April 12, 1938. H. C. PIERCE 2,113,926

BOX STACKING MACHINE

Filed July 17, 1934 3 Sheets-Sheet 1

FIG. 2.

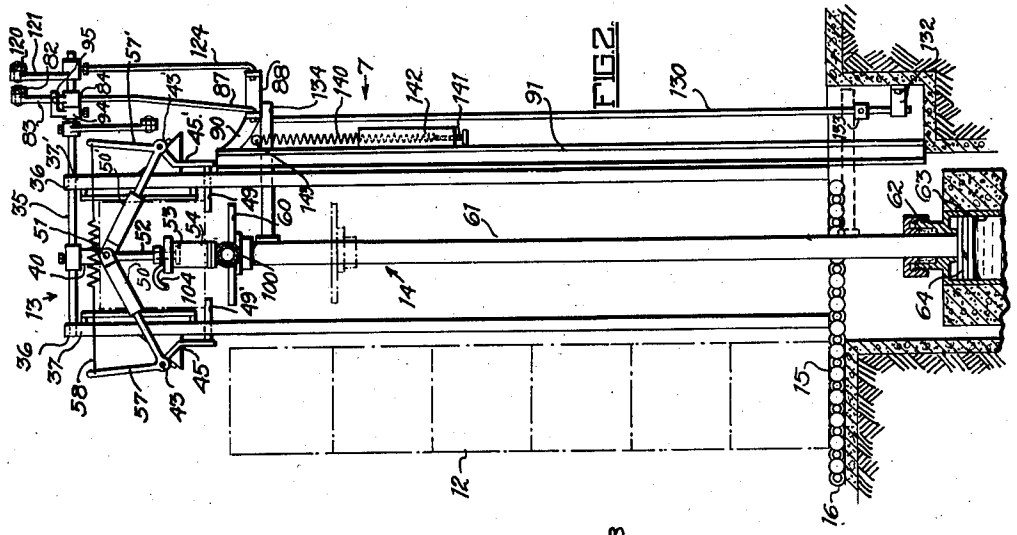


FIG. 1.

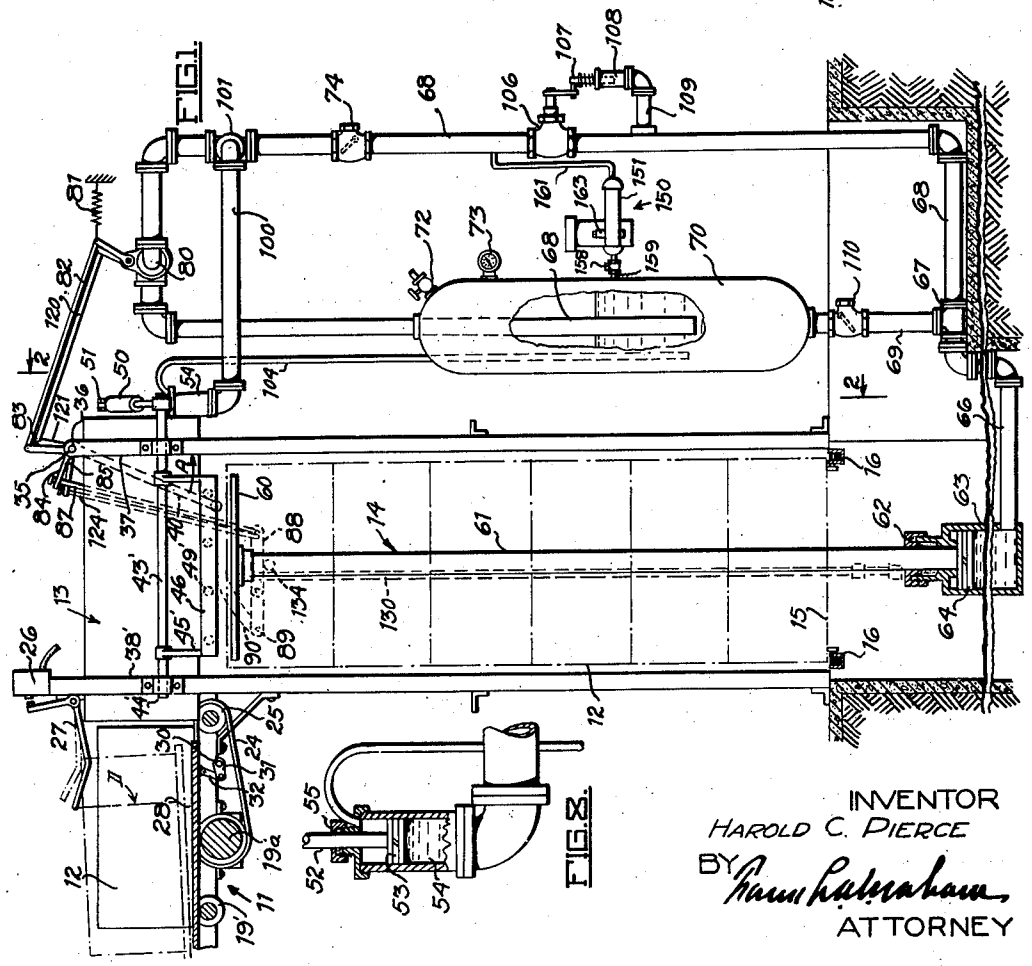


FIG. 3.

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BOX STACKING MACHINE

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FIG. 3.

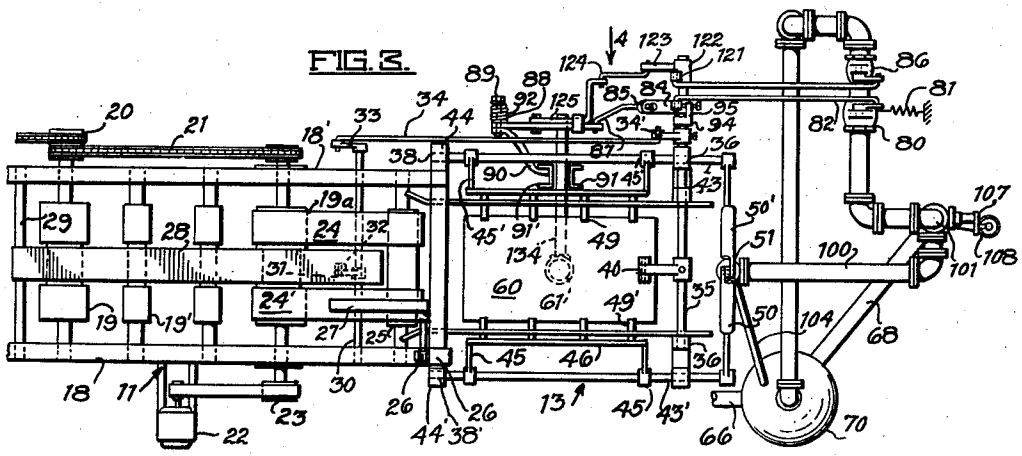


FIG. 4.

