April 20, 1954 R. H. CASTON ET AL 2,675,916

ELECTRONIC INSPECTING APPARATUS

Filed June 28, 1949 6 Sheets-Sheet 1

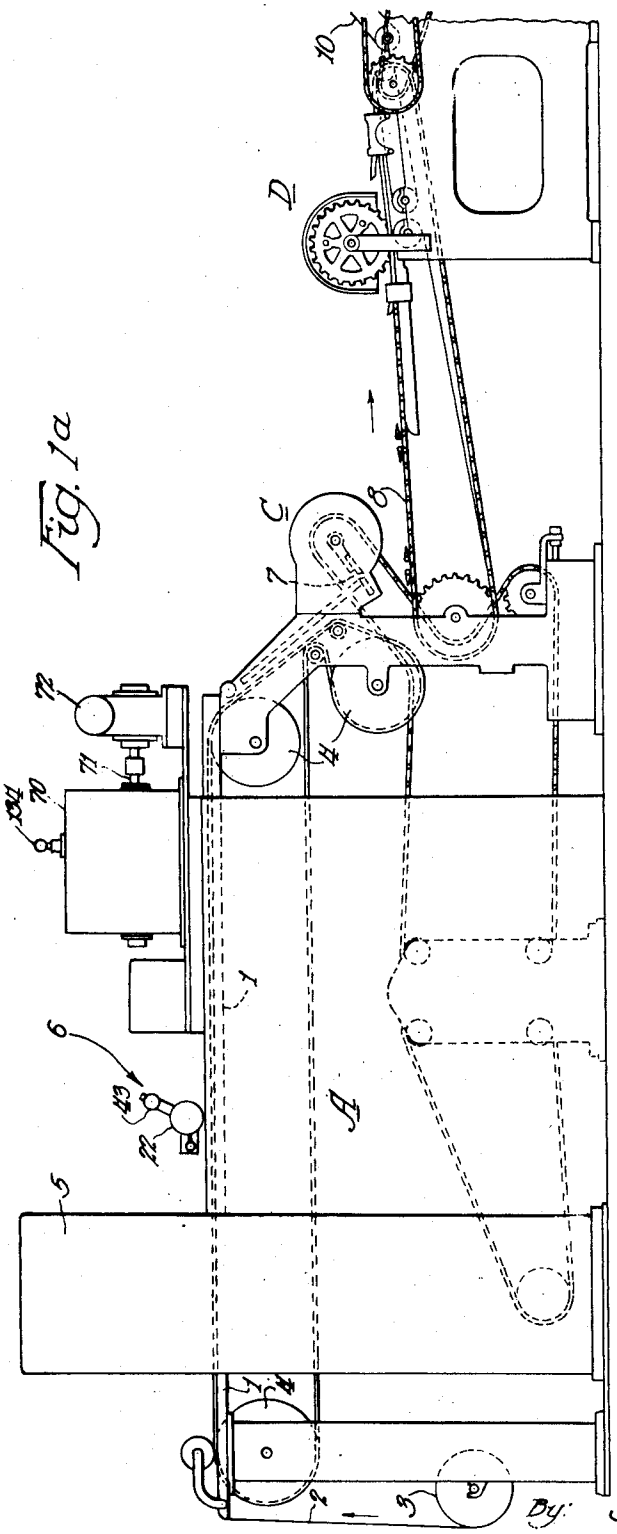


Fig. 1a

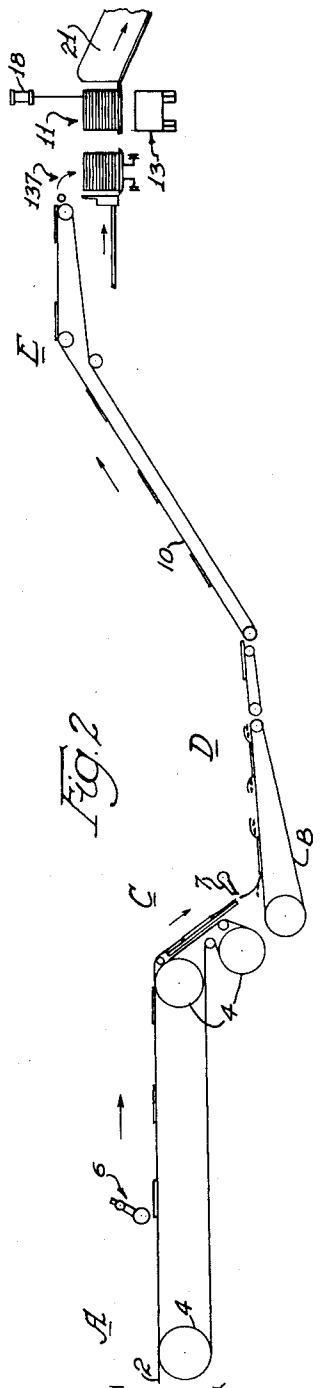


Fig. 2

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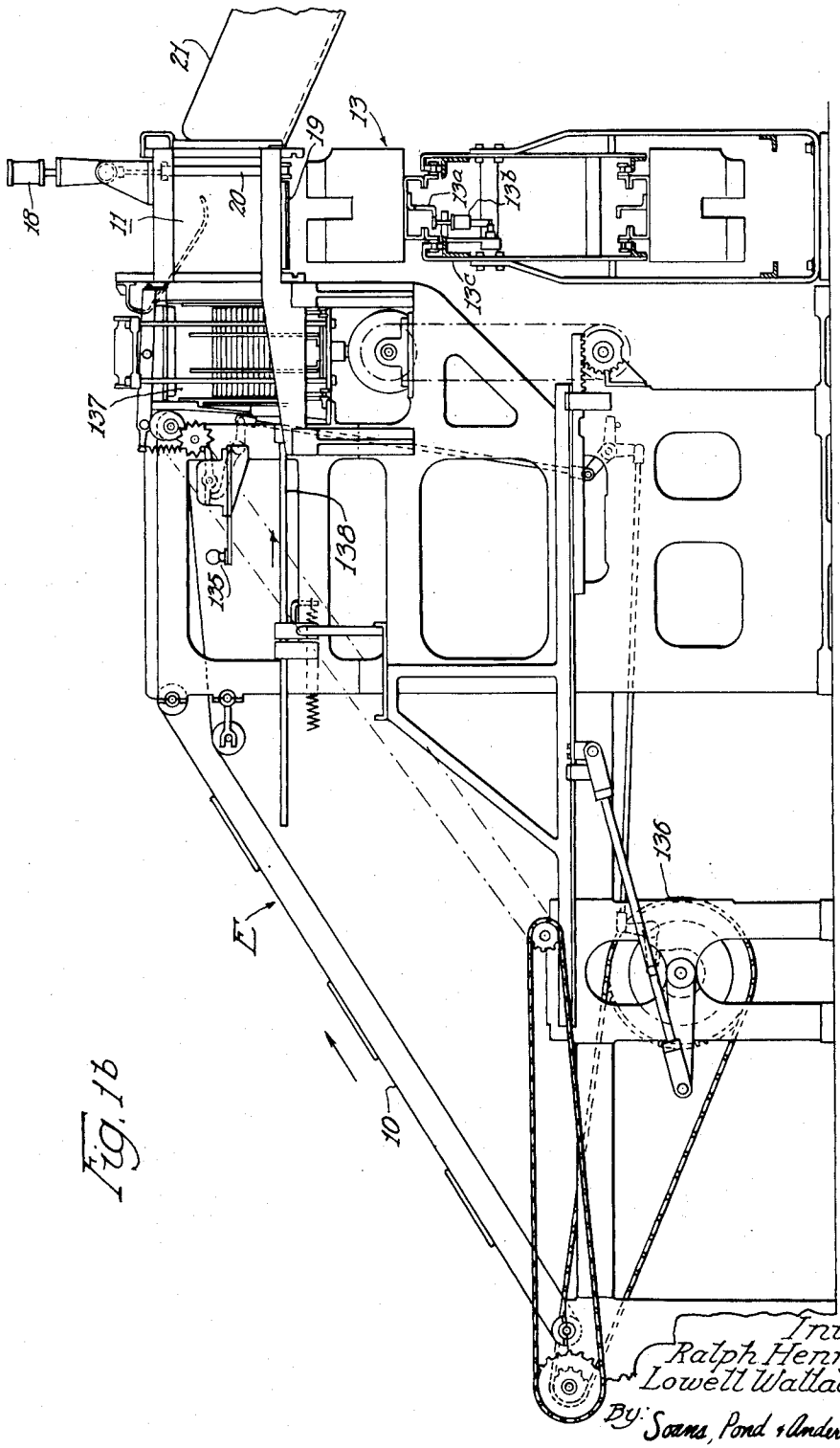


