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COMBINATION FLUID ACTUATED MEANS AND CONTROL VALVE

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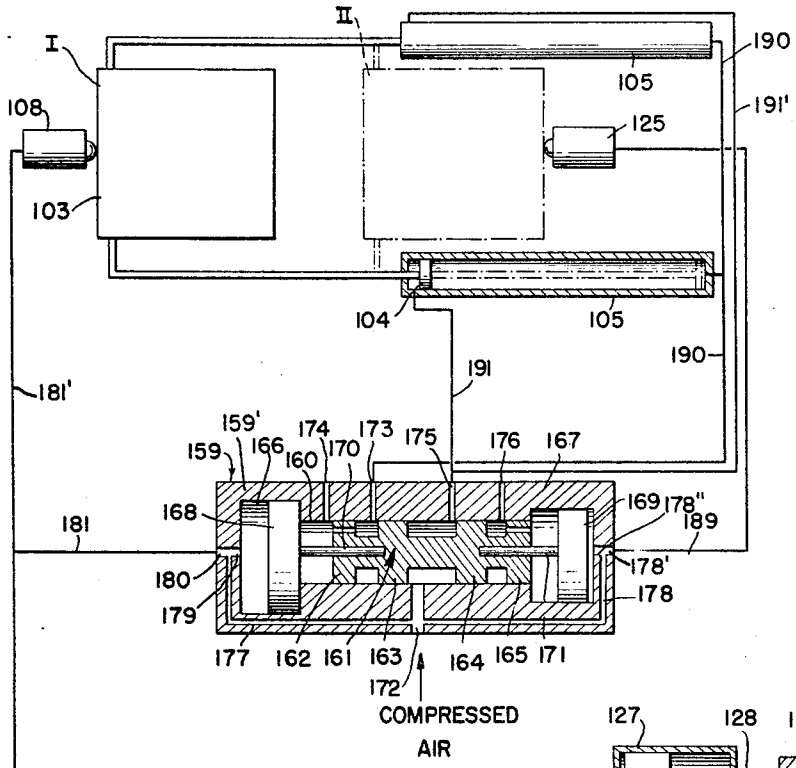
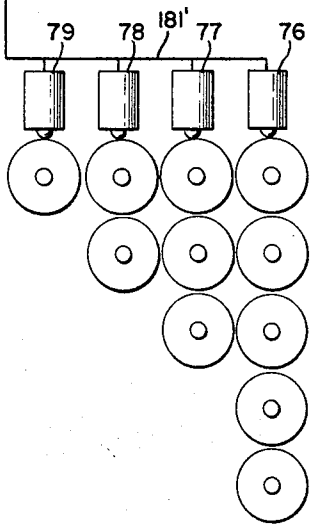
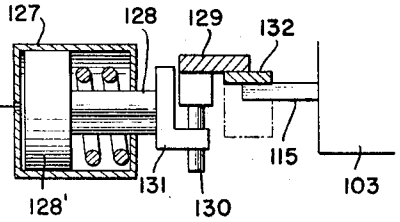
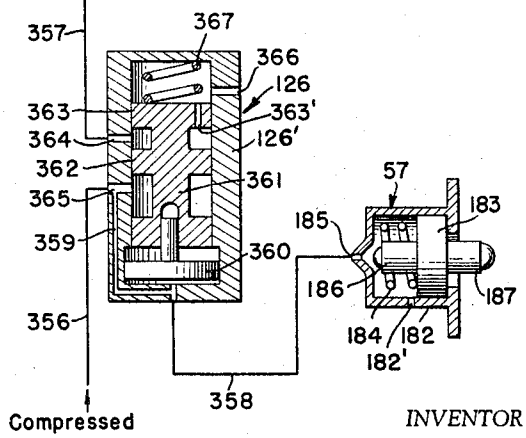


Fig. 1.

Fig. 2.







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COMBINATION FLUID ACTUATED MEANS AND CONTROL VALVE

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7 Claims. (Cl. 91—39)

The present application is a divisional application of my copending application Serial No. 815,022, filed May 22, 1959, now Patent No. 3,130,528 granted April 28, 1964 and entitled "Packing Machine."

The present invention relates to a packing machine for packing objects, such as bottles in containers, such as bottle 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 capped 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.

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 prerequistite 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 machine in a reliable and safe manner, and to prevent faulty operation thereof.

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 more 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:

FIGURE 1 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; and

FIGURE 2 is a schematic diagrammatic view, showing certain of the operating members in cross section on an enlarged scale, of the control system cooperating with a cam arrangement.

