Sept. 20, 1966 J. M. ANDERSEN 3,273,723

PACKING MACHINE

Original Filed May 22, 1959 7 Sheets-Sheet 1

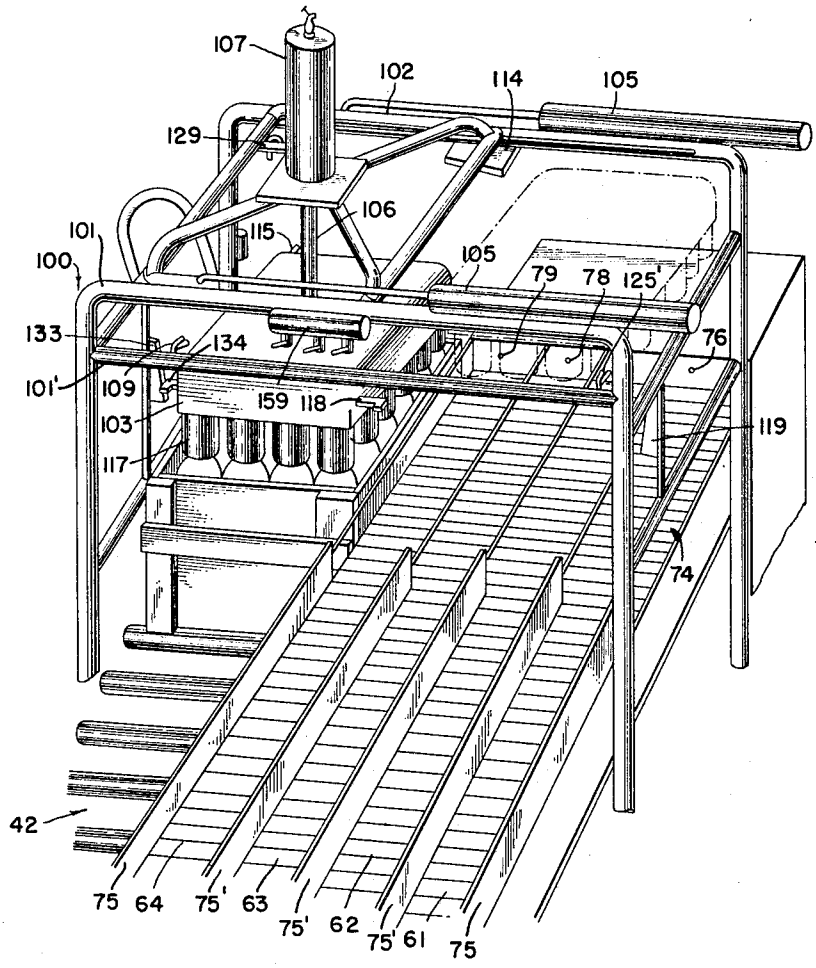


FIG. 1.

INVENTOR

JOHN MORITZ ANDERSEN

BY Paul M. Craig, Jr.

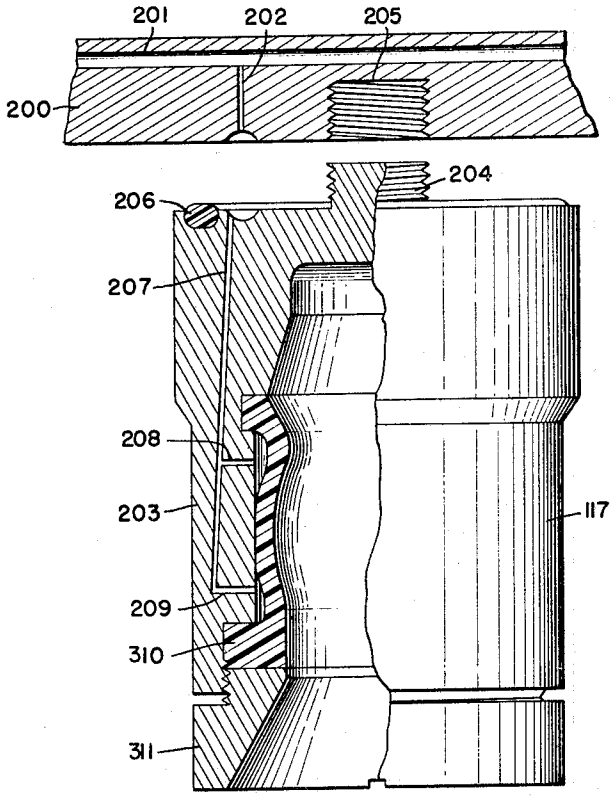
ATTORNEYS

Sept. 20, 1966 J. M. ANDERSEN 3,273,723

PACKING MACHINE

Original Filed May 22, 1959 7 Sheets-Sheet 2

Fig. 9.



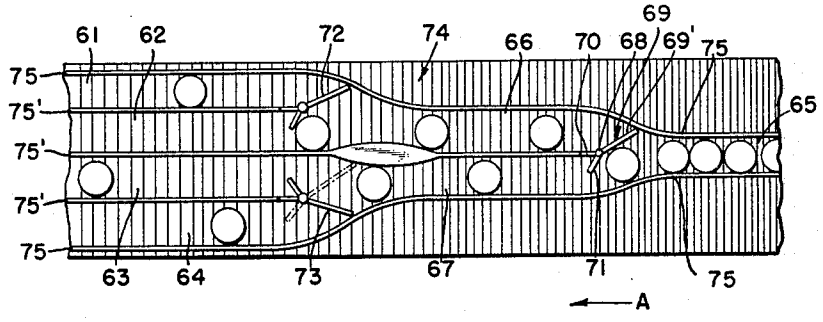


Fig. 2.

INVENTOR

JOHN MORITZ ANDERSEN

BY Paul M. Craig, Jr.

ATTORNEYS

Sept. 20, 1966 J. M. ANDERSEN 3,273,723

PACKING MACHINE

Original Filed May 22, 1959 7 Sheets-Sheet 3

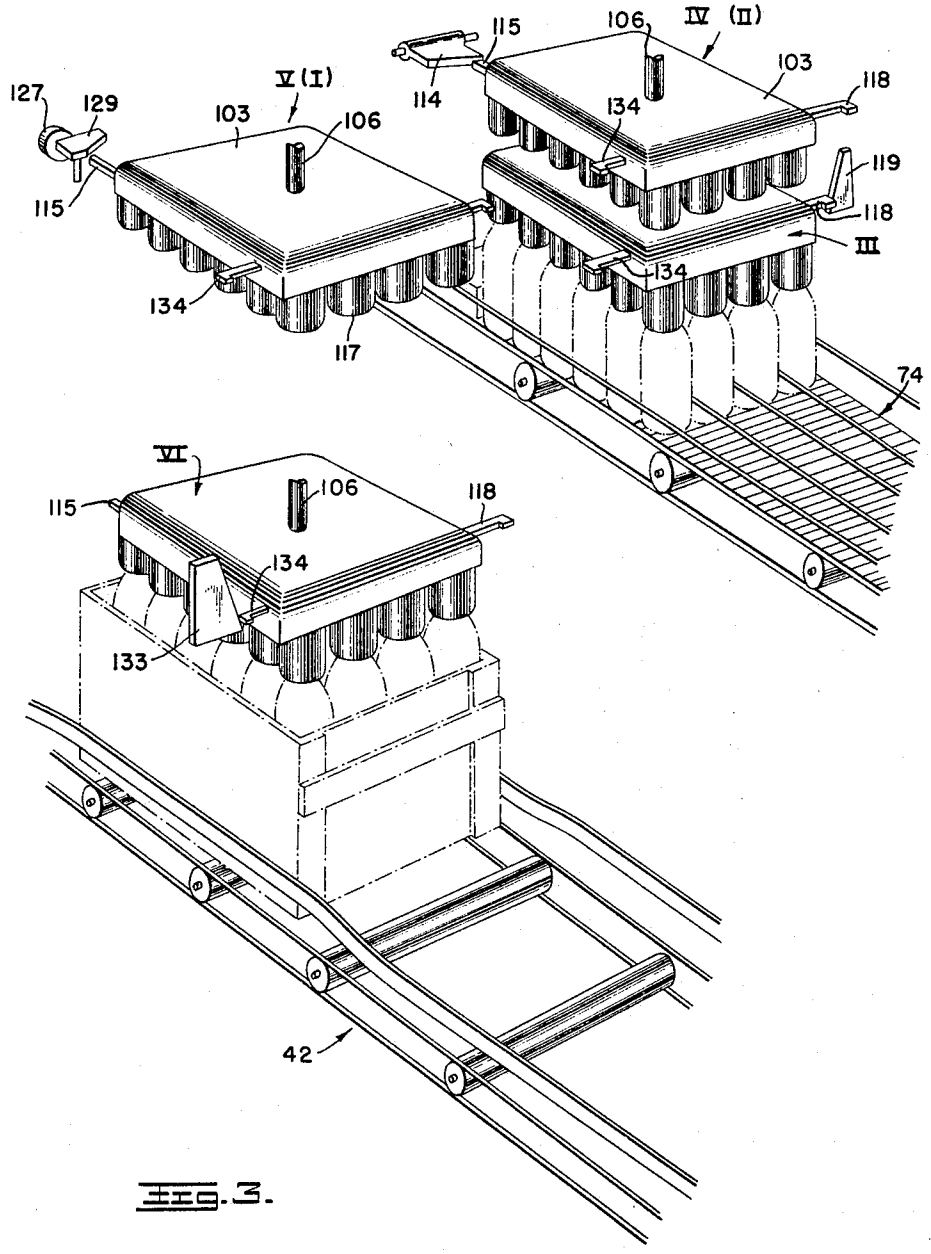


FIG. 3.

INVENTOR

JOHN MORITZ ANDERSEN

BY Paul M. Craig, Jr.

ATTORNEYS

Sept. 20, 1966 J. M. ANDERSEN 3,273,723

PACKING MACHINE

Original Filed May 22, 1959 7 Sheets-Sheet 4

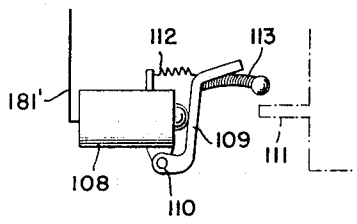


FIG. 4.

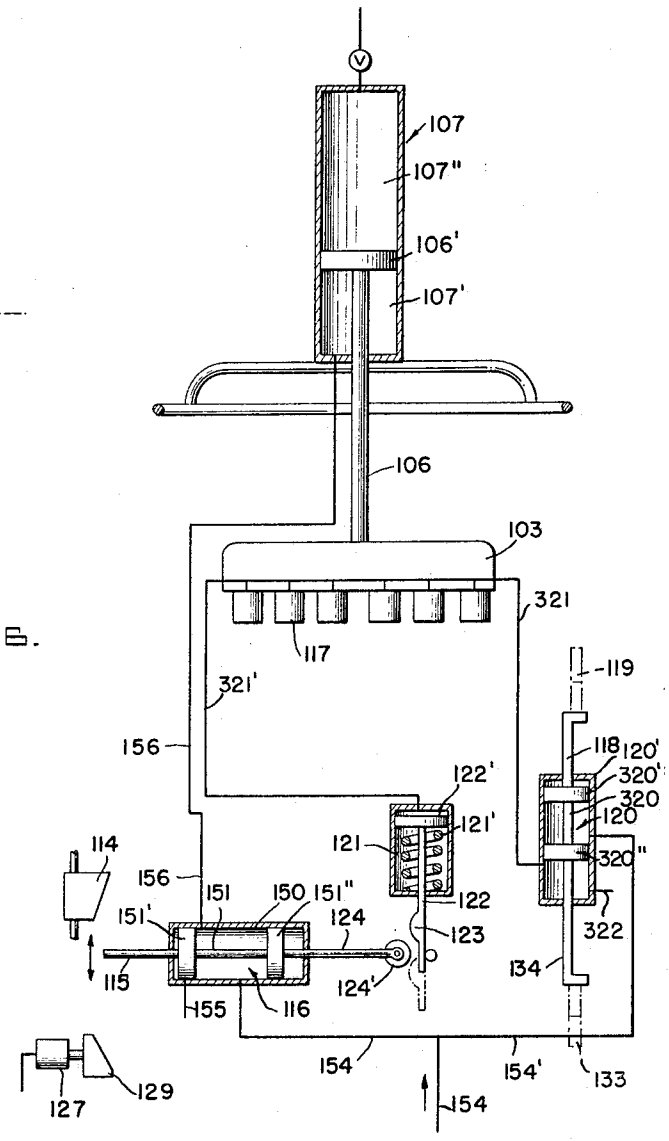
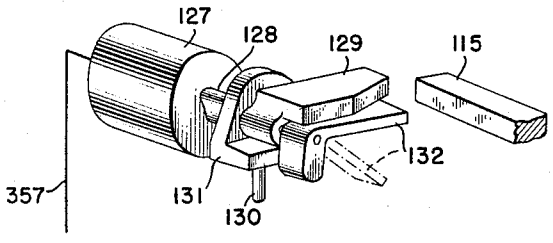


FIG. 5.

FIG. 7.



INVENTOR

JOHN MORITZ ANDERSEN

BY Paul M. Craig, Jr.

