June 22, 1965 L. POVLACS 3,190,055

PACKAGING MACHINE

Filed March 30, 1962 3 Sheets-Sheet 1

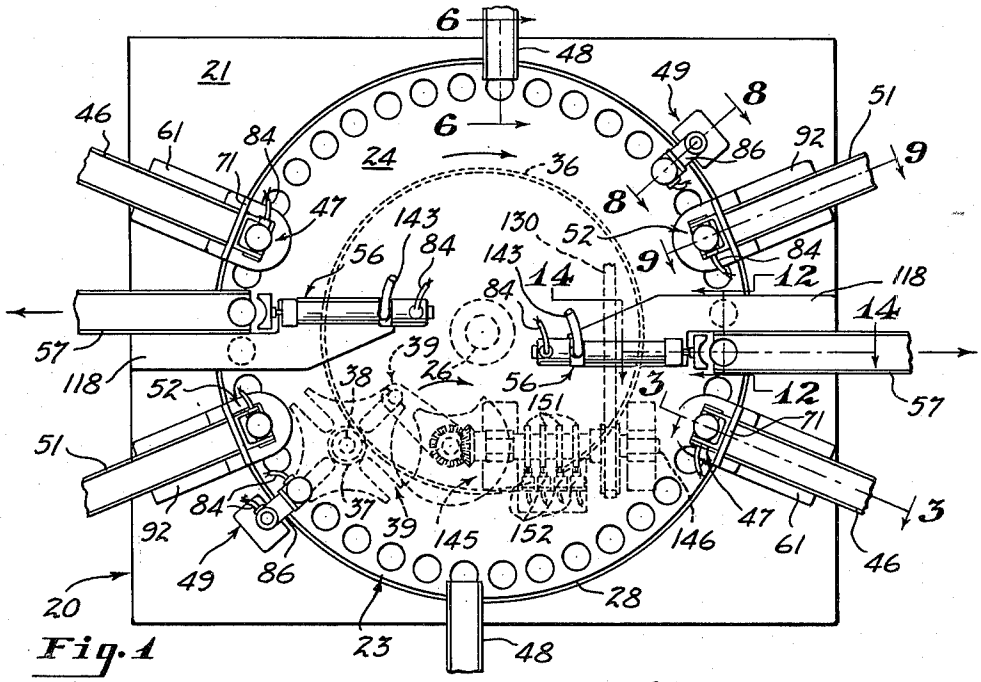


Fig. 1

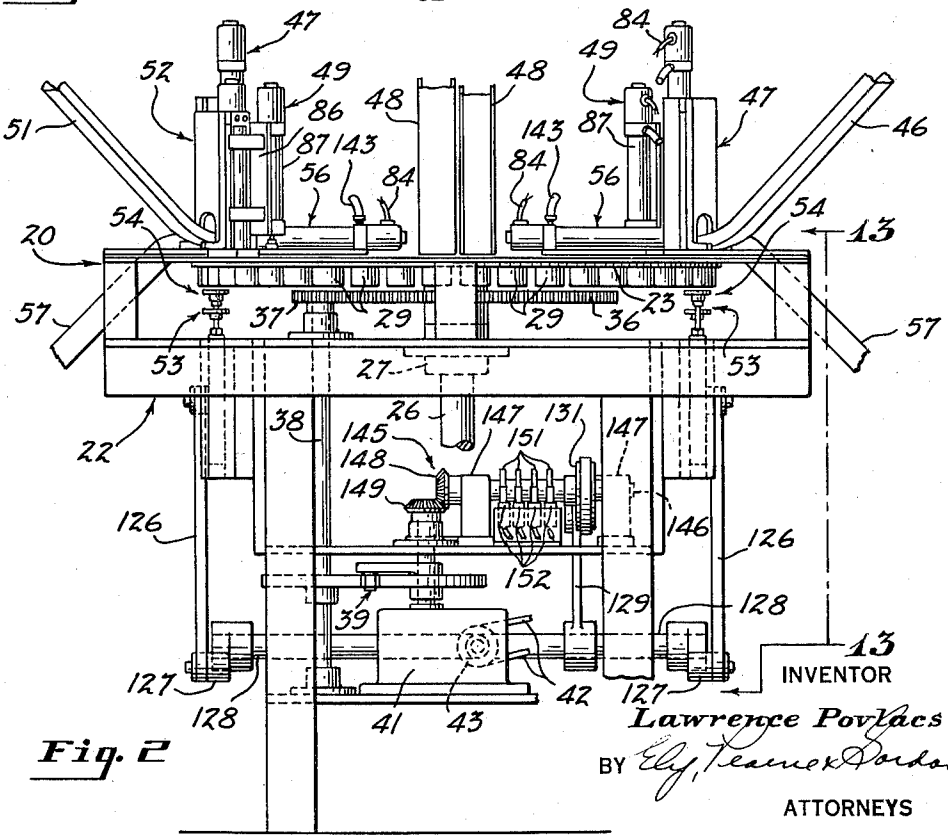


Fig. 2

INVENTOR
Lawrence Povlacs
BY Ely, Pearne & Gordon
ATTORNEYS

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PACKAGING MACHINE

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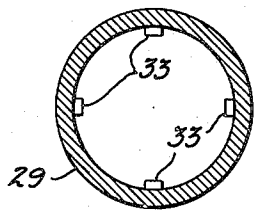


