Nov. 13, 1951 E. F. SHAW 2,574,595

CAN FILLING MACHINE

Filed July 22, 1948 3 Sheets-Sheet 1

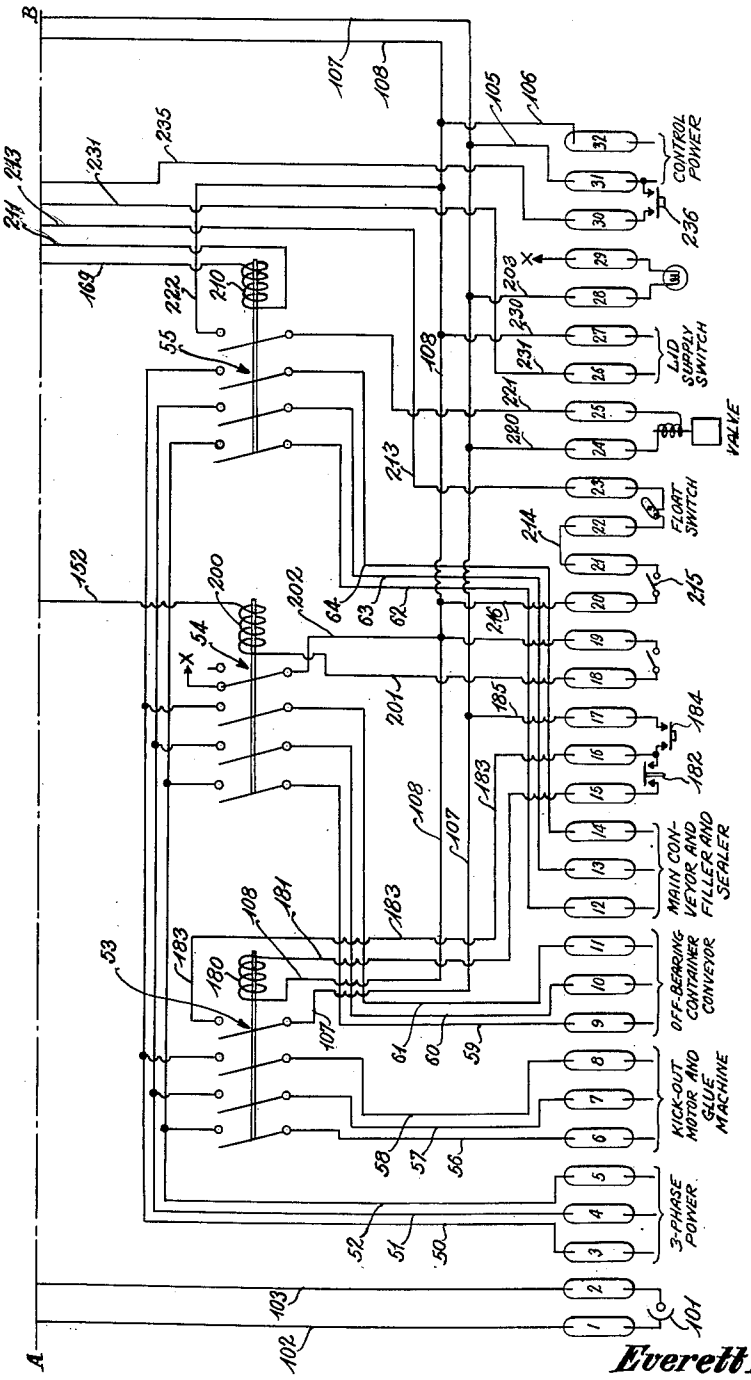


