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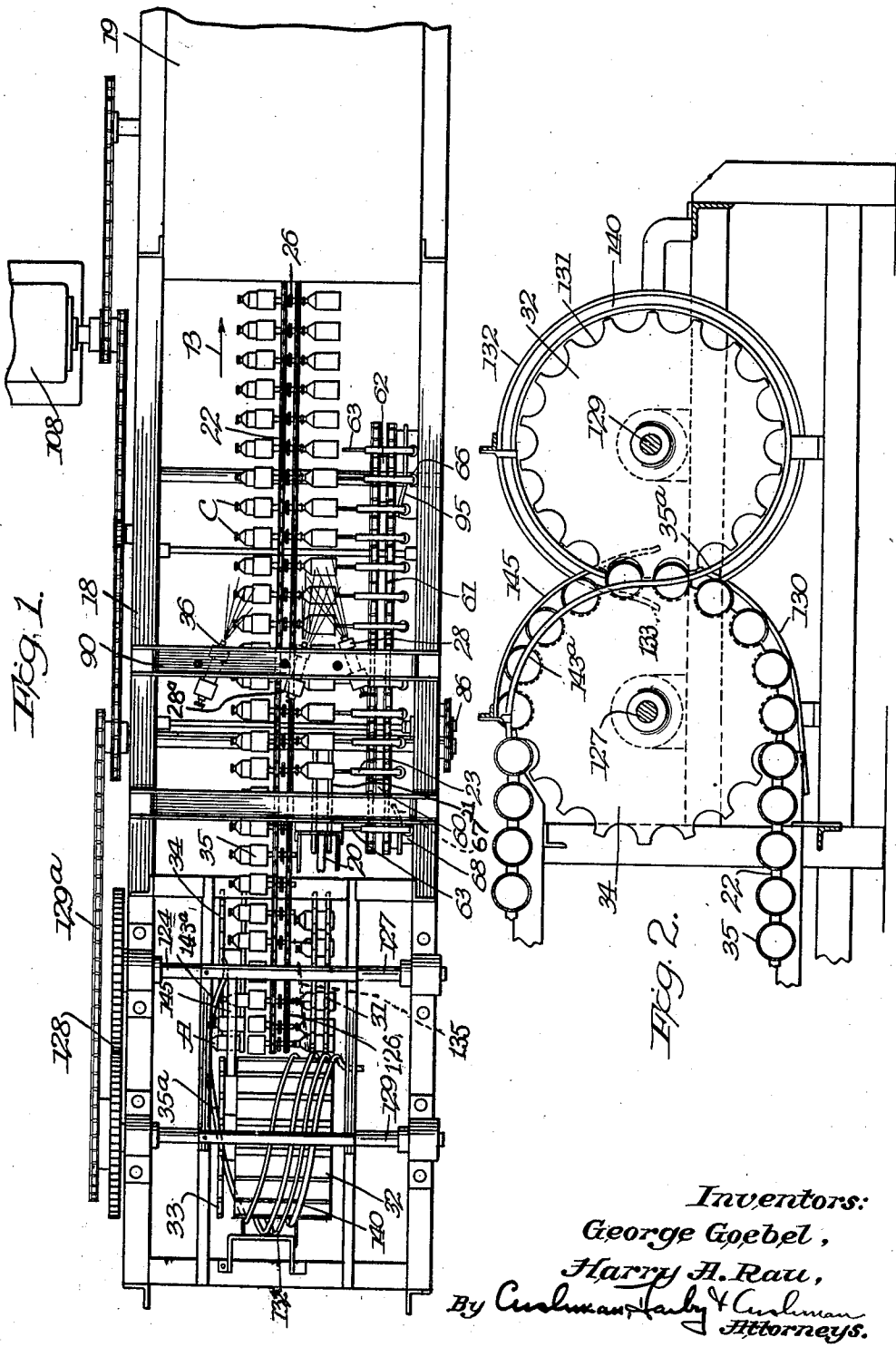
G. GOEBEL ET AL

