

Sept. 21, 1937.

C. D. LAKE

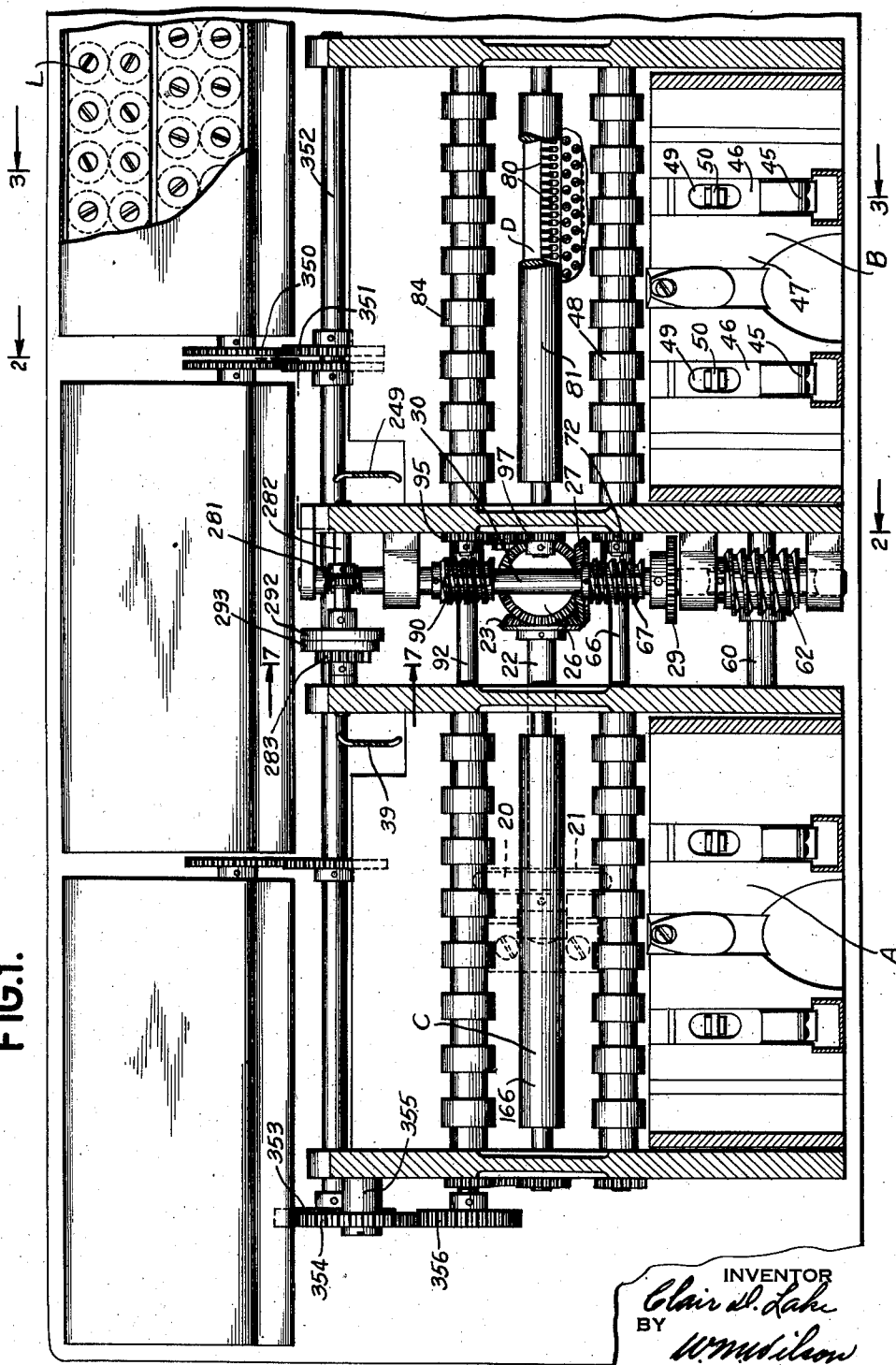
2,093,566

PERFORATED RECORD CONTROLLED MACHINE

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6 Sheets-Sheet 1

FIG. 1.



INVENTOR
Clair D. Lake
BY
W. M. Wilson
ATTORNEY

Sept. 21, 1937.

C. D. LAKE

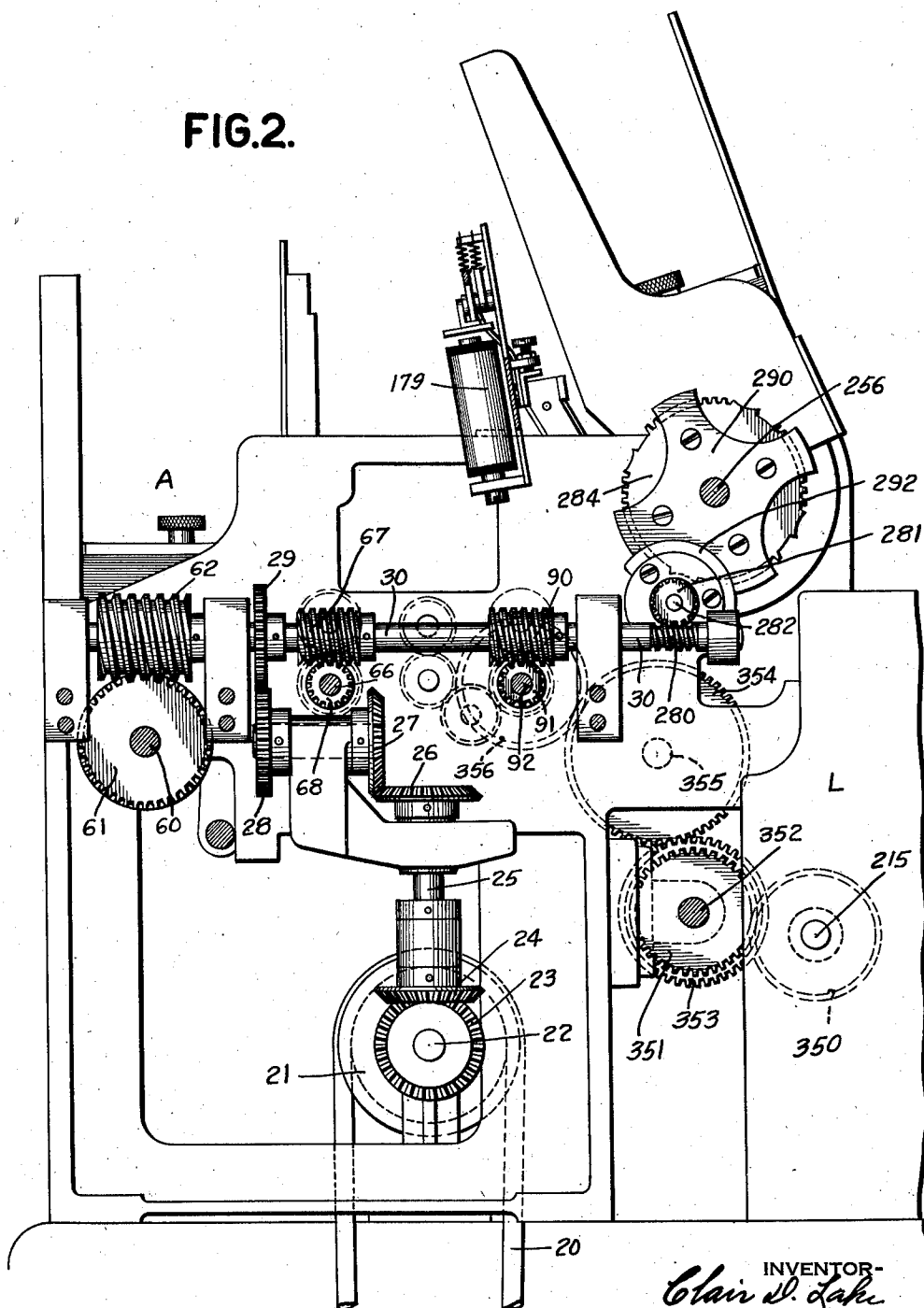
2,093,566

PERFORATED RECORD CONTROLLED MACHINE

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6 Sheets-Sheet 2

FIG.2.



