Nov. 8, 1966 J. CASCIO ET AL 3,283,930

TRAY FEED MECHANISM

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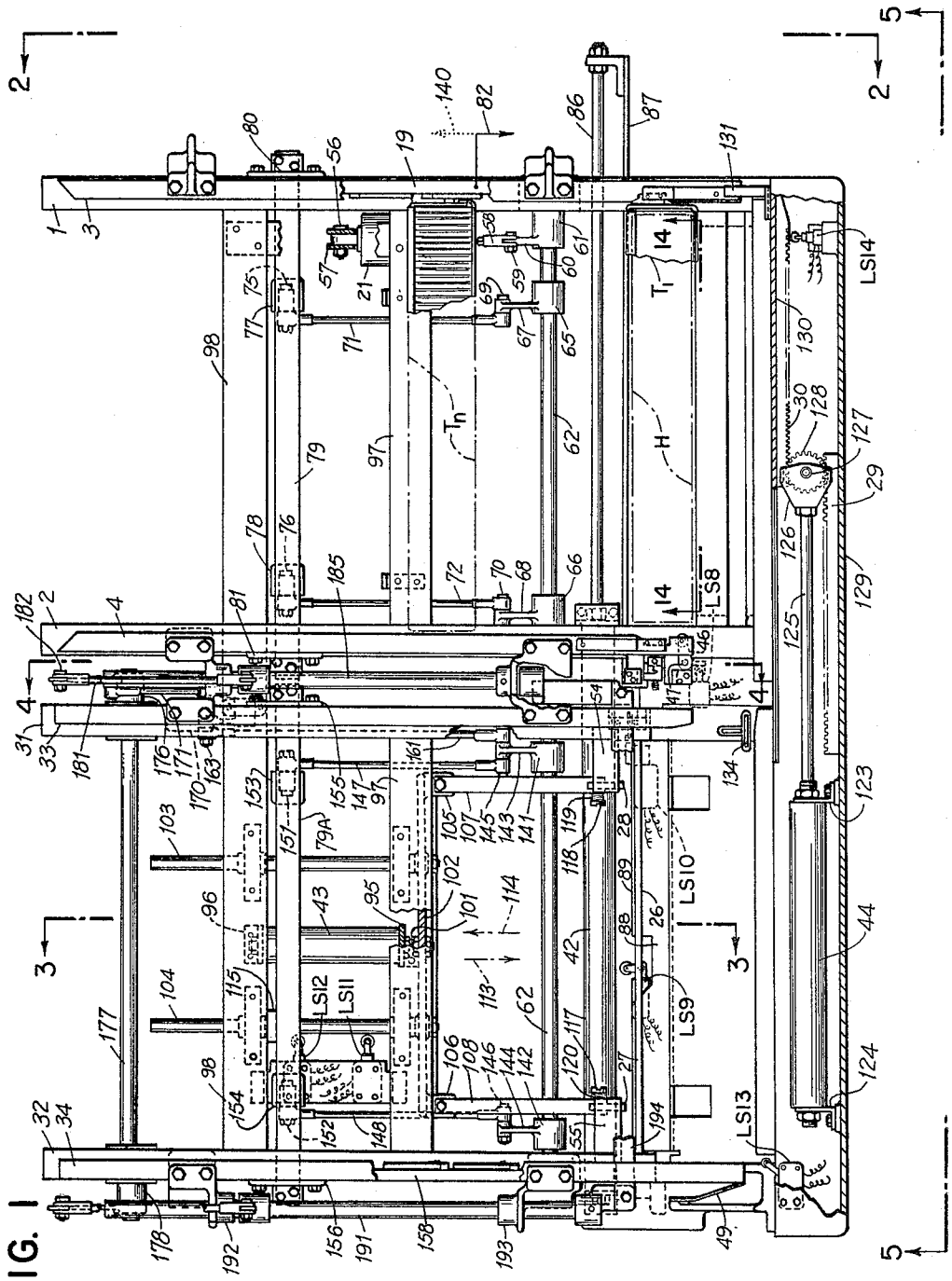


FIG. 1

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TRAY FEED MECHANISM

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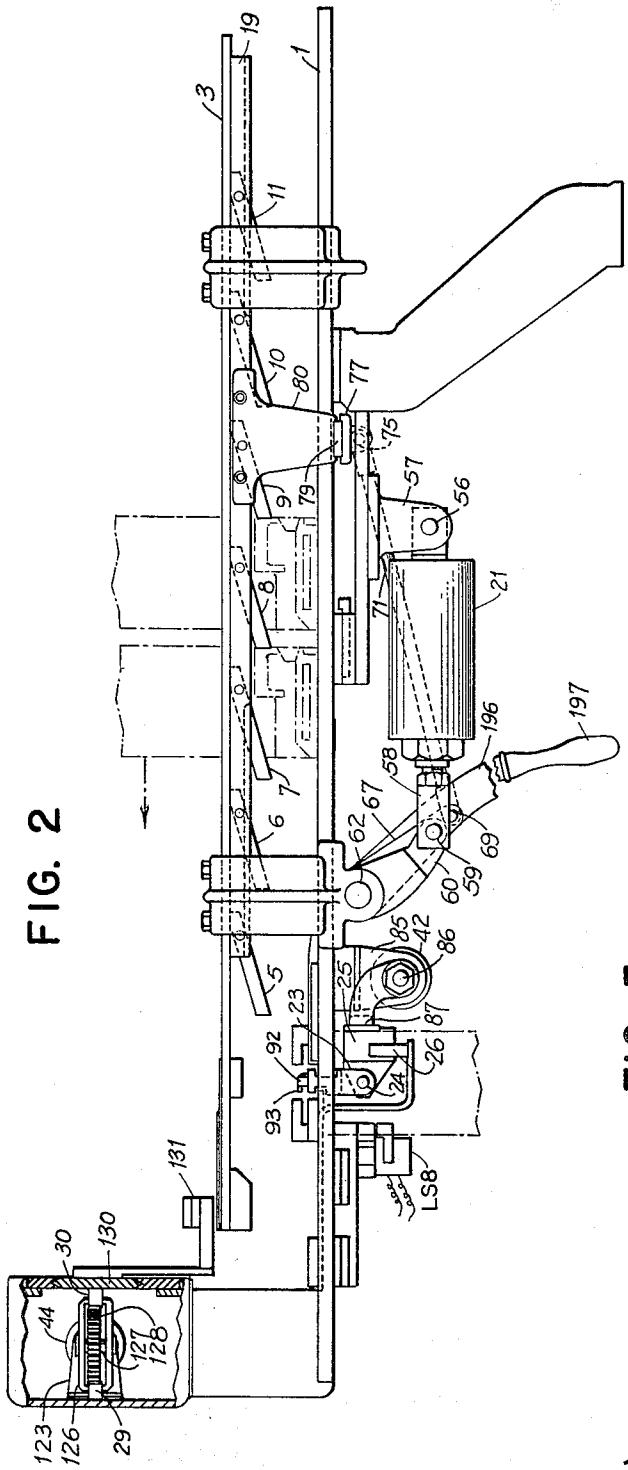


FIG. 2

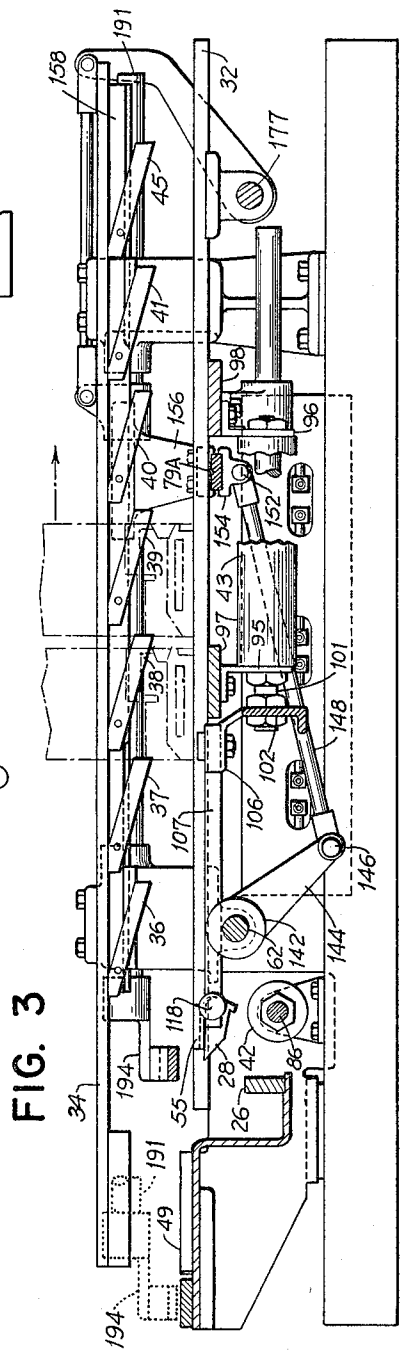


FIG. 3

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TRAY FEED MECHANISM

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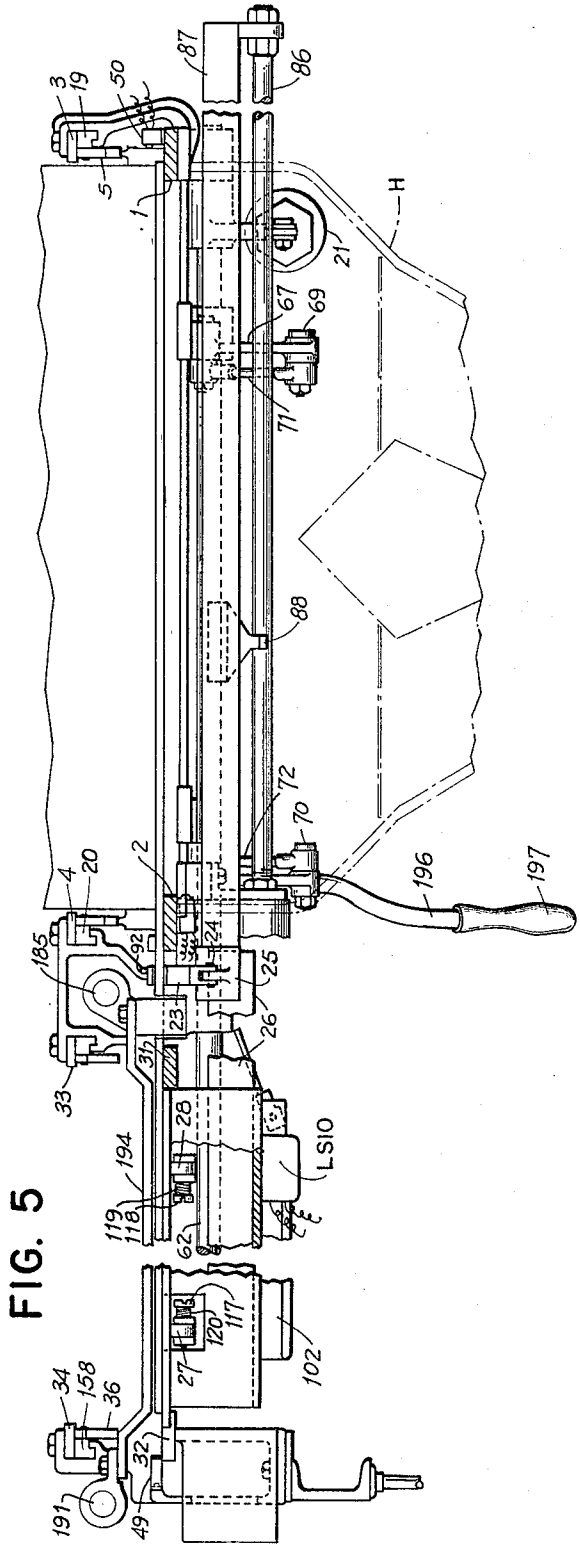


