Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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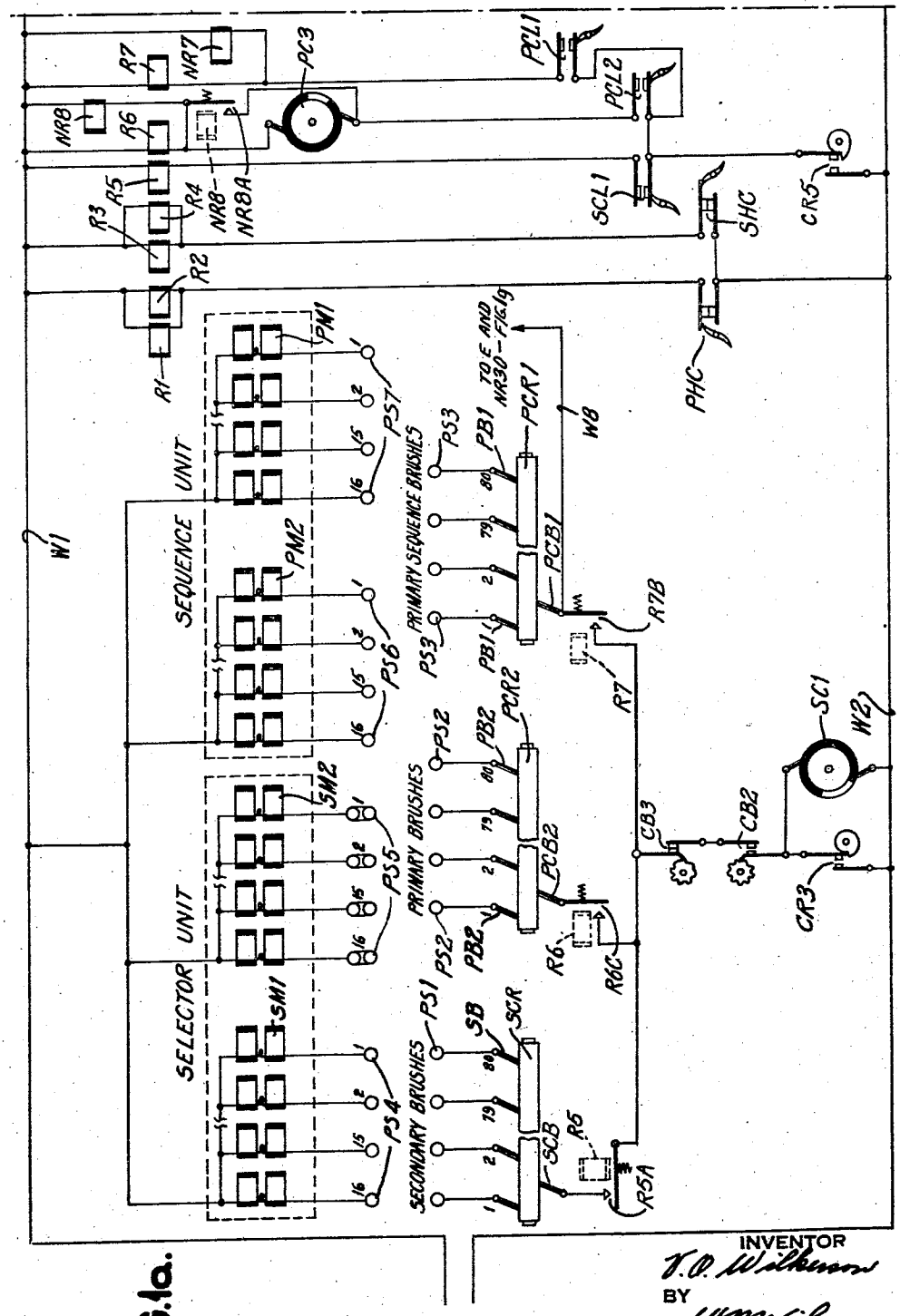


FIG. 1a.

INVENTOR
V. O. Wilkerson
BY
W. M. Wilkerson
ATTORNEY

Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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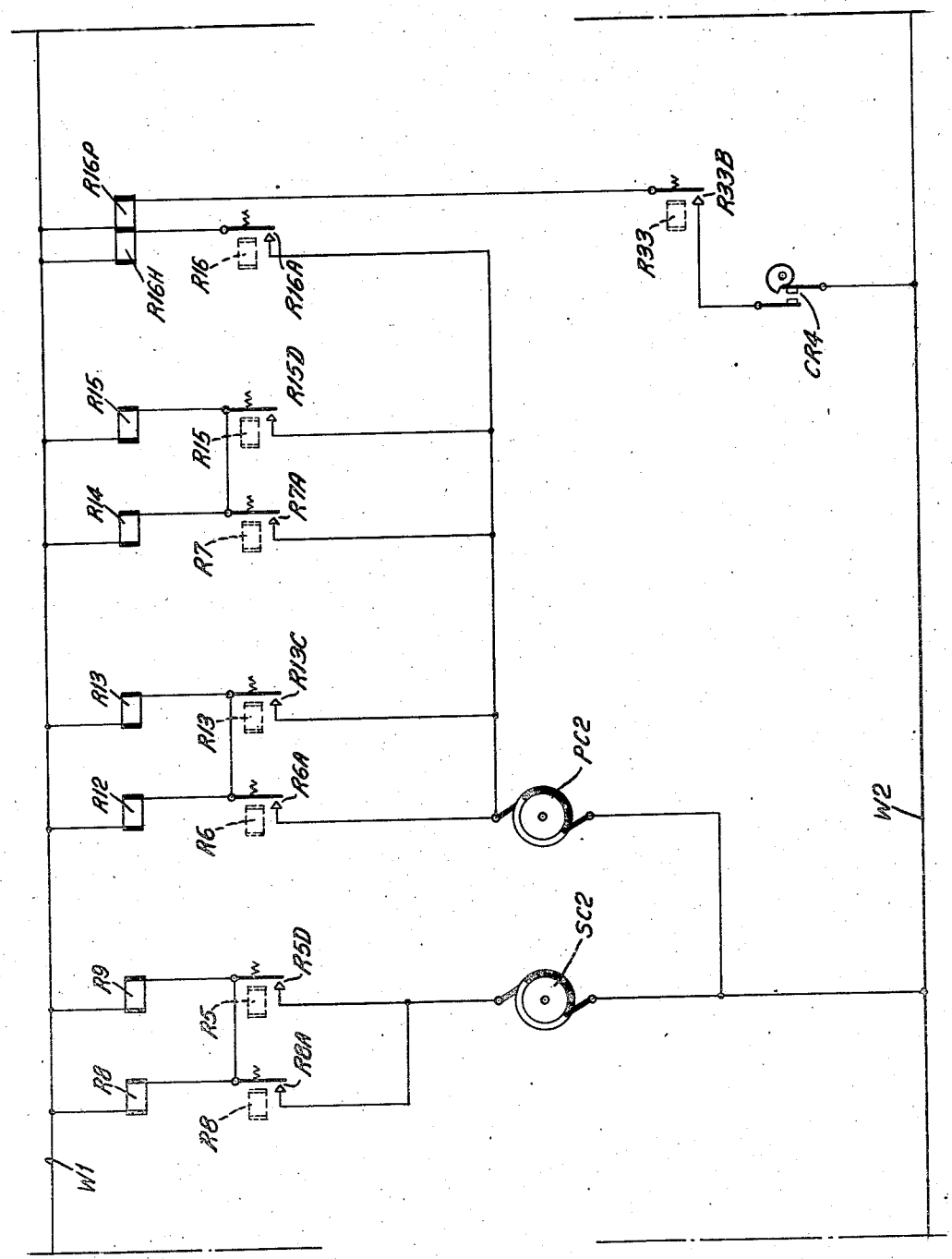


FIG. 4.

INVENTOR.
V. O. Wilkerson

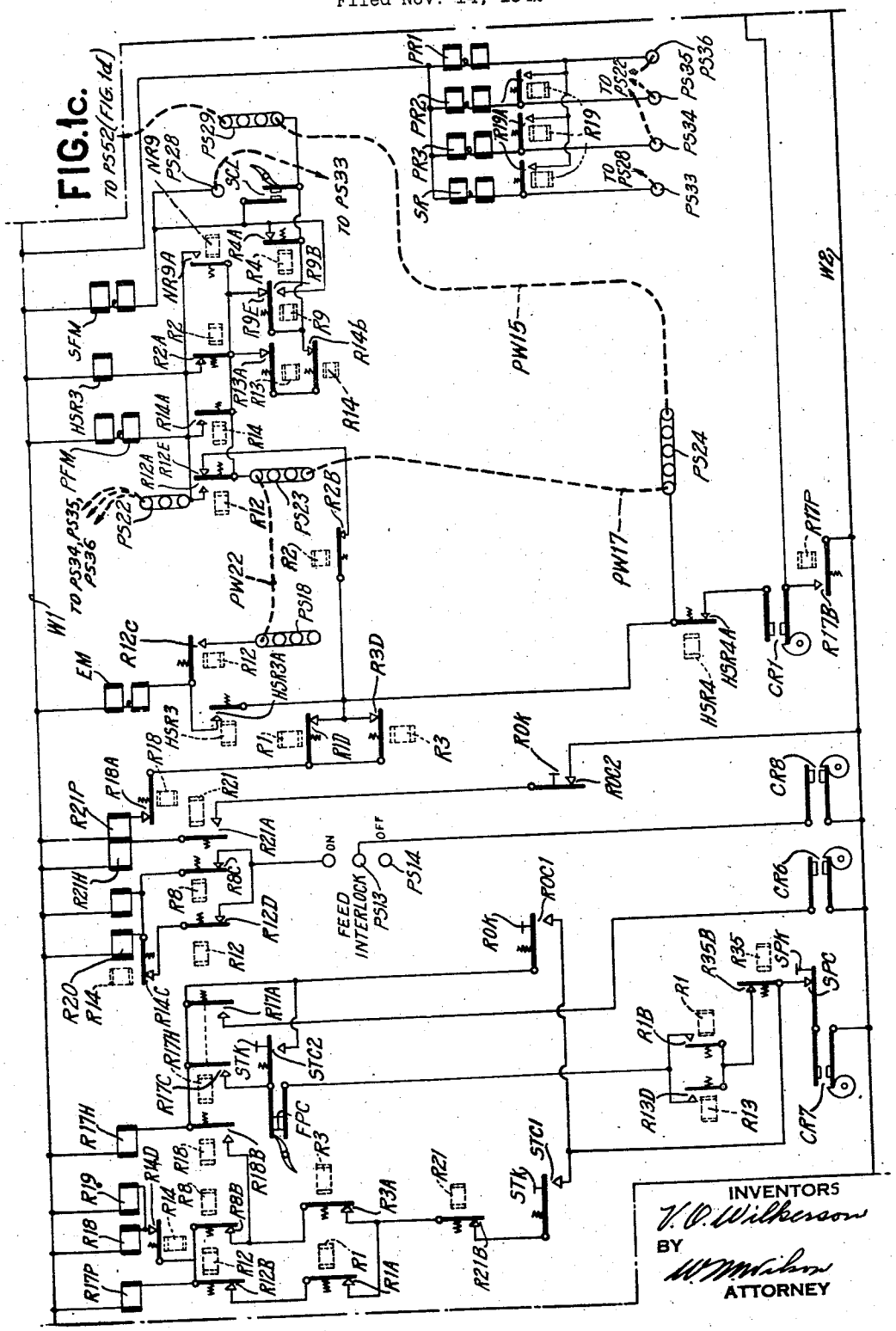
BY

ATTORNEY.

Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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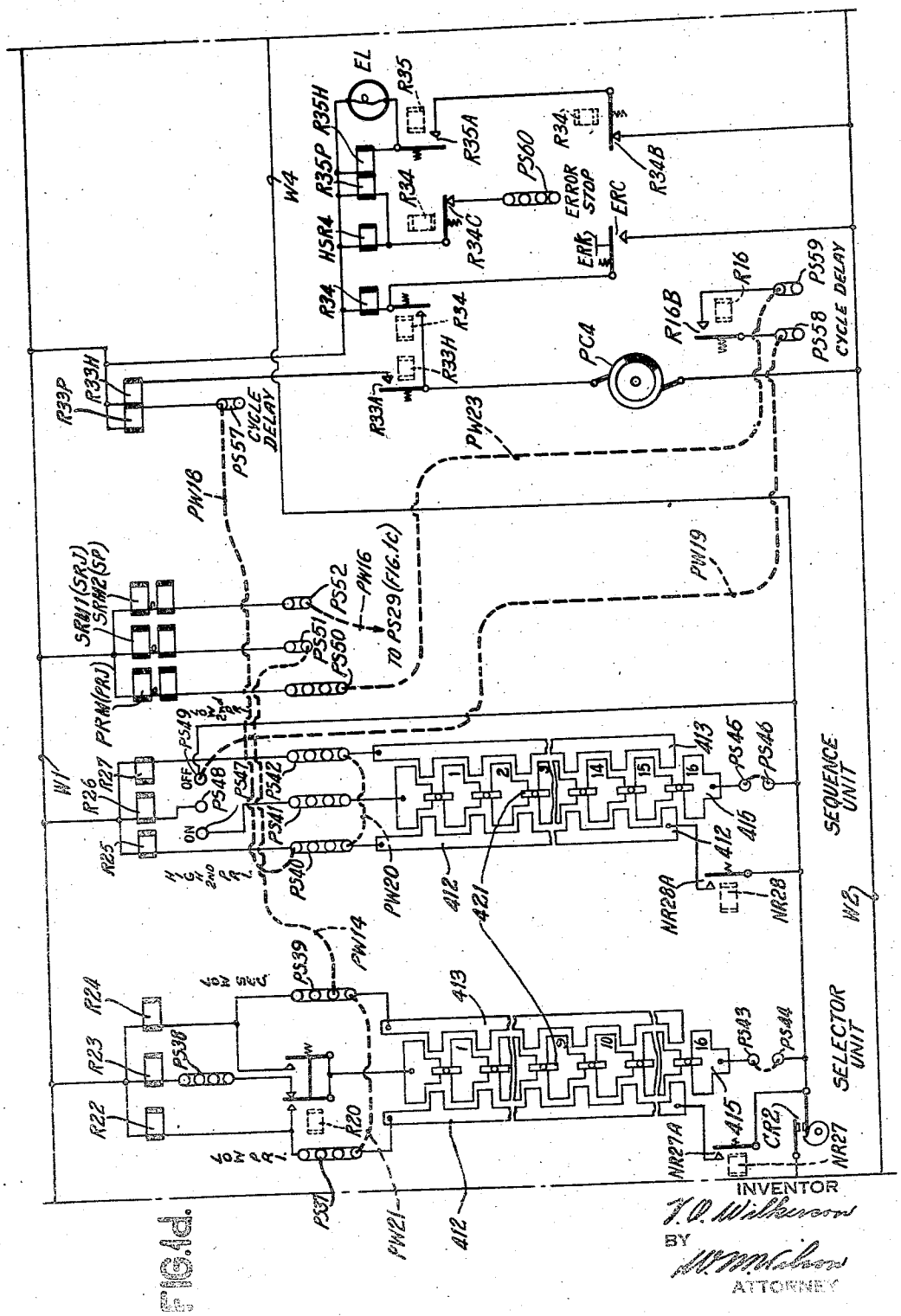


Fig. 4d.

Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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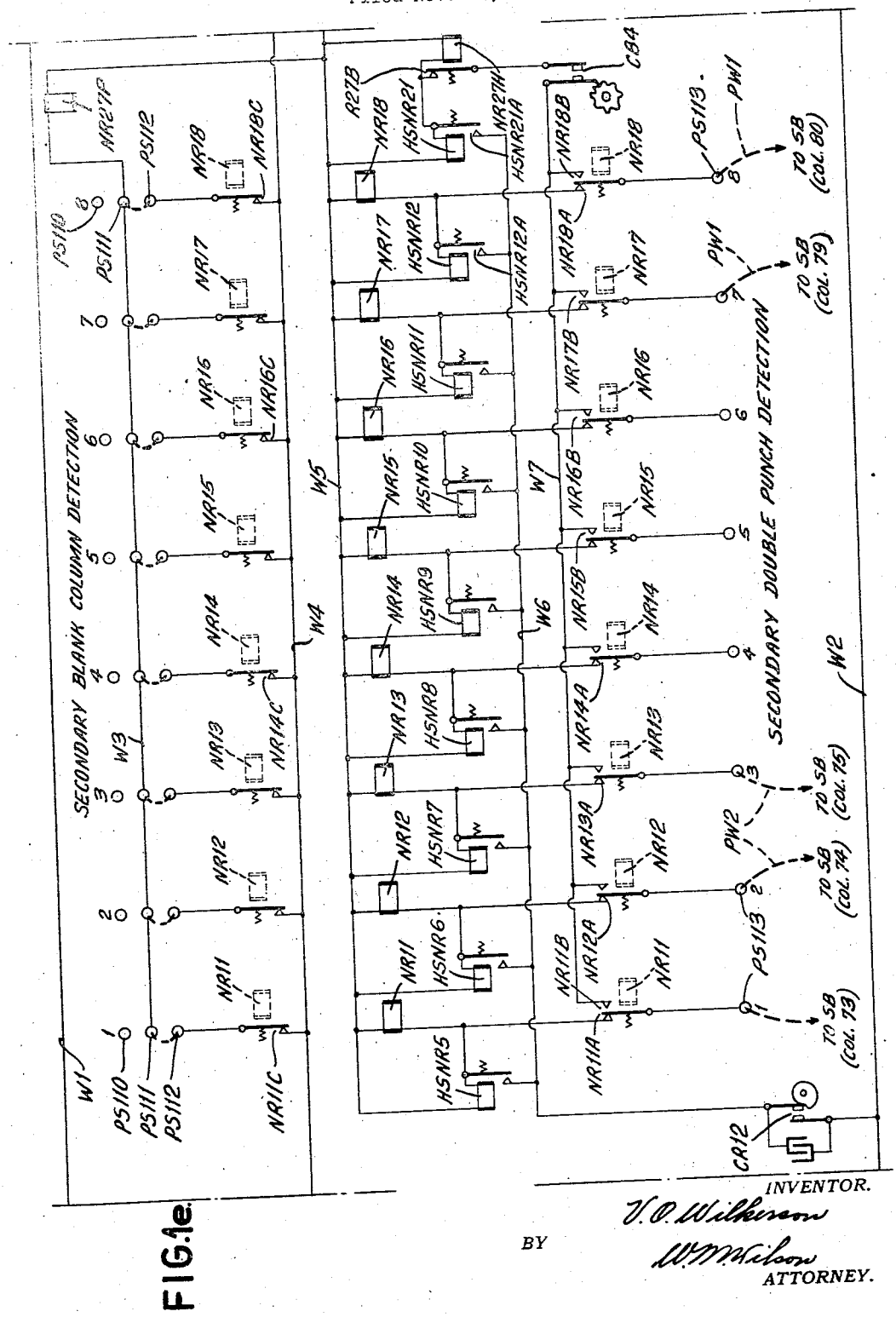


FIG. 1e.

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Oct. 1, 1946. V. O. WILKERSON 2,408,715

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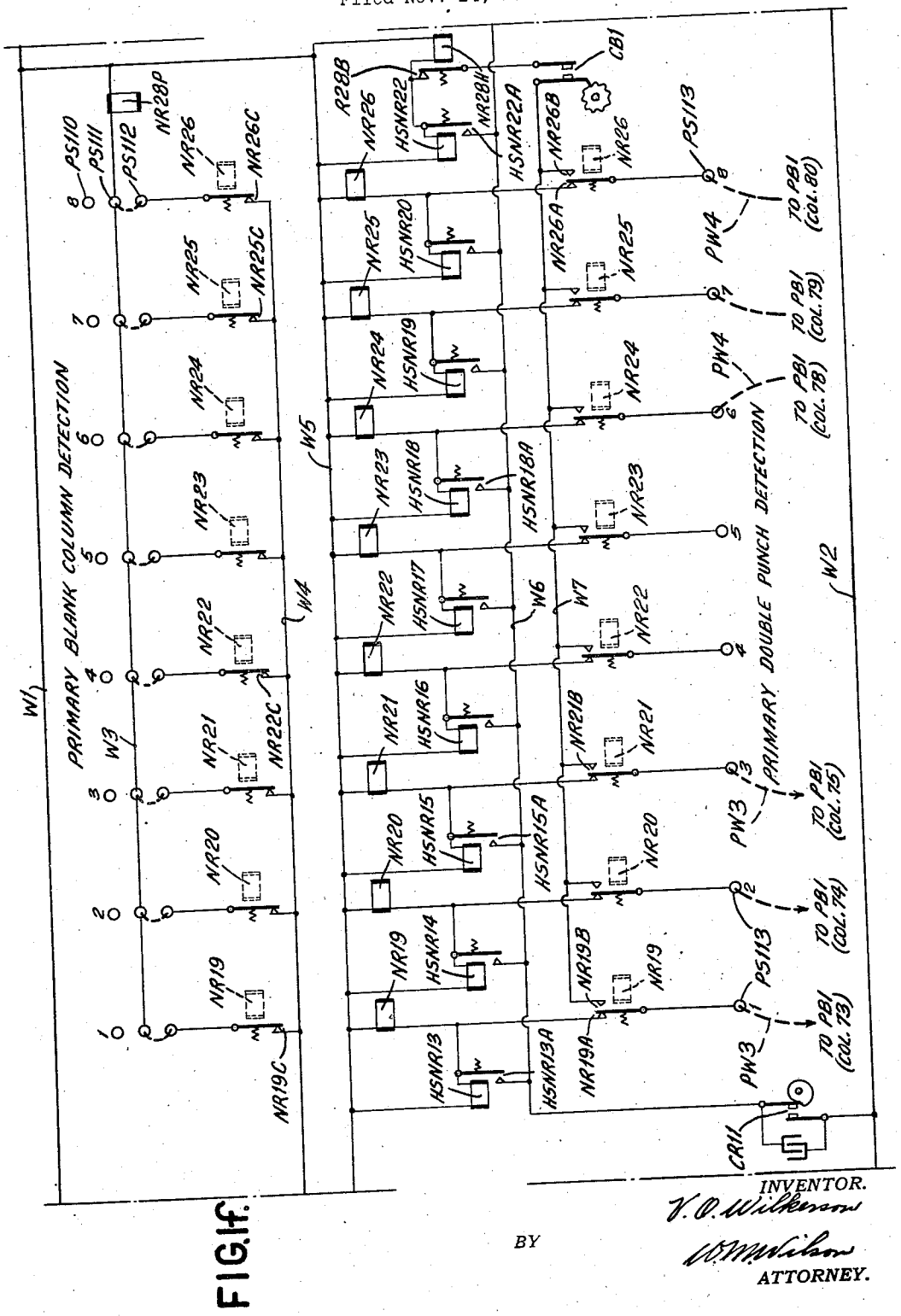


FIG. 1.

INVENTOR.
V. O. Wilkerson

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ATTORNEY.

Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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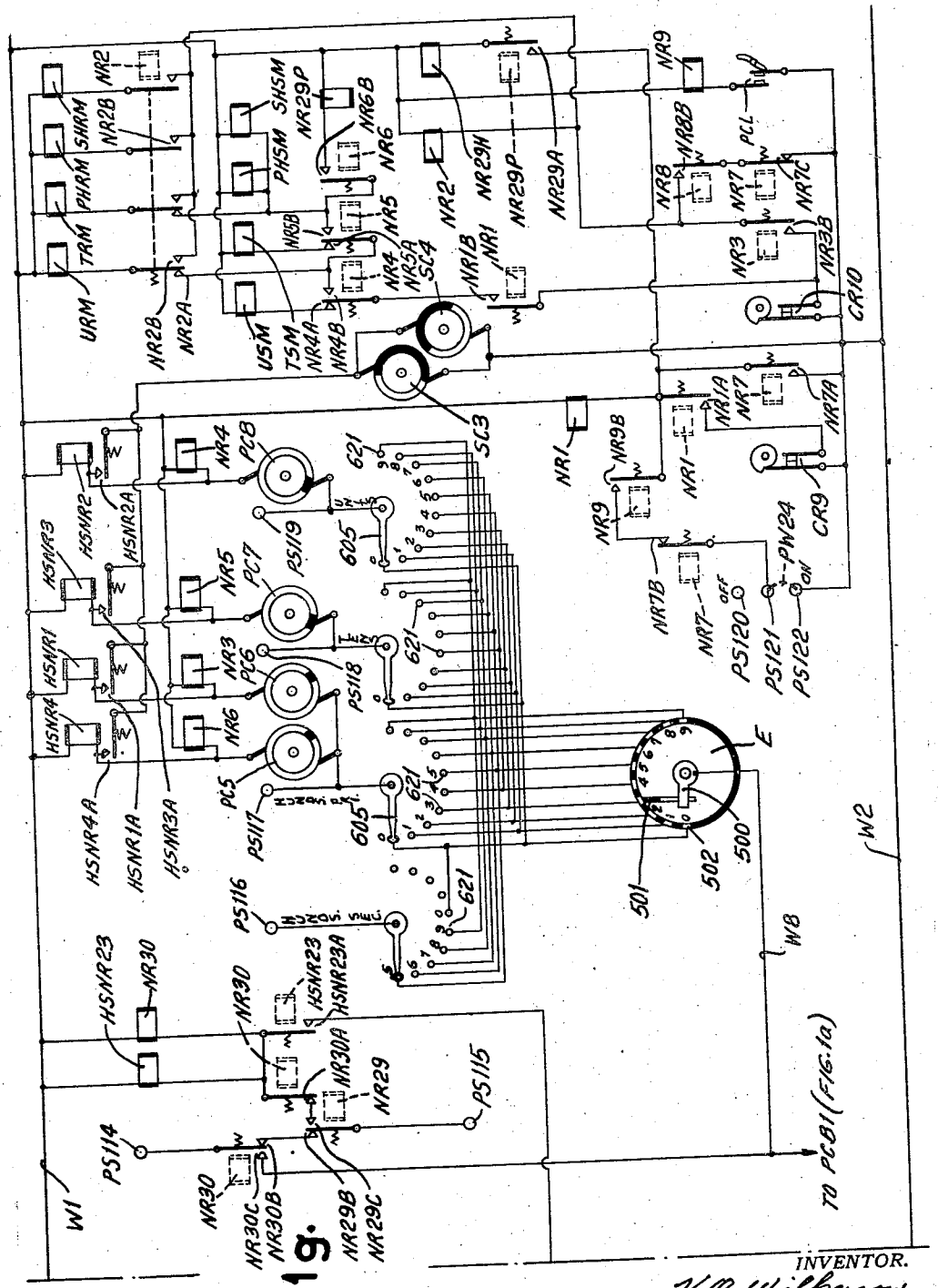


FIG. 19.

