May 6, 1969 E. E. ROTH ET AL 3,442,400

CARTON PALLETIZING APPARATUS

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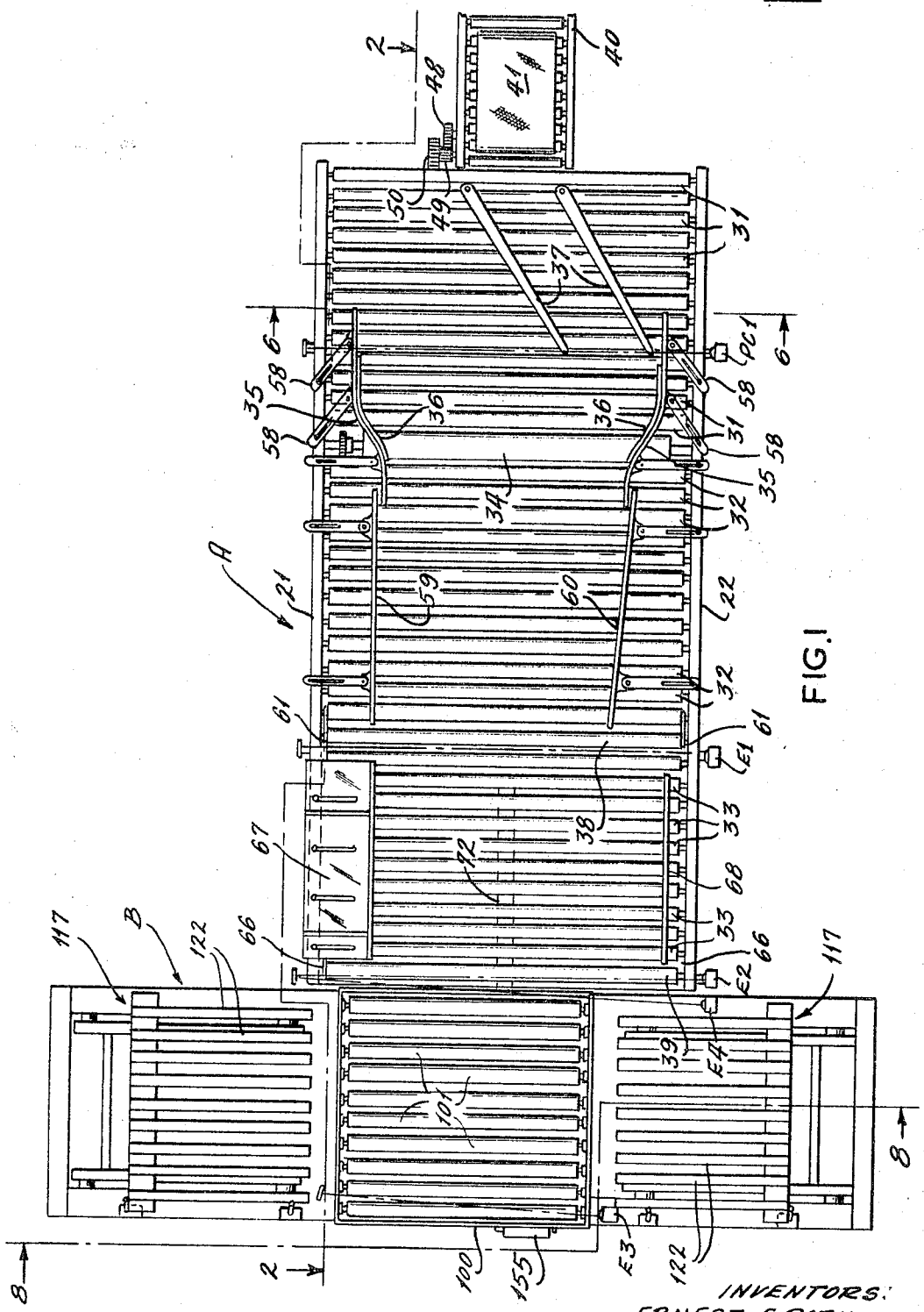

FIG. 1

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May 6, 1969 E. E. ROTH ET AL 3,442,400

CARTON PALLETIZING APPARATUS

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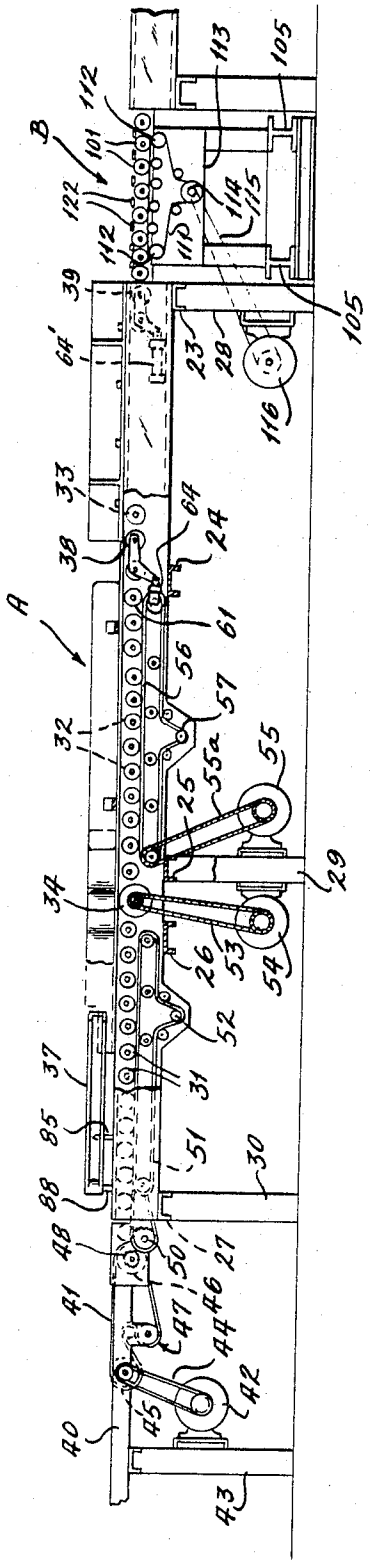

FIG. 2

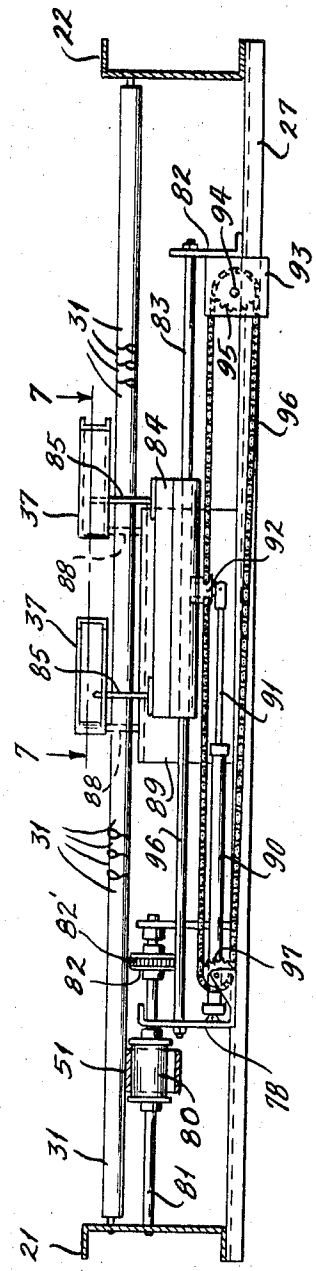

FIG. 6

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CARTON PALLETIZING APPARATUS

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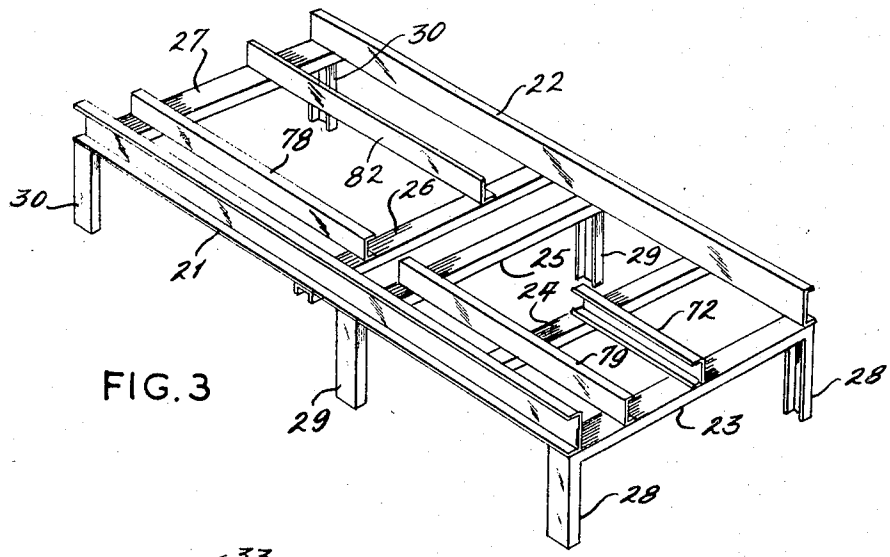

