United States Patent [19]

Green

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[54] **MAIL CANDLING APPARATUS**

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[51] **Int. Cl.** **B07c 5/342**

[58] **Field of Search**..... 209/DIG. 2, 111.7, 111.6; 250/219 DQ, 219 TH; 356/240, 204, 205, 206

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Primary Examiner—Allen N. Knowles

[57] **ABSTRACT**

A mail candling apparatus for feeding an envelope to photocell scanners which depending on the density of the envelope as when the envelope contains an enclosure, will reject the envelope or when the envelope is empty will pass the same for disposal and including means for rejecting the envelope when containing bulky material.

5 Claims, 6 Drawing Figures

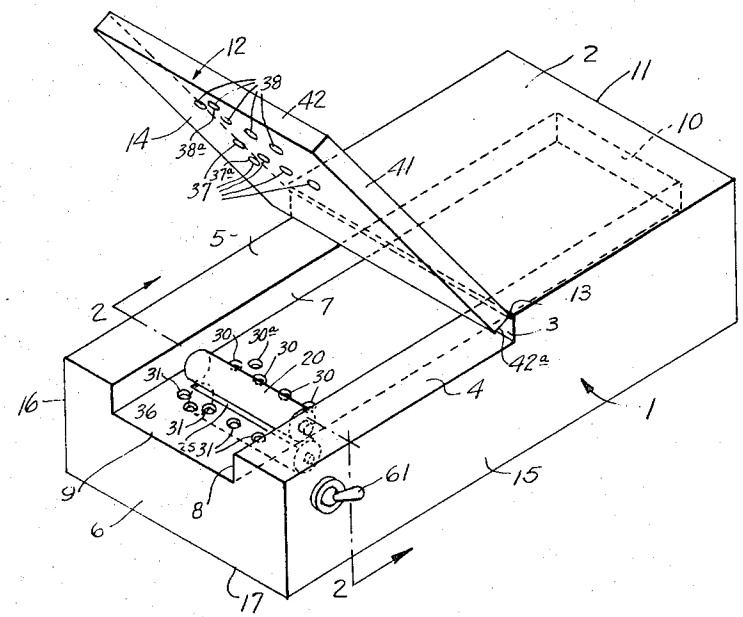


FIG. 1.