2,334,087

COATING APPARATUS

Filed Oct. 17, 1938

4 Sheets-Sheet 1



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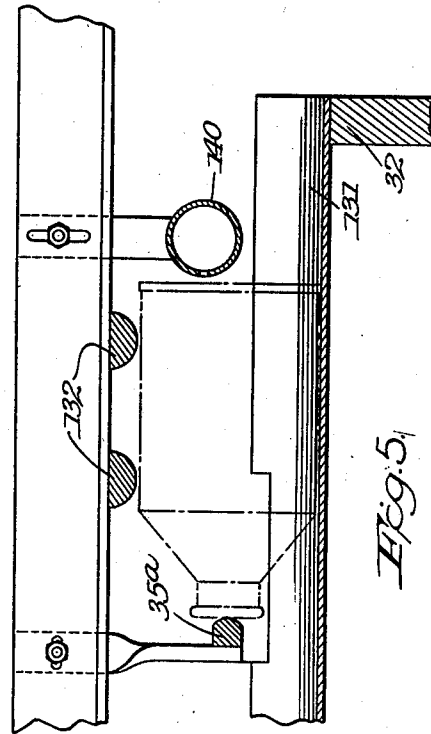
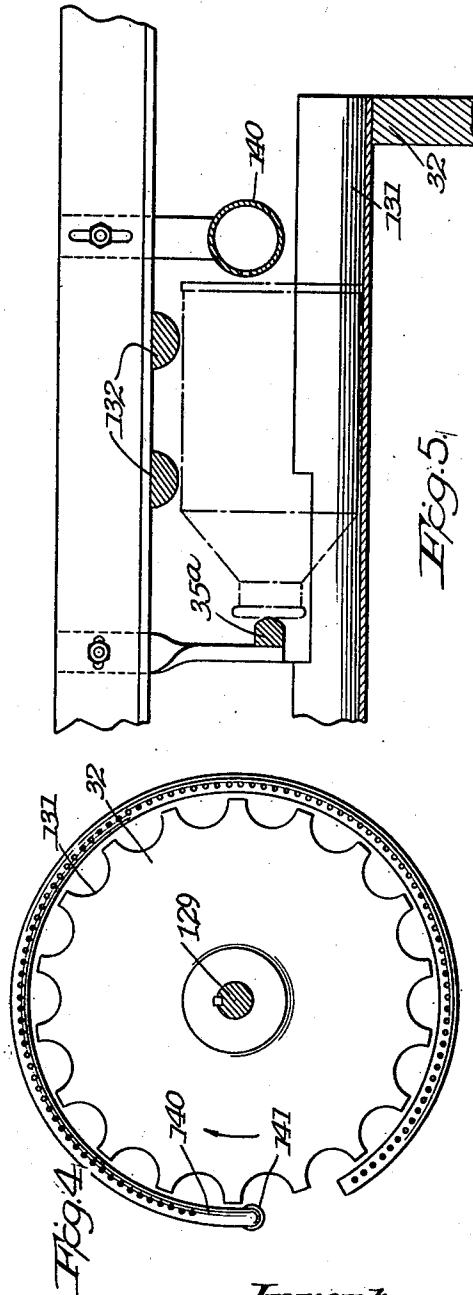
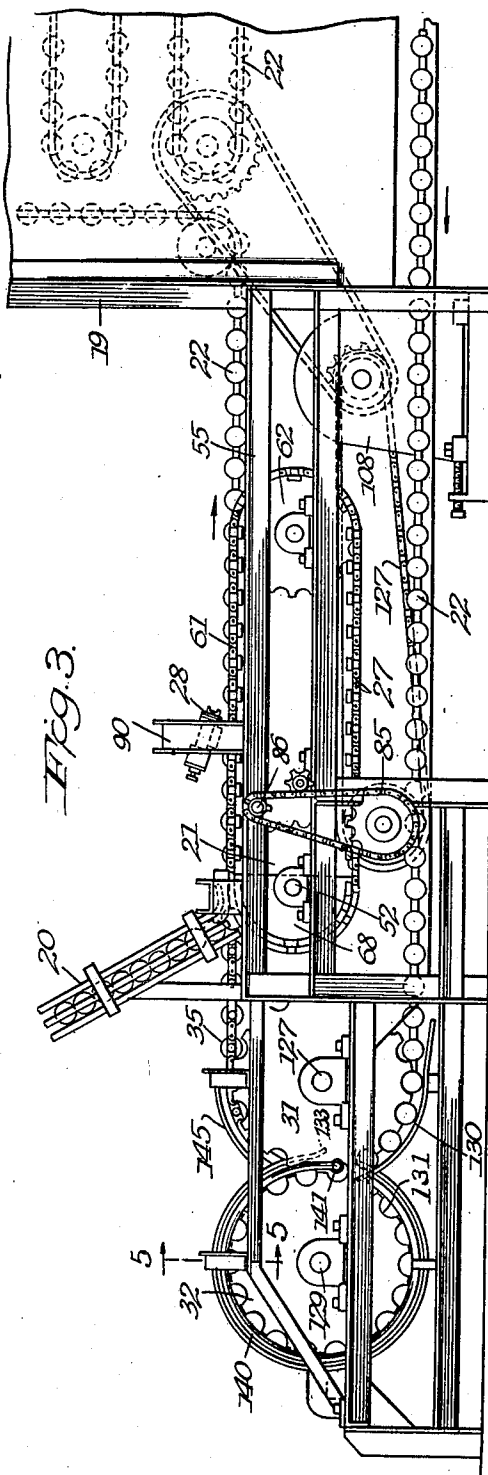
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COATING APPARATUS