INVENTOR-
C. D. Lake
BY
W. M. Wilson
ATTORNEY-

Sept. 21, 1937.

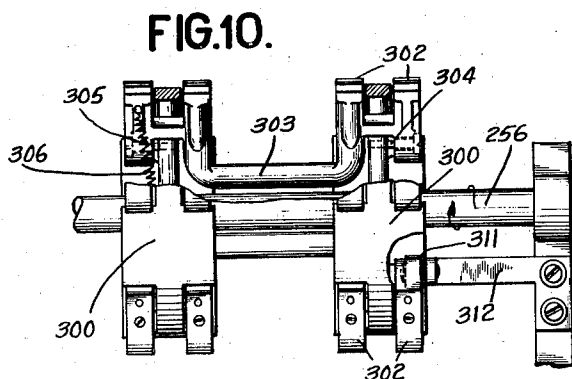
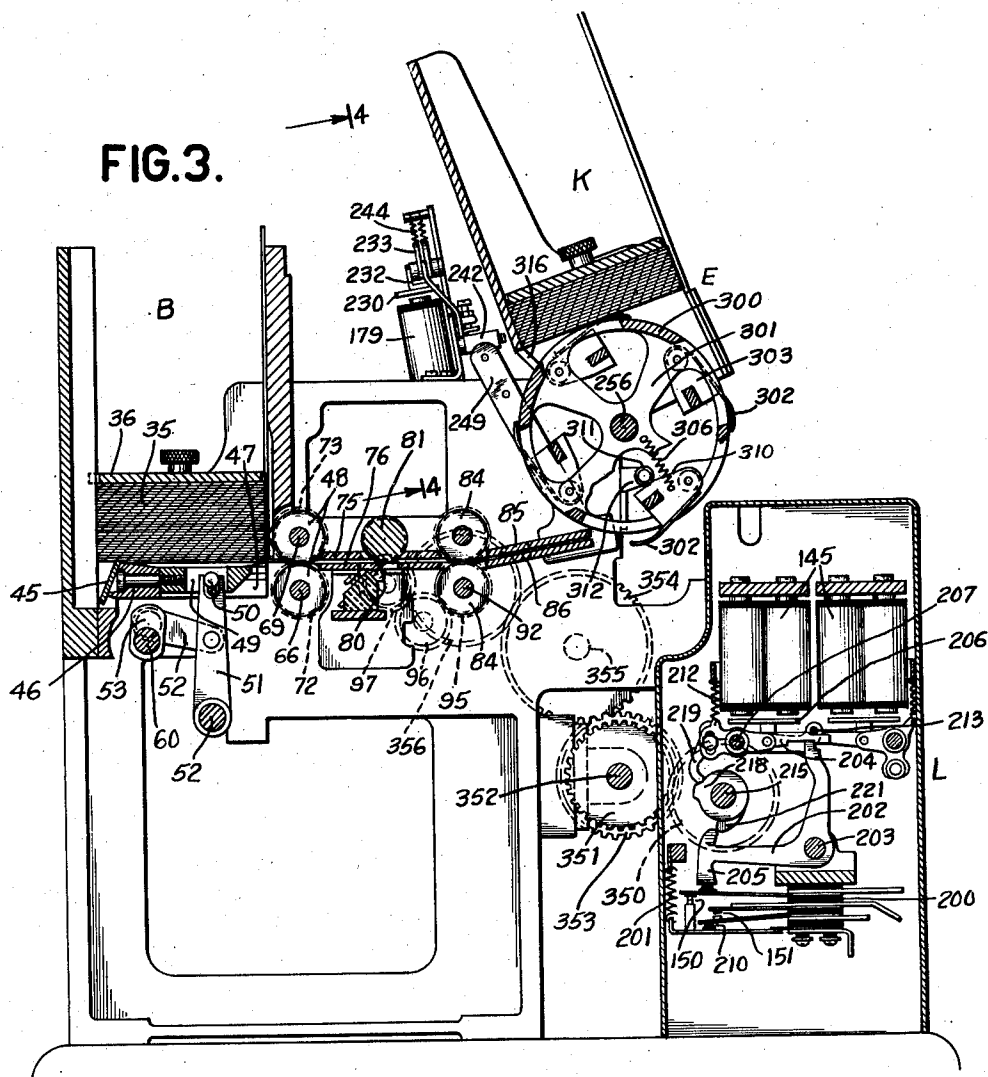
C. D. LAKE

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PERFORATED RECORD CONTROLLED MACHINE

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6 Sheets-Sheet 3



INVENTOR
Clair D. Lake
 BY *W. M. Wilson*
 ATTORNEY

Sept. 21, 1937.