Fig. 16

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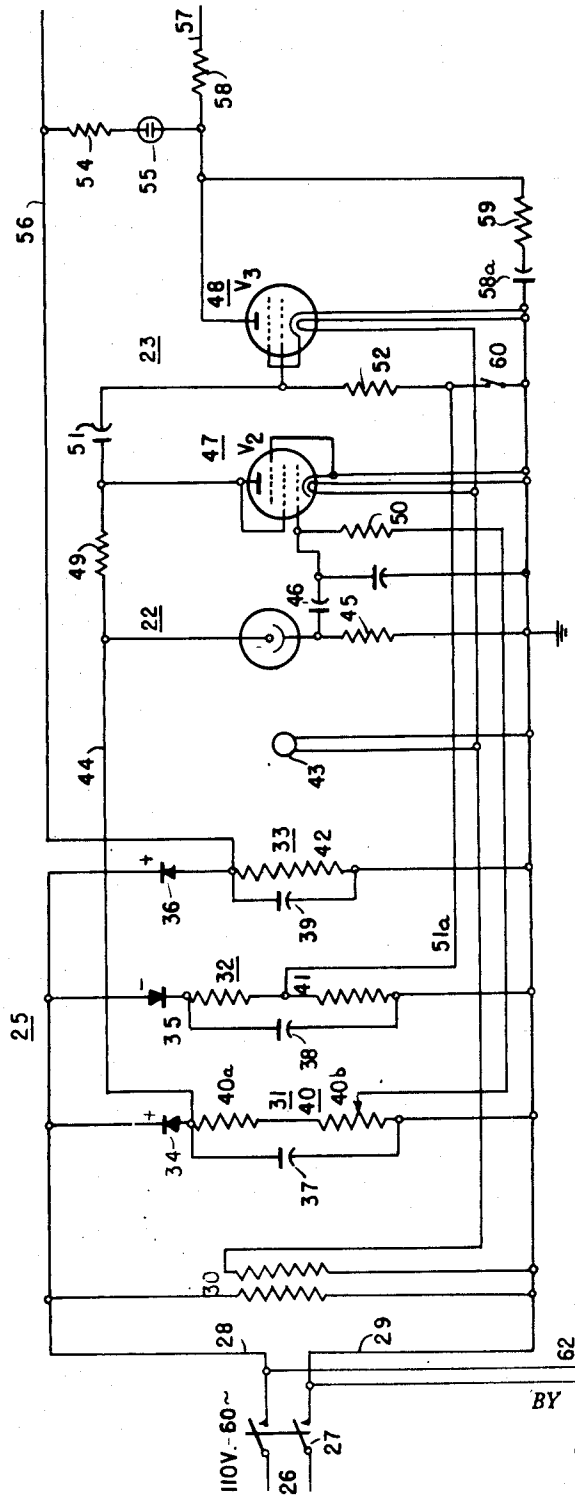


FIG. 3

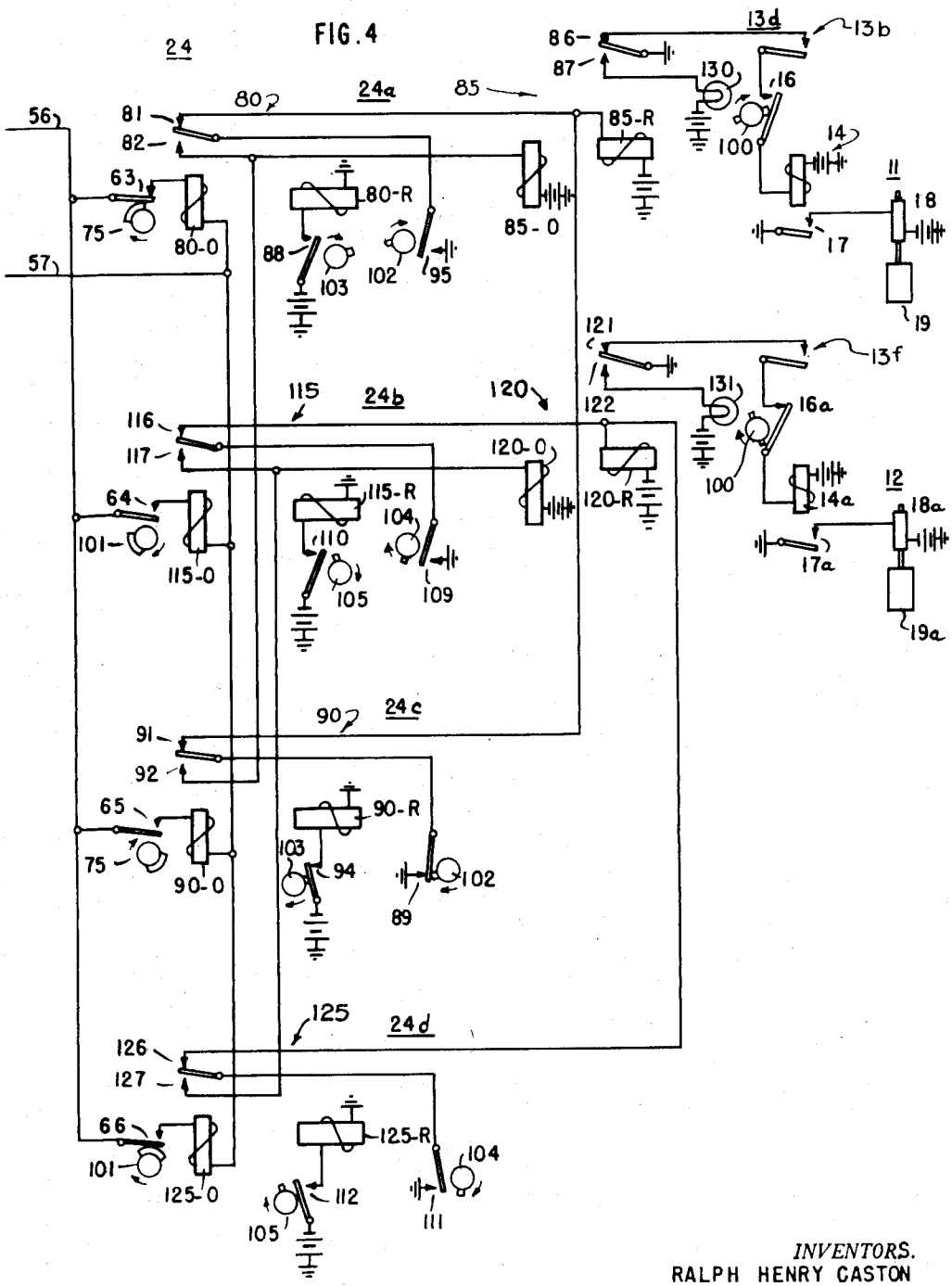
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ELECTRONIC INSPECTING APPARATUS

