

June 10, 1930.

J. W. BRYCE

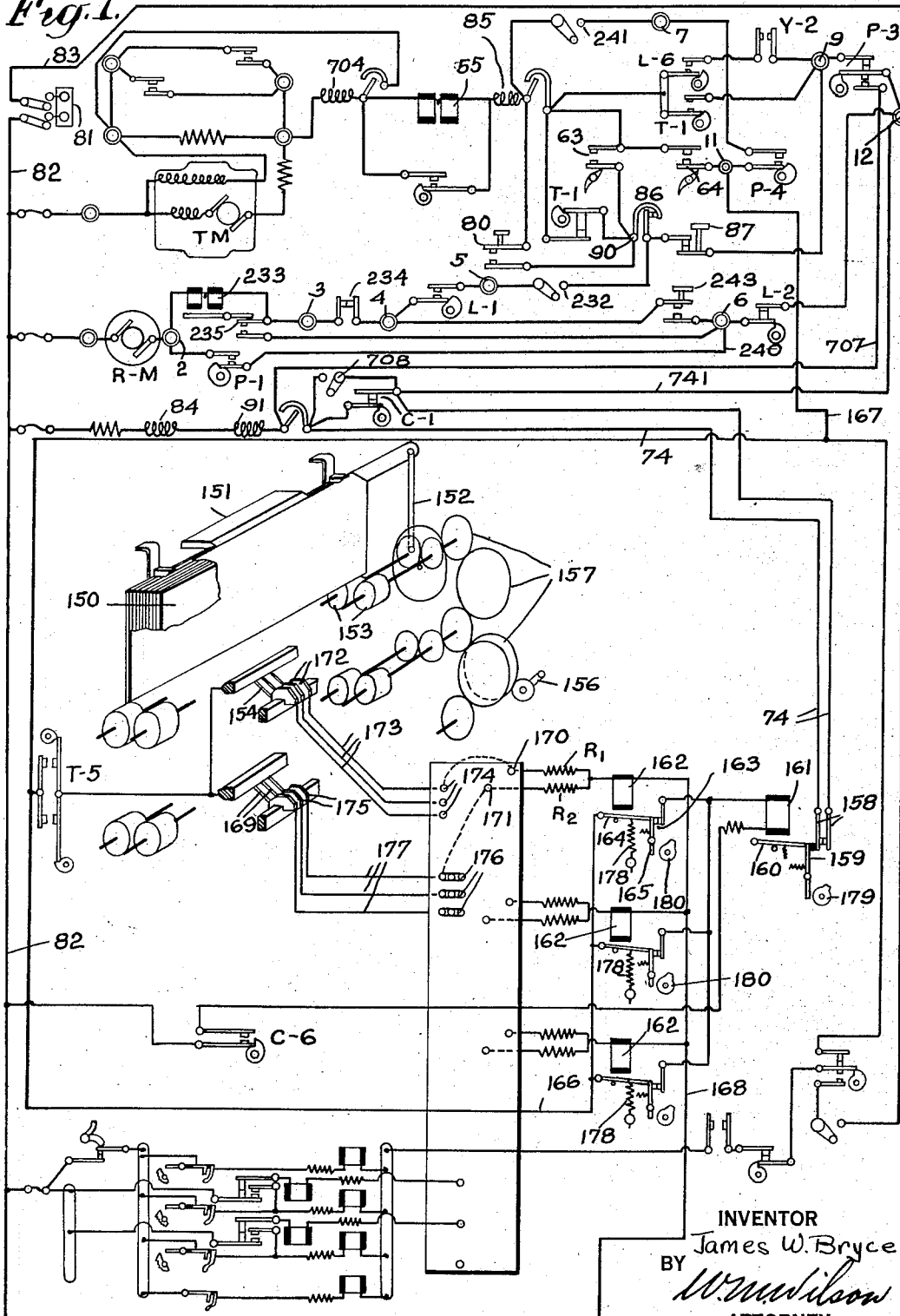
1,763,033

AUTOMATIC CONTROL SYSTEM

Filed Jan. 21, 1928

2 Sheets-Sheet 1

Fig. 1.



