Oct. 7, 1952 L. H. BOWES 2,613,021

CARTON PACKING APPARATUS

Filed March 24, 1947 4 Sheets-Sheet 1

Fig. 1.

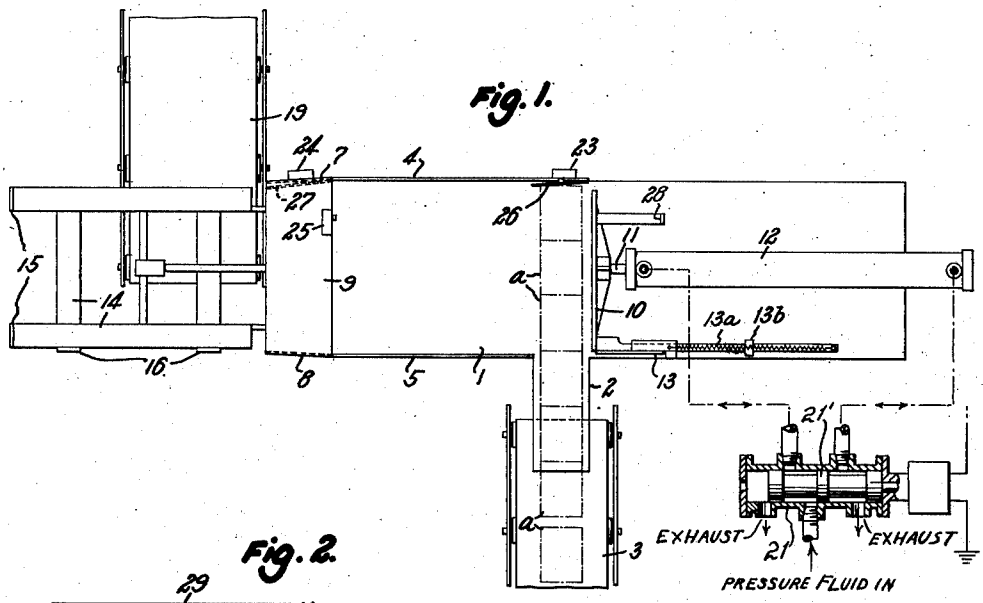
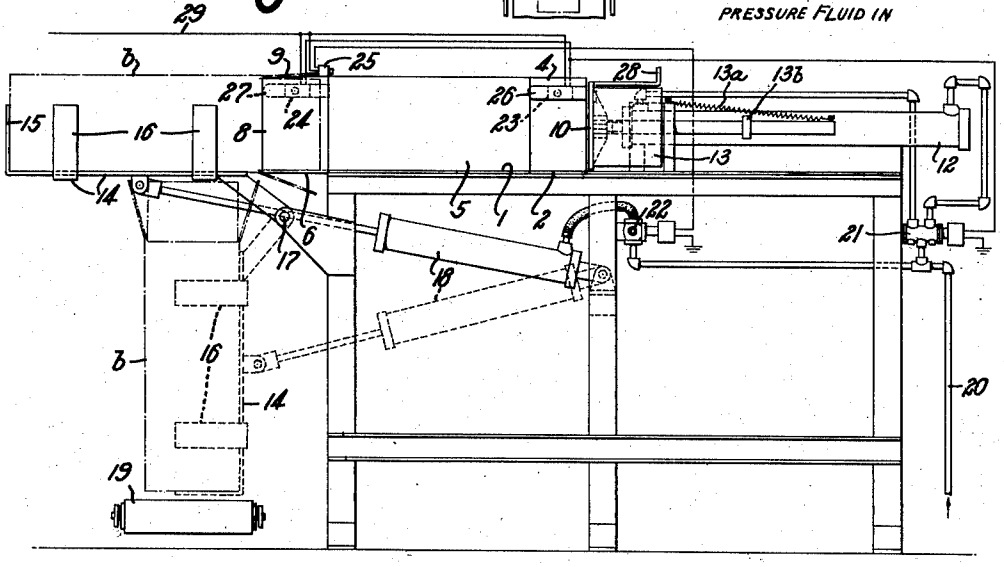


Fig. 2.



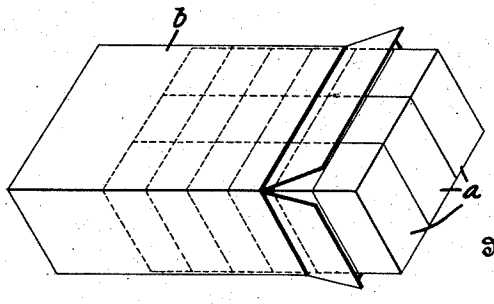


Fig. 3.

Inventor

Leslie H. Bowes

By W. T. Finkel Jr.

Attorney

Oct. 7, 1952 L. H. BOWES 2,613,021

CARTON PACKING APPARATUS

Filed March 24, 1947 4 Sheets-Sheet 2

Fig. 4.

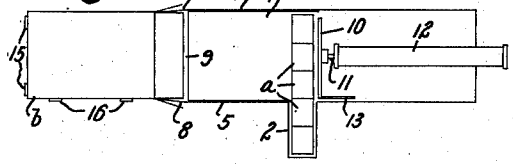


Fig. 5.