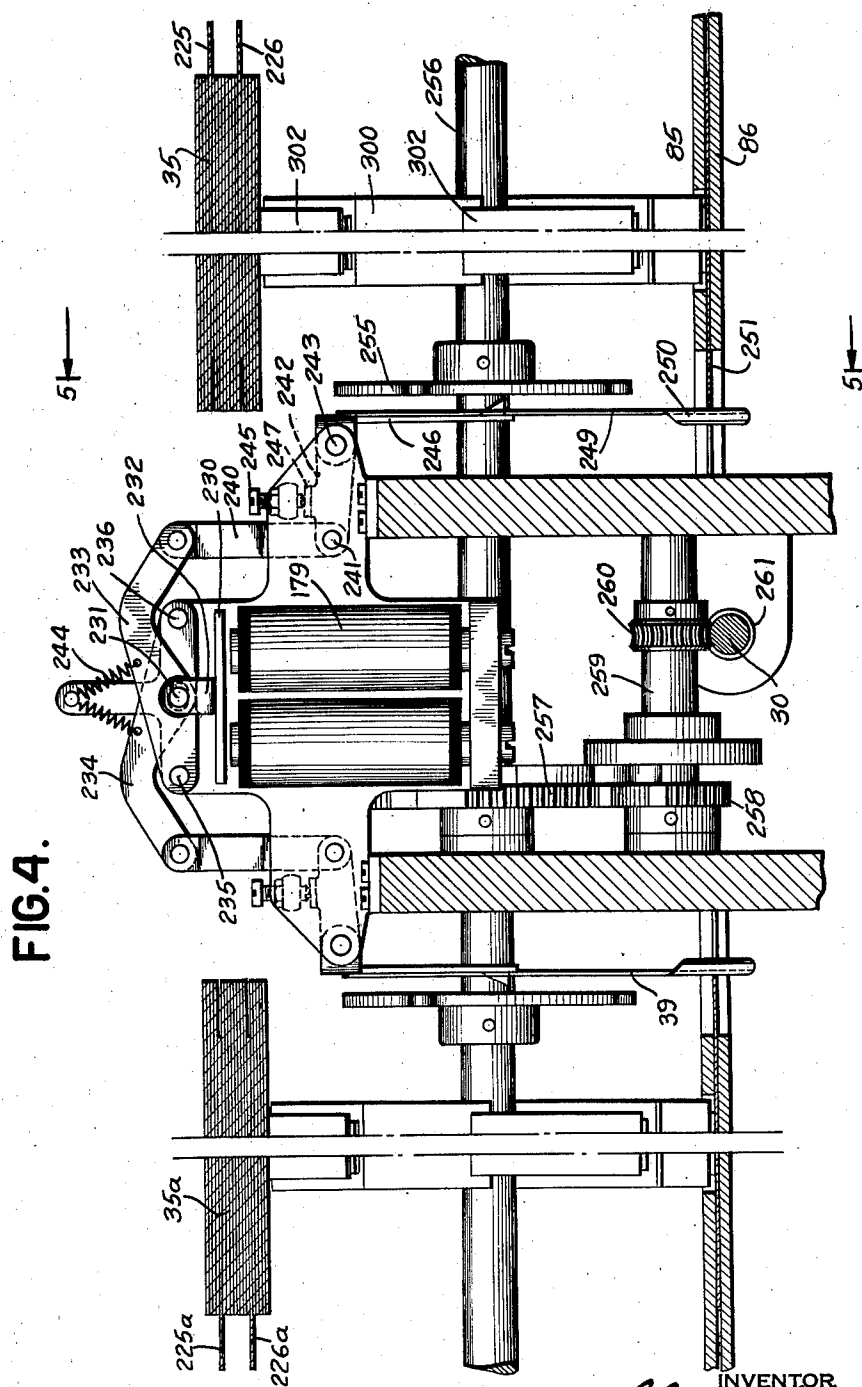
C. D. LAKE

2,093,566

PERFORATED RECORD CONTROLLED MACHINE

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6 Sheets-Sheet 4



INVENTOR
Clair D. Lake
BY
W. W. Wilson
ATTORNEY

Sept. 21, 1937.

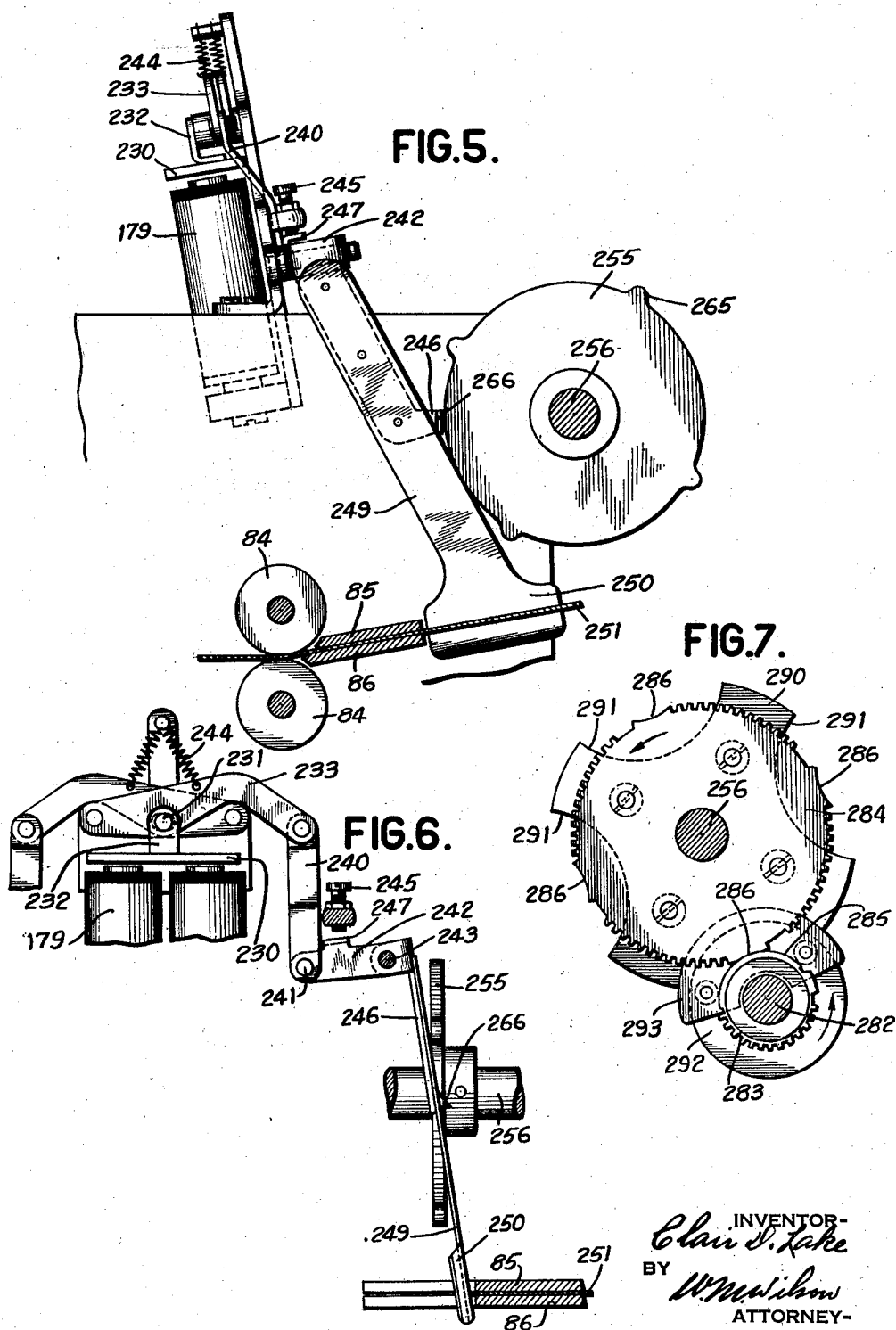
C. D. LAKE

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PERFORATED RECORD CONTROLLED MACHINE

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6 Sheets-Sheet 5



UNITED STATES PATENT OFFICE

2,093,566

PERFORATED RECORD CONTROLLED
MACHINE

Clair D. Lake, Binghamton, N. Y., assignor, by
mesne assignments, to International Business
Machines Corporation, New York, N. Y., a cor-
poration of New York

Application February 20, 1933, Serial No. 657,559

9 Claims. (Cl. 209—110)

The invention relates to record card controlled machines and particularly to machines for comparing a plurality of groups of record cards to determine whether the cards of one group bear a predetermined relationship to the cards of another group.

While the invention is not limited to such use, it finds its most practical application in comparing two files or stacks of tabulating machine control cards to determine whether the several cards in one file each contains data perforations identical with data perforations on a corresponding card in the other file. It is well known that data are represented on record cards, which are to be used subsequently to control tabulating machines, by perforating them in different locations, the perforations representing different characters by their locations on the cards. As these perforated cards are used to control mechanical accounting machines, it is very important that their perforations or index points, as they are commonly called, be properly located, and in cases where extreme accuracy is required, each card, after being perforated, is verified to determine that all of its perforations are correctly positioned. This is ordinarily done by passing the cards through a verifying machine, which is provided with a key for each character which may be represented on the cards by index points. The keys must be depressed according to the characters which are supposed to be represented by the perforations on the cards, and if the depressed keys fail to agree with the perforations in the cards the machine indicates this fact to the operator. This verifying operation involves substantially the same amount of labor as the card punching operation.