FIG. 5

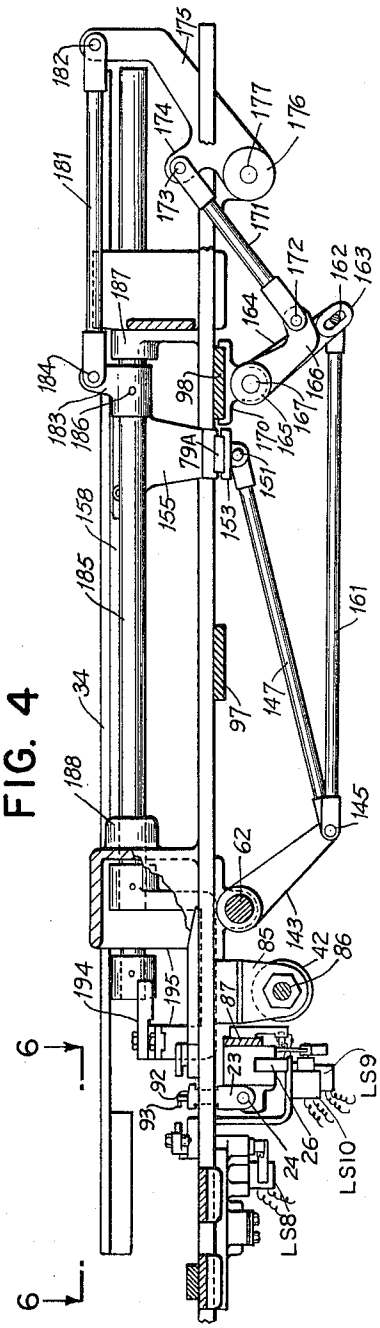


FIG. 4

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TRAY FEED MECHANISM

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FIG. 6

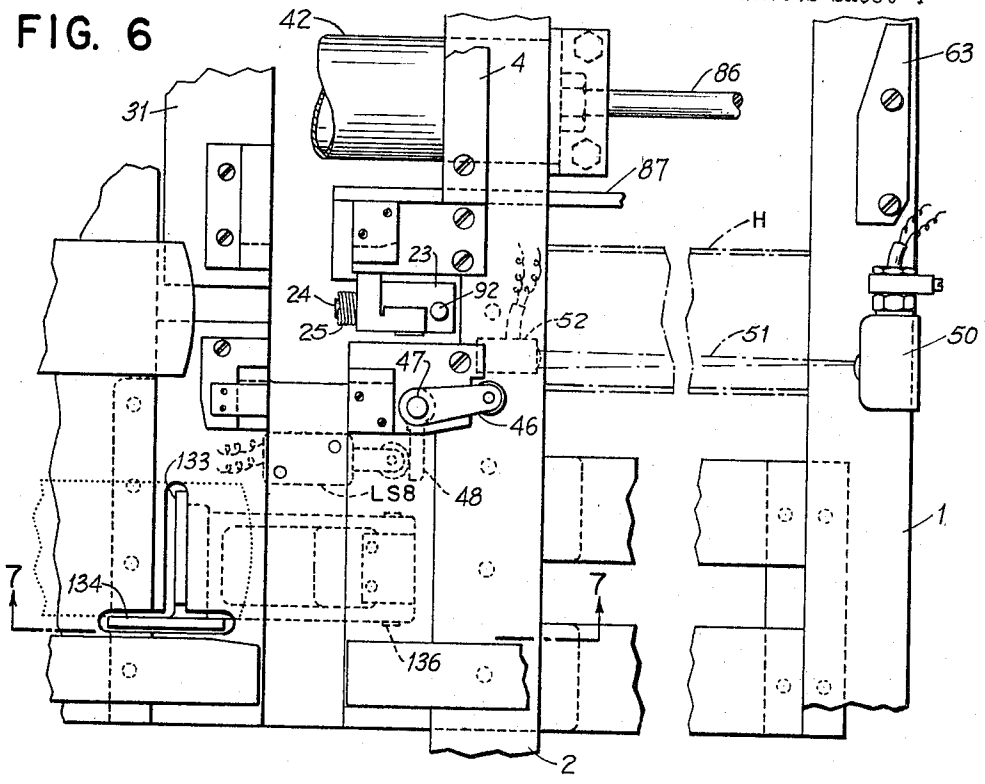
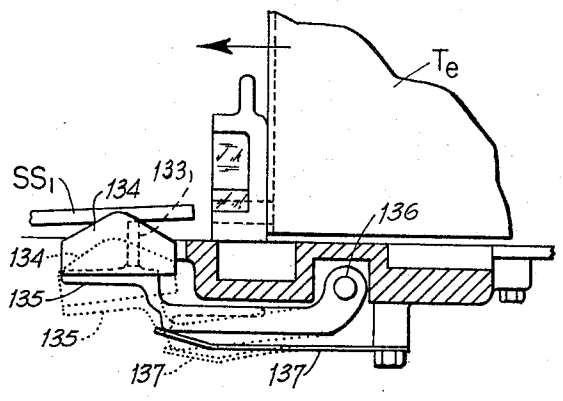


FIG. 7



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TRAY FEED MECHANISM

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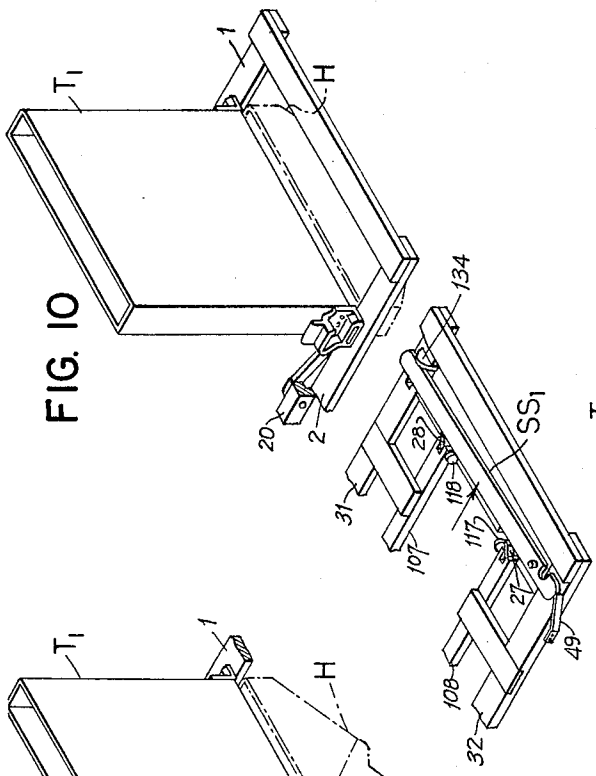