INVENTOR.
V. O. Wilkerson

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Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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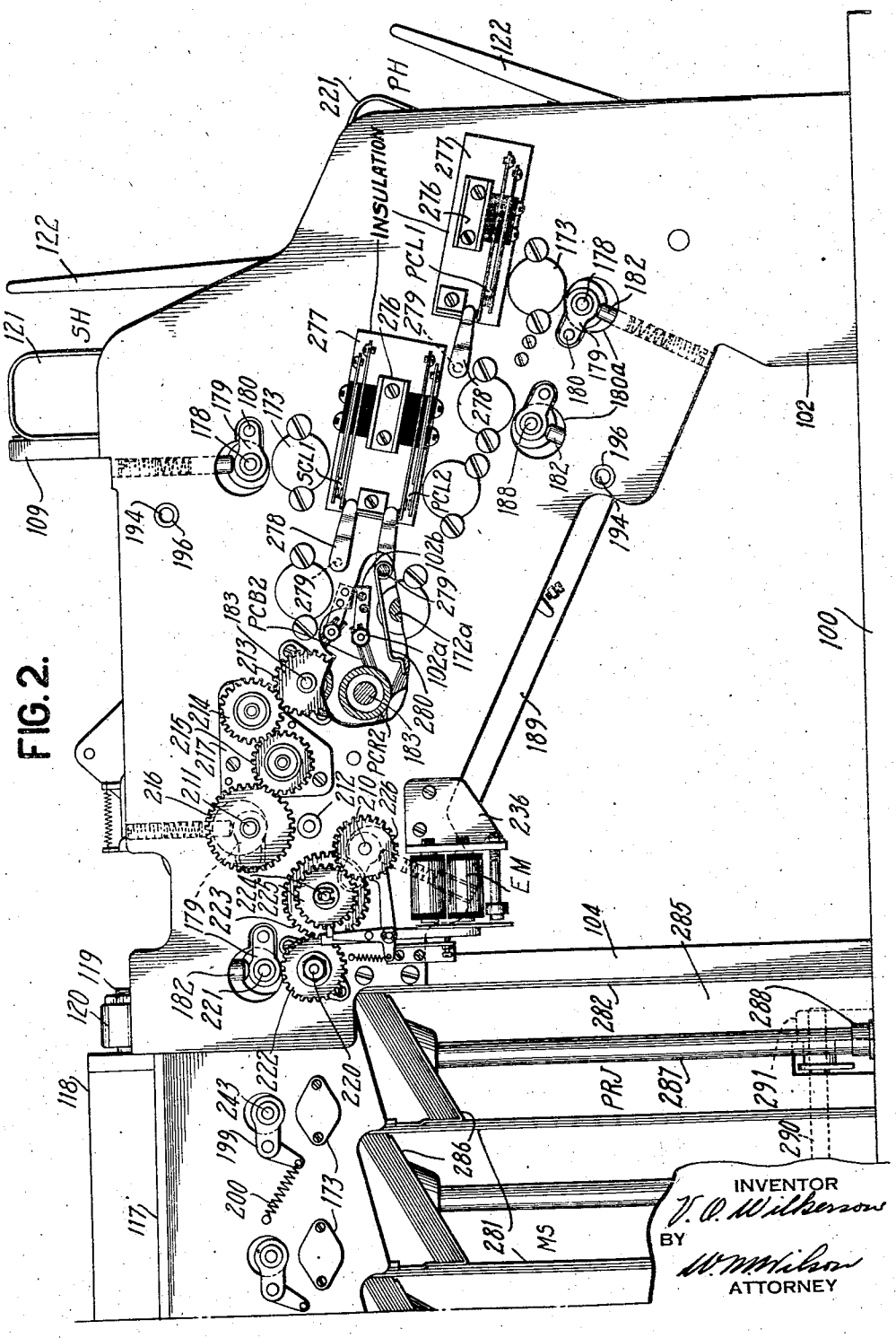


FIG. 2.

INVENTOR
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Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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FIG.3a.

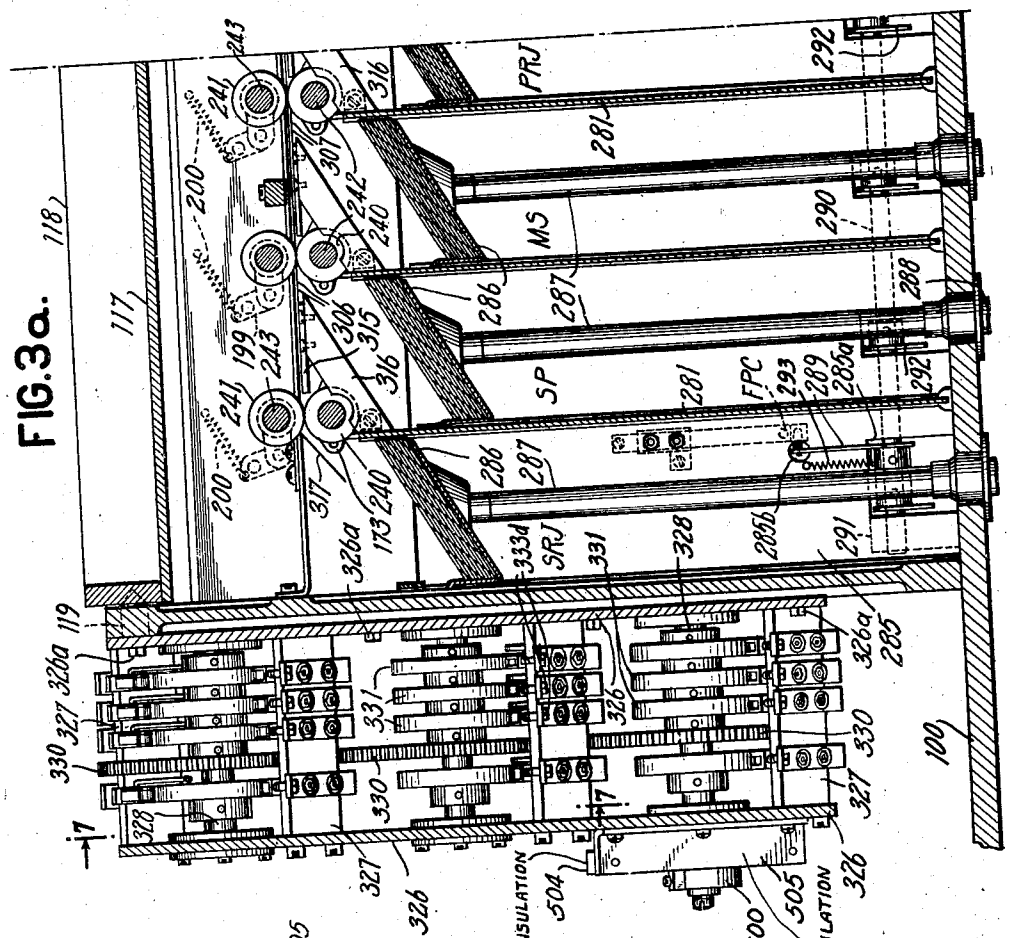
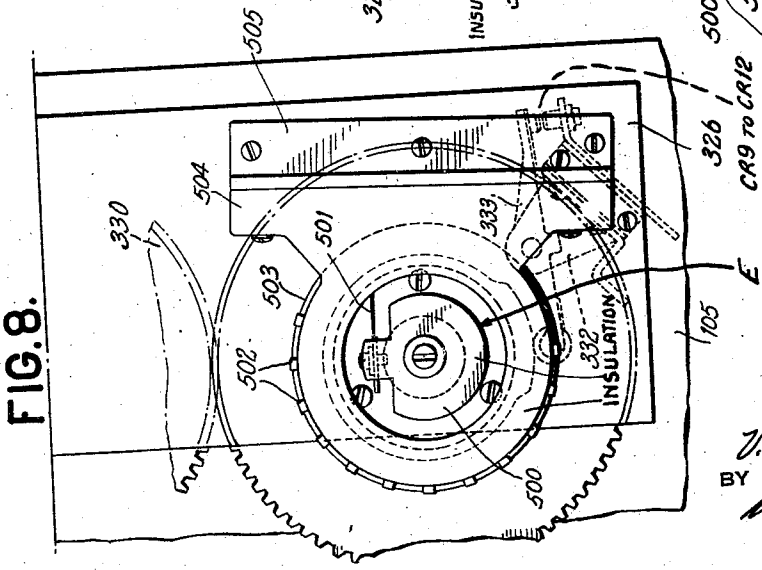


FIG.8.

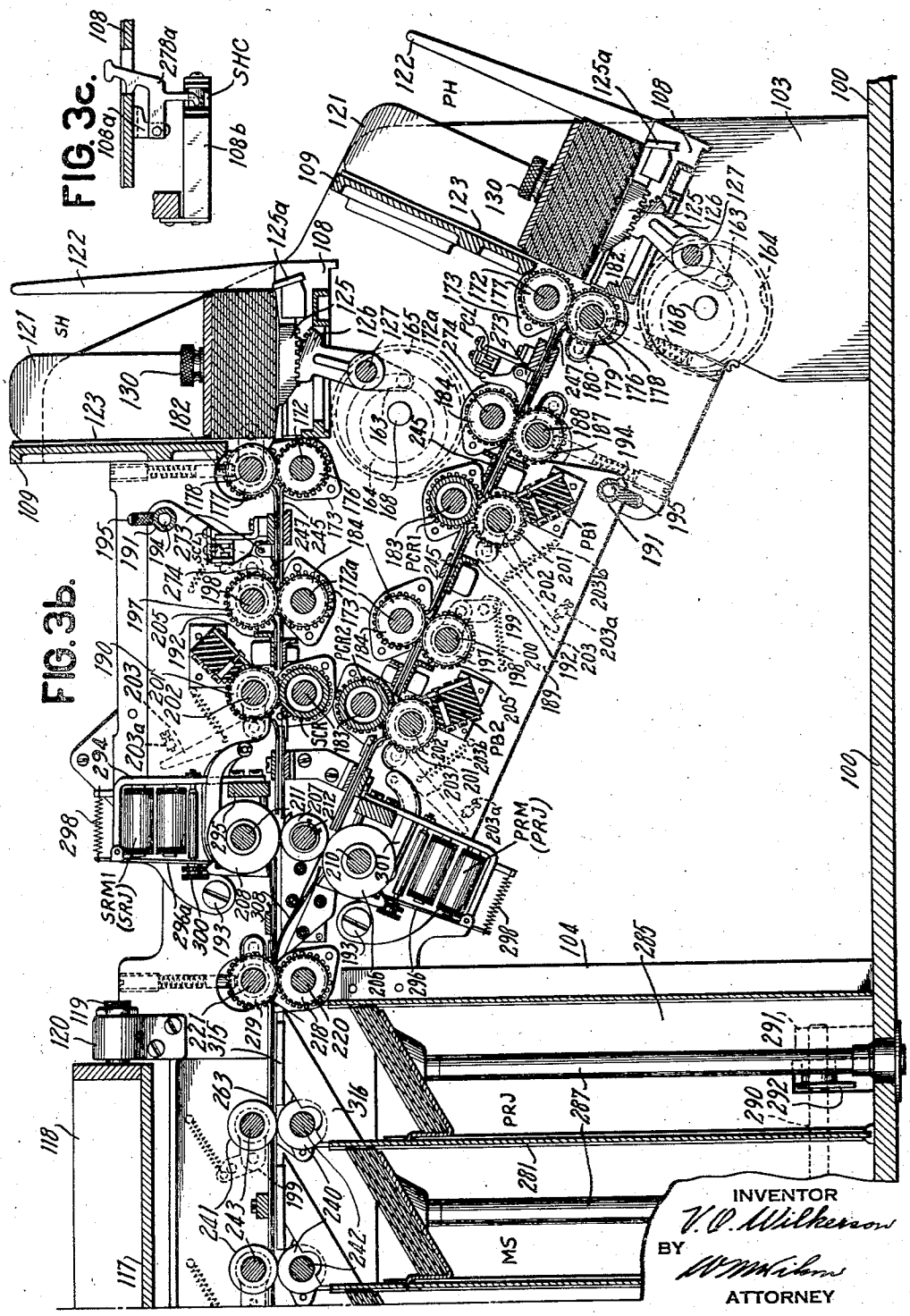


INVENTOR
V. O. Wilkerson
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Oct. 1, 1946. V. O. WILKERSON 2,408,715

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RECORD CONTROLLED MACHINE

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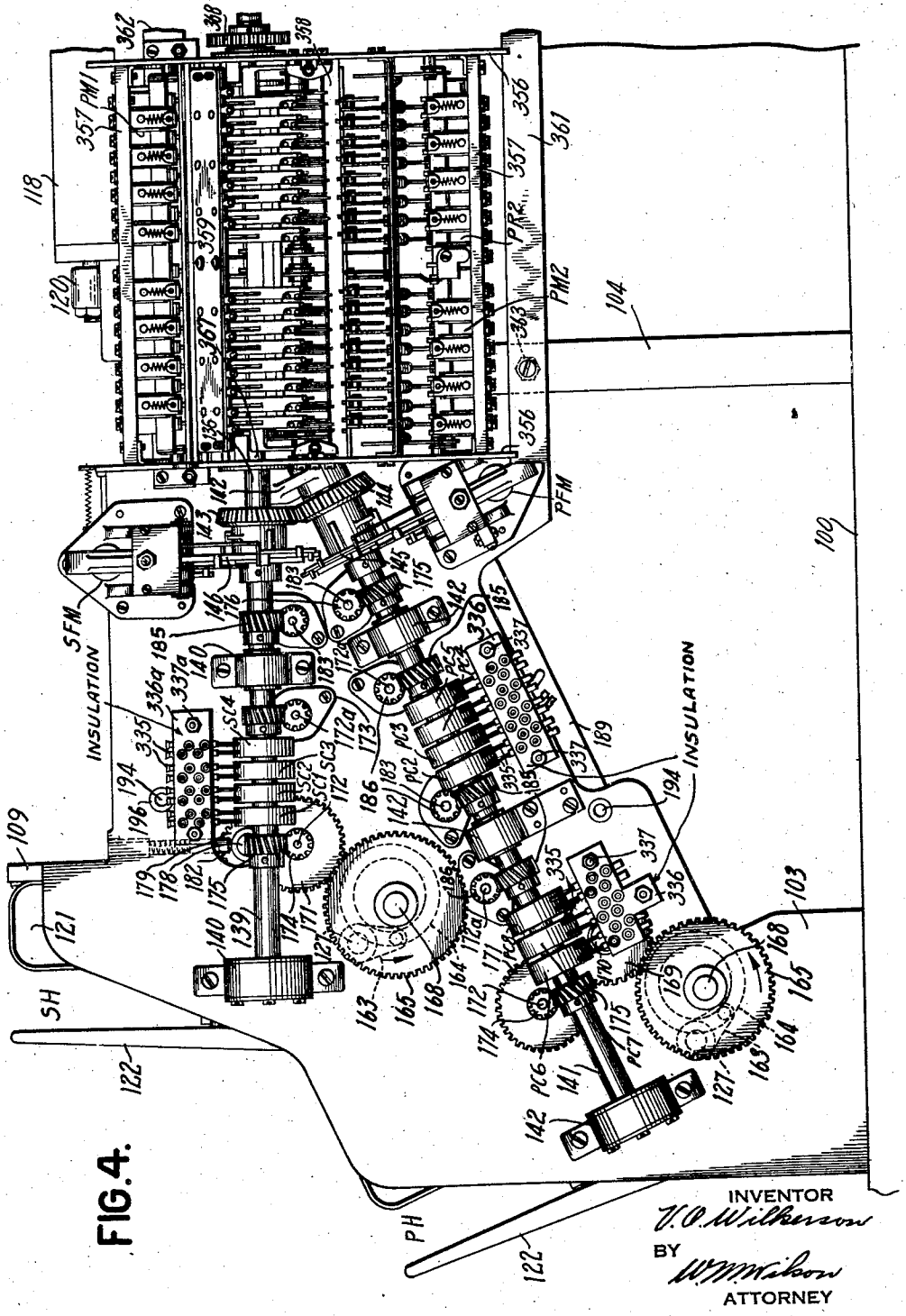


FIG. 4.

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FIG.5.

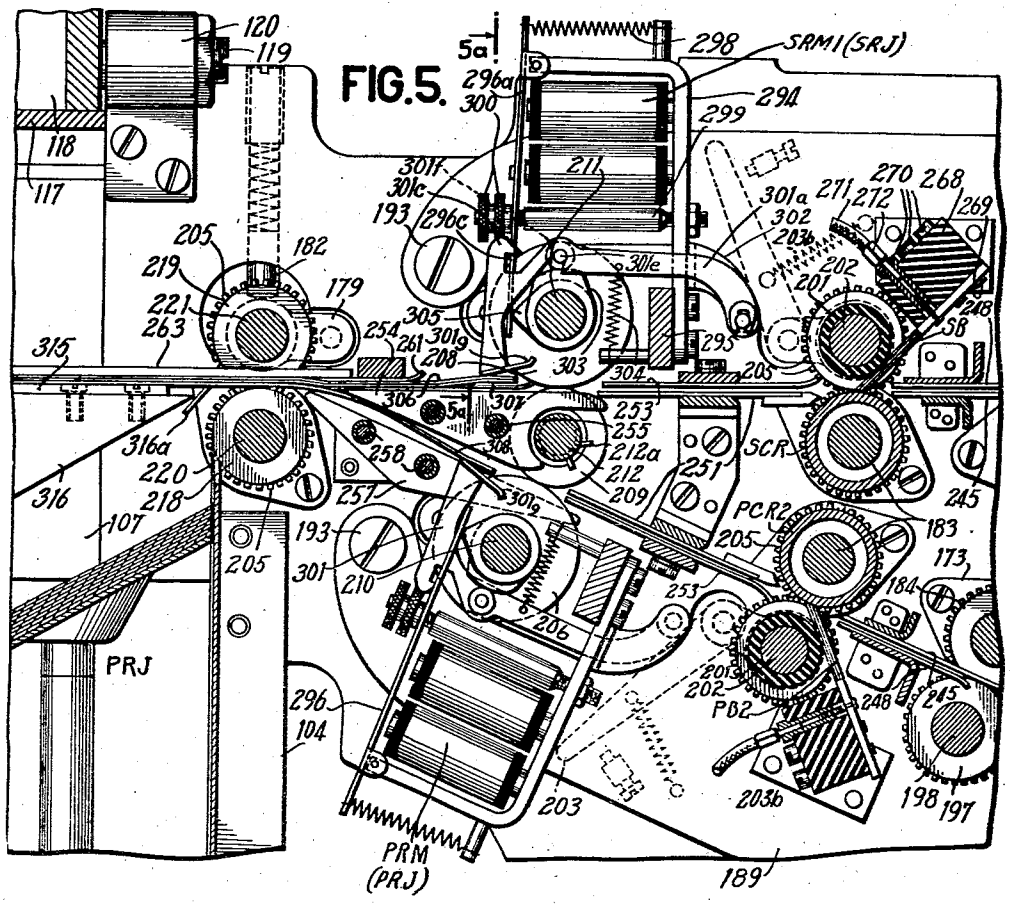


FIG.6c.

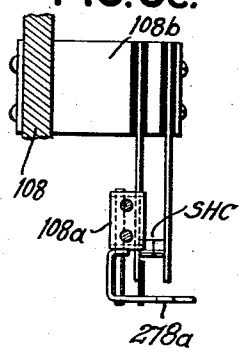
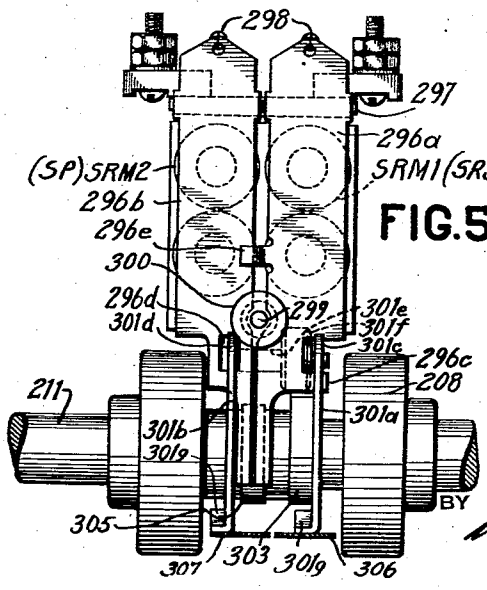


FIG.5a.



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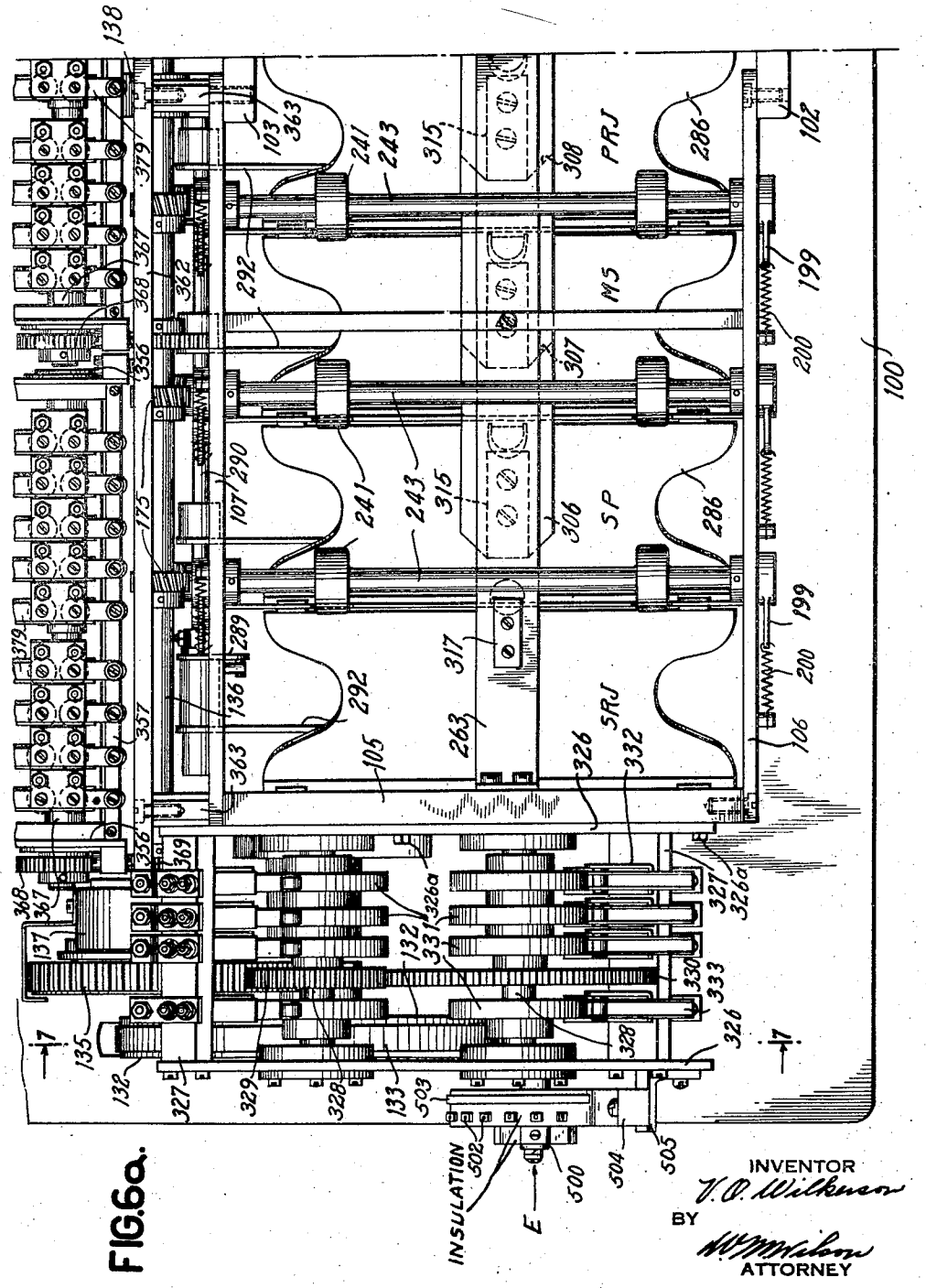


FIG.6a.