Fig. 7

Fig. 3

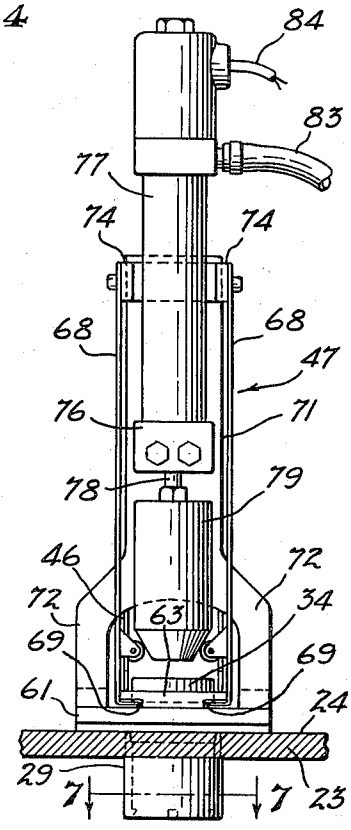


Fig. 4

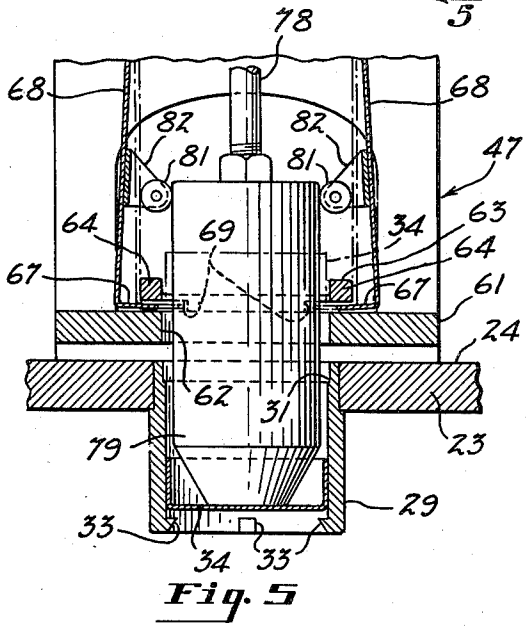


Fig. 5

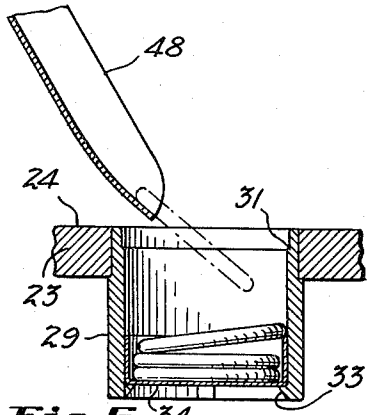


Fig. 6

INVENTOR

Lawrence Poylacs

BY Ely, Pearne & Gordon

ATTORNEYS

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PACKAGING MACHINE

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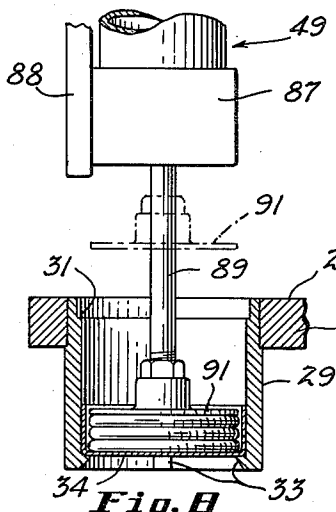


Fig. 8

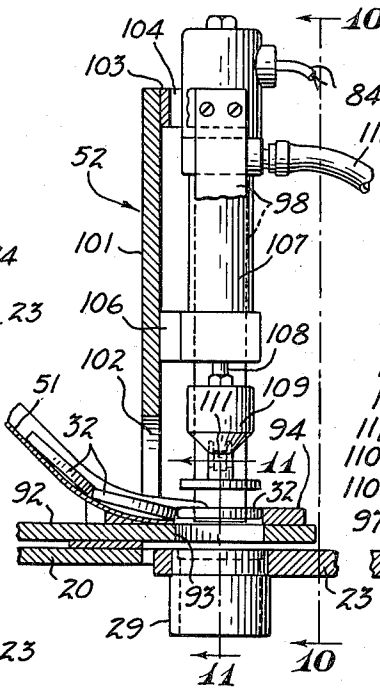


Fig. 9

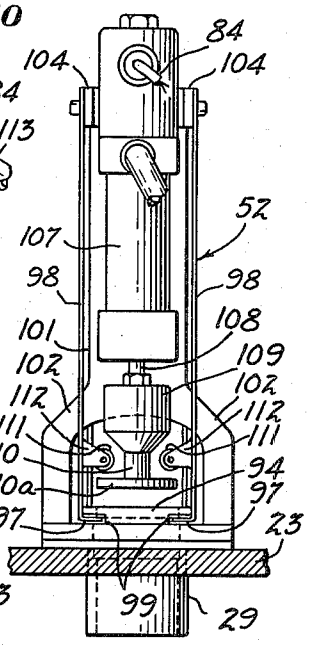


Fig. 10

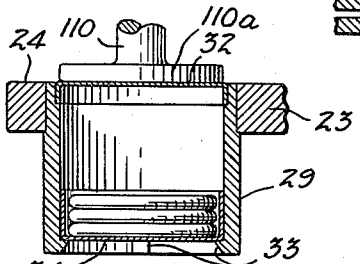


Fig. 11

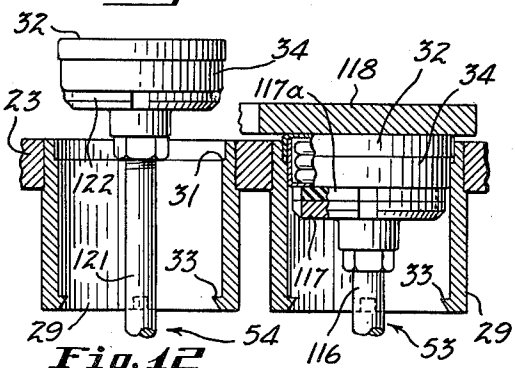


Fig. 12

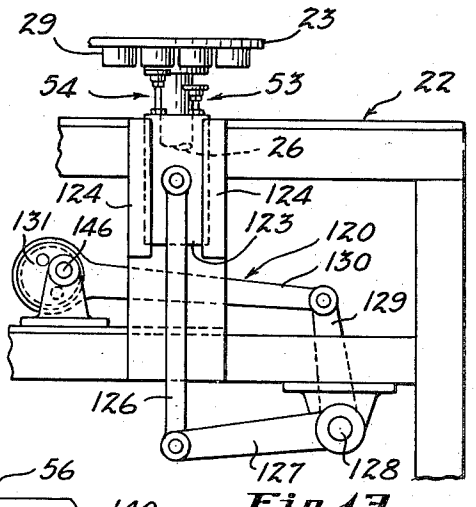


Fig. 13

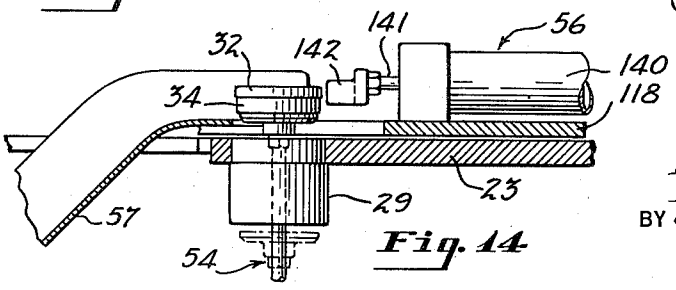


Fig. 14

INVENTOR

Lawrence Povlacs

BY Ely, Pearne & Gordon

ATTORNEYS

United States Patent Office 3,190,055 Patented June 22, 1965

3,190,055

PACKAGING MACHINE

Lawrence Povlacs, Springfield Township, Summit County, Ohio, assignor to The Akwell Corporation, Akron, Ohio, a corporation of Delaware

Filed Mar. 30, 1962, Ser. No. 183,798
6 Claims. (Cl. 53—282)

This invention relates to machines for filling and closing boxes and, more particularly, to a machine for filling and closing boxes comprising box bottoms and box lids that telescopingly receive the box bottoms for closing the same after they are filled. Although the invention is illustrated and described in detail with reference to boxes that are made of thin, rigid, sheet metal or plastic and that are cylindrical in plan and of relatively shallow dimensions, it will be readily appreciated that the invention is applicable to a wide variety of boxes as regards the material of which they are constructed and the configuration and proportions of the boxes.

The machines of the invention are adapted to be fed with box bottoms, box contents, and box lids, either by hand or by associated automatic feeding machines forming no part of the present invention. However, the invention has been developed with a view toward completely automatic feeding of box bottoms, contents, and lids.

