Dec. 26, 1944. H. S. JOHNS ET AL 2,365,762

CONVEYING APPARATUS

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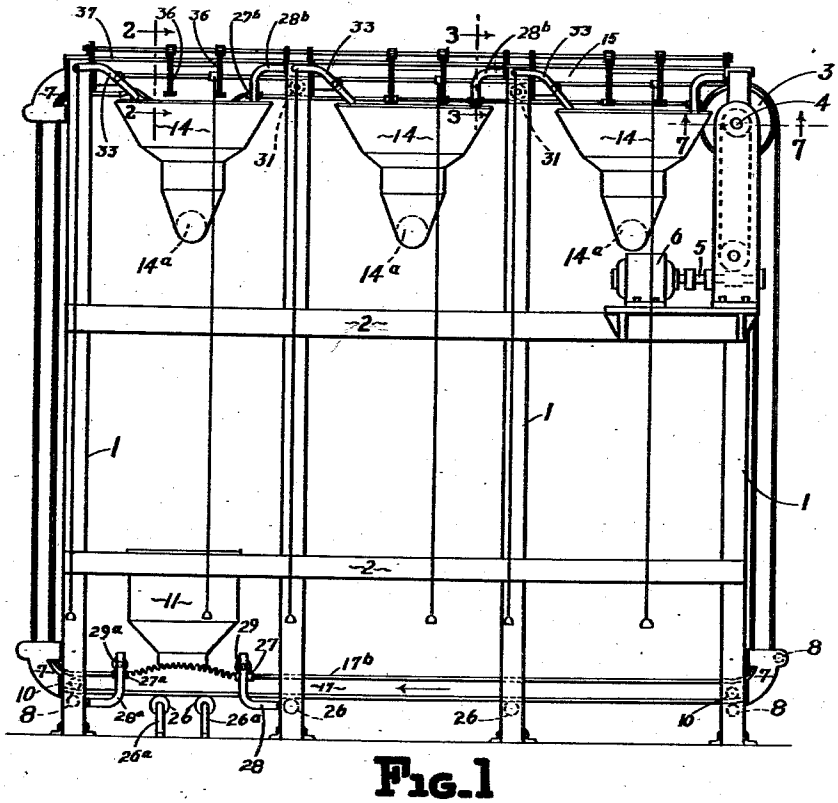


Fig. 1

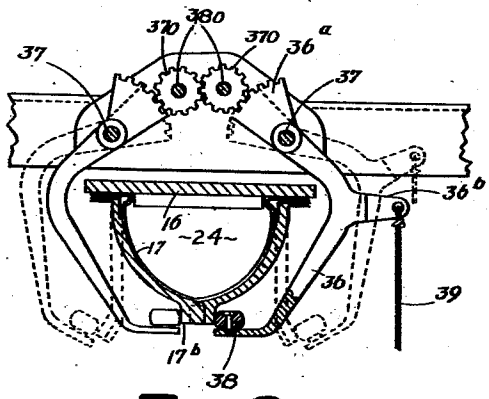


Fig. 2

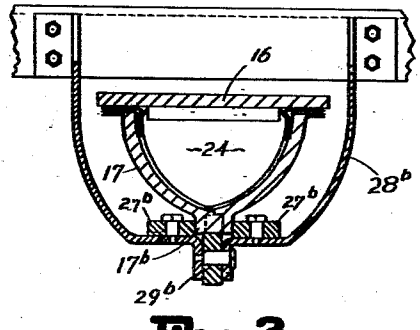


Fig. 3

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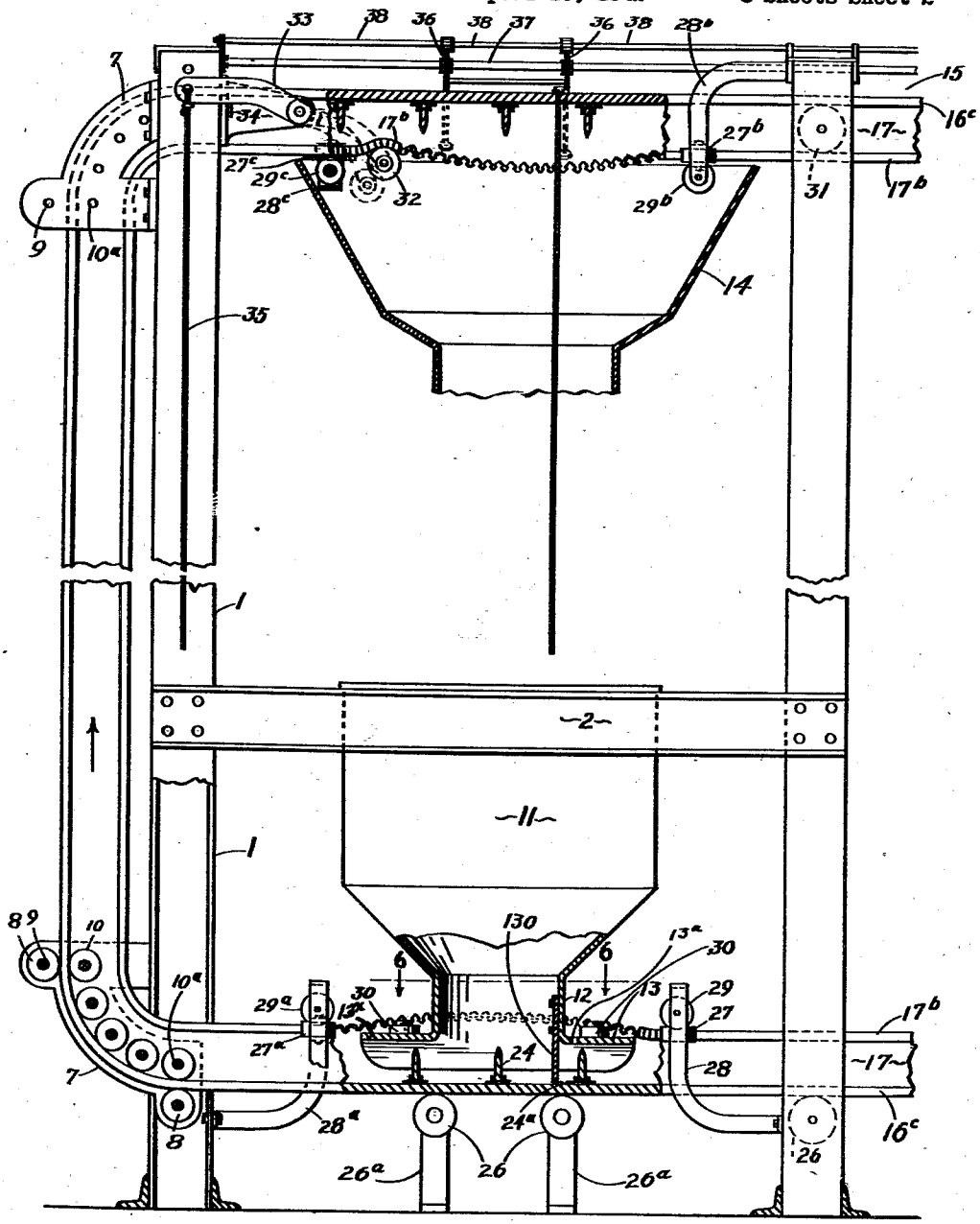


FIG. 4

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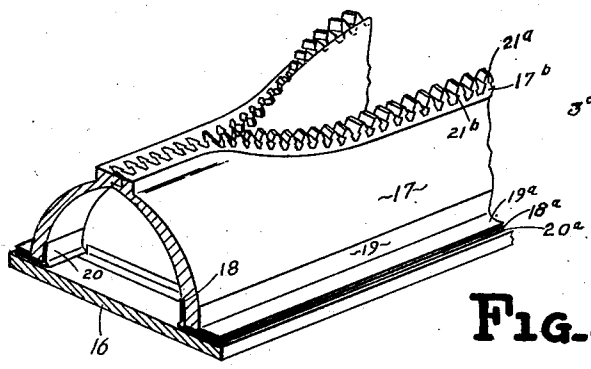