Fig. 1a

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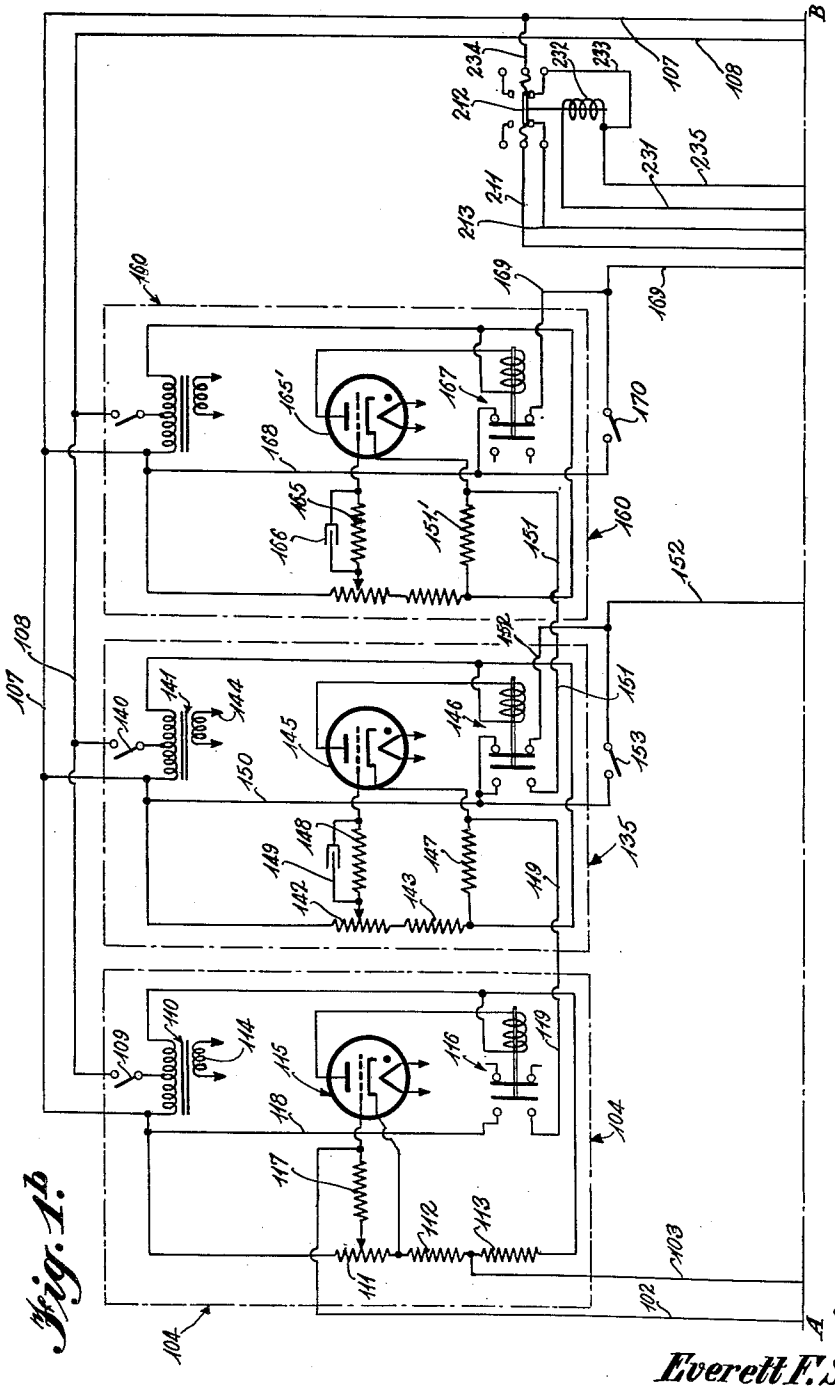