The machines of the invention are adapted for use in packaging almost any kind of box contents. However, in this respect, the invention has been developed primarily for the packing of solid articles and more particularly for the packaging of various types of rubber latex prophylactic devices and the like, which must be handled with care to prevent damaging them by pinching them between the box bottoms and box lids during the box closing operation.

The principal object of the invention is to provide fast acting and reliable, automatic machines for sequentially receiving box bottoms and box lids of the general character described, positioning the boxes for filling with the article, articles, or material to be packaged, closing the filled boxes, and ejecting the filled boxes.

More specific objects of the invention are to accomplish the foregoing principal objective without any possibility of damaging the contents of the boxes during the closing operation, and to provide machines for these purposes that are simple in basic design and compact in size.

The foregoing objects of the invention are achieved by performing the filling and closing of boxes largely within the confines of a series of pockets extending along the path of travel of a conveyor. The pockets are advanced from one station to another by the conveyor and the several operations of positioning a box bottom, filling the box bottom, positioning a box lid, closing the filled box bottom in telescoping relationship with the lid, and discharging the filled and closed box are performed sequentially at successive stations along the path of the conveyor. Ideally, as illustrated and described hereinafter by way of example, the conveyor is one of the rotating turret type with the pockets disposed in a closed circular path about the axis of the turret, the several operating stations being disposed about the periphery of the turret. The foregoing and other features of the invention are described in detail hereinafter with reference to the accompanying drawings illustrating a presently preferred form of the invention.

In the drawings—

FIGURE 1 is a plan view of a box filling and closing machine embodying the invention;

FIG. 2 is a side elevational view of the machine of FIG. 1;

FIG. 3 is an enlarged elevational view of a portion of the machine of FIG. 1 at a first operating station, shown partly in section as indicated by the line 3—3 in FIG. 1;

FIG. 4 is another enlarged elevational view of the mechanism of FIG. 3, shown partly in section as indicated by the line 4—4 in FIG. 3;

FIG. 5 is a further enlarged, fragmentary, elevational view of the mechanism of FIG. 3, shown partly in section as indicated by the line 5—5 in FIG. 3, but with the plunger of FIG. 3 moved to its lowered position to show its function of pushing a box bottom into a position to be filled in one of the pockets of the conveyor;

FIG. 6 is an enlarged, vertical sectional view of another portion of the machine of FIG. 1 at a second operating station, the plane of the section being indicated by the line 6—6 in FIG. 1;

FIG. 7 is a similarly enlarged, horizontal sectional view of the pocket structure shown in FIGS. 3–6, the plane of the section being indicated by the line 7—7 in FIG. 4;

FIG. 8 is an enlarged, elevational view of another portion of the machine of FIG. 1 at a third operating station, shown partly in section as indicated by the line 8—8 in FIG. 1;

FIG. 9 is an enlarged, elevational view of still another portion of the machine of FIG. 1 at a fourth operating station, shown partly broken away and partly in section as indicated by the line 9—9 in FIG. 1;

FIG. 10 is another enlarged, elevational view of the mechanism of FIG. 9, shown partly in section as indicated by the line 10—10 in FIG. 9;

FIG. 11 is a further enlarged, fragmentary, elevational view of the mechanism of FIG. 9, shown partly in section as indicated by the line 11—11 in FIG. 9, but with the plunger of FIG. 9 moved to its lowered position to show its function of pushing a box lid into position in one of the pockets of the conveyor for engagement by a filled box bottom therein;

FIG. 12 is an enlarged elevational view of still another portion of the machine of FIG. 1 at fifth and sixth operating stations, shown partly in section as indicated by the line 12—12 in FIG. 1 with a pair of plungers shown in raised positions to illustrate their respective functions at the two stations;

FIG. 13 is an elevational view of the mechanisms at the fifth and sixth operating stations of FIG. 12, including a common operator for the two plungers at those stations, with the plungers in their lowered positions, this view being on the same scale as FIG. 2 and taken as indicated by the line 13—13 in FIG. 2; and

FIG. 14 is an enlarged, fragmentary, elevational view of still another portion of the machine of FIG. 1 at the sixth operating station, shown partly in section as indicated by the line 14—14 in FIG. 1.

Rotary table and drive

Referring first to FIGS. 1 and 2, the machine shown therein comprises a stationary table 20 of generally rectangular configuration having a flat top surface 21. The table 20 may be supported by any desired frame structure, such as shown and generally designated 22, that will also provide for the support of various other parts of the machine disposed below the table 20. A circular, center portion of the table 20 is cut out to receive a conveyor in the form of an annular, rotary table or turret 23 having a flat top surface 24 that is flush with the top surface 21 of the table 20. The annular, rotary table 23 is mounted for rotation about its axis on a vertically disposed shaft 26 that is suitably journaled in the frame structure 22. An upper bearing 27 for the shaft 26 is shown in FIG. 2, but an extension of the shaft therebelow to a second bearing (not shown) is broken away for clarity of illustration of other mechanisms. The lower bearing (not shown) for the shaft 26 may be mounted on the frame structure 22 at a convenient elevation in any desired manner to support

the shaft 26 rigidly for resisting any lateral loads imposed thereon.

The rotary table 23 may suitably consist of an annular plate 28 having a multiplicity of round holes cut therethrough and uniformly spaced about its circumference and a short distance inwardly from its periphery. In each of these holes, a relatively short pocket or cylinder 29 is rigidly mounted as shown in FIGS. 2–6, details of the cylinder being shown in FIG. 7.

Referring to the cylinders 29 in more detail, each has a maximum internal diameter for a distance downwardly from the upper end thereof to a circumferential shoulder 31, the distance from the top of the cylinder to the shoulder 31 preferably being equal to the vertical height of a circular box lid 32 to be received in the upper end of the cylinder. The maximum diameter of the cylinders 29 is selected to receive the box lid 32 with a close, sliding fit, and the width of the shoulder is substantially equal to the thickness of the material of the box lid so that the internal surface of the cylinder below the shoulder will be flush with the internal surface of the box lid when inserted into the cylinder as shown in FIG. 11. Below the shoulder 31, the cylinder 29 has a uniformly cylindrical interior contour except for interruption by a plurality (four in this instance) of inwardly directed lugs 33 equally spaced about the internal wall of the cylinder (FIG. 7). The lugs 33 serve as stops for engaging the bottom surface of a circular box bottom 34 received in the cylinder with a close, sliding fit, as shown in FIG. 6. Preferably, the lugs 33 extend radially inwardly for a distance only slightly exceeding the wall thickness of the box bottom 34 so as to leave ample room for an upwardly moving plunger to enter the cylinder 29 from the bottom thereof and engage most of the bottom surface of the box bottom for pushing it upwardly as shown in FIG. 12 and described hereinafter.