FIG. 5

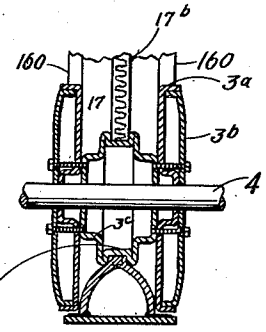


FIG. 7

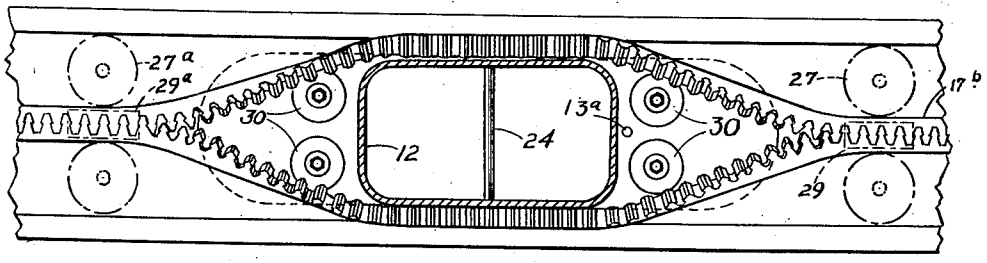


FIG. 6

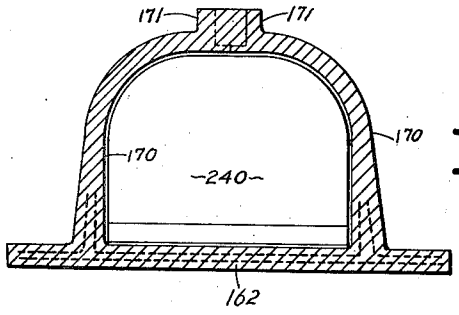


FIG. 14

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FIG. 8

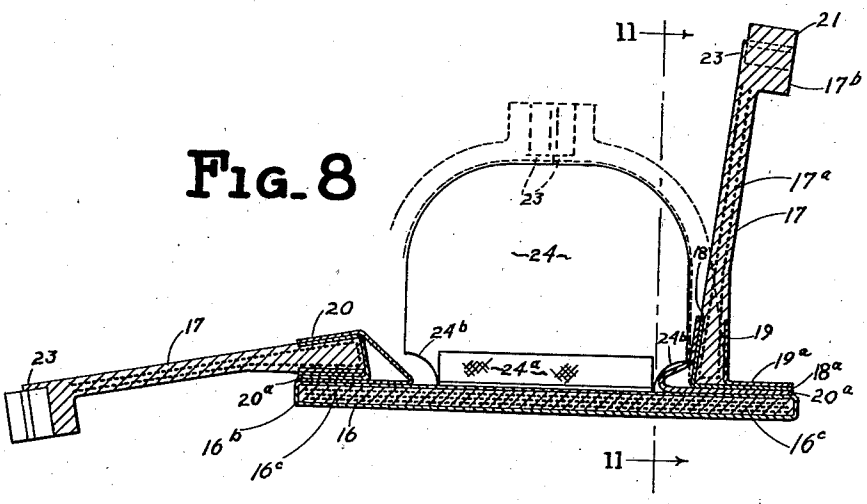
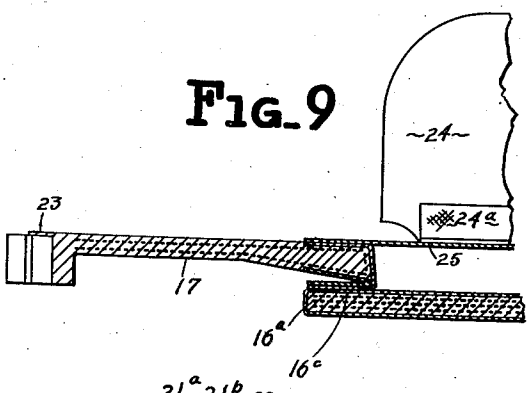


FIG. 9



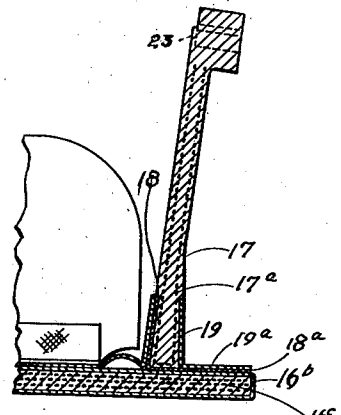


FIG. 10

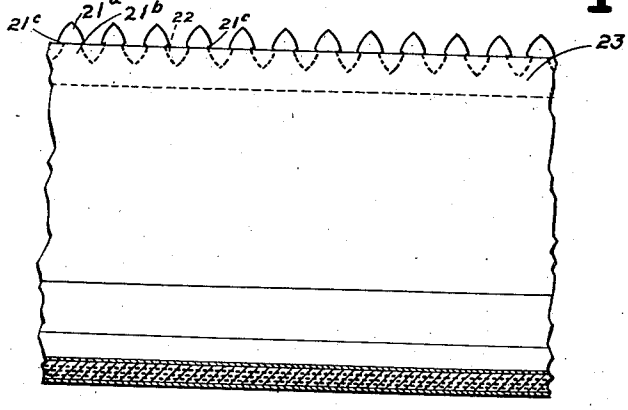


FIG. 11

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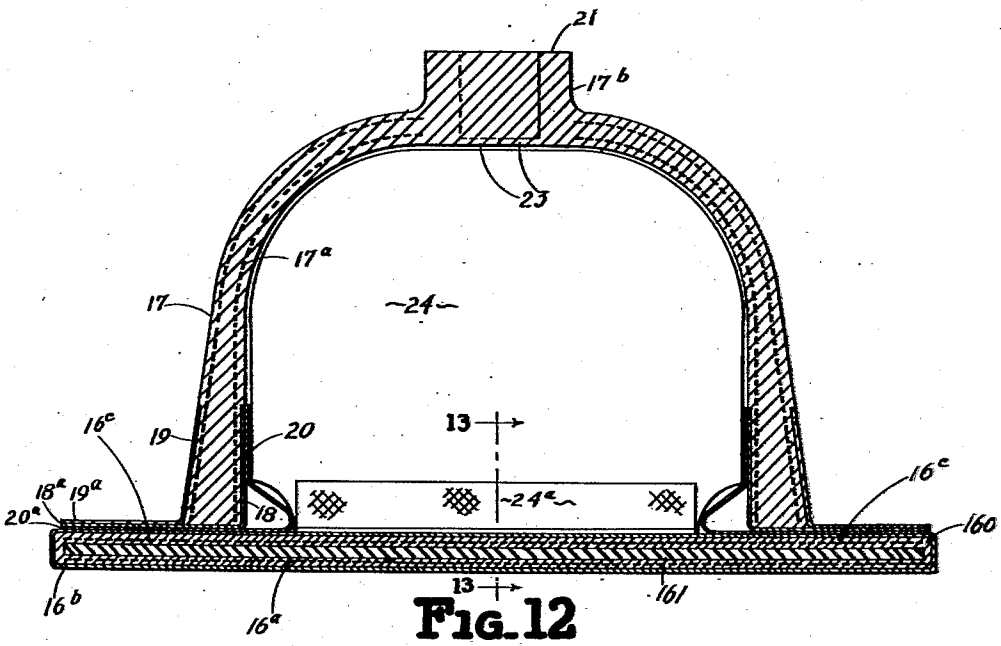


