

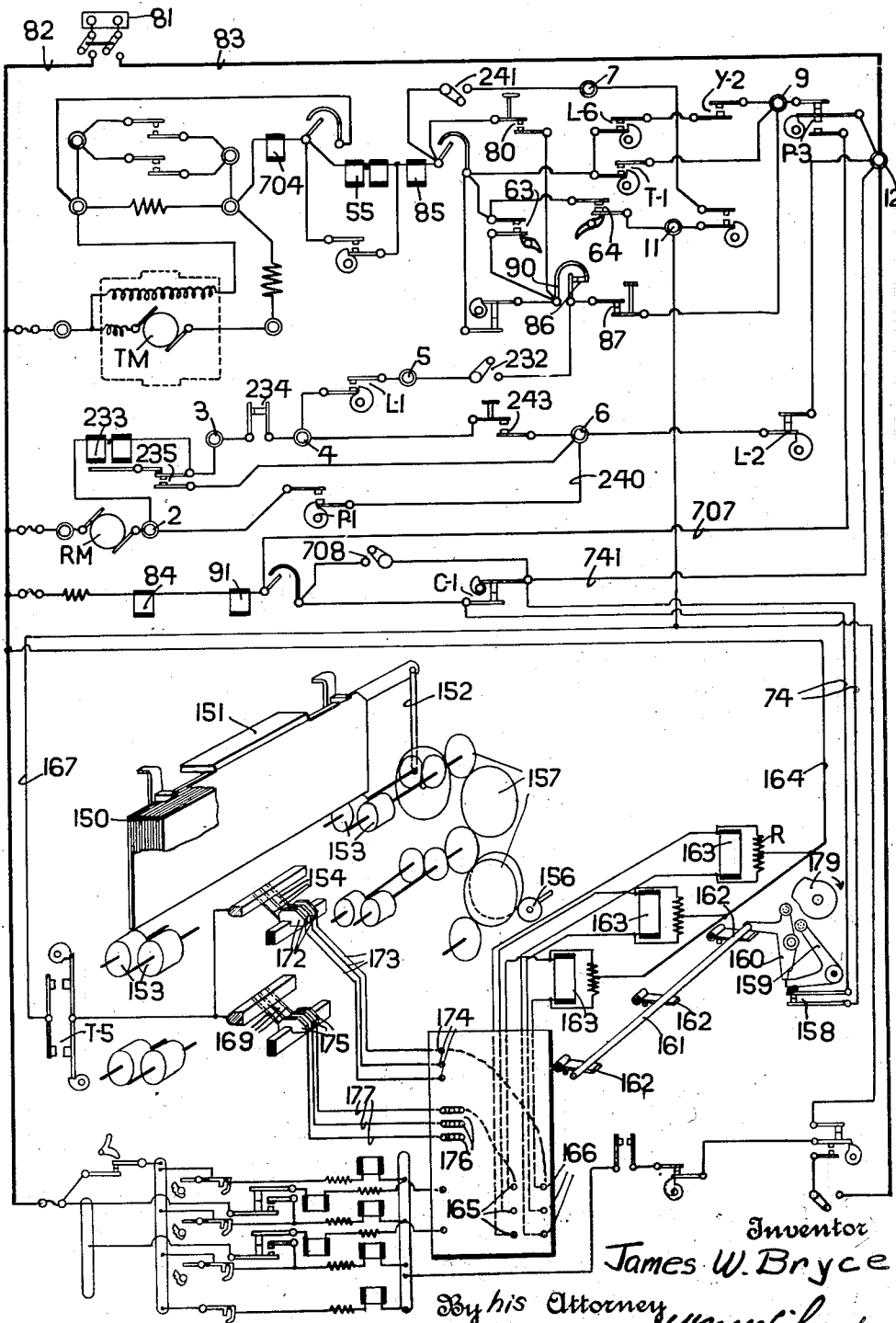
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AUTOMATIC CONTROL SYSTEM

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AUTOMATIC CONTROL SYSTEM

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The invention relates to accounting machines and more particularly to automatic control systems for record controlled tabulators.

Record controlled tabulators are designed to add, list and print totals of items automatically entered in the machine from control records on which the items are represented by index point perforations located in differential positions in the several card columns, each column ordinarily representing one character which may be either a number or a letter. There are two systems of representing characters in the card columns. The simple one consists of representing each character by a single perforation in a column in which case, obviously the number of characters which may be designated is limited to the actual number of index point positions in the card column. The other system consists in representing a single character by one or more index points in which case the capacity of the card column is enormously increased as each index point position may represent a character by itself and may also enter into combination with any other index point or points in the column to represent a different character.