The rotary table 23 is revolved about the axis of its supporting shaft 26, to which it is drivingly secured, with an intermittent, stepwise movement for advancing the pockets 29 along a horizontal, circular path, each increment of movement being equal to the center-to-center spacing of the pockets. This rotary movement of the table 23 and supporting shaft 26 is imparted by a large gear 36 fixed to the shaft 26 and driven by a pinion 37 on a drive shaft 38. Intermittent rotary movement of the drive shaft 38 is imparted by a conventional Geneva drive, generally designated 39. The Geneva drive is in turn driven at a constant speed by connection through a speed-reducing gear box 41 to a driving belt 42 acting between a driving pulley 43 for the gear box and a motor (not shown). The motor may be mounted in any suitable location on the table frame structure 22 or elsewhere in fixed relationship with the table frame structure.

Associated mechanisms

Disposed about the rotary table 23 in positions for coaction therewith are a number of associated mechanisms that are built into the filling and closing machine or are separately mounted for cooperation therewith. These include a separate machine (partly shown) and an associated mechanism at a first station for feeding box bottoms 34, one after another, into the pockets 29 as they arrive at the first station; a separate machine (partly shown) at a second station for feeding articles or material into each box bottom in each pocket as the pockets arrive at the second station; an optional mechanism (depending upon the character of articles or material to be packaged) located at a third station for compacting the contents of each box bottom as its pocket arrives at that station; a separate machine (partly shown) and an associated mechanism at a fourth station for feeding box lids into each pocket arriving at that station; a mechanism at a fifth station for moving a box bottom and its contents upwardly into box closing relationship with a box lid in each pocket arriving at that station; and two mechanisms at a sixth and final station for respectively lifting a closed box and its contents upwardly out of each pocket arriving at the final station and ejecting the filled and closed box laterally off of the rotary table 23 and stationary table 20 for discharge from the filling and closing machine. In order to obtain maximum production from a machine of the character herein described, two complete sets of the aforesaid separate machines and associated mechanisms may be disposed about the rotary table 23 at two sets of six stations, each set of six stations being distributed about a 180 degree sector of the rotary table.

Referring to FIG. 1, both sets of separate machines and associated mechanisms, distributed about the rotary table as described above, are shown in whole or in part. Thus, a pair of oppositely disposed chutes 46 lead to the rotary table 23 from any desired type of machine (not otherwise shown) for feeding box bottoms one after another down the chutes to mechanisms 47 for inserting a box bottom into each pocket 29 arriving therebelow, as indicated in FIGS. 3–5. Suitable, automatic machines for this purpose, which sort, orient, and feed box bottoms from bulk in a hopper into a chute, such as the chutes 46, are known and available on the market.

A pair of substantially oppositely disposed chutes 48 lead to the rotary table 23 from any suitable machines (not otherwise shown) for feeding articles or material to be packaged down the chutes 48 and into each box bottom 34 in each pocket 29 arriving below the discharge ends of these chutes.

A pair of oppositely disposed mechanisms 49 are mounted on the stationary table 20 adjacent the periphery of the rotary table 23 for compacting the contents of each box in each pocket arriving at these locations, as illustrated in FIG. 8, in order to insure that an article failing to drop entirely within the confines of a box bottom at the preceding station, as indicated in FIG. 6, will be moved entirely into the box bottom prior to the box closing operation to be described. This compacting mechanism 49 may also be desirable for compacting loose material into the box bottoms where the material being packaged is capable of compaction after falling freely from one of the feeding chutes 48. In many instances, the compacting mechanisms 49 may be found to be wholly unnecessary and may be omitted.

A pair of oppositely disposed chutes 51 lead to the rotary table 23 from any desired type of machine (not otherwise shown) for feeding box lids one after another down the chutes to mechanisms 52 for inserting a box lid 32 into each pocket 29 arriving therebelow, as indicated in FIGS. 9–11. Suitable automatic machines for this purpose may be closely similar to machines for feeding box bottoms to the chutes 46 and are known and commercially available.

A pair of oppositely disposed mechanisms 53 (FIGS. 2, 12, and 13) are mounted on the frame structure 22 below the path of travel of the pockets 29 for moving each filled box in each pocket arriving thereabove upwardly within the pocket into box closing relationship with the box lid positioned in the pocket at the preceding station, as described in more detail hereinafter.

Another pair of oppositely disposed mechanisms 54 for lifting each filled and closed box upwardly out of each pocket arriving thereabove are mounted on the frame structure 22 below the path of travel of the pockets 29; and another pair of oppositely disposed mechanisms 56 at the same angular positions as the lifting mechanisms 54 (relative to the axis of the rotary table) are positioned above the rotary table 23 for engaging and laterally ejecting each filled box and its contents off of the rotary table, across the adjacent part of the stationary table 20, and down a discharge chute 57, as indicated by arrows. Filled and closed boxes so discharged from the filling and closing machine may be collected from the discharge chutes 57

in any desired manner (not shown) for storage or for packing in larger containers for shipment.

Box bottom handling

Referring to the details of the two mechanisms 47 for inserting box bottoms into pockets 29 therebelow, one such mechanism is shown in detail in FIGS. 3–5. As shown, this mechanism may comprise a supporting base plate 61 mounted on the stationary table 20 and having an aperture 62 therethrough at a location vertically aligned above the path of travel of the pockets 29. The aperture 62 is of sufficient size and of appropriate shape to permit a box bottom 34 to drop freely therethrough into a pocket 29 therebelow.

A U-shaped positioning block 63 is secured to the base plate 61 with legs 64 of the block directed toward and straddling the lower end of the chute 46 to receive therebetween the box bottoms 34 that slide down the chute. The closed end of the slot between the legs 64 and the width of this slot are selected to register with the aperture 62 in the base plate 61. Thus, a box bottom 34 sliding down the chute 46 is stopped by the plate 63 in vertical alignment with the aperture 62 in the base plate 61, for subsequently dropping downwardly through this aperture. Such downward movement of a box bottom is initially prevented by a pair of feet 67 that are directed inwardly toward each other from the lower ends of a pair of vertically extending leaf springs 68. The leaf springs 68 are biased to urge the feet 67 inwardly toward each other to the positions shown in solid outline in FIG. 4 and in phantom outline in FIG. 5, until stopped by abutment of the lower portions of the springs against the sides of the positioning block 63. Undercuts 69 in the sides of the block 63 (FIGS. 3 and 4) permit the spring feet 67 to move inwardly as shown for supporting and preventing downward movement of a box bottom until it is released as described below.

An upright frame member 71, having a yoke structure at its lower end, is rigidly mounted on the base plate 61 with legs 72 of the yoke structure spaced, as shown in FIG. 4, to permit box bottoms to move therebetween while sliding off the lower end of the chute 46. Adjacent the upper end of the frame member 71, a U-shaped bracket 73 is rigidly secured thereto and provides a pair of arms 74 to which the upper ends of the leaf springs 68 are secured (FIGS. 3 and 4). About half way up the vertical height of the frame member 71, a second bracket 76 is secured thereto for supporting a pneumatic cylinder and piston mechanism, including an air cylinder 77, piston rod 78, and piston (not shown) enclosed within the cylinder 77. The lower end of the piston rod 78 may have a plunger head 79 secured thereto for downward movement with the piston rod to push box bottoms downwardly into a pocket 29. The plunger head 79 also serves as a cam for separating the feet 67 on the leaf springs 68 against the resilient biasing force of these springs to release a box bottom for downward movement momentarily prior to being engaged by the plunger head. For this purpose, the lower end of the plunger head 79 is given a frusto-conical shape, as shown, to provide converging cam surfaces for engaging a pair of cam follower rollers 81, which are respectively secured to the inner, opposed faces of the leaf springs 68 by mounting brackets 82.