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4 Sheets-Sheet 2



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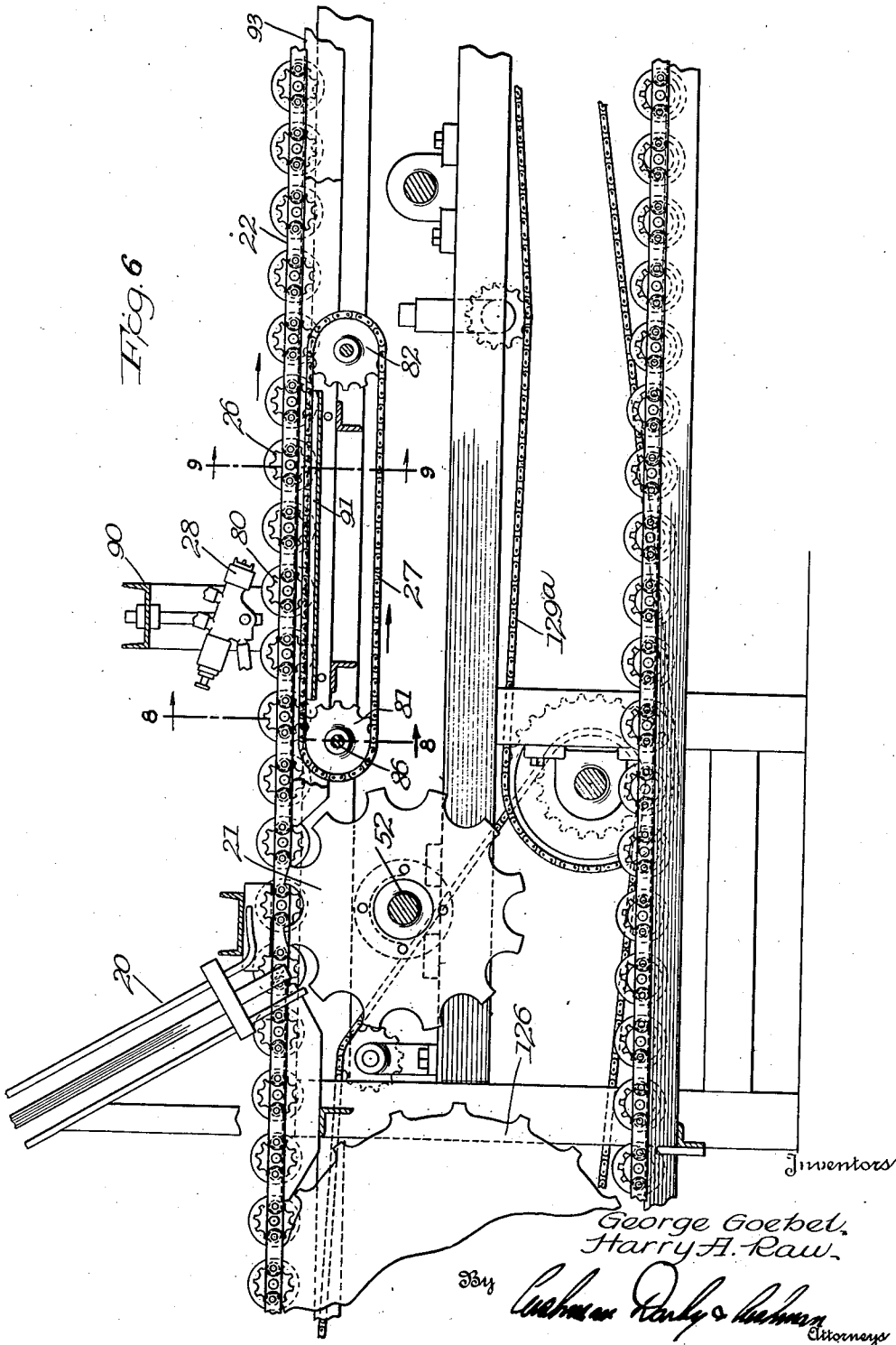
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COATING APPARATUS

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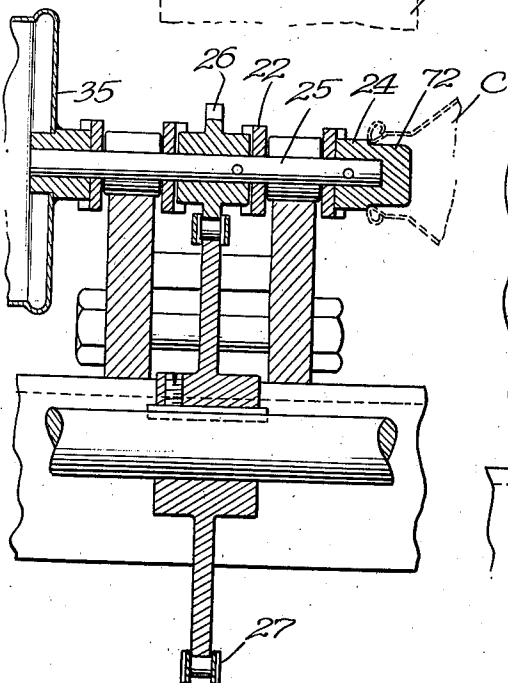
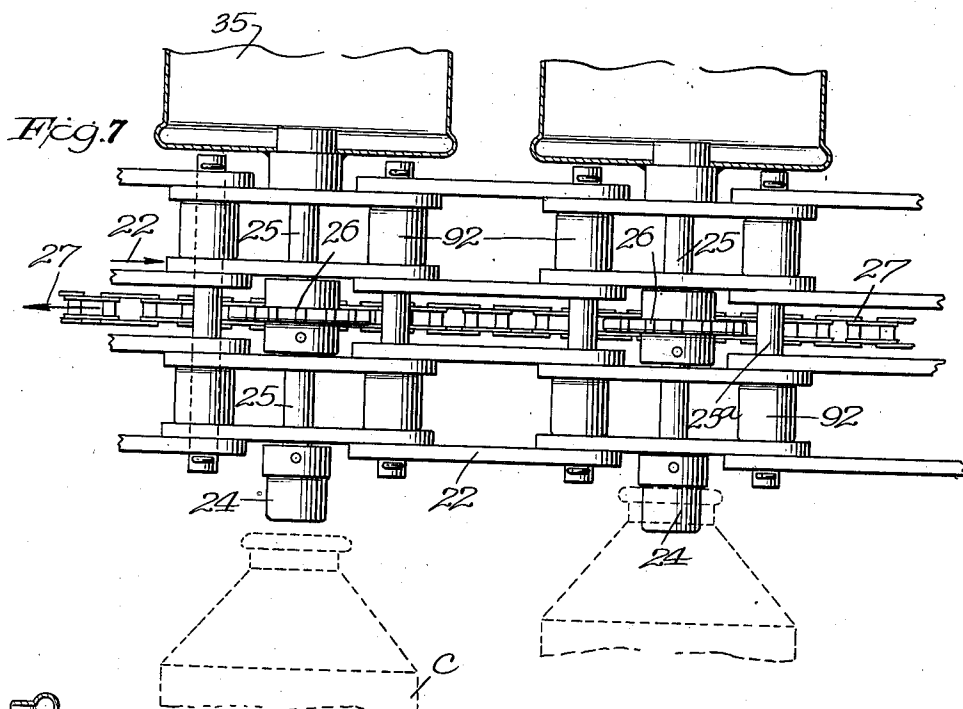