Fig. 1b

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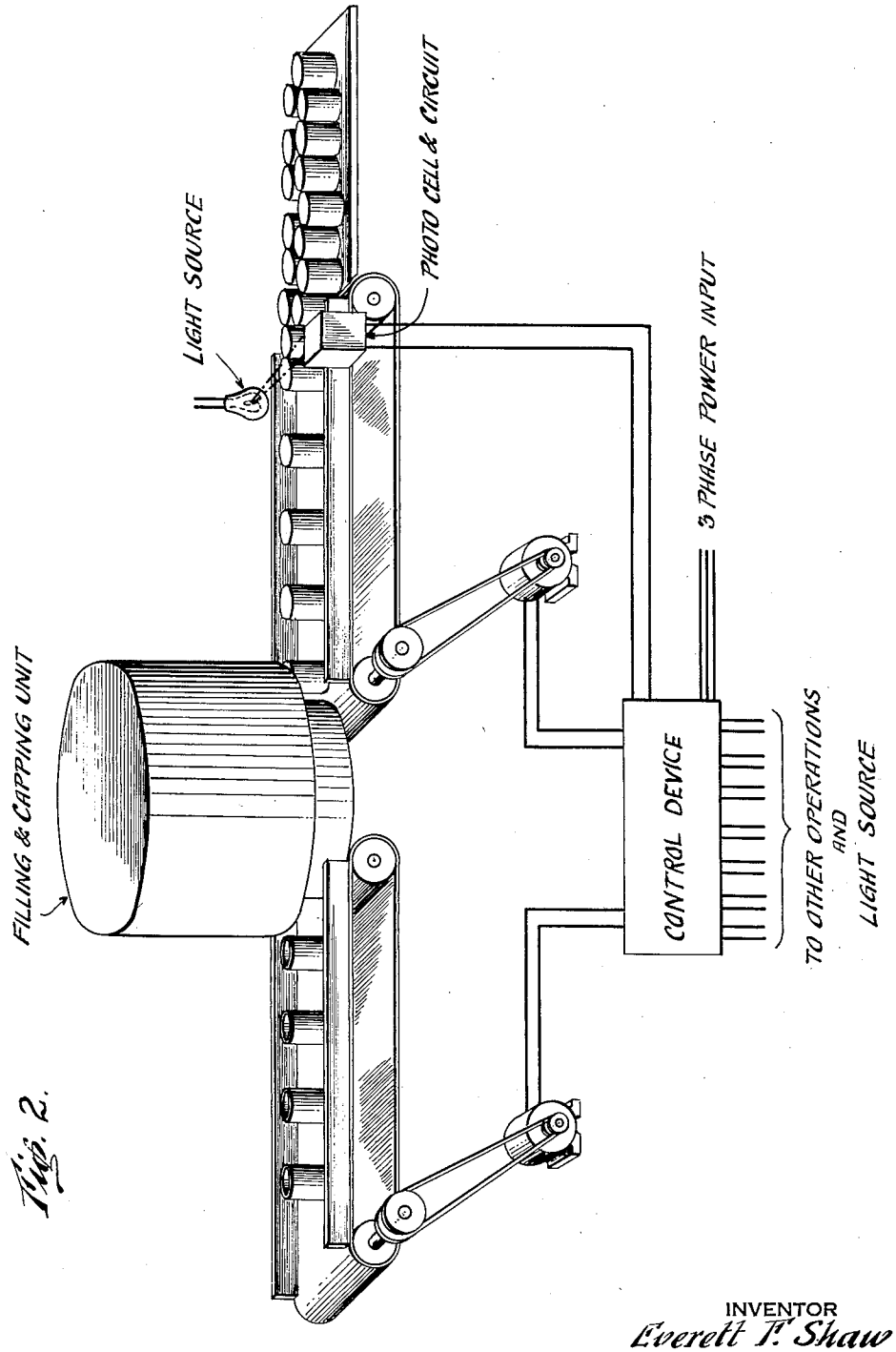


Fig. 2.

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CAN FILLING MACHINE

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Application July 22, 1948, Serial No. 40,142

8 Claims. (Cl. 226—99)

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This invention relates to electronic control circuits and more particularly to an electronic control circuit for controlling the operation of an automatic container filling and sealing machine.

Automatic machinery for filling and sealing containers of various kinds are now well-known to industry. In oil industry, for example, it is common to package lubricating oil by the use of such automatic machinery. In some instances, the lubricating oil is packaged in metal cans and in others, in fibre containers. Similarly, in the soft drink industry, soft drinks are commonly packaged in bottles and bottle caps affixed thereto.