ATTORNEYS

Sept. 20, 1966 J. M. ANDERSEN 3,273,723

PACKING MACHINE

Original Filed May 22, 1959 7 Sheets-Sheet 5

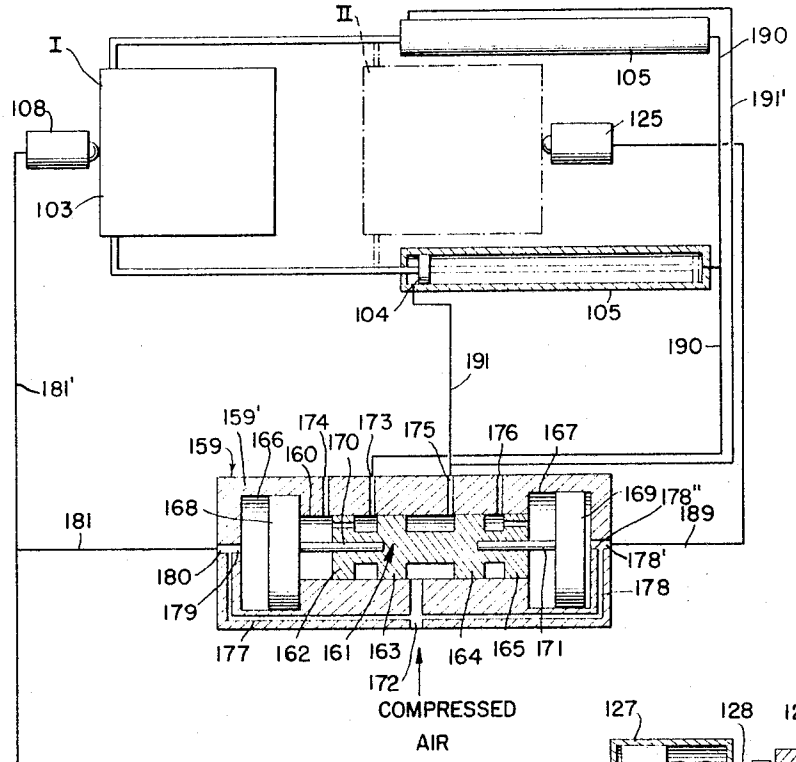
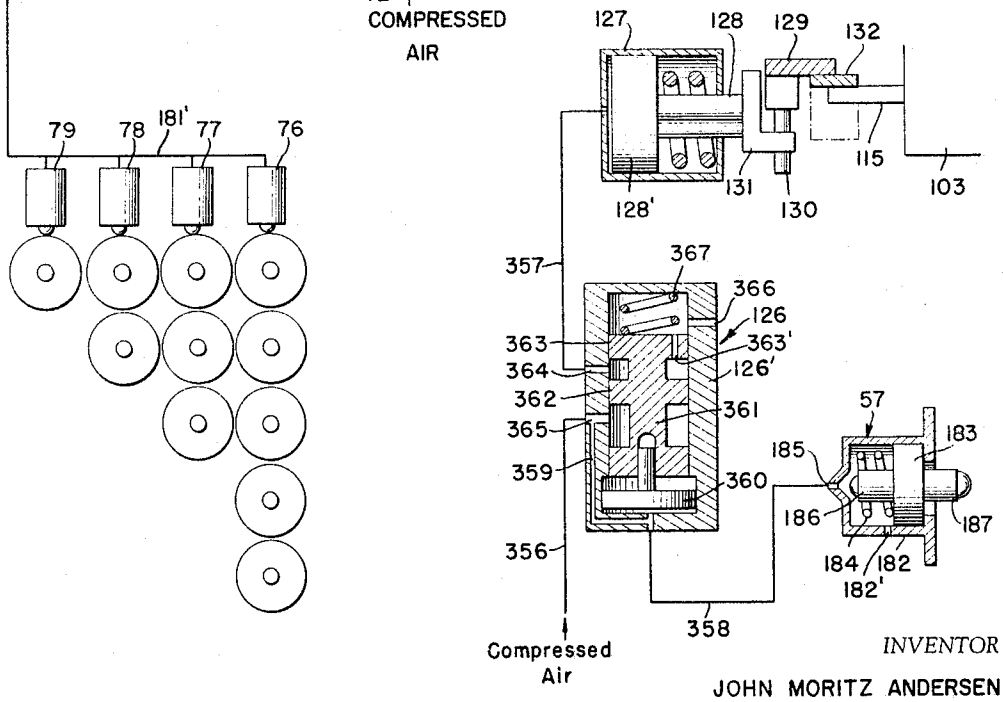


FIG. 5.

FIG. 8.



INVENTOR
JOHN MORITZ ANDERSEN

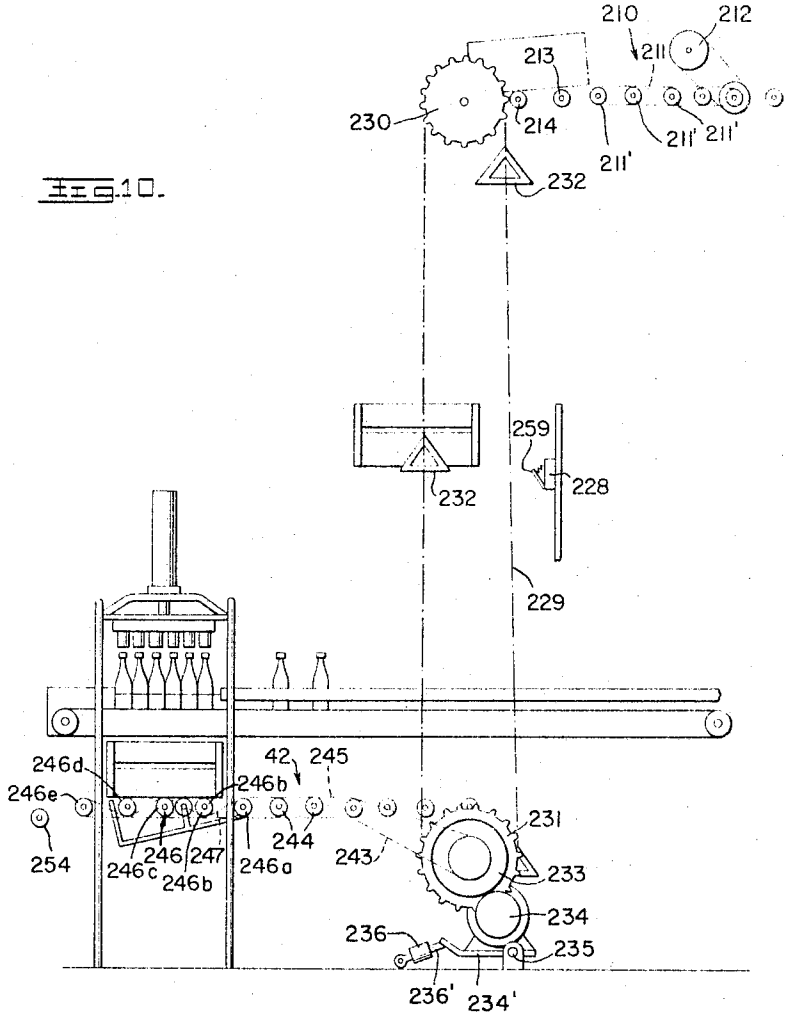
BY Paul M. Craig, Jr.
ATTORNEYS

Sept. 20, 1966 J. M. ANDERSEN 3,273,723

PACKING MACHINE

Original Filed May 22, 1959 7 Sheets-Sheet 6

FIG. 10.



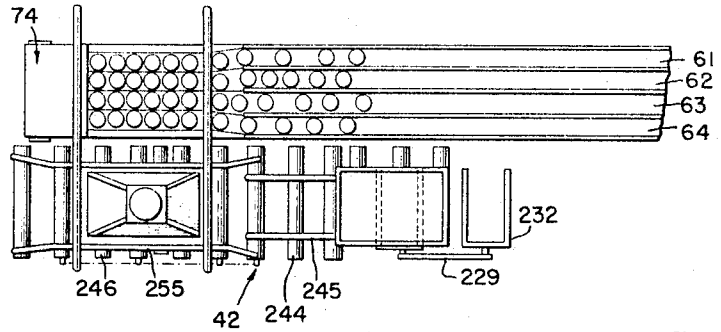


FIG. 11.

INVENTOR.

JOHN MORITZ ANDERSEN

BY Paul M. Craig, Jr.

ATTORNEYS

Sept. 20, 1966 J. M. ANDERSEN 3,273,723

PACKING MACHINE

Original Filed May 22, 1959 7 Sheets-Sheet 7

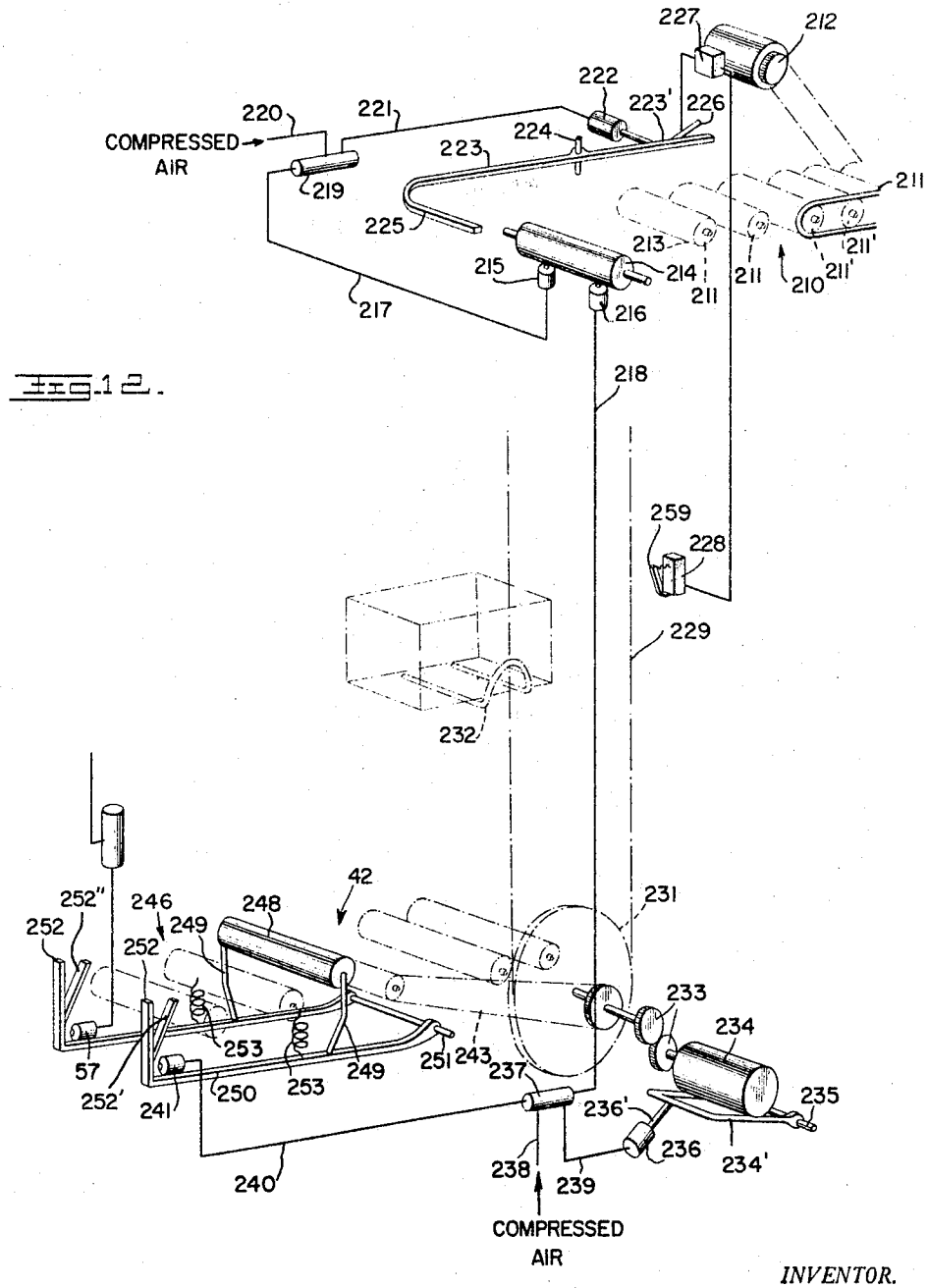


Fig. 12.

INVENTOR.
JOHN MORITZ ANDERSEN
BY Paul M Craig, Jr.

ATTORNEYS

United States Patent Office 3,273,723 Patented Sept. 20, 1966

3,273,723

PACKING MACHINE

John Moritz Andersen, Bergen, Norway, assignor to A/S Hansa Bryggeri, Bergen, Norway

Original application May 22, 1959, Ser. No. 815,022, now Patent No. 3,130,528, dated Apr. 28, 1964. Divided and this application Apr. 27, 1964, Ser. No. 362,876

8 Claims. (Cl. 214—1)

The present application is a divisional application of my copending application Serial No. 815,022, filed May 22, 1959, now Patent Number 3,130,528, and entitled "Packing Machine."

The present invention relates to a packing machine for packing objects, such as bottles in containers, such as bothe cases, and more particularly relates to an automatic conveying and packing machine for automatically conveying or feeding the containers, such as empty bottle cases and the objects to be packed, such as the filled bottles, to the packing machine, transferring, within the packing machine, the filled and capper bottles from a bottle conveyor track into the empty case disposed on a case conveyor track, and upon filling the empty case with the prerequisite number of bottles, automatically transporting the filled case for further disposition.

Additionally, the present invention relates to an automatic pneumatic control system for automatically feeding the bottles and cases to the packing machine and for automatically transferring within the packing machines the filled bottles into the cases.

Accordingly, it is an object of the present invention to provide a simple, relatively inexpensive, and reliable packing machine for packing objects, such as bottles, in empty cases.

It is another object of the present invention to provide a system for automatically feeding the correct number of bottles on the conveyor track for the filled bottles, and to initiate the actual transfer cycle operative to transfer the bottles into the empty cases when the prerequisite number of bottles are in the proper positions thereof.

Another object of the present invention resides in the provision of a pneumatic control system for automatically controlling the cycling operation of the packing machaine in a reliable and safe manner, and to prevent faulty operation thereof.

A further object of the present invention resides in the provision of a case feeding arrangement operative to feed the empty bottle cases into the packing machine in the required manner.

A still further object of the present invention is the provision of a simple control system including pneumatic and electric controls for operating the feed system for the empty bottle cases feeding the same into the packing machine to be filled thereat with the filled and capped bottles.

Still another object of the present invention resides in the provision of a packing machine provided with a bottle-gripping head in which the individual bottle gripping cups may be readily replaced and interchanged, for example, in case of defects or repairs or to adapt the machine to other objects to be packed.

Still a further object of the present invention is the provision of a bottle-gripping head provided with bottle-gripping cups which may be readilyconverted into a system automatically detecting defects in the quantity as well as in the quality of the individual bottles.