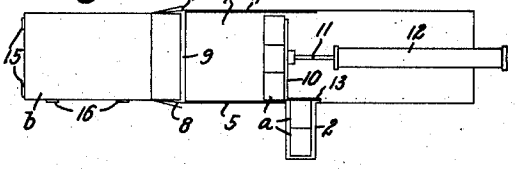


Fig. 6.

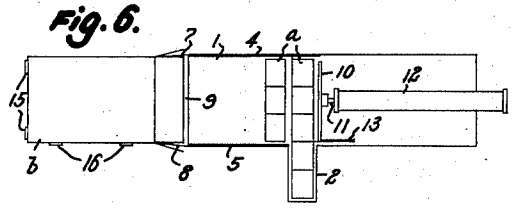


Fig. 7.

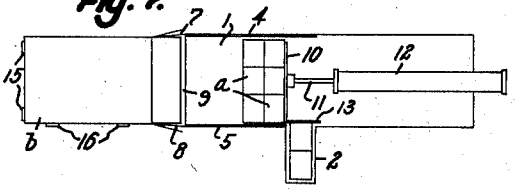


Fig. 8.

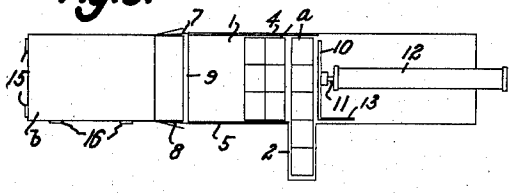


Fig. 9.

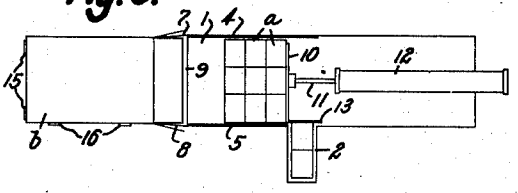


Fig. 10.

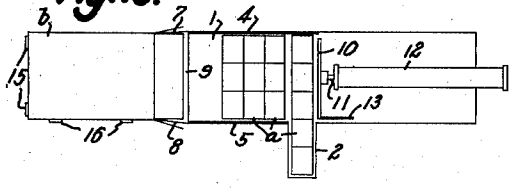


Fig. 11.

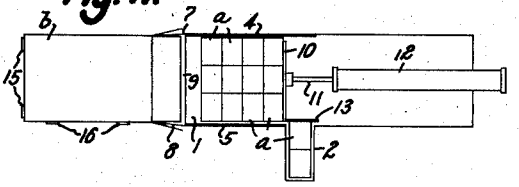


Fig. 12.

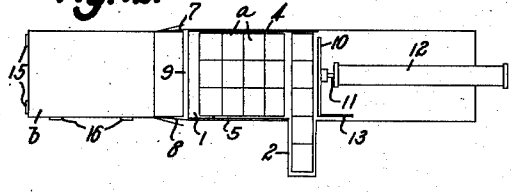


Fig. 13.

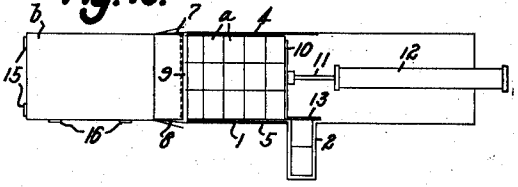


Fig. 14.

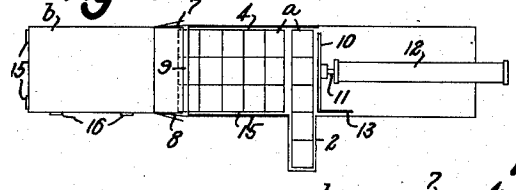


Fig. 15.

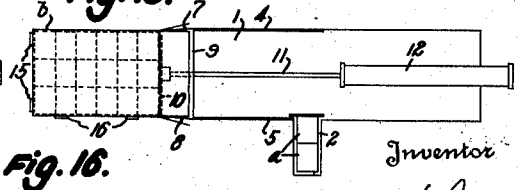
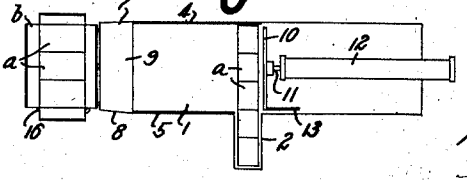


Fig. 16.



Inventor
Leslie H. Bowes
by
M. M. Fuchs Jr.
Attorney

Oct. 7, 1952 L. H. BOWES 2,613,021

CARTON PACKING APPARATUS

Filed March 24, 1947 4 Sheets-Sheet 3

Fig. 17.

