Dec. 16, 1958 S. HILLMAN 2,864,215

PACKAGING MACHINE

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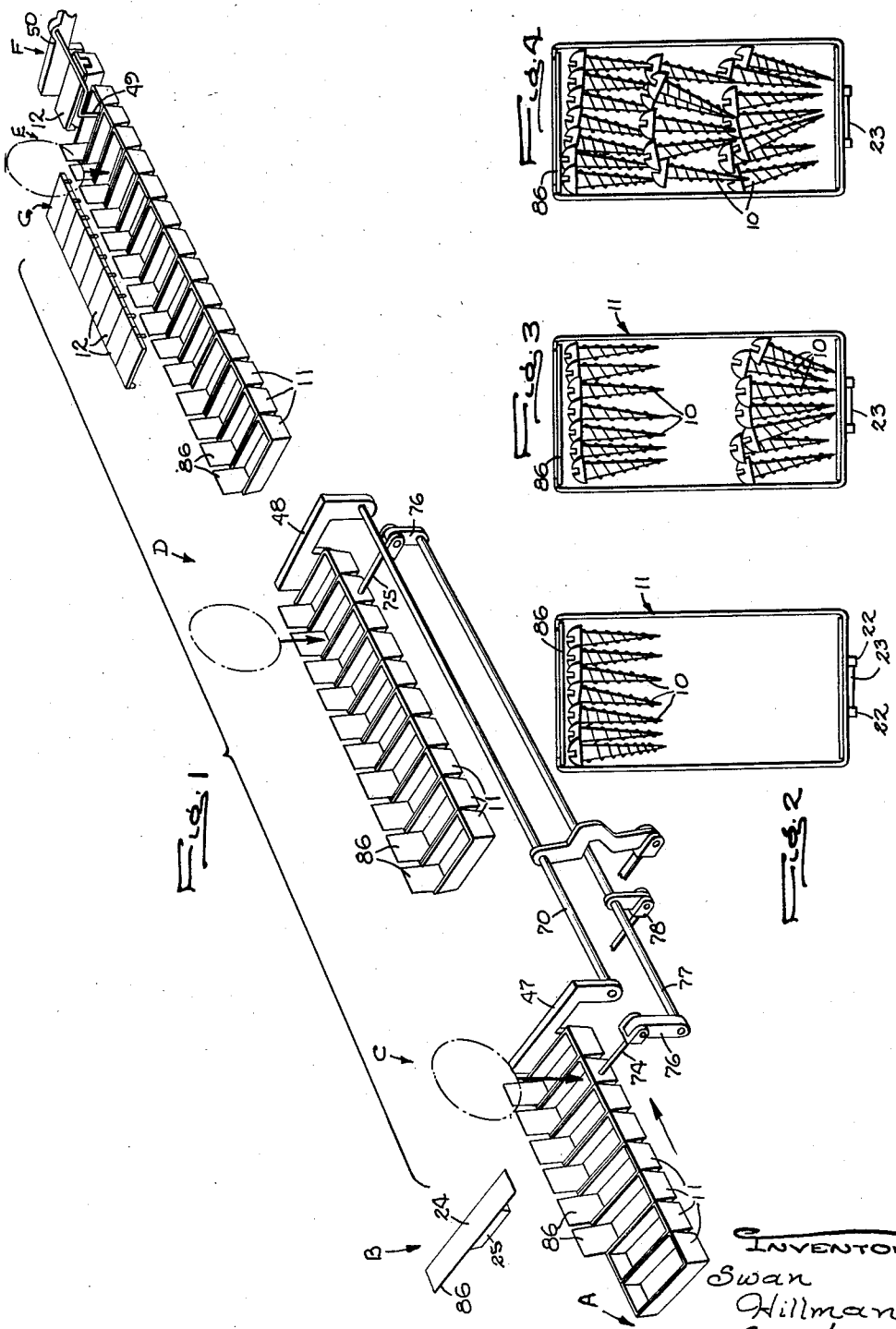


Fig. 1

Fig. 2

Fig. 3

Fig. 4

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PACKAGING MACHINE

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Fig. 5

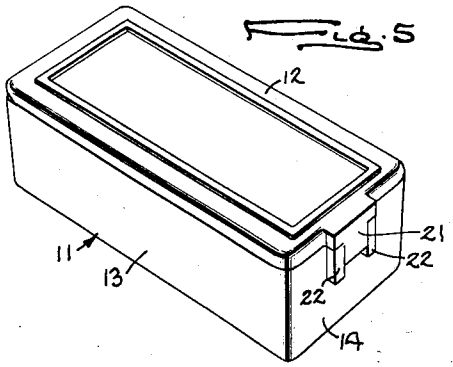
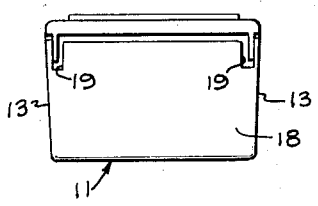


Fig. 6



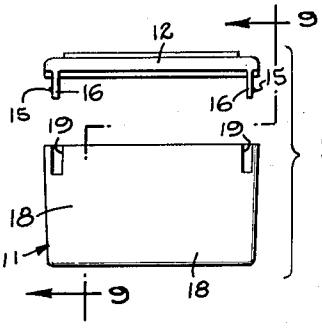


Fig. 7

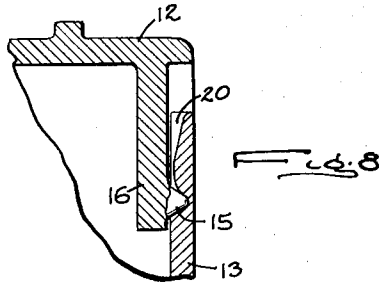


Fig. 8

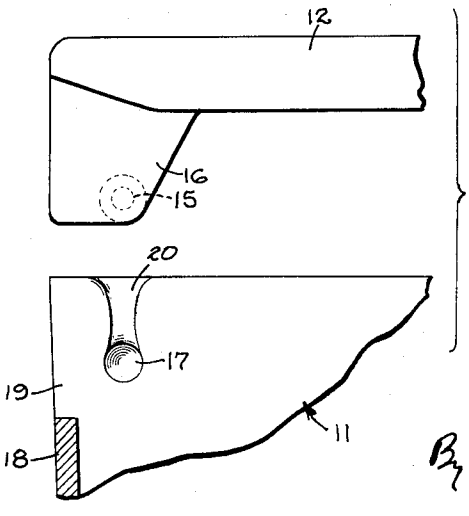


Fig. 9

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PACKAGING MACHINE

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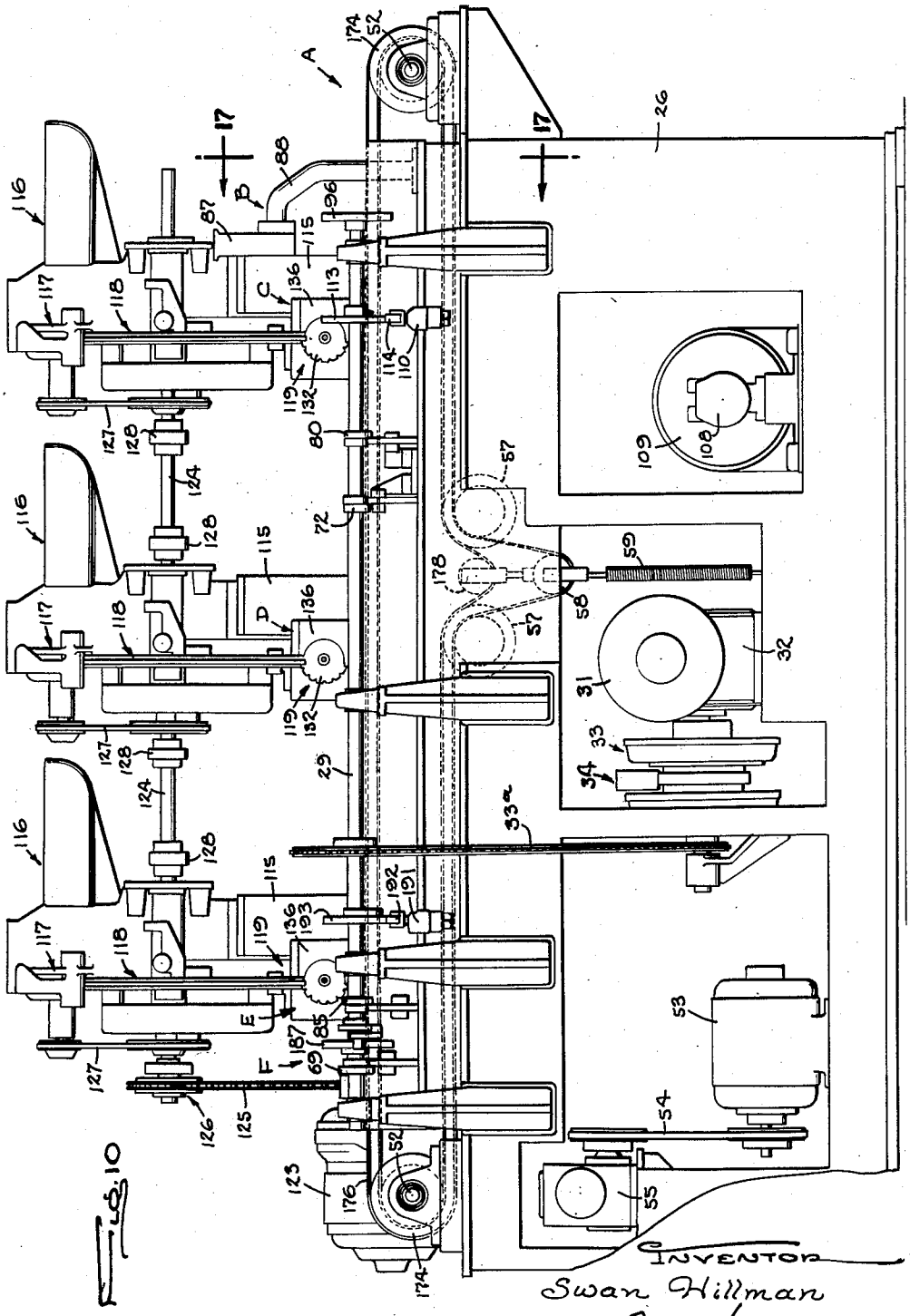


Fig. 10

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PACKAGING MACHINE

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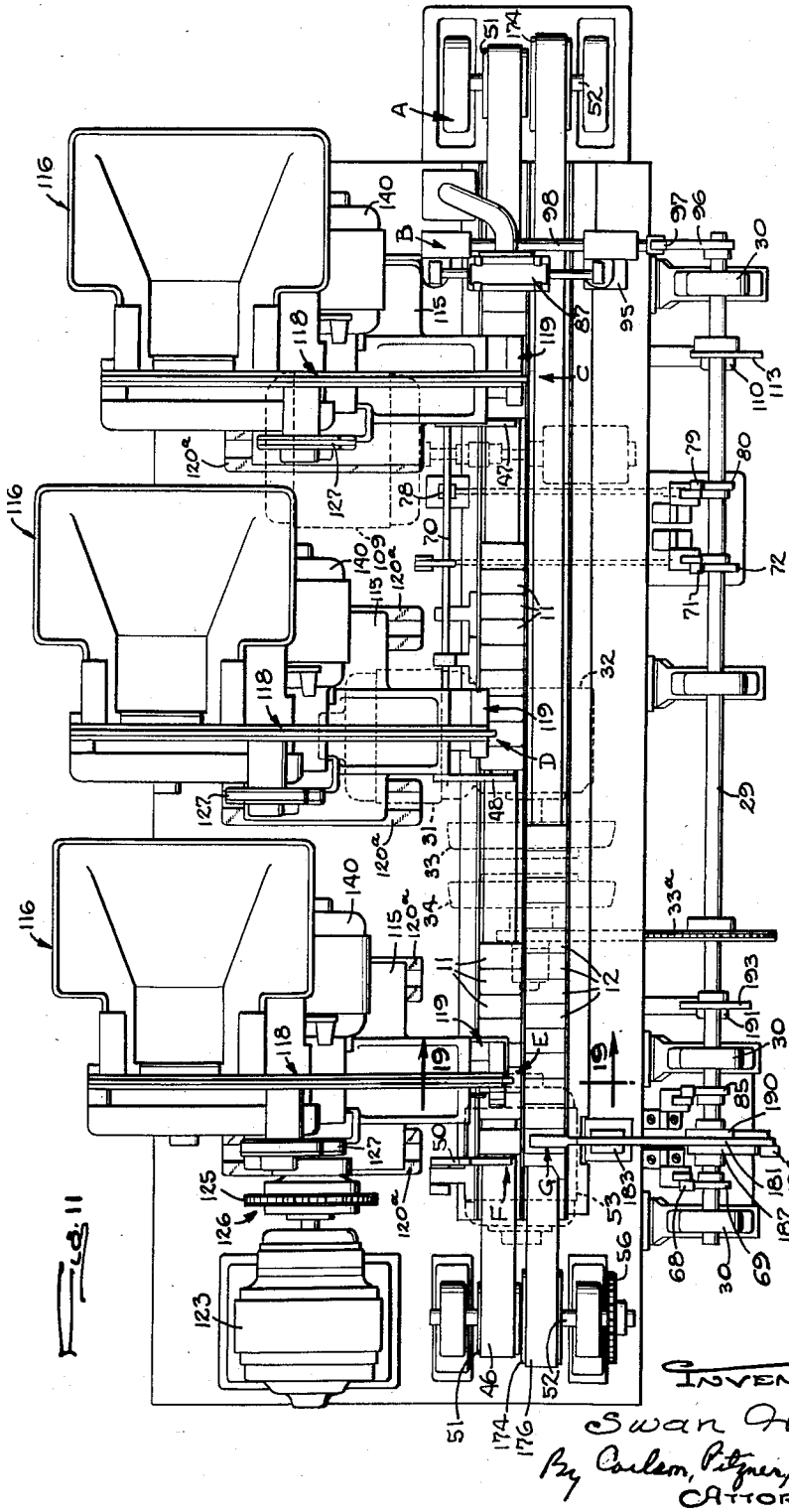