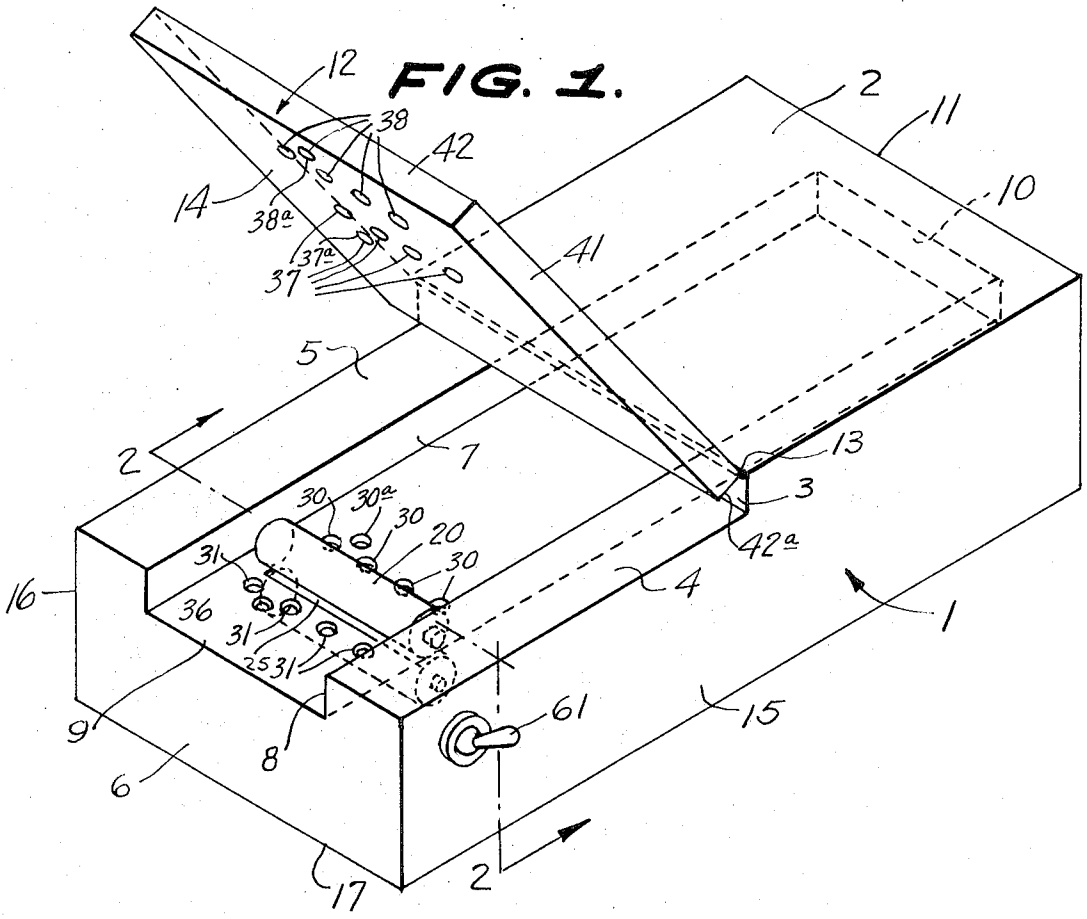


FIG. 2.

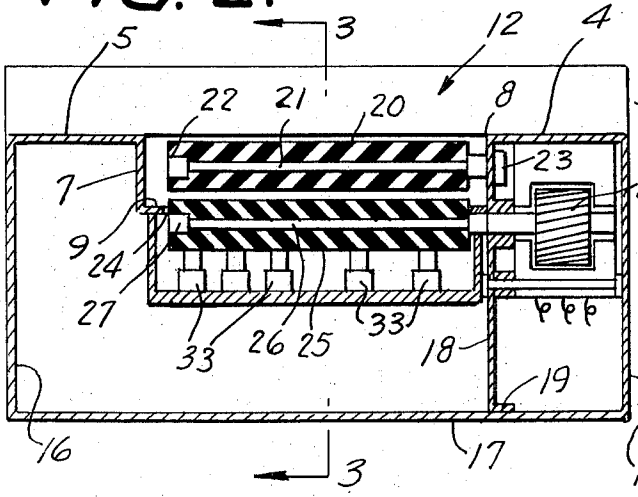
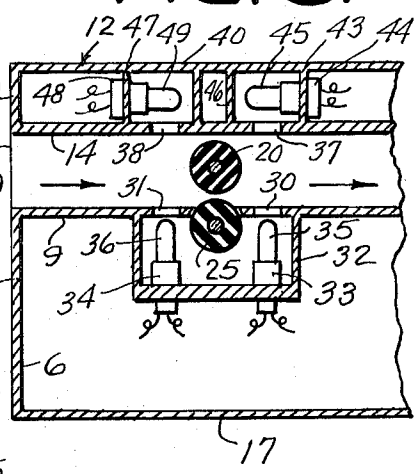


FIG. 3.