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 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, thereafter, 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.

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 packing 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.

An impulse control valve **57**, which is illustrated in detail in FIGURE 2, 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 to follow.

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.

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.

The bottle conveyor track includes an endless, moving belt which carries along the upper side thereof guide members of any suitable construction which branch off into the respective tracks. However, along the last section of the case conveyor track, the center guides 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, respectively, against which the first bottle in each row of the conveyor tracks 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 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 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 with the packing machine, a framework is provided which includes two horizontal guide rods at the top thereof for guiding therealong the bottle-gripping-head **103** horizontally back and forth from an initial position 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 (shown in dotted line) 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. The horizontal movement of the bottle-gripping-head **103** takes place by means of pistons **104** reciprocating in two parallel-acting, horizontally disposed pneumatic cylinders **105**. Additionally, the bottle-gripping-head **103** is carried on a piston assembly adapted to move in a vertically disposed pneumatic cylinder which is operative to lower the bottle-gripping-head **103** into a lower position III from the end position II thereof to thereby enable gripping of the bottles disposed on the tracks, and thereupon lifting the same to the end position IV. The bottle-gripping-head **103** thereupon moves or transports the bottles in a firmly gripped manner from position IV over to the end V by actuation of pistons **105** in cylinders **104**. While in the end position V, the bottle-gripping-head **103** is lowered again by the piston-cylinder assembly into another lower position designated by VI 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.

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, 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 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** which carries a pivot arm adapted to rotate about a pivot pin. The outer free end of the pivot arm is actuated by a projection at the bottle-gripping-head **103** in such a manner that the pivot arm is pivoted or swung 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 thereof moves upwardly from a lowered position; however, as the bottle-gripping-head is lowered the projection actuates the arm in a direction that swings pivot arm away from the impulse control device of the valve **108** whereby the impulse control device **108** remains unaffected. A return spring urges the pivot arm back to an intermediate position thereof so as to be ready to be moved to the release position thereof as soon as the projection has been moved downwardly a certain distance.

The impulse control valve **108** is operatively connected over line or conduit **181'** with the four impulse control valves **76** through **79** arranged in the four bottle tracks, 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.

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 FIGURE 1 which is of identical construction as the impulse control valve **108** mentioned hereinabove. 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 whereas it remains, in contrast thereto, unaffected when the bottle-gripping-head **103** is moved or displaced horizontally from the initial position I directly above the case conveyor to the position II thereof directly above the bottle conveyor 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** in order that the bottle-gripping-head **103** will be displaced from its position IV directly above the bottle track into the position V directly above the case track. Furthermore, by suitably arranging the actuating lever 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 acts on the axially sliding rod **115**. In other words, as soon as the axially sliding rod **115** comes into engagement with the cam arrangement **129** illustrated in FIGURE 2, the axially sliding rod **115** is pushed axially inwardly, whereupon a suitable power cylinder system is actuated 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 to receive the bottles. If no empty case is in the proper position on the case conveyor track ready to be filled with the bottles held by the bottle-gripping cups, the bottle-gripping-head **103** will remain in the position V thereof until an empty case actually arrives in position on the case conveyor track. The axially sliding rod **115** will then be actuated by the cam arrangement **129**, 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** which is operative to effectively supply compressed air from the compressed air input or supply line **356** over the control slide valve generally designated by reference numeral **126** to the compressed air cylinder **127** 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** by axially displacing the same inwardly 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. The cam plate **129** is 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 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**. 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 I thereof.

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, and 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.

The slide valve assembly generally designated by reference numeral **159** includes a casing or housing **159'** pro-

vided 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, 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 and terminating in the left end of the end chamber **166** whereas the other branch passage **180** extends toward the left 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**.

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 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 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, 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 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 of the bottle conveyor track 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 presure 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'**.

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** is 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**.

In the position of the slide valve assembly **161, 162, 163, 164, 165** of control slide valve generally designated by reference numeral **159** illustrated, 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, from the position I to the position II thereof.

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. Consequently, as the bottle-gripping-head arrives in the second upper end position II thereof, the control devices 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 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 chamber of horizontal cylinders 105, the impulse control valve 108 is again re-opened 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 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, 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 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, 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 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, other control slide valves will take over the control function.

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.

Such positive over-pressure is obtained as the bottle-gripping-head 103 with the bottles suspended therefrom 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', 178'', the piston 169 pushes 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.

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 is closed by the presence of an empty case on the case conveyor track 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 and branch pasthe valve casing 126' to raise the piston 360 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 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, 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. 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 impulse 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.