This particular electronic circuit has been devised for the purpose of controlling the operation of a machine that packages lubricating oil in containers and glues the top in place on these containers. The principles of this invention are applicable to devices for packaging materials in metal or fibre containers or in bottles. The machine with which the present control device is specifically adapted to operate is one of the type in which the first or main conveyor carries the containers through the filling and sealing machine, and the second conveyor receives the filled containers from the first conveyor and conveys these filled containers to an unloading station from which the filled containers are placed in shipping cartons.

Several conditions can exist that will necessitate the stopping of the machine, but the most common is the failure of the man or men at the unloading station to clear away the filled containers sufficiently rapidly so as to make room for the containers being fed to the unloading station by the second conveyor. In the absence of automatic control, when this condition occurs, the second conveyor will eventually become jammed and the first conveyor attempting to feed into the second conveyor will then also become jammed.

In normal operation, is is not necessary that every container be removed immediately from the unloading station for there is some room at the unloading station in which containers may accumulate for a short period of time. Thus, the packers at the unloading station may lag a short time behind the operation of the second conveyor without causing any difficulty and since the packers can normally pack at a somewhat greater rate than the second conveyor can deliver this lag may be overcome, in many instances, without stopping the machine. Furthermore,

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there is sufficient space on the second conveyor so that even if the second conveyor is stopped, the first conveyor may continue to deliver onto the second conveyor for a short period of time before it completely fills the second conveyor and causes jamming. Again, therefore, the first conveyor need not always be stopped merely because the second conveyor is stopped, unless the stoppage of the second conveyor continues for too long a period.

In order to take advantage of this situation and permit both conveyors to operate for as great a proportion of time as is possible and at the same time prevent as much stopping and starting of the conveyors as is possible, and furthermore to prevent the stopping and starting of the first or main conveyor unnecessarily, the present control system has been devised.

In accordance with the principles of the present invention the above-described machine or other machines of that type can be photoelectrically controlled so that the presence of containers at the unloading station will have no effect on the operation of either conveyor until a predetermined time has elapsed. This time is determined to be such that by the time it has expired, a sufficient number of containers will have accumulated at the unloading station so that accumulation of additional containers at that station is likely to cause jamming of the second conveyor. At this time an electronic circuit stops the operation of the second conveyor.

If the containers at the unloading station are now removed, the electronic control circuit will allow the second conveyor to start again and normal operation will continue. If, however, the second conveyor remains inoperative for a predetermined length of time, the electronic control circuit performs the additional function of stopping the first or main conveyor. This second predetermined period of time is such as will permit the first or main conveyor to feed onto the second conveyor after it has been stopped, for a period of time not quite sufficient to so fill the second conveyor as to cause jamming of the first conveyor.

At any time that the surplus of containers at the unloading station is removed from the unloading station, both the second and first conveyors are allowed to resume operation by the electronic control circuit, the excess number of containers on the second conveyor pass onto the unloading station and normal operation is resumed.

Several additional safety and control circuits

are incorporated in the electronic control device here disclosed as specifically illustrative of the principles of this invention. The details and advantages of these additional circuits as well as further details and advantages of the basic circuit of this invention will be apparent from the following detailed description and from the appended drawings.

In the drawings, Figures 1*a* and 1*b* taken together are a schematic illustration of the preferred form of electronic control device of this invention; and Figure 2 is a schematic illustration of a conveyor system with drives and controls therefor.

As illustrated the control device of this invention operates from ordinary 120 volt alternating current power and controls a special 3-phase 440 volt alternating current which is used to drive a main conveyor along with the major operating elements of the filling and sealing machine, a second conveyor that conveys filled containers to the unloading station, and a kick-out mechanism that moves the containers from the main conveyor to the second conveyor. A glue machine may also be powered from this source, by being connected in the kick-out motor circuit.

Since the power circuits and the control circuit, that is the 440 volt circuits and the 120 volt circuit are completely separate except that the relays operated by the control circuit control the power circuits, it will be expedient to first consider the power circuits and thereafter to describe the control circuits.

