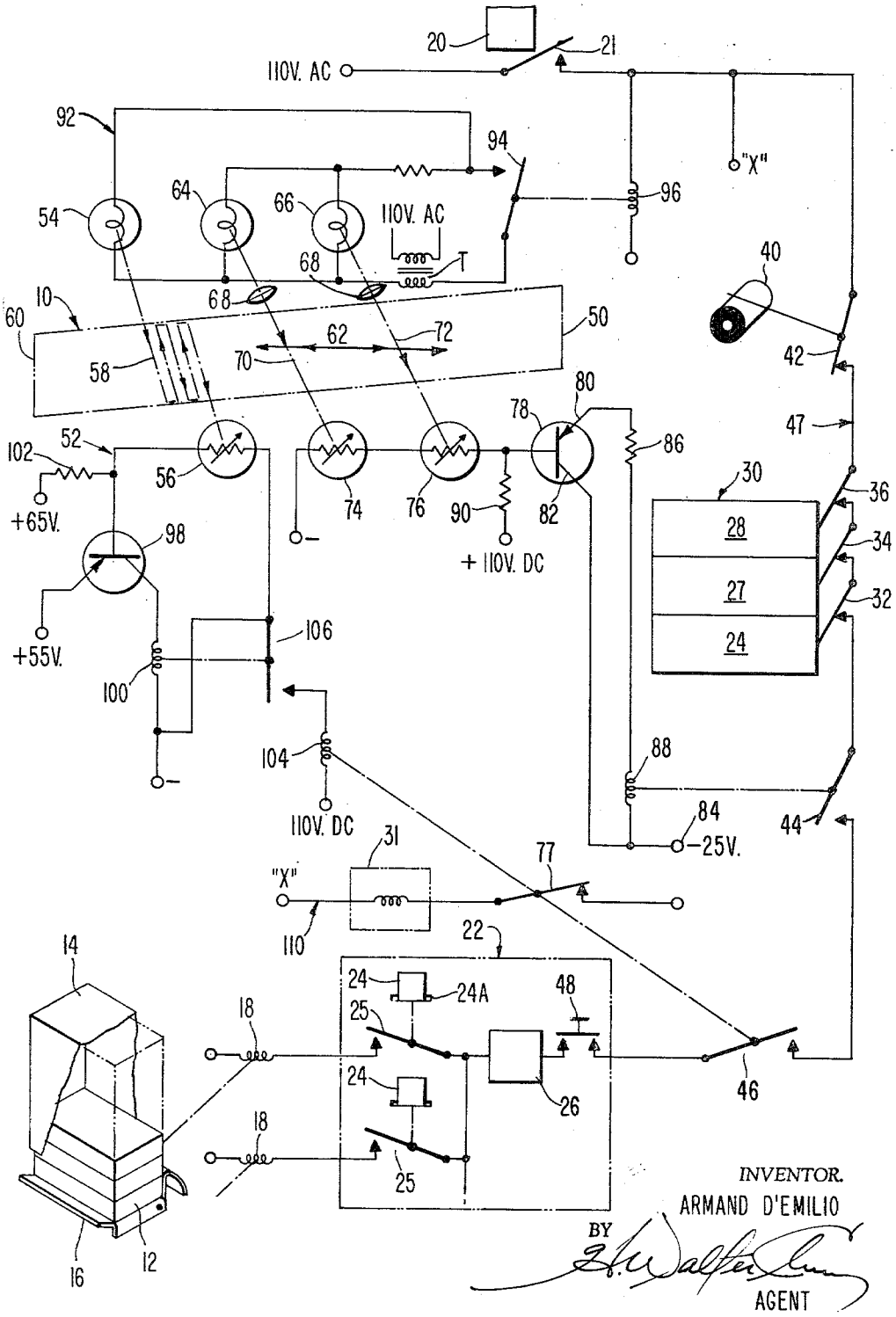
May 25, 1965 A. D'EMILIO 3,185,851

PHOTOCELL CONTROLLED ANTI-EJECTION CIRCUIT FOR AN ARTICLE HANDLING APPARATUS

Filed June 29, 1962



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United States Patent Office 3,185,851 Patented May 25, 1965

3,185,851
PHOTOCELL CONTROLLED ANTI-EJECTION CIRCUIT FOR AN ARTICLE HANDLING APPARATUS

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Filed June 29, 1962, Ser. No. 206,471
10 Claims. (Cl. 250—223)

The invention hereinafter described and claimed relates to electrical control circuits. More specifically however, it has to do with electrical control circuits having electrical anti-jam means for use with chutes of article storage and issuing apparatus wherein the chute is adapted to receive articles at one point and deliver them to another, and as a result thereof to actuate associated apparatus.