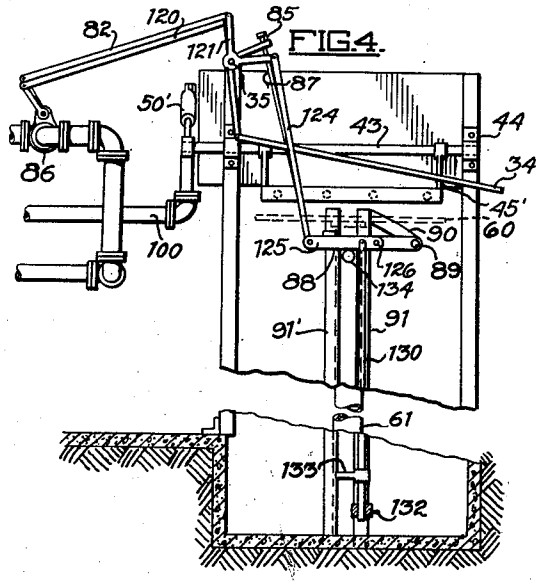
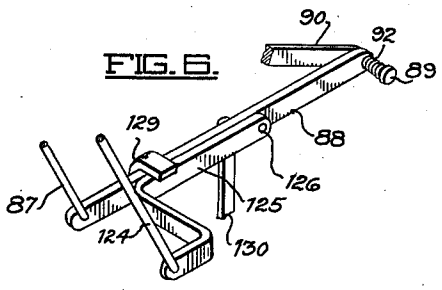


FIG. 6.



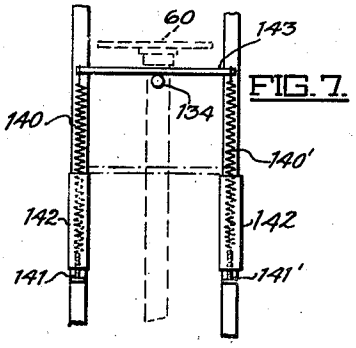
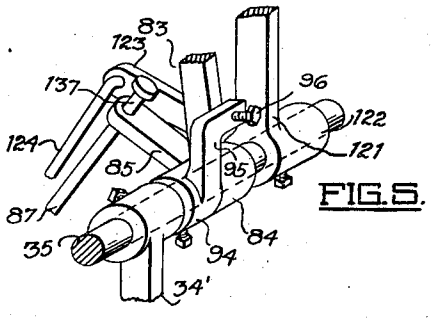


FIG. 7.

FIG. 5.



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BOX STACKING MACHINE

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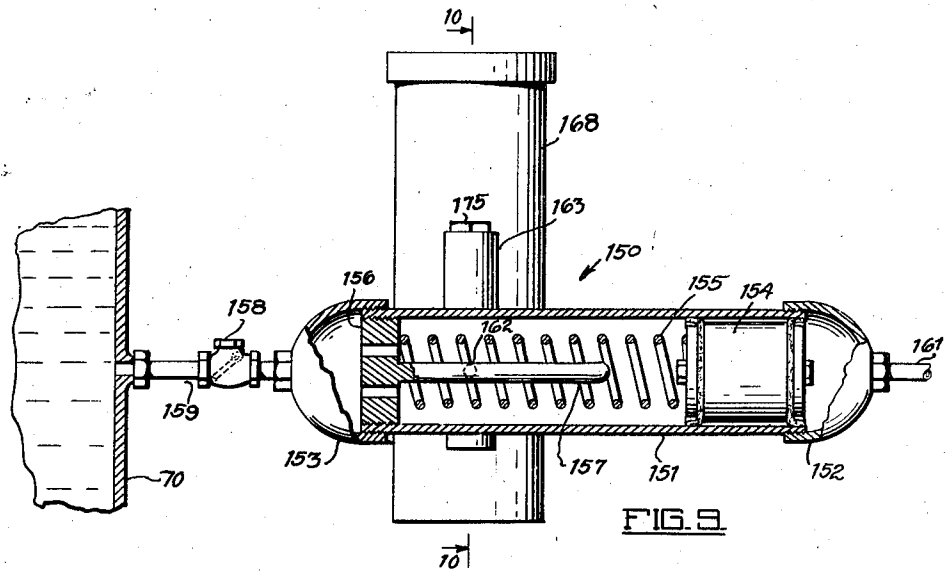


FIG. 9

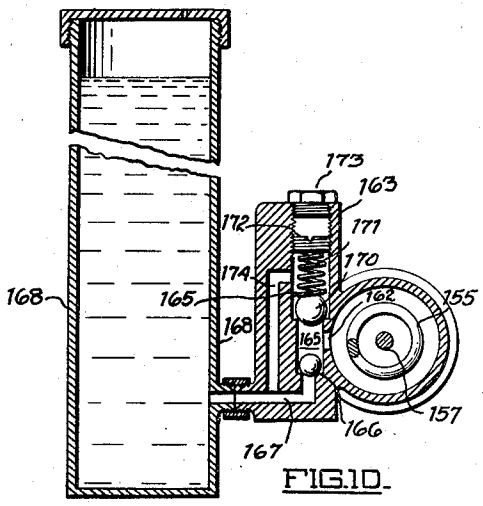


FIG. 10.

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Patented Apr. 12, 1938 2,113,926

UNITED STATES PATENT OFFICE

2,113,926

BOX STACKING MACHINE

Harold C. Pierce, Anaheim, Calif., assignor, by direct and mesne assignments to Food Machinery Corporation, a corporation of Delaware

Application July 17, 1934, Serial No. 735,575

29 Claims. (Cl. 214—6)

This invention has to do in a general way with machines for stacking articles, such as crates, boxes and the like, and is more particularly related to improvements in that type of stacking machine which is shown and described in my co-pending application Serial No. 655,607, filed on February 7, 1933, now Patent No. 2,005,906.

Stacking machines of the general character contemplated by this invention embody conveyor means supported at an upper level and adapted to deliver the articles to be stacked into a trap which in turn is automatically operated to deposit the articles received therein onto an elevator platform situated therebelow. As the successive articles are deposited, one on top of the other, on the elevator, the elevator is automatically lowered in a step-by-step manner until it reaches its bottom level where a second conveyor removes the stack of articles from the elevator platform, after which the elevator is automatically returned to its upper level for the reception of another stack of articles.

It is a primary object of this invention to produce a stacking machine of the class described wherein the energy accumulated through the downward movement of the weight of the article over a predetermined distance is stored and subsequently used to return the elevator to its upper level below the trap.

More specifically, my invention contemplates a self-energizing stacking machine in which all of the power required for operating the machine is obtained from the weight of the articles themselves moving downwardly through a predetermined distance during the stacking operation. In this connection, my invention further contemplates a new and improved form of elevator which is for uni-directional operation in that the weight carried by the elevator is always transposed from an upper level to a lower level and in which such weight is utilized to generate the necessary power to raise the elevator to its upper level when empty.

It is a further object of this invention to provide an elevator and a stacking machine of the class described in which the elevator and the trap are operated hydraulically, and in this connection it is a still further object of this invention to provide an elevator of the class described with means for automatically replacing any pressure fluid which might leak from the system so as to maintain the proper pressure conditions.

The mechanism for operating the elevator in the device contemplated by this invention consists in a general way of a hydraulic cylinder and pneumatic cylinder, these two cylinders being interconnected at their bottom portions by means of what I may term a discharge conduit and a pressure conduit. The discharge conduit is provided with a check valve adapted to permit the flow of pressure fluid from the hydraulic cylinder into the pneumatic cylinder and the pressure conduit is provided with a check valve adapted to permit the discharge of pressure fluid from the pneumatic cylinder into the hydraulic cylinder. The pneumatic cylinder contains a compressible fluid such as air which is under a normal pressure sufficient to hold the elevator at its upper level, and the discharge conduit is provided with control valve means associated with operating means which in turn are actuated by an article received in the trap, such operating means being effective to normally hold the valve closed and to open the valve by an article received in the trap. In this way an article received in the trap is effective to establish communication between the hydraulic cylinder and the pneumatic cylinder so that the weight of such article, when it is deposited upon the elevator, forces pressure fluid from the hydraulic cylinder into the pneumatic cylinder, thereby permitting the elevator to lower and effecting a partial compression of the pressure fluid in the pneumatic cylinder. This continues in a step by step manner as each successive article is received in the trap until the complete stack has accumulated on the elevator when it reaches its lower level. At this point the stack of articles is removed by the lower conveyor and at the same time the elevator, when it reaches its lower position, is effective to close a control valve in the pressure conduit so that the pressure accumulated in the pneumatic cylinder is applied to the hydraulic cylinder. As soon as the stack of articles is removed from the elevator such accumulated pressure becomes effective to lift the elevator to its upper level where it is again balanced by the normal pressure in the pneumatic cylinder.

