Nov. 8, 1966 F. J. THURSTON ETAL 3,283,471

AUTOMATIC PACKING APPARATUS

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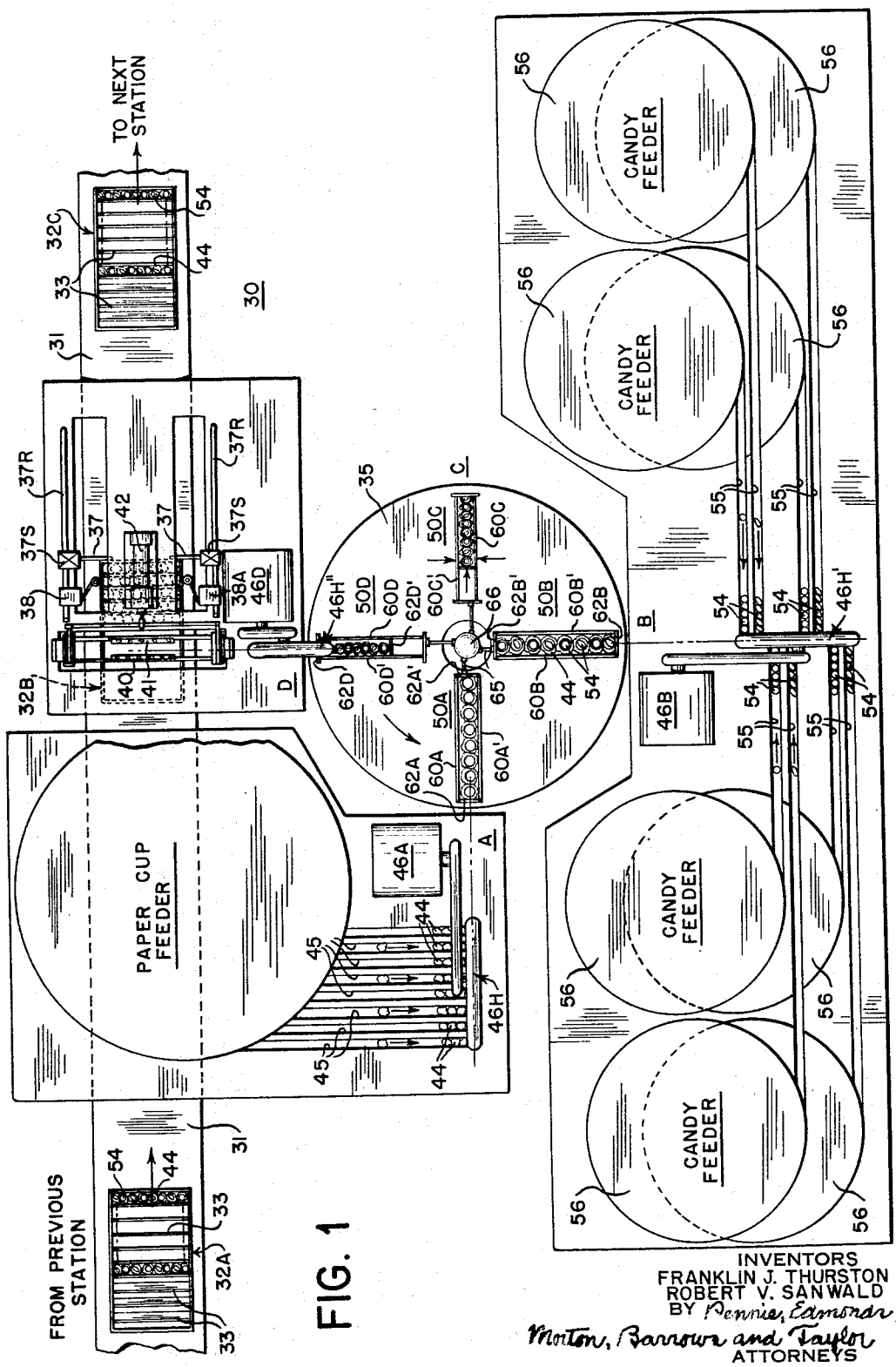


FIG. 1

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FIG. 2

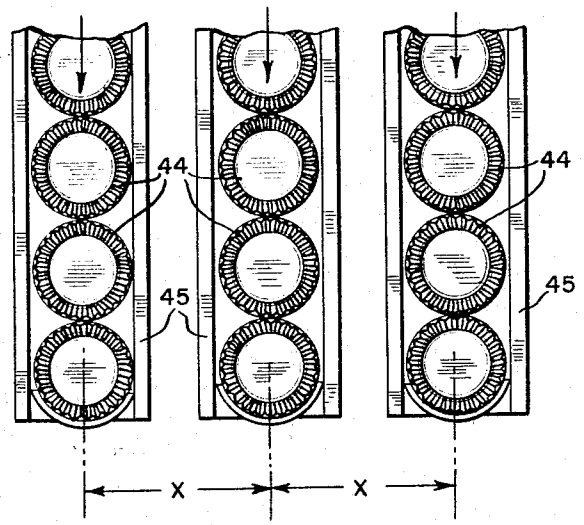


FIG. 3

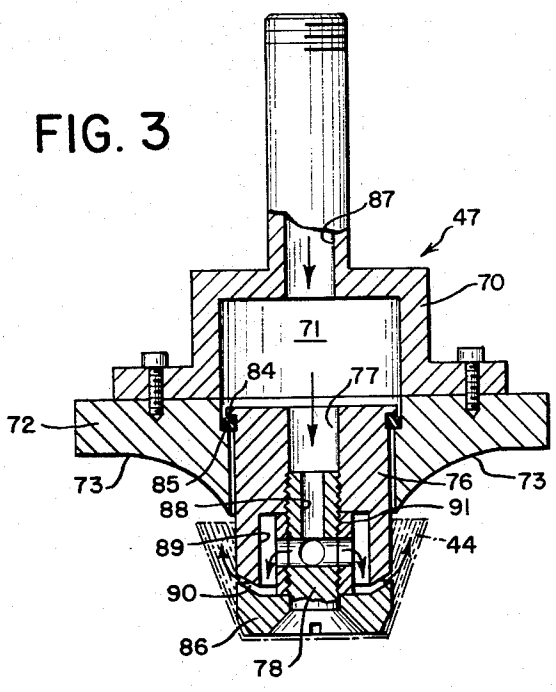
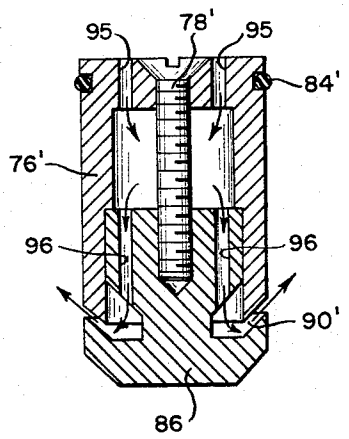


FIG. 4

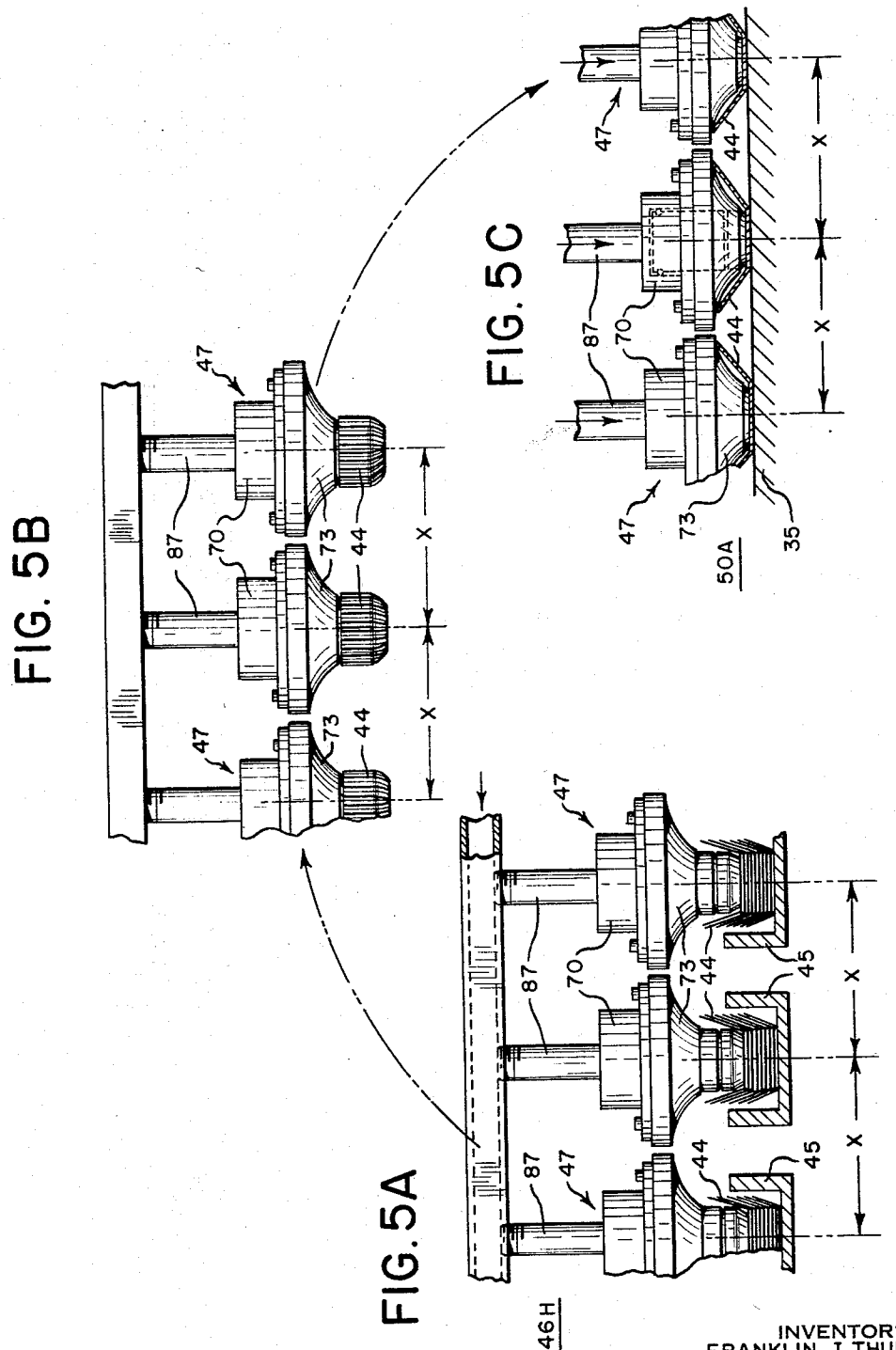


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FIG. 6

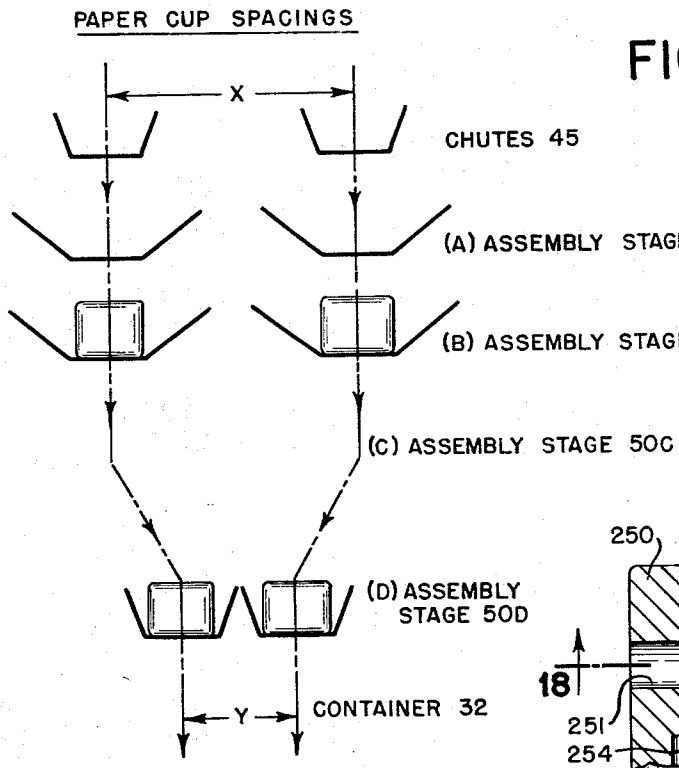


FIG. 17

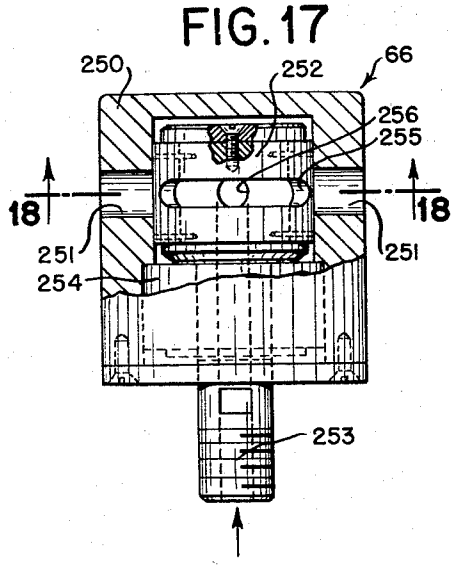


FIG. 7

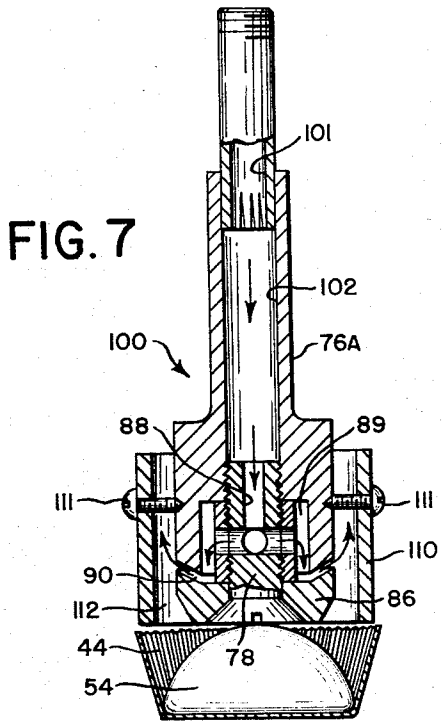
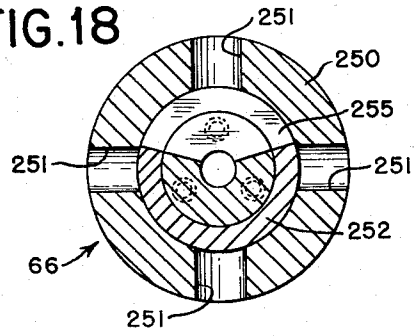


