

Oct. 11, 1955

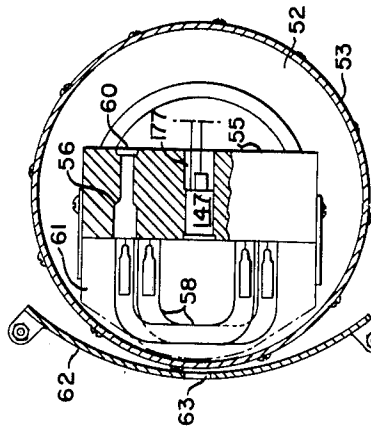
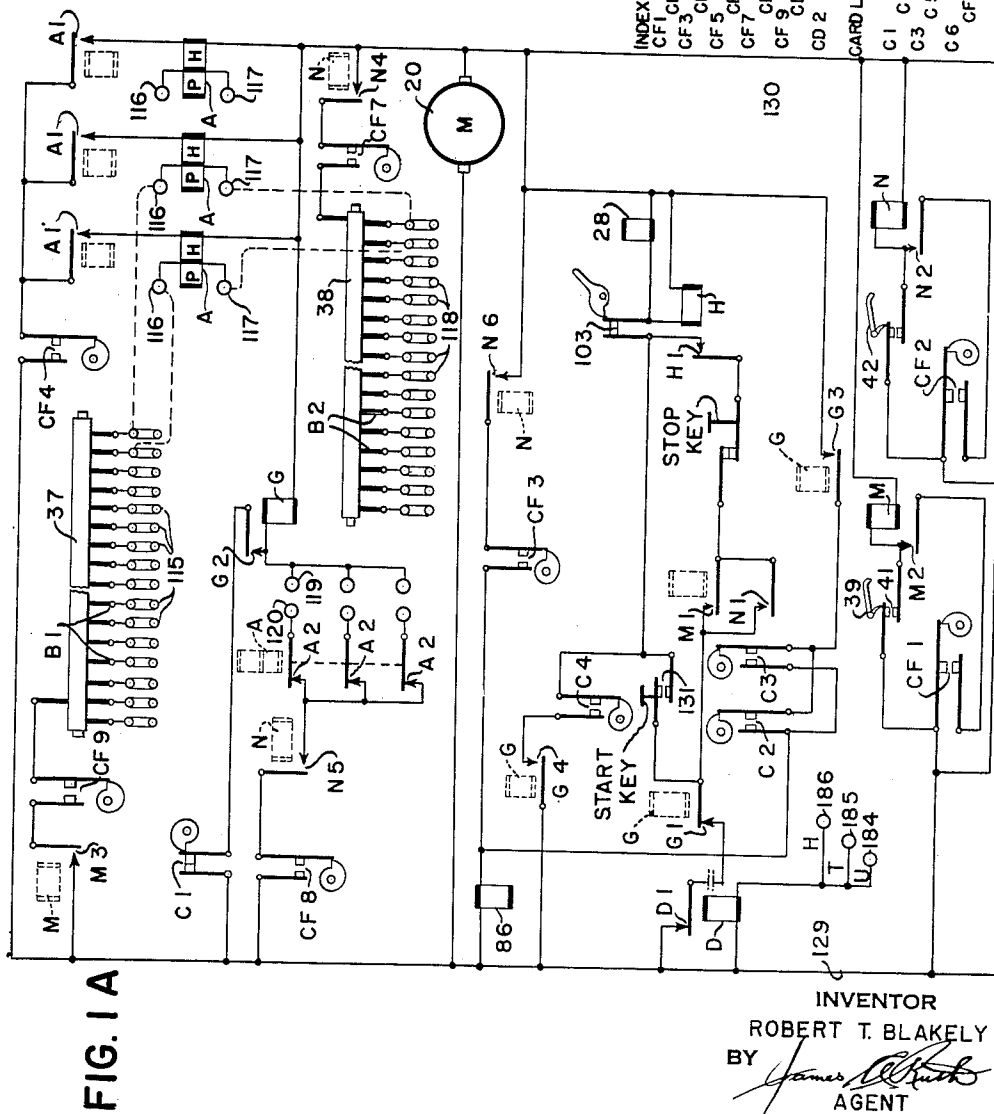
R. T. BLAKELY