Controlled, appropriately timed reciprocation of the plunger head 79 and piston rod 78 may be effected pneumatically from a single air supply hose 83 and a spring (not shown) contained within the cylinder 77, whereby the plunger head may be driven downwardly by air pressure supplied through the hose 83 and returned upwardly by the spring. Alternatively, of course a 2-way pneumatic action may be used in a known manner for actuating the cylinder and piston mechanism pneumatically in both directions. Control of the action of the cylinder and piston mechanism in timed relationship with the other movements of the machine and its various components may be effected in a known manner by solenoid controlled valves (not shown), one being mounted in the upper end of the cylinder 77 and controlled by electrical leads 84 for this purpose.

A continuous supply of box bottoms 34 may be maintained in the chute 46 so that one box bottom after another will slide down the chute into position below the plunger head 79, as guided and stopped by the positioning block 63, where it will be initially supported by the feet 67 of the springs 68. This will occur each time the plunger head 79 is raised (FIG. 3).

When stepwise rotation of the rotary table 23 has brought a pocket 29 to rest in the position shown in FIGS. 3 and 4, the cylinder and piston mechanism is actuated to drive its plunger head 79 downwardly, causing it to act upon the cam rollers 81 so as to separate the springs 68 and retract the spring feet 67 apart. The mechanism is proportioned and timed so that the lower end of the plunger head enters the box bottom positioned therebelow and engages or closely approaches the surface of the box bottom momentarily after retraction of the spring feet 67 has freed the box bottom for downward movement. Continued downward movement of the plunger head 79 either closely follows or pushes the box bottom downwardly through the aperture 62 in the base plate 61 and into the pocket 29 to a position preferably spaced slightly above the inwardly directed stop lugs 33 in the pocket (FIG. 5). During this operation of the plunger head 79, the spring feet 67 are maintained in their retracted positions shown in solid outline in FIG. 5 by rolling engagement of the cam follower rollers 81 with the parallel, opposite sides of the plunger head above the frusto-conical lower end thereof.

Immediately upon reaching its lowermost position shown in FIG. 5, the plunger head 79 is retracted upwardly until it has returned to the raised position of rest shown in FIG. 3. This permits another box bottom 34 to slide into position as described above. Until the plunger has closely approached its upper position during its return stroke, one side of the plunger head also serves as a stop for the lowermost box bottom left on the chute 46, preventing it from sliding into position below the plunger until the plunger head has nearly completely returned to its uppermost rest position.

Box bottom filling

Each box bottom seated in a pocket 29 as described above is advanced to a second station along the path of travel of the pockets for receiving articles or material to be packaged from the chute 48 that is located at that station. This may require a number of successive stepwise movements of the rotary table 23. Since a box bottom 34 is seated in each pocket 29 arriving below each mechanism 47 each time the table stops, a box bottom arrives and stops in a position to be filled opposite each chute 48 at the second station each time the rotary table stops. By feeding articles or material down both of the chutes 48 in predetermined numbers or measured quantities in timed relationship with the stepwise movement of the rotary table, each box bottom arriving in position below a chute 48 is filled from the chute.

As shown in FIG. 6, three articles have been dropped into a box bottom 34 from a chute 48 thereabove, the third article being shown in phantom outline as it is about to drop from the chute 48 and in solid outline as it may land on top of the two preceding articles, with one edge of the third article failing to fall completely into the box bottom and remaining partially supported on the upper edge of the box bottom. In other instances, the articles may fall completely inside the box bottom into the positions shown and described below with reference to FIG. 8.

Tamping mechanism

Similar stepwise movements of the rotary table 23 eventually bring each filled box below one or the other

of the two tamping mechanisms 49 for compacting articles or material into the box bottom in the event any part thereof should not have settled completely below the upper edge of the box. Each tamping mechanism 49 may be mounted on a frame 86 that is in turn mounted on the stationary table 20 (FIG. 1), one such mechanism being partly shown in more detail in FIG. 8. As shown in FIG. 8, the tamping mechanism may comprise a pneumatic cylinder 87 mounted on a supporting bracket 88 carried by the frame 86 in any desired manner. The cylinder and piston mechanism may also include a piston rod 89 having a tamping head 91 secured to the lower end thereof for downward movement to compact or tamp articles or material into box bottoms 34. The head 91, for this purpose, may have a configuration and size selected to slide freely into but substantially fill the transverse cross section of the box bottoms, as indicated in FIG. 8. During each dwell of a pocket 29 and contained box bottom 34 and its contents below the head 91, the cylinder and piston mechanism of the compacting device is actuated to drive the head 91 downwardly to the position shown in FIG. 8 and quickly retract it to a raised, inactive position shown in phantom outline in FIG. 8.

Box top handling

Referring to the details of the two mechanisms 52 for inserting box tops into pockets 29 therebelow, one such mechanism is shown in detail in FIGS. 9 and 10 and differs only in a few minor details from the mechanism 47 for inserting box bottoms into pockets 29 at the first station. As shown, the mechanism for inserting box tops into pockets 29 may comprise a supporting base plate 92 mounted on the stationary table 20 and having an aperture 93 therethrough at a location vertically aligned with a pocket 29 when the table 20 is at rest. A U-shaped positioning block 94 is secured to the base plate 92 and is provided with spaced legs to provide a slot therebetween for receving and stopping box tops in alignment with the aperture 93 in the base plate 92. The base plate 92 and positioning block 94 correspond generally to the similar parts of the mechanism 47 for handling box bottoms, except that the aperture 93 in the base plate 92 and the spacing of the legs of the positioning block 94 are slightly greater for accommodating the slightly greater diameter of the box tops.

As in the mechanism 47 for handling box bottoms, downward movement of a box top in the mechanism 52 is initially limited by a pair of feet 97 that are directed inwardly toward each other from the lower ends of a pair of vertically extending leaf springs 98. The leaf springs 98 are biased to urge the feet 97 inwardly toward each other to the positions shown in FIG. 10 where they are stopped by abutment of the lower portions of the springs against the sides of the positioning block 94. Undercuts 99 in the sides of the block 94 permit the spring feet 97 to move inwardly as shown for supporting and limiting downward movement of a box top until it is released as described below.

