes may be made in the construction and arrangement of the various parts without departing from the general principles and scope of the invention. It may also be readily adapted for purposes other than those specifically explained, and to this end portions of the construction may be utilized without others. The terms and expressions employed herein have been used for purposes of description rather than of limitation.

What I claim is:

1. In apparatus of the class described, an endless conveyor member, means for supporting a portion of said member in a series of slings, means for driving said conveyor member by pulling the same at a point remote from said slings, and means driven by said conveyor member for applying a pull thereto at another point adjacent said slings.

2. In apparatus of the class described an endless conveyor member, means for supporting a portion thereof in a series of slings, means for driving said member by pulling the same at a point beyond said slings, and means driven by said conveyor member for applying a pull thereto in advance of said slings.

3. In apparatus of the class described an endless conveyor member, means for supporting a portion thereof in a series of slings, means for driving said member by pulling the same at a point beyond said slings, and means driven by said conveyor member for applying a pull thereto in advance of said slings and at an intermediate point between portions of said slings.

4. In apparatus of the class described an endless conveyor member, means for supporting a portion thereof in a series of slings, means for driving said member by pulling the same at a point beyond said slings, and means driven by said conveyor member for applying a pull thereto at a point between portions of said slings.

5. In apparatus of the class described a conveyor chain, a plurality of sprockets arranged to support said chain in a series of slings, means for pulling said conveyor chain at a point beyond said slings and through the chain rotating said sprockets, and means auxiliary to said chain for driving one of said sprockets from another.

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