FIG. 18

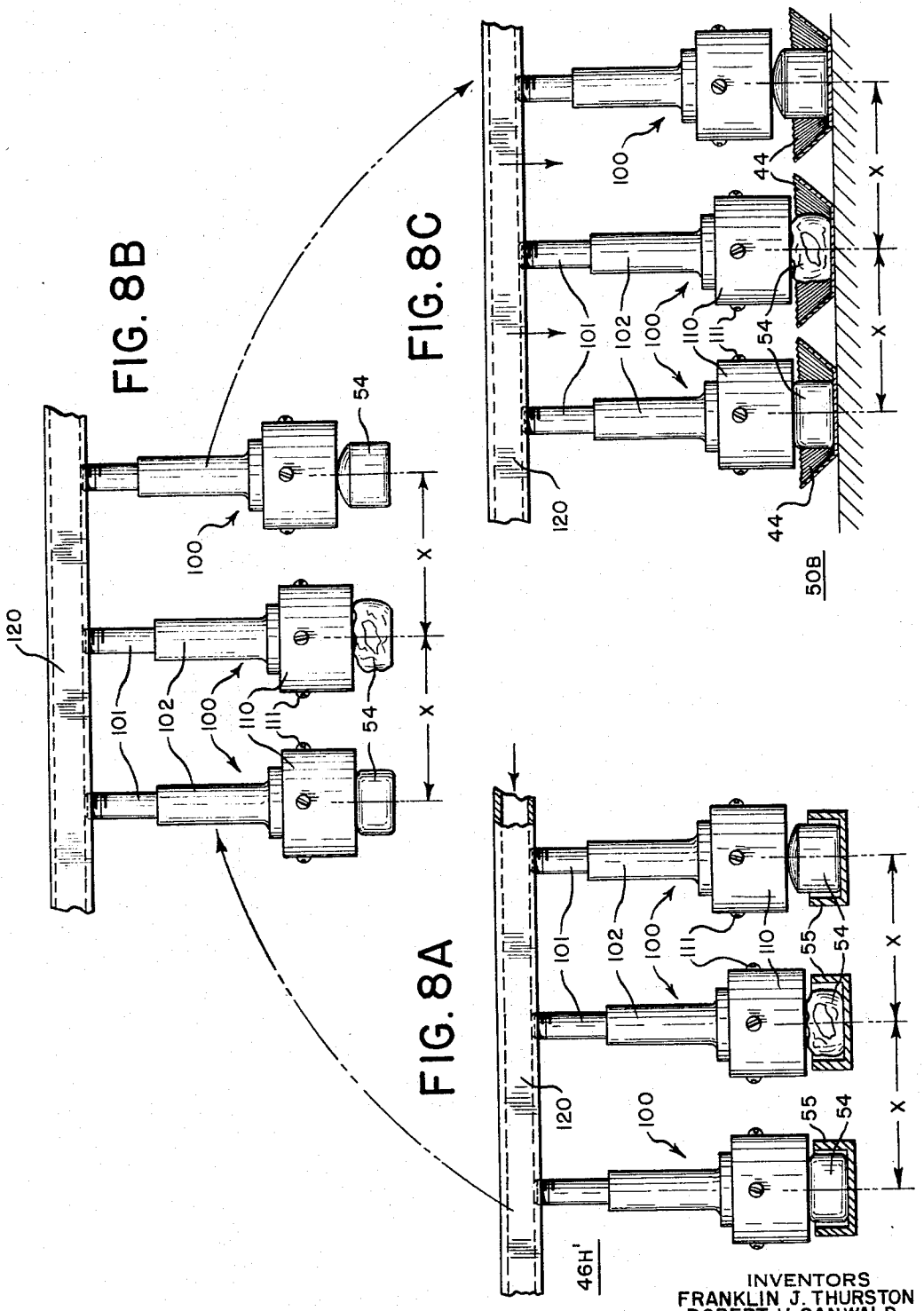


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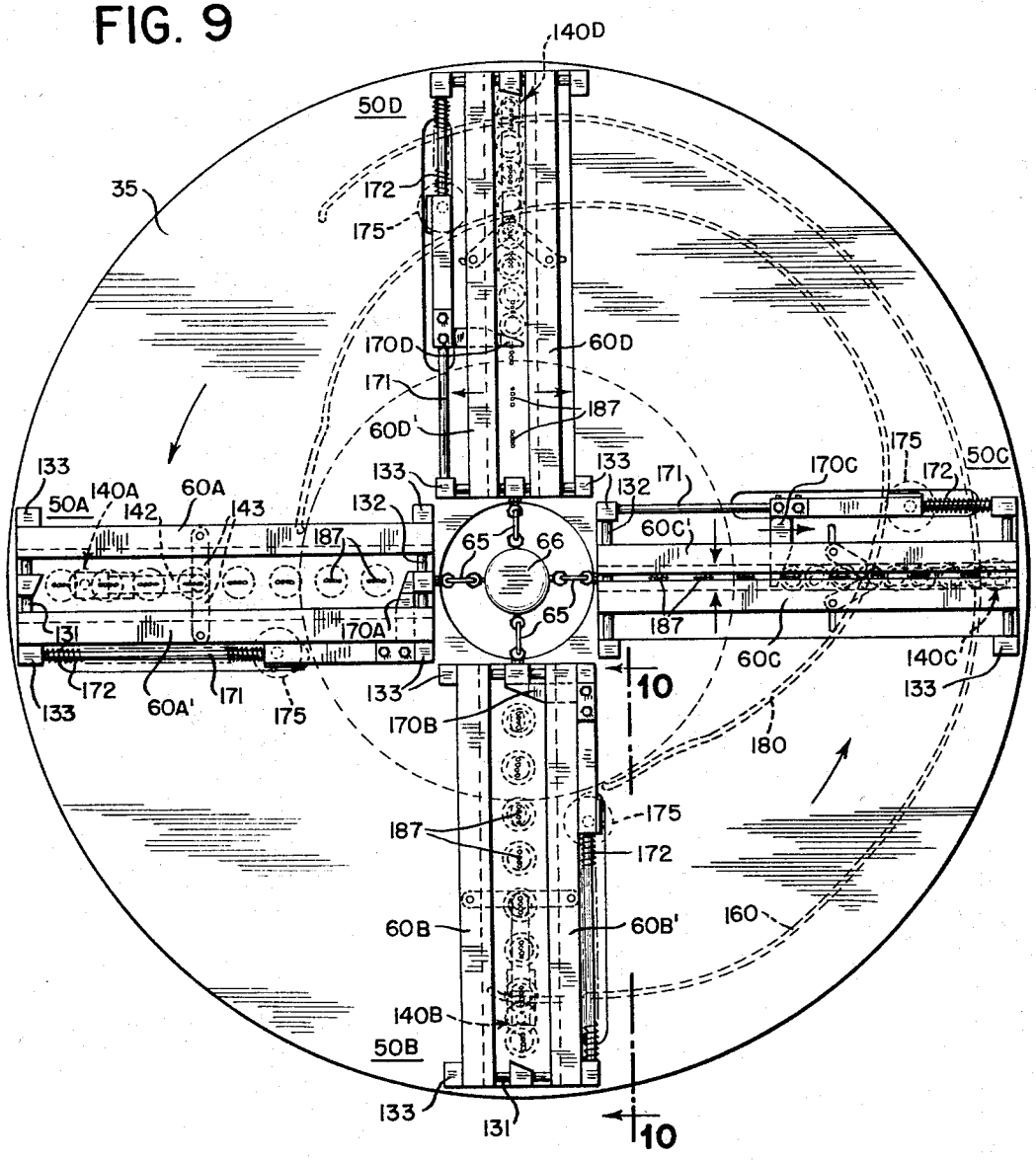
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FIG. 9



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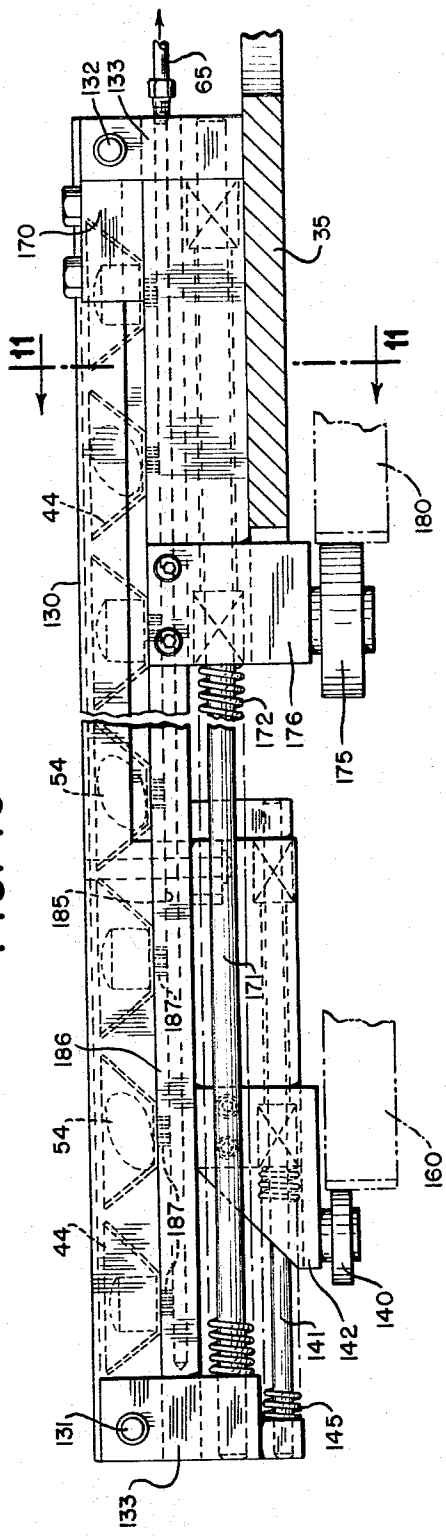


FIG. 10

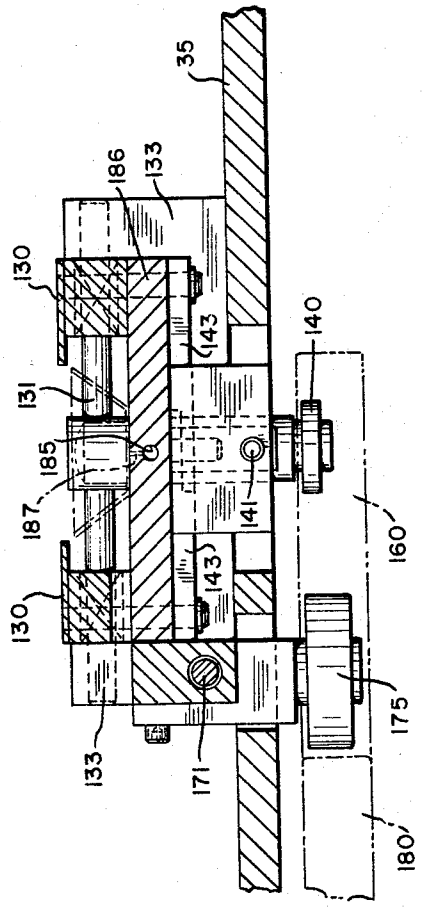


FIG. 11

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FIG. 12

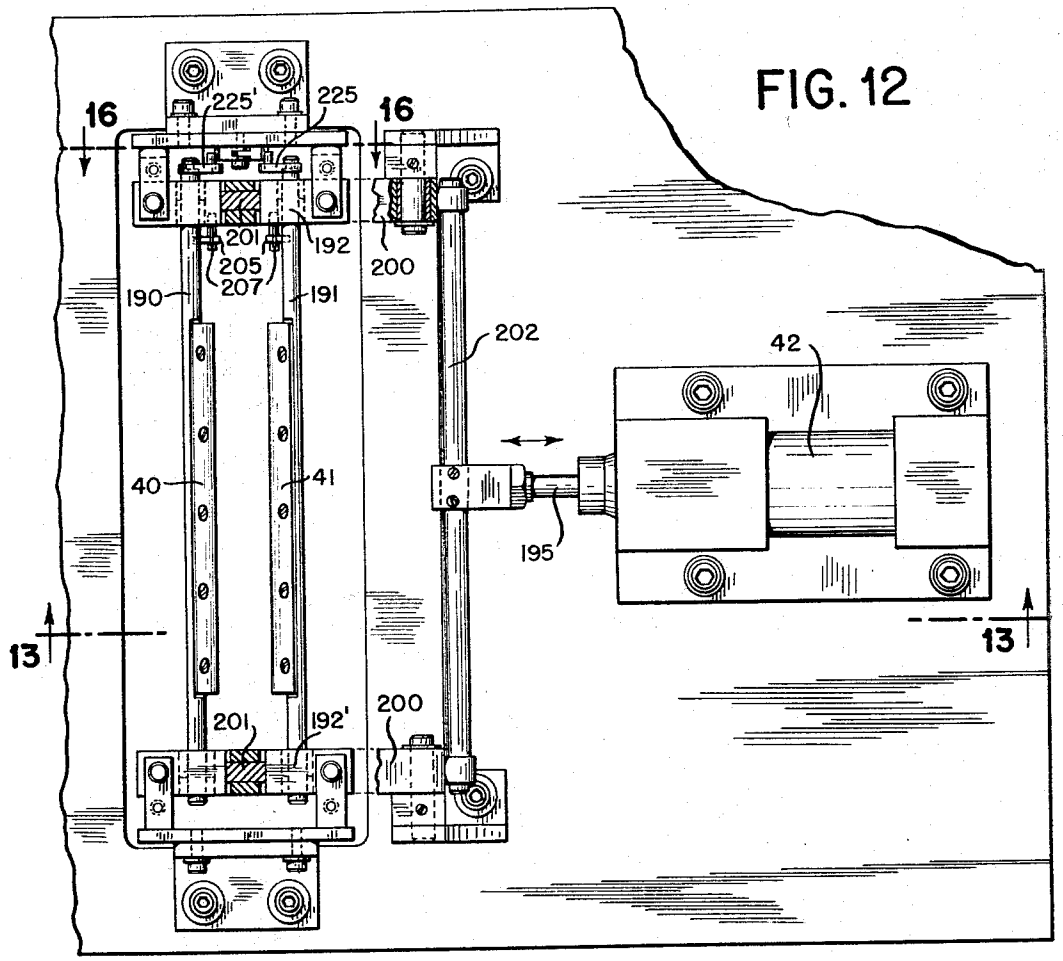
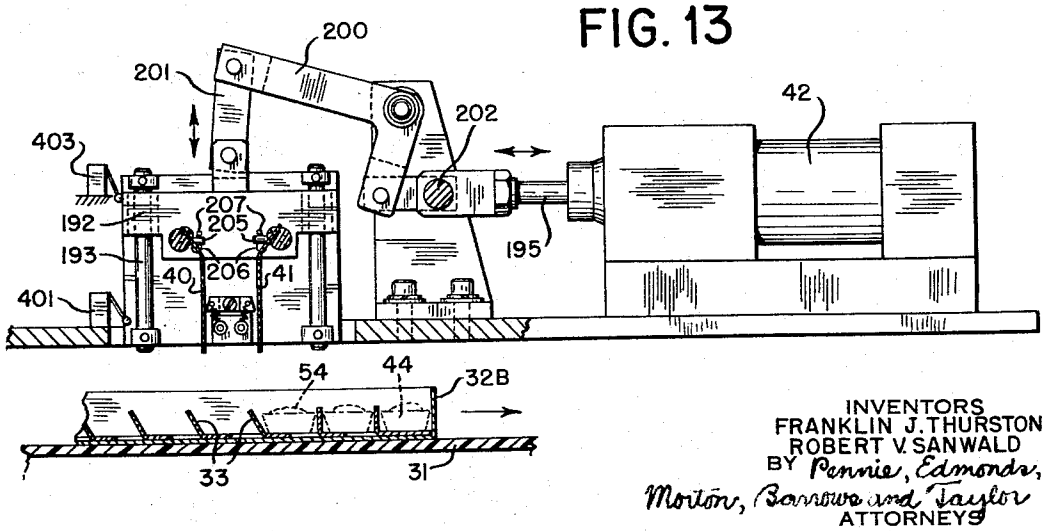