Many businesses, which make use of perforated card accounting, find it necessary to keep duplicate files of their record cards; and as the cards are ordinarily punched one at a time, the cards of the original file and the cards of the duplicate file are punched either by different operators or by the same operator at different times. If the cards of the original file agree card by card with those of the duplicate file, then, it is a fair indication that the punching in both files is correct.

The present invention provides for a machine which automatically compares the original file and the duplicate file, card by card, and automatically separates any incorrectly punched cards from the files, thereby obviating the necessity for manual character by character verification.

The principal object of the invention is to provide a new and improved device for comparing

records bearing index points and forming one record file with records bearing index points and forming another record file.

Another object of the invention is to provide a record comparing device of this nature with mechanism for extracting from the files such records as do not compare with other records in a predetermined manner.

Another object of the invention is to provide a record comparing device of this nature with electrical record analyzing devices.

Another object of the invention is to provide a record comparing device of this nature, which has automatic mechanism for feeding a plurality of groups of records, comparing their index points and separating from the groups any record whose data representing index points do not conform to those on a corresponding record in another group.

The preferred form of mechanism, so far as at present known, by which the invention may be practiced is illustrated in the accompanying drawings, in which the same reference numerals refer to the same parts throughout the several views, and in which:

Fig. 1 shows a horizontal section through a machine embodying the invention;

Fig. 2 is a vertical section on line 2—2 of Fig. 1;

Fig. 3 is a vertical section on line 3—3 of Fig. 1, the section being chosen to show the card feeding devices and the automatic comparing device;

Fig. 4 is a detail of a mechanism for offsetting incorrectly punched cards from the card files or stacks;

Figs. 5 and 6 are additional detail views, at right angles to each other, of parts of the card offsetting mechanism, illustrating their operation;

Fig. 7 is a detail of a Geneva drive device for operating the card stacker mechanism;

Fig. 8 is a circuit diagram of the electrical connections of the machine;

Fig. 9 shows two cards, similarly punched, such as the machine compares and operates upon; and

Fig. 10 is a detail, partly in section, of the card stacker mechanism.

The machine is provided with two similar card feed mechanisms, each for feeding the cards of one of the card files or stacks, which are to be compared, one by one through the machine. Two separate analyzing mechanisms are also provided, one of which analyzes a card of one file while the other is analyzing the corresponding card of the other file. The two analyzing mechanisms jointly control a device for offsetting individual

cards from the card stacks or files, and this joint control is such that, if perforations in the two cards being compared agree, the offsetting device is prevented from operating and the cards feed to separate stackers to be stacked. When the perforations in the two corresponding cards of the files fail to agree, the analyzing mechanisms cause operation of the offsetting device so that both cards are offset from their stacks or files. This offset, as herein illustrated, is just sufficient to permit an offset card to be grasped and easily pulled out of the stack, the offset cards being fed to the stackers and stacked along with the others.

The general scheme of operation of the machine may be understood from Figs. 1 and 3. Each of two card supply hoppers A and B receives one of the card files or stacks to be compared and verified. The cards are fed one by one from each hopper to suitable analyzing mechanism, shown at C for hopper A and at D for hopper B.

While a card from hopper A is being analyzed by analyzer C, a corresponding card from hopper B is being analyzed by analyzer D. If the perforations in these two cards agree, the cards feed in a straight line to their stacker mechanisms, of which that corresponding to hopper B is shown at E in Fig. 3. If the perforations in the two cards fail to agree, the analyzing mechanisms cause pusher arms 39 and 249 (Fig. 1) to move sideways and displace the cards laterally. The cards still feed to the stackers, but, when stacked, their ends project from the stacks as shown for certain cards in Fig. 4. This displacement indicates that at least one of the two cards is incorrectly punched, and they may be grasped by their projecting ends and withdrawn from the stacks.

The cards which the machine is to compare and verify are illustrated in Fig. 9. These are standard tabulating cards of the single hole type; that is, each character is represented by a single perforation, which designates the character by its position on the card. The cards are divided into columns, and a digit may be represented in each column. Ordinarily the ten digits are printed in each column, each digit being printed in the position in which the card must be perforated to control tabulating equipment in accordance with that digit. In Fig. 9 two corresponding cards are represented, one of which may belong to the original card file and the other to the duplicate card file. As one of these cards is a duplicate of the other the same data are represented on both by the perforations. The purpose of the machine is to detect any corresponding cards in the two files, that is, cards which should be duplicates of each other, whose perforations are not the same.

The machine, as illustrated, will now be described and its operation explained in detail.

Referring first to Figs. 1, 2, and 3, the machine is driven by a suitable motor (not shown) through a belt 20. This belt drives a pulley 21 which is fixed to and drives a shaft 22. The shaft 22 carries a bevel gear 23 which meshes with a bevel gear 24 fixed on a short vertical shaft 25. A bevel gear 26, fixed on the upper end of shaft 25 meshes with a bevel gear 27 fast to one end of a short horizontal shaft, to whose other end is fixed a spur gear 28. The spur gear 28 meshes with a spur gear 29 fixed to a shaft 30. The shaft 30, of course, rotates as long as the driving motor is in operation, and, as will be explained later, drives

the card feeding devices and the other mechanically operating parts of the machine.

The card feed mechanisms, analyzing devices and card stackers are identical for each of the two files or stacks of cards which are to be operated upon, and one only of these trains of mechanisms will be described. Referring to Fig. 3, a stack of cards 35 is placed in the hopper B, and a weight 36 presses them down so that the lowermost card of the stack cooperates with picker mechanism. This picker mechanism (see also Fig. 1) consists of a pair of knives 45 each carried by a reciprocable member 46, which may slide in a slot in the floor plate 47 of the hopper. The upper edge of each knife 45 projects above the floor plate 47 a distance slightly less than the thickness of one of the record cards. Thus, as the members 46 are reciprocated in their slots, the knives 45 catch behind the edge of the lowermost card and force it into the feed rolls 48. Each reciprocation of the structure 46, then, forces a card from the hopper B into the feed rolls 48, thereby causing the cards to feed one at a time.

The member 46 (Figs. 1 and 3) is provided with a slot 49 in which is fixed a pin 50, which fits into a bifurcation in the upper end of a lever 51 pivoted at 52. The lever 51 is connected by a link 52 to an eccentric 53 which is fast on shaft 60. The shaft 60 (see Fig. 2) extends across the machine and at its central portion, has a worm wheel 61 fixed to it.

The worm wheel 61 meshes with a worm 62 fixed to the shaft 30, which, as previously explained, rotates as long as the machine is in operation. It will be understood, then, that as long as the machine is in operation, the picker mechanism reciprocates and at each reciprocation forces the lowermost card out of the supply hopper B and into the feed rolls 48.

The lower feed rolls 48 (see Fig. 3) are mounted on a shaft 66, which (see also Fig. 2) has a worm wheel 68 fixed on it. The worm wheel 68 meshes with a worm 67 fast on shaft 30, which rotates as long as the machine is in operation. The upper feed rolls 48 are mounted on a shaft 69 and suitable spur gears, indicated at 72 and 73 in Fig. 3, interconnect the shafts 66 and 69 so that whenever one of these shafts rotates the other must also rotate. The picker mechanism, then, delivers the cards, one by one to the feed rolls 48 which advance them into the analyzing mechanism.