2,720,642

FLASHTUBE IGNITION CIRCUIT FOR RECORD CONTROLLED MACHINES

Filed May 26, 1951

2 Sheets-Sheet 1

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2 Sheets-Sheet 2

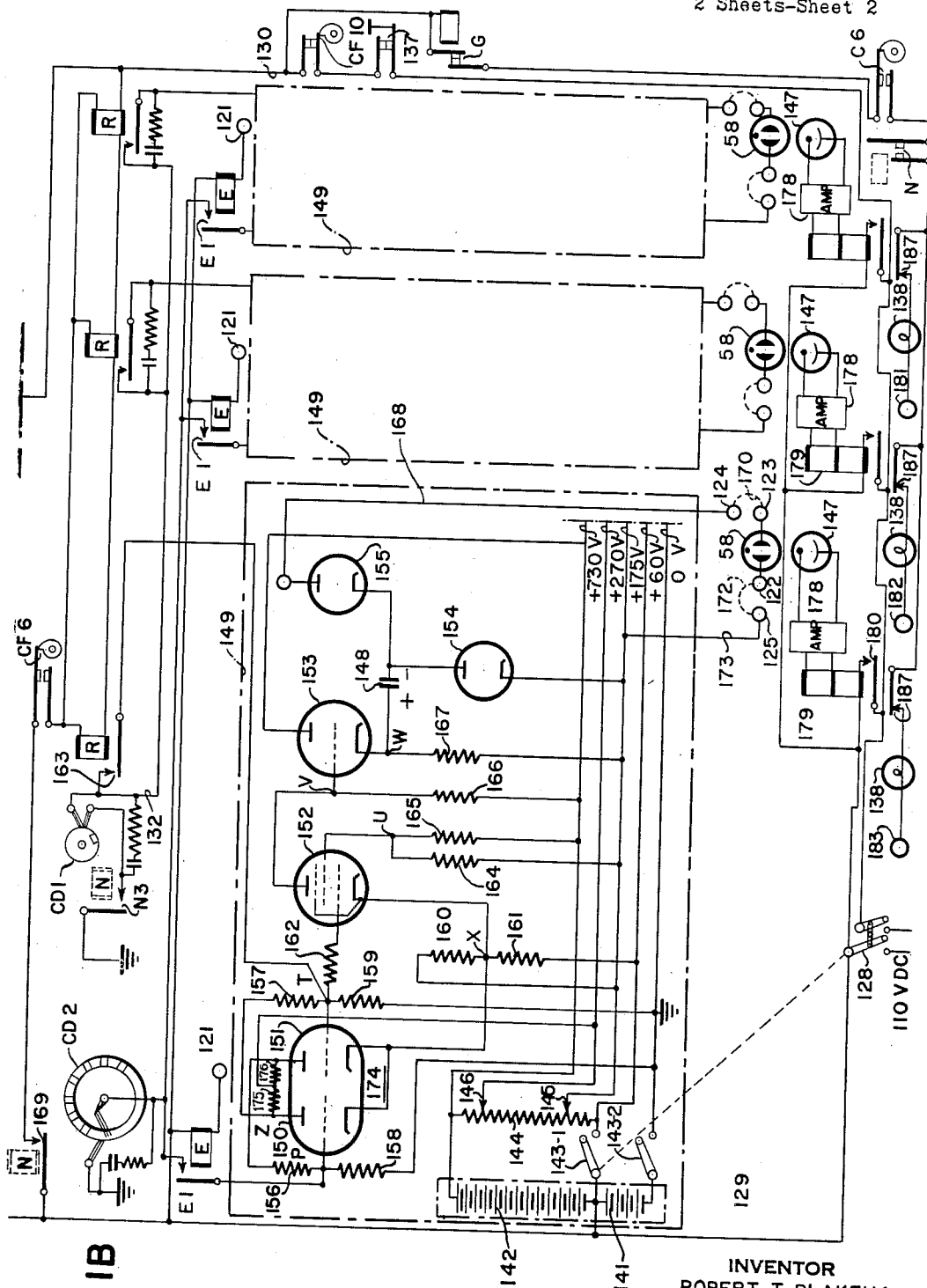


FIG. 1B

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2,720,642

FLASHTUBE IGNITION CIRCUIT FOR RECORD CONTROLLED MACHINES

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Application May 26, 1951, Serial No. 228,454

8 Claims. (Cl. 340—318)

This invention relates generally to photographic recording machines for the recording of statistical data and more particularly to apparatus for controlling the discharge of energy through a flash tube.

The invention disclosed and claimed herein is an improvement over apparatus shown and claimed in a Patent 2,346,251, issued to J. W. Bryce and granted on April 11, 1944, for Recording Device, to which patent reference should be made.

Briefly, the above referred to patent relates to a record card controlled machine in which the data borne by individual record cards, successively arranged in the well-known manner according to various control groups, is translated into characters which are recorded on a film strip by means of light produced from a plurality of flash tubes differentially timed to operate according to the positions of data representing perforations in the record cards.

The device of the patent comprises, in summary, three basic units and a circuit for synchronizing the apparatus in each. The first unit is the usual mechanism for feeding record cards one at a time from a supply hopper past a pair of perforation analyzing stations to a receiving stacker. The second unit is the translating mechanism for translating the data sensed by the analyzing stations into alphabetical and numerical characters; selected by the differentially timed flashes of high intensity light which includes an assembly for holding a row of stationary flash tubes within a rotatable cylinder having lines of translucent characters inscribed on its surface. The third unit includes mechanism for holding and advancing a strip of film behind a lens aperture which is focused upon the character bearing cylinder, thus providing for the recording of the characters at such times as they are illuminated by the flashes of light from the flash tubes.