Three-phase power, normally 440 volts, alternating current, is supplied to the control device at terminals **3**, **4** and **5** and carried by heavy conductors **50**, **51** and **52** to three 4-pole, single-throw, magnetically-operated power switches **53**, **54** and **55**. Three of the poles of the first magnetically-operated power switch **53** control the flow of current to the kick-out motor and glue machine which are connected to terminals **6**, **7** and **8** of the present device, these terminals being connected to the switch **53** by appropriate conductors **56**, **57** and **58**. Three of the poles of the second magnetically-operated power switch **54** control the flow of current to the second container conveyor motor, that is the off-bearer conveyor motor. This motor is connected to terminals **9**, **10** and **11** of the present device and these terminals are connected by conductors **59**, **60** and **61** to the appropriate terminals of the second magnetically-operated switch **54**. The third magnetically-operated power switch **55** controls the flow of current to the motor that drives the main conveyor and main operating parts of the filling and sealing machine. This motor, or motors, are connected to terminals **12**, **13** and **14** and these terminals are connected in turn by conductors **62**, **63** and **64** to the third magnetically-operated power switch **55**. This completes the power wiring and the additional pole of each of the three magnetically-operated power switches **53**, **54** and **55** are used for the control circuit.

The operation of the control circuits starts with a photoelectric cell **101** connected to terminals **1** and **2** of the device shown in Figures 1*a* and 1*b*. This photoelectric cell is so placed that it will receive light from a source that is located on the opposite side of the conveyor. Conductors **102** and **103** connect the photocell **101** through terminals **1** and **2** to a control circuit generally designated as **104**. As can be seen in Figure 1*b* this circuit is enclosed in the left-hand dotted box.

Power for the operation of the control circuits is supplied from a source not shown to terminals **31** and **32** of this device and is carried from these terminals through conductors **105** and **106** and conductors **107** and **108** to the photocell circuit **104**. Upon arriving at the photocell circuit **104**, power line **108** passes through a cut-off switch **109** and is then connected to an intermediate point on the primary winding of a transformer **110**.

The power line **107** is connected directly to one end of the same primary winding of this transformer **110** and thus, the winding acts as an auto transformer yielding an increased voltage across its outer ends. Across this auto transformer winding is connected in series a potentiometer **111** and two fixed resistances **112** and **113**. The potentiometer may have a resistance of 1000 ohms; resistor **112**, a resistance of 4000 ohms and resistance **113**, a resistance of 5000 ohms. These are but examples that have been found practical and may be varied widely within the skill of the art.

The arrangement is such that one end of the potentiometer is connected directly to the end of the primary winding to which the power line **107** is connected and the other end of the potentiometer winding is connected through the two resistances **112** and **113** in series, to the high voltage end of the primary winding.

A secondary winding **114** is also provided on the transformer **110** and this winding serves to supply heater current to a thermionic tube **115**.

The thermionic tube, which is preferably of the thyratron type, has its plate connected through the operating coil of a relay **116** to the high voltage end of the primary of the transformer **110**. The cathode of this thermionic tube **115** is connected to a point in the circuit between the end of the potentiometer **111** and adjacent end of the nearest resistor **112**. The grid is connected through a grid resistor **117** to the slider of the potentiometer **111**.

One of the photocell leads **102** is connected directly to the grid of this thermionic tube **115** and the other lead **103** from the photocell is connected to a point in the circuit between the resistors **112** and **113**.

When the light from the source impinges on the photocell **101** the current produced in the circuit which includes the conductors **102**, **103**, resistances **112** and **117** and a portion of the potentiometer **111**, produces a voltage drop across the resistors **112**, **117** and the resistance element of potentiometer **111**. This voltage drop serves to, at least in part, nullify the bias potential on the grid of the gas triode **115** to cause it to lose control. When this occurs the gas triode becomes conducting and the current flowing therethrough energizes the winding of the relay **116** to cause the armature thereof to move to the left and engage the contacts to which conductors **118** and **119** are connected. The action of relay **116** completes a circuit which includes the resistance **147**. The voltage drop across resistance **147** serves as a charging potential for condenser **149**. The resistance **143**, the potentiometer **142** and the capacity of condenser **149** control the time required for the condenser **149** to become sufficiently charged that it will cause the grid of the gas triode **145** to lose control and thereby render the gas triode conductive. The condenser **149** and associated resistances comprise a time-delay circuit which effects a delay in the operation of the relay **146** associated with the gas triode **145**. As illustrated in Figure 1*b* this first

time-delay circuit is shown as enclosed in the second dotted box 135 for purpose of easy identification.