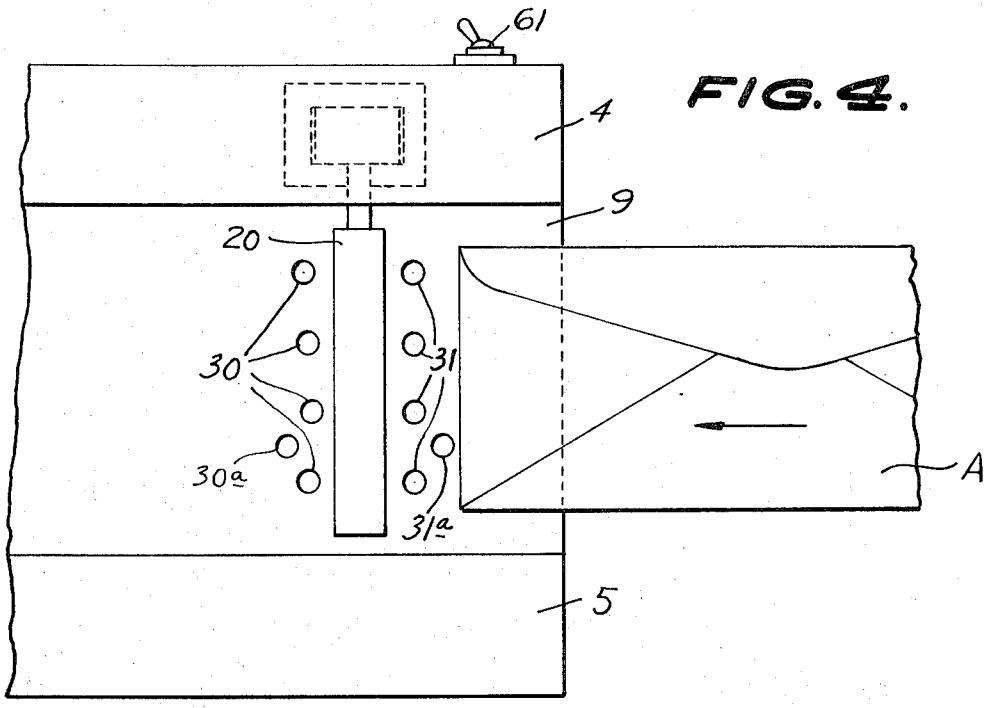


FIG. 4.

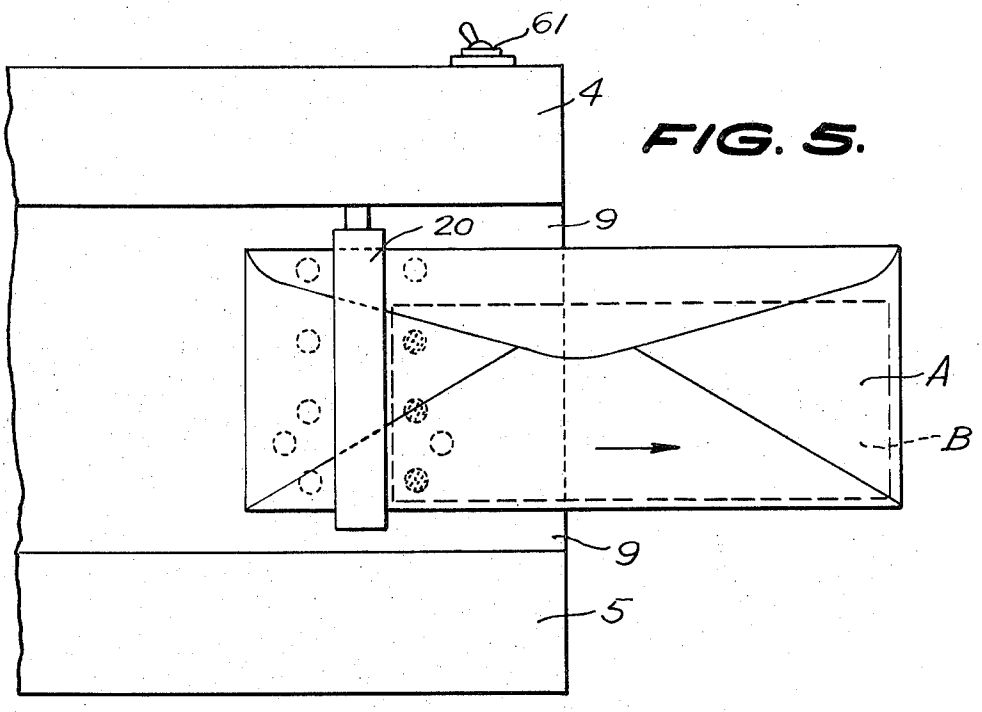


FIG. 5.