While of broader applicability the invention is particularly adapted for use in the control of apparatus such as shown and described in the co-pending application entitled "Inventory Control System and Apparatus" Serial No. 162,630, filed December 12, 1961, in the names of Frederic T. C. Brewer, William A. White and Walter E. Colburn, and the invention shown and described in the co-pending application entitled "Article Delivery Chute" Serial No. 188,679, filed April 19, 1962 in the name of Gerard A. Naab, and both assigned to the assignee of the present invention.

The apparatus of the Brewer et al. application is cyclically operable, after a plurality of pre-operative conditions have been satisfied, to issue or deliver a pre-selected of a plurality of different articles from a locked storage area in a cabinet through a chute (as more specifically disclosed in the Naab application) to a point of access from the exterior thereof. Passage of the article through the chute interrupts a sensing circuit thus to initiate operation of a recording device to make a record of the article delivery.

Unfortunately, however, chutes of this type are subject to "stuffing." That is, blocking of the chute with a foreign object, such as wadded paper or cloth, inserted in the chute above the sensing means before initiating a cycle of operation thus to prevent the record being made upon issuance of an article which would be stopped by the stuffing material before passing through the sensing means, then, after the cycle is completed, removing the stuffing and appropriating—or stealing—the article.

It is the primary object of the present invention to provide electrical control circuitry for article handling apparatus having as a feature thereof means to overcome the above-mentioned "stuffing" problem in chutes.

More specifically, it is an object of the invention to provide improved electrical circuitry capable of sensing the jamming of a chute to prevent passage therethrough of articles, and thereby, in response to such condition, prevent operation of associated article issuing apparatus.

In accordance with the above objects and first briefly described the invention comprises electrical circuitry for effecting operation of article handling apparatus having a plurality of pre-operative conditions which must be met before effecting delivery of an article into a chute through which the article passes to a point of access. The article delivery chute has separated article receiving and delivery openings whereby an article entering the receiving opening will pass through the chute to the delivery opening. Between the openings, the chute is provided with circuit means for sensing the passage of the article through the chute and responsive thereto to effect actuation of associated apparatus, such as a recorder. Between the receiving opening of the chute and the sensing means, anti-jam circuit means is provided to detect stuffing of the

chute, and in the presence thereof to prevent actuation of the issuing apparatus and thereby foil illicit operation of the apparatus.

Other objects and features of the invention will become apparent from the following description of the preferred embodiment of the invention when taken with the accompanying schematic drawing.

The single figure of the accompanying drawing is a schematic of the preferred embodiment of the invention.

While obviously of broader applicability, the invention is shown, by way of example, as it would be incorporated in the chute 10 of an article issuing apparatus, such as disclosed in the above mentioned co-pending applications, to which reference may be had, if desired, for structural details unimportant to an understanding of the present invention. Briefly, however, and as shown fragmentarily on the accompanying schematic, the apparatus comprises a cabinet (not shown) for housing in a locked compartment, a plurality of articles 12, such as drug packages, in separate bins 14, such as shown and described in the co-pending application of Richard I. Kester, entitled "Article Storing and Issuing Apparatus," Serial No. 187,636, filed April 16, 1962, now abandoned, and assigned to the assignee of the present invention. The bins have an ejection mechanism 16 operated by a solenoid 18.

To obtain issuance of a particular article in the mechanism of the Brewer et al. application, certain preliminary conditions must be met before the solenoid 18 can be activated. First, a door 20 must be opened, simultaneously therewith closing switch 21 and exposing to the operator a drug selection console 22 (shown at bottom of drawing) removably housing a plurality of key plates 24 (only two of which are shown) in slots 24A, each plate having indicia identifying the articles stored in a particular bin. As described in the aforesaid Brewer et al. application a bin is selected for activation by withdrawal of its corresponding identification key plate 24 from its slot thus closing its associated switch 25. Means 26 forming the subject matter of the co-pending application entitled "Electrical Circuit," Serial No. 189,637, filed April 23, 1962, in the names of Richard E. Wiley and assigned to the assignee of the present invention, prevents operation of the apparatus if more than one plate 24 is removed from the console.