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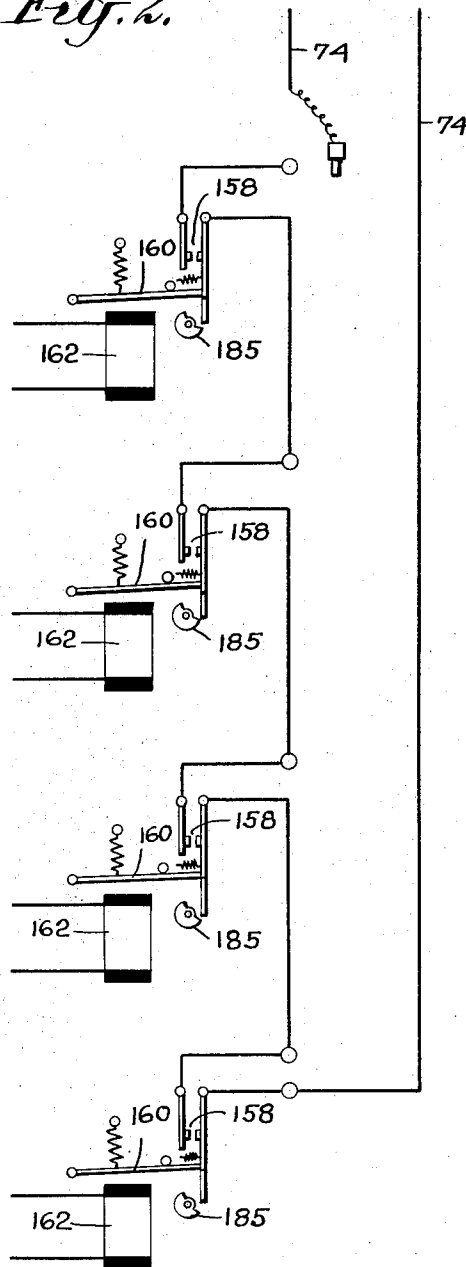
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Fig. 2.



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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 simpler 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 cir-

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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 a pair of resistances to each of the analyzing brushes for a given card column. These magnets cooperate with their respective armatures which may serve to control the contacts in control circuit directly or as in the present instance through the medium of a supplemental control relay. Each pair of resistances is in serial connection with the perforations in the cards permitting an impulse to be sent through the magnet when the circuit is closed through a perforation in a card. A single impulse, however, will not permit the magnet to be energized sufficiently so that it will attract its related armature to open the contacts in the control circuit. Transmission of concurrent double impulses, such as that which will occur when the perforations in the columns of successively fed cards agree, will cause the magnet to attract its armature to open contacts which are in series with main control relay circuit. As the cards feed beneath the analyzing brushes the circuit to the main relay will be broken as long as the card column is identical in successive cards as in this case at the same instant during the cycle concurrent impulses will be sent to the magnet. If the controlling perforations are different in the given column of two successive cards, one of the magnets will not be energized sufficiently to attract its armature permitting the circuit through the main control relay to be completed and the main control relay will, thereupon, open the contacts in the control 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.

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 in

Fig. 1 is shown a diagrammatic representation one embodiment of the control system in combination with a tabulator card feed.

Fig. 2 is a modification of the improved controlling device.

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 combination hole cards are analyzed while at rest or in motion would serve the purpose of explanation and embodiment equally as well.

Referring now to Fig. 1, 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 depress-

ing 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 revolution 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 remains energized. If 86, 63 or 87 is opened the tabular 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 lever 159 and latched in place by an armature 160 of a relay 161.

Relay 161, in the present instance, is con-

trolled by a series of relays 162 any number of which may be provided to control from any desired column or columns. Relay 161 is in series with the multiple connected contacts 163, one side of the line 82 extending to relay 161 through cam contacts C—6 and from the other side of relay 161 through the cam contacts 163, latch lever 165 and armature 164 of any relay 162 under consideration, by wires 166 and 167 to binder post 11. 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 the other side 83 of the line. Cam contacts C—6 are arranged to close near the end of a card cycle.