FIG. 12

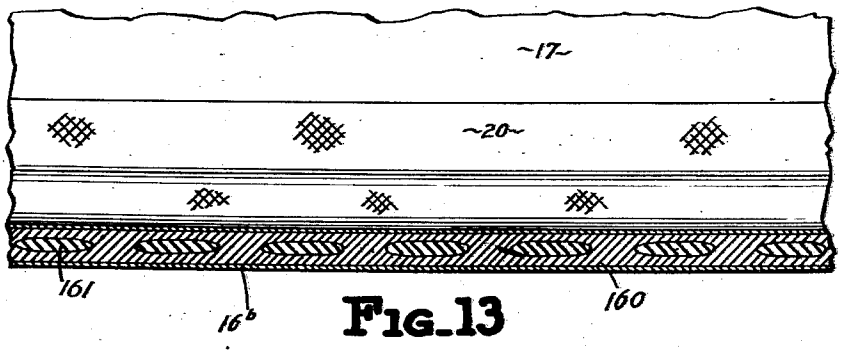


FIG. 13

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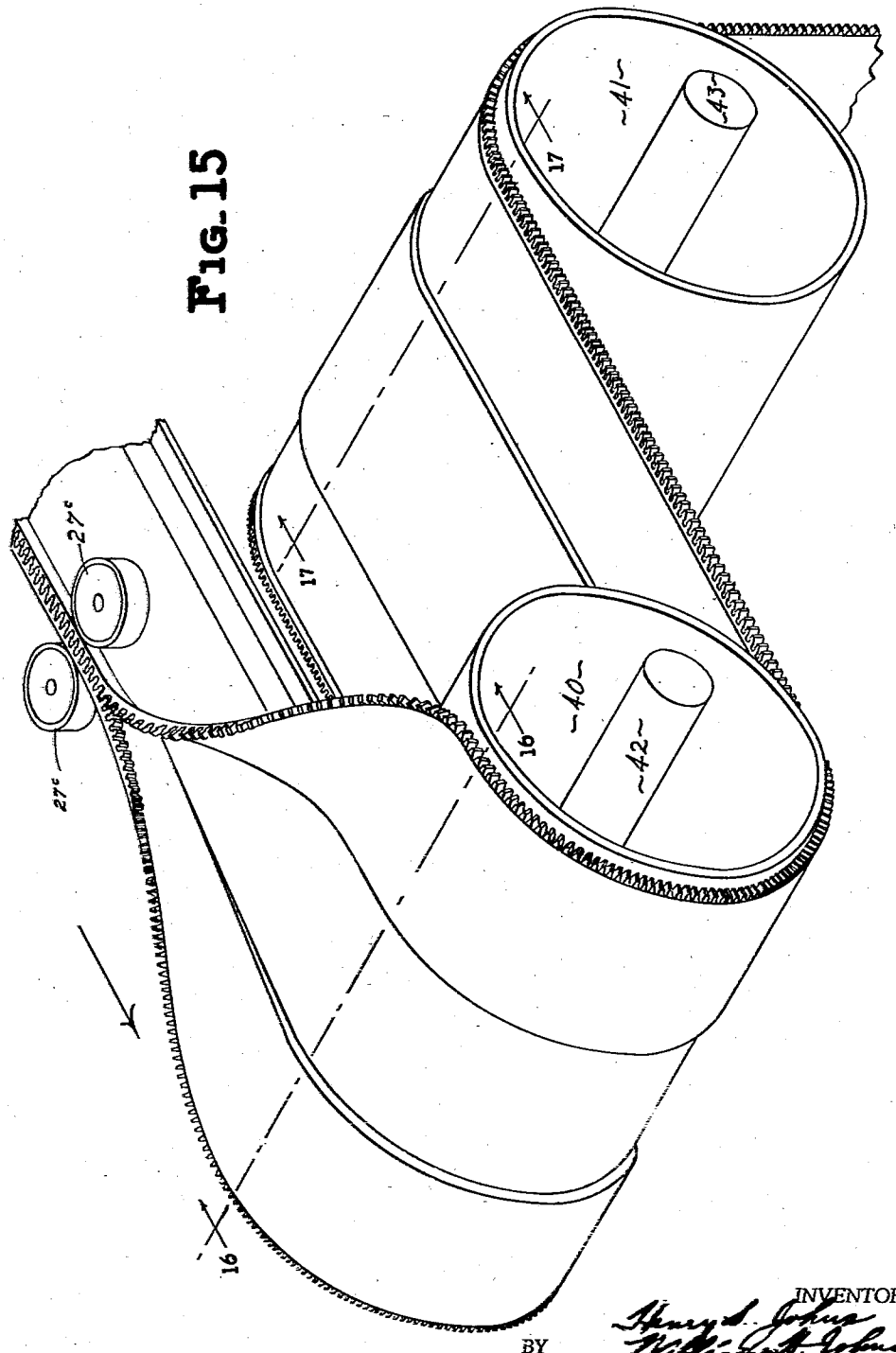
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CONVEYING APPARATUS

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FIG. 15



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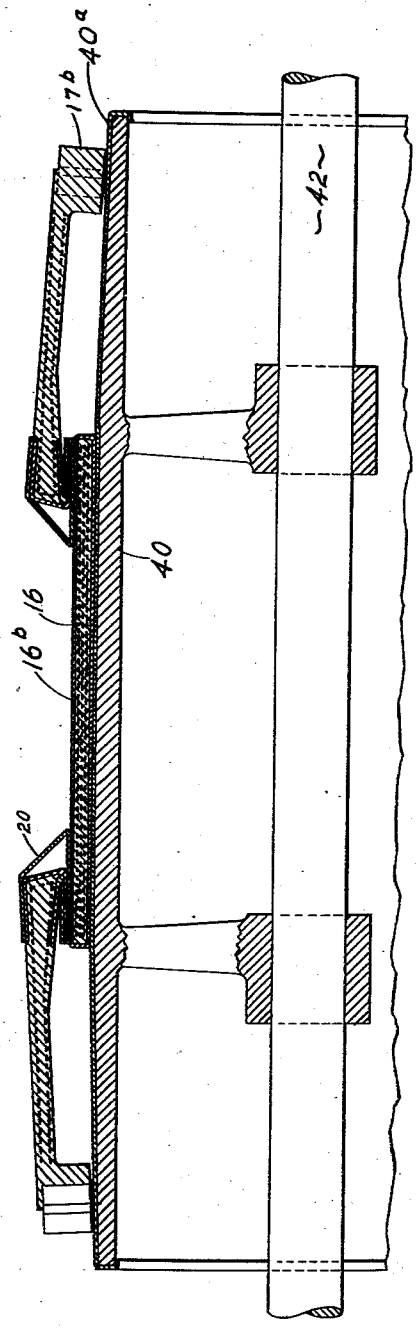