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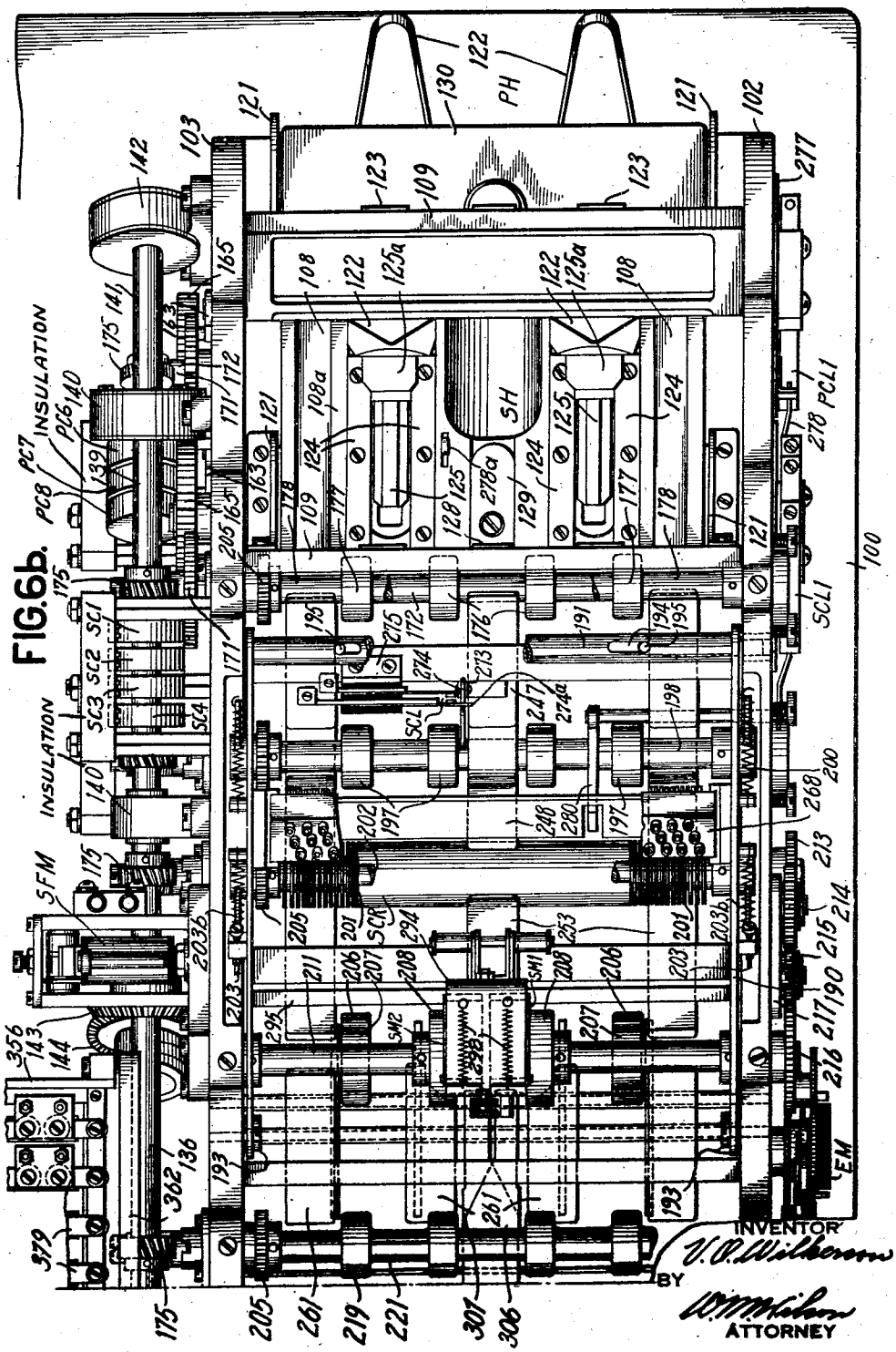


FIG.6b.

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RECORD CONTROLLED MACHINE

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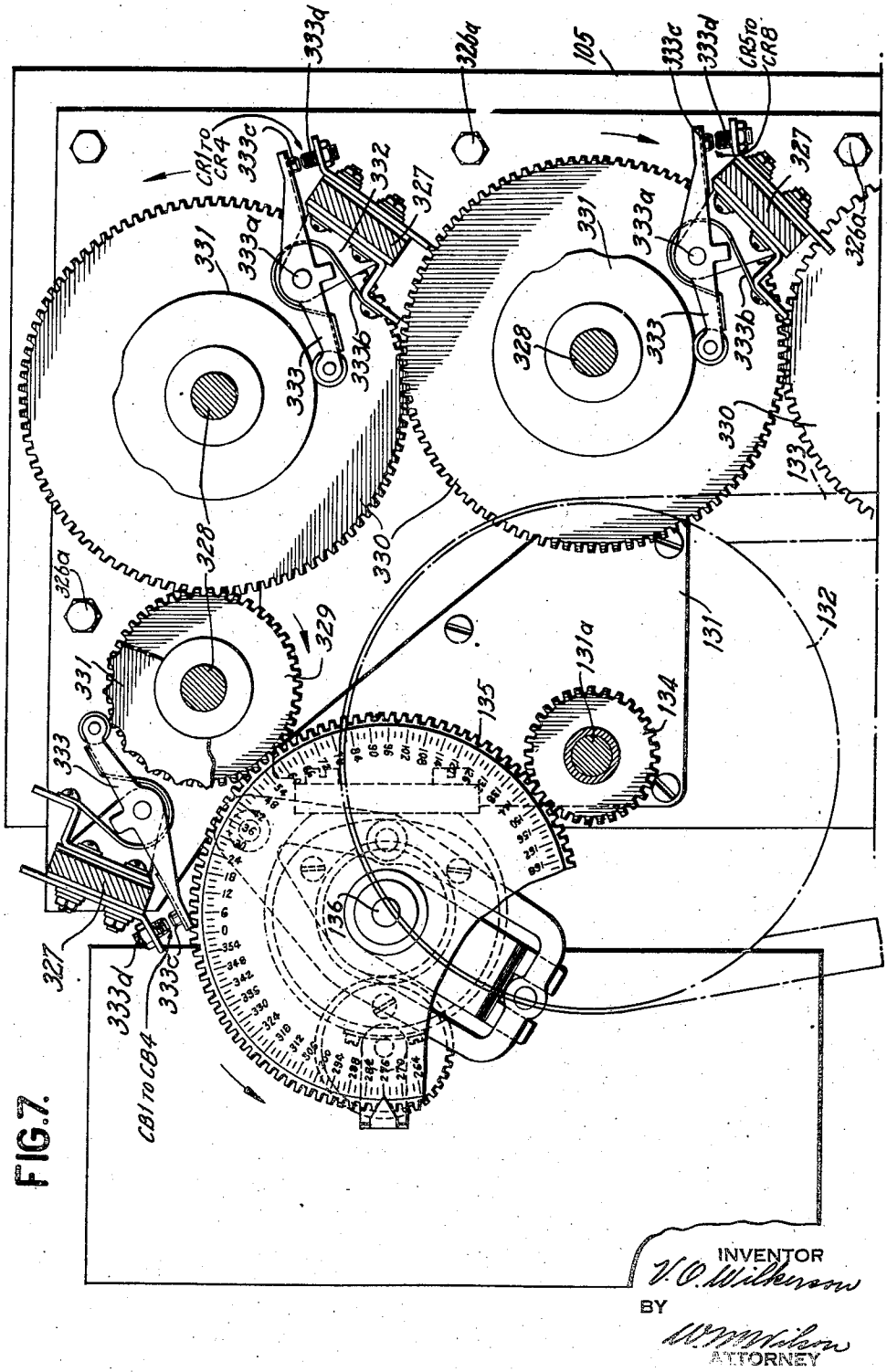


FIG. 7.

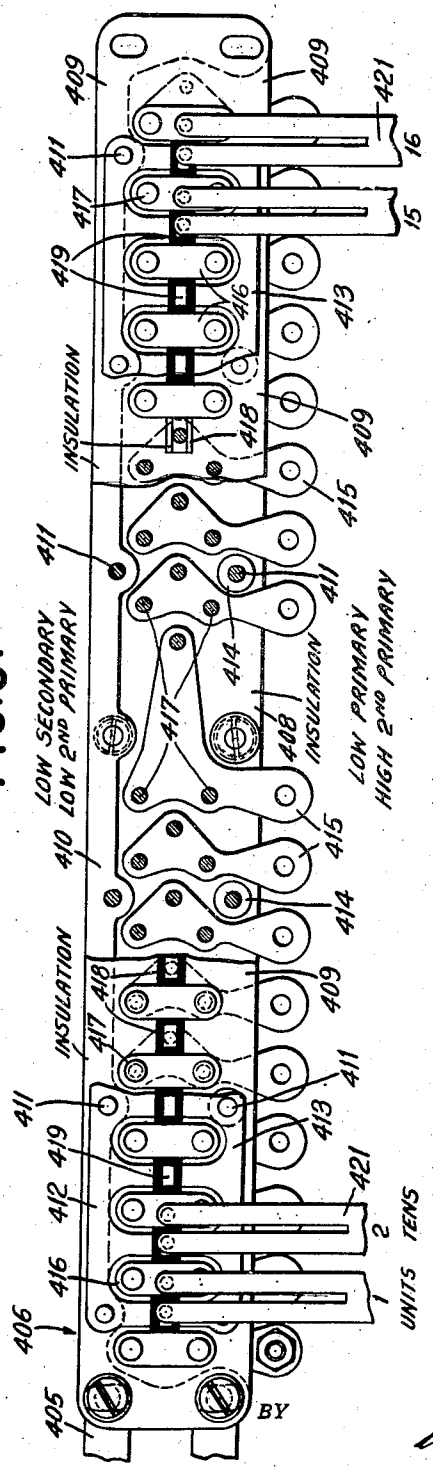
INVENTOR
V. O. Wilkerson
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Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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FIG. 9.



INVENTOR.
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FIG.10a.

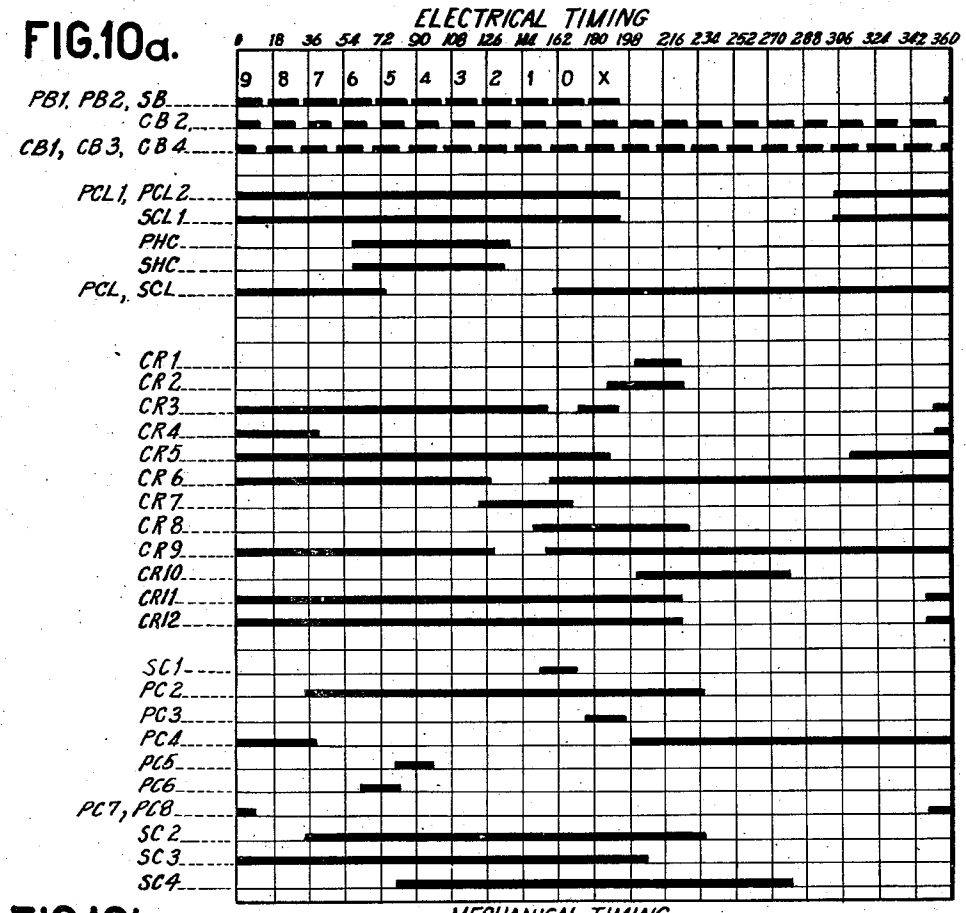
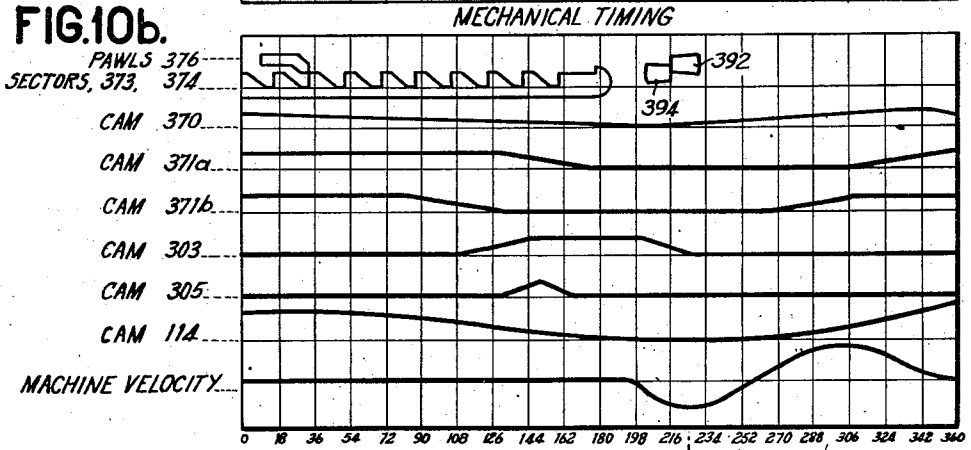


FIG.10b.



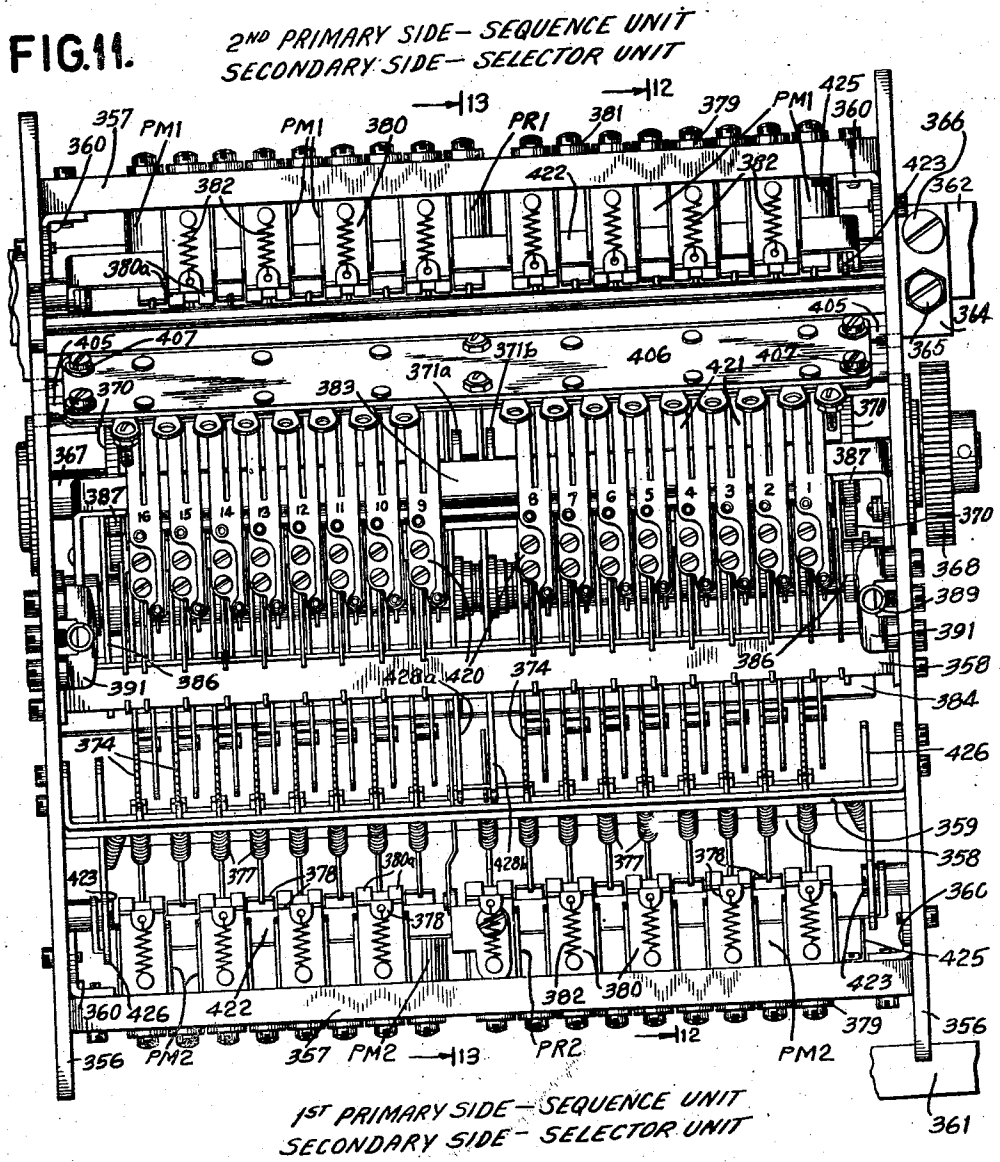
INVENTOR
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ATTORNEY

Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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FIG. 11.



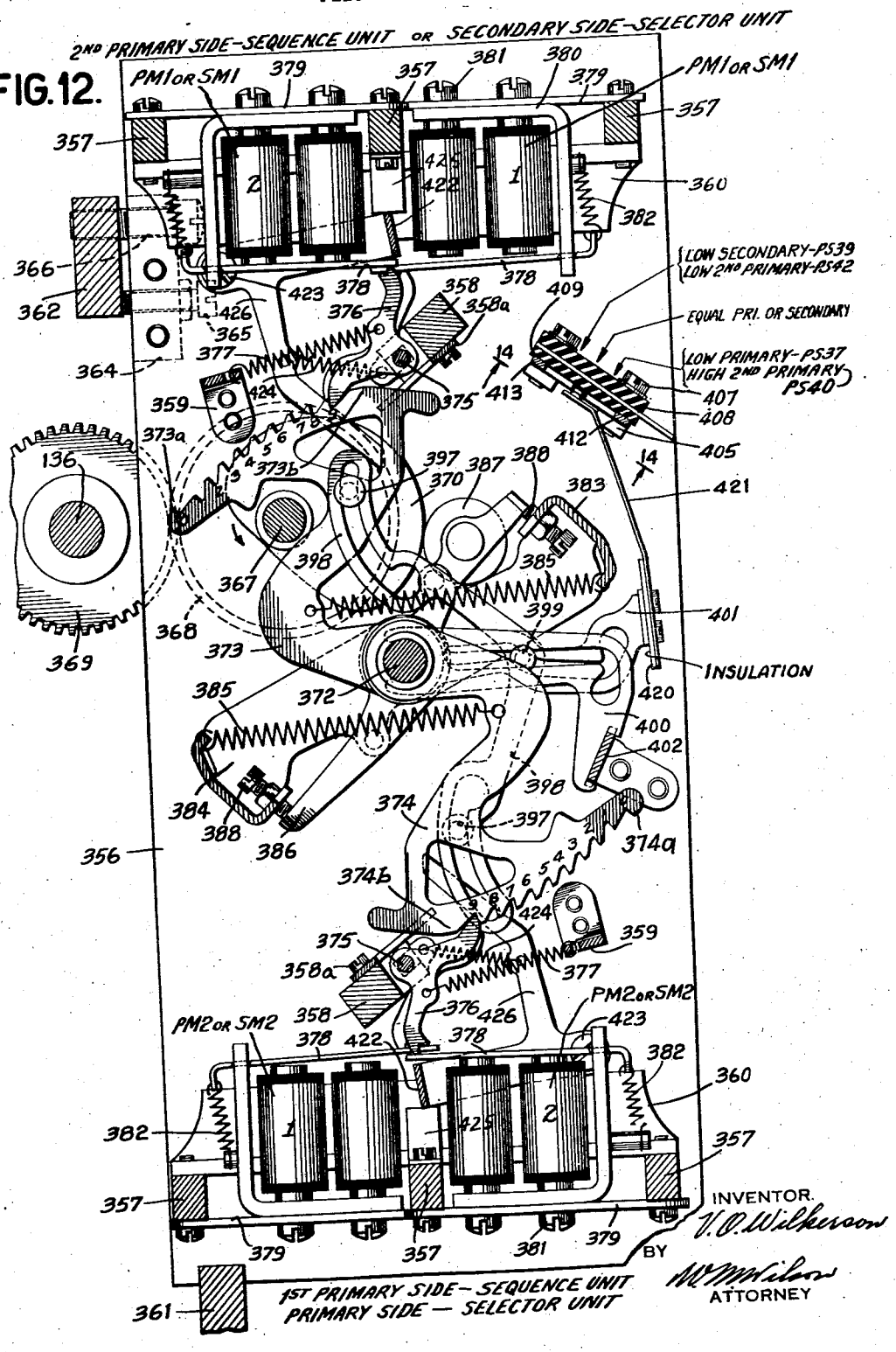
INVENTOR
V. O. Wilkerson
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Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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FIG. 12.

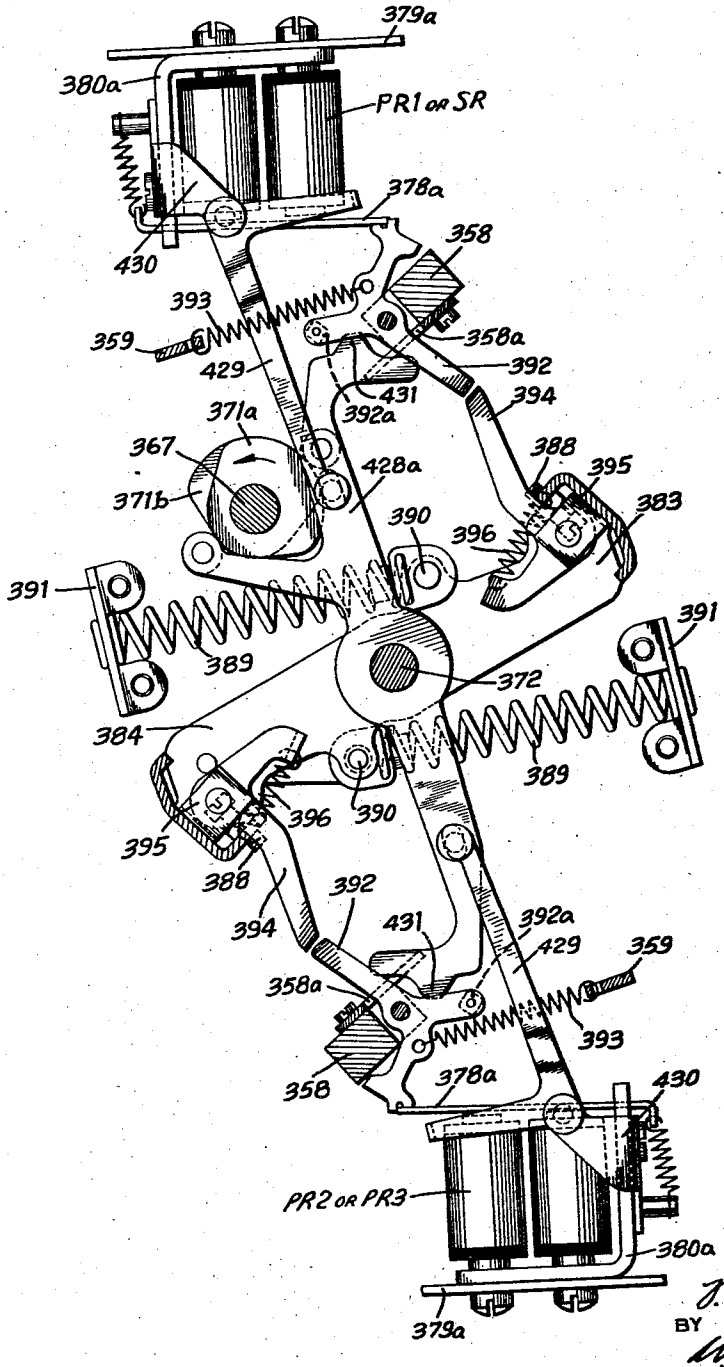


Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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FIG.13.



INVENTOR
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Oct. 1, 1946. V. O. WILKERSON 2,408,715

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FIG.14.

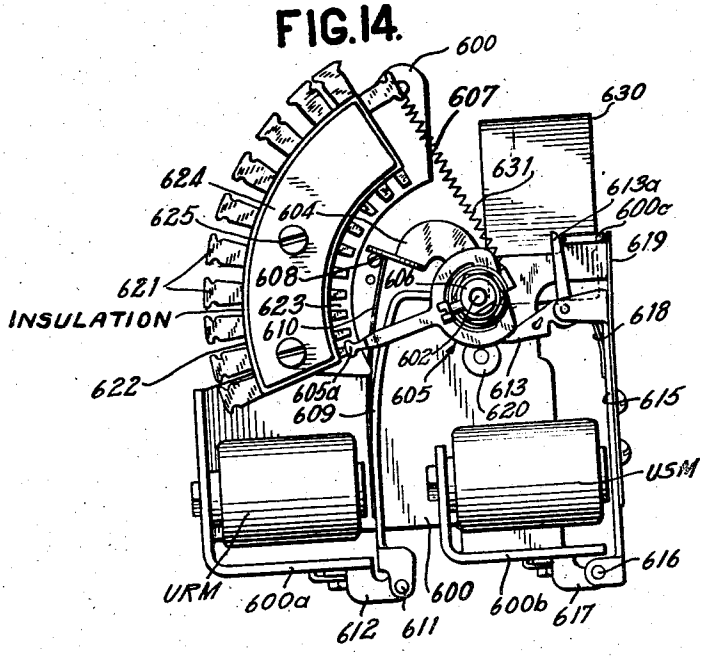
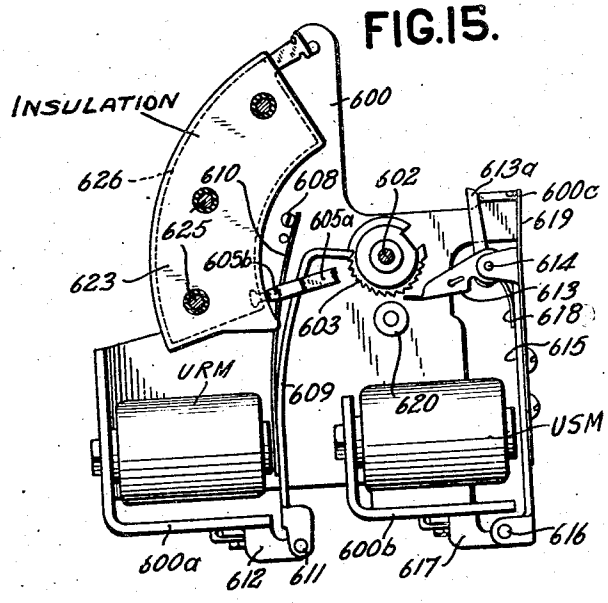


FIG.15.