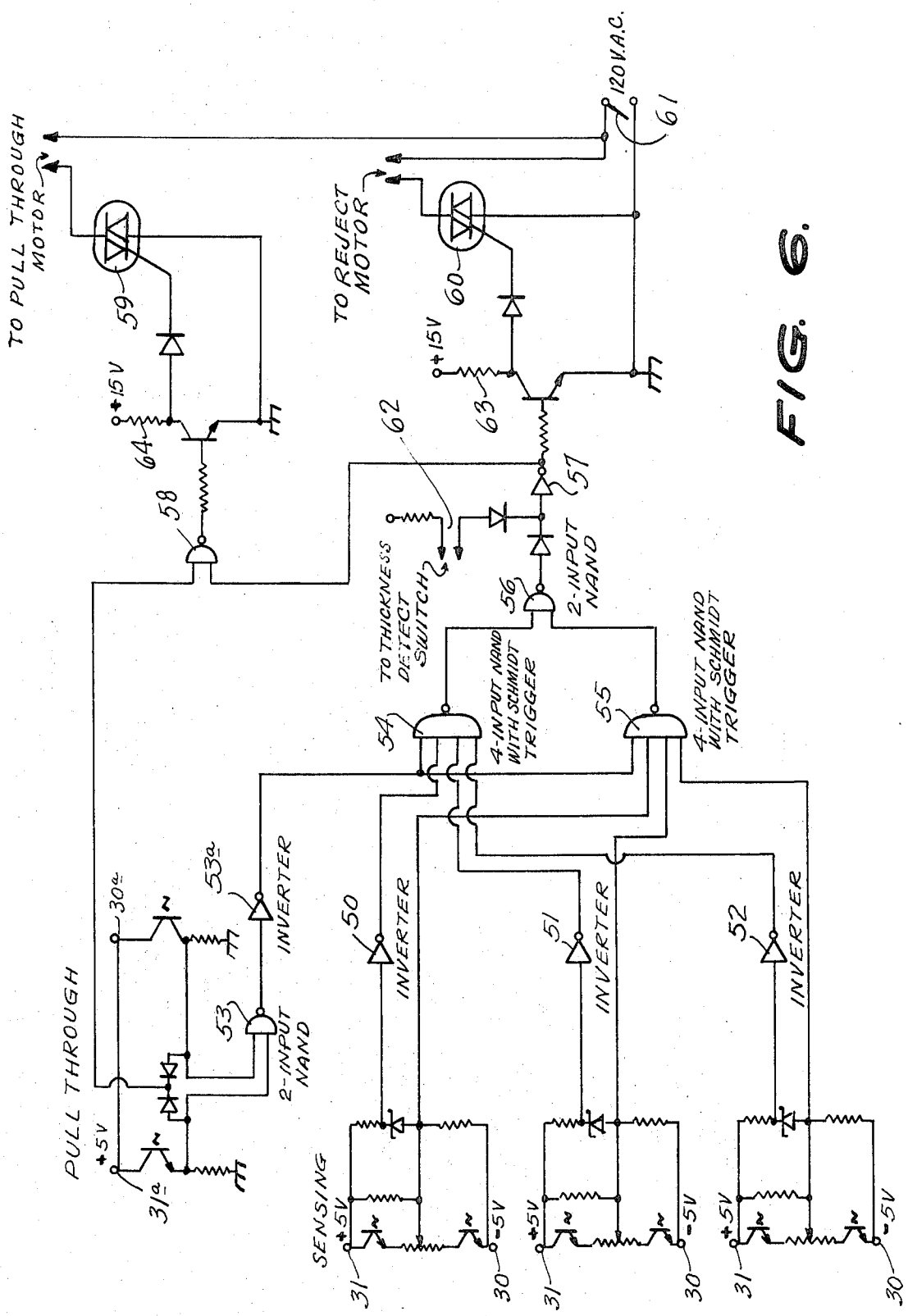

TO PULL THROUGH MOTOR
TO REJECT MOTOR
120 V.A.C.
61
59
60
+15V
64
63
62
57
58
56
2-INPUT NAND
TO THICKNESS DETECT SWITCH
54
4-INPUT NAND WITH SCHMIDT TRIGGER
55
4-INPUT NAND WITH SCHMIDT TRIGGER
50
51
52
INVERTER
INVERTER
INVERTER
53
53a
2-INPUT NAND
INVERTER
PULL THROUGH
30a
+5V
31a
SENSING
+5V
-5V
31
30

FIG. 6

MAIL CANDLING APPARATUS

The present invention is concerned with a mail candling apparatus for automatically detecting any material left in an envelope.

The principal object of the invention is to provide an economically produceable and relatively small mail candling device which can scan envelopes of different weights and texture of paper without adjustment to compare the density of the envelopes and rejects envelopes containing enclosure, but passes empty envelopes.

A further and important object of the invention is to provide a mail candling device having two or more sensing circuits working together to compare the density of material passing thereby and when any circuit detects a difference in density, that is mail of more or less density than another circuit, means will be activated that will send the mail back to the operator and which sensing circuits will not be effected by diagonal seams of envelopes, postage stamps, black printing or the like on the envelope.

Further objects of the invention will be in part obvious and in part pointed out in the following description of the accompanying drawings.

FIG. 1 is a perspective view of an apparatus according to the invention with the lid thereof being in its open position,

FIG. 2 is a cross-sectional view taken on line 2—2 of FIG. 1,

FIG. 3 is a sectional view of the feeding and scanning portion of the apparatus taken on line 3—3 of FIG. 2,

FIG. 4 is an enlarged top view of the feeding and scanning portion of the apparatus with the lid raised and showing the manner of introducing an envelope therein.