FIG. 3

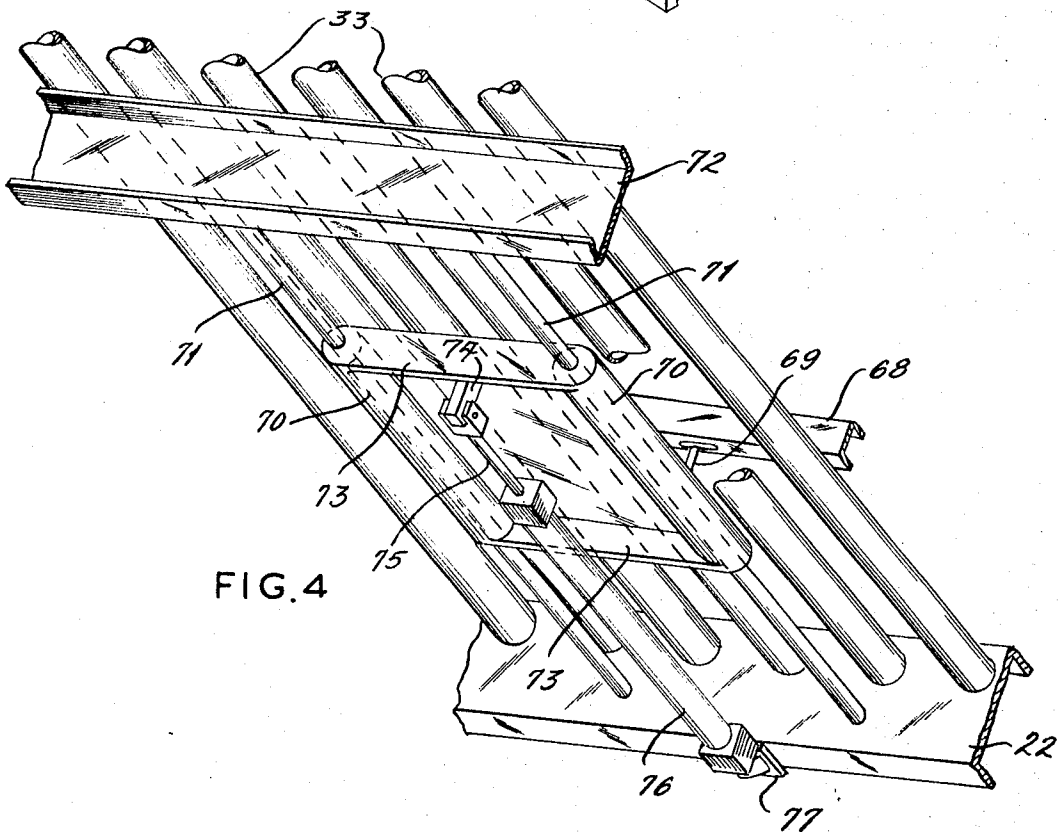

FIG. 4

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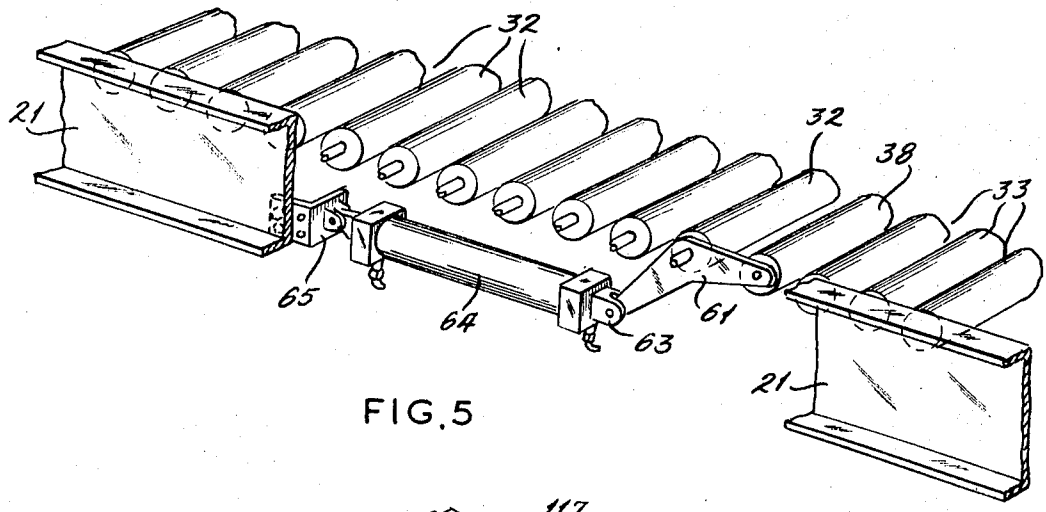

FIG.5

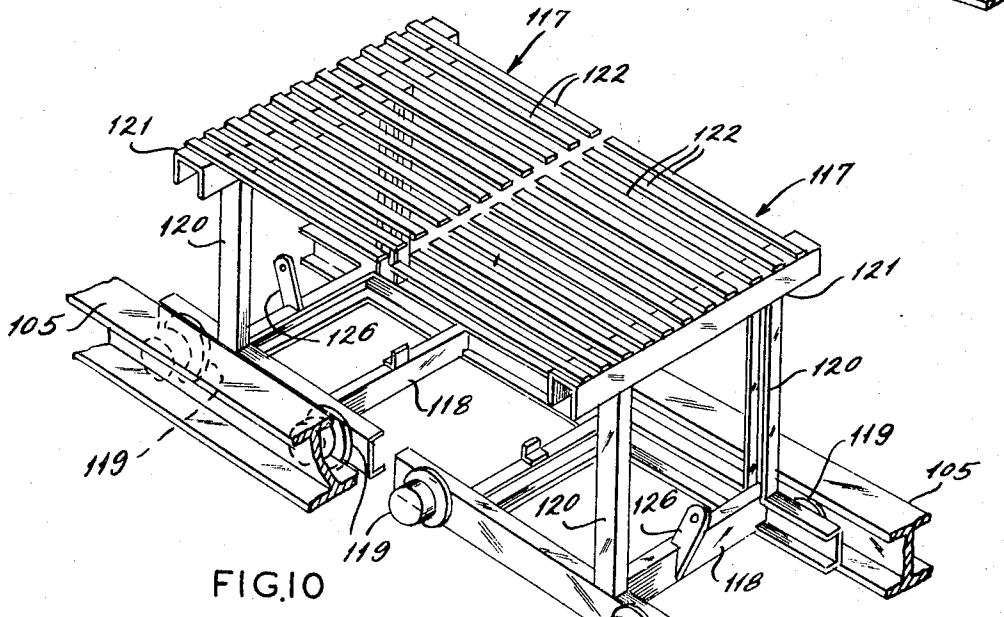

FIG.10

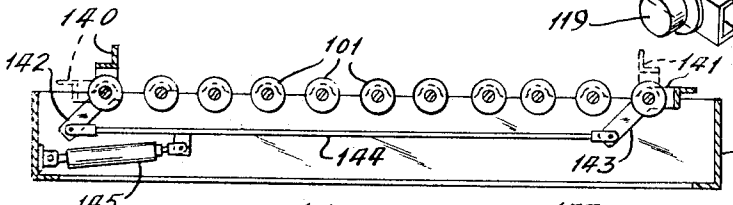

FIG.14

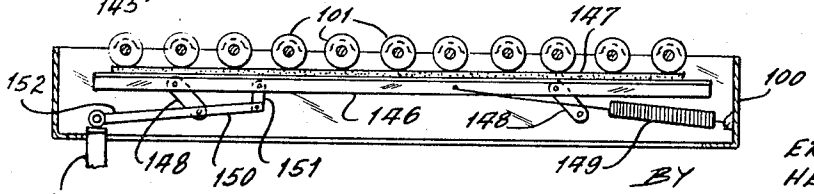

FIG.15

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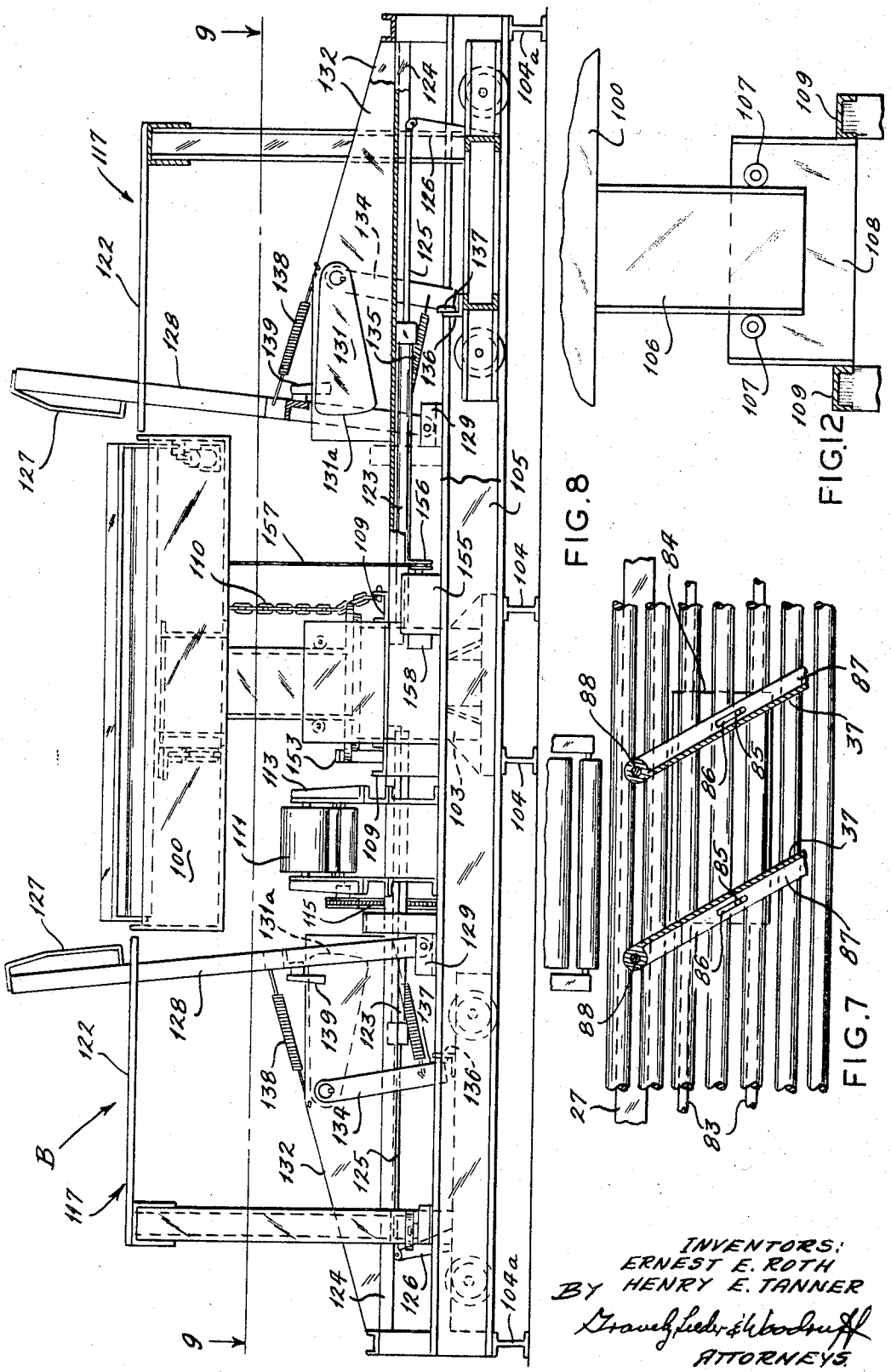