Fig. 11

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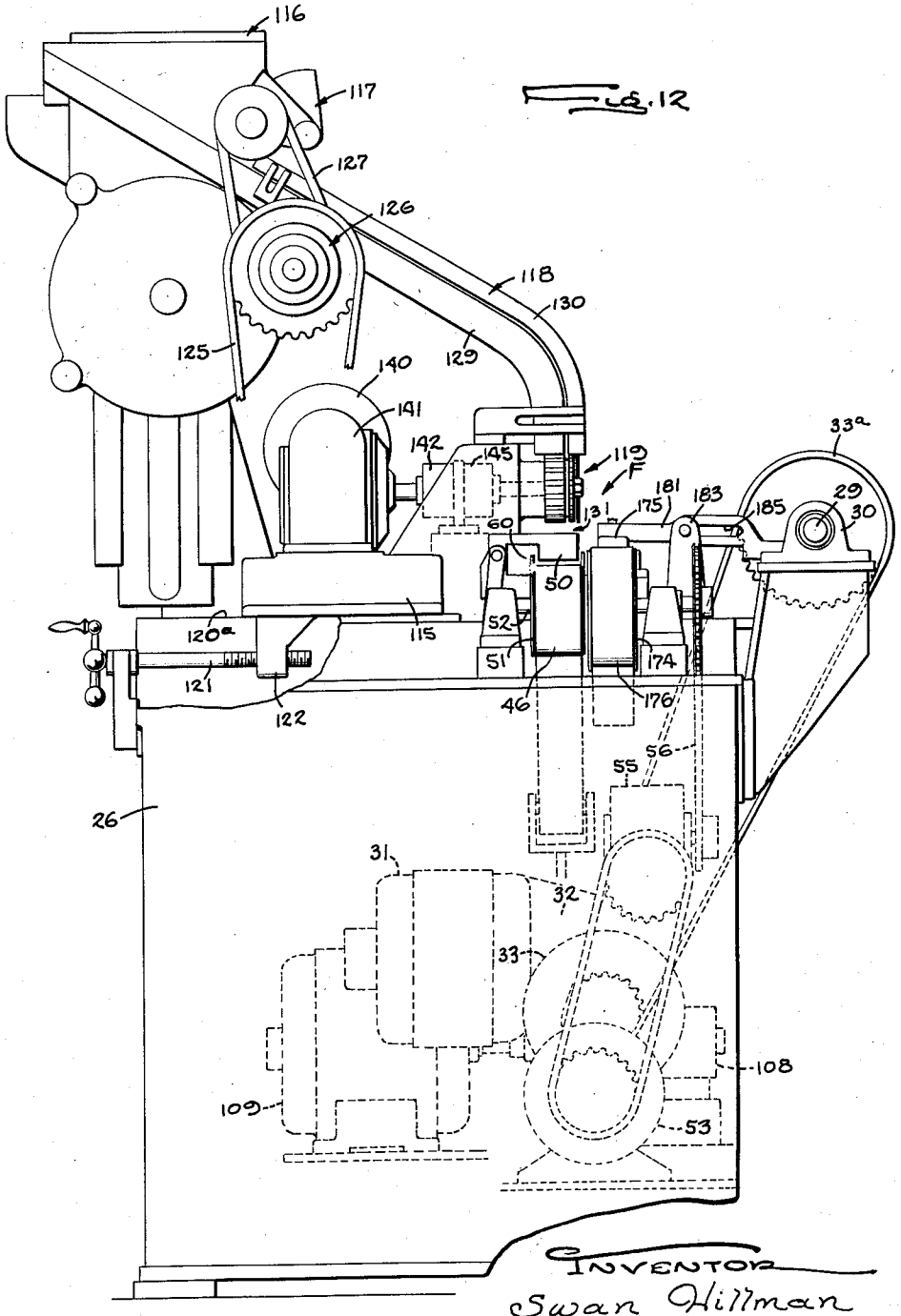


Fig. 12

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PACKAGING MACHINE

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Fig. 13

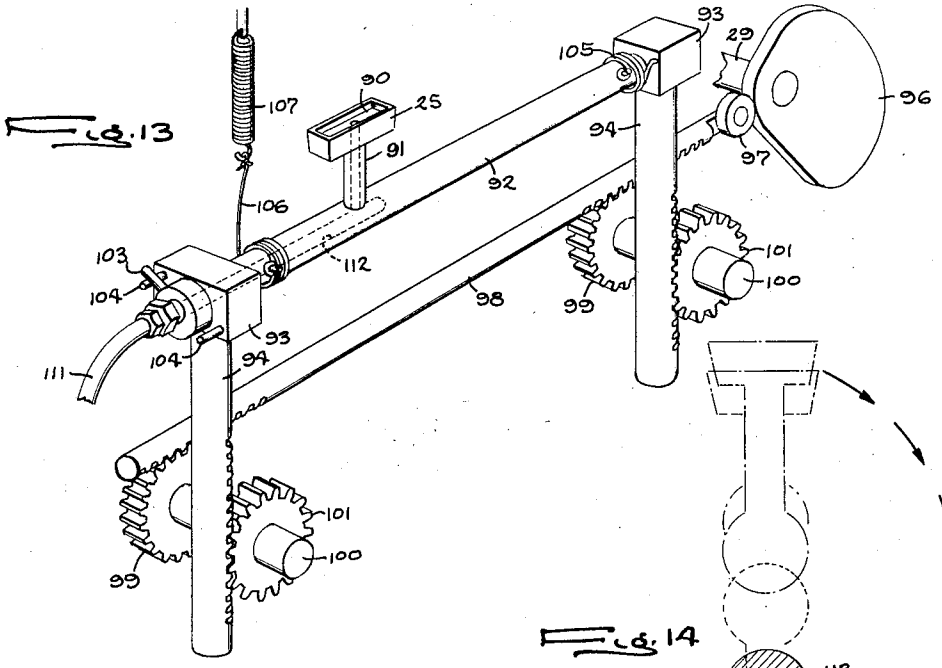


Fig. 14

Fig. 15

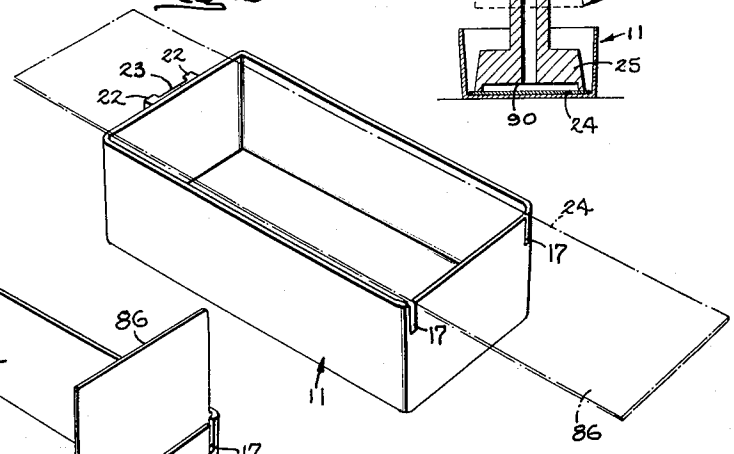
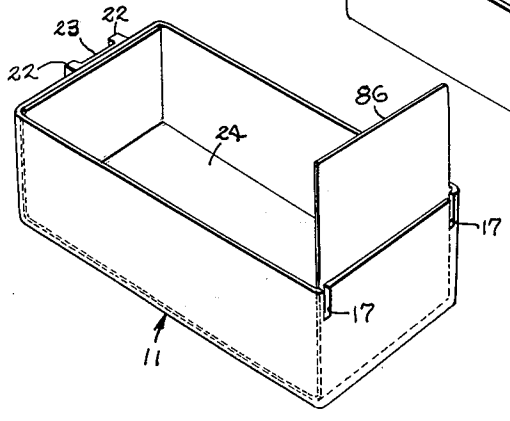


Fig. 16



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Fig. 17

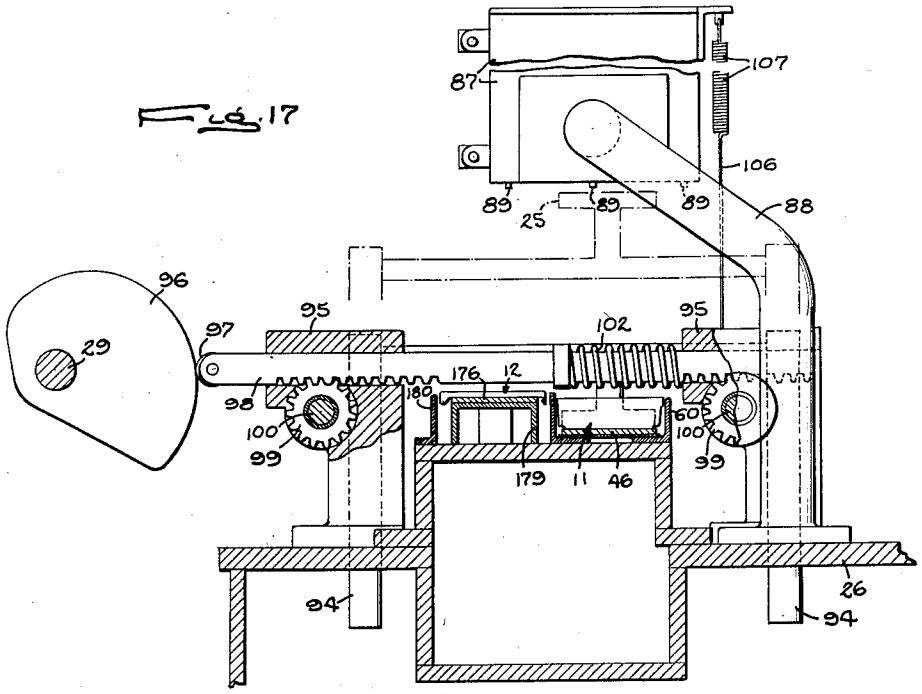
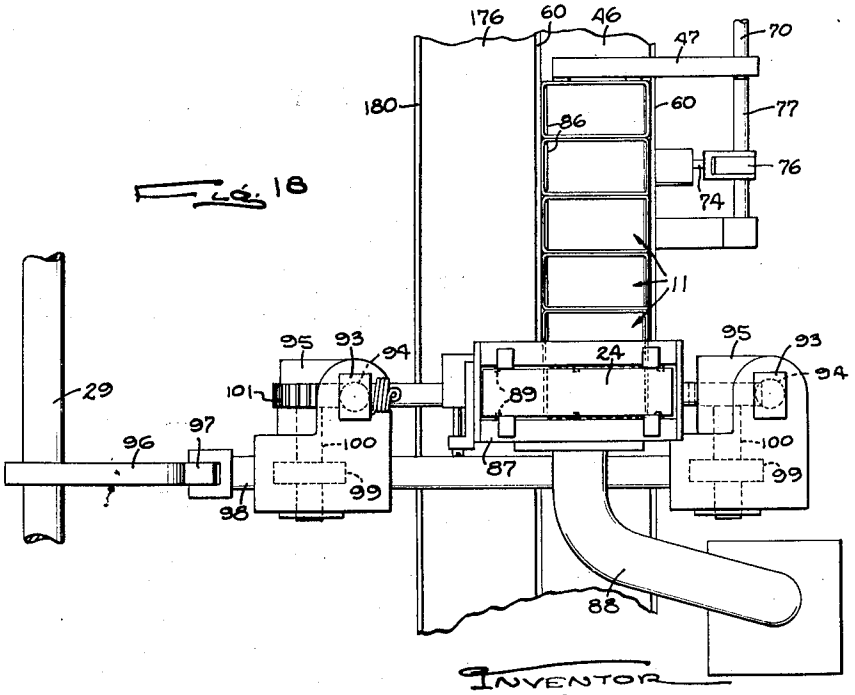