FIG. 13



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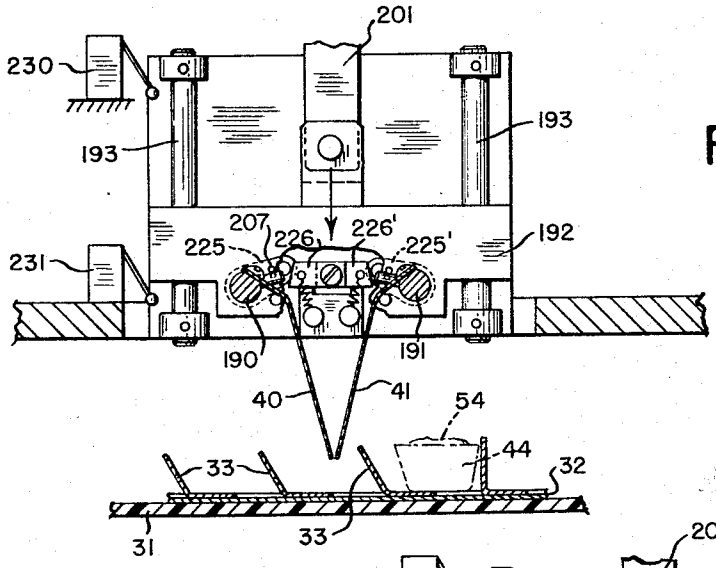


FIG. 14

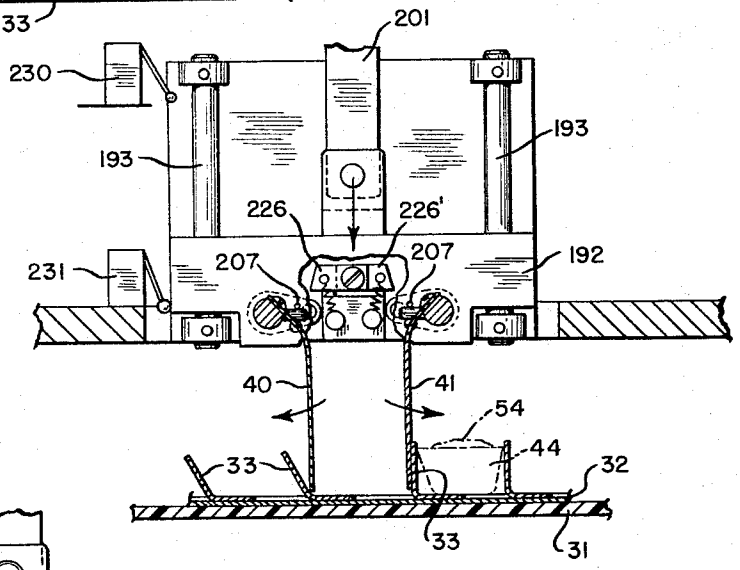


FIG. 15

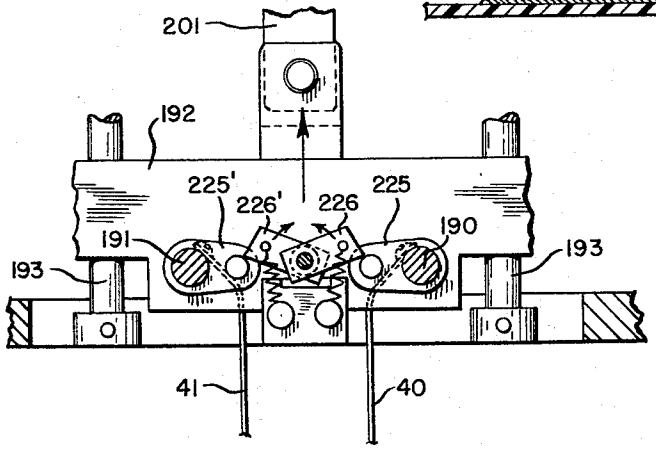


FIG. 16

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FIG. 19

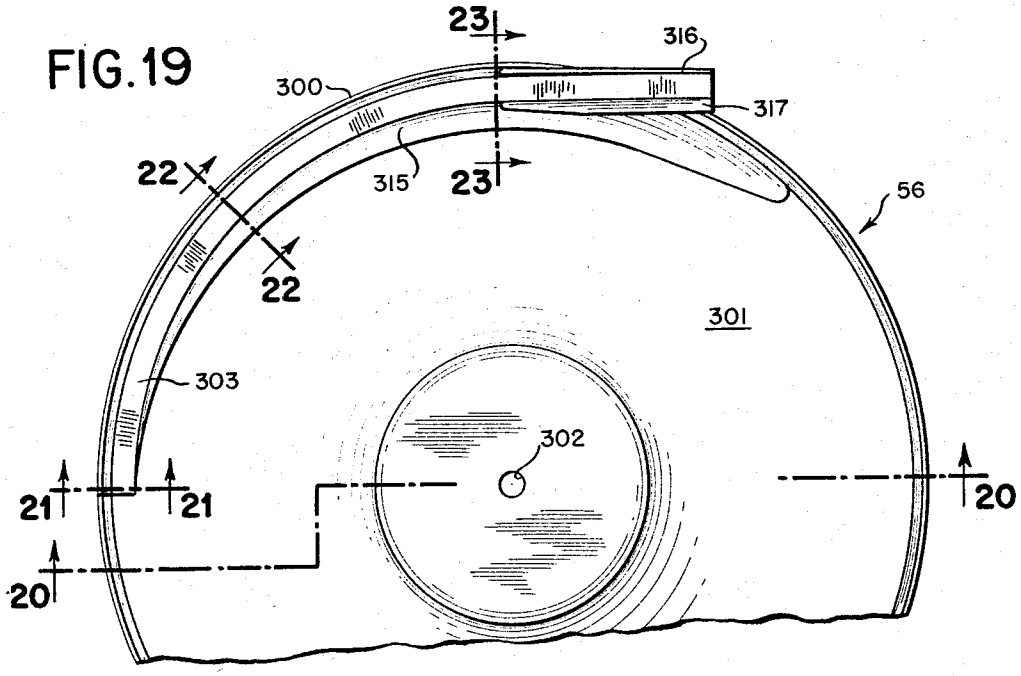


FIG. 20

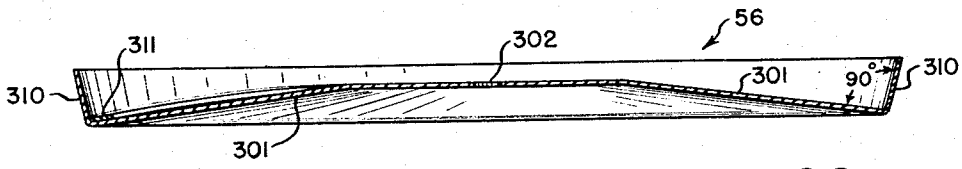


FIG. 21

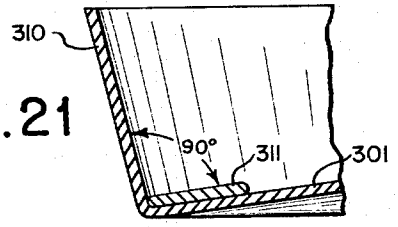


FIG. 22

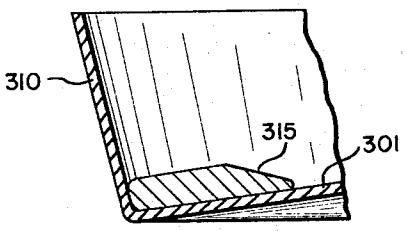
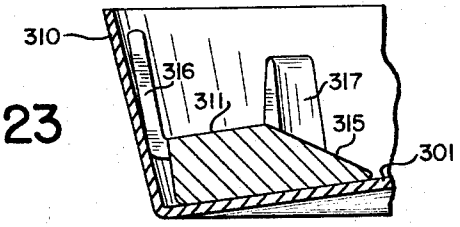


FIG. 23



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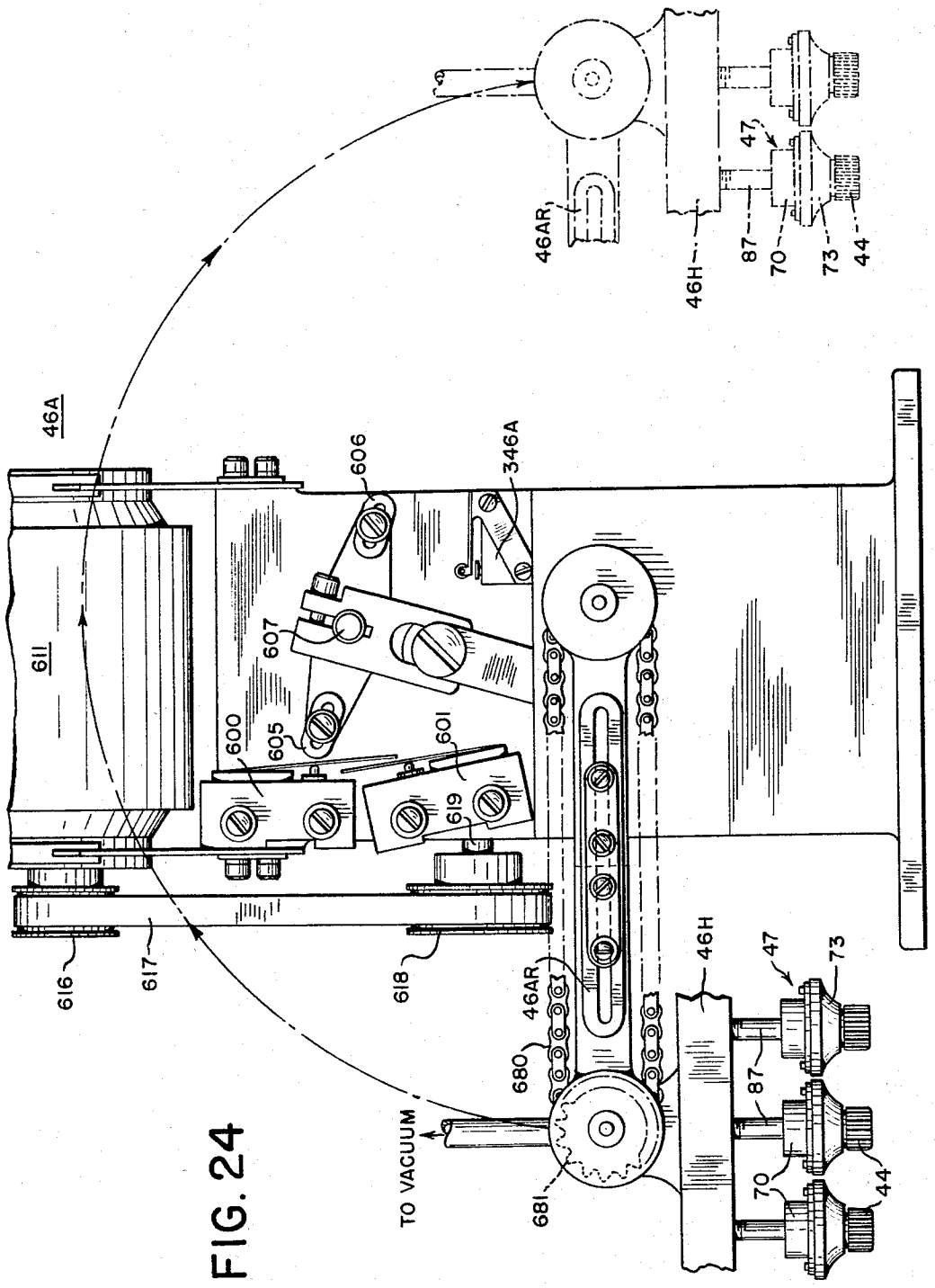