Fig. 8

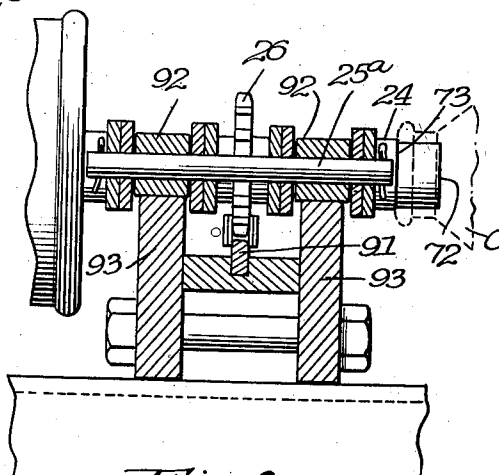


Fig. 9

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UNITED STATES PATENT OFFICE

2,334,087

COATING APPARATUS

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Application October 17, 1938, Serial No. 235,496

10 Claims. (Cl. 91—45)

The present invention relates to a coating apparatus and, more particularly, to an apparatus for coating cone-top cans such as are used for packaging beer and other beverages.

Cans intended for the packaging of beverages must be coated on both the interior and exterior surfaces, the coating on the exterior being of a nature to prevent rust. Difficulties have heretofore been experienced in coating the entire exterior surfaces of such cans, including the lip or mouth of the can, during passage of the can through a single machine. That is to say, all of the exterior portion of the can except the lip or mouth can be thoroughly coated by supporting the can upon a member inserted into the mouth of the can, but the supporting of the can by a mouth-engaging member interferes with the thorough and complete coating of the mouth itself.

Because of the above difficulties, the coating of the exterior of a can has heretofore been carried out upon two different mechanisms, one to coat the exterior of the body portion of the can and the other to coat the mouth or lip of the can.

The principal object of the present invention is to provide an apparatus of such construction that a can or similar article may be thoroughly coated over its entire exterior surface, including its mouth or other aperture, during passage through a single apparatus.

A further object of the invention is to provide an apparatus of the type described and in which the container or other article will be supported without possibility of marring the container or any coating applied thereto.

Another object of the invention is the provision in an article coating or similar apparatus of means to support a can or other article successively at two different points on the article so that the article may be successively coated over different portions or areas thereof.

Another object of the invention is the provision of a means to transfer the articles from one supporting means to another supporting means without interrupting the travel of the article and without marring it in any way.

Still another object of the invention is the provision of means to support a can or other article and to so move the article during the coating operation that the coating substance will be thoroughly and evenly distributed thereon.

Other objects and advantages of the invention will be apparent from the following specification and drawings wherein:

Figure 1 is a plan view of the infeed or spraying portion of the apparatus.

Figure 2 is a vertical longitudinal sectional view of the article transfer mechanism.

Figure 3 is a side elevation of the infeed or spraying portion of the apparatus.

Figure 4 is a detail vertical sectional view showing the transfer drum in side elevation.

Figure 5 is a transverse vertical sectional view on the line 5—5 of Figure 3.

Figure 6 is a longitudinal vertical sectional view showing the infeed and spraying portion of the apparatus.

Figure 7 is a plan detail view of the article supporting conveyor.

Figure 8 is a transverse vertical sectional view on the line 8—8 of Figure 6, and

Figure 9 is a transverse vertical sectional view on the line 9—9 of Figure 6.

The structure and operation of the present apparatus may be generally described as follows: The embodiment of the apparatus disclosed herein is primarily intended for applying lacquer to the exterior of cone-topped cans C, that is, cans having a cone-shaped top wall and a mouth or pouring spout formed to receive a cap of the crown type.

Cans to be coated are delivered to the infeed and spraying portion 18 of the machine through an infeed chute 20 (Figures 1 and 3), each can falling into a pocket of an infeed spider 21. As shown in Figures 1 and 3, the upper run of the main conveyor 22 of the apparatus moves alongside the infeed spider 21 and each can C moving down upon the spider will be forced laterally of the latter by an aligned reciprocable rod of a can seating mechanism 23, and so that, as shown progressively in the lower portion of Figure 7, the mouth of the can will be brought into engagement with an aligned supporting element, head or stud 24 on the adjacent side of the conveyor 22, the mouth of the can then fitting snugly about the supporting element.