Fig. 18



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PACKAGING MACHINE

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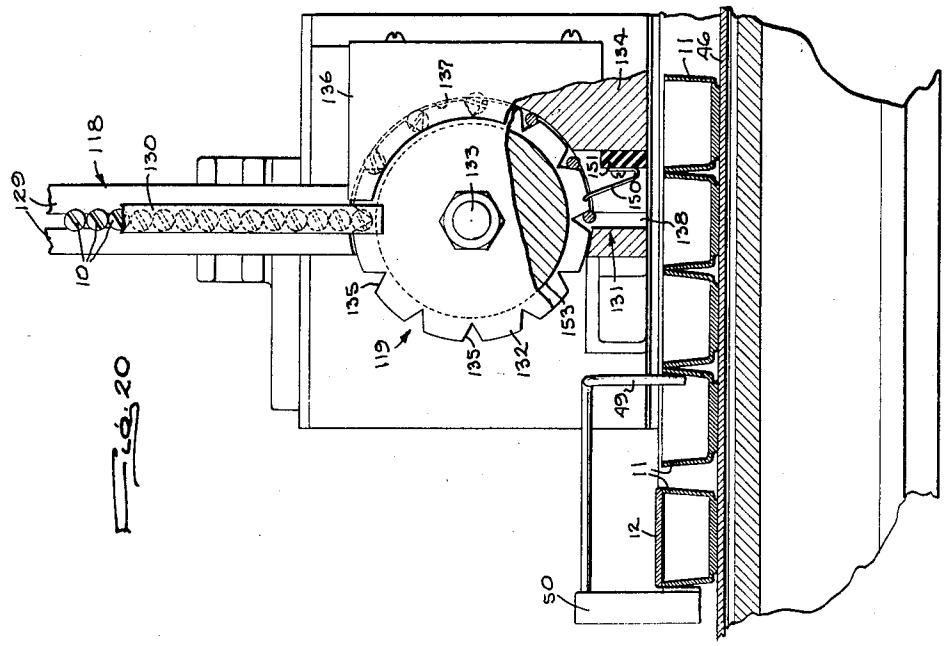


Fig. 20

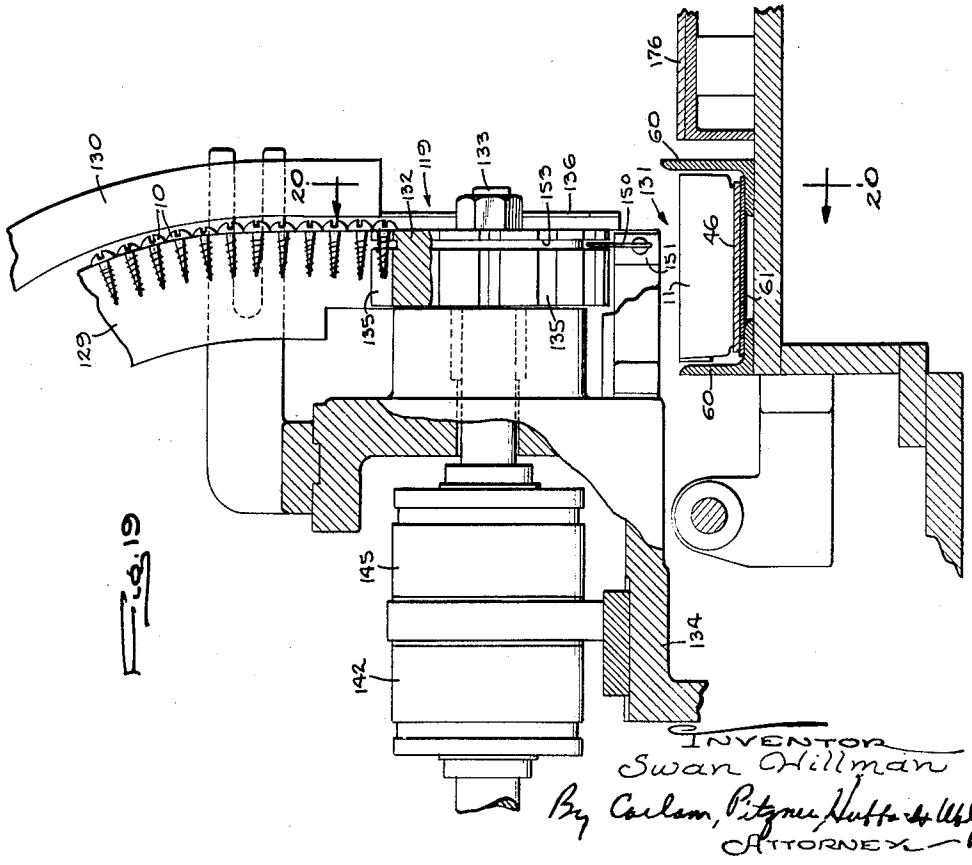


Fig. 19

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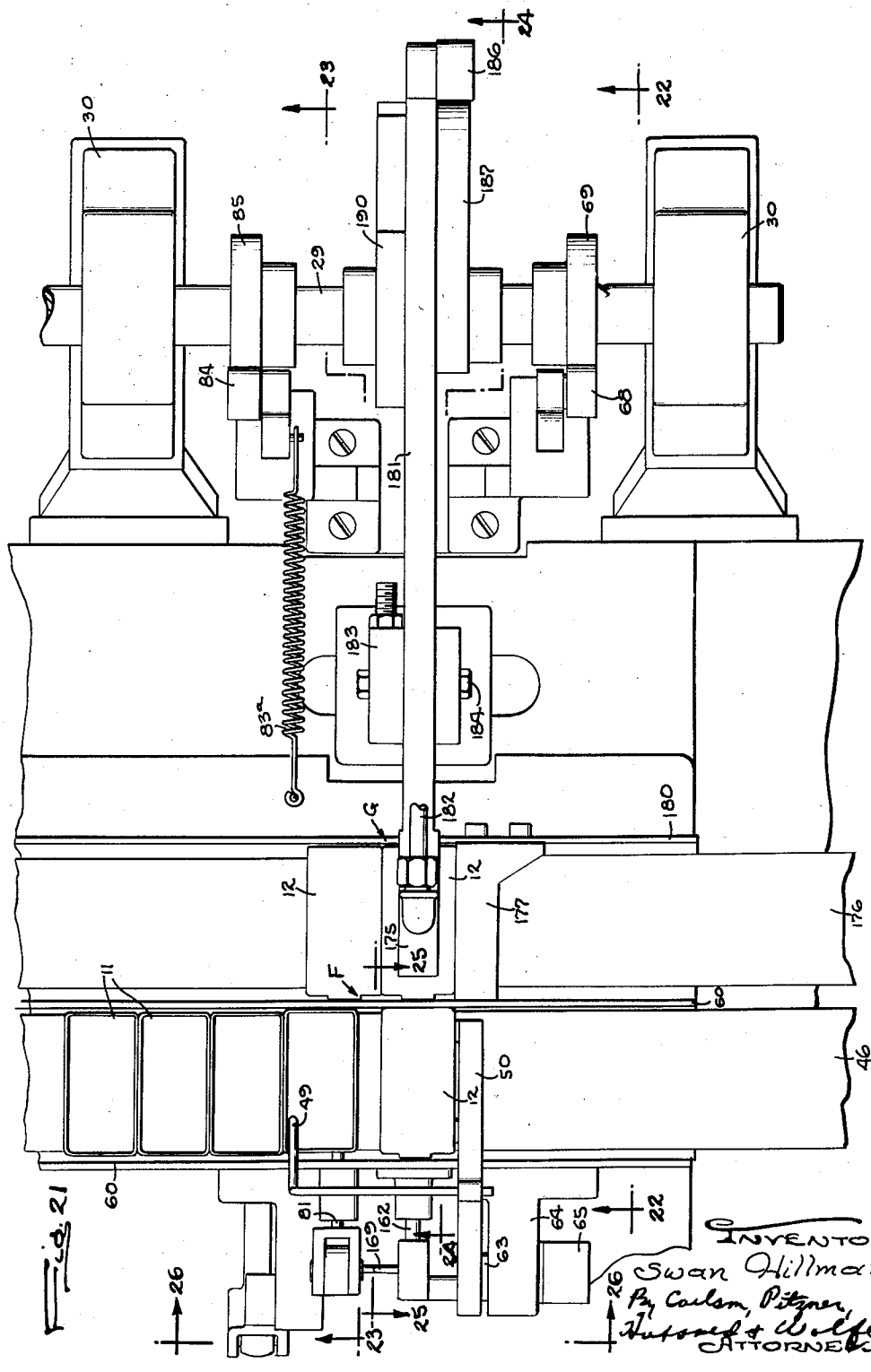


Fig. 21

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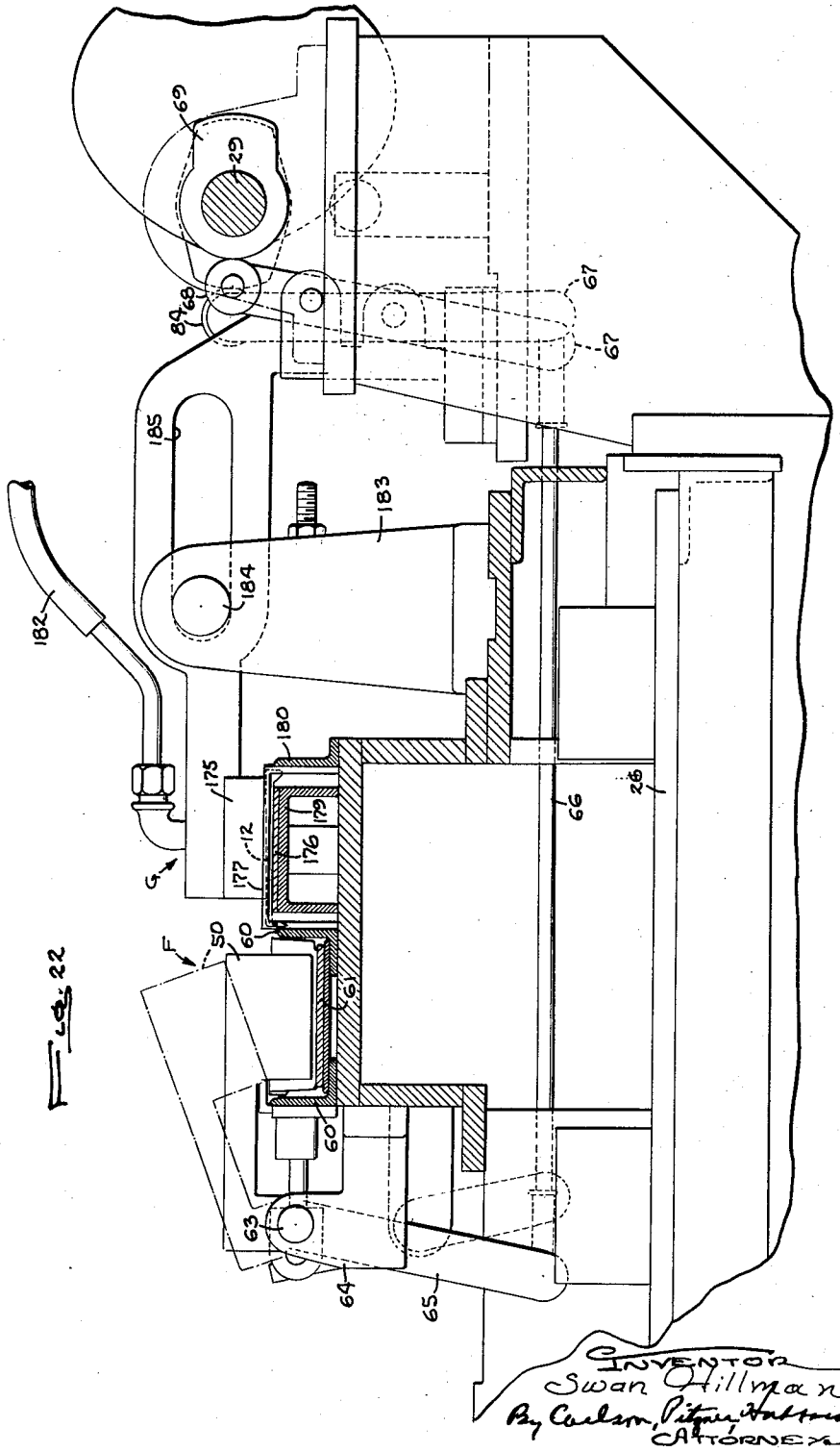