FIG. 8

FIG. 12

FIG. 7

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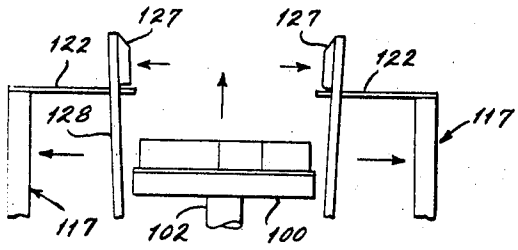

FIG.16-A

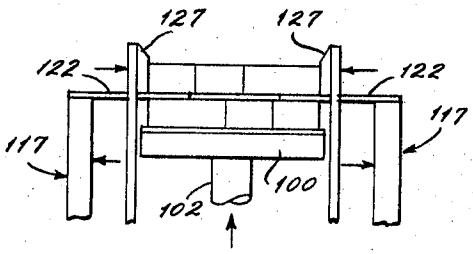

FIG.16-D

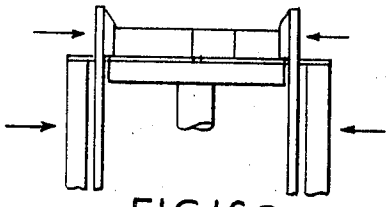

FIG.16-B

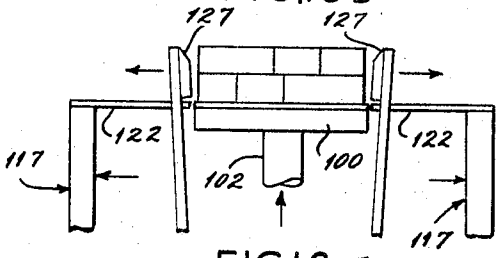

FIG.16-E

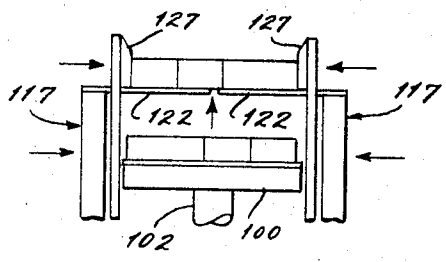

FIG.16-C

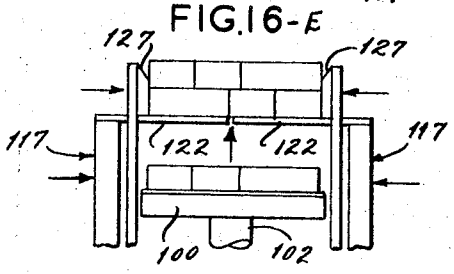

FIG.16-F

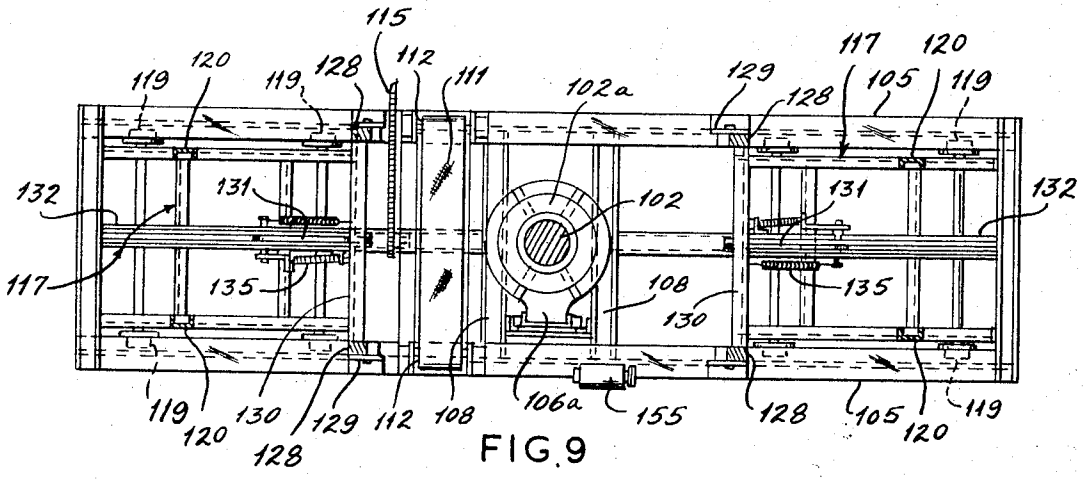

FIG.9

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May 6, 1969 E. E. ROTH ET AL 3,442,400

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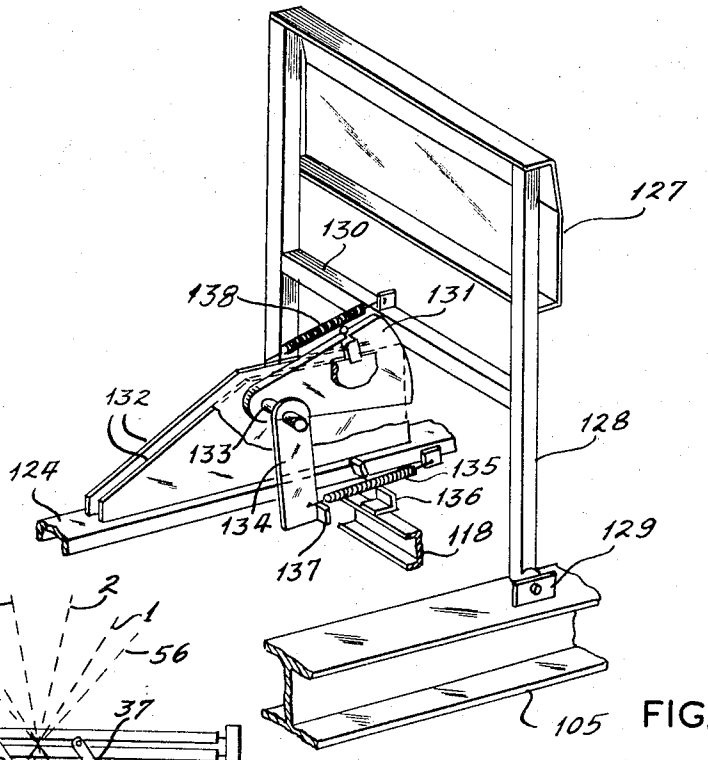

FIG.13

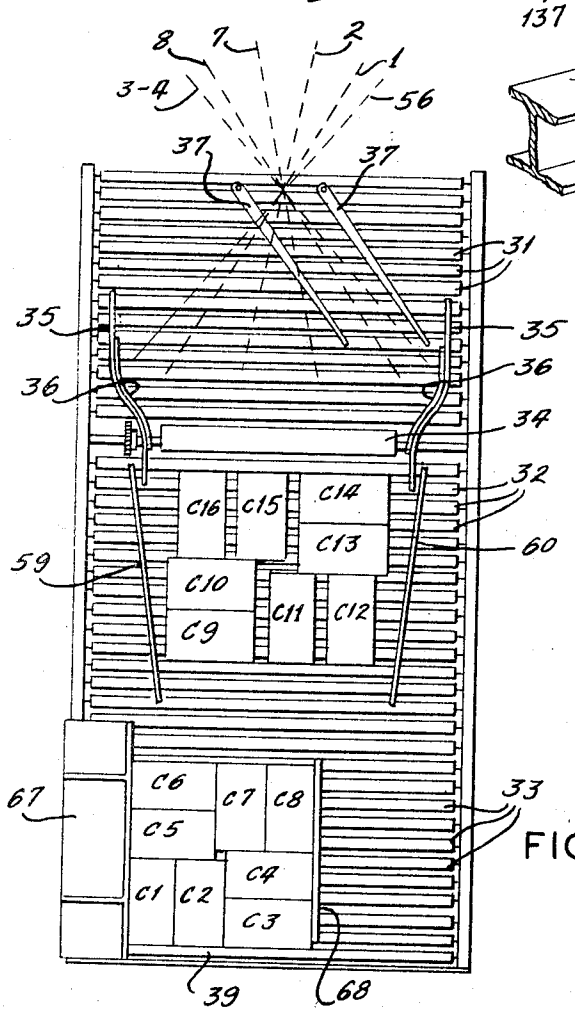

FIG.11

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CARTON PALLETIZING APPARATUS