FIG. 10

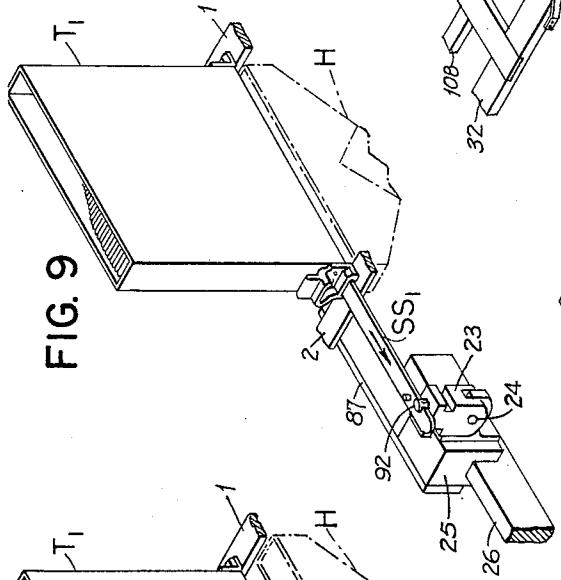


FIG. 9

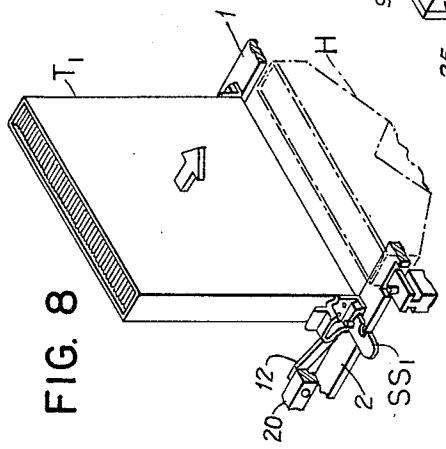


FIG. 8

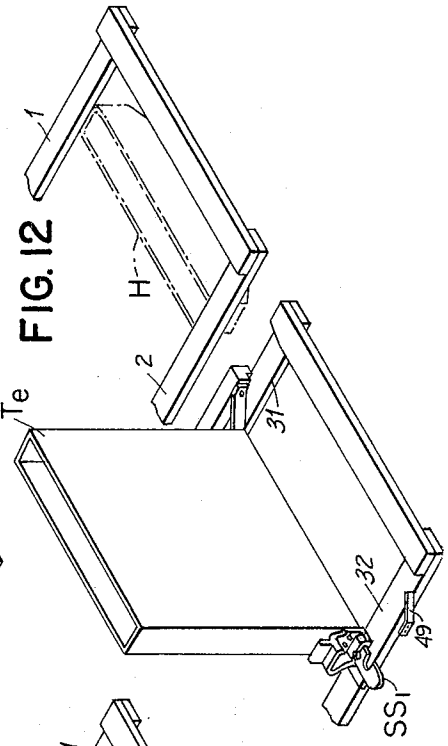


FIG. 12

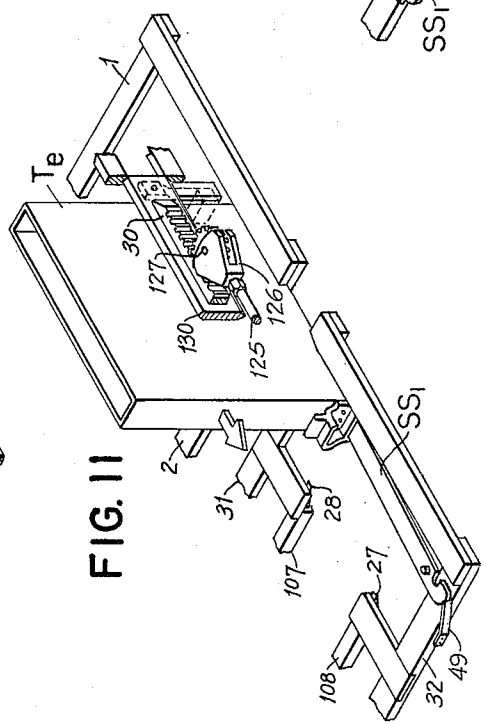


FIG. 11

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TRAY FEED MECHANISM

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FIG. 14

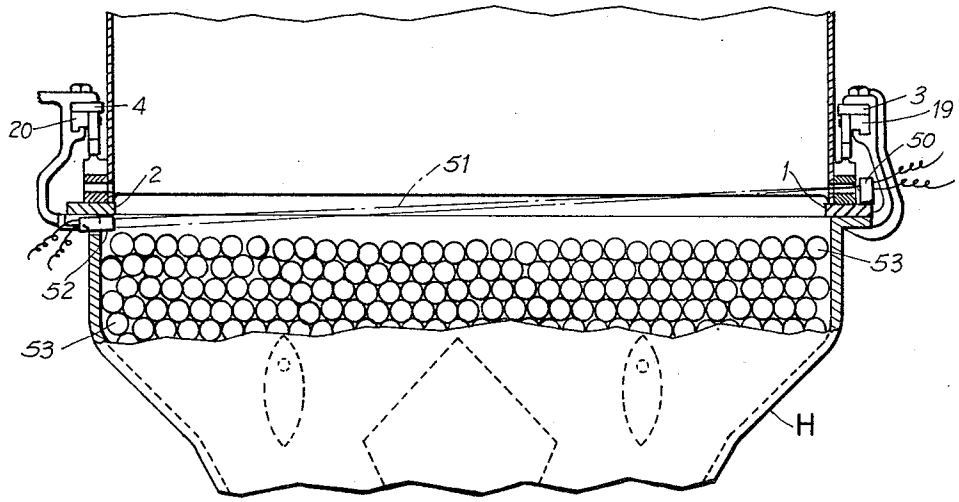
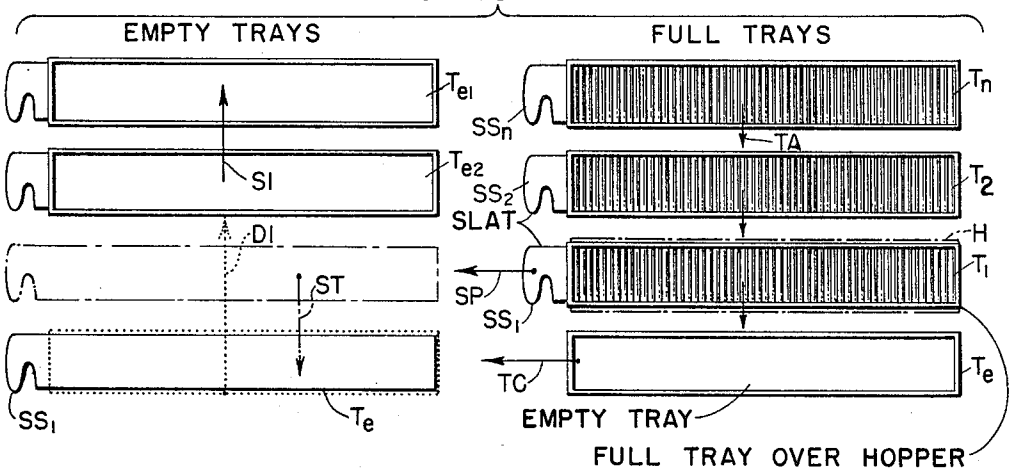


FIG. 13



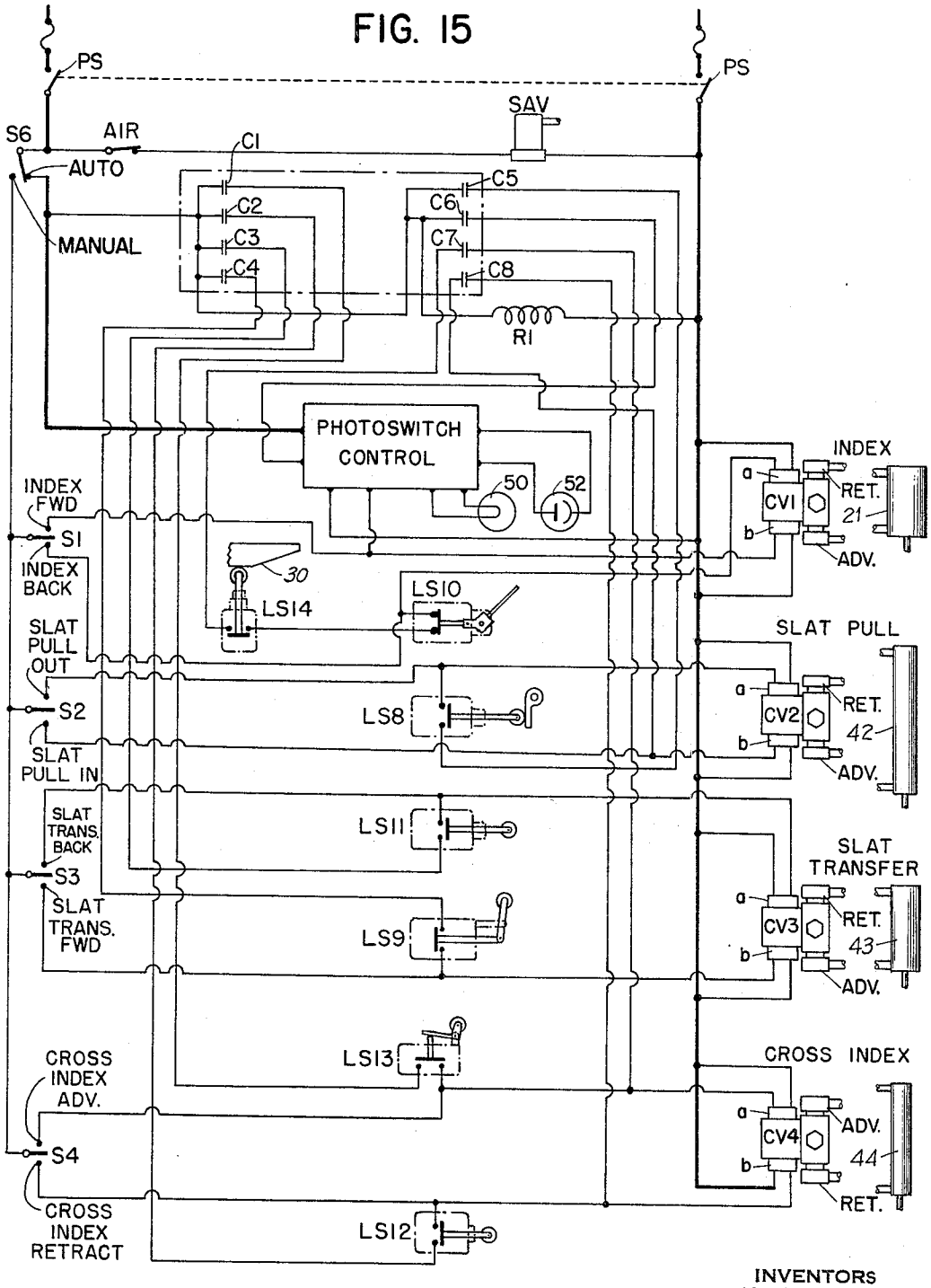
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TRAY FEED MECHANISM

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FIG. 15



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United States Patent Office

3,283,930

Patented Nov. 8, 1966

3,283,930

TRAY FEED MECHANISM

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Filed July 30, 1964, Ser. No. 386,280
7 Claims. (Cl. 214—302)

This invention relates, generally, to cigarette-feeding devices for cigarette-packaging machines provided with a feed hopper, and particularly to an improvement to the tray-feeding means of such machines. More particularly, the invention relates to automated mechanisms, control means therefor, for rendering the operation of the tray-feeding means substantially fully automatic.

The principal object of the invention is to minimize the possibility of interruption of the supply of cigarettes to the feed hopper of the packaging machine. Another object of the invention is to reduce the amount of physical effort by the operator, and to permit the operator to devote more time to machine supervision and quality inspection. Still another object of the invention is to effect a decrease in the physical agitation of the cigarettes as the trays are moved through the tray-feeding device. Still another object of the invention is to effect a decrease in the number of cigarettes which are so damaged or mutilated while they are being discharged from the trays into the feed hopper that they must be rejected as unsalable. Still another object of the invention is to enhance the general quality and salability of the product. Still another object of the invention is to effect improved efficiency and speed of operation, with concomitant economic advantages.