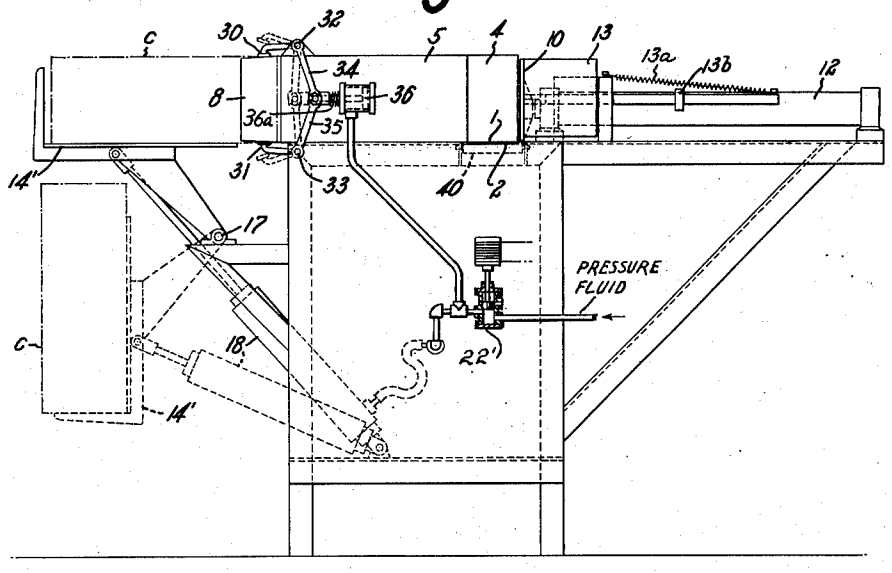
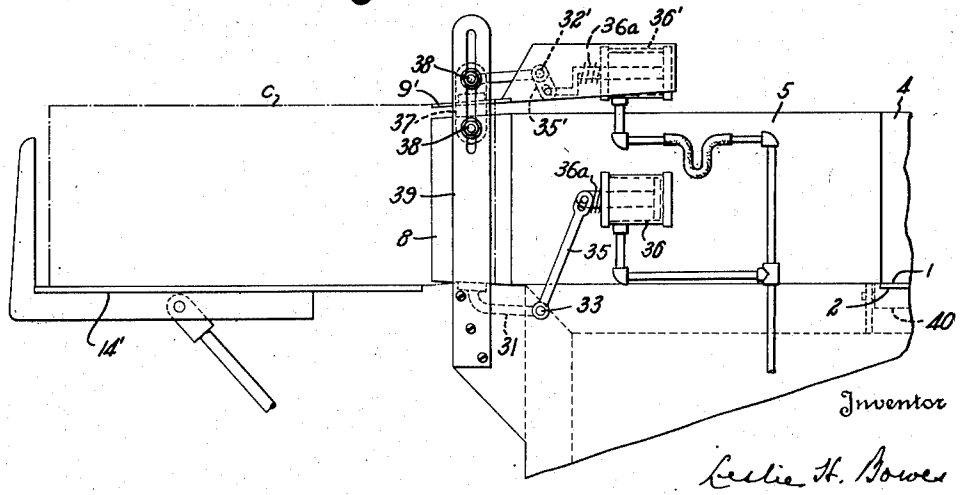


Fig. 18.



Inventor

Leslie H. Bowes

By M. M. Finnell Jr.

Attorney

Oct. 7, 1952 L. H. BOWES 2,613,021

CARTON PACKING APPARATUS

Filed March 24, 1947 4 Sheets-Sheet 4

Fig. 19.

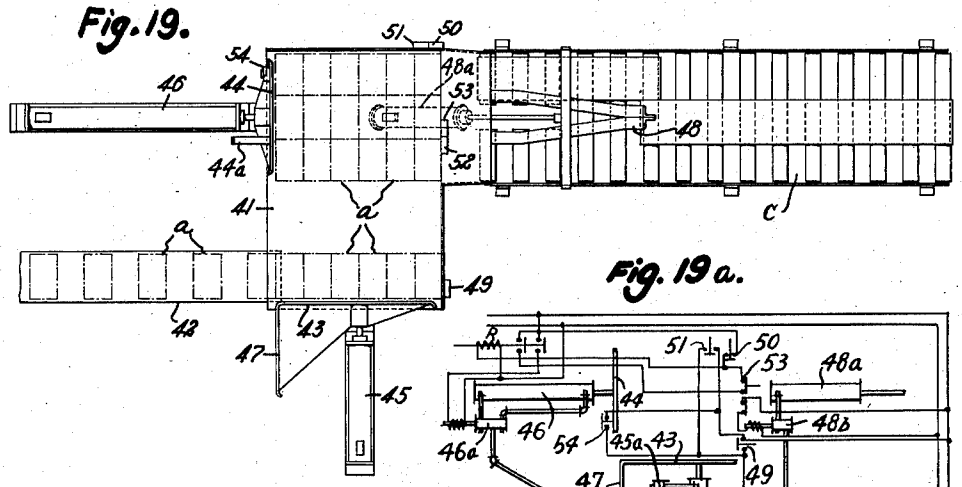


Fig. 19a.

Fig. 20.