The flash tubes used to produce the necessary brief flashes of high intensity light are neon tubes which require a high operating voltage. The machine which is described in the patent does not have a source of voltage high enough to cause the neon tubes to operate directly therefrom. Accordingly provision was made to allocate to each such neon tube a plurality of condensers so interconnected that they could be individually charged at the normal machine operating voltage, then be serially connected together in a bank, to provide a source of voltage approximately equal to the said machine voltage times the number of condensers used. This means was thus used to provide a voltage which was high enough to cause the neon tube connected thereto to discharge and produce a brief high intensity flash of light.

The number of data receiving columns provided in the record cards is usually 80, and hence 80 flash tubes would thus normally be required for the translation of data contained in all the record card columns. As the above referred to patent discloses, 10 condensers were considered to be the least number necessary for the effi-

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cient and reliable operation of each flash tube. Hence, the total of 800 required condensers attended by some 1600 switching contacts comprised a bulky and inconvenient assembly in which the failure of a single switching contact, or condenser, could result in much lost time in its finding and repair.

The principal object of the instant invention resides in the provision of a simple novel electron tube controlled circuit for discharging a flash tube in response to data read from a record card.

A further object of the invention resides in the provision of but a single energy storage condenser for operating each flash tube.

A specific object of the invention resides in the provision of an electron discharge tube control means for charging a condenser to a required voltage and in further using this same electron discharge tube as the control means for initiating the discharge of said condenser through a flash tube.

The circuit of the device described in the above mentioned Patent 2,346,251 to J. W. Bryce discloses a condenser bank operated series of checking relays for indirectly determining whether or not a flash tube was operated for each record card perforation sensed by the brush analyzing stations.

Hence, another object of the invention resides in the provision of means for directly and positively checking the proper operation of each flash tube.

Another object of the invention resides in the provision of inertialess means for controlling charging and discharging of the flash tube energy storage condensers.

Further, it is a feature of the invention to use an electron discharge gate tube controlled from a double stability trigger for controlling the charge and discharge of each flash tube energy storage condenser.

Another object of the invention resides in the provision of means insuring that a flash tube will operate only as desired.

Specifically, it is a feature of the invention to use a pair of oppositely connected rectifiers in each flash tube circuit, one of said rectifiers being operative during the charging of the flash tube energy storage condenser, the other being operative to prevent spurious discharge of said condenser through the flash tube.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle. Other embodiments of the invention employing the same or equivalent principle may be used and structural changes made as desired by those skilled in the art without departing from the present invention and within the spirit of the appended claims.

In the drawings:

Figures 1a and 1b comprise a circuit diagram of a record controlled recording device incorporating the invention.

Figure 2 is a sectional view of the rotatable character bearing drum showing the flash tubes and photoelectric cell fixedly mounted therein.

Figure 3 is a timing diagram.

Like reference characters are utilized throughout the drawings to designate like parts in this application and in the Patent No. 2,346,251, issued to J. W. Bryce on April 11, 1944, above referred to.

Refer now particularly to Figure 1b showing a circuit diagram of the flash tube control apparatus.

The power source for the machine is shown schematically represented by the commercial supply supplemented by batteries 141 and 142. The commercial supply is intended to energize all that apparatus disclosed in the herein-

above mentioned Patent No. 2,346,251 to J. W. Bryce while batteries 141 and 142 are intended to supply the power requirements of the circuit of the present invention. It will be noted that switch 143-1 inserted in series with the plus 60 volt line and switch 143-2 inserted in series with the ground line are effective to disconnect the batteries from the circuit and also are mechanically linked to and operated whenever switch 128 is operated.

Battery 141 delivers current at a potential of 60 volts while battery 142 delivers current at a potential of 670 volts and is provided with a voltage dividing resistor 144 placed across its terminals and having a pair of taps 145 and 146 for supplying current at potentials of 175 and 270 volts respectively. These potentials are delivered to the various circuit components by means of buses which are labelled with the respective voltage impressed upon them.

Each neon flash tube 58 is provided with an energy storage condenser 148 of .25 μ fd. for its operation and an electronic circuit for controlling the charging and discharging of the energy storage condenser. The complete electronic circuit 149 is shown only for one data order, two other data orders being shown schematically. It will be understood, however, that in practice up to 80 data orders will ordinarily be supplied.

The control circuit for causing the charging and discharging of the energy storage condensers 148 includes a pair of triode tubes 150, 151, here shown placed in a single envelope and connected as a double stability trigger 174 of known type, a phase reversing tube 152, a triode tube 153 and a pair of rectifiers 154 and 155.

Triodes 150 and 151 are shown having their anodes and grids cross connected by resistors 156 and 157. Each grid thereof is provided with resistive connections 158, 159 to the zero voltage bus. The cathodes of triodes 150, 151 are connected together and to the common point of resistors 160 and 161 respectively connected to the 175-volt and 60-volt buses.

