March 26, 1963 R. H. DUNCAN 3,082,871

QUALITY CONTROL SORTING DEVICE

Filed Oct. 17, 1960 2 Sheets-Sheet 1

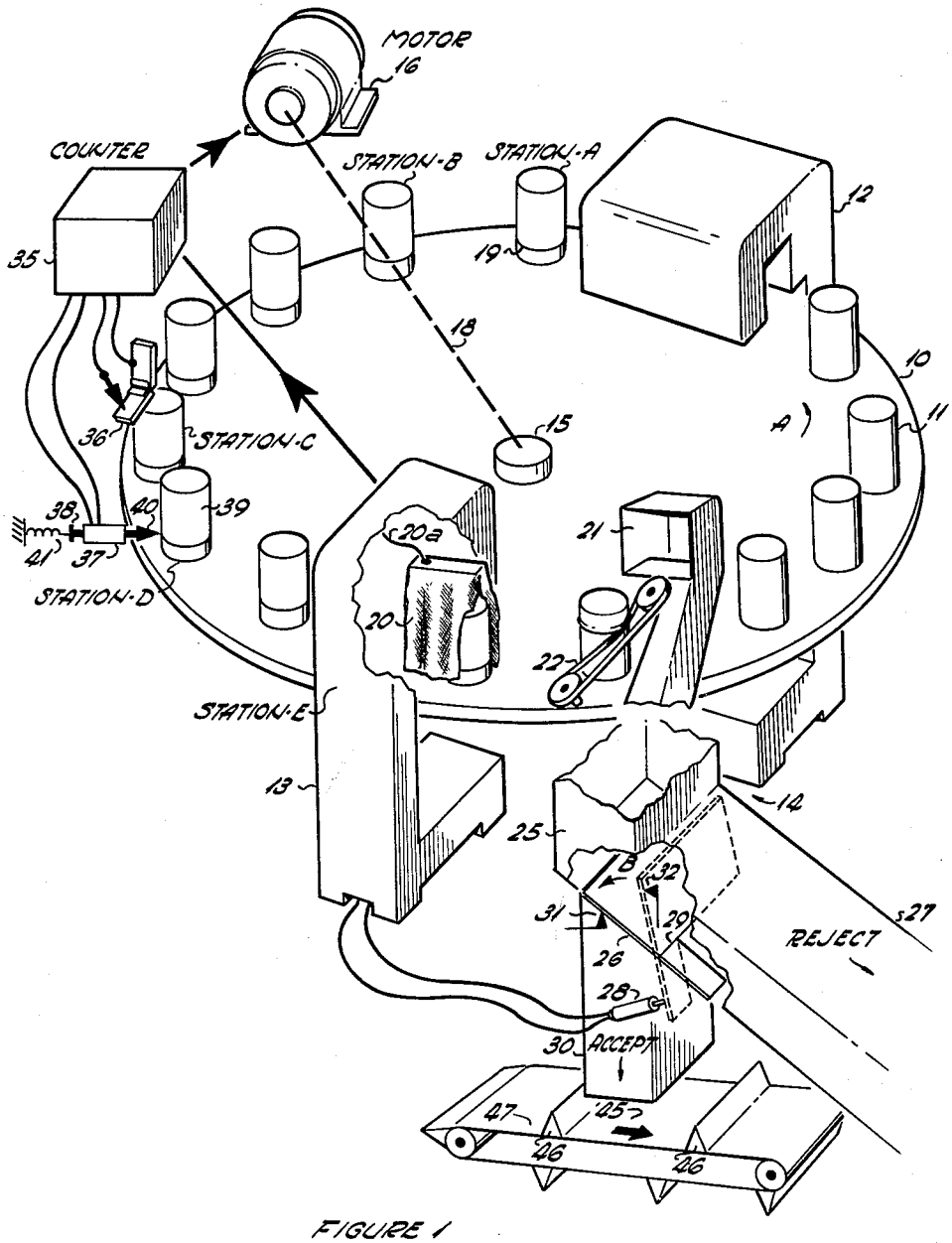

FIGURE 1

INVENTOR.
ROBERT A. DUNCAN

BY

ATTORNEY

March 26, 1963 R. H. DUNCAN 3,082,871

QUALITY CONTROL SORTING DEVICE

Filed Oct. 17, 1960 2 Sheets-Sheet 2

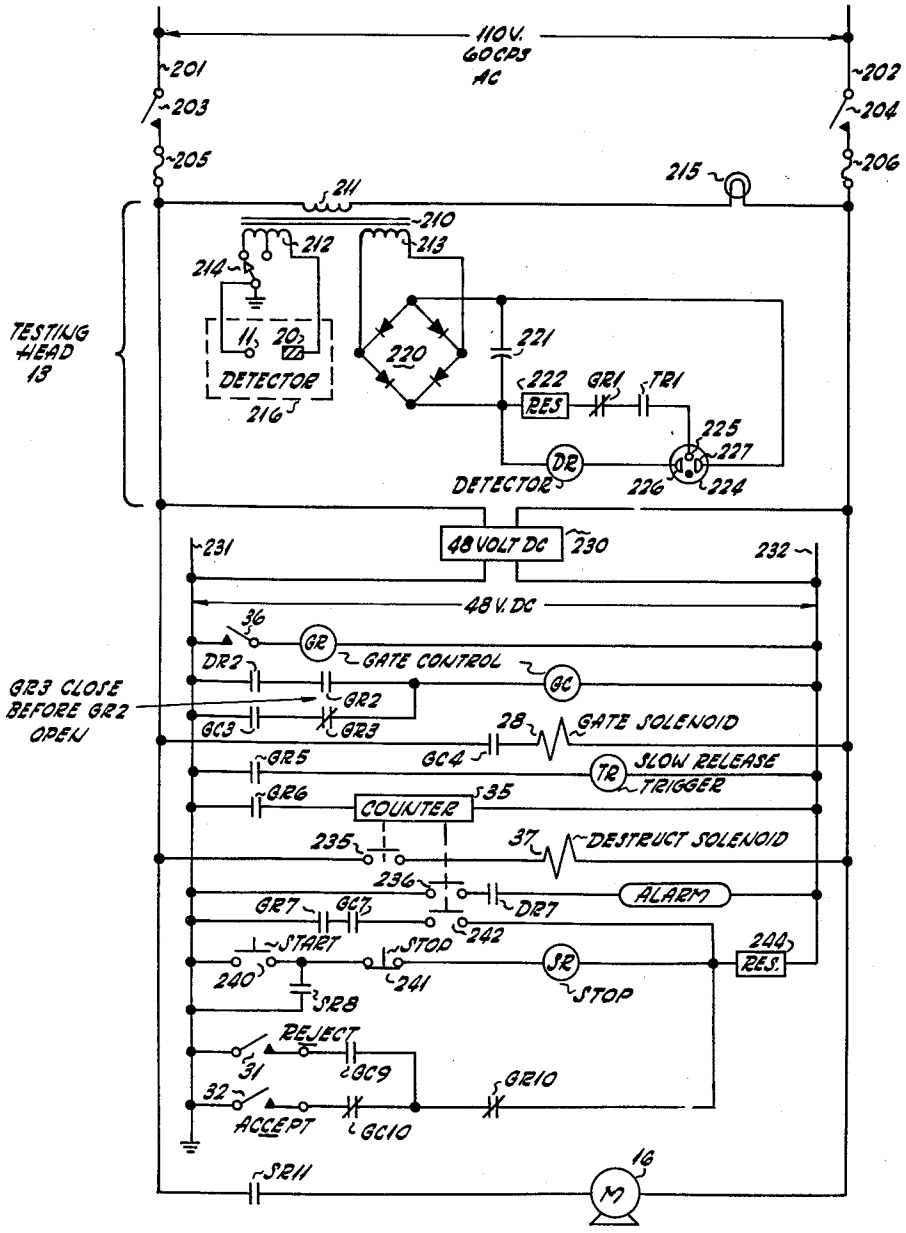

FIGURE 2

United States Patent Office 3,082,871 Patented Mar. 26, 1963

3,082,871

QUALITY CONTROL SORTING DEVICE

Robert H. Duncan, Arlington Heights, Ill., assignor to International Telephone and Telegraph Corporation, New York, N.Y., a corporation of Maryland

Filed Oct. 17, 1960, Ser. No. 63,209
13 Claims. (Cl. 209—81)

This invention relates to controls for automatic machines and more particularly to quality control sorting devices that automatically test goods made of dielectric materials.

Most automated production lines require quality control circuits or devices which accept or reject products or goods produced thereon and which cause a corrective action if the goods fail to meet acceptable standards. Usually, these quality controls are considered satisfactory if less than a predetermined number of defective products or goods are passed as acceptable. However, on some production lines it is necessary to reject all defective goods. For example, if defective goods are a health hazard, all goods must be 100% acceptable and even a single defective item cannot be tolerated. More specifically, certain quality control sorting machines test goods shaped or formed into thin membranes which are impervious to the passage of moisture and other agents. When goods of this type are defective, the impervious barrier breaks down and there is a resulting health hazard. Thus, the machines which test these membranes should detect not only the smallest pin holes, but also mechanically weak portions of the membrane which may rupture at a later time. Moreover, these quality control circuits and the machine itself should be completely self-checking and fail-safe.