A feature of the invention is the provision of a U-shaped tray-support arranged to accommodate a plurality of trays, and having a full-tray entrance point, a delivery station situated over a hopper, an empty-tray exit point, and a tray-control mechanism arranged to automatically advance the trays in a co-planar U-shaped path, from the entrance point, to the delivery station, and thence to the exit point.

Another feature of the invention is the provision of a light source and a photo-electric device positioned in the feed hopper for ascertaining whether or not the level of cigarettes in the hopper has dropped below a predetermined point.

Still another feature of the invention is the provision of a first circuit closing device controlled by the photo-electric device, when the level of cigarettes in the hopper has dropped below a predetermined point, for controlling an electrically actuated pneumatic valve, to control, in turn, the advance of a first pneumatic cylinder coupled to a tray-advance mechanism, thereby to advance an emptied cigarette tray from, and a full tray to, a delivery station situated over the hopper, and to advance all other full trays in the machine one position, in a co-planar path.

Still another feature of the invention is the provision of a slat-pulling mechanism coupled to a second pneumatic cylinder, controlled by an electrically actuated pneumatic valve, controlled by a second circuit closing device actuated incident to the positioning of a full tray over the hopper, for laterally pulling or retracting the slat or bottom from the full tray, thus permitting the full tray to deliver its contents into the hopper without deviating from the aforesaid co-planar path.

Still another feature of the invention is the provision of circuitry and mechanism controlled thereby for ensuring that when the level of cigarettes in the hopper is at a predetermined high point, the first circuit closing device will be open, thereby preventing the tray-advancing mechanism from advancing the full trays along the aforesaid co-planar path.

Still another feature of the invention is the provision of a slat-transfer mechanism coupled to a third pneumatic cylinder, controlled by an electrically actuated pneumatic valve, controlled by the momentary actuation of a third circuit closing device, actuated incident to the lateral retraction of the slat from the tray positioned over the hopper, for advancing the slat one position forward and placing it in longitudinal alignment with the emptied tray situated one position forward of the delivery station and in the aforesaid co-planar path.

Still another feature of the invention is the provision of a re-set mechanism coupled to the third pneumatic cylinder, controlled by an electrically actuated pneumatic valve, controlled by a fourth circuit closing device, actuated incident to the completion of the slat-transfer motion, for retracting and re-setting the slat-transfer mechanism.

Still another feature of the invention is the provision of a tray cross-indexing mechanism coupled to a fourth pneumatic cylinder, controlled by an electrically actuated pneumatic valve, controlled by a fifth circuit closing device, actuated incident to the re-setting of the slat-transfer mechanism, for re-setting the slat-pulling mechanism and, at the same time, for retracting the previously-emptied tray laterally over and into engagement with the longitudinally aligned slat without deviating from the aforesaid co-planar path, to "thread" the slat into the tray and to close the bottom thereof.

Still another feature of the invention is the provision of a cross-indexing reset mechanism coupled to the fourth pneumatic cylinder, controlled by an electrically actuated pneumatic valve, controlled by a sixth circuit closing device, actuated incident to the completion of the cross-indexing motion, for resetting the cross-indexing mechanism.

Still another feature of the invention is the provision of a tray-advance-cycle completing mechanism coupled to the first pneumatic cylinder, controlled by an electrically actuated pneumatic valve, controlled by a series circuit through the sixth circuit closing device, actuated incident to the completion of the cross-indexing motion, through the seventh circuit closing device, actuated incident to the resetting of the slat-pulling mechanism, and through an eighth circuit closing device, actuated incident to the resetting of the cross-indexing mechanism, for moving the empty tray mechanism one position backward, and for moving the just-emptied tray two positions backward without deviating from the aforesaid co-planar path, thus completing one tray-advancing cycle.

Still another feature of the invention is the provision of mechanism and circuitry for ensuring that after the machine has been placed in operation, each successive step in its tray-advancing cycle can be initiated only if and when the immediately preceding step has been satisfactorily completed, and when all of the steps of a tray-advancing cycle have been satisfactorily completed, for furnishing a "satisfaction signal."

Still another feature of the invention is the provision of mechanism and circuitry for ensuring that after the machine has been placed in operation, a new tray-advancing cycle can be initiated only if and when the preceding tray-advancing cycle has been satisfactorily completed and a "satisfaction signal" has been furnished.

Still another feature of the invention is the provision of an alternative control circuit comprising manually operable push-buttons which may be used by the operator as an alternative control, in the event that a failure or trouble condition occurs in one of the switch mechanisms.

Still another feature of the invention is the provision of a manually operable lever which may be used by the operator for adjustment or maintenance purposes.

Still another feature of the invention is the provision of a manually operable "run out" push button, to be used

when shutting down the machine, and which effectuates circuitry for by-passing the "system shut-down" circuitry, thus enabling the packaging machine to run out those cigarettes remaining in the hopper.

The foregoing features are combined within a unitary structure of novel configuration, to provide a machine for automatically packaging cigarettes at a speed heretofore unobtainable, with a decrease in the percentage of damaged cigarettes and requiring little physical effort on the part of the operator.

The nature of the invention and its distinguishing features and advantages will be more clearly understood from the following detailed description and the accompanying drawings in which:

FIG. 1 is a plan view of an automatic tray-feed device as applied to a cigarette-packaging machine;

FIG. 2 is a side elevation of the machine, viewed in the direction of arrows **2—2** of FIG. 1;

FIG. 3 is a vertical section of the machine, on line **3—3** of FIG. 1;

FIG. 4 is a vertical section of the machine, on line **4—4** of FIG. 1;

FIG. 5 is a front elevation of the machine, viewed in the direction of arrows **5—5** of FIG. 1;

FIG. 6 is a partial plan view of the machine, viewed in the direction of arrows **6—6** of FIG. 4;

FIG. 7 is a front elevation of the slat threading mechanism, viewed in the direction of arrows **7—7** of FIG. 6;

FIG. 8 is a perspective view of a full tray as it is about to be positioned over the feed hopper of a cigarette packaging machine;

FIG. 9 is a perspective view of a full tray, after it has been positioned over the hopper, and as the slat is being pulled out;

FIG. 10 is a perspective view of a full tray positioned over the hopper, and of the slat which was withdrawn therefrom, after the slat has been advanced forwardly to the position in which it is in readiness to be threaded into a previously-emptied tray;

FIG. 11 is a perspective view of a previously-emptied tray which was advanced forwardly, and is now being pushed laterally, to thread it onto the forwardly-advanced slat;

FIG. 12 is a perspective view of an empty tray, after it has been threaded onto a slat, and after it has been moved two spaces in a rearward direction;

FIG. 13 is a diagrammatic flow chart for the machine showing, rudimentary form, the relative movement and the positions assumed by full trays, empty trays, and bottom slats;

FIG. 14 is a front elevation of the hopper, viewed in the direction of arrows **14—14** of FIG. 1, showing the location of the light source and photoelectric cell;

FIG. 15 is an electro-pneumatic diagram showing, in schematic form, the switch and relay contacts, tthe electrical connections, the electro-pneumatic valves controlled thereby, and the pneumatic cylinders respectively controlled by the valves.

It is to be understood that where the same part or element appears in more than one of the figures of the drawings, it will carry the same identifying designation throughout.

In supplying cigarette packaging machines with cigarettes it has heretofore been the practice for the operator to place the full trays on conveyor rails having a portion thereof extending above the hopper, to manually operate a lever to forwardly advance the full trays so as to place a full tray at the delivery station above the hopper, to then manually pull the slat from the tray which is positioned above the hopper, to visually observe when the level of cigarettes in the hopper has dropped to a point indicating the need for an additional supply of cigarettes, to again manually operate the lever to advance another full tray which, in advancing, pushes the just-emptied tray forwardly, and then to manually replace the slat into the just-emptied tray, and to manually remove the tray from the conveyor rails.

Such a mode of operation, obviously, entails a considerable amount of physical effort by the operator, as well as requiring a high degree of alertness in order for the operator to constantly observe the level of cigaretttes in the hopper. All of this enhances operator-fatigue; also, it limits the productivity of the machine.

In certain other cigarette packaging machines, the tray-feeding mechanism comprising a conveyor along which the full trays are advanced, up to a certain point, and are then seized by a tray gripping mechanism which lifts a tray bodily, swings it through an arc, thereby inverting the full tray over a feed hopper and dumping the cigarettes from the full tray into the hopper. The then emptied tray is then swung back into its previous position, is advanced therefrom, and is replaced by another full tray. The motion of the full tray, incident to its being swung through an arc, and the dumping of the cigarettes from the full tray into the feed hopper, results in undesirable agitation of the cigarettes, and as a consequence an undesirable large percentage of the cigarettes are damaged or mutilated and, hence, must be rejected as unsalable.

It is an object of the invention, as exemplarily disclosed in the accompanying drawings, to overcome these undesirable aspects; and to improve the quantity and quality of the output of a cigarette packing machine, and to accomplish this with less operator-fatigue.

GENERAL DESCRIPTION

To facilitate an understanding of the instant invention, it will first be described in very general terms. Refer to FIG. 1, which is a plan view of the structure of the invention showing, inter alia, cigarette trays and supporting the actuating means therefore. Only two cigarette trays, T_1 and T_n, are indicated. Tray T_1 is indicated as being positioned at the delivery station above the hopper H of a cigarette packaging machine of a type well known in the art. The cigarette packaging machine may be of the type disclosed in U.S. Pat. No. 1,847,060 granted February 23, 1932, to W. B. Bronander. When the packaging machine is in operation the hopper must be constantly replenished with a fresh charge of cigarettes supplied from a full tray, e.g., T_1. At, or near, the top of the right end of the hopper H is a light source which causes a light beam to be directed toward a photoelectric cell situated at, or near, the left end of hopper H, and slightly below the top edge thereof. When the hopper H is substantially full, the level of the cigarettes therein will be at such a height that the light beam will be prevented from impinging upon the photoelectric cell, at which time the cell will be non-conductive. However, when the supply of cigarettes in the hopper falls below the level of the light beam, the light beam is permitted to impinge upon the photoelectric cell, causing it to become conductive and to establish a control circuit, to be subsequently described in detail, which will activate electro-pneumatic mechanisms, also to be subsequently described in detail, to automatically initiate a tray-advance cycle comprising: the advance of full cigarette trays from an entrance point, to present a full tray to the delivery station, to withdraw the slat from the bottom of the full tray to enable it to discharge its contents into the hopper, to push the slat forwardly one position to place it in longitudinal alignment with the just-previously-emptied tray, to laterally move the just-previously-emptied tray to "thread" the slat into the bottom thereof, to move the just-"threaded"-tray rearwardly two positions, and then to move all of the empty trays rearwardly one position toward the exit point, the trays, from entrance to exit, traversing a prescribed co-planar U-shaped path.