Each supporting device or stud 24 is fixed to a spindle 25 which is rotatable in the conveyor chain 22, and immediately after the can has been positioned on the supporting stud or head 24 a pinion or sprocket 26 midway of the spindle 25 will come into engagement with the upper run of an endless chain 27 (Figure 6) moving below the conveyor 22 and in the opposite direction to the direction of movement of the latter, as indicated by the arrows in Figure 7. As a result, the spindle 25 and the can C carried thereby will be rotated on their longitudinal axes. During such

rotation the can will move beneath a pair of spray guns 28 and 28a (Figure 3); one of which is positioned to direct lacquer upon the bottom wall of the can, the other gun being mounted to direct lacquer upon the side wall, cone top and the exterior portion of the mouth of the can. Since the can is rotating on its own axis during the spraying, its exterior will be entirely coated with the lacquer.

During the above spraying, the aligned rod of the can seating mechanism 23 is in contact with the center of the bottom of the can, but the rod will move out of contact with the can when the spraying is concluded, the can remaining upon the supporting element or head 24 to be carried through the drier portion 19. As described in the divisional application for Article handling apparatus, Serial Number 465,380, filed November 12, 1942, by Helene Goebel, administratrix of George Goebel and Harry A. Rau, the conveyor 22 moves alternately back and forth in the drier 19 so that the can will be subjected to drying treatment for approximately fifteen minutes. Throughout the initial and greater part of its travel in the drier 19 the conveyor 22 moves through the upper part of the drier, where it will be subjected to the action of heated air, but the lowermost run of the chain in the drier 19 moves through a cooling chamber so that each can will be fairly cool when it leaves the drier. As indicated in Figure 3, the lower run of conveyor 22 which moves from the lower portion of the drier 19 will move about a pocketed spider 31 and while the chain is moving about this spider, the cans C will be removed from the supporting heads 24 of conveyor 22 and will be positioned upon a transfer drum 32 (Figures 1 to 3).

As generally illustrated in Figure 3, drum 32 is provided with a plurality of axially extending grooves in its periphery, in which the cans are received. While rotating with the drum, the cans will be moved to the far ends of the grooves so that their conical ends will be positioned in aligned pockets of a disc 33 which rotates with transfer drum 32. After such movement with the drum 32 and disc 33, the cans will be received in pockets of a spider 34 formed of a pair of aligned and pocketed discs, spider 34 being fixed to the same shaft as spider 31, as indicated in Figure 1. Cans carried by the spider 34 will be in axial alignment with cup-shaped supporting elements or carriers 35 carried on the spindles 25 at the opposite end thereof from the heads 24. The carriers 35 are of sufficiently large internal diameter to receive the base portions of the cans, and the cans will be moved into the carriers 35 by a fixed inwardly inclined guide element or strip 35a shown in plan in Figure 1.

As indicated in Figures 1 and 3, shortly after a can is positioned in one of the carriers 35, the section of the chain 22 upon which that carrier is positioned will move over the previously mentioned oppositely moving endless chain 27 so that the spindle 25 with which the carrier 35 is associated will be rotated, causing the can to rotate. While thus rotating, the can will move beneath a spray gun 36 which will direct lacquer upon the rotating lip and inner surface of the mouth of the can.

Rotation of the can will cease after its spindle 25 has moved out of engagement with the endless chain 27, and the can will again move through the drier 19. As stated above, the conveyor 22 moves alternately back and forth within

the drier 19 so that the can will again be in the drier for approximately fifteen minutes. Also, during all of this travel through the oven, the can C will be subjected to the action of heated air, as described in said divisional application.

The cans may be removed from the carriers 35 by a removing mechanism such as disclosed in said divisional application.

The detailed construction of the various mechanisms of the apparatus is set forth below.

Infeed mechanism and mechanism for conveying cans by engagement with can mouth

Referring to Figure 3, the infeed chute 20 is formed of substantially vertically extending rods secured together in suitable arrangement to guide a cone top can downwardly through the same with the longitudinal axis of the can lying in a horizontal plane, the lower end of the chute terminating above the rotary infeed spider 21. As best shown in Figures 1 and 6, the infeed spider 21 is formed of two discs 50 secured to a hub 51 keyed on a shaft 52 journaled between the side frame elements 54 and 55.

Shaft 52 is rotated by reason of the fact that it carries a large sprocket wheel 58 formed of spaced discs having notches 59 in their peripheries, which notches are engaged by the spindles 25 on main conveyor chain 22 as the main conveyor chain moves over the wheel 58 by a drive imparted thereto as hereinafter described.

As part of the can seating mechanism 23, shaft 52 also has a pair of spaced sprocket wheels 60 secured thereto, preferably on a common hub 60a, and a pair of relatively spaced sprocket chains 61 move about these sprocket wheels, and also about a second pair of sprocket wheels 62 positioned somewhat further along the frame of the machine as shown in Figure 3, so that the upper run of the two chains 61 will be parallel to the upper run of main conveyor chain 22.

At the moment that a can C is positioned in one set of the pockets provided in the peripheries of the discs 50 of infeed spider 21, one of a series of rods or plungers 63 each reciprocally mounted in the two laterally spaced endless chains 61 will be opposite the central portion of the bottom of a can, as best shown in Figure 1. As described in said divisional application, the rod 63 is urged toward the bottom of the can by a spring surrounding the rod and positioned between the adjacent chain 61 and the head of an angled bar, which angled bar extends along the rod and back over the chains 61 to the opposite and rear end of rod 63. The rear end of the rod 63 has a roller 66 journaled thereon, which roller engages a cam track 67 extending about an arcuate plate 68 fixed to the framework of the apparatus.