On consideration, it will be seen that the circuit of trigger 174 has two stable conditions. The balanced condition, in which the currents are equal in the two symmetrical halves of the circuit, may be seen to be unstable, for if from this state the anode current of one tube is slightly increased its anode potential will fall. This, then will produce a reduction of the grid potential of the other tube, decreasing its anode current and hence increasing its anode potential. This in turn increases the grid potential of the first tube, further increasing its anode current. So the process will continue until the anode current of the second tube is reduced to zero.

A condition in which only one tube passes anode current is thus seen to be stable. Moreover, since the circuit is symmetrical there are two such stable conditions or states.

The normal, or off, stable status of trigger 174 obtains when tube 150 is conducting current and tube 151 is thereby rendered non-conductive.

The value of resistors 160 and 161 are so chosen that the voltage at the cathodes of the tubes is approximately 120 volts at the times when tube 151 is conducting. The grid of triode 151 is connected to the grid of tube 152 through a resistor 162 and is also connected through the normally open contact 163 of an R relay, commutator contact CD1 and a contact of N relay, later to be described, to ground, or zero volts. The cathode of tube 152 is also connected to the junction X of resistors 160 and 161 and thereby assumes the same potential as the cathodes of triodes 150 and 151. Thus, when contact 163, brush contact CD1 and contact N3 of relay N are closed ground potential is impressed upon the grid of tube 152 and as its cathode is maintained at a potential substantially in excess of zero this tube is rendered non-conductive and ceases to draw current from the potential dividing resistors 160 and 161 thereby permitting their junction point X to rise in potential. Commutator con-

tact CD1 is made for only a short time interval and when this contact is broken point T at the grid of tube 151 will rise to a potential of some 35 volts less than the potential of point X thereby rendering tube 151 non-conductive and setting the trigger in its normal status.

One cycle of revolution of cam CD-1 is necessary to set the trigger in its normal or off status, i. e., triode 151 non-conductive and triode 150 conductive. Hence, it will be understood that the normal status of the circuit obtains when tube 150 is conductive, tube 151 is non-conductive, tube 152 is rendered non-conductive and tube 153 is rendered conductive.

The screen grid of tube 152 is supplied with proper operating potential from the mid-point U of a resistor voltage divider comprising resistors 164 and 165 connected in series across the 175-volt and 730-volt buses. The plate of tube 152 receives its voltage via a resistor 166 from the 730-volt bus and also is directly coupled at point V to the grid of tube 153. Tube 153 acts to control the charge and discharge of the energy storage condenser 148 which is connected to the cathode of tube 153 at point W. The cathode of control tube 153 is also connected via load resistor 167 to the 175-volt bus while its plate is supplied with 730 volts directly from the bus of that voltage.

Bridging condenser 148 and resistor 167 is a charging diode 154 whose cathode is connected to the 175-volt bus. Condenser 148 is provided with a separate discharge path passing through diode 155, wire 168, plug sockets 123, 124 and plugwire 170 therefor, through neon flash tube 58, plug sockets 122, 125 joined by plugwire 172 and wire 173 to the 175-volt bus, resistor 167 back to condenser 148.

The purpose of diodes 154 and 155 is to insure that the condenser is charged along one path and discharged along another path.

In the operation of the circuit the voltages existing at lettered points was approximately as shown herebelow.

Table of voltage values

	P	Y	Z	T	X	V	W	U
Trigger Normal---	110	250	160	70	105	645	625	380
Trigger On-----	90	205	270	120	120	190	200	310

The values of resistors and tube types used is as shown herebelow.

Resistor table

Resistor:	Value in ohms
156-----	150,000
157-----	150,000
158-----	120,000
159-----	120,000
160-----	500
161-----	250
162-----	100,000
164-----	10,000
165-----	17,000
166-----	5,500
167-----	7,500
175-----	20,000
176-----	20,000

Tube types

150-151-----	6SN7
152-----	6L6
153-----	6N7
154-155-----	25Z6

Character drum

Refer now to Figure 2. The character carrying drum 53 may be made of any suitable transparent material such as a transparent plastic. The drive gearing (not shown) which drives the drum is preferably proportioned

so that the drum 53 will make one complete revolution during three machine cycles, that is to say, if three cards in succession pass the analyzing brushes, then, during the transit of these three cards there will be one complete revolution of drum 53. The cylindrical drum is preferably opaque on its surface, except at each character displaying portion where the drum is translucent. The character displaying portions may be termed character patterns.

The drum is provided with a plurality of columns of character patterns (shown in the above mentioned Bryce patent). Each column of character patterns may, for example, comprise three sets of digits 9 through 0 inclusive. When the drum is being continuously rotated the various digital characters are successively presented to an exposing position 63. When the machine is at rest and the drum in its normal home position, no characters will be presented to the exposing position. When the drum commences to rotate the first character to be brought to the exposing position will be the digit 9, the next the digit 8 and so on.