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FIG. 4



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FIG. 5a

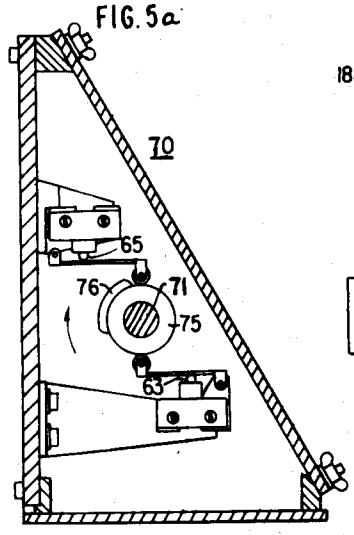


FIG. 5b

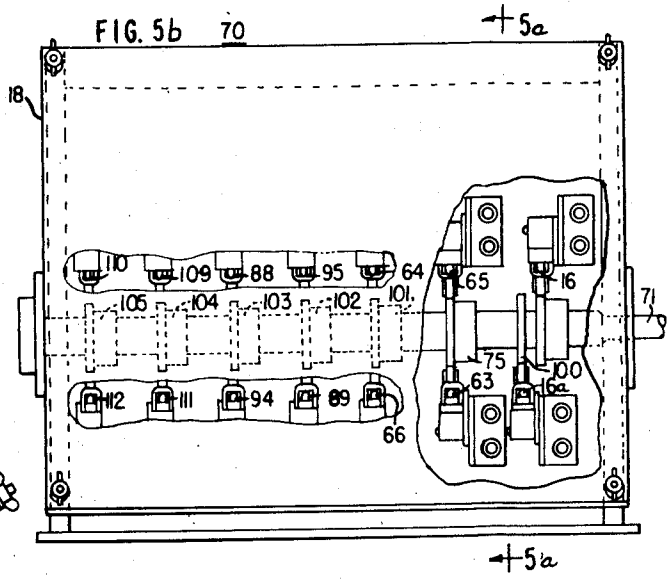


FIG. 6

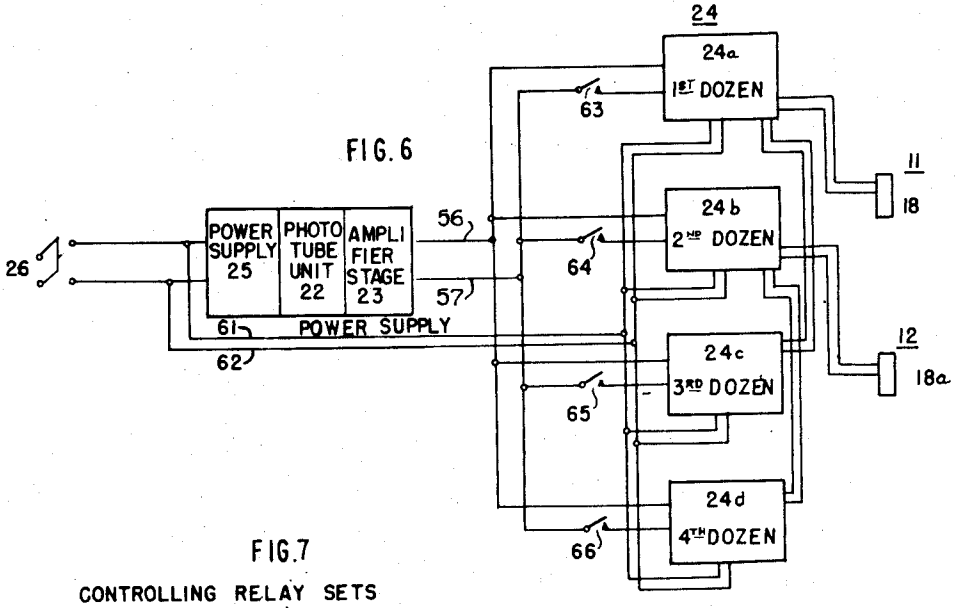
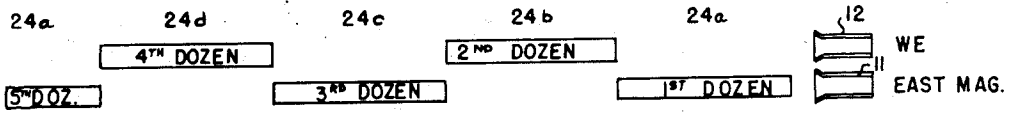


FIG. 7

CONTROLLING RELAY SETS



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ELECTRONIC INSPECTING APPARATUS

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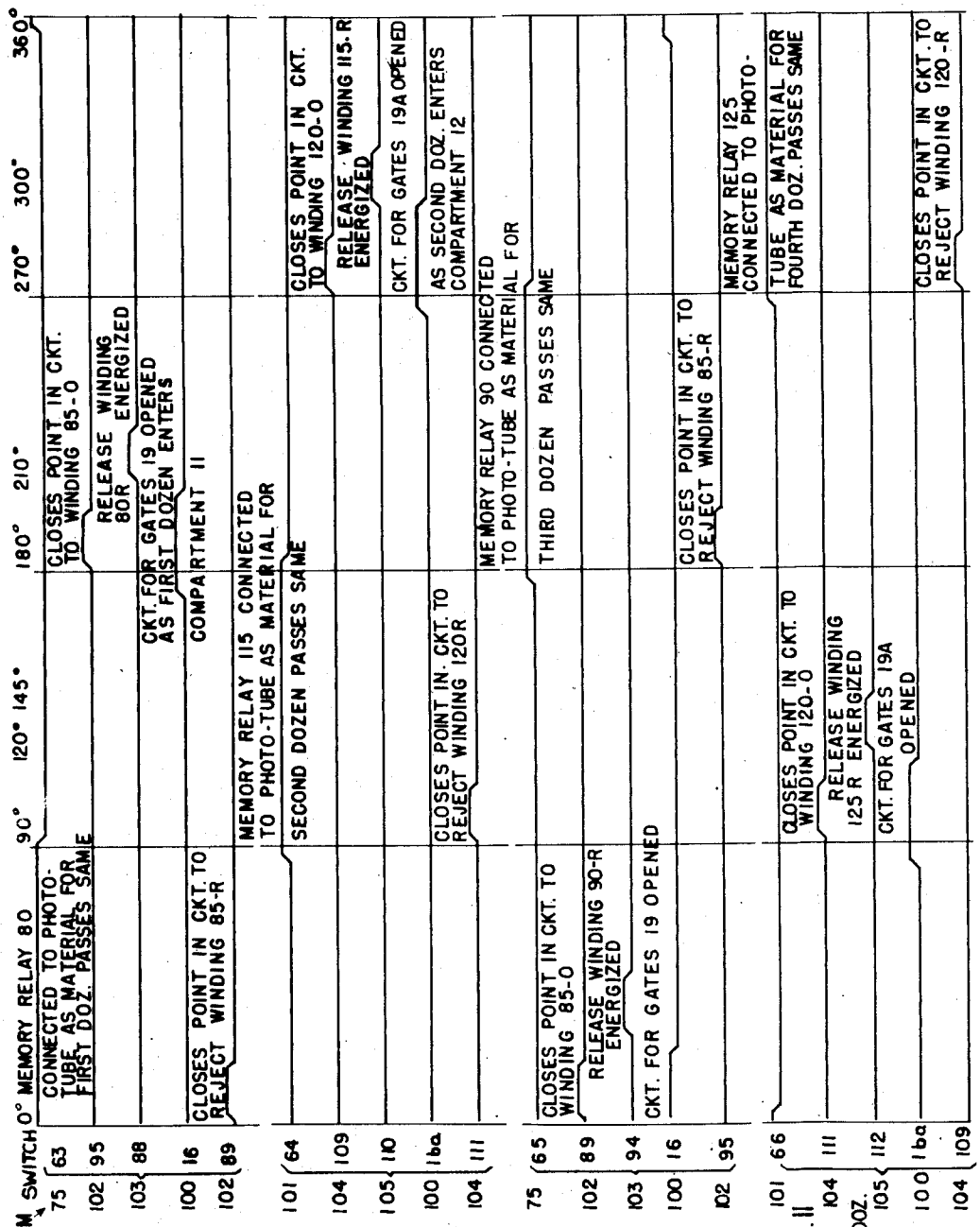


FIG. 8 1ST DOZ.