FIG. 5 is a view similar to FIG. 4 but showing the rejection position of an envelope with enclosure, and

FIG. 6 is an electrical diagram of the apparatus.

Referring now more particularly to the accompanying drawings in which like and corresponding parts will be designated by the same reference characters, numberal 1 generally indicates a hollow box having a flat half-top 2 with intermediate wall 3 normal to said top and ledges 4 and 5. Said box has end wall 6 with longitudinal walls 7 and 8 extending from said end wall to the opposite box end wall 11 and with base wall 9 extending between walls 7 and 8 for the length thereof forming a mail slot which opens at wall 6 as the entrance thereof and also in wall 1 at exit opening 10.

A hollow lid 12 is hinged by hinge 13 to wall 3 in such a manner that said lid can be raised as shown in FIG. 1 or closed as shown in FIGS. 2 and 3, with the bottom 14 of said lid being seated on ledges 4 and 5 and providing a continuous cover for the length of said mail slot 7–9 with half-top 2.

Box 1 also has side walls 15 and 16, bottom 17 completing a rectangular hollow box. Upright wall 18 extends contiguous with wall 8 to bottom 17 and is fastened thereto at flange 19.

A resilient roller 20 has an axle 21 with tightening nut 22 on one end and having its other end rotatable in bearing 23 attached to wall 8 so that said roller extends laterally of and is spaced above base wall 9.

Base wall 9 has a lateral slot 24 below roller 20 in which extends a second resilient roller 25 which has an axle 26 with tightening nut 27 on one end and which axle 26 is fixedly attached to shaft 28 extending through wall 18 as part of a reversible electric motor 29 connected to wall 18.

Base wall 9 also has a series of openings 31 therethrough on the mail feed-in side of rollers 20 and 25 with a further opening 31a just in front of openings 31. Further base wall 9 has a series of openings 30 on the mail feed-out side of rollers 20 and 25 with opening 30a just beyond openings 30.

A housing 32 suspended below base wall 9 has a series of lamp sockets 33 with photo-electric cells 35 therein, supported by said housing with each cell below one of said openings 30 and 30*a*. A further series of sockets 34 are supported by said housing with photo-electric cells 36 therein and each cell 36 is below one of the base wall openings 31 and 31a.

Lid bottom 14 has a series of openings 37 each positioned for being directly opposite an opening 30 when said lid is in its closed position. Also said lid has opening 37*a*, a series of openings 38 and opening 38*a* each positioned for being directly opposite opening 30*a*, one of said openings 31 and opening 31*a*, respectively, when said lid is closed.

Lid 12 has side walls 39 and 41, top 40, end walls 42 and 42a which with bottom 14 provides a hollow lid. Partitions 43, 46 and 47 extend from top 40 to bottom 14 providing lamp areas.

Lamp sockets 44 are mounted in partition 43 so that lamps 45 in said sockets are each above one of said openings 37 and 37*a*. Also lamp sockets 48 are mounted in partition 47 so that lamps 49 in said sockets are each above one of said openings 38 and 38*a*.

As shown in FIG. 6 each opposite pair of photocells 30 and 31 is connected between a positive and negative supply voltage with a potentiometer, the three being in series with the potentimeter between the photocells. The value of the resistance of the potentiometer is chosen so that for normal envelopes, most of the voltage drop is across the resistor, so that for denser envelopes an increasing voltage drop will appear across both photocells and this will automatically increase the voltage change seen at the potentiometer for a given change in photocell current, so that the increased sensitivity required is automatically provided. The potentiometers are adjusted for zero voltage at the taps when the photocells are uniformly lighted. Potentiometer adjustments are necessary on assembly because of differences after assembly. Small Zener diodes are connected to the potentiometer taps and are biased so that a voltage of 2.5 volts higher than the tap voltage is also available. For each of the photodiode pairs, the voltage 2.5 volts over the potentiometer tap voltage is fed to a logical inverter 50,51 or 52. The output voltage of each of said inverters is less than 0.4 when the input is greater than 2.0 volts. The output of each photodiode pair circuit is two voltages, the potentiometer tap voltage and the inverter output voltage.

