United States Patent

[11] 3,563,170

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[73] Assignee **Reynolds Metals Company**
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Continuation-in-part of application Ser. No. 601,135, Dec. 12, 1966, now Patent No. 3,496,863

[54] **MACHINE FOR MARKING THE EXTERIOR CYLINDRICAL SURFACES OF CANS IN A CONTINUOUS NONINDEXING MANNER**
19 Claims, 28 Drawing Figs.

[52] **U.S. Cl.** **101/40,** 198/22, 198/25, 214/1, 118/230
[51] **Int. Cl.** **B41f 17/22,** B65g 47/52
[50] **Field of Search** ..... 101/38-—40, 35; 118/46, 230, 500; 198/22, 25, 179, 210; 214/1B1, 1BS; 193/32—34

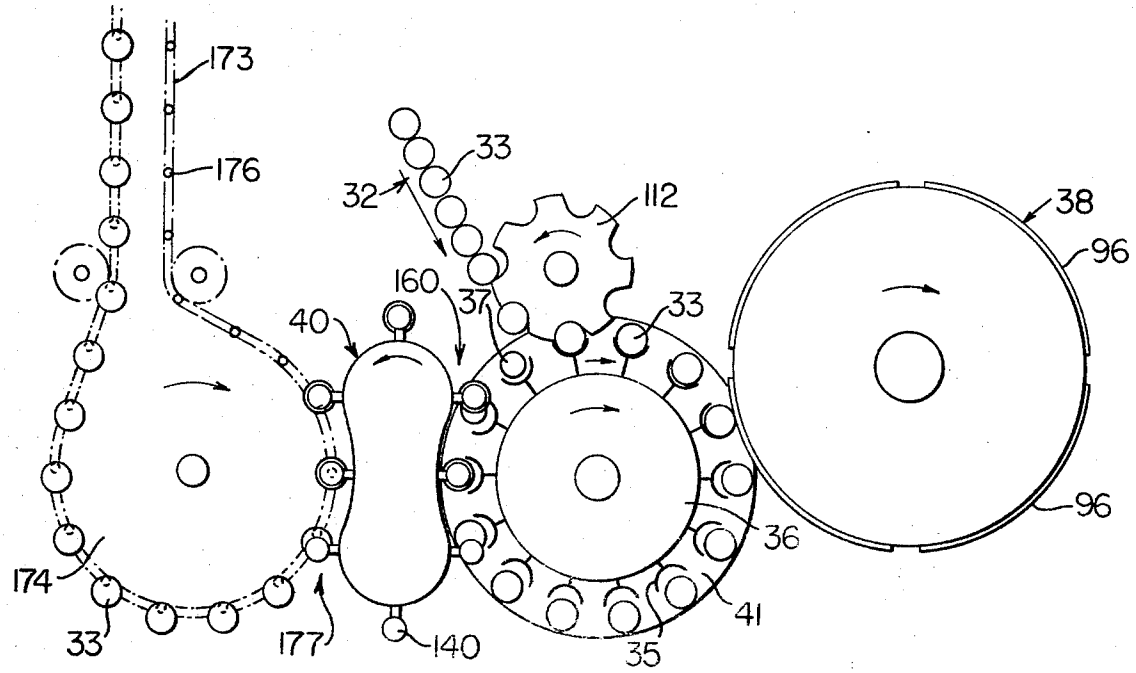
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Primary Examiner—Robert E. Pulfrey
Assistant Examiner—Clifford D. Crowder
Attorney—Glenn, Palmer, Lyne, Gibbs & Thompson

ABSTRACT: A machine for continuously marking the exterior surfaces of cylindrical containers having a continuously rotatable nonindexing cradle-supporting wheel which carries a plurality of cradles about its outer periphery with each of the cradles adapted to receive an associated container from a precision infeed device. The infeed device uses a star wheel to assure rapid and positive placement of each container on an associated cradle in a stable manner. The machine also has a simple pickoff apparatus comprised of a fixed track which supports a plurality of vacuum devices for movement thereon and the vacuum devices operate to move the cans away from the machine after they have been printed without decreasing the operating speed of the machine.



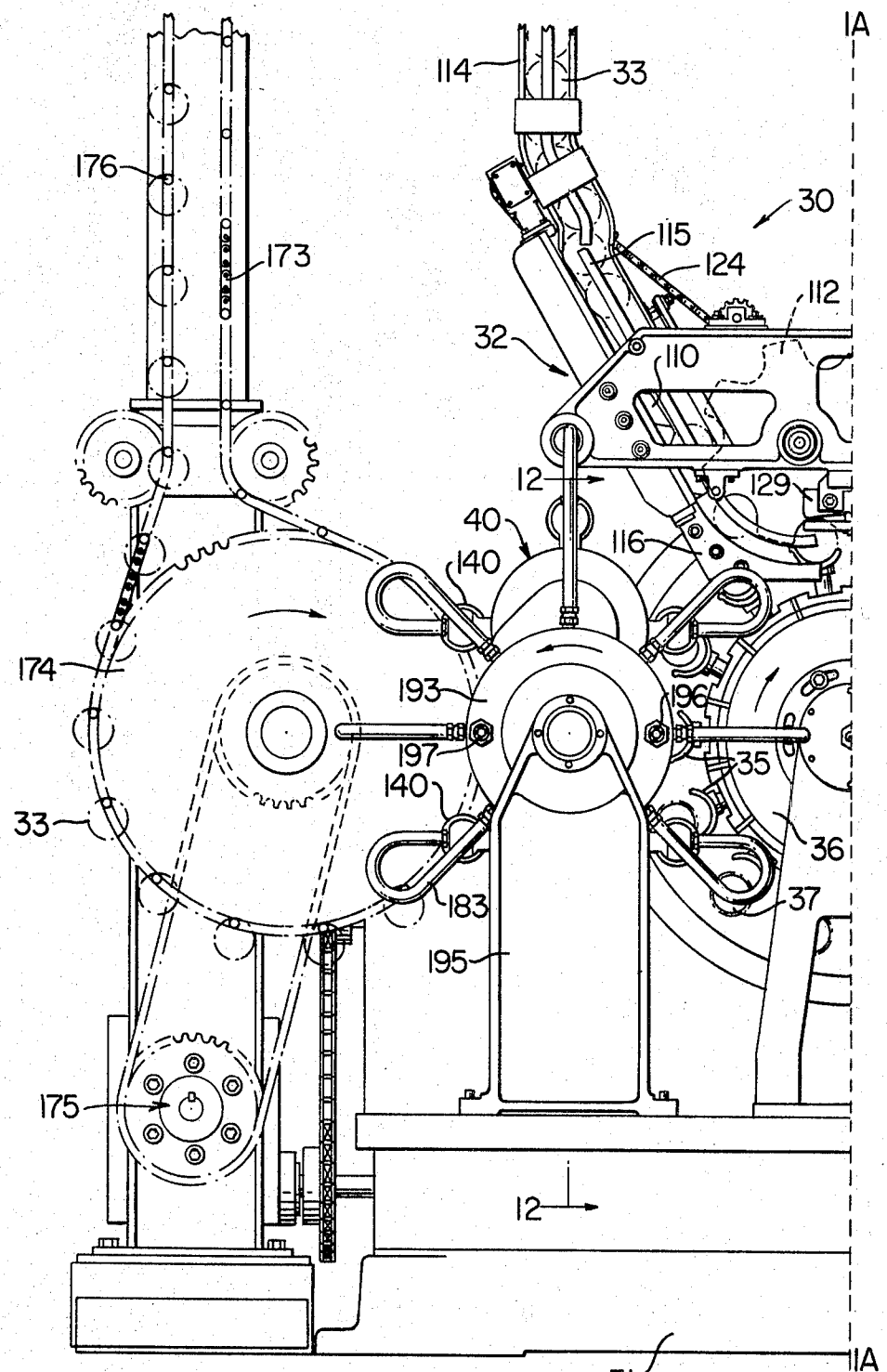


FIG. 1A

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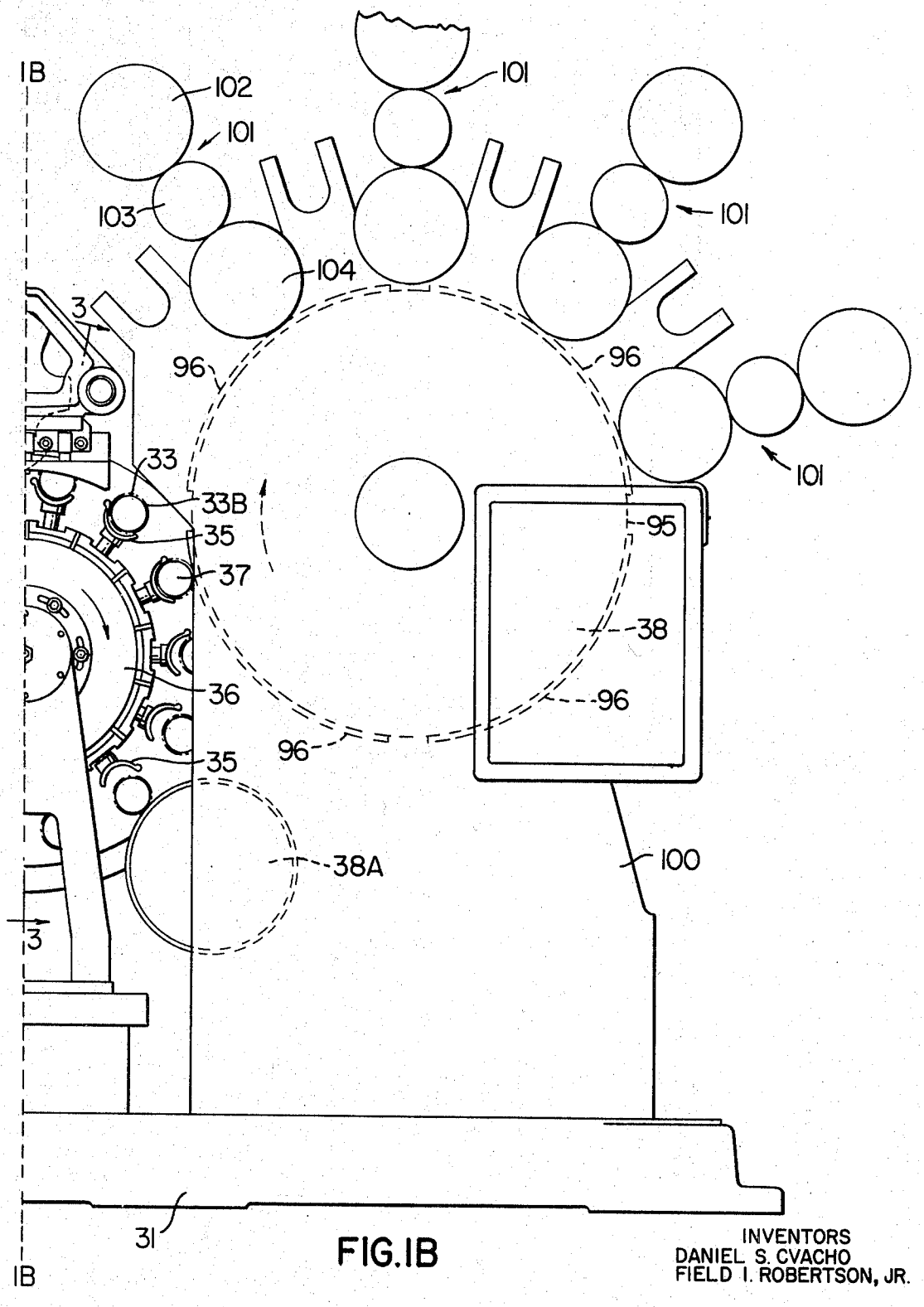


FIG.1B

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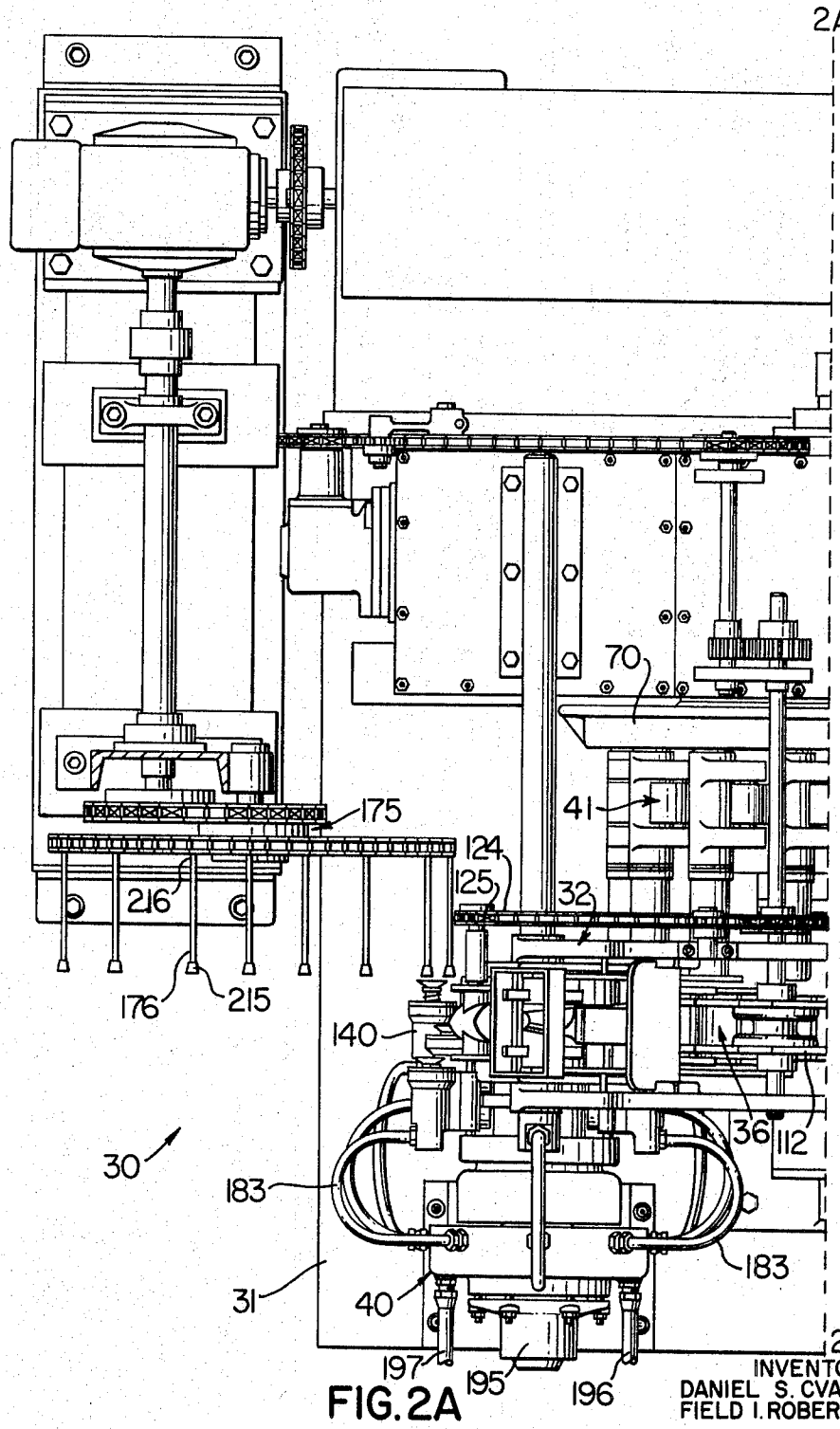