FIG. 9 2ND DOZ

FIG. 10 3RD DOZ.

FIG. 11 4TH DOZ.

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UNITED STATES PATENT OFFICE

2,675,916

ELECTRONIC INSPECTING APPARATUS

Ralph Henry Caston and Lowell Wallace Zabel, Neenah, Wis., assignors to International Cellucotton Products Company, Chicago, Ill., a corporation of Delaware

Application June 28, 1949, Serial No. 101,892

7 Claims. (Cl. 209—74)

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This invention relates to the high-speed manufacture of articles which prior to sale, or prior to packaging are assembled in sets, groups, or stacks each containing a plurality of said articles. As an incident to such manufacture, it may be desirable, for various reasons, to cull out or select for special treatment certain of these assemblies. For example, a change in characteristics or an abnormality in one of the supplied ingredients or components of the articles may be the basis for such selection.

This invention is of especial value in connection with an automatic arrangement for effecting the high-speed production of soft and compressible articles, such as a plurality of sanitary napkins and the like from continuous rolls of gauze-like material, which articles are assembled in stacks or packages. Particularly, the invention relates to inspecting apparatus for use with an arrangement of this general type, which is operative to inspect the gauze-like material prior to its use in the manufacture of the individual sanitary articles, and as a result of such material inspection, to segregate the stacks of completed napkins which are found to be defective from those napkin stacks which are found to be acceptable.

In one arrangement of automatic apparatus used in the manufacture of articles of this general type, the independent pad-making and stacking units are spaced apart and deposit stacks of pads into individual buckets or receivers carried by a single, common conveyor unit. The conveyor and associated buckets in turn deliver the stacked articles to suitable packaging equipment. An installation of this preferred general type is disclosed in a co-pending application of Jones and Banks, Ser. No. 92,424, which was filed May 10, 1949.

In the manufacture of the gauze material such as is used in the pad-making equipment described, it is customary in the textile mills to mark defects or splices in the gauze by means of a series of black stitches, or a section of black tape, applied to the gauze at the point of defect or splice. Such markings are, of course, undesirable in any articles which are intended for sale.

It is, therefore, a general object of this invention to provide automatic and positive-acting means for inspecting the gauze, detecting portions of the material which are marked as defective and rejecting articles made of such defective material.

In the manufacture of certain articles, such as

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sanitary napkins, of which one part comprises a gauze-like material folded about a napkin body, some of the gauze surfaces become inaccessible for inspection after the article is completed, and for this reason the inspection of the gauze is desirably made prior to its inclusion in the individual articles. Although the inspection is necessarily made at such time to insure the detection of each marked portion, the contemporaneous removal of such portion is considered somewhat impractical by reason of the high-speed operation of the automatic pad-making equipment.

In view of these considerations, a further object of the invention is to provide an apparatus for use in the manufacture of sanitary napkins, which is operative to inspect the continuous strip of gauze before it is folded around the pads to detect any defective portion, and to initiate the operation of a mechanism which will reject the articles made from such defective portion, but not until after the articles have been included in a stack.

Other objects and advantages of the invention will be understood by reference to the following specification and accompanying drawings (6 sheets), in which we have described and illustrated a preferred embodiment of the mechanism for effecting the inspection and rejection of defective sanitary napkins.

In the drawings,

Figs. 1*a* and 1*b*, when placed adjacent each other, illustrate side elevations of the automatic pad-making equipment and the inspecting apparatus of the invention,

Fig. 2 is a schematic illustration of the operating elements of the automatic pad-making apparatus,

Figs. 3 and 4, when arranged in side by side relation, illustrate the circuit diagram of the inspecting unit of the invention,

Fig. 5*a* is an end view of the timing mechanism of the inspecting apparatus, and Fig. 5*b* is a front view of the same mechanism which includes broken away portions to more clearly illustrate certain details thereof.

Fig. 6 is a schematic illustration of the circuit layout for the inspecting unit which especially shows the arrangement of the individual relay sets of the control unit,

Fig. 7 is a schematic illustration showing the travel path of the successive pad groups as manufactured, the accompanying legend properly identifying the controlling relay set for each napkin stack in each cycle, and

Figs. 8, 9, 10 and 11 are diagrams which illustrate the effective operating times of the timing mechanism cam units of the inspecting apparatus.

GENERAL DESCRIPTION

The general arrangement and functioning of the inspecting apparatus of the invention as applied to sanitary napkin making apparatus may be best understood by reference to Figs. 1*a* and 1*b* of the drawings. As shown there, a cyclic sanitary napkin making machine comprises pad making and wrapping apparatus A, wrapper cutting apparatus C, end tab folding apparatus D, and cyclic stacking or article-grouping apparatus E, which may be of the general type shown in the co-pending application heretofore mentioned. The pad making and wrapping apparatus A embodies a table 1 over which a strip of gauze 2 is drawn from a source of gauze supply in the form of a roll, such as 3, by a conveyor belt which travels around suitable rollers or drums 4.

A continuous web of wadding material (not shown) is fed transversely of the length of table 1, and pad sections of the proper width are cut from the web by means of a reciprocating cutter unit 5. The width of the pad cut from the web is substantially less than the width of the gauze strip and such pad is deposited approximately centrally of the moving gauge by means associated with the cutting mechanism 5. Successive pads are deposited in longitudinally spaced relation on the gauze strip. At least one of the margins of the gauze which project beyond the side edges of the deposited pads passes beneath an inspection device 6 as said gauge travels through the machine. Said margins are folded longitudinally around the pads as they progress along the indicated path of travel, thereby forming a continuous string of gauze connected sanitary pads. The gauze connected pads are propelled from the pad making apparatus A to the rotary cutter C. The gauze between the adjacent ends of the spaced pads is severed at the proper intervals from the pad ends by means of a rotary knife 7 in the cutter C and the independent pads are thereafter deposited on a conveyor 8 of the folding apparatus D which folds the gauge end flaps over the gauze wrapped pad portions. The folded napkins are discharged by the folding apparatus D to a conveyor 10 of the stacking apparatus E and said conveyor 10 feeds the pads into a pad receiving and stacking means 137. In this instance, twelve napkins successively delivered to said stacking means constitutes a full stack. Successive dozens of napkins are delivered from said stacking means alternately to storage compartments 11 and 12 of the apparatus as represented in Fig. 7. A pair of horizontally reciprocable plungers, one of which is represented at 138 in Fig. 1*b*, are provided for alternately delivering the napkins stacks from the stacking means 137 to storage compartments 11 and 12. From the said storage compartments, the napkin stacks are normally discharged to buckets on a receiving conveyor 13.

As explained in detail in the aforementioned co-pending application, triggers such as indicated at 13*a* (Fig. 1*b*) are mounted on the bottom of each of a series of bucket members on said conveyor 13, each trigger depending from its bucket member so as to be operative incident to its travel with its bucket, to actuate one of a pair of switches 13*b* or 13*f* (Figs. 1*b* and 4), which are mounted on the stationary conveyor framework 13*c*. As switch 13*b*, for example, is operated by a passing trigger, the contacts of such switch are closed to normally complete an electrical circuit 13*d* (Fig. 4). The electrical circuit 13*d* as thus completed, extends from *a* battery over or through the winding of a slave or separation control relay 14, switch 16, switch 13*b*, and switch 86 to ground. (In the diagram Fig. 4, a source of power for operating various parts is indicated as one or more batteries for purposes of simplicity. In actual practice, the batteries would be replaced by connection to a suitable source of power such as indicated at 61 and 62 in Fig. 3.) Slave relay 14 is thus operated and its switch 17 completes an energizing circuit for a solenoid 18 which, on operation, opens the bottom gates 19 of the compartment 11 through suitable linkage members 20 (Fig. 1*b*) to effect discharge of a napkin group or stack from said compartment 11 to said receiving conveyor 13. The cam triggers are arranged beneath the buckets to normally alternately actuate the gates of the storage compartments 11 and 12 to effect delivery of the contents of said compartments to the receiving buckets on the conveyor.