Another object of the present invention resides in the provision of a packing machine for packing bottles into empty cases which is automatically controlled and which prevents in a very reliable manner any faulty operations thereof.

These and other objects, features and advantages of the present invention will become apparent from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, one embodiment in accordance with the present invention and wherein:

FIG. 1 is a partial perspective view of the overall construction of the packing machine in accordance with the present invention illustrating the main components thereof which transfer the filled bottles from a bottle conveyor track into an empty case disposed on a case conveyor track by means of a bottle-gripping head mounted and guided on the frame structure of the machine;

FIGURE 2 is a schematic top plan view showing a section of the bottle conveyor track and the automatic distributor arrangement thereof in accordance with the present invention;

FIGURE 3 is a partial perspective view of the bottle conveyor track, the case conveyor track, and the bottle-gripping head in its various operating positions in relation to certain cam actuating members and to the conveyor tracks;

FIGURE 4 is an enlarged elevational view of an impulse control valve for the pneumatic control system in accordance with the present invention;

FIGURE 5 is a partly schematic diagrammatic view of the control system in accordance with the present invention for effecting the horizontal movement of the bottle-gripping head showing certain parts thereof in cross section on an enlarged scale for purposes of clarity;

FIGURE 6 is a partly schematic diagrammatic view of the bottle-gripping head in side elevational view and partly in section and indicating the operative connection thereof illustrated schematically with the different valves forming part of the pneumatic control system effecting the vertical movement of the bottle-gripping head;

FIGURE 7 is a perspective enlarged view of a cam arrangement forming part of the bottle-gripping-head control system in accordance with the present invention;

FIGURE 8 is a schematic diagrammatic view, showing certain of the operating members in cross section on an enlarged scale, of the control system cooperating with the cam arrangement of FIGURE 7;

FIGURE 9 is a vertical cross-sectional view, on an enlarged scale, through a bottle-gripping cup in accordance with the present invention;

FIGURE 10 is a somewhat schematic side-elevational view of the forward conveying system for the empty and filled cases in accordance with the present invention;

FIGURE 11 is a top plan view of the forward conveying system illustration in FIGURE 10; and

FIGURE 12 is a schematic perspective view of the forward conveyor system for the cases used in the packing machine in accordance with the present invention.

The packing machine in accordance with the present invention comprises a first conveyor track, which will be referred to hereinafter as the bottle conveyor track, on which bottles are moved forwardly in irregular sequence to an end station, located within the packing machine, and another conveyor track, which will be referred to hereinafter as the case conveyor track, on which cases are also moved forwardly in an irregular sequence to the filling station also located within the packing machine in accordance with the present invention. Additionally, the packing machine in accordance with the present invention includes a bottle-gripping-head which, in the course of an operating cycle, is actuated and moved in such a manner that the bottles on the first conveyor track, i.e., on the bottle conveyor track, are gripped by the bottle-gripping-head, are thereupon transported from the bottle conveyor track to the case conveyor track, and, there-

after, are placed into an empty case disposed on the case conveyor track within the filling station.

Additionally, control devices are provided in the packing machine according to the present invention for initiating the operating cycle from an initial position of the various parts thereof in which the bottle-gripping-head had been stopped upon completion of the previous operating cycle if such stoppage is occasioned, for instance, by idling or faulty operational conditions of the packing machine.

The operating cycle of the packing machine in accordance with the present invention is subdivided into two consecutive periods, namely into a first period in which the bottles are gripped by the bottle-gripping-head and are transported to an intermediate position and into a second period in which the bottles are transported from this so-called intermediate position over to the empty case awaiting the bottles within the filling station and the actual emptying or filling of the bottles down and into the empty case. The first operating period is thereby controlled by control devices which are effected or actuated by the bottles through impulse control devices and are placed into operation when all of the impulses necessary for proper operation thereof are received so as to indicate thereby that a sufficient supply of bottles, i.e., the prerequisite number of bottles is available for packing purposes. Accordingly, one of the primary objects of the present invention is to achieve an effective control for the packing machine.

Another feature of the present invention resides in the fact that the aforementioned second period is initiated or actuated by governing or control devices in such a manner as to constitute a continuation of the first period which control or governing devices in turn are actuated by impulse control devices receiving the corresponding control impulses from an empty case when in the proper position on the case conveyor track at the filling station. It is, therefore, an additional object of the present invention and a requirement for proper operation of the packing machine in accordance with the present invention which automatically packs a predetermined number of bottles, for example, twenty-four in number, into a case located at a predetermined position on a conveyor track within the machine, that the empty cases are brought forward or supplied to this position in a manner which is as continuous as possible so that the empty cases will not accumulate and cause mutual interference and disturbance in case the operation of the packing machine per se should stop for any reason whatsoever.

Accordingly, it is also a purpose and object of the present invention to provide an effective forward conveying or feed system for the empty cases through the packing machine in accordance with the present invention which packs a predetermined number of bottles or the like into each case whereby the forward conveying or supply system of the cases is so controlled that the empty cases are only moved or conveyed in the forward direction thereof when such forward conveyance cannot disturb or impair the smooth flow and even movement of the cases through the packing machine.

For that purpose, the present invention provides a control system for bringing forwardly or supplying empty cases into the packing machine in which the empty cases to be filled within the packing machine with objects, such as bottles, are conveyed to a packing point or station within the machine where the empty case is automatically filled and then continues its forward transportation, and in which the transportation of the filled cases away from the packing point is automatically released or initiated by the weight of the filled case to actuate a trip starting mechanism in the form of a catch lever. The trip starting mechanism including the catch lever, according to another feature of the present invention, is provided additionally with an impulse control device which upon release of the filled case, i.e., when the case no longer rests against the catch lever, will initiate the resumed conveyance of empty cases for further transportation into the packing machine, and more particularly, to the packing point thereof.

The present invention also relates, in its more general aspect, to the control of those machines and apparatus which are operative, by the use of a pneumatic medium under pressure, such as compressed air, to perform working operations on certain goods as soon as certain prerequisite conditions have been complied with.

In the automatic operation of industrial plants, it happens oftentimes that one kind of goods or materials will be supplied to a particular machine which will also receive, at some other time, some other kind of goods or materials upon which this same machine will also perform a working operation that will act simultaneously only on a certain quantity of each. As a typical example of this general type of machines may be mentioned packing machines where the produced and/or processed goods are supplied to the packing machines, for example, on a conveyor belt while the machine is also supplied at the same time with packaging means, for example, on another conveyor belt onto which a certain number or a certain quantity of the produced or processed goods is transferred by a packaging head or the like from the goods conveyor belt to the packaging means on the packaging conveyor belt.

Experience has taught that not even in the best-organized industrial plants will the flow of goods run evenly and continually at all times. Consequently, every automatic working operation for such machines or installations calls for an appropriate control system which will start the operating cycle only on the condition that certain prerequisite requirements have been met. When packing, for example, objects brittle in packaging, it will be necessary that the working operation will be performed only if the correct number of undamaged objects are present and that the packaging means will be in the correct position within the packaging means.

Accordingly, the present invention also aims at producing a very simple system for the control of such interrelated working operations where the operation will only be performed when several prerequisites have been complied with.

The control system with which the present invention is concerned is of the type in which compressed air is supplied to the pneumatic devices which operate or initiate the different steps of the operation thereof by means of suitable slide valve control devices, the piston-type or spool-like slide members of which reciprocate between two end positions of which one may be, for instance, an active position and the other an inactive position or in which both positions may be active positions.

According to the present invention, the piston- or spool-type slide member of a slide valve is caused to be moved from one end position thereof to the other by a pressure chamber, located at one end of the slide member which is supplied with compressed air connected in a line system in parallel with the compressed air supply leading to the impulse control valves so as to cause an increase in pressure or over-pressure in this chamber, in case and only in case all of the respective impulse control valves are closed.

The impulse control valves according to the present invention are thereby so interconnected with each other that the corresponding valve is closed at the exact moment the condition has been complied with at those points of the operating cycle where this condition has to be complied with, and is opened again when this condition no longer exists. The opposite end of the control valve in accordance with the present invention may be either spring-loaded to obtain the return movement thereof or may be so constructed as to form a pressure chamber operative to effect the return movement by compressed air within this pressure chamber.

According to another feature in accordance with the present invention, this last-mentioned end of the control slide valve may, in other cases, have a greater or smaller pressure surface than the first-mentioned end thereof. In case the pressure surfaces of the spools of the slide valve assemblies are of different sizes, i.e., where one of the slide members has a greater pressure surface, closure of the impulse control valve in parallel with the other pressure chamber will immediately cause the slide assembly to be moved to the opposite end position thereof. On the other hand, where the pressure surfaces are essentially the same, the slide member will be moved to the opposite position thereof only when one of the impulse control valves connected with the first pressure chamber is effectively opened.

GENERAL DESCRIPTION

Bottle supply system

Referring now to the drawing wherein like reference numerals are used throughout the various views to designate corresponding parts, and more particularly to FIGURE 1 thereof, reference numeral **42** generally designates a roller-type conveyor section by which an empty case is carried forward into a position corresponding to a predetermined packing position and is stopped thereat by devices not shown in this view. The control devices stopping the empty cases and releasing the same upon being filled by the weight of the case in such a manner that each case will be stopped in the proper position thereof within the packing machine for filling while being empty, and for being thereupon carried forwardly by the rollers **42** as soon as it is filled will be more fully described hereinafter by reference to FIGURES 10, 11 and 12.

An impulse control valve **57**, which is not shown in FIGURE 1 and which is illustrated in detail in FIGURE 8 and shown again schematically in FIGURE 12 of the drawing, is actuated by an empty case and is released as soon as the case is filled with the required number of bottles as will become more apparent from the detailed description in connection with FIGURES 10 through 12.

It is also understood that the control devices for moving forward the empty and filled cases as well as the controls for each individual case may be designed and constructed in any suitable appropriate manner known in the prior art, one embodiment thereof being specifically illustrated and described hereinafter by reference to FIGURES 10 through 12.

As a rule, twenty-four half-bottles are packed in an upright position in each empty case so that there are four parallel rows of bottles with six bottles in each row in each case when filled. As shown in FIGURES 1 and 2 of the drawing, four parallel bottle conveyor tracks **61**, **62**, **63** and **64** are provided at the packing machine in accordance with the present invention whereby each track supplies bottles to the machine. Actually, in some instances, the bottles may be supplied onto each of these four tracks **61**, **62**, **63** and **64** from individual bottling and capping apparatus of which a corresponding number would be provided in that case. However, the multiplicity of bottling and capping apparatus is in fact unnecessary, because, as illustrated in FIGURE 2, a single main supply track **65** may be utilized which splits into two branch tracks **66** and **67**, and which, in turn, splits again into the four bottle conveyor tracks **61**, **62**, **63** and **64** so that the same are supplied from a single main track **65** in the construction according to the present invention.

A triple-armed control rocker member generally designated by reference numeral **69** (FIGURE 2) which is pivotal about a vertical axis or shaft **68** may be provided therefor in front of the main entrance to the first bifurcation leading into branch tracks **66** and **67**. The triple armed control rocker member (control arm) **69** which is pivotally mounted about the pivot axis **68** thereof is provided with a blocking arm portion **69'** extending in a direction away from the pivot shaft **68** opposite the direction of movement of the conveyor system **74** indicated by arrow A. The triple-armed rocker member **69** additionally includes two uniform obliquely shorter control arm portions **70** and **71** which point in the opposite direction from arm portions **69'**, i.e., in the direction from pivot shaft **68** thereof corresponding to the direction of movement indicated by the arrow A. The main control arm portion **69'** thereby operates as switching arm whereas the shorter arm portions **70** and **71** of the triple-armed rocker member **69** act as control members.

As soon as a bottle reaches the branching point where the main conveyor track **65** splits into the two branch tracks **66** and **67**, the main control arm **69'** will be disposed in such a manner as to block one of the branch tracks, for example, branch track **66** in the position illustrated in FIGURE 2. As a result thereof, the bottle will be moved forwardly into the initial portion of the other branch track **67**. However, when this bottle has moved a sufficient distance onto this branch track **67**, the bottle will come in contact with the corresponding control arm portion **71** whereby the rocker member **69** is rotated about the pivot **68** thereof in a clockwise direction as seen in FIGURE 2 so that the control arm **69** will swing over to block the branch track **67** for the next bottle. Consequently, the branch track **67** onto which the bottle has just been conveyed is thereby blocked so that the next bottle in turn will be conveyed onto the first branch track **66**. It is quite obvious that this arrangement will convey the bottles in a continuous stream alternately to each of the two branch tracks **66** and **67**.

Each of the two branch tracks **66** and **67** terminates in a corresponding bifurcation provided with a distributor device **72** and **73**, respectively, which is identical or equivalent to the triple-armed rocker member **69** both as to construction and/or operation so that a continuous stream of bottles derived from a single bottling and capping point over main track **65** will be distributed evenly into the four individual tracks **61**, **62**, **63** and **64** by the arrangement illustrated in FIGURE 2 with every fourth bottle from the bottling and capping apparatus arriving on the same track.

The bottle conveyor track includes an endless, moving belt generally designated by reference numeral **74** (FIGURES 1 and 2) which carries along the upper side thereof guide members **75** and **75'** of any suitable construction which branch off into the respective tracks. However, along the last section of the case conveyor track **74**, the center guides **75'** are preferably of greatly reduced dimension in order to enable the bottles to move as close together into the position relative to each other which they must assume in the case in which they are to be packed.

An impulse control valve **76**, **77**, **78** and **79** is disposed at the end of each row or track **61**, **62**, **63** and **64**, respectively, (FIGURES 1 and 5) against which the first bottle in each row of the conveyor tracks **61**, **62**, **63** and **64** presses with a predetermined force. The impulse control valves **76**, **77**, **78** and **79**, which are preferably of identical construction and which will be described more fully hereinafter, are spring loaded in such a manner that it will take a minimum of six bottles in each single row or track **61** through **64** in order to actuate a respective one of these impulse control valves. Preferably, however, a spring stiffness is selected which is somewhat greater, for instance, in such a way that each control valve is actuated only by the presence of eight bottles in a row.