FIG. 2A

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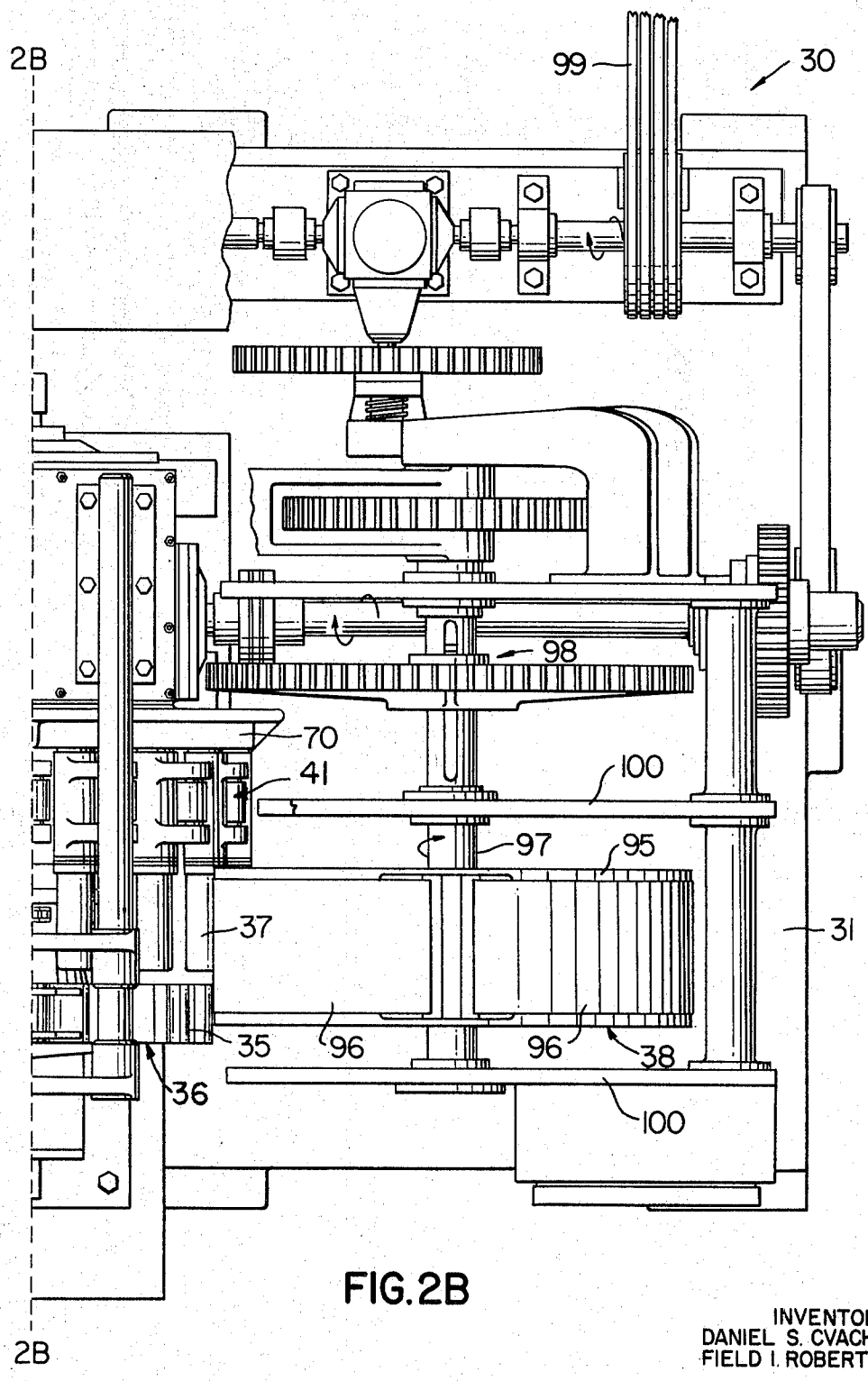


FIG. 2B

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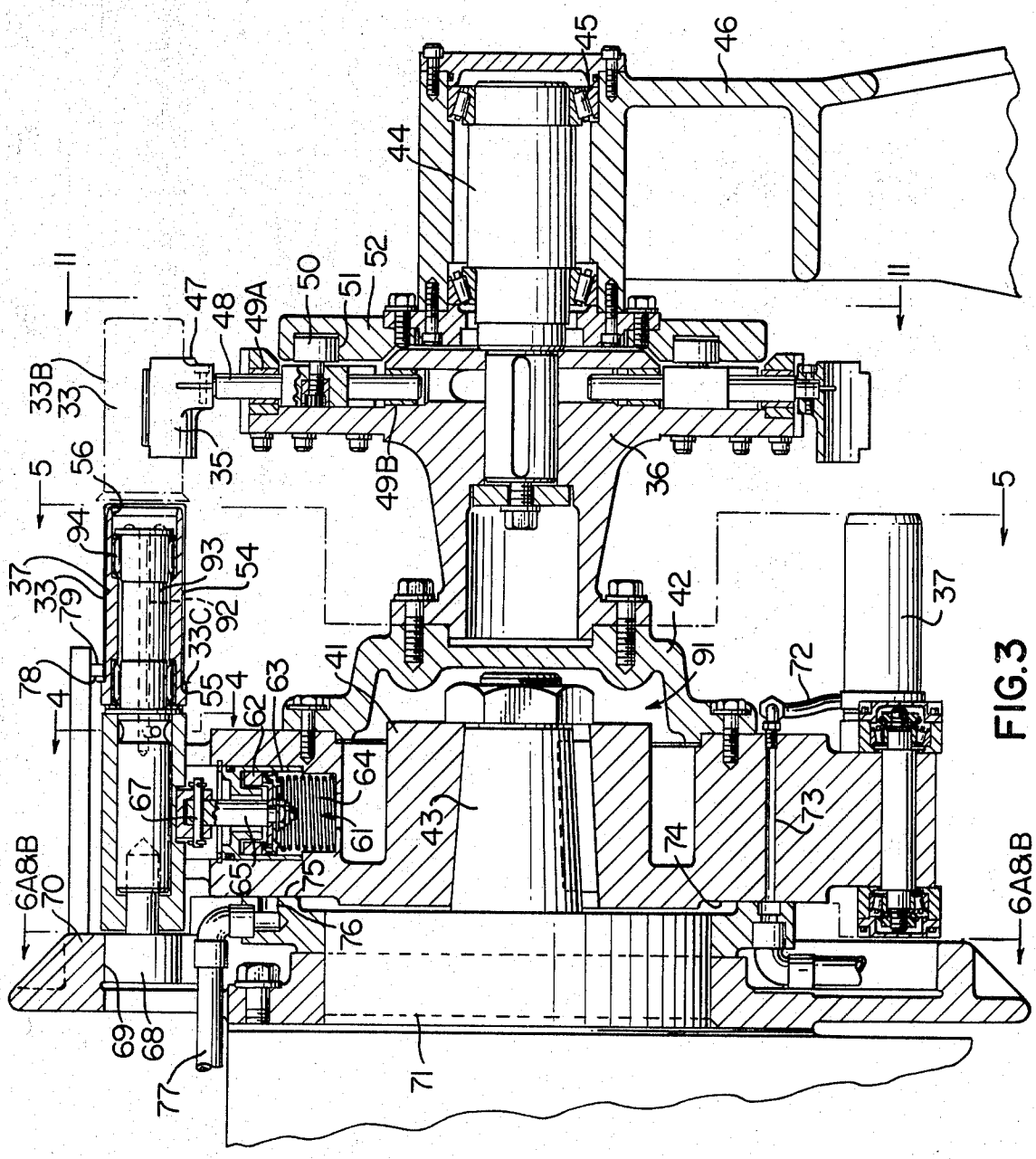


FIG.3

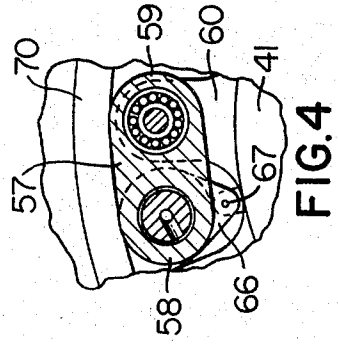


FIG.4

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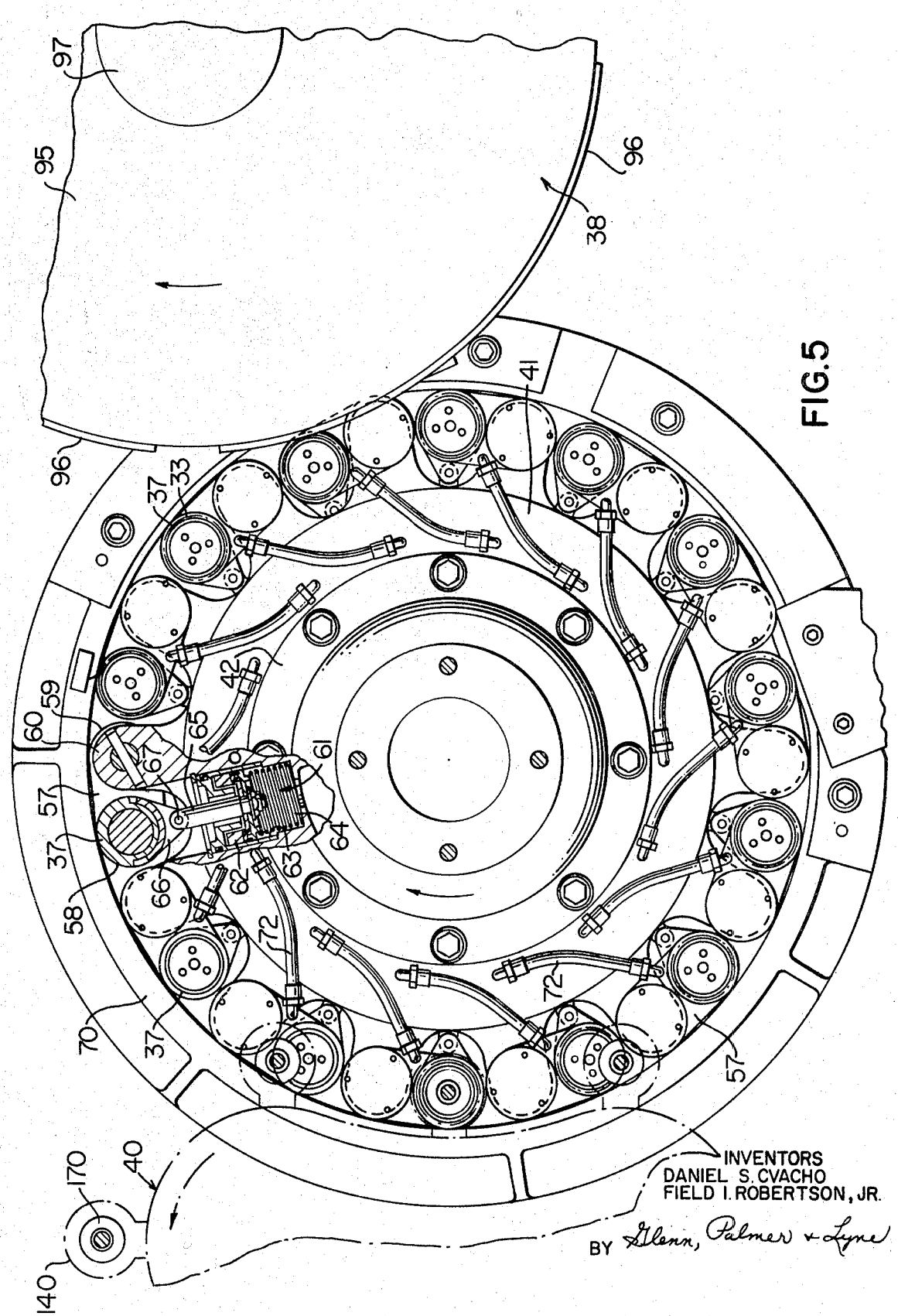


FIG.5

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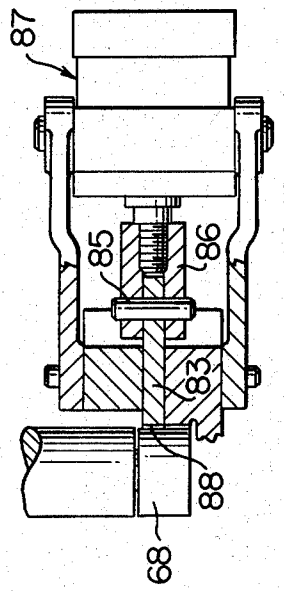