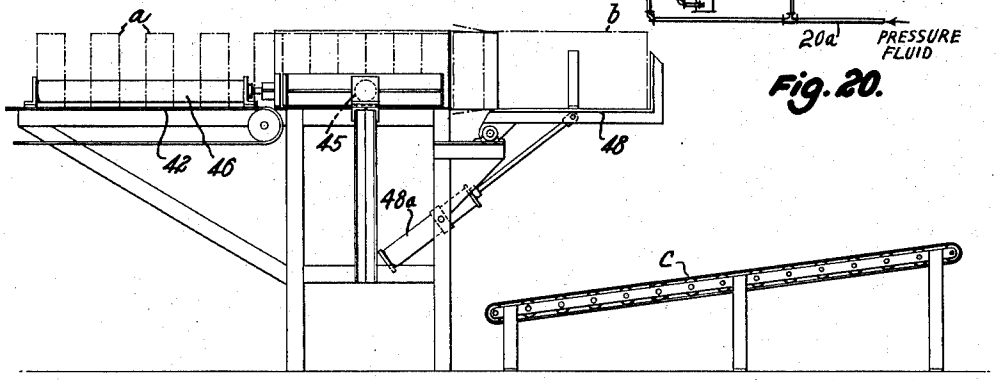
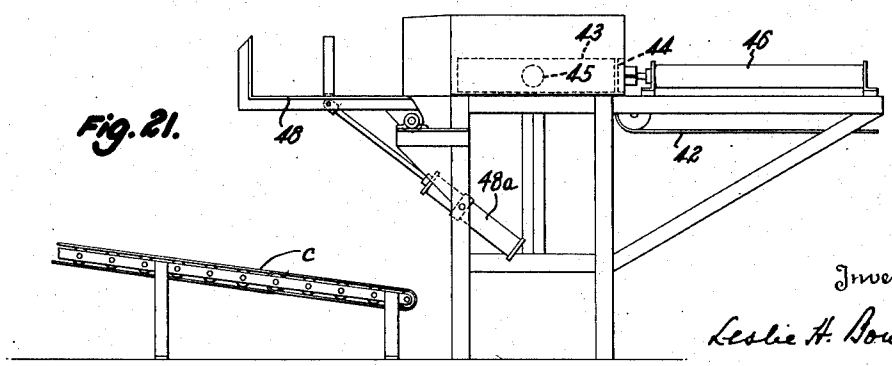


Fig. 21.



Inventor

Leslie H. Bowes

By N. H. Finnell Jr.

Attorney

Patented Oct. 7, 1952 2,613,021

UNITED STATES PATENT OFFICE

2,613,021

CARTON PACKING APPARATUS

Leslie H. Bowes, Wadsworth, Ohio, assignor, by mesne assignments, to Morton Salt Company, Chicago, Ill., a corporation of Illinois

Application March 24, 1947, Serial No. 736,739

11 Claims. (Cl. 226—14)

1

This invention relates to carton packing apparatus, and it has special reference to apparatus for assembling appropriate, predetermined multiples of package units, such as cartons, bags and the like of salable commodities, and inserting them into shipping containers.

It is known that various types of apparatus for a similar purpose have been devised, but such types are ordinarily of a complicated and cumbersome nature, and are expensive to obtain, operate and service.

One object of the present invention is to provide carton packing apparatus of relatively simple construction and few moving parts, but capable of rapidly and efficiently performing the operations for which it is designed.

Another object is to provide for the substitution of mechanism of substantially straight-line operation, preferably in response to fluid-actuated means, for the complicated mechanisms of packing apparatus of types now common in the art.

A further object is to provide means whereby the arrangement of the units to be packed, and the progress of their passage through the apparatus under the influence of the arranging and feeding mechanisms thereof will serve to control the timed actuation of such mechanism.

The invention comprises, in a broad sense, apparatus for receiving in succession from a suitable source, such as a travelling conveyor, a plurality of package units, arranging such units in appropriate series, assembling such series in multiples predetermined as adequate to fill a shipping container of selected capacity, inserting them into the container, and discharging the filled container for subsequent closing and sealing. And it will be understood that these operations will be performed substantially automatically in response to control means actuated by the package units, the series thereof, and the multiples of such series, as long as the package units are received from said source, thus requiring little attention from an operator other than the supplying and positioning of shipping containers to replace those filled, all as will be explained more fully hereinafter and finally claimed.

In the accompanying drawings illustrating the invention, in the several figures of which like parts are similarly designated,

Fig. 1 is a top plan view of apparatus of preferred form embodying the features of the invention, an enlarged semi-diagrammatic showing of one of the pressure fluid control valves being associated therewith

2

Fig. 2 is a side elevation of the apparatus shown in Fig. 1,

Fig. 3 is a perspective view of a shipping container with a multiple of series of package units partially inserted therein,

Figs. 4 to 16 illustrate, schematically, the successive steps of the package unit arranging and container filling operations of the apparatus shown in Figs. 1 and 2,

Fig. 17 is a side elevation of apparatus similar to that shown in Figs. 1 and 2 but equipped with means for holding bags, rather than packing cases, as the shipping containers,

Fig. 18 is an enlarged fragmentary side elevation of apparatus similar to that of Fig. 17, but provided with an adjustable support for certain of the bag holding means,

Fig. 19 is a plan view of a modified form of packing apparatus in accordance with the invention,

Fig. 19*a* is a schematic representation of the pressure fluid actuated and control means, and the electrical switches, elements and wiring of the modification of Fig. 19, and

Figs. 20 and 21 are side elevations of the opposite sides of the apparatus of Fig. 19.

Although the apparatus of the invention may be designed to handle various sizes of package units, and series and multiples of such units, it will be seen that in the embodiments herein illustrated the selected multiples comprise eighteen package units arranged in series of three or six package units each, the multiples being inserted into paperboard packing cases or shipping containers, as shown in Fig. 3.