In the event that the napkin group or stack in the compartment (compartment 11, for example) includes a napkin made from a defective piece of gauze, the switch 86 in said circuit 13*d*, will be opened (as hereinafter explained) to prevent delivery of the napkin stack to the conveyor 13 and to effect the subsequent displacement of the defective stack from said compartment 11 to a reject chute or conveyor 21.

INSPECTING AND REJECTING UNIT

Such circuit operation and napkin rejection is initiated by the inspecting device 6 (Fig. 1*a*) which is arranged to examine the moving gauze as it passes over the table 1 of the pad-making machine said inspecting apparatus comprises a photoelectric tube unit 22, an amplifier unit 23, a memory or registering device 24, and a suitable power supply unit 25.

The power supply unit 25 is adapted to be energized over two main power supply leads 28 and 29 which are connected to a suitable power source 26 (such as a 115-volt 60 cycle alternating current source), on closure of a switch means 27. The power supply unit essentially comprises a transformer member 30 and a series of networks 31, 32, and 33, respectively, connected across supply leads 28 and 29 so as to supply positive and negative potentials of various values to the tube and relay elements of the phototube unit 22, amplifier unit 23, and memory device 24.

The phototube 22, which may conveniently comprise any commercially available, high-vacuum phototube, such as the RCA number 929, is normally mounted adjacent an interrelated light source 43. Suitable mounting means (not shown) allow focusing and positioning of the light source relative to the material being inspected to insure proper functioning of the unit in operation. The anode of the phototube is connected to supply lead 44 and positive voltage is supplied to the anode by network 31 which includes selenium rectifier 34, and voltage divider 40 which comprises a fixed resistance 40*a*, a variable resistance or potentiometer 40*b*, and a condenser or capacitor 37. The cathode of phototube 22 is connected to the power supply lead 29 through a load resistance 45, which is in the order of 4.7 megohms, and is also connected to the control element of the first tube in the amplifier unit 23 by a condenser 46.

The amplifier unit may conveniently comprise a pair of electronic tubes 47 and 48 electrically interconnected so as to be operatively controlled by predetermined output signals of the phototube 22.

The first electronic tube 47 in the amplifier unit may conveniently comprise a detector amplifier pentode tube, such as RCA tube number 9001, or any other similar type amplifier tube. The plate of the amplifier tube 47 is connected to supply lead 44 through resistance 49, which may be in the order of .27 megohm, whereby positive voltage is supplied to the plate by network 31. The control grid of the amplifier tube 47 is connected to said adjustable resistance 40b in the voltage divider network 31 by means of grid resistor 50, and positive bias potential is supplied thereover by network 31 to render the tube 47 normally conductive. The grid of tube 47 is further connected to the cathode circuit of the phototube 22 through condenser 46, the amount of conductivity of the amplifier tube 47 being determined by voltage changes in the cathode circuit of the phototube 22.

The sensitivity of response of the tube 47 to variations in the phototube cathode circuit may be controlled by adjustment of the variable potentiometer 40b, the value of the bias voltage supplied to the grid of amplifier 47 as a result of the adjustment of the potentiometer 40b directly affecting the amount of voltage change required in the phototube cathode circuit to overcome such bias and to effect the desired conductivity of amplifier tube 47. The resistance 40b in the preferred embodiment is adjustable to values which produced a bias voltage of between 0 and 43 volts.

The conductivity of tube 48 is controlled responsive to variations in the voltage values of the plate circuit of amplifier tube 47, which are transmitted over a condenser 51 to the interconnected grid circuit of the second tube 48 in the amplifier stage 23. Electronic tube 48 may conveniently comprise a gas filled thyratron tube, such as RCA tube number 2D21, or any other commercially available tube having similar characteristics and ratings. As arranged in the illustrated circuit, tube 48 is normally biased to cut off by the negative voltage output of the network 32 which comprises rectifier 35, voltage divider 41 and filter capacitor 38. The network 32 is connected to the amplifier grid over conductor 51a and grid resistance 52. The plate of thyratron tube 48 is connected to the network 33, comprising selenium rectifier 36, filter capacitor 39, and resistance 42, by means of conductor 56, one or more of the relay windings 80–O, 115–O, 90–O or 125–O, conductor 57, and resistance 58, whereby positive voltage is supplied by the network 33 to the plate of the thyratron tube 48. A neon tube 55 which may be of the conventional type is connected across leads 56 and 57 so as to be operated responsive to striking of amplifier tube 48 and the resultant potential drop across resistance 58 and one or more of the aforementioned relay windings. A resistor 54 connected in series with the neon tube 55 is operative as a current limiting resistor therefor.

The plate circuit of the thyratron tube is thus connected to the memory device unit 24 over resistance 58 and conductor 57, whereby each energization of the plate circuit effects similar energization of the interconnected members in the memory device 24. A condenser 58a, which may be in the order of 16 microfarads, is connected in series with a resistance 59 which may be in the order of 50 ohms, and the series arrangement is connected between the plate and cathode circuit of thyratron tube 48, whereby a tuned or resonant circuit is formed with certain relays in the memory device 24 with each energization of the thyratron tube. The cathode of tube 48 is connected to main supply lead 29 and is interconnected with the thyratron grid circuit by means of a manual reset switch 60. Operation of switch 60 will render the grid of tube 48 more positive with respect to the cathode and cause the tube to strike and to transmit a signal over leads 56 and 57 to the memory device 24. In normal operation of the amplifier stage, however, an amplified signal is automatically transmitted to the memory device 24 over conductors 56 and 57 with each passage of a defective portion through the inspection zone in a manner to be described hereinafter, the manual switch being employed in the event the operator desires to reject a selected group of pads for examination or some other purpose.

The memory or registering device 24, as shown in Figs. 6 and 4, may be viewed as comprising four similar and separate relay sets 24a, 24b, 24c and 24d which are energized over a common supply set of conductors 61 and 62 by the main control switch 26. Actually the number of relay sets employed may be varied in accordance with the particular application of the device, at least two sets being desirable for proper functioning of this type arrangement. Each of the relay sets is arranged to be selectively connected to the phototube 22 and amplifier stage 23 by cam controlled switches 63, 64, 65, and 66. Each of the switches 63, 64, 65, and 66 is controlled to close separately and in sequence (Figs. 8, 9, 10, and 11), each being arranged to close substantially for the period that the material for a dozen napkins passes beneath the inspection unit 6. Since the switches are continuously recycled in the same order, and there are four switches, each relay set is connected to the amplifier once with the passage of the material for each four dozen napkins, and each set, as a result of such cyclic connection, is associated with a predetermined dozen of each of four dozen napkins. For example, switch 63 will be closed and relay set 24a will be connected to the amplifier 23 and the phototube 22, as the material for the first dozen napkins of each four dogen napkins to be manufactured passes the inspection apparatus 6. Relay sets 24b, 24c, and 24d will be similarly connected by successively operated switches 64, 65 and 66 as the material for successive napkin dozens passes the inspection apparatus.

With reference to Fig. 4, each of the relay sets 24a, 24b, 24c and 24d, as there illustrated, are somewhat similar in arrangement, minor differences being effected by the interconnection of certain relays in several of the circuits so as to avoid unnecessary duplication of the operating members.