Since these membranes and similar goods are usually made of a dielectric material, a quality control device may conveniently detect defective goods by subjecting them to a high voltage field which causes a spark to pass between electrodes placed on either side of the dielectric material if it is defective. Known controls of the type described have relied upon a relay which is connected in series with the primary winding of a high voltage transformer that produces the electrical field applied across the dielectric material. If the material breaks down, the resulting current flow operates the relay to reject the defective goods. Controls of this type have two drawbacks. First, partially defective goods sometimes allow passage of an electrical current for either a very short period of time or at a low rate of current flow, and the relay fails to operate. Second, these controls have not been fail-safe since faulty components could cause defective goods to be accepted even though the relay does operate.

Accordingly, an object of this invention is to provide new and improved quality control sorting devices which automatically tests goods made of dielectric material. More particularly, an object of this invention is to provide an improved quality control system which detects and rejects all articles falling in a border zone between acceptable and nonacceptable quality. Another object is to provide a quality control device which does not pass any defective goods and which rejects acceptable goods if there is any doubt as to the outcome of a test.

Yet another object of the invention is to provide quality control circuits for machines which automatically reject all goods tested if the machines fail to function properly. Still another object is to accomplish these and other objects at a minimum expense and with minimum modifications to existing machines.

In accordance with one aspect of this invention, each of the tested goods is passed through an electrical field having a voltage which exceeds the breakdown voltage of

the dielectric material of which the tested goods is made, if such material is defective in even the slightest degree. The electrical field is produced by a high voltage transformer having three windings. Across one of the windings is a detector which short circuits that winding if the dielectric material breaks down, thereby effectively destroying the inductive coupling between the three transformer windings. In series with another of the windings is a normally conductive device, such as a cold cathode gas tube, which becomes non-conductive immediately upon the destruction (in any degree) of the inductive coupling between the transformer windings. When the gas tube becomes non-conductive, the tested goods are rejected. To accept or reject the tested goods, the controlled machine includes a mechanical gate which deflects the goods after they are tested into either an "accept" or "reject" chute. The gate is positioned so that it automatically falls under the influence of gravity into a reject position. Only after the successful completion of a test upon acceptable goods is the gravity actuated gate raised to deflect the tested goods into the accept chute. Limit switches detect the position of the gravity actuated gate and stop the machine if the gate fails to reach the desired position.

In accordance with another aspect of this invention, the machine tests itself under direction of the quality control circuit or device. More specifically, each of the tested goods is counted by the quality control circuit. After a predetermined number of tests are completed, the controlled machine automatically destroys one of the goods before it is tested. The destroyed one of the goods is given a defect which falls in the border region between acceptable and non-acceptable quality. If the high voltage testing device fails to detect this defect, the machine is stopped, an alarm is sounded, and all goods accepted since detection of the last automatically destroyed article are immediately rejected.

The above mentioned and other features and objects of this invention and the manner of obtaining them will become more apparent, and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a diagrammatic showing of an exemplary automatic machine incorporating the quality control features of this invention; and

FIG. 2 is a schematic circuit diagram showing the quality control circuit for operating the controlled machine of FIG. 1.

Where possible, simple terms are used and specific items are described hereinafter to facilitate an understanding of the invention; however, it should be understood that use of such terms and reference to such items are not to act in any manner as a disclaimer of the full range of equivalents normally given in patent law. For example, the invention is described in connection with relay circuitry, whereas electronic flip-flop circuits or other devices may be substituted for the relays. The invention is also described in connection with the testing of extremely thin membranes made of dielectric material, whereas the invention may be used to test any article which, if defective, breaks down when placed in a high voltage field. Moreover, some of the self-checking, fail-safe features may be built into other types of automatic machines. Quite obviously, still other examples could be selected to illustrate the manner in which the terms that have been used and the items which have been described are entitled to a wide range of equivalents.

General Description

FIGURE 1 shows the principles of an exemplary automatic machine for producing and testing goods made of

dielectric material, together with portions of the quality control circuit or device that controls the machine. To facilitate an understanding of the invention, only those portions of the machine which are directly related to the quality control circuit are shown.