Disposed within the drum, but not rotatable with it, are a plurality of gaseous discharge tubes, such as neon tubes. Normally these tubes are not lit. When it is desired to record a character a source of potential is momentarily applied to the neon tube at the instant the desired character is in the proper position for recording. The bright light from the neon tube will trans-illuminate the character and such character will be recorded on the film as is explained in detail in the hereinabove referred to Patent 2,346,251 to J. W. Bryce.

Since the drum 53 is rotatable, it is provided with hollow hubs (not shown) so as to allow for the provision of supports extending from the outside of the drum through the hubs and into the interior of the drum to support the neon tubes and checking photocells therein. A pair of cables may also be led into the interior of the drum through one of the hollow hubs. Such cables afford the connective wires to provide current for the individual neon tubes and their corresponding checking photocells. 58 designates an individual neon tube while 147 designates an individual checking photocell. Each such photocell is mounted directly behind its corresponding neon tube in holes 177 drilled through support 55. The neon tubes are generally U-shaped. The neon tube terminal ends fit into conductive socket elements 56 which are molded in the support block 55. The rear of each socket element receives the plug tip 60 connected to a wire contained in the cable provided for the neon tubes.

The photocells 147 are provided with the usual terminals for connection to the wires in the second cable. A series of opaque baffles 61 are provided between the neon tubes to prevent illumination from a tube related to one column from affecting, or trans-illuminating, characters in another column. It is understood that a single neon tube is provided for each column of translucent characters on the drum. A mask 62 with a central slot 63, also denoting the character exposing position, is interposed between the drum and camera unit (not shown) so that only a single line of characters will be photographed at a time.

Machine circuit diagram

Before the machine is started up to effect recording operations pertaining to a run of cards, certain plug connections must be first made. Assuming that auto-control is desired on several classification columns, plug connections are established from the plug sockets 115 wired to the advance sensing brushes B1 for these card columns to the sockets 116 which are connected to the pickup coils *p* of the usual duo wound auto-control relays A. Other plug connections are made from sockets 117 of these same pickup coils to the double sockets 118 which are wired to the regular sensing brushes B2 for the classification columns. If two columns, for ex-

ample, are to be used for auto-control, two pickup coils of relays A are plugged up in this manner and plug connections also are made from a pair of the 119 sockets to the 120 sockets which are wired to contacts A2 of the two utilized A relays. The number of connections between 119 and 120 depend upon the number of columns which are plugged up for auto-control.

Other plug connections are made from desired ones of the sockets 118 of the B2 brushes to sockets 121 which connect to relay coils generally designated E. It will be understood that one of these relay coils E is provided for each column of recording but for simplicity in the circuit diagram only a few of such coils are shown. The circuits which will be made through coils E are the sensing circuits to be closed by sensing of character designations to control recording of designated characters. The current supply for these sensing circuits is at a relatively low line voltage. On the other hand, with the present machine, the neon tubes are fired with current at a relatively high voltage and it is desirable that the high voltage circuits be isolated from the sensing circuits. Accordingly, the relay coils E are utilized, these being energized under line voltage applied through the card sensing circuits. These relays E in turn are utilized to close contacts for applying reversing potential to the double-stability trigger 174 so as to turn the trigger 174 and thereby initiate the neon tube discharge as will be hereinbelow explained in detail.

The opposite terminals of each individual neon tube 58 are connected to plug sockets 122 and 123. A plug connection 170 is made from the 123 socket of a tube to a 124 socket and another plug connection 172 is made from the 122 socket of the tube to a 125 socket. It will be understood that as many neon tubes are utilized as are necessary for the required number of columns to be recorded. In practice there is one neon tube for each column of characters upon the drum and while only a few neon tubes have been shown in the circuit diagram for simplicity of illustration, it will be appreciated that more are provided.

It may be here mentioned that with the present machine exposure of variable data from the character carrying drum 53 is effected by flashing the neon tubes at the proper differential time.

It will be appreciated that if a neon tube associated with a drum column should fail to fire for any recording operation, the result would be that there would be no exposure on the film for that particular column. With such a tube failure, many lines of film might be run through the machine before the tube failure was detected because it would only be after the film had been removed, developed and examined that the tube failure would be apparent or detected. To prevent such undesired operation, testing and indicating means are provided. While this testing and indicating means will be subsequently described in greater detail, its general principle of operation may be mentioned here. Each time that a particular neon tube 58 fires it will illuminate its corresponding photocell as well as the particular character then at the exposing position opposite slot 63.