FIG. 24

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FIG. 26

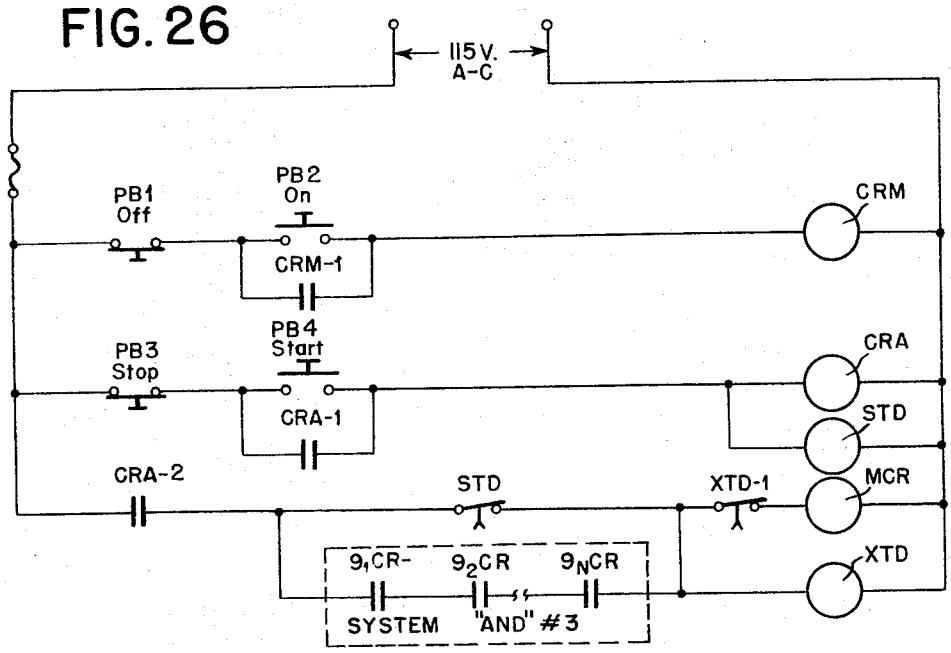
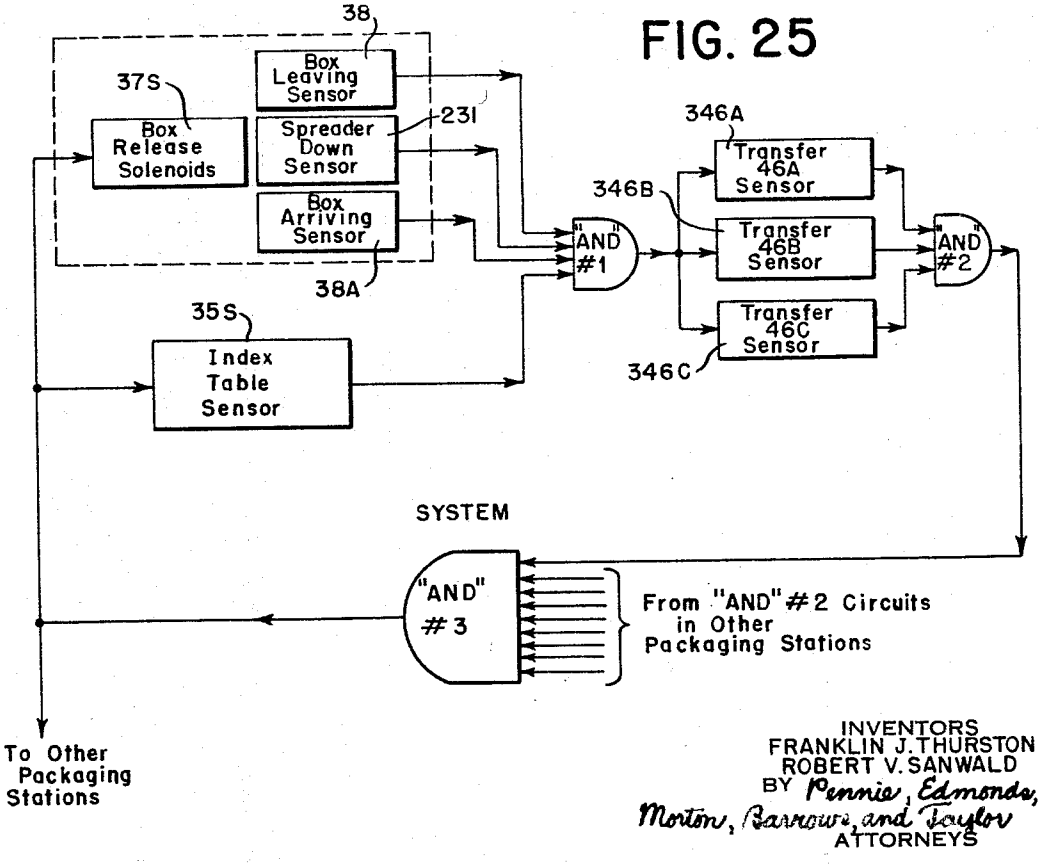


FIG. 25

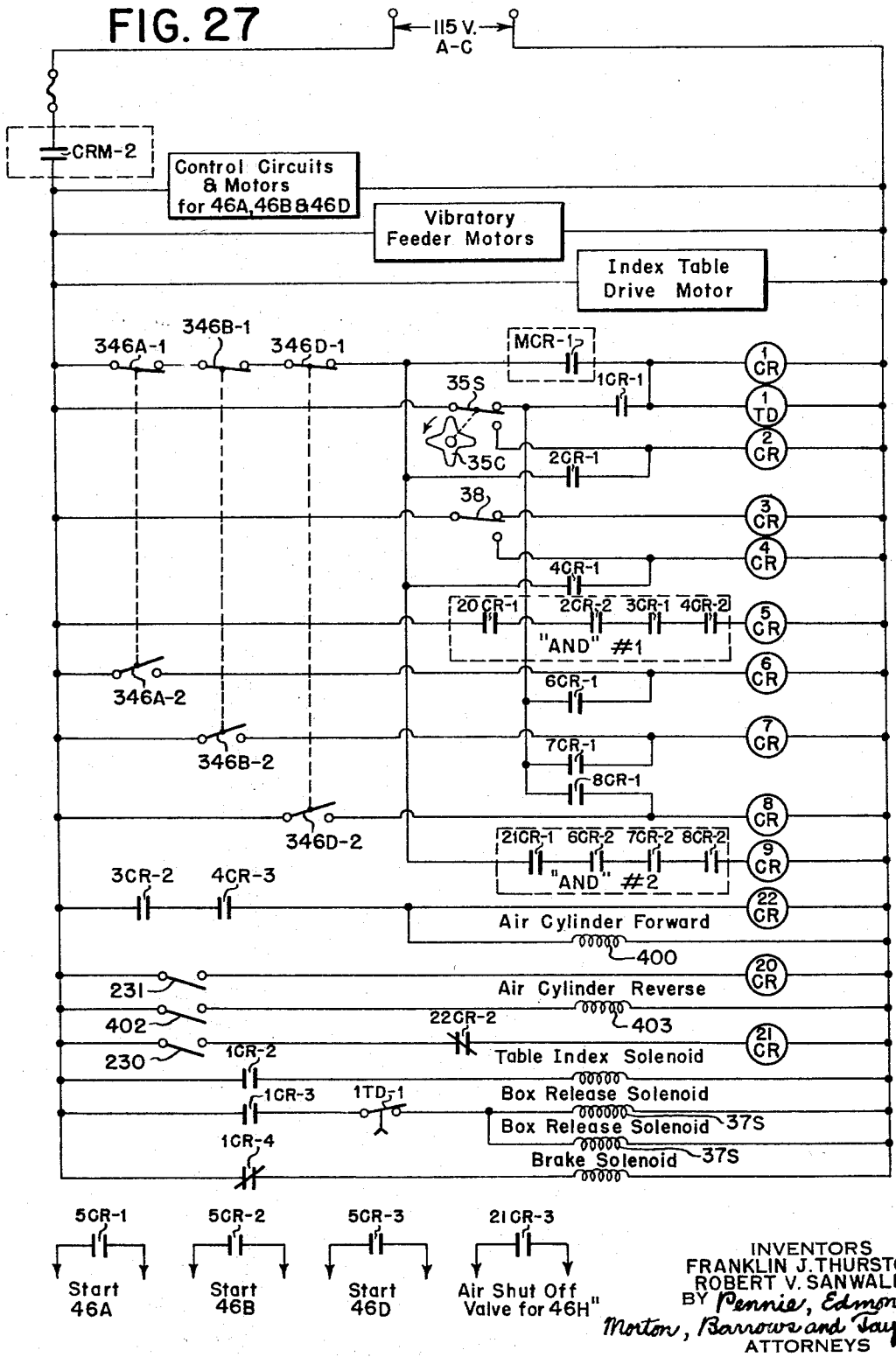


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FIG. 27



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AUTOMATIC PACKING APPARATUS

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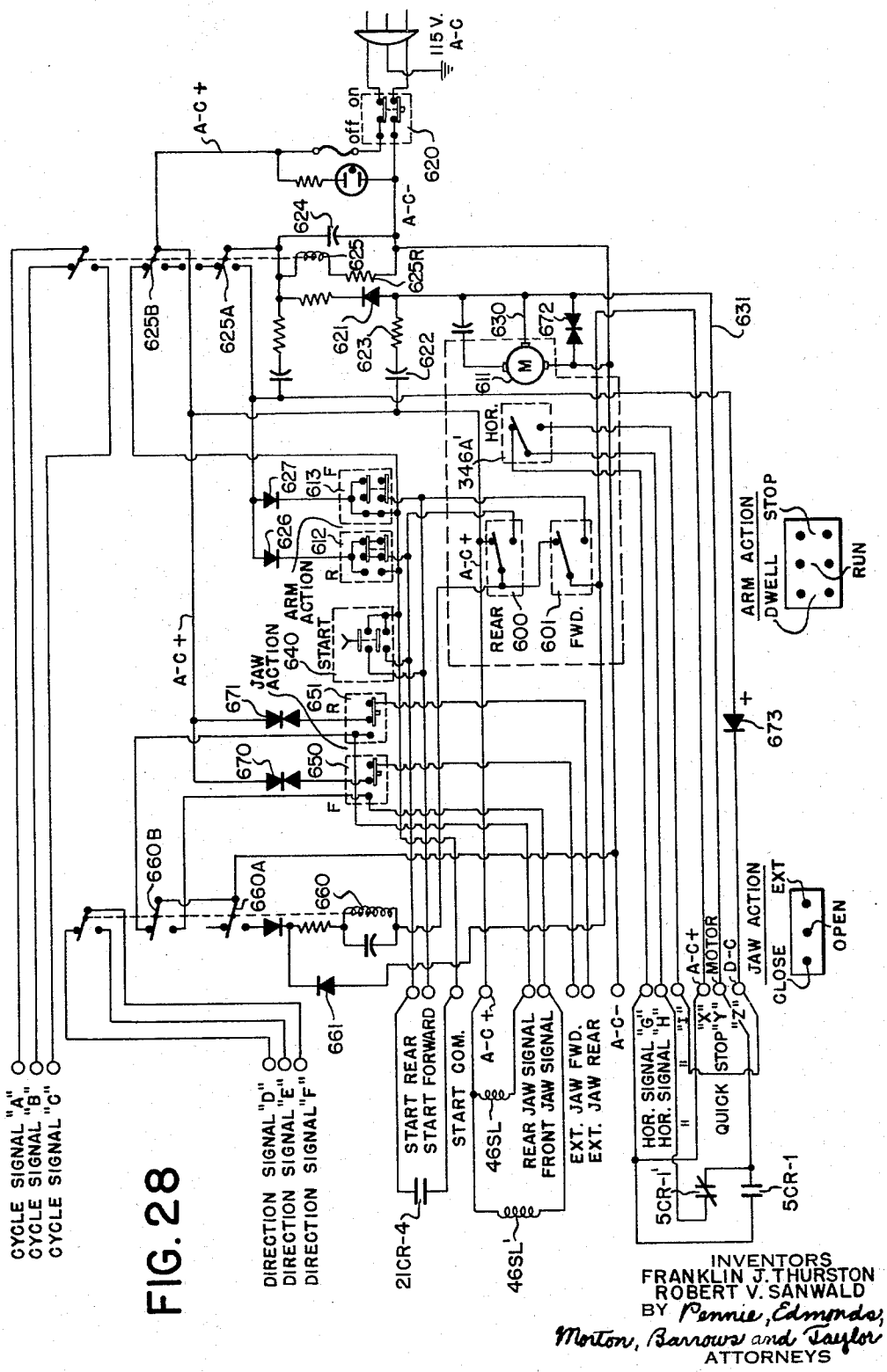


FIG. 28

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United States Patent Office

3,283,471

Patented Nov. 8, 1966

3,283,471

AUTOMATIC PACKING APPARATUS

Franklin J. Thurston, Bethesda, and Robert V. Sanwald, Burtonsville, Md., assignors, by mesne assignments, to GBL Corporation, Washington, D.C., a corporation of Maryland

Filed Dec. 14, 1962, Ser. No. 244,639
15 Claims. (Cl. 53—55)

The present invention relates to methods and apparatus for packing rows of articles in a container, and more particularly to apparatus which is adapted to automatically assemble and load into container cartons rows of comestible articles and the like. The apparatus of the present invention is particularly well suited for automatically packing delicate candies wherein each piece is packed in an individual decorative protective corrugated paper cup.

Although various types of automatic packing machines have been proposed in the prior art, most of the methods and machines that have been proposed for packing delicate comestible articles have never been widely used because they have been found to be unreliable or lacking in flexibility of operation, particularly where the delicate articles of various shapes and sizes must be rapidly packed without omissions and without damage.

It is a principal object of the present invention to provide methods and apparatus for rapidly and reliably assembling and packing a wide variety of various shaped comestible articles or the like in any desired or prescribed pattern within a container and without damaging the container, the individual articles or the protective paper cups, etc.

In accordance with the present invention a novel method for packing containers with delicate comestible articles is provided wherein an entire row of articles is automatically packed in resilient protective cups on a staging assembly station and the entire row of cupped articles is then transferred as an ensemble into the container. Following the method steps, an entire row of protective cups is mounted on the staging station with the opening of each cup being spread to an enlarged diameter and the spacings between cups being extended sufficiently to accommodate the spread cup dimensions. The assembly station with the row of spread and spaced cups is then moved to an article loading station where an entire row of articles is deposited in the row of spread cups. In the third operating step, the assembled spread row of cupped articles is compacted in width and length and advanced to a container loading station where the entire compacted row of cupped articles is transferred to the final container.

In the preferred embodiment of the invention a conventional conveyor-belt is provided for transporting each container adjacent to a row-loading station, and control means are provided for momentarily stopping the container-box successively at each row loading station whereupon an individual row of articles is placed into the box. Since each of the row-loading stations provided to form an entire container-packing system is identical, only a single station will be described herein.

In accordance with one featured aspect of the invention, a special index table equipped with one or more staging stations (preferably four) is provided for assembling in steps each row of cupped articles to be loaded. In the first step, a full row of corrugated paper cups is transferred from conventional orienting and parts-feeding devices to a vacant assembly station on the index table. In this first operating step, an entire row of protective cups is transferred from a row of stacked cups by a transfer arm equipped with special pneumatically actuated

pick-up heads (one for each cup). In the transfer operation, the paper cups are positioned at exaggerated spacings in an assembly station on the rotatable index table and the open ends of the corrugated cups are spread outwardly by the special pick-ups heads as the cups are placed in their rest positions in the assembly station.

In the second operating step, the assembled row of spread corrugated paper cups is rotatably advanced to an article loading station where an entire row of candy articles or the like is picked up by a transfer device equipped with a row of compressed air-actuated pick-up heads and transferred to and positioned in the waiting row of spread paper cups. The article-loaded row of paper cups mounted on the table in an assembly station at exaggerated spacings is then rotatably advanced to a final transfer device equipped with a special pneumatically energized pick-up head that is adapted to pick up the entire assembled row of cupped articles and transfer the entire ensemble into a waiting container mounted on the conveyor belt.