Referring to Figs. 1 and 2, wherein the invention is embodied in apparatus of a preferred and simple form, it will be seen that the feed platform or top 1 of the packing table has a platform extension 2 onto which package units *a* are fed by a travelling conveyor 3. At the side of the table opposite the platform extension 2 the table top 1 is provided with an abutment and guide wall 4, and the opposite side of the table top has a similar, though shorter, guide wall 5.

The table top 1 and walls 4 and 5 merge into an open throat with its bottom wall 6 in alignment with and forming a continuation of the table top 1, and its side walls 7 and 8, and top wall 9 converging, the side walls 7 and 8 constituting continuations of the guide walls 4 and 5, respectively.

Adjacent to the end of the table top 1 opposite the throat is a pusher plate 10 carried by the piston rod 11 of an air cylinder 12 and recipro-

cable in a straight line longitudinally of the table top in response to movement of the piston rod 11. Arranged to close the passage from the platform extension 2 to the table top 1 upon feeding movement of the pusher plate 10 is a reciprocable gate member 13 biased to close the said passage by a spring 13a and serving alternately to permit and interrupt entry of package units from the platform extension 2 to the table top 1 as the gate member reciprocates. A stop 13b limits movement of the gate member 13 under the influence of the spring 13a, and the gate member is moved against the influence of the spring by engagement therewith of the pusher plate 10.

In appropriate proximity to the throat there is arranged a holder for a packing case or shipping container, this holder preferably comprising an open framework 14 having arms 15 and 16 upstanding from its outer end and from one side, respectively, and it is pivoted to the table at 17 for swinging movement from a horizontal position (full lines Figs. 1 and 2) to a vertical position (broken lines Fig. 2), and vice versa, in response to the functioning of an air cylinder 18. When the holder is in the vertical position (Fig. 2) the filled packing case or shipping container b will fall from it onto a conveyor 19 by which it and others previously and subsequently filled and discharged may be transported to an appropriate closing and sealing machine (not shown).

Compressed air or other appropriate pressure motive fluid is supplied to the cylinders 12 and 18 from a line 20, and its admission to and exhaust from these cylinders is controlled through electrically actuated valves 21 and 22, respectively, in response to operation of the switches 23 and 24, and 25, the valve 21 being a four-way valve (Fig. 1) and the valve 22 being a three-way valve of substantially the type shown in Fig. 17. The switches 23 and 24 are furnished with depressor strips 26 and 27, respectively, contacted and depressed and released by the fed package units in series and multiples thereof, and the switch 25 is operated by a trip arm 28 reciprocating with the pusher plate 10.

In describing the operation of this preferred embodiment of the invention, having reference particularly to Figs. 4 to 16, it will be assumed that a continuing succession of package units a is being fed by the conveyor 3 toward and onto the platform extension 2, that there is a supply of packing cases or shipping containers b at hand adjacent to the holder 14—15—16 and that the machine attendant has arranged one such case or container upon the holder with its open top or end embracing the throat 6—7—8—9 (see particularly Fig. 2).

With the pusher plate 10 retracted, and the gate member 13 held back against the influence of the spring 13a, as shown particularly in Figs. 1, 2 and 4, it will be apparent that an aligned series of three of the package units a will have been pushed upon the table top 1 by action of the belt conveyor 3, in line with the pusher plate and with the leading unit of the series pressing against the depressor strip 26 of switch 23 tending to close this switch. Now, when the attendant closes the main switch (not shown) in the line 29 current will flow through the switch 23 to the operator of valve 21 to force the piston 21' thereof to the left, Fig. 1 and will thus actuate this valve to exhaust pressure fluid from the left-hand end of cylinder 12 and admit pressure fluid from line 20 to the right-hand end of cylinder 12 thus to project its piston and advance the pusher plate 10 so that it will move the series of three units a to the position shown in Fig. 5 in which the leading unit of the series, in passing, permits release of the depressor strip 26 and opening of the switch 23, whereupon fluid will exhaust from the right-hand end of cylinder 12 and will be admitted to the left-hand end thereof so that the pusher plate 10 will be retracted to its initial position, carrying with it the gate member 13.

It will be noted that when the pusher plate 10 advances, the spring 13a will cause the gate member 13 to be advanced with it to arrest feed of the package units a onto the table top (Fig. 5), and when the pusher plate is retracted the gate member will also be retracted to permit a further series of package units to feed onto the table top (Fig. 6).

This operation will be repeated, step-by-step, as shown in Figs. 7 to 14, until six series of package units are in place upon the table top (Fig. 14), whereupon, as the last series of these six is moved forward by the pusher plate 10, advancing with it the five series previously fed, the leading unit of the first of the six series will contact and operate the depressor strip 27 to close the switch 24 which holds the valve 21 in cylinder charging condition (for cylinder 12) until all of the six series of package units have cleared the depressor strip 27 and have been projected, as a complete multiple of units, into the packing case on the holder 14—15—16 (Fig. 15). Just upon completion of this operation, the trip arm 28 will open the switch 25 to permit actuation of valve 22 to exhaust the cylinder 18 of the holder and drop the holder to the vertical position (Figs. 2 and 16) and discharge the filled packing case, open end up, upon the conveyor 19. Immediately thereafter the pusher plate 10 will be retracted, the holder will again be elevated for reception of another packing case, and the filling of this case will be performed.