FIG. 22

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PACKAGING MACHINE

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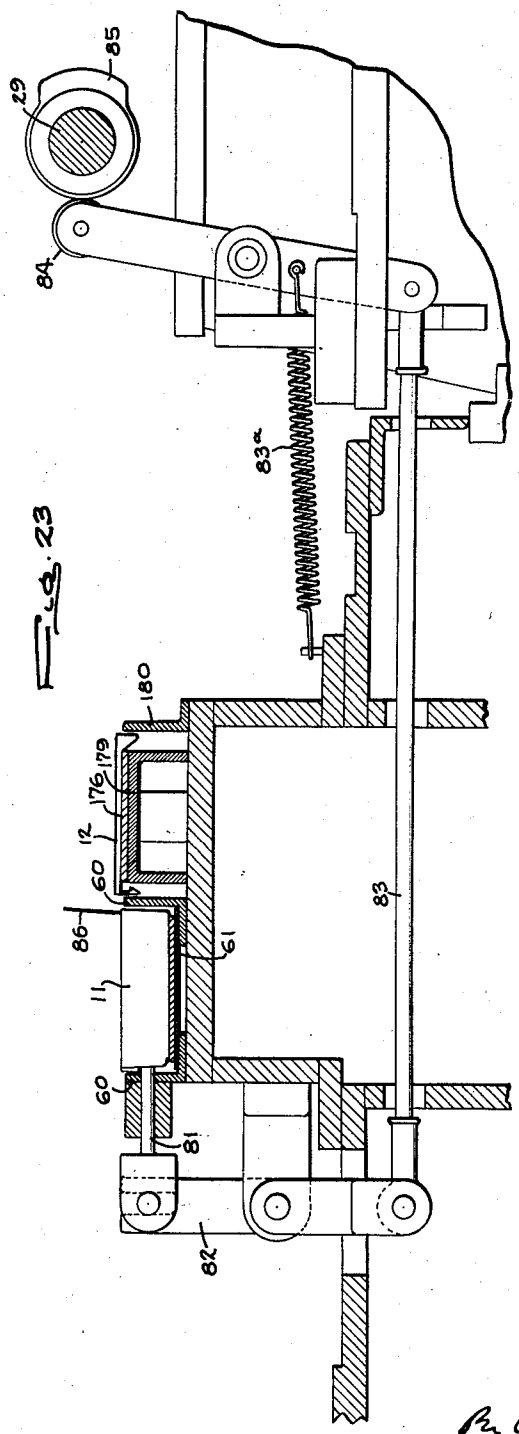


Fig. 23

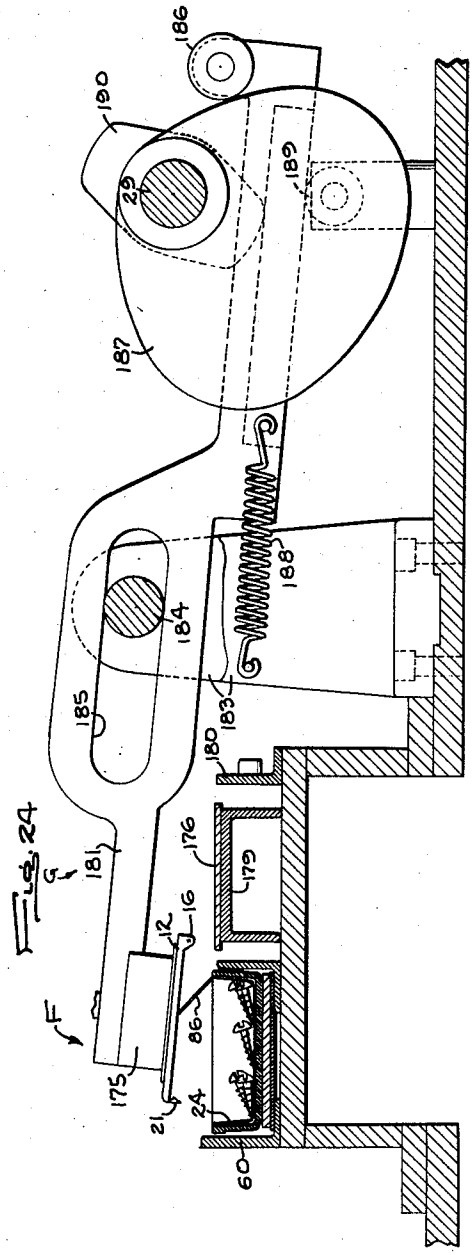


Fig. 24

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Dec. 16, 1958 S. HILLMAN 2,864,215

PACKAGING MACHINE

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Fig. 25

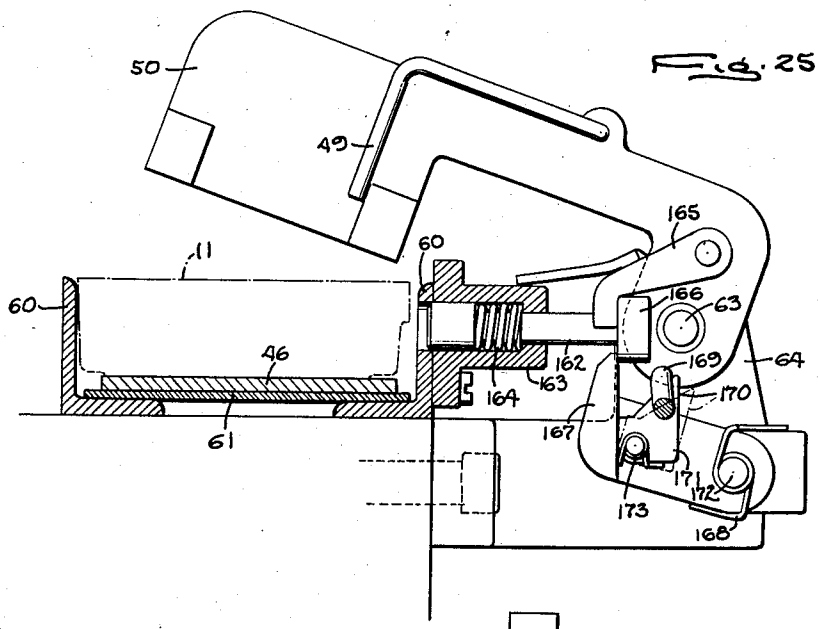
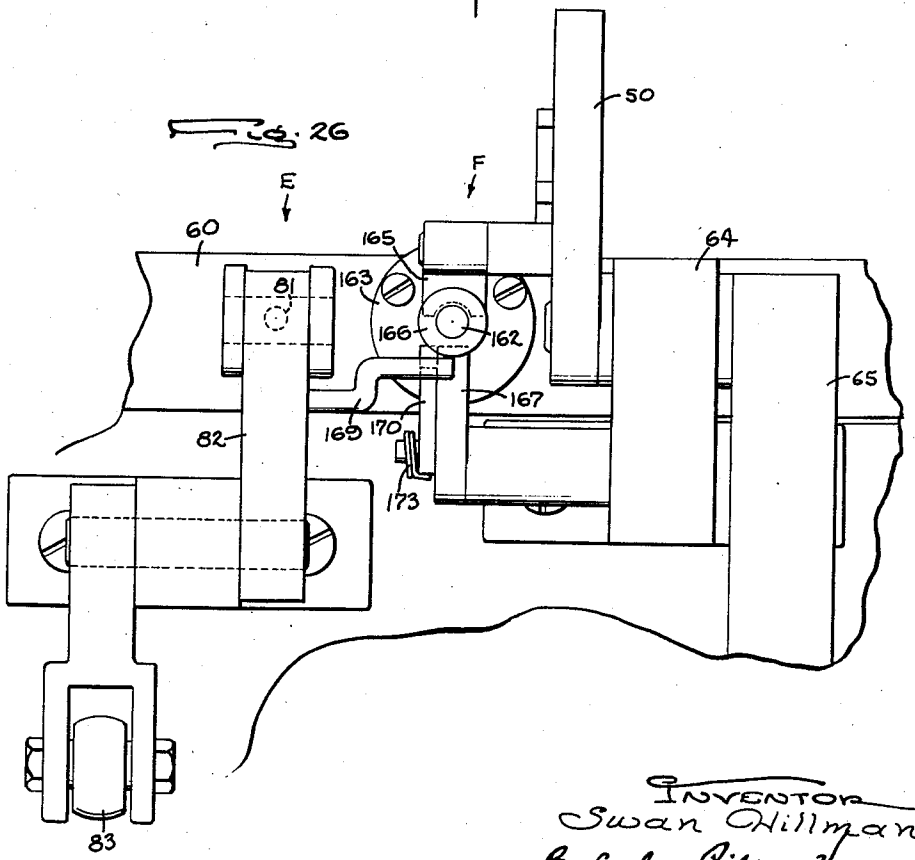


Fig. 26



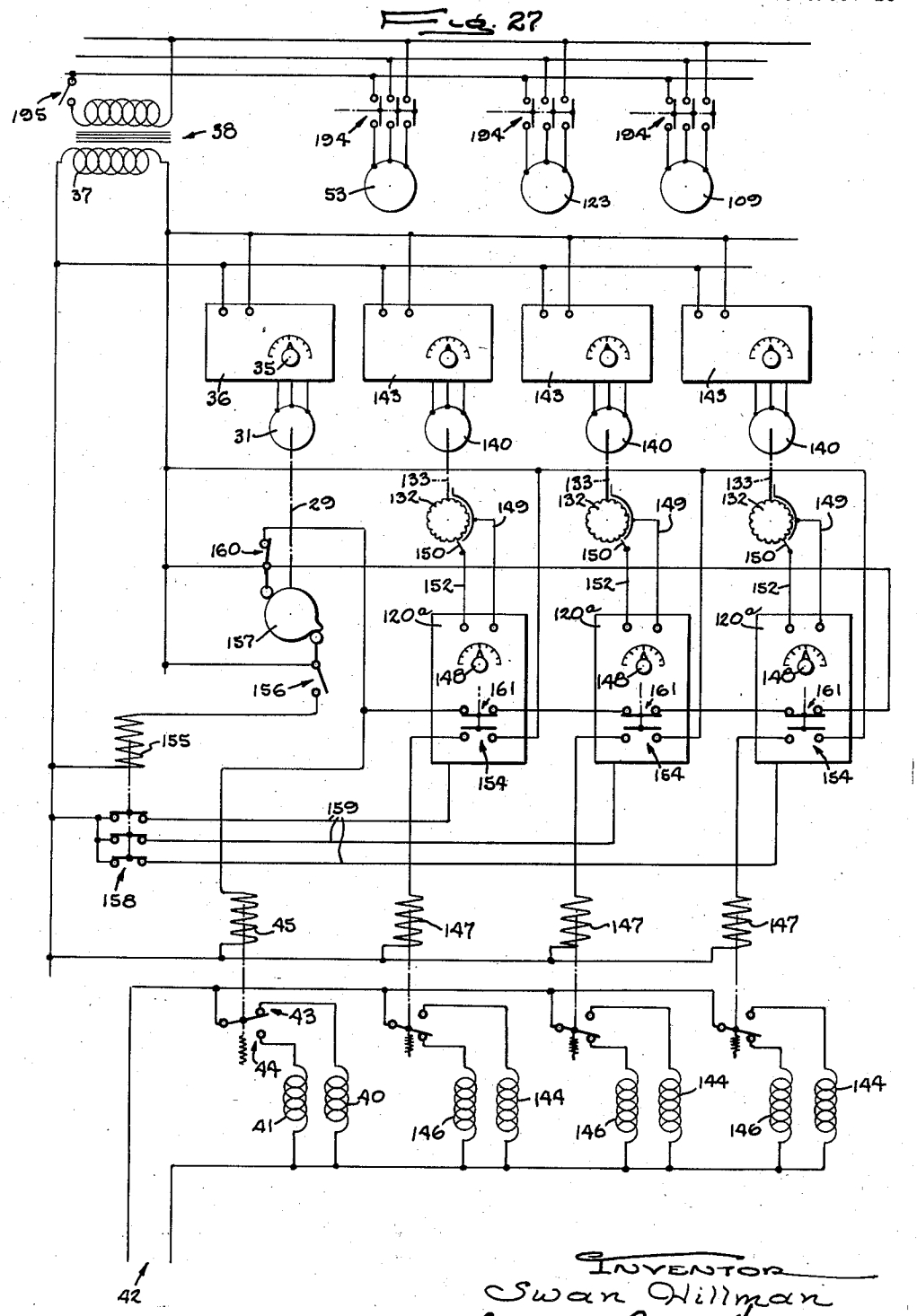
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PACKAGING MACHINE

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Fig. 27



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United States Patent Office 2,864,215 Patented Dec. 16, 1958

2,864,215

PACKAGING MACHINE

Swan Hillman, Rockford, Ill.