The cards are fed through the machine automatically and analyzed by suitable mechanism which in turn controls the accumulating and printing devices of the machine so that the data represented by the perforations in the card may be accumulated and printed. The cards may be analyzed while they are at rest or while they are in motion and while the present system is designed for either type of analysis and for single or combinational hole perforation systems, it is shown for the sake of illustration only in connection with single perforation analysis while the cards are in motion.

The controlling records are usually divided into groups representing different classifications, the group classification being represented in each card by similarly located perforations and it is desirable to continue the automatic feeding of the records to the analyzing mechanism as long as the group classification does not change but to interrupt

the card feed for the purpose of taking totals or performing other operations when the group changes. This is ordinarily accomplished by providing two sets of brushes which are spaced apart so that one card feeds to one of them as the preceding card feeds to the other so that the same index point positions on successive cards are under the two analyzing mechanisms simultaneously.

Tabulators which analyze and control with the records in motion are ordinarily of the electrical type and the analyzing mechanism consists of brushes cooperating with individual contacts. The cards are fed between the brushes and their cooperating contacts to hold an electric circuit open as long as there are no perforations in the card but to permit engagement of each brush with its cooperating contact through the card when it encounters a perforation on the card.

In machines of the moving card type a single row of brushes usually suffices to completely analyze each card, these brushes of course, searching the several index point positions at differential times and differentially controlling the adding and printing mechanism to enter items therein according to the differential time at which the circuit is made at the analyzing brushes. The automatic control system may consist of a circuit including the two sets of analyzing brushes in series and if the cards under the two sets of brushes contain identical controlling perforations this circuit will be closed at some time in the machine cycle serving to keep the card feed active to feed another card during the succeeding card feeding cycle. If the controlling perforations are not identical in successive cards, this series circuit fails to make and the machine either stops or automatically takes a total of the data entered into the accumulators. This system, however, is limited ordinarily to the simpler system of character designation in which each character consists of a single index perforation.

The present invention contemplates a system of automatic control which may be used to analyze cards either in motion or at rest and of either a single or combinational system of character designation. The control

circuit which determines whether or not the machine shall feed cards during the successive card feeding cycle is controlled from a series of magnets, a single magnet being provided for each controlling card column which are wired through each of the analyzing brushes for a given card column to one side of the line. These magnets cooperate with their respective armatures which may serve to control the contacts in control circuit directly or if so desired, through the medium of a supplemental control relay. Each relay is shunted by a resistance, the equi-resistance point of which is wired to the other side of the line. When the perforations in successively fed cards agree there will be no difference in potential across the terminals of the relay magnet and the magnet will, therefore, not be energized. Whenever the perforations in successively fed cards disagree current will flow through only one part of the resistance and the current through the relay magnet caused by the difference in potential will cause the magnet to attract its armature to open contacts which are in series with main control relay circuit. The machine will, thereupon, either stop after the entry of the data from the card under the lower brushes or automatically institute total taking.

The two sets of control brushes according to the present invention may furthermore be of the same electrical polarity whereby either set may be used for printing or adding control if desired.

The principal object of the invention is to provide an improved automatic control device for record controlled accounting machines adapted for either single or combinational hole designations and to provide an improved form of mechanism and arrangement of parts for this purpose.

A further object of the present invention resides in the provision of an automatic control device which is flexible so as to permit one or more card columns to be used for automatic controlling and to generally simplify the construction of the control device and materially reduce the number of parts heretofore employed for this purpose.

A further object of the present invention is to so organize the elements comprising the automatic control that one of said elements may inherently constitute the factor which determines the time constant of the controlling circuit.

Another object of the present invention is to provide a single automatic control device for controlling machine operation in combination with a plurality of controlling devices associated with one or more card columns.

Another object of the present invention is to provide an automatic controlling device for record controlled accounting machines employing either the single or combinational

hole system adapted to control machine operation while the records bearing the designations are in motion or at rest and in which each analyzing mechanism consists of a single row of analyzing devices.

A further object of the invention is to provide an automatic control system for accounting machines which is adapted to control machine operation from cards in motion by making an absolute comparison of the cards and controlling the operation in accordance with like or unlike card columns.

These and incidental objects which will be pointed out hereinafter will be clear from the following detailed description which should be read in connection with the accompanying drawing in which there is shown a diagrammatic representation of the control system in combination with a tabulator card feed.