As seen along the central right hand edge of the schematic, the plate 24, along with a customer identifying key plate 27 and an operator-identifying key plate 28, is inserted in the shuttle 30 of a charge recorder 31 to close associated normally open switches 32, 34 and 36. If the charge recorder contains a sufficient quantity of record tape 40, shown just above the shuttle, another normally open switch 42 is closed. If the article sensing and the anti-jam portion of the circuits, now to be described, are energized, as described later, switches 44 and 46 also will be closed, thus to complete the bin actuating circuit means, generally identified by the numeral 47—except for closure of start switch 48. Closure of the start switch, which is located on the console 22, now will actuate the selected bin 14 to issue or project an article or package 12 into the article receiving opening 50 of the chute 10.

The circuit 47 can be traced from the 110 v. A.C. source at the upper left of the schematic, through door switch 21, tape switch 42, shuttle switches 36, 34 and 32, anti-jam switch 44, detector or article sensing switch 46, start switch 48, error circuit 26, and article plate switch 25 to the bin actuating solenoid coil 18.

The chute is provided with article sensing means comprising an electro-optical circuit means 52 for sensing or detecting the passage of an article therethrough, and coincidental therewith initiating operation of the charge recorder 31 to make a record of the transaction, all as more fully described in the above mentioned co-pending

application of Brewer et al. The sensing circuit means comprises a radiant energy exciter or lamp **54**, and optical means (not shown) for directing a beam of light **58** from lamp **54** back and forth across the chute to a photo-optical device, such as photo-resistor **56**, preferably in parallel paths vertically displaced in equal increments less than the minimum major dimension of any package issued from the bins, thus to assure detection of an article passing through the chute. The optical means provided for this purpose may be a series of lens and prisms, such as shown and described in the above identified Naab application. Further details of the sensing circuit means for controlling operation of the article issuing bin mechanism and the recorder in a system such as disclosed in the Brewer et al. application, are described below.

As mentioned before, chutes of this kind are subject to stuffing, that is, some object, such as a wad of paper or cloth, may be inserted through the access opening **60** and upwardly through the chute past the beam **58** and into the area **62**, thus to intercept a package prior to its passing through the beam **58** and hold it in this area until a cycle of the machine is completed, after which the stuffing is removed and the package appropriated without a record of the transaction being made by the recorder **32**.

In particular accordance with an important feature of the present invention the means to prevent such stuffing comprises a source of radiant energy, preferably such as light bulbs **64** and **66**, and means, such as lens **68**, arranged to project their beams in paths **70** and **72** across the chute to associated ray sensitive devices, such as photo-resistors **74** and **76**.

The photo-resistors are connected in series to the base of a PNP amplifying type of transistor **78**, the emitter and collector electrodes **80** and **82** which are connetced to a minus voltage **84**, of approximately —25 v. in this embodiment, through a resistor **86** having a value of 3.3K ohms, and a relay **88**. The relay is operatively connected to the normally open switch **44** in the bin circuit **47**—or other associated apparatus to be controlled. A resistor **90** of 30K ohms has one end connected to the line between the photo-resistor **76** and the base of transistor **78**, and its other end to +110 v. D.C.

Lamps **54**, **64** and **66** from which light normally impinges upon photo-resistors **56**, **74** and **76**, respectively, are energized by means of a 6 v. secondary circuit **92** which receives its energy through a transformer T from a 110 v. A.C. line. If desired, a voltage dropping resistor of 5 ohms may be provided in the sub-circuit to extend the life of lamps **64** and **66**. While circuit **92** may be closed in other suitable ways, in the present case closure is effected by means of a normally open switch **94**, actuation of which is by a relay **96** which gets its energy from the 110 v. A.C. supply upon closing of door switch **21**.

In operation under normal conditions—that is, with no foreign object in the chute to prevent an ejected article from passing completely through the chute to the article delivery opening **60**—light from lamps **64** and **66** impinges upon photo-resistors **74** and **76** dropping their combined resistance to a maximum of 100K ohms, and the current through the photo-resistors to the low impedence side of the transistor is 0.5 ma. However, the 30K ohm resistor **90** will bleed off, or subtract 0.33 ma. leaving only 0.17 ma. to reach the transistor. This latter current (0.17 ma.) multiplied by the amplification factor of the transistor (a minimum of 40) gives a current of 6.8 ma. which is sufficient to energize relay **88** to close switch **44**.

Now, if light from either or both of the lamps **64** and **66** is prevented from impinging upon its companion photo-resistor for a sufficient length of time, such as by jamming of the chute, their total series resistance becomes greater than 500K ohms and the current through them, by reason of the current through resistor **90** and the leakage current through the transistor, becomes less than 0.1 ma. The base of the transistor thus becomes more positive cutting off the current to relay **88** which drops out, opening switch **44** to cut the power in circuit **47** and thus prevent operation of the bins, or other associated apparatus.