The card on being fed forward by the feed rolls 48 moves between an upper plate 75 and a lower plate 76 which serve to guide it accurately while it is in the analyzing mechanism. The analyzing mechanism consists of a plurality of electrical brushes 80, of which one is provided for each card column in which perforations may occur. These brushes 80 are located in a single row across the machine, and extend through an opening in the lower plate 76. Directly above the brushes 80 is a conducting roll 81, whose lower portion extends through an opening in upper plate 75. The brushes 80 are resilient and, as long as no imperforate portion of a card is between them and roll 81, they bear on conducting roll 81, and make electrical contact with it. The roll 81, as will be explained later, rotates as long as the machine is in operation, so that the brushes 80 will contact with different portions of it at different times. This tends to prevent pitting of the roll due to the action of the electric current. The card is fed by the feed rolls 48

between the brushes 80 and the conducting roll 81 with an uninterrupted, steady motion, and the imperforate portions of the card prevent contacting of the roll by the brushes.

When a perforation in a card column reaches one of the brushes 80, however, the brush cooperating with that column enters the perforation, and makes momentary contact with the conducting roll 81. This momentary contact causes an impulse of electric current to flow, as will be explained in connection with the circuit diagram, and this impulse occurs at a time in the cycle of machine operation which corresponds to the location of the perforation on the card column, or, in other words, to the value of the digit represented by the perforation.

Before the rear edge of the moving card leaves the feed rolls 48, its forward edge enters the grip of additional feed rolls 84, and these eventually advance it, between spaced plates 85 and 86, to the stacker mechanism, indicated generally by E. The feed rolls 84 are driven by the shaft 30, (see Fig. 2) through a worm 90 and worm wheel 91 in a manner entirely similar to that already explained in connection with the feed rolls 48.

Incidentally the shaft 92, on which the lower feed rolls 84 are mounted, also drives the conducting roll 81 of the analyzing mechanism, this drive being effected by suitable gears indicated at 95, 96, and 97 in Fig. 3.

The stacker mechanisms, one of which is indicated generally at E in Fig. 3, are mounted fast on a shaft 256. This shaft is rotated with an intermittent motion by the Geneva mechanism shown in Fig. 7, whose driving connection from the drive shaft 30 of the machine is illustrated in Fig. 2. A worm 280 is formed on one end of shaft 30 and meshes with a worm pinion 281 on a short cross shaft 282 (see also Fig. 1). A mutilated pinion 283 (Figs. 1 and 7) is also fixed to shaft 282 and cooperates with a mutilated gear 284 fixed to shaft 256. The mutilated pinion 283 has teeth about a portion of its periphery, and the remainder of its periphery is smooth as indicated at 285. The mutilated gear 284 is provided with four sets of teeth separated by extensions 286 with indented edges to cooperate with the smooth concentric portion 285 of the pinion 283.

The number of teeth in each set on gear 284 is the same as the total number of teeth on pinion 283. As the pinion 283 rotates, then, it drives the gear 284 with an intermittent motion, the gear 284 being driven whenever the teeth of pinion 283 mesh with any one of its sets of teeth and remaining stationary when the smooth portion 285 of the pinion periphery cooperates with any one of the extensions 286. A positive lock is provided to hold gear 284 stationary during the periods when it is at rest. One part of this lock consists of a plate 290 fastened to the gear and provided with four arcuate recesses 291. A disk 292 is pinned to shaft 282 and carries an attached segmental plate 293 in the plane of plate 290. The contour of this plate 293 corresponds to the arcuate recesses 290 and its periphery is concentric with shaft 282. As long as the plate 293 is within one of the recesses 291 it prevents plate 290, with attached gear 284 from rotating. When, during rotation of pinion 283, plate 293 has been turned clear of a recess 291, the plate 290 and attached gear 284 are free to turn. Just at this time, the teeth of pinion 283 engage one of the sets of teeth on gear 284 and drive this gear through one quarter of a revolution, after

which plate 293 is turned into another recess 291, thereby again locking gear 284 against movement. Thus the gear 284 and shaft 256, to which it is attached, make one quarter of a revolution for each revolution of pinion 282, and are stationary for an interval after each quarter revolution.

Each stacker mechanism (see Figs. 3 and 10) consists of two narrow drums 300 fixed to shaft 256 by spiders 301. These drums are spaced apart on the shaft a distance somewhat less than the length of the tabulating cards which are fed through the machine. As these drums are fast to the shaft 256 they rotate for a quarter revolution and then stop for an interval as the machine operates. Each drum 300 carries four pairs of grippers 302, evenly spaced about its circumference, whose ends project through slots in the surface of the drums.

Aligned pairs of grippers on both drums are mounted on a common pivoted supporting structure 303, which is pivoted at 304 on the right hand drum in Fig. 10 and at 305 on the left hand drum. An individual spring, as shown at 306 in Fig. 10, rocks each gripper supporting structure 303 so that the protruding ends of its grippers 302 press against the outside surface of their drum 300, as shown in the case of the upper three grippers illustrated in Fig. 3. Each gripper supporting structure 303 is provided with a cam surface, shown at 310 in Fig. 3, which cooperates with a roll 311, pivoted on a bracket 312 fastened to the machine frame.

It will be recalled that shaft 256 rotates for a quarter revolution and then stops for an interval. Before it stops, the roll 311 encounters cam surface 310 on one of the supporting structures 303, thereby rocking the supporting structure against the action of its spring 306, and forcing the grippers attached to this particular supporting structure to open position, as shown for the lowermost gripper 302 in Fig. 3. The timing of the drive for the stacker drums is such that a set of open grippers 302 arrives and stops opposite the guide plates 85 and 86 just before a card has been fed clear of the feed rolls 84. At this time, the leading edge of the card lies between the open grippers 302 and the surfaces of the stacker drums 300. After the stacker drums start their next quarter revolution, the cam surface 310 clears the roll 311 and the spring 306 rocks the supporting structure 303 with its attached grippers 302 back to gripping position. The card is thereby gripped between the grippers 302 and the outer surface of the stacker drums 300 and carried by the stacker. At the end of this quarter revolution, of course, another set of grippers arrives in open position opposite the guide plates 85 and 86 to grip the next card. Eventually a card gripped on the stacker encounters a stripper plate 316, and the subsequent movement of the stacker drum strips it from the grippers as it arrives in the discharge hopper K.

The picker mechanism for the supply hopper A, the feed rolls for feeding the cards from this hopper, and the analyzing mechanism B for analyzing the cards fed out of this hopper are entirely similar to corresponding devices just described in connection with supply hopper B. These several mechanisms are driven by the same shaft 30 which drives the corresponding mechanisms associated with hopper B, the shaft extending across the machine for this purpose and the drive being entirely similar to that just described. It will be understood, then, that as each

card feeds from hopper B into its analyzing mechanism, a corresponding card from hopper A feeds into the other analyzing mechanism, and the analyzing brushes of the two analyzers analyze corresponding index hole positions on the two cards at the same time.

The purpose of the analyzing mechanisms is to control comparing devices to determine whether the cards of each pair simultaneously fed are like or unlike in their perforations, and to offset from the card stacks those cards which are unlike. The card comparing mechanism is very similar in construction and operation to the usual automatic control devices which are used on standard electrical tabulating machines, and which are well known. The operation of these devices will first be explained in connection with a circuit diagram shown in Fig. 8, and thereafter the mechanical parts of the comparing mechanism will be described and explained.