The principal parts of the machine are a conveyor **10**, carrying a plurality of mandrels such as **11**, a machine **12** for applying the thin membranes of dielectric material over the supporting mandrels, a testing head **13**, and a sorter **14**. While the conveyor **10** may take any suitable form, it is here shown as a "merry-go-round" type which rotates on a hub **15** in the direction of arrow A when power is applied to an associated drive motor **16**, all as indicated by the dashed line **18**. The mandrels **11** are made of a material having good electrical conducting characteristics and shaped to conform exactly to the inside configuration of the dielectric material being tested. For example, if the dielectric material were a rubber glove, the mandrel would be shaped like a hand.

The exact manner in which the dielectric material is fitted over the mandrels is unimportant to this invention. For example, an operator may manually place the dielectric material over the mandrel, or the machine **12** may deposit the dielectric material on the mandrels by a dipping process. In any event, the dielectric material is on each mandrel when it leaves the machine **12**, as indicated by line **19**. Thereafter, the machine may perform any suitable operations at a series of successive stations. For example, a trademark may be imprinted on the goods at station A.

The testing head **13** includes any suitable means for applying a high voltage field to the outside of the dielectric material. Thus, a small flexible curtain **20** of metal wire links having good electrical characteristics may drape over the dielectric material in a manner which ensures 100% contact between the screen and the outside surface of the dielectric material as the supporting mandrel passes through an opening in the testing head **13**. The mandrel forms one electrode which is preferably at the ground potential of conveyor **10**, and the curtain **20** forms a second electrode which is energized via conductor **20***a* to apply the high voltage field across the dielectric material.

The sorter **14** includes any suitable means for stripping the dielectric material from the mandrel and depositing such material in a hopper **21**. As here shown, the stripper includes a running belt **22** that partially wraps the mandrel and runs in a direction which rolls the dielectric material upward and off the end of the mandrel with a force sufficient to throw the material into the hopper **21**. Thereafter, the material falls into a chamber **25**, here shown as a greatly enlarged fragmentary view.

Means are provided for automatically rejecting all goods tested by the controlled machine if there is a direct current power failure. More specifically, within the chamber **25** is a gravity actuated gate **26** which normally falls to the position shown. Thus, unless there is a specific control, all of the tested goods slide down a reject chute **27** and are discarded. On the other hand, if an article tested at the testing head **13** is an acceptable product, a gate solenoid **28** is energized and the gate **26** swings on pivot **29** to the position shown by dotted lines, thus covering the entrance to the reject chute and deflecting the tested goods into an accept chute **30**. If there is a power failure, the gate solenoid **28** does not operate or release, as the case may be, gravity acts as depicted by arrow B, and the gate **26** falls to the position shown by solid lines, thereby deflecting the tested goods into the reject chute **27** whether they are or are not of acceptable quality. A pair of limit switches **31**, **32** sense the position of the gravity operated gate to determine whether the articles are being properly deflected into the reject or the accept chutes. If the gate does not assume a proper position, the motor **16** stops and an alarm sounds.

In carrying out this invention, the controlled machine tests itself under the direction of the electrical quality control circuit. More particularly, the electrical quality control circuit includes a counter **35**, counter switch contacts **36** which are mechanically closed by each mandrel as it passes station C of the conveyor, a destruct solenoid **37**, circuitry leading to the motor **16**, and the testing head **13**. The counter counts each of the tested goods responsive to the closures of the counting contacts **36**. After a predetermined number of the goods have been tested, the destruct solenoid **37** is energized thereby retracting an armature **38** and piercing the dielectric material **39** with a point **40** to produce a pin hole. Thereafter, a spring **41** retracts the armature **38** to prevent the point **40** from damaging other dielectric material on other mandrels as they pass station D. The counter remembers the position of the destroyed goods and if the testing head does not reject the destroyed article, the counter automatically stops the driving motor **16** and sounds an alarm.

Means are provided for keeping separate all goods tested since the last preceding self-test of the machine if the machine fails to detect the destroyed article. More specifically, the accept chute **30** is positioned to deposit all acceptable goods on a conveyor belt or other system **45**. The conveyor system is divided into a series of pockets or receptacles by dividers **46**. Each time that the machine successfully completes its self-test the conveyor **45** is advanced and acceptable goods are dropped into the next pocket or receptacle **47**. If the machine fails to pass its self-test the conveyor **45** is stopped and all goods in the pocket or receptacle then under accept chute **30** are destroyed.