In one embodiment, each relay set, as for example relay set 24a, may comprise a memory or separation initiating relay 80 having an operating winding 80–O arranged to be connected in the plate circuit of thyraton tube 48 by contact 63 for a given period in each cycle of four dozen napkins and a reject relay 85 having an operating winding 85–O controlled in its operation with the first dozen napkins of each cycle by the switch 82 of memory relay 80. Memory relay 80 and reject relay 85 are of the standard two-winding,

mechanical, latch-up type relays which mechanically lock their switch contacts in the operated position on energization of the primary windings 80–O or 85–O and unlock their said contacts in response to energization of the secondary or release windings 80–R and 85–R. Operating circuits for the release windings of relays 80 and 85 are respectively controlled for operation with the first dozen napkins of each cycle by contacts switch 88 in the circuit of winding 80–R and switches 89 and 91 in a circuit with winding 85–R.

The normally closed switch 86 of reject relay 85 is in the control circuit 13*d* for the solenoid 18 to allow normal operation of the gates 19 of compartment 11 whenever the contained dozen are acceptable. Should the napkin group be defective, switch 86 will be opened in a manner to be described, and the gates will be prevented from operating, thereby to temporarily retain the abnormal group or stack of napkins in the storage compartment 11.

Each of the relay sets 24*b*, 24*c* and 24*d* may be similar in arrangement and operation to relay set 24*a*, each relay set being adapted to control an individual reject relay such as 85, connected in the operating circuit, 13*d* for the gates of storage compartment 11. However, since the third dozen napkins in this arrangement are stored and delivered by the same compartment as the first dozen of each cycle (i. e. by compartment 11), a common reject relay, such as 85, may be used for the first and third relay sets (24*a* and 24*c*) to control the operating circuit for the gates of said compartment 11, and a reject relay 120 which is common to relay sets 24*b* and 24*d* may be employed for controlling the gates 19*a* of compartment 12, thereby to minimize the number of separate operating members required in the control system.

Accordingly, in the preferred embodiment, relay set 24*c* which controls acceptance of the third dozen napkins is interconnected with relay set 24*a*. Relay set 24*c* comprises an individual memory relay 90, of the described mechanical locking type, which has its operating circuit 90–O connected to the thyraton plate circuit by switch 65 whenever gauze material for the third dozen napkins of a cycle passes the inspection unit. Switch 91 of memory relay 90 is arranged to control a second operating circuit for the operating winding 85–R of the reject relay 85 to control the delivery of the third dozen and cam controlled switch 95 and switch 81 of memory relay 80 control said second operating circuit for the release winding of reject relay 85–R. A release circuit for memory relay 90 is controlled by cam controlled switch 94.

Relay sets 24*b* and 24*d* are interconnected in a manner similar to that of relay sets 24*a* and 24*c* and are operative to control the acceptance and rejection of the second and fourth dozen which are stored and delivered by compartment 12.

In Fig. 4, in the apparatus for operating the gates 19*a*, the elements designated 14*a*, 16*a*, 17*a* and 18*a* respectively correspond in function to the elements designated 14, 16, 17 and 18 for operating the gates 19. In the reject relay 120, the elements designated 120–O, 120–R, 121, 122 and 131, respectively correspond in function to the elements 85–O, 85–R, 86, 87 and 130 of the reject relay 85. In the memory relay 115, the elements designated 110, 115–O, 115–R, 116 and 117 respectively correspond to elements 88, 80–O, 80–R, 81 and 82 of memory relay 80. In the memory relay 90, the elements designated 90–R and 92, correspond respectively to the elements 80–R and 82 of memory relay 80. In the memory relay 125, the elements 125–R, 126 and 127 respectively correspond to the elements 80–R, 81 and 82 of the memory relay 80.

A timing mechanism 70 comprising a series of cam actuated switches is employed for sequentially connecting the four relay sets to the amplifier unit. This timing mechanism 70 (Figs. 5*a* and *b*) comprises a cam shaft 71 synchronized in its rotation to the speed of the pad-making machine by a reduction gear arrangement generally shown at 72 (Fig. 1*a*). In the present embodiment, the cam shaft 71 is driven by gear arrangement 72 at the rate of one revolution for the passage of each four dozen pads beneath the inspection unit. The shaft 71 mounts a series of cams at spaced intervals along its length, the outer periphery of each cam having a cam lobe such as 76, which is disposed to contact and operate a pair of cooperatively mounted microswitch units which are interconnected in the operating circuits for the above described relay sets. One of the said cams, indicated at 75, cyclically and independently connects each relay set 24*a* and 24*c* to the amplifier stage 23 for a predetermined interval in each operating cycle. The remaining cams designated 100 to 105 respectively, are similarly associated with pairs of switches in circuits as shown in Fig. 4 and said cams are timed to operate in accordance with the cam-operating diagrams illustrated in Figs. 8 to 11, inclusive, to effect the other relay operations as hereinafter explained.

STANDBY CONDITION

Prior to placing the automatic pad-making apparatus into operation, power supply switch 27 for the power pack unit 25 is closed to energize the heating elements of the various tube units in the amplifier stage with a voltage in the order of 6.3 as obtained from the secondary of transformer 30. The light source 43, which is also energized by the transformer 30, is adjusted so as to effect proper focusing of the light output relative to the inspecting zone through which the gauze material is arranged to pass in its movement. The white surface of the gauze is effective to reflect the radiant light energy output of the adjusted light source to the sensitized cathode of the phototube 22 to cause the cathode to responsively emit electrons within the phototube body. The emitted electrons are drawn to the positive plate or anode of the tube to thus render the phototube 22 normally conductive whenever gauze material lies within the inspection zone.

Amplifier tube 47 is also normally rendered conductive responsive to the positive bias supplied to the grid thereof by network 31 as switch 27 is closed. Thyratron tube 48 is, in turn, biased to cut off by the negative potential supplied to its grid over resistance 52. As a result, the thyratron plate circuit and the members interconnected in such plate circuit are not energized at this time.

OPERATION

As the starting switch (not shown) for the automatic pad-making machinery is closed, the movement of the gauze beneath the inspection unit 6 will be effected and the white surface of the moving gauze material will reflect the radiant energy of the light source to the cathode of the phototube unit 22 to render the tube contin-

uously conductive. Power take-off members on the pad-making machine A drive the reduction gear unit 72 and the cam shaft 71 at a predetermined rate of speed to effect operation of the inspecting equipment in synchronism with the moving gauze. As shown in Figures 5*a*, 5*b* and 8, in the initial operation of shaft 71, cam 75 is effective to operate micro-switch 63 to close its contacts for the first quarter of the shaft revolution. Since the shaft makes one revolution with the passage of each four dozen napkins, memory relay 80 is thus connected in the plate circuit of thyratron tube 48 over conductors 56 and 57 and micro-switch 63 for the period that the gauze for the first dozen passes the inspection unit.

(*a*) *Travel of an acceptable dozen*

As the gauze moves beneath the inspecting unit, fluctuations in the light reflecting characteristics vary the amount of radiant energy reflected to the phototube 22. Instantaneous changes in the value of current passing through the load resistance 45 are effected with such variations and are transmitted in the form of voltage changes through condenser 46 to the control grid of the first amplifier tube 47. Voltage changes in the positive direction due to increased reflection of the white gauze material will have little effect on the positively biased amplifier tube 47. Small voltage variations in the negative direction will likewise have little effect on amplifier tube 47, and if the material for the first dozen napkins is acceptable, that is, does not include black markings of the described type, no further circuit operation will occur. Micro-switch 63 will be opened by cam 75 to disconnect the relay set 24*a* from the thyratron circuit as the portion of the material to be used in the second dozen enters the inspection zone, and relay set 24*b* is in turn connected to the thyratron plate circuit by cam actuated switch 64. The electrical control circuit 13*d* associated with relay set 24*a* is subsequently completed by closing of switch 13*b* by the passing cam trigger 13*a*, whereby solenoid 18 operates and the gates 19 of compartment 11 are opened to effect deposit of the first dozen napkins into its assigned bucket.