As an example, the potentiometer 142 may have a resistance of 10,000 ohms, the resistor 143, 10,000 ohms; the cathode resistor 147, 10,000 ohms; the grid resistor 148, 10,000 ohms; and the grid condenser 149, a capacity of 0.5 microfarad. The thermionic tube 145, may then be an 884 tube, and this same type may be used in the photocell and second time-delay circuits as well.

The thermionic tube utilized in the photocell circuit 104 is preferably of the thyratron type, that is, it is a gas triode adapted to continue to conduct current once its grid loses control. However, since the plate potential is alternating, the thyratron is automatically extinguished at the end of each half cycle. The resistances and potentiometer may be adjusted to give the desired grid bias potential in a manner well-known to those skilled in the art. The transformer 110 will also be designed to give the desired filament voltage and the desired plate voltage for the proper operation of the thermionic tube.

Each time a container intercepts the light which impinges on the photoelectric cell gas triode 115 becomes conductive and relay 116 is actuated. However, due to the time-delay elements in circuit 135 gas triode 145 will not fire. On the other hand, if a container is allowed to intercept the beam of light for a sufficiently long period, the condenser 149 will have time to become charged to the point where the grid of gas triode 145 will lose control and the tube will become conductive and operate the relay 146.

When relay 146 is operated the circuit is completed which includes a resistance 151' which is connected in the grid cathode circuit of a third gas triode 165'. Current flowing through resistance 151' produces a voltage drop which serves to charge the condenser 166 through a combination of resistances similar to those connected in the grid circuit of tube 145. The time-delay circuit consisting of the condenser 166 and resistance 165 serves to delay the operation of relay 167.

It should also be noted that prior to the operation of the relay 146 of the first time-delay circuit 135, the power line 107 is connected through conductor 150, one pair of contacts in the relay, and conductor 152 to one of the magnetically-operated power relays 54. Its function there will be described later. It should also be noted that a manually operable switch 153 is provided to connect the power conductor 107 directly to conductor 152 thus shorting out one pair of contacts of the relay 146 and preventing this relay from opening the circuit to conductor 152, when that is desired.

The second time-delay circuit is constructed similarly to the first time-delay circuit except for the fact that the grid resistor 165 and the grid condenser 166 have different values (for example, 12 megohms and 0.5 microfarad) to give the circuit a different time-delay and the relay 167 serves only to open a circuit from the power line 107 through conductor 168 to conductor 169. Conductor 169 carries power current to another of the magnetically-operated power switch 55 for a purpose hereinafter described. Again the relay contacts of the relay 167 may be shunted out by a manually operated switch 170 to prevent this time-delay circuit from controlling the part of the operation that it would normally control.

Referring now to Figure 1a, it will be apparent that the first magnetically-operated power switch

53 is controlled in its action by an operating coil 180. It will also be apparent that power line 108 terminates at one end at this operating coil. The other end of this operating coil is connected by a conductor 181 to terminal 15 of the device and that terminal 15 is connected through a stop switch to terminal 16 which is in turn connected by a conductor 183 to one of the contacts of the fourth pole of the magnetically-operated power switch 53. When this switch is closed it connects conductor 183 to power line 107. Thus, once the stop switch 182 and the power switch 53 are closed, they will remain closed until the stop switch is manually opened. Thus, the kick-out motor and the glue machine and other elements of the machine that is desired to have continue to operate, will continue to operate, until manually stopped.

Once the stop switch has been opened and the power switch 53 has opened, the closing of the stop switch 182 will not close the power switch 53 and thus will not again start this part of the machinery. However, by closing a starting switch 184 which connects terminals 16 and 17, the power line 107 may be connected directly through conductor 185, the terminal 17, the starting switch 184 and the stop switch 182, to the conductor 181 which leads to the operating coil 180 of the power switch 53. This closes the power switch and the mechanism governed by it will start or resume operation.