In accordance with the invention, cam-actuated compressing rams, forming the side walls of each assembly station on the index table, are provided to gradually compact or compress the assembled row of cupped articles from the exaggerated center line spacings utilized in the assembly receiving stations in steps **1** and **2** to a narrower and shorter length row that can be received by the container-box. Thus the length and width of the assembled row of cupped articles that is delivered to the transfer mechanism at the third transfer operation corresponds to the row width and row length of the boxed articles.

In the preferred embodiment of the invention, a self-commutating vacuum manifold is provided to supply desired suction action to small apertures under each paper cup in the assembly station floor to securely hold each cup in place as the indexing table rotatably advances from station to station in the staging and loading operation. The vacuum supply is removed from the apertures just prior to the commencement of action of the compression rams.

In accordance with a further aspect of the invention, a pneumatically actuated spreader mechanism is provided which is adapted to physically separate and spread the spacer members that are conventionally utilized in containers to separate individual rows of cupped articles. The spreader fingers, which are controlled in timed relationship with the operation of the cupped candy transfer, move downwardly into the candy box on the conveyor belt with the fingers in a compact closed position and then spread outwardly so as to move flattened out or deformed spacer members to an upright vertical position. The spread fingers are spaced sufficiently so that the transfer arm pick-up head may pass between the spreader members and deposit the row of compacted cupped articles in the container.

Electrical logic control circuits are provided to maintain each step of the assembly, transfer and article-delivery operation in timed synchronization. Interlock and logic control circuits are also provided to assure continuity and synchronization of operation between each of the plural row-loading stations within a container-packing system.

The packing methods and apparatus of the present invention provide a flexible, high speed packaging operation which can be reliably utilized to replace a number of human operators having relatively slow and limited article handling capabilities. The methods and apparatus of the present invention eliminate human handling of comestible articles and the like and at the same time maintain a quality packaging aspect that is important to product merchandising.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings in which:

FIG. 1 shows a simplified plan view of a single article row-loading station provided by the present invention;

FIG. 2 is a plan view showing spaced rows of stacked protective cups delivered to the cup-loading station;

FIGS. 3 and 4 are partial sectional views of pneumatic actuated paper-cup pick-up heads provided by this invention;

FIGS. 5A, 5B and 5C are elevation views illustrating the pick-up, transfer and placement operations of the pick-up heads shown in FIGS. 3 and 4;

FIG. 6 is a schematic illustration showing the spacings of the protective paper cups during the various steps of the packing operation;

FIG. 7 is a sectional view showing a preferred embodiment of a compressed air-actuated cupped-candy pick-up head;

FIGS. 8A, 8B and 8C are elevation views illustrating the pick-up, transfer and placement operation of the pick-up heads shown in FIG. 7;

FIG. 9 is a plan view of an indexing, staging and assembly station provided by the invention;

FIGS. 10 and 11 are side and end views respectively of an individual assembly station as shown in FIG. 9;

FIGS. 12–16 are plan and elevational views showing the spacer spreader apparatus provided by the invention;

FIGS. 17 and 18 are sectional elevation and plan views of a vacuum commutating manifold for the assembly stations as shown in FIG. 9;

FIGS. 19–23 are partial plan and sectional views showing the features of a preferred hopper-bowl and orientation segment for delivering oriented candy articles and the like to a loading station;

FIG. 24 is a simplified elevation view of an electrically operated transfer device preferred for use in practicing the present invention; and

FIGS. 25–28 are simplified block and schematic diagrams of electrical logic control circuits for energizing and controlling the apparatus of the invention.

For purposes of explaining the methods and apparatus of the invention, a preferred embodiment of apparatus for packing delicate chocolate covered candies will be described. Referring to FIG. 1, there is shown in simplified plan view a single row packing station **30** which includes a continuously driven conveyor belt **31** provided to deliver individual box-containers **32** equipped with row separators or spacers **33**. As illustrated a box-container **32A** is supported and transported on conveyor belt **31** from previous row-loading stations (identical to **30**) to a loading station immediately adajacent to index table **35**. Box **32B** is shown in the "stop" or "loading" position and is held in the fixed loading position by holding fingers **37** which are actuated to release the box by solenoids **37S**.

The solenoid actuated holding fingers are mounted on rod members **37R** and are adjusted in position with respect to box **32B** so that the next empty row lies immediately beneath the spreader fingers **40** and **41**. Presence of the box at the loading station is sensed and indicated by micro-switches **38** and **38A**, the operation of which will be described in further detail in connection with an explanation of the electrical logic control circuits shown in FIGS. 25 and 27. Spreader fingers **40** and **41** mechanically driven by pneumatic-actuator **42** are provided to assure proper spacing and upright positioning of the conventional row-spacers in the container box **32B**. The detailed operation of this mechanism will be discussed in further detail in connection with the description of FIGS. 12–16 below. As indicated above, the apparatus provided at **30** is adapted to automatically place a single

complete row of cupped candies between a predetermined pair of partitioning dividers or spacers in box **32B**.

The present invention provides excellent packaging flexibility insofar as it permits intermixing of different candy types and container cups within a given row as desired. The desired flexibility of programming a container's contents is effected by the provision of a central staging index table **35**, upon which are assembled rows of cupped candies of various types in any desired predetermined order or sequence. Stocks of corrugated paper cups **44** are supplied from a conventional vibratory feeder in pre-oriented positions by inclined chutes **45**. Three transfer devices **46A**, **46B** and **46D** are provided with plural pick-up heads to load and unload the four assembly and staging stations **50A**, **50B**, **50C** and **50D**, as shown. The transfer devices are preferably of the type described in pending patent application Serial No. 216,626, filed August 13, 1962 by John D. Goodell et al., now Pat. No. 3,182,813.

In the example shown in FIG. 1, eight individual corrugated paper cups are delivered to station **50A** by transfer mechanism **46A** having eight individual cup pick-up heads at **46H**. As described in greater detail below, the pick-up heads **46H** are arranged to deliver the eight individual corrugated paper cups to station **50A** with the open sides up and with the side walls flattened or pressed outwardly and downwardly so that the mouths of the cups are extended to a larger diameter.

As shown, the operations of transfer mechanisms **46A**, **46B** and **46D** are synchronized with one another and maintained in operating timed relationship with the dwell times in the rotation of index table **35** as will be explained in greater detail below. Transfer mechanism **46B** with its pick-up head **46H'** is provided to deliver eight pieces of candy **54** to the spread paper cups at station **50B**. Rows of pre-oriented candies (with proper spacings) are delivered to the pickup head **46H'** by inclined chutes **55** as shown. The centers of chutes **55** are spaced to match the center line spacings of the individual pick-up heads on **46H'** and in turn to match the center-to-center spacings of the spread cups in station **50B**. The individual candies are advantageously delivered to chutes **55** by vibratory hopper feeders **56** having special non-marring track and bowl configurations and orientation segments as illustrated in FIGS. 19–23.

After the candies have been delivered to the individual cups at station **50B** by transfer device **46B**, index table **35** is advanced to station **50C** and thence to station **50D** where transfer mechanism **46D** with plural pick-up heads **46H''** is automatically operated to transfer the entire row of 8 cupped candies to box **32B**. During the course of travel from **50B** to **50D**, the side walls **60B** and **60A** and end wall **62B** are automatically driven inwardly to restore the corrugated side walls of the individual paper cups to their normal upright positions and to correspondingly shorten the length and width of the row of cupped candies as indicated at stations **50C** and **50D**. The shortened length, as explained above, corresponds to the row length that can be accommodated by the width of box **32B**.

In the preferred embodiment of the invention as illustrated in the simplified plan view of FIG. 1, small apertures (see FIGS. 9–11) are provided in the floor surface of each station **50A–50D** on centers that fall beneath each container cup. The apertures are connected to a vacuum supply via ducts **65** and commutating manifold **66** which will be described in greater detail in connection with FIGS. 17 and 18 below.

It will be appreciated that the apparatus shown at **30** may be readily programmed to automatically load various types of candy within an individual row as required and that the several stations **30** that are operatively combined to form an entire automatic packing system may be cooperatively programmed with candies and receiving

cups to form any desired packaging pattern within a given container layer.

Reference will now be made to the remaining figures in connection with a more detailed explanation of the invention. It will be seen in FIG. 2 that the stacks of pre-oriented paper cups **44** are delivered in inclined chutes **45** with center-to-center spacing of X. The distance X is greater than the center-to-center spacing which the cups will have when mounted in wall-to-wall contact with one another in box **32**. The spacing X is selected to permit a spreading or flattening out of the corrugated side walls of the individual cups without causing interference between the spread edges of adjacent cups. (See FIG. 5C.)

A pick-up head provided for use as a paper cup pick-up device at **46H** is shown in sectioned view at FIG. 3. The special head **47** which is designed to pick-up individual paper cups **44** from the tops of stacked cups delivered by chutes **45**, includes an upper housing **70** with internal chamber **71** and a lower frame support **72** having an upperly curved under surface **73** as shown. A central cylindrical plunger assembly **76** is provided having an upper cylindrical bore **77**, the lower portion of which is threaded to receive screw member **78**. The entire core member **76** is adapted to move up and down in chamber **71** being restrained in its travel at the lower end of the chamber by the engagement of lip **85** with O-ring **84**. A 360° slit aperture is defined by the adjacent spaced surfaces of **76** and end cap **86**. A source of compressed air is connected to the upper end of duct **87** and flows downwardly through chamber **71**, bore **77**, bore **88** in screw **78**, through the annular chamber **89** and upwardly through the slit aperture **90** as shown. The width of aperture **90** is determined by selection of the length of spacer **91**.

The upward flow of air through slit aperture **90** between the cylindrical surface of core **76** and the side wall surface of cup **44** produces a reduced pressure along the inner surface of the cup wall causing the top wall of the cup to collapse inwardly and separate from the remaining cups in the stack. During the pick-up operation the cylindrical core **76** is disposed in its downward position as shown in FIG. 3. Core **76** remains in its down most position during the transfer operation as shown in FIGS. 5A and 5B. When the pick-up head **46H** is transferred to station **50A** on index table **35**, the side walls of cups **44** are spread outwardly by the curved surfaces **73** as shown in 5C. Thus the top diameters of the individual cups **44** are substantially increased and so conditioned to receive a wide variety of shapes and sizes of candies. When the transfer of head **46H** is moved to receiving station **50A**, it will be seen that the central core **76** is moved upwardly in chamber **71** and the pressure reducing action due to upward flow of air through slit aperture **90** is automatically cut-off by the upward movement of **76** into chamber **71**. Prior to the return of pick-up head **46H** by transfer apparatus **46A**, the air pressure to the individual pick-up heads **47** is turned off so that the individual cups **44** remain on the surface of table **35** at station **50A**. An entire row of paper cups with spread tops is thus delivered to **50A** and upon return of the transfer arm for **46A**, index table **35** is rotatably driven so that station **50A** is moved to the position occupied by station **50B** (see FIG. 1).

An alternative embodiment for the core of pick-up head **47** is shown at **76'** in FIG. 4. In this embodiment, an end cap **86** is supported from the top of core **76'** by screw member **78'**. Compressed air is supplied via duct **87** and chamber **71** via ducts **95** and **96** to slit aperture **90'**. The operation of this core member in conjunction with pick-up member **47** is the same as described above.

A preferred embodiment of a special compressed air operated pick-up head for **46H'** and **46H''** is shown in FIG. 7. This head is particularly well suited for picking up a variety of differently shaped candies either mounted in cups as shown in FIG. 7 or without cups as delivered in the supply chutes **55**. Since certain portions of this head are identical in construction to portions of pick-up head **47** (FIG. 3), the like or similar parts are given the same numbers. Compressed air is supplied to each individual pick-up head **100** via telescoping tubes **101** and **102**. In operation the lower cylindrical core **76A** is adjusted so that the tip of the pick-up head (**86** and **78**) just comes in contact with the delicate candy surface. The adjustment is not critical since lifting action is achieved by dynamic air flow, no seal being required.

Pick-up head **100** has a cylindrical sleeve **110** secured to **76A** by screw members **111**. Sleeve **110** and the lower outer wall surface of **76A** defines an annular shaped orifice through which the upward flow of compressed air from aperture **90** is directed. The upward flow of air creates a reduced pressure area at the mouth opening **112**. Operational experience has clearly indicated that this head is capable of reliably picking up all known irregularly shaped pieces of candy. The operation of pick-up head **100** is to be contrasted with conventional vacuum type pick-up heads wherein successful operation is dependent upon the maintenance of a substantially air-tight seal between the surface of a concave rubber pick-up head and the surface of the article to be picked up. By way of contrast, the present head is a dynamic type pick-up device which relies upon flow of air around the outer periphery of the candy article or the like for its lifting action.

The operation of pick-up heads **100** as utilized at **46H'** in the transfer of candies from chutes **55** to assembly station **50B** is illustrated in FIGS. 8A, 8B and 8C. Compressed air for the entire pick-up head is supplied via manifold duct **120** as indicated. The same pick-up head is utilized at **46H''** except that the individual heads **100** are spaced closer together on centers Y corresponding to the actual candy spacings provided for in the individual box container.

In certain applications where it is necessary or desirable to mount a minimum amount of equipment on the movable pick-up arm, the core **76A** for each pick-up head may be mounted in a fixed position adjacent the transfer arm and the sleeve **110** may be extended to the movable head with a flexible hose. The hose may be connected to a short piece of surgical rubber tubing, the open end of which functions as the pick-up head for the cupped candies.

Operation of the automatic assembly compacting apparatus on index table **35** will now be described in connection with the plan view showing of FIG. 9. The drive mechanism for index table **35** may be any one of several well known conventional arrangements such as a four-position Geneva movement or an equivalent cam drive which is shaft driven by an electrical motor through an electrically actuated clutch mechanism. A solenoid actuated indexing mechanism is included as a part of the drive mechanism to assure positive indexing of the table at 90° intervals corresponding to the loading and unloading stations A, B, C and D. Since the operation of such driving mechanisms is well known and does not form a part of the present invention, descriptions of the control circuits will be restricted to the control circuit diagram shown in FIG. 27. Indexing table **35** is advanced in 90° intervals of rotation from station A to B to C to D after each of the respective loading and transfer operations is completed by transfer mechanisms **46A**, **46B** and **46D**. Transfer device **46A** is adapted to place a full row of corrugated paper cups (8 in the example shown) between the side wall ram members **60A** and **60A'** at station **50A**. The movable side wall rams **60A** and **60A'** are disposed in their outermost position so that the widest clearance between the inner edges of these ram members is provided for the reception of transferred and spread paper cups. The side rams are identical for each of the four stations **50A**, **50B**, **50C** and **50D**, each pair of side rams being mounted for limited inward and outward movement on rod members **131** and **132**. Rods **131** and **132** are in

turn rigidly supported to the surface of table **35** by posts **133** as shown.