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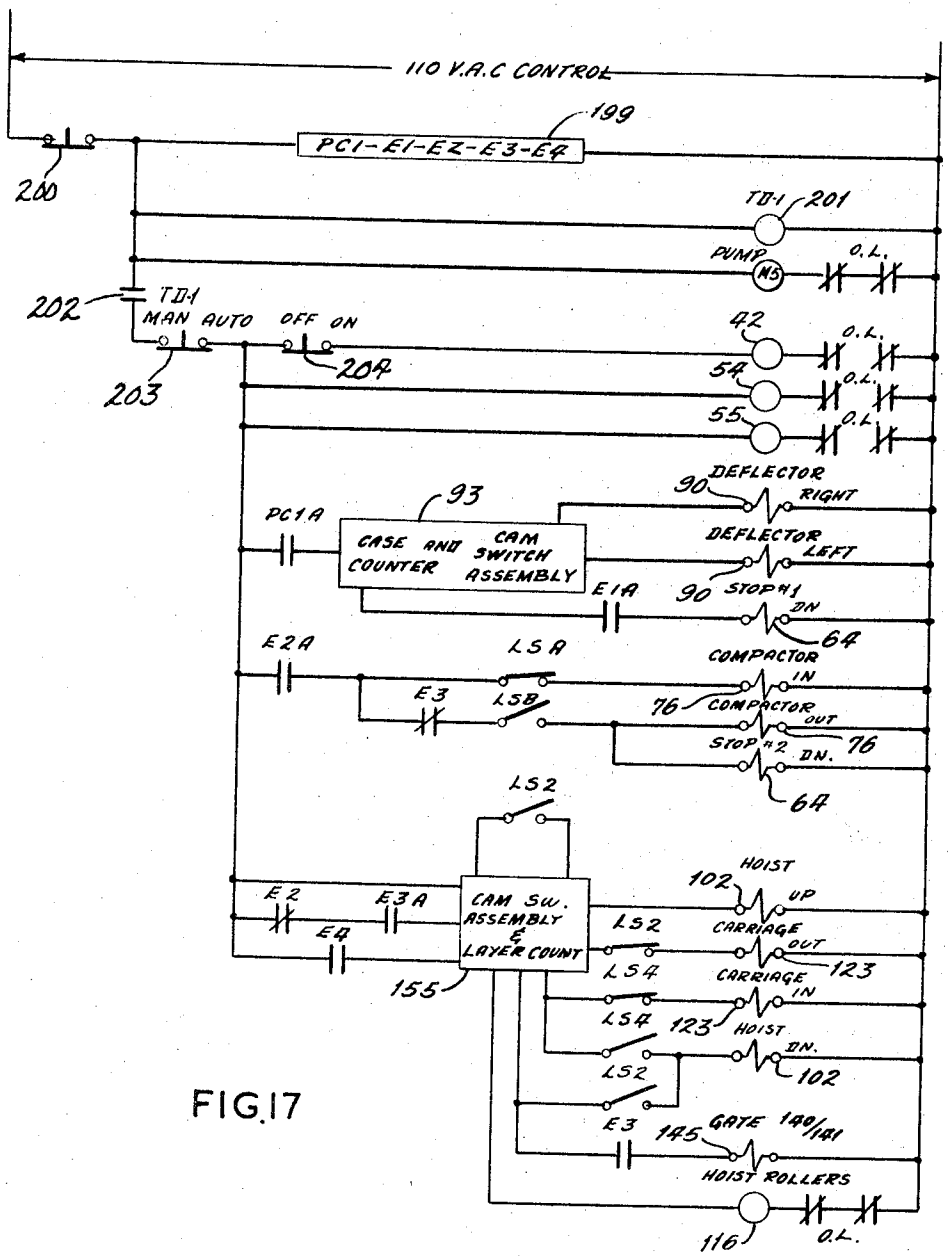

FIG. 17

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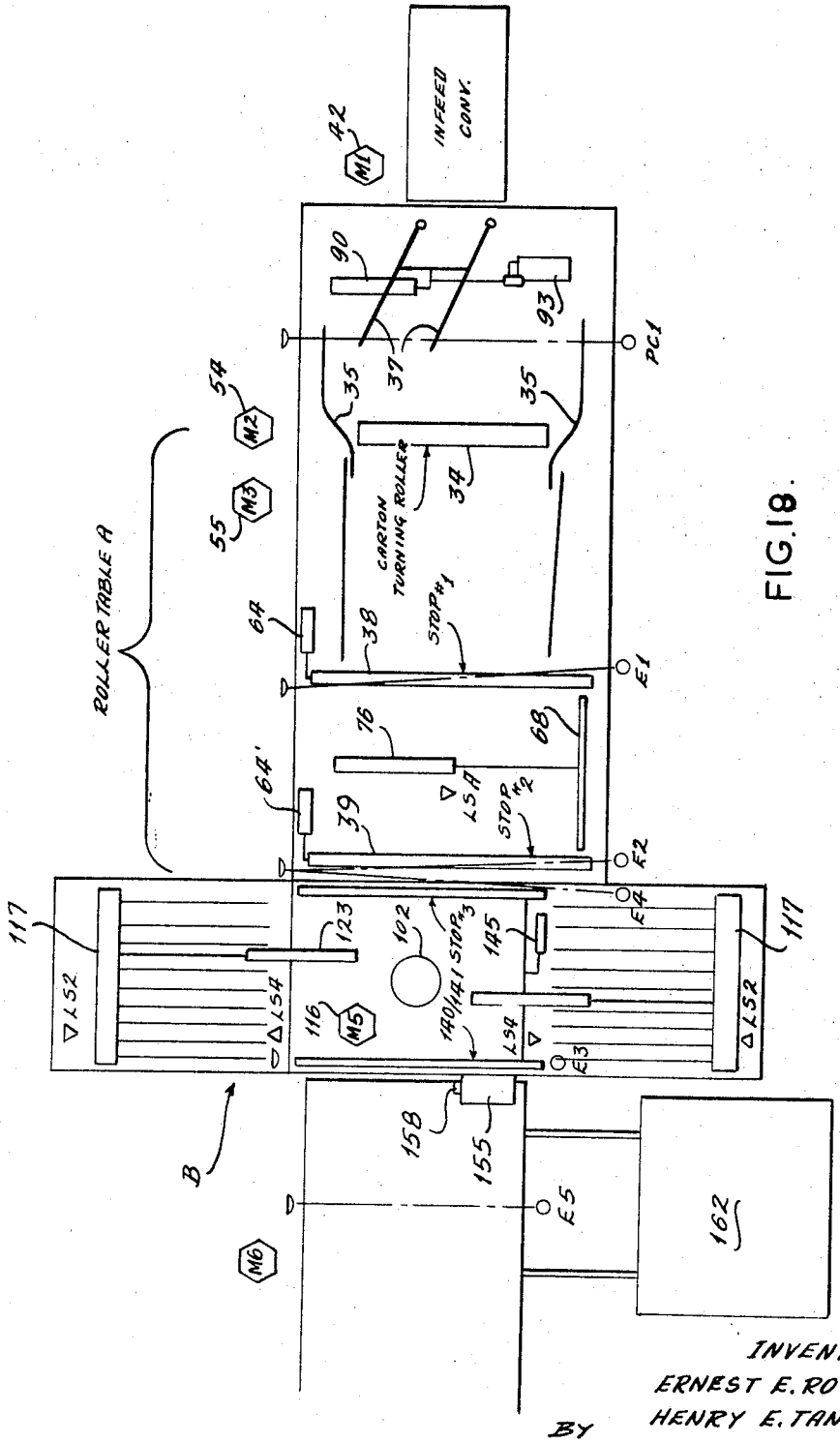

FIG. 18.

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May 6, 1969 E. E. ROTH ET AL 3,442,400

CARTON PALLETIZING APPARATUS

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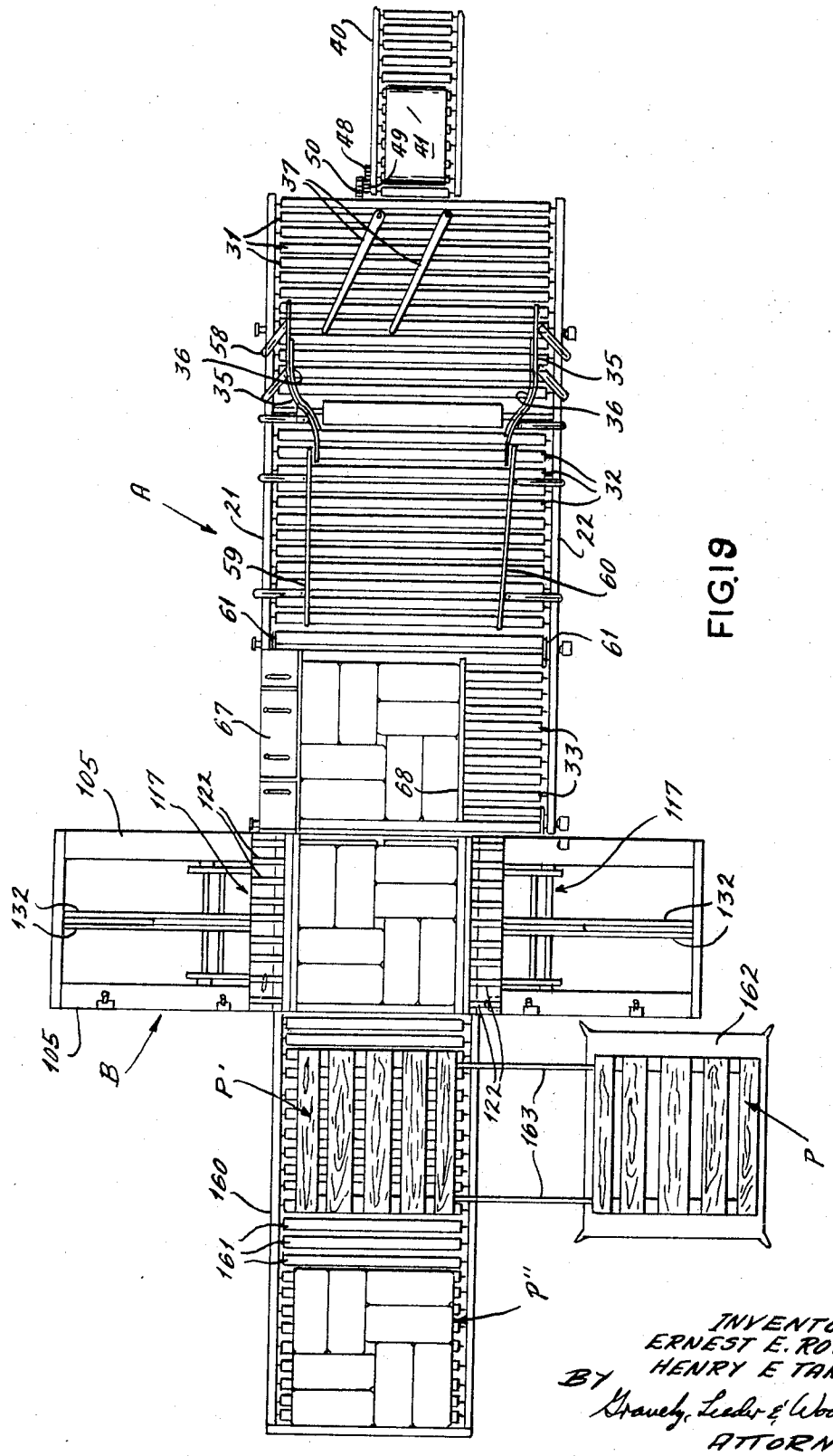

FIG. 19

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CARTON PALLETIZING APPARATUS