Detailed Description

For a more complete understanding of the electrical quality control circuit reference is made to FIG. 2. To assist the reader those items in FIG. 2 which are also shown in FIG. 1 are identified by the same reference numerals. The symbols used in FIG. 2 are those commonly used in the industrial control field. Thus, normally open relay contacts are depicted by parallel lines as shown at TR1 and normally closed relay contacts are indicated by a diagonal line crossing parallel lines as shown at GR1. A solenoid is depicted by a zigzag line as shown at **37** and a resistor is shown by a hollow box including the letters "RES" as at **222**. Each relay is depicted by a circle enclosing two identifying letters and its contacts are identified by these same two letters and a numeral suffix, the suffix indicating a particular set of contacts. Thus, relay DR controls contacts DR2 and DR7.

The quality control circuit of FIG. 2 is powered by a source of 110 volts, 60 cycles per second, A.C. power (such as commercial power) connected to bus bars **201**, **202** and by a 48 volt, D.C. rectifier **230** connected between bus bars **231**, **232**.

The testing head **13** includes a three-winding transformer **210**, a detector **216** including the mandrel electrode **11** and the curtain electrode **20**, and a normally conductive cold cathode gas tube **224**. With the electrode **11** connected to one end of winding **212** of the transformer **210**, and with the electrode **20** connected to the other end of the winding **212**, a spark jumps across the gap, short circuits the winding **212**, and effectively destroys the inductive coupling across the transformer **210** when defective dielectric material is placed in the gap. A range switch **214** selects the potential of the voltage applied across electrodes **11**, **20**. This voltage is high enough to burn through any mechanically weak portions of the dielectric material.

Means are provided for guarding against low voltage on the A.C. line **201**, **202** which might otherwise preclude detection of borderline rejects. More specifically, plates **226**, **227** of the cold cathode gas tube **224** are supplied from a full wave rectifier **220** of conventional design connected across a second winding **213** of the trans-

former 210. The number of turns in the windings 212, 213 are selected so that the potential applied across plates 226, 227 falls below the voltage required to sustain the tube 224 before the voltage applied across electrodes 11, 20 falls below that required to burn through defective portions of the dielectric material. Thus, the gas tube 224 is made non-conductive if the voltage on the A.C. line falls; therefore, the testing head will indicate a reject before the voltage applied across electrodes 11, 20 reaches an inoperatively low level.

The output of the rectifier 220 is filtered by a capacitor 221 to provide the D.C. voltage required to sustain the gas tube 224. The capacitance must be low enough to establish a time constant which allows gas tube 224 to be extinguished quickly when a reject is found. On the other hand, the capacitance must be high enough to sustain the gas tube 224 throughout those periods in the output of rectifier 220 when the output potential falls below the voltage required to sustain tube 224.

To energize the machine, any suitable switch, such as a pushbutton for example, is operated to energize the circuit via contacts 203, 204 and circuit protecting fuses 205, 206. Connected in series across the A.C. bus bars 201, 202 is the primary winding 211 of the transformer 210 and a ballast lamp 215. The lamp 215 protects transformer 210 by preventing a dead short across the transformer winding 211 when the detector 216 fires across defective dielectric material to shunt the winding 212.

When the winding 211 is energized, a voltage is induced in the winding 213, rectified at 220 and filtered by capacitor 221. However, the voltage appearing on the plates 226, 227 of tube 224 does not raise to a firing potential. Also connected across the output terminals of the full wave rectifier 220 and in series with the gas tube is the winding of a detector relay DR which does not operate because the gas tube 224 has not fired as yet.

Nothing further happens until a manually operated "start" button is pushed.

To start the machine, contacts 240 are closed in any suitable manner such as by the operation of a manual "start" key. Responsive thereto, stop relay SR operates over a circuit traced from the ground bus 231 through contacts 240, 241, and the winding of stop relay SR to the battery bus 232 via resistor 244. When relay SR operates, contacts SR8 close to bypass the start contacts 240, thus allowing the "start" button to be released. Motor 16 starts to drive conveyor 10 when contacts SR11 close.

As the conveyor turns counter switch contacts 36 close to count the goods tested by the machine and to indicate to the quality control circuit that a test is in order. When contacts 36 close, gate control relay GR operates over an obvious circuit. Responsive thereto, contacts GR1 open to break a circuit to the control electrode 225 of the gas tube 224. Contacts GR2 close without effect. Contacts GR5 close to operate trigger relay TR over an obvious circuit, and contacts GR6 close to pulse the counter 35. After the trigger relay TR operates contacts TR1 close to prepare a circuit to the gas tube control electrode 225. When the mandrel passes beyond counting contacts 36, they open to release relay GR, thus closing contacts GR1 and firing gas tube 224 by applying a trigger potential to control electrode 225. The path to the control electrode 225 is completed during the slow release time of trigger relay TR after gate control relay GR has released to close contacts GR1 and open contact GR5. Thereafter relay TR releases.