The three inverter output voltages are fed to one 4-input NAND gate 54 and the three potentiometer tap voltages are fed to a second 4-input NAND gate 55. The fourth input to both gates 54 and 55 is to enable voltage generated by photocells 30*a* and 31*a* circuits. The output of each 4-input NAND gate 54 or 55 is above 2.2 volts unless all four inputs of one NAND gate 54 or 55 rises above 2.0 volts in which case the output voltage of that gate drops below 0.4 volts. Thus, the output of both 4-input NAND gates 54 and 55 is 2.2 volts, when all photocells are evenly illuminated.

The outputs of the two 4-input NAND gates are fed to a 2-input NAND gate **56.** When both inputs of gate **56** are above 2.0 volts, the output is below 0.4 volts.

The two electronic switch circuits shown, for the reversable pullthrough motor and the reject reverse action are conventional saturated switching circuits.

Photocells **30***a* and **31***a* are connected through 2-input NAND gate **53** and inverter **53***a* to both gates **54** and **55.** Also said photocells **30***a* and **31***a* are connected to 2-input NAND gate **58** which is also connected to inverter **57.**

A thickness detect switch **62** is connected in front of inverter **57.**

The 4-input NAND gates specified are Texas Instruments type SN 5413 which incorporate a Schmidt trigger into the same integrated circuit, which allows the outputs of these gates to be sharp switching pulses with relatively slowly varying inputs. This feature avoids an "indecisive" or jittery output which could severely stress output electrical and mechanical components.

The 2-input NAND gates are type SN 5400, the inverters type 5404 and triacs type TIC22, all of Texas Instrument. The photocells are Clairex type CLT 3160.

Box **1** will contain the entire mechanical and electrical components shown in the drawings and, for example could be five inches high, nine inches wide and eighteen inches long. The slot **7–9** would be one inch deep by five inches wide and eighteen inches long. **61** indicates the On and Off switch for the circuit of FIG. **6** and lamps **45** and **49** are also connected to said switch.

The apparatus is designed with two or more sensing circuits working together to compare the density of the envelope it is sensing. When any circuit detects a difference, more or less in density than the other circuit, the reversable motor **29** will be activated that will send the envelope back to the operator. For example, when a check left in an envelope passes over one circuit the density will change for one circuit thereby creating an off balance in voltage and cause the rejection of the envelope. The apparatus will identify any envelope dark or light in texture and reject only when something has been left in the envelope.

The arrangement of the sensing photocells **30** and **31** is a major factor in the proper functioning of the device. Two or more photocells **30** and **31** operating together must detect a change in density of an envelope passing thereover. This will allow the diagonal seam of the envelope to pass as well as a postage stamp black printing on the envelope and the like. The check or other document left in the envelope will be sufficiently wide and squared on the end with the arrangement of the photocells **30** and **31** to effect satisfactory detection.

The envelope candler operates by sensing relative light transmission across the width of the envelope in two or more long narrow regions whose long dimension is parallel to the leading edge of the envelope. As the envelope passes through the scanning regions of the light transmissions **37–38** and sensing photocells **30** and **31,** it can, when an enclosure enters or leaves said regions, detect through the differences in light transmissions between said regions. The sensing device is sensitive only to enclosures or obstructions in envelopes such as checks, letters and the like of predetermined width. It is not sensitive to enclosures or obstructions of lesser width, such as stamps, seams addresses, envelope lettering and the like. The sensing circuits automatically compensate for changes in overall transmission so that its operation is unaffected by the use of thick colored or other unusual envelopes.

If the enclosure is a coin or something folded too small to be detected by the photocells **30** and **31,** then a gauge electrically connected to switch **62** of the circuit will detect the thickness of the enclosure and reject the envelope.

In the operation of the apparatus when envelope A is advanced to cover photocell **31***a* reversable motor **29** will be turned on and will remain on while either photocell **31***a* or **30***a* is covered which also causes the 2-input NAND gate **53** and inverter **53***a* to cause the candling circuit.

The candling circuits sense light transmission through the envelope A by means of photocells **30** and **31,** which are operated in pair. Each pair of photocells **30** and **31** are placed at the same distance from the lower edge of the envelope A and said photocells form two or more columns of three or more photocells each. The two columns of candling photocells are both parallel to the leading edge of the envelope A and are placed so that they are both covered as long as both photocells **30***a* and **31***a* are covered.