Relays 162 are connected to one side 82 of the line by a wire 168, the other side of each relay 162 having a connection to resistances R_1 and R_2 . Resistances R_1 and R_2 may be placed in series connection with upper and lower brushes 154 and 169 respectively, of a particular card column when suitable plug connections are effected. The free terminals of resistances R_1 and R_2 are connected to respective plugs 170 and 171. Contact of upper brushes 154 with contact plug 172 is made through the perforation in the cards, suitable wire connections 173 connecting plugs 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 170 and 171 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 162 attract, when energized, their related armatures 164. When so moved against the tension of its connected spring 178 it releases lever 165 permitting contacts 163 to open under their own resiliency. If any relay 162 is not energized contacts 163 will remain closed permitting a circuit to be established through relay 161 when contacts C—6 make. Energization of any magnet 161

will, under the conditions specified, attract its armature 160, releasing latch lever 159 and similarly permitting contacts 158 to open under their own resiliency. The control circuit 74 when opened remains open until it is restored by a cam 179. This cam rotates once each machine cycle and serves to restore contacts 158 to closed and latched condition after the contacts C—1 have opened and closed. Contacts 163 when opened are restored in a similar manner by cams 180 which are so timed that they restore contacts 163 to closed and latched position after contacts C—6 close and open at the end of a machine cycle.

As premised hereinbefore, resistances R_1 are plugged to the upper brushes 154 and the resistances R_2 to the lower brushes 169. During the passage of successively fed cards either of the resistances R_1 or R_2 will be in circuit connection with a magnet 162 sending an impulse to the magnet when the circuit is completed through the perforations of a card. The current impulses passing through a particular magnet 162 may comprise either the summation of component currents through the combined resistances R_1 and R_2 as when the card perforations agree, or single impulses sent at different times when the perforations in successively fed cards disagree, or none at all if there are no perforations in given card columns under the upper or lower brushes. The resistances R_1 and R_2 are so selected and the tension of spring 178 is so adjusted that a single impulse reaching magnet 162 controlled by either resistances R_1 and R_2 is not sufficient to attract armature 164 of magnet 162. A concurrent double impulse, will however, energize magnet 162 sufficiently to attract armature 164.

As long as the perforations in the card columns agree all the relays 162 will attract their respective armatures 164 so that as cam contacts C—6 make relay 161 will not be energized since the circuit is broken at the series of contacts 163. As soon as one of the analyzing brushes 154 and 169 encounters a perforation when the other does not encounter a perforation, impulses will be transmitted to one of the relays 162 at different times. This will result in retaining the associated armature 164 in its normal position. As contacts C—6 make current will pass through the closed contacts 163 energizing the control relay 161. 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 causes the tabulating motor TM to cease operation at the end of the cycle on the opening of cam contacts T—1.

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 234 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. The 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. For example, while a supplemental relay 161 has been provided it is readily apparent that relay 161 may be dispensed with and circuit 74 may be controlled directly from any of the magnets 162. Referring to Fig. 2 of the drawings it will be observed that in this instance contacts 158 are open and in series with the control circuit 74. If the perforations are alike, in all card columns all of the relays 162 will be energized and circuit 74 will be closed so that when cam contacts C—1 open the motor control relay 84 will continue to be energized and tabulating operations will continue. If, however, one of the relays 162 is not energized due to disagreement in the perforations in like card columns armature 160 will retain the related contacts 158 open so that as contacts C—1 open circuit 74 will be opened, resulting in deenergizing motor control relay 84 and stopping the tabulating motor. As heretofore cams 185 restore contacts 158 to open and latched position.

What is claimed is:—

1. In an automatic control system for a record controlled tabulating machine comprising a relay of the type responsive only to impulses of higher values, record controlling means whereby an impulse of one value or an impulse of a higher value is transmitted to said relay and means for controlling machine operation in accordance with the magnitude of the impulses transmitted to said relay.

2. In an automatic control system for a record controlled tabulating machine comprising a relay of the type responsive only to currents of predetermined value but non-responsive to currents of other values, record controlling means whereby currents of various values including the predetermined values are transmitted to said relay, and means for controlling machine operation in accordance with the response or non-response of said relay.