Assuming the proper perforated records are in the supply magazine (not shown), the operator of the machine first closes main line supply switch 128 providing D. C. current supply to buses 129 and 130. The start key is now depressed, closing start key contacts 131 to complete the following circuit: from left line 129, through the D1 contact of the detecting and testing relay D, through the master auto-control contacts G1, through the start key contacts 131, through the film lever contacts 103 and through the card feed clutch magnet 28 to the other side of the line 130. A branch circuit is also completed through a holding relay H which on energization closes contacts H1. Energization of magnet 28 starts card feeding in the customary manner and the card is advanced from the supply hopper and in the first machine cycle

reaches a position in which its leading edge is under brushes B1 in which position card lever contacts 41 are closed. Closure of these card lever contacts causes energization of relay coil M, closing contacts M2 to provide a stick circuit for the coil through cam contacts CF1. Coil M also closes contacts M1. These M1 contacts and the stop key contacts and now closed contacts H1, shunt the start key contacts 131 so that the start key may now be released and the machine will continue in automatic operation until cards are exhausted or a change in card group occurs. During the second card cycle, the first card is fed to a position in which it causes the second card lever contacts 42 to close. Accordingly, coil N is energized, closing contacts N1 which are in shunt with contacts M1. Coil N also closes contacts N2 to provide a stick circuit for the coil by way of cam contacts CF2. The stick circuits for these relay coils M and N are provided so as to maintain the coils energized during the intervals in which the card lever contacts open between successive cards.

During the third card cycle, the first card will be sensed by the B2 brushes and the second card by the B1 brushes. At the beginning of this third cycle, the energy storage condensers 148 will be charged by establishment of the circuit from the ground through N3 now closed, through the commutator timer CD-1 to a line 132, thence through the normally open contacts 163 of an R relay, now closed by virtue of the operation of cam contact CF6, to point T of trigger 174 thereby causing the trigger to be turned off to normal, if on, or maintained in the normal state. If trigger 174 were in its on status tube 152 would be conducting. By grounding point T through the above-mentioned circuit this point connected through resistor 162 to the grid of tube 152, is driven to a low potential thereby rendering the tube non-conducting and causing the potential existing at point V to rise sufficiently to render the control tube 153 conductive. When this tube conducts, the potential at point W is raised to approximately 625 volts. As the other side of the condenser is connected through diode 154 to the 175-volt bus the potential across the condenser becomes 450 volts and the condenser is charged to this potential through tube 153 acting as a charging resistance. It had been found that discharge of the condenser 148 would sometimes occur sporadically when the potential of point W was raised. This was believed to be due to the difference in impedance between the charge and discharge parts. So, to better equalize these paths, discharge diode 155 was made a part of the circuit. When point W is at a high potential and condenser 148 is charging the plate of diode 155 is negative relative to its cathode thereby insuring an open discharge circuit. After a period of time has elapsed for allowing the energy storage condensers for each data order to become fully charged the circuit established from the left line 129 through contacts 169 of the N relay, now energized, cam contacts CF6, thence through the R relays to the right line 130 is broken when cam contacts CF6 open deenergizing these R relays and opening contacts 163.

During the third machine cycle, the leading card is sensed, the recording control relays E are energized, and the auto-control circuits are set up.

Assuming that the cards under the brushes have agreeing group designating perforations, the auto-control circuits are established as follows: from left side of line 129, through the M3 relay contacts, cam contacts CF9 to common conductor roll 37, thence through the B1 brushes sensing the group perforations, thence through the plug connections between sockets 115 and 116, through the pickup coils *p* of auto-control relays A, thence through the plug connections from 117 to 118, back through the B2 brushes to the contact roll 38, through CF7 cam contacts, through relay contacts N4 and back to the D. C. line 130. The auto-control magnets A are of the usual dual winding type and the ener-

gized pickup coils close the stick contacts A1 to energize the companion holding coils *h* through circuits extending from line 129, through cam contacts CF4. The energized A magnets open the related A2 contacts so as to prevent energization of master auto-control relay coil G. It may be pointed out that if the cards do not have corresponding group perforations, then the A2 contacts will remain closed and upon closure of cam contacts CF8 near the end of the cycle, the circuit of coil G will be established via relay contacts N5. Coil G will then open contacts G1 to break the card feed clutch magnet circuit.

The relay coils E are energized under the control of the B2 brushes as they sense the usual well known IBM character designating perforations in the card in columns where recording is desired. The circuits are from line 130, through the N4 contacts now closed, the CF7 contacts to contact roll 38, thence through B2 brushes, through the plug connections from 118 to 121 (Fig. 1b), through the relay coils E and back to the D. C. line 129. It will be understood that the relays E are energized at differential times in accordance with the differential positions of the holes in the records. Relay coils E only energize momentarily but upon energization, they close their related E1 contacts. With such E1 contacts closed, a flashing circuit or circuits is established as will now be described.