The article sensing portion of the circuit comprises the photo-resistor **56** in series circuit with a PNP amplifying type transistor **98** and a sensitive, fast acting relay **100**, with a base resistor **102** of 30K ohms value from a +65 v. supply, and a second relay **104** controlled by relay **100** through a normally open switch **106** from a 110 v. D.C. supply. Switch **46** in circuit **47** is operatively connected to relay **104** and, as mentioned above, cooperates with other switches to control operation of the associated equipment.

In operation, light from lamp **54** traverses the chute back and forth to impinge upon photo-resistor **56** causing its resistance to drop to a maximum of 62K ohms. This tries to drive 900 μa. through the base of transistor **98**. However, the resistor **102** bleeds it of 330 μa. leaving only 570 μa. which turns the transistor "off." The beta times 570 μa. results in a minimum of two milliamps through relay **100** to energize it and thus energize relay **104** by closing switch **106**.

If light beam **58** is broken, as by an article passing through the chute, the photo-resistor **56** momentarily is darkened and its resistance rises to 400K ohms. This permits 140 μa. to balance the 330 μa. from the 30K ohm resistor **102**, back biasing the transistor **98** causing the relay **100** to become de-energized opening switch **106** to de-energize relay **104** thus to close switch **77** in line **110** to the recorder, and open switch **46** in circuit **47** to prevent further operation of the bins until completion of the recorder cycle. Line **110** is connected to the 110 v. A.C. source by connection (not shown) of its terminal "X" with circuit **47** at its terminal "X" shown just to the right of door switch **21**. Other means, not important here, are used to hold the circuit closed for one cycle of operation of the recorder and then shut it off. Reference may be had to the above-identified co-pending application of Brewer et al. for such details. Relay **88** in the anti-jam circuit is slow acting, therefore an article passing through the beams **70** and **72** will have no effect on normal operation of the apparatus.

Having now described the preferred form of the invention it is clear that it provides a control circuit for article delivering apparatus having the attributes and features set forth at the beginning of this specification.

What is claimed is:

1. In electrically operative article ejecting and handling apparatus operable to eject an article into and to pass it through a chute from one point to another:
   - (A) an electrical control circuit for connecting said apparatus to a source of electricity;
   - (B) a first sensing means positioned between said points in the chute to sense an article as it passes along its path of movement through the chute and responsive thereto to actuate associated apparatus; and
   - (C) a second sensing means positioned between said one point and said first sensing means to sense material placed in the path of movement of said article to prevent the article from passing through said first sensing means during a cycle of operation, and operable in the presence of such material in the path of movement to render the article handling apparatus inoperable until the material is removed;
   - (D) said second sensing means having means to delay its operation for a period of time normally to permit the said article to pass thereby without rendering said apparatus inoperable.

2. An electrical control circuit for article ejecting and handling apparatus cyclically operable to eject an article into a chute through which it passes by force of gravity from one portion to another, comprising:

(A) means for connecting said article ejecting apparatus to a source of electricity comprising,
(1) an electrical conductor, and
(2) a plurality of first switches series connected in said conductor;
(B) first article sensing means positioned at a point between said chute portions and normally operative to close one of said first switches to prepare said circuit for operating said article ejecting apparatus, and responsive to the sensing of an article passing through the chute to effect actuation of an associated device; and
(C) second sensing means between said one chute portion and said first sensing means normally closing a second of said first switches to render said control circuit operable, but effective in the presence of material placed in the chute to prevent the article from passing through said first sensing means after being ejected into said chute, thus to open said second switch to render the said ejecting apparatus inoperable until the material is removed;
(D) said second sensing means having means to delay its operation for a period of time long enough normally to permit the said article to pass thereby without rendering said apparatus inoperable.

3. An electrical circuit according to claim 2 wherein said second sensing means comprises:
(A) at least one radiant energy source,
(B) a radiant energy sensing device,
(C) means for directing a beam of radiant energy across said chute from said source to said sensing device to produce an electrical output from the latter, and
(D) means responsive to the said electrical output in one mode of operation to close said second of said first switches in said circuit to render said article ejecting apparatus operable, and in another mode of operation to open said second switch in response to the blocking of said beam from said sensing device thus to render said article ejecting apparatus inoperable.