Application January 24, 1955, Serial No. 483,629

15 Claims. (Cl. 53—60)

This invention relates to a machine for packaging elongated articles such as screws, bolts, nails, etc. in oblong open top boxes with an accurately determined number of articles in each box. In certain of its aspects, the invention is concerned with the labeling and closing of the boxes.

The general object of the invention is to provide a machine of the above character in which a label in the form of a liner is inserted into each box, the latter is filled with a predetermined number of articles and the open end of the box is closed by a separately formed lid automatically as the box advances successively through a plurality of stations.

Another object is to advance the boxes from station to station in a novel manner to compact the articles to avoid spilling of the same while permitting boxes which are defective to be removed from a series of the boxes for correction of the defect and to be replaced in the series without interrupting the advance of other boxes or interfering with continuous operation of the machine.

A further object is to deliver the articles to each box in a novel manner to insure the receipt in the box of the proper number of articles and to avoid spilling of the articles or interference with closing of the box due to articles overhanging the top edges of the box.

The invention also resides in the novel construction of mechanisms for inserting liners into the boxes and closing the open ends of the boxes with the separately formed lids.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

Figure 1 is a diagrammatic perspective view showing the various steps of packaging articles in a machine embodying the novel features of the invention.

Figs. 2, 3, and 4 are plan views showing the distribution of articles at successive stations of the machine.

Fig. 5 is a perspective view of a box with a lid assembled thereto.

Fig. 6 is a rear end view of the box and assembled lid.

Fig. 7 is an exploded view similar to Fig. 6.

Fig. 8 is a fragmentary transverse sectional view showing the hinge elements of the box and lid.

Fig. 9 is an enlarged fragmentary sectional view taken along the line 9—9 of Fig. 7.

Fig. 10 is a front elevational view of the machine.

Fig. 11 is a plan view of the machine.

Fig. 12 is an end elevational view of the machine looking to the right in Fig. 11, a part of the frame being broken away.

Fig. 13 is a fragmentary perspective view of the liner inserting mechanism.

Fig. 14 is a diagrammatic view showing different positions of the liner holder.

Figs. 15 and 16 are perspective views showing a liner respectively before and after insertion into a box.

Fig. 17 is a fragmentary sectional view taken along the line 17—17 of Fig. 10.

Fig. 18 is a fragmentary plan view of the liner inserting mechanism.

Fig. 19 is a fragmentary sectional view of screw feeder mechanism taken along the line 19—19 of Fig. 11.

Fig. 20 is a fragmentary sectional view taken along the line 20—20 of Fig. 19.

Fig. 21 is a fragmentary plan view of the final filling and closing stations.

Figs. 22 to 26 are fragmentary sectional views taken respectively along the lines 22—22 to 26—26 of Fig. 21.

Fig. 27 is a schematic wiring diagram of the control circuits for the various power operated mechanisms.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail the preferred embodiment. It is to be understood, however, that I do not intend to limit the invention by such disclosure, but aim to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

The machine shown in the drawings for purposes of illustration is particularly suited for packaging elongated articles such as screws **10** is a rectangular open top box **11** (Figs. 5 to 9) which is adapted to be closed by a flat rectangular lid **12** hinged to one end portion of the box to swing into and out of a closed position (Figs. 4 and 5) of abutment with flush upper edges of upstanding side walls **13** and a front wall **14** of the box. The hinge comprises lugs **15** projecting outwardly from depending ears **16** on the lid and fitting into inwardly opening recesses **17** on the box side walls. The upper portion of the rear wall **18** is slotted as indicated at **19** adjacent the side walls to receive the ears during opening of the lid and to free the upper portions of the side walls for flexing outwardly to receive the ears and the lugs **15** during movement of the lid bodily and flatwise toward the body, preformed grooves **20** in the side walls guiding the lugs into the recesses **17**. A latch **21** depending from the front edge of the lid is received between forwardly projecting vertical guides **22** (Figs. 5 and 15) on the front wall **14** to center the lid laterally relative to the box during assembly of the two, the latch hooking around a forwardly projecting keeper **23** (Figs. 15 and 16) on the front wall **14** to hold the lid releasably in its closed position. To render a label **24** visible from the exterior of each box, the latter and the lid are formed of a transparent thermosetting resin.

Generally stated, the improved machine operates to support a plurality of empty boxes **11** side by side with their open ends up and to advance the boxes sidewise along a predetermined path from a loading station A (Fig. 1) where the boxes are delivered to the machine by hand to a station B (Fig. 1) where a label **24** in the form of a liner is inserted into each box by a holder **25**. From the liner station, the boxes advance to one or more filler stations C, D and E at each of which a group of screws **10** of a predetermined number is deposited in each box with the axes of the screws extending longitudinally of the box, the sum of the different groups equaling the total number of screws to be packaged in each box. Where, as shown in the drawings, the screws are substantially shorter than the boxes, the groups of screws at the different stations are delivered to different longitudinal sections of each box to avoid piling of the screws and spilling of the same over the edges of the box. Finally, the boxes advance to a closing station F where a lid **12** is moved bodily and downwardly toward each box for assembly of the two together automatically. To compact the screws below the top edges of the upstanding box walls **13**, **14**, and **18**, the advance of each box is interrupted abruptly

at a plurality of points between the successive filling stations to impart a sidewise shaking movement to the box tending to settle the screws in the lower part of the box.

The various operating stations are spaced along the top of an elongated frame or base **26**. Motions for actuating mechanisms at the different stations in timed relation to each other is derived from a camshaft **29** extending longitudinally of the frame and journaled in spaced bearings **30**. This shaft is driven by an electric motor **31** (Figs. 10, 11, and 12) through a gear reduction **32**, a clutch **33**, and a chain **33***a*, the motor speed being variable by adjustment of a knob **35** of a motor controller and rectifier unit **36** (Fig. 27) connecting the motor to a secondary **37** of a transformer **38** whose primary is connected to a source **39** of alternating current. Both the clutch **33** and a brake **34** acting between the frame and the output shaft of the clutch are of the electromagnetic friction type having their windings **40** and **41** arranged for connection to a suitable source **42** of direct current (Fig. 27) alternately through normally open contacts **43** and normally closed contacts **44** of a camshaft relay **45**.

Transfer of the boxes **11** to the various stations and location of the same accurately with respect to the associated operating mechanisms is effected by novel advancing means which not only interrupts the advance of the boxes at a plurality of points between stations for compacting the screws **10** therein, but also, permits removal of defective boxes and replacement after correction of a defect while advance of the other boxes and operation of the machine continues. For these purposes, the advancing means comprises a conveyor **46** having a continuously advancing and horizontally disposed upper run supporting and frictionally engaging the bottom walls of the boxes to carry the same along the path of the run. A plurality of stops **47**, **48**, **49**, and **50** at the operating stations are movable into the paths of the boxes along the conveyor for abutment with leading surfaces thereof to stop advance of the boxes in accurately located positions relative to the operating mechanisms at the stations. After operation of such mechanisms, the stops are retracted permitting continued advance of the boxes with the conveyor.

In the present instance, the conveyor **46** is an endless belt extending around drive and idler pulleys **51** and fast on horizontal shafts **52** journaled on opposite ends of the frame. A motor **53** mounted on the frame **26** is connected to one of the shafts **52** through a belt **54**, a speed reduction **55** (Fig. 10) and a chain **56** and is energized continuously during operation of the machine. To maintain the conveyor belt under tension, its lower run extends over the tops of spaced idler pulleys **57** and under an intermediate pulley **58** (Fig. 10) which is urged downwardly by a spring **59** anchored on the frame **26**. The boxes are retained on the conveyor by guide rails **60** upstanding from the frame **26** along opposite sides of a horizontal plate **61** backing the upper run of the conveyor.

To interrupt the advance of each box **11** at a plurality of points between successive stations, certain of the latter are spaced apart along the conveyor **46** distances equal to several times the width of the boxes and the boxes, which are permitted to pile up against each other in a group behind certain of the stops **47** to **50** as shown in Fig. 1, are released from the leading end of the group one at a time. Thus, each box in the group advances in short steps toward the associated stop. With several boxes piled up to form a group, the boxes behind a defective box simply advance with the conveyor to fill the space resulting from removal of the defective box. The space behind the group then is available to receive the defective box after correction of the defect. While each station may be spaced a substantial distance from each of the adjacent stations with a separate stop at each station, stops are provided in this instance only at the filling stations C, D and E and the closing station F. The liner station B is disposed sufficiently close to the first filling station C that the group of boxes at the latter extend rearwardly into the liner station. Thus, the same stop **47** is utilized to position boxes properly relative to the operating mechanisms at both of these stations. Although separate stops **49** and **50** are provided at the third filling station E and the closing station F, the latter also are spaced close together.

The stop **50** at the closing station F is a flag (Figs. 1, 21, 22 and 25) projecting rigidly and horizontally across the conveyor belt **46** from a rock shaft **63** paralleling the latter and journaled on a frame support member **64**. An arm **65** fast on and depending from the shaft **63** (Fig. 22) is connected through a link **66** to one end of a lever **67** fulcrumed intermediate its ends on the frame and carrying at its other end a follower roller **68** engageable with a cam **69** on the cam shaft **29** for advancing and retracting the flag. Similar flags constituting the stops **47** and **48** at the first two filling stations C and D are fast on a common rockshaft **70** (Figs. 1 and 11) which is connected through a similar linkage to a follower **71** (Fig. 11) for actuation by a cam **72** on the camshaft **29**. Suitable springs (not shown) act between the flag linkages and the frame **26** to hold the follower rollers against the cams. The stop **49** at the third filling station E is a finger (Figs. 1 and 21) secured at one end to the closing station flag **50** for advancing and retracting movement therewith and projecting first horizontally therefrom along the conveyor **46**, then inwardly across the latter, and finally downwardly into a box at the third filling station.

Release of the leading boxes **11** one at a time from each group for intermittent advance of the trailing boxes is effected by holding the box adjacent the leading box against movement with the conveyor **46** during retraction of the associated stop **47** to **50** and by releasing such adjacent box after advance of the stop back into the path of the boxes, the leading box of the group advancing with the conveyor upon retraction of the stop. Herein, the boxes adjacent the leading boxes at the first two filling stations C and D are held against movement with the leading boxes by plungers **74** and **75** pivoted on arms **76** upstanding from a rockshaft **77**. The latter is journaled on the frame and is connected through a linkage **78** to a follower roller **79** (Fig. 11) engageable with a cam **80** on the camshaft **29** for advancing the plungers to press the boxes against the opposite guide rail **60** just prior to and during retraction of the flags and for retracting the plungers after advance of the flags. A similar plunger **81** carried by an arm **82** at the third filling station E (Fig. 23) is connected to a similar linkage **83** including a follower roller **84** engageable with a cam **85** on the camshaft **29**. A spring **83***a* acts between the frame **26** and the linkage to hold the follower against the cam and to cooperate with the latter to advance and retract the plunger to press a box **11** at the third filling station against the opposite guide rail and to release the box.