As shown in Fig. 17, the apparatus may be provided with means to receive a bag c, instead of the packing case, upon the holder 14', and to clamp the upper and lower walls of the open end of the bag against the outer surfaces of the parts 9 and 6, respectively, of the throat at the table end.

These clamping means may comprise sets of clamping feet 30 and 31 fixed upon oscillatory shafts 32 and 33, respectively, to which motion is imparted through levers 34 and 35 by an air cylinder 36 which may, preferably, be controlled in response to movement of the holder 14' from horizontal to vertical position, and vice versa by the three-way valve 22' which controls admission and exhaust of pressure fluid for the cylinder 18 (Fig. 17). Thus when the holder is in horizontal position, by virtue of pressure fluid admitted to cylinder 18, the clamping feet 30 and 31 will be forced to clamping position and hold the bag walls fixed against the parts of the throat to insure placement of the bag during insertion of the multiple of package units into it, and when the holder initiates its movement to vertical position the pressure fluid will be exhausted from cylinders 18 and 36 simultaneously, and under the influence of the spring 36a the clamping feet will be released.

In Fig. 18 a modification of the clamping means is shown. Here, provision is made for vertical adjustment of the top 9' of the throat to accommodate it to the increase in height of the package units which may occur due to atmospheric

conditions. In this modification the top member 9' may be provided with ears 37 at its opposite ends adjustably secured by bolts 38 in slotted standards 39 arranged at opposite sides of the throat. Inasmuch as the clamping feet must be adjusted vertically along with the member 9', it has been found expedient to have the shaft 32', operating lever 35' and cylinder 36' for these clamping feet carried by the member 9'. The clamping feet 31 and their asosciated parts 33, 35 and 36 may be in arrangement similar to that described in connection with Fig. 17. Obviously, the cylinders 36' and 36 will be energized and deenergized simultaneously, and in the same manner as just described in relation to the parts of Fig. 17.

It will be noted that the holder 14' of Figs. 17 and 18 is provided with a plate on its open framework in order that there may be adequate support for the non-rigid wall of the bag resting against it.

As shown in Figs. 17 and 18, that portion of the table top in line with the platform extension 2 may have its surface provided with, or formed of, a plurality of rollers 40 which will facilitate feed of the package units from the conveyor 3 to the table top and at the same time tend to prevent their possible misalignment.

In Figs. 19 to 21, a modification embodying a structural and, to some extent, a functional, departure from the preferred embodiment of Figs. 1, 2 and 4 to 16 is shown. In this modification the table top 41 to which the package units *a* are fed by a conveyor 42 is provided with two pusher plates 43 and 44, respectively, projectible and retractible in directions normal to each other, under the influence of their respective cylinders 45 and 46.

The pusher plate 43, which carries a gate member 47 similar in function to that of Figs. 1 and 2, serves to advance series of six package units *a* step-by-step until three such series are in multiple arrangement in alignment with the other pusher plate 44, whereupon that pusher plate 44 is actuated to advance the multiple of units into the packing case or shipping container *b* (Fig. 20) positioned upon the tiltable holder 48 actuated by the cylinder 48*a*. Appropriate switches 49, 50, 51, 52, 53 and 54 and control elements for the pusher plate and holder operating cylinders, including suitable valves 45*a*, 46*a* and 48*b*, all as shown in Fig. 19*a*, are provided for actuation in a manner effectively corresponding to the similar means of Figs. 1 and 2.

More specifically, having reference particularly to Figs. 19 and 19*a*, the operation of this modified form of the invention is as follows: As the package units *a* are fed successively by the conveyor 42 onto the table top 41, they will be successively arranged in aligned series of six units across the path of reciprocation of the pusher plate 43, and when the leading unit of such a series is pressed by following units against the operator of the switch 49, as shown in Fig. 19, this switch will be closed and the solenoid operator of the four-way valve 45*a* connected therewith will be energized to actuate the valve to admit pressure fluid from the line 20*a* to the rear end of the cylinder 45 to project its piston and the pusher plate 43 forward, carrying the series of units out of line with the path of other units fed toward the table top 41 by the conveyor 42 but temporarily arrested by the gate member 47. It will be understood that the operator of the switch 49 is similar to the operator 26 of the switch 23 (Fig. 1) and hence, when the leading unit of the series has been pushed past this operator, the switch 49 will be permitted to open, and the valve 45*a* will be operated to admit pressure fluid to the forward end of the cylinder 45 to retract the pusher plate 43, the pressure fluid in the rear end of the cylinder 45 meanwhile exhausting through the valve 45*a*. Thus, with the pusher plate 43 retracted, the gate member 47 will clear the path for movement of another series of six of the package units *a* onto the table top 41 into the path of reciprocation of the pusher plate 43.

These operations will be repeated until three series of package units *a* have been moved forward into the path of reciprocation of the pusher plate 44 to form a predetermined multiple of the units appropriate to fill the container *b*, and as the leading series of such multiple strikes the operating means of the switches 50 and 51 these switches will be closed to complete energizing circuits for the relay R and the solenoid operator of the valve 45*a*, respectively. The relay R has two sets of normally open contacts; one set of contacts, when closed by energization of the relay, completing a holding circuit for relay R through the normally closed switch 53.