INVENTOR
V. O. Wilkerson
BY
W. M. Wilson
ATTORNEY

Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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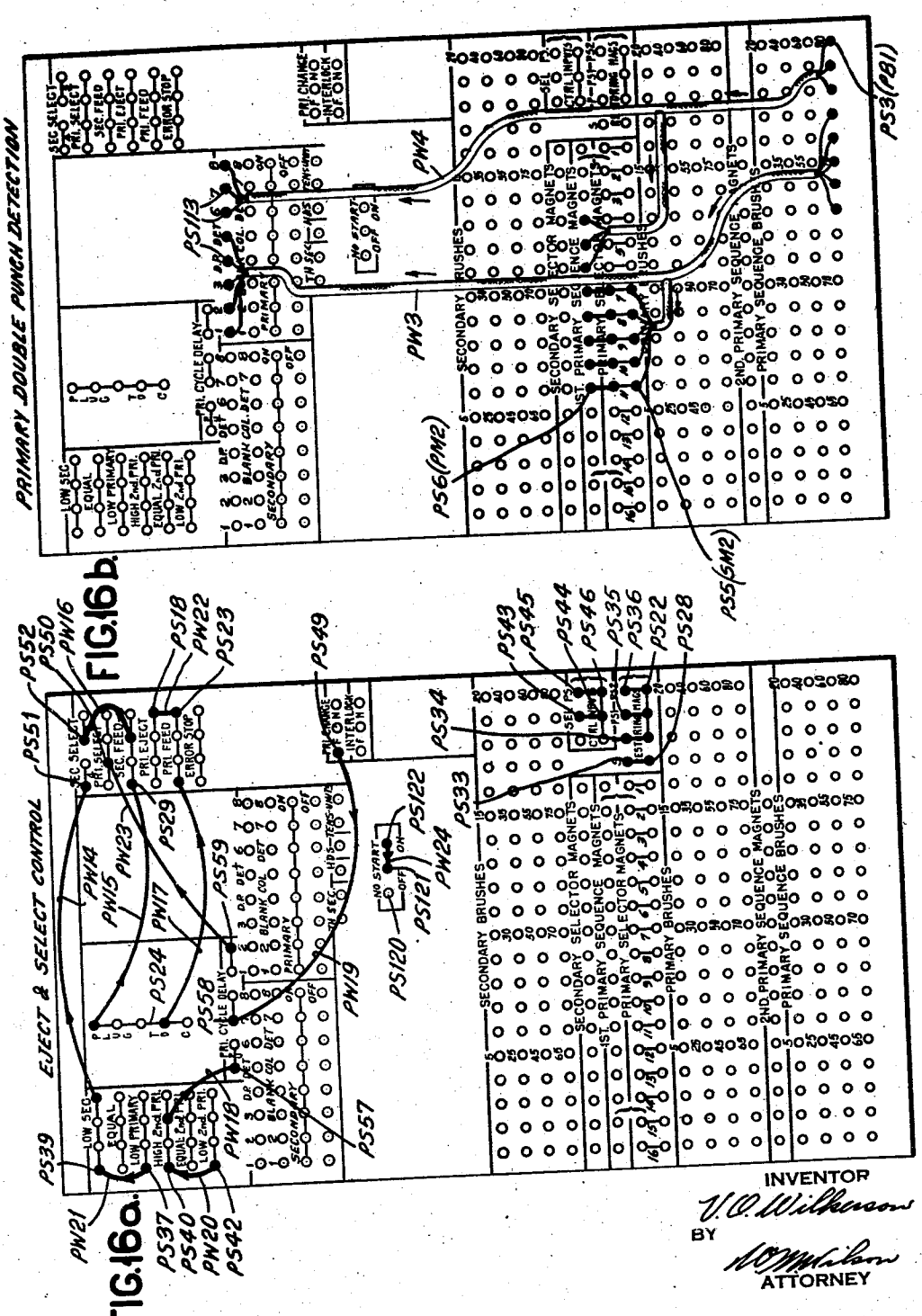


FIG. 16b.

FIG. 16a.

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Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

Filed Nov. 14, 1942 25 Sheets-Sheet 23

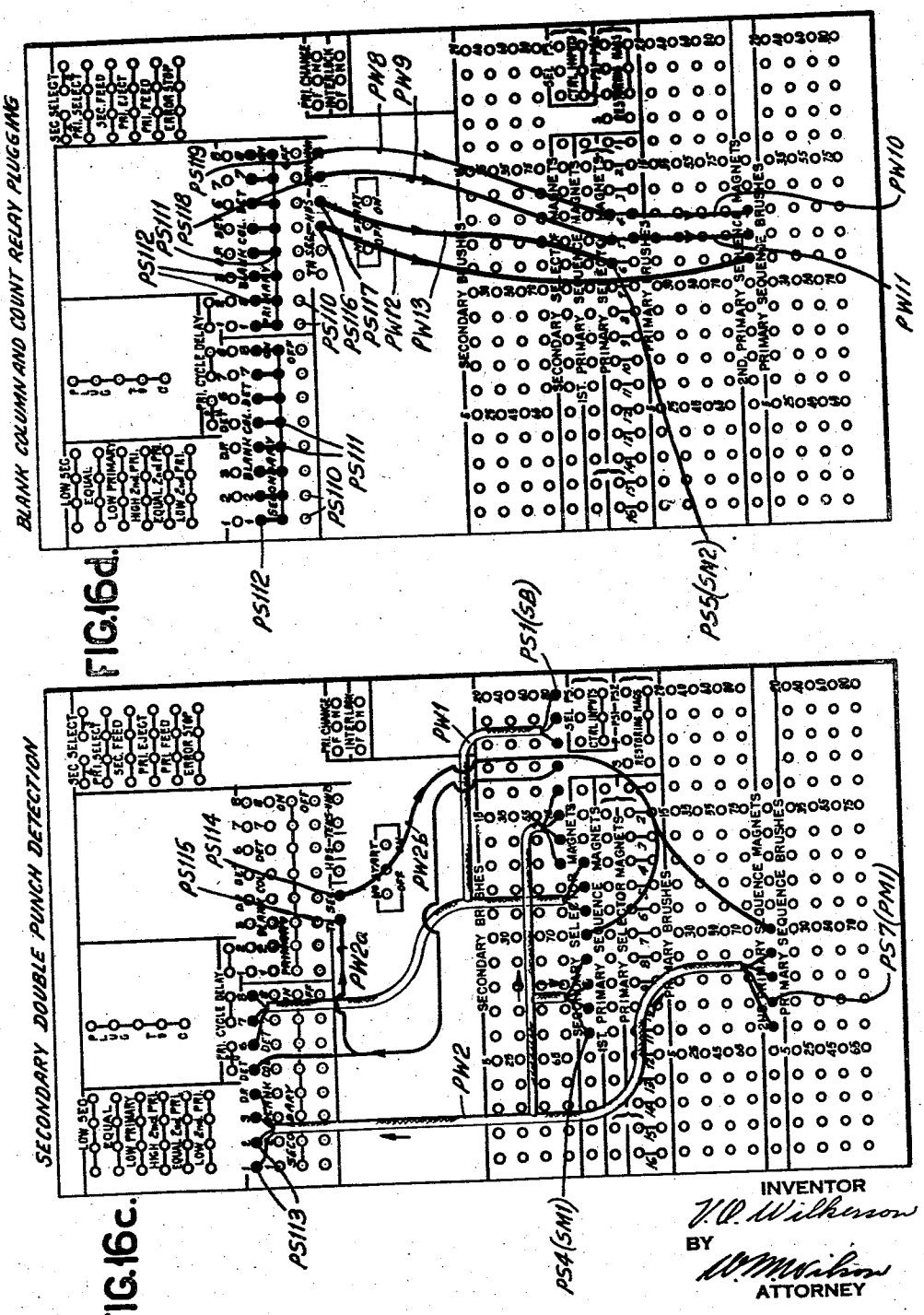


FIG. 16d.

FIG. 16c.

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Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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FIG. 17a

Oct. 1, 1946. V. O. WILKERSON 2,408,715

RECORD CONTROLLED MACHINE

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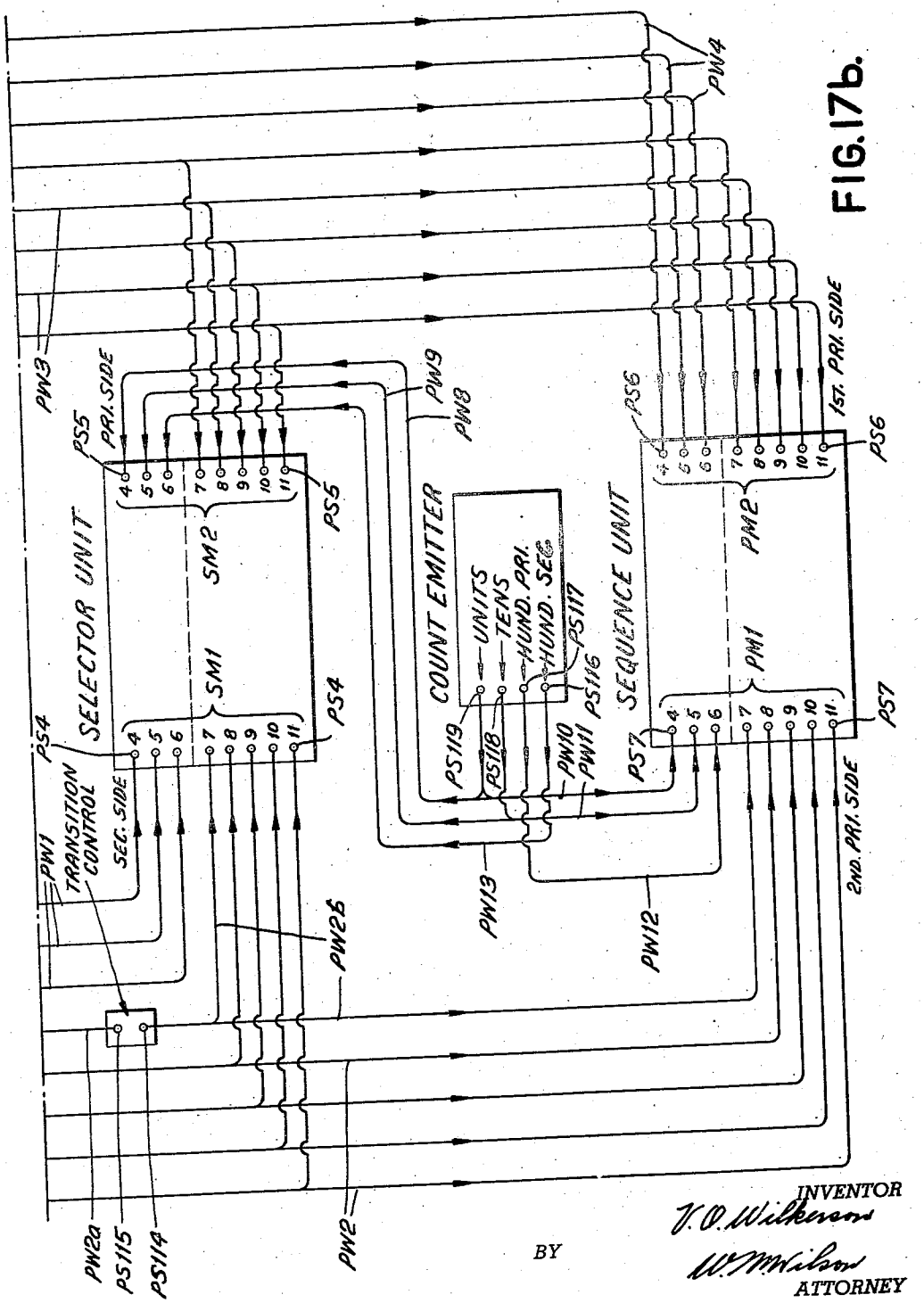


FIG. 17b.

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W. M. Wilson
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Patented Oct. 1, 1946

2,408,715

UNITED STATES PATENT OFFICE

2,408,715

RECORD CONTROLLED MACHINE

Victor O. Wilkerson, Vestal, N. Y., assignor to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application November 14, 1942, Serial No. 465,606

8 Claims. (Cl. 209—110)

1

This invention relates to record controlled card assorting machines.

The principal object of the present invention is to provide a means for checking the sequence of a series of serially numbered records such as the well known perforated record cards used in the Hollerith system of perforated card accounting.

In the manufacture of records such as the well known Hellerith perforated record cards, it is quite common for a customer to order from the manufacturer sets of serially punched cards. These sets of cards are used for many purposes such as in the preparation of inventories where each item must have a serial number and the items must be listed in order of serial numbers. In the manufacture of such sets of records at the factory, it is fairly common for errors in the sequence to occur which are often caused by the handling of the cards during the steps of manufacture and also may be caused by skipping of the serial number punching mechanism which results in duplications of numbers or gaps in the sequence. It may also happen that cards are incorrectly punched by the card punching mechanism which serially punches the cards. The application of such serially number punched sets of cards in practice is dependent upon the completeness of the set, as usually the cards are used in the order of serial numbers and the sets must often match sets of numbered forms. Thus, if a card is missing or is incorrectly punched, a great deal of annoyance results and vexatious errors in the record system result.

It is the principal object of the present invention to provide a machine which enables sets of records in sequence to be checked automatically before they are shipped to the customer to insure that all cards will be present, accurately punched, and punched with the proper numbers in serial order.

An object is to provide a serial number checking machine having provisions for selecting and segregating cards which are out of sequence or incorrectly numbered.

Another object is to provide a record card assorting machine with means to select and segregate records which are not punched or otherwise designated in columns in which they may be designated.

An object is to provide a record card assorting machine for selecting and segregating records which may have more than one designation in a column which should only have one designation.

Another object is to provide a machine capable

2

of checking the sequence of two portions of a serially numbered set at one time.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Figs. 1*a* to 1*g*, inclusive, comprise a wiring diagram of the machine.

Fig. 2 is a front elevation of the card feeding and sensing section of the machine with the front cover removed.

Figs. 3*a* and 3*b* together comprise a vertical longitudinal section.

Fig. 3*c* is a vertical section showing the hopper contacts.

Fig. 4 is a rear elevation of the card feeding and sensing section of the machine with the rear cover removed.

Fig. 5 is a large scale vertical section showing parts of the card sensing and distributing mechanism.

Fig. 5*a* is a vertical section on the line 5*a*—5*a* in Fig. 5.

Figs. 6*a* and 6*b* together comprise a plan view of the machine with the machine cover removed.

Fig. 6*c* is a plan view of the hopper contacts.

Fig. 7 is a vertical section on the line 7—7 in Fig. 6*a*.

Fig. 8 is a view in elevation of the emitter as viewed from the left in Fig. 6*a*.

Fig. 9 is a detail view of the switch mechanism for one of the comparing units.

Fig. 10*a* is an electrical timing chart.

Fig. 10*b* is a mechanical timing chart.

Fig. 11 is a large scale elevation of the sequence comparing unit as viewed from a point behind the machine.

Fig. 12 is a vertical section on the line 12—12 of Fig. 11.

Fig. 13 is a vertical section on the line 13—13 in Fig. 11.

Fig. 14 is an elevation of the units counting relay.

Fig. 15 is a vertical section showing the mechanism for rotating the wiper assembly of the units counting relay.

Figs. 16*a* to 16*d* consist of plugboard charts showing how the machine is plugged.

Figs. 17*a* and 17*b* together comprise a diagram illustrating schematically how the sequence checking operation is effected.

In the drawings the machine is disclosed as a

modified form of the one disclosed in application Serial No. 347,226, filed July 24, 1940, by D. W. Rubidge et al. It will be understood that the mechanical structure of the machine disclosed in said application has been unchanged except to the extent of providing additional circuit timing commutators on the primary and secondary card feeding shafts and of providing the selector unit with the simpler form of switching unit used in the sequence unit. The present invention has been incorporated in the machine disclosed in said application mainly by changes in the wiring and the provision of additional counting relays. It will be understood that the machine of said application has been selected purely for purposes of illustration and there is no intention to be limited to the specific form of machine selected for purposes of disclosure of the present invention.

I. *System of designating electrical parts of machine*

In describing the invention it will be found convenient, and will make the drawings more nearly self-explanatory, to designate the various controlling magnets, contacts, relays, and other electrical elements by means of capital letters derived as far as possible by taking the initial letters of the name of the magnet or other element; and where more than one of a kind is present, to distinguish them by means of numerical suffices. Thus, the relays are designated R1, R2, NR1, NR2, HSR1, HSR2, etc. Other illustrations of this system of designations are the letters EM (eject magnet), PFM (primary card feed magnet), and SFM (secondary card feed magnet).

Due to the complexity of the wiring of the machine, the wiring diagram would become a maze of crossing wires difficult to follow if it were attempted to show each relay magnet opposite the contacts it controls. Accordingly, the circuits in Figs. 1*a* to 1*g* have been laid out so as to extend as directly as possible from one line wire to the other with the relay magnets separated from their contacts. In order to avoid confusion, the contacts associated with each magnet will be designated with the same letters and numbers as the magnets plus the letters A, B, C, etc. Thus the contacts of relay R1 are designated R1A. In addition the relay magnets will be shown in dotted lines adjacent the contacts wherever the latter appear in solid lines.

II. *Framework*

The main framework comprises a heavy oblong base casting 100 (Figs. 2, 3*a*, 3*b*, 4, 6*a*, and 6*b*) supported by four legs (not shown) secured to the base. Two frame castings 102, 103 are secured to the top surface of the base 100 along the front and rear edges nearest the right hand end of the base (see Figs. 2, 3*b*, 4 and 6*b*). The frame castings 102, 103, which are more or less alike but irregular in outline, extend upwardly and to the left. The left hand ends of both frame castings 102, 103 are secured to the upper ends of a pair of vertical bars 104 (Figs. 2, 3*b*, 4 and 5) which are secured to base 100. An end plate 105 (Figs. 3*a* and 6*a*) is secured to base 100 near the left hand end thereof and extends at right angles to the planes of frame castings 102, 103. Front and rear plates 106, 107 (Figs. 2, 3*a*, 3*b* and 6*a*) are secured to the front and rear vertical edges of plate 105, respectively, and to the frame castings 102, 103. Two pairs of

frame castings 108, 109 (Figs. 3*b* and 6*b*) join the frame castings 102, 103 and form part of the two card hoppers which will be described hereinafter.

The framework mounted on base 100 just described supports the card feeding, sensing, comparing, distributing and analyzing mechanisms, and the card pockets and hoppers.

The legs attached to the base support a framework (not shown) on which are mounted the driving motor and, where direct current is not available, a suitable motor generator. The relays, fuse box, a terminal board and other usual appurtenances of an electrically controlled machine are also wholly or partly supported by this framework or partly by the base.

The usual hinged glass shelf 117, with which sorting machines and other record controlled machines are commonly equipped, is provided above the card pockets. This consists of a sheet of plate glass secured in a frame 118 (Figs. 2, 3*a*, and 3*b*) pivoted on conical studs 119, one of which is threaded into a hole in plate 105 (Fig. 3*a*) while the other is similarly mounted on a bracket 120 secured to rear frame casting 103 (Figs. 3*b* and 5). The shelf 117 thus can be swung upwardly and rearwardly to remove cards which may become jammed above the pockets.

III. *Card Hoppers*

The machine is provided with two separate card sensing and feeding mechanisms for control by two separate batches of perforated record cards, consequently two card hoppers are provided. The record cards used in this machine may be of the well known type now used in the Hollerith system of perforated card accounting. The size of the card and the number of columns available for recording data is unimportant but the machine will be described herein as designed for control by eighty column cards like the one described and claimed in Patent No. 1,772,492. The machine is easily adapted for control by either 34 or 45 column cards, this requiring merely a change in the spacing of the card sensing brushes in the case of 45 column cards, and in addition, a change in the dimensions of the card hoppers in the case of 34 column cards.

As a means of distinguishing them, the hoppers will be termed the primary and secondary hoppers, and the adjectives "primary" and "secondary" will also be used in naming the cards placed in these hoppers, and in designating the card feeding, sensing, and comparing mechanisms, and other parts associated with the hoppers or controlled by the respective cards. It will be understood that the words "primary" and "secondary" as used herein are employed purely as a convenience in description for the purpose of identifying the parts of the machine and the records and have no special significance. Thus, the cards which in one case may be placed in the primary hopper and become primary cards for a specified type of operation, may at another time be placed in the secondary hopper and thereby become for the moment secondary cards for a different type of operation.

The primary hopper is generally designated PH while the secondary hopper is designated SH in Figs. 2, 3*b*, 4 and 6*b*. These hoppers and the card picker mechanisms associated therewith are constructed in a well known way, having been used for a number of years in "International" record controlled machines, such as sorting machines, reproducers, and multiplying punches. Conse-

quently, only a very brief description of the hoppers will be given herein. Both hoppers are alike in details of construction and differ only in that the primary hopper PH is inclined owing to the fact that the cards from the two hoppers are fed to a common point for distribution to the card pockets.

Each pair of frame plates **108**, **109** forms the bottom and one side of one of the hoppers. Two sheet metal card guides **121** (Figs. 2, 3*b*, and 6*b*) are secured to the top of each frame casting **108** adjacent frame castings **102**, **103** and serve to guide the ends of the cards. Two posts **122**, etc., are also secured to the edges of each frame casting **108** opposite the frame castings **109** and guide the right hand or trailing edges of the cards, while two metal strips **123** (Figs. 3*b* and 6*b*) secured to the right hand face of each frame casting **109** guide the leading edges of the cards. When the cards are placed in the hoppers the lowest card lies partly on top of ribs **108***a* (Fig. 6*b*) formed in the frame castings **108** and also on picker guides **124** secured to said castings.

Card pickers **125** (Figs. 3*b* and 6*b*) of well known construction are provided having the usual picker knife **125***a* and are guided for reciprocatory movement by the guides **124**. Each picker **125** is provided with rack teeth meshing with gear segments **126** secured to shafts **127** journaled in frame castings **102**, **103**, there being two pickers **125**, two segments **126**, and one shaft **127** associated with each hopper. The usual adjustable throat knife **128** (Fig. 6*b*) and throat block **129** are provided to prevent feeding more than one card at a time from each hopper. In order to keep the cards flat in the hoppers, the latter are provided with the usual follower weights **130** (Figs. 3*b* and 6*b*). In Fig. 6*b* the secondary cards and the secondary hopper follower weight have not been shown in order to illustrate the construction of the secondary hopper more clearly.

One or both shafts **127** are oscillated at regular intervals to push one card from the associated hopper to the left in Fig. 3*b* into position to be gripped by feed rollers to be described later. The means for oscillating the shafts **127** will be described in part IV dealing with the driving mechanism.

IV. *Driving mechanism*

The driving mechanism is shown in Figs. 4, 6*a*, 6*b*, and 7. A bracket in the form of a casting **131** is secured to the left hand face of frame plate **105** (Figs. 6*a* and 7) and mounted on this casting is a stud **131***a* on which is journaled a driven pulley **132** connected to the main driving motor (not shown) by a belt **133**. When the machine is in use, the pulley **132** is continually driven by the motor. Secured to pulley **132** (Fig. 7) is a pinion **134** meshing with a gear **135** which is loose on the main drive shaft **136**. The latter is journaled in bearings **137**, **138** (Fig. 6*a*) secured to the casting **131** and plate **107**, respectively. Gear **135** and shaft **136** are coupled by mechanism disclosed in Patent No. 2,174,705, which causes the speed of the drive shaft **36** to vary between maximum and minimum limits.

Coaxial with shaft **136** (Figs. 4 and 6*b*) is the secondary feed shaft **139** journaled in two bearings **140** secured to the rear face of frame casting **103**. The primary feed shaft **141** is journaled in three bearings **142**, also secured to frame casting **103**, and makes an angle of approximately 24° with shafts **136**, **139**, the extreme right hand bearings **142** (Fig. 4) being located so that the right hand end of shaft **141** extends quite close to the left hand end of shaft **136**. Secured to the left hand end of shaft **136** (Fig. 4) is a bevel gear **143** meshing with the bevel gear **144** loosely mounted on shaft **141**. Obviously bevel gear **144** rotates continually at a varying speed while the machine is in operation.

V. *Card feed clutch mechanism*

The feed shafts **139**, **141** may be selectively clutched to shaft **136** by means of two one-revolution clutches generally designated **145** and **146**, termed the primary and secondary feed clutches respectively. The clutches **145** and **146** are controlled by two magnets designated PFM and SFM in Fig. 4, and called the primary and secondary feed magnets, respectively. Both of these clutches are shown in Fig. 4 and appear directly to the left of the bevel gears **143**, **144**. The lower of these clutches in Fig. 4 is the primary feed clutch while the secondary feed clutch is located directly above the primary feed clutch and are of a form now well known in the art. The mechanism of the two clutches and the clutches are identical except that the parts of the primary clutch are reversed in location and direction of movement relative to the secondary clutch due to the fact that gears **143**, **144** rotate in opposite directions and due to limitations of space which preclude mounting the magnets and other parts in the same relative positions with respect to the associated feed shafts. Thus the corresponding parts of the clutch mechanisms are symmetrically located with respect to the bisector of the angle between shafts **139**, **141**. Since the specific construction of the clutches is not material to the present disclosure, they will not be described in detail. The clutches are described in detail in the Page application. It will suffice to state that each time the magnet SFM or PFM is energized, shaft **139** or **141** is clutched to the main drive shaft **136** and will continue to rotate as long as the magnet is kept energized or repeatedly energized.

VI. *Card feed rollers*

Two independent feed mechanisms are provided for feeding the cards from the hoppers to the point where the distribution of the cards to the pockets is determined and, in addition to these feed mechanisms, a common feed mechanism for conveying the cards to the pockets is provided. The first two feed mechanisms are driven by shafts **139**, **141** and will be termed the secondary feed mechanism and primary feed mechanism, respectively, while the third feed mechanism is driven by shaft **136** and will be called the pocket feed mechanism. These feed mechanisms are conventional in details of structure.