The impulse control valves **76**, **77**, **78** and **79** will initiate the movement and gripping operation of the bottle-gripping-head **103** as soon as all of these impulse control valves are actuated by the correct number of bottles in each of the rows or tracks **61** through **64** as will appear more fully hereinafter in connection with the description of the control system.

Bottle-gripping-head system

At one point in the conveyor system, and more particularly where the conveyance or transportation of the individual bottles ends within the packing machine, a framework generally designated by reference numeral **100** is provided (FIGURE 1) which includes two horizontal guide rods **101** and **102** at the top thereof for guiding therealong the bottle-gripping-head **103** horizontally back and forth from an initial position I (FIGURE 3) corresponding to one end position of the operating cycle in which the bottle-gripping-head **103** is disposed directly above an empty case in the waiting position thereof on the case-conveyor-track, waiting thereat to be filled with bottles, into another position II (FIGURE 3) corresponding to another end position in the operating cycle in which the bottle-gripping-head **103** is disposed directly above the first six bottles in each of the four single tracks **61**, **62**, **63** and **64**. The horizontal movement of the bottle-gripping-head **103** takes place by means of pistons **104** (FIGURE 5) reciprocating in two parallel-acting, horizontally disposed pneumatic cylinders **105** (FIGURES 1 and 5). Additionally, the bottle-gripping-head **103** is carried on a piston assembly **106**, **106'** (FIGURES 1 and 6) adapted to move in a vertically disposed pneumatic cylinder **107** which is operative to lower the bottle-gripping-head **103** into a lower position thereof corresponding to the position III (FIGURE 3) from the end position II thereof to thereby enable gripping of the bottles disposed on the tracks **61** through **64**, and thereupon lifting the same to the end position corresponding to position IV (FIGURE 3). The bottle-gripping-head **103** thereupon moves or transports the bottles in a firmly gripped manner from position IV over to the end position designated by position V (FIGURE 3) by actuation of pistons **105** in cylinders **104**. While in the end position V (FIGURE 3), the bottle-gripping-head **103** is lowered again by the piston-cylinder assembly **106**, **106'**, **107** into another lower position designated by VI (FIGURE 3) whereby the bottles are lowered into the awaiting empty case, and are thereafter emptied into this case, whereupon the bottle-gripping-head **103** returns in the empty condition thereof to the first end position designated by I (FIGURE 3). The foregoing briefly describes the six main or end positions designated by I, II, III, IV, V and VI into which the bottle-gripping-head **103** is moved sequentially during an operating cycle, whereby positions I and V correspond to the first end position and positions II and IV to the second end position of the bottle-gripping-head **103** in the horizontal movement thereof along guide rails **101**, whereas the positions III and VI correspond to the lowered positions of the bottle-gripping-head **103** into which the bottle-gripping-head **103** is lowered from the end position II and V, respectively, and out of which the bottle-gripping-head **103** is raised again into the respective positions IV and I. The actual control for achieving these various positions will be described more fully hereinafter.

The various positions I through VI appear more clearly in FIGURE 3 of the drawing.

The foregoing also indicates that the movement of the packing member or bottle-gripping-head **103** has its starting point in position I during the operating cycle in which the movement of the bottle-gripping-head **103** is actuated or effected by the impulse control valve **108** (FIGURES 4 and 5) which carries a pivot arm **109** (FIGURE 4) adapted to rotate about a pivot pin **110**. The outer free end of the pivot arm **109** is actuated by the projection **111** at the bottle-gripping-head **103** in such a manner that the pivot arm **109** is pivoted or swung counterclockwise in a direction that will cause valve **108** to be actuated or effected thereby only when the bottle-gripping-head **103** together with the projection **111** thereof moves upwardly from a lowered position; however, as the bottle-gripping-head is lowered the projection **111** actuates the arm **109** in a direction that swings pivot arm **109** clockwise, i.e., away from the impulse control device of the valve **108** whereby the impulse control device **108** remains unaffected. A return spring **112** urges the pivot arm **109** back to an intermediate position thereof so as to be ready to be moved to the release position thereof as soon as the projection **111** has been moved downwardly a certain distance. In order to facilitate the circumventing movement of the pivot arm **109**, the outer end of the pivot arm **109** is provided or constructed as a coil spring **113**.

The impulse control valve **108** (FIGURE 5) is operatively connected over line or conduit **181'** with the four impulse control valves **76** through **79** arranged in the four bottle tracks **61** through **64** respectively, which are actuated by the bottles in these tracks, and, more particularly, is connected with the impulse control valves **76** through **79** in such a manner that when and only in case when all five valves **76** through **79** and **108** are actuated, and only in such a case, compressed air will be supplied to the two cylinders **105** which act in parallel to thereby move the bottle-gripping-head **103** from the starting position I to the position II thereof. The details of operation of how this is achieved will be described more fully hereinafter by reference to a complete description of FIGURE 5. As the bottle-gripping-head **103** moves from position I into the position II, a slidable rod **115** extending outwardly from the bottle-gripping-head **103** in a direction corresponding to the direction of movement of the conveyor belt **74** is adapted to come into contact with a cam face formed by a cam plate **114** (FIGURES 1, 3 and 6) adapted to rotate about a horizontal pivot pin (FIGURE 3) upwardly from the horizontal position thereof in any suitable manner. If the cam face **114** is in proper place, it will come into contact with the slidable rod **115** and will press the same axially inwardly as the bottle-gripping-head **103** reaches the position II. This in turn will open a valve generally designated by reference **116** (FIGURE 6) which is operative to permit the escape of air from the lower side or working chamber **107'** of the piston **106'** reciprocating within the vertical pneumatic cylinder generally designated by reference numeral **107**, whereby the bottle-gripping-head **103** is lowered in the direction towards the neck of the bottle into the position III thereof.

The underside of the bottle-gripping-head **103** carries a predetermined number of bottle-gripping cups **117** which corresponds to the exact number and ultimate disposition of the bottles in the case to be filled. The details and construction of each bottle-gripping cup **117** will be described more fully hereinafter by reference to FIGURE 9.

The bottle-gripping-head **103** is provided with another axially sliding rod **118** (FIGURES 1 and 3) adapted to cooperate with a relatively stationary cam face **119** (FIGURES 3 and 6) suitably secured on a relatively stationary part of the packing machine such as the frame (**100**) thereof and which is so constructed and arranged as to actuate the axially sliding rod **118** when the bottle-gripping-head **103** is lowered into the position III thereof from the position II thereof. Actuation of the axially sliding rod **118** causes a control slide valve generally designated by reference numeral **120** (FIGURE 6) to admit compressed air to the individual bottle-gripping cups **117** which in the meantime had been lowered so as to assume their respective positions around each bottle-neck whereby each of the cups **117** is operative to grip one bottle. The compressed air is thereby supplied from any suitable source such as a tank or compressed air reservoir fed by a compressor of any appropriate construction over a supply or input line **154** (FIGURE 6) which is in communication with the cylinder space of cylinder **120** over a branch line **154'**. The cylinder **120** is operatively connected with the individual cups **117** of the bottle-gripping-head **103** over a line **321**, and is also operatively connected over a line portion **321'** in series with the line **321** with a cylinder **121** (FIGURE 6) which is, therefore, supplied with compressed air at the same time compressed air is supplied to the bottle-gripping cups **117**. The cylin-

der 121 includes a piston member 122' normally spring-loaded by a coil spring 121' so that the piston member 122' normally assumes the upper position thereof as viewed in FIGURE 6. The piston member 122' is provided with a piston rod 122 which, in turn, includes a cam portion 123 adapted to cooperate with a roller-type cam follower 124' rotatably mounted at the end of sliding rod 124 so as to return the valve generally designated by reference numeral 116 to a position thereof whereby compressed air is again supplied to the lower side or working chamber 107' within the vertically arranged cylinder 107 over line 156.

This is accomplished by the operative engagement of the cam portion 123 suitably mounted or provided at the piston rod 122 which during the downward movement of the piston member and piston rod assembly 122', 122 comes into operative engagement with the cam follower 124' mounted at the end of the piston rod 124 as soon as compressed air is supplied over line 321' and line 321 from the cylinder 120 to the upper space of the cylinder 121 whereby the axially-movable sliding rod 124 is displaced in the axial direction thereof toward the left into the position thereof illustrated in FIGURE 6. As is quite clearly visible from FIGURE 6, the piston rod 124 effects axial displacement of the slide assembly including piston rod 151 and spool members 151' and 151'' within cylinder 116 in a direction opposite to that described hereinabove when the axially displaceable sliding rod 115 came into operative engagement with cam plate 114. The details of the operation in proper sequence will be described more fully hereinafter. It suffices for the present purposes to mention that the operative engagement of the cam portion 123 with the cam follower 124' applies compressed air from the compressed-air supply line 154 over cylinder 116 and line 156 to the lower side 107' of the vertically disposed cylinder 107 whereby the piston member 106' together with the piston rod 106 and therewith the bottle-gripping-head 103 is again lifted, however, at that time with the bottles firmly gripped by the individual respective bottle-gripping-cups 117 to which compressed air is now supplied also over line 321, valve 120 and line 154'.

As the bottle-gripping-head 103 is lifted in the manner described hereinabove, the axially sliding rod 115 which previously by engagement with the cam member 114 was operative to place the piston-like spool members 151' and 151'' within cylinder 116 into such a position that the bottle-gripping-head 103 had been lowered, again had been moved outwardly in the axial direction thereof by the intervening interaction between cam member 123 and cam follower 124', i.e., in the left direction as viewed in FIGURE 6. Consequently, the axially slidable rod 115 will abut against the underside of the plate or cam member 114 as the bottle-gripping-head 103 is lifted thereby lifting or swinging the cam plate 114 upwardly so as not to move the axially slidable rod 115 into a position which would cause lowering of the bottle-gripping-head 103. In other words, during upward movement of bottle-gripping-head 103, the cam plate 114 will not actuate the sliding rod 115.

An impulse control valve 125 is provided at the right end of the horizontal trajectory or path of the bottle-gripping-head 103 as viewed in FIGURES 1 and 5 which is of identical construction as the impulse control valve 108 mentioned hereinabove. FIGURE 1 clearly shows the respective positions of the pivot arms 109 and 125' of the impulse control valves 108 and 125 which are mounted in the horizontal path of the bottle-gripping-head 103, for example, on the horizontal strut 101' disposed below the tubular frame member 101 and interconnecting the downwardly bent leg portions thereof. The impulse control valve 125 which is identical with the valve 108 is operative in such a manner that it will be actuated or affected when the bottle-gripping-head 103 moves from the lowered position III thereof to the upper position IV thereof (FIGURE 3) whereas it remains, in contrast thereto, unaffected when the bottle-gripping-head 103 is moved or displaced horizontally from the inital position I directly above the case conveyor 42 to the position II thereof directly above the bottle conveyor 74 and thereupon vertically from position II to position III. The impulse control valve 125 is interconnected in the control system in such a manner that when it is actuated it will provide a supply of compressed air to the horizontal compressed-air cylinders 105 (FIGURES 1 and 5) in order that the bottle-gripping-head 103 will be displaced from its position IV directly above the bottle track 74 into the position V directly above the case track 42. Obviously, the bottles now move along with the horizontal movement of the bottle-gripping-head 103 since they are firmly gripped by the bottle-gripping-cups 117 which remain supplied with compressed air during this movement. Furthermore, by suitably arranging the actuating lever 125' of the impulse control valve 125 in the path of the bottle-gripping-head 103 it can be so arranged that it will be actuated only during the upward movement of the bottle-gripping-head 103 from the position III thereof when it arrives about in position IV thereof but not during the downward movement thereof.

As the bottle-gripping-head 103 approaches the end of the horizontal trajectory or movement from the position IV into the position V thereof, the axially sliding rod 115 comes into the path of a cam arrangement 129 which is shown on an enlarged scale in a perspective view thereof in FIGURE 7, and which acts on the axially sliding rod 115 in a manner corresponding to the cam plate 114. In other words, as soon as the axially sliding rod 115 comes into engagement with the cam arrangement 129 illustrated in FIGURE 7, the axially sliding rod 115 is pushed axially inwardly in the direction of the cylinder 150, i.e., in the right direction as viewed in FIGURE 6, whereupon the lower cylinder space 107' within cylinder 107 disposed below the cylinder member 106' is placed into communication with the discharge line 155 over the line 156 so that the bottle-gripping-head 103 is lowered in the position VI thereof. The cam arrangement 129, however, is so constructed as to actuate rod 115 only if at the same time an empty case is in the proper position on the case conveyor track 42 to receive the bottles firmly gripped by the individual bottle-gripping cups 117. If no empty case is in the proper position on the case conveyor track 42 ready to be filled with the bottles held by the bottle-gripping cups 117, the bottle-gripping-head 103 will remain in the position V thereof with the bottles firmly gripped by each of the bottle-gripping cups 117 until an empty case actually arrives in position on the case conveyor track 42. The axially sliding rod 115 will then be actuated by the cam arrangement 129 illustrated in FIGURE 7, as will appear more fully hereinafter, as soon as the empty case arrives in the proper position thereof whereupon the bottle-gripping-head 103 is lowered into position VI thereof.