(*b*) *Travel of a defective dozen*

Assuming, however, that the gauze for the first dozen is defective and carries a black string or tape in the manner described, as the black marking passes through the inspection zone, the amount of radiant energy reflected to the phototube cathode by the gauze material is suddenly decreased, and the electron emission of the cathode of phototube 22 is correspondingly reduced. An instantaneous current change in the negative direction appears across the load resistance 45 which is transmitted as a negative voltage fluctuation through condenser 46 to the control grid of amplifier tube 47. The conductivity of tube 47 is accordingly decreased to effect a voltage change at the plate of tube 47 which is transmitted over condenser 51 to the grid circuit of thyratron tube 48. The grid of the thyratron tube 48, which is normally biased to cut off by the negative voltage supplied over grid resistance 52 and network 32, is made more positive by the positive voltage change in the plate circuit of the tube 47 to effect increased conductivity of thyratron tube 48 and energization of the thyratron plate circuit.

Memory relay 80, which is presently connected in the thyratron plate circuit by closed switch 63, is operated by a circuit extending from the positive side of the network 33 over conductor 56, micro-switch 63, the primary or operating coil 80–O of relay 80, conductor 57, resistor 53 and the conducting thyratron tube 48, to the negative side of network 33. Neon tube 55, being connected across conductors 56 and 57 in series with resistance 54, will strike responsive to the potential drop across resistor 53 and the operating winding of relay 80–O as the operating circuit to the primary winding 80–O of relay 80 is completed. A visual signal is thus provided for the operator to indicate the presence of a defect in the material passing beneath the inspection unit at that time.

Relay 80 operates, and at its switch 81 opens a point in the operating circuit for the release winding 85–R of relay 85, and at its switch 82 prepares an operating circuit for the primary or operating winding 85–O of reject relay 85. Relay 80, in operating, mechanically locks switch 82 in the closed position through associated mechanical means (not shown).

Thyratron tube 48 is de-energized almost immediately following its energization, by means of a resonant circuit comprising condenser 58*a*, resistance 59 and the primary coil of relay 80. The resonant circuit is shock-excited to oscillation by the firing of the thyratron tube 48, and the values of the circuit are so selected that during the negative half cycle of the timed circuit oscillation, the plate voltage of the thyratron tube 48 will be decreased to a value sufficient to effect extinguishing of the thyratron tube. The operating circuit for the primary winding of relay 80 is thus immediately de-energized to prepare the amplifier for subsequent operation. The relay switch 82 of memory relay 80 is maintained closed by the described mechanical locking means to indicate a defect in the gauze for the first dozen napkins.

If further defective portions are detected in the gauze section for the first dozen, the phototube 22 and amplifier circuit 23 will be re-operated in the described manner to transmit a further signal to the primary or operating winding of relay 80. Such signal will, of course, provide no further operation of the relay set. Switch 63 is opened as the material for the second dozen enters the inspection zone to prevent further transmission of signals to relay 80 for this cycle.

The moving gauze section is converted into twelve individual sanitary pads in the manner described in the said co-pending application, and conveyor 10 carries the napkins to the stacking machine E for accumulation into a single stack and for insertion into storage compartment 11. At the approximate time that the first dozen is being stacked and counted, cam shaft 71 approaches the mid-point of its operating cycle, and, as indicated in Figure 8, micro-switch 95 is closed by cam 102 for a brief angular interval whereby an operating circuit is completed to the primary winding of reject relay 85. Such operating circuit extends from a battery over the primary winding 85–O through switch 82 and closed micro-switch 95 to ground.

Reject relay 85 operates and its switch 86 opens a point in the operating circuit for slave relay 14, and its switch 87 completes a circuit for a signal lamp 130 to signal the operator that the dozen presently contained in the storage compartment 11 is defective. Such means may also be used to operate a relay counter in an obvious

manner, if desired, to determine the number of napkin dozens which are defective during a given period of manufacture. A brief angular period after energization of relay winding 85–O, micro-switch 88 is closed by cam 103 to effect the energization of the secondary or release winding of memory relay 80. (See Figure 8 of the cam indicating diagram.) The release winding 80–R of memory relay 80 operates and effects release of the mechanical lock for switch 82. The energizing circuit for the primary winding 85–O of reject relay 85 is opened by the opening of switch 82, switch 86 of relay 85 being locked in the open position by the described relay mechanical means.

As the cam switch 13b is operated a short time later by its associated bucket tripping lever 13a, the open circuit condition in the operating circuit for slave relay 14 prevents operation thereof and additionally of solenoid 18. The defective napkin stack is therefore temporarily retained in the storage compartment 11. As the succeeding napkin group assigned to this compartment, that is, the third napkin dozen of the cycle, is moved into the storage compartment in the normal manner, the defective first dozen remaining in the storage compartment will be engaged by the incoming new stack or third dozen, whereby said defective stack will be forced out of compartment 11 to the reject chute or conveyor 21 (Fig. 1b) as an incident to said delivery of said new stack.

Micro-switch 89, which is connected in the first operating circuit for release winding 85–R of reject relay 85, is operated by cam 102 a short interval after the cam shaft commences the second quarter of its cycle and an operating circuit is completed to release winding 85–R. The release winding 85–R energizes to effect the mechanical unlocking of switch 87, whereby switch 86 is reclosed and the circuit for slave relay 14 is prepared for subsequent operation by assigned cam trigger 13a. The relays in relay set 24a are now restored and the set is conditioned for re-operation in the next cycle if necessary.

In each cycle of operation, the disposal of each of four successive stacks or dozens of napkins is controlled successively by the relay sets 24a, 24b, 24c and 24d, in the manner in which the disposal of the first stack is controlled by said relay set 24a as above explained. These four relay sets are successively placed in operative relation to the circuits which control the operation of the discharge gates 19 and 19a of the storage compartments 11 and 12 respectively, by the cams 75 and 101 and the pairs of switches associated therewith.

OVERLAP OF SELECTOR CAMS

Actually, as shown in Figs. 8 to 11 inclusive, switches 63, 64, 65 and 66, which prepare the relay sets for sequential operation, overlap each other for a slight angular period of the shaft revolution. Such overlapping of the cams is utilized to provide means for effecting rejection of two dozen napkins wherever a defect is detected in the material at the dividing point of the gauze used for two successive dozens. For example, if the last portion of material used in the manufacture of the first dozen or the first portion of material used in the manufacture of the second dozen is found defective, relay sets 24a and 24b will both be operated by the signal received from the amplifying circuit 23 and the phototube 22 over simultaneously closed switches 63 and 64.

The following table illustrates in detail the sequence of operation of each relay in each set as a defect is discovered in the particular dozen which the set is assigned to control. Additionally, it sets forth the cam movements and switch operation which effect the selective and successive operation of the relays described.

TABLE—OPERATION IN ONE CYCLE

Dozen	1	2	3	4
Memory Relay Prepared	80	115	90	125
By Switches	63	64	65	66
Reject Relay Operated	85	120	85	120
Switches Operating Reject Relay Primary Winding	95	109	89	111
Switches Operating Memory Relay Release Winding	88	110	94	112
Switches Operating Release Winding of Reject Relay	89	111	95	109

RELAY SET INTERCONNECTIONS

As shown in the table, reject relay 85 is used for effecting rejection of the first and third dozen napkins and reject relay 120 is used for effecting rejection of the second and fourth dozen. Dual use of these relays is effected by the provision of parallel operating circuits extending between relay sets 24a and 24c, and between 24b and 24d.