An upright frame member 101, having a yoke structure at its lower end, is rigidly mounted on the base plate 92 with legs 102 of the yoke structure spaced to permit box tops to move therebetween while sliding off the lower end of the chute 51 toward the positioning block 94. Adjacent the upper end of the frame member 101, a U-shaped bracket 103 is rigidly secured thereto and provides a pair of arms 104 to which the upper ends of the leaf springs 98 are secured. About half way up the vertical height of the frame member 101, a second bracket 106 is secured thereto for supporting a pneumatic cylinder and piston mechanism, including an air cylinder 107, piston rod 108, and piston (not shown) enclosed within the cylinder 107. The lower end of the piston rod 108 may have a plunger head 109 secured thereto for downward movement with the piston rod to push box tops downwardly into a pocket 29. In this case, the plunger head 109 has a shorter stroke than the plunger heads 79 in the mechanisms 47 for handling box bottoms, and is differently proportioned for that reason and is provided with a lower extension 110 having a disk-like head 110*a* for engaging and pushing box tops downwardly into a pocket 29. The body of the plunger head 109 serves as a cam for separating the feet 97 on the leaf springs 98 against the resilient biasing force of these springs to release a box top for downward movement momentarily prior to being engaged by the plunger extension disk 110*a*. For this purpose, the plunger head 109 is given a frusto-conical shape, as shown, to provide converging cam surfaces for engaging a pair of cam follower rollers 111, which are respectively secured to the inner, opposed faces of the leaf springs 98 by mounting brackets 112. In this respect, the body of the plunger head 109 is identical with the plunger heads 79 of the mechanisms 47, but is considerably shorter by reason of its shorter stroke.

Controlled, appropriately timed reciprocation of the plunger head 109 and piston rod 108 may be effected pneumatically from a single air supply hose 113 and a spring (not shown) contained within the cylinder 107, whereby the plunger head may be driven downwardly by air pressure supplied through the hose 113 and returned upwardly by the spring. Control of the action of the cylinder and piston mechanism in timed relationship with the other movements of the machine and its various components may be effected in a known manner by solenoid controlled valves (not shown), one being mounted in the upper end of the cylinder 107 and controlled by electrical leads 84 for this purpose.

A continuous supply of box tops 32, arranged with their closed top surfaces uppermost, may be maintained in the chute 51 so that one box top after another will slide down the chute below the plunger head 109, will move into position against the positioning block 94 between the spaced legs thereof, and will tend to drop downwardly toward the aperture 93 in the base plate 92 each time the plunger head 109 is raised (FIG. 9). Downward movement of the box tops through the aperture 93 is initially limited by the feet 97 of the springs 98. This operation is substantially the same as the corresponding operation of the box bottom handling and positioning mechanism of FIGS. 3–5.

When stepwise rotation of the rotary table has brought a pocket 29 to rest in the position shown in FIGS. 9 and 10, the cylinder and piston mechanism is actuated to drive its plunger head 109 downwardly, causing it to act upon the cam rollers 111 so as to separate the springs 98 and retract the spring feet 97 apart. The mechanism is proportioned and timed so that the disk 110*a* of the plunger head extension 110 engages the upper surface of the box top momentarily after retraction of the spring feet 97 has freed the box top for downward movement. Continued downward movement of the plunger head 109 either closely follows or pushes the box top downwardly through the base plate aperture 93 and into the pocket 29 until the lower open end of the box top engages the internal, circumferential shoulder 31 of the pocket 29, as more clearly shown in FIG. 11. During this operation of the plunger head 109, the spring feet 97 are maintained in their retracted positions by rolling engagement of the cam follower rollers 101 with the parallel, opposite sides of the plunger head above the frusto-conical lower end thereof.

Immediately upon reaching its lowermost position shown in FIG. 11, the plunger head 109 is retracted upwardly until it has returned to the raised position of rest shown in FIGS. 9 and 10. This permits another box top to slide into position as described above. As will be clearly apparent, the general operation of the mechanisms 52 for handling box tops is the same as the operation of the mechanisms 47 for handling box bottoms in every significant respect.

Box closing

Referring to the details of the two mechanisms 53 for

closing the filled boxes, one such mechanism is shown in detail in FIGS. 12 and 13. As shown, this mechanism may comprise a vertically disposed plunger rod 116 having a plunger head 117 fixed on its upper end, the plunger assembly being disposed below the rotary table 23 and the path of pocket cylinders 29 for continuous reciprocating movement upwardly and downwardly into and out of one superposed pocket after another. The plunger assembly is located to be coaxial with a pocket 29 each time the rotary table 23 is at rest, whereby upward movement of the plunger into a pocket will engage a filled box bottom 34 over a substantial area of its bottom surface and raise the box and its contents upwardly within the pocket into telescoping engagement with a box lid 33 positioned therein at the preceding station.

The plunger head 117 is desirably provided with an upper cushioning layer 117*a* of sponge rubber or the like (FIG. 12) so that the box can be fully closed by the plunger without danger of breaking the box bottom. Since the internal surface of the pocket cylinder 29 is flush with the internal surface of the box lid 32 as it rests on the shoulder 31 of the pocket cylinder, there is no possibility for contents of the box to be pinched between the upper edge of the box bottom and the lower edge of the box lid during this box closing operation.

While the table 23 is still at rest, the box closing plunger assembly retracts sufficiently to clear the aligned pocket 29 so as to permit the table 23 to rotate and advance the pockets. While the table 23 is advancing, this plunger assembly completes its downward movement to its lowermost position shown in FIGS. 2 and 13 and then rises again to enter the next pocket moved into alignment therewith. The time required to advance the table 23 one step compared to the time for one cycle of movement of the box closing plunger is sufficiently small so that this plunger will not again rise to the level of the bottoms of the pockets until the next pocket has arrived in vertical alignment therewith in a condition of rest. The telescoping fit of the box bottom 34 into the box lid 32 should be a sufficiently tight fit so that the box will remain closed without continued vertical support from the plunger assembly.

As shown in FIGS. 1 and 12, a stationary plate 118 is mounted horizontally above the table 23 in closely spaced relationship therewith over the box closing station so that a box lid 32 positioned in a pocket 29 at the preceding station will slide thereunder in substantial engagement therewith as the table is rotated to advance this pocket to the box closing station. This plate 118 thereby holds the box lid downwardly against the upward frictional force applied thereto by the telescoping movement of the filled box bottom 34 upwardly into the box lid as described above. The plate 118, in the present instance, also forms a support for the box ejecting mechanism 56 at the next succeeding station (as described below).

Actuation of the box closing plunger assembly in timed relationship with the intermittent rotation of the table 23 is conveniently effected by an eccentric and lever mechanism, generally designated 120, that also operates a similar plunger assembly for raising the filled and closed boxes out of the pockets at the next succeeding and closely adjacent station. This eccentric and lever mechanism 120, is generally indicated in FIG. 2 and shown in more detail in FIG. 13, and will be described hereinafter in connection with the box raising and ejecting mechanisms.

Box raising and ejecting

Referring to the details of the two sets of mechanisms 54 and 56 for raising filled and closed boxes out of the pocket cylinders 29 at a final station and ejecting them outwardly from the rotary table 23 for discharge down a chute 57, one such raising mechanism 54 is shown generally in FIGS. 1 and 2 and in more detail in FIG. 14.