While as stated above the system is applicable to existing machines operating either on stationary or moving cards and in connection with single or combinational systems it has been shown as applied to a machine of the single index point type in which cards are adapted to be analyzed while in motion. The particular type of machine does not enter into the present invention as any other form of machines in which single or combinational hole cards are analyzed while at rest or in motion would serve the purpose of explanation and embodiment equally as well.

Referring now to the drawing, a stack of cards to be analyzed is indicated at 150 which are adapted to be advanced by a picker 151 operated by an arm 152 into cooperative relationship with a pair of feeding rolls 153. The picker feeds one card at a time to the rolls 153 which advance it during one machine cycle to the upper or control analyzing brushes 154 and during a later machine cycle to the lower or adding analyzing brushes 169. The rolls and feed mechanism are driven from a shaft 156 rotated by the tabulating motor TM and a gear train indicated generally by 157. The usual form of card feed clutch (not shown) controlled by a relay magnet 55 is interposed in the system to effect card feed only at given times as is customary in machines of this nature. Current to the tabulating motor TM for feeding cards is supplied from a suitable source 81, which when closed, supplies current to the left side of line 82 and right side of line 83. The tabulating motor TM is started in operation by depressing the start key 80. Current then flows through the TM motor, a relay 704, card feeding clutch magnet 55, motor relay 85, start key 80, contacts 86, now closed, emergency stop key 87 now closed, to binder post 9, thence through upper cam contacts P-3 now closed, to binder post 12 on the other side of the line 83.

The above has energized the clutch magnet 55, engaged the customary one revolu-

tion clutch thereby starting cards feeding through the machine.

After the initiation of the cycle by the start key 80, motor relay 85 attracts its armature and establishes a stick circuit to keep the tabulator motor in operation. From the relay point 85 a line extends to the usual upper card lever contacts 63 and another line extends to cam contacts T—1. From T—1 a line also extends to cam contacts L—6. After the tabulator motor has operated to a certain amount T—1 closes establishing a circuit to binder post 9. As soon as the upper card lever contacts 63 have closed another holding circuit is established from these contacts to terminal 90, thence to contacts 86, stop key 87, to binder post 9. The card lever contacts 63 maintain the operation of the tabulator provided a relay 84 which controls contacts 86 remains energized. If either 86, 63 or 87 are opened the tabulator will be stopped at the end of the cycle when cam contacts T—1 open, the operation being continued up to that time.

As in previous machines, prior to starting up any tabulator operation a resetting cycle is carried out. On a resetting operation such as one manually initiated before starting the tabulator, lower cam contacts P—3 make establishing a circuit 707 to control relays 91 and 84 thereby energizing these relays. After control relay 91 is energized a stick circuit is established through the relay armature, cam contacts C—1 and by wire 741 back to binder post 12. Cam contacts C—1 break once per card cycle, but during the time that these contacts break there is a second holding circuit through the armature of relay 91 and through a control circuit 74 and back by wire 741 to binder post 12. This circuit is maintained until card groups change. Following the breaking of circuit 74 the tabulator motor is maintained in operation until cam contacts C—1 open whereupon control relays 91 and 84 are deenergized and the tabulator is stopped as previously described.

The present devices whereby the automatic control of the machine is effected by control of the circuit 74 will now be described. The automatic control of the circuit 74 may include a pair of contacts 158 which are normally kept closed by a bell crank lever 159 normally latched in place by a lever 160. An extension of lever 160 carries a rod 161 overlying one of a series of armatures 162 of relays 163.

Any number of relays may be provided to control any desired column or columns. Relays 163 are shunted by resistances R the mid point of which is connected to one side of the line 82 by a wire 164. The mid point referred to divides the resistance R into sections of equal value. The terminals of relay 163 are in series connection with upper and lower brushes 154 and 169 respectively of a

particular card column when suitable plug connections are effected. The terminals of the relay are connected to pairs of plug sockets 165 and 166. Contact of upper brushes 154 with contact plug sockets 172 is made through the perforations on the cards, suitable wire connections 173 connecting plug sockets 172 to plug sockets 174. Similarly lower brushes 169 contact with plugs 175 by perforations in the cards, plugs 175 being connected to plug sockets 176 by connecting wires 177.

For automatic control in any desired column suitable plug connections are made from the related plug sockets 165 and 166 to the plug sockets 174 and 176 of the column in which control is to be made from. An example of one of such connections is shown in the drawings in dotted lines.