Inasmuch as the accumulating weight on the elevator is effective to produce a corresponding increase in pressure which in turn would normally be followed by an increase in the speed of the downward movement of the elevator, I consider it desirable to provide means for controlling the speed so that it is substantially constant. In this form of my invention such means comprises a pressure control valve positioned in the discharge conduit and adapted to restrict or obstruct the passage through such conduit as the pressure therein increases.

Although the machine contemplated by this invention may embody a mechanically operated trap or any other type of trap which will automatically deposit the articles onto the elevator platform as they are received therein, I consider it preferable for smoothness in operation and ease in control to employ a trap which is maintained in its closed position by hydraulic pressure from the discharge conduit. The trap contemplated by this invention is so constructed that the weight of the articles received therein will open the trap.

It is another object of this invention to provide a machine of the class described with an improved safety switch which will be effective to stop the trap delivery conveyor in the event a second box or article is delivered to a point adjacent the trap before a first article has been deposited from the trap onto the elevator or before the trap is closed.

The details in the construction of a preferred form of my invention, together with other objects attending its production, will be best understood from the following description of the accompanying drawings, which are chosen for illustrative purposes only, and in which

Fig. 1 is an elevational view with parts broken away showing a preferred form of my invention;

Fig. 2 is an end elevation which may be considered as having been taken in the plane represented by the line 2—2 of Fig. 1;

Fig. 3 is a plan view of the device shown in Fig. 1;

Fig. 4 is a rear elevation taken in the direction of the arrow 4 in Fig. 3;

Fig. 5 is a perspective view showing one set of valve operating levers;

Fig. 6 is another perspective view showing a set of valve actuating levers which co-operate with the lever members shown in Fig. 5;

Fig. 7 is a fragmentary end view which may be considered as having been taken in the direction of the arrow 7 in Fig. 2;

Fig. 8 is an enlarged view with parts broken away showing details in the construction of a preferred form of hydraulic trap control mechanism;

Fig. 9 is an enlarged fragmentary view with parts in section showing a preferred form of automatic pressure liquid supply mechanism; and

Fig. 10 is a sectional elevation on the line 10—10 of Fig. 9.

More particularly describing the invention as herein illustrated, reference numeral 11 indicates what I may term an upper or a trap delivery conveyor adapted to deliver articles such as crates or boxes 12 into a trap generally indicated by reference numeral 13. The trap 13 is automatically effective to deposit the articles so received onto an elevator generally indicated by reference numeral 14. Under the weight of the articles deposited on the elevator, the elevator lowers in a step-by-step manner, as will be hereinafter more completely described, until it reaches its lower level where the bottom of the stack of articles, generally indicated by reference numeral 15, is deposited on what I may term a lower conveyor generally indicated at 16. This lower conveyor is in continuous operation and is effective to draw the stack of articles off the elevator platform after which the elevator is automatically raised to its upper level and the general process just described is repeated.

In this form of my invention, the upper or trap delivery conveyor 11 consists of a pair of side rails 18 and 18' which are suitably supported at the desired elevations, such rails constituting the supports or a plurality of roller members generally indicated at 19 and 19'. Roller members 19 are live rollers, being provided with sprocket wheels 20 over which chains 21 extend and are driven from any suitable source of power such as the motor indicated at 22 and the belt and pulley indicated at 23. The last live roller indicated at 19a is provided with a pair of spaced belt members 24 and 24' which extend over a pulley 25 and are adapted to feed the articles into the trap 13.

The motor 22 which drives the conveyor system is controlled by a conveyor arresting switch 26 situated above the run of the inner end of the conveyor. Associated with this switch is a lever member 27 which has a projecting end extending out over the path of the boxes or articles traversing the conveyor. In the event the trap is open, or in the event an article is contained therein, or if for any reason an article becomes jammed in the trap, it is important that means be provided to automatically stop the conveyor, and the switch and lever member just referred to constitute such means, since if a box traversing the inner end of the conveyor is lifted into engagement with the lever 27 such lever will be effective to throw the switch and the switch and lever become operative as a conveyor arresting means by stopping the motor 22.

In order to complete this safety device it is necessary to provide some means in the conveyor for lifting the box to a point at which it will engage the lever 27 when the trap is occupied or before the trap is closed. In other words means must be provided for giving "operative effect" to the conveyor arresting means. Such means is in the nature of a movable member positioned in the path of oncoming articles in the conveyor and, in this form of my invention, comprises a tongue 28 which is pivotally mounted at 29 across the conveyor and is positioned in the center portion of the conveyor beneath the path of the articles which pass therethrough. For the purpose of elevating this tongue to raise an article into engagement with the lever 27, I provide a cross shaft 30 situated near the inner end of the trap, such shaft being equipped with a crank 31 having a link 32 attached to the bottom of the tongue. The outer end of the shaft 30 is provided with an arm 33 which is connected to a link 34 with another arm 34' which in turn is keyed to what I may term the main actuating shaft 35, such shaft being mounted in bearings 36 which are provided on top portions of standards 37 and 37' which in turn constitute a portion of the elevator mechanism and also support one side of the trap. The other side of the trap is supported by similar standards 38 and 38' which in this form of my invention also constitute a support for one end of the conveyor rails 18 and 18'.

The portion of the shaft 35 within the trap carries what I may term a lever member 40 which is keyed to the shaft and the shaft is biased inwardly, by means which will be hereinafter more fully described, so that the lever member when engaged by an article received in the trap will be swung in the direction of the arrow A of Fig. 1, thereby pulling the link 34, and swinging the shaft 35 so as to elevate the tongue so that an article positioned thereover or moving into such position will be brought into engagement with the lever member 27 as indicated in broken lines in Fig. 1. It will be seen that this operation is effective to stop the conveyor and prevent further

delivery of articles into the trap. As will be observed from Fig. 3, the tongue 28 is of a substantial length and from the broken line position of the tongue 28 shown in Fig. 1, it will be seen that it is inclined into a position above the plane of the conveyor members 24—24' and 19'. From this it will be apparent that a box positioned above the rear portion of the tongue with its front end at or behind the broken line "D" (Fig. 1) it will be elevated out of contact with the conveyor members and its progress stopped, without contacting the lever 27 to stop the conveyor. In the event this occurs the rear end of such a box will be engaged by the front of the next box or series of boxes being advanced by the conveyor, the forward movement of such box or boxes (depending on the length and angle of the tongue), being effective to advance the first box into engagement with the lever 27 to stop the conveyor.

It will be understood that this operation, just described, actually occurs only in case of emergency since the boxes are placed on the delivery conveyor at a rate such that the trap can open and close depositing the articles onto the elevator before a second box reaches a position in front of the trap.

The construction of the trap itself may be varied to suit the particular type of the article which is to be handled by the machine. It is an important feature of this invention however that the trap is constructed so that it is automatically opened by the weight of an article received therein. In this form of my invention the trap is shown as comprising a pair of shafts 43 and 43' which are pivoted in bearings 44 and 44' on opposite sides of the trap frame. Fixedly mounted on each of the shafts 43 and 43' are a pair of spaced arms indicated at 45 and 45', respectively. The arms 45 and 45' comprise downwardly and inwardly extending sections which are followed by vertical sections, the last mentioned sections carrying a cross member 46 in which inwardly extending fingers are mounted. Such fingers, indicated by reference numerals 49 and 49', extend inwardly below the path of the articles to be received in the trap so as to support them in the manner indicated in broken lines in Fig. 2. It will be observed that the peculiar shape of the arms 45 and 45' is effective to locate the pivotal axis of each set of arms at a substantial distance outside of the line of force applied to the fingers 49 and 49' by the weight of a box received thereon, so that the weight of the box, as pointed out above, is effective to automatically open the trap.