Referring to Fig. 8, the electrical power for the machine is obtained from a source S, and the machine circuits may be connected to this source by a manual switch SW. The motor M for driving the machine is connected across the main lines of the machine circuits through motor relay contacts 100, which are controlled by motor relay coil 101. Assuming that the separate stacks of cards have just been placed in their respective hoppers, the machine may be started into operation by depressing the start key 102, whereupon a circuit is established from the source S through main line 105, wire 106, stop key contacts 103, normally closed, start key contacts 102, stick relay coil 107, wire 108, motor relay coil 101 and wire 109 to main line 110 and back to the other side of source S.

The energization of motor relay coil 101 closes its contacts 100, and throws the motor M directly across the main line, whereupon the machine starts in operation. The energization of stick relay coil 107, which is included in the starting circuit, closes its contacts 115 which are arranged in a shunt around the start key contact 102. This shunt, however, becomes effective only after cards have been fed into both of the analyzing mechanisms, where they close card lever contacts 116 and 117 of which 116 cooperate with the cards from hopper A and 117 cooperate with the cards from hopper B. These contacts in the well known manner remain open as long as cards are not feeding through the analyzing mechanism, and close whenever a card is in or passing through the analyzing mechanism.

When starting the machine the start key contacts 102 must be held closed manually until the cards feed to the analyzing mechanisms and close card lever contacts 116, 117. These contacts, on closing, establish a circuit extending from the source S through main line 105, card lever contacts 116 and 117, wire 121, relay coil 122 and through wire 123 and main line 110 back to the source S. The energization of relay coil 122 closes its contacts 133 and completes the shunt around start key contact 102. After this the start key may be released to open contacts 102, and the motor relay coil is maintained energized by a circuit extending as follows: from source S, through main line 105, wire 106, stop key contacts 103, wire 130, card lever relay contacts 133, now closed, stick relay contacts 115, stick relay coil 107, wire 108, motor control relay coil 101, wire 109 and main line 110 back to the source S. After this, the driving motor M remains in continuous operation, but may be stopped by de-

pressing the stop key to open contacts 103. Opening of these contacts breaks the circuit of motor relay 101, which opens contacts 100 and thus breaks the motor circuit.

The successive cards from the two card hoppers A and B now feed in synchronism with each other to the analyzing brushes 80 and 140, respectively, cards from hopper B feeding between the brushes 80 and conducting roll 81, and cards from hopper A feeding between the brushes 140 and conducting roll 166. Each analyzing brush 80 is connected to an individual socket 141, and each brush 140 is connected to an individual socket 142. The sockets are provided to permit plugging of the analyzing brushes cooperating with any desired card columns in circuit with the comparing mechanism, and thereby impart great flexibility of operation to the machine. The comparing mechanism is controlled by the analyzing brushes in a manner very similar to that in which the well known auto-controlled devices at present in use are controlled, and the principles of operation of this mechanism, in the form shown in the present case, are fully explained in U. S. patent to Bryce, No. 1,787,719, dated January 6, 1931. An auto-control relay 145 is provided for each card column on which comparison may be desired. The terminals of these relay coils are brought out to individual sockets 146 and 147, and, when a comparison is desired in any particular card column, the analyzing brush 80 cooperating with that card column is plugged from its socket 141 to socket 147 of control magnet 145. The corresponding brush 140 of the other analyzing mechanism is plugged from its socket 142 to socket 146 of this control relay 145. In other words, the control relay 145 is wired directly between an analyzing brush 80 and the corresponding brush 140. In the circuit diagram, the several relay coils 145 are indicated as plugged in circuit properly with the analyzing brushes.

It may be stated at this point that whenever a control relay 145 is energized, it opens its relay contacts 150 which are normally closed, and closes its contacts 151 which are normally open. A common wire 155 is connected to one contact of each pair 150 and to the main line 105 through a commutator 156 and wire 168. The commutator 156 is provided with suitable segments to supply current impulses to any analyzing brushes, which are plugged in circuit, whenever index point positions on record cards are cooperating with them, and to break the brush circuits at other times. This is a well known arrangement in record controlled electrical machines to prevent sparking at the brushes. Each of the other contacts of pairs 150 is connected individually to one terminal of its relay coil 145 through a resistance 160, and to the other terminal of its coil through a resistance 161. The resistances 160 and 161 form two arms of a Wheatstone bridge connection with the coil 145 connected across them. If the cards feeding through the two analyzing mechanisms each presents a perforation in a certain column at the same time to their respective analyzing brushes 80 and 140, current will flow from the source S through main line 110 to a common brush 165 cooperating with the conducting roller 166, thence to brush 140 and, through a plug cord, to socket 146, thence to resistance 161, contacts 150 normally closed, and wire 155 to commutator 156 and through wire 168, card lever contacts 117 and 116, closed as long as cards are feeding through the machine, and main line 105 back to the source S. Current

will likewise flow from source S through main line 110 and wire 170 to brush 171, cooperating with conductor roller 81, corresponding analyzing brush 80 and through plug connections to socket 147 of the relay coil 145, thence to resistance 160, contacts 150 and back to the source S through the circuit just traced. This represents the condition in which the perforation in the two cards feeding through the machine agree.

It will be noted that current is flowing through the analyzing brushes and through the resistances 160 and 161, but no current flows through the relay coil 145, because both terminals of this coil are at the same electrical potential, one terminal being connected through an analyzing brush 140 directly to main line 110, and the other terminal being connected through analyzing brush 80 and wire 170 to the same main line 110. The presence of corresponding index point perforations in cards under the two analyzing mechanisms, therefore, does not effect energization of any of the relay coils 145. Obviously, also, the absence of perforations under both analyzing brushes has no effect on the coils 145 because the card material between the brushes 80 and 140 and their respective contact rollers 81 and 166 insulates the coil 145 from the line 110. If a perforation occurs in a card under one set of analyzing brushes, however, without at the same time a hole occurring under the other corresponding analyzing brush, the Wheatstone bridge circuit will be unbalanced and the coil 145 energized. Assume, for example, that an analyzing brush 140 encounters a hole in a card, while at the same time the corresponding analyzing brush 80 does not encounter a hole. Current will then flow from the source S through main line 110, common brush 165, conducting roller 166, analyzing brush 140, socket 142 through a plug connection to socket 146. It will be noted that, as no current can flow through the analyzing brush 80, the socket 147 and consequently the terminal of coil 145 which is connected to it is not at the same potential as the other terminal of the coil which is connected to socket 146. The current flowing from analyzing brush 140 therefore divides, part of it flowing through the resistance 161 and part of it flowing through the relay coil 145 and resistance 160. The return circuit through contacts 150 is the same as that previously described. This operation, however, has energized relay 145, causing it to open its contacts 150 and close its contacts 151.