The bars which carry brushes 154 and 169 are connected to binder post 11 through contacts T—5 and wire 167. Contacts T—5 make and break once for each machine cycle, making just prior to the adding portion of the cycle and breaking after the adding portion but before the card completely clears the brushes. From the binder post 11 the circuit extends through lower card lever contacts 64, cam contacts T—1 to binder post 9, or alternatively through cam contacts L—6 and Y—2, thence through cam contacts P—3 to binder post 12 to one side 83 of the line.

Magnets 163 attract when energized their related armatures 162. When so moved the rod 161 is elevated rocking lever 160 to release bell crank 159 thereby releasing contacts 158 to permit them to open under their own resiliency. The control circuit 74 when open remains open until it is restored by a cam 179. This cam 179 may be made to rotate when the restoring action is necessary by a one revolution clutch or similar mechanism after all necessary operations have been performed in connection with the last card of the group which is now under the lower brushes. Consequently all contacts 158 will be closed at the beginning of each cycle in which cards are actually fed.

As premised hereinbefore, the resistances R are shunted across the relay magnets. As long as the perforations in the card columns agree there will be no difference in potential at the terminals of the relay magnet and consequently the magnet will not attract its armature 162. As soon as one of the analyzing brushes 154 and 169 encounters a perforation when the other does not encounter a perforation a difference in potential at the relay magnet terminals will be established and the energization of the magnet will consequently attract its related armature to release bell crank 159 so that the automatic circuit will be opened. The automatic circuit is thus opened and remains open until restored by cam 179 causing the machine to either stop

or begin automatic total taking, as desired, owing to the opening of cam contacts C—1 which deenergizes motor control relay 84 to open the motor control contacts 86 and cause the tabulating motor TM to cease operation at the end of the cycle on the opening of cam contacts T—1.

As the cam 179 rotates in the direction of the arrow it will first strike a roller carried by the bell crank 159 rocking the latter to subsequently close contacts 158. Lever 160 may be restored to the position where it latches bell crank lever 159 by gravity or spring action but it is preferably returned positively. To this end an upward extension of lever 160 carries a roller also coacting with cam 179 so that as the high point of the latter coacts with the roller lever 160 and the attracted armature 162 will be positively restored.

Attention is directed to the fact that in order to insure the instantaneous controlling action by relays 163 it is essential that the time constant of the circuit be so selected that energization or deenergization of the magnets will be practically instantaneous to afford a quick operation of the various controlling relays. The time constant desired is usually obtained by properly proportioning the inductance and resistance in the circuit and in order to have this factor the proper value auxiliary resistances are ordinarily connected in the circuit. The present arrangement provides for this since in every case where a difference in potential exists between the relay terminals the current will pass through the magnet 163 and through one of the portions of the resistance R and since there is a portion of the resistance which is in series with the coil there is provided the necessary amount of resistance to give the required "fast operating circuit." Thus the present arrangement dispenses with the auxiliary resistance usually provided and inherently provides for the proper time constant of the circuit.

Switch 708 is an automatic control switch which is opened when the machine is running under automatic control and closed when the automatic control is to be cut out of operation. When the switch 708 is open and perforations in the cards at the upper and lower brushes disagree the tabulating motor TM will be stopped in the manner previously described and a resetting and total taking operation may then be performed automatically or initiated manually.

If automatic initiation is desired switch 232 is first closed. The cam contacts L—1 close momentarily toward the end of each tabulating cycle. Contacts 234 are in series with contacts L—1 and controlled by the card feed clutch so that if the clutch is to disengage at the end of the cycle these contacts will close establishing a circuit to the resetting motor

RM traced as follows: from left side of line 82, reset motor RM, binder post 2, reset clutch magnet 233, binder post 3, contacts 235 closed toward the end of the last tabulating cycle, binder post 4, contacts L—1, binder post 5, switch 232, stop key 87, back to binder post 9 to the other side of line 83. The energization of the reset clutch magnet 233 attracts its armature and closes contacts 235 which establish a holding circuit for the reset magnet 233 traced as follows: from binder post 2, reset clutch magnet 233, through contacts 235, binder post 6, thence through contacts L—2 now closed, up to binder post 12 and back to the right side of the line. While reset motor RM is rotating and reset magnet 233 energized, the usual form of clutch member will rotate a reset shaft and reset the totalizers to zero but prior to such resetting the printing of the total standing upon the totalizers may be effected by the usual form of mechanism provided for this purpose.