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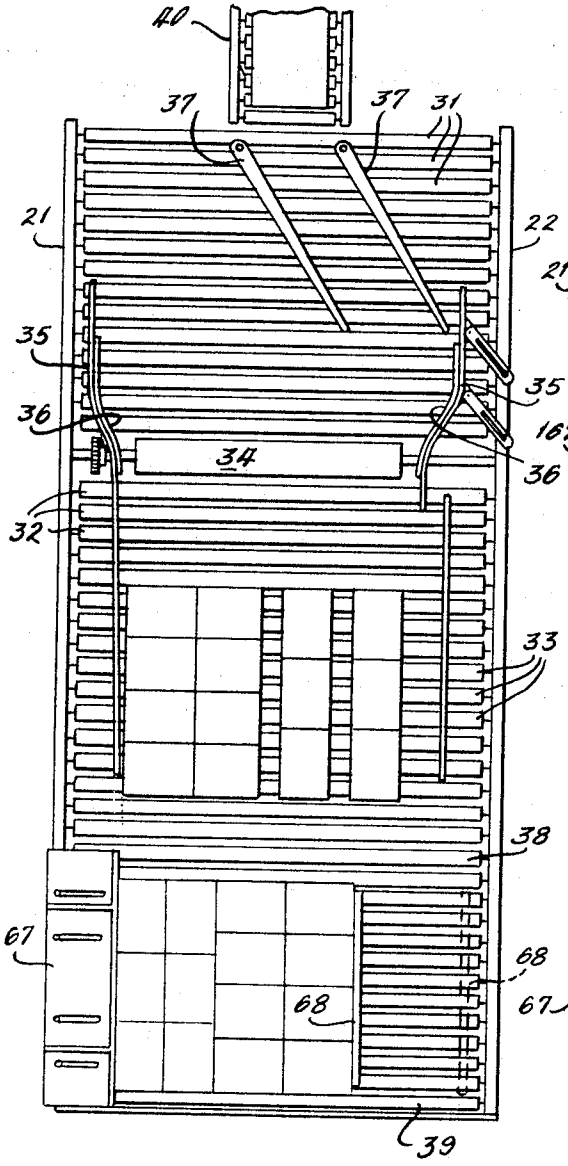

FIG. 20

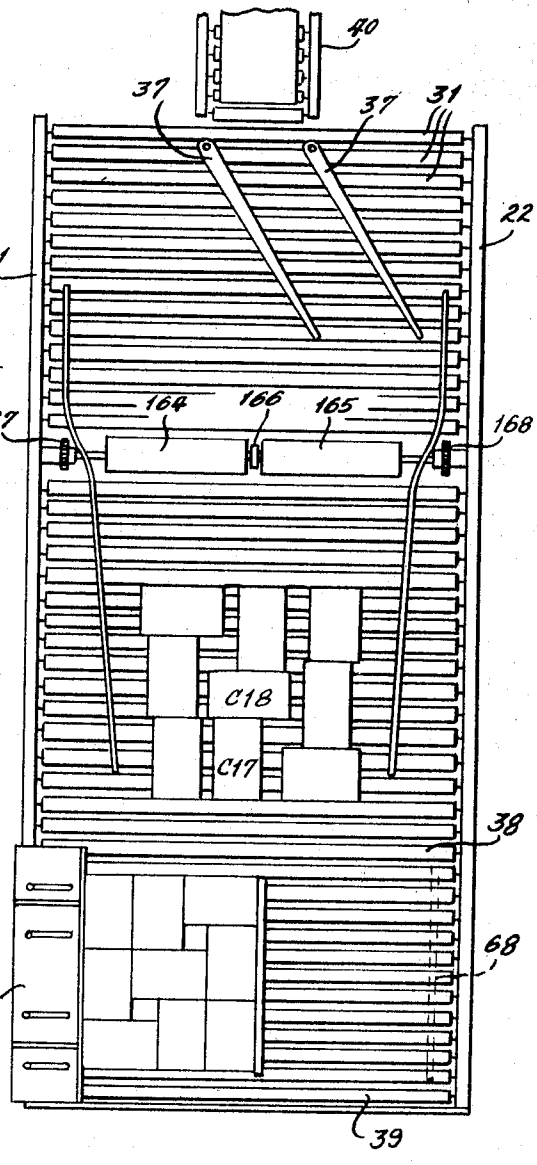

FIG. 21

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United States Patent Office 3,442,400
Patented May 6, 1969

3,442,400

CARTON PALLETIZING APPARATUS

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Filed Mar. 2, 1967, Ser. No. 620,090
Int. Cl. B65g 47/24, 47/82
U.S. Cl. 214—6 6 Claims

ABSTRACT OF THE DISCLOSURE

Carton palletizing apparatus in which elevator means is movable between a lower carton receiving position and an elevated carton storing position, means being located in the carton storing position in the form of tines which are insertable between the rollers forming the bed of the elevator means so as to be moved inwardly coincidentally with the elevator means to take over support and temporary storage of the cartons while the elevator means is lowered to the first position to receive additional cartons. The apparatus is capable of handling a plurality of cartons in a layered pattern and storing a plurality of layers until a suitable stack has been formed, which stack may then the deposited on a pallet for transportation and subsequent handling.

A carton palletizing apparatus of substantially floor level layout in which cartons are fed to make-up compact patterns of cartons on a continuously operating powered roller table and then transferred as patterns to a stacking device. The stacking device sequentially elevates each pattern of cartons and retains the same in elevated position such that a stack of patterns is built up from the bottom until a desired number of layers is collected. The stacking device then receives a pallet and raises the pallet under the stack where the stack is transferred onto the pallet and the thus loaded pallet is lowered and conveyed away or removed by suitable means, as by a fork-lift truck. The apparatus is provided with a system of controls that can form predetermined patterns, arrange for interlocked layers in a stack, and generally operate substantially automatically so long as the cartons are continuously supplied.

Palletizing apparatus heretofore available to the industry has generally involved large, high rise and expensive mechanism that is complicated to manufacture, is cumbersome to ship to the place of use and set up properly, and is large and high so that carton feeding conveyor systems are rendered expensive to set up. Most of the prior apparatus has been designed to stack layers of cartons from the top, thus demanding height in the apparatus to accommodate the top stacking mode of operation.

The important objects of the present invention are to overcome the problems of construction, the size of apparatus, the high level conveyance and handling of cartons, and the complications and expenses normally associated with prior apparatus.

Other important objects of the present invention are to provide a low level, table heighth apparatus that utilizes relatively standard components, improved stacking means for layering patterns of cartons from the bottom to accelerate the pelletizing operation, and reduction in the construction costs, expense of shipment of the total apparatus by having smaller and less bulky units.

There is disclosed herein certain preferred forms of palletizing apparatus which illustrate the principles of this invention, said forms being disclosed in more detail in the following description when considered in view of the accompanyng drawings, wherein:

FIG. 1 is a plan view of carton palletizing apparatus

illustrating a preferred form and organization of components;

FIG. 2 is a longitudinal and partly sectional view of the apparatus as seen along line 2—2 in FIG. 1;

FIG. 3 is a perspective view of the table frame utilized in the apparatus of FIG. 1;

FIG. 4 is a fragmentary perspective view of a component in the apparatus of FIG. 1, the showing being on an enlarged scale taken from below the table frame;

FIG. 5 is an enlarged fragmentary view of the stop means in the conveyor system of the apparatus;

FIG. 6 is an enlarged transverse sectional view taken at line 6—6 in FIG. 1;

FIG. 7 is an enlarged fragmentary sectional view taken at line 7—7 in FIG. 6;

FIG. 8 is a greatly enlarged and fragmentary sectional view of the stacking device in the apparatus of FIG. 1, the view being taken along line 8—8 thereof;

FIG. 9 is a partly sectional plan view of the stacking device as seen along line 9—9 in FIG. 8;

FIG. 10 is a simplified perspective view of the stacking device shown in FIG. 8;

FIG. 11 is a schematic view of the action of the pattern control guide means associated with the apparatus of FIG. 1;

FIG. 12 is a fragmentary detail view of the stabilizing means for the elevating table shown in FIG. 8;

FIG. 13 is a typical compacting dam and actuating means to lock and release the dam, the means being incorporated in pairs of the stacking device of FIG. 8;

FIG. 14 is a fragmentary sectional view of the coordinated carton stop means employed with the elevating table in the stacking device of FIG. 1;

FIG. 15 is also a fragmentary sectional view of the braking means employed to stop the rollers in the elevating table of the stacking device of FIG. 1;

FIGS. 16A through 16F are schematic elevational views of the sequential steps in the operation of the carton stacking device of FIG. 1;

FIG. 17 is a greatly simplified circuit diagram by which the several functions and sequential steps of the palletizing apparatus of FIG. 1 may be coordinated and controlled;

FIG. 18 is a schematic plan view of the apparatus embodying the control system of FIG. 17;

FIG. 19 is a plan view of a modified palletizing apparatus embodying the components and control features illustrated in the foregoing view, but enlarged to include pallet loading and loaded pallet discharge;

FIG. 20 is a plan view of another modification for forming carton patterns; and

FIG. 21 is still another plan view of a modified palletizing apparatus for forming carton patterns.

Turning now to FIGS. 1, 2 and 3, the palletizing apparatus A is organized on a low level table structure (FIG. 3) which includes longitudinal side members **23**, **24**, **25**, **26** and **27**, and supported by pairs of legs **28**, **29** and **30**. A series of load supporting rollers are suitably supported at the opposite ends in the side members **21** and **22**, the rollers being arranged in groups, as follows: The group of rollers **31** comprise a carton receiving section on the table; the next group of rollers **32** comprise a carton pattern collecting section on the table; and the next group of rollers **33** comprise a carton compacting and loading section on the table. Between the groups of rollers **31** and **32** there is positioned a large diameter carton turning roll **34** which cooperates with adjustably fixed turning abutments **35** located at the opposite ends of the turning roll **34**. Each abutment **35** is faced with a friction pad **36** which retards the sliding action of a corner or other part of a carton to the extent that the

carton swings or pivots into a position rotated about 90 degrees from its alignment when issuing from between a pair of pattern control guides 37. The pivoting carton passes over the turning roll 34 and is quickly stabilized in its correct turned attitude.