Rigidly mounted on the ends of the shafts 43 and 43' are telescoping lever members 50 and 50' which are pivotally connected to each other as indicated at 51.

A pivot member which connects the levers at the point 51 is in turn connected to a vertical piston rod 52, the lower end of which is provided with a piston 53 contained in a cylinder 54, the top of which is provided with a packing gland 55 through which the piston rod extends. As will appear from the description of the elevator operating means, this piston and cylinder mechanism constitutes hydraulic means for closing the trap and holding the same closed until an article is received therein. For the purpose of assisting in the opening movement of the trap during the arrival of the first article therein I may provide the shafts 43 and 43' with fixed lever arms 57 and 57', the upper ends of which are interconnected by means of a tension spring 58.

I will now describe the elevator 14 and its associated mechanism. This elevator consists of a platform 60 which is mounted on the upper end of what I may term a piston rod 61 which constitutes a portion of means which will hereinafter be referred to as "piston means." This piston rod extends through a packing gland 62, the top of what I may term a hydraulic cylinder 63, and is provided with a piston member 64 within the cylinder. The bottom of the hydraulic cylinder 63 is equipped with an inlet-outlet conduit or a pressure-discharge conduit 66 which is connected through a T-fitting 67 with a discharge or outlet conduit 68 and an inlet or pressure conduit 69.

Reference numeral 70 indicates what I may term a pneumatic cylinder. The discharge conduit 68 is shown as extending through the top of such cylinder into the bottom portion thereof so that it is below the normal liquid level therein and the pressure conduit 69 is shown as being connected into the bottom of the pressure cylinder.

It will thus be seen that the pneumatic cylinder and the hydraulic cylinder, together with their associated conduits, constitute a closed system so that when liquid is provided therein in sufficient quantity to rise above the bottom of the discharge conduit 68 the entire system can be maintained under pressure. In the operation of this device I provide the pneumatic cylinder with a compressible gas such as air under a pressure (of, say 40 pounds) sufficient to counterbalance and support the piston 64 with its associated elevator mechanism at a position where the elevator is at its uppermost level immediately below the trap when it is empty. This compressible fluid may be supplied from any suitable source through a valve indicated at 72, a gage 73 being provided for the purpose of indicating the pressure in the pneumatic cylinder.

From the construction so far described it will be seen that, when weight is applied to the platform 60 of the elevator, such weight will be effective to press the elevator downwardly, forcing the hydraulic fluid from the cylinder 63 through the conduit 68 and a check valve 74 therein which is positioned so as to permit the uni-directional flow of fluid from the hydraulic cylinder into the pneumatic cylinder 70. This downward movement of the elevator will thus continue until the weight on the platform is counterbalanced by the pressure developed in the compressible fluid contained in the pneumatic cylinder. In a machine for stacking articles such as is contemplated by this invention, it is important that the downward movement of the elevator take place in a step by step manner so that the elevator is stopped at a position at which the top of the article received thereon lies in a plane just below the bottom of the trap so that the trap is closed after the top of the article has cleared its closing position. For the purpose of intermittently stopping the elevator in this manner I provide the discharge conduit 68 with what I may term a first valve 80, which is normally held in a closed position by means of a tension spring 81 and is adapted to be opened by means of a link 82 connected with one arm 83 on a lever member 84 which is rotatably mounted on the shaft 35. This lever member 84 has another arm 85 which is connected through a link 87 with an elevator return control lever 88. The lever 88 is

pivotally mounted on a pin 89 which is secured in a bracket 90 mounted across standards 91, 91' and constitutes a part of the elevator frame. Spring and nut means, generally indicated at 92, are provided on the pin 89 for the purpose of holding the lever 88 in position. This lever system just described is used in controlling the upward movement of the elevator and its operation will be taken up in detail later in the specification.

For the purpose of actuating the valve 80 by an article received in the trap which, it will be remembered, is effective to push the lever 40 and rotate the shaft 35, I provide on the shaft 35 a fixed collar member 94 which is provided with a finger 95 extending behind the lever 83, such finger being provided with an adjustable screw 96 adapted to engage the lever member 83. It will thus be seen that, when an article is received in the trap and engages the lever 40 to rotate the shaft 35, such rotation will be effective to swing the finger 95 so as to engage the lever 83, thereby swinging the valve 80 and opening the same against the action of the tension spring 81. The lever member 40 is made of a length such that it is engaged by the article until the latter has reached a position where the top thereof is below the closing plane of the trap. In this way the lever member 40 is permitted to swing back to its normal position under the action of the tension spring 81 when the box reaches a position where the trap will be clear to close.

As was previously pointed out, cylinder 54 and the piston 53 are provided for the purpose of closing the trap and holding the same closed until an article is received therein. This is accomplished by connecting the piston member 54 through a conduit 100 with a T-fitting 101 positioned in the conduit 68 between the valve 80 and the hydraulic cylinder 63. It will thus be observed that when the valve 80 is closed the bottom of the piston 53 is subjected to the pressure of the hydraulic cylinder resulting from the weight on the platform 60. In order that there will be no substantial opposition to the downward movement of the piston under the weight of an article in the trap when the valve is opened, I connect the top of the cylinder 53 with the pneumatic cylinder 70 below the liquid level therein through the medium of a conduit 104.

It will be apparent that, as the weight on the elevator increases with the deposition of each article thereon, the pressure in the hydraulic cylinder 63 will increase and this would normally be followed by an increase in the speed of the downward movement of the elevator. It is desirable, however, that the elevator travel at a substantially constant speed and, for the purpose of effecting this, I provide the conduit 68 with what I may term a pressure controlled valve 106 which is adapted to be actuated by means of a piston member 107 in a cylinder 108 which in turn is subjected to the pressure of the fluid in the conduit 68 through the medium of a connection 109. The pressure valve therefore is effective to obstruct or partially restrict the passage through the conduit 68 as the pressure of the liquid in such conduit increases.

From the construction so far described it will be apparent that the compressible fluid in the pneumatic cylinder 70 is compressed by the weight of the articles on the elevator moving downwardly through their distance of travel to such an extent that there is sufficient pressure in the cylinder to lift the elevator when it is empty. In a device which does not embody the trap and which is not used for stacking articles such as would be used merely for the purpose of carrying one article from one upper level to a lower level, it will be seen that a single conduit connecting the hydraulic cylinder and the pneumatic cylinder would be sufficient to apply the pressure of the pneumatic cylinder to the piston in the hydraulic cylinder and raise the elevator to its upper level as soon as the article was moved. In the box stacking machine, however, where it is important that the elevator be stopped intermittently during its downward movement, I prefer to employ the second conduit which I have termed the discharge conduit 69.

In order to prevent the liquid discharged from the hydraulic cylinder entering the pneumatic cylinder through the discharge conduit during the downward movement of the elevator, I provide the pressure conduit with a check valve indicated at 110 which is mounted so as to permit uni-directional movement of the liquid from the pneumatic cylinder into the hydraulic cylinder. In this way the check valves 74 and 110 control the movement of the pressure liquid so that it travels from the hydraulic cylinder into the pneumatic cylinder through conduit 68 during the downward movement of the elevator and is returned to the hydraulic cylinder from the pneumatic cylinder through the conduit 69 for raising the elevator after the stack of articles has been removed therefrom.