This sequence of operation is achieved by the aforementioned impulse control valve 57 (FIGURES 8 and 12) which is operative to effectively supply compressed air from the compressed air input or supply line 356 (FIGURE 8) over the control slide valve generally designated by reference numeral 126 to the compressed air cylinder 127 (FIGURES 7 and 8) which is operatively connected with the control slide valve 126 by a line 357. A piston member 128' adapted to reciprocate within the cylinder 127 is mounted on a piston rod 128 which in turn is operative to move a vertically movable cam plate 129 inwardly and outwardly into the path of the axially sliding rod 115 in a horizontal direction. The cam plate 129, as mentioned hereinabove, in that case actuates the axially sliding rod 115 (FIGURES 6 and 7) by axially displacing the same inwardly in the direction toward the cylinder 150 thereof if the axially sliding rod 115 has already arrived in a position in front of the cam face of cam plate 129. If, however, the axially sliding rod 115 has not yet

arrived in front of the cam face of cam plate **129**, the outer end of the axially sliding rod **115** will be pushed or axially moved inwardly by the cam face of the plate **129** as soon as the bottle-gripping-head **103** arrives in that position. For the same reason that cam plate **114** is suspended or mounted so as to be capable of sliding or pivoting upwardly and downwardly, as mentioned hereinabove, the cam plate **129** is also mounted in such way as to be capable of sliding vertically upwardly on the end of the piston rod **128** by the use of a vertical support pin **130** secured to plate **129** which is slidably fitted into or received in a guide bore provided in bracket plate **131** which in turn is suitably secured to be the end of the piston rod **128**. Simultaneously therewith, an extra safeguard in the form of a rotating plate **132** is provided which is held by gravity in a rotary position thereof in which it abuts against the underside of the cam plate **129** but which is adapted to be pivoted downwardly by the end of the axially sliding rod **115** when the latter is pushed down. As soon as the axially sliding rod **115** has passed the rotary blocking plate **132**, the latter will tilt back to its normal position under gravity abutting against the underside of the cam plate **129** regardless of whether the cam plate **129** has or has not been axially moved outwardly by the piston member **128'** disposed within cylinder **127** (FIGURE 7). This arrangement is to prevent the forward movement of an empty case which would cause cam plate **129** to be pressed outwardly by the supply of compressed air in the cylinder **127** exactly at the moment when the bottle-gripping-head **103** is lifted into the upper position 1 thereof.

As mentioned hereinabove, an axially inward displacement of the axially sliding rod **115**, i.e., a movement thereof toward the right as viewed in FIGURE 6, causes the bottle-gripping-head **103** with the bottles suspended therein to be lowered since the control valve **116** is thereby actuated to cause a discharge of the compressed air within cylinder **107** below the piston member **106'** through the line **156** and discharge line **155**. When the bottoms of the bottles are in proper position directly above the bottom of the case disposed therebelow, a cam face **133** (FIGURE 3) will come into operative engagement with a rod **134** (FIGURES 3 and 6) which is secured to the opposite end of the valve sliding assembly **320, 320'** and **320''** which itself is operative to control the supply of compressed air to the bottle-gripping-cups **117** over line **321** as mentioned hereinabove. As a result of the actuation of the axially sliding rod **134** by engagement with the cam **133**, the axially sliding rod **134** is moved in the axially inward direction toward the cylinder **120**, i.e., toward the right as viewed in FIGURE 3 and in the upward direction as viewed in FIGURE 6, whereupon the control slide valve assembly **320, 320', 320''** is moved into a position in which the air is released from the bottle-gripping cups **117** over line **321** and discharge line **322**. Consequently, the bottles are released as soon as the pressure is removed from the bottle-gripping cups **117** and the bottles are permitted to drop just a short distance which is insufficient to damage the bottles but which, at the same time, is sufficient for the bottle necks to clear the bottle-gripping cups **117** when the filled case now moves forwardly on the case conveyor track **42** as will be described more fully hereinafter. Springs (not illustrated) may also be used in any suitable manner to contribute to the absorption of any shocks or bumps to which the bottles may be subjected when they are being let down into the empty case as soon as the cups **117** release the bottle necks.

At the same time as the air is permitted to escape from the bottle-gripping cups **117** over line **321** and discharge line **322**, air is also permitted to escape from the upper cylinder chamber of cylinder **121** whereupon the piston **122'** and piston rod **122** including the cam portion **123** thereof will be moved back in the upward direction within cylinder **121** by the coil spring **121'** whereby the cam follower **124'** and therewith the axially sliding rod **124** and the slide valve assembly **151, 151', 151''** is moved axially toward the left as viewed in FIGURE 6 so that compressed air from supply line **154** is again permitted to reach the lower cylinder chamber **107'** in cylinder **107** over line **156** whereby the bottle-gripping-head **103** is again raised or lifted. The bottle-gripping-head **103** thereby returns to the first position I thereof which is the initial position of the cycle of operation. The cycle of operation will then repeat itself.

Pneumatic control system for bottle-gripping-head assembly

It has been mentioned by way of introduction, and it has also been referred to hereinabove in this description that the packing machine in accordance with the present invention is pneumatically operated, i.e., is operated by the aid of cylinders and reciprocating pistons, the piston rods of which move or displace the respective parts of the packing machine to and fro as the case may be. In general, the cylinders used in connection with the pneumatic control system of the present invention are supplied with compressed air over control slide valves which may be either cam or impulse actuated.

Referring now to FIGURE 6 which illustrates the two cam-actuated valves generally designated by reference numerals **116** and **120** of the system in accordance with the present invention, and more particularly the control slide valve **16** operative to control lifting and lowering the bottle-gripping-head **103**, and the control slide valve **120** operative to selectively supply or discharge compressed air from the gripping cups **117**, each valve, includes a sliding member provided with two spools or piston members. The control slide valve **116** includes a piston rod or slide member **151** provided with two spools or piston members **151'** and **151''** whereas the control slide valve **120** includes a sliding member or piston rod **320** provided with two spools **320'** and **320''** rigidly mounted thereon. The contract slide assembly **151, 151'** and **151''** carries at each end thereof an outwardly extending rod **115** and **124** which are actuated by cams **114** and **129** and by cam **123**, respectively. The cylinder casing **150** of valve **116** is provided with an inlet aperture or port essentially in the center thereof in which terminates the supply line **154** for supplying compressed air. A discharge line **155** is provided near one end of the casing **150**. Intermediate the point of connection of the discharge line **155** and of the supply line **154**, a connecting line **156** terminates in the casing **150** which line **156** leads to the lower working chamber **107'** of cylinder **107** to be controlled thereby. The connecting line **156** is thereby so arranged and located in the casing **150** of the control slide valve **116** that when the slide assembly **151, 151', 151''** is moved to one end position thereof within the casing **150**, for instance, when being forced toward the left by the abutment of cam portion **123** against the cam follower **124'** on the sliding rod **124**, the compressed air supply line **154** is placed into communication with the connecting line **156** leading to the respective cylinder chamber **107'**. As soon as the slide assembly **151, 151', 151'', 124** and **115** is pressed or displaced in the opposite direction, for example, by engagement of the rod **115** with the cam member **114**, i.e., into the right end position thereof within casing **150**, the air connecting line **156** is effectively brought into communication with the discharge line **155** which discharges, for example, into the open air whereby the pressure medium in the cylinder **167**, and more particularly in the lower cylinder section **107'** is permitted to escape. Any suitable throttling device which may be adjustable may be inserted thereby into discharge line **155** or possibly also into connecting line **156** to control the rate of descent of the bottle gripping head **103**. The compressed-air supply line **154**, under

these operating conditions, with the slide assembly **151**, **151'**, **151''** in the right end position thereof, is effectively connected only with a closed chamber formed between the two spools **151'** and **151''**. Since the two spools **151'** and **151''** are of the same size, the compressed air will exert no displacing force on the slide assembly **151**, **151'**, **151''** which will, therefore, remain in this position until it is again displaced by engagement of a respective cam portion with the corresponding actuating or sliding rod.

The operation of the control slide valve **120** is similar to that of control slide valve member **116**. The slide assembly includes a sliding rod **320** and two spools **320'** and **320''** to which are secured the sliding rods **113** and **134**. The casing **120'** is provided essentially in the center thereof with suitable means providing a connector with the compressed-air branch line **154'** which thereby supplies compressed air from the reservoir or compresssor over line **154** and **154'** to the cylinder casing **120'**. Near one end of the casing **120'**, i.e., near the lower end thereof as seen in FIGURE 6 and physically near the end which is valved by the spool **320''**, a discharge **322** is provided which leads into the atmosphere. Intermediate the point of connection of the supply line **154'** and of the discharge line **322** a connecting line **321** terminates within casing **120'** which leads to the individual bottle-gripping-cups **117** and which is so arranged and located within the casing **120'**, that in one end position, for example, in the end position of the slide assembly **320**, **320'**, **320''** illustrated in FIGURE 6 which is the upper end position thereof and which is caused by the abutment of the rod **134** with the cam face of cam member **133**, moving the slide assembly **320**, **320'** and **320''** axially upwardly as viewed in FIGURE 6, the connecting line **321** is effectively placed into communication with the discharge line **322** whereupon the bottle-gripping-cups **117** are without compressed air, and, therefore, are unable to grip the necks of any bottles. As soon as the actuating rod **118** of the slide assembly **320**, **320'** and **320''** comes into abutment with the cam face of cam member **119** thereby displacing the slide assembly **320**, **320'** and **320''** in the opposite direction, i.e., in the downward direction as viewed in FIGURE 6, the supply line **154'** supplying compressed air is placed into communication with the connecting line **321** whereby the bottle-gripping-cups **117** are supplied with compressed air and are operative to grip the bottle necks.

Since both spools **320'** and **320''** are of the same size, the slide assembly **320**, **320'**, **320''**, **134** and **118** will not change its position from that it assumes when pushed upwardly, as viewed in FIGURE 6 into the position illustrated therein, since the supply line **154'** effectively supplies compressed air into a closed chamber formed between the two spools **320'** and **320''**.

In addition to the pneumatic control system illustrated in FIGURE 6, the packing machine in accordance with the present invention includes a further pneumatic control system including a different type of control slide valve assembly, illustrated in FIGURE 5 and which will be described now in greater detail. The slide valve assembly generally designated by reference numeral **159** in FIGURE 5 includes a casing or housing **159'** provided with a central bore **160** in which is slidingly disposed a slide assembly generally designated by reference numeral **161** and provided with four spools **162**, **163**, **164** and **165**. An enlarged chamber **166** and **167** each accommodating therein a reciprocating piston **168** and **169** is in communication at each end with the central bore **160**. Each piston **168** and **169** is provided with a stem-like piston rod **170** and **171**, respectively, which is of such diameter as to be axially slidable within corresponding bores provided in the end portions of the slide assembly **161**.

The two outermost spools **162** and **165** of the slide assembly **161** merely serve to govern or control the same since they are provided with small bores establishing a communication between a respective chamber and the space between two adjoining spools **162** and **163** and two adjoining spools **164** and **165**, respectively.

Equidistant from the ends of central bore **160** is provided a supply port **172** for supplying compressed air to the casing **159'** while a first compressed air connecting port **173** and a first air discharge port **174** are provided in the left portion of casing **159'** intermediate the left end of the bore **160** and the port **172**. A second compressed-air connecting port **175** and a second air discharge port **176** are provided between the centrally disposed compressed air inlet port **172** and the right end of the central bore **160**. The two compressed-air connecting ports **173** and **175** are located within the casing **159'** in such position that when the slide assembly **161** is in one end position thereof, for instance, in the left end position as viewed in FIGURE 5, a communication is established between the supply inlet port **172** and the first connecting port **173** through the space between the two spools **163** and **164** while the second connecting port **175** is placed into communication with the second air discharge port **176**. After the slide assembly **161** is moved to the opposite end position thereof, the space between the spools **163** and **164** now establish a communication between the supply port **172** and the second connecting port **175** while the first connecting port **173** is placed into communication with the first outlet or discharge port **174**.

Two narrow passages **177** and **178** branch off from the supply or inlet port **172** of which only one will be described more fully since the other is of identical construction and operation. More particularly, the passage **177** splits into a first branch or passage **179** extending toward the right as viewed in FIGURE 5 and terminating in the left end of the end chamber **166** whereas the other branch passage **180** extends toward the left of FIGURE 5 and connects with a line or conduit **181** suitably connected thereto. Line **181** is operatively connected with the line or conduit **181'** which itself has a plurality of branch lines leading to the respective impulse control valves **76**, **77**, **78**, **79** and **108**.

As will become more obvious from an inspection of FIGURE 8, each impulse control valve **79**, **78**, **77**, **76** and **108** which is of identical construction with impulse control valve **57**, therefore comprises a casing **182** with a reciprocating piston member **183** therein which is normally urged against one end, namely the right end as viewed in FIGURE 8 of the casing **182** by the spring **184**. An air or connecting port **185**, for example, in the form of an inlet bore or the like, is provided in the opposite end of the casing **182** which is adapted to be closed by a stem portion **186** suitably secured to the piston **183** when the piston is pressed inwardly, i.e., toward the left as viewed in FIGURE 8 against the force of spring **184** by the outwardly extending actuating pin portion **187**, as will be described more fully hereinafter. However, ordinarily, when the piston assembly **183**, **186**, **187** is in the normal position thereof, as shown in FIGURE 8, air is permitted to escape through a discharge opening or port **182'** suitably provided in casing **182**.

Each individual control impulse valve **76**, **77**, **78**, **79** and **108** is constructed in this manner, and each row of bottles thereby push or press against a respective actuating pin portion **187** extending outwardly of the respective housing or casing **182** against the force exerted by a respective spring **184**. It is the extent and magnitude of the force exerted against the spring force of spring **184** which ultimately determines whether the respective impulse control valve is closed or remains open.

It is quite obvious from FIGURE 5 that if a number of such impulse control valves **76–79** and **108** each including the elements **182**, **183**, **184**, **185**, **186**, **187** and **182'** are operatively connected in parallel with an air line corresponding to line **181'**, compressed air which normally flows through the passage **177** of the control slide valve **159** will escape into the atmosphere through any one or all of discharge ports **182'** of these impulse

control valves 76–79 and 108 until each and every one of these impulse control valves which are operatively connected with the line 181' are closed by a sufficiently high pressure against the respective actuating pin portions 187. In connection with the impulse control valve 76, 77, 78 and 79 this will occur, for instance, when at least eight bottles in each row of the four tracks 61, 62, 63 and 64 of the bottle conveyor track 74 (FIGURE 1) rest against the respective actuating pin portion 187 thereof. A fifth impulse control valve 108 is also operatively connected with the line 181' and thereby is also operatively connected in parallel with the other parallelly connected impulse control valves 76 through 79 which in effect requires closure of all of the impulse control valves 76 through 79 and 108 in order to prevent the escape of air flowing from inlet 172 through passage 177, branch passage 180, line 181 and line 181' into the atmosphere. In other words, as long as a single one of these impulse control valves 76 through 79 and 108 is open or unaffected, the pressure in lines 181, 181' will be essentially atmospheric pressure. As soon as all the impulse control valves 76 through 79 and 108 are closed, immediately thereafter, and only in that event, the pressure in line 181, 181' will rise rapidly above atmospheric pressure to a predetermined over-pressure.