Fig. 16

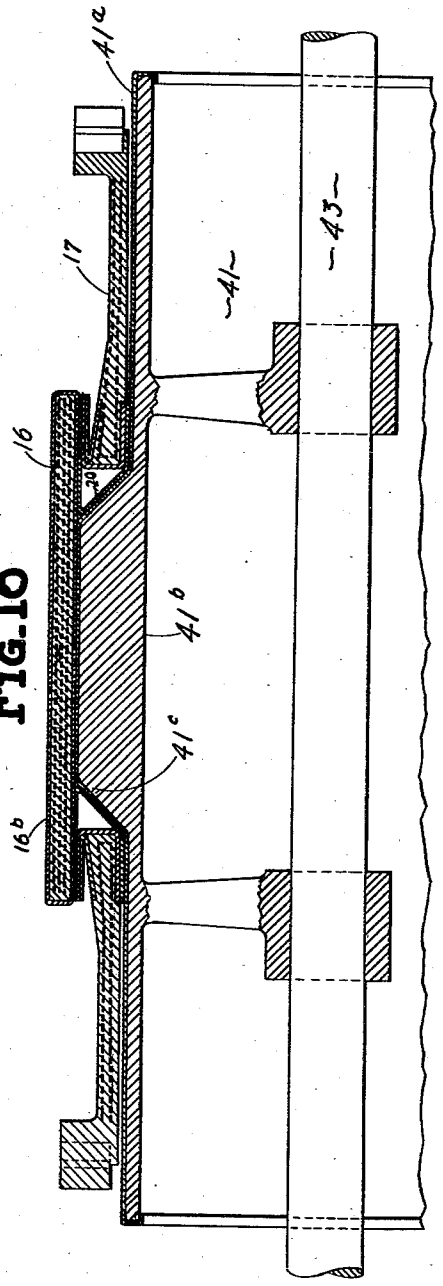


Fig. 17

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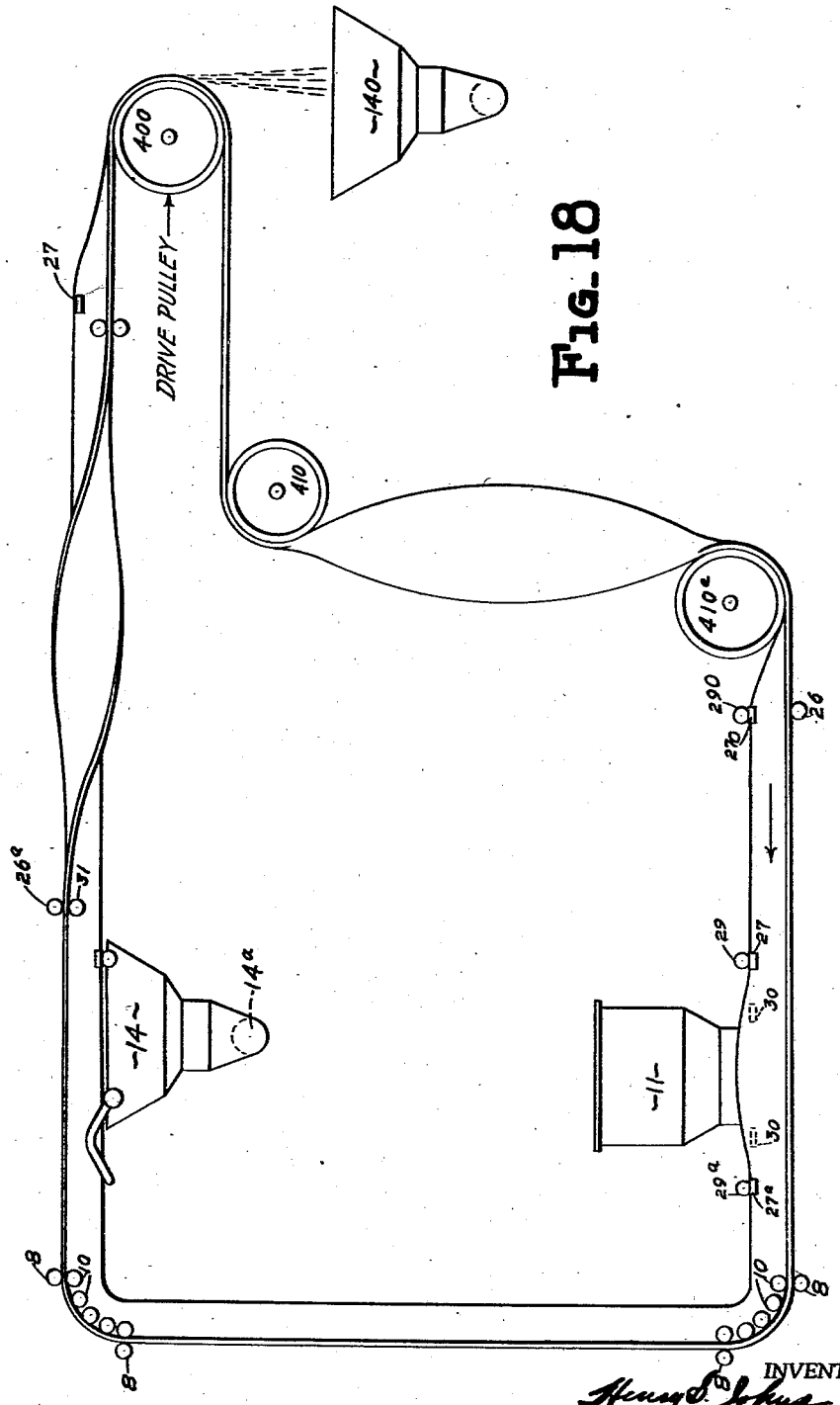


Fig-18

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Patented Dec. 26, 1944

2,365,762

UNITED STATES PATENT OFFICE

2,365,762

CONVEYING APPARATUS

Henry S. Johns and William H. Johns,
Cleveland Heights, Ohio

Application April 18, 1942, Serial No. 439,502

33 Claims. (Cl. 198—162)

This invention relates to conveying apparatus of the type which comprises an endless tubular conveyor belt, successive parts of the tubular portion whereof are adapted to be continuously opened as these parts are brought below a loading station and above an unloading station by the movement of the belt and which successive parts are adapted to be continuously closed after having been moved beyond said stations.

It is the general purpose and object of this invention to provide a construction of tubular conveyor belt which is more efficient in operation, while being less expensive of production, than other belts of the foregoing type with which we are familiar; to provide a belt of this type which can be shipped conveniently and which, for a given length and capacity, will occupy much less space in shipment than required by any other belt of this type with which we are familiar; also to provide a belt of this type which is readily adaptable for use with, and will accommodate numerous variations in, respect to the arrangement and location of loading and unloading stations and of cooperating pulleys and other supporting devices; also to provide for our conveyor belt means cooperating with structural features thereof for driving, loading and unloading the same.

Further and more limited objects of the invention will appear hereinafter in the specification and they, together with the objects listed hereinbefore, will be realized in and through the construction and arrangement of parts shown in the drawings hereof, wherein Fig. 1 represents a somewhat diagrammatic side elevational view of a conveying apparatus constructed in accordance with our invention; Figs. 2 and 3 are enlarged details in section taken on the lines 2—2 and 3—3 respectively of Fig. 1; Fig. 4 is a sectional elevational view of the left hand end of the elevational view shown in Fig. 1; Fig. 5 a detail in perspective of a portion of our conveyor belt showing one form of interlocking projections and recesses; Fig. 6 a detail in sectional plan, taken on the line 6—6 of Fig. 4, the closing rollers being shown in dot-and-dash lines; Fig. 7 a central sectional view through the drive pulley shown in Fig. 1, the view being taken on the line 7—7 and looking in the direction of the arrows; Fig. 8 a transverse sectional view through a conveyor belt constructed in accordance with our invention, the positions of the sides when interlocked to form a tube being shown in broken lines; Fig. 9 a detail in transverse section of one side of a slightly modified construction of conveyor belt embodying our invention and showing the positions of the parts when one of the side members of said belt is folded downwardly, and Fig. 10 a similar view of the opposite side of the said conveyor belt showing the positions of the parts when the other side member is in its upright position with reference to the base; Fig. 11 a sectional elevation taken on the line 11—11 of Fig. 8 and showing the preferred shape of complementary interlocking projections and recesses; Fig. 12 a transverse sectional view through a modified construction of our conveyor belt, and Fig. 13 a sectional view taken on the line 13—13 of Fig. 12; Fig. 14 a transverse sectional view taken through a further modified form of construction of our conveyor belt; Fig. 15 an enlarged detail in perspective of a portion of our conveyor belt and showing modified forms of rollers associated therewith; Figs. 16 and 17 are details in section taken on the lines 16—16 and 17—17, respectively, of Fig. 15; and Fig. 18 a diagrammatic side elevational view of a conveyor loading and unloading apparatus constructed in accordance with our invention and illustrating the flexibility of operation possessed by our conveyor belt.

Describing by reference characters the general features of construction of the apparatus shown in Figs. 1 and 4, 1 denotes vertical upright members and 2 horizontal bracing members, constituting opposite sides of a framework for the support of the loading and unloading stations and the various instrumentalities which support and propel our conveyor belt in its travel and which cooperate with certain features of construction of the belt for the purpose of discharging thereinto the material to be conveyed and for discharging therefrom the material so delivered thereto. 3 denotes a drive pulley supported by said framework by means of which our conveyor belt is driven, the said pulley being mounted on a shaft 4 and being driven by the shaft 5 of a motor 6, shown as supported by one of the horizontal bracing members 2.

Adjacent to each of the other corners of the framework and supported by opposed vertical upright members 1 are curved plates 7, each jointly supporting outer rollers 8, on shafts 9, adapted to engage the outer surface or bottom of the base of our conveyor belt, the said rollers being located on opposite sides of each of the corners of the framework to which the plates 7 are secured. In addition, each of the plates supports a curvilinear series of rollers 10, supported on shafts 10^a by each of said plates, these rollers being adapted to engage the inner surfaces of

opposed side flanges of our conveyor belt in a manner to be described hereinafter and the said series extending around each of the corners to which the plates 7 are applied.