At the instant relay contacts E1 are closed a circuit is established from ground through one of the segments of the timing commutator CD-2, contacts E1 which are closed as determined by the card analyzing circuits to the grid of triode 150 at point P. It will be recalled that when trigger 174 is resting in its normal status that tube 150 is maintained conductive and that point P is maintained at approximately the same potential as point X. Establishment of the said circuit through the E1 contacts hence has the effect of shorting resistor 158, causing zero potential to be applied to the grid of tube 150, rendering said tube non-conductive and through medium of well known trigger action simultaneously causing tube 151 to become conductive for reversing said trigger from its normal status to its on status. The assumption of the on status of the trigger causes point T to assume the same potential as point X. Hence tube 152 is also rendered conductive and the potential at point V is thereby lowered sufficiently to cause the grid of tube 153 to be driven beyond cut-off to render the last mentioned tube non-conductive.

The cessation of conduction through tube 153 abruptly causes the potential at point W to fall thereby establishing proper conditions for the discharge of the energy storage condensers 148 through their respective flash tubes 58 as follows: from the left hand side of the condenser at point W through resistor 167, wires 173, 172, flash tube 58, thence over wires 170 and 168 through discharge diode 155 to the other side of the condenser thereby causing neon tube 58 to emit a brief flash of light, the duration of which may be varied by varying the constants of the condenser and resistor 167.

It may be mentioned here that the commutator CD-2 is timed for a very short duration of circuit closure, only sufficient for reversing the status of trigger 174. The constants of condenser 148 have been chosen at some .25 microfarad which at the charging potential of approximately 450 volts stores energy to maintain the neon tube flash for a time interval sufficient to effectively expose the passing character of a character column on the drum to the film in the camera unit as disclosed in the hereinbefore mentioned Patent No. 2,346,251 to J. W. Bryce to which reference should be made for a showing of the complete machine.

It will be understood that while the circuit has been traced for one particular column and for one neon tube, exposures may occur for a multiplicity of columns.

It will be understood that the related character on the drum is passing the exposure position at the time the re-

lated neon tube is illuminated under control of the corresponding index point in the card and the commutator contacts CD2 close for a short period of time in which the said index point is being sensed. The characters selected by the designations in the card columns can thus be exposed and recorded at differential points of the cycle and such exposure for different columns may occur either concurrently or at different differential times depending on whether like or unlike designations are sensed in the card columns. Exposure during a card cycle of characters in different columns will, however, be effected on a common line on the film.

After exposure, film feed may be effected. Upon closure of cam contacts CF3 a circuit is completed from line 130, through relay contacts N6 now energized, through the CF3 contacts and through film feed solenoid 36. Energization of the solenoid followed by its subsequent deenergization upon opening of cam contacts CF3 causes line spacing of the film.

Provision is now made for detecting proper operation or more exactly, mis-operation of the neon tube or tubes.

The circuits for detection of proper operation of the flash tubes is positive in its operation; i. e., if the flash tubes light up no change is made in the operation of the machine, however, should any one of the flash tubes fail to light provision is made for stopping the machine. Referring to Figs. 1b and 2, it will be noted that each photocell 147 is mounted directly behind its corresponding neon flash tubes and is connected to an amplifier 178 for amplifying the photocell output to a sufficient level for operation of relay 179 connected thereto. It will be understood that each time a neon tube is flashed that its corresponding photocell will emit a voltage pulse which is amplified and renders relay 179 energized. Each relay 179 is provided with a separate holding coil connected in series with its respective relay contacts 180 and right line 130. Depending upon which orders have been selected, plug connections are made between plug sockets 181—184, 182—185 and 183—186 to set up connections for arresting operation of the machine as follows.

In the event of a non-flashing operation relay 179 will fail to pick up, and contacts 187 will remain closed. With card still in the machine and the N contact closed every time C6 closes the tube 138 will flash and relay coil D being energized will open D1 to break the card feed clutch circuit. The relays 179 that were energized will be retained energized through key contact 137 and cam contact CF10. Depression of key 137 will drop 179 after a tube has been replaced where necessary.

The G relay contact shown in series with cam contact C6 will prevent inadvertent operation and pick-up of relay coil D on a control break.

After there has been a neon tube failure, the operator detects which tube is faulty by the flashing on and off of the corresponding indicator lamp 138, replaces it and then provision is made for opening up the signal, or warning, circuit through lamp 138 and relay coil D. Opening up of such circuit for relay D and lamp 138 is afforded by manual operation of the key which controls normally closed contacts 137.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. Means for transilluminating a selected character derived from a continuously rotating drum, said means comprising a gaseous discharge tube with means for firing it, said firing means comprising a condenser adapted

to receive a charge, first rectifier means connected in series with said condenser for establishing a selected charging path, an electron discharge tube means comprising at least an anode, a control grid and a cathode, connected in series with said condenser and said first rectifier means and a source of high potential for controlling the charging of the condenser from the high potential source when said electron discharge tube is rendered conductive, second rectifier means connected in series with said condenser and said gaseous discharge tube for preventing premature discharge from said condenser during the time it is being charged, and means for rendering said electron discharge tube non-conductive at a differential time with the rotation of said drum for firing said gaseous discharge tube by discharge of said condenser therethrough thereby transilluminating a selected character.