FIG.7

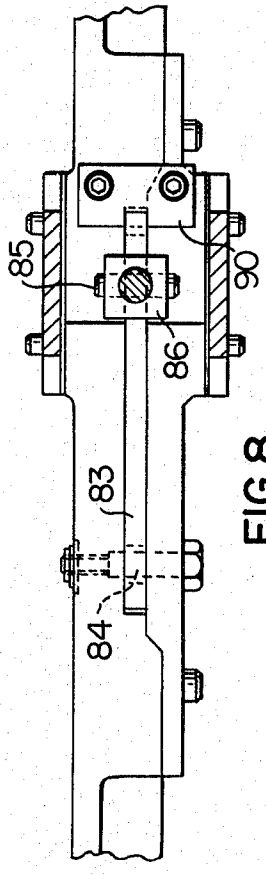


FIG.8

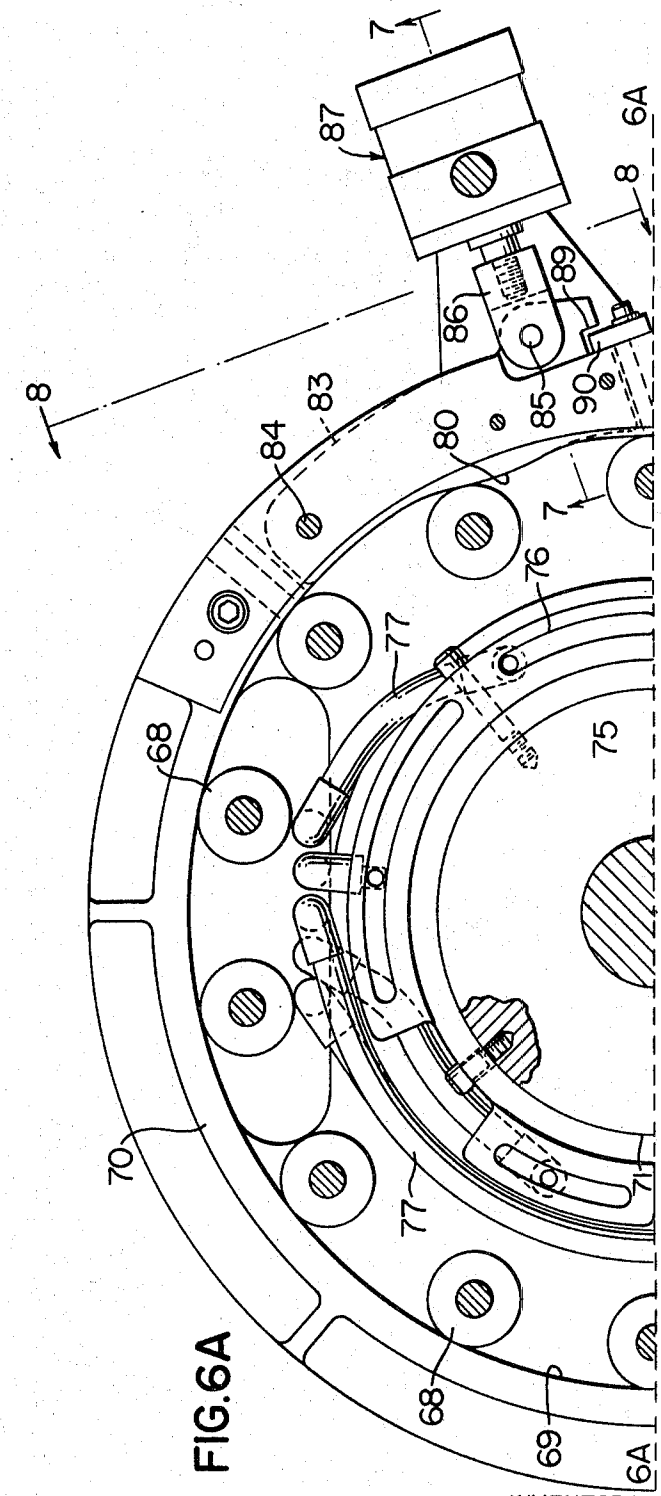


FIG.6A

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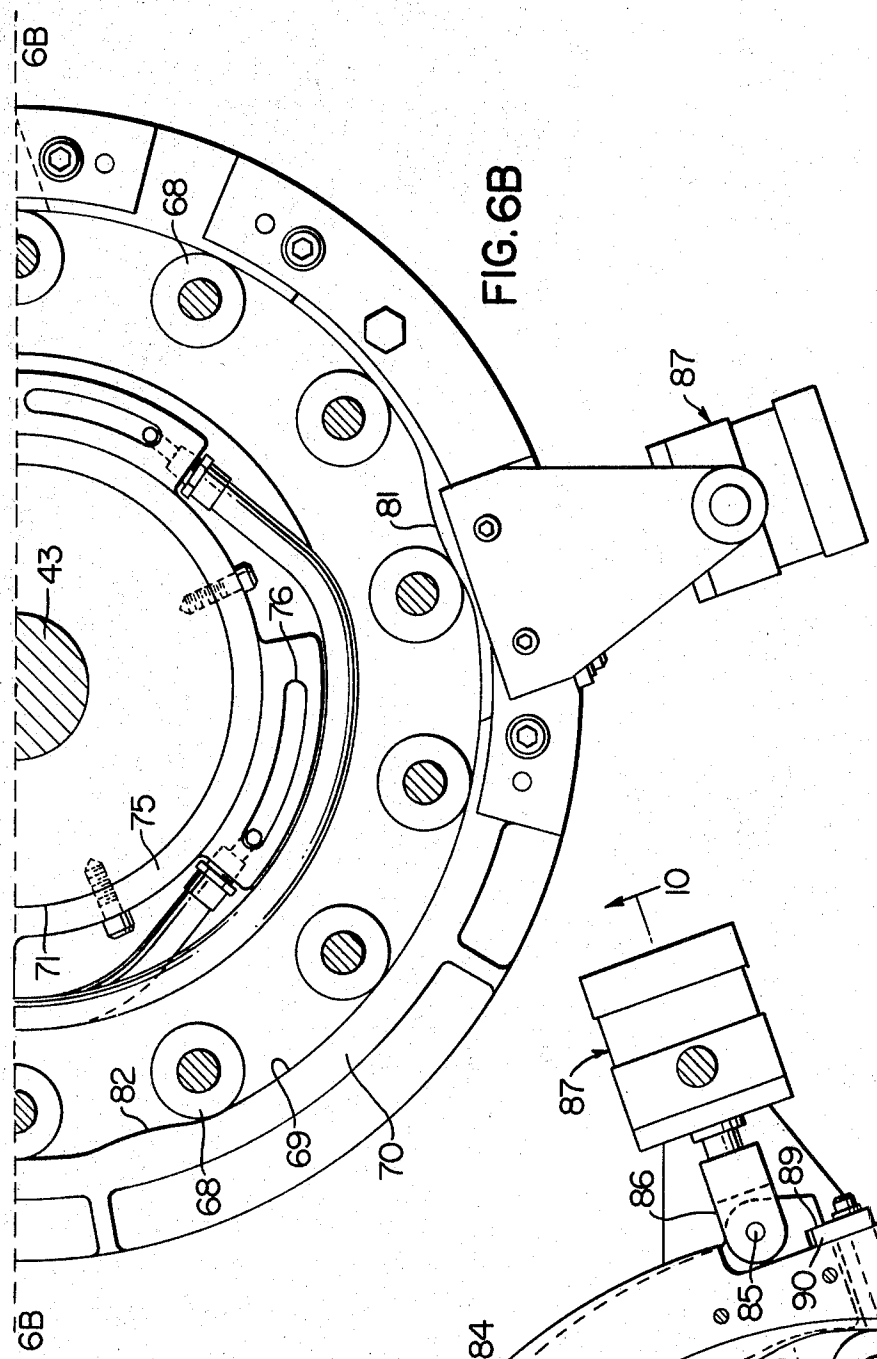


FIG.6B

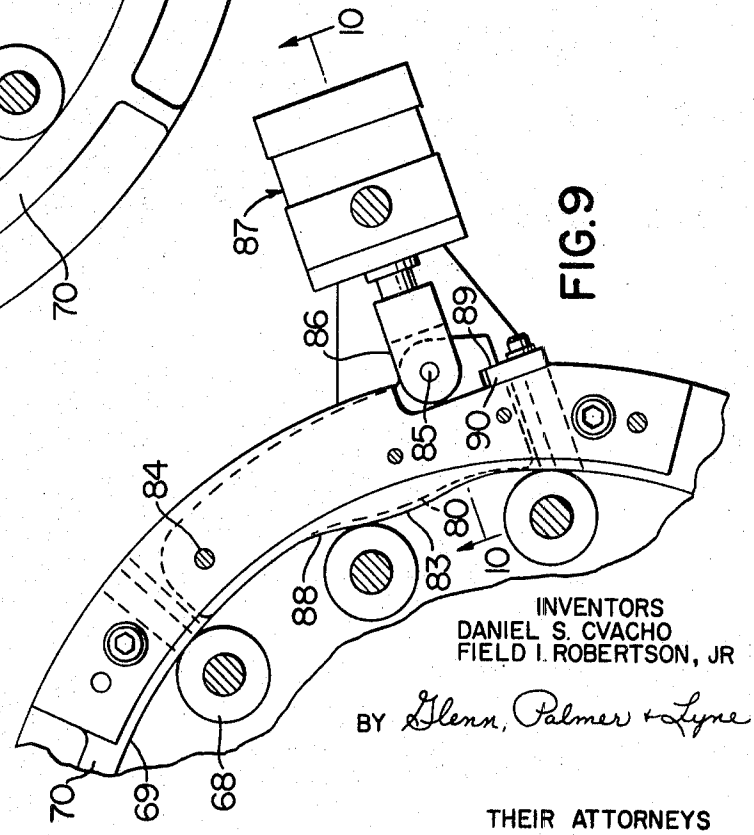


FIG.9

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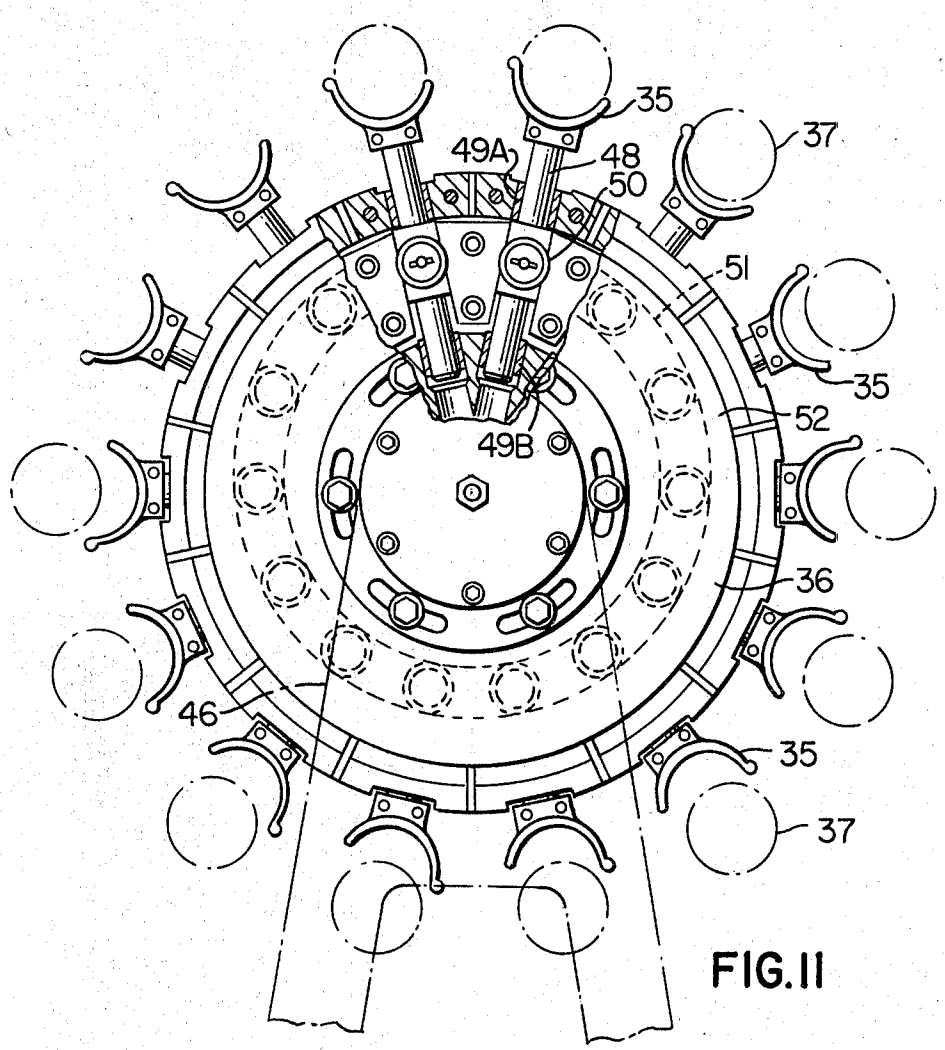


FIG.11

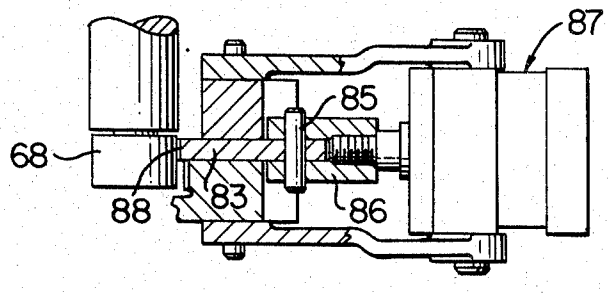


FIG.10

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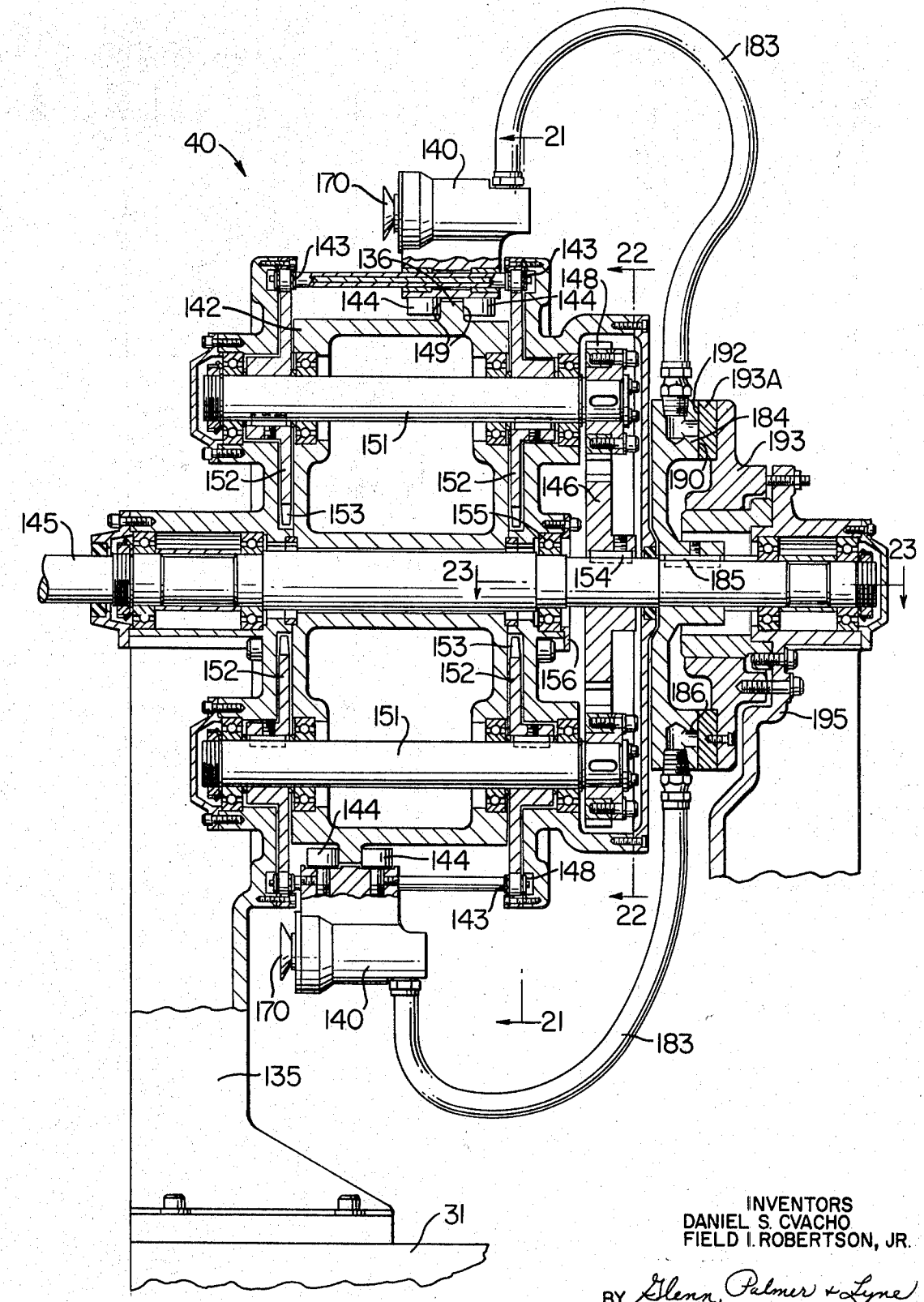


FIG.12

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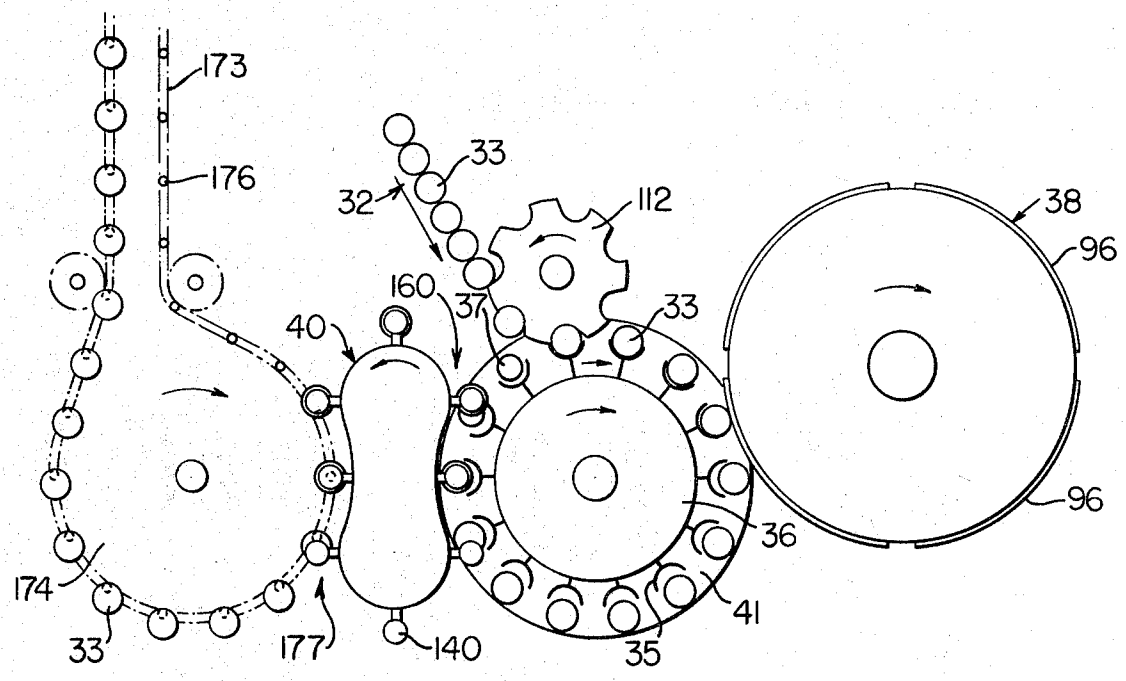