Means are provided for detecting defective dielectric material passing between electrodes 11, 20. More particularly, when gas tube 224 fires its series connected detector relay DR operates. If a deffective dielectric material is between the electrodes 11, 20, a spark jumps across the gap, thereby causing a short circuit across the winding 212 and effectively destroying the inductive coupling across transformer 210. Responsive thereto, current ceases to flow through the fullwave rectifier bridge 220 and gas tube 224 ceases to conduct. Detector relay DR releases when current ceases to flow between the plate electrodes 226, 227 of tube 224. As will become more apparent as this specification proceeds, a release of relay DR rejects the tested goods. If acceptable goods are tested no spark jumps across the gap 11, 20 and detector relay DR remains operated. Again, as will become more apparent, the continued operation of relay DR causes goods to be accepted.

Assuming that acceptable goods are tested both the detector relay DR and the gate control relay GR are operated when counter switch contacts 36 close. With both of these relays operated, a second gate control relay GC operates over a circuit traced from ground bus 231 through contacts DR2, GR2 and the winding of relay GC to the second 48 volt bus 232. Responsive to the operation of gate control relay GC, contacts GC3 close, thereby preparing a locking path which is completed through contacts GR3 when the gate control relay GR releases after the counter contacts 36 open. The contacts GR2 do not open until after the contacts GR3 have closed. Thus, relay GC is normally operated and remains operated until a tested article is found to be defective.

When gate control relay GC operates, contacts GC4 close to energize the gate solenoid 28 thereby moving the gravity actuated gate 26 (FIG. 1) into an accept position and allowing the tested goods to fall through the accept chute 30 to a pocket in conveyor system 45.

If it is assumed that a defective article is passing between electrodes 11, 20, a spark jumps across the gap and detector relay DR releases, as described above. With relay DR released, contacts DR2 are open when counter contacts 36 close to operate relay GR and, in turn, to close contacts GR2, and open contacts GR3. Therefore, gate control relay GC does not operate, contacts GC4 do not close and the gate solenoid 28 is not energized. Thus, the gate 26 remains in its gravity actuated position which directs the tested goods into the reject chute 27. Hence, failure of any of the circuitry just described results in a failure to energize gate solenoid 28, gravity continues to act, and gate 26 falls to reject all tested goods whether they are or are not acceptable.

In carrying out this invention, the detector relay will not reoperate after the detection of defective goods unless there is a positive control action. That is, relay DR remains unoperated until the next article is moved into a test position and counter contacts 36 close. Responsive thereto, the gate control relays GR, GC operate, as explained above, contacts GR5 close and the trigger relay TR reoperates over an obvious circuit. When trigger relay TR operates, contacts TR1 close again to prepare a circuit which is completed at contacts GR1 to the control electrode 225 of the cold cathode gas tube when counter contacts 36 open to release relay GR and during the slow release time of relay TR. Thereafter, the next article is tested and the cycle is repeated.

Means are provided for causing the controlled machine to test itself periodically and to reject all goods tested since its last self-test if trouble is detected. In greater detail, each time that an article is tested contacts 36 close to operate gate control relay GR whereupon contacts GR6 close to drive counter 35 one step. Preferably the counter is provided with an interlock circuit so that it cannot take two steps responsive to a single closure of contacts 36. After counter 35 has counted an entire production lot, it closes contacts 235 in any suitable manner, thus connecting the destruct solenoid 37 across the A.C. bus bars 201, 202. Responsive thereto, armature 38 (FIG. 1) is attracted and a pin hole is placed in the dielectric material by point 40. The counter 234 remembers the position of the destroyed article and continues to count the goods tested until it has counted the

number of stations between the station "D" associated with the destruct solenoid and the station "E" associated with the testing head 13. In the exemplary machine of FIG. 1, two stations are counted. Thus, after the destroyed goods have moved to the station "E" the counter 35 closes contacts 236, 242 in any well known manner. Since a defective article is now between electrodes 11, 20 detector relay DR releases and contacts DR7 open, thus no alarm sounds. On the other hand, if the detector relay DR failed to release, contacts DR7 are closed when contacts 236 close, and an alarm is sounded. It should be understood that contacts DR7 are exemplary only and that similar contacts on any other relay that is likely to fail may also be included in the "Alarm" circuit.