Between the group of rollers 32 and 33 there is a stop roll 38 which may on command rise above the upper load supporting surface of rollers 32 to stop passage of cartons. At the end of the group of rollers 33 there is another stop roller 39 which also on command rises above the top surface of rollers 33 to stop the passage of cartons. The supply of cartons is obtained from a conventional roller conveyor the end of which is seen at 40. Between this conveyor 40 and the rollers 31 there is disposed a carton speed-up belt conveyor 41 whereby cartons arriving in end to end abutment from conveyor 40 can be separated to create a desired spacing so that each carton can proceed to move between the control guides 37. The group of rollers 31 also is operated to increase the carton spacing so that little opportunity is afforded for carton pile up, unless an obstruction develops.

As an example of the belt and roller drive means there is seen in FIG. 2 a drive motor 42 mounted on the legs 43 of the belt conveyor frame. The motor 42 is connected by sprocket chain 44 to the end of the belt drive roll 45. The belt 41 is trained over a roll 46 and returns through a slack take-up device 47. The roll 46 drives a gear 48 which meshes with a direction reversing gear 49 (FIG. 1) of a speed gear 50. The speed gear 50 drives a belt 51 passing in driving engagement under the group of rollers 31 and runs through a slack take-up device 52. The turning roller 34 has a separate drive by sprocket chain 53 from motor 54. All of the rollers 32 and 33 are driven from a common motor 55 and sprocket chain 55*a*, the drive belt 56 passing against the under side of these rollers and through a slack take-up device 57. In one preferred apparatus A, and to illustrate the operation thereof, the cartons were fed by conveyor 40 at about 50 f.p.m. and accelerated by belt 41 to about 137 f.p.m. to effect a spacing thereof. Each carton on reaching the rollers 31 was speeded up to about 148 f.p.m. to increase the spacing due to the action of the pattern control guides 37 in fanning back and forth widthwise of the rollers 31, as will be explained presently. The turning roller 34 was driven at a speed to move the cartons at about 210 f.p.m. to complete carton turning rapidly and stabilize the turned position, after which the rollers 32 and 33 were driven to effect carton movement at about 180 f.p.m. to effect the collecting and movement of cartons in a pattern. Of course, other linear speeds can be selected, depending upon the character of carton contents and weight, and in this connection the term "carton" shall be taken to mean any article, case, bag or box which has sufficient shape retention ability to be caused to turn by the action of the fraction surfaces 36 and roll 34, and be responsive to pushing so as to move into a compact pattern.

Still with reference to FIGS. 1, 2, 4 and 5, it is seen that the groups of powered rollers 31, 32 and 33 assemble and advance patterns of cartons that have been selected for make-up by the control guides 37. In the section of rollers 31 there are adjustable supports 58 for locating the abutments 35 which initiate carton turning. Beyond the abutments 35 there are guide rails 59 and 60 fixed in position over the group of rollers 32 to act to keep the cartons together in some semblance of the desired pattern. Adjacent the ends of rails 59 and 60, there is the stop rail 38 which on command is raised above the top line of rollers 32. Actuation of stop roller 38 is effected by a pair of bellcranks 61 (one being shown in FIGS. 2 and 5) located at the ends of the roller 38. The bellcrank 61 has its arm 62 (FIG. 5) actuated by the rod 63 of a pressure cylinder motor 64. The base end of the motor 64 is pivoted in a bracket 65 carried by the frame side member 21. The side not shown is similar to what has just been described. When the roller 38 is down it bridges the last roller 32 and the first roller 33. In a like manner stop roller 39 is actuated by pressure cylinder motor means 64' moving bellcranks 66 (FIG. 1).

The group of rollers 33 support a pattern of cartons generally assembled near the adjustable guide 67 carried by the frame side member 21. Opposite the guide 67 is a compacting ram 68 which moves over the rollers 33 to compact the cartons against the guide 67 and align the pattern for movement out of the compacting section of rollers 33. The ram 68 is connected by a pair of rods 69 (one being seen in FIG. 4) to slides 70 which move on guide rods 71. The guide rods 71 are supported in and between side member 22 and an intermediate member 72 (see FIG. 3). The slides 70 are cross connected by straps 73, and one strap 73 has an arm 74 to which the end of piston rod 75 is connected. The rod 75 is actuated by the cylinder motor 76 supported by bracket 77 from side member 22.

As is seen in FIG. 2, the drive means 51, 53 and 56 for the rollers 31, 34 and 32–33 are operatively supported in the frame (FIG. 3) between the side member 21 and intermediate members 78 and 79. A typical support for the belt means 51 is seen in FIG. 6 where the pulley 80, support belt 51, and the pulley shaft 81 is driven by a sprocket wheel 82 and sprocket chain 82' from gear 50 (FIG. 2). In addition to supporting the pulley 80, the member 78 and a spaced parallel angle member 82 (FIG. 6) support a pair of rods 83 on which slides an actuator 84 (FIG. 7) having a pair of fingers 85 engaged in slots 86 in the lower flanges 87 of the pattern control guides 37. As is seen in FIGS. 6 and 7, the control guides 37 have the carton entrance ends pivoted on shafts 88 supported by the frame cross member 27 on an extension base 89. The actuator 84 is connected to a piston-cylinder motor means 90, the piston rod 91 of which is attached to the drive boss 92 on the actuator and the cylinder of which is attached to the intermediate member 78. The motion of actuator 84 is monitored by a group of cams contained in a box 93 and actuated by the shaft 94 driven by sprocket 95 and chain 96. The chain ends are attached to the boss 92, and one loop of the chain runs over the idler sprocket 97 while the other runs over the cam shaft sprocket 95.

Looking now at FIG. 11, and with due regard to the plan view of FIG. 1, there is shown somewhat diagrammatically the operation of the pattern control guides 37 in order to make up a pattern of eight cartons. In order to make up such a pattern of cartons the control guides 37 must be fanned crosswise of the carton supporting rollers 31 in the receiving section of the table to six different settings. For example, the control guides 37 must initially be positioned in the direction represented by the broken line 1 such that the carton C1 passes between the control guides 37 and is picked up by the acceleration roller 34 without engaging or brushing against the friction surface 36 on the side abutment 35. Thus carton C1 will proceed straight into its pattern position. The control guides 37 are then moved to position 2 as represented by the broken line 2 where carton C2 is directed straight in and passes over the roller 34 to assume its position along side of carton C1. At this point the control guides 37 are fanned in a counterclockwise direction to a position represented by broken lines 3–4, where cartons C3 and C4 in succession are directed so that the leading corner thereof brushes against the friction surface 36 on the abutment 35, causing the cartons to start a turning operation which is stabilized by the acceleration roller 34 such that each of the cartons is turned 90° to the cartons C1 and C2. Immediately following the passage of carton C4 the control guides 37 are fanned in a clockwise direction to a position represented by broken lines 5–6 where successive cartons C5 and C6 are directed against the friction surface 36 of abutment 35 to effect a

90° turn before passing into the pattern of the cartons previously collected. The control guides **37** are then moved to the position represented by broken line **7** where carton C7 is directed straight through to take its position along side of the turned carton C5 and C6. This is followed by the guides being positioned as represented by the broken line **8** where the final carton C8 passes into the pattern without being turned. The foregoing description relates to the forming of a pattern of eight cartons which is assembled against the stop roller **38** in a loose fashion. At this time the stop roller **38** is retracted into the surface of the rollers **32** and the loose pattern is advanced to the stop roller **39**. Once the pattern has cleared the stop roller **38**, this roller immediately rises to isolate the next pattern of cartons from the previous pattern of cartons. While a second pattern of cartons is being assembled the first pattern is being compacted by the action of the ram **68** compressing the cartons into abutting adjacency against the guide **67**. When this compacting operation has been completed and the ram **68** set on its withdrawal movement, the stop roller **39** is lowered and the compacted pattern of cartons is fed into a stacking device which will be described presently.

During the compacting and feeding operation for the first described pattern of cartons, the second pattern of cartons is being assembled adjacent stop roller **38** and between the side guide rails **59** and **60**. In the second pattern the sequence of assembling the cartons is reversed to the first pattern so that when the patterns are stacked there will be an interlocking relation created as is well understood in this art. It is not believed necessary to repeat the sequence of movement of the control guides **37**, except to say that in making up the second pattern cartons C9 and C10 are directed into position with the guides in the position represented by broken lines **5–6**. Cartons C11 and C12 are positioned with the guides **37** in the respective positions represent by broken lines **7** and **8**. Cartons C13 and C14 are positioned with the guides **37** in the respective positions of the broken lines **1** and **2**, and finally cartons C15 and C16 are positioned when the guides have moved to the position represented by the broken lines **5–6**. So long as the subject pattern of eight cartons is called for the control guides **37** will fan back and forth as above described first for one pattern and then for the interlocking pattern layout.

It can be appreciated that the groups of load supporting rollers **31**, **32** and **33** will greatly accelerate the rate of handling cartons, because a number of different operations can be performed simultaneously in front of the stops **38** and **39**. That is to say, while a pattern of cartons is being compacted a second pattern of cartons can be collecting, and while the patterns of cartons are being fed into the stacking device in sequence a third pattern can be readied for assembly, all without interference. The disclosure last above described in connection with FIGS. 1 and 11 represents means for feeding patterns of cartons into a stacking device, and in its broadest sense this portion of the palletizing apparatus A can be thought of as a feeder for the stacking device now to be described.

Referring now to FIGS. 1 and 8, it can be seen that the stacking device B is positioned at the end of the carton pattern forming table such that an elevator frame **100** is positioned initially such that its group of carton supporting rollers **101** are in the plane with the carton supporting rollers **33** in the compacting and loading section previously described. The elevator frame **100** is supported by the ram **102** (FIG. 9) of an elevator hoist unit **103**. The elevator hoist unit **103** is supported on suitable floor engaging beams **104** which are part of a general frame composed of beams **105** which are supported on the beams **104** as well as on other beams **104***a*. Thus a rigid frame work is created for the operating components of the stacking device B. The elevator frame **100** is prevented from twisting out of proper alignment by means of a stabilizing device shown in FIG. 12. This device includes a stabilizer projection **106** running between rollers **107** carried in a frame **108**—the frame **108** is supported between cross members **109** which are, in turn, supported from the beam structure previously described. It can be seen in FIG. 8 that a safety chain **110** is connected between a frame member **109** and the elevator frame **100** so that the elevating ram **102** can not exceed a predetermined elevation. It can be seen in FIG. 9 that the ram **102** works in a cylinder **102***a*, and that the cylinder has an extension **106***a* which engages in the stabilizer **106** for purposes of maintaining proper alignment between the cylinder **102***a* and the elevator frame **100**.