It will be noted that as soon as the leading series of the units *a* operates the switches 50 and 51 the solenoid operator of the valve 46*a* will be actuated to cause this valve to admit pressure fluid to the rear end of the cylinder 46 to project its piston and the pusher plate 44 forward, thus permitting the switch 54 to close immediately to close an alternative circuit for energizing the solenoid operator of the valve 45*a*, thereby holding the pusher plate 43 in its forwardly projected position. At the same time, the forward movement of the pusher plate 44 will cause the multiple of package units to be projected into the container *b* supported by the tiltable holder 48 the operating cylinder 48*a* of which is under pressure through its three-way control valve 48*b* the solenoid operator of which is energized through the normally closed switch 52.

When the multiple of package units has been projected into the container *b* they will have freed the operating means for the switch 51 and this switch will open automatically, the pusher plate 43 being held in its forwardly projected position, however, through the medium of the alternative circuit already closed by the switch 54 through the solenoid operator of its control valve 45*a*. At the limit of forward movement of the pusher plate 44, its switch operating arm 44*a* engages and opens the normally closed switches 52 and 53, thereby deenergizing the solenoid operator of the valve 48*b* and the holding circuit of relay R. The valve 48*b* is thus free for operation to exhaust the cylinder 48*a* and permit the tiltable holder 48 to drop and discharge the filled container *b* onto the conveyor C. Opening of the circuit through the relay R deenergizes the solenoid operator of the control valve 46*a* of the cylinder 46 so that this valve may operate to cause the cylinder 46 to retract the pusher plate 44 to its starting position. Obviously, when the pusher plate 44 is retracted, the switch 54 will be opened and the pusher plate 43 will be retracted by operation of its valve-controlled cylinder 45.

It will be apparent that whether the invention is embodied in the preferred form of apparatus illustrated in Figs. 1, 2 and 4 to 16, or modified as shown in Figs. 19 to 21, an essential feature of operation is the same, namely that the package units are fed to the apparatus singly in succession, and are then, by the apparatus, arranged

in appropriate series and these series then arranged in appropriate multiples and finally, as such multiples, inserted in suitable packing cases or containers, the arrangement of the units in series, the series in multiples and the inserting of the multiples in the cases or containers being operations performed in response to control means actuated by the units themselves during their feed or travel through the apparatus.

Various changes and modifications are considered to be within the principle of the invention and the scope of the following claims.

What I claim is:

1. In carton packing apparatus, a feed platform onto which package units are fed successively, pusher means reciprocable transversely to the direction of feed of said units for moving them on said platform and determining successive series of predetermined numbers of said units and for arranging said series in predetermined multiples, control means actuated by said units on said platform as they are moved to predetermined position thereon for causing reciprocative movement of said pusher means sufficient to advance a series of units out of the path of feed of the units onto the platform, a repetition of such controlled reciprocative movement serving to cause successively fed series of units to be consolidated into a predetermined multiple, and control means actuated by the units of said successive series on said platform after their consolidation into a multiple for causing a reciprocative movement of said pusher means in excess of that last defined and sufficient to insert such multiple of units into a container positioned to receive them.

2. In carton packing apparatus, a feed platform, means for successively feeding package units onto and across said platform in predetermined direction, reciprocating pusher means having a short stroke substantially normal to said predetermined direction of feed and a long stroke, control means actuated by a package unit on said platform when a predetermined number of units constituting a series thereof have been delivered to said platform by said feed means and effective for causing a short stroke of said pusher means, and control means independent of said first control means and actuated by a package unit on said platform when a plurality of series of units has been moved to predetermined extent on said platform by successive short strokes of said pusher means and effective for causing a long stroke of said pusher means.

3. In carton packing apparatus, a feed platform, means for successively feeding package units onto and across said platform in predetermined direction, means for supporting a container at one end of said platform in position to receive therefrom a group of package units comprising a plurality of series thereof, reciprocating pusher means having a short stroke substantially normal to said predetermined direction of feed and a long stroke effective for pushing a group of package units from said platform into a container at said one end thereof, control means actuated by a package unit on said platform when a predetermined number of units constituting a series thereof have been delivered to said platform by said feed means and effective for causing a short stroke of said pusher means, and control means actuated by the leading package unit of a series of units in the movement thereof by said pusher means on said platform when a plurality of series of units constituting a group thereof has been moved to predetermined extent on said platform by successive short strokes of said pusher means and effective for causing a long stroke thereof.

4. In carton packing apparatus, a feed platform, means for successively feeding package units onto and across said platform in predetermined direction, pusher means reciprocable substantially normal to said predetermined direction and having a short stroke and a long stroke, control means actuated by a package unit on said platform when a predetermined number of units constituting a series thereof have been delivered to said platform by said feed means and effective for causing a short stroke of said pusher means, and control means actuated by the leading package unit of a series and maintained actuated by the succeeding units of that series in the movement thereof on said platform when a plurality of series of units has been moved to predetermined extent on said platform by successive short strokes of said pusher means and effective for causing a long stroke of said pusher means.