Referring to FIGS. 1 and 8, let it be assumed, for example, that the full tray T_1, which is shown as it is being pushed forwardly (in the direction of the arrow) toward

the hopper H, or delivery station, corresponds to tray T_1 shown in FIG. 1. The trays are supported by support bars **1** and **2**, are guided by guide bars **3** and **4**, and are pushed frowardly by a plurality of tray-pawls, e.g., **12**, which, in turn, are carried by pusher bar **20** which, in its turn, is activated by a first pneumatic cylinder (designated **21** on FIG. 2).

Referring now to FIG. 9, the forward motion of the full tray T_1 has continued until it has reached the position illustrated in FIG. 9, where the tray T_1 is directly above the hopper H. This is the delivery station. After the tray T_1 has come to a stop in its position over the hopper, an electric circuit is closed to control a second pneumatic cylinder, (designated **42** on FIGS. 1 and 2) causing the slat-puller **23** to engage with slat S^1 and to pull it laterally from tray T_1, in the direction of the arrow. The withdrawal of the slat S_1 permits the cigarettes in tray T_1 to be delivered into the hopper H. Slat puller **23** is secured by slat puller **24** to slat-puller bracket **25** which, in turn, is supported by slat-puller guide **26**.

Referring now to FIG. 10, the slat S_1, after having been pulled laterally (or leftwardly) to a prescribed point, an electric circuit is closed to control a third pneumatic cylinder, (designated **43** on FIG. 1 and 3) causing the slat S_1 to be transferred one position forwardly, by the slat pusher fingers **27** and **28**, in the direction of the arrow. When the tray (not shown) which had immediately preceded tray T_1 had delivered its contents into the hopper, and when the level of cigarettes in the hopper had fallen below the level of the light beam, the circuit was re-established to cause, in the manner previously described, the forward co-planar movement of the trays. The just-emptied tray (preceding tray T_1) after having moved one step forward was then in longitudinal alignment with slat S_1, following which the just-emptied tray was in readiness to be moved laterally toward slat S_1. The combination of forward and lateral motions of the just-emptied tray is indicated by the bent arrow.

Referring now to FIG. 11, after the tray preceding tray T_1 reached the position where it was in longitudinal alignment with slat S_1, an electric circuit was closed to control a fourth pneumatic cylinder (designated **44** on FIGS. 1 and 3), causing the tray preceding Tray T_1 to be shifted laterally in the direction of the arrow, by means of moving rack **30** (and stationary rack **31** shown in FIG. 1 and FIG. 2), thereby causing the slat S_1 to be "threaded" or inserted into the bottom of the tray preceding tray T_1. When the "threading" operation shall have been completed, the tray preceding tray T_1, will be ready to be pushed rearwardly.

Referring now to FIG. 12, after the tray (shown in FIG. 11) shall have completed its lateral motion, a series electric circuit will have been closed to control pneumatic cylinder **21**, to push the just-emptied tray rearwardly two positions, and to push the previously emptied trays rearwardly one position. The trays are supported by support bars **31** and **32**, are guided by guide bars **33** and **34** (not shown in FIG. 12), the just-"threaded"-tray is pushed rearwardly two steps by the double-indexing pushing dog **195**. The empty trays are then pushed rearwardly, one step at a time, by a plurality of pawls (such, for example, as **39** through **41** shown in FIG. 3). At this time, one tray-advance cycle will have been completed.

Referring now to FIG. 13, there are diagrammatically represented a plurality of full trays, respectively designated T_1, T_2, and T_n, and forwardly movable in the direction of the arrow T_a. Tray T_1 is positioned at the delivery station situated over the hopper H, and is about to have its bottom slat S_1 withdrawn laterally (in the direction of the arrow SP) to permit tray S_1 to empty its contents into the hopper H. Slats S_2 and S_n, respectively associated with trays T_2 and T_n and constituting the bottoms thereof, retain the contents of the full trays while the trays are being advanced. The tray T_e, shown immediately forward of and adjacent to tray T_1, represents the tray which immediately preceded tray T_1, in the machine, and whose contents were emptied into the hopper H hence, it will be observed, tray T_e has no bottom slat. Just to the left of tray T_1, in longitudinal alignment therewith, and shown in broken lines, is a representation of the slat S_1 after having been pulled out of tray T_1. Just to the left of empty tray T_e, in longitudinal alignment therewith, is a slat S_1 after having been transferred one position forward (in the direction of the broken line arrow ST). Also, just to the left of empty tray T_e, in longitudinal alignment therewith, and shown by dots superimposed on slat T_e, is a representation of empty tray T_e after having been cross-indexed leftwardly (in the direction of the arrow TC) to effect the "threading" of slat S_1 into the bottom of the empty tray T_e, so that it may be returned with the preceding empty trays. After the "threading" operation shall have been completed, tray T_e will be rearwardly moved two spaces (or "double indexed"), in the direction of the dotted arrow DI. At the same time, the empty trays E_{e1} and T_{e2} will be rearwardly moved (or "single indexed") one space at a time, in the direction of the arrow, so that they may be removed from the machine. At the conclusion of this movement, the empty tray T_e will have assumed the position just vacated by empty tray T_{e2}. The conclusion of this series of tray and slat manipulations completes one tray-advance cycle.

DETAILED DESCRIPTION

Referring to FIG. 1, this is a plan view of an automatic cigarette tray-feed embodying the instant invention as applied to, and used in conjunction with, a cigarette packing machine of a type known and used in the art. Such cigarette packers comprise a hopper H, as indicated by broken lines in FIGS. 1, 2, 5 and 8 through 13, and also as indicated by full lines in FIG. 14.

Still referring to FIG. 1, the tray-feed of the instant invention comprises a tray conveyor having co-planar tray-supporting rails **1** and **2**, and co-planar tray-guiding rails **3** and **4** for full trays loaded into the machine, and also tray-supporting rails **31** and **32**, and tray-guiding rails **33** and **34** for empty trays to be unloaded from the machine. The tray feed has a full tray entrance point at the upper ends of rails **1** and **2**, a delivery station situated above the hopper H, and an empty tray exit point at the upper ends of rails **31** and **32**.

The instant invention also comprises tray manipulating mechanism for intermittently propelling trays through the conveyor, and for controlling the removal and replacement of the tray bottom slats. The tray manipulating mechanism is powered by the pneumatic cylinders **21**, **42**, **43**, and **44**. Each such cylinder has a piston therein which may be either advanced or retracted, in accordance with the admission of compressed air to either the advance or retract side of the piston by the electrical actuation of its respective advance or retract valve. The trays are urged through the tray-feed conveyor in a substantially U-shaped co-planar ambit, as shown in FIG. 13, and as described in the "General Description."

Referring now to FIG. 14, this is a front elevation, partly in section, of the hopper H, viewed in the direction of arrows **14—14** of FIG. 1. At the right-hand side of the hopper H is positioned a light source **50** which emits a light beam **51**. The light beam **51** is focused so that, in the absence of any opaque obstruction, it will impinge upon a photo-electric cell **52** positioned at the left-hand side, and slightly below the top edge, of the hopper H. Obviously, when the level of the cigarettes, e.g., **53**, in the hopper H falls below the level of the photo-electric cell **52**, the impingent light beam **51** will cause the cell **52** to become conductive, thereby causing a circuit to be established through the normally open contacts of the photoswitch.

Tray advance motion

Now referring to FIG. 1, let it now be assumed that the conveyor has been loaded with full trays, only two of which are indicated in FIG. 1, T_1 and T_n. Let it be further assumed that the control switch S6 (FIG. 15) for the machine has been set in its "auto" position, thus preparing the tray-feeding mechanism to proceed on an automatic basis. Referring now to FIGS. 1 and 2, and also to FIG. 15, the closure of the photoswitch (FIG. 15) applies power through the "advance" coil CV1B of electro-pneumatic valve CV1, causing it to operate, and thereby admit, compressed air to the "advance" side of pneumatic cylinder **21** to move its piston forward. The cylinder **21** is pivotally supported by stud **56** in bracket **57**. The piston rod **58** of cylinder **21** is pivotally connected by stud **59** to cylinder level **60**, integral with hub **61**, secured to lever shaft **62**. The lever shaft **62** extends across the machine (as will be evident from FIGS. 1 through 5), and has secured thereto levers which actuate the tray pawls **36**, etc. of FIG. 3. The mechanism for pushing the empty trays rearwardly, toward the point of exit, will be hereinafter described in detail. Also secured to the shaft **62** are the hubs **65** and **66** of levers **67** and **68**, respetcively. The ends of levers **67** and **68**, respectively, are pivotally connected by studs **69** and **70** to the tray-pusher rods **71** and **72**, respectively. The rods **71** and **72**, respectively, are pivotally connected by studs **75** and **76** to tray-pusher brackets **77** and **78**, respectively. The brackets **77** and **78** are secured to the tray-pusher cross bar **79** which is connected with the box-shift yoke brackets **80** and **81**. The brackets **80** and **81**, respectively, are secured to the tray-pusher bars **19** and **20**, **20** not shown in FIGS. 1 and 2. Pivotally supported on bar **19** are a plurality of tray-pusher pawls, **5** through **11**. Similarly, the corresponding tray-pusher bar (**20**, not shown) carries a corresponding set of pawls. The "advance" or leftward, motion of piston rod **58** causes the lever **60**, the lever shaft **62**, and the levers **67** and **68** secured thereto to be displaced angularly in a clockwise direction. The clockwise motion of levers **67** and **68** causes the tray-pusher rods **71** and **72**, the tray-pusher cross-bar **79**, the brackets **80** and **81**, the tray-pusher bars, e.g., **19** and the tray-pusher pawls **5**, etc., to be moved forwardly, as indicated by the arrow **82**. The forward motion of the pawls **5**, etc., causes them to engage with the lower portion of the trays, thereby pushing the trays forwardly, and in a co-planar path.