If the bottle-gripping-head 103 arrives in the position V thereof without an empty case in position on the case conveyor track 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 soon as the bottle-gripping-head 103 arrives in the position I thereof, the impulse control valve 108 is closed as described hereinabove. However, closure of the impulse control valve 108 in itself is insufficient 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 of the bottle conveyor track 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 1 and 2 of the present application is used for controlling the movement and operation of the bottle-gripping-head 103, 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.

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 corresponding to position I over to a position directly above the bottle conveyor track, 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 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.

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 illustarted 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. A system for controlling the operating cycle of an automatically operated machine, comprising fluid actuated means, supply means for supplying a fluid medium under pressure, and connecting means operatively connecting said supply means with said fluid actuated means including control valve means selectively controlling the supply of said fluid medium to said fluid actuated means, said control valve means, having two end positions and being provided with a pressure chamber at least at one end thereof, normally open impulse control valve means operatively connected in parallel with said pressure chamber and supplied with said fluid medium under pressure from said supply means to cause an over-pressure in said pressure chamber only whenever said impulse control valve means is in its closed position, and said impulse control valve means including a plurality of impulse control valve members interconnected in such a way that said over-pressure may build up in said pressure chamber only upon closure of all of said impulse control valve members.

2. A system for controlling the operating cycle of an automatically operated machine according to claim 1, including conduit means connecting said supply means with said pressure chamber and said impulse control valve means, and including throttling means to lessen the amount of air which escapes while said impulse control valve means is open.

3. A system for controlling the operating cycle of an automatically operated machine according to claim 1, wherein said control valve means includes a pressure chamber at both ends thereof adapted to be supplied with said fluid medium from said supply means.

4. A system for controlling the operating cycles of an automatically operated machine according to claim 1, said control valve means including a slide assembly provided with two pistons, one piston having a larger piston area than the other, said pistons having a non-positive connection with said slide assembly.

5. A system for controlling the operating cycle of an automatically operated machine, comprising pneumatically actuated means, supply means for supplying a pneumatic medium under pressure, and connecting means operatively connecting said supply means with said pneumatically actuated means including control valve means selectively controlling the supply of said pneumatic medium to said pneumatically actuated means, said control means having two end positions and being provided with a pressure chamber at least one end thereof, normally open impulse control valve means operatively connected in parallel with said pressure chamber and supplied with said pneumatic medium under pressure from said supply means to cause an over pressure in said pressure chamber only upon actuation of said impulse control valve means to thereby close the same, said impulse control valve means including a plurality of control valve members interconnected in such a way that said over pressure may build up in said pressure chamber only upon closure of all of said impulse control valve members, and said control valve means including a slide assembly and a piston non-positively connected with said slide assembly and adapted to move within said pressure chamber.

6. A system for controlling the operating cycle of an automatically operated machine, comprising fluid actuated means, supply means for supplying a fluid medium under pressure, and connecting means operatively connecting said supply means with said fluid actuated means including control valve means selectively controlling a supply of said fluid medium to said fluid actuating means, said control valve means having two end positions and being provided with a pressure chamber at least at one end thereof, said control valve means including a slide assembly provided with two pistons, one piston having a larger piston area than the other, a plurality of impulse control valve means, said impulse control valve means being operatively connected with each of said two pistons to actuate the same during the occurrence of said fluid medium under pressure in a respective pressure chamber and the impulse control valve means intended to dominate the operation of said system being operatively connected with the piston of larger diameter.

7. A system for controlling the operating cycles of an automatically operated machine according to claim 4, wherein said slide assembly includes a spool valve member having axially aligned closed end bores in its opposite axial end faces and each of said pistons having an axially extending piston rod telescopically freely engaged within a corresponding bore.

References Cited by the Examiner

UNITED STATES PATENTS

1,131,182	3/1915	Turner	137—625.66
1,973,467	9/1934	Davis	91—424 X
2,346,829	4/1944	Davis	91—425
2,738,772	3/1956	Richter	91—51 X
2,879,467	3/1959	Stern	91—48 X
2,880,755	4/1959	Brown	137—625.69 X
2,886,010	5/1959	Hayos et al.	91—51 X
2,947,286	8/1960	Baltos	91—51 X
2,953,149	9/1960	Lynn	91—51 X
2,962,002	11/1960	Hayner	91—417 X
3,045,611	7/1962	Murray	91—307 X

FOREIGN PATENTS

145,473	12/1951	Sweden.

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