As mentioned hereinabove, the passage 178 in the right portion of the casing 159' is identical with passage 177 with the modification that the line 189 connected with the outwardly extending branch passage 178' itself is only connected with a single impulse control valve, namely with the impulse control valve 125. The inwardly extending branch passage 178'' again leads toward the right end of the enlarged end chamber 167.

A connecting line 190 operatively connects the right end of each cylinder 105 of the two parallelly acting horizontal cylinders 105 with the first connecting port 173. The second connecting port 175, that is, the one disposed to the right of the intake 172 is operatively connected with the left end of each of these horizontal cylinders 105 over lines 191 and 191'.

Operation of the pneumatic control system for bottle-gripping-head

The operation of the pneumatic control system for the bottle-gripping-head 103 in accordance with the present invention is as follows:

If either of the two lines or conduits 181, 181' or 189 (FIGURE 5) are effectively closed by the respective impulse control valves 76 through 79, 108 and 125 connected thereto, this will cause an increase in pressure over and above atmospheric pressure in the corresponding end chamber 166 or 167 provided within control slide valve 159 and operatively connected therewith. An increase in the pressure in either end chamber 166 or 167 will cause the slide assembly 161, 162, 163, 164, 165 to be displaced to one or the other side of the central bore 160 provided in valve casing 159' so that the connecting port 175 or 173 which is disposed opposite to the side supplied with increased pressure will be operatively placed into communication with the compressed-air inlet port 172 (FIGURE 5).

In the position of the slide valve assembly 161, 162, 163, 164, 165 of control slide valve generally designated by reference numeral 159 illustrated in FIGURE 5, it is assumed that all the impulse control valves 76 through 79 as well as the impulse control valve 108 are closed. As a result thereof, compressed air is supplied over the inlet port 172 to the connecting port 175 which in turn will supply compressed air to the left side of the horizontal cylinders 105 through connecting lines 191 and 191'. This in turn will cause the piston members 104 and therewith the bottle-gripping-head 103 supported thereon to move toward the right along guide rails 101 and 102, from the position I to the position II thereof (FIGURE 3).

Under these operating conditions, impulse control valve 125, which is such as to be actuated only under certain operating conditions, namely as the bottle-gripping-head 103 is lifted from position III to position IV thereof will not be actuated or affected as the bottle-gripping-head 103 moves from the position I into the position II shown in FIGURE 5. Consequently, as the bottle-gripping-head arrives in the second upper end position II thereof, the control devices described hereinabove for moving the bottle-gripping-head in the downward direction and thereupon in the upward direction will take over the control to move or displace the bottle-gripping-head from the position II into the position III and thereupon back into the position IV thereof, and it is only during this upward return movement of the bottle-gripping-head 103 from the position III into the position IV that the impulse control valve 125 is affected or actuated.

It is also clear from FIGURE 5 that as soon as the bottle-gripping-head 103 begins to move away from its position I, as compressed air is supplied from inlet port 172 through connecting port 175 and connecting lines 191 and 191' to the left working chambers of horizontal cylinders 105, the impulse control valve 108 is again reopened under the force of the respective spring 184 thereof disposed in the casing 182 thereof. As a result thereof, the pressure in the line system 181, 181' and therewith in the end chamber 166 drops back to atmospheric pressure. However, the opening of valve 108 and the consequent pressure drop in lines 181 and 181' as well as in chamber 166 will have no effect on the position of the slide assembly 161, namely for two reasons:

(a) First and foremost, pistons 168 and 169 are non-positively or loosely connected with the stems 170 and 171 thereof within the slide assembly 161 so that the return stroke of either piston 168 or 169 does not necessarily move back the slide assembly 161; and

(b) Additionally, the friction between the slide assembly 161 and the central bore 160 within which the former is accommodated requires a positive predetermined over-pressure acting on the piston of the opposite end in order to return the slide assembly 161 to the other end position thereof from the one in which it presently finds itself.

Such a positive over-pressure can be obtained only when the operating conditions are such that the impulse control valves which control the respective end chamber 166 and 167 over lines 181 and 189 are closed. This means that the control slide valve 159 including the slide assembly 161 and piston assemblies 168, 170 and 169, 171, respectively, will be moved from the right end position thereof in which it is shown in FIGURE 5 into the left end position thereof, only when the impulse control valve 125 is closed, i.e., as the bottle-gripping-head 103 arrives or approaches the end position IV thereof during the upward movement from the position III thereof. Under these circumstances, the pressure in the passage 178, branch passages 178', 178'' and line 189 is permitted to build up to a predetermined over-pressure which acts on the right face of piston 169 so that the slide assembly 161 will be moved in the opposite direction into the left end position thereof as viewed in FIGURE 5, whereupon compressed air is supplied from the inlet port 172 through the connecting port 173 into the line 190 thereby applying compressed air to the right face of the pistons 104. This in turn will move the pistons 104 toward the left as viewed in FIGURE 5 and will also move the bottle-gripping-head 103 from the position IV into the position V thereof.

As is quite obvious from the foregoing description of the control slide valve 159, the latter is double-acting, which means in practice that five impulse control valves 76 through 79 and 108 connected in parallel are operatively connected with one side thereof whereas a single impulse control valve 125 is operatively connected with the other side thereof. In case the impulse control

valve **125** is omitted and also passage **178** as well as branch passages **178'** and **178''** together with line **189** are omitted, and a spring is substituted for the piston **169** which will spring-load the slide assembly **161** so as to normally move toward the left, the slide assembly **161** would thereby become single-acting, which means in practice that only one of the movements thereof would be controlled by impulse control valves. The same can also be accomplished, instead of omitting passages **178, 178'** and **178''** and piston **169** and substituting therefor a return spring, by providing the piston **168** with a larger effective cross-sectional area than the piston **169**. Under these circumstances, it would be sufficient to effectively close the line **189**. In that case, i.e., when the piston **168** is made larger than the piston **169**, the control slide valve arrangement is such that with a double-acting slide valve assembly, the side with the larger piston area will normally dominate in case the impulse control valves of both sides, i.e., the impulse control valves **76** through **79** and **108** as well as the impulse control valve **125** and/or any other number of impulse control valves which may be operatively connected in parallel with lines **181** and **189** are simultaneously closed. Such an arrangement is conceivably desirable in many cases. In connection with the present case, the simultaneous control influence which would effectively close the impulse control valves of both sides could not happen, however, it is evident that in this case the same effect would be obtained regardless of which of the two pistons **168** and **169** is made larger.

Furthermore, it is also understood that the control slide valve assembly **159** described hereinabove may be varied or modified within the spirit and scope of the present invention, for example, by connecting additional apparatus to be controlled with the ports **174** and **176** which, in that case, would have to be operated at a somewhat lower pressure than the main apparatus.

In summary, as the impulse control valves **76** through **79** and **108** are closed by the application of a predetermined force to the respective actuating pin portions **187** thereof, the pressure in the line system **181, 181'**, normally supplied from the inlet port **172** over passage **177** and branch passage **180**, is permitted to build up to a pressure above atmospheric pressure whereby the over-pressure will also exist within chamber **166** by reason of the existence of the branch passage **179**. This will apply an over-pressure to the left face of the piston **168** thereby moving the slide assembly **161** toward the right end position thereof. As a result thereof, as soon as the slide assembly **161, 162, 163, 164, 165** arrives in the right end position thereof as shown in FIGURE 5, the inlet port **172** is effectively placed into communication with the connecting port **175** thereby supplying compressed air over lines **191** and **191'** to the left working chamber of horizontally disposed cylinders **105**. As a result thereof, the pistons **104** slidably accommodated within cylinders **105** are actuated and displaced toward the right as viewed in FIGURE 5 so that the bottle-gripping-head **103** is moved from the position I thereof into the position II thereof.

As the bottle-gripping-head **103** arrives in the position II thereof, the impulse control valve **125** is not affected or actuated thereby, as explained hereinabove, except as the bottle-gripping-head **103** reaches the position IV from the position III thereof. Consequently, as the bottle-gripping-head **103** arrives at the position II thereof in which the bottle-gripping-head **103** is in the upper position above the bottle conveyor track **74**, the control slide valves **116** and **120** will take over the control function as described hereinabove.

More particularly, as the bottle-gripping-head **103** arrives in the position II thereof, the sliding rod **115** comes into abutment with the cam plate **114** so that the slide assembly **151, 151', 151'', 115** and **125** is moved into the other end position thereof, i.e., toward the right into the right end position thereof as viewed in FIGURE 6, whereupon the lower working chamber **107'** of the cylinder **107** which controls the vertical movement of the bottle-gripping-head **103** is placed into communication with the atmosphere over connecting line **156** and discharge line **155**. This will enable the bottle-gripping-head **103** to be lowered into the position III thereof since the cylinder **106'** from which the bottle-gripping-head is suspended by piston rod **106** is permitted to move downwardly as the compressed air is permitted to escape from the working cylinder **107'**.

As soon as the bottle-gripping-head **103** arrives in the position III thereof, the sliding rod **118** of the valve assembly **320, 320', 320'', 118** and **134** comes into engagement with the cam plate **119**, thereby displacing the slide assembly **320, 320', 320'', 118** and **134** in the direction thereof corresponding in FIGURE 6 to a downward movement of the slide assembly **320, 320', 320'', 118** and **134**.

As soon as the last-mentioned slide assembly **320, 320', 320'', 118** and **134** arrives in the opposite end position thereof, i.e., the end position opposite that shown in FIGURE 6, compressed air is supplied to the individual bottle-gripping cups **117** from the supply line **154** over branch line **154'** and connecting line **321**. At the same time, compressed air is also supplied from connecting line **321** over series connecting line portion **321'** to the upper working chamber of the cylinder **121** thereby acting against the upper face of piston **122'** which is thereby displaced downwardly, as viewed in FIGURE 6, against the force exerted thereagainst by the coil spring **121'**. As the piston assembly **122, 122'** moves downwardly, the cam portion **123** provided at the piston rod **122** comes into engagement with the cam follower **124'** rotatably supported on the sliding rod **124** whereby the slide assembly **151, 151', 151'', 124** and **115** is displaced again into the opposite end position thereof, i.e., into the left end position thereof corresponding to the position illustrated in FIGURE 6, whereby compressed air is permitted to reach from the supply line **154** over connecting line **156** the lower working chamber **107'** of the cylinder **107**. As a result thereof, the piston **106'** and piston rod **106** together with the bottle-gripping-head **103** is again raised from the position III into the position IV thereof, taking along the bottles which have been firmly gripped around their bottle necks by the bottle-gripping cups **117**.

As pointed out hereinabove, the cam member **114** is unaffected, i.e., is not actuated as the bottle-gripping-head **103** moves into the position IV thereof so that the slide valve assembly **151, 151', 151''** remains in the left end position as shown in FIGURE 6 and compressed air continues to be supplied to the lower working chamber **107'** whereby the piston assembly **106, 106'** and therewith the bottle-gripping-head **103** will remain in the uppermost position thereof.

As also pointed out hereinabove, as soon as the bottle-gripping-head **103** left its end position I, the impulse control valve **108** opened. However, opening of this impulse control valve **108** accompanied by the pressure drop in the line **181** and in the end chamber **166** did not have any effect on the position of the slide assembly **161, 162, 163, 164, 165** since the pistons **168** and **169** with the stems **170** and **171** thereof were non-positively connected with the slide assembly **161** and since the friction between the slide assembly and more particularly between the circumferential surfaces of the spools **162, 163, 164, 165** thereof and the internal surface of the central bore **160** require a positive, predetermined over-pressure against the end of the piston on the opposite side, i.e., against the piston **169** in order to move the slide assembly **161** back to the left end position, as viewed in FIGURE 5.

Such positive over-pressure is obtained as the bottle-gripping-head **103** with the bottles suspended therefrom by the gripping action of the bottle-gripping cups **117** is conveyed upwardly from the position III into the position IV thereof as indicated hereinabove. This is so since

the impulse control valve **125** will be closed as soon as the bottle-gripping-head **103** arrives in the position IV thereof, whereupon pressure is permitted to build up in the passage **178**, branch passages **178'** and **178''** and line **189** and therewith in the right end portion of the end chamber **167**, i.e., in the part of the end chamber **167** which will exert pressure against the right end face of the piston **169**. As soon as sufficient pressure exists in the line system **189**, **178'**, **178''**, the piston **169** pushes the slide assembly **161** to the left end position thereof, whereby compressed air is supplied from the inlet port **172** over the connecting port **173** and the connecting line **190** to the right end of the cylinders **105** which in turn will produce a force on the right faces of pistons **104** moving the same together with the bottle-gripping-head **103** toward the left from the position IV into the position V.

As explained hereinabove, as the bottle-gripping-head **103** moves from position IV to the position V thereof and as it arrives at the latter position, the impulse control valve **108** does not close, i.e., remains unaffected so that the other control devices are permitted to take over the control of the bottle-gripping-head **103**, as will appear more fully hereinafter.

The control effecting the downward movement of the bottle-gripping-head **103** from the position V thereof into the position VI thereof, the subsequent release of the bottles gripped by the bottle-gripping cups **117** and the return of the bottle-gripping-head **103** from the position VI into the position I thereof now takes place as follows:

As the bottle-gripping-head **103** arrives in the position V thereof, the sliding rod **115** of the slide assembly **151**, **151'**, **151''** comes into contact with the cam face **129** provided the impulse control valve **57** (FIGURES 8 and 12) is closed by the presence of an empty case on the case conveyor track **42** in position to receive the bottles suspended from the bottle-gripping-head **103**. If this is the case, i.e., if the impulse control valve **57** is closed, pressure is permitted to build up within the slide control valve **126**, and more particularly within the line system **358** and branch passage **359** branching off the inlet port **365** provided within the valve casing **126'** to raise the piston **360** as shown in FIGURE 8 and therewith the slide assembly **361** provided with two spools **362** and **363** which valve the inlet port **356**, the connecting port **364** and the discharge port **366**. In the position illustrated in FIGURE 8, i.e., when the impulse control valve **57** remains open by the absence of an empty case in position below the bottle-gripping-head on the bottle conveyor track **42**, the connecting line **357** connecting the cylinder **127** with the connecting port **364** is placed into communication with the discharge port **366** over a connecting passage **363'** provided in the spool **363**. A coil spring **367** which effectively renders the control slide valve **126**, a single-acting valve normally urges the various parts thereof into the position illustrated in FIGURE 8. Since compressed air through supply line **356** and inlet port **365** effectively operates against a closed chamber in which the equal areas of spools **362** and **363** are exposed at both ends thereof, the compressed air at the inlet port **365** is ineffective to move the slide assembly **361**.