In operating a machine of the class described for the purpose of stacking articles it is necessary that the trap be maintained in its closed position during the upward movement of the elevator even though an article may be received therein. Also, it is important that the trap be permitted to open as soon as the elevator reaches its uppermost position. In other words, it is necessary for the successful operation of this machine that a valve be closed between the connection 101 and the pneumatic cylinder during the upward movement of the elevator and, if a box is received in the trap, the trap during such period in the operation of the machine, must be held closed by the hydraulic pressure on the bottom of the piston 53 until the elevator reaches its uppermost position. As soon as the elevator reaches its uppermost position, however, and assuming that a box is received in the trap, it is important that the trap be permitted to open. In other words, that open communication be established between the fitting 101 and the pneumatic cylinder, but, if an article has not yet been received in the trap, it is important that a valve be retained in its closed position until an article is received. For the purpose of satisfactorily carrying out these operations, I provide, in addition to what I have termed the first valve 80, a second valve 86 which is operated as follows. The second valve is connected through a link 120 with an upwardly extending arm 121 on a collar member 122 rotatably mounted on the shaft 35.

The collar member 122 is provided with a forwardly extending arm 123 which is connected through a link 124 with a lever member 125, such lever member being pivotally mounted on the lever member 88 as indicated at 126 and the lever member 88 is provided with a finger 129 which extends over the top of the lever 125 and is adapted to pull the same down when the lever member 88 is pulled down. The lever member 88, however, is free to move upwardly with respect to the lever member 125. Through the action of the finger

129, both lever members are pulled downwardly by means of a control bar 130 which extends downwardly along the elevator frame where its lower end is slidably received in a socket 132.

The bottom portion of the control bar 130 is provided with a stop member 133, adapted to be engaged by a projecting arm 134 mounted on the back of the elevator piston rod 61. It will thus be seen that when the elevator reaches the lower limit of its travel the bar 134 engages the stop 133, pulling the control bar 130 downwardly, thereby swinging both levers 88 and 125, such movement in turn being effective to swing the collars 84 and 121 on the shaft 35 which in turn is effective to close the valve 86 and open the valve 80.

As soon as the stack of articles has been removed from the elevator platform by conveyor means 15 and 15' the accumulated pressure in the pneumatic cylinder is effective to force the hydraulic fluid into the bottom of the hydraulic cylinder and raise the elevator to its upper position, and as soon as the elevator starts its upward movement and the stop 133 is free of the arm 134, the lever member 88 is free to swing upwardly under the action of the tension spring 81 by virtue of the sliding connection 137 between the link 87 and the lever arm 83. In other words, the valve 80 is immediately closed as soon as the elevator starts its upward movement and is not opened again until an article is received in the trap. In this way the trap is held in its closed position for the reception of an article, even though the elevator may have been raised to a point at which the stop arm 134 engages the bottom of the lever member 125 to swing the same and open the valve 86. It will also be apparent that an article received in the trap, during the upward movement of the elevator, will not open the trap due to the closed valve 86.

In order to avoid any possible sluggishness in the downward movement of the elevator when the first box or article is placed thereon, I provide the back of the frame with a pair of tension springs 140 and 140'. Such springs are mounted on screw adjustments 141 and 141' in the bottom of cylindrical containers 142 and 142'. The tops of the springs are connected by a cross bar 143 which is situated in the path of the projecting arm 134 on the back of the elevator piston rod. The springs are preferably positioned and adjusted so that they are placed under tension during the upward movement of the elevator at the top of its travel for a distance corresponding substantially to the height of one of the articles. In this way the tension of the springs co-operates with the weight of the first article to speed up the downward movement of the elevator during its initial operation.

It will be seen from the construction as described that the compressible fluid in the pneumatic cylinder 70 constitutes what is in effect a counterbalance for the weight of the elevator and its associated parts, so that the elevator will travel downwardly under the weight of an article placed thereon and will be moved up to its top normal or top position by the action of this counterbalance when the elevator is empty.

It has previously been stated that this invention has as one object the automatic replacement of any pressure liquid, which might leak through the glands and fittings of the system during its operation, so as to maintain a constant "counterbalancing pressure" at all times. This object is accomplished through the mechanism generally indicated at 150 in Fig. 1 and shown in detail in Figs. 9 and 10.

Referring now to Figs. 1, 9 and 10 and the mechanism 150 shown therein, reference numeral 151 indicates what I may term an equalizing cylinder having a cap 152 on its "high pressure" end and a cap 153 on its "low pressure" end. The cylinder 151 contains a "floating" piston member 154 which is biased toward the high pressure end by a spring 155 which engages an apertured block 156, such block being provided with a stop pin 157. The low pressure end of the cylinder is connected through a check valve 158 and a conduit 159 with the pneumatic cylinder 70, and the high pressure end of the cylinder 151 is connected through an open conduit 161 with the discharge conduit 68.

At the low pressure end of the cylinder 151 I provide an opening 162 which communicates with a valve block 163. This valve block has a chamber 165 adapted to receive liquid entering through the port 162, such chamber having an upwardly opening check valve 166 provided on the end of a passage 167 which leads to a liquid supply reservoir 168.

Above the chamber 165, I provide a second chamber 165' which contains an upwardly opening check valve 170 normally held in a closed position by a compression spring 171 and an adjustment nut 172 which can be set to hold the check valve 170 against opening until a predetermined pressure is applied therebelow. A cap 173 is provided on the top of the chamber 165'.

The portion of the chamber 165' between the check valve 170 and the adjustment plug or nut 172 communicates with a passage 174 which returns to the passage 167, so that all liquid passing through check valve 170 is merely returned or recirculated to the reservoir 168.

In operation, it is seen that a substantial pressure will be applied to the "high pressure" end of the cylinder 151 during the downward movement of the elevator, thereby pushing the piston toward the "low pressure" end, and during the upward movement of the elevator, when the pressure liquid is flowing from the pneumatic cylinder into the hydraulic cylinder through pipe 69, suction or a materially less pressure will be applied to the "high pressure" end of cylinder 151 thereby permitting the spring 155 to push the floating piston 154 toward the "high pressure" end of the cylinders and cause liquid from reservoir 168 to flow into the cylinder 151.

Assuming, now, that the valve 170 is set to open under a pressure of 40 pounds or more it will be seen that as long as the pressure from cylinder 70 against check valve 158 is greater than 40 pounds the liquid in the cylinder, following the path of least resistance during the "pressure" stroke of the plunger 154 will merely "circulate" through the check valve 170 back into the reservoir 168. If any liquid has leaked from the elevator system, however, so that the pressure in cylinder 70 is at any time less than 40 pounds, the check valve 170 will be held closed by the action of the spring 171, and liquid will be forced through check valve 158 into cylinder 70 until the pressure is reestablished therein.

It will thus be seen that this mechanism constitutes means for automatically replacing pressure liquid in the system during the downward movement of the elevator.