To facilitate their insertion and retention in successive boxes **11** dwelling at the liner station B, the liners **24** preferably are elongated flexible strips substantially longer than the boxes so as to lie along the bottom wall and at least one of the end walls **14** and **18** of each box. Each liner, in the present instance, is approximately the same width as a box and long enough to lie along the bottom and both end walls of the box with one end portion **86** (Figs. 15 and 16) projecting above the rear wall **18** and adapted to be bent over above the contents of the box after the latter is filled. The material for the liners, which may be thin cardboard, is flexible enough to permit a liner to be stored in flattened condition and to be bent to lie along the bottom and end walls of a box as an incident to movement flatwise into the latter, but is sufficiently stiff or resilient to tend to straighten out against the end walls and frictionally engage the same for retention of the liner within the box.

At the liner station B, the liners **24** are stacked in side by side relation in a magazine **87** (Figs. 17 and 18)

which supports one terminal liner at opposite marginal portions to expose the intermediate portion that is to lie along the bottom wall of a box. Transfer of the liners one by one from the magazine to the boxes is effected by the holder **25** which is adapted to grip the exposed portion of the terminal strip at longitudinally spaced points and is moved in timed relation to the advance of boxes into the station and back and forth between the magazine **87** and a position within and adjacent the bottom wall of a box dwelling in the station. In this instance, the magazine is a vertical chute of rectangular cross section secured rigidly to the frame **26** by a bracket **88** and disposed directly above the dwelling position of boxes in the liner station. The terminal liner at the bottom of the stack is urged downwardly by the weight of the liners above it and, if desired, an additional weighted block (not shown), and is supported by fingers **89** (Fig. 18) which are secured to the bottom of the chute at spaced points and project inwardly across the bottom opening a short distance sufficient to hold the stack while permitting the terminal liner to be stripped therefrom.

The holder **25** in this instance is a metal block of rectangular shape having a rectangular recess **90** on one side and mounted to reciprocate vertically and revolve about a horizontal axis between one position of abutment against the terminal liner **24** in the magazine **87** with the recess opening upwardly as shown in phantom in Fig. 14 and another position of abutment against the bottom wall of a box **11** with the recess opening downwardly as shown in full in Fig. 14. To insure that the liners are pressed into the corners of the boxes, the block is approximately as wide and as long as the interior of the box while being small enough for easy entry into the boxes.

The mounting for the holder **25** includes a hollow arm **91** rigid at one end with the side of the holder opposite the recess **90** and communicating with the latter through a bore in the block. At its other end, the arm projects rigidly and radially from a horizontal shaft **92** journaled at opposite ends in bearings **93** carried by rack bars **94** which are slidable vertically in stationary guides **95** (Fig. 17) secured to the frame **26** on opposite sides of the conveyor **46**. The rack bars are raised and lowered in timed relation to the advance of boxes with the conveyor by a cam **96** fast on the camshaft **29** and acting against a follower roller **97** carried by a horizontal rack bar **98**. The latter is slidable endwise in the guides **95** and meshes with two pinions **99** fast on shafts **100** journaled in the guides and carrying pinions **101** meshing with the teeth of the vertical rack bars **94**. A spring **102** (Fig. 17) acts between one guide **95** and the horizontal rack **98** to maintain the follower **97** against the cam and to urge the holder **25** to its upper position.

Movement of the holder **25** back and forth about the axis of its shaft **92** and through a half revolution between its upper and lower position is limited by abutment between an arm **103** rigid with the shaft and two stops in the form of lugs **104** projecting from the bearing **93** on one of the vertical rack bars **94**. Normally, the holder is yieldably urged into its upper position by a torsion spring **105** encircling the shaft and secured at opposite ends to the latter and the bearing on the other rack bar. To swing the holder to its lower position and back as an incident to vertical reciprocation of the rack bars, a cable **106** encircling and secured at one end to the holder shaft **92** is connected at its other end to a contractile spring **107** anchored to the magazine **87**. This spring permits bodily movement of the holder downwardly into a box at the bottom of its range after arcuate movement of the holder is completed upon abutment of the arm **103** with the lower stop **104**. A similar bodily movement of the holder vertically toward the magazine as shown in phantom in Fig. 14 is effected by making the cable long enough to provide slack after the spring **107** has contracted completely as shown in Fig. 13.

From the time the holder **25** approaches its upper position of abutment with the terminal liner **24** of the magazine **87** and until the holder is within the box and approaching its lower position adjacent the bottom wall of the box, a vacuum is created in the holder recess **90** to pick up and hold the terminal liner against the holder. In this instance, such vacuum is created by a pump **108** (Figs. 10 to 12) having a continuously energized motor **109** and communicating with the holder recess **90** through a valve **110** (Fig. 10), a flexible conduit **111** (Fig. 13), a bore **112** in the holder shaft, and the hollow holder arm **91**, the valve being actuated in timed relation to swinging of the holder by a cam **113** on the camshaft **29** and acting on a follower **114** on the valve actuator.

Each of the screw delivery mechanisms at the filler stations C, D, and E (Figs. 10, 11, 12, 19 and 20) is of the same construction comprising generally a base **115** supporting the mechanism and mounted on the frame **26** for movement transversely of and toward and away from the conveyor **46**, a hopper **116** adapted to receive a plurality of screws **10** in bulk and including suitable agitating and alining mechanism **117** for arranging the screws side by side in a row and delivering the same by gravity to a downwardly inclined chute **118**, a feeder **119** adapted to receive the screws from the lower end of the chute and deliver the same one by one to a box **11** beneath the feeder on the conveyor **46**, and a counter **120***a* (Fig. 27) controlling the feeder **119**. Horizontal guideways **120** (Fig. 12) on the frame support the base for sliding movement transversely of the conveyor belt, the position of the base being varied by turning an adjusting screw **121** threaded into a depending nut **122** on the base and rotatable but fixed axially relative to the frame.

Power for actuating the agitating mechanisms **117** of the hoppers **116** is derived from a continuously energized motor **123** mounted on the frame **26** and connected to a horizontal shaft **124** through a chain **125** and a slip clutch **126**. The shaft **124** which extends through and is journaled in the hopper supports is connected to the individual agitating mechanisms by belts **127** and is divided into sections connected together by universal joints **128** to permit shifting of the hoppers with their supporting bases transversely of the conveyor **46**.

Each chute **118** includes vertical plates **129** (Fig. 19) spaced apart horizontally a distance narrower than the heads of the screws **10** but far enough to receive the shanks, the screws being held between such plates by a third plate **130** spaced from the latter and cooperating therewith to form a guideway for the heads. At the lower ends of the plates **129** and **130** which terminate a substantial distance above the conveyor **46**, the guideway is vertical and the screws are disposed horizontally with their axes extending transversely of the conveyor.

Screws **10** disposed in the lower end of the chute **118** are picked up one by one by the feeder **119** and transferred to a discharge point **131** just above a box **11** on the conveyor. Accurate control of such delivery of screws is achieved by a novel construction of the feeder which comprises a cylindrical drum member **132** rotatable about a horizontal axis beneath the lower end of the chute and having its periphery disposed closely adjacent the chute end to block the gravitation of screws therefrom. The drum is fast on a shaft **133** journaled in a bearing carried by a fixture **134** on the base **115**. Outwardly opening recesses or grooves **135** of V-shaped cross section extend axially of the drum and are spaced angularly around its periphery to receive the screws one by one from the chute and transfer the same around an arcuate path to the discharge point **131** beneath the axis of the drum as the latter rotates. To hold the screws against axial movement out of the recesses **135**, a plate **136** secured to the fixture **134** is spaced axially from one end of the latter to abut the screw heads. The screws are held in the recesses during

rotation of the drum clockwise as viewed in Fig. 20 by a semicylindrical wall 137 of the fixture extending circumferentially around the drum along the screw path from the chute 118 to the discharge point 131. At the latter, horizontally spaced walls of the fixture define a vertical guideway 138 extending downwardly from the drum and terminating adjacent the open end of a box 11 dwelling at the station (see Fig. 20).

To avoid piling up of screws in each box and spilling over the top edges thereof, the discharge points 131 of the different screw delivery mechanisms are disposed over different longitudinal sections of the box. This is accomplished by turning the screws 121 to adjust the positions of the bases 115 and thereby the discharge points transversely of the conveyor 46. Thus, the discharge points of the first and second stations C and D are disposed above opposite end portions of the boxes for delivery of screws to such end portions as shown in Figs. 2 and 3, leaving the maximum space available for the deposit of screws in the center portion of each box at the third filler station E.

The shaft 133 of each feeder drum 132 is rotated to carry the recesses 135 one by one past the chute 118 by a motor 140 mounted on the base 115 and coupled to the drum shaft through a speed reducer 141 (Fig. 12) and a clutch 142. Each motor is of the direct current type and is energized from the secondary 37 of the transformer 38 (Fig. 27) through a controller 143 including a rectifier. The clutch is of the electromagnetic friction type whose driving and driven elements are drawn into engagement upon energization of a winding 144 (Fig. 27). A brake 145 also of the electromagnetic friction type acts between the base and the drum shaft to stop the latter upon energization of its winding 146. Connection of the windings 144 and 146 of each feeder clutch and brake unit to the direct current source 42 is under the control of a relay 147 operable when energized to complete the clutch circuit and when deenergized to complete the brake circuit.

To rotate the feeder drum 132 in timed relation to advance of the boxes 11 with the conveyor 46 and only when a box is dwelling at the discharge point 131 and to stop the drum after delivery of a predetermined number of screws to each box, the clutch and brake relay 147 is controlled jointly by the counter 120 and the camshaft 29, the counter controlling the relay directly and being controlled in turn by the camshaft. The counter 120a may be any suitable mechanism adapted to count intermittent pulses and actuate switches to effect control operations in response to a particular number of pulses which may be varied, for example, by turning a dial 148. In this instance, a pulse is delivered to the counter each time a screw is deposited in a box 11 by completion of a circuit extending from the counter through a conductor 149 to the cylindrical wall 137 of the feeder fixture 134 which is formed of conducting material, then through the screw just before it enters the discharge guideway 138 and a resilient finger 150 supported on a block 151 of insulation secured to the fixture, and finally back to the counter through a conductor 152. To avoid contact of the counting finger 150 with the feeder drum 132 and a false indication of the deposit of a screw, the drum which is electrically conductive is formed with a circumferential groove 153 wider than the finger and extending radially and inwardly beyond the recesses 135, the finger extending into the groove to contact each screw as the latter approaches the discharge guideway.

The energizing circuit for the relay 147 of each feeder drum 132 extends across the transformer secondary 37 through contacts 154 of the associated counter 120a, these contacts being open for deenergization of the relay and energization of the brake winding 146 at the end of a correct count as shown in Fig. 27 and closed for energization of the relay and energization of the clutch winding 144 in response to energization of a counter reset relay 155. Energization of the latter through the transformer secondary 37 is effected once during each revolution of the camshaft 29 and just after advance of the stops 47 to 50 by closure of a switch 156 momentarily by a cam 157 on the camshaft. Upon energization of the reset relay, normally closed contacts 158 thereof in circuits including conductors 159 to the respective counters are opened momentarily and the contacts 154 of each counter are closed for energization of the feeder relays 147 to energize the clutches 142 and deenergize the brakes 145.

An accurate count of screws 10 in each box 11 is insured by stopping the camshaft 29 thereby halting advance of the boxes with the conveyor whenever any of the feeder drums 132 fails to deliver the correct number of screws to a box dwelling in the associated filler station, the camshaft remaining stopped until all of the counters have indicated delivery of the correct number of screws. Such control is accomplished by connecting the camshaft relay 45 to the transformer secondary 37 through parallel circuits, one including a normally closed shutdown switch 160 which is actuated by the cam 157 on the camshaft 29 just before retraction of the stops 47 to 50 for advance of the boxes 11 with the conveyor 46. The other circuit extends in series through a switch 161 of each counter. This switch is opened in response to energization of the reset relay 155 and is closed at the same time the clutch-brake contacts 154 are opened at the end of a correct count of screws. Thus, the switches 161 complete a circuit for the camshaft relay bypassing the shutdown switch so that the camshaft continues to rotate as long as each feeder is delivering the correct number of screws to each box.