However, as the pressure is permitted to build up in line **358** upon closure of the bore **185** in the simpulse control valve **57**, the slide assembly **361** is raised by the upward movement of the piston **360** thereby effectively disconnecting the connecting line **357** from the discharge line **366** while placing the supply line **356** into communication with the connecting line **357** so that compressed air is supplied to the cylinder **127** whereupon the cam plate **129** is effectively moved into the path of the rod **115**.

As the rod **115** comes into abutment with the cam plate **129**, the slide assembly **151**, **151'**, **151''** is again moved toward the right as viewed in FIGURE 6 whereupon the compressed air prevailing in the lower working chamber **107'** of the cylinder **107** is again permitted to escape through line **156** and discharge line **155** in the manner mentioned hereinabove.

If the bottle-gripping-head **103** arrives in the position V thereof without an empty case in position on the case conveyor track **42** below the bottle-gripping-head **103**, nothing will happen until such case arrives and initiates the control cycle in connection with the impulse control valve **57**, control slide valve **126**, cylinder **127** and piston assembly **128**, **128'** in order to move the cam plate **129** into abutment with the rod **115** in the manner described hereinabove to effect lowering of the bottle-gripping-head **103**.

As the bottle-gripping-head **103** arrives in the position VI, the sliding rod **134** thereof comes into abutment with the cam plate **133** so that the sliding rod **134** is moved in the direction corresponding to the movement of the bottle-gripping-head **103** from the position I into the position II thereof which corresponds to an upward movement of the slide valve assembly **320**, **320'**, **320''**, **118** and **134** as shown in FIGURE 6. As soon as this upward movement of the slide valve assembly **320**, **320'**, **320''** of FIGURE 6 is completed, the supply of compressed air over lines **154** and **154'** is disconnected again from the connecting line **321** and therewith from the bottle-gripping cups **117** and from the series connecting line portion **321'** and the cylinder **121**. As a result thereof, the bottle-gripping cups **117** release their hold on the bottle necks which are thereupon dropped a small distance into the awaiting empty case. At the same time, the piston assembly **122**, **122'** moves upwardly under the force exerted thereon by spring **121'** so that the cam portion **123** again comes into abutment with the cam follower **124'** after a short lapse of time and thereby moves the sliding rod **124** of the slide assembly **151**, **151'** and **151''** of the control slide valve **116** toward the left so that compressed air is again supplied from supply line **154** over connecting line **156** to the lower working chamber **107'** of the cylinder **107** which causes the piston assembly **106**, **106'** and therewith the bottle-gripping-head **103** to move upwardly into the initial position I in which the cycle of operation starts all over again.

As soon as the bottle-gripping-head **103** arrives in the position I thereof, the impulses control valve **108** is closed as described hereinabove. However, closure of the impulse control valve **108** in itself is sufficient to initiate the next cycle of operation unless impulse control valves **76** through **79** are also closed, i.e., unless there is a sufficient number of bottles in each of the four rows **61** through **64** of the bottle conveyor track **74** which actuates the impulse control valves **76** through **79**.

As soon as this is the case, the pressure in the line **181** and **181'** is permitted to build up as described hereinabove, whereupon the bottle-gripping-head **103** is conveyed or displaced from the position I into the position II thereof, as described hereinabove. This initiates the next cycle of operation.

While the control slide valve arrangement illustrated in FIGURES 5, 6 and 8 of the present application is used for controlling the movement and operation of the bottle-gripping-head **103** and of the bottle-gripping cups **117**, it is understood that the use thereof is not limited to this specific application which is only given as an example, but that the control system may be used in connection with any other installation in which a movement in the cycle of operation is to be initiated only when a number of predetermined conditions are complied with.

Bottle-gripping cup

The detail of one of the bottle-gripping cups **117** is shown in FIGURE 9. As mentioned hereinabove, each bottle-gripping cup **117** is secured in the bottle-gripping-head **103** in a position which corresponds to the desired positions of the bottles in the case. For that purpose, the bottle-gripping-head **103** is provided with a plate **200** which forms the underside thereof. The plate **200**

is provided with a main duct **201** operatively connected with the lines **321** and **321'** while a branch duct **202** leads from the main duct **201** downwardly to each bottle-gripping cup **117**.

Each bottle-gripping cup **117** is formed by an inverted cup-like part **203** which is provided at the top thereof with a threaded tap **204** for engagement into a female threaded portion **205** machined into the underside of the bottle-gripping-head plate **200**. A gasket **206** used for sealing purposes is placed along the upper edge of the cup-like part **203** into an appropriate recess provided thereat. The compressed air supplied to each bottle-gripping cup **117** over the branch duct **202** in the plate **200** is supplied within the cuplike part **203** to the elastic gripping member **310** over a duct **207** and branch ducts **208** and **209** into the space formed between the inner surface of the cuplike part **203** and the outer surface of the elastic cup-shaped gripping member **310**. The gripping member **310** is fitted into the inside of the cup-like part **203** and is so designed as to readily fit around the bottle neck of a bottle in such a way that upon supply of compressed air over branch ducts **208** and **209**, the gripping member **310** securely grips the bottle neck of a bottle. In order to secure the bottle-gripping member in a readily interchangeable manner within the cup-like part **203**, a threaded bushing **311** is provided which is threadably secured in the lower threaded portion of the cup-like part.

The construction of the bottle-gripping cup **117** in accordance with the present invention makes possible a ready replacement of one type of gripping cup **117** with another, for example, if the packing machine in accordance with the present invention is to be used for bottles having different types of bottle necks. Additionally, the present construction of the bottle-gripping cups also enables ready and relatively inexpensive replacement of any cup **117** that may develop a leak in a pneumatic system. It is quite obvious that otherwise, if a cup develops a leak, the piston **122'** in the cylinder **121** which is operative by means of the cam portion **123** on the piston rod **122** to return the control slide valve **116** to the "lifting" position thereof cannot be actuated since the cylinder **121** is operatively connected in parallel with each of the gripping cups **117**.

If for one reason or another it becomes desirable to control or sense the presence of a bottle neck, rather than providing a control system normally used at the outlet of the capping or labeling machines, where bottles with broken necks are otherwise sorted out, the present system may be so modified and arranged as to normally force the bottle-gripping members **310** out of the seat thereof so as to intentionally cause a leak if no bottle neck is present when the pressure is supplied over line **321** and duct **201** to the individual bottle-gripping cups **117**. In either of the two aforementioned cases, the cylinder **121** cannot be actuated because no pressure can develop in the line **321'** connected in series with the line **321** as long as one-bottle-gripping cup **117** develops a leak so that the bottle-gripping head **103** would remain in the position III thereof under these circumstances.

The foregoing clearly indicates that the control system of the packing machine in accordance with the present invention offers a number of simple means for the prevention of faulty operation as the bottle-gripping-head **103** which is operative to grip the bottles and transport the same from the bottle conveyor track **74** to an empty case located in a predetermined position on the case conveyor track **42**, goes through an operating cycle which may be divided into two separate periods:

(A) The first period controls the movement from an initial position directly above the empty case conveyor track **42** corresponding to position I over to a position directly above the bottle conveyor track **74**, corresponding to the position II, thereupon lowering the bottle-gripping-head **103** to grip the bottles in the position III thereof, gripping the bottles and lifting the bottle-gripping-head **103** with the gripped bottles to the upper position thereof corresponding to the position IV and transporting the same or displacing the same back to the position directly above the empty case conveyor track **42** corresponding to the position V.

(B) Then follows the second period, which includes the steps of lowering the bottle-gripping-head **103** from the position V into the position VI thereof, releasing the bottles in the position VI, and thereupon lifting the bottle-gripping-head **103** back to the initial position corresponding to the position I.

Each of these periods will be initiated or permitted only when all requirements for faultless and continuous completion of the respective period are present.

Each separate stage or step of the operating cycle of each period is controlled in each position of the bottle-gripping-head **103** in such a way that they will be initiated only if the bottle-gripping-head proceeds from the predetermined preceding position.

It is also understood that the individual control devices such as the impulse control devices and slide valve assemblies of which one embodiment each has been illustrated and described herein for purposes of illustration, may be modified in many ways insofar as the actual construction thereof is concerned without departing from the spirit and scope of the present invention. For example, the separate individual impulse control valves may be constructed as cam-geared slide valves, operatively connected with one another by a series connection.

Case conveyor mechanism

Referring now to FIGURES 10, 11 and 12, which illustrate the case conveying mechanism, a first conveyor system generally designated by reference numeral **210** is shown in FIGURES 10 and 12 which is adapted to carry the cases from a case storage (not shown) to the packing machine in accordance with the present invention where they are to be filled with a predetermined number of bottles in the upright position thereof. If there is any question of space in the location of the packing machine, the first conveyor **210** may be placed in proximity to the ceiling. The conveyor **210** includes a conveyor belt **211** which is driven from an electric motor **212** operatively connected with one of the conveyor belt **211** as shown in FIGURES 10 and 12.

The first conveyor belt **211** does not extend all the way to the end of the upper conveyor system **210** but instead a number of rollers **213** forming a downwardly sloping gravity-type conveyor section of a length slightly longer than the length of an empty case are provided intermediate the end of the belt conveyor **211**, **211'** and the last roller **214** of the first conveyor system **210**. The last roller **214** of the first conveyor system **210** of the rollers **211'**, **213** and **214** arranged in series is mounted so as to be movable in the vertical direction, and is operative to control two valves **215** and **216** (FIGURE 12) which control the supply of the empty cases to the packing machine.

The valves **215** and **216** are straight-way air valves which close under the influence of a control force thereby causing an impulse producing over-pressure in the connecting air lines **217** and **218**, respectively. The impulse control valves **215** and **216** may thereby be constructed in a manner identical with that of the impulse control valve **57** illustrated in FIGURE 8.

Upon closure of the impulse control valve **215**, an over-pressure is permitted to build up in the connecting line **217** connecting the impulse control valve **215** with the pneumatic control slide valve **219**. Compressed air is supplied to the pneumatic control slide valve **219** over supply line **220**. A line **221** interconnects the control slide valve **219** with an actuating cylinder **222** provided with a piston reciprocating therein which actuates the rearwardly disposed hooking arm portion **223'** of a pivotally secured

hooking arm 223 pivotally mounted on the pivot pin 224. The pneumatic control slide valve 219 may thereby be so constructed as to supply compressed air to the actuating cylinder 222 over connecting line 221 when the pressure in line 217 is permitted to increase upon actuation of the impulse control valve 215. The control slide valve 219 may thereby be constructed in a manner similar to that of the control slide valve 126 of FIGURE 8.

The pivotally mounted hooking arm 223 is provided with an outer hook-shaped end portion 225 which is so arranged that as the hooking arm 223 is pivoted outwardly, i.e., counterclockwise as viewed in FIGURE 12, the hook-shaped end portion 225 thereof comes to lie in the path of the case on conveyor 210, and more particularly projects itself in front of the case rolling down under the force of gravity on the rollers 213, and thereby stops the empty case at the end of the case conveyor section 210. At the same time, the rearwardly disposed arm portion 223' of the hooking arm 223 actuates an electric switch 226 schematically illustrated in FIGURE 12, which is operatively connected over a suitable contact 227 to stop the driving motor 212. The connection between the electric switch 226 and the electric contact 227 is made in any conventional manner so that the control influence of the electric switch 226 is operative to stop the driving motor 212 which will remain stopped thereafter, i.e., remain de-energized even if the switch 226 is no longer actuated thereupon, whereas the control influence of another switch 228 will be necessary in order to restart or re-energize the driving motor 212. The switch 228 will be described more fully hereinafter. The entire transportation or conveyance of the case over the last section fo the case conveyor system 210 is so timed that the empty case rolls down quicker over the rollers 213 than the normal supply speed of the next following cases which are transported on the conveyor belt 211, in such a way that as the first case arrives on the roller 214, actuation of the impulse control valve 215 stops the driving motor 212 before the next following case has been transported on the conveyor belt 211 such a distance that it would also be able to roll down by gravity on the rollers 213. Consequently, the first case will stand by itself at the front end of the case conveyor 210, resting against the hook portion 225 of the hook arm 223 while the next following case is effectively stopped a short distance from the first case, i.e., a short distance from the front end of the conveyor belt 211 even though the cases were originally transported on the conveyor belt 211 essentially end-to-end with the first case.

A second conveyor system in the form of an endless chain 229 is provided in the case conveyor system which runs over an upper sprocket wheel 230 and a lower sprocket wheel 231 and which carries altogether a plurality, for example, three lifting forks, all designated by reference numerals 232. Each lifting fork 232 is so adjusted as to lift a case off the end of the first case conveyor 210 and to lower it as the second conveyor 229 moves downwardly. Consequently, the vertical conveyor 229 acts as a bucket-type elevator which lowers each empty case as it arrives at the front end of the first conveyor 210 in a manner to be described more fully hereinafter. The lower sprocket 231 is driven over a clutch designated by reference numeral 233 which also will be described more fully hereinafter from a continuously operating electric motor 234. The base 234' of the motor 234, however, is mounted so as to be tiltable about a tilting shaft 235. The tilting movement of the base 234' for the motor 234 is realized by a pneumaic cylinder 236 which is so located in the system that the piston rod thereof is operative to tilt the motor 234 upwardly, i.e., in a clockwise direction in FIGURES 10 and 12.