When counter 35 closes contacts 242, the destroyed goods are in the testing head and relays DR and GC should have released. If the machine or the quality control circuit has failed to operate properly upon the testing of the destroyed goods, the gate control relay GC remains operated and a circuit is completed from ground bus bar 231 through contacts GR7, GC7 and 242 to the right-hand side of the stop relay SR. This ground shunts relay SR which releases to open contacts SR11 and stop motor 16. Contacts SR3 open to break the holding circuit to relay SR so that the machine will not restart until the "Start" button 240 is pushed. With this arrangement, all goods in the production lot tested may be rejected even though there were some acceptable articles. Thus, when the machine fails its self-test, the alarm is sounded, the machine stops, and all goods in one pocket on the conveyor 45 are destroyed.

In carrying out another self-checking test, the controlled machine tests itself to determine whether the gravity actuated gate is in the correct position. Thus, depending upon the position of the gate 26, limit switch 31 or limit switch 32 closes to indicate "accept" or "reject" positions. When counter contacts 36 close to operate the gate control relays GR, GC and if the gate is in the correct position, there is no effect. However, if the gate is not in the correct position, a circuit is completed for applying ground to the right-hand winding of stop relay SR, thus shunting it and causing it to release.

More specifically, as the goods are counted by contacts 36, relay GR operates to open contacts GR10, thus breaking the shunt circuit and allowing relay SR to remain operated. After an article has been counted, contacts 36 open and relay GR releases to close contacts GR10. If the goods pass the quality control test, relay GC holds over contacts GC3, GR3 and gate 26 is in the accept position, thus closing contacts 32. Reject limit switch contacts 31 are open. Therefore, the shunt path to relay SR is open at contacts 31, GC10 when relay GR releases to close contacts GR10. In a similar manner, if defective goods are detected, relay DR releases to open contacts DR2. When counter switch contacts 36 close, relay GR operates to open contacts GR3 and closes contacts GR2; relay GC releases. If the gate is in the reject position contacts 32, GC 9 are open and there is no effect. On the other hand, if it is assumed that relay GC is released when the accept limit switch 32 is closed or operated when the reject limit switch 31 is closed, a circuit is completed from the ground bus 231 through contacts GC9 or GC10, as the case may be, and contacts GR10 to shunt relay SR. Since ground is now applied to both sides of relay SR, it releases to open contacts SR11 and stop the drive motor 16. The resistor 244 prevents a dead short across rectifier 230 at this time.

It is thought that the advantages of the above described circuit will be readily apparent from the foregoing description. Thus, with the cold cathode gas tube 224 normally conductive before each test, relay DR is normally energized. If any spark occurs between electrodes 11, 20, the gas tube is quickly extinguished and the detector relay DR immediately releases. There is no need for an occurrence of a spark having either a minimum time duration or minimum current flow. As the rectified D.C. voltage applied across the plates 226, 227 is insufficient to ionize the tube, relay DR will not reoperate after detection of a reject unless trigger relay TR operates to close contacts TR1. Thus, any power failures or marginal tests trip the circuit and there must be a positive operation to reinitiate testing. Moreover, since the gravity actuated gate automatically falls to a reject position, any mechanical failures of the controlled machine results in automatic rejection of the tested goods even though acceptable. Still further, the limit switches operate continuously to check the gate to be sure that it is positioned properly. Finally, the destruct solenoid is operated periodically to test the testing head. Contacts of the various relays are connected in the alarm circuit when counter contacts close and the destroyed goods are tested. Thus, each relay must be in the proper position. Therefore, the quality control circuit is completely fail-safe.

Since it has been common practice to provide quality control circuits which test dielectric material of the type described by subjecting it to a high voltage field, and further since the controlled machines have included the conveyors, drive motors, etc., all of the above described advantages are realized at a minimum expense and with a minimum modification to existing machines.

It is to be understood that the foregoing description of a specific example of the invention is not to be considered as a limitation on its scope.

I claim:

1. A quality control sorting machine that tests goods made of dielectric material, detector means for applying a voltage across said dielectric to test the voltage breakdown characteristics thereof, and means to reject all goods having an unacceptable breakdown characteristic, means for testing the machine comprising means for periodically damaging the dielectric of one of the goods to be tested to render its breakdown characteristic unacceptable, and means responsive to the non-detection of the goods having a damaged dielectric for stopping the machine and sounding an alarm thereby indicating that all goods tested since the preceding machine test should be destroyed.