After passing the filling stations C, D and E, each filled box 11 advances with the conveyor and against the flag 50 at the closing station F where a lid 12 is pressed downwardly onto the box to assemble the two by interengagement of the hinge elements 15 and 17 and the latch elements 21 and 23 at opposite ends of the lid and box. To hold the box stationary and position the same precisely for the closing operation, a plunger 162 is advanced against one end of the box to urge the box against the opposite guide rail 60 in timed relation to and after advance of the flag 50. This plunger 162 (see Figs. 21, 25 and 26) is slidably mounted in a block 163 secured to a guide rail 60 and is yieldably urged outwardly to its advanced position by a spring 164 encircling the plunger and acting between a shoulder thereon and the block.

To retract the plunger 162 when the flag 50 is retracted, a dog 165 pivoted on the flag and yieldably urged by gravity downwardly toward the plunger abuts and pulls rearwardly against an enlarged latch head 166 at the inner end of the plunger until the head moves behind a keeper lever 167. This lever 167 is pivoted on the frame support 64 for the flag rockshaft 63 and is yieldably urged upwardly by a spring 168 toward the plunger. To advance the plunger simultaneously with advance of the plunger 81 at the last filling station E, an arm 169 movable with the latter plunger abuts a surface 170 of a dog 171 pivoted on the keeper 167 to swing the latter downwardly about its pivot 172 and away from the latch 166. The keeper dog is yieldably urged toward its keeper release position shown in full in Fig. 25 by a spring 173 which permits rotation of the dog to a position shown in phantom during retraction of the plunger arm 169.

Lids 12 to be assembled on the boxes 11 are advanced one by one to a pick-up position G spaced from a box in the closing station F and are transferred from such position onto the box by a holder 175 movable back and forth between the two. In this instance, each lid is deposited on the upper straight run of a conveyor belt 176 at the loading station A and advances with the latter and up against a stationary stop 177 which locates the leading edge of the lid in alignment with the leading surface of the box 11 abutting the flag 50 at the closing station F. The conveyor belt 176 is similar to the box

conveyor 46 and extends parallel to the latter around pulleys 174 on the driving and idler shafts 52 of the box conveyor, a resiliently mounted roller 178 (Fig. 10) maintaining the belt under tension. An inverted channel 179 secured to the frame provides a backing for the lid conveyor disposed approximately on a level with the tops of boxes on the belt conveyor. Each lid is deposited on the lid conveyor with its longtiduinal axis extending transversely thereof and is maintained in such position by the adjacent guide rail 60 of the belt conveyor which engages the depending latch 21 of the lid and a spaced rail 180 secured to the frame and engaging the ears 16 of the lid. The lid stop 177 is formed as a U-shaped bracket secured to the lid guide rail 180.

To insure bending over of the projecting label end 86 into each box when the lid 12 is assembled thereto, the pick-up position G for the lids is located adjacent the rear end 18 of the box at the closing station F and the lid holder 175 moves each lid horizontally across the box end to bend over the label portion as an incident to moving the lid onto the box. In the present instance, the lid holder 175 is a block of resilient material such as rubber carried by the outer end of an elongated horizontally disposed lever 181 and having a downwardly opening rectangular recess communicating with a flexible hose 182 through a bore in the lever. Intermediate its ends, the lever is guided between and is pivotally and slidably connected to spaced posts 183 on the frame by a pin 184 spanning the posts and extending through a longitudinal slot 185 in the lever. The other end of the lever carries a follower roller 186 engageable with a cam 187 on the camshaft 29 for shifting the lever horizontally from the box 11 to the pick-up position G against the action of a spring 188 stretched between the lever and the posts 183. A resiliently mounted roller 189 acts against the underside of the other end of the lever to urge the same against another cam 190 which operates to raise the holder 175 twice during each revolution of the camshaft and during its transfer between the pick-up position and the box.

A vacuum is created in the holder recess for gripping a lid by opening a valve 191 (Fig. 10) in a connection (not shown) between the holder hose 182 and the pump 108. The valve actuator carries a follower roller 192 which engages a cam 193 on the camshaft for opening the valve as the holder descends onto a lid in the pick-up postition G and maintaining the valve open until the lid has been pressed onto a box.

Operation

The machine above described is prepared for operation by stopping the motor 31 with the camshaft 29 in a position in which the stops 47 to 50 have been advanced from their retracted positions just prior to the time when the cam 157 actuates the counter reset switch 156. A group of boxes then is placed manually on the box conveyor 46 behind each of the stops 47 to 50, the boxes in each group containing liners 24 and the same numbers of screws 10 which are delivered at previous stations during automatic operation. Next, a group of lids is placed on the lid conveyor 176 behind the stop 177 and a stack of liners is inserted into the magazine 87. Screws in bulk are deposited in the hoppers 116 and the agitator motor 123 is energized briefly to deliver a plurality of screws to the lower ends of the chutes 118, the feeder drums 132 being turned by hand to fill each recess 135 between the chute and the discharge point 131. Finally, the counters 120a are adjusted by turning their dials 148 for the desired numbers of screws to be delivered at the different stations. In this instance, the total number of screws in each box is twenty, seven being delivered at each of the first two stations and six at the last station.

With the camshaft 29 stopped in this position in which the stops 47 to 50 have just advanced, the liner holder 25 is stopped in its downward movement in a position shown in phantom in Fig. 14 just above a box 11 in the liner station B. Also, at this time, the lid holder 175 is poised above a box in the closing station, the valves 110 and 191 of both holders being open. The counter switches 161 are closed in the circuit of the camshaft relay 45 while the contacts 154 are open in the circuits of the feeder relays 147 as shown in Fig. 27 for energization of the feeder brake windings 146.

After switches 194 have been closed to connect the vacuum pump motor 109, the hopper motor 123 and the conveyor belt motor 53 to the alternating current source 39, and power is available at the direct current source 42 for the clutch and brake units of the camshaft 29 and the feeders 132, operation of the machine is started by closing a switch 195 thereby connecting the primary of the transformer 38 to the alternating current source 39 and energizing the camshaft and feeder motors 31 and 140 at the desired speeds. The switch 160 for the camshaft relay 45 then being closed, the clutch winding 40 is energized for rotation of the camshaft 29.

As the camshaft 29 rotates clockwise from its stopped position shown in Fig. 27, the cam 157 closes the counter reset switch 156 momentarily and the counter contacts 154 close for energization of each relay 147 and the clutch winding 144 of each feeder 119 to rotate the drums 132 and start the delivery of screws 10 at the filler stations C, D and E. When the correct number of screws has been delivered to the box below the discharge point 131 of each filler station, the contacts 154 of the associated counter open for deenergization of the feeder relay 147 and the clutch winding 144 and energization of the brake winding 146 to stop the delivery of screws. Also, the switch 161 of the counter closes in the circuit bypassing the shutdown switch 160. If the count at all three filling stations C, D and E is correct, such bypass circuit is completed so that rotation of the camshaft 29 continues when the shutdown switch 160 is opened by the cam 157. If the correct number of screws has not been delivered at any one of the filling stations, the switch 161 of the counter 120a thereof fails to close and the camshaft is stopped by opening of the shutdown switch for energization of the camshaft brake winding 41 and deenergization of the clutch winding 40 thereby disabling the mechanism for advancing the boxes. Such shutdown continues until each counter indicates the delivery of the correct number of screws by closure of its bypass switch 161.

After the camshaft 29 has passed the position in which the cam 157 actuates the shutdown switch 160, the cams 69 and 72 retract the flags 47, 48 and 50 to permit advance of the boxes abutting the flags and, after such boxes have passed beneath the flags, allow the latter to be advanced by their springs back into the box path. The stop finger 49 at the third filling station E is retracted with the closing flag 50 but the abutting box is retained by the third plunger 81. At the closing station F, the locating plunger 162 is retracted with the flag 50 by abutment of the dog 165 with the latch head 166 and the latter is shifted thereby behind the keeper 167.

As soon as the flags begin to advance, the cams 80 and 85 retract the plungers 74, 75, and 81 at the three filling stations C, D and E permitting each group of boxes to advance with the conveyor, the flags having returned to their advanced positions by the time the boxes reach such positions. At the third filling station where the stop finger 49 abuts the trailing wall of the leading box as shown in Fig. 21, the plunger and finger movement are timed for entry of the finger into the next adjacent box as soon as the leading side wall thereof passes beneath the finger. After the stops 47 to 50 reach their advanced positions, the cams 80 and 85 allow the filling station plungers 74, 75 and 81 to be advanced by their springs, the arm 169 moving with the third filling station plunger 81 against the surface 170 of the keeper dog 171 to swing

the latter and the keeper **167** about the pivot **172** (Fig. 25) to release the locating plunger **162** for advance by its spring **164** against the box at the closing station F.

The advance of the boxes **11** one step as described above is completed by the time the cam **157** reaches its starting position just prior to actuation of the counter reset switch **156** thereby terminating one cycle of the machine. During this cycle, the liner holder **25**, which is poised above a box at the liner station just after advance of the boxes, is lowered to press the liner **24** thereon into the box as shown in full in Fig. 14. The cam **96** then permits the holder to be raised by its spring **102** to its upper position of abutment with the bottom terminal liner in the magazine **87** as shown in phantom in Fig. 17 and in full in Fig. 13, the valve **110** being closed from the time the holder starts its upward movement and until it reaches the upper position. Then, the cam **113** opens the valve to connect the holder recess **90** to the pump **108** and apply a vacuum to the recess for gripping the terminal liner. Such vacuum is maintained while the cam **96** advances the horizontal rack bar **98** to lower the holder and until the latter reaches its bottom position within the box as described above.

At the closing station F where the holder **175** is poised above the box abutting the flag **50** at the start of the cycle, the cam **190** allows the resiliently mounted roller **189** to swing the lever **181** about its fulcrum pin **184** to press the lid bodily and downwardly onto the box, the ears **16** of the lid entering between the box side walls **13** and the latch **21** entering between the guides **22** and hooking around the keeper **23** on the box. The cam **193** then permits the valve **191** to close relieving the vacuum in the holder recess and the cam **190** raises the holder which, at the same time, is shifted horizontally by the cam **187** back to the pick-up position. At the latter, the cam **190** again permits the roller **189** to lower the holder onto a lid abutting the stop **177** as shown in Fig. 22. The cam **193** then opens the valve **191** to create suction in the holder recess for gripping the lid after which the cam **190** raises the holder and the cam **187** allows the spring **188** to shift the holder horizontally back to its starting position. During such shifting, the lid in the holder moves endwise across the adjacent end of the box as shown in Fig. 24 to fold the projecting liner portion **86** inwardly and downwardly over the screws **10** in the box.

During continuous operation of the machine, each box **11** is deposited on the conveyor **46** at the loading station A with its length extending crosswise of the conveyor and advances with the latter and up against the trailing box of the group behind the flag **47** at the first filling station C. As the boxes adjacent the flag are released one by one, the box advances step by step first to the liner station B where a liner **24** is inserted and then to the first filling station C where seven screws **10** are dropped into one end portion of the box with their axes extending longitudinally of the box as shown in Fig. 2. Upon release from the first filling station, the box advances with the conveyor **46** successively to the second filling station D where seven screws **10** are dropped into its other end portion as shown in Fig. 3 and to the third filling station E where six screws **10** are deposited in the intermediate portion of the box as shown in Fig. 4 in the space between the groups of screws in the end portions.

As the box **10** approaches each of the last two filling stations D and E, it advances sidewise and step by step with the boxes of each group. Such intermittent starting and stopping of the box produces a sidewise shaking which, due to extension of the screw axes longitudinally of the box, tends to settle the screws below the top edges of the box side walls. Should any of the boxes in the groups at the last two filling stations be defective by reason of an improperly inserted label or an incorrect number of screws, the machine operator may simply lift the defective box from the group, the trailing boxes then crowding up to fill the space left by removal of the defective box. After the defect is corrected, the box is returned to the conveyor **46** at the end of the group. The particular box advancing means and the spacing of the stations thus make it possible to continue the operation of the machine thereby avoiding costly shutdowns whenever it is necessary to remove and correct defective boxes. A further compacting of the screws is effected in the closing operation, any screws which project upwardly higher than the top edges of the upstanding box walls being engaged and pressed downwardly into the box by the lid **12** during its bodily movement toward the box.