FIG. 13

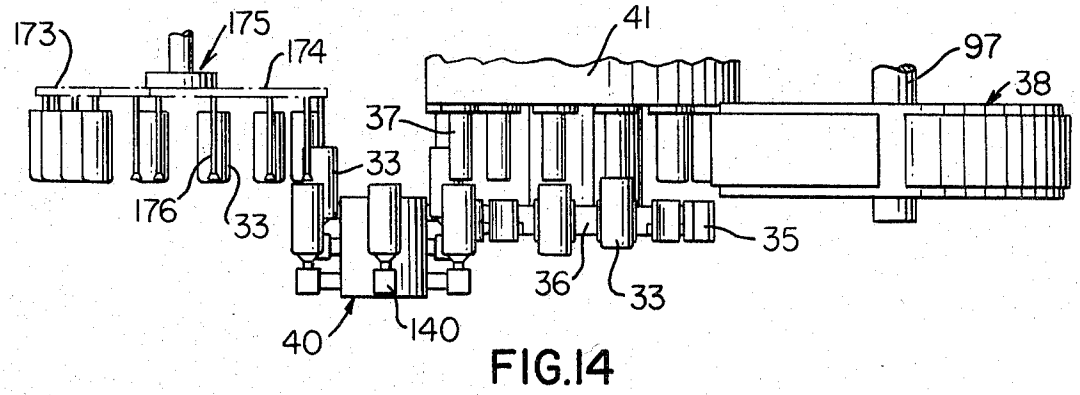


FIG. 14

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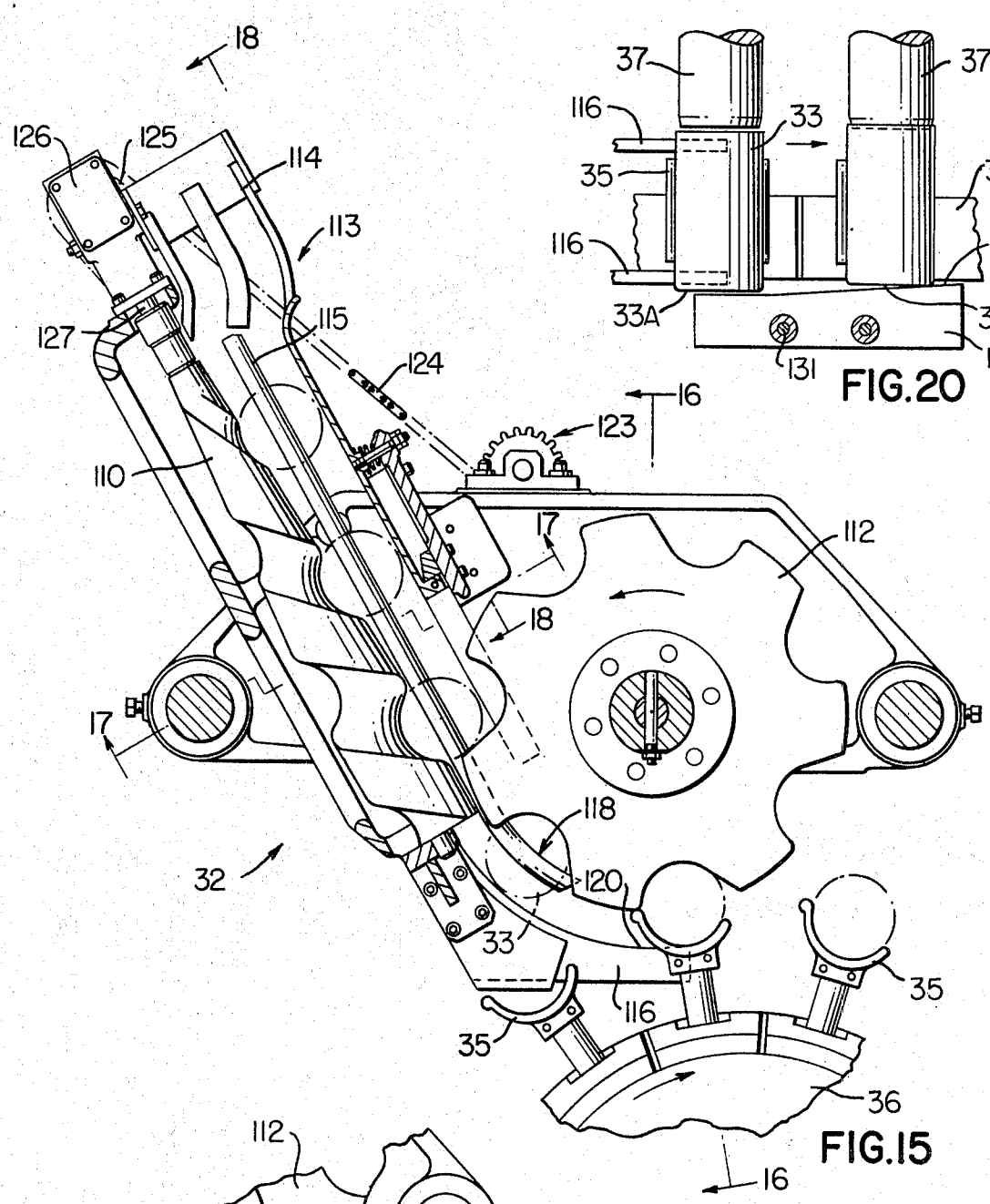


FIG.15

FIG.20

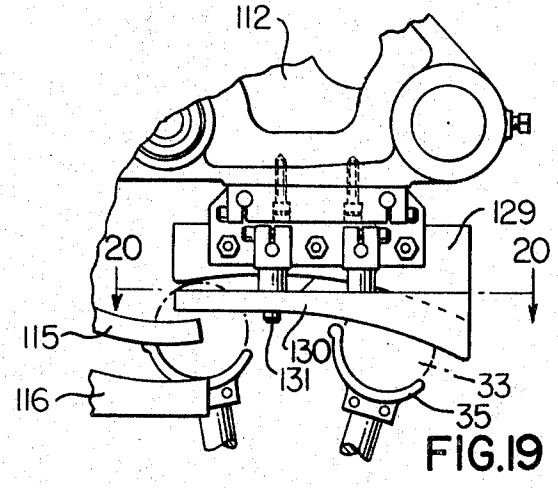


FIG.19

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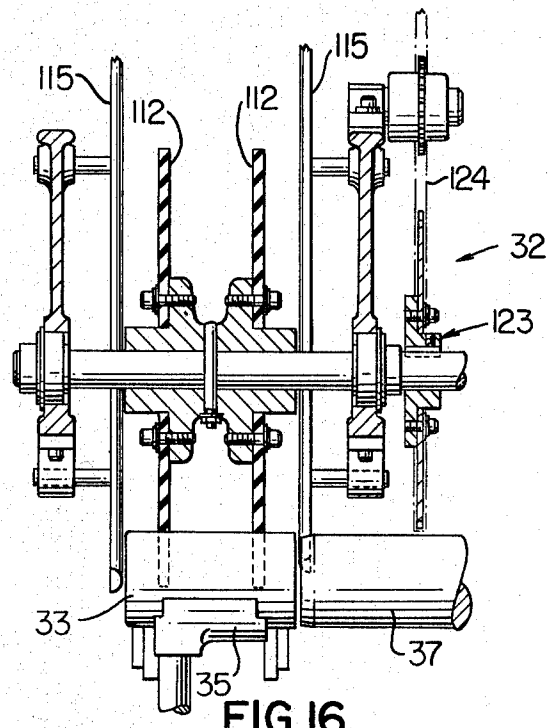


FIG.16

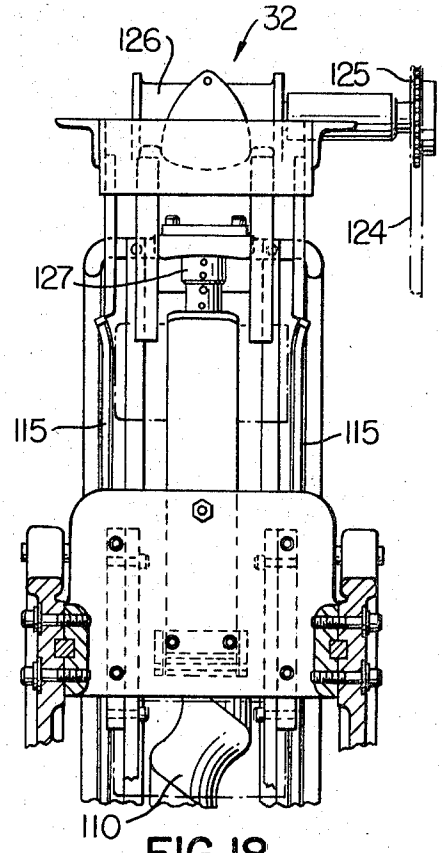


FIG.18

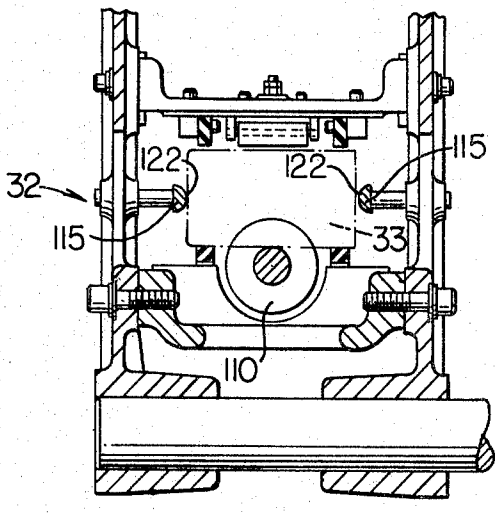


FIG.17

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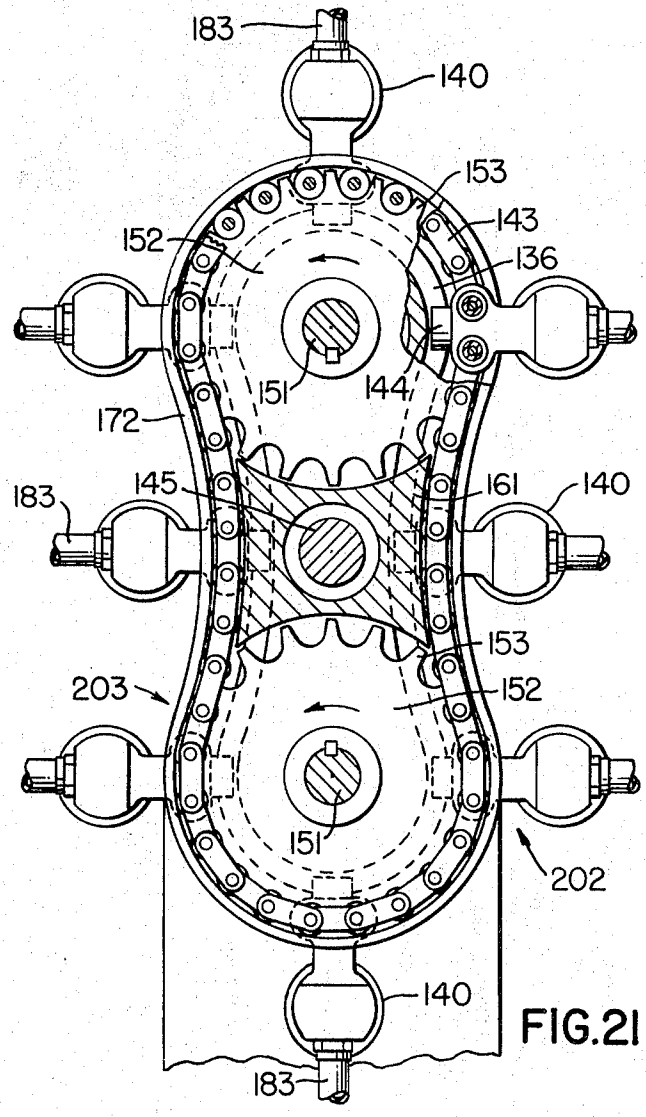


FIG.21

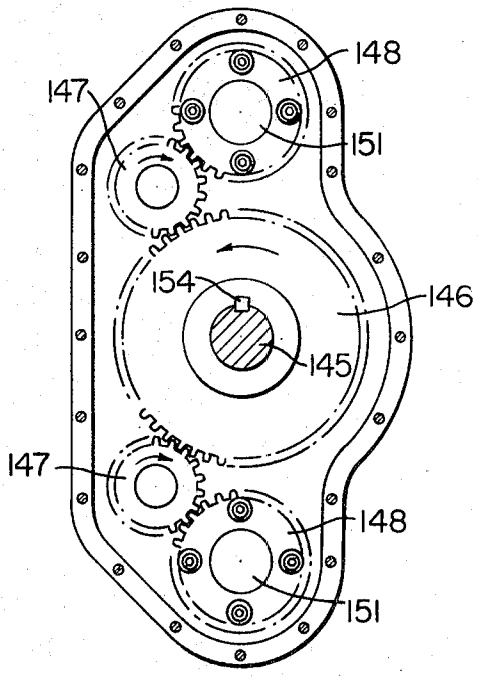


FIG.22

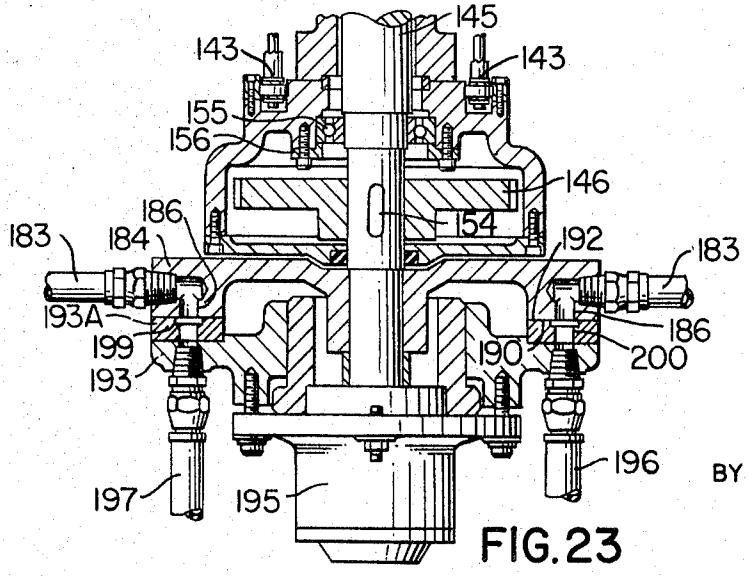


FIG.23

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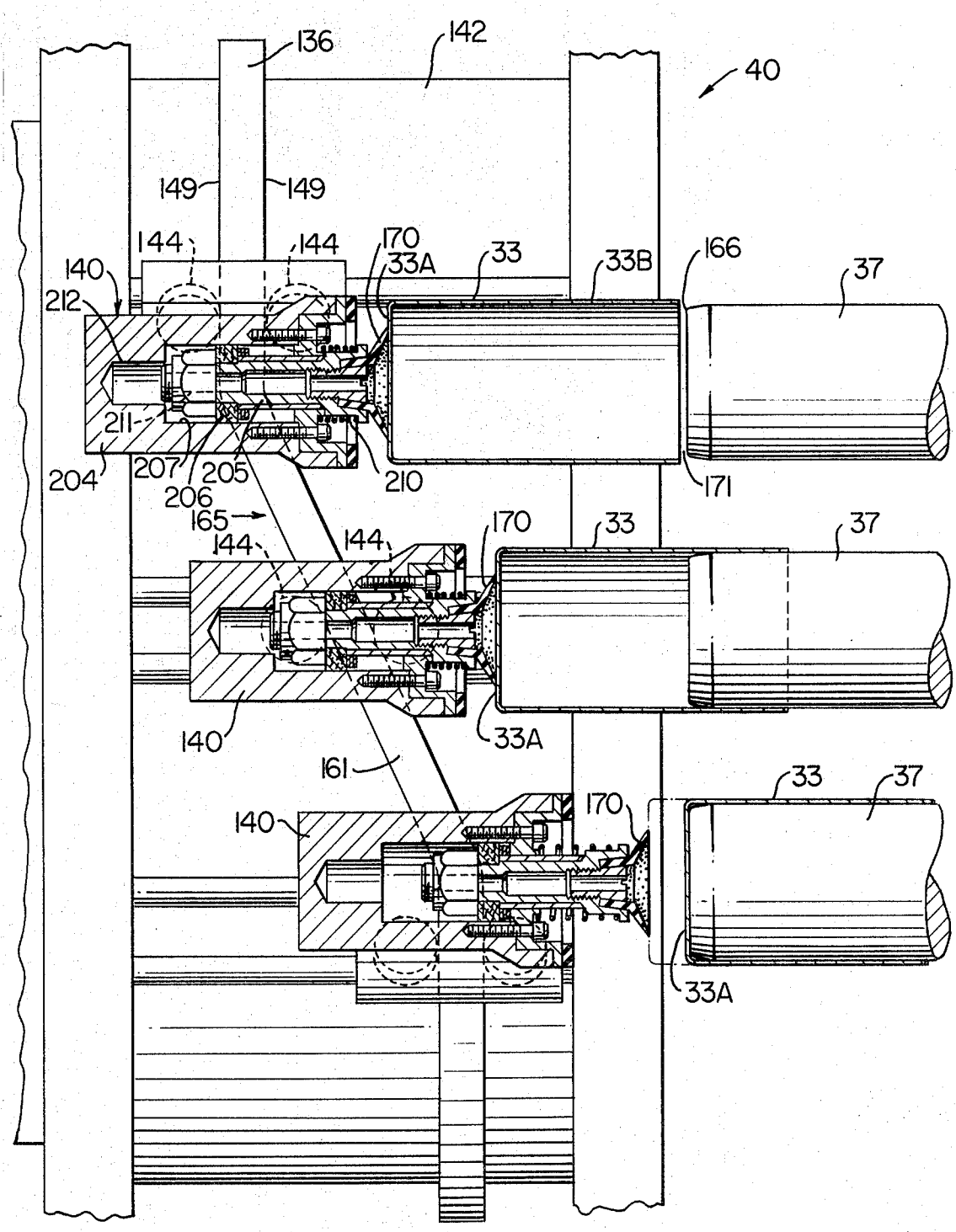