Double-indexing mechanism

Referring now to FIGS. 1, 2, 3, 4, and 12, the lever shaft **62**, it will be remembered, extends across the whole machine. FIG. 2 shows a side elevation of the full-tray advance mechanism (as shown in plan in the right-hand bay of FIG. 1). FIG. 3 shows a sectional view of the empty-tray mechanism, whereby the empty trays are pushed rearwardly, and in the aforesaid co-planar path toward the exit point. The mechanism shown in FIG. 3 is, in general, similar to the mechanism shown in FIG. 2, except that the motion of the trays in FIG. 3 is the reverse of that shown in FIG. 2; and, also, FIG.3 provides a mechanism for imparting a double-indexing motion to the empty tray which had been cross-indexed.

In the left-hand bay of FIG. 1, secured to the lever shaft **62** are the hubs **141** and **142** of levers **143** and **144**, respectively. The ends of levers **143** and **144**, respectively, are piovtally connected by studs **145** and **146** to the tray-pusher rods **147** and **148**, respectively. The rods **147** and **148**, respectively, are pivotally connected by studs **151** and **152** to tray-pusher brackets **153** and **154**, respectively. The brackets **153** and **154** are secured to the tray-pusher cross-bar 79_a which is connected with the box-shift yoke brackets **155** and **156**. The brackets **155** and **156**, respectively, are secured to the tray-pusher bars **157** and **158**, **157** not shown in FIGS. 1 and 3. Pivotally supported on bar **158** are a plurality of tray-pusher pawls, **36** through **41**, and **45**. Similarly, the corresponding tray-pusher bar (**157**, not shown) carries a corresponding set of pawls.

It should be remembered that the pneumatic cylinder **21** was powered in the "advance" direction. At that time, the lever-shaft **62**, it will be remembered, was rotated in a clockwise direction. The levers **143** and **144** secured to shaft **62**, likewise, move in a clockwise direction. The clockwise motion of levers **143** and **144** causes the tray-pusher rods **147** and **148**, the tray-pusher cross-bar 79_a, the brackets **155** and **156**, the tray-pusher bars, e.g. **158** (FIG. 3), and the tray-pusher pawls **36**, etc., to be moved forwardly, as indicated by the arrow **113**. However, the forward motion of the pawls **36**, etc., does not effect any motion of the trays at this time, but merely positions the pawls to permit their subsequent engagement with empty trays, to effect their rearward movement when the tray-pusher bar moves in the rearward direction.

Also pivotally connected to the end of levers **143** by stud **145** is the double-index push rod **161** (FIGS. 1 and 4). The rod **161** is adjustably and pivotally connetced by adjusting stud **162** to the double-index yoke **163**. The yoke **163** is at the end of lever **164** integral with hub **165**. Also integral with hub **165** is lever **166**. The hub **165** is pivotally supported by double-index pin **167**, which, in turn, is supported by double-index bracket **170**, secured to cross bar **98**. The lower end of connecting rod **171** is pivotally connected by stud **172** to lever **166**; while the upper end of rod **171** is piovtally connected by stud **173** to an arm **174** of the double-index lever **175**. The hub **176** is secured to right-hand end of the double-index shaft **177**, while the hub **178** of a similar double-index lever is secured to the left-hand end of shaft **177**. The upper end of the double-index lever **175** is piovtally connected to connecting rod **181** by stud **182**. The left-hand end of rod **181** is pivotally connected to the guide shaft lever **183** by stud **184**. The guide shaft lever **183** is fixedly pinned to the double-index shaft **185** by pins **186**. The right-hand shaft **185** is slidably supported by bearing members **187** and **188**. Similarly, the left-hand double-index shaft **191** is slidably supported by bearing members **192** and **193** (FIG. 1). At the forward ends of the double-index shafts **185** and **191**, and carried thereby, is the double-index pusher bracket assembly **194**. In FIG. 4, assembly **194** is shown in its normal position, whereas in FIG. 3, the dotted lines indicate the position of the bracket assembly when it is moved forwardly.

Still having in mind the fact that cylinder **21** was powered in the "advance" direction, the lever shaft **62** rotated in a clockwise direction. The lever **143** (FIG. 4), secured to shaft **62**, likewise moves in a clockwise direction, as previously described. However, the clockwise motion of lever **143** also causes rod **161** to move to the left, thereby causing the clockwise rotation of levers **164** and **166**. The clock-wise rotation of lever **166** causes rod **171** to move leftwardly, thereby causing lever **175** to rotate in a counter-clockwise direction, causing shaft **177** to rotate with it. The counter-clockwise rotation of lever **175** pushes rod **181**, shaft lever **183** and shaft **185** toward the front of the machine. At the same time in a similar manner, the corresponding double-index lever on the left-hand side of the shaft **177** causes the double-index shaft **191** also, to move toward the front of the machine. The forward movement of the double-index shafts **185** and **191** moves the double-index pusher bracket assembly **194** carried thereby to the forward position, as indicated in dotted lines in FIG. 3. However, the forward motion of the double-index pusher bracket assembly **194** must be completed before an empty tray is crossed indexed. An opening **195** is provided to allow the empty tray to be positioned in front of the double-index pusher bracket assembly **194** for eventual indexing two spaces to the rear.

It will be remembered that, in the cigarette tray-feeding machine of the instant invention, a complete tray-advance

cycle comprises a series of discrete steps. Each of such steps must be performed in a predetermined order, and each such steps must evidence satisfactory completion thereof before the next succeeding step may be initiated. To ensure that each step is, in its turn, completed a plurality of electrical switches, known as limit switches, are employed. Each step in the operation of the machine, as it is satisfactorily completed, will operate that particular limit switch which is operatively associated therewith. Each of these switches is uniquely identified on the drawings by a designation consisting of a numeral prefixed by the letters "LS."

Slat pulling motion

Referring now to FIGS. 1 and 13, let it now be assumed that the "advance" motion of the piston of cylinder **21** has culminated in advancing the full tray T_1, in the afore-said co-planar path to the delivery station over the hopper H. This condition is also illustrated in FIG. 9. When tray T, has been properly positioned over the hopper H it will contact arm **46**, FIG. 6, which is pivoted on pin **47**. Secured to and depending from pin **47** is another arm **48**, which, when arm **46** is moved by contact with moving tray T_1, causes arm **48** to move in a clockwise direction and to actuate the limit switch LS8, thereby closing its normally open contacts. The closure of the contacts of LS8 applies power through the C5 contacts of relay R1 (FIG. 15) and the "retract" coil CV2*a* of electro-pneumatic valve CV2, causing it to operate, and thereby admit compressed air to the "retract" side of pneumatic cylinder **42**, which is fixedly supported by bracket **85** (FIG. 2). The retraction of the piston of cylinder **42** will cause its piston rod **86** to move leftwardly. Referring now to FIGS. 1 and 2 the piston rod **86**, at its right-hand end, is secured to the bottom shifter **87** which, at its left-hand end, is affixed to the slat puller bracket **25** (FIG. 4). The bracket **25** is slidably supported by slat-puller guide bar **26**. The slat puller **23** is pivotally supported on slat puller bracket **25** by the slat pullerpin **24**. The slat puller carries, at its top, a slat-puller-holddown consisting of a vertical member **92** having a short pin **93** projecting horizontally forward therefrom. The function of the slat puller mechanism, as previously explained, is to engage its holddown with the notch in the left-hand end of the slat, and to pull out the slat from the bottom of the full tray, e.g., T_1, after it has been positioned over the hopper H, so that the tray may empty its contents into the hopper (see FIG. 9), without deviating from its co-planar level.

Referring again to FIGS. 1 and 13, let it now be assumed that the "retract" motion of the piston of cylinder **42** has started to move the slat-puller mechanism to the left. As the tray is moved forward towards its position over the hopper, the slat will contact a wedge shaped mover **63**, which positions the notch in the forward edge of the slat in line to contact the slat puller vertical pin **92**. After limit switch LS8 has been actuated, the "retract" motion of the piston of cylinder **43** moves the slat-puller mechanism to the left thus withdrawing the slat from the tray. As the slat puller mechanism moves to the left slat puller bracket **25** contacts limit switch LS10 but no contact is made at this time due to the override feature of the switch. However, the pulse switch cam **88** secured to the bottom shifter **87** contacts limit switch LS9 and momentarily actuates it, thereby momentarily closing its normally open contacts. The closure of the contacts of LS9 applied power through the C4 contacts of relay R1 (FIG. 15) and the "advance" coil CV3*b* of the electro-pneumatic valve CV3, causing it to operate to admit compressed air to the "advance" side of the pneumatic cylinder **43**.

Slat transfer-forward motion

Referring now to FIGS. 1 and 3, the cylinder **43** is fixedly supported by brackets **95** and **96**, respectively, secured to fixed cross bars **97** and **98**. The piston rod **101** of cylinder **43** is secured to the movable slat-pusher cross bar **102**. The bar **102** is secured to and is movably supported by the pusher rods **103** and **104** which are slidably supported in having blocks secured to the cross bars **98** and **97**. Projecting forwardly from the slat-pusher cross bar **102**, and secured to the ends thereof by slat-pusher brackets **105** and **106**, are the slat-pusher bars **107** and **108**, respectively. The slat pusher bars **107** and **108** carry at their respective forward ends the yieldably supported pusher fingers **28** and **27**. The fingers **28** and **27** are respectively pivoted on pins **118** and **117**, and are upwardly tensioned by springs **119** and **120**, respectively.

Still referring to FIGS. 1 and 3, and remembering that the satisfactory completion of the slat pulling motion has culminated in the energization of the "advance" side of pneumatic cylinder **43**, the piston rod **101** moves forwardly (in the direction of the arrow **113**), thereby also moving the cross bar **102**, the slat pusher bars **107** and **108**, and the pusher fingers **28** and **27** forwardly. The forward movement of the slat pusher bars moves fingers **27** and **28** from the influence of the finger holddown bars **54** and **55**. The tension springs **119** and **120** force the fingers up and place them in position to engage the slat which was just withdrawn from a full tray. As the slat is pushed forward it contacts the slat shifter spring **49**, which properly locates slat so that it may be threaded into empty tray, before empty tray reaches cammed portion of elevator bracket **135**.