Supported by and between opposed braces 2 is the feed hopper 11 of a loading station, the lower end of the hopper being of funnel shape and provided with a discharge neck 12 having its lower end formed into upwardly covex saddles 13, 13x extending in opposite directions from the bottom of the said neck. The purpose of this construction will be explained hereinafter.

14 denotes each of a series of discharge hoppers located respectively at the unloading stations and which hoppers are supported by and between longitudinal brace members 15 which are connected to the tops of the opposed upright members 1. Three such discharge hoppers at corresponding unloading stations are shown, but the number of the same may be increased or diminished without affecting the general purposes and objects of our invention; and each discharge hopper is provided with a delivery tube, indicated at 14a. Certain details of construction of the means for supporting our conveyor belt and for operating upon the same in transit will be set forth hereinafter in connection with the details of construction of the said belt.

Conveyor belt

The conveyor belt constituting an important part of our conveying apparatus consists generally of a wide, flat or planar base 16 made of flexible material preferably having the elastic characteristics of rubber and shown herein as consisting of as many pliable reinforcing layers 16a as may be necessary to impart the desired strength thereto, the whole being covered with sheet rubber 16b. The sides of the belt, indicated at 17, are preferably made of rubber reinforced with fabric, indicated at 17a. Each of these sides is connected to the base at a point remote from an edge thereof, by means of inner and outer hinges 18 and 19, the said hinges being preferably made of army duck cut on the bias and molded into the inner and outer surfaces of the sides 17, with the inner hinge extending beneath the bottom of the belt side to which it is attached and also extending beneath the outturned end 19a of the outer hinge, as shown at 18a. By spacing the bottoms of the sides from the side edges of the base 16, the base is provided on its upper (or inner) surface with side flanges, designated generally by the numeral 16c.

In the form of our invention shown in Figs. 5 and 8, the lower inner surface of each of the sides 17 has also attached thereto a fabric strip 20, which strip is also attached to the base 16 and which extends outwardly from this point of attachment beneath the outturned portion 18a of the hinge member 18, as shown at 20a. The outturned portions of the hinge members 18 and 19 and the strip 20 may be secured to the base by being stitched thereto, as well as by being cemented together and to said base, or by being molded into the base. The strip 20 serves to prevent access of finely divided material or liquid or semi-liquid material between the base of each side 17 and the portion of the belt base 16 on which these sides are mounted. The strips 20 also cooperate with the inner and outer hinge members 18 and 19 in preventing the sides 17, when in open position, from swinging downwardly beyond the point where the inner of the ends of the out-turned ends 18a may become separated from the portion of the base 16 therebeneath. For convenience of detailed description, our conveyor belt will be assumed to be in the position shown in Fig. 5, and the terms "upper" and "lower" have been used and will be used hereafter in connection with such description, but without any intention of limiting thereby the positions which different portions of our conveyor belt will asume during its operation in an apparatus such as shown herein.

The upper edge of each of the sides 17 is thickened, as shown at 17b, and these thickened portions constitute shoulders having projections 21, each comprising a substantially wedge shaped portion 21a carried by a stem 21b, locking shoulders 21c being formed between the base of each wedge-shaped portion and the stem. In our preferred construction, shown in Fig. 11, the outer sides of the wedge-shaped portions are outwardly convex, meeting in a common line of contact. The recesses 22 formed between these projections are complementary in shape to the projections, and the projections and recesses in the top of one of the sides of the conveyor tube are staggered with respect to the projections and recesses in the top of the opposite side.

Carried by the inner face of the outer end of each of the sides 17 is a flap 23, the same being preferably of rubber and each extending along the inner surfaces of the projections and recesses and being slightly wider than necessary to reach the true centers of the wedge-shaped projections 21a. This will cause the edges of the flaps on the sides to abut each other under pressure when the projections on the shoulder of one of the sides are interlocked with the recesses formed in the shoulder on the opposite side, thereby forming a tight joint and enabling our conveyor belt to carry liquid or semi-liquid material without leakage. In order to enable material in our conveyor belt to be conveniently raised while the conveyor is passing upwardly, as from a load receiving station to one of the unloading stations shown in Fig. 1, we have provided the same with partitions 24 which may be conveniently secured to the base by and between angular braces 24a. These partitions, known to the trade as "flights," serve to prevent the material from accumulating in the lower ends of the vertical stretches and are substantially coextensive in shape and area with the space enclosed by the base and sides of our belt when the sides are closed, as shown in broken lines on Fig. 8.

In Figs. 9 and 10, we have shown a modification of the means for preventing access of liquid, semi-liquid, or finely divided material, beneath the hinged ends of the sides and the portions of the base to which the sides are so hinged. The means shown herein consists of a sheet 25, preferably of rubber, which is cemented or otherwise suitably secured to the lower inner surfaces of the opposed belt sides. This sheet is of such extent as to be stretched slightly by the sides when the latter are in wide open position, as indicated in Fig. 9, and it is particularly useful where our conveyor belt is used for the transportation of sticky material, such as raw sugar and wet salt. When the belt is opened up for discharging the material therefrom, the sheet 25 is worked by the opening movement of the sides, which action assists in loosening the engagement between the sticky material and the said sheet, which had been functioning theretofore as the inner base of the belt. The sheet 25 also serves the same purpose as the fabric strips 20 in preventing

material from entering between the hinged joints and the portions of the base therebeneath.

When the sheet 25 is employed, the flights 24 will be secured direct thereto, by means of the angular braces 24a. It will be noted that the lower ends of the flights in Fig. 8, as well as in Figs. 9 and 10, are cut away, as shown at 24b, to accommodate the fullness of the strips 20, as well as the fullness of the sheet 25, when the sides 17 are interlocked at their outer edges.

As will be noted from an inspection of Figs. 8 and 10, the bases of the sides 17 do not extend at right angles with respect to the axes thereof, but are slightly beveled, whereby, when the sides are in open position with their bases engaging the upper or inner surfaces of the base of the belt, they will extend outwardly at an angle of about 7 degrees from the perpendicular drawn from the base. This manner of mounting the sides upon the belt base insures a tight joint between the lower inner ends of the sides and the upper or inner surface of the base when the sides are interlocked.

In Figs. 12 and 13, there is shown a further modification of our conveyor belt wherein the base, designated 160, is provided with reinforcing members 161 extending thereacross. The reinforcing members may be of any desired shape, those shown here being flattened bars having tapered ends to avoid injuring the fabric or rubber in which they are embedded, the parts of the conveyor tube shown in these views being substantially identical with corresponding parts shown in Fig. 8, and designated by the same numerals that are applied thereto in the former view. This construction of base is useful for conveyor belts which are intended for heavy duty purposes.

In Fig. 14 there is shown a further modification of our conveyor belt wherein the sides 170 are formed with the base 162, the sides and the base being preferably made of the same material as employed in the construction of the conveyor belt shown in the preceding views and the shouldered outer edges 171 of the sides being provided with interlocking projections and recesses of the construction shown more particularly in Fig. 11. In this form of our conveyor belt, the sides, when unlocked, extend at substantially right angles from the base. A flight, similar to the flight 24, is shown at 240.

Special features of driving, supporting, and loading and unloading mechanisms which cooperate with construction of conveyor belt

We will now describe in detail the manner in which the portions of our apparatus are constructed in order: first, to separate the interlocked top edges of the sides of our conveyor belt at a loading station thereby to enable the material to be delivered between the said sides; second, to interlock the top edges of said sides after having been thus opened; third, to separate the interlocked edges of the sides when the conveyor belt is moved above any one of the unloading stations; and fourth, to interlock the edges after this separation. We will also describe certain cooperating features between the construction of our conveyor belt and the means for supporting the same in transit.