The several pairs of contacts 151 are wired in parallel, one end of the parallel connection being connected to main line 105 by wire 175. The other end of the parallel connection is connected by wire 176 through cam operated contacts 177 and 178 to a magnet 179 (whose function is to operate the card offsetting mechanism) and thence to line 110. It will be recalled that the contacts 151 may close at any time while a record card is being analyzed, as the several index point positions on the card cooperate successively with the analyzing brushes. The card offsetting mechanism, which is operated by magnet 179 and whose operation will be explained later, must operate at a certain time after the card has left the analyzing brushes. The closing of any one of the pairs of contacts 151, therefore, merely arranges for completion of the circuit through magnet 179. The actual completion of the circuit to energize this magnet is effected later, when the card has cleared the analyzing brushes and is in position to be operated upon by the offset-

ting mechanism. Closure of any pair of contacts 151, due to the presence of a perforation in a card under one set of analyzing brushes without a corresponding perforation in the card under the other set of analyzing brushes, completes a circuit from main line 105 through wire 175 and through any pair of closed contacts 151 and wire 176 to cam contacts 177, which are closed during the analyzing operation, thence through wires 182 and 183 to stick relay coil 180 and through wire 181 to line 110. Stick relay coil 180 is thus energized and closes its contacts 185. Another circuit is thereby closed for the stick relay coil 180, this circuit extending from main line 105, through wires 175 and 187 to cam contacts 186, which are also closed during the card analyzing operation, thence through stick relay contacts 185, coil 180 and wire 181 to line 110. After the analyzing operation is completed and the card leaving the analyzing brushes is in position to be offset, cam contacts 178 close, thereby energizing the offset mechanism magnet 179. The circuit extends as follows: from main line 105 through wires 175 and 187 to cam contacts 186, thence through stick relay contacts 185, wire 183 and cam contacts 178 to magnet 179 and back to main line 110.

After the card offsetting mechanism has had an opportunity to operate, and prior to the beginning of the analysis of the following card cam contacts 186, 177, and 178 open, and control relay contacts 150 and 151 are restored to closed and open positions, respectively, thereby conditioning the circuits for comparing the next cards which feed to the analyzing mechanisms. The mechanical operation of restoring contacts 150 and 151 will be explained in the explanation of the mechanical operation of the control or comparing unit.

The mechanical parts of the card comparing mechanism are shown in Fig. 3, the mechanism being indicated generally by L. The operation of this device is entirely similar to that of the well-known automatic control unit for tabulating machines, which is described in detail in the U. S. patent to Lake No. 1,822,594, September 8, 1931. Although the operation of this device is well known, it will be described briefly in the present case. The auto-control relay magnets 145 are arranged in two rows for the purpose of conserving space. The two rows of magnets control their contacts 150 and 151 in the same manner, and the only difference in the structures associated with the two rows are obvious mechanical modifications of the parts to provide for operating from their different positions. The operating mechanism associated with the left hand row of magnets 145 will therefore be described, it being understood that the mechanisms operated by the other row are substantially the same.

The contacts 150 and 151 are mounted on leaf springs which are supported by a block of insulating material 200. A spring 201 pulls upwardly on the leaf spring which carries lower contact 150. When the machine is in operation, a bell crank 202 pivoted at 203 is latched by a latch member 204 in the position shown in Fig. 3. The bell crank 202 has an extension 205 on one of its arms to press downwardly on the leaf spring support of upper contact 150 and hold the contacts 150 closed.

The contacts 151 under these conditions open under their own resiliency. The latch member 204 is mounted on the armature structure 206 of magnet 145, the armature structure being pivoted

at 207 and normally held in latching position by a spring 212. Energization of the magnet 145 causes its armature structure to rotate counterclockwise about pivot 207, thereby causing latch member 204 to release bell crank 202. The spring 201, thereupon pulling upwardly on the lower contact 150, causes an insulating knob 210 supported on the leaf spring support of lower contact 150 to press upwardly on the leaf spring supporting lower contact support 151, thereby closing contacts 151. Incidentally, the free end of the leaf spring supporting upper contact 150 moves upwardly under its own resiliency and opens contacts 150. It will therefore be understood that whenever magnet 145 is energized, contacts 150 open and contacts 151 close, the reason and function for this operation having been explained in connection with the circuit diagram.

It has also been explained that the contacts 150 and 151 when opened and closed, respectively, during the analysis of a card, must remain in operated positions until the analysis of the card is complete; and that after the analysis of the card is completed, and before the analysis of the following card begins, they must be restored to their normal positions as shown in Fig. 3. The restoring mechanism consists of a pair of cams mounted on shaft 215. It may be remarked at this point that it is customary to construct the automatic control devices in sections, each of standard size and each containing the complete mechanism for effecting automatic control within its capacity. In the present machine (see Fig. 1) three standard automatic control sections have been used for the comparing device, and as the drive for the restoring mechanism of each of these sections is substantially the same, the driving connections for the right hand section only in Fig. 1 will be described.

The shaft 215 (see Fig. 3) has a gear 350 attached to its end which meshes with a gear 351 (see also Fig. 1) fixed to shaft 352. Shaft 352 extends across the machine, and, at one end, carries a gear 353 which meshes with a gear 354 rotatably mounted on a stub shaft 355. Gear 354 meshes with a gear 356 fixed to the end of shaft 92 which carries the lower feed rolls 84. The shaft 92, supporting feed rolls 84, it will be recalled, is operated from the main drive shaft 30 of the machine. The gear ratio is such that shaft 215 makes one revolution for each card sent through the analyzing section of the machine. When the magnet 145 is deenergized, the spring 212 restores the armature structure to latching position, and a cam 221, mounted on shaft 215 restores the bell crank 202 into latching position, where it is latched by the latch member 204. Of course, when this occurs, the extension 205 on the bell crank arm closes contacts 150 and opens contacts 151, whereby the comparing device is restored, in readiness to operate, if necessary, according to the following cards passing through the analyzing mechanisms. A positive restoring device is provided for the armature structure in case the armature sticks, and the spring 212 fails to restore it. This consists of a bail 213 extending over the latching members 204, and pivoted on pivot 207. An extension 219 on this bail cooperates with a cam 218 on shaft 215, and just after the bell cranks 202 have been rocked to latching position, a hump on the cam engages extension 219 and rocks the bail clockwise, whereupon it restores any armature structures which have not been restored by their springs 212, to latching position.

It will be recalled that the primary function of the apparatus is to offset corresponding cards from the two card stacks when they do not agree in their index point perforations. In Fig. 4, two stacks of cards, which have been compared, are shown at 35 and 35a. As a result of the comparison, the machine has offset two cards 225 and 226 from stack 35 and two corresponding cards 225a and 226a from stack 35a, thus indicating that the perforations in these offset cards do not agree with those in corresponding cards in the other stack. The offsetting operation is performed by mechanism operated by magnet 179.

Referring to Fig. 3 for a moment, the actual offsetting operation occurs just after a card which is to be offset has left the feed rolls 84, and is in position with its forward edge within an open gripper device of the stacker E but before the gripper device actually grips it. At this instant the card is free between the plates 85 and 86 and may be forced to one side.

The magnet 179 (Figs. 4, 5, and 6) has an armature 230, which hangs from a pin 231 extending through an upstanding ear 232 on the armature 230 and through holes in levers 233 and 234, which are pivoted on the magnet supporting frame at 235 and 236, respectively. The free end of lever 233 carries a depending link 240 whose lower end is pivoted at 241 to a lever 242, which is pivoted at 243 on the magnet supporting frame. A spring 244 holds the free end of lever 233 upwardly, to maintain the armature 230 in unattracted position, and forces a sideways extending lug 247 on lever 242 against a stop screw 245. The lever 242 is yoke-shaped at its end distant from the pivot 241, and a depending member 246 is fast to this yoke-shaped end. A pusher member 249 is pinned to the depending member 246 forming substantially an integral structure therewith. The lower end of the pusher member 249 is broadened as shown at 250, and this broadened end portion lies opposite one edge of the card, which is passing between the plates 85 and 86. The relation of this pusher member to a card which is between the plates 85 and 86 is shown in Fig. 4, the card being indicated at 251.