As best shown in FIGS. 12 and 13, the box raising mechanism comprises a vertically disposed plunger rod 121 having a plunger head 122 fixed on the upper end thereof, this plunger assembly also being disposed below the rotary table 23 and the path of pocket cylinders 29 for continuous reciprocating movement upwardly and downwardly into and out of one superposed pocket after another. This plunger assembly is located to be coaxial with a pocket 29 each time the rotary table is at rest, whereby upward movement of the plunger into and through a pocket will engage a filled and closed box in the upper open end of the pocket over a substantial area of the bottom surface of the box and lift the filled and closed box above the level of the table 23 and stationary plate 118 (FIG. 12) for ejection from the machine.

While the table 23 is still at rest, the box raising plunger assembly retracts sufficiently to clear the aligned pocket 29 and permit the table 23 to rotate and advance the pockets. While the table 23 is advancing, this plunger assembly continues its downward movement to its lowermost position shown in FIGS. 2 and 13 and then rises again to enter the next pocket moved into alignment therewith. As is the case with the box closing plunger 53, the time required to advance the table 23 one step is sufficiently small so that this plunger will not again rise to the level of the bottoms of the pockets until the next pocket has arrived in vertical alignment therewith in a condition of rest.

The plunger rod 121 of the box raising mechanism and the plunger rod 116 of the box closing mechanism, being disposed at closely spaced, adjacent stations as shown, may be mounted for simultaneous actuation by the eccentric and lever mechanism 120. This mechanism includes a vertically reciprocable block or slide 123 to which both plunger rods 116 and 121 are fixed, as best shown in FIG. 13. The block 123 is mounted for its vertical movement between a pair of guide plates 124 that are, in turn, mounted in any suitable manner on the frame structure 22.

Vertical movement of the block 123 is effected by a driving pitman 126 actuated by a generally horizontal lever 127 that is fixed to one end of and is in turn actuated by rocker shaft 128. The rocker shaft 128 is mounted on the frame structure 22 for oscillation in suitable bearings (not shown) and is rocked in precisely timed relationship with the intermittent rotation of the table 23 by means of a generally vertical crank arm 129 fixed on the shaft 128 at a point intermediate its ends. The crank arm 129 is oscillated by means of a generally horizontal connecting rod 130 having an enlarged bearing bushing at the driving end thereof for receiving, in driving relationship therewith, an eccentric disk 131 forming a part of a master control mechanism hereinafter described. An identical driving linkage is provided between the second set of box closing and box raising plunger assemblies and the opposite end of the rocker shaft 128 (FIG. 2).

As will be evident from the foregoing, the driving linkage for both the box closing mechanism 53 and box raising mechanism 54 may be designed and proportioned to raise and then lower the plunger assemblies of the two mechanisms simultaneously each time the table 23 comes to rest.

The plunger assembly of the box raising mechanism 54, like that of the box closing mechanism 53, moves axially upwardly into an aligned pocket cylinder 29 to engage the filled and closed box therein over a substantial area of its bottom surface for raising the same upwardly out of the pocket cylinder to a level above the top surface of the rotary table 23 and stationary table 20 and somewhat above the stationary plate 118. While the filled and closed box is supported in such raised position, it is pushed radially outwardly of the table and down the discharge chute 57, as described below, whereupon the plunger assembly of the box raising mechanism descends to its idle position shown in FIGS. 2 and 13.

Referring to FIGS. 1, 2, and 14, the box ejecting mechanism comprises an air cylinder 140 mounted in a fixed

location on the stationary plate 118, the axis of the cylinder 140 being horizontal and directed more or less radially with respect to the rotary table 23. A piston (not shown) in the air cylinder 140 drives a piston rod 141 that terminates at its outer end in a pushing head 142 suitably contoured for engaging a filled and closed box partially about the periphery thereof to push it horizontally off of the plunger head 122 of the raising mechanism 54 when the filled and closed box is raised out of a pocket cylinder as described above. The air cylinder 140 may be actuated in one direction by air pressure supplied from an air hose 143 and returned by a spring (not shown) contained within the air cylinder; or a double acting air cylinder may alternatively be employed if desired. The piston rod 141 and its pushing head 142 are normally retracted as shown in FIGS. 1 and 14 and may be actuated in timed relationship to the operation of the box raising mechanism 54 to push a filled and closed box horizontally into the discharge chute 57 for removal by sliding down the chute. As in the case of the air cylinder mechanisms previously described, the air cylinder 140 and its piston rod 141 may be energized by a conventional solenoid controlled valve (not shown) mounted in the cylinder 140 for controlling the flow of air pressure thereto, the solenoid valve being in turn controlled by electrical leads 84 connected thereto (FIG. 1).

When stepwise rotation of the rotary table 23 has brought a pocket 29 to rest above the box raising mechanism 54 as shown in FIGS. 12–14 the box raising mechanism is first actuated to lift the filled and closed box upwardly into the path of the pushing head 142 of the ejecting mechanism 56. Thereupon, the ejecting mechanism 56 is actuated to eject the filled and closed box, and the piston rod 141 and pushing head 142 are then immediately retracted to their idle positions.

Timing mechanism

The various air cylinders of the mechanisms 47 for inserting box bottoms into the pockets 29, of the tamping mechanisms 49, of the mechanisms 52 for inserting box tops into the pockets, and for the ejecting mechanisms 56 are governed by solenoid controlled valves energized by electrical leads 84, as noted above, and they may all be subject to a single master control, generally designated 145 (FIG. 2), mounted on the frame structure 22 as shown in FIGS. 1 and 2. This master control may suitably comprise a horizontal shaft 146 mounted in bearings 147 for continuous rotation. Such rotation of the shaft 146 may be imparted by a beveled gear 148 on one end of the shaft 146 and a mating beveled gear 149 on the upper end of the drive shaft for the Geneva drive that rotates the table 23. Thus, the master control shaft 146 will rotate precisely in timed relationship with the Geneva drive.

Four cams 151 are mounted on the master control shaft 146 for respectvely engaging four micro switches 152 therebelow. The four micro switches are respectively connected by wires (not shown) to the sets of electrical leads 84 for the four air cylinder mechanisms to be controlled, and the cams 151 may be appropriately shaped to energize and actuate the air cylinder mechanisms with precision in timed relationship with the rotation of the table 23. All of the other operating parts of the machine, i.e., the rotary table 23 and the box closing and box raising mechanisms 53 and 54 are directly driven mechanically from a common output shaft of the gear box 41, as previously described. Thus, all of the individual operating mechanisms of the machine may be synchronized for carrying out their respective functions in proper and accurately timed relationship as described.

From the foregoing detailed description of an illustrative embodiment of the present invention, it will be apparent that I have provided a completely automatic machine for rapidly and efficiently filling, closing, and ejecting boxes having telescoping bottoms and lids without damage to delicate materials or objects being packaged in the boxes. It will also be apparent to those skilled in the art that many variations may be made in the specific details of the particular embodiment of the invention disclosed herein for illustrative purposes, without departing from the principles and scope of the invention. Accordingly, the invention contemplates and is intended to include all such variations as are covered by the appended claims.