Assuming our belt to be traveling in the direction indicated by the arrow in Fig. 1 and that the upper edges of the sides thereof are interlocked in the manner shown in Figs. 5, 6 and 12, the lower stretch of the conveyor belt will be supported by means of the rollers 8 and 10 at the right hand corner while the bottom of the stretch between the said corner and extending beneath the loading station (including the hopper 11) will be supported by rollers 26, supported by and between opposed vertical side members 1 of the framework and by brackets 26a. As successive portions of the conveyor belt approach the hopper 11, the outer sides of the shouldered edges 21 of the sides 17 are engaged between a pair of rollers 27 carried by a bracket 28 having the arms thereof secured to opposite upright members 1. These shouldered edge portions are held against upward movement by a roller 29, also carried by the upper portion of the said bracket and bearing downwardly upon the tops of the interlocked edges. The rollers 27 and 29 are located a short distance from the adjacent end of the saddle 13 and the adjacent surface of the hopper neck 12; and this neck serves to spread apart and thus separate successive interlocked outer-edge portions of the tubular conveyor belt intermediate of the rollers 27 and 29 and the said neck. Where the neck is angular in section, rollers 30 will be provided on the saddles 13, 13x, thereby to prevent the inner surfaces of the sides of the conveyor belt from being chafed by engagement with the corners of said neck. Where our tubular conveyor belt is provided with the flights 24, there is danger of air being forced thereby into the opened receiving interior portion of the conveyor and into the material as the latter is being delivered from the neck 12 of the hopper into such portion. In order to prevent this action, an opening 13a is provided in the saddle 13 which is located on the side of the neck 12 toward which our conveyor belt is being moved. In addition, a flap valve 130 of flexible material, such as rubber, is secured to the side of the hopper neck 12 adjacent to the opening 13a, said flap valve extending into the conveyor tube for substantially the full depth and width of the latter. The lower end of the flap will be wiped or moved aside by the flights as they pass successively beneath the hopper neck; but practically all of the air which may be interposed between a flight and the flap will be forced out before the flight encounters the flap. As the successive separated portions of the conveyor belt pass the loading station hopper, the top edges of the sides thereof are brought together and the teeth or projections thereof are interlocked by means of another set of rollers 27a and 29a, similar to the rollers 27 and 29, respectively, and carried by a bracket 28a, similar to the bracket 28. The detailed construction of the means for interlocking the upper edges of the sides of the conveyor belt and for holding the same interlocked are shown in Fig. 3, wherein these parts are shown in the inverted positions which they occupy when used with the upper stretch of the conveyor belt and wherein the rollers corresponding to rollers 27 are designated 27b, the roller corresponding to the roller 29 is designated 29b, and the arms of the bracket are designated 28b.

The portion of our conveyor belt which has just received its charge of material from the hopper 11 passes around the left hand corner of the framework, the central portion of the bottom being supported by the rollers 8 and the side flanges being supported by the rollers 10. When the tubular conveyor belt reaches the left hand upper corner, it is carried across the hoppers 14, with its edges directed downwardly. It is supported in its transit across the top of the framework by rollers 31 mounted on opposed vertical

members 1 and engaging the side flanges of the base.

For the purpose of opening the portions of the conveyor belt passing across any one or more of the hoppers 14, each hopper is provided with a roller 32 which is pivotally carried by the lower end of a lever arm 33 which is pivotally supported by a bracket 34 secured to one of the uprights. The opposite end of this lever has a cable 35 attached thereto. By pulling upon this cable, the roller 32 will be brought into contact with one of the side edges 17b of the conveyor belt, as shown in full lines on Fig. 4, and will press the teeth at this point out of engagement with the recesses provided therefor in the opposite edge. To prevent the separation of the edges from extending beyond the side of the hopper which the conveyor belt is approaching, each hopper is provided within such side with a bracket 28c which supports rollers 27c and 29c corresponding to the rollers 27b and 29b. This location of the rollers 27c and 29c is shown in Fig. 4, it being unnecessary to indicate the same in each of the hoppers in Fig. 1. The successive portions of the conveyor belt, passing above any of the discharge hoppers 14 which is selected for discharging purposes, will remain open until said portions advance to the selected set of closing rollers 27b, 29b carried by a bracket 28b, these parts being identical in construction with the correspondingly numbered parts arranged on opposite sides of the hopper 11. The sides of the conveyor belt are sufficiently resilient to render it unnecessary to keep the roller 32 elevated longer than necessary to effect the initial separation of the interlocked edges of our conveyor belt, since the tendency of the sides to assume a position at right angles to the base will insure the edges being progressively separated after passing the holding rollers 27c and 29c, through the initial separation thereof, until these edges are again interlocked by rollers 27b and 29b.

Reference has been made hereinbefore to the fact that the material contained within our conveyor belt may be discharged into any one or more of the hoppers 14. To accomplish this operation, we provide each of the hoppers with means for maintaining the edge portions of the sides of the conveyor belt interlocked while passing above such hopper. These means are shown more particularly in Fig. 2, and comprise lever arms 36 pivotally mounted upon rods 37 and of such shape as to enable the conveyor belt to pass between the opposed lower portions of the same, the lower end of each arm being provided with a roller 38, which rollers are adapted to be brought into engagement with the shouldered side edges 17b of the conveyor belt sides. The upper end of each arm 36 is provided with a gear segment 36a meshing with a pinion 370, said pinions being mounted on shafts 380. One of the arms 36 is provided with a projection 36b to which a suitable cable 39 may be attached. Normally the parts will be in the positions shown by dotted lines in Fig. 2 thereby to permit the load to be discharged from the conveyor belt. However, when it is desired to eliminate any hopper from receiving any of the contents of the conveyor belt, the inner end of the arm 33 therein will be left in its depressed position, as shown in broken lines in Fig. 4, so that the roller thereon will not engage a shouldered edge of the conveyor belt, while the arms 36 will occupy the broken-line positions shown in Fig. 2. However, when the conveyor belt has been opened by a roller 32 and it is desired to prevent further discharge of material therefrom at that point, the appropriate cable 39 will be pulled downwardly, thereby causing the rollers 38 on the arms 36 to interlock the outer edges of the conveyor belt, the rollers being held in such interlocking engagement during the interval of time required for the travel of that portion of the belt which was immediately adjacent to the rollers 27c and 29c, when the rollers 38 were so engaged, to and beyond the rollers 27b, 29b, whereupon the cable 39 may be released and the arms 36 and the rollers thereon will assume the positions shown in dotted lines in Fig. 4, and the conveyor belt will thereafter traverse the top of the hopper without discharging thereinto.

Reference has been made hereinbefore to the drive roller 3. This roller is designed and constructed in such manner as to cooperate with the particular construction of our tubular conveyor belt. As will be seen by reference to Fig. 7, the side flanges 160 of the base of the belt are engaged by peripheral flanges 3a carried by opposite sides 3b of the pulley 3. These sides are connected by an intermediate hub portion 3c having a central groove 3d therein and extending thereabout for the reception of the interlocked shouldered edges 17b of the tubular portion of the conveyor belt. The outer sides of the hub portion are bent toward the shaft 4, to provide with the adjacent portions of the pulley sides recesses or grooves for the reception of the sides 17 of the conveyor, should the said sides be separated or unlocked. By this construction, our conveyor belt will be supported by the base flanges 160 and, if closed, the shouldered edges 17b can be maintained in their interlocked position while passing around the pulley.

One of the important advantages of the construction of our tubular conveyor belt is its ability to cooperate with ordinary types of rollers for the purpose of discharging the contents of the same, regardless of the direction in which the belt may be driven. This capability will be obvious from an inspection of Figs. 15 and 18, in the former of which figures a pair of rollers 40, 41 is shown as mounted on shafts 42 and 43 respectively, and holding rollers 27c are provided in proximity to and in advance of the roller 40 toward which the conveyor belt is traveling. It will be obvious that the rotation of the roller 40 in the direction indicated by the arrow will separate successive interlocked portions of our conveyor belt that have passed the rollers 27c and spread the sides outwardly, whereby the belt will be operated and its contents discharged over the said roller. By eliminating the roller 41, driving the roller 40 in the reverse direction, and locating a pair of closing rollers on the opposite side of the roller 40 from the rollers 27c, the tubular belt will be opened by the roller 40 and its contents discharged from below the said roller.

While any type of cylindrical roller will function in the manner described, there are certain features of the rollers 40 and 41 (and particularly of the roller 41) which are designed more particularly for the purpose of affording effective means for driving and for supporting our conveyor belt while in its open condition. Each of the rollers 40 and 41 is provided with a covering (40a and 41a, respectively) which will present a non-slipping driving surface when engaged by the belt. We have found rubber lagging to be suitable for this purpose. It will be noted that the roller 40 is crowned, thereby to pre-

vent side-slipping of our conveyor belt while thereon, the central portion of the roller supporting the bottom or outer surface of the base 16 of our belt while the side portions of the roller support the outer shouldered ends 17b.