3. In an automatic control system for a record controlled tabulating apparatus comprising a relay of the type non-responsive only to an impulse of a certain value but responsive to an impulse of a higher value, record controlling means whereby the impulses of different magnitudes are transmitted to said relay and means for controlling

machine operation in accordance with the magnitude of the impulses transmitted to said relay.

4. In a tabulating apparatus comprising in combination a plurality of card circuits and a relay for determining machine operation having a circuit connection with the perforations of successively fed controlling cards whereby said relay receives an impulse of one value or an impulse of a higher value in accordance with unlike or like card perforations, respectively, means whereby said relay is responsive to the higher value impulses only, and means for controlling machine operation in accordance with the magnitude of the impulses received by said relay.

5. In an automatic control system for a record controlled machine comprising in combination analyzing means for successively analyzing index point designations in card columns on controlling records, a pair of circuits controlled by said index point designations, a relay in circuit connection with the pair of circuits, and means whereby said relay is responsive or non-responsive to determine machine operation in accordance with like and unlike perforations in given card columns of successively fed cards.

6. In an automatic control system for a record controlled tabulating machine comprising a relay, of the type responsive only to double value impulses, record controlling means whereby single or double value impulses are transmitted to said relay and means for controlling machine operation in accordance with single or double impulses transmitted to said relay.

7. In an automatic control system for a record controlled machine comprising an electro-magnet, energized by either single or double value impulses but responsive only to double value impulses, record controlling means whereby single or double value impulses are transmitted to said electro-magnet and means for controlling machine operation in accordance with single or double value impulses transmitted to said electro-magnet.

8. In an automatic control system for a record controlled machine comprising in combination a plurality of circuits having a serial connection through the perforations of successively fed cards, an electro-magnet in circuit connection with both card circuits, a plurality of current limiting devices associated with the card circuits whereby currents of various magnitude are transmitted to said electro-magnet in accordance with like and unlike perforations of successively fed cards, and means for controlling machine operation when a current of a predetermined magnitude is transmitted to said electro-magnet.

9. In a tabulating machine comprising in combination means for comprising successively fed cards said means comprising a plu-

ality of circuits which are adapted to be completed serially through the perforations of cards if said perforations agree and to be interrupted by one or the other of the cards if said perforations disagree, a relay responsive only to currents of a predetermined value but energized when either card circuit is established, and means for controlling the value of current through said relay in accordance with the agreement or disagreement of perforations in a given card column of successively fed cards.

10. In a tabulating apparatus comprising in combination a plurality of control circuits including a relay for controlling machine operation having a circuit connection through the perforations of successively fed controlling cards, means whereby said relay is responsive only to currents of a predetermined value and means for controlling current values in accordance with the establishment of a plurality of circuits synchronously or dis-synchronously.

11. In a tabulating apparatus comprising in combination a plurality of card circuits including a relay for determining machine operation having a circuit connection through the perforations of successively fed controlling cards said relay being responsive only to currents of a predetermined value, and means for controlling current values in accordance with the establishment of a plurality of circuits synchronously or dis-synchronously.

12. In an automatic control system for a record controlled machine including a relay responsive only to currents of a predetermined value, record controlled means for permitting the passage of currents through said relay of different values, and means for controlling machine operation in accordance with the value of current passing through said relay.

13. In a tabulating apparatus comprising in combination a plurality of card circuits including a relay for determining machine operation having a circuit connection with the perforations of successively fed controlling cards whereby said relay receives a single or a double value impulse in accordance with unlike or like card perforations respectively, means whereby said relay is responsive to double value impulses only, and means for controlling machine operation in accordance with the magnitude of the impulse received by said relay.

14. In an automatic control system for a record tabulating machine comprising in combination, a relay, analyzing means for successively analyzing index point perforations of a given card column whereby single value impulses are transmitted to said relay when card perforations disagree and double value impulses when card perforations agree and means whereby the ensuing type of machine operation is dependent upon the mag-

nitude of the impulse transmitted to said relay.

In testimony whereof I hereto affix my signature.

JAMES W. BRYCE.