It will be recalled that whenever the magnet 179 is energized, which occurs whenever a card disagreeing with the corresponding card in the other stack has just left the feed rollers 84 and is between plates 85 and 86, this card will be pushed to one side so as to be offset from its stack when it reaches the discharge hopper.

Energization of magnet 179 attracts its armature 230, which moves downwardly and rocks arm 233 clockwise about its pivot 235, in opposition to the spring 244. The link 240 attached to the end of arm 233 thereupon rocks lever 242 counterclockwise around its pivot 243, whereupon the broad end portion 250 of pusher member 249 is forced against the edge of card 251 and forces it to the right as shown in Fig. 6. When this happens the card on reaching the discharge hopper will be offset as indicated for the cards 225 and 226 in Fig. 4.

After the magnet 179 is deenergized, which occurs shortly before the analyses of the following cards begin, the spring 244 tends to restore the pusher mechanism to the position shown in Fig. 4. The spring is assisted by a positive restoring device in the shape of a cam 255 (Figs. 4 and 5) cooperating with the member 246 which supports the pusher 249. The cam 255 is mounted on shaft 256, which carries the card stackers, and which

rotates one quarter of a revolution for each card analyzing operation. The cam 255 is provided with four humps 265 which are arranged to strike an extension 266 on member 246 at the proper time to restore this member, and the attached linkage connecting it to armature 230, after the offsetting operation has been performed.

Referring to Fig. 4 it will be noted that exactly similar mechanism is provided for offsetting cards from stack 35a. This mechanism is operated by the magnet 179 in exactly the same manner as just described in connection with the offsetting mechanism for stack 35.

The general operation of the machine, as illustrated in the drawings, will now be briefly summarized. One stack of perforated cards is placed in the supply hopper A (see Fig. 1) and another stack, which should agree card for card with the stack in hopper A, is placed in supply hopper B.

The machine is started in operation by depressing the start key 102 (Fig. 8), whereupon the motor M drives the mechanical parts. The two sets of card picker knives (of which one of those operating in connection with supply hopper B is shown at 45 in Fig. 3) each feeds cards successively from the supply hoppers into the feed rolls. Corresponding cards from the two hoppers are simultaneously analyzed by the respective analyzing devices, of which that for hopper B consists of brushes 80 and conducting roll 81. As long as the index point perforations in corresponding cards agree, the cards from each stack feed in a straight line to the stacker mechanism, one of which is shown at E in Fig. 3, and are stacked thereby in discharge hoppers, one of which is indicated at K. Whenever one analyzing mechanism finds a perforation in a card which it is analyzing and the other analyzing mechanism does not find a corresponding perforation in the card which it is analyzing, a circuit is prepared to energize an offsetting magnet 279. The circuit is actually completed and the magnet 279 actually energized at a later time in the operation of the machine, just after the disagreeing cards feed clear of feed-rollers 84, and before they have been gripped by the grippers of their respective stackers. The magnet 179 (see Fig. 4) on being energized attracts its armature 230 and, through suitable levers and linkages, rocks pusher members, one of which is indicated by 249, from the position shown in Fig. 4 to that shown in Fig. 6. The pusher members, in rocking, displace the two disagreeing cards to the side, offsetting them from the normal path of card travel. Thereafter the gripper members of the stackers close on the displaced cards and feed them into their respective discharge hoppers. The stacks in the discharge hoppers, therefore, have the disagreeing cards offset as indicated for the cards 225, 266, 255a, and 226a in Fig. 4.

The invention has now been disclosed in connection with what is believed to be the preferred form of mechanism for practicing it, but it will be obvious that modifications of the mechanism and other methods of utilizing the invention will readily occur to those skilled in the art. It is to be understood that the invention is intended to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a machine of the class described, a card feed mechanism for normally feeding a card in a straight line of travel, card analyzing means, a card stacker arranged toward the end of said line of travel and provided with gripper members

for seizing a card after it reaches the stacker, a deflecting device for operating on the card to displace it to one side of its normal straight line of travel yet maintaining the same plane of travel and mechanism controlled by said analyzing means for operating said deflecting device.

2. In a machine of the class described, a card feed mechanism for normally feeding a card bearing index points in a straight line of travel, a card analyzing device, a card stacker arranged toward the end of said line of travel and provided with grippers for seizing a card after it reaches the stacker, a deflecting device for operating on the card after it reaches the stacker, but before the grippers seize it, to displace it to one side of the straight line of travel yet maintaining the same plane of travel, an electromagnet for operating said deflecting device, a circuit including said electromagnetic device and means for controlling said circuit under control of said card analyzing device.

3. A record card comparing machine for comparing, card by card, stacks of cards on which data may be represented by index points, comprising analyzing mechanism for concurrently analyzing corresponding cards from each stack, card feeding mechanisms for advancing cards continuously and synchronously past said analyzing mechanism, comparing mechanism controlled by said analyzing mechanism, and means controlled by said comparing mechanism when index points on corresponding cards disagree to concurrently offset laterally from the stacks such disagreeing cards, without interruption of the synchronous operation irrespective of the index points.

4. A record card controlled machine wherein cards travel from a supply hopper to a receiving pocket past a card analyzing station, comprising means for sensing predetermined designations in the cards when they reach said station, means for imparting a predetermined movement of a card transversely of its normal line of travel and in its own plane before reaching said pocket, and means controlled by the sensing means for operating the second named means when predetermined cards are sensed by the sensing means whereby to offset the predetermined cards relative to the others.

5. In a record card controlled machine, a record supply hopper, a receiving hopper, means for conveying the records from the supply hopper to the receiving hopper, means adapted when operated to offset the records horizontally and transversely of their line of travel between the hoppers, an analyzing device adapted to sense designations in said records during their passage between said hoppers, and means controlled by the analyzing device for operating the offsetting means in accordance with designations in the records.

6. A device of the class described, comprising a record receiving pocket, a pusher element located at the entrance to said pocket and adapted to move a record entering said pocket a small amount parallel with the cards in said pocket whereby certain cards may be caused to project beyond the others in the pocket, means to actuate the pusher element, and means responsive to a predetermined designation in a record for controlling the actuating means.

7. In combination, a record receiving station, a record analyzing station, means to convey a batch of records from the analyzing station to the receiving station, means to move the records at

right angles to their line of travel and in their own planes prior to reaching said station whereby certain of the records in the batch reach said station physically displaced or offset a predetermined amount relative to the other records of the batch which were previously conveyed to said station, and means controlled through said analyzing station for operating the moving means on the occurrence of records having a predetermined designation whereby such records on reaching said station are caused to project beyond the records of the batch which do not have said designation.

8. In a record controlled machine, means to place a batch of records in a common stack, means associated with the stack for displacing records in their own planes and transversely of their normal line of travel into the stack whereby certain records of the batch may be stacked upon the other records of the batch in a position dis-

placed in a direction parallel with the planes of the records of the batch which were previously stacked, means to detect a predetermined designation in a record, and means controlled by the detecting means for actuating the displacing means.

9. A record card controlled machine having means for delivering a batch of records to a common stack and means for distinguishing certain records from others by virtue of data designations in the records, comprising a member for imparting an offsetting movement to the records in their own plane an extent less than a dimension of the records to displace them whereby certain records of the batch are stacked so as to project beyond other records of the batch previously delivered to the stack, and means for actuating said member under control of the distinguishing means.

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