FIG. 24

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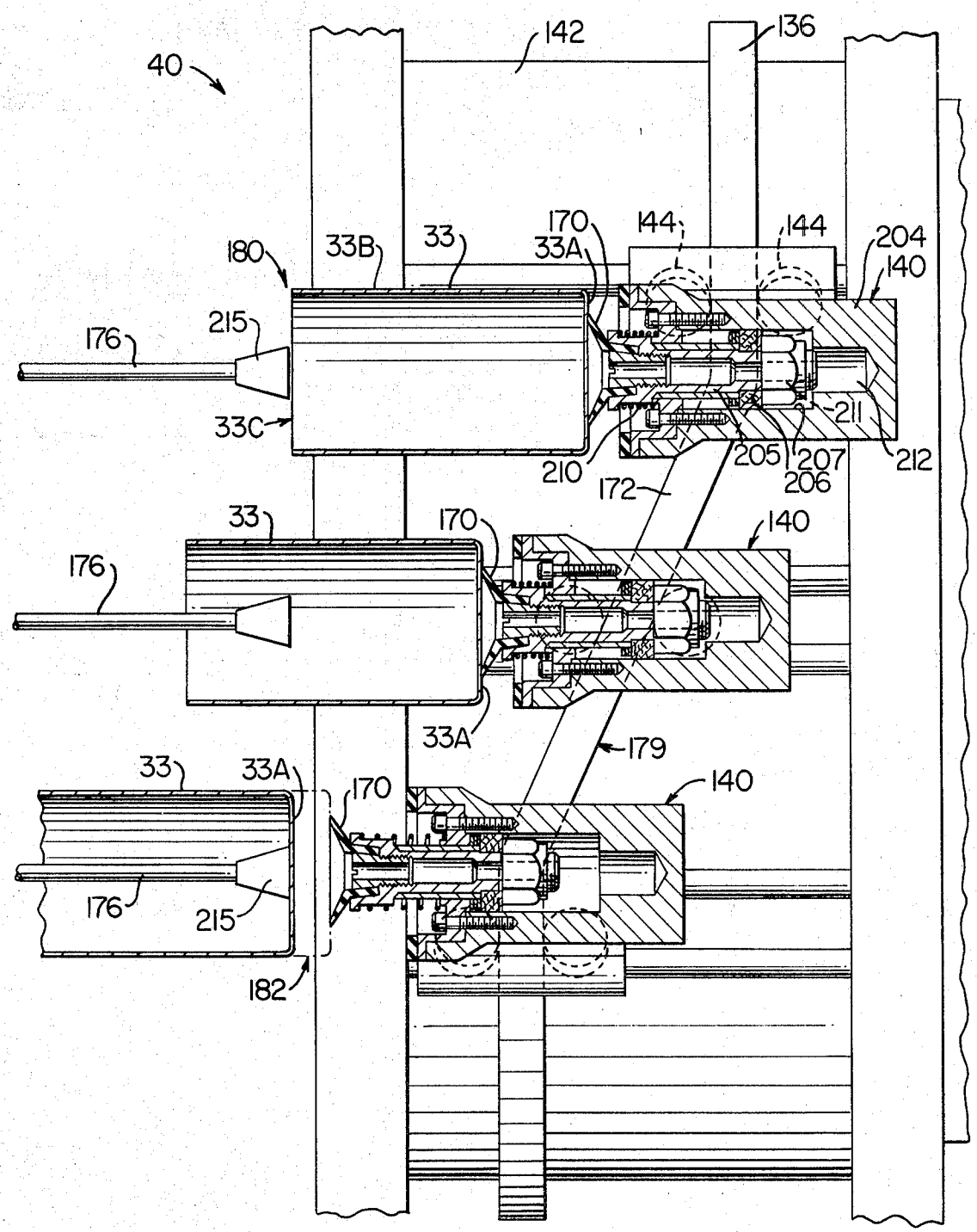


FIG.25

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MACHINE FOR MARKING THE EXTERIOR CYLINDRICAL SURFACES OF CANS IN A CONTINUOUS NONINDEXING MANNER

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation in part of application Ser. No. 601,135, filed Dec. 12, 1966 which is now issued as U.S. Pat. No. 3,496,863.

BACKGROUND OF THE INVENTION

Various machines have been proposed in the past, including in the above referenced application, for continuously printing the outer cylindrical surfaces of can bodies. Although it has been shown that such cylindrical surfaces can be printed at high speeds, each of the present machines is deficient in its capability to infeed cans to be printed in a positive and high speed manner and further each of the present machines is deficient in its capability to rapidly and efficiently move the printed cans away from the machine.

SUMMARY

This invention provides an improved machine for marking, as by printing, cylindrical containers which has an infeed which introduces such containers to the machine in a high speed and positive manner and which has a pickoff apparatus for moving the containers away from the machine in an efficient and rapid manner.

Other details, uses and advantages of this invention will become apparent as the following description of the embodiments thereof presented in the accompanying drawings proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings show present preferred embodiments of this invention, in which:

FIGS. 1A and 1B illustrate an exemplary can printing machine having the improved can infeed and pickoff apparatus of this invention upon aligning FIGS. 1A and 1B along their respective break lines 1A–1A and 1B–B;

FIGS. 2A and 2B illustrate a plan view of the can printing machine of FIGS. 1A and 1B upon aligning FIGS. 2A and 2B along their respective break lines 2A–2A and 2B–2B;

FIG. 3 is an enlarged, fragmentary cross-sectional view taken on the line 3–3 of FIG. 3;

FIG. 4 is a fragmentary cross-sectional view taken on the line 4–4 of FIG. 3;

FIG. 5 is an enlarged, fragmentary, cross-sectional view taken on line 5–5 of FIG. 3;

FIGS. 6A and 6B illustrate a view taken on line 6A & B–6A & B of FIG. 3 upon aligning FIGS. 6A and 6B along their respective break lines 6A–6A and 6B–6B;

FIG. 7 is a cross-sectional view taken on line 7–7 of FIG. 6A;

FIG. 8 is a fragmentary cross-sectional view taken on line 8–8 of FIG. 6A;

FIG. 9 is a fragmentary view illustrating the cam of FIG. 6A in another operating position;

FIG. 10 is a cross-sectional view taken on line 10–10 of FIG. 9 and illustrates the cam in a manner similar to the illustration of FIG. 7;

FIG. 11 is a view with a parts in section and parts broken away taken substantially on the line 11–11 of FIG. 3;

FIG. 12 is an enlarged cross-sectional view taken on line 12–12 of FIG. 1A;

FIG. 13 is a schematic view in elevation particularly illustrating the machine of FIGS. 1A and 1B together with its infeed and pickoff apparatus;

FIG. 14 is a schematic view looking normally downwardly toward the machine and its associated infeed and pickoff apparatus as illustrated in FIG. 13;

FIG. 15 is an enlarged view with parts in section and parts broken away particularly illustrating the relative position of a screw conveyor and infeed starwheel comprising the improved infeed of this invention;

FIG. 16 is a view with parts in section and parts broken away essentially on the line 16–16 of FIG. 15;

FIG. 17 is a view with parts in section and parts broken away essentially on the line 17–17 of FIG. 15;

FIG. 18 is a view with parts in section and parts broken away essentially on the line 18–18 of FIG. 15;

FIG. 19 is a fragmentary view particularly illustrating a pair of cradles carried on the cradle-supporting wheel moving into position to receive cans from the infeed;

FIG. 20 is a fragmentary view essentially on the line 20–20 of FIG. 19;

FIG. 21 is a view with parts in section and parts broken away on the line 21–21 of FIG. 12;

FIG. 22 is a view essentially on the line 22–22 of FIG. 12;

FIG. 23 is a fragmentary view with parts in section and parts broken away essentially on the line 23–23 of FIG. 12;

FIG. 24 is a greatly enlarged view with parts in section and parts broken away particularly illustrating the manner in which each vacuum device comprising the pickoff apparatus of this invention moves along an associated track immediately adjacent cans being carried on mandrels carried on the mandrel-supporting wheel of the machine of FIGS. 1A and 1B and particularly illustrating one of the vacuum devices at three successive positions along its track to highlight the manner in which an associated can is removed from its mandrel; and

FIG. 25 is a view similar to FIG. 24 and illustrates a vacuum device at three successive positions and highlighting the manner in which each vacuum device positively deposits its can on an associated can supporting pin to move the can away from the machine.

DESCRIPTION OF ILLUSTRATED EMBODIMENT

Reference is now made to FIGS. 1A and 1B and FIGS. 2A and 2B of the drawings wherein an exemplary machine designated generally by the reference numeral 30, is illustrated and is adapted to apply marking means in a predetermined pattern on the exterior surface of containers, such as cylindrical cans, for example. The machine 30 is capable of applying marking means such as an ink coating on selected surface portions of each can, or on the entire cylindrical surface of each at speeds in excess of 650 cans per minute and has both an improved can infeed and a can pickoff apparatus which are capable of moving the cans to and away from the machine to assure marking at this high rate of speed.

The use of the term "marking means" or the term "-marking" used in this specification includes within its scope the application of any suitable material against an associated container means or can including the application of ink, paint, an a protective coating, a separate label such as paper, and the like. Further, the term marking means also includes within its scope the embossing or other similar surface treatment of a can which may be accomplished in a high speed operation similar to the exemplary ink printing operation which is described in this specification.

The machine 30 has a main supporting frame 31 a portion of which supports an improved infeed which is designated generally by the reference numeral 32 and which will be described in detail later in this specification. The infeed 32 carries and serially places a plurality of containers such as metal cans on associated substantially semicylindrical cradles 35 which are carried about the periphery of a rotatable wheel 36 comprising the machine 30. Each cradle 35 receives an associated can 33 from the infeed 32 and carries such can in a clockwise direction as viewed in FIGS. 1A and 1B so that it may be aligned with a particular mandrel 37 being orbited behind the wheel 36.

Each can 33 is transferred from its associated car cradle 35 and telescoped over a cooperating mandrel 37 which is

orbited adjacent thereto in a clockwise direction. As the particular can carrying mandrel 37 is moving in a clockwise direction, an ink applicator 38 carried by the frame 31 applies printing ink directly on the outer cylindrical surface of the can 33 during simultaneous movement of both the can carrying mandrel 37 and ink applicator 38 to permit a high speed operation without smearing or distortion of the ink being applied on the can 33.

Each can carrying mandrel 37 is orbited away from the ink applicator 38 in a clockwise direction and each can 33 may have additional means such as a protective coating, for example, applied thereon by another applicator which will be designated generally by the reference numeral 38A. At a circumferential position which is downstream of the applicator 38A, each can 33 is removed by one exemplary embodiment of a can pickoff apparatus of this invention which is designated generally by the reference numeral 40 and such pickoff apparatus will be described in detail later in this specification. The pickoff apparatus 40 deposits each printed can on an associated conveyor which carries the cans away for further processing such as ink drying, product filling, storing, shipping or other operations as desired.

The exemplary open ended metal cans 33 may be of any suitable known construction and in this disclosure are shown as being made in one piece (see FIGS. 24 and 25) having an integral bottom wall 33A, a seamless right circular cylindrical side wall surface 33B, and an open end 33C which may be flanged outwardly and is adapted to be subsequently closed by fastening an end closure thereon in a known manner. The machine 30 is capable of printing the cylindrical surface 33B of each can at speeds in excess of 650 cans 33 per minute, as previously mentioned, without noticeable distortion in the printed media and with the ink applicator 38 printing one or more colors.

The description will now proceed by first completely describing in general terms the operation of the machine 30 after the cans 33 are received from the improved infeed 32 of this invention and the manner in which ink is applied to each can. With an understanding of this portion of the machine the need to provide a high speed and reliable can infeed as well as a high speed and efficient can pickoff apparatus will be readily apparent whereupon the detailed description of the improved infeed 32 of this invention will be made followed by a detailed description of the can pickoff apparatus 40 of this invention.

THE CRADLES 35 AND ASSOCIATED SUPPORTING STRUCTURE

As illustrated in 1A and 1B of and FIGS. 3 and 11, the wheel 36 is directly connected to a mandrel-carrying wheel 41 by interconnecting hub 42, and the wheel 41 is driven by a shaft 43 so that upon rotating shaft 43 the wheels 41 and 36 rotate in unison.

The wheel 36 is also rotatably supported about a central shaft 44 which is rotatably mounted on antifriction roller bearings 45 carried by an associated portion 46 of the machine frame 31 and it will be seen from FIG. 3 that the wheel 36 rotates about the axis of the shaft 44. Each cradle 35 has a concave substantially semicylindrical recess 47 which holds and supports the cylindrical side wall 33B of its associated can 33. Each cradle 35 is carried on a cylindrical rod 48 supported for radial telescoping movement in a pair of spaced apart axially aligned sleeve bearings 49A and 49B to enable radial inward and outward movement of each rod 48 and its associated cradle 35 relative to the supporting wheel 36 while still being orbited by the wheel 36 in a manner to be described hereinafter.

Each rod 48 which supports each cradle 35 has a cam follower 50 fastened transverse thereto which is received in a annular cam groove 51 formed in an outwardly directed section 52 of the frame portion 46 and the cam groove 51 is eccentrically arranged relative to the longitudinal axis of the shaft 44. As the wheel 36 is rotating about the axis of its shaft 44 by rotation of the wheel 41, each cradle 35 has its radial position precisely controlled by the configuration of the cam groove 51. As a particular cradle 35 approaches the discharge end of the can infeed 32 an associated can 33 is deposited thereon and as seen in FIG. 11 will support and carry such can 33 in a clockwise direction with the cam groove 51 properly positioning the cradle 35 so that its associated can 33 will be properly axially aligned with an associated mandrel 37 whereupon the can will be axially moved from its cradle 35 and telescoped over its associated mandrel 37 as will be described hereinafter.

Immediately after a particular can 33 has been transferred onto its mandrel 37, the cam b groove 51 causes the associated cradle 35 to be moved radially inwardly out of alignment with the associated mandrel 37 as seen in FIG. 11. Thus, should the can 33 not be fully telescoped on its mandrel, a high pressure air jet is used to blow the can 33 away from wheel 41 and the blowoff of such can is not impeded by the cradle 35 on which the can 33 was previously carried.

From the above description it is seen that the cradles 35 are continuously rotated in position so that each cradle 35 receives a can 33 from the infeed 32. The cradles 35 then move the cans 33 in position for transfer onto associated mandrels 37 and as will now be described.

THE MANDRELS 37

As illustrated particularly in FIGS. 3—5, 6A, and 6B, each mandrel 37 has a cylindrical outer surface 54 over which an associated can 33 has its open end telescoped until the flanged end 33C of the can 33 abuts a shoulder 55 of a an associated mandrel 37 to properly position the can 33. The terminal outer end 56 of each mandrel 37 is open and is adapted to be interconnected to a vacuum source so that once a mandrel 37 is properly aligned with a particular cradle 35, the open end 56 of the mandrel 37 is interconnected to the vacuum source and to pull the can 33 from the position shown by dotted lines in FIG. 3 until such can is telescoped over its associated mandrel 37 as shown by solid lines.

Each mandrel 37 is pivotally mounted to the wheel 41 by a link 57 having one end 58 pivotally mounted to the mandrel 37 and the other end 59 pivotally mounted to a stationary and radially extending part 60 of the wheel 41, see FIGS. 4 and 5. Each mandrel 37 is normally pivoted radially outwardly by an associated actuator 61. Each actuator 61 includes a piston 62 slidably disposed in a radial bore 63 provided in the wheel 41 and the piston 62 is urged radially outwardly by a compression spring 64. Each piston member 62 carries a piston rod 65 pivotally fastened by a pin 67 to a flange 66 of its associated mandrel 37.