A cam follower mechanism is provided to gradually move the side wall compacting rams **60** inwardly as the staging and receiving station **50B** is advanced through 90° intervals from station B to C and finally to D. The cam drive mechanism includes a cam follower **140** which is slidably supported on rod member **142** as indicated. **140** is mechanically coupled to side rams **130** by arm member **142** and toggle links **143**. Radially outward movement of cam follower **140** on its support rod **141** draws the side rams **130** inwardly to a desired compacting position as shown in FIG. 10. Cam follower **140** is spring loaded inwardly by spring member **145** mounted on rod **141**. Thus the side rams **130** are maintained in a spring loaded-outwardly-spaced position at all times until such time as cam follower **140** is driven in a radially outward position. As shown in FIGS. 10 and 11, a cutout in the surface of table **35** is provided to permit free movement of cam follower **140** in a radial direction beneath the table surface.

Inward movement of the side wall rams is controlled or programmed by extended cam **160** which is supported by the main base support for the index table (not shown) and position arranged to function cooperatively with cam follower **140**. As illustrated cam **160** is mounted beneath the surface of table **35** extending from a starting point adjacent station **50B** and continuing on through a path following along the outer peripheral edge of table **35** to a terminal point slightly beyond station **50D**. In normal operation, cam follower **140** engages cam **160** at station B and is driven gradually in a radially outward direction as the table is rotationally advanced to station C and beyond. The outward movement of cam **140**, as explained above, moves the side wall rams **60** inwardly causing the side walls and paper cups to be compressed inwardly and hence restored to a normal width corresponding to that of the cup delivered in chutes **45**. As cam follower **140** is advanced to station, D, cam **160** is so shaped as to permit the cam follower **140** to move radially inwardly. Thus the ram walls are permitted to move in an outward direction and access between the adjacent inner top edges of rams **130** is thereby afforded the pick-up head for transfer device **46D**.

After table **35** has advanced slightly beyond station D the termination of cam **160** permits cam follower **140** to move to its radially innermost position and the assembly station is thus restored to a condition for receiving another charge of paper cups at station A.

A single end positioned compacting ram **170** is provided to gradually compress the assembled row of paper cups and candies to a length that can be accommodated by the box-container **32**. As shown in FIG. 9, cam **170** is slidably supported on rod **171** and spring loaded inwardly by coil spring **172**. Cam follower **175** is pivotally attached to ram **170** by arm **176**.

A separate programming cam **180** is provided underneath table **35** and supported by the base frame to drive cam follower **175** and force end ram member **170** inwardly so as to shorten the row length of candy-filled paper cups. The lengthwise compacting operation provided by ram **170** is commenced shortly after the candies have been loaded into the cups at station **50B** (see FIG. 9). By the time assembly station **50B** has advanced to position C and then to D, the entire row length has been compacted to its proper length to be received by box **32**. When a given assembly and staging station has reached station D, it will be seen that the cooperative action of side rams **60** and end compacting ram **170** have effectively restored each of the paper corrugated cups to its normal dimensions and thus positioned the entire row of cupped candies on centers corresponding to the centers of the plurality of pick-up heads on the transfer arm of **46D** (see FIG. 6).

After an assembly station has passed station D, the cam **180** is so shaped as to permit cam follower **175** to gradually return to its innermost rest position. Thus by the time an assembly station has been returned to station A, the length and width dimensions of the station floor area are returned to maximum.

In the preferred embodiment of the invention, a vacuum supply duct **185** is provided in the floor **186** of each assembly station on the index table and connected to a vacuum supply by duct **65** through a vacuum commutator **66**. A plurality of small apertures **187** are provided which communicate between duct **185** and the upper and outside surface of **186**. These small apertures provide the required suction action to hold each paper cup in its proper position as the index table is advanced from station A to B and thence to C. Commutator **66** is provided to switch the vacuum supply on as an assembly station advances to point A and then turn the vacuum supply off as the assembly station progresses beyond B and nearly to station C. The suction action provided by the small apertures is advantageously used during that portion of the operating cycle when the walls of the station are spread. The cups being empty during part of the travel might otherwise have a tendency to be displaced as the table is rotated. The vacuum is switched off just prior to the time where the cams **160** and **180** initiate the compacting action by rams **60** and **170** respectively. The individual cups are thus released to move freely with the inward and outward movements of the above described compacting walls.

Operation of the commutating vacuum manifold will now be described in connection with FIGS. 17 and 18 which show a preferred embodiment of the vacuum commutator **66** referred to above. The commutator includes an outer cylindrical shell **250** which is secured to and arranged to rotate with the index table **35**. Shell **250** defines four port holes **251** which communicate between the outer surface of the shell and an internal cylindrical bore which is adapted to receive a rotating commutator core member **252**. Core member **252** is supported for rotation by an attached hollow stem member **253** which fits in the internal race member of ball bearing **254** as shown. The internal bore of stem **253** is connected to a vacuum supply (not shown) and the vacuum supply is successively coupled to ports **251** and tubes **65** (see FIG. 9) via slot **255** which is cut through the shell **252** so as to form a fan-shaped slot (approximately 160°) that is connected to the internal bore **256** of stem **253**. Thus it will be seen that rotation of table **35** and shell **250** around cylindrical core **252** causes the vacuum supply to be applied to each of the ports **251** throughout 160° of table rotation. The vacuum supply is then turned off as the slot **255** passes beyond any one of the given port holes and the suction at the plural apertures **187** disposed beneath each of the paper cups is thereby removed.

The 160° slot **255** is mechanically phased with respect to stations A, B, C, and D so that the vacuum is switched to a duct **65** just prior to the arrival of an assembly and staging station at point A and turned off just prior to the arrival of an assembly and staging station at point C in the indexing operation. It will be appreciated that the vacuum commutator **66** and its associated cup-holding apertures disposed in each of the assembly stations may be eliminated for purposes of simplification. However, the operation of the holding device does afford a greatly improved stability and reliability of operation insofar as the individual paper cups are firmly held in their proper positions during the initial staging operations. The provision of the vacuum-holding apparatus described above also makes it possible to operate the entire packing apparatus at a faster rate than would otherwise be possible due to undesired movements of the unloaded paper cups.

Operation of the spacer-spreader apparatus provided as a part of this invention, will now be described in connection with FIGS. 12–16. As indicated above, the

spreader apparatus is mounted on a platform along with transfer mechanism 46D immediately above the box conveyor belt 31 and is arranged to operate in timed relationship with the delivery of candy by 46D from table 35 to box 32. The sole function of this apparatus is to make certain that each and every box row spacer is standing in an upright position and properly spaced with respect to each neighboring spacer so as not to interfere with the delivery of the row of cupped-candies. As shown in FIG. 12, a pair of flexible spreader members 40–41 mounted on rotatable shafts 190–191 are provided to physically spread the spacers in 32. Rods 190 and 191 are supported in the vertical elevator members 192 and 192'. Elevator members 192 are adapted to slide up and down vertically on rod members 193. The entire spreader assembly, including members 40 and 41 mounted on rods 190 and 191 and the vertical elevator members 192, is driven up and down by a conventional pneumatic actuator 42 having a piston arm 195 which is coupled to elevator members 192 via crank arms 200 connecting length 201 and connecting arm 202 as shown. Radial indexing pins 205 are mounted in rods 190–191 and are retained against stop pins 206 by leaf springs 207, thus the spreader fingers 40 and 41 are spring loaded to a normal spaced vertical position as shown in FIG. 13. When pneumatic actuator 42 is energized with compressed air, the entire spreader assembly is driven downwardly on the support rods 193 and during the downward course of travel cam followers 225 and 225', which are secured to the ends of shafts 190–191 respectively, come in contact with the outer end surfaces of cams 226, 226'. Rods 190 and 191 are caused to rotate counter-clockwise and clockwise respectively as viewed in FIG. 14. This rotational action in turn causes spreaders 40 and 41 to move inwardly until their tips come in contact with one another as shown in FIG. 14. As the downward motion progresses and the cam followers 225, 225' overtravel cams 226 and 226' respectively, the spreader fingers 40 and 41 are again driven outwardly by the leaf springs 207 to the spaced condition illustrated in FIG. 15. This final outward spreading action spreads each downwardly inclined spacer forcing it to a normal upright or vertical position as illustrated in FIG. 15.

Spreaders 40 and 41 are maintained in the position shown in FIG. 15 until an entire charge or row of cupped candies has been delivered by the pick-up head of 46D downwardly through and between the spreaders 40 and 41 and into the box. Thus, an inclined row spacer 33 as shown in FIG. 14 is moved to an upright position as shown in FIG. 15 so that no interference to proper delivery and positioning of a delivered row of candy can occur.

After a row of candy has been delivered to box 32, pneumatic actuator 42 is energized in the reverse direction causing the entire spreader mechanism to move upwardly past the spring loaded cams 226 and 226' as shown in FIG. 16 and back to a normal top rest position as shown in FIG. 13. Pick-up head 46H'' is then removed from the box by transfer device 46D and returned to a start position in readiness for another delivery cycle.

Position-sensing microswitches 230 and 231 are provided as indicating devices which function cooperatively with elevator member 192 as shown in FIGS. 14 and 15 to develop control signals for the logic and interlock circuits shown in FIGS. 25 and 27. Switch 230 is actuated by elevator member 192 and so indicates the presence of the spreader mechanism at the top position and switch 231 is actuated by 192 when the spreader mechanism is in the downward position shown in FIG. 15.

The features of an improved hopper bowl for a vibratory type feeder such as used at 56 in FIG. 1 are illustrated in FIGS. 19–23. The hopper bowls are preferably of the type shown and described in pending application Serial No. 91,523 filed February 24, 1961 by Boris, now Pat. No. 3,114,448, wherein the orientation segment 300 comprises a separate segment that is removable from the main base segment of the bowl 301. The entire bowl assembly comprising sections 300 and 301 is driven by a conventional vibratory drive device which is attached to the base of the bowl section 301 by a central mounting hole 302 as shown in FIGS. 19 and 20. Since the driver mechanism forms no part of the present invention, and since the operation of such devices is well known, further description of the driver will not be given.

The feeder bowl and its accompanying orientation segment is adapted to deliver pieces of delicate candies and the like at a relatively high feed rate without marring the candy surfaces. Randomly oriented candies are deposited in hopper bowl 301 and individual candies are delivered up the inclined floor 311 of the orientation segment 300 for delivery out of the terminal end of the orientation segment to the inclined delivery chutes 55 as shown in FIG. 1. The base section of the hopper bowl is formed by joining the surfaces of two frustums having the same axis but with respective apexes directed in opposite directions. One frustum forms the annular outer wall 310 of the base section of the bowl and the second frustum forms the bottom floor 301 of the hopper base. (See FIGS. 19 and 20.) The two frustums are arranged so that the smaller diameter of the wall 310 is equal to the larger diameter of the floor section 301, and the sum of the apex angles for the two frustums is equal to 180°. The two frustums are joined along the common diameter as shown in FIG. 20 so that the angle between the outwardly sloping floor surface 301 and the wall 310 is never less than 90°. Thus candy pieces moving around the bottom of 301 and coming in contact with the outer wall surface 310 make only a line contact with the wall surface and marring of the candy surface due to abrasion is therefore maintained at a minimum.

The same 90° angular relationship is maintained between the floor 311 of the orientation segment and the surface of wall 310 as shown in FIGS. 21–23. Candies that are advanced progressively up the inclined floor 311 of the orientation segment 300 which are not properly oriented are permitted to return back to the floor of the hopper bowl 301 down a gently inclined surface 315 with a minimum of damage to the candies. The total slope length of 315 is made longer nearer the terminal or delivery end of the orientation segment to compensate for the increased height of floor 311 (see FIG. 19). Properly oriented candies are guided onto the supply chutes 55 by sidewalls 316 and 317 at the terminal end of the orientation section.

In order that an individual row-packing station 30 may function continuously and properly as described above, it is necessary that the individual transfer mechanisms 46A, 46B and 46D operate in proper timed synchronization with the arrival of empty or loaded assembly stations on table 35. It is apparent that an empty container must be in position for receiving a charge of cupped candies when transfer mechanism 46D effects a transfer operation from station 50D to the conveyor belt. As indicated above, it is also necessary that the spacer spreader be operated in timed synchronization with the operation of transfer device 46D so that the spreader fingers are separated within the container box and in readiness for receiving the transfer head. Furthermore, the plural row-loading stations within a packing system must operate in timed synchronization to assure that each step in the loading operation is safely completed before a partially filled box is passed on to a subsequent loading station. A variety of control circuits may be devised to perform the required interlock and synchronization functions. A simplified block diagram of the logic circuits that are utilized in a preferred control circuit are shown in FIG. 25. The circuit utilizes a plurality of well known "AND" circuits for maintaining interlocked or synchronized control of each operation involved in the transfer of a single row of cupped candies to a con-

tainer carton. In beginning a normal operation, box arriving sensor switch 38A and box leaving sensor 38, provide two input control signals to "AND" circuit number 1. Position sensor 35S for index table 35 provides a third input and the down position sensor 231 for the spreader mechanism provides a fourth input signal as indicated. When control inputs are present from all four sensors, "AND" circuit No. 1 energizes the transfer devices 46A, 46B and 46C which causes the three transfer mechanisms to commence their respective transfer operations to stations 50A and 50B and from 50D to the waiting box on the conveyor belt system. Completion of the transfer operations by 46A, 46B and 46C is sensed by limit switches 346A, 346B and 346C, which are mounted on the respective transfer mechanisms as shown in FIG. 24 for example. Operation of these three limit switches completes the operation of "AND" circuit No. 2 as shown which, in turn, applies an input control circuit to the system "AND" circuit No. 3. The system "AND" circuit No. 3 requires simultaneous inputs from the "AND" No. 2 circuits of each and every one of the row-packing stations 30 that function cooperatively to make up an entire box packing system. When the transfer operations are completed by the three transfer devices 46A, 46B and 46C in each row packing station, an output signal is supplied from "AND" circuit No. 3 to the control solenoid on the index table and to the box release solenoids 37S which retract stop members 37 and allow the loaded box to pass on.

With the arrival of a subsequent box as sensed by box arriving sensor 38A and the departure of a box that has just been supplied with an individual row of cupped candies, a new operating cycle is commenced. It will be seen that the "AND" logic circuits function to provide a complete interlock system, not only within the several devices which comprise an individual row-packing station 30 but also between the plural stations that are combined to form an entire system.