Operation of the interconnected sets, if the first dozen and third dozen of the same cycle are both defective, is accomplished as follows. Reject relay 85 will be first operated (to effect rejection of the first dozen) over the operating circuit completed through the primary winding 85–O from battery, over closed switch 82 of memory relay 80, and micro-switch 95 to ground. After release of the first dozen napkins into its assigned bucket has been prevented by the operated reject relay 85, and opened switch 86, an operating circuit to the release winding 85–R to effect release of relay 85 is normally completed from battery over release winding 85–R, switches 91 and 89 to ground. However, since the third dozen is also defective, memory relay 90 will be in its operated condition, and at its switch 91 will have opened a point in the operating circuit for release winding 85–R. Thus, release winding 85–R of reject relay 85 will be prevented from energizing, the switch 87 will be maintained locked closed to indicate the defect, and as the switch 13b is closed by the assigned passing trigger, the electrical circuit 13d will be inoperative and the third dozen will be retained in the compartment for eventual rejection to chute 21. If the first dozen in the next cycle are not defective, release winding 85–R of reject relay 85 will be subsequently energized by completion of a second operating circuit extending from battery, over the release winding 85–R, switches 81 and 95 to ground. The relay sets 24a and 24c are thus operative to effect rejection of the first and third dozens, if defective, through use of a single reject relay. The relay sets 24b and 24d are, of course, operated in a similar manner.

SYNCHRONIZING UNITS

It is apparent from the foregoing that the operation of the inspection unit timing mechanism must be closely synchronized with the movement of the gauze material through the equipment. Suitable test equipment in the form of signal lamps 134 (Fig. 1a) and 135 (Fig. 1b) are arranged to provide means for comparing their relative movements. Indicating lamp unit 134 is arranged to be connected to a source of potential with each closure of switch 95 (Figs. 4 and 5b) in the timing arrangement 70 which is approximately at the time that the cam shaft 71 reaches

the half-way mark in each cycle. The indicating light 135 (Fig. 1b) is arranged to be connected to a source of potential over a micro-switch (not shown) closed as an incident to each operation of a magnetic clutch member 136 on the stacking machine E. Since the magnetic clutch 136 is operated whenever a dozen napkins are accumulated in the receptacle 137, the indicator light 135 will be illuminated four times for each cycle of the timing unit 70 or four times for each illumination of the indicator light 134. The equipment will be thus properly synchronized if lamp 134 and lamp 135 are illuminated simultaneously at the half-way mark in each cycle of the inspecting unit.

CONCLUSION

The inspecting apparatus which has been described in the foregoing is operable during manufacture of individual articles to effect extremely accurate and positive selection of article groups which are acceptable for commercial use. The novel inspecting arrangement, which permits inspection of the material during the early stages of article manufacture and delays rejection of the defective material until the articles are completed and included in counted groups, accomplishes a unit which offers a minimum of interference with the automatic operations of the equipment. As a result, the production of commercial articles is accomplished in an extremely rapid and sanitary manner. Also, such arrangement, by reason of its inspection of the material prior to its inclusion in the articles, enables the unit to detect each of the defective portions in a positive and reliable manner.

The simplicity of the relay circuits, and the various interconnections between the pairs of circuits so as to employ single relays in a dual capacity provides an arrangement which is comparatively inexpensive and which requires a minimum of plant maintenance. The dependability, simplicity and accuracy of the arrangement provides an inspecting unit which is adaptable for use with many types of article producing equipment and is therefore considered a definite advancement in the art.

Various other features of the invention which are believed to be new are set forth in the accompanying claims.

We claim:

1. In apparatus for making sanitary napkins which comprises absorbent pads enclosed in wrappers of sheet material, inspecting means operating on the sheet material components to detect abnormalities therein, means for receiving and assembling the napkins into stacks, means normally operative to receive the stacks from said assembling means, other means for receiving from said assembling means stacks which include sheet material having abnormalities detected by said inspecting means, and means controlled by said inspecting means for causing delivery to said other means, of said last mentioned stacks.

2. In combination with article making apparatus wherein components of articles are fed along a predetermined path of travel and converted to the desired articles by fabricating operations performed successively along said path of travel, the apparatus being such that in the length of said path of travel there are a plurality of articles in various stages of fabrication, means for collecting said articles in groups and holding the groups for discharge from the apparatus, an electric impulse generating device for inspecting one of the components of each article while in an incompleted stage of fabrication in said path of travel, a plurality of relay sets, means cyclically connecting each of said relay sets to said inspecting device for periods during which components for successive predetermined groups of articles pass said inspecting device, a relay for controlling the discharge of said article groups from said group holding means, and means successively connecting the respective relay sets of said plurality of relay sets to said discharge controlling relay, said last mentioned means including timing means for delaying actuation of said discharge controlling relay to predetermined times after the completion of the inspection of said components for successive predetermined groups of articles, whereby time is afforded for the fabrication of said articles and the collection thereof in groups as aforesaid before impulses generated by said inspecting device are enabled to effect actuation of said discharge controlling relay.

3. In combination with article making apparatus wherein components of articles are fed along a predetermined path of travel and converted to the desired articles by fabricating operations performed successively along said path of travel, the apparatus being such that in the length of said path of travel there are a plurality of articles in various stages of fabrication, means successively operable to collect into groups, articles delivered one by one to said means, a pair of holding compartments alternatively operative to receive said groups of articles from said means, means for receiving said article groups from said compartments, an electric impulse generating means for inspecting one of the components of each article while in an incompleted stage of fabrication in said path of travel, two pairs of relay sets, a pair of relays for controlling the delivery of article groups from said holding compartments to said receiving means, connections between said relay sets and said pair of relays whereby the relays of said delivery controlling pair are respectively connected to said pairs of relay sets, timing means operative to cyclically connect the relays of one pair of said relay sets to said inspecting means alternately with those of the other pair of said sets, whereby a component of articles for four successive groups thereof is inspected during each cycle of said timing means, and other timing means in the connections between said relay sets and said pair of discharge controlling relays for delaying actuation of the latter to predetermined times after the completion of the inspection of said components for successive predetermined groups of articles, whereby time is afforded for the fabrication of said articles and the collection thereof in groups as aforesaid before impulses generated by said inspecting device are enabled to effect actuation of said discharge controlling relays.

4. Apparatus for the class described comprising means for feeding articles successively along a path of travel common to all of said articles, means for receiving said articles from said feeding means and assembling said articles in groups containing predetermined numbers of said articles, means selectively operable to discharge said groups from said receiving means in predetermined diverging directions, means for inspecting a part of each article prior to delivery thereof to said assembling means, and means controlled by said inspecting means for effecting delivery of article groups which contain an article having

a condition detected by said inspecting means in a predetermined one of said diverging directions.

5. Apparatus of the class described comprising means for combining a plurality of components into unitary articles, means for receiving and assembling said articles in groups, inspecting means acting on a portion of one of the components while such portion remains accessible for inspection independently of other components before combining of the same is completed, and means controlled by said inspecting means for separating from normal article groups, a group which contains a condition detected by said inspecting means.

6. In combination, means for feeding articles successively, assembling said articles into successive groups containing predetermined numbers of the articles, and for temporarily storing such article groups, a conveyor for receiving such groups from said storing means, means for normally effecting the delivery of said groups to said conveyor, an inspecting device arranged to inspect a part of each article prior to incorporation of each such article into a group as aforesaid, a relay set operatively connected to said inspecting device for actuation of said relay set as an incident to the passage past said inspecting device of a defective article part, and means controlled by said relay set for preventing the operation of said normal delivery means to thereby cause a group of articles containing an abnormality detected as aforesaid to be retained in said storing means for special, subsequent disposition.

7. Apparatus of the class described comprising means for assembling articles in successively

formed stacks of articles, a plurality of holding compartments, means for successively delivering to said compartments, stacks of said articles, inspecting means operative in relation to a portion of each article prior to the assembling thereof into stacks as aforesaid, a conveyor for receiving said stacks from said holding compartments, means for normally effecting delivery of the stacks successively from said holding compartments to said conveyor, auxiliary means for also receiving said stacks from said holding compartments, means controlled by said inspecting means for disabling said normal delivery means, said means for delivering the stacks from said assembling means to said compartments being operative as an incident to the delivery of a stack of articles to one of said storage compartments to also effect discharge from said compartment to said auxiliary means of an article stack containing an abnormality detected by said inspecting means.

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