4. An electrical circuit according to claim 2 wherein said second sensing means comprises:
(A) a plurality of radiant energy sources;
(B) means for energizing said sources;
(C) a plurality of radiant energy sensing devices;
(D) means for directing beams of radiant energy across said chute from ones of said sources to corresponding ones of said sensing devices to produce an electrical output from said sensing devices; and
(E) means connecting said sensing devices in series circuit with,
(1) amplifying means, and
(2) relay means operable in response to said electrical output to close said second of said first switches thus to render said control circuit operable, and to open said second switch to render said control circuit inoperable if one or more of said radiant energy beams is blocked or otherwise prevented from impingement upon its corresponding sensing device for a predetermined period of time.

5. An electrical control circuit for ejecting and article handling apparatus cyclically operable to eject an article into and through a chute from one portion to another and to make a record thereof by recorder means, comprising:
(A) means for connecting said article ejecting apparatus to a source of electricity, comprising,
(1) an electrical conductor,
(2) a plurality of first switches in series in said conductor operable to closed condition upon fulfillment of certain pre-operative conditions, and

(3) a normally open start switch for effecting final closure of said circuit to actuate said article ejecting means to introduce an article into said chute,
(B) circuit means, for connecting the recorder to a source of electricity and having
(1) a normally open second switch,
(C) first sensing means comprising;
(1) a first radiant energy source,
(2) a first radiant energy sensing device,
(3) means for directing a radiant energy beam from said first source to impinge upon said first sensing device to produce an electrical output therefrom, and
(4) means responsive to said output to effect closure of one of said first switches, and responsive to interruption of said radiant energy beam by an article passing through the chute to open said one of said first switches to inactivate said article ejecting apparatus, and to close said normally open second switch in said recorder circuit thus to actuate said recorder; and
(D) second sensing means in said chute between said one portion and said first sensing means comprising,
(1) a second radiant energy source,
(2) a second radiant energy sensing device, and
(3) means for directing a second radiant energy beam from said source to impinge upon said second sensing device to produce an electrical output therefrom, and
(4) means responsive to said output to close another of said first switches and responsive to the blocking of said second radiant energy beam by jamming material in said chute to open said first switch and thus prevent operation of said article ejecting apparatus until said material is removed.

6. An electrical control circuit for article ejecting and handling apparatus cyclically operable to eject an article into and through a chute from one portion to another and to make a record thereof by a recorder, comprising:
(A) means for connecting said ejecting apparatus to a source of electricity, comprising,
(1) an electrical conductor,
(2) a plurality of first switches in series in said conductor operable to closed condition upon fulfillment of certain pre-operative conditions, and
(3) a normally open start switch for effecting final closure of said circuit to actuate said article ejecting means to introduce an article into said chute,
(B) circuit means for connecting said recorder to a source of electricity and having
(1) a normally open second switch;
(C) first article sensing means comprising;
(1) a lamp,
(2) a photo-resistor,
(3) means for directing a light beam from said lamp to impinge upon said photo-resistor to produce a weak electrical output current therefrom, and
(4) means having a current amplifier and a relay, and responsive to said output current to close one of said first switches, and responsive to interruption of said beam by an article passing through said chute to open said one of said first switches, and to close said normally open second switch in said circuit means for connecting said recorder to a source of electricity thus to actuate said recorder to make a record of the article; and
(D) second sensing means in said chute between said one portion and said first sensing means comprising,

(1) a plurality of lamps,
(2) a plurality of photo-resistors, and
(3) means for directing a light beam from each of said lamps upon a corresponding of said photo-resistors thus to produce a weak electrical output therefrom, and
(4) means having a current amplifier and a relay and responsive to said output current to close another of said first switches, and responsive to blocking of said beam by jamming material in said chute to open one of said first switches thus to prevent operation of said article ejecting apparatus until such material is removed.

7. A circuit according to claim 5 and further including:
(A) a further first switch in the circuit between said source of electricity and all the other of said first switches; and
(B) means for closing said further first switch whereby said radiant energy exciters are energized.

8. Apparatus according to claim 7 wherein: the print elements in said recorder comprise removable charge plates having indicia thereon, and further including:
(A) more of said series connected first switches each adapted for closure by one of a plurality of said printing plates when the plates are in printing position in the recorder.

9. A circuit in accordance with claim 8 and further including:
(A) a still further of said first switches which is adapted to be closed by removal from its housing of an article identifying charge plate.

10. A circuit according to claim 9 and further including:
(A) means in said circuit to detect when more than one article identifying charge plate is removed from said housing at one time, and
(B) means responsive to such condition to render the ejecting apparatus inoperative.

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