Reset of slat transfer mechanism

Referring to FIGS. 1 and 13, as the slat transfer mechanism satisfactorily completes its forward motion, the micro-switch actuator **115** carried by rod **104**, having passed limit switch LS12 without action, due to its override provision, actuates the limit switch LS11, thereby closing its normally open contacts. The closure of the contents of LS11 applies power through the C3 contacts of relay R1 (FIG. 15) and the "retract" coil CV3*a* of electro-pneumatic valve CV3, causing it to operate to admit compressed air to the "retract" side of pneumatic cylinder **43**. As the piston of cylinder **43** is retracted (in the direction of arrow **114**), it carries with it the mechanical element controlled thereby, including the slat pusher fingers **27** and **28**. The slat pusher fingers **27** and **28** are reset under the finger holddown bars **54** and **55**, and thus resume their normal positions; but the slat, e.g., S_1, remains in its forward position, in readiness to be "threaded" into the bottom of a previously-emptied tray, as previously described with reference to FIG. 11.

Reset of slat puller mechanism

Referring now to FIGS. 1, 5, 6 and 15, as the slat transfer mechanism satisfactorily completes its reset motion, the microswitch actuator **115** carried by rod **104** actuates the limit switch LS12, thereby closing its normally open contacts. The closure of the contacts of LS12 establishes two control circuits. The first circuit applies power through the C2 contacts of relay R1 (FIG. 15), the LS12 contacts, the C8 contacts of relay R1, and the "advance" coil CV2*b* of electro-pneumatic valve CV2, causing it to operate, and thereby admit compressed air to the "advance" side of pneumatic cylinder **42**. The advance of the piston of cylinder **42** will cause its connecting rod **86**, the bottom shifter **87**, and the slat-puller mechanism to move rightwardly, thus restoring the slat-puller mechanism to its normal position.

Cross-index empty tray

Referring now to FIGS. 1, 2, 5, 6, 7, 11, 13, and 15, the second circuit established by the closure of the contacts of LS12 applies power through the C2 contacts of relay R1 (FIG. 15), the LS12 contacts, and the "retract" coil CV4*b* of electro-pneumatic valve CV4, causing it to operate, and thereby admit compressed air to the "retract" side of pneumatic cylinder **44**. To facilitate an understanding of the invention, let it be assumed that the tray T_1 (FIG. 1) has been immediately preceded by a tray T_e (not shown in FIG. 1, but shown in FIG. 11) which, after having emptied its contents into the hopper H, had been advanced one position forwardly (as diagrammatically indicated in FIG. 13). The empty tray T_e was thereby placed in longitudinal alignment with the slat S_1, which has been pulled out of tray T_1, and has been advanced one position forwardly, as above described. Cylinder **44** is fixedly supported at its ends by brackets **123** and **124**. Actuable by the piston of cylinder **44** is the piston rod **125** which has secured to it at its right-hand end, the yoke **126**. The yoke **126** carries pin **127** upon which the gear **128** is rotatably supported. The gear **128** meshes with the front (or stationary) rack **29**, and the rear (or moving) rack **30**. The front rack **29** is fixedly supported by the front panel housing; while the rear rack **30** is secured to the plate **130** of the tray cross-indexing mechanism. The tray pusher assembly **131** is secured to plate **130**.

Referring now to FIG. 1, as the piston of cylinder **44** is retracted, the piston rod **125** moves leftward, and it carries with it the yoke **126** and the gear **128** rotatably supported therein. Since the gear **128** is in engagement with the stationary rack **29**, the gear **128**, in moving to the left, rotates in a counter-clockwise direction which, obviously, causes the moving rack **30**, the tray cross-indexing mechanism secured thereto, and the empty tray (e.g., T_e, FIG. 11) to, also, move leftwardly, without deviating from the aforesaid co-planar path; that is to say, the tray is now being "cross-indexed."

"Thread" slat into empty tray

Referring now to FIGS. 1, 2, 6, 7, 11, and 13 (but particularly to FIG. 7), the slat S_1, which is in longitudinal alignment with the approaching empty tray T_e, is held in a raised position by the elevator cross piece **133**. The elevator cross piece is integral with elevator front piece **134** which is pivotally supported by elevator pin **136**, and is urged upwardly by flat spring **137**. As the empty tray T_e continues its "cross-indexing" or leftward motion, the advancing empty tray T_e cams the elevator front piece **134** down, against the tension of flat spring **137**. The downward movement of elevator front piece **134** lowers the elevator cross-piece **133** sufficiently that the right-hand end of slat S_1 is positioned in the same horizontal plane as the slot in the bottom of empty tray T_e. As the tray T_e completes its cross-indexing motion, the slat S_1 is "threaded" into the bottom thereof, thereby conditioning the tray T_e for re-use.

Reset of cross-indexing mechanism

Referring now to FIGS. 1 and 15, as the cross-indexing mechanism satisfactorily completes its leftward motion it actuates the limit switch LS13, thereby closing its normally open contacts. The closure of the contacts of LS13 closes a first circuit and prepares a second circuit. The first circuit applies power through the C1 contacts of relay R1 (FIG. 15), and the "advance" coil CV4*a* of electro-pneumatic valve CV4, causing it to operate, and thereby admit compressed air to the "advance" side of pneumatic cylinder **44**. The advance of the piston of cylinder **44** will cause its connecting rod **125**, the yoke **126**, and the gear **128** pivoted therein, to move rightwardly. The gear **128**, in moving to the right, rotates in a clockwise direction which, obviously, causes the moving rack **30**, and the tray cross-indexing mechanism secured thereto to, also, move to the right, thereby causing the tray cross-indexing mechanism to be reset.

Reset of tray advance mechanism

Referring to FIGS. 1, 2, and 15, as the tray cross-indexing mechanism satisfactorily completes its reset motion, a cam surface on movable rack **30** actuates the limit switch LS14, thereby closing its normally open contacts. Limit switch LS13 remained operated after the leftward motion of the cross-indexing mechanism had been completed and the cross-indexing mechanism was reset. At the same time that the slat-puller mechanism was reset it actuated the limit switch LS10, thereby closing its normally closed contacts which remained closed but did not complete any circuit at that time. Therefore, when LS14 is operated it applies power through the series-connected contact C1 of relay R1 (FIG. 15), the contacts of LS13, the C7 contacts of relay R1, the contacts of LS14, and LS10, and the "retract" coil CV1*a* of electro-pneumatic valve CV1, causing it to operate, and thereby admit compressed air to the "retract" side of the previously-described pneumatic cylinder **21**, to move its piston backward.

Referring to FIGS. 1 and 2, the "retract" motion (rightward as viewed in FIG. 2) of piston rod **58** causes the lever **60**, the lever shaft **62**, and the levers **67** and **68** secured thereto to be displaced angularly in a counter-clockwise direction. The counter-clockwise motion of lovers **67** and **68** causes the tray-pusher rods **71** and **72**, the tray-pusher cross-bar **79**, the brackets **80** and **81**, the tray-pusher bars, e.g., **19**, and the tray-pusher pawls **5**, etc., to be moved rearwardly, as indicated by the arrow **140**. However, the rearward motion of the pawls **5**, etc., does not effect any motion of the trays, but merely resets the pawls to their respective normal positions.

Double-indexing mechanism—Advance

Referring now to FIGS. 1, 2, 3, 4, 12 and 13, let it be remembered that the powering of pneumatic cylinder **21** resulted in the counter-lockwise rotation of lever shaft **62** (FIG. 2). The counter-clockwise rotation of shaft **62** and of levers **143** and **144** secured thereto, by means of the previously-described linkage, cause the tray-pusher bars **157** and **158** (FIG. 3, **157** not shown) to move rearwardly, carrying the pivotally-mounted tray pawls **36**, etc., with them. Each pair of oppositely disposed pawls will engage with an empty tray, and will move it one space rearwardly, without deviating from the aforesaid co-planar path. At the same time, the counterclockwise rotation of shaft **62** rotates lever **143** affixed thereto, also, to rotate counter-clockwise. The counter-clockwise rotation of lever **143** actuates the previously described linkage, thereby causing double-index lever **175** to rotate in a clock-wise direction, and causing shaft **177** and the corresponding double-indexing lever at the left-hand end of shaft **177** to rotate with it. The clockwise rotation of the two double-indexing levers, by means of the previously-described linkages, cause the double-index shafts **185** and **191**, together with the double-index bracket assembly **194** carried thereby, to be moved two spaces rearwardly. The double-index-bracket assembly, prior to this, had engaged with the tray which had been cross-indexed. Thus the empty tray, after cross-indexing, is moved two spaced toward the rear of the machine, without deviating from the aforesaid co-planar path. This completes one tray-advance cycle.

Referring to FIGS. 1 through 6, the lever **196** (FIGS. 2 and 5), also, is fixedly secured to lever-shaft **62**. The lever **196**, at its lower end, terminates in the hand grip **197** (FIGS. 2 and 4). The hand lever provides a means whereby the operator, when the power supply is disconnected from the machine, may, by moving the hand grip **197** leftwardly, cause the lever shaft **62** to rotate in a clockwise direction. The clockwise rotation of shaft **62**

causes the full tray advancing mechanism, and the empty tray advancing mechanism, to be moved forwardly, in the manner previously described.

Conversely, when the hand grip **197** is moved rightwardly, the lever shaft **62** is caused to rotate in a counter clockwise direction. The counter clockwise rotation of shaft **62** will then cause the full tray advancing mechanism, the empty tray single index advancing mechanism and the empty tray double index advancing system, to be moved rearwardly, in the manner previously described Thus it will be seen, that the to and fro movement of the lever **195** is simulative of the advance and retract motions, respectively, of cylinder **21**.

Single-step control by push buttons

Referring now to FIG. 15, the power switch PS, shown in its normal or "off" position, will be closed by the operator when it is desired to start the machine. The switch "AIR" will be closed by the operator to energize the air supply SAV. If it is desired that the machine be operated on its regular or automatic basis the two-position switch S6 will be set at its "auto" position, thereby operating relay R1, and preparing the machine for automatic operation. At this time the light source **50** will be energized to furnish illumination for exciting photoelectric cell **52**. From this point forward the machine will operate, performing its several sequential steps in the manner hereinbefore described. At this time it is assumed that the three-position push button switches S1, S2, S3, and S4, are in their normal or neutral positions.