The normal operation of the machine is as follows: assuming the parts positioned as shown

in Fig. 1, with the elevator platform 60 held in its uppermost position by virtue of the air pressure in the pneumatic cylinder 70, the valve 80 being held in its closed position by the tension spring 81 and the valve 86 being open so that the trap is held in its closed position by virtue of the piston member 53, it will be observed that as the box 12 is advanced into the trap by the conveyor member 24, it advances into engagement with the lever 40, swinging the same in the direction of the arrow A, to open the valve 80 and raise the tongue 28 in its broken line position. When the valve 80 is open, the cylinder 54 is free to discharge back into the pneumatic cylinder, and as pointed out above the shape of the arms, which carry the fingers 49 and 49' supporting the box, is such that the weight of the box is effective to swing the arms and open the trap against the action of the fluid in the cylinder 54. As the trap is opened, the box is deposited onto the platform and its weight depresses the elevator forcing hydraulic fluid from the cylinder 63 through the conduits 66 and 68, through the open valves 80 and 81, and back into the pneumatic cylinder. The downward travel of the elevator continues as long as the box is engaged with the lever 40 and holds the same in its valve opening position. When the lower end of the lever is cleared by the top of the box, the lever is swung back into the inclined position shown, thereby closing the valve 80 and permitting the tongue 28 to drop into its normal position. As has also been pointed out above, the length of the lever 40 is such that the position at which the elevator is stopped supports the uppermost box with its upper level immediately below the level of the trap. As successive boxes are delivered into the trap the elevator is depressed in a step by step manner until the stack reaches the point indicated in broken lines in Fig. 1, where the lowermost box rests upon the bottom conveyor represented by numerals 16 and 16'. The bottom conveyor is immediately effective to withdraw the stack from the elevator platform and, in the meantime, the projecting arm 134 has engaged the stop 133 on the rod 130 to swing the lever 88 and its associated lever 125 downwardly, thereby closing the valve 86 and holding the valve 80 open. As soon as the stack of boxes has been removed from the elevator platform, the pressure in the pneumatic cylinder is effective to start the ascent of the piston 64 and its associated parts. When the rod 134 has been raised away from the stop member 133, the rod 134 is free to be swung upwardly under the action of the tension spring 81 which closes the valve 80. Since the lever member 125 and 88 are free to have relative movement with respect to each other, and in view of the frictional resistance in the valve 86, this latter valve is held in its closed position while the valve 80, as pointed out above, is permitted also to close under the action of the spring 81. In this way, in the event a box is not delivered into the trap before the elevator reaches its uppermost position the conduit 68 will be in a closed position at the time the valve 86 is opened by the engagement of the arm 134 with the upper lever member 125. If, in the meantime, a box is received in the trap, the lever member 40 is swung back to its valve opening position. Since the trap is held closed by virtue of the check valve 74, and the valve 86, during the entire upward movement of the elevator, it is impossible for the trap to be opened by a box received therein until the valve 86 is opened in the manner described above. The valve 106, as pointed out above, controls the speed of the downward travel of the elevator and, in the event any pressure fluid leaks at any point in the system during its operation, such fluid is replenished to maintain the proper pressure in the pneumatic cylinder by virtue of the pressure equalizing unit indicated at 150. In the event the trap is held open by a broken box, or in the event the rate at which the boxes are placed on the conveyor is greater than the rate at which the elevator is traveling downwardly to receive the boxes, the tongue 28 is effective to operate the safety switch 27, thereby preventing a box being delivered into the elevator when the latter is open.

It is to be understood that, while I have herein described and illustrated one preferred form of my invention, the invention is not limited to the precise construction described herein but includes within its scope whatever changes fairly come within the spirit of the appended claims.

I claim as my invention:

1. In a stacking machine the combination of: a trap adapted to receive articles to be stacked; elevator means for receiving articles from said trap; conveyor means for delivering articles into said trap; means including a switch for operating said conveyor; a lever positioned above said conveyor for throwing said switch; a tongue in said conveyor for lifting an article on said conveyor into engagement with said lever; and means actuated by a first article received in said trap for raising said tongue whereby a second article in said conveyor above said tongue will engage said lever and throw said switch.

2. A stacking machine embodying: a trap; an elevator below said trap; hydraulic means for actuating said elevator; a pneumatic cylinder; a discharge conduit leading from said hydraulic means to said pneumatic cylinder; a normally closed valve in said discharge conduit; and means actuated by an article received in said trap for opening said valve thereby establishing communication between said hydraulic means and said pneumatic cylinder.

3. A self energizing elevator embodying: a hydraulic cylinder containing a liquid; a piston member in said hydraulic cylinder supported on said liquid; a weight receiving platform on said piston member; a pneumatic cylinder containing a liquid and a gas under sufficient pressure to lift the weight of said piston member and its associated parts to a predetermined level; a conduit for delivering liquid from the bottom of said hydraulic cylinder into said pneumatic cylinder; a valve in said conduit; additional conduit means for conducting liquid from said pneumatic cylinder to said hydraulic cylinder; and a check valve in said last mentioned conduit adapted to automatically open when the pressure in the pneumatic cylinder is greater than the pressure in said hydraulic cylinder.

4. A self energizing elevator embodying: a hydraulic cylinder containing a liquid; a piston member in said hydraulic cylinder supported by the liquid therein; a weight receiving platform supported by said piston member; a pneumatic cylinder containing a liquid and a gas under sufficient pressure to lift the weight of the hydraulic piston and its associate parts to a predetermined level; a conduit for delivering liquid from the bottom of said hydraulic cylinder into said pneumatic cylinder at a point below the level of the liquid therein; a valve in said con-

duit; yieldable means for holding said valve closed; and means actuated by an article received on said elevator for opening said valve; additional conduit means for conducting liquid from said pneumatic cylinder to said hydraulic cylinder; and a check valve in said last mentioned conduit adapted to automatically open when the pressure in said pneumatic cylinder exceeds the pressure in said hydraulic cylinder.

5. A self energizing elevator embodying: a hydraulic cylinder containing a liquid; a piston member in said hydraulic cylinder supported by the liquid therein; a weight receiving platform supported by said piston member; a pneumatic cylinder containing a liquid and a gas under sufficient pressure to lift the weight of the hydraulic piston and its associated parts to a predetermined level; a conduit for delivering liquid from the bottom of said hydraulic cylinder into said pneumatic cylinder at a point below the level of the liquid therein; a valve in said conduit; yieldable means for holding said valve closed; and means including a lever actuated by an article received on said elevator for opening said valve whereby the weight of said article is effective to depress said elevator and compress said compressible fluid in said pneumatic cylinder; additional conduit means for conducting liquid from said pneumatic cylinder to said hydraulic cylinder; and a check valve in said last mentioned conduit adapted to automatically open when the pressure in said pneumatic cylinder exceeds the pressure in said hydraulic cylinder.

6. A machine for stacking articles embodying: a hydraulic cylinder containing a liquid; a piston member in said hydraulic cylinder supported by the liquid therein; an elevator platform supported by said piston member; a pneumatic cylinder containing a liquid and a gas under sufficient pressure to counterbalance the weight of said piston and its associated parts at a predetermined level; a discharge conduit for delivering liquid from the bottom of said hydraulic cylinder into said pneumatic cylinder at a point below the level of the liquid therein; a trap situated above the upper level of said platform for receiving articles to be stacked and releasing same onto said elevator; hydraulic means communicating with said discharge conduit for holding said trap closed, a valve in said discharge conduit; means normally holding said valve closed thereby preventing the opening of said trap and the release of pressure fluid from said hydraulic cylinder to said pneumatic cylinder; and means actuated by an article received in said trap for opening said valve, thereby permitting the opening of said trap and the downward movement of said piston and elevator.

7. A machine for stacking articles embodying: a hydraulic cylinder containing a liquid; a piston member in said hydraulic cylinder supported by the liquid therein; an elevator platform supported by said piston member; a pneumatic cylinder containing a liquid and a gas under sufficient pressure to counterbalance the weight of said piston and its associated parts at a predetermined level; a discharge conduit for delivering liquid from the bottom of said hydraulic cylinder into said pneumatic cylinder at a point below the level of the liquid therein; a trap situated above the upper level of said platform for receiving articles to be stacked and releasing same onto said elevator; hydraulic means communicating with said discharge conduit for holding said trap closed, a valve in said discharge conduit; means normally holding said valve closed thereby preventing the opening of said trap and the release of pressure fluid from said hydraulic cylinder to said pneumatic cylinder and means including a lever member adapted to be engaged by an article received in said trap for opening said valve thereby permitting the opening of said trap and the downward movement of said piston and elevator; said lever being of a length such that it will clear said article when the top thereof has descended to the level of the bottom of said trap.