The clutch 233 consists of two wheels, the circumference of which are in frictional contact with each other. As soon as the base 234' and therewith the motor 234 are tilted upwardly by actuation of the cylinder 236 and the piston provided with piston rod 236' the lower clutch wheel 233 is tilted out of engagement with the upper clutch wheel 233 so that the drive of the lower sprocket wheel 231 is thereby effectively stopped whereupon the bucket elevator 229 ceases to operate.

The disconnecting control cylinder 236 which is operative to stop the movement of the bucket elevator 229 as described hereinabove is supplied with compressed air over a control slide valve 237 in which terminates a compressed air supply line 238 and a connecting line 239 operatively connecting control slide valve 237 with the actuating cylinder 236. Another line 240 interconnects the control slide valve 237 with the impulse control valve 241.

The impulse control valve 216 which is also actuated by the vertically movable roller member 214 located at the end of the upper conveyor system 210 is so interconnected with the control slide valve 237 over line 218 that the slide assembly within the control slide valve 237 is displaced into a position in which the supply of compressed air is served or disconnected as soon as the impulse control valve 216 is closed by actuation thereof to thereby relieve the cylinder 236 of the compressed air, reengage clutch 233, and therewith re-start operation of the bucket elevator 229, assuming under these circumstances that no other control impulse is produced at the same time by the impulse control valve 241 which is operatively connected with the control slide valve 237 over line 240. The effect of the impulse control valve 241 operatively connected with the control slide valve 237 over line 240 will be described more fully hereinafter.

A third case conveyor system generally described by reference numeral 42 is provided in the conveyor system for the empty cases in accordance with the present invention which is driven by a drive arrangement 243 driving the first section thereof. The transmission or drive means 243 itself is driven from the same shaft as the lower sprocket wheel 231 of the bucket elevator 229. Consequently, the empty cases will be carried forwardly on the conveyor 42 only while the bucket elevator 229 is also running.

The conveyor section 42 is also a roller-type conveyor. Rubber V-belts 245 engage around the first three rollers 244 of the conveyor system 42 which together with these three rollers 244 obtain thereby a good grip under the case transported thereon and thereby carry the same forwardly in the direction of the packing machine. Of the next five rollers generally designated by reference numeral 246, the first, third and fifth rollers 246*a*, 246*c* and 246*e* are positively driven by a chain 247 whereas the second and fourth rollers 246*b* and 246*d* are idling rollers. The rollers 246*a*, 246*c* and 246*e* that are positively driven are roughened-up at the surfaces thereof in order to enhance the conveyance or transporting characteristics thereof. An idling roller 248 is disposed between the second and third rollers 246*b* and 246*c* which is pivotally mounted on upright lugs 249 (FIGURE 12) secured approximately to the center of the two hook-shaped rods 250 which themselves are pivotally supported at the rear end thereof on a shaft 251 and are provided at the opposite end thereof, i.e. the end farthest away from the bucket elevator 229 with hook-shaped portions 252. The hook-shaped rods 250 are normally urged upwardly by respective springs 253. The rearwardly extending projections 252' and 252'' are pivotally secured intermediate the ends thereof so as to form effectively actuating levers. As a result of such an arrangement, the upper ends of levers 252' and 252'' are adapted to be engaged by the arrival of an empty case, thereby pivoting the same in such a manner that the lower ends of levers 252' and 252'' pivot in a backward direction and therewith press against the actuating pin members 187 of impulse control valves 57 and 241.

The arrangement of the third conveyor section 42 is such that when an empty case is put down on the third

conveyor system **42** from the bucket conveyor **229**, it is gripped by the first rollers **244** provided with the aforementioned V-belts **245** and is thereby carried forwardly as long as these rollers **244** are driven over the drive arrangement **243** from the common drive means also driving the bucket elevator **229**. Furthermore, the first driven roller **246***a* of the driven roller section **246** driven in any suitable manner will also continue to carry an empty case forwardly; however, the idling roller **248** normally rises above the level of the sesond and third rollers **246***b* and **246***c* so that an empty case will only climb up over the idling roller **248** to such an extent that it will rest with its rear edge thereof just barely past the first roller **246***a* but will not be carried any further under these circumstances. Only the arrival of a new empty case behind the first empty case in the row of cases on conveyor track **42** will push the first empty case over the upwardly extending idling roller **248** and will thereby tip it over the obstacle formed thereby so that the first case thereby clears the obstacle in the form of the idling roller **248** and is thereupon moved on until it abuts against the hook-shaped end portions **252** of the two hook-shaped rods **250**.

The tension spring **253** are adjusted in such a manner that when an empty case rests on the idling roller **248** the hook-shaped rods **250** will be in the upper position thereof and thereby block any further movement of the case. However, when the empty case is filled with bottles upon discharge of the bottles from the bottle-gripping-head **103**, which in practice means that the weight thereof is increased by an additional ten to fifteen kilograms, this extra weight will press down the idling roller **248** thereby also pressing down the hook-shaped rods **250** operatively connected therewith. The respective dimensions of the parts have thereby been so selected and adjusted that the hook-shaped end portions **252** of the hook-shaped rods **250** are pushed below the upper edges of the rollers **246** whereupon the impulse control valves **57** and **241** are again disengaged and the filled case is carried forwardly by the driven rollers **246** which now come into gripping engagement with the underside of this case. After having passed the driven fifth roller **246***e*, the conveyor section **42** passes over into an inclined roller conveyor section **254** for taking away the filled cases under the force of gravity. Only the first portion of the inclined roller conveyor section **254** is illustrated in FIGURE 10.

In order to guide the empty cases correctly within the section containing the hook-shaped rods **50**, guide rails **255** (FIGURE 11) having leaf springs (not shown) are provided which exert a certain frictional engagement against the sides of the cases thereby preventing any unintentional forward movement or conveyance thereof.

Impulse control valves **241** and **57** which are of the straight-way impulse valves illustrated in FIGURE 8 in connection with the impulse control valve **57**, are provided along the upper edges of the hook-shaped rods **250** in the path to be actuated by lever arms **252'** and **252''** pivotally secured, for example, to the hook-shaped end portions **252**. The valve **241** is thereby operatively connected over line **240** with the control slide valve **237** which is actuated thereby upon closure of valve **241** in such a manner as to supply compressed air from supply line **238** over valve **237** to line **239** and therewith to cylinder **236** whenever the front edge of a case shoves against the hook-portion **252** whereby clutch **233** and therewith the drive for the bucket elevator **229** and the third conveyor system **42** is stopped. The other valve **57** is operatively connected with the pneumatic control system controlling the filling of the bottles into the cases as described in connection with FIGURE 8.

In order to complete the description of the forward conveying system for the empty cases, it may be mentioned that the starting motor switch **228** (FIGURES 10 and 12) for controlling the starting operation of the belt **211** on the conveyor section **210** is suitably placed or secured to the frame of the bucket elevator **229** in such a manner that the outwardly pointing arm **259** thereof projects into the path of the lifting forks **232** when the same are moved upwardly in order to catch another empty case at the end of the conveyor section **210**. The switch **228** is thereby so constructed and interconnected with the control system that in case the driving motor **212** is already energized, i.e., rotates, nothing will happen when the arm **259** is actuated. However, if motor **212** is de-energized, actuation of the switch **228** by engagement of the lifting forks **232** with the arm **259** thereof will start the driving motor **212** provided the disconnecting motor switch **222** is not actuated at the same time. If this were the case, nothing would happen then nor when the switch **226** is released subsequently thereto.

These control features are realized in practice in any well known manner, for instance, with the aid of a relay having lock-in contacts whereby the motor switch **226** is inserted into the lock-in contact circuit and switch **228** in the connecting circuit.

Operation of the case conveyor system

The mode of operation of the forward conveying system for the empty cases in accordance with the present invention is as follows:

Empty cases are brought forwardly in a more or less continuous flow on the conveyor section **210** until a case has been carried forwardly over bucket elevator **229** all the way, i.e., until it rests against the hook-shaped end portions **252**. Necessarily, an empty case must be just behind the first one because the next to the first case is used to shove the first case over the obstacle formed by the idling roller **248**. Furthermore, an empty case is also apt to be on its way down on a lifting fork **232** of the bucket elevator **229**, and an empty case is in all probability at that time at the end of the conveyor section **210**. If any empty case is not at the end of the conveyor section **210**, the conveyor belt **211** will continue to operate until an empty case is brought forwardly to this point thereby causing the motor **212** driving the belt **211** to stop by actuation of control roller **214** which, when pressed down, actuates impulse control valve **215**. In addition thereto, an empty case is apt to be at the end of the conveyor belt **211** as the empty cases are generally transported end to end while on the conveyor belt **211**.

As an empty case is brought into position at the filling place in the packing machine, the forward end thereof will actuate the lever arms **252'** and **252''** thereby closing the impulse control valves **57** and **241**. Actuation of the impulse control valve will shift the control slide valve **237** into the position thereof in which compressed air is supplied to the cylinder **236** over line **239** whereby the base **234'** together with the motor **234** is tilted by actuation of the piston **236'** so as to disengage the clutch **233** whereby both the bucket elevator **229** and the third conveyor system **232** are stopped. Thus, whenever an empty case rests against the hook-shaped members **250**, the impulse control valve **241** is actuated which in turn will control the control slide valve **237** so as to disengage the clutch and therewith the driving motor **234** from the second and third conveyor systems **239** and **42**, respectively. The control slide valve **237** will thereby remain in this position disengaging the clutch **233** even after the valve **241** is no longer actuated, i.e., after the empty case is filled and is moved forwardly as a result of depressing the roller member **248** by the additional weight of the filled case. The control slide valve **237** can be returned to the position thereof in which the cylinder **236** is connected with the discharge, i.e., to the position thereof in which the clutch **233** is re-engaged only by actuation of the impulse control valve **216**, i.e., with an empty case positioned at the last roller member **214** of the first conveyor system. The control slide valve **237** is thereby so constructed, in any suitable manner, for example, as described hereinabove, that the impulse control valve **241** dominates over the

impulse control valve **216** so that the control slide valve **237** remains in the stop position when both valves **241** and **216** are simultaneously actuated. However, as soon as the impulse control valve **241** is released, i.e., as soon as the empty case has been filled with bottles, the impulse control valve will now take over the control function to control the control slide valve **237** to return the latter to the driving position thereof in which the clutch **233** is engaged as soon as an empty case arrives or is in position on the roller **214**.

Consequently, actuation of the impulse control valve **241** will effect a disengagement of the clutch or coupling **233** even if the impulse control valve **216** should be actuated at the same time. On the other hand, acauation of the impulse control valve will engage the clutch or coupling **233** provided the impulse control valve **241** is not engaged.

As mentioned hereinabove, the impulse control valve **57** on one of the hook portions **252** is operative to control the bottle-gripping-head **103** to undergo the movement thereof to transfer the bottles to the empty case which is assured thereby to be at that time in proper position against the hook-shaped end portions **252**. As soon as the bottles are placed into the empty case, the idling roller **248** is pressed downwardly against force of springs **253** whereupon the filled case is placed upon the driven rollers **246** with all its weight and is thereby conveyed forwardly until it reaches the inclined conveyor section **254** which will convey or transport, by gravity, the filled cases to any suitable place, for example, to the storehouse, not shown in the drawings.

While I have shown and described one specific embodiment in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of many changes and modifications within the spirit and scope of the present invention. Moreover, the control system is not limited in its application to a packing machine as shown and illustrated herein but may be utilized in connection with any system which requires for automatic operation thereof that certain prerequisite conditions are fulfilled. Consequently, it is obvious that the present invention is not limited to the details thereof, as well as to the details of the individual parts, but is susceptible of many changes and modifications, both as to its structure and application, and I therefore do not wish to be limited to the details described and shown herein, but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

I claim:

1. An article gripping mechanism comprising a substantially rigid body portion; elastic means connected to said body portion and in the unstressed condition, having a configuration complementary to the configuration of the article portion to be gripped and having a substantially uniformly different dimension than the article portion; means to supply fluid under pressure to expand said elastic means into gripping engagement with the article; said body portion having a seat; said elastic means having a sealing portion in engagement with said seat, normally forming a fluid tight seal; said body portion and said sealing portion permitting relative movement therebetween responsive to a predetermined amount of expansion of said elastic means to produce fluid leakage; separate sensing means responsive to said leakage to control the operation of said article gripping mechanism.

2. A gripping mechanism comprising, a substantially rigid body portion, elastic means mounted on said body portion to form an expansible chamber between said body portion and said elastic means, means to supply fluid under pressure to said expansible chamber to distort said elastic means for gripping purposes, said body portion having a seat, said elastic means having a sealing portion in engagement with said seat normally forming a fluid tight seal, said body portion and said sealing portion permitting relative movement therebetween responsive to a predetermined amount of expansion of said elastic means to produce fluid leakage, separate sensing means responsive to said leakage to control the operation of said article gripping mechanism.

3. A gripping mechanism as defined in claim **1**, further comprising means for moving said mechanism through a cycle in which objects are gripped at a receiving station and transported to a discharge station.

4. A gripping mechanism as defined in claim **1**, further comprising means threadably secured within said body portion to thereby secure said elastic means within said body portion in a readily interchangeable manner.

5. A gripping mechanism as defined in claim **2**, further comprising means for moving said mechanism through a cycle in which objects are gripped at a receiving station and transported to a discharge station.

6. A gripping mechanism as defined in claim **2**, further comprising means threadably secured within said body portion to thereby secure said elastic means within said body portion in a readily interchangeable manner.

7. A gripping mechanism as defined in claim **1**, including a base member, a plurality of said body portions and elastic means independently secured to said base member.

8. A gripping mechanism as defined in claim **2**, including a base member, a plurality of said body portions and elastic means, independently secured to said base member.

References Cited by the Examiner

UNITED STATES PATENTS

2,120,272	6/1938	Williams	53—95 X
2,619,237	11/1952	Socke	214—1
2,862,634	12/1958	Chalich	214—309
2,897,988	8/1959	Enock	214—309
2,929,653	3/1960	Hund	294—99 X

FOREIGN PATENTS

1,093,458	5/1955	France.

MARVIN A. CHAMPION, *Primary Examiner.*