Cam contacts P—1 serve at the proper time in the resetting cycle to establish a circuit 240 to binder post 6 to shunt out reset magnet 233. These contacts serve to maintain the reset motor RM in operation until the end of the reset cycle and upon being opened interrupt the resetting operation bringing the reset motor to rest. Just before the resetting operation is completed contacts P—4 close. The closure of these contacts provided the automatic start switch 241 is previously closed establishes a circuit through the motor relay 85 to restart the tabulating of the next group. This circuit is traced as follows: from left side of line 82 through tabulator motor TM, relay 704, clutch magnet 55, relay coil 85, auto start switch 241 closed, binder post 7, contacts P—4 now closed, binder post 11, lower card lever contacts 64 closed and upper card lever contacts 63, motor relay contacts 86, stop key 87, to binding post 9, upper contacts P—3 which have again been closed, back to line 83.

If it is desired to delay the total printing and resetting after tabulating the cards of a group the switch 232 may be opened in which case the reset motor RM will not operate automatically but only when the reset key 243 is depressed. Furthermore, if switch 241 is opened, tabulating will not be resumed automatically after a resetting and total taking operation but only on closure of start key 80.

The invention has been described in connection with a single operative embodiment thereof but it will be understood that many modifications will readily occur to 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:

1. In an automatic control system for a record control machine comprising in combi-

nation analyzing means for analyzing index point designations on controlling records, a pair of circuits controlled by said analyzing means controlled by said index point designations, a relay magnet in circuit connection with said analyzing means adapted to control machine operation and means cooperating with said relay magnet comprising a resistance adapted to prevent energization of said magnet when the perforations in successively fed cards agree.

2. In a tabulating machine comprising in combination means for comparing successively fed cards said means comprising a circuit which is adapted to be completed through the perforations of cards if said perforations agree, a magnet in said circuit adapted to control machine operation, and means for preventing energization of said magnet when the perforations in successively fed cards agree.

3. In a tabulating machine comprising in combination means for comparing successively fed cards said means comprising a circuit which is adapted to be completed through the perforations if said cards agree, a relay magnet in said circuit adapted to control machine operation and means whereby said magnet is energized to alter machine operation only when the perforations in successively fed cards disagree.

4. In a tabulating machine comprising in combination means for comparing successively fed cards said means comprising a circuit which is adapted to be completed through the perforations if said cards agree, a relay magnet in said circuit adapted to control machine operation and means comprising a resistance in circuit connection with said relay whereby said magnet is energized to alter machine operation only when the perforations in successively fed cards disagree.

5. In a tabulating machine comprising in combination means for comparing successively fed cards said means comprising a circuit which is adapted to be completed through the perforations of said cards if the perforations are alike, a relay magnet in said circuit adapted to alter machine operation and means whereby said relay magnet is responsive or non-responsive in accordance with unlike or like perforations, respectively, in successively fed cards.

6. In a tabulating machine comprising in combination means for comparing successively fed cards said means comprising a circuit which is adapted to be completed through the perforations if said cards of the perforations are alike, a relay magnet in said circuit adapted to determine the ensuing type of machine operation, and a resistance in shunt with said relay magnet adapted to cause said relay to be responsive or non-responsive in accordance with unlike or like perforations, respectively, in successively fed cards.

7. In a tabulating machine comprising in combination means for comparing successively fed cards said means comprising a circuit which is adapted to be completed through the perforations of said cards if the perforations are alike, a relay magnet in said circuit, and a controlling device cooperating with said relay adapted to determine whether or not said relay magnet is energized during the passage of unlike or like cards.

8. In a tabulating machine comprising in combination means for comparing successively fed cards said means comprising a circuit which is adapted to be completed through the perforations of said cards if the perforations are alike, a relay magnet in said circuit and a controlling device comprising a resistance in shunt with said relay magnet adapted to determine whether or not said relay magnet is energized during the passage of unlike or like cards.

9. In a tabulating machine comprising in combination means for comparing successively fed cards said means comprising a circuit which is adapted to be completed through the perforations of said cards if the perforations agree, a relay magnet in said circuit adapted to control machine operation, and means comprising a pair of resistances of equal value in shunt with said magnet for controlling the energization of said magnet in accordance with like or unlike perforations of successively fed cards.

10. In an automatic control device for tabulating machines comprising a control circuit, a relay magnet in said circuit, and a subdivided resistance in shunt with said magnet whereby each division of said resistance determines the time constant of said circuit.

In testimony whereof I hereto affix my signature.

JAMES W. BRYCE.