Although a number of well known article manipulator devices may be used to function at 46A, 46B and 46D, applicants have found the article manipulator apparatus described in pending patent application Serial No. 216,626 filed August 13, 1962 by John D. Goodell et al., to be particularly well suited for this purpose. While the apparatus described in that application is illustrated with electro-mechanically actuated grasping jaws, a pneumatic actuated pick-up head such as has been described above, is readily substituted for the grasping jaws as is illustrated in FIG. 24. The transfer device illustrated is that for 46A and includes pick-up head 46H which is supported on transfer arm 46AR. The pick-up head 46H is maintained in the same plane throughout the arcuate path of travel by the action of sprocket chain 680 and sprocket gear 681 which causes the pick-up head to rotate in a direction opposite to that of the arm rotation and thereby holds the head in a fixed horizontal plane. The structural details of this operation form no part of the present invention and hence will not be described herein. Reference should be had to the co-pending application identified above for a detailed explanation of this apparatus. The transfer arm and pick-up head 46H are driven through an arcuate path of travel by drive motor 611, pulley 616, belt 617, pulley 618, and shaft 619. Microswitches 600 and 601 are provided to sense and indicate electrically when the transfer arm has reached its rear position of travel and its forward position of travel, respectively. Microswitch 346A is a double-pole double-throw switch (see FIG. 27) and is provided to sense the transfer arm position at a point intermediate the rear and forward positions of travel. Switch 346A accordingly is used to indicate when the arm has reached a normal rest position (e.g., straight up) and the transfer mechanism is stopped at or started from this position.

All three switches 600, 601 and 346A are actuated by cams 605 and 606 which are driven by the crank arm central drive shaft 607 as shown.

A simplified schematic diagram of a preferred electrical control circuit for an individual row packing station incorporating the logic circuits shown in FIG. 25, is shown in FIGS. 26 and 27. The entire control circuit is energized by 115 volts A.-C. as shown and the logic circuits are formed from serially connected switch contacts on a plurality of relays that are, in turn, actuated by position sensing or limit sensing switches mounted on the several transfer mechanisms, the indexing table, the spacer spreader and the box sensor on the conveyor belt system.

A description of the switch and relay operations will now be described in sequence as these operations take place during a normal operating cycle. Actuation of push-button start switch PB2 (FIG. 26) energizes the main control relay CRM which through its switch contacts distributes power to the entire control system. Relay CRM is self latching through its contacts CRM–1 and system power is turned off in a conventional manner by depressing push-button switch PB1 to momentarily open its normally closed contacts. Operation of the packing system is commenced by momentarily pushing push-button switch PB4 to energize control relay CRA and time delay relay STD. The coils of CRA and STD remain energized through the self latching operation of contact CRA–1 on control relay CRA. The entire operation is stopped by momentarily depressing stop button PB3. Relay MCR is momentarily actuated through the closure of contacts CRA–2 and the normally closed contacts of time delay relay STD connected in series as shown. The momentary closure of the switch contacts of master control relay MCR energizes control relay 1CR (see FIG. 27) and time delay relay 1TD via switch contacts MCR–1 which are connected in series with the normally closed limit switch contacts 346A–1, 346B–1 and 346D–1. As explained above, these switches are located on the respective transfer devices 46A, 46B and 46D and are normally held in a closed position by cams on the respective transfer arms when those arms are in their start positions. Each of the aforementioned switches assumes a normally open position in all other arm positions. Accordingly, when the respective transfer arms are in start position, relays 1CR and 1TD are electrically energized through the momentary closure of MCR–1 and are electrically latched to an energized position by contacts 1CR–1 of relay 1CR. Contacts 1CR–1 are connected in series with the normally closed switch contacts of cam actuated switch 35S. Switch 35S is mounted on the index table and is momentarily tripped by the operation of cam 35C. Cam 35C is attached to the rotating surface of table 35 and is physically positioned with respect to switch 35S so that the normally closed contacts thereof are momentarily opened each time the index table 35 is advanced 90° to a new position.

Energization of relay 1CR causes box release solenoids 37S to be energized through the closure of contacts 1CR–3 connected in series with contacts 1TD–1 of time delay relay 1TD. At the same time, the brake solenoid for the index table is de-energized with the opening of normally closed contacts 1CR–4, and the index table is caused to advance 90° with the energization of the table index solenoid through the closure of contacts 1CR–2.

The box release solenoids 37S are energized just long enough to allow the previously loaded box 32 to be conveyed away by the conveyor belt a sufficient distance to clear stop members 37. The time of energization is determined by the adjustment of time delay relay 1TD.

With the indexing of table 35 to a new position, switch 35S is momentarily tripped by cam 35C releasing relay 1CR and time delay relay 1TD and, in turn, energizing relay 2CR. Relay 2CR self latches through contacts 2CR–1 and the serially connected contacts 346A–1, 346B–1 and 346C–1, as shown. When a previously

loaded box leaves the loading position, the contacts of box sensor switch **38** are switched to the normally open position causing relay **4CR** to be electrically energized and self latched through its contacts **4CR–1**. A new box **32A** moved into position by the conveyor belt once again closes the contacts of **38** (as shown) causing relay **3CR** to be energized once more.

With relay **2CR** energized indicating that the index table **35** has been properly indexed to a new position, relay **3CR** energized indicating that a new box **32** has been properly advanced and located at the loading point, and relay **4CR** energized indicating that the previously loaded box **32C** has been removed from the loading position, relay **5CR** is energized through the serially connected contacts **2CR–2**, **3CR–1**, **4CR–2** and **20CR–1**. Relay **20CR** is energized by the down-position sensor switch **231** for the spreader. As indicated, these four relay contacts connected in series function cooperatively as the "AND" circuit No. 1 illustrated and described above in connection with FIG. 25.

As soon as any one of the three transfer mechanisms **46A**, **46B** or **46D** leaves its rest position the series circuit formed by the switch contacts **346A–1**, **346B–1** and **346D–1** is broken causing relay **2CR** and relay **4CR** to be de-energized. Movement of the transfer arm for the pick-up device **46A** closes switch contacts **346A–2** (which otherwise remain open when the arm is in the "start" position) causing relay **6CR** to be energized and self latched through contacts **6CR–1**. In like manner, contacts **346B–2** and **346D–2** are closed as soon as the transfer arms for **46B** and **46D** are moved from the normal rest position. Accordingly, relays **7CR** and **8CR** are energized by the closing of **346B–2** and **346D–2**, and each of these relays is latched by the closing of its respective contact **7CR–1** and **8CR–1**. The actuation of relays **3CR** and **4CR** energizes the solenoid **400** which opens a control valve that supplies air pressure to pneumatic cylinder **42** to drive that cylinder in the forward direction and, in turn, drive the spreader mechanism downwardly. At the same time, control relay **22CR** is energized by the serially connected contacts **3CR–2** and **4CR–3**, as shown. When the spreader mechanism is driven to its "down" position, limit switch **231** is closed causing the coil of relay **20CR** to be energized. The closure of relay **20CR** causes the contacts of that relay **20CR–1** to be closed, thereby completing the operation of "AND" circuit No. 1 as described above. The operation of "AND" circuit No. 1 energizes relay **5CR** which, through the closure of contacts **5CR–1**, **5CR–2** and **5CR–3**, energizes the drive motors and control circuits for transfer device **46A**, **46B** and **46D**, respectively.

The delivery of a charge of cupped candies to the container box by transfer device **46D** is sensed by the closure of limit switch **402**. Closure of the switch contacts for **402** energizes the valve control solenoid **403** which causes compressed air to be supplied to pneumatic actuator **42** in the reverse direction. The reverse direction actuation of **42** elevates the spreader mechanism and when the entire mechanism has reached its top position, switch **230** is closed. Closure of the switch contacts **230** causes relay **21CR** to be energized through the normally closed contacts **22CR–2**. It will be apparent that relay **21CR** is de-energized as soon as **22CR** is energized by the operation of relays **3CR** and **4CR**. The operation of relay **21CR** causes contacts **21CR–1** to be closed which effectively completes the operation of "AND" circuit No. 2 shown in FIG. 25. "AND" circuit No. 2 in turn energizes relay **9CR**, indicating that an entire row packing operation by station **30** has been completed. The operation of relay **9CR** closes contacts 9_1 CR as shown in FIG. 26 which combined with the closings of relay contacts 9_2CR–9_nCR completes the operation of "AND" circuit No. 3 as shown. "AND" circuit No. 3 energizes relay MCR once more and initiates another operating cycle in each of the plural row-loading stations **30** that form the entire box packing system.

As indicated at the bottom of FIG. 27, start power for the various transfer devices **46A**, **46B** and **46D** is provided by the closure of contacts **5CR–1**, **5CR–2** and **5CR–3** respectively. Shut-off of the compressed air supply to pick-up head **46H''** is controlled by contacts **21CR–3**.

Since transfer devices **46A** and **46B** are arranged to deliver articles to the index table **35** whereas transfer mechanism **46D** is arranged to remove articles therefrom, programming of the air supplied to the latter pick-up head is opposite to that for the pick-up heads **46H** and **46H'**. Thus the control circuits which actuate and control the pick-up heads **46H** and **46H'** are energized when those heads are in the pick-up positions immediately above chutes **45** and **55**, respectively, and are de-energized when the pick-up heads are in the put-down positions above stations **50A** and **50B**, respectively. The air supply to **46H''**, on the other hand, is energized with compressed air when that head is above station **50D** and is de-energized when the head is located in the box **32**.

In the preferred embodiment of the invention, the air supply to pick-up head **46H''** is not switched to the "off" or "drop" condition until the spreader apparatus has been elevated to the "up" position. To this end, switch **402** is provided to sense the "down" or "drop" position of the arm for **46D**, and the closure of the contacts of this switch energizes valve control solenoid **403** which reverses the direction of air flow to air cylinder **42**. Cylinder **42** thereby drives the spreader apparatus to the "up" position which causes switch **230** to be closed energizing the coil of relay **21CR** as indicated in FIG. 27. The air supply to pickup head **46H''** is then shut off by contacts **21CR–3**, as will be explained in further detail in connection with FIG. 27. It should be noted that relay **21CR** is energized by switch **230** through the normally closed contacts **22CR–2** of relay **22CR**. Relay **21CR**, therefore, is energized only after relay **22CR** is de-energized by the drop-out of relay **4CR**. Relay **4CR** is de-energized when contacts **346A–1**, **346B–1** and **346D–1** are opened during the return trips of the transfer arms for the several transfer devices.

The energization of relay **21CR** results in closing of contacts **21CR–1** which completes the operation of "AND" circuit No. 2, and as explained above the operation of "AND" circuit No. 2 closes relay **9CR** and completes the operation of "AND" circuit No. 3 as shown in FIGS. 25 and 26.

Time delay relay XTD is energized by "AND" circuit No. 3 and the normally closed contacts XTD–1 of that relay are connected in series with relay MCR as shown. Thus "AND" circuit No. 3 is effectively opened after a predetermined period of time and the continued indexing of table **35** is precluded in the case where a box does not arrive in time to actuate **3CR** and **4CR** (via sensor **38**) before the table completes one index advance.

A schematic diagram of a preferred electrical control circuit for the transfer devices **46A**, **46B** and **46D** is shown in FIG. 28. It is understood that a separate control circuit such as shown in FIG. **28** is provided for each of the electrically operated transfer mechanisms **46A**, **46B** and **46D**. Interlocked operation of the separate transfer devices is effected by the control diagram shown in FIG. 26. Transfer arm **46AR** is programmed by the cooperative action of the rearward and forward position sensing microswitches **600** and **601** and the setting of arm action switches **612** and **613**. Switches **612** and **613** are double-pole triple position switches which may be set to a "stop" position, a "run" position (center) and a "dwell" position as indicated in the legend at the bottom of FIG. 28.

A.-C. power is supplied to motor **611** via double-pole, double-throw "on"-"off" switch **620**. For purposes of explanatory convenience, the respective sides of the

A.-C. line are identified as A.-C. plus (+) and A.-C. minus (−), as indicated. The A.-C. minus side of the line is connected directly to the lower terminal of induction motor **611** and the plus A.-C. side of the line is connected to the upper and middle terminals of the induction motor via the normally closed contacts of microswitches **600** and **601** connected in series as shown. When the A.-C. switch **620** is closed to the "on" position, A.-C. power is applied to charging diode **621**, the anode of which is connected to motor **611** as shown. Diode **621** functions to charge capacitor **624** to a plus D.-C. potential and when the D.-C. potential on **624** reaches the pull-in voltage for relay coil **625**, relay **625** is caused to close. With the closure of relay **625**, the positive D.-C. voltage developed across capacitor **624** is applied to the outer "dwell" and "stop" terminals of arm action switches **612** and **613** via coupling diodes **626** and **627**. When switches **612** and **613** are sent to the "stop" position, the D.-C. voltage on **624** is connected to the armature terminal **630** of motor **611** via conductor **631** and the contacts of either switch **600** or **601** as the arm is moved to the rearward or forward positions, respectively. Upon the closing of either switch **600** or **601**, the plus A.-C. side of the line is disconnected from the armature of motor **611** and the plus D.-C. voltage is connected to the armature winding instead. Upon the application of D.-C. voltage to the armature of motor **611**, the motor is caused to stop very suddenly and, accordingly, the transfer arm is brought to a "stop" position at either the rearward, the middle or the forward position of travel. In the present application, the machine is programmed to stop at an intermediate or middle position of travel. Stop time is preferably made relatively short for the end positions (e.g., 100 milliseconds). In operation the "stop" time would ordinarily be made sufficiently long to permit operation of the pneumatically actuated pick-up heads. In the circuit diagram shown in FIG. 28, the "stop" time is determined by the discharge time of capacitor **624** through relay coil **625**, resistor **625R** and the winding resistance of the armature for motor **611**. The discharge of capacitor **624** causes relay **625** to drop out and the capacitor **624** is thereby disconnected from the arm action switches **612** and **613** as described above. Motor **611** remains in the stopped position until such time as the start common is momentarily switched to either the "start forward" or the "start rear" terminals indicated on the terminal board connection at the left of FIG. 28. In the case of transfer device **46D**, motor **611** is re-started by the closure of contacts **21CR–4** connected between the "Rear Start" and the "Start Common" as shown. These switch contacts are not required for the operation of the other transfer devices **46A** and **46B** as will be explained below.

Motor **611** may be started at any time following the drop out of relay **125** with the closure of switch contacts **21CR–4**. Closure of contacts **21CR–4** supplies A.-C. voltage to the armature of motor **611** via the closed contacts of microswitch **600** or **601** which senses either the rearward or the forward positions of the transfer arm. Following the momentary application of A.-C. common to motor **611**, the rearward or forward position microswitch that had been actuated is then restored to the normally closed position (as shown in FIG. 28) and plus A.-C. voltage is applied to the armature continuously until the arm is once more returned to an end delivery or pick-up position.