The primary and secondary feed mechanisms are essentially the same in direction of feed, details of construction and general arrangement, but there are more feed rollers in the primary card feed mechanism than in the secondary feed mechanism since the primary cards sometimes must be sensed twice whereas the secondary cards are only sensed once prior to their distribution to the pockets. The primary and secondary feed mechanisms will be described first and are shown in Figs. 2, 3*b*, 4, 5 and 6*b*. The description will begin with the hoppers and follow the paths of the cards to the point of distribution to the pockets.

Secured to each shaft **127**, which it will be recalled are rockable to actuate the card pickers **125**, is an arm **163** (Figs. 3*b* and 4) having a

roller in a cam groove 164 formed in a gear 165. Gears 165 may be journaled on frame casting 103 in any suitable way as by means of studs 168 or long shafts supported by both frames 102, 103. The gear lowest or primary 165 meshes with an idler gear 169 (Fig. 4) journaled on a stud 170 carried by frame casting 103. Gear 169 meshes with a gear 171 secured to a feed roller shaft 172 journaled in anti-friction bearings 173 carried by the frame castings 102, 103 adjacent the primary hopper PH (see Figs. 2 and 3b). The secondary gear 165 meshes directly with a gear 171 secured to a similar feed roller shaft 172 journaled in bearings 173 adjacent the secondary hopper SH. Secured to the respective shafts 172 are spiral gear pinions 174 meshing with spiral gears 175 fixed to the shafts 139, 141, respectively. Thus the feed roll shafts 172 may be driven in unison but in opposite directions while pickers 125 are driven in unison but in the same direction by shafts 139, 141 through the two trains of gearing just described.

Each feed roll shaft 172 is provided with card feeding rollers 176 cooperating with similar rollers 177 secured to a shaft 178 (Figs. 3b and 6b). The shafts 178 are journaled in arms 179 (see Fig. 2 also) pivoted at 180 in suitable recesses formed in the front faces of the castings 102, 103. Shafts 178 project through large openings 180a in the frames 102, 103.

Housed in holes in the frame castings 102, 103, at an angle to the bore of openings 181, are spring pressed plungers 182 (Figs. 2 and 3b) which, by engagement with the ends of arms 179, press rollers 177 into firm contact with rollers 176. This general scheme of mounting one feed roll shaft in fixed bearings and the other on spring actuated arms has been used for all the feed rollers. Due to limitations of space and other reasons, the means whereby the spring pressure is applied will vary in details of construction. The two sets of feed rollers 176, 177 rotate whenever the respective feed shafts 139, 141 turn and grip the cards advanced from the hoppers PH and SH and convey said cards toward the left (Fig. 3b) to a position to be gripped by the next set of feed rollers associated with the respective hoppers.

Certain of the remaining feed rollers of the primary and secondary feed mechanisms are journaled in fixed bearings carried by the frame castings 102, 103 in the same general fashion as the rollers 176 but the coacting rollers of each feed mechanism are mounted on a pivoted frame to permit removal of cards which fail to feed properly or jam in the feed mechanism. There is one of these pivoted frames for each feed mechanism, the one for the secondary feed mechanism being arranged to swing upwardly while the other swings downwardly. The two frames are substantially alike in details but the one for the primary feed mechanism is longer due to the greater number of feed rollers required for feeding the primary cards PC.

Journaled in fixed anti-friction bearings 173 (Figs. 2, 3b and 4) in the frame castings 102, 103 are two pairs of feed roller shafts 172a, 183, for the primary feed mechanism and one pair similarly designated for the secondary feed mechanism. Feed rollers 184, like the feed rollers 176 are secured to shafts 172a, while to the feed roller shafts 183 are secured metallic contact rollers which are insulated from the shafts 183 (see Fig. 5 also). The contact rollers for the primary feed mechanism are designated PCR1, PCR2 while the one for the secondary feed mechanism is designated SCR. The contact rollers PCR1, PCR2, SCR, and feed rollers 184 are driven from the respective feed shafts 139, 141 by spiral gears 185 (Fig. 4) secured to said shafts and meshing with spiral gear pinions 186 secured to the shafts 182, 183.

Cooperating with the feed rollers 184 on the shaft 172a nearest the primary hopper PH (Fig. 3b) are feed rollers 187 on a shaft 188 which is mounted on frame castings 102, 103 in the same fashion as the feed roller shafts 178 by means of arms 179 actuated by spring pressed plungers 182. The feed rollers cooperating with the contact rolls PCR1, PCR2, SCR and with the remaining feed rollers 184 are all mounted on the pivoted frames mentioned above.

These frames are shown in Figs. 3b, 5, and 6b. They include a pair of side plates 189, in the case of the primary feed mechanism, and a pair of side plates 190 in the case of the secondary feed mechanism. These pairs of plates are rigidly joined together, in each case, at the ends nearest the hoppers, by means of tubes 191, and along the edges of the plates by a number of angle strips 192. At the ends opposite the hoppers, the plates 189, 190 are pivoted to the confronting faces of frame castings 102, 103 by means of screw studs 193. The ends of tubes 191 are provided with spring pressed bolts 194 (Figs. 3b and 6b) having knurled finger pieces 195 working in slots in the tubes 191 which bolts enter the bore of hardened steel bushings 196 pressed into holes (Figs. 2 and 4) in the frame castings 102, 103. The right hand end of the frame of which plates 189 are part can be lowered by pressing the finger pieces 195 of the bolts 194 associated with these plates toward each other to release the bolts. Similarly the right hand end of the frame including plates 190 may be raised.

Cooperating with the feed rollers 184 immediately to the right of the contact rollers PCR2, SCR are feed rollers 197 (Figs. 3b and 6b) secured to shafts 198. The ends of shafts 198 extend through large holes in the respective plates 189, 190 and are journaled in bearings carried by the arms of bell cranks 199 pivoted on plates 189, 190. Springs 200, attached to the other arms of bell cranks 199 and to pins carried by plates 189, 190, respectively, urge the feed rollers 197 into contact with feed rollers 184. The holes in plates 189, 190 through which shafts 198 project, permit a small amount of movement of feed rollers 197 away from rollers 184 to allow for the thickness of the cards and the walls of said holes act as stops to prevent the rollers 197 from becoming displaced from their proper positions more than a small amount when the frame units of which plates 189, 190 form part are lowered or raised, respectively. Cooperating with the contact rollers PCR1, PCR2, SCR are feed rollers 201, most clearly shown in Figs. 5 and 6b, which are made of some form of insulating material, such as "Bakelite," mounted on shafts 202. These shafts are mounted in bearings on the short arms of bell cranks 203 pivoted in the plates 189, 190 and operated by springs 203b which urge rollers 201 into engagement with the contact rollers PCR1, PCR2, SCR. The shafts 202 for the feed rollers 201 work in open slots in the plates 189, 190 to permit removal of the feed rollers when desired. In order to prevent the feed rollers 201 from moving far enough to damage the card sensing brushes or unhook the springs 203b when the frames including plates 189, 190 are lowered or

raised, respectively, adjustable stops 203*a* are provided to limit movement of the arms 203 supporting the feed rollers to an amount a little more than is sufficient to compensate for the thickness of the cards and allow for reasonable wear.

Cooperating with each contact roller PCR1, PCR2, SCR is a pair of contact roll brushes, these pairs of brushes being designated PCB1, PCB2, SCB (Fig. 1*a*) for the respective contact rollers. As shown in Fig. 2, each pair of brushes is mounted in the end of a metallic terminal post 102*a* the latter having two parallel slots in which the brushes are clamped. The posts 102*a* extend through large holes in the frame casting 102 and are secured in the ends of short bars 102*b* of insulating material mounted on the frame casting 102.

The various feed rollers described above, including the contact rollers, all have the same diameter whereby the primary and secondary cards will be fed at a uniform speed and in exact synchronism. Shafts 139, 141 drive these feed rollers by means of spiral gears 175 and spiral pinions 174 as in the case of the feed rollers 176, 177 (Figs. 4 and 6*b*). Dependence is not placed on friction between the cards and the feed rollers to feed the cards accurately but each coacting pair of feed rollers is geared together for driving purposes by a pair of spur gears 205 (Figs. 3*b*, 5, and 6*b*) secured to the feed roller shafts.

The distribution of the cards to the pockets is determined at the point where the primary and secondary lines of feed meet. The space between this point and brushes SB, PB2 may be termed the eject station. Here the primary and secondary cards are gripped by the eject feed rollers, designated 206, 207 in the case of the primary feed mechanism, and 208, 209 in the case of the secondary feed mechanism. These feed rollers are most clearly shown in Figs. 5 and 6*b* while their driving connections are best shown in Figs. 2 and 4. The feed rollers 206 and 208 are mounted in the frame castings 102, 103 on shaft 210 which are mounted like the feed rollers 177 in arms 179 actuated by spring pressed plungers 182. The feed rollers 207, 209 are mounted on anti-friction bearings supported by a shaft or rod 212 carried by frame castings 102, 103 intermediate shafts 210, 211, the anti-friction bearings being prevented from moving axially of shaft 212 by some simple means such as wire snap rings or spring clips 212*a* (Fig. 5) sprung into grooves in the shaft 212, there being a pair of spring clips for each roller 107, 109. Rollers 206, 207 and 208, 209 are not geared together as at this point in the feed of the primary and secondary cards it is not necessary that they be fed exactly in synchronism hence frictional contact of the eject feed rollers with the cards is sufficient properly to feed the cards.

The secondary eject feed rollers 208, 209 are driven by the secondary feed shaft 139 through a train of gears designated 213, 214, 215, 216 in Figs. 2 and 6*b*. In this train, gears 213 is secured to the secondary contact roller shaft 183 driven by shaft 139; gears 214, 215 are idler gears mounted on studs carried by a plate 217 secured to frame casting 102; while gear 216 is secured to the shaft 211. Thus eject feed rollers 208, 209 rotate when the secondary feed shaft 139 turns.

The primary eject feed rollers 206, 207 are driven by the main shaft 136 through a one revolution clutch controlled by a magnet designated EM in the drawings and hereinafter to be called the eject magnet. The first pair of pocket feed rollers is designated 218, 219 in Figs. 3*b*, 5, and 6*b* and are mounted on shafts 220, 221, respectively, which shafts are rotatably mounted in frame castings 102, 103 in the same general fashion as shafts 172, 172*a*, 178, 188 with correspondingly designated parts. Shaft 220 is driven by a spiral gear pinion like the pinions 172 in Fig. 4 secured to shaft 220 and meshing with a spiral gear like 175 fixed to shaft 136 (Fig. 6*b*).

Secured to shaft 220 is a gear 222 (Fig. 2) meshing with a gear 223 rotatably mounted on a stud 224 carried by frame casting 102. A gear 225 is loosely mounted on stud 224 and meshes with a gear 226 fixed to shaft 210. The eject clutch is located between gears 223, 225 and is quite similar to the primary and secondary feed clutches. The magnet EM is mounted on a bracket 236 secured to the front face of the frame casting 102. The eject clutch is engaged when magnet EM is energized and operates like the primary and secondary feed clutches. It is believed a description of the operation of the eject clutch is unnecessary, particularly as this type of one revolution clutch is now well known in the art of construction perforated record card controlled machines. All of these clutches are fully described in the Page application.

Three pairs of pocket feed rollers are provided to the left of the pocket feed rollers 218, 219 and are designated 240, 241 in Figs. 3*a*, 3*b*, 6*a*, and 6*b*. Feed rollers 240 are secured to shafts 242 mounted in fixed bearings 173 carried by the plates 106, 107 which shafts are provided with spiral gear pinions like 172 in Fig. 4 meshing with spiral gears 175 (Fig. 6*a*) on shaft 136. The feed rollers 241 may be made of rubber and are secured to shafts 243 journaled in the arms of bell cranks 199 actuated by springs 200 as in the case of the feed rollers 197. The pocket feed rollers 240, 241 are not geared together as extreme accuracy of feed is not necessary after the cards have passed the eject station. However, feed rollers 218, 219 are coupled together by gears 205 (Fig. 5).

VII. *Card guides*

The cards are supported and guided from one pair of feed rollers to the next by means of card guides which are shown in Figs. 3*a*, 3*b*, 5, 6*a*, and 6*b*. These guides consist of substantially flat bars or strips extending in the line of travel of the cards but may be bent slightly at one or both of their ends to prevent catching the cards. The guides are designated 245, 247, 248, 251, 253, 261, 263, and are mounted in various ways. The guides 245, 247, 251, 253, 261 are secured to suitable cross-bars mounted between the frames 102, 103 while the guides 248 are secured to cross-bars mounted in plates 189, 190. The guide 263 consists of a long bar extending lengthwise of plates 106, 107 above the card pockets. The bar 263 is secured to the plates 106, 107 by suitable cross bars and is located half way between the plates. At its left hand end, bar 263 is secured to plate 105 (Figs. 3*a* and 6*a*).

At the point where the cards from the primary and secondary cards meet there is provided a set of card guides consisting of four plates 254 (Fig. 5) mounted on two rods 255 carried by plates 102, 103. The plates 254 are shaped like an arrowhead to accommodate shaft 212 and their edges guide the cards over and under said shaft. The edges of a set of triangular plates 257 similarly mounted on cross rods 258 support the primary cards between the pairs of feed rollers 206, 207 and 218, 219.

VIII. *Card sensing brushes*

The holes in the cards are sensed by three groups of card sensing brushes as the cards pass the contact rollers. The primary cards are first sensed by the group of primary brushes designated PB1 and then by the group of primary brushes PB2, while the secondary brushes are sensed only by the group of secondary brushes SB. The brushes SB, PB1, and PB2 cooperate with the contact rollers SCR, PCR1, PCR2, respectively, and are so spaced that the corresponding index point positions on one secondary card and two successive primary cards are all sensed together as the respective cards are fed in unison past the respective brushes, assuming that both card feed shafts 139 and 141 are rotating. There are eighty brushes in each group since the machine as shown in the drawings is designed for control by cards having eighty columns of index point positions.

Fig. 5 shows the brushes SB and PB2 on a larger scale than Fig. 3b. The brushes SB, for example, are secured in transverse slots in a bar 268 made of insulating material, such as "Bakelite," secured in the frames 189, 190. Eye-bolts 269, through the "eyes" of which the shanks of the brushes SB project, are threaded into holes in headed sleeves or thimbles 270 located in holes in the bar 268 at right angles to the slots in which the brushes are laid. The heads of the sleeves may be slotted, as shown, or provided with square or hexagonal heads for turning the sleeves to draw up the eye-bolts tight and thereby clamp the brushes in their slots. The electrical connections are made by attaching the circuit wires 271 to plugs 272 which are pushed into the bores of thimbles 270. Due to the closeness of the spacing of the brushes, the holes for thimbles 270 and eye-bolts 269 are staggered as shown in Fig. 6b to ensure that neither the thimbles 270 nor plugs 272 can make electrical contact with each other. The feed rollers 201 are provided with eighty deep circumferential slots through which the brushes extend into contact with the contact rollers. The brushes PB1 and PB2 are similarly mounted.

In conjunction with the comparing units, the brushes may compare data on two successive primary cards and, if desired, the data on the first of the two primary cards can at the same time be compared with the data on a secondary card. Thus a dual comparison of data on three different cards can be made simultaneously in a single card feeding cycle.

IX. *Card levers*

The primary and secondary cards actuate card levers in the course of their feeding movement from the hoppers to the eject rollers 206, 207 and 208, 209. These card levers in turn actuate certain card lever contacts for controlling the operation of the machine and are shown in Figs. 2, 3b, and 6b.

The central card guide strip 247 (Figs. 3b and 6b) located between the pairs of secondary feed rollers 176, 177 and 184, 197 and between the central guide strip 245, extending between the primary contact rollers PCR1 and rollers 176, 177 (Fig. 3b only) each have mounted thereon brackets 273. Pivoted on brackets 273 are card levers 274 which are made of stiff insulating material such as "Bakelite." One arm of each card lever extends downwardly and to the left (Fig. 3b) close to the line of contact of feed rollers 184, 197, and into the paths of cards fed by feed rollers 176, 177. The other arm of each card lever 274 engages the longer of two spring contact members 274a (Fig. 6b) carrying contacts designated SCL in the case of the secondary feed mechanism. The spring contact members 274a are insulated from each other and brackets 275 by means of which the contact members are mounted on the bars 246. The contacts SCL, PCL are engaged by and rocked clockwise (Fig. 3b) to force the contacts closed.

When the leading edges of the cards are about to pass between the brushes PB1, PB2, SB and the coacting contact rollers PCR1, PCR2, SCR, further card levers are actuated. The contacts controlled by these card levers are shown in Figs. 2 and 6b and are designated PCL1, PCL2, SCL1. The spring contact members carrying these contacts are insulated from each other and brackets 276 by means of which these members are mounted on the front face of frame casting 102. Since these contacts are mounted quite close to the frame casting 102, thin sheets of fibre insulation or "Bakelite" 277 are interposed between blocks 276 and frame casting 102 and are large enough to prevent possible accidental grounds between the contact members and the frame casting 102.

Each pair of contact members is actuated by an arm 278 (Fig. 2) secured to a stub shaft 279 journaled in a tube secured in a hole in the frame casting 102. Behind the frame casting 102 card lever arms 280 are secured to stub shafts 279 and project into the paths of the cards quite close to the respective contact rollers. The arm 280 for operating contacts SCL1 is shown in Fig. 6b in plan view and is arranged to be depressed by a passing card thereby rocking the stub shaft 279 and the arm 278 operating contacts SCL1 in a counterclockwise direction (Fig. 2) to close contacts SCL1. Similarly contacts PCL1, PCL2 are closed when a card is about to pass between brushes PB1, PB2 and contact rollers PCR1, PCR2, respectively, but in this case the arms 278 are rocked clockwise, since their associated arms 280 are located above the line of feed of the primary cards instead of below and consequently are lifted by the primary cards. The card levers associated with contacts PCL1, PCL2, SCL1 thus operate to close these contacts only when a card is very close to the position where sensing of the holes is about to commence.

The primary and secondary hoppers are provided with contacts designated SHC, PHC in Fig. 1a which are opened whenever cards are placed in the hoppers and are closed whenever the hoppers become exhausted of cards. The construction of these contacts is shown in Figs. 3c and 6c. The underside of each casting 108 is provided with a bracket 108a on which is pivotally mounted a lever 278a. One arm of each lever 278a extends upwardly through a slot in the casting 108 as shown in Fig. 6b, whereby the lever will be rocked clockwise (Fig. 3c) whenever cards are placed in the secondary hopper, for example. One arm of the lever 278a engages one of the members supporting the contacts SHC and presses such contacts apart whenever the lever is rocked clockwise. The members carrying the contacts SHC are supported on a bracket 108b which is secured to casting 108.

These contacts are used for two purposes; one to automatically condition the machine for operation under control of cards from either one or both feeds and second to stop the machine when cards become exhausted before the last card

which leaves the exhausting hopper can enter the brushes SB1, PB1 in order to enable the operator to replenish the card. The temporary exhaustion of cards from either hopper does not, as was formerly the case, cause a hiatus in the operation of the machine, since the operator can now place more cards in the hoppers and the machine will resume feeding cards without leaving a gap other than the normal short gap which exists between cards. Were it not for the provision of the contacts SHC, PHC and circuits controlled thereby, the machine would continue to run until the card levers SCL1, PCL1 open and, when more cards are placed in the hopper, the new cards would be unable to close the one cycle gap which would exist between the first of the new cards in the hopper and the last card which left the hopper.

X. *Card pockets*

Four card pockets are provided to which the cards are selectively distributed by the card distributing mechanism in accordance with the comparison of data on the cards. The pockets are shown in Figs. 2, 3*a*, 3*b*, 5, 6*a*, and 6*b* and are designated as follows: SRJ the secondary reject pocket; SF, split pair pocket; MS, merged sets pocket; and PRJ, primary card reject pocket. The pockets PRJ and SRJ receive the rejected primary and secondary cards. The split pair pocket SP receives the secondary cards which are paired or matched with primary cards having the same data but which are to be kept separate from the associated primary cards, hence the convenient short name. Pocket MS receives the matched or paired primary and secondary cards when they are to be kept together and not split between the pockets SP and MS. Pocket MS also receives the primary cards which are to keep the secondary cards separate from the corresponding primary cards. Pocket MS will also receive all cards when one set of cards is to be filed with another set in numerical sequence.

It is desired to point out that the names given the pockets is purely for convenience in description because as will be shown later, the cards which fall in primary reject pocket PR, in certain types of operation of the machine, may be the ones it is desired to select for use in preparing a statement on a tabulating machine and the ones that fall in pockets MS or SP may or may not be used after the operations are finished. In other words, the term "reject pocket" for pockets SR and PR does not necessarily mean that the cards falling in these pockets are not used for any purpose.

The construction of the pockets is old and well known, having been used in "International" record controlled machines for some time, for this reason the pockets will not be described in minute detail.

The side walls of the pockets consist of the end plate **105** (Figs. 2, 3*a*, 3*b* and 6*a*) three partition plates **281**, and an end plate **282**.

The back walls of the pockets are formed of a plate **285** secured to the back of the machine. Associated with each card pocket is a card platform **286** secured to a tube **287** which slides in a tube **288** secured in a hole in base **100**. A long coil spring in each tube **288** exerts an upward force on tube **287** sufficient to balance the weight of tube **287** and card platform **286**. As the cards accumulate on the tops of the card platforms their weight causes the platforms and tubes to descend until the pocket eventually becomes full.

When any pocket becomes full, it operates the usual full pocket stop contacts designated FPC in Fig. 3*a*. These contacts are carried by spring contact members insulated from each other and the plate **285** on the rear face of which they are mounted just behind the secondary reject pocket SRJ (Figs. 3*a* and 6*a*). The contacts are closed when no pocket is full but are opened by means of an arm **289** secured to a shaft **290** journaled in bearings **291** mounted on base **100** behind plate **285**. Arm **289** is curved forwardly through an opening **285***a* in plate **285**, upwardly, and thence rearwardly through a hole **285***b* in plate **285** and is provided with an insulating pin engaging the rear side of the rear contact member of contacts FPC. Secured to the shaft **290** behind each pocket are arms **292** which extend forwardly into the path of the associated card platforms **286**. A spring **293** (Fig. 3*a*), attached to a pin on arm **289** in front of plate **285** and to a pin secured to said plate, holds said arm against plate **285** so as to keep contacts FPC open, the rear spring contact member being biased so as to tend to move forwardly to close the contacts.

When a pocket becomes nearly full, its platform engages the associated arm **292** and, with the addition of a few more cards, the platform moves arm **292** downwardly. This causes arm **289** to move forwardly permitting contacts FPC to open.

XI. *Card distributing mechanism*

The disposition of the cards to the pockets SRJ, SP, MS, PRJ is effected by card distributing mechanism. This mechanism is shown in detail in Figs. 3*a*, 3*b*, 5, 5*a*, 6*a* and 6*b*, and is controlled by three magnets designated PRM and SRM1, SRM2, hereinafter termed the primary and secondary reject magnets, respectively. The mechanism directly associated with these magnets is most clearly shown in Figs. 5 and 6*b*. The construction of the magnets and the mechanism individual to each are practically identical but the location and direction of movement of the corresponding parts is reversed as these magnets are located on opposite sides of the lines of feed of the cards in the respective feed mechanisms. The parts of the two magnets SRM1, SRM2 and magnet PRM, as well as the mechanism individual to them, are symmetrically located with respect to the bisector of the angle between the lines of feed of the primary and secondary cards as is clearly shown in Fig. 5. Consequently a description of the secondary reject magnets SRM1, SRM2 and the mechanism individual to them will suffice for the primary reject magnet PRM and the mechanism individual to the primary reject magnet, the corresponding parts being identically designated except for one or two exceptions.

The magnets SRM1, SRM2 are mounted on a bracket **294** (Figs. 3*b*, 5, 5*a*, and 6*b*) which is secured to a bar **295** mounted on the frame castings **102**, **103**. The armatures **296***a*, **296***b* of magnets SRM1, SM2 are pivoted at **297** to brackets **294** and are normally held away from the poles of the magnets by means of springs **298**. Movement of the armatures toward the poles of the magnet is limited by a shoulder formed in a long stud **299** screwed into member **294**. The left hand end of stud **299** adjacent the shoulder is threaded and reduced in diameter and extends loosely through confronting notches (Fig. 5*a*) in the armatures, the radius of the notches being smaller in diameter than the smooth part of stud **299** but larger than the threaded end. Thumb screws

300 screwed on the threaded portion just mentioned limit movement of both armatures 296 away from the poles of the magnet in response to the tension of springs 298.

The armatures 296a, 296b are shaped to provide a lug 296c and an opening 296d (Fig. 5) which are engaged by hook-shaped portions 301c, 301d of curved blade operating arms 301a, 301b pivoted on a bracket 302 secured to the bracket 294. Thus armature 296a of magnet SRM1 holds the arm 301a in raised position and armature 296b holds arm 301b in raised position. The blade operating arm 301b has a pin 301e carrying a roller 301f cooperating with a cam 303 secured to shaft 211 and a spring like 304 (Fig. 5) normally tends to draw the arm 301b downwardly to cause roller 301f to follow the periphery of cam 303. This cam is so proportioned that the arm 301b is raised a slight amount during each revolution of shaft 211 so as to free the hook-shaped portion 301a from the edge of opening 296d and relieve magnet SRM2 from the frictional load caused by the contact of such edge with the hook-shaped portion 301a. This enables the armature 296b to move faster and the impulses of current through magnet SRM2 are timed to occur only when arm 301b is being held up by cam 303.

The pin 301e on which roller 301f is mounted is provided with a reduced portion (Fig. 5a) cooperating with a notch in arm 301a to hold said arm up against the tension of its spring 304 as shown in Fig. 5. Thus both arms 301a, 301b are controlled by a common cam. Armature 296a is provided with a lug 296b whereby the latter is always operated when magnet SM1 is energized.

The arms 301a, 301b are roughly L-shaped in general outline with the portion below hook portions 301a, 301b extending downwardly to a point just above the line of feed of the secondary cards and slightly to the left of shaft 211 (Fig. 5). At this point these members are formed with lugs 301g (see Fig. 5a also) which are at right angles to the plane of the bulk of members 301a, 301b. Lugs 301g slope upwardly from left to right and at their extreme right hand ends are also bent upwardly. Armatures 296a, 296b extend downwardly into a position to be engaged by a common cam 305 fixed to shaft 211, but the thumb screws 300 are so adjusted that springs 298 normally hold the armatures 296a, 296b clear of the cam.