What is claimed is:

1. In a box filling and closing machine for filling a box bottom of a given size and configuration and closing it with a similarly configured lid dimensioned for telescopingly receiving the box bottom with close sliding fit, means mounted for movement as a unit from station to station of the machine and defining a pocket movable in its entirety from station to station by the movement of said means and having an open upper end and a vertically continuous side wall, said pocket comprising a lower section defined by said side wall and having a vertical dimension at least as great as the box bottom and having a substantially uniform cross section dimensioned to embrace the box bottom with a close sliding circumferential fit, and an upper section defined by said side wall and being of sufficiently larger cross-sectional dimensions to receive the box lid with a close sliding fit, stop means located at the bottom of said upper section and projecting inwardly from the periphery thereof sufficiently to limit downward movement of the box lid but insufficiently to prevent passing of the box bottom thereby, whereby a box bottom prepositioned and filled in the lower section of the pocket may be conveyed by movement of said pocket defining means as a unit to a box closing station and closed by pushing it upwardly into telescoped relationship with a box lid that has been inserted into the top section and is being held down against said stop means.

2. A box filling and closing machine according to claim 1 in which the lower section of the pocket for receiving the box bottom substantially exceeds the height of the box bottom to permit compactible box contents to extend above the box bottom before closing the same and yet remain below the upper section of the pocket, and the lower section of the pocket, at least over the portion thereof above the box bottom seated therein, is defined by an imperforate peripheral side wall shell having a planar upper edge constituting said stop means and forming a plane of contiguity of the upper and lower sections, whereby said contents extending above the box bottom will be guided into the box lid and compacted within the closed box as the box bottom is pushed upwardly into telescoped relationship with the box lid while the box lid is held against said stop means, with no opportunity for trapping or pinching any of said contents between the telescopingly-engaged portions of the box bottom and lid.

3. A box filling and closing machine comprising a conveyor including means mounted for movement as a unit from station to station of the machine and, defining a plurality of pockets having bottom openings and open upper ends for sequentially receiving box bottoms one at a time in upright position to be filled, said pockets being spaced along a predetermined path and being movable in their entireties and in succession from station to station by the movement of said conveyor, and each pocket having a vertically continuous side wall configured to circumferentially embrace a box bottom with a close sliding fit, means for actuating the conveyor to move said pockets in their entireties sequentially from station to station along said path, means at one of said stations for inserting a box bottom into each of said pockets arriving at that station, means at an advanced station for placing at least one object to be packaged into a box bottom in each of said pockets arriving at said advanced station, means at a further advanced station for inserting a box

lid into each of said pockets at said further advanced station, lifting means mounted below said path at a still further advanced station for upward movement through the bottom opening of each of said pockets arriving at that station to raise a box bottom and its contents upwardly within the pocket into box closing relationship with a box lid in the same pocket, and restraining means mounted above said path for cooperating with said lifting means to restrain upward movement of a box lid in a pocket while a box bottom and its contents are moved upwardly within the same pocket into box closing relationship therewith by said lifting means.

4. A box filling and closing machine comprising a conveyor in the form of a flat, circular, horizontal table mounted for rotation about a central vertical axis, a multiplicity of pockets each extending downwardly into said table with a vertically continuous side wall for receiving a box bottom of predetermined size and shape in an upright position to be filled; each of said pockets moving as a unit about said axis upon rotation of said table and having inwardly directed first stop means located to limit downward movement of a box bottom into the pocket, a lower section of each pocket, for a distance above said stop means at least as great as the height of a box bottom, being configured to embrace a box bottom with a close sliding peripheral fit, an upper section of each pocket being configured and dimensioned to receive a box lid adapted for telescoping engagement over such a box bottom with a close sliding fit, second stop means at the bottom of said upper section and projecting inwardly from the periphery thereof sufficiently to limit downward movement of such a box lid therebeyond but insufficiently to prevent passage of such a box bottom downwardly therebeyond, and said upper section above said stop means having a vertical height sufficient for such a box lid to be seated therein in vertical alignment with such a box bottom seated in the pocket against said first stop means; and an intermittent drive for rotating said table about said axis and moving said pockets stepwise about a circular path from one to another of a series of stations spaced along said path; whereby a box bottom may be seated in an upright position to be filled in a pocket against the first stop means thereof while the pocket is at one station, a box lid may be seated in that pocket in vertical alignment with that box bottom and against the second stop means at a subsequent station along said path, and the box bottom may be pushed upwardly into telescoped box closing relationship with that box lid while both that bottom and that lid are constrained in axial alignment by that pocket.

5. A box filling and closing machine comprising an annular, horizontal table mounted for rotation about a vertical, central axis, a plurality of upwardly opening pockets extending into said table from the upper surface thereof and being equally spaced from and about said axis for sequentially receiving box bottoms of a given size and configuration, one at a time in upright position to be filled, each of said pockets being defined by a vertically continuious side wall comprising a lower section configured to surround and embrace such a box bottom with a close sliding, circumferential fit and inwardly directed stop means located to limit downward movement of a box bottom into said lower section, said lower section extending upwardly from said stop means a distance at least as great as the height of said box bottoms, and each of said pockets comprising an upper section that is movable with said lower section as a unit upon rotation of said table and is of sufficiently larger cross-sectional dimensions than said lower section to receive with a close sliding fit a box lid telescopingly engageable over such a box bottom, and second stop means at the bottom of said upper section and projecting inwardly from the periphery thereof sufficiently to limit downward movement of such a box lid thereby but insufficiently to prevent passing of such a box bottom thereby whereby such a box bottom in the lower section of a pocket may be closed by pushing it upwardly into telescoped relationship with such a box lid while the latter is held downwardly in said upper section against said second stop means.

6. A box filling machine comprising a conveyor including a carriage having a flat top surface, means defining a plurality of pockets in the form of recesses extending downwardly into said flat top surface for receiving box bottom elements to be filled and box lid elements for closing the box bottom elements, and means for actuating the conveyor to move said pockets one after another along a predetermined path; and a box element feeder disposed above said path for feeding box elements into said pockets, said feeder comprising a stationary frame, a box element positioning member mounted on said frame for peripherally embracing and laterally positioning a box element in vertical alignment with one of said pockets therebelow, a pair of leaf springs connected in spaced relationship at their upper ends to said frame and having a pair of feet respectively connected to the lower ends thereof and projecting inwardly toward each other therefrom, said leaf springs being biased to urge said feet toward each other under opposite side edges of a box element disposed between the leaf springs for momentarily supporting the box element, and said leaf springs being otherwise free to be flexed so as to move said feet outwardly away from each other to release the box element for downward movement into a pocket, a plunger mounted on said frame for movement between said leaf springs from a rest position above said feet downwardly between said feet for pushing box elements into said pockets one after another and for reverse movement back to said rest position, and cam means acting between said plunger and said leaf springs for moving said feet away from each other upon downward movement of said plunger and for permitting reverse movement of said feet to their said biased position upon upward return movement of said plunger.

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ROBERT A. LEIGHEY, *Examiner.*