Drive motor **611** is stopped at a rest position intermediate the pick-up and put-down positions for the respective transfer mechanisms via microswitch **346A'** (for machine **46A**) the contacts of which are arranged to connect terminal Z to terminal Y, thereby applying D.-C. voltage directly to the armature winding of motor **611**. The direct application of D.-C. to the armature of motor **611** causes the motor to stop very suddenly. A.-C. is supplied to terminal Y from terminal X via the normally closed contacts **5CR–1'** of relay **5CR** and the normally closed contacts of **346A'** connected in series therewith. When **346A** is actuated by cam **607** (see FIG. 24) D.-C. is immediately applied to the motor armature via the normally closed contacts **5CR–1'** and the normally closed contacts of **346A'**. When relay **5CR** is energized, D.-C. is removed from the motor armature by the opening of the normally closed contacts **5CR–1'** and A.-C. is applied to the motor by the closing of contacts **5CR–1**. The entire transfer arm is thereby stopped at a normal rest position somewhere midway between the rear position and the forward position for the transfer arm and the arm remains at that rest position until such time as relay **5CR** is energized.

Motor **611** may also be re-started from a stopped rearward or forward arm position by depressing push-button switch **640**. The starting common voltage or the plus side of the A.-C. line is supplied to start switch **640** via contacts **625B** of relay **625** when relay **625** is in the de-energized condition.

Although the control circuits shown in FIG. 28 may be programmed to provide several different modes of operation, in the present loading application, the preferred mode is that in which the pick-up head is allowed to dwell momentarily at each end of the arm travel. Thus both arm action switches **112** and **113** are set to the dwell position, and the arm action is halted for a fixed time interval at each end of the arm travel. As described above, motor **611** is brought to a sudden halt with the application of D.-C. voltage from capacitor **624** through diode **626** or **627** and conductor **631** to the armature terminal **630**. In this mode of operation, the A.-C. start common is automatically restored to the motor winding by contacts **625B** on relay **625** (when that relay drops out) and the lower contacts of **612** and **613**.

Compressed air to the pneumatically actuated pick-up heads for transfer devices **46A** and **46B** is turned on by the energization of solenoid actuated valve **46SL** connected between the A.-C. plus terminal and the wear jaw signal terminal at the left of FIG. 28. Energization of valve solenoid **46SL** turns on the compressed air supply to the pick-up heads **46H** and **46H'** when those heads are immediately above chutes **45** and **55** as shown in FIG. 1. For the transfer device **46D**, valve solenoid **46SL'** is connected between A.-C. plus terminal and the forward jaw signal terminal so that the pick-up head **46H''** is energized for picking up cupped candies at station **50D** which corresponds to the front or forward position for the transfer device. Energization of solenoid **46SL** is effected by closure of relay **660**. Relay **660** is energized and closed when the forward microswitch **601** is actuated by the arm thereby disconnecting the switch arm from the plus A.-C. side of the line. The upper terminal of relay coil **160** is then connected to the minus A.-C. side of the line through motor **611** via coupling diode **661**. Relay **660** is then latched in the energized position via contacts **660A** which return the upper terminal **660** to the minus A.-C. side of the line.

While the present invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood that various changes may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. Apparatus for filling containers with rows of comestible articles or the like wherein each article is nested in a resilient protective cup of frusto-conical shape and each row of cupped articles occupies a space of predetermined length and width in said container, said apparatus comprising

a rotatable staging index table having at least one row assembly station disposed on the top surface thereof, said station including two sidewalls and two end walls which define the floor boundaries of said station, at least one of said sidewalls and one of said end walls

being mounted for movement with respect to the table surface and the opposite cooperating walls so that the floor surface of said station can be reduced to a minimum length and width that corresponds to the length and width of a packed row of cupped articles in said container,

a cup loading station disposed adjacent a first indexing position for the assembly station on said index table including means for supplying a row of pre-oriented protective cups at spaced intervals exceeding the cup-to-cup spacings available in said container,

means for transferring a row of said cups from the cup supply station to said assembly station with the sidewalls of said cups spread outwardly to enlarge the top openings thereof,

an article loading station disposed adjacent a second indexing position for the assembly station on said index table including means for supplying a row of pre-oriented comestible articles at spaced intervals corresponding to the spacings between the spread and spaced cups at said assembly station, and means for transferring a row of said articles from said station to said row of cups,

a container loading station adjacent a third index position for the assembly station on said index table including conveyor means for delivering in sequence individual containers from a supply source to said loading station,

cam means associated with said index table for displacing said movable sidewalls as said index table is rotated so that the floor area of said assembly station is a maximum at said first and second index positions and is reduced to said minimum length and width and then increased again before said assembly station is advanced to said third index position,

drive means for rotating said index table and intermittently advancing said assembly station to each of the respective indexing positions in sequence,

and transfer means for picking up the assembled row of cupped articles from said assembly station when it is located at said third index position and transferring and depositing the row in a container at said container loading station.

2. Apparatus in accordance with claim **1** wherein vacuum operated cup holding means are provided in the floor of said assembly station, said holding means comprising a plurality of small apertures disposed in said floor surface with means to connect said apertures to a vacuum supply.

3. Apparatus in accordance with claim **2** wherein commutator means is provided for connecting and disconnecting said apertures to a vacuum supply line, said commutator means being phased to connect said apertures to a vacuum supply line when the assembly station is at the first and second index positions and to disconnect said apertures therefrom when the index table and assembly station is advanced to the third index position.

4. A pneumatic pick-up head adapted to handle cup-shaped articles having outwardly flaring flexible side walls, said apparatus comprising

a pressure supply line for connection to a compressed gas supply,

a frame housing defining a chamber connected to said supply line, the lower end of said chamber being open,

a plunger core slidably mounted in said chamber for limited upward and downward movement through the open end of said chamber,

said plunger core having a central axial bore opening at the upper end of the plunger to admit compressed gas from said chamber,

and a slit aperture adjacent the lower end of the core communicating between the external peripheral surface of said core and said bore in an outwardly and upwardly inclined direction at an acute angle with respect to said bore.

5. A pneumatic pick-up head in accordance with claim **4** characterized in that the lower surface of said frame housing is curved outwardly and upwardly with respect to the centrally disposed plunger core.

6. A pneumatic pick-up head comprising a pressure supply line for connection to a compressed gas supply, a cylindrical core member having a central axial bore connected at one end to said supply line, a slit aperture communicating between the external peripheral surface of said core and said bore in an outwardly inclined direction at an acute angle with respect to said bore, and a cylindrical sleeve mounted around at least a portion of the core adjacent said aperture and in coaxial alignment with said core thereby defining an annular space through which the discharge of compressed gas from said aperture is directed.

7. Apparatus in accordance with claim **1** wherein said cup transfer means comprises

a plurality of pneumatically operated pick-up heads, one for each article, each head having a pressure supply line for connection to a compressed gas supply,

a frame housing defining a chamber connected to said supply line, the lower end of said chamber being open,

a plunger core slidably mounted in said chamber for limited upward and downward movement through the open end of said chamber, said plunger core having a central axial bore opening at the upper end of the plunger to admit compressed gas from said chamber,

and a slit aperture adjacent the lower end of the core communicating between the external peripheral surface of said core and said bore in an outwardly and upwardly inclined direction at an acute angle with respect to said bore.

8. Apparatus in accordance with claim **1** wherein the means for picking up the assembled row of cupped articles comprises.

a plurality of pick-up heads, one for each cupped article, each head having a pressure supply line for connection to a compressed gas supply,

a cylindrical core member having a central axial bore connected at one end to said supply line,

a slit aperture communicating between the external peripheral surface of said core and said bore in an outwardly and upwardly inclined direction at an acute angle with respect to said bore,

and a cylindrical sleeve mounted around at least a portion of the core adjacent said aperture and in coaxial alignment therewith thereby defining an annular space through which the discharge of compressed gas from said aperture is directed.

9. Apparatus for filling containers with rows of comestible articles or the like wherein adjacent rows of packed articles are separated with flexible spacers, said apparatus comprising

a row-loading station including conveyor means for supporting and delivering in sequence individual containers from a supply source to said station,

electrically operable stop means mounted adjacent said conveyor for stopping the travel of a container box thereon, said means being adapted when electrically energized to release said container for advance travel,

container sensor means mounted adjacent said row-loading station for producing a control signal in response to the arrival of a container to be loaded,

a staging station for delivering an assembled row of pre-oriented comestible articles to a point adjacent said loading station,

means for transferring said assembled row of articles from said assembly station to said container, said means including plural pneumatically actuated pick-

up heads, one for each article, and a support arm for said heads with drive means for transporting said arm and said heads between said assembly station and a stopped container on the conveyor,

first transfer arm sensor means provided to produce an arm-delivery output signal when a row of articles has been delivered to said box,

second transfer arm sensor means provided to produce an arm-return output signal when said arm has returned from said container to the start position,

spreader means mounted above a stopped container on said conveyor for spreading the flexible spacers defining a row space in said container, said means including a pair of spaced fingers mounted for up and down movement on a support elevator, with cam means provided to close and then open said fingers during the downward movement of the elevator, reversible drive means for driving said elevator to either the up position or the down position,

first control means responsive to the signal from said container sensor for energizing said elevator drive in the down direction and responsive to the signal from the arm delivery sensor for energizing said elevator drive in the up direction,

and second control means responsive to said arm-return signal provided to energize said stop means and thereby release said container.

10. Apparatus in accordance with claim **1** wherein each of the pre-oriented comestible articles supplied to said article loading station is delivered by a vibratory hopper feeder, said hopper having an upright annular wall and an outwardly and downwardly sloping bottom floor, the inner surface of said wall defining an article delivery spiral shelf-track originating at said bottom floor and terminating at a discharge chute near the upper periphery of said hopper, the included angle between the inner wall surface and the track and bottom floor surfaces being at least ninety degrees.

11. Apparatus in accordance with claim **9** wherein each pneumatically actuated pick-up head comprises

a pressure supply line for connection to a compressed gas supply,

a cylindrical core member having a central axial bore connected at one end to said supply line,

a slit aperture communicating between the external peripheral surface of said core and said bore in an outwardly and upwardly inclined direction with respect to said bore

and a cylindrical sleeve mounted around at least a portion of the core adjacent said aperture and in coaxial alignment therewith thereby defining an annular space through which the discharge of compressed gas from said aperture is directed.

12. Apparatus in accordance with claim **9** wherein said staging station comprises

a rotatable staging index table having at least one row assembly station disposed on the top surface thereof, said station including two sidewalls and two end walls which define the floor boundaries of said station, at least one of said sidewalls and one of said end walls being mounted for movement with respect to the table surface and the opposite cooperating walls so that the floor surface of said station can be reduced to a minimum length and width that corresponds to the length and width of a packed row of cupped articles in said container,

a cup loading station disposed adjacent a first indexing position for the assembly station on said index-table including means for supplying a row of pre-oriented protective cups at spaced intervals exceeding the cup-to-cup spacings available in said container,

means for transferring a row of said cups from the cup supply station to said assembly station with the sidewalls of said cups spread outwardly to enlarge the top openings thereof,

an article loading station disposed adjacent a second indexing position for the assembly station on said index table including means for supplying a row of pre-oriented comestible articles at spaced intervals corresponding to the spacings between the spread and spaced cups at said assembly station, and means for transferring a row of said articles from said station to said row of cups,

a third index position for said index table adjacent said row loading station,

cam means associated with said index table for displacing said movable sidewalls as said index table is rotated so that the floor area of said assembly station is a maximum at said first and second index positions and is reduced to said minimum length and width and then increased again before said assembly station is advanced to said third index position,

drive means for rotating said index table and intermittently advancing said assembly station to each of the respective indexing positions in sequence,

and transfer means for picking up the assembled row of cupped articles from said assembly station when it is located at said third index position and transferring and depositing the row in a container at said container loading station.

13. Apparatus in accordance with claim **12** wherein vacuum operated cup holding means are provided in the floor of said assembly station, said holding means comprising a plurality of small apertures disposed in said floor surface with means to connect said apertures to a vacuum supply.

14. Apparatus for filling containers with rows of comestible articles or the like wherein each article is nested in a resilient protective cup of frusto-conical shape and each row of cupped articles occupies a space of predetermined length and width in said container, said apparatus comprising

a staging table having at least one row assembly station disposed on the top surface thereof, said station including two sidewalls and two end walls which define the floor boundaries of said station, at least one of said sidewalls and one of said end walls being mounted for movement with respect to the table surface and the opposite cooperating walls so that the floor surface of said station can be reduced to a minimum length and width that corresponds to the length and width of a packed row of cupped articles in said container,

a cup loading station disposed adjacent said assembly station including means for supplying a row of pre-oriented protective cups at spaced intervals exceeding the cup-to-cup spacings available in said container,

means for transferring a row of said cups from the cup supply station to said assembly station with the sidewalls of said cups spread outwardly to enlarge the top openings thereof,

an article loading station including means for supplying a row of pre-oriented comestible articles at spaced intervals corresponding to the spacings between the spread and spaced cups at said assembly station, and means for transferring a row of said articles from said station to said row of cups,

a container loading station including conveyor means for delivering in sequence individual containers from a supply source to said loading station,

cam means associated with said table for displacing said movable sidewalls so that the floor area of said assembly station is a maximum when the row of cups is delivered to said assembly station and when the row of articles is transferred into said cups and is reduced to said minimum length and width and

then increased to an expanded width and length,
drive means for operating said cams,
and transfer means for picking up the assembled row of cupped articles from said assembly station after said sidewalls have been returned to said expanded width and length and for transferring and depositing the row in a container at said container loading station.

15. Apparatus in accordance with claim **9** wherein said staging station comprises

a staging table having at least one row assembly station disposed on the top surface thereof, said station including two sidewalls and two end walls which define the floor boundaries of said station, at least one of said sidewalls and one of said end walls being mounted for movement with respect to the table surface and the opposite cooperating walls so that the floor surface of said station can be reduced to a minimum length and width that corresponds to the length and width of a packed row of cupped articles in said container,

a cup loading station disposed adjacent said assembly station including means for supplying a row of pre-oriented protective cups at spaced intervals exceeding the cup-to-cup spacings available in said container,

means for transferring a row of said cups from the cup supply station to said assembly station with the sidewalls of said cups spread outwardly to enlarge the top openings thereof,

an article loading station including means for supplying a row of pre-oriented comestible articles at spaced intervals corresponding to the spacings between the spread and spaced cups at said assembly

station, and means for transferring a row of said articles from said station to said row of cups,

cam means associated with said index table for displacing said movable sidewalls so that the floor area of said assembly station is a maximum when the row of cups is delivered to said assembly station and when the row of articles is transferred into said cups and is reduced to said minimum length and width and then increased to an expanded width and length prior to the arrival of the pneumatically actuated pick-up heads,

and drive means for operating said cams.

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