As has been explained, in connection with Figure 1b, the conductor 152 is connected through the time-delay circuit 135 to the power line 107 until such time as the time-delay circuit 135 operates, or if the by-pass switch 153 is closed, continuously. As can be seen in Figure 1a, conductor 152 connects to one end of operating coil 200 of the second power switch 54. The other end of this operating coil 200 connects by a conductor 201 to terminal 18 of this device. Terminal 18 is connected in turn by a manually operated switch to terminal 19 which is in turn connected directly to power line 108, thus completing the circuit and closing the power switch 54. Whenever the relay circuit 135 breaks the circuit between conductor 152 and power line 107, the power switch 54 will open, but will close again as soon as the circuit is reestablished.

In order that the operator be given a warning when the circuit is opened and thus when the second conveyor has stopped, the power switch 54 is equipped with a special contact so that the fourth pole of this switch makes contact when the other poles are open. The power line 108 is connected by a conductor 202 to one contact of this pole of this switch and the other contact is connected by a conductor (which is not fully shown) to the terminal 29 of the device. A signal light can be connected between the terminal 29 and the terminal 28 which is in turn connected by conductor 203 to the power line 107 so that the signal light will be lighted and the power switch 54 is opened. Any other signal device may replace the light, as, for example, a bell or a buzzer.

The power switch 55 which controls the main driving motor of the filling and sealing machine and thus drives the main conveyor, is controlled by a relay coil 210, one end of which is connected to the conductor 169 which receives power from the power line 107 through the second time-delay circuit 160, except when that time-delay circuit operates to open the circuit to the conductor 169. The other end of the operating coil 210

is connected by a conductor 211 through a circuit breaker 212, and a conductor 213 to the terminal 23. The terminal 23 is connected through a float switch which is closed as long as a sufficient supply of filling liquid is available to the terminal 22. The terminal 22 is connected in turn by a conductor 214 to the terminal 21. This terminal is connected by a manually operable switch 215 to the terminal 20 which is in turn connected by a conductor 216 to the power line 108. Thus, except when the circuit is broken by the second time-delay circuit 160, the power switch 55 will remain closed and if opened, will close again as soon as the circuit is reestablished through the time-delay circuit 160. Again, the time delay circuit 160 may be rendered inoperative to open the circuit by use of the manual switch 170. The power switch 55, will also be opened if the circuit breaker operates, or the oil level switch or manually-operated switch 215, are opened.

The fourth pair of contacts of the power switch 55 are used to control the operation of an electrically-operated oil valve which is connected across terminals 24 and 25 of the device. Terminal 24 is connected directly to the power line 107 by a conductor 220 and terminal 25 is connected to one side of the fourth pole of the power switch by a conductor 221. The other side of this pole of the power switch is connected by a conductor 222 to the power line 108.

A safety switch is arranged so as to be opened when the supply of lids is exhausted, or nears exhaustion, and this switch is connected between terminals 26 and 27. The connections are such that the opening of this switch will open the circuit breaker 212 and stop the machine.

Terminal 27 is connected directly by conductor 230 to power line 108 and terminal 26 is connected by conductor 231 to one end of the operating coil 232 of the circuit breaker 212. The other end of this operating coil is connected by conductor 233 through one pair of the contacts of the circuit breaker 212 to the power line 107. Obviously, once the circuit breaker is open, reclosing of the safety lid switch between terminals 26 and 27 will not reestablish the circuit because the circuit will be opened at the contacts of the circuit breaker. Resetting is provided for by a conductor 235 which connects to the operating coil 232 at the end electrically adjacent the circuit breaker. This conductor 235 connects to terminal 30 and a reset switch 236 is provided between terminals 30 and 31, terminal 31 being connected to power line 107. Thus closing of the reset switch will reset the circuit breaker 212.

To place the machine in operation, a starting switch 184, between the terminals 16 and 17, is actuated to start the kick-out motor and glue machine; the can conveyor motor is started by closing the switch between terminals 18 and 19; and the filler and sealer motor is started by closing the switch between terminals 20 and 21. This is assuming, of course, that the circuit breaker 212 is closed. If not, it would be closed at the beginning of the operation by operating the reset button.