8. A machine for stacking articles embodying: a hydraulic cylinder containing a liquid; a piston member in said hydraulic cylinder supported by the liquid therein; an elevator platform supported by said piston member; a pneumatic cylinder containing a liquid and a gas under sufficient pressure to counterbalance the weight of said piston and its associated parts at a predetermined level; a discharge conduit for delivering liquid from the bottom of said hydraulic cylinder into said pneumatic cylinder at a point below the level of the liquid therein; a trap situated above the upper level of said platform for receiving articles to be stacked and releasing same onto said elevator; a valve in said discharge conduit; means normally holding said valve closed thereby preventing the release of pressure fluid from said hydraulic cylinder to said pneumatic cylinder; means actuated by an article received in said trap for opening said valve; a return conduit connecting the bottom of said pneumatic cylinder with the bottom of said hydraulic cylinder; and a check valve in said return conduit arranged to permit flow of liquid from said pneumatic cylinder to said hydraulic cylinder, whereby the pressure in said pneumatic cylinder is effective to raise said piston when the weight of said articles has been removed from said platform.

9. A stacking machine embodying: a hydraulic cylinder; a piston member in said cylinder; an elevator platform supported by said piston member; a trap situated above the upper level of said platform and adapted to receive articles to be stacked; means supporting said trap; a pneumatic cylinder containing a compressible fluid under sufficient pressure to support said elevator at its upper level when empty; a discharge conduit for delivering liquid from the bottom of said hydraulic cylinder into said pneumatic cylinder; a valve in said conduit; hydraulic means communicating with said conduit at a point between said valve and said hydraulic cylinder for maintaining said trap closed; and means actuated by an article received in said trap for opening said valve whereby the weight of said article is effective to open said trap.

10. A stacking machine embodying: a hydraulic cylinder; a piston member in said cylinder; an elevator platform supported by said piston member; a trap situated above the upper level of said platform and adapted to receive articles to be stacked; means supporting said trap; a pneumatic cylinder containing a compressible fluid under sufficient pressure to support said elevator at its upper level when empty; a discharge conduit for delivering liquid from the bottom of said hydraulic cylinder into said pneumatic cylinder; a valve in said conduit; hydraulic means communicating with said conduit at a point between said valve and said hydraulic cylinder for maintaining said trap closed; means actuated by an article received in said trap for opening said valve whereby the weight of said article is effec-

tive to open said trap and permit the deposition of said article onto said platform; and means for closing said valve after a predetermined downward movement of said elevator whereby the pressure in said conduit from said hydraulic cylinder is effective to close said trap.

11. A stacking machine embodying: a hydraulic cylinder; piston means in said cylinder; a platform supported by said piston means; a pneumatic cylinder; a discharge conduit connecting said cylinders; a check valve in said discharge conduit permitting the flow of fluid from said hydraulic cylinder to said pneumatic cylinder; a pressure conduit connecting said cylinders; a check valve in said pressure conduit permitting the return of pressure fluid from said pneumatic cylinder to said hydraulic cylinder; trap means for receiving articles to be stacked and depositing same on said elevator platform; a valve in said discharge conduit; means actuated by an article received in said trap for opening said valve thereby permitting downward movement of said piston under the weight of said article; and means for closing said valve when the top of the uppermost article on said platform has reached a predetermined point.

12. A stacking machine embodying: a hydraulic cylinder; piston means in said cylinder; a platform supported by said piston means; a pneumatic cylinder; a discharge conduit connecting said cylinders; a check valve in said discharge conduit permitting the flow of fluid from said hydraulic cylinder to said pneumatic cylinder; a pressure conduit connecting said cylinders; a check valve in said pressure conduit permitting the return of pressure fluid from said pneumatic cylinder to said hydraulic cylinder; a trap means for receiving articles to be stacked and depositing same on said elevator platform; a valve in said discharge conduit; means actuated by an article received in said trap for opening said valve thereby permitting downward movement of said piston under the weight of said article; means for closing said valve when the top of the uppermost article on said platform has reached a predetermined point; and a pressure actuated valve in said discharge conduit for obstructing the passage therethrough as the fluid pressure increases.

13. A stacking machine embodying: a hydraulic cylinder; piston means in said cylinder; a platform supported by said piston means; a pneumatic cylinder; a discharge conduit connecting said cylinders; a check valve in said discharge conduit permitting the flow of fluid from said hydraulic cylinder to said pneumatic cylinder; a pressure conduit connecting said cylinders; a check valve in said pressure conduit permitting the return of pressure fluid from said pneumatic cylinder to said hydraulic cylinder; trap means for receiving articles to be stacked and depositing same on said elevator platform; a first valve in said discharge conduit; means actuated by successive articles received in said trap for opening said first valve; means for successively closing said first valve as the top of the uppermost article on said platform reaches a predetermined point below said trap; a second valve in said discharge conduit; opening and closing means for said second valve; and means associated with said elevator and said opening and closing means for closing said second valve when said elevator reaches the bottom of its travel and opening said second valve when said elevator reaches the top of its travel.

14. A self energizing elevator embodying: a hydraulic cylinder containing a liquid; a piston member in said hydraulic cylinder supported by said liquid; a weight receiving platform supported by said piston member; a pneumatic cylinder containing a liquid and a gas under a normal pressure sufficient to support said platform and piston at a predetermined level; a conduit for delivering liquid from the bottom of said hydraulic cylinder into said pneumatic cylinder at a point below the level of the liquid in said pneumatic cylinder; and auxiliary hydraulic means connected with said conduit and operable, under the application of weight to said platform, to automatically maintain a predetermined minimum liquid pressure in said pneumatic cylinder.

15. In a stacking machine, the combination of: a trap adapted to receive articles to be stacked; elevator means for receiving articles from said trap; conveyor means for delivering articles into said trap; means for arresting the operation of said conveyor; a movable member positioned above said conveyor for actuating said conveyor arresting means; means in said conveyor for lifting an article on said conveyor into engagement with said movable member; and means actuated by a first article received in said trap for raising said article lifting means whereby a second article in said conveyor above said lifting means will be raised into engagement with said movable member to actuate the same and arrest the operation of said conveyor.

16. In a device of the class described: an elevator adapted to be lowered by the weight of an article received thereon; hydraulic means for actuating said elevator; a pneumatic cylinder; a discharge conduit leading from said hydraulic means to said pneumatic cylinder; a valve in said discharge conduit; means for opening said valve to establish communication between said hydraulic means and said pneumatic cylinder, thereby permitting the flow of hydraulic fluid into said pneumatic cylinder and the consequent depression of said elevator under the weight of an article supported thereon; additional conduit means for conducting liquid from said pneumatic cylinder to said hydraulic cylinder; and a check valve in said last mentioned conduit adapted to automatically open when the pressure in said pneumatic cylinder exceeds the pressure in said hydraulic cylinder.

17. In a device of the class described; an elevator adapted to be lowered by the weight of an article received thereon; hydraulic means for actuating said elevator; a pneumatic cylinder; a discharge conduit leading from said hydraulic means to said pneumatic cylinder; a valve in said discharge conduit; means for opening said valve to establish communication between said hydraulic means and said pneumatic cylinder, thereby permitting the flow of hydraulic fluid into said pneumatic cylinder and the consequent depression of said elevator under the weight of an article supported thereon; means for closing said valve to arrest the downward movement of said elevator; additional conduit means for conducting liquid from said pneumatic cylinder to said hydraulic cylinder; and a check valve in said last mentioned conduit adapted to automatically open when the pressure in said pneumatic cylinder exceeds the pressure in said hydraulic cylinder.