The magnet PRM controls similar mechanism which differs only in that the threaded end of pin 299 projects through a hole in the armature 296 of this magnet and the cams 303, 305 are secured to shaft 210.

The distribution of the cards to the respective pockets is effected by means of three guide blades designated 306, 307, 308 in Figs. 5 and 6b. These blades vary in length and are located in superposed relation beneath the bar 263. The two top blades 306, 307 (Figs. 3a and 6a) lead to the pockets SP and MS respectively, while the blade 308 leads to the pocket PRJ.

The blades 306, 307 extend horizontally under the lugs 301g of the arms 301a, 301b associated with magnets SRM1, SRM2 while the blade 308 is curved downwardly toward the right into cooperation with the lug 301g of the arm 301 associated with the magnet PRM. All of the blades are of greater width than bar 263 throughout substantially the entire length of the latter (Fig. 6a) but the extreme right hand ends (Figs. 5 and 6a) of blades 306, 307 are narrowed and cut away to form two tongues which clear each other and press side-by-side upwardly against the underside of lugs 301g of arms 301a, 301b whereby the free end of blade 307 may be depressed by member 301b, independently of blade 306, below the line of feed of the secondary cards without affecting the blade 306. However, since both arms 301a, 301b are released when magnet SRM1 is energized, in consequence of lug 296e, both blades 306, 307 will be depressed together whenever magnet SRM1 is energized.

With magnets SRM1, SRM2 in deenergized condition, the blades 306, 307 are held above the line of feed of the secondary cards which permits the secondary cards to pass underneath both these blades and over the blade 308 to the pocket MS. The energization of magnet SRM1 causes armature 296 of this magnet and the armature 296b of magnet SM2 to move to the right (Fig. 5) disengaging lug 296c and opening 296d from the hook-shaped portions 301c of arms 301a, 301b. This allows springs 304 to draw the arms 301a, 301b downwardly as the cam 303 rotates thereby depressing both blades 306, 307 below the line of feed of the secondary cards. In this case the secondary cards will pass over both blades 306, 307, under bar 263, and be guided to the secondary reject pocket SRJ. The energization of magnet SRM2, however, causes only the blade 307 to be depressed and secondary cards will be guided between blades 306, 307 to the pocket SP.

The blade 308 normally occupies a position below the line of feed of the primary cards as shown in Fig. 5 whereby the primary cards may pass over said blade and underneath blade 307 into the pocket MS. When magnet PRM is energized the blade 308 is pushed upwardly above the line of feed of the primary cards and the primary cards will then pass beneath all the blades into the primary reject pocket PRJ. When any magnet SRM1, SRM2, PRM is operative to cause the associated blades to move inwardly, that is, between the card guides 254, the cards affected travel between the lugs 301g and the operative blade. The lugs 301g are inclined away from the lines of feed of the cards and bent at their right hand ends as shown in Fig. 5 in order to prevent the cards from being caught by the arms 301, 301a, 301b.

The blades 306, 307, 308 are secured, as by welding, at their left hand ends to blocks 315 (Figs. 3a, 3b, 5 and 6a). The latter are secured by suitable screws to the beveled surface of card deflector blocks 316 which are secured to the partition plates 281 directly beneath bar 263. The deflector blocks 316 extend upwardly and to the right at an angle to the partition plates 281, being beveled for that purpose, and the planes of the bevels are at right angles to each other so that blocks 315 are horizontal. The heads of the screws securing blocks 315 are countersunk to avoid catching the edges of the cards as they pass over the left hand ends of the blades. Tongues 316a (best shown in Figs. 5 and 6a) pierced out of the blades 306, 307, 308 extend downwardly and to the left to deflect cards away from the space between blocks 315 and deflectors 316. Over pocket SR (Figs. 3a and 6a) a deflector 317 is secured to the top of bar 236 and extends downwardly and to the left, being bent around the edges of a large hole in bar 263.

XII. *Circuit timing devices*

A number of devices such as commutators and impulse distributors are provided for the purpose of controlling the times of closure and dura-

tion of various circuits and to prevent arcing between the sensing brushes and contact rolls. These devices will be described in this section.

There are two main groups of these timing devices designated CB1 to CB4, CR1 to CR11 in Figs. 1*a* to 1*e* and of which CB1 to CB4 rotate twice per card cycle, while CR1 to CR11 rotate once per card cycle. The variable speed driving mechanism disclosed in Patent No. 2,174,705, causes all of the shafts to be driven at a variable speed which at one point in the cycle is approximately 40% below, and at another point in the cycle is a similar amount above the average speed. As shown in Fig. 10, the speed is constant during substantially the first half of the cycle but is reduced by the variable speed driving mechanism at the point where the card feed clutches controlled by magnets PFM, SFM are engaged in order to reduce the shock of engagement. It is desirable that the timing devices designated CB1 to CB4 and CR1 to CR11 be always driven at a constant speed and for this reason they are driven directly by pulley **132**, instead of by shaft **136** as was the case in the machine disclosed in the Page application.

Figs. 3*a*, 6*a*, 7 and 8 show the timing devices CB1 to CB4 and CR1 to CR11. These devices are mounted in a supplemental frame comprising two plates **326**, and short cross-bar **327** one of which plates is secured to the left side of plate **105** by means of bolts **326***a* (Fig. 7). Rotatably mounted in suitable anti-friction bearings, on the plates **326** are four shafts **328** to which are secured gears **329**, **330**. The gear **329** meshes with the gear **135**, which it will be recalled, is driven by the pulley **132** through the pinion **134**. The gear **329** is one half the diameter of the gear **135** whereby the upper left hand shaft **328** (Fig. 8) is driven at twice the speed of gear **135**. Gears **330** are of the same diameter as gear **135** whereby the other three shafts **328**, of which only two are shown at the right in Fig. 8, are driven at the rate of one revolution per card cycle.

Secured to the shafts **328**, are eleven cams **331** made of non-metallic composition such as "Bakelite" or material of similar characteristics in order to make the operation of the timing devices as quiet as possible. Secured to the bars **327**, are eleven brackets **332**, each of which supports a cam follower lever **333**, pivoted on a stud **333***a*. Each cam follower lever is actuated into contact with the adjacent cam **331** by means of a spring **333***b* and the cam follower lever is provided with a suitable roller cooperating with the cam. Each lever **333** is provided with a contact element **333***c* cooperating with a contact element **333***d*. The brackets **332** and the contact elements **333***d* are separated from the bars **327** by means of strips of insulating material and the electrical connections are made to the brackets and to the contact elements **330***d*. It is evident from Fig. 7 that rotation of the cams **331** causes the contact elements **333***c*, **333***d*, to make and break according to the location of the high and low points on the cams. The cams **331** located on the shaft **328** carrying gear **329** have scalloped edges and the contacts which they actuate are designated CB1 to CB4 in Fig. 1*a*. These contacts are termed circuit breakers, and their principal function is to prevent arcing at the brushes SB, PB1, PB2 when the card is sensed. The remaining contacts **333***c*, **333***d* are designated CR1 to CR11 in Figs. 1*a* to 1*d* and their function is to control the points of closure, opening, and duration of circuits through the various relays, switch mechanisms, and control magnets of the machine.

A group of primary commutators designated PC2 to PC8 (Figs. 1*a*, 1*b*, 1*c*, 4*b*, and 6*b*) is mounted on the primary shaft **141**. The brushes **335** for this group (Fig. 4) are mounted in slots in two support blocks **336** in the same general fashion as the brushes PB1, PB2, SB. Blocks **336** are mounted on the frame casting **103** by means of hexagonal posts screwed into said casting.

A group of secondary commutators SC1 to SC4 is mounted on the shaft **139** and its brushes **335***a* are mounted on block **336***a* in the same fashion as the brushes **335** on a block **336***a* supported by posts **337***a*.

XIII. *Plugboard*

A plugboard, the details of which are not shown, is provided to secure flexibility of operation and is so constructed that the machine may be preset for operation by multi-prong plugs or plug wires. The plugboard is removably mounted in the machine whereby it may be removed and another one like it, but plugged according to a different plan, substituted for the one removed. The plugboard and the mechanism for locating it in the machine and locking it in place are well known in the art and substantially identical in details of construction with the one disclosed in the Page application.

The face plate of the plugboard in the present machine is different from the one in the Page application because of the provision of a greater number of control relays, magnets, and plug sockets. Figs. 16*a* to 16*c* show the face plate used in the present machine.

XIV. *Analyzing mechanism*

The analyzing mechanism comprises two sections or comparing units each having two groups of sixteen controlling magnets. Both are identical in construction. In the present section, the construction of the primary comparing or sequence unit will be described first, and the respects in which the secondary comparing unit, or selector unit, differs from the primary unit will be explained at the proper point.

Fig. 4 shows a rear elevation of the sequence unit, while Fig. 11, is a similar view, on a larger scale, of the same unit. Portions of both units appear in Figs. 6*a* and 6*b* to illustrate their location, manner of mounting in the machine, and the driving connections which are identical for both units. The mechanism for each unit is mounted in a pair of side plates **356** (Figs. 4, 6*a*, 6*b*, 11 and 12) secured together by six magnet support bars **357**, two stop pawl support bars **358** (Figs. 4, 11, 12, and 13) and two spring anchoring bars **359**. The magnet support bars **357** are secured to plates **356** by means of angle strips **360** screwed to said plates.

The two rigid frames thus formed by plates **356** and the bars **357**, **358**, **359** are mounted on two rectangular bars **361**, **362** (Figs. 4, 6*a*, 11 and 12) secured to the main framework of the machine by means of two pairs of hexagonal screw studs **363**. The pair of studs for bar **361** are screwed into the support bar **104** (Fig. 4) and the end plate **105** (Fig. 6*a*), while the pair for bar **362** are screwed into plate **105** and the rear frame casting **103**, respectively. The lower, horizontal edges of plates **356** have open rectangular slots (see Fig. 12) embracing the bar **361** while the upper front corners of the plates are adjustably secured to bar **362** by means best shown in Figs.

11 and 12. This means consists of blocks 364, secured to plates 356; a stop screw 365, screwed into a threaded hole in block 364 and abutting the side of bar 362; and a clamping screw 366 passing loosely through a hole in block 364 and into a threaded hole in bar 362. By loosening the screws 366 for each comparing unit and turning screws 365 in the proper direction, the unit may be adjusted relative to bar 362 by a pivoted movement on bar 361. This adjusting means is provided for the purpose of bringing the drive gears for the comparing units into proper meshing relation.

There is provided a separate drive shaft 367 (Figs. 4, 6a, 11 and 12) for each comparing unit which shafts are journaled in the frame plates 356. Secured to the shafts 367 are gears 368 which mesh with gears 369 secured to the main drive shaft 136. Each shaft 367 has secured thereto a pair of bail operating cams 370 (Figs. 11 and 12) each of which is located adjacent one of the side plates 356, and also a pair of restoring cams 371a, 371b (see Fig. 13 also) located close together on a common hub near the center of the shaft. Thus shaft 367 and cams 370, 371a, 371b are rotated continually by the main drive shaft 136.

Each of the comparing units is provided with a main support rod 372 (Figs. 12 and 13) which is secured to the centers of the side plates 356 and the bulk of the moving parts of the comparing units are supported by these rods. Rotatably mounted on rod 372 in interspersed relation are two series of sectors designated 373, 374 in Figs. 11 and 12. There may be sixteen sectors in each series to correspond with the number of comparing magnets in the comparing units. In the case of the primary comparing unit, each sector 373 is associated with one of the comparing magnets PM1 and is paired with one of the sectors 374 which sector, in turn, is associated with one of the magnets PM2. There is a pair of magnets like PM1, PM2, and a pair of sectors 373, 374 for each denominational order of both comparing units. In the selector unit, the corresponding magnets are designated SM1, SM2. The sectors 373, 374 for each denominational order are located side by side but are separated by certain parts which are mounted on rod 372 between the sectors. The pairs of sectors may be separated from each other by suitable spacing washers or by the hubs to which the sectors are secured.

The bars 358 (Figs. 11, 12, and 13) are transversely slotted and are also longitudinally grooved to support pivot wires 375. The wires 375 act as pivots for stop pawls 376 located in and spaced by the transverse slots in the bars 358. There is a stop pawl 376 for each sector 373, 374 and each pawl is located in the plane of its cooperating sector so as to be capable of engaging ratchet teeth formed in the sector. Springs 377, anchored to the pawls and to the spring anchoring bars 359, tend to rock the pawls 376 into engagement with the ratchet teeth on the sectors 373, 374. Combs 358a secured to bars 358 hold the pawls 376 and sectors 373, 374 in alignment.

Normally the pawls are held out of engagement with the sectors by means of the armatures 378 of the comparing magnets. The comparing magnets SM1, SM2, PM1, PM2 are mounted on narrow plates 379 (Figs. 6a, 6b, 11 and 12) each secured to the central bar 357 and to one of the outer bars. Since the coils of the magnets are larger in diameter than the width of the space allotted to each pair of sectors 373, 374 with their pawls and other parts comprising one denominational order, the magnets of each group of sixteen are arranged in two parallel rows of eight each, with the magnets in staggered relation. Thus the two pawls 376 associated with the two sectors 373, 374 shown in Fig. 12 are controlled by the left hand magnet PM1 and the right hand magnet PM2, while the right hand magnet PM1 and the left hand magnet PM2 control the pawls associated with the pair of sectors 373, 374 immediately behind those shown in Fig. 12. The numerals 1 and 2 on the coils of the magnets indicate the denominational orders. The small numbers 1 to 16 in Fig. 11 just below shaft 367 also indicate the denominational orders, with 1 designating the units order, 2 the tens, and so on.

In the ordinary use of a machine of this type, the magnets PM1 and PM2 will be plugged to the primary brushes PB1 and PB2, respectively, to place magnets PM1 under control of the holes in the second of two successive primary cards and magnets PM2 under control of the first of the two cards. Similarly, magnets SM1 and SM2 will ordinarily be connected to brushes SB and PB2, respectively. It is evident that the numeral suffixes in the designations indicate to which of the two sets of primary card sensing brushes the magnets correspond.

The comparing magnets have L-shaped yokes 380 (Fig. 12) secured to the plates 379 by the same screws 381 as are used to secure the cores of the coils to the yokes. The vertical portions of the yokes are provided at their ends with rectangular slots (see Fig. 11) to form a pair of posts 380a which project through aligned slots located on opposite edges of the armatures 378. The horizontal portions of the slots in the yokes 380 and the sides of the slots in the armatures 378 are slightly beveled and these beveled portions coact to form pivots for the armatures. Springs 382 (Figs. 11 and 12), attached to the armatures 378 and to pins carried by yokes 380, tend to hold the armatures in engagement with the stop pawls 376.

The free ends of armatures 378 associated with the left hand row of magnets PM1 (Fig. 12) and the right hand magnets PM2 rest on shoulders formed in the tails of the associated pawls 376 and abut the vertical walls of the shoulders. The armatures 378 for the right hand magnets PM1 and the left hand magnets PM2 have openings adapted to hook over the tooth formed by the shoulders in the pawls and rest on the shoulders. Thus the armatures 378 normally hold pawls 376 out of engagement with the sectors 373, 374.

Rotatably mounted on the rods 372 are two bails 383, 384 associated with the two series of sectors 373, 374, respectively. The bail 383 projects through the planes of all the sectors 373 and is connected to the sectors by means of springs 385 which tend to draw the sectors 373 into engagement with the bails so that oscillation of the bails will cause the sectors to follow the movements of the bails provided none of the pawls 376 have been released. Bail 384 is similarly associated with sectors 374.

Oscillation of the bails is controlled by the cams 370. Rotatably mounted on rod 372 adjacent the side plates 356 are cam follower levers 386 (Fig. 12) having rollers 387 engaging the respective cams 370. The ends of the levers 386 engage the ends of screw studs 388 located at the ends of bails. Heavy coil springs 389 (Fig. 13),

anchored to pins **390** carried by the arms of the bails and to brackets **391** secured to plates **356**, have a tendency to rock the bails in a counterclockwise direction (Figs. 12 and 13) and thereby, through the screw studs **388**, press the rollers **387** into contact with cams **370**.

There are nine ratchet teeth in each sector **373**, **374** and also abutments **373***a*, **374***a* comprising zero stops projecting a greater distance radially of rod **372** than the ratchet teeth so as to arrest the sectors in a zero position by engaging the ends of stop pawls **376** in every case where a stop pawl is not released by energization of a magnet. In other words, the sectors **373**, **374** will always move to zero positions unless stopped in other positions by release of the stop pawls **376**. The ratchet teeth have the numerical values shown in Fig. 12 by the small numerals adjacent the teeth and the cams **370** are so shaped that, as the bails move in a clockwise direction, the ratchet teeth will pass the ends of pawls **376** in synchronism with the sensing of the corresponding index-point positions on the record cards. In other words, all of the "9" teeth will be approaching and close to the ends of pawls **376** when the brushes reach the "9" index point position and so on for the other index point positions.

Fig. 12 shows the positions the sectors **373**, **374** for the tens order of the sequence unit assume when both of two successive primary cards have a "9" hole in the tens column of the card field in which the numbers compared are recorded. In this figure the bails **383**, **384** have moved to their limit of travel in a clockwise direction, reached after about 198° of movement of shaft **136** from the point where the sensing of the card commences, and the cam roller **387** is on the dwell shown in Fig. 10 between the 198° and 216° positions of the cycle.

Normally, movement of the bails **383**, **384** is prevented by mechanisms controlled by certain restoring magnets designated PR1, PR2, PR3 and SR. The mechanism controlled by magnets PR1, PR2 is shown in Fig. 13 which illustrates the bail control mechanism for the sequence unit. Restoring magnets PR1 and PR2 are constructed like the comparing magnets PM1, PM2, SM1, SM2, etc., and are similarly mounted on the bars **357** by means of plates **379***a* like the plates **379**. The armatures **378***a* of magnets PR1, PR2 engage shoulders in stop pawls **392** actuated by springs **393** anchored to bar **359**. The stop pawls project into the paths of stop arms **394** pivoted on slotted blocks **395** secured to the centers of bails **383**, **384**. Springs **396**, anchored to bails **383**, **384** and to ears formed in the stop arms **394** normally hold the stop arms against the bails which act as stops to limit clockwise movement of the stop arms.

Each pair of sectors **373**, **374**, in moving to various positions under control of the card sensing brushes, will also move relative to each other different extents angularly about rod **372** according to whether the hole in one of the columns compared is higher or lower in value than the other but will not move relative to each other when the holes are of the same value. Each pair of sectors **373**, **374** is connected together mechanically to control a switching device for manifesting which of the holes in two cards compared is higher or lower in respect to the column compared and also to indicate when the holes are equal in value. This mechanical connection is most clearly shown in Fig. 12.

Both sectors **373**, **374** are provided with pins

397 located equal distances from rod **372** and having circumferential slots riding in curved slots formed in a differential link **398** which in outline has some resemblance to an ox bow as viewed from the right hand margin in Fig. 12. Each differential link has a pin **399** which extends through, and projects from both sides of the differential link. The front end or head of the pin **399** is provided with a circumferential groove embracing a straight slot formed in a guide plate **400**, while the shank of the pin acts as a rivet to secure a grooved collar to the rear side of the differential link. The grooved collar is of substantially the same dimensions as the head of the pin and the groove in the collar embraces a cam slot formed in a contact control arm **401**.

The guide plates **400** are forked at one end to partly surround rod **372** and also have a shallow rectangular slot at the other end embracing a support bar **402** secured to plates **356**. The upper and lower edges of bar **402** are provided with slots to prevent the guide plates from being displaced along said bar. The rod **372** is provided with circumferential grooves into which the forked portions of guide plates **400** are located. Thus the guide plates are maintained in accurately spaced relation on rod **372** and bar **402**, respectively.

The guide slots in the plates **400** are straight and extend radially of rod **372**. It is evident that links **398** may rotate about pins **399** as an axis and that pins may also slide radially of rod **372** but cannot be displaced angularly of rod **372**. The curved slots in links **398** are so designed that, when both sectors of a pair move equal distances, as would be the case when both holes in a given column of two successive primary cards have the same numerical value, both ends of the link will receive equal angular displacements and consequently pin **399** (Fig. 12) will remain stationary so far as movement radially of rod **372** is concerned. On the other hand, if a hole in a given column of the first of the two primary cards, for example, is lower in value than the hole in the same column of the second primary card, the sector **374** will move clockwise a greater extent than the sector **373**. As a result, the lower end of link **398** will be moved farther to the left than the upper end is moved to the left, causing pin **399** to move to the left.

The contact control arms **401** are rotatably mounted on rod **372** and the slots therein have two long straight portions, angularly displaced with reference to rod **372** and substantially radial of rod **372**, and also a relatively short straight portion connecting the longer portions but making a rather sharp angle to a line passing through the center of rod **372**. When both sectors **373**, **374** of a pair are at either of their limits of travel or in positions having the same value, the pin **399** will be located at the center of the short connecting portion of the slot in arm **401** thus holding said arm in a neutral position. When any pin **399** is caused to move to the left, as is the case where a hole in a given column of the first of two primary cards is lower than the hole in the second primary card, pin **399** enters the left hand straight portion of the slot in the associated contact control arm **401** causing said arm to rock clockwise. On the other hand, when the numerical relation of the holes is reversed and pin **399** moves to the right from the neutral position, pin **399** enters the right hand straight portion of the slot in contact control arm **401**, camming said arm in a counterclockwise direction.

Summarizing the foregoing, the switch con-

trol arms 401 move in a clockwise direction (Fig. 12) when the first of two successive primary cards is lower than the second card, and move counterclockwise when the second primary card is lower in value.

The selector unit, controlled by the magnets SM1, SM2, is identical in construction with the sequence unit so far as such unit has been described up to the present point. The magnets SM1, SM2 are located at the same relative positions as the magnets PM1, PM2 (Fig. 12), and it will be understood that the arms 401 move clockwise when the primary card is lower than the secondary card with which it is compared and counterclockwise when the secondary card is lower. Fig. 12 is captioned to correspond with the captions over plug sockets PS37, PS39 in Fig. 16*a*. The restoring magnets designated SR and PR3 are provided for this unit and are located in the same relative positions as the magnets PR1, PR2 (Fig. 13). The magnet PR2, in the present case, causes a reading taken from the brushes PB1 to be erased from the sequence unit while magnet PR1 causes a reading from the brushes SB to be erased. Similarly, the magnets SR and PR3 cause the readings taken from brushes SB and PB1, respectively to be erased.

The switching mechanism for the sequence unit shown in Figs. 9, 11 and 12 is substantially identical with the switch unit disclosed in the Page application, and will be briefly described.

The enlarged portions of the slots in the parts designated 396, 400, 401 have no useful purpose so far as the operation of the comparing units are concerned, but are provided to facilitate assembly, and for this purpose are made large enough to insert the heads of the pins 397, 399 to engage the grooves in said pins with the edges of the slots.

The contact control arms 401 operate switching mechanisms which may be used to selectively control the various card feed magnets, reject magnets, and eject magnet, either directly or through relays. The switching mechanism also controls the restoring magnets PR1, PR2, PR3, SR to cause the number entered in the comparing units to be erased by restoring the sectors 373, 374. The switching mechanism for the sequence unit is shown to best advantage in Figs. 9, 11, 12 and 14.

Mounted on posts 405 (Figs. 9, 11 and 12), which are rectangular in cross section and pressed into holes in the side plates 356, is a switch contact assembly generally designated 406 in the drawings, screws 407, threaded into transverse holes in posts 405, being used to secure the switch contact assembly to the posts. The base of the switch contact assembly consists of a base plate 408 (Fig. 9) and a face plate 409 both of stiff insulating material like "Bakelite" separated by a thin and narrow spacing strip 410, also of insulating material. The rivets 411, which secure the plates 408, 409 and the spacing strip 410 together also secure two common contact strips 412, 413 to the face of the strip 409. Washers 414, through which the rivets 411 along the lower edges of strips 408, 409 pass, space said plates apart a distance equal to the thickness of strip 410.

Located between the two strips 408, 409 is a series of seventeen terminal plates 415 the shanks of which project downwardly in Fig. 9 beyond the edges of strips 408, 409 and have holes for terminal screws. The upper portions of plates 415 to some extent resemble 45° right triangles in shape with the apexes of the 90° angle pointing to the right. On the face of the strip 409 are seventeen contact plates 416. Each terminal plate 415 is riveted to the strip 409 and to one of the contact plates 416 by means of a common pair of metallic rivets 417 so that each terminal plate 415 is electrically connected to a contact strip 416.

The contact strips 412, 413 are serrated and so arranged that the serrations confront each other and extend into the spaces between the contact plates 416, but the serrations on one contact strip do not touch either the plates 416 or the serrations on the other contact strip. Fitting between the abutting ends of the serrations in strips 412, 413 and the opposing edges of the contact plates 416 are rectangular blocks 418 of insulating material secured to terminal plates 415 by means of rivets 419 the round shanks of which pass through holes in the strip 409 and the rectangular heads of which are set in rectangular grooves formed in blocks 418. After the switch assembly has been riveted together, the faces of the strips 412, 413, plates 416, blocks 418, and rivets 419 are ground flat to obtain a uniform height above the strip 409. The extreme left hand contact plate 416 (Fig. 9) associated with the extreme left hand contact rivet 419, has no other purpose than to provide a metallic backing for the rivets 417 which secure said plate to the left hand terminal plate 415.

Secured to each of the contact control arms 401 (Figs. 11 and 12) is a narrow plate of insulating material 420 on which is mounted a contact wiper blade 421 having two contact fingers each carrying contact points. Normally the fingers of each blade 421 bridge the gap between the contact rivets 419 of one terminal plate 415 (Fig. 9) and the contact plate 416 of the next terminal plate 415 at the right. When the holes in the columns of two cards have the same value, that is, the numbers recorded are equal, the contact control arms 401 remain in the central or equal position, as has already been explained, whereby the terminal plates 415, contact plates 416, and contact rivets 419 will be connected in series by the fingers of contact blades 421 as shown diagrammatically in Fig. 1*d*. This condition prevails in respect to unused orders of the comparing units, as for example, if only the lower four orders were used for comparing numbers having four digits, the sectors 373, 374 for the fifth to sixteenth orders would always move to the "0" position causing their associated arms 401 to remain in the central or "equal" position.