When both elements of a photocell pair of both columns are evenly illuminated, both outputs of the circuit are small. If, for example, the left photodiode **31** of FIG. **1** in the circuit is obstructed by an enclosure that has not reached the left hand photodiode **30,** the potentiometer tap voltage will go negative, pulling the input voltage of the inverter **50** through the Zener diode, and the output of said inverter will go to over 2.2 volts. If, on the other hand, the left hand photodiode **30** is obstructed by an enclosure which was not detected on the leading edge because of a folded corner of the enclosure then when the trailing edge of the enclosure passes the left hand photodiode **31,** the potentiometer tap voltage will rise to 2.0 volts or above. The inverter **50** output will remain lower than 0.4 volts.

If all photocells **31** are obstructed by an enclosure which has not reached the photocells **30,** the output of all inverters **50, 51** and **52** will go to 2.2 volts and the output of the 4-input NAND gate **54** will drop to 0.4 volts.

Voltages going negative on the input of 4-input NAND gate **55,** will not cause its output to change, but if the trailing edge of an enclosure is detected by all photodiode pairs the potentiometer tap voltages will all rise to 2.0 volts or more, causing the output of the second 4-input NAND gate to drop to less than 0.4 volts.

Rejection of the envelope A is caused by the following:

As long as both inputs to 2-input NAND gate **56** are high, the output is below 0.4 volts. When either input drops below 0.8 volts the output rises to 2.2 volts. When an enclosure is detected, the output of either 4-input NAND gate **54** or **55** drops below 0.8 volts and the output of the 2-input NAND gate **56** rises to above 2.2 volts. When the input to inverter **57** is below 0.8 volts, the output is 2.2 volts, which biases transistor **63** to saturation, so that less than **1** volt appears on the gate of triac **60,** which remains off. When an enclosure B is detected, the input to inverter **57** rises above 2.2 volts, the output drops below 0.4 volts and transistor **63** is cut off, and the **15** volt supply through the 100 ohm resistor continuously fires the triac **60** actuating the re-

verse action of the motor **29**. 2-input NAND gate **58**, transistor **64** and triac **59** operate in a similar manner whenever photocells **31***a* or **30***a* are covered. Taking the second input of 2-input NAND gate **58** from inverter **57** stops the pullthrough phase of motor **29** when the reverse action of said motor is active.

I claim:

1. A mailing candling apparatus comprising a box having a slot capable of having mail passed therethrough and which slot is defined by bottom, top and side walls, a reversible motor driven means extending across said slot and capable of moving mail along, a pair of photocells exposed through said slot bottom with one before said driven means and one after said driven means, two straight series of photocells exposed through said slot bottom with each series extending laterally of said slot between said pair of photocells and with one series positioned before said driving means and the other series positioned after said driving means, means exposed through said slot top for directing light across said slot to each one of said photocells, electrical circuit connected to said pair of photocells capable of operating said motor when mail passes over either one of said pair of photocells, electrical means connecting each opposite pair of photocells of said series of photocells as sensing circuits connected to said driving means and capable of reversing said driving means to reject mail from said slot when one sensing circuit creates an off-balance in voltage upon passage of mail with an enclosure therein.

2. A mail candling apparatus as claimed in claim **1** wherein said motor driven means includes a pair of superposed rollers extending between said slot side walls and a reversible electrical motor is operatively connected to one of said rollers and said electrical circuit and electrical means.

3. A mail candling apparatus as claimed in claim **1** wherein said box partially provides said top wall and a lid is pivotally con-nected to said box and provides the remainder of said top wall when positioned across said slot.

4. A mail candling apparatus as claimed in claim **1** wherein said electrical means includes a potentiometer with said two photocells connected thereto and between a positive and negative voltage supply in series with said potentiometer between said photocells, Zener diodes connected to said potentiometer taps, an inverter connected to said diodes, a pair of NAND gates with said inverter connected to one of said gates and said potentiometer taps connected to the other of said gates, a further NAND gate connected to the output of said pair of NAND gates and switching circuits connecting the output of said further gate to said motor driven means.

5. A mail candling apparatus as claimed in claim **4** wherein said electrical means includes a plurality of potentiometers with each potentiometer connected to and between one photocell from each series thereof, positive and negative voltage supplies each connected to one photocell from each series thereof and in series with their respective potentiometer, Zener diodes connected to said potentiometer taps, inverters each connected to the diodes of one potentiometer, a pair of 4-input NAND gates with one gate connected to the output of said inverters and the other gate connected to said potentiometer taps, a 2-input NAND gate connected to the output of said pair of gates and switching circuits connecting the output of said 2-input NAND gate to said motor driven means.

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