As indicated in Figure 1, each spring urges the corresponding rod 63 toward the spider 21 and during movement of a rod 63 along the lower run of the path of travel of the chains 61, each spring is free to move its rod to its extreme inward position (the upward position of Figure 1), this movement being suitably limited. When the roller 66 of the rod engages the cam shoulder 67, the rod will be retracted through the chains 61 so that its inner end will be clear of a can C just being positioned in the infeed spider 21. Immediately thereafter, the roller will move off the upper and inwardly inclined end of cam shoulder 67 so that the inner end of the rod 63 will contact with the bottom wall of the can

which has been deposited in the pocket of the infeed spider 21. The spring associated with each rod 83 is of sufficient strength to slide the cam through the pocket of the infeed spider 21 to bring the mouth of the can onto the aligned can supporting head 24 of the main conveyor chain 22.

As best shown in Figures 7 to 9, each can supporting head 24 is pinned to one of the spindles 25 included in the main conveyor chain 22, and the outer end of each head 24 is of sufficiently reduced diameter, as indicated at 72 in Figure 8, to enable the mouth of the can to freely slide upon the head. However, the reduced portion 72 is of sufficiently large diameter to prevent the can from tilting sufficiently far to fall from the same. The inner end of the reduced portion 72 terminates in an outwardly facing shoulder 73, as shown in Figure 9, which limits the inward movement of the can C with respect to the head.

After the main conveyor 22 moves a very short distance in the direction indicated by the arrow B in Figure 1, each can C will be freed from the infeed spider 21, and the presser rod 63 aligned with each can will be carried by its similarly moving supporting chains 61 away from the stationary cam 67 so that the roller 66 of that rod will be entirely disengaged from the cam 67 and the rod will be held in contact with the bottom of the can by its spring 64, as indicated in Figure 1. Almost immediately thereafter, as shown in Figures 6 and 7, the sprocket wheel 26 fixed intermediate the length of the can supporting spindle 25 will contact with the sprocket chain 27, which moves about sprocket wheels 81 and 82 (Figure 6) and in the opposite direction to the direction of travel of main conveyor 22, as shown by the arrows in Figure 7. Sprocket chain 27 is driven through the sprocket chain 85 (Figure 3) which moves about a sprocket wheel at the outer end of the shaft 86 which carries sprocket wheel 81.

Since the presser rod 63 is at this moment in contact with the bottom of the can C, the can will be held in a substantially horizontal plane while the spindle 25 which carries the same is being rotated at a fairly rapid speed of rotation by chain 27. While such rotation is continuing, the can will move beneath the two spray guns 28 and 28a supported from a cross frame 90. The spray guns are supplied with lacquer under pressure from any suitable source, and spray gun 28 is positioned at such an angle, as shown in Figures 1 and 3, that it will direct a spray of lacquer against the bottom wall of the can and also against the side wall of the can. The spray gun 28a is supported at such an angle by the frame 90 that it will direct lacquer against the conical top portion of the can and somewhat about the exterior of the can mouth. Due to the rapid rotation of the can during the spraying, lacquer will be deposited over all of the above described exterior surfaces of the can. Also, by reason of the fact that the rotation of the cans continues for a brief time after each can has passed out of the range of the spray guns, the lacquer will be freely flowed over such exterior portion of the cans to be evenly distributed thereon. Due to the fact that the can is supported by its mouth, as indicated in Figure 9, the spray gun 28a may not project lacquer over the entire lip surface of the can.

As shown in Figures 8 and 9, the upper run of can rotating chain 27 moves along a fixed guide

strip 91 which serves to hold such upper run in contact with the sprocket wheel 80 fixed to each spindle 25. At the same time, and throughout the movement of a spindle 25 along the path of the upper run of conveyor 22, rollers 92 freely mounted on the link connecting pins 25a will ride along fixed trackways 93. Thus, the conveyor 22 will be prevented from twisting laterally.

As indicated in Figure 6, the main conveyor 22 moves out of contact with the endless chain 27 shortly after a can has passed beneath the spray guns, and the rotation of the cans will cease at the latter point. At the same time, as indicated in Figure 1, the presser rod 63 which has heretofore been in contact with the bottom of the can, will be retracted from the can by reason of the fact that the roller 66 on the presser rod will come into contact with a fixed cam shoulder 95 arranged concentric with the axis of the sprocket wheels 82, cam shoulder 95 being of such conformation that it will retract each presser rod 63 from a can bottom as the presser rod moves downwardly and about the sprocket wheels 82 with the rod carrying sprocket chains 61.

While the cans are moving to the oven or drier 19 on the main conveyor 22, the presser rods 63 will move through the lower run of travel of the can seating mechanism chains 61 to again ride along the stationary can shoulder 67 to engage another can newly positioned upon the infeed spider 21.

As described in said divisional application, the drier 19 is of such construction that the coating applied to a can will be entirely dried during movement of the can through the drier.

The mechanism for transferring cans from the studs 24 to the carriers 35 is described in detail in said divisional application. However, the operation of this mechanism will be entirely clear from the following description thereof.