I claim as my invention:

1. In a packaging machine, the combination of, means for supporting a plurality of rectangular open top boxes and advancing the same step by step along a predetermined path, a liner station disposed along said path at a dwell position of the boxes and including a magazine adapted to support a plurality of flat rectangular liners in a stack and to engage a terminal liner in the stack at opposite marginal portions thereby leaving an intermediate portion of the liner exposed, a suction device smaller than said boxes adapted to enter the open ends thereof and, when a vacuum is applied to the device, to grip said intermediate portion of said terminal liner at points spaced apart a distance slightly less than the length of said boxes, means supporting said device for movement back and forth between a position of engagement with the terminal liner in said stack and an inserting position within a box dwelling in said station, means operable in timed relation to said adavncing means to shift said device into and out of said inserting position during dwelling of said boxes and to shift the device into engagement with said terminal liner during advance of the boxes, and means operable in timed relation to movement of said device to apply vacuum to the device when the latter abuts said terminal liner for gripping the latter and to maintain the vacuum until the device is in said inserting position for stripping of the terminal liner from the stack and inserting the same into a box, said liners being flexible to permit bending thereof as an incident to movement into said boxes with the device.

2. In a machine for packaging material in rectangular open top boxes, the combination of, a liner inserting station including a magazine adapted to support a plurality of elongated flexible liners longer than said boxes in flattened condition in a stack and to engage the terminal liner at opposite marginal portions thereby leaving an intermediate portion of the liner exposed, means at said station for supporting a box with the opening thereof in a predetermined position relative to said magazine, a liner holder smaller than said boxes adapted to move into and out of the same and, when actuated, to grip said intermediate portion of said terminal liner at points spaced apart a distance slightly less than the length of the boxes means mounting said holder for movement back and forth between a pick-up position of gripping engagement with said intermediate portion and an inserting position within and adjacent the bottom of a box in said position, said holder carrying said terminal liner broadwise away from the stack and broadwise through the open end and to the bottom of the box, and means for actuating said holder during movement thereof from said pick-up position to said inserting position.

3. In a machine for packaging material in rectangular open top boxes, the combination of, a liner inserting station including a support for an elongated flexible liner longer than said boxes, means at said station for supporting a box with the opening thereof in a predetermined position relative to said liner support, a linear holder smaller than said boxes adapted to move into and out of the same and to grip the liner at points spaced apart longitudinally of the liner a distance slightly less than the

length of the boxes, and means mounting said holder for movement back and forth between a pick-up position of gripping engagement with said liner and an inserting position within and adjacent the bottom of a box in said predetermined position, said holder carrying the liner away from said support and broadwise through the open end and to the bottom of the box with the end portions of the liner bending as an incident to entry into the box.

4. In a machine for packaging in an oblong rectangular open top box a predetermined number of elongated articles such as screws substantially shorter than the box, the combination of, means for supporting the box with its open end up and advancing the same sidewise and step by step along a horizontal path with the longitudinal axis of the box extending transversely of the path, a plurality of filling stations spaced along said path at different dwell positions of said box, mechanism at each of said stations for counting out a group of said articles and operable, during a dwell of the box at the station, to discharge the articles at a point above the box for gravitation of the articles into the box, said groups of all of said mechanisms totalling said predetermined number, and means supporting said mechanisms with said discharge points thereof located above different sections of said box and said path spaced transversely of the latter along the box axis whereby to distribute the articles evenly throughout the box and avoid piling of the articles and spilling of the same over the top edges of the box.

5. In a machine for packaging in an open top box a predetermined number of articles, the combination of, means for supporting the box with its open end up and advancing the same step by step along a horizontal path while maintaining an axis of the box in a predetermined angular position relative to the path, a plurality of filling stations spaced along said path at different dwell positions of said box, mechanism at each of said stations for counting out a group of said articles and operable, during a dwell of the box at the station, to deliver such group to a discharge point above the box and discharge the articles for gravitation into the box from said point, said groups of articles of all of said mechanisms totalling said predetermined number, and means supporting said mechanisms with said discharge points thereof located above different sections of the box spaced longitudinally of said axis thereof whereby to distribute the articles evenly through out the box and avoid piling of the articles and spilling of the same over the top edges of the box.

6. In a machine for packaging in an open top rectangular box a predetermined number of elongated articles such as screws substantially shorter than the box, the combination of, means for supporting the box with its open end up and advancing the same sidewise along a horizontal path, a plurality of filling stations spaced along said path with the adjacent stations separated by a distance several times the width of said box, means for interrupting the advance of the box at each of said stations and also at a plurality of points between the adjacent stations whereby to effect a horizontal shaking of the box and compacting of the articles previously deposited therein, mechanism for counting out said predetermined number of the articles to provide a plurality of groups whose numbers total the predetermined number, and means at the respective stations operable, during dwelling of the box at the stations, for discharging said groups into the box with the lengths of the articles extending along the length of the box.

7. In a machine for packaging a predetermined number of articles in each of a succession of containers, the combination of, means for supporting a plurality of containers and advancing the same step by step along a predetermined path, a plurality of filling stations spaced along said path at dwell positions of the containers, mechanism including a feeder at each of said stations operable when activated to advance screws one at a time for delivery to a container dwelling in the station, means operable in timed relation to said advancing means and during each dwell period of the containers to activate said feeder, a counter at each station operable to count articles delivered by said feeder and to stop the latter after delivery of a predetermined group of articles, the sum of the articles of said groups at all of said stations totalling said predetermined number, and means including said counters controlling said advancing means and operable in timed relation to advance of the containers and at the end of each dwell period thereof to disable the advancing means until each of said feeders has delivered the correct number of articles constituting the group to be delivered by the feeder.

8. In a machine for packaging a predetermined number of articles in each of a succession of containers, the combination of, means for supporting a plurality of containers and advancing the same step by step along a predetermined path and successively past a plurality of stations spaced along the path at dwell positions of the containers, filler mechanism at each of said stations operable during dwelling of the containers to deliver a predetermined group of articles to the container dwelling at the station, the sum of the articles of all of said groups being equal to said predetermined number, and means including a counter at each of said stations controlling said advancing means and operable to disable the latter when the associated filler mechanism at any of the stations fails to deliver the correct numbr of articles constituting the group to be delivered by the mechanism.

9. In a machine for packaging a predetermined number of articles in each of a succession of containers, the combination of, means for supporting a plurality of containers and advancing the same step by step along a predetermined path and successively past a plurality of filling stations spaced along the path at dwell positions of the containers, a feeder mechanism at each of said stations operable in timed relation to said advancing means to count out a predetermined group of said articles and, during dwelling of a container at the station, to deliver such group to the container, the sum of the articles of all of said groups equalling said predetermined number, means controlling said advancing means and operable in timed relation to advance of said containers to disable the advancing means a predetermined time interval after each advance of the containers, and a plurality of counters one responsive to each of said filler mechanisms, each of said counters operating to count the articles delivered by the associated filler mechanism and cooperating with the other counters to render said controlling means ineffectual thereby permitting continued operation of said advancing means when all of the filler mechanisms deliver the correct numbers of articles in their respective groups during said time interval.

10. In a machine for packaging elongated articles in open top containers, the combination of, a carrier mounted to rotate about a horizontal axis and having a plurality of outwardly opening recesses at spaced points around its periphery each adapted to receive one article, a chute adapted to support a series of said articles in side by side relation and terminating adjacent a peripheral portion of said carrier on the upper side of the latter with the terminal article resting on such portion to drop into one of said recesses during rotation of the carrier past one end of the chute, a wall extending around said carrier peripheral portion in one direction from said chute to a discharge point on the under side of the carrier to hold articles in said recesses until the articles reach the discharge point, means on said carrier defining a groove extending around said peripheral portion and intersecting said recesses, and a feeler disposed between said chute and said discharge point and extending into said groove to engage articles in said recesses as the latter move past the feeler, drive means operable when energized to rotate said carrier, and means including a counter controlling

said drive means in response to engagement of said feeler with articles in said recesses and operating to deenergize the drive means to stop rotation of the carrier when a predetermined number of articles have moved past the feeler to the discharge point.

11. In a machine for packaging articles in open top containers, the combination of, a rotary carrier having a plurality of outwardly opening recesses at spaced points around its periphery each adapted to receive one article, means supporting said carrier for rotation about a fixed axis, a chute adapted to support a series of said articles and terminating adjacent the peripheral portion of said carrier on the upper side thereof with the terminal article resting on such portion to drop into one of said recesses during rotation of the carrier past the end of the chute, a wall extending around said peripheral portion in one direction from said chute to a discharge point spaced therefrom to hold articles in said recesses until the articles reach the discharge point and then permit gravitation of the articles from the carrier, means for supporting a plurality of said containers with their open ends up and advancing the same step by step to a dwell position beneath said discharge point for gravitation of articles from the latter into the containers, drive means operable when energized to rotate said carrier in said direction, and means including a counter controlling said drive means and operable to energize the drive means in timed relation to said advancing means and after each advance of containers and to deenergize the drive means to stop the carrier when a predetermined number of articles have been delivered to the discharge point.

12. In a packaging machine, the combination of a closing station, means at said station for supporting in a predetermined position a rectangular open top box adapted to be closed by a flat lid and having a bendable liner lying along and extending beyond the top of one end wall of the box, means at said station for supporting in a pick-up position spaced from said box position a lid adapted to close the box, a lid holder adapted to grip the lid at said pick-up position and hold the same during transfer to the top of a box dwelling at said station, and mechanism supporting said holder for movement of the holder and the lid from said pick-up position to said box position along a path extending first longitudinally of the box and inwardly across the top of said end wall thereof and then downwardly toward the box to close the latter, said lid, during movement with said holder along said path, engaging the projecting liner in the box and folding the same inwardly and downwardly over the contents of the box.

13. In a packaging machine, the combination of, a closing station, means for supporting a plurality of filled open topped boxes with their open ends up and advancing the same one by one into a predetermined position at said closing station, means for supporting a plurality of lids and advancing the same one by one to a predetermined pick-up position adjacent said box position at said closing station with exterior surfaces of the lid exposed, each of said lids being adapted to close the top of one of said boxes and having parts interlocking with parts on the box to hold the two together when the lid is moved bodily toward and pressed downwardly onto the box, a lid holder movable back and forth between said pick-up position and said box position and downwardly toward a box at the latter and including a gripping device adapted when actuated to pick up a lid by engagement with said exposed exterior surfaces thereof, mechanism operated in timed relation to said box advancing means to move said holder into and out of said box position during dwelling of a box therein and into and out of said lid position during advance of the boxes, and mechanism operable in timed relation to said holder moving mechanism to actuate said gripping device after movement of the holder into said lid position and to maintain the device actuated until the lid picked up thereby has been pressed downwardly onto the box.

14. In a packaging machine, the combination of, a closing station, means for supporting a filled open topped box with its open ends up and advancing the same into a predetermined position at said closing station, means disposed adjacent said box position for supporting a flat lid in a predetermined pick-up position with the exterior side of the lid exposed, said lid being adapted to close the top of said boxes and having parts interlocking with parts on the box to hold the two together when the lid is moved bodily toward and pressed downwardly onto the box, a lid holder operable when activated to grip the exposed side of the lid, mechanism supporting said holder at said station for movement from said lid position first to a position above said box, then bodily and downwardly toward the latter, and finally back to said lid position, and mechanism for activating said holder during movement thereof from said lid position to said box position for pick-up and assembly of the lid to the box and then inactivating the holder to leave the lid on the box.

15. In a machine for packaging articles in a plurality of open top boxes, the combination of, means for supporting the boxes and advancing the same step by step along a horizontal path, a liner inserting station disposed along said path at a dwell position of said boxes and including mechanism movable toward and away from said path and operable in timed relation to advance of the boxes to deliver a liner to the interior of each box while the latter is dwelling at said station, a filling station spaced along said path from said liner station and including mechanism actuated in timed relation to advance of said boxes and during dwelling of a box at the station to deposit a predetermined number of articles in the box and on top of the liner therein, a closing station disposed along said path beyond said filling station, means for supporting and advancing a plurality of lids one by one to a pick-up position adjacent said closing station, a lid holder movable back and forth between said pick-up position and a box dwelling at said closing station and operating in timed relation to advance of said boxes to grip and transfer lids one by one from said pick-up position to said closing station and press the same downwardly onto the top of a box dwelling at the closing station.

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