The elevator rollers **101** are adapted to be driven at certain times by a drive belt **111** when the elevator frame **100** is in its lowermost position. The drive belt is operatively supported (FIGS. 2, 8 and 9) on end pulleys **112** which are supported in a suitable frame structure **113** mounted from the main beams **103** as can be seen in FIG. 2. The belt **111** is trained over a drive pulley **114** which is driven by a suitable sprocket chain **115** from motor means **116** supported on a leg **28** of the table frame shown in FIG. 3. The motor means **116** is of reversing type so that the belt **111** can at proper times be directionally controlled for turning the rollers **101** in the elevator frame **100** either to bring the pattern of cartons on to the elevator, and to discharge a loaded pallet from the elevator or to reverse the rollers for the purpose of initially bringing in an empty pallet upon which a stack of cartons is to be deposited.

The stacking device B as is shown in FIGS. 8 and 10 includes a pair of carton supporting carriages **117**. The carriages are identical but formed for right and left hand assembly, and it will be appreciated that the same reference numerals will be used on similar parts in order to simplify the description. As can be seen best in FIG. 10, each carriage **117** includes a base frame **118** made up of longitudinal and transverse members, and this frame carries wheels **119** which are adapted to run on the inner flanges of the main longitudinal beams **105**. Each base frame **118** is provided with a pair of vertical columns **120** which are adapted to support a channel member **121**. The channel member **121** must be of sufficient structural ability, along with the columns **120** and the base frame **118**, to form a rigid support for a plurality of tines forming a plane which is substantially tangent to the rollers **101**. Thus, support rollers **101** on the elevator frame can be brought up very close to the underside of the tines **122** to minimize any vertical difference in the tine surface relative to the roller surfaces. It can be observed in FIG. 8 that the carriages **117** are operated by piston cylinder motor means in which the cylinder **123** is carried in a central longitudinal extending channel **124** and the piston rod **125** is connected to a fixed arm **126** on the carriage. The piston cylinder motor means **123** are operated in unison so that the carriages **117** move in and out relative to the elevator frame **100** at the same time. Since the tines **122** of the carriages **117** are adapted to support the pattern of cartons, and since the tines must be removed from such support each time a new layer of cartons is brought to the stacking device. it is necessary that the tines be withdrawn from the carton supporting position and in order to accomplish this the cartons must be retained so as not to move outwardly with the tines **122**. This is accomplished by means of providing a pair of holding dams **127**. Each dam **127** is carried on a pivoting frame **128** having its lower end pivotally supported in a suitable bracket **129** as can be seen in FIGS. 8, 9 and 13. The pivot frames **128** are provided midway of the vertical height with a cross member **130** for the purpose of cooperating with a retractable locking plate **131**. When the locking plate **131** engages the cross member **130** the holding dams **127** are vertically positioned with the dams **127** closely adjacent the pattern of cartons supported on the tines **122**. The locking plate **131** is pivotally mounted between a pair of plates **132** carried

on the central channel **124**, and —the pivot shaft **133** for the locking plate **131** carries a depending arm **134** to which is connected an actuating spring **135**. It can be observed in FIG. 13 that the spring **135**, being anchored to the central channel **124**, constantly urges the arm **134** in a direction to lift the locking plate **131** upwardly so as to intercept and prevent the cross member **130** in the pivot frame **128** from passing back over the locking plate **131** once it has moved rightwardly to the locking position.

It can be appreciated that the holding dams **127** must be coordinated with the operation of the carriages **117**, and this is accomplished in the following manner: As can be seen in FIG. 8, when the carriages **117** are in their retracted or outermost position each thereof is provided with an abutment element **136** which is engaged with a tab **137** on the lower end of the arm **134**, thereby holding the locking plate **131** in its retracted position so that the pivot frames **128** can be drawn backwardly by a spring **138** to rest against a stop **139**. As the carriages **117** move inwardly toward each other the abutment elements **136** move inwardly thereby freeing the arms **134**, under the influence of spring **135**, to permit the stop plates **131** to move to locking positions. However, the plates **131** can not move to locking positions until the cross member **130** in the pivot frames **128** has cleared the top edge of the locking plates. Once this clearance has been established the locking plates will snap upwardly and the curved end edges **131***a* on each thereof will apply a suitable holding engagement so that the pivot frames **128** will remain inwardly in binding contact with the cartons. As the frames **117** return to the outward position of FIG. 8 the dams **127** are not freed from carton engaging positions until the tines **122** are very nearly at the withdrawn position, at which time the abutment elements **136** engage the tabs **137** on the arms **134** of the locking plates **131** to withdraw the locking plates and thus free the pivot frames **128** so that the dams **127** will be removed from the possibility of interfering with the handling of the cartons.

It will be observed in FIG. 14 that the elevated frame **100** is provided with a pair of coordinated stop gates **140** and **141**, gate **140** being located at the carton feed side of the stacking device B and the gate **141** being located at the outlet side of the stacking device. Each gate is comprised of a longitudinal channel member mounted by suitable actuating arms **142** and **143** respectively about the pivot axis of the adjacent elevator rollers **101**. The arms **142** and **143** are interconnected by an actuating rod **144**, and the rod **144** is powered by a suitable piston cylinder motor means **145**. It will be observed that when the gate **140** is in its full line position for stopping cartons the gate **141** is in its retracted position. The reverse coordination of these gates is shown in broken outline.

It has previously been pointed out that the rollers **101** in the elevator frame **100** are driven in the proper direction by the drive belt **111** when t he elevator frame **100** has been lowered so that the rollers **101** engage the drive belt. When the elevator frame **100** is raised it is desirable that the rollers **101** be stopped. This is accomplished by means of a brake device which is shown in FIG. 15. The brake device includes a brake beam **146** having brake lining **147** adapted to engage the rollers. The brake beam **146** is maintained in proper attitude for engaging all of the rollers **101** simultaneously by pivot arms **148** carried in the frame **100**. The pivot arms **148** are so positioned with respect to the brake beam **146** that a spring **149** can be utilized to lift the brake beam **146** into proper braking position. Removing the brake pressure is accomplished by a retract arm **150** connected to the brake beam at link **151** and having its opposite end **152** located in a position to engage a fixed striker **153** (FIG. 8) mounted on the the cross member **109**. It can be appreciated that as the frame **100** descends relative to the fixed striker **153**, the retract arm **150** pivots in a direction to draw the brake beam **146** inwardly against the action of the spring **149** so that the rollers **101** are free from braking restraint and can be freely driven by the belt **111**.

Turning now to the views of FIGS. 16A through 16F, it can be seen that the components of the stacking device B have a predetermined sequence of operation which will now be described. In FIG. 16A the carriages **117** are withdrawn so that the dams **127** are free to pivot to open positions. This allows the elevator frame **100** to pass upwardly between the dams **127** to the required heighth such that the tines **122** (FIG. 16B) may be inserted under the first layer of cartons. As the tines **122** pass under the cartons the dams **127** move in and retain the cartons in compact relation on the tines **122**. This action allows the hoist to descend empty to receive a second layer. Hoisting the second layer (FIG. 16C) brings the cartons up under the tines **122** to the position shown in FIG. 16D. At this time the carriages **117** withdraw but the dams **127** remain in clamped position against the cartons until the tines **122** are fully withdrawn and the top layer is allowed to drop only a short distance onto the second layer of cartons. In FIG. 16E the elevator frame **100** has raised both layers to the proper heighth so the tines **122** may be inserted under the two layers upon reversal of the carriages **117**. The carriages again run inwardly to insert the tines **122** under the two layers and close the dams **127** as before. The elevator frame **100** again descends to receive a third layer, and in FIG. 16F the third layer is brought up to a position where the tines **122** may again be withdrawn. The cycle of events as above described is repeated as many times as is needed to build up a multiple layer of cartons. The number of layers is predetermined and under the control of counting means in the box **155** (FIG. 8).

A typical apparatus of the character disclosed in FIGS. 1, 2, 4, 5, 6, 8, 9 and 14 is provided with control means which is disclosed in greatly condensed form in the electrical diagram of FIG. 17 and the schematic layout in FIG. 18. The following will make reference to these views of the drawing, and any others deemed helpful will be referred to. It is, of course, understood that there will be a suitable source of compressed air and a fluid pressure source which need not be shown.

It has been pointed out above that electric motor means **42** (FIG. 2) drives the supply conveyor **40** as well as the group of rollers **31** constituting the carton receiving section of the table of load supporting rollers. A separate electric motor means **54** is provided to drive the turning roll **34**. Motor means **55** drives the group of rollers **32** in the pattern collecting section of the table and the group of rollers **33** in the compacting and loading section of the table. Fluid pressure motor means **90** (FIG. 6) controls the pattern guides **37**, air motor means **76** (FIG. 4) operates the compacting ram **68**, air motor means **64** and **64'** (FIG. 2) operate the respective stops **38** and **39**, air motor **145** (FIG. 14) operates the gates **140** and **141**, fluid pressure motor means **102** (FIG. 9) operates the hoist **103**, and electric motor **116** (FIG. 2) drives the belt **122** for driving the hoist rollers **101**.

If it is assumed that the apparatus is just starting up, the operator closes the master switch **200** (FIG. 17) which supplies suitable current (say 110 volt A.C.) to the various electric eyes PC1, E1, E2, E3, E4 and E5 stationed about the apparatus in FIG. 1, but represented collectively at **199** in FIG. 17. Concurrently an hydraulic pressure pump (not shown) is started and brings hydraulic fluid up to operating pressure for actuating various motor means in the apparatus, such as motor means **90** driving the pattern control guides **37**, the elevator ram **102**, and the motor means **123** for actuating the carton supporting carriages **117**. Motor means **64**, **64'**, **76** and **145** are operated by compressed air. After a desired time, a time delay unit **201** closes its contact **202** to complete the supply of current to the various means, switches, and devices provided to handle the operation, either manually or automatically, as may be selected at switch **203**.