The compression spring 64 of each actuator 61 urges its associated mandrel 37 radially outwardly relative to its supporting wheel 41. In addition, fluid under pressure may also be introduced in the cylinder bore 63 below the piston 62 to aid the spring 64 and more accurately control the force tending to move each mandrel 37 outwardly.

Each mandrel 37 carries a cam follower 68 at the rear end thereof which is adapted to roll against a cam surface 69 formed on a stationary member 70 which rotatably supports the previously described drive shaft 43 on a suitable bearing 71. Each actuator 61 urges its mandrel 37 radially outwardly tending to maintain its cam follower 68 against the cam surface 69 of the stationary member 70 during the entire orbiting movement of the mandrel 37 by rotating the wheel 41.

Each mandrel 37 has a hollow interior fluidly interconnected to a flexible conduit 72 which is in turn placed in fluid communication with an integral passage 73 formed through the wheel 41, see FIG. 3, and passage 73 interrupting a rear face valve surface 74 provided on wheel 41. The face valve surface 74 of the wheel 41 rotatably slides against a cooperating flat face valve surface 75 of the stationary member 70 and the valve surface 75 is interrupted by a plurality of elongated slots 76 which are serially placed into fluid communication with each passage 73 in the wheel 41 as the wheel 41 is rotated.

The various slots 76 in the stationary member 70 can be supplied or fluidly interconnected with a suitable fluid pressure source or vacuum source by a conduit 77, or the like, and as illustrated in FIGS. 3, 6A, and 6B.

As a particular passage 73 of an associated mandrel means 37 is aligned with a slot 76 in the stationary member 70 and the associated mandrel 37 is properly aligned with a cradle 35, the vacuum source can be interconnected to the mandrel 37 to draw the can 33 carried by the cradle 35 onto the mandrel means 37 in the manner illustrated in FIG. 3.

The machine 30 has suitable can detection means, such as a pair of stationary detection electrodes or members 78 and 79, see FIG. 3, which may be carried by the stationary member 70 and positioned relative to a mandrel 37 to contact and associated metal can 33 telescoped thereon to complete an electrical circuit from one member 78 through the metallic container body 33 to the other member 79. Each mandrel 37 is made from an electrical insulating material having a low coefficient of friction to readily permit a can 33 to be telescoped thereon and removed therefrom. If the forward open end 33C of the can 33 is not fully telescoped onto its mandrel 37 an electrical circuit cannot be completed between the members 78 and 79 whereby such circuit will indicate either that a particular can 33 has been jammed on the mandrel 37 so as not to be properly positioned or that the mandrel 37 did not receive a can 33 from its associated cradle 35, whereupon the detection members 78 and 79 will actuate associated equipment to automatically cause fluid under pressure to be blown through the hollow mandrel 37 to blow off any jammed can 33 and prevent it from being carried to the ink applicator 38.

The detection members 78 and 79 will also operate the cam track 69 to prevent the ink applicator 38 and applicator 38A from applying ink or other material on a mandrel 37 which does not have a can 33 thereon or which has an improperly supported can 33 which has not been previously blown off.

As illustrated in FIGS. 6A, 6B, and 7—9 the cam track 69 of the stationary member 70 defines a substantially circular path for the cam roller 68 of each mandrel 37 except that such circular path includes inwardly disposed convex arcuate sections 80, 81 and 82 so constructed and arranged that as each roller 68 is being orbited in a clockwise direction each roller 68 will be smoothly and progressively moved radially inwardly by each arcuate section in opposition to the force of its actuator 61 and thereafter move smoothly and progressively radially outwardly back to the normal circular orbiting path of the cam surface 69 to thereby prevent the applicators 38 and 38A from applying their associated substances on an empty mandrel 37 or a mandrel 37 having a jammed can.

Thus, it is seen that the cam roller 68 of an associated mandrel 37 will follow the orbiting path determined by the cam track 69 and its arcuate portions 80, 81 and 82 for a purpose hereinafter described, the arcuate cam portions 80 and 81 being so constructed and arranged to cause the outer cylindrical surface 33B of a particular can 33 to trace part of the arcuate paths of the ink applicator 38 and other applying device 38A while the arcuate portion 82 facilitates the transfer of a particular can 33 to the pickoff apparatus 40.

As previously stated, the arcuate portions 80 and 81 of the cam track 69 are adapted to prevent a particular mandrel 37 from tracing the desired arcuate paths of the ink applicator 38 and the applicator 38A when the previously described detection members 78 and 79 determine that either a can 33 has not been telescoped over its associated mandrel 37.

A cam 83 is pivotally mounted to the stationary member 70 by a pivot pin 84 and is pivotally interconnected by a pivot pin 85 to a piston rod 86 of fluid actuator 87 carried by the stationary member 70. The cam 83 has a cam surface 88 which is constructed and arranged so that when the actuator 87 is in a deactuated position the cam surface 88 permits each cam roller 68 to trace the arcuate stationary part 80 of the cam track 69, see FIGS. 6A and 6B. However, when the actuator 87 is actuated by the detectors 78 and 79 the piston rod 86 is extended until a stop flange 89 on the cam 83 abuts a stationary stop 90 on the member 70 in the manner illustrated in FIG. 9 whereby the cam 83 is pivoted in a clockwise direction about the pivot pin 84 by the actuator 87 so that the cam surface 88 thereof will now control the path of movement of each cam roller 68 in the manner illustrated in FIGS. 9 and 10 while still permitting smooth and progressive radial inward movement of the orbiting cam roller 68 and its associated mandrel 37 and, thereafter, smooth and progressive radial outward movement of the cam roller 68 and its associated mandrel 37 back to the circular path defined by the cam track 69.

With the cam 83 pivoted to the position illustrated in FIG. 9, the particular mandrel 37 being controlled by the cam 83 follows a path relative to the ink applicator 38 such that the ink applicator 38 will not apply its ink to either the empty mandrel 37 or to a jammed can 33 being carried thereby.

In this exemplary machine 30 the cam 83 and actuator 87 for the arcuate portion 80 of the cam track 69 have been described in detail; however, similar components are provided for the arcuate part 81 of the cam track 69 to prevent the other applicator 38A from applying its associated material to an empty mandrel 37 or a jammed can 33 carried thereon.

As illustrated in FIG. 3, each cylindrical bore 63 of each actuator 61 is in direct fluid communication with a chamber 91 formed between the wheel 41 and the hub 42 and the chamber 91 may be suitably interconnected to a source of fluid under pressure. The fluid in chamber 91 provides THE accurately controlled force which cooperates with the force of the compression springs 64 and tends to maintain the cam followers 68 in engagement with the cam track 69 with a constant force during the entire orbiting movement thereof for a purpose hereinafter described. In addition, each mandrel 37 has central support shaft 93 provided with an axial opening 92 extending therethrough and the cylindrical surface portion 54 of mandrel 37 is supported by bearings 94 on the shaft 93 whereby during orbiting movement of the mandrel 37 its outer portion 54 is also free to rotate.

THE INK APPLICATOR 38

As illustrated in FIGS. 1B, 2B and 5, the ink applicator 38 includes a rotatable cylindrical drum 95 carrying a plurality of flexible ink transferring blankets 96 about its outer periphery. Four of such blankets 96 are illustrated in the drawings and are normally made of a rubberlike material which is approximately one-eighth of an inch thick. The drum 95 is rotated by a shaft 97 which is rotatably mounted on the frame 31 and is driven by a suitable gear train 98 in a synchronous manner with the rotation of the wheels 41 and 36 previously described. The wheels 41 and 36, drum 95, and all driven components of machine 30 are driven by drive belts 99 through suitable gear trains and associated driving mechanisms.

Suitable supports 100 of the frame 31 support a plurality of sets 101 of rolls 102, 103 and 104 of ink applicators which transfer, in a conventional manner, suitable colored inks from reservoirs thereof in suitable doctored and metered amounts to the rollers 104 of the sets 101 thereof with the roller 104 having raised surfaces thereon formed in a predetermined pattern so that the inks transferred by the rolls 103 to the raised surfaces of the rolls 104 will be applied onto the respective blanket 96 in the predetermined pattern of the raised portions of the rollers 104 to form at least part of the marking or informational means for a particular can 33.

By having a plurality of sets 101 of rolls, a multicolored marking or ink pattern may be applied to approximately the last half of each blanket 96 as the same is rotated in a circular path by its supporting drum 95 in a clockwise direction.

As each blanket 96 transfers its ink pattern to the outer cylindrical side wall 33B of a particular can 33 to form the marking means thereon, that particular blanket 96 is orbited past the sets 101 of rollers to have more ink applied thereto for subsequent application to another can 33.

From the above detailed description it will be apparent that a particular can 33 is transferred from its cradle 35 to an as-

sociated freely rotatable mandrel 37 of wheel 41 whereby the can 33 and its mandrel 37 is orbited by wheel 41 toward the ink applicator. The orbiting is achieved continuously, i.e. in a nonindexing manner. As the particular can 33 is engaged by a blanket 96, which is also moving at a constant peripheral speed, the can 33 and its mandrel 37 are cammed by a cam portion 80 of cam track 69 so that the can 33 remains in full contact and at constant precisely controlled contact pressure over an altered (noncircular) orbiting path during printing to assure the desired amount of the cylindrical surface 33B of can 33 has ink applied thereon. During the interval that each can 33 is being printed it and its mandrel 37 are both orbiting and rotating. It will be appreciated that were it not for this camming by cam portion 80 the can 33 would merely touch blanket 96 at full pressure along a single line. Obviously, this would not produce the desired results.

The machine 30 thus assures that the cylindrical surface 33B of each can 33 is printed without distortion, ink smudging, or the like. Further, the entire printing is achieved with the wheels 36 and 41 rotating continuously.

The other applicator 38A schematically illustrated in FIG. 1B may be formed in a manner similar to the applicator 38 except that the applicator is suitably modified to apply its associated substance, such as a protective coating, or the like, on each can 33 after it is suitably processed by the applicator 38.

After the applicators 38 and 38A have performed their associated functions on the cans 33, such cans are removed from the wheel 41 by improved pickoff apparatus 40 of this invention which is to be described in detail subsequently.

It will be readily apparent from the above description that the cans 33 must be rapidly and precisely deposited on cradles 35 carried by wheel 36 and rapidly and effectively removed from a mandrels 37 carried by wheel 41 so as not to require the machine 30 to be slowed down in any way merely to move cans 33 to be processed to and from the machine 30. Accordingly, the detailed description will now proceed with a description of the infeed 32, followed by the detailed description of the pickoff apparatus 40 and finally the specification will conclude with a brief general description of the operation of machine 30 with its improved infeed 32 and pickoff apparatus 40.

THE INFEED 32

The infeed 32 is provided to rapidly and efficiently feed a plurality of cans 33 into the machine 30 while each can 33 is maintained under positive control, i.e., each can is placed precisely in position and moved so that it can not jostle around or become skewed in any way, so as to enable it to be easily picked up by an associated cradle 35 of wheel 36. Further, a minimum number of component parts are utilized in the infeed 32 to provide efficient movement of the cans 33.

Reference is now made to FIGS. 1A, 13, and 15 through 20, which illustrate the infeed 32 in more detail. The infeed 32 has a screw conveyor 110 which is disposed substantially vertically and adapted to carry the cans 33 toward the cradle supporting wheel 36 and hence cradles 35. The infeed 32 also has pickoff star wheel 112 which is adapted to engage and move each can 33 as it is discharged from the lower end of the screw conveyor 110 and the star wheel 112 cooperates with associated guides comprising the infeed 32 to precisely and positively position each can 33 on an associated cradle 35 of the cradle-supporting wheel 36.

The dimensional and structural arrangement of the star wheel 112 is such that each can 33 is deposited upon its associated cradle 35 without tendency of the can 33 to be unstable in its cradle and so that such can may be immediately transferred from its cradle 35 in telescoped relation over an associated mandrel 37, in the manner previously described in detail. Further, the infeed 32 provides a smooth, rapid, and continuous flow of cans 33 to the machine while assuring that the cans will not tend to be jammed on associated mandrels 37 because of instability that might occur if cans 33 were not positively placed in position.

The cans 33 are fed to the upper end indicated at 113 of the screw conveyor 110 through a substantially vertically arranged supply chute 114 and are urged toward the screw conveyor 110 by gravity. A pair of oppositely arranged guides each designated by the same reference numeral 115 is provided and the guides 115 are arranged in substantially parallel spaced apart relation and aligned parallel to the axis of the screw conveyor 110 so that as the cans 33 are introduced from the supply chute 114 and moved downwardly toward the main portion of the machine 30 by the screw conveyor 110, they are axially aligned within confined limits as determined by the guides 115.

The infeed 32 also has an arcuate guide 116 at the lower end of the screw conveyor 110 which is adapted to engage the outer cylindrical surface 33B of each can 33 and cooperate with the infeed star wheel 112 to assure smooth transfer of each can into an associated cradle 35. The arcuate guide 116 is preferably made of antifriction material and, in addition, it will be seen that its lower end 120 is also positioned to enable accurate pickup of each can 33 by an associated cradle 35 as it is moved into position beneath the guide 116 by rotation of the cradle-supporting wheel 36.

In addition, the star wheel 112 is also preferably made of an antifriction material, see FIG. 16, and with both the star wheel 112 and guide 116 being made of antifriction material it will be appreciated that after each can 33 is received on the screw conveyor and into an associated pocket of the star wheel 112 (as seen at 118), it is comparatively free to slide relative to the guide 116 and star wheel 112 while being firmly held in position in a nonjostling manner until it is deposited into its associated cradle 35. One antifriction plastic material which has been effectively utilized for the guide 116 and the star wheel 112 in one embodiment of this invention is a plastic material sold under the name of "Teflon" and made by the E. I. DuPont de Nemours Co. of Wilmington, Delaware. Also, for the same purpose and to prevent damage to the exterior cylindrical surfaces 33B of the cans 33 as they are moved by the screw conveyor 110, it too may be made of an antifriction material such as Teflon, or the like.

Each of the previously mentioned guides 115 is closely controlled so as to axially confine each can 33 within predetermined limits and each guide 115 preferably has a semicircular terminal end 122, as viewed in cross section, so as to provide essentially a line contact (with its associated minimum drag) at opposite ends of each can 33.

The star wheel 112 is suitably driven by a drive assembly 123 operatively coupled to the shaft of the star wheel 112 and a chain drive 124 extends from the assembly 123 and drives a sprocket wheel 125 mounted at the upper end 127 of the screw conveyor 110 which drives the conveyor 110 through a gear box 126. The drive 123 is suitably interconnected with the drive for the machine 30 so that the infeed star wheel 112, screw conveyor 110, and wheel 36 are all cooperating in a synchronized manner to assure the cans 33 move smoothly into the machine.

As seen in FIGS. 1A and 19, the infeed 32 also has a top guide 129 which prevents each can 33 from jostling around in its cradle 35 as it exits the infeed star wheel 112. A fixed cam plate 130 is also provided and suitably fixed to the machine by fastening members 131 and the cam plate has a cam surface 132 which is adapted to engage the bottom 33A of each container 33 to start axial movement of each particular container 33 along its associated cradle 35 and toward an associated mandrel 37 to enable easier telescoping movement thereof over such mandrel 37; see FIGS. 19 and 20. Thus, as each can 33 reaches the lower extremity of the infeed 32 it is not only positioned in a positive manner on the cradle 35 but is also started in its axial movement toward an associated mandrel 37.

From the above description it will be apparent that the infeed 32 moves the cans 33 to the machine 30 in a rapid and

positive manner, without permitting the cans to jostle about, and utilizes a minimum number of component parts to provide optimum operating efficiency.

THE PICKOFF APPARATUS 40

Reference is now made to FIGS. 1A, 2A, 5, 12, 13, and 21—25 of the drawings, which illustrate the high speed pickoff apparatus 40 of this invention. The pickoff apparatus 40 includes a support 135 which is suitably mounted to the frame 31 of the machine 30 and the support 135 has a track 136 which has a special contoured configuration and, as will be apparent particularly from FIG. 21 of the drawings, the track has a peripheral outline resembling a Figure 8. The pickoff apparatus 40 also includes a plurality of vacuum devices each designated by the reference numeral 140 and only a few representative ones of such devices being so designated. The vacuum devices 140 are suitably fastened together in spaced apart relation and supported for movement about the track 136 and such vacuum devices 140 are suitably interconnected to a vacuum source as will be described in detail subsequently in this specification.