5. In carton packing apparatus, a feed platform, means for successively feeding package units onto and across said platform in predetermined direction, means for supporting a container at one end of said platform in position to receive therefrom a group of package units comprising a plurality of series thereof, pusher means opposed to said supporting means reciprocable substantially normal to said predetermined direction and having a short stroke and a long stroke effective for pushing a group of package units from said platform into a container at said one end thereof, control means actuated by a package unit on said platform when a predetermined number of units constituting a series thereof have been delivered to said platform by said feed means and effective for causing a short stroke of said pusher means, and package unit controlled means actuated by a package unit in its movement on said platform by said pusher means when a plurality of series of units constituting a group thereof has been moved to predetermined extent on said platform by successive short strokes of said pusher means and effective for causing a long stroke thereof.

6. In carton packing apparatus, a feed platform, means for successively feeding package units onto and across said platform in predetermined direction, pusher means at one side of said platform reciprocable substantially normal to said predetermined direction, a second pusher means reciprocable substantially normal to said first pusher means, the latter having a relatively short stroke effective for moving a multiple series of package units from said feed means successively across said platform and said second pusher means having a relatively long stroke effective for moving clear of said first pusher means a group of package units constituting a multiple series of units positioned on said platform by successive strokes of said first pusher means, control means actuated by a package unit on said platform when a predetermined number of units constituting a series thereof have been delivered to said platform by said feed means and effective for causing a stroke of said first pusher means, and control means actuated by a package unit on said platform when a group of package units has been assembled on said platform by successive strokes of said first pusher means and effective for causing a stroke of said second pusher means.

7. In carton packing apparatus, a feed platform, means for successively feeding package units onto and across said platform in predetermined direction, pusher means reciprocable over said platform transversely to said direction of feed, control means actuated by a package unit on said platform when a predetermined number of units constituting a series thereof have been delivered to said platform by said feed means and effective for causing operation of said pusher means, the latter moving the units on said platform a predetermined distance, pusher means reciprocable in a direction substantially normal to the direction of operation of said first pusher means, and control means actuated by a package unit on said platform when a plurality of series of units has been moved to predetermined position on said platform by said first pusher means and effective for causing operation of said second pusher means.

8. In carton packing apparatus, a feed platform, means for delivering package units to said platform transversely thereof and determining successive series of predetermined numbers of said units and for arranging said series in predetermined multiples constituting a group and moving the resultant group of units on said platform lengthwise thereof, said means comprising a feed conveyor for delivering successive series of units to said platform and control means actuated by the leading unit of a series delivered to said platform and pusher means reciprocable lengthwise of said platform, and control means actuated by the units of said group on said platform after their consolidation into a group effective for causing a reciprocative movement of said pusher means sufficient to insert said group of units into a container positioned to receive it.

9. In carton packaging apparatus, a feed platform, means for feeding onto said platform at one side thereof package units arranged in successive series transversely of said platform constituting a group of units with each series thereof extending lengthwise of said platform and for moving said group lengthwise of said platform, said means comprising a feed conveyor for delivering successive series of units to said platform and control means actuated by the leading unit of a series delivered to said platform and a pusher reciprocable lengthwise of said platform, and normally ineffective control means at the other side of said platform effectively actuated by the leading unit of the series of said group at said other side of said platform and maintained effective by the succeeding units of that series in the movement of said group on said platform lengthwise thereof, said control means being effective when actuated by said units of said group for causing reciprocative movement of said pusher sufficient to insert said group of units into a container positioned to receive it.

10. In carton packing means, a feed platform, means for feeding package units onto said platform at one side thereof and across said platform, a pusher reciprocable lengthwise of said platform having a short stroke and a long stroke, control means at the other side of said platform opposed to said feed means and actuated by a package unit on said platform when a predetermined number of units constituting a series thereof have been delivered to said platform by said feed means and effective for causing a short stroke of said pusher, and normally ineffective control means at one side of said platform effectively actuated by the leading unit of the series of said group at said one side and maintained effective by the succeeding units of that series in the movement of said group on the table lengthwise thereof, said second control means being effective when actuated by said units of said group for causing a long stroke of said pusher.

11. In carton packing apparatus, a feed platform, means for successively feeding package units onto and across said platform in predetermined direction, reciprocating pusher means having a short stroke substantially normal to said predetermined direction of feed and a long stroke, control means actuated by a package unit on said platform when a predetermined number of units constituting a series thereof have been delivered to said platform by said feed means and effective for causing a short stroke of said pusher means, and control means operable irrespective of the number of successive short strokes of said pusher means and actuated by a package unit on said platform when a plurality of series of units has been moved to predetermined extent on said platform by successive short strokes of said pusher means and effective for causing a long stroke of said pusher means.

LESLIE H. BOWES.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,467,019	Tzibides	Sept. 4, 1923
1,515,589	Beckmann	Nov. 18, 1924
1,831,130	Mudd	Nov. 10, 1931
1,935,409	Mudd	Nov. 14, 1933
1,953,524	Woodward	Apr. 3, 1934
2,047,272	Kimball et al.	July 14, 1936
2,109,294	Kimball et al.	Feb. 22, 1938
2,148,820	Kimball et al.	Feb. 28, 1939
2,350,560	Kimball et al.	June 6, 1944
2,470,795	Socke	May 24, 1949