The small numbers in Fig. 9 below the blades 421 and in Fig. 1*d* adjacent the diagrammatic representation of said blades indicate the denominational orders of the comparing units. Assume that certain columns of a secondary card are punched to represent the number 6896 while the same columns of the primary card are punched 6977. Since the two numbers are equal in the highest order the control arm 401 for this order will remain in equal position. The arm 401 for the third or hundreds order, will move counterclockwise (Fig. 12) causing its contact blade 421 to move upwardly (Fig. 9) or to the right (Fig. 1*d*). The contact blade 421 for the units order will move in the same direction as the primary card is higher than the secondary card in both the units and hundreds orders. The arm 401 and blade 421 for the tens order will move in a clockwise direction (Fig. 12) or to the left in Fig. 1*d* since the primary card is low-

er than the secondary card in the tens columns. The blade **421** for the hundreds order, in moving upwardly in Figs. 9 and 12 slides over the fourth contact plate **416** from the left (Fig. 9), or the fourth from the top in Fig. 1*d*, to a position to bridge the gap between said plate and one of the serrations in strip **412** thereby electrically connecting said strip with the fourth contact plate from the left in Fig. 9. In Fig. 1*d*, in order to simplify the wiring diagram, the contact plates and terminal plates are shown in a simplified form as if the contact plates were T shaped with the vertical part of the T extending between the serrations in strips **412**, **413**. It is apparent that this movement of the hundreds arm **401** and its blade **421** has the effect of breaking the circuit to the units and tens blades **421** and no current can flow through them notwithstanding the fact that the units order blade **421** contacts with the strip **412** and the tens order blade **421** with the strip **413**. As the tens order blade also breaks the circuit to the units order blade, there is no danger of a back circuit to contact strip **413** through the units and tens order blades **421**.

Knock-off mechanism is provided for the armatures of the comparing magnets SM1, SM2, PM1, PM2 and the restoring magnets PR1, PR2, PR3, SR. The knock-off mechanism for the comparing magnets PM1, PM2 of the sequence unit is shown in Figs. 11 and 12. A separate knock-off bail **422** is provided for the armatures of each group of comparing magnets SM1, SM2, PM1, PM2. Each bail is pivoted on a pair of screw studs **423** carried by side plates **356** and extends transversely of the tips of armatures **378** on the same side thereof as the coils of the comparing magnets. Springs **424** anchored to bars **358**, hold the knock-off bails against the edges of angle strips **425** secured to bars **357**, which angle strips act as stops for the knock-off bails. Secured to each bail is a pair of side arms **426** which extend into the paths of bails **383**, **384**. When the latter push the sectors **373**, **374** back to their starting position by rotation in a counterclockwise direction, the noses of pawls **376** wipe over the teeth in sectors **373**, **374** and eventually ride up on the smooth portions **373***b*, **374***b* of the sectors which are made slightly higher than the teeth for the purpose of camming the pawls **376** slightly beyond the latching position. At this point the bails **383**, **384** strike the arms **426** and rock bails **422** clockwise thereby forcing the armatures **378** into latching relation with the pawls **376** in the event the armatures should stick to the poles of the magnets.

The knock-off mechanism for magnets PR1, PR2, is illustrated in Figs. 11 and 13. Rockably mounted on rod **372** is a pair of cam follower levers **428***a*, **428***b* each having two rollers cooperating with one of the cams **371***a*, **371***b* whereby both levers **428***a*, **428***b* are oscillated periodically when shaft **367** rotates. Cam **371***b* is timed approximately 50° in advance of cam **371***a* (Fig. 16), so that lever **428***b* always rocks to the left (Fig. 13) ahead of lever **428***a*. As a convenience of manufacture, levers **428***a*, **428***b* are alike and may be made with the same die but they have separate functions.

Lever **428***a* has pin and slot connections to arms of two armature knock-off levers **429**, each associated with one of the magnets PR1, PR2. The levers **429** are pivoted on brackets **430** secured to the L-shaped yokes **380***a* of the restoring magnets PR1, PR2 and the other arms of levers **429** have bent-over lugs cooperating with the armatures **378***a* of the restoring magnets. It is apparent that once in each cycle of shaft **367** the lever **428***a* will be rocked counterclockwise, thereby operating the levers **429** to force the armatures **378***a* away from the poles of the magnets. Before this takes place lever **428***b* is similarly rocked and, by engagement of cam lugs **431** formed in said lever with square studs **392***a* secured to pawls **392**, said pawls are rocked clockwise slightly beyond their latching positions with armatures **378***a*. Thus both the pawls **392** and armatures **378***a* are positively restored whenever sticking thereof occurs. The selector unit is similarly constructed. The levers **428***a*, **428***b*, as well as the pawls **392** are guided by the combs **358***a* in both comparing units.

Since the construction and operation of the comparing units has been described in detail in the present section, in subsequent sections dealing with the various types of operation of which the machine is capable, only general reference will be made to the operation of the comparing units.

XV. *Machine control keys*

The machine is provided with a group of four manual controlling keys which consist of the start key STK, the stop key SPK, the runout key ROK, and the error reset key ERK. These keys are mounted at a convenient place at the front of the machine on the top surface of the casting **100**. Since these keys are of conventional form, their mechanical structure is not shown but they, with their contacts, are shown in the wiring diagram in Figs. 1*c* and 1*d*. The start key and the runout key, each when depressed, closes contacts designated STC1, STC2 in the case of the start key and ROC1, ROC2 in the case of the runout key. The stop key SPK opens contacts SPC when depressed. The error stop reset key closes contacts ERC when depressed.

XVI. *Impulse emitter*

The mechanism which controls the counting and feeding of cards quantitatively includes an impulse emitter generally designated E in Fig. 1*g*. This emitter is conventional in principle of operation, consequently only a very brief description will be given of its mechanical construction with reference to Figs. 3*a*, 6*a*, and 8. Secured to the lowest shaft **328** is a brush carrying member **500** which may be made of insulating material, such as "Bakelite." This brush carrier carries two brushes **501**, one of which cooperates with a row of 12 segments **502** of which only nine are actually used. The other brush **502** cooperates with a continuous contact segment **503** which provides a means of connecting the brush **501** which cooperates with segments **502** to the circuits of the machine. The segments **502**, **503** are part of a molded member **504** of insulating material which is secured to a bracket **505** mounted on the left hand plate **326**. The molding **504** has a large central opening to accommodate the brush carrier **500** and the inner ends of the segments **502** and the inner surface of the segment **503** are molded flush with the cylindrical surface of the opening in the molding **504**. The brush carrier **500** rotates continuously while the machine is in operation.

With reference to Fig. 1*e*, the common segment **503** is connected to a plug socket PS78 and a cooperating plug socket PS79 is connected to the line wire W2 through the contacts of circuit breakers CB1 to CB4 and the cam actuated contacts CR3. The emitter E is timed so that im-

pulses are passed therethrough to make the plug sockets PS57 live in the same order as the brushes SB, PB1, PB2 sense the holes in the cards and in synchronism therewith. In other words, the brush 501 which cooperates with the segments 502 will touch the "9" segment 502 at the time when a card brush arrives at the "9" index point position on a card. This emitter E is used in a variety of ways in conjunction with the units and tens counting relays to be described in the next part of the specification to omit impulses which have numerical values.

XVII. *Counting relays*

The machine is provided with four counting relays, termed the units relay, the tens relay, the hundreds primary relay, and the hundreds secondary relay, shown diagrammatically in Fig. 1*g*. These relays are of the form known as dial relays and are more or less conventional in principle and general details of mechanical construction, consequently only a very brief description will be given herein in reference to Figs. 14 and 15 which show the units relay. These relays are alike, consequently a description of one will suffice for all.

The units count relay has a main frame 600 formed with offset lugs 600*a*, 600*b* on which are mounted the units stepping magnet USM and the units restoring magnet URM. The frame 600 also is provided with a fixed post 602 on which is rotatably mounted a contact wiper assembly which includes a ratchet 603, a stop arm 604 and a wiper arm 605. The latter is insulated from the ratchet 603 and stop arm 604. A collar 606 on post 602 retains the wiper assembly on the post 602. A spring 607 anchored to a pin on the frame 600 and to a lug forming part of the stop arm 604, normally holds the latter against a stop pin 608 carried by the frame 600. A retaining pawl 609 forming a part of the armature of magnet URM is held by a leaf spring 610 against the teeth of the ratchet 603 as shown in Fig. 15. The spring 610 is secured to pawl 609 and bears against the pin 608. The armature or pawl 609 is pivoted at 611 to a bracket 612, secured to the lug 600*a* on which the magnet URM is secured. When the magnet URM is energized, the armature or retaining pawl 609 is attracted sufficiently to release the ratchet 603 and permit the spring 607 to restore the wiper assembly to the position of Fig. 14 by a counterclockwise movement.

The wiper assembly is actuated in a clockwise direction step by step by means of a pawl 613 which is pivotally mounted at 614 on the end of the armature 615 of magnet UCM. This armature is pivoted at 616 to a bracket 617 mounted on the lug 600*b* of frame 600. The feed pawl 613 is provided with an arm 613*a* which cooperates with a lug 600*a* formed in the frame 600 to normally hold the pawl 613 out of engagement with the teeth of ratchet 603. A spring 618 coiled around the pivot 614 urges the pawl 613 in a clockwise direction. A leaf spring 619 secured to the armature 615 has its upper end bearing against the right hand side of lug 600*c* and holds the pawl 613 in the retracted position of Figs. 14 and 15. When the magnet USM is energized, the armature 615 rotates in a counterclockwise direction (Fig. 15) which initially allows the spring 618 to rotate the pawl 613 in a clockwise direction into engagement with the teeth of ratchet 603 so that with further movement of the armature 615 the ratchet 603 is rotated in a clockwise direction one tooth space. A collar 620 carried by a pin secured to the frame 600 cooperates with the end of the pawl 613 in its leftward movement and limits the rotation of the ratchet 603 to one tooth space and at the same time, in a well known way, prevents overthrow of the ratchet 603 and the wiper assembly of which it is part.

The wiper 605 is composed of two cooperating resilient fingers 605*a*, 605*b*, of which the front finger 605*a* in Fig. 14 wipes over the front sides of the inner ends of ten contact segments 621 which are clamped between two plates 622, 623 of insulating material by means of a plate 624 secured to the frame 600 by means of screw 625. The rear finger 605*b* of the wiper, which is not shown, traverses the rear side of a metallic plate which is designed to act as a common contact strip for the relay. This plate 626 is insulated from the frame 600 by means of a plate of insulating material of the same general shape as the plate 624. When the wiper 605 is stepped in a clockwise direction by the magnet USM, the fingers of the wiper 605 electrically connect together segments 621 and the plate 626.

The tens and hundreds relays are provided with the stepping magnets TSM, PHSM, SHSM, corresponding to magnet USM; and with restoring magnets TRM, PHRM, SHRM, corresponding to magnet URM.

XVIII.—*Operation of the machine*

The sequence checking operation is carried out with respect to one thousand cards at a time of which the group numbered 001 to 500 will be placed in the primary hopper PH for checking under control of the brushes PB1, while the remaining cards numbered 501 to 1000, will be placed in the secondary hopper for checking under control of the brushes SB. Provided all numbers are correctly punched in the cards, the corresponding columns of all the cards except in the hundreds order will always agree in designations with the further exception of the transfers from 9 to 0 which take place from the units, tens, and hundreds columns. The transfer from the hundreds column will only take place after the checking of the next-to-the-last card on the secondary side of the machine, when the sequence changes from 999 to the thousands order. This last change is accomplished under control of a special circuit operative during the last card sensing cycle of the run of each thousand cards.

In the hundreds order the cards will never agree in designations since the numbers range from 0 to 4 on the primary side and from 5 to 9 and 0 on the secondary side. This part of the checking operation is controlled by an emitting device having circuits arranged to cause the hundreds orders always to agree when the sequence is correct.

For the purpose of explaining the principles of the invention, it will be convenient to assume that the serial numbering of the cards is designated by means of perforations placed in a serial number field comprising the last eight columns of the cards which, in the illustrative machine disclosed, would be the 73rd to 80th columns. It will be convenient to assume that a batch of cards arbitrarily numbered 501,001 to 502,000 is to be checked. The cards numbered 501,001 to 501,500 are placed in the primary hopper face down with the "9" positions to the left, Fig. 3*b*, while the cards numbered 501,501 to 502,000 are similarly placed in the secondary hopper.

Figs. 17*a* and 17*b* show in schematic form by means of block diagrams how the brushes PB1

and SB are connected to the comparing units and to the count emitting device. In Fig. 17*b*, the blocks entitled "selector unit" and "sequence unit" diagrammatically represent the two comparing units, and the individual plug wire connections from the brushes PB1 and SB are shown to agree with Figs. 16*b* and 16*c*. In these two figures, the plug wires PW1 to PW4 are shown as cables with branches in order to avoid confusion, but the individual plug wires are shown in Figs. 17*a* and 17*b*.

Fig. 17*a* shows two columns of figures divided into three groups by dot and dash lines to illustrate typical groups of cards on each side of the machine, including a group to show the starting sequences and comprising the first three cards fed on each side of the machine, transfer sequences to illustrate how a transfer operation is effected, and a terminating sequence to illustrate the transfer to the thousands order. The last card at the top in both sides is included for convenience in understanding the transition which occurs between batches of cards and between the two groups checked.

The box labeled count emitter in Fig. 17*b* comprises the impulse emitter E and the contacts of the four counting relays described in Section XVII. In Figs. 17*a* and 17*b* the directions of flow of the brush and count emitter impulses are shown by arrow heads in the plug wires. This has also been done in Figs. 16*a* to 16*d*.

The machine is plugged as shown in Figs. 16*a* to 16*d* which show by means of four separate plugboard charts how different functions and controls are plugged. Actually all of the plug wires are placed on a single plugboard but this would exhibit only a confusion of plug wires if it were attempted to show all the wires in a single figure. The captions at the top in Figs. 16*a* to 16*d* explain the purposes of the plug wires on the various charts. As far as possible, without creating confusion, the plug wire connections are shown in Figs. 1*a* to 1*g* by means of dotted lines. In some cases connections are made by double point plugs, the so-called "bottle plugs" as indicated by the short thick, solid straight lines. For instance, the common connections between magnets PM2, SM2 for positions 7 to 11 of the comparing units and plug wires PW3 in Fig. 16*b* are made by means of these plugs. Detailed mention of these plugs in tracing circuits hereinafter will be avoided as unnecessary and obvious. Figs. 17*a* and 17*b* show simpler and more direct connections to magnets SM1, PM2.

When the start key STK (Fig. 1*c*) is depressed, contacts STC1 are closed, thereby establishing a starting circuit as follows: from line wire W2 (Fig. 1*c*) contacts CR7, stop key contacts SPC, the start key contacts STC1, contacts R21B, R1A, R3A, R12B, R8B, and the coil R17P of the starting relay, to line wire W1. A parallel circuit is also established to relays R18, R19 through contacts R14B. The energization of coil R17P closes contacts R17B and enables impulses to be given the magnets EM, PFM, and SFM as follows: line wire W2, contacts R17B, CR1, HSR4A, the plug wire PW17, contacts R2A, and magnet PFM to line wire W1. A parallel circuit is also established through the relay HSR3 thereby closing contacts HSR3A. This connects the magnet EM in parallel with the magnet PFM through contacts HSD3A. Another parallel circuit is established by way of plug wire PW15 and contacts R4A to magnet SFM and line wire W1.

The energization of the magnets PFM and SFM causes the primary and secondary feed shafts 141 and 139 (Fig. 4), respectively to be clutched to the main shaft 136 thereby starting the feeding of primary and secondary cards together.

The energization of relay R19 in parallel with coil R17P by closing contacts R19A (Fig. 1*c*) has the effect of connecting the restoring magnets PR1 to PR3 and SR in parallel with magnets PFM and SFM. This insures that the two comparing units will be completely cleared of any numbers which may remain therein after the last operation of the machine.

During the first card feeding cycle of the machine a card will be fed from both of the hoppers past the card levers (Fig. 3*b*) thereby closing the contacts PCL and SCL (see Fig. 1*a* also). This cycle carries the cards up to a point where the leading edges are about to operate the card levers 280 which actuate the card lever contacts SCL1 and PCL1, respectively. Since neither of the contacts PCL1, SCL1 will be closed during the first cycle, a holding circuit cannot be established for the relay R17P (Fig. 1*c*) through the coil R17H and contacts R1B, R13D. A one-cycle holding circuit however, is established by closure of the contacts R17A which enables a circuit to be established from line wire W2 through contacts CR6, R17A, and coil R17H, to line wire W1. This circuit is broken, however, toward the end of the first cycle since the contacts CR6 open at 128° or at about the "2" point in the cycle (Fig. 10*a*).

It is necessary, therefore, to press the start key STK again to start the machine on the second card cycle. The magnets EM, PFM and SFM are again energized by circuits similar to the ones traced above. During the second card feeding cycle, the first secondary card and first primary card are fed past the brushes SB and PB1, respectively, and the second secondary card and second primary card are advanced from the hoppers SH and PH, respectively. Before the first primary and secondary cards pass brushes SB and PB1 they operate the card levers 280 to effect the closure of the contacts SCL1, PCL1. With reference to Fig. 1*a*, the closure of these contacts causes the relays R5, R7 and NR7 to be energized by closure of contacts CR5 at about the time the card levers 280 are operated by the leading edges of the cards.

The energization of the relays R5 and R7 closes contacts R5D and R7A, respectively, thereby enabling energization of relays R8, R9, R14, and R15 (Fig. 1*b*) through the closure of the circuits by the commutators SC2 and PC2. The contacts R14D (Fig. 1*c*) now open and prevent energization of relays R18, R19 throughout the run of the machine. In this type of machine, this prevents energization of the restoring magnets SR and PR1 to PR3 except selectively in accordance with comparison of the primary and secondary cards, according to how the machine is plugged.

At the end of the second feeding cycle, the contacts R13D (Fig. 1*c*) are still open owing to the fact that the contacts PCL2 have not yet closed, whereby relays R6 and NR8 remain deenergized. Relay R6 controls the relays R12, R13 (Fig. 1*b*) which remain deenergized. It is necessary, therefore, to press the start key STK, a third time, again energizing the coil R17P through the contacts R1A, R12B. In this cycle, however, relays R18 and R19 are not energized since relay R14 was previously energized during the second cycle opening contacts R14D. Thus the comparing

units will not be reset during the third cycle when the first primary card passes the brushes PB2 except under selective control.

Early in the third cycle the contacts PCL2 close and enable energization of relay R6 by a circuit traced from line wire W2, through contacts CR5, PCL2 (Fig. 1a), the commutator PC3, and relay R6 to line wire W1. Relay NR8 is also energized in parallel with relay R6. Energization of the relay R6 closes contacts R6A (Fig. 1b) to energize relays R12 and R13 in parallel through commutator PC2. The closure of contacts R13D (Fig. 1c) enables a holding circuit to be established during the third cycle through coil R17H traced as follows: line wire W2, contacts CR7, SPC, R35B, R13D, FPC, R17C, and hold coil R17H, to line wire W1.

It will be noted, with reference to Fig. 10a, that the contacts CR6, CR7 overlap whereby the coil R17H is maintained continuously energized as long as the machine is in operation and cards continue to feed on both sides of the machine. From this point on the machine runs without further manual control until some event occurs which will cause the machine to stop. The machine may stop as a result of several events occurring during the course of its operation, as for example, any of the pockets might become too full thereby opening contacts FPC. This interrupts the holding circuit normally established by contacts CR7 and results in the coil R17H becoming deenergized when contacts CR6 open.

The deenergization of coil R17H causes contacts R17B to open and prevents further impulses to the magnets PFM and SFM and the restoring magnets PR1 to PR3 and SR. As a result, the machine will stop feeding cards and the card lever circuits will remain energized since cards remain in the course of feed and commutators SC2, PC2 are in closed condition at the time of stoppage. When the excess cards are removed from the full pocket, contacts FPC reclose and permit reenergization of the coil R17H by means of the start key STK through contacts STC2 (Fig. 1c). These contacts are in parallel with contacts R17C and, since the contacts SPC, R35B, R13B, R13D and FPC are now all closed, the coil R17H will again be energized, when contacts CR7 close, thereby closing contacts R17B to allow further impulses to be given the magnets PFM, SFM to resume the feeding of cards.

During the first two cycles of the machine the relay R21P (Fig. 1c) remains deenergized in consequence of the fact that relay R18 is energized during these cycles opening contacts R18A (Fig. 1c) to prevent impulses to the coil R21P. By the end of the second cycle however, the contacts R14D will have been opened and prevent the energization of relay R18 during the third cycle.

At the end of the second cycle, relay R21P is energized by a circuit from line wire W2, contacts R17B (Fig. 1c), CR1, HSR4A, R1D, R3D, R18B, and coil R21P, to line wire W1. Contacts R21A close and establish a holding circuit for coil R21H which is maintained through the contacts ROC2 of the runout key ROK. This circuit is maintained continuously while the machine is in operation. Relay R21 opens contacts R21B and prevents any further circuits from being established to the relays R17P, R18, R19 through the contacts STC1 after the machine has been started.

During the first cycle of the machine, when the first primary and secondary cards are advanced from the hoppers PH and SH, respectively, the contacts PCL, SCL close. The closure of the contacts PCL energizes relay NR9 (Fig. 1g) thereby closing the contacts NR9B. This in turn closes a circuit as follows: line wire W2, the plug PW24, contacts NR7B, NR9B, and relay NR1 to line wire W1. The contacts NR1A also close to establish a temporary holding circuit for relay NR1 through contacts CR9. The contacts NR1B also close and permit the establishment of a circuit at the end of the first cycle leading from line wire W2, contacts CR10, NR1B, NR4A, and the units stepping magnet USM, to line wire W1. The energization of the units stepping magnets advances the units counting relay one step to carry the wiper arm 605 on the "1" contact 621.

During the second card feeding cycle, the first primary and secondary cards will pass the brushes SB and PB1 respectively. Early in the cycle the card lever contacts PCL1 will close and energize relay R7 as explained above and also the numbering relay NR7 which is in parallel with relay R7 (Fig. 1a). Contacts NR7A close (Fig. 1g) and maintain the holding circuit for relay NR1 throughout the run of the machine until the last primary card has passed the brushes PB1. Contacts NR7B open and interrupt the circuit which was used to initially energize relay NR1.

Also during the second cycle, the serial numbers punched in the first primary and secondary cards will be entered in both comparing units. The first primary card will be numbered 501,001 while the first secondary card will be numbered 501,501 as shown in Fig. 17a in which the eight-digit numbers at the bottom are the serial numbers of the first three primary and secondary cards.

It will be noted that the brushes SB for the first five columns of the serial number field, beginning at the left (Fig. 17a) and comprising eight columns of the secondary card, control the seventh to eleventh positions of both comparing units by energizing the magnets SM1, PM1. A typical circuit for one of the magnets SM1 is traced as follows: Line wire W2, contacts CR3, CB2, CB3, R5A, the common brush SCB, contact roller SCR, the brush SB for column 73 (see Fig. 17a also) split plug wire PW2, and the magnet SM1 for position 11 of the selector unit to line wire W1. A branch circuit also extends through one of the branches of this same plug wire PW2 to position 11 of the sequence unit. Since column 73 is punched with a "0" hole (Fig. 17a) the energization of the magnets SM1, PM1 has no effect in the comparing units other than to permit the sectors 373 (Fig. 12) for these units to move the maximum extent until stopped by the projections 373a corresponding to the "0" position.

Similarly "0" is entered in positions 8 of both units. The sectors 373 for positions 9 of both comparing units, however, will be arrested at the "5" position, while the sectors 373 for positions 7 will be arrested at the "1" position. Thus, positions 7 to 11 of both comparing units will stand at 00501 at the end of the second cycle. These entries are made in the secondary side of the selector unit and in the second primary side of the sequence unit (see Fig. 16c showing the plugging for this operation). Also during this cycle, the seventh to eleventh positions of the selector unit, primary side, and the sequence unit, first primary side will receive the entry 00501 by energization of the magnets SM2, PM2, the circuits being traced the same as above substituting the contacts R7B, brush PCB1, contact roller

PCR1, and brushes PB1, for the contacts R5A, brush SCB, contact roller SCR and brushes SB. In this case the energization of the magnets SM2, PM2 is effected through the split plug wires PW3. So far as the seventh to eleventh positions of both comparing units are involved, an equal condition will be established in both selector and sequence units showing that the upper five denominational orders or columns of the serial number field are correctly punched. An error in one of the first cards is not likely to be repeated in the other since they are 500 apart in numbering.

During the second cycle the number 501 punched in columns 78 to 80 of the secondary card is entered in positions 4, 5 and 6 of the secondary side of the selector unit through plug wires PW1 by circuits traced similarly to the entry of the other five digits in the seventh to eleventh positions to plug wires PW2, energizing the magnets SM1 for positions 4, 5 and 6. Also the value 001 is entered in positions 4, 5 and 6 of the first primary side of the sequence unit through plug wires PW4. Thus, by the end of the second cycle, the value 00501501 will have been entered in the secondary side of the selector unit and the value 00501001 will have been entered in the first primary side of the sequence unit by direct circuits from the brushes SB and PB1, respectively. Also a direct comparison will have been made of the upper five digits or columns through the seventh to eleventh positions of both comparing units, which as stated, results in an equal condition.

It will be remembered that during the first cycle a unit was entered in the units count relay by stepping its wiper arm 605 to the "1" contact 621. The emitter E (Figs. 1*g* and 8) is timed to rotate in synchronism with the sensing of the cards, in other words, the brush 501 passes on to the "9" contact or segment 502 at about the same time the brushes PB1, SB both reach the "9" index-point position of the primary and secondary cards. At the "1" point in the second cycle the emitter E and the counting relays emit the values 001 into the first primary side of the sequence unit by circuits traced as follows: line wire W2 (Fig. 1*a*), contacts CR3, CB2, CB3, R7B, wire W3, the arm 500 and brush 501 of emitter E, the "1" segment 502, the "1" contact 621 of the units counting relay, wiper arm 605 to plug socket PS119. From this point the circuit is traced through plug wire PW10 (see Figs. 16*d* and 17) to plug socket PS7 and magnet PM1 for the fourth order of the sequence unit, causing the sector 373 for the fourth order of such unit to be stopped at "1." Simultaneously therewith "1" also is entered in the fourth order on the first primary side from brush PB1 for column 80 and plug wire PW4 to the magnet PM2 for position 4 thereby creating the equal position for position 4 of the sequence unit.