The roller 41 is constructed to provide an efficient support for the inner surface of the base 16 of our conveyor belt and for the sides 17 thereof. For this purpose the central portion of the roller 41 is provided with a central widened rib 41b, the ends of the rib being tapered, as shown at 41c, thereby to conform to the shape of the portions of the fabric strips 20 in contact therewith.

In Fig. 18, we have illustrated diagrammatically the capability of our conveyor belt to adapt itself to various locations and arrangements of unloading stations, as well as its capability of operation with ordinary types of rollers. In this view, assuming that the conveyor belt is driven in the direction indicated by the arrow, it will receive its load from the hopper 11 and will conduct such load above the hopper 14 of an unloading station, where it may be discharged in the manner described hereinbefore; or, if not discharged there, by giving the conveyor belt a half turn, its contents may be discharged over a pulley 400, similar to the pulley 40 in Fig. 14, the contents being received within a hopper 140, similar to the hopper 14. The conveyor belt may then be driven, in its open position, around a pulley 410, which may be similar to the pulley 41 in Fig. 14, following which it may be given another half turn and conducted around a second pulley 410a, similar to the pulley 410, following which it will be closed by a series of rollers 270 and 290, arranged similarly to the rollers 27 and 29, respectively.

It will be noted that while the edge engaging rollers 29b and 29c are above the top edges of the hopper, as shown in Fig. 4, and that the roller 32 engages one of the side edges of the conveyor belt when such side edges are also above the top of the hopper, these rollers as well as the arms 36 and rollers 38 are located within the space which would be occupied by projecting the sides of the hopper upwardly; in other words, these rollers are located above, but within the border of the sides of the hopper.

It will be evident that a tubular conveyor belt constructed in accordance with our invention is not only simple of construction, but economical of production, the same consisting of three elements having the elastic characteristics of rubber, said elements being a base (which serves the double function of a portion of the conveyor tube as well as a support for the same) and sides which, in our preferred construction, are flexibly connected to the base. Furthermore, this simplicity of construction of the conveyor is attended with a corresponding simplicity in the construction of the means for opening and closing the tubular portion thereof which receives and discharges the load. The conveying apparatus shown, described and claimed in this application is a continuation in part of our application Serial No. 372,997, filed January 3, 1941.

It will be evident that a conveyor belt constructed in accordance with our invention and embodying the planar base and the sides hingedly connected thereto can be used as a conveyor belt of trough-like formation, by merely supporting the sides in proper angular relation with respect to the base by means of suitably arranged rollers adapted to engage the outer surfaces of said sides.

Having thus described our invention, what we claim is:

1. In conveying apparatus, a movable tubular conveyor belt made of flexible material and comprising a planar base and sides connected to and spaced apart by said base, the outer edges of the said sides being provided with interlocking means.

2. In conveying apparatus, the base of the tubular conveyor belt recited in claim 1 being extended beyond the bases of the sides to provide flanges for cooperation with anti-friction supporting devices.

3. In conveying apparatus, a movable tubular conveyor belt made of flexible material and comprising opposed sides adapted to be brought together to provide an enclosure, the edges of such opposed sides being provided each with interlocking means, said means comprising alternating projections and complementary recesses on each of said edges, each projection having a widened outer end portion united to the narrower end of a stem portion, the recesses being complementary in shape to the projections and the projections and recesses on one of the said edges being staggered with respect to and substantially identical with those on the other of said edges and the said projections being spaced apart longitudinally of the edges from which they respectively extend.

4. In conveying apparatus, the tubular conveyor belt recited in claim 3 being provided with a planar base and with sides connected to said base, the sides presenting opposed edges wherein the alternating projections and complementary recesses are provided and the base extending beyond the bases of the sides to provide flanges for cooperation with anti-friction supporting devices.

5. In conveying apparatus, the edges of the tubular conveyor belt recited in claim 3 being provided with shoulders projecting outwardly therefrom and the interlocking means recited in said claim being formed in said shoulders.

6. In conveying apparatus, the movable tubular conveyor belt recited in claim 1 being provided with a flap of elastic material secured to the inner surface of the outer edge portion of each side and adapted to abut each other when the outer edge portions of the sides are united.

7. In conveying apparatus, a movable tubular conveyor belt made of flexible material and comprising a wide planar base and sides hingedly connected to said base, the outer edges of the said sides being provided with interlocking means.

8. In conveying apparatus, the base of the tubular conveyor belt recited in claim 7 being extended beyond the bases of the sides to provide flanges for cooperation with anti-friction devices.

9. In conveying apparatus, a movable tubular conveyor belt made of flexible material and comprising a base and sides and means hingedly connecting the sides to said base, the outer edges of said sides being provided with interlocking means, said means comprising alternating projections and complementary recesses on each of said edges, each projection having a widened outer end portion united to the narrower end of a stem portion, the recesses being complementary in shape to the projections and the projections and recessses on the outer edge of one of the sides being staggered with respect to and sub-

stantially identical with those on the outer edge of the opposite side.

10. In conveying apparatus, the base of the tubular conveyor belt recited in claim 9 being planar and extending beyond the bases of the sides to provide flanges for cooperation with anti-friction supporting devices.

11. In the conveying apparatus recited in claim 7, a flexible strip secured to the lower inner end portion of each side and to the base and each providing a cover for the joint formed between the bottom of a side and the base.

12. In the conveying apparatus recited in claim 7, a sheet of flexible material secured at its opposite ends to the lower inner end portions of the sides and extending across the upper or inner surface of the base.

13. A conveying apparatus comprising a movable tubular conveyor belt formed of flexible material and comprising a wide substantially planar base and sides secured to said base, the outer edges of said sides being provided with shoulders projecting beyond the outer surfaces of the bodies of the sides and the said shoulders being provided with means for interlocking the side edges, a loading station beneath which the conveyor belt is moved with its sides extending upwardly from said base, means for separating the interlocked edges of the portions of the conveyor belt brought into load-receiving position with respect to said station, means for interlocking the outer edges of the successive portions of the conveyor belt after having passed such load-receiving position, an unloading station above the delivery outlet of which the conveyor belt is moved, means located adjacent to the latter station for separating the interlocked edges of the portions of the conveyor belt passing thereby, and means at said latter station for thereafter interlocking the edges of such portions of the conveyor belt, the means for interlocking the outer edges of the portions of the conveyor belt after having passed the load-receiving position and after the said portions have been separated adjacent to the unloading station comprising pairs of rollers, each pair being adapted to engage the outer surfaces of the shouldered edges of the sides thereby to press the same toward each other as the conveyor belt passes by said rollers, and means for driving said conveyor belt.

14. A conveying apparatus comprising a movable tubular conveyor belt of flexible material comprising a wide substantially planar base, sides secured to said base, each side having at its outer edge complementary projections and recesses whereby they may be interlocked with the complementary projections and recesses on the outer edge of the opposite side, said projections and recesses extending substantially parallel with the said base when interlocked, a loading station beneath which the conveyor belt is moved with its sides extending upwardly from said base and an unloading station above the delivery outlet of which the conveyor belt is moved with its sides extending downwardly from said base, means adjacent to the loading station for separating the interlocked edges of said conveyor belt as successive portions of said belt approach load-receiving position, means beyond the loading station for interlocking the outer edges of the portions of the sides that have passed thereby, means at the unloading station adapted to engage the lower edge portion of one of the sides of the conveyor belt, thereby to remove the projections and recesses thereof from engagement with the complementary recesses and projections on the outer edge of the other side, and means for driving said conveyor belt.