2. In a record controlled machine, in combination means for feeding records one by one in succession, cyclic means for analyzing each record for data contained therein, a gaseous discharge tube, with means for firing it comprising a condenser adapted to receive a charge, a bistable trigger which is operable to different ones of either of two sustained electrical on and off states, means operable by said analyzing means for shifting the electrical status of said bistable trigger from its off state to its on state at a differential time in a card analyzing cycle upon the sensing of data contained in a record card, and electron discharge means responsive to each alternation of the trigger and adapted to render said condenser charged when said trigger rests in its off status and to cause said condenser to be discharged through said gaseous discharge tube when said trigger rests in its on status.

3. Means for transilluminating a selected character derived from a continuously rotating drum, said means comprising a gaseous discharge tube with means for firing it, said firing means comprising a condenser adapted to receive a charge, first rectifier means connected in series with said condenser for establishing a selected charging path, an electron discharge tube means comprising at least an anode, a control grid and a cathode, connected in series with said condenser and rectifier means and a source of high potential for controlling the charging of the condenser from the high potential source when said electron discharge tube is rendered conductive, second rectifier means connected in series with said condenser and said gaseous discharge tube for preventing premature discharge from said condenser during the time it is being charged, means for feeding records one by one in succession, cyclic means for analyzing each record for data contained therein, and a bistable trigger which is operable to different ones of either of two sustained electrical on and off states, means operable by said analyzing means for shifting the electrical status of said bistable trigger from its off state to its on state at a differential time in a card analyzing cycle upon the sensing of data contained in a record card, and electron discharge means responsive to each alternation of said trigger adapted to render said condenser charged when said trigger rests in its off status and to cause said condenser to be discharged through said gaseous discharge tube when said trigger rests in its on status.

4. In a circuit for charging and discharging a condenser adapted for storage of sufficient energy to operate a high intensity gas discharge tube, in combination, a condenser adapted to receive a charge of electrical energy, means adapted to be rendered operable during a charging period of said condenser, other means adapted to be rendered operable during a discharging period of said condenser, a source of charging potential; a gas discharge tube adapted to dissipate a charge on said condenser, and a single means operable to different ones of either of two electrical conditions for determining whether said condenser will be charged or discharged.

5. In a circuit adapted selectively to render a condenser charged or discharged, in combination, a condenser, a

source of energy for charging said condenser, means adapted to dissipate a charge on said condenser when charged, a pair of rectifier devices, one in series connection with said condenser and said source of energy, the other in series connection with said charge dissipating means and said condenser, and means connected in series relation with said condenser, the source of energy and one of said rectifier devices for determining which of said rectifiers will be rendered conductive to enable charging or discharging of said condenser.

6. In a circuit adapted to selectively render a condenser charged or discharged, in combination, an energy storage condenser, a source of energy for charging said condenser, means adapted to dissipate a charge on said condenser when charged comprising a gas discharge tube for converting electrical energy into a flash of light, means operable to one or the other of two electrical conditions for determining whether said condenser will be charged or discharged depending upon which of said electrical conditions is assumed, and a pair of rectifying devices adapted to cause said condenser to be charged over one circuit path in response to one of said electrical conditions and to be discharged over another circuit path in response to the other of said electrical conditions.

7. In a record controlled machine, in combination, means for feeding records one by one in succession, cyclic means for analyzing each record for data contained therein, a gaseous discharge tube, with means for firing it comprising a condenser adapted to receive a charge, a bistable trigger which is operable to different ones of either of two sustained electrical on and off states, means operable by said analyzing means for shifting the electrical status of said bistable trigger from its off state to its on

state at a differential time in a card analyzing cycle upon the sensing of data contained in a record card, a source of electrical energy for charging said condenser, a charging path and a discharging path for said condenser each path incorporating a rectifying means, and electron discharge means responsive to each alternation of said trigger and adapted to render said condenser charged when said trigger rests in its off status over one of said paths and to cause said condenser to be discharged over the other of said paths through said gaseous discharge tube when said trigger rests in its on status.

8. In a circuit for charging and discharging a condenser adapted for storage of sufficient energy to render a gas discharge tube operative, in combination, a condenser adapted to receive a charge of electrical energy, first means adapted to be rendered operable for charging said condenser, second means adapted to be rendered operable to furnish a discharge path for energy stored in said condenser, a source of charging potential; a gas discharge tube adapted to dissipate a charge on said condenser, and electronic means operable by a change in status to determine whether said condenser will be charged or discharged over separate electrical paths under control of said first or second means, respectively.

References Cited in the file of this patent

UNITED STATES PATENTS

1,933,650	Bascom	Nov. 7, 1933
2,341,541	Grier	Feb. 15, 1944
2,509,850	Mulinen	May 30, 1950
2,510,484	Vossberg	June 6, 1950
2,554,549	Albert	May 29, 1951