18. A stacking machine embodying: a trap; an elevator below said trap; hydraulic means for actuating said elevator; a pneumatic cylinder; a discharge conduit leading from said hydraulic

means to said pneumatic cylinder; a normally closed valve in said discharge conduit; a lever member actuated by an article received in said trap for opening said valve, thereby establishing a communication between said hydraulic means and said pneumatic cylinder, said lever member being of a length such that it will swing clear of said article to close said valve when the top of said article has descended to a point just below the level of the bottom of said trap; and yieldable means for swinging said lever to close said valve.

19. For use in a stacking machine of the class described, a trap embodying: a frame; a pair of oppositely disposed vertical plates mounted in the sides of said frame to form a guide passage; arms pivotally mounted on each side of said frame outside of said guide plates; fingers on the lower ends of said arms adapted to normally extend horizontally below said guide passage; releasable means for supporting said arms in the said normal position; and means actuated by an article received in said trap for releasing said arm supporting means, the pivotal axes of said arms being spaced outwardly a substantial distance from the article supporting ends of said fingers, whereby the weight of an article received in said trap is automatically effective to open the same upon the release of said arm supporting means.

20. A stacking machine embodying: a trap; an elevator below said trap; hydraulic means for actuating said elevator; a pneumatic cylinder; a discharge conduit leading from said hydraulic means to said pneumatic cylinder; a normally closed valve in said discharge conduit; means actuated by an article received in said trap for opening said valve, thereby establishing communication between said hydraulic means and said pneumatic cylinder; and a pressure actuated valve in said discharge conduit for obstructing the passage therethrough as the fluid pressure increases.

21. The combination of: an elevator adapted to be lowered by the weight of articles supported thereon; hydraulic means for actuating said elevator; a pneumatic cylinder; a discharge conduit leading from said hydraulic means to said pneumatic cylinder; a valve in said discharge conduit; means for opening said valve to establish communication between said hydraulic means and said pneumatic cylinder, thereby permitting the flow of hydraulic fluid into said pneumatic cylinder and the consequent depression of said elevator under the weight of articles supported thereon; and a pressure actuated valve in said discharge conduit for obstructing the passage therethrough as the fluid pressure increases.

22. A self energizing elevator embodying: a hydraulic cylinder containing a liquid; a piston member in said hydraulic cylinder supported by said liquid; a weight receiving platform supported by said piston member; a pneumatic cylinder containing a liquid and a gas under a normal pressure sufficient to support said platform and piston at a predetermined level; a conduit for delivering liquid from the bottom of said hydraulic cylinder into said pneumatic cylinder at a point below the level of the liquid in said pneumatic cylinder; and auxiliary hydraulic means connected with said conduit and operable, under the application of weight to said platform, to automatically maintain a predetermined minimum liquid pressure in said pneumatic cylinder, said last mentioned means comprising an equalizing cylinder, means connecting opposite ends of said equalizing cylinder with said pneumatic cylinder and said conduit, respectively, a check valve in the connection between the equalizing cylinder and said pneumatic cylinder adapted to open toward said pneumatic cylinder, a piston in said equalizing cylinder, yieldable means in said equalizing cylinder biasing said piston toward said conduit, liquid supply means having an inlet passage communicating with said equalizing cylinder, a check valve in said passage adapted to open toward said equalizing cylinder, said liquid supply means also having a liquid return passage, and an adjustable check valve in said last mentioned passage adapted to open away from said equalizing cylinder.

23. In an elevator system of the class described, the combination of: a hydraulic cylinder; a piston in said cylinder; a pneumatic cylinder; a discharge conduit connecting said cylinders; a check valve in said discharge conduit permitting flow of fluid from said pneumatic cylinder to said hydraulic cylinder; a pressure conduit connecting said cylinders for delivering pressure fluid from said hydraulic cylinder to said pneumatic cylinder; a valve in said discharge conduit; means for opening said valve, thereby permitting downward movement of said piston under the weight of an article supported thereby; means for closing said valve when said platform has reached a predetermined point; and auxiliary hydraulic means interposed between said pressure conduit and said pneumatic cylinder and operable under the application of weight to said piston to automatically maintain a predetermined minimum liquid pressure in said pneumatic cylinder.

24. In an elevator system of the class described, the combination of: a hydraulic cylinder; a piston in said cylinder; a pneumatic cylinder; a discharge conduit connecting said cylinders; a check valve in said discharge conduit adapted to open toward said hydraulic cylinder; a pressure conduit connecting said cylinders for delivering pressure fluid from said hydraulic cylinder to said pneumatic cylinder; valve means in said pressure conduit for controlling the flow of fluid therethrough; and auxiliary hydraulic means interposed between said pressure conduit and said pneumatic cylinder, and operable under the application of weight to said piston to automatically maintain a predetermined minimum liquid pressure in said pneumatic cylinder.

25. In a stacking machine, the combination of: a trap adapted to receive articles to be stacked; elevator means for receiving articles from said trap; conveyor means for delivering articles into said trap; means for arresting the operation of said conveyor; a movable member positioned in the path of the oncoming boxes on the conveyor for actuating said arresting means; means in said conveyor for lifting an article on said conveyor to give operative effect to said arresting means; and means actuated by a first article received in said trap for raising said article lifting means whereby a second article in said conveyor in passing over said lifting means will be raised to effect and arrest the operation of said conveyor.

26. In a stacking machine the combination of a trap adapted to receive articles to be stacked, an elevator for receiving articles from said trap, a conveyor for delivering articles into said trap, and means for arresting the operation of said conveyor comprising: a normally inoperative conveyor arresting mechanism; a movable member positioned in the path of oncoming articles in said conveyor and associated with said conveyor ar-

resting mechanism for giving operative effect thereto; and means actuated by an article in said trap for moving said movable member whereby another article in said conveyor will engage said conveyor arresting mechanism to arrest said conveyor.

27. In a stacking machine, the combination of: a trap adapted to receive articles to be stacked; an elevator for receiving articles from said trap; a conveyor for delivering articles into said trap, said conveyor including travelling members adapted to support and move articles thereon toward said trap; an elongated tongue pivotally mounted in said conveyor and extending forwardly from its axis in the direction of travel of articles on said conveyor, said tongue being normally positioned below the plane of support on said travelling members; means actuated by an article in said trap for swinging said tongue into an upwardly inclined position whereby an article on said conveyor above said tongue is raised out of contact with said travelling members, means for arresting the operation of said conveyor; and means associated with the forward end of said tongue and adapted to be engaged by an article on said forward end for actuating said conveyor arresting means.

28. In combination, a conveyor for delivering articles, said conveyor including driven members adapted to support and move articles thereon, means at the delivery end of said conveyor actuated by an article delivered from said conveyor for raising an article on said conveyor out of contact with said driven members, and conveyor arresting means actuated by an article in raised position above said conveyor.

29. In combination, a conveyor for delivering articles, said conveyor including driven members adapted to support and move articles thereon, an elongated tongue pivotally mounted in said conveyor and extending forwardly from its axis in the direction of travel of articles on said conveyor, said tongue being normally positioned below the plane of support on said driven members, means actuated by an article delivered from said conveyor for swinging said tongue into an upwardly inclined position whereby an article in said conveyor above said tongue is raised out of contact with said driven members, and conveyor arresting means operable by an article in raised position above said conveyor.

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