In operation, all mechanism would continue to function as long as the filled containers were removed promptly from the unloading station and no safety switch opened. If the filled containers are allowed to accumulate at the unloading station for a predetermined length of time, usually about four seconds, photocell circuit 104 will operate the time delay circuit 135 and the time delay circuit 135 will stop the off-bearing container conveyor. If the containers are thereafter removed, the off-bearing container conveyor will then start again for the time-delay circuit 135 will return to its original state and close the circuit controlling the off-bearing container conveyor motor.

If the stoppage continues, after another predetermined time, the second time-delay circuit 160 will operate and this will stop the filling and sealing mechanism, including the main conveyor. As soon as the containers are removed from the unloading station, however, operation will be resumed.

Failure of supply of filling liquid or failure of supply of lids will result in a similar shutting down of operation except that failure of supply of lids will result in the opening of the circuit breaker which must then be reset by operation of the reset switch.

Many variations and modifications of the circuit which has been specifically described, will be obvious to those skilled in the art and these are within the broader scope of this invention. Numerous details of this circuit may be omitted. The broader concept of this invention is directed to the basic controls of this circuit as defined in the broader of the appended claims, although many of the detailed circuits are believed to add patentable novelty and are included within some of the more specific claims.

I claim:

1. A device for controlling the operation of an automatic container filling and sealing machine that includes a power-driven container conveyor and a second power-driven container conveyor for conveying filled containers to an unloading station, said device comprising a light source and a photocell positioned adjacent the unloading station and arranged so that the photocell will detect the presence of containers at the unloading station, a time-delayed electrical circuit connected so as to be controlled by said photocell and thus operate upon the continued presence of containers at the unloading station, an electrical control for the second conveyor connected to said time-delayed circuit so as to be controlled thereby to stop said second conveyor upon the continued presence of containers for a predetermined period of time at the unloading station, a second time-delayed circuit controlled by the first time-delayed circuit so as to operate after the first time-delayed circuit has been in operation for a predetermined period of time, and an electrical control for the first conveyor connected to said second time-delayed circuit so as to be controlled thereby to stop said first conveyor upon the further continued presence of containers at the unloading station.

2. A device as defined by claim 1, further characterized in that the photocell is positioned so that light will be intercepted by the containers at the unloading station, a thermionic tube circuit is provided for control by the photocell, the photocell is connected to the grid circuit of this thermionic tube so as to cause the tube to pass substantial current when the photocell receives light, and the thermionic tube circuit is connected to actuate the first time-delayed circuit.

3. A device as defined in claim 2, in which time delay in the time-delayed circuits is produced by a resistance-condenser combination.

4. A device as defined in claim 1 in which the container filling and sealing machine is one adapted to fill containers with oil and in which

an electrical motor drives a main conveyor and actuates the main elements of the machine, a second electrical motor drives an off-bearing conveyor and a third electrical motor drives a mechanism for moving filled containers from the main to the off-bearing conveyor and in which the control device includes a separate magnetically-operated power switch controlling each of said three motors and in which the switch for the off-bearing conveyor motor is connected for control to the first-mentioned time-delayed circuit, the switch for the main conveyor motor is connected for control to the second time-delayed circuit and the switch for the third motor is connected for control to a manually controllable circuit.

5. A device as defined in claim 1 in which a manually-operable switch is provided for each of the time-delayed circuits and in which each of these manually-operable switches is connected to its time-delayed circuit in such a manner as to render the time-delayed circuit ineffective to stop the mechanism controlled by it.

6. A device as defined in claim 1 in which a manually-operable switch is provided for the circuit of the photocell and each of the time-delayed circuits for interrupting the supply of operating current to these circuits.

7. A device as defined in claim 1 in which a circuit breaker is provided for stopping the main container conveyor if the supply of filling material fails.

8. A device as defined in claim 1 in which an electrically-operated valve is provided for stopping the flow of filling material when the main container conveyor is stopped.

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