After leaving the drier 19, a can mounted on a can supporting head 24 and moving with the lower run of the conveyor 22 will move to the left as viewed in Figures 1 and 3 so that the can will be carried beneath (and entirely clear of) the infeed spider 21 to the extreme end portion of the run of the conveyor 22, which encircles a large double sprocket wheel 126 best shown in Figure 1. Sprocket wheel 126 is fixed to a shaft 127 (Figure 3) suitably journaled in the side frames of the apparatus and, as shown in Figure 1, is geared as at 128 to a shaft 129 at the extreme end of the apparatus which is driven through a series of sprocket chains 129a from the motor 108.

The two sprocket chains of which the main conveyor 22 is formed will be engaged by the two sprocket wheels of double sprocket 126 so that the spindles 25 will be maintained horizontal.

Shaft 127 has the spider 31 fixed thereto alongside the sprocket wheel 126 and the spider 34 is fixed to shaft 127 at the opposite side of sprocket 126. As shown in Figure 1, as a spindle 25 moves adjacent double sprocket 126, the can C carried by the supporting head 24 of that spindle will move into a pocket of spider 31 and rotation of the spider with shaft 127 will move the can upwardly as shown in Figure 3. Just before moving upwardly about the spider 31, the side wall of each can will contact with a pair of guide strips 130 (Figs. 2 and 3) which will force the can to lie in a horizontal plane.

A lateral guide bar 135 is positioned adjacent the guide bars 130, guide bar 135 being inclined outwardly toward the plane of the spider 31, so

that as the cone top wall of a can comes in contact therewith the mouth of the can will be moved out of engagement with the can supporting head 24 and the can will merely be supported in the pockets of spider 31 by the bottom guide strips 130.

As illustrated in Figure 3, the pockets of the spider 31 are aligned with grooves or pockets 131 in the transfer drum 32 and a pair of spaced helical guide bars 132 (Figure 1) surround the periphery of transfer drum 32, the infeed ends 133 of the bars 132 projecting between the discs 134 of which the sprocket 31 is formed, with the extreme lower ends of the infeed portion 133 of the guide bars positioned substantially directly between the axes of the spider 31 and transfer drum 32 and between the two discs of which spider 31 is formed.

By the above arrangement, each can will be freed from its supporting head 24 immediately after it comes in contact with the lower guide 130 and lateral guide 135 and the cans will then be moved up the lower guide 130, free of the conveyor 22, by engagement of the pockets of the spider 31 with the side walls of the cans. Just after the can thus carried by the spider 31 comes into engagement with one of the pockets or grooves 131 of transfer drum 32 fixed to shaft 129, the opposite portion of the can will also come into contact with the infeed end 133 of the helical guide bars 132, so that the can will now be completely stripped from the spider 31 and will move upwardly with the transfer drum 32.

A pipe 140 of helical form (Figure 1) also encircles the periphery of transfer drum 32, this pipe being positioned somewhat to the side of the helical guide bars 132 nearest the plane of spider 32, and between these guide bars and the periphery of the transfer drum (Figure 5). Pipe 140 has apertures therein on its surface facing along the grooves 131 and the pipe is supplied with compressed air from a suitable source through a line 141. The guide bar 35a, also of generally helical form, is positioned on the side of the guide bars 132 opposite pipe 140, and between guide bar 132 and the periphery of the transfer drum. The guide bars 132 and 35a and the pipe 140 are suitably supported by brackets adjacent the drum 32 as illustrated in Figure 5.

By the above construction of guide elements about the transfer drum 32, as soon as a can is completely freed from the spider 31, it will be forced upwardly as viewed in Figure 1 by the jets of compressed air issuing from the pipe 140. Such movement of the can along the grooves 131 will cause the can to be moved out of the vertical plane of the spider 31 and into the plane of spider 34. It will be observed that the provision of the helical guide bar 35a opposite the compressed air pipe 140 will cause cans to be moved along the grooves 131 of the transfer drum by a continuous and gradual movement. That is to say, there can be no sudden movement of the cans along the grooves such as might cause the mouths of the cans to be dented.

Each can will remain upon the transfer drum 32 during one full revolution of the same, and, as best indicated in Figure 1, at the time that this one revolution is completed, the mouth of the can will project from the far edge of the drum and will partly lie in the spider or disc 33. In other words, as indicated in Figure 1, each can enters the drum 32 directly in the plane of the spider 31 but, because it moves in a helical path, leaves the drum in the plane of spider 34,

somewhat as indicated at A in Figure 1. At this moment, also, the can will ride beneath an arcuate guide bar 145 (Figure 3) which overlies the can receiving spider 34 and the can will be stripped from drum 32 and placed in an aligned pocket of spider 34. As shown in Figures 1 and 2, the substantially helical guide bar 35a which surrounds transfer drum 32 has its outfeed end 143a extending away from the transfer drum 32 with the extreme end portion thereof return bent toward the spider 34 with the result that as upwardly moving cans are removed from the transfer spider by fixed arcuate guide 145, the cans will simultaneously be moved axially of the spider 34 and into cup-shaped holders 35 provided on the main conveyor 22 and of sufficient diameter to receive the body portion of the can, but of such length that at least the conical top wall of the can will project therefrom.

After a can has been positioned in the cup-shaped carrier or supporting means 35 as illustrated in Figure 1, the movement of the main conveyor 22 toward the drier will bring the projecting cone-shaped portion of the can beneath the spray gun 36, as shown in Figure 1. Gun 36 is supported at such an angle that it will direct lacquer upon the mouth of the can, including the inner wall of such mouth. During movement beneath the spray gun 36, the spindle 25 to which the carrier 35 is secured will be rotated by movement of the endless chain 27 beneath the same and in engagement with the sprocket 26 which is secured to the spindle.