The track 136 may be made as a separate member attached to associated supporting structure. However, in this example of the invention, the track 136 is formed as an integral part of a frame member 142 which is suitably fastened to the support 135 in a fixed manner. The vacuum devices 140 are suitably fastened together at predetermined spaced apart intervals by being fastened to a chain conveyor 143 and each vacuum device 140 has a pair of spaced apart roller 144 rotatably supported thereby and extending beneath or inwardly of the chain conveyor 143. The rollers 144 are adapted to engage opposite substantially vertically arranged surfaces 149 of the track 136.

The vacuum devices 140 are moved about their support track by moving the chain conveyor 143 and, as the chain conveyor 143 is moved, the cam rollers 144 engage the opposite surfaces 149 of track 136, causing each vacuum device 140 to follow the contour of the track 136. In addition to having the general shape of a figure 8, for reasons to be subsequently described, the track 136 has sections which are inclined with respect to a vertical plane and these inclined sections are utilized to assure that the vacuum devices 140 are properly moved to enable each can 33 processed by the machine 30 to be effectively and rapidly moved away from the machine.

Having described the manner in which the vacuum devices 140 are supported and fastened together along the chain conveyor 143 in spaced apart relation and the manner in which the track 136 guides the motion of the vacuum devices, the description will now continue with a description of the drive for the chain conveyor 143. In particular, it will be seen from FIGS. 12, 21, and 22 that a main drive shaft 145 is provided and the drive shaft 145 is suitably operatively connected in a synchronous manner to the drive means for the wheel 36 and wheel 41 to assure proper operation of the machine 30.

The drive shaft 145 has a central gear 146 keyed thereto which drives a pair of smaller gears 147. The gears 147 in turn drive a pair of gears 148 and each gear 148 is suitably fixed to an associated shaft 151. Thus, upon rotating the drive shaft 145 the shafts 151 arranged on opposite sides of the shaft 145 are also simultaneously rotated. Each shaft 151 has a pair of sprocket wheels 152 suitably keyed thereto and each sprocket wheel 152 has sprocket teeth 153 which extend within cooperating spaces of the chain conveyor 143 so that upon rotating shaft 145 the chain conveyor 143 and vacuum devices 140 are moved along the closed loop track 136.

As will be apparent from FIGS. 12 and 23 of the drawings, the main drive shaft 145 is keyed to the gear 146 by a key 154 and the shaft 145 is rotatably supported adjacent gear 146 by a bearing 155 which has its outer race carried by frame member 142 and which is held in position by a retaining ring 156. Further, the shaft 145 has suitable means to prevent axial movement thereof in the form of thrust bearings and associated fastening means for fastening the shaft 145 in position with respect to its thrust bearings.

Referring now to FIGS. 13 and 21 of the drawings, it is seen that the wheel 41 carries the mandrels 37 in an arcuate path designated by the reference numeral 160. The track 136 has an arcuate section 161 which corresponds to one portion of the arcuate path 160 traveled by the mandrels 37 as they are orbited by their associated wheel 41. The support 142 supports the chain conveyor 143 and hence the vacuum devices 140 along the arcuate section 161 of track 136 and in axially spaced apart relation from the mandrels 37 as they are orbited by wheel 41.

The drive shaft 145 drives the gear train utilized to drive the chain conveyor 143 so that the vacuum devices 140 are driven along the arcuate track section 161 at the same speed as the mandrels 37 and their telescoped containers are moved by wheel 41. The chain conveyor 143 is moved by the track section 161 so that each vacuum device 140 travels substantially in axial alignment with an associated mandrel 37 and can 33 over the full length of arcuate section 161 and upon applying a vacuum on the vacuum device 140, in a manner to be described subsequently, the axial alignment of each vacuum device 140 with an associated can 33 over the full length of arcuate section 161 assures positive removal of such can 33 from its mandrel 27.

The above described structure represents a significant improvement over the structure utilized in previously proposed devices wherein with such prior devices a particular pickoff member is in alignment with associated cans only a comparatively small time interval, resulting in many cans not being properly picked off and other cans being dropped, thereby making it necessary to repeatedly stop the overall operation, which increases operating costs.

As will be apparent from FIGS. 13 and 21 of the drawings the length of the arcuate track section 161 is greater than the circumferential distance between an immediately adjacent pair of mandrels 37, thereby providing movement of each container 33 in aligned relation opposite as associated vacuum device 140 for a sufficient distance to assure positive removal of each can 33 by its associated vacuum device 140. In particular, the length of the arcuate track section 161 may be preferably several times greater than the circumferential distance between an immediately adjacent pair of mandrels 37.

Not only does the track 136 have the general shape of a figure 8 as previously mentioned, it is also inclined along selected portions with respect to a vertical plane. In particular, it will be seen from FIG. 24 of the drawings that the arcuate section 161 is inclined as indicated by the reference numeral at 165 at an acute angle with respect to a vertical plane 166 in which the terminal ends of the mandrels 37 are normally orbiting. As each vacuum device 140 moves along its arcuate track section 161 it together with an associated can 33 held by vacuum thereagainst progressively moves along the inclined portion at 165 of track section 161 so that each can 33 is moved away from its associated supporting mandrel 37.

FIG. 24 illustrates a vacuum device 140 and an associated can 33 at three positions along section 161 to highlight the unique construction and arrangement of the track 136. In particular, it will be seen that in the lower position of FIG. 24 an associated vacuum device 140 and a mandrel 37 with its associated can 33 are moved into position so that they start moving together in axial alignment. At this point the vacuum is applied on the vacuum device 140, as will be described in detail subsequently, whereupon as the vacuum device 140 moves along the arcuate track section 161 it pulls its associated can 33 so that it adheres against its vacuum cup 170 and the vacuum device 140 with the can 33 adhered to its vacuum cup 170 is shown in the center position in FIG. 24.

Further movement of the vacuum device along the track section 161 results in the associated can 33 being pulled completely away from its associated mandrel 37, leaving a space at 171 therebetween, whereupon such can 33 is now effectively removed from its mandrel 37 and free to be moved by its vacuum device 140 along the track 136 for transfer onto an associated conveyor for movement thereof away from the

machine 30 and in a manner to be described in detail subsequently.

As will be apparent from FIGS. 13 and 21 of the drawings, the track 136 has another arcuate section 172 arranged downstream of the arcuate track section 161. The use of the word "downstream" in this context means that as the chain conveyor 143 is moved about the track 136 the arcuate track section 161 is considered as being encountered first to enable the vacuum devices 140 to remove cans 33 from orbiting mandrels 37 and the arcuate section 172 is encountered secondly and downstream of arcuate section 161 in can flow relation.

The pickoff apparatus 40 also includes another endless or continuous chain conveyor 173 which has one end thereof (not shown) supported in any suitable manner and adapted to associate with any suitable device to enable further processing of the cans or removal thereof, as desired. The chain conveyor 173 is supported adjacent the machine 30 on a suitable sprocket wheel 174 which is driven in a synchronous manner with the endless chain conveyor 143 by a drive 175.

The chain conveyor 173 has a plurality of spaced apart can supporting pins 176 suitably fastened thereon so as to extend substantially laterally from the side of the chain in a direction transverse to the plane in which the chain conveyor 173 is normally moving. The pins 176 are fastened to the chain conveyor 173 in spaced apart relation with the distance between each immediately adjacent pair of pins corresponding to the arcuate spacing between a pair of immediately adjacent mandrels 37 on the mandrel supporting wheel 41 and hence corresponding to the arcuate distance between each immediately adjacent pair of vacuum devices. As the chain conveyor 143 moves vacuum devices 140 along the arcuate section 172 of track 136 the cans 33 held on the vacuum devices 140 move in an arcuate path 177 which is identical to the arcuate path of the pins 176 and the path of the pins 176 is controlled by the construction and arrangement of the sprocket wheel 174.

Reference is now made to FIG. 25 of the drawings wherein it will be seen that the sprocket wheel 174 supports the endless chain 173 so that the terminal ends of its can-supporting pins 176 move substantially in a vertical plane indicated by the reference numeral 180. The arcuate section 172 of track 136 also has an inclined portion indicated by the reference numeral 179 which is inclined at an acute angle with respect to the vertical plane 180 and is inclined substantially in an opposite direction from the previously described inclination 165 which is provided on the arcuate section 161 of track 136.

After the cans 33 have been picked off their associated mandrels 37 by vacuum devices 140, they are moved along track 136 by the vacuum devices 140 and upon reaching arcuate section 172 it will be seen that such arcuate section moves each can forward in telescoped relation over an associated can-supporting pin 176. FIG. 25 highlights a particular can 33 as it is moved in telescoped relation over an associated pin 176 and shows three positions or illustrations of such can.

In the top illustration of FIG. 25 the vacuum device 140 is shown as it moves its can 33 into the arcuate and inclined section 172. The center illustration shows the can 33 partially telescoped over its associated pin 176 by the movement of the vacuum device 140 toward pin 176 and as caused by the arcuate and inclined section 172. The lower illustration of FIG. 25 shows the can 37 completely telescoped over its supporting pin 176 and the vacuum on the vacuum device 140 released so that the can is now spaced away, as shown at 182, from the terminal end of the vacuum cup 170 and is free to be carried away by the chain conveyor 173.

Thus, it is seen that the track 136 has two arcuate sections defining opposite sides thereof and comprised of arcuate section 161 and arcuate section 172. Each of the arcuate sections 161 and 172 is also inclined with respect to a vertical plane. The arcuate section 161 is inclined so that it moves the vacuum devices 140 from a position which is quite close to the vertical plane 166 in which the terminal ends of the mandrels 37 are rotating to a position spaced apart therefrom. A vacuum is applied on each vacuum device 140 as each device 140 and an associated mandrel with a can 33 carried thereon start running together and the vacuum continues to act on its associated can over a large arc defined by the arcuate length of arcuate section 161 whereby there is little likelihood that the vacuum cup 170 is not in full contact with the bottom 33A of its associated container 33 to assure that the container is pulled away in a positive manner from its associated mandrel 37 and by the mechanical axial force produced by the outwardly inclined arcuate ramp section 161.

Likewise, downstream of section 161 the arcuate section 172 cooperates with a sprocket wheel 174 with its endless chain conveyor 173 and can-supporting pins 176 to assure that each can 33 tracks or moves in alignment with an associated can-supporting pin 176 over a large arcuate length corresponding to the length of section 172. During such large arcuate movement the vacuum is released from each device 140 and because the arcuate section 172 is inclined toward the pins 176 the associated can 33 carried by a vacuum device 140 is deposited in telescoped relation on its associated pin 176 in a positive manner, whereupon the empty vacuum device 140 continues rotating about its track 136 toward the arcuate section 161 for pickup of another can 33 in the manner previously described.

The detailed structural arrangement and operation of various members of pickoff apparatus 40 has been described; however, it will be appreciated that it is necessary that the vacuum supplied to the vacuum devices 140 be properly applied to assure smooth operation. Thus, a detailed description of the operation of the vacuum devices 140 and manner of supplying vacuum thereto will now be made, In particular, the vacuum devices 140 are supported in predetermined spaced-apart relation about the endless chain conveyor 143 in the manner previously described and each vacuum device 140 has a flexible fluid supply conduit 183 connected to its rear end portion.

As previously explained, the drive shaft 145 is rotated to drive the chain conveyor 143 and the shaft 145 has a plate 184 keyed thereto by a key 185 to provide rotation of the plate 184 with the shaft 45. The plate 184 has a plurality of passages 186 therein, each communicating with an associated flexible conduit 183 which in turn end leads to an associated vacuum device 140. The plate 184 has a rear face valve surface 190 which slidably engages a cooperating valve face 192 of an annular ring 193A fastened to a fixed member 193 which is suitably carried by the frame 31 through a support 195. Thus, as the shaft 145 is rotated it will be seen that the plate 184 has its surface 190 moved in rotatable sliding engagement with the valve face 192 of ring 193A.

The member 193 and ring 193A have suitable internal passages which enable a vacuum or pressure to be directed to the vacuum devices 140, as desired, through associated passages 186 n and conduits 183. In particular, it will be appreciated ta that as each vacuum device 140 moves to the entrance portion 202 of arcuate section 161, vacuum is provided to each device 140 through conduit 196 and such vacuum is held thereon by a continuous internal channel 200 in the annular ring 193A. The channel 200 has an arcuate configuration and length which assures vacuum is maintained on each device 140 from point 202, see FIG. 21, to a point within the arcuate section 172 whereupon the vacuum is released to release each can 33 from its associated vacuum device 140.

Each can 33 should be released from its vacuum device 140 merely by cutting off the vacuum, i.e., the particular channel 186 for a given device 140 moves out of register with channel 200. However, it may be desired to apply a pressure outwardly through each device 140 to assure the vacuum is broken. Pressure is applied from a suitable pressure source through another line 197 communicating with another portion of a suitable internal channel 199 provided within the annular ring 193A, whereupon each can 33 is partially blown away from associated vacuum device 140 essentially in the manner illustrated in the lower position of FIG. 25 and adjacent a point 203 (see FIG. 21) near the terminal discharge end of arcuate

and inclined section 172. The channel 199 has an arcuate configuration and length which correspond to a comparatively short arcuate distance on either side of point 203.

Each vacuum device 140 has a main housing portion 204, see FIGS. 24 and 25, which supports its vacuum cup 170 for axial sliding movement toward and away from the housing 204. The vacuum cup 170 is suitably supported on a shaft 205 which carries a seal 206 and the outer outer periphery of seal 206 slidably engages a cylindrical bore 207 provided in the housing 204. A spring 210 is provided and acts between the housing 204 and a portion of the shaft 205, carrying the vacuum cup 170, to normally urge the vacuum cup 170 outwardly away from the housing 204. Thus, the vacuum cup 170 is slidably supported within the housing 204 by the shaft 205 and the seal 206 provides a fluid-tight seal.

The shaft 205 has a bore 211 extending therethrough which communicates with a chamber 212 in the rear of the housing 204 and each chamber 212 has an associated flexible conduit 183 suitably fluidly connected thereto. Upon applying a vacuum on each vacuum device 140 by reducing the pressure in an associated chamber 212 has an associated flexible conduit 183 suitably fluidly connected thereto. Upon applying a vacuum on each vacuum device 140 by reduction in the pressure in an associated chamber 212, the associated vacuum cup 170 is caused to adhere against the bottom surface 33A of an associated can 33 and thereby override the spring 210 and retract the vacuum cup 170 from the lower position illustrated in FIG. 24 to the intermediate and upper positions illustrated in such FIG.

Once a particular vacuum device 140 is rotated into arcuate track section 172, the vacuum source is shut off merely by continued movement of the particular device 140 along track 136, whereupon an associated spring 210 helps to move its associated cup 170 and can 33 toward an associated pin 176 and essentially from the central position illustrated in FIG. 25 to the bottom position of such FIG. As previously indicated, a pressure source may then be placed in suitable fluid communication with the chamber 212 in the rear of each particular vacuum device 140 which is primarily effective to assure breaking of the vacuum and may also offer some propelling force tending to urge the particular can 33 in telescoped relation over to associated pin 176.

Thus, it is seen that the vacuum devices 140 are effective to remove each can 33 from an associated mandrel 37 and further the vacuum devices 140 may also be used in association with a suitable pressure source to aid in the removal of each can 33 from an associated vacuum device 140, if desired.

In describing the improved pickoff apparatus 40 reference has been made to the track 136 having a peripheral outline in the general shape of a figure 8 and having arcuate sections 161 and 172 which are also suitably inclined. However, it will be appreciated that in accordance with the teachings of this invention the job objective is to provide arcuate track sections wherein the vacuum devices or other suitable devices move in aligned relation with first the mandrels 37 and then the can-supporting pins 176 over arcuate and inclined distances of sufficient length to assure smooth positive transfer of each can from one moving member to another with optimum efficiency; therefore, the final configuration of the particular track 136 utilized need not necessarily be in the shape of a figure 8 but may be of any other suitable shape.

Having described in detail the component parts of the machine 30, and in particular the improved infeed 32 and pickoff apparatus 40 of this invention, the description will now conclude with a general presentation of the overall operation of the machine 30.

GENERAL OPERATION OF THE MACHINE 30

The machine 30 is powered by a suitable prime mover such as an electric motor, which drives belts 99 which in turn drive suitable cooperating linkages such as shafts, gears, chain drives, and the like, whereby the various parts of the machine 30 are driven in a synchronous manner to enable uninterrupted printing of the exterior cylindrical surfaces 33B of cans 33.