15. A conveying apparatus comprising a movable tubular conveyor belt formed of flexible material and comprising a substantially planar base with sides secured to said base and each provided at its outer edge with interlocking means adapted, when engaged, to hold the said edges in contact with each other, a loading station beneath which the conveyor belt is moved with its sides extending upwardly from said base, means adjacent to the loading station for separating successive portions of the outer edges of the sides of the conveyor belt as the conveyor belt is brought to said station, means adjacent to and beyond the said loading station for engaging, pressing together and interlocking the successive portions of the outer edges which have been thus separated, an unloading station comprising a hopper above the bottom of which the conveyor belt is moved with its sides extending downwardly from said base, means adjacent to and within the boundary of the side of the hopper toward which the conveyor belt is moved for separating the successive portions of the interlocked outer edges of the sides of the conveyor belt, and means located adjacent to and within the boundary of the opposite side of the hopper for engaging the outer edges of the sides thereby to interlock the successive portions of the said edges, means for operating the last mentioned separating means, and means for driving said conveyor belt.

16. In the conveying apparatus recited in claim 15, means within the boundary of said unloading hopper and intermediate of the separating and engaging means for engaging the outer edges of the said sides, thereby to hold the same interlocked, and means for operating the last mentioned side-engaging means.

17. In the conveying apparatus set forth in claim 13, a roller adapted to press upwardly against the interlocked portions of the shoulders and located adjacent to the rollers which press the shouldered edges of the conveyor belt together after the said edges have passed beyond the load-discharging zone.

18. A conveying apparatus comprising a movable tubular conveyor belt formed of flexible material and comprising a wide planar base and sides secured to said base within and spaced from the outer edges thereof, thereby to provide side flanges for said base, the sides being provided each at its outer edge with means whereby it may be interlocked with the outer edge of the opposite side, a group of rollers arranged to support said conveyor belt during an angular change in the direction of travel thereof and around which the conveyor belt passes, said group of rollers comprising rollers adapted to engage the outer surface of the base of the conveyor belt and arranged on opposite sides of the angle formed by said conveyor belt in changing its direction of travel and rollers also arranged on opposite sides of said angle and adapted to engage the inner surfaces of said flanges.

19. A conveying apparatus comprising a movable tubular conveyor belt formed of flexible material and comprising a base and sides secured to said base and provided each at its outer edge with means whereby it may be interlocked with the outer edge of the opposite side, a loading station comprising a hopper having a saddle at its lower end extending therefrom and adapted

to be received within the portions of the said conveyor belt which are successively approaching said hopper, means for separating the outer edges of the sides of the portion of the conveyor belt passing the said saddle and hopper, means for interlocking the outer edges of the sides of the portions of the conveyor belt which have passed beyond the said hopper, the said conveyor belt having flights extending thereacross and the said saddle having an opening arranged adjacent to the side of the hopper toward which the conveyor belt is moved, a flap valve carried by said side of the hopper beyond the said opening and adapted to extend transversely of the conveyor belt, and means for driving said conveyor.

20. A conveying apparatus comprising a tubular conveyor belt formed of flexible material and comprising a substantially planar base with sides secured thereto and each provided at its outer edge with means for interlocking the same with the outer edge of the other side, a loading station beneath which the conveyor belt is moved with its sides extending upwardly from said base, means adjacent to the loading station for separating successive portions of the outer edges of the sides of the conveyor belt as the latter are brought to said station, means adjacent to and beyond the said loading station for engaging successive portions of the outer edges which have been thus separated, thereby to interlock such edges, an unloading station comprising a hopper above the bottom of which the conveyor belt is moved with its sides extending downwardly from said base, means for engaging and holding interlocked successive portions of the outer edges of the sides of the said belt as the latter is brought above the hopper, means located beyond the latter edge-engaging means for separating the successive portions of the outer edges of the sides of the conveyor belt as these portions are also brought above the hopper, means located beyond the said separating means for engaging the outer edges of the sides thereby to interlock the successive portions of the said edges that have been thus separated before the last mentioned portions pass beyond the hopper, means for operating the last mentioned separating means, and means for driving said conveyor belt.

21. In the conveying apparatus recited in claim 20, means interposed between the edge separating means and the final edge engaging means and adapted to be brought into and out of engagement with the opposite outer edges of the sides of the conveyor belt, and means for operating the last mentioned means.

22. In conveying apparatus, a movable conveyor belt made of flexible material having a base and sides and means hingedly connecting the sides to the base, the said means comprising a flexible strip secured to the lower portion of each of said sides and extending continuously throughout the length of the latter and being secured in turn to the said base.

23. In the conveying apparatus recited in claim 22, the means hingedly connecting the sides to the base comprising flexible strips united to the inner and outer lower end portions of each of the sides and secured to said base.

24. A conveying apparatus comprising, in combination, a movable tubular conveyor belt of flexible material and comprising a base and sides secured to said base and each having at its outer edge means for interlocking the same with the outer edge of the other side, a loading device past and below which the said conveyor belt is adapted to be moved, said loading device comprising a hopper, saddles extending in opposite directions from the delivery portion of said hopper and longitudinally with respect to said conveyor belt and adapted and arranged to be received within the tubular portions thereof, means located in advance of said hopper and adapted to engage the outer edges of the said sides, thereby to hold these edges interlocked, and means located beyond the said hopper for locking said outer edges together.

25. In the conveying apparatus set forth in claim 24, rollers supported by the saddles in front of and at the rear of the hopper and adapted to engage the inner sides of the conveyor belt.

26. In conveying apparatus, a movable tubular conveyor belt made of flexible material and comprising a planar base and sides connected to and spaced apart by said base, the outer edges of the said sides being provided with interlocking means and the said base being extended beyond the bases of the sides to provide flanges, anti-friction devices engageable by said flanges, and a drive pulley having sides each having a peripheral flange adapted to engage a side flange of the conveyor belt and provided with a central hub having a recess located at the central portion thereof for receiving the edges of the sides of the conveyor in their interlocked position, there being recesses provided between the central portion of the hub and the sides of the pulley for the reception of the sides of the conveyor belt when the latter are separated.

27. In conveying apparatus, a movable tubular conveyor belt made of flexible material and comprising a wide planar base and sides formed with and projecting normally at substantially right angles from said base, the outer edges of said sides being provided with interlocking means, said means comprising alternating projections and complementary recesses on each of said edges, each projection having a widened outer end united by shoulders with a stem, the recesses being complementary in shape to the projections, and the projections and recesses on one of the sides being staggered with respect to and substantially identical with those on the opposite side.

28. In conveying apparatus, a movable tubular conveyor belt made of flexible material and comprising a wide substantially planar base and sides formed with and projecting normally at substantially right angles from said base, the outer edges of said sides being provided with interlocking means.

29. In conveying apparatus, the base of the movable tubular conveyor belt recited in claim 28 being extended beyond the sides to provide flanges for cooperation with anti-friction devices.

30. In conveying apparatus, a movable tubular conveyor belt made of flexible material and comprising a wide substantially planar base and sides secured to said base and each having at its outer edge alternating complementary recesses and projections, the projections and recesses of one edge being staggered with respect to and substantially identical with the projections and recesses on the opposite edge and so arranged that when the outer edges of the sides are pressed together, the same will be interlocked to provide a hollow tubular conveyor with the interlocked projections and recesses extending substantially parallel with the base.

31. In the conveying apparatus recited in claim 30, the sides of the conveyor belt being spaced from the outer edges of the base thereby to provide side flanges for cooperation with guiding and supporting devices.

32. In the conveying apparatus set forth in claim 22, the outer edges of the sides being provided with interlocking means.

33. A conveying apparatus comprising a movable tubular conveyor belt formed of flexible material and comprising opposed sides adapted to be brought together to provide an enclosure, the edges of such opposed sides being provided each with interlocking means, the said interlocking means comprising alternating projections and complementary recesses on each of said edges, each projection having a widened outer end portion united to the narrower end stem portion, the recesses being complementary in shape to the projections and the projections and recesses on one of the said edges being staggered with respect to and substantially identical with those on the other of the said edges and the said projections being spaced apart longitudinally of the edges from which they respectively project, a loading station beneath which the conveyor belt is moved with its edges presented upwardly, means for separating the interlocked edges of the portions of the conveyor belt brought into load-receiving position with respect to said station, means for interlocking the outer edges of the successive portions of the conveyor belt after having passed such load-receiving position, an unloading station having a delivery outlet above and beyond which the said conveyor belt is moved, means located above said delivery outlet for separating the interlocked edges of the portions of the conveyor belt passing thereby and means for thereafter interlocking the edges of such portions of the conveyor belt, and means for driving the said conveyor belt.

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