After the spindle has moved out of engagement with the endless chain 27 and from beneath spray gun 36, the can C will be carried into the drier 19, following the same course of travel that it followed when supported upon the supporting head 24. However, as described in said divisional application, during the present movement through the drier, the can will move only through the heated portion of the drier; that is, when the carrier 35 leaves the rear end of the oven, the can will be removed by a suitable can-removing apparatus such as disclosed in said divisional application.

The operation of the entire apparatus has been set forth in the general description and operation of the apparatus at the opening portion of this specification. Figure 1 illustrates how two apparatus of the present invention may be positioned side by side in such a way as to conserve floor space, namely, by having the drier blower and motor of one drier 19 offset with respect to the blower and motor of the other drier, and with these blowers, motors, et cetera, positioned between the two apparatus.

It will be understood that the various mechanisms described as forming part of the present apparatus may be used either together, as described, or as portions of other article handling apparatus.

All structure disclosed but not claimed herein is claimed in said divisional application filed November 12, 1942.

The terminology used in the specification is for the purpose of description, the scope of the invention being indicated in the following claims.

We claim:

1. In combination, a link conveyor; spindles rotatable with respect to the links of said conveyor, means on said spindles to support articles, a pinion on each of said spindles, means to rotate said spindles during movement of said con-

veyor to rotate the articles supported by the spindles, said means comprising a moving chain positioned to engage the pinions on said spindles and moving in the opposite direction from the direction of movement of said link conveyor, and means to coat the articles during their rotation.

2. The combination in a coating mechanism, of a conveyor, a spindle rotatable with respect to said conveyor and extending therethrough, stud means at one end of said spindle to extend into the open end of a container to support the same, cup shaped means at the opposite end of said spindle to enclose a portion of a container to support the same, and means to coat the containers while supported by said two last-named means.

3. The combination in a coating mechanism, of a conveyor, means on said conveyor to support an article by engaging a portion thereof, means on said conveyor to support the article by engaging another portion of the article, coating means in the path of movement with said conveyor of said two last-named means, and means to transfer the article from one of said supporting means to the other of said supporting means.

4. The combination in a container coating mechanism, of an endless conveyor provided with transversely extending elements, one end of each element being of stud form to extend into the open end of a container, the opposite end of each element being of cup-like form to enclose the body portion of a container, means to transfer containers from one end of an element to the opposite end of an element, and coating means in the path of movement with said conveyor of both ends of said elements to coat articles supported at such ends.

5. The combination in a container coating mechanism, of an endless conveyor provided with transversely extending elements, one end of each element being of stud form to extend into the open end of a container, the opposite end of each element being of cup-like form to enclose the body portion of a container, means to transfer containers from one end of an element to the opposite end of an element by axial movement of the articles, and coating means in the path of movement with said conveyor of both ends of said elements to coat articles supported at such ends.

6. In combination, a link conveyor, transverse spindles rotatable in the links of said conveyor, means on said spindles to support articles, a pinion on each of said spindles, means to rotate said spindles during movement of said conveyor to rotate the articles supported by the spindles, said means comprising a moving chain positioned to engage the pinions on said spindles and moving in the opposite direction from the direction of movement of said link conveyor, means to coat the articles during their rotation, and fixed means to support the spindles during their rotation and to support the spindle engaging portion of said moving chain.

7. The combination in a coating apparatus, of a conveyor means, a plurality of stud type members extending in one direction from said conveyor means, a plurality of cup type supporting members extending in another direction from said conveyor means, said stud type supporting members being adapted to engage the interior of a hollow article to support the same and said cup type supporting members being adapted to have articles positioned therein for support, coating means adjacent the path of movement with the conveyor means of each type of member, and means in the path of travel of said conveyor means to transfer articles from a member of one of said types to a member of the other type.

8. The combination in a coating apparatus, of a conveyor means, a plurality of stud type members extending in one direction from said conveyor means, a plurality of cup type supporting members extending in another direction from said conveyor means, said stud type supporting members being adapted to engage the interior of a hollow article to support the same and said cup type supporting members being adapted to have articles positioned therein for support, coating means adjacent the path of movement with the conveyor means of each type of member, means to position an article in supported position with respect to one type of member, and means in the path of travel of said conveyor means to transfer articles from a member of one of said types to a member of the other type.

9. The combination in a coating apparatus, of an endless conveyor provided with two series of article engaging elements, one series projecting from the conveyor at an angle to the other series, one series of article engaging elements being of such form as to engage the interior of a hollow article, the other series of article engaging elements being of a form to engage the exterior of an article, means to transfer articles from the elements of one series to the elements of the other series, and coating means in the path of movement with the conveyor of each series of elements to coat articles supported by the elements.

10. The combination in a container coating mechanism, of a conveyor, a plurality of transversely extending spindles carried by and rotatable with respect to said conveyor, a stud element at one end of each spindle to extend into the open end of a container to support the same, a cup-shaped element at the opposite end of each spindle to enclose a portion of a container to support the same, means to transfer containers from the elements at one end of the spindles to the elements at the opposite ends of the spindles, and means in the path of movement with said conveyor of both ends of the spindles to coat containers supported by such ends.

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