This activation by switch **203** will condition the roller table A and elevator hoist unit B to go into operation, and will start electric motors **54, 55** and **116**. No cartons will be fed to the table A until electric motor **42** is started to drive the belt **41** or other means, as well as rollers **31** in the table, by closing switch **204**.

It is assumed also that the deflectors **37** are in the position **1** as in FIG. 11 and that the apparatus is programmed for forming layers in the order and sequence shown in FIG. 11. The incoming cartons C1, C2, C3, etc. will pass the electric eye PC1 closing and opening its contact PC1A to signal a counting relay in the box **93** to step around and signal the fluid pressure motor **90** through control valves represented (FIG. 17) by solenoids to move the deflectors **37** in the sequential order described in connection with FIG. 11. The cartons are collected against stop roll **38**, some being turned by the combined action of the roll **34** and side abutments **35**. As the first carton reaches stop roll **38** it breaks the light beam for eye E1 that opens contact E1A. At the proper time in the counting cycle stop roll **38** is retracted by actuation of its air motor **64** through a solenoid control and when the light beam from electric eye E1 is clear the eye contact E1A closes to cause air motor **64** to raise roll **38** to stop the second group of cartons, as shown being assembled in FIG. 11. The first group of cartons runs into stop roll **39** and breaks the light beam from electric eye E2 which closes its contact E2A which signals the compacting ram air motor **76** to move the ram **68** in for compacting the cartons and in this movement it will open limit switch LSA and in the end position actuate a limit switch LSB which will reverse the air motor **76** and signal air motor **64'** to lower stop roll **39** so that the compacted cartons may proceed on to the elevator rollers **101**. The elevator is provided with a pair of interconnected gates **140–141** subject to movement by the motor means **145**. At this stage in the cycle of operation gate **141** is up and gate **140** is retracted.

The feed of the cartons onto the elevator rollers **101** is possible when the frame **100** is in its lowest position, when the gate **140** is retracted, and when the electric eye E3 is not blocked, such as by the presence of a pallet or other cartons. As the group or layer of cartons clears electric eye E2 the motor means **64'** for stop roll **39** will raise the same to catch the next following group of cartons. When the cartons move into the elevator unit B and block the electric eye E3 the contact E3A will close and hoist motor means **102** will be signalled by switch means in box **155** to rise. This being the first layer in a load, the carton supporting carriages **117** will move from the "out" positions by actuation of motor means **123** after the hoist **103** has elevated the cartons to its maximum heighth position so that they are carried above the level of the tines **122**. The motion of the hoist **103** is transmitted by cable **157** (FIG. 8) to a series of cams on a rotary shaft (not shown) in the counter box **155**. The shaft in the box **155** is rotated oppositely to the tension in cable **157** by a motor (spring tension type) **158** so that as the hoist **103** descends the rotary shaft will follow the movement and actuate suitable microswitches.

When the hoist **103** reaches the top position, a switch in box **155** will signal the motor means **123** to move the carriages **117** inwardly so that the tines **122** slide under the cartons. At the proper "in position" of tines **122** the limit switches **LS4** are actuated to stop the carriages and signal the hoist **103** to lower and receive a second layer of cartons. The raising of the second and following layers will be slightly different due to a cam in the box **155** which will stop the hoist **103** when the top surfaces of the layer of cartons is just below (about ¼") the tines **122**. Upon stopping the hoist **103** at the latter position, a signal will be sent to the motor means **123** to reverse and withdraw the carriages **117**. The withdrawal of the carriages will result in actuation of limit switches LS2 to signal the hoist **103** to continue up to its top position where it supports both layers. The hoist reaching the top position will by cable **157** (FIG. 8) signal the carriages **117** to move inwardly so that the tines **122** support the new load.

This cycle keeps up while a counter in box **155** counts off the desired number of layers wanted in the stack. When the count has been satisfied, stop roll **39** will not be allowed to drop again until the stack on the hoist is removed. Thus, when the hoist **103** gets to the bottom on its last trip and when it blocks the electric eye E4, the hoist table having taken on a pallet P, it will be signalled to rise until it stops just under tines **122**. At this point, a cam switch in box **155** will stop the hoist and move the carriages **117** out. Actuation of the out limit switches LS2 will indicate that the hoist **103** can lower to its down position, and when it reaches the position the hoist rollers **101** will engage a moving belt **111** driven by motor means **116**. Simultaneously, the stop gates **140–141** will be actuated by air motor means **145** to hold gate **140** (FIG. 14) raised and gate **141** lowered. The rollers **101** are driven to urge the pallet loaded with layers of cartons out of the apparatus onto any suitable take-away conveyor or onto a suitable lift truck or bed of a take-away conveyance. When the loaded pallet has cleared the electric eye E3, a signal will be receeived by the motor means **145** to lower gate **140** and raise gate **141** so that a repetitious cycle of loading another pallet can take place in accordance with the foregoing description.

In FIG. 19 there is shown a modified apparatus in which means is provided for bringing empty pallets into the stacking unit B and for taking loaded pallets out. Whereever parts and components are shown in this view that are similar to the parts and components seen in FIG. 1 similar reference numerals will be applied. Previously presented description will, therefore, not be repeated in the interest of brevity.

The apparatus of FIG. 19 includes a conveyor frame **160** for supporting load carrying rollers **161** that may be power operated or may be free turning, as desired. To one side of the frame **160** there is a platform **162** upon which are placed the empty pallets P, either by hand or by a fork-lift truck. The platform **162** is connected by slide members **163** to the frame **160** so that each pallet P can be conveniently moved into position as shown by pallet P'. Once the desired stack of cartons has been assembled in the stacking unit B, the pallet P' is moved into the elevator frame **100** and elevated to receive the carton stack. The loaded pallet is lowered to the level of the frame **160** and is moved out to the position of loaded pallet P'' where it may be removed by a fork-lift truck.

The apparatus of FIG. 19 is shown in connection with the formation of a pattern of cartons different from the pattern formed by the apparatus of FIGS. 1 and 11. This is intended to illustrate the variations of carton pattern control that is available, although the control means described in FIG. 17 is related to the apparatus of FIG. 1.

The apparatus of FIG. 20 illustrates a modified form of apparatus in which a different carton pattern may be made up. Similar parts and components in this view will be denoted by reference numerals used in FIG. 1. The prinicipal difference resides in the formation of layers of 14 cartons instead of 8 cartons.

The apparatus of FIG. 21 illustrates a further modification in which parts and components similar to those in FIG. 1 will be denoted by similar reference numerals. Principally the modified apparatus is preprogrammed to make up layers of nine (9) cartons and in effecting this result, the carton turning roll is divided into two sections **164** and **165** with a bearing **166** disposed therebetween. Section **164** is provided with a drive sprocket **167** and section **165** has a drive sprocket **168** whereby separate motor means, like motor means **54** in FIG. 2, may be provided for rotating either roll section or rotating the sections at different speeds or in reverse directions so that

the cartons directed by guides 37 over the adjacent ends may be turned from an end-on position as carton C17 to a cross-wise position as carton C18.

In the various forms of apparatus illustrated herein, the pattern control is predetermined to alternate the carton patterns so that the final stack will be interlocked. However, it is contemplated that the patterns may be made up without reversing so that there will be no interlocking layers.

It should now be understood in what manner the apparatus is intended to function to produce the advantages enumerated above. Having described certain forms of apparatus and a preferred form, it is intended to include variations within the spirit and scope of the appended claims.

What is claimed is:

1. In carton palletizing apparatus, a conveyor table upon which cartons are accumulated in patterned layers, an elevator device adjactent said conveyor table movable between a first position level with said conveyor table and other positions elevated above the first position, said elevator device being provided with a plurality of rollers forming the carton layer supporting surface, powered means located adjacent said first position of said elevator device to be engaged by said rollers for rotating the rollers in a first direction, movement of said elevator device toward said other positions breaking the roller rotating engagement, stop means on said elevator device operable selectively to intercept carton layer movement onto and off of said supporting surface of rollers, means adjacent the first position level of said elevator device to feed an empty pallet upon said elevator device, said powered means being reversible to bring the pallet under the stack of carton layers, said elevator device raising the pallet to accept the stack of carton layers, and control means to set said powered means for operation to rotate said rollers in said first direction for discharging the loaded pallet and begin receiving subsequent layers of cartons, carton layer holding means operable adjacent said other positions of the elevator device to support successive layers of cartons brought to said other positions and form a stack of carton layers.

2. In carton palletizing apparatus the combination of elevator means movable between a first carton receiving and discharge position and a second carton storing position, a plurality of power driven carton supporting rollers spaced apart on said elevator means to define a platform surface, feeding means at said first position to feed cartons onto said elevator platform surface, discharge means at said first position to receive cartons for discharge from said elevator platform surface, carton storage means adjacent said second carton storing position comprising reversibly movable frame means having a plurality of tines extending in a direction to occupy a position adjacent said elevator platform surface in a first position and to retract from adjacent said elevator platform surface in a seocnd position, said tines on said frame means

being spaced apart to interleaf with said spaced carton supporting rollers, and means to displace said frame means of said carton storage means between said first and second positions respectively to take over carton support and to release cartons to said carton supporting rollers, said rollers being drivable in a forward direction to feed the cartons thereon and to discharge a completed stack therefrom, the rollers also being drivable in the reverse direction to bring in an empty pallet from the discharge position upon which a stack of cartons is to be deposited.

3. The combination of claim 2 in which said carton storage means comprises a pair of opposed movable frame means each having a plurality of tines which together support cartons.

4. The combination of claim 2 in which said elevator means is provided with cooperating gate means adjacent said feeding means and discharge means, power operated means adjacent said first elevator carton receiving and discharge position to engage and drive said carton supporting rollers for moving cartons, and brake means on said elevator means to stop roller rotation upon elevator movement toward said second carton storing position.

5. The combination of claim 2 in which alignment means is operably mounted adjacent said second carton storing position and across the path of movement of said movable frame means, said alignment means intercepting the cartons on said tines upon retraction of said tines and being movable to a position causing the cartons to remain substantially aligned with said elevator means.

6. The combination of claim 5 in which means in said apparatus is operably mounted to retain said alignment means in said carton aligning position, said retainer means being released by movement of said frame means toward its retracted position.

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