Now let it be assumed that, for some reason, possibly for maintenance or adjustment purposes, the operator desires to selectively energize some single operational step, to the exclusion of other steps. Under this condition the operator would operate switch S6 to its "MAN" position, thereby preventing the machine from being operated on an automatic basis. Under this position, if switch S1 were set to its upward or "INDEX FWD" position, power would be connected through the advance coil CV1*b* of pneumatic valve CV1, causing cylinder **21** to be energized in the "advance" direction. Similarly, if switch S1 were set to its lower or "INDEX BACK" position, power would be connected to retract CV1*a* coil of pneumatic valve CV1, causing the cylinder **21** to be energized in its "retract" direction. In like manner switch S2 controls, in its upward position, the "retract" motion of cylinder **42**, and in its lower position controls the "advance" motion of cylinder **42**. Similarly, in like manner, the upper and lower positions of switch S3, respectively, control the "retract" and "advance" motions of cylinder **43**. And again, in like manner, switch S4 in its upper and lower positions, respectively, controls the "advance" and "retract" motions of cylinder **44**. Thus it will be seen that, by means of the above described circuitry, the operator is afforded at will, complete selective control of the "advance" or "retract" motions of each of the pneumatic cylinders **21**, **42**, **43**, and **44**.

Reference is hereby made to U.S. Patent 2,799,413 granted to S. Innocenti on July 16, 1957, and which, to the best of applicant's knowledge, is the closest prior art.

We claim:

1. In an automatic tray-feeding device for cigarette-packaging machines provided with a vertical feed hopper and to which the cigarettes are fed from trays having slidably removable bottom slats; a substantially U-shaped conveyor situated in a substantially horizontal plane above said hopper for movably supporting said trays in a common horizontal plane; said conveyor having an entrance point for full trays, a delivery station over said hopper, and an exit point for empty trays, all co-planar with respect to each other; means comprising a first set of tray pawls carried by a first pair of pusher bars oscillatable in a forward and backward motion for advancing said full trays one step at a time to said delivery station, means for oscillating said bars, and for advancing a preceding and previously emptied tray one step forward of said delivery station, means for resetting said first part of pusher bars to their normal position, wherein all of said trays traverse a co-planar path; means comprising a slat-puller oscillatable in a left and right motion for pulling out the bottom slat from a full tray positioned over said delivery station to cause said full tray to discharge its contents into said hopper and means for resetting said slot puller to its normal position without causing said full tray to deviate from said co-planar path; means comprising slat-pusher fingers for transferring said pulled-out slat forwardly one position in advance of its pulled-out position, and means for resetting said slat-pusher fingers rearwardly to their normal positions; means comprising empty-tray cross-indexing pusher means for leftwardly moving the said preceding and previously emptied tray from its position one step forward of said hopper and for subsequently rightwardly moving said pusher means to reset it to its normal position without causing said cross-indexed tray to deviate from said co-planar path; means comprising tray-actuated slat elevator means for litfing the right-hand end of the said forwardly transferred slat to cause it to be threaded into the bottom of said cross-indexed tray during its said lateral movement; means comprising an empty-tray double-indexing assembly carried by a pair of double-indexing shafts oscillatable in a forward and backward direction for pushing a preceding and previously emptied tray two steps rearwardly toward said exit point, means for oscillating said shafts, and wherein said tray continues to traverse said co-planar path, and means for resetting said double-indexing shafts to their normal positions; and means comprising a second set of tray pawls carried by a second pair of pusher bars oscillatable in a forward and backward motion for pushing empty trays rearwardly one step at a time toward said exit position and wherein said empty trays do not deviate from said co-planar path.

2. An automatic tray-feeding device according to claim **1**, in which the means for oscillating said first pair of pusher bars comprises a first pneumatic cylinder having a reciprocable piston therein; and in which the means for oscillating said slat-puller comprises a second pneumatic cylinder having a reciprocable piston therein; and in which the means for transferring said pulled ou slat forwardly and for retracting said slat-pusher comprises a third pneumatic cylinder having a reciprocable piston therein; and in which the means for leftwardly moving and for subsequently resetting said empty-tray cross-indexing pusher comprises a fourth pneumatic cylinder having a reciprocable piston therein; and in which the means for oscillating said empty-trays double-indexing shafts comprising the aforesaid first pneumatic cylinder; and in which the means for oscillating said second pair of tray pushers also comprises the aforesaid first pneumatic cylinder.

3. An automatic tray feeding device according to claim **2**, in which the means for oscillating said first pair of pusher bars comprises a lever shaft carrying a first pair of bell cranks linked by connecting rods to said first pair of pusher bars; and in which the means for oscillating said empty-tray double-indexing shafts comprises the aforesaid lever shaft and a third bell crank carried thereby and linked by connecting rods and by motion multiplying levers to said double-indexing shafts; and in which the means for oscillating said second pair of pusher bars comprises the aforesaid lever shaft and a second pair of bell cranks carried thereby and linked by connecting rods to said second pair of pusher rods; and in which said lever shaft is rotated in a first direction by a first motion of said reciprocable piston of said first pneumatic cylinder to cause said first and said second pairs of pusher bars and said empty-tray double-indexing assembly to be moved forwardly; and in which said lever shaft is rotated in a second direction by a second and reverse motion of said reciprocable piston of said first pneumatic cylinder to cause said first and said second pairs of pusher bars and

said empty-tray double-indexing assembly to be moved rearwardly.

4. In an automatic tray-feeding device according to claim 1, a photo-electric cigarette-level monitoring device situated within and near the top of said vertical feed hopper and energizable incident to a low level of cigarettes in said hopper; a first electro-pneumatic valve actuated incident to the energization of said monitor; a first pneumatic cylinder having a reciprocable piston therein and actuable by said first electro-pneumatic valve for energizing said first cylinder to cause its piston to move in a first direction to initiate an operating cycle of the machine; and means linking said piston of said first cylinder with said first and said second set of tray pusher bars and with said empty-tray double-indexing assembly for controlling the forward and backward movements thereof.

5. An automatic cigarette packaging machine having in combination, a cigarette feeding hopper equipped with a photo-electric cigarette-level monitor, a uniplanar conveyor structure situated above said feeding hopper, a plurality of removable-bottom-slat cigarette trays movably supported by said conveyor; said conveyor having an entrance point for full trays, a delivery station located above said hopper, and an exit point for empty trays, all in co-planar relationship; an electro-pneumatically driven tray-feeding, tray slat-removing, and tray slat-replacing mechanism whose operating cycle is initiated by said cigarette-level monitor: for moving a full tray from said entrance point to said delivery station, for removing the slat from said tray at said delivery station, for replacing a bottom slat into a tray, for moving said tray with a replaced slat two positions, and then moving said tray one position at a time toward said exit point, and for at all times maintaining said trays in an upright position and in co-planar relationship, and for performing a check operation to ensure that each successive step in the operating cycle has been completed before starting the next succeeding step.

6. An automatic cigarette packaging machine comprising in combination: a cigarette feeding hopper, a photo-electric cigarette-level monitor at the top of said hopper, a first electro-pneumatic valve actuated by said monitor, a first pneumatic cylinder; a U-shaped uniplanar cigarette tray conveyor having a full try entrance point, a cigarette delivery station situated above said hopper, a cross-indexing section, and an empty tray exit point, all in co-planar relationship; and plurality of removable-bottom slat cigarette trays movably supported by said conveyor, a tray-feeding mechanism advanced by said first pneumatic cylinder under control of said first valve and actuated by said monitor incident to a low level of cigarettes in said hopper to move all full trays one position forward and to position a full tray in said delivery station above said hopper, a second electro-pneumatic valve actuated incident to the positioning of a full tray in said delivery position, a second pneumatic cylinder, a slat-pulling mechanism retracted by said second pneumatic cylinder under control of said second valve for removing the slat from the bottom of the full tray in said delivery station to permit said full tray to empty its contents into said hopper, a third electro-pneumatic valve actuated incident to the retraction of a slat, a third pneumatic cylinder, a slat-transfer mechanism advanced by said third cylinder under control of said third valve for transferring said retracted slat one position forward, a fourth electro-pneumatic valve actuated incident to the transferring of said retracted slat, a slat-transfer-reset mechanism retracted by said third pneumatic cylinder under control of said fourth valve for resetting said slat-transfer mechanism, a fifth electro-pneumatic valve actuated incident to the resetting of said slat-transfer mechanism, a slat-pull-reset mechanism advanced by said second pneumatic cylinder under control of said fifth valve for resetting said slat-pulling mechanism, a fourth pneumatic cylinder, a tray cross-indexing mechanism retracted by said fourth pneumatic cylinder also under control of said fifth valve for laterally moving an empty tray from its forward position and longitudinally threading it with a forwardly advanced slat, a sixth electro-pneumatic valve actuated incident to completion of cross-indexing, a cross-index-reset mechanism advanced by said fourth pneumatic cylinder under control of said sixth valve for resetting said cross-indexing mechanism, a seventh electro-pneumatic valve actuated incident to the resetting of said slat-pulling mechanism, an eighth electro-pneumatic valve actuated incident to the resetting of said cross-indexing mechanism, an empty-tray rearwardly pushing mechanism retracted by said first pneumatic cylinder under the concurrent control of said sixth, seventh and eighth valves when all preceding functions have been completed for pushing previously-emptied trays one step rearwardly and for pushing the last cross-indexed empty tray two positions rearwardly, thereby readying the machine for another tray feeding cycle, and at the same time maintaining all of said trays in an upright position and in co-planar relationship.

7. An automatic cigarette packaging machine having in combination a cigarette feeding hopper, a photo-electrically controlled cigarette-level-indicating monitor at the top of said hopper; a uniplanar cigarette-tray-feeding conveyor situated above said hopper and having in co-planar relationship an entrance point, a delivery station, and an exit point, a plurality of removable-bottom-slat cigarette trays movably supported in co-planar relationship by said conveyor; tray manipulating mechanism comprising automatic means for sequentially performing the steps of an operating cycle comprising moving full trays from said entrance point, halting a full tray and removing the bottom slat thereof at said delivery station to empty said tray, replacing the bottom slat of an emptied tray, and for moving the bottom-replaced emptied trays toward said exit point while maintaining all of said trays in an upright position and in co-planar relationship; and automatic operation sequence-control means whereby the first step of said operating cycle is initiated under control of said cigarette-level-indicating monitor only when the cigarette level drops below a predetermined point, and whereby each of the succeeding steps may be performed only when the immediately preceding step has been satisfactorily completed, and whereby a new operating cycle may be initiated only when all of the steps of the immediately preceding operating cycle have been satisfactorily completed.

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