The cans 33 are moved from the supply chute 114 by the screw conveyor 110 and as each can reaches the lower end of the screw conveyor 110 it is picked up by the infeed star wheel 112 which cooperates with arcuate guide 116 to positively place such can on an associated cradle 35 of wheel 36 while such cradle is being orbited by wheel 36. The orbiting cradle 35 carries its associated can 33 in a clockwise direction, as seen in FIG. 1A, away from the infeed 32 with the particular can 33 being held therein by the configuration of the cradle 35 and associated guides to prevent the associated can 33 from moving around on its cradle 35.

The cam track 51 of the stationary member 52 controls the radial position of each cradle 35 in such a manner that the can 33 carried thereby will be subsequently aligned with a particular mandrel 37 being orbited by the wheel 41 whereby such can 33 is then telescoped over an associated mandrel 37 by interconnecting the hollow member 92 of such mandrel 37 to a vacuum source. The detection members 78 and 79 then determine whether the can 33 is properly telescoped on its mandrel 37. If such can 33 is properly positioned, the associated mandrel 37 will be allowed to follow arcuate portions 80 and 81 of the cam track 69. However, if the detection members 78, 79 detect that a can 33 has not been telescoped on its mandrel 37 or is jammed thereon so as not to be in a proper position, the detection members 78 and 79 cause a fluid pressure source to be interconnected to the particular hollow member 92 of the mandrel 37 to attempt to blow off such jammed can 33, the particular arcuate portion 80 having been moved radially inwardly to permit such blow off condition.

As the particular mandrel 37 is being orbited in a clockwise direction, the cam track 69 at the arcuate portion 80 thereof causes the outer cylindrical surface 33B of the associated can 33 to tend to trace the arcuate or circular path of movement of a particular blanket 96 of the ink applicator 38.

The cam track 69 and arcuate portion 80 are so constructed and arranged that when a particular blanket 96 is orbiting in a clockwise direction, the forward and non-ink carrying part of the blanket 96 will engage the cylindrical side wall surface 33B of the can 33 being carried by its orbiting mandrel 37 with a constant pressure because the blanket 96 tends to move or pivot the mandrel 37 radially inwardly when the can 33 and the blanket 96 are in pressure contact. The actuator 61 of the particular mandrel 37 opposes such force of the blanket 96 tending to move the mandrel 37 inwardly so that a constant force is applied between the blanket 96 and the side wall 33B of can 33 throughout the entire time that the blanket 96 is in contact with the can 33, causing the blanket 96 to be compressed by a constant force and by an amount determined by the actuator 61 and cam surface 80 of the track 69.

Since the first portion of the blanket 96 does not carry printing ink thereon and since there is differential movement between the can 33 and the blanket 96, the orbiting blanket 96 causes the can 33 and its associated mandrel member 54 of the mandrel 37 to rotate in a counterclockwise direction, even though the entire mandrel 37 and can 33 are orbiting in a clockwise direction so that by the time the last half of the blanket 96 comes into engagement with the side wall 33B of the can 33, the can 33 is rotating at the same speed of rotation as drum 95 so that the printing ink on the blanket 96 will be applied to the can 33 without slippage therebetween as the same are moving in unison, Further, because the can 33 is, in effect, tracing part of the arcuate path of movement of the blanket 96 during the marking or printing operation and because the cam follower 68 of the respective mandrel 37 moves against the arcuate portion 80 of the cam track 69, the entire printing by the blanket 96 against the side wall 33B of the can 33 is with a constant pressure between the side wall 33B and blanket 96 and hence without marking distortion.

Thus, it can be seen that not only is the particular can 33 being orbited by its wheel 41 at the same time that the ink-ap-

plying blanket 96 is moving to provide a relatively high speed printing operation, but also the blanket 96 is applying the ink directly to the entire outer cylindrical side wall 33B of can 33 at a constant pressure and without smudging or distortion.

After the particular mandrel 37 has traced the arcuate path of movement of the blanket 96 and has ink printed thereon in the manner previously described, the printed can 33 is moved toward the other applying device 38A which will also apply its associated material on the side wall 33B of the can 33 with a constant pressure and in a manner similar to that previously described for the ink applicator 38.

However, as previously described, should a particular mandrel 37 being orbited by the wheel 41 toward the applicators 38 and 38A have a jammed can 33 thereon or no can present, the detecting member 78 and 79 cause actuators 87 at the arcuate portions 80 and 81 of the cam track 69 to be actuated in such a manner that when the particular cam roller 68 of the sensed mandrel approaches the same, the cam members 83 are pivoted radially inwardly to force the mandrel 37 out of the path of engagement with the blanket 96 of the ink applicator 38 and the applicator 38A in the manner previously described. In this manner the blanket 96 will not be damaged by an offset flange 33C of a jammed can 33 and an empty mandrel 37 will not have ink and the like applied thereon.

Each mandrel 37 is then orbited into alignment with an associated vacuum device 140 of pickoff apparatus 40. Each vacuum device 140 is moved by a chain conveyor 143 along an arcuate and inclined track section 161 of track 136 whereupon a vacuum device is moved in substantially axial alignment with a can 33 carried by an associated mandrel 37. A vacuum is then applied which together with the inclination of the track section 161 cooperate to remove the associated can 33 from its mandrel 37. The can 33 is now held by a vacuum acting against its bottom 33A and the vacuum device 140 and its can are moved along another arcuate and inclined track section 172 of track 136, which is arranged downstream of track section 161.

Another chain conveyor 173 is provided as part of the pickoff apparatus 40 and such chain conveyor has a plurality of pins 176 suitably fastened thereon. The chain conveyor 173 is moved by a sprocket wheel 174 so that its pins move along an arcuate path corresponding to arcuate section 172 whereby each can 33 is now moved while in axial alignment with an associated pin 176 substantially over the full length of arcuate section 172 whereupon the vacuum is cut off and the can 37 placed on its pin 176. It will also be appreciated that the horizontal component of the force acting against a given can 33 due to the inclination of the arcuate section 172 causes the can 33 to be positively deposited on its associated pin 176 and then carried away from the machine 30 by such pin 176 for further processing or use, as desired.

Each of the pins 176 provided on the conveyor 173 may have a comparatively larger knoblike portion 215 at its terminal end which causes each container or can 33 received thereon to be inclined toward the base 216 thereof. The knoblike portion 215 assures each can 33 remains on its pin 176 as the can is moved away from the machine 30.

While present exemplary embodiments of this invention, and methods of practicing the same, have been illustrated and described, it will be recognized that this invention may be otherwise variously embodied and practiced within the scope of the following claims.

We claim:

1. A machine for continuously applying marking means on cylindrical containers comprising a continuously rotatable cradle-supporting wheel carrying a plurality of cradles about its outer periphery with each of said cradles having a substantially semicircular cross-sectional configuration and each being adapted to receive an associated container, a precision infeed for placing each of said containers on an associated cradle, said infeed comprising, a screw conveyor for carrying said containers toward said cradle-supporting wheel and a pickoff star wheel for engaging and moving each container as it is discharged from said screw conveyor and depositing it on an associated cradle of said cradle-supporting wheel, said star wheel having a plurality of pockets each having a substantially semicircular cross-sectional configuration and each being adapted to hold an associated container in a nonjostling manner until it is positively deposited on its associated cradle to minimize any tendency of said container to be unstable in its cradle, an arcuate guide at the lower end of said screw conveyor, said star wheel and arcuate guide cooperating after each container is received from said screw conveyor into an associated pocket to provide controlled sliding movement of the container relative to said guide and its associated star wheel pocket to assure a smooth positive transfer of each container into an associated cradle of said machine, said arcuate guide having a lower end positioned to enable accurate pickup of each container by an associated cradle, a pair of closely controlled vertical guides adapted to engage and axially align said containers within predetermined limits as they are conveyed by said screw conveyor, each of said vertical guides providing essentially a line contact at each end of said containers which imposes minimum drag on said containers during sliding movement thereof along said vertical guides, a continuously rotatable mandrel-supporting wheel carrying a plurality of mandrels about its outer periphery and being arranged adjacent said cradle-supporting wheel and operatively associating therewith to receive each container in telescoped relation over an associated mandrel to enable the subsequent application of marking means thereon, and a fixed cam plate adapted to engage one end of each container and start axial movement thereof along its supporting cradle and toward an associated mandrel to enable subsequent easier telescoping thereof over an associated mandrel.

2. A machine for continuously applying marking means on cylindrical containers comprising, a continuously rotatable cradle-supporting wheel carrying a plurality of cradles about its outer periphery with each of said cradles being adapted to receive an associated container from an infeed for said machine, a continuously rotatable mandrel-supporting wheel carrying a plurality of mandrels about its outer periphery and being arranged adjacent said cradle-supporting wheel and operatively associating therewith to receive each container in telescoped relation over an associated mandrel, a pickoff apparatus for moving said containers away from said machine, said pickoff apparatus comprising, an endless conveyor, a plurality of vacuum devices fastened along said endless conveyor in spaced apart relation with each vacuum device being adapted to be operatively connected to a vacuum source, a support supported alongside said cradle-supporting wheel and having a noncircular fixed track for supporting and guiding said endless conveyor and said vacuum devices for movement thereon in an endless noncircular path defined by said noncircular track, said track having one arcuate track section corresponding to one portion of an arcuate path traveled by said mandrels and their associated telescoped containers, said one arcuate track section supporting said vacuum devices in axially spaced apart relation from said mandrels, and a drive for moving said endless conveyor and hence said vacuum devices on said track and said one fixed arcuate track section at the same speed as the speed of said mandrels and their associated telescoped containers along said one portion of said arcuate path and so that each vacuum device travels in said arcuate path substantially in axial alignment with an associated mandrel and container over the full length of said one portion of said arcuate path, said supporting of said support and hence said track alongside said cradle-supporting wheel assuring each movement of said vacuum devices in the required manner using a comparatively simple mechanism, and upon applying a vacuum upon each device the axial alignment of each device over said full length assures positive removal of the associated container from its supporting mandrel.

3. A machine as set forth in claim 2 in which said one arcuate track section is also arranged in an inclined manner so that it extends at an angle with respect to a vertical plane in which

the terminal ends of said mandrels are normally rotating and as each vacuum device moves around said one arcuate track section it together with its associated container adhered thereagainst moves along said inclined section and progressively away from said mandrel-supporting wheel.

4. A machine as set forth in claim 3 in which the arcuate length of said one arcuate track section is greater than the circumferential distance between an immediately adjacent pair of mandrels to assure movement of each container in aligned relation opposite an associated vacuum device for a sufficient distance to assure positive removal of each container by such vacuum device.

5. A machine as set forth in claim 3 wherein said endless conveyor comprises a chain conveyor.

6. A machine as set forth in claim 5 in which said track has an inclined track section arranged downstream of said one track section, said downstream track section being inclined in a direction toward another conveyor carrying a plurality of spaced apart container supporting pins with each pin being adapted to receive an associated container in telescoped relation thereover for carrying thereof away from said machine.

7. A machine as set forth in claim 6 and further comprising a fluid pressure source operatively connected to said vacuum devices whereby upon placing a particular container in telescoped relation over an associated pin the vacuum holding the particular container is shut off and fluid pressure is applied to provide a positive release of the particular container onto said pin.

8. A machine for continuously applying marking means on cylindrical containers comprising, a continuously rotatable cradle-supporting wheel carrying a plurality of cradles about its outer periphery with each of said cradles being adapted to receive an associated container from an infeed for said machine, a continuously rotatable mandrel-supporting wheel carrying a plurality of mandrels about its outer periphery and being arranged adjacent said cradle-supporting wheel and operatively associating therewith to receive each container in telescoped relation over an associated mandrel, a pickoff apparatus for moving said containers away from said machine, said pickoff apparatus comprising, a plurality of vacuum devices fastened together in spaced apart relation and adapted to be operatively connected to a vacuum source, a support having a track for supporting and guiding said vacuum devices, said track having one arcuate track section corresponding to one portion of an arcuate path traveled by said mandrels and their associated telescoped containers, said one arcuate track section supporting said vacuum devices in axially spaced-apart relation from said mandrels, a drive for moving said vacuum devices along said one arcuate track section at the same speed as the speed of said mandrels and their associated telescoped containers along said one portion of said arcuate path and so that each vacuum device travels substantially in axial alignment with an associated mandrel and container over the full length of said one portion of said arcuate path, and upon applying a vacuum upon each device the axial alignment of each device over said full length assures positive removal of the associated container from its supporting mandrel, said one arcuate track section being arranged in an inclined manner so that it extends at an angle with respect to a vertical plane in which the terminal ends of said mandrels are normally rotating and as each vacuum device moves around said one arcuate track section it together with its associated container adhered thereagainst moves along said inclined section and progressively away from said mandrel-supporting wheel, said track having another arcuate track section arranged downstream of said one track section, said other arcuate track section being substantially identical to said one arcuate track section and facing in an opposite direction therefrom and said pickoff apparatus further comprising another continuous chain conveyor having a plurality of container-supporting pins fastened to said other conveyor in spaced apart relation corresponding to the arcuate spacing between a pair of immediately adjacent vacuum devices, a sprocket wheel for moving and guiding said other chain conveyor and its pins, said sprocket wheel having an effective diameter corresponding to the effective diameter of said mandrel-supporting wheel so that as said other continuous chain conveyor is moved by said sprocket wheel therearound said pins move in an arcuate path corresponding to said other arcuate track section causing each container as it is moved by its associated vacuum device along said other arcuate track section to be aligned with an oppositely arranged pin, and upon disconnecting the vacuum to a particular vacuum device with the associated container arranged opposite its associated pin a compression spring provided as an integral part of the vacuum device and held compressed by said vacuum is released and causes the associated container to be propelled toward and telescoped over its associated pin.

9. A machine as set forth in claim 8 in which said downstream track section is inclined in a direction toward the plane of said sprocket wheel and hence toward said pins, said inclined downstream track section enabling each container to be effectively deposited in telescoped relation over its associated pin.

10. A machine as set forth in claim 9 in which said track has a peripheral outline of a figure 8 thereby enabling the provision of said arcuate sections within a comparatively small space.

11. A machine as set forth in claim 9 and further comprising a fluid pressure source operatively connected to said vacuum devices whereby upon placing a particular container in telescoped relation over an associated pin the vacuum holding the particular container is shut off and fluid pressure is applied to provide a positive release of the particular container onto said pin.

12. A machine as set forth in claim 9 in which each of said pins has a comparatively larger knoblike portion at its terminal end which causes each container received thereon to be inclined toward the base of the particular pin to assure the container remains on the pin.

13. A machine as set forth in claim 9 in which said track is formed in said support as an integral part thereof.

14. A machine as set forth in claim 9 in which each of said vacuum devices has a pair of cooperating rollers fastened thereto and adapted to engage opposite sides of said track to guide the associated vacuum device therealong.

15. A machine as set forth in claim 8 in which said infeed comprises a screw conveyor for carrying said containers toward said cradle-supporting wheel and pickoff star wheel for engaging and moving each container as it is discharged from said screw conveyor and depositing it on an associated cradle of said cradle-supporting wheel, said star wheel assuring rapid and positive placement of each container on its associated cradle to minimize any tendency of said container to be unstable in its cradle.

16. A machine as set forth in claim 15 in which said screw conveyor is arranged in a substantially upright manner and conveys containers from its upper end to its lower end and further comprising a downwardly inclined supply chute for supplying containers to the upper end of said screw conveyor, said containers being urged toward said screw conveyor by gravity.

17. A machine as set forth in claim 16 and further comprising a pair of vertical guides, said vertical guides being adapted to engage and axially align said containers as they are conveyed by said screw conveyor.

18. A machine as set forth in claim 16 in which said infeed star wheel is made of an antifriction material, and further comprising an arcuate guide at the lower end of said screw conveyor which is also made of an antifriction material and after each container is received from said screw conveyor into a pocket of said star wheel said container may easily move relative to said guide and star wheel pocket to assure a smooth transfer of an associated container toward an associated cradle of said machine, said arcuate guide having a lower end positioned to enable accurate pickup of each container by an associated cradle.

19. A machine as set forth in claim 18 and further comprising a cam plate adapted to engage one end of each container and start axial movement thereof along its supporting cradle and toward its associated mandrel to enable subsequent easier telescoping movement thereof over an associated mandrel.