2. A quality control sorting machine as set forth in claim 1, comprising a three winding high voltage transformer, said detector means being connected in series with one of said windings so that breakdown of said dielectric material shunts said one winding for effectively destroying the inductive coupling between said transformer windings, means normally rendered conductive by voltages induced across said transformer and in a second of said windings before each article of goods is tested, said last named means being rendered effectively non-conductive when said dielectric material breaks down under said high voltage to destroy the inductive coupling between said transformer windings, and means dependent upon continued current flow through said last named means for accepting said tested goods, and reject means responsive to the destruction of said inductive coupling for rejecting said goods.

3. The quality control machine of claim 2 and accept and reject chutes, limit switches associated with said chutes and selectively controlled by said machine for deflecting said tested goods into said accept or reject chutes, and means controlled by said limit switches for causing said machine to test itself after each test of said goods to determine whether the tested goods are properly deflected into said accept or reject chutes.

4. The quality control machine of claim 3 and a gravity actuated gate for normally deflecting said tested goods into said reject chute, and means responsive to the testing of acceptable goods for operating said gate against the pull of gravity for deflecting said tested goods into said accept chute whereby gravity acts upon said gate automatically to reject all tested goods if said gate operating means fails to function properly.

5. A quality control sorting circuit in a machine for testing goods made of dielectric material comprising a three winding high voltage transformer, detector means connected in series with one of said windings for applying a voltage across said dielectric material so that a breakdown of said dielectric material shunts said one winding to effectively destroy the inductive coupling between said transformer windings, means normally rendered conductive by voltages induced across said transformer and in a second of said three windings before each article of goods is tested, said last named means being rendered effectively nonconductive when said dielectric material breaks down under said high voltage, means responsive to continued current flow through said last named means for accepting said tested goods and responsive to said destruction of said inductive coupling for rejecting said tested goods, means for counting each of said goods that is tested, and means responsive to the counting of a predetermined number of said tested goods for causing said machine to test itself.

6. The quality control circuit of claim 5 and means for keeping separate the goods that have been tested and accepted until after said machine has successfully tested itself, whereby the previously accepted goods can be destroyed if a next immediate one of said last named tests shows machine failure.

7. The quality control circuit of claim 5 wherein said machine is controlled by a plurality of relays, an alarm circuit including the contacts of at least one of said relays, and means controlled by said counting means for periodically closing said alarm circuit whereby an alarm is sounded if said contacts are not then in the proper position.

8. In an automatic machine for testing thin membranes of dielectric material, the combination comprising test means for detecting damaged ones of said membranes, means for counting each membrane tested by said machine, means controlled by said counting means for damaging one of said membranes after the testing of a predetermined number of said membranes, and means for stopping said machine if said testing means fails to detect said damaged membrane.

9. The combination of claim 8 and a testing head comprising a three-winding transformer, means including a pair of electrodes connected to opposite ends of one of said three windings for applying a high voltage across said dielectric material, whereby a breakdown of said dielectric material shunts said one winding and effectively destroys the inductive coupling across the transformer, means connected across a second of said windings and normally held conductive by voltages induced in said second winding, means energized via said last named means when conductive for accepting said membranes, and means for rejecting said membranes when said last named means is non-conductive.

10. The combination of claim 9 and an accept chute and a reject chute, a gravity actuated gate normally deflecting said membranes into said reject chute after being tested by said machine, and means responsive to the testing of acceptable membranes for actuating said gate to deflect said membranes away from said reject chute and into said accept chute, whereby said gate drops under the influence of gravity to reject the membranes tested by said machine if there is a direct current power failure.

11. The combination of claim 8 and an accept chute and a reject chute, a gravity actuated gate normally deflecting said membranes tested by said machine away from said accept chute and into said reject chute, and means responsive to the testing of acceptable membranes for actuating said gate to deflect said acceptable membranes away from said reject chute and into said accept chute.

12. The combination of claim 11 and limit switches controlled by said gravity actuated gate, and means responsive jointly to the completion of each test and to operation of said limit switches for stopping said machine if said gate does not move to a commanded position.

13. The combination of claim 8 and a quality control circuit including a plurality of relays, an alarm circuit including contacts of at least one of said relays, and means responsive to the counting of a predetermined number of said membranes for closing said alarm circuit, whereby an alarm is sounded if said relay contacts are not then in the proper position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,468,843	Sunstein	May 3, 1949
2,589,070	Frissbie	Mar. 11, 1952
2,767,839	Frommer	Oct. 23, 1956
2,769,973	Denholm	Nov. 6, 1956