A branch circuit is also established from plug socket PS119 through plug wire PW8 to the plug socket PS5 and magnet SM2 for position 4 of the primary side of the selector unit, thereby entering a unit in position 4 of the selector unit. This takes place at the same time that a unit is entered in position 4 on the secondary side from the brush SB for column 80 through the plug wire PW1. Similar circuits are traced from the plug sockets PS117, PS118, through plug wires PW9, PW11, PW12, at the "0" point in the second cycle to energize the magnet SM2 for position 5 of the selector unit and magnets PM1 for positions 5 and 6 of the sequence unit whereby the sectors 373, 374 for these positions will be stopped at the "0" position.

In column 78 of the secondary card, the value 5 is punched; however, the hundreds secondary counting relay has its "0" contacts 621 (Fig. 1*g*) wired to the "5" segment 502 of the emitter E, whereas the "5" contact 621 is wired to the "0" segment 502 for emitter E. The effect of this wiring is to cause the value 5 to be entered in the hundreds order, that is position 6 of the selector unit, although the hundreds secondary counting relay has not yet been advanced a unit. This circuit is made through plug wire PW13 and is traced in the same general way as the one from the units relay. Thus the "5" entered from brush SB for column 78 agrees with the "5" emitted by emitter E and the hundreds secondary relay.

The small numbers adjacent the contacts 621 of the counting relays in Fig. 1*g*, indicate the actual values emitted to the comparing units to which the relays are plugged. Only six of the contacts of each of the hundreds relays are used because of the fact that one half of one thousand cards is being checked on the primary side and the other half on the secondary side. Thus, in the hundreds position on the primary side the numbers will range from 0 to 5 while on the secondary side the count will range from 5 to 0. The hundreds stepping magnets PHSM, SHSM are always impulsed together so that the hundreds relay could be combined as a single relay with a double set of contacts and one stepping magnet, if desired. For each change of hundreds in the hundreds order of the serial number the hundreds relays should both be stepped a unit. For example, with respect to the two groups designated "transfer sequence" (Fig. 17) it will be noted that when the numbering of the secondary cards changes from 600 to 700, the primary cards change from 100 to 200. For this reason the "7" contact for the secondary hundred stepping relay is connected to the same emitter contact 502 as the "2" contact 621 of the hundreds primary relay whereby, when the hundreds secondary relay has been stepped to "7," the emitter E will emit the value 7 through such relay and the value 2 through the hundreds primary relay.

With respect to the next-to-the-last cards, the hundreds secondary relay causes the emitter to emit "9" to match the secondary card and the primary relay causes emission of "4" to match the 4 on the primary card, as illustrated by the lowest of the top group of numbers designated "transition sequence."

In Fig. 17*a* the lines under the highest numbers on each side indicate the next highest card of each group which, on the secondary side, of course, is the number of the first primary card of the next batch of one thousand cards to be checked. The two numbers of each group checked have been added in Fig. 17*a* for the purpose of showing the transfer from the hundreds to the thousands order which occurs in column 77 of the secondary cards and must be taken care of by positions 7 of the comparing unit. This transfer would cause a disagreement between the last primary and secondary cards in column 77 and selection of such cards if not prevented. A transition control for this purpose will be explained more clearly hereinafter. For present purposes it is convenient to assume that the circuit from the brush SB for column 77 on the secondary side passes directly to positions 7 of the comparing

units through plug wires PW2*a*, PW2*b* as one wire.

The effect of the emitter E and the counting relays is to always emit to the primary side of the selector unit impulses representing the values of the holes which should be sensed by brushes SB for columns 78, 79 and 80 of the secondary card; and to emit to the second primary side of the sequence unit the values which should be sensed by the brushes PB1 for the same columns of the primary card.

In a sequence of only a thousand cards punched with eight digits, beginning - - - - - 001, all but the last card on the secondary side will be designated alike in the five higher order columns, that is columns 73 to 77 in the present case. Thus, if the cards are correctly punched and in proper sequence in the higher order positions 7 to 11 of sides of both comparing units should always compare alike. It might happen however, that, in the batch of cards designated 501,001 to 502,000, one of the cards might have a hole other than 5 in column 75 (see Fig. 17). For example, a "6" might be punched in the third card so that the serial number of such card would be 601,503. This would cause the switching units for the comparing units to assume the low primary condition (Fig. 12) for the selector unit, and high second primary condition for the sequence unit.

This causes one selection circuit to be established at the end of the cycle as follows in the case of the selector unit: line wire W2 (Fig. 1*c*), contacts R17B, contacts CR2 (Fig. 1*d*), the contact elements 415 and wiper elements 421 of the selector unit up to the 9 order wiper 421, common strip 412, plug wires PW14, PW21, and magnet SRM1, to line wire W1. This energization of magnet SRM1 takes place at the end of the feeding cycle in which takes place the comparison of the "6" in column 75 of the secondary card with the 5 appearing in column 75 of the primary card. The energization of magnet SRM1 causes both of the blades 306, 307 to be pushed upwardly with the result that the secondary card having the "6" hole in column 75 will be selected and ultimately conveyed into the pocket SRJ.

Another selection circuit is established (Fig. 1*d*) through the sequence unit from contacts CR2 through the wiper 421 for position 9 of the sequence unit, common strip 412, plug wire PW18, and the coil R33P of the cycle delay relay to line wire W1. Relay R33P closes contacts R33A to establish a holding circuit for the coil R33H of the cycle delay relay through the commutator PC4 which circuit will be held through coil R33H until the 7 point of the following card feeding cycle.

The cycle delay relay also closes contacts R33B (Fig. 1*b*) to enable the contacts CR4 to close a circuit through relay R16P which is established during the card feeding cycle after the one in which coil R33P is energized. Relay R16P closes contacts R16A enabling a holding circuit to be established at "7" through the coil R16H by commutator PC2. Thus, the relay R16P remains energized through the remainder of the cycle following the one in which the secondary card designated with a serial number 601,503 is fed to the brushes PB2. The relay R33P—R33H will be deenergized at "7" of this cycle, also the comparing units will be reset.

Commutator PC2 holds coil R16H energized and overlaps the contacts PC4 so that relay R16P will be kept energized not only through the cycle in which the primary card designated 501,003 moves to the brushes PB2, but also through the cycle in which the same card moves past brushes PB2 to the eject station. During this last cycle, the contacts CR2 close a circuit to plug socket PS49 (Fig. 1*d*) thence through plug wire PW19, contacts R16B, plug wire PW23, and magnet PRM, to line wire W1. This causes the plate 308 to be pushed upwardly to deflect primary card number 501,003 into the pocket PRJ. Thus both the card numbered 601,503 and the primary card numbered 501,003 will be selected and segregated from the remaining cards and may be compared visually to see which is correctly punched.

It is necessary to select both the primary and secondary cards when a disagreement occurs in the five highest denominational orders of a serial number because of the fact that the comparing units cannot tell which of two numbers compared is the correct number. All the comparing units can do is tell whether one number is equal to, higher, or lower than the other. For example, in the illustrative case discussed, the primary card might have been incorrectly punched 601,503 and the secondary card correctly punched 501,503. In this case the numbers again would be unequal and the comparing unit would again make a selection.

If only the magnet SRM1 were plugged to select the secondary card, in this last example, the correctly numbered card would be selected, but the incorrect primary card would not be selected. On the other hand, the secondary card might have been numbered 401,503 which would cause a circuit through magnets PRM and SRM1 to be made by way of the common strips 413 instead of the common strips 412. It is clear that, upon any inequality between the primary and secondary cards, the comparing units operate together to select both the cards which should be alike. While it is conceivable that both cards might be alike yet punched with the wrong serial number, it is very unlikely because the compared cards will always be 500 apart and the error would be present in all cards and noticed when the lots of one thousand cards are assembled in proper order prior to shipment. In the use of this machine it is desirable to examine the first and last cards of each group visually not only before undertaking the sequence checking operation, but also when assembling the cards in the boxes for shipment to make sure the groups of numbers run consecutively, not only in the lowest three orders but also in the five highest orders.

It is necessary to delay the impulse to the magnet PRM because of the fact that the primary cards must be fed one more cycle after sensing by brushes PB1 past brushes PB2 before arriving at the eject station, whereas the secondary card arrives immediately at the eject station at the end of the cycle in which it is sensed.

In the event that the relays count and emit a number which does not agree with the number punched in the columns 78, 79, and 80 of either card, an unequal condition will be created in positions 4, 5 and 6 of one, and possibly both of the comparing units. For example, let it be assumed that the card designated 501,501 is missing and the cards start at 501,502 on the secondary side. When the value 501 is emitted to positions 4, 5, and 6 of the primary side of a selector unit, the value 502 will be entered in the corresponding positions of the secondary side, thereby again creating a low primary condition in the selector unit. This causes the magnet SRM1 to be selected by a circuit similar to the one traced

above except that the circuit will extend through the selector unit to the wiper 421 for position 6 and thence to contact strip 412. As a result, the first secondary card will become deposited in pocket SRJ. Since there is no provision for stopping the primary feed mechanism to permit the secondary cards to get back into step with the counting relays, the counting device will remain one step behind the serial numbers punched on the secondary cards with the result that all subsequent secondary cards will be deposited in pocket SRJ. In the case of the first type of error discussed above, the cards are in proper order in respect to the first three digits throughout the two halves of the sequence being checked, with the result that the checking operation may continue. This also will be true when two cards of a set are interchanged, for example, card numbers 501,502 and 501,700 (Fig. 17*a*) are merely interchanged. These two cards will be rejected but the counting device will continue in step with the other cards.

It is necessary after each time a count of 9 is reached to effect a units transfer to the counting relay associated with the next higher order. For example, when the ninth primary card punched 501,009 is sensed, it is necessary to restore the units relay and impulse the stepping magnet TSM for the tens relay so that this relay may properly control the emission of one unit to the comparing unit to match the next succeeding card punched 501,010.

It will be noted from Fig. 10*a* that the contacts PC8 are closed at the "9" point in the cycle. When the wiper arm 605 for the units relay steps to the 9 contact 621, besides the emission of the value "9" to position 4 of both comparing units to match the 9 punched in column 80 of both the primary and secondary cards, a second circuit is established through contacts PC8 and HSNR2, relays NR4, to line wire W1. Commutators SC3, SC4 hold relays NR2, HSNR4 until the beginning of the next cycle. This causes the contacts NR4A to open and NR4B to close whereby the closure of contacts CR10 instead of energizing the units stepping magnet USM, closes a circuit to the units restoring magnet URM through contacts NR2B. This causes the units relay to be reset to "0" and have the same effect as if there had been provided a second "0" contact on the stepping relay and magnet USM had been energized to move the wiper 605 of the units relay to such 0 contact. In addition to the impulse delivered to the magnet URM, an impulse is delivered to the tens stepping magnet TSM through the contacts NR5A thereby causing the tens relay to be stepped one unit in place of the units relay. In other words, the normal counting impulse is delivered to the tens stepping magnet TSM instead of the units stepping magnet USM. Thus, when the cards punched 501,510 and 501,010 are sensed, the counting relays will cause the emission to positions 4, 5 and 6 of the comparing units of the values 510 and 010. The same thing will happen when the tens relay reaches the count of 9. Since the tens relay can only change from 9 to 0 in consequence of a transfer impulse controlled by the units relay through the commutator PC8, it is quite evident, as indicated in Fig. 17*a*, by the group entitled "transfer sequence," that transfer will be simultaneous for both the units and tens order. When the cards numbered 501,199 and 501,699 are sensed together the units magnet URM will be energized as before. Since both the units and tens relays stand at 9 both relays NR4, NR5 will be energized together by closure of commutators PC7, PC8, with the result that both the units restoring magnet URM and the tens restoring magnet TRM will be energized in parallel through the contacts NR4B, NR5B, and an impulse will also be delivered to the primary hundreds stepping magnet PHSM and secondary hundreds stepping magnet SHSM through contacts NR5B. This will restore the units and tens relays and advance the hundreds relay one unit. On the following cycle, when the cards designated 501,200 and 700 are sensed the values 200 and 700 will be emitted to positions 4, 5, and 6 of the comparing units.

The last primary and secondary cards will be numbered 501,500 and 502,000, respectively, since the numbers started with 001 on the primary side and 501 on the secondary side. One the last card sensing cycle when these cards are sensed and compared, it is necessary for the hundreds primary relay to emit 5 and for the secondary relay to emit 0 to match the perforations which should be present in the hundreds columns of these cards. This means that after the next to the last card is sensed on each side the units and tens relays must be reset to 0 and the hundreds relays advanced one more step to the 6th segments which, it will be noted in Fig. 1*g*, are connected to the "5" segment 502 of the emitter E in the case of the primary hundreds relay and the "0" segment in the case of the hundreds secondary relay.

The contacts PC5 are timed to close at 4, consequently, during the next-to-the-last cycle during which the cards 501,499 and 501,999 are compared, all three relays NR4, NR5, and NR6 will be energized and holding circuits therefor established as described above by the relays HSNR2, HSNR3, HSNR4. This has the effect of energizing magnets URM, TRM through circuits as described above for the normal hundreds transfer since the primary and secondary hundreds orders are changing from 5 to 0 and 9 to 0, respectively, and additionally, by the closure of contacts NR6B connects relay NR29P in parallel with the hundreds stepping magnets PHSM, SHSM. This advances both the hundreds relays one more step prior to the analysis of the last cards to be compared so that at the end of the next to the last cycle the units and tens relay will have been reset to 0 to enable the emission of 0's during the following cycle while the primary hundreds relay will have been stepped forward to the 5 contact 621 and the secondary relay to the 0 contact. Thus on the following cycle the count emitting device is able to emit 500 to match the primary card and 000 to match the secondary card. The effect of the relay NR29P will be explained more clearly hereinafter. If the last primary card is actually numbered 501,500 and the last secondary card 502,000, an agreement will be reached in both comparing units and the last two cards will be treated the same as the others which agree with the counting device.

When the "5" impulse is emitted by the hundreds primary relay, a circuit will be established from the wiper arm 605 of the hundreds primary relay in parallel with the circuit to magnet PM1 for position 6 of the sequence unit. This parallel circuit extends through the commutator PC6 which closes at "5" (Fig. 10*a*) and the relays NR3 and HSNR1 in parallel to line wire W2. Relay NR3 closes its contacts NR3B (Fig. 1*g*) to enable a circuit to be established at the end of

the last cycle which circuit extends from line wire W2 through contacts CR10, NR3B, and relay NR2, to line wire W2. Contacts NR2A also close and connect all of the restoring magnets URM, TRM, PHRM, SHRM, in parallel thereby causing the automatic restoration of the hundreds relays, the units and tens relays having already been restored. This places the count emitter in condition for the next batch of cards which, in all probability will range from 502,001 to 503,000.

Normally, the brush SB for column 77 (Figs. 16*c*, 17*a*, and 17*b*) controls the magnets SM1, PM1 for position 7 of both comparing units through the plug wires PW2A, PW2B and the contacts NR29B, NR30B. When the primary card number 499 is sensed, the relay NR29P is energized as described above closing the contacts NR29C. During the next cycle, the brush SB for column 77 will sense the "2" hole in such column and the impulse controlled by the brush will be transmitted through plug wire PW2A, contacts NR29C, NR30A, and relay HSNR23, to line wire W1. This occurs at the "2" point in the cycle. Relay NR30 is energized in parallel with HSNR23 and a holding circuit is established for both relays through contacts CR11 and HSNR23A. All this occurs before the "1" point in the cycle is reached. Immediately upon energization of relay NR30, it closes its contacts NR30C. This enables a second circuit to be established, at the "1" point in the cycle, from line wire W2 (Fig. 1*a*), contacts CR3, CB2, CB3, R7B, wire W8, contacts NR30C (Fig. 1*g*) and plug wire PW2*b* to the magnets SM1, PM1 for the positions 7 of both comparing units, whereby the magnets are energized at the "1" point instead of the "2" point. Since the primary card has a "1" hole in the thousands column, the equality condition will be created in the seventh to eleventh positions of both units. Thus the last cards will not be selected notwithstanding the fact that they differ by 1 in the thousands column. It is in this manner that the machine takes care of a transition from 501,999 to 502,000.

The operation will be the same regardless of the value of the hole in the thousands column of the secondary card since the primary card will always be less by 1 and the circuit which energizes relays HSNR23, NR30 may be closed by a perforation of any value and will always have the same effect in the comparing units as the next lowest value hole appearing in the primary card. Thus, in the sequence 502,001 to 503,000 the last secondary card will have a "3" hole and the last primary card a "2" hole in column 77.

Means are provided to detect the presence of more than one perforation in any column of the serial number field. There is a double punch detecting device associated with each side of the machine. These devices are shown in Figs. 1*e* and 1*f* and appear diagrammatically in Fig. 17*a*, being there shown by means of suitably labeled boxes. The operation of these devices is alike in all respects, consequently, only the secondary device will be described in detail. Each detector has a capacity of eight columns and includes the plug sockets PS113 which are connected to the secondary brushes SB by means of branches in the plug wires PW1, PW2, PW2*a*, as shown in Fig. 16*c*.

Let it be assumed that there is a superfluous hole appearing in column 80 of a secondary card. A circuit will be established from brush SB for column 80, through plug wire PW1 to the plug socket 113 for position 8 of the double punch detector (Figs. 1*e*, 17*a*, and 17*b*) thence through contacts NR18A, relays NR18, HSNR12 in parallel, and wire W5 to line wire W1. Relay HSNR12 closes its contacts HSNR12A to maintain a holding circuit for itself and relay NR18 from line wire W2, through contacts CR12, wire W6, contacts HSNR12A, the coils of relay NR18, HSNR12, and wire W5, to line wire W2. The relay NR18 closes its contacts NR18B which remain closed until the end of the sensing period. This effect is produced by the first perforation occurring in column 80 regardless of its value.

When the second perforation is sensed by brush SB for column 80, another circuit will be established through plug wire PW1, contacts NR18B, CB4, R27B, relays HSNR21, NR27H, and wire W5, to line wire W1. Contacts HSNR21A close and establish a holding circuit for relay HSNR21 and also for the coil NR27H which is in parallel with relay HSNR21. Relay NR27H closes contacts NR27A (Fig. 1*d*) permitting a circuit to be established from line wire W2, contacts R17B (Fig. 1*c*), CR2 (Fig. 1*d*), NR27A, the contact strip 412 of the selector unit, the plug wires PW21, PW14, and magnet SMR1 to line wire W1. The energization of the latter causes the secondary card which has the extra hole in column 80 to ultimately become deposited in the pocket SRJ.

The primary double punch detector shown in Fig. 1*f* operates in exactly the same way and comprises the group of relays NR19 to NR26, corresponding to the relays NR11 to NR18; relays HSNR13 to HSNR20, corresponding to the relays HSNR5 to HSNR12; and the relays HSNR22, NR28H, corresponding to the relays HSNR21, NR27H. Relay NR28H (Fig. 1*f*) closes its contacts NR28A (Fig. 1*d*), thereby closing a circuit to the contact strip 412 of the sequence unit and thence to plug wire PW18 to the cycle delay relay R33P which, functions as described above, to control the magnet PRM and causes a primary card having two holes in each column to become deposited in the pocket PRJ.

The relays NR11 to NR18 for the secondary double punch detector and NR19 to NR26 of the primary double punch detector also may be considered part of the blank column detectors for the primary and secondary cards. For this purpose, these relays control contacts designated with the letter C. For example, in the case of the circuits described above for column 80, the contacts NR18C will be opened upon occurrence of the first hole in column 80. If all the columns of the serial number field have holes, then all of the contacts designated NR11C to NR18C will have been opened at the end of the sensing period whereby the closure of contacts CR2 will have no effect insofar as the secondary blank column detector is concerned. However, if any column lacks a hole such as column 80 of the secondary card, the contacts NR18C will remain closed and a circuit will be established from line wire W2 (Fig. 1*c*), contacts R17B, CR2 (Fig. 1*d*), wire W4, contacts NR12C, wire W3, the coil NR27P and wire W5, to line wire W1. The coil NR27P also controls the contacts NR27A (Fig. 1*d*) which have the same effect of selecting the magnet SRM1 as described above in the case of the secondary double punch detector. The relay NR28P (Fig. 1*f*), controlled by contacts NR19C to NR26C similarly controls the contacts NR28A (Fig. 1*d*) and has the same effect as the coil NR28H of selecting the magnet PRM when the primary card lacks a hole in any column.

The operations described above may be summarized as follows:

The lowest three orders of each card as it is fed are compared with the appropriate section of the counting device which is advanced in step with the feeding of the cards. If the cards on both sides of the machine are complete in sequence, i. e., none missing and none duplicated, the feeding continues without interruption until 500 cards have been fed on both sides of the machine. Also the five highest orders of each card on one side of the machine are compared with the same orders of a companion card on the other side and the feeding continues as long as there is no disagreement between each pair of cards compared. In other words, as long as the equal condition persists in the two comparing units the feed continues without selection.

If a disagreement occurs only in one or more of the five highest columns of the cards, both cards will be selected and deposited in pockets PRJ, SRJ, and the feeding and checking of cards continues since the cards are in proper sequence in the lowest three orders.

In the event a card on either side of the machine disagrees with the corresponding section of the counting device, such card will be selected and deposited in pocket PRJ or SRJ, as the case requires, and the feeding and checking of cards continues.

The selection of a card which disagrees with the counting device may put the cards following the selected card out of step with the counting device in which case all the cards following the selected card also will be selected.

When two successive cards are merely interchanged, as 505 interchanged with 506 in the sequence 504, 506, 505, 507, only the interchanged cards will be selected and the checking will continue with 507, the first card in step with the counting device.

A card may be merely misplaced in the file as, for example, card 5 might occur between cards 15 and 16 in sequence 15, 5, 16. The cards will be out of step with the counter from the count of 5, when the card 6 is selected until the count of 15, when card 5 is compared with 15 on the counter (the count being a unit behind the cards fed) causing the selection of card 6 to 15, and 5. The card 16 will then be fed after the count of 16 and the checking resumed until another error occurs.

If a card is missing all subsequent cards on that side of the machine will be selected as there is no chance for the counter to get back into step with the cards.

The checking proceeds independently on both sides of the machine so that an error in sequence on one side does not affect the sequence checking operation on the other, save in the one case first discussed, of cards failing to agree in the five highest orders.

The check for double punching and blank columns proceeds independently of the sequence check and without disturbing the latter. A card double punched or lacking a hole in some column is rejected and the checking of the cards continues.

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

the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a record assorting machine, sorting means, means to feed one portion of a serially designated set of records and separate means to feed the other portion in step with the first portion, said portions together supposedly comprising a complete single serial sequence having serial number designations, a certain number of the denominations being identically serially designated throughout said set, the remaining denominations comprising two separate sequences, means to sense the designations in both portions, means to count the records of both portions according to the repeated sequences, comparing means controlled by the sensing means and counting means for comparing the identically designated denominations of a record from one portion with the same denominations of a record from the other portion to detect non-identity of the identically designated denominations and to detect non-identity of the remaining denominations of either portion with the counting device, and means controlled by said comparing means for controlling the sorting means to segregate all non-identical records from the identical records.

2. In a record assorting machine, record sorting means, means to feed one portion of a set of records having serial numbers represented by data designations differentially disposed in the columns of a serial number field, each of said columns corresponding to a denominational order of the serial number, said field comprising a plurality of columns, means to feed the other portion of said set in step with the feeding of said first portion; a predetermined number of highest order columns of the records of said portions being identically designated, the remaining lowest order columns of said records being designated according to two separate sequences in numerical order according to the designations, each of said portions being designated according to one of said sequences; means to sense said designations, sequence counting means for counting the sequences in the lowest order columns separately in step with the feeding of both portions of said set, means controlled by the sensing means for comparing the designations in the highest order columns of a record from one portion with the designations in the corresponding columns of a record from the other portion and for comparing the lowest order columns with the numbers counted by the sequence counting means, and means controlled by the comparing means for controlling the sorting means to segregate from said portions all records not agreeing in the highest order columns and not agreeing with the sequence counting means in the lowest order columns.

3. In a record assorting machine, record sorting means, means to separately feed one half of a series of records arranged in numerical sequence according to serial number designations variably disposed in the columns of a serial number field in which each column corresponds to a denominational order, a certain number of the highest order denominational order columns being identically designated, the lowest order columns of each half of said series being designated according to ascending numbers starting at unity in the lowest order and progressing in step up to half the number of records in said series, means to compare the highest order columns of both halves to detect records which are not alike in

numbering in the highest orders; record counting means, for counting the records of both halves of said series in step with the feeding of said records, means to compare the numbers counted with the numbers designated in the lowest order columns, and means controlled by the comparing means for controlling the sorting means to segregate all non-agreeing records from the agreeing records.

4. In a machine of the class described, means for sensing, one record at a time, serial number designations in a series of records supposed to be in numerical order, the records of one portion of said series being successively presented to the sensing means in the same numerical order as the records of the other portion of the series, the records of one portion being identically designated in the lower orders of said numbers, according to the order of presentation, with the records of the other portion, a consecutive number representing device including means to maintain the representations of said device in step numerically with the numbers on the records of both portions; record comparing means including means connected to the sensing means for receiving consecutive numbers from the records under control of the sensing means and including means connected to said number representing device to receive numbers from said device, and including means to manifest the fact that a number designated on a record of either portion of said series is out of step with the number representing means, and machine control means controlled by the manifesting means according to whether or not the records are in step with the representing means.

5. In a record controlled machine, means to separately feed two sequences of records identified by sequence designations, each sequence supposedly comprising a complete consecutive set between two sequence limits, one of said sequences when complete corresponding in designations record-for-record in numerical order of presentation with the other sequence in respect to one part of the sequence designations and identical in all records in respect to another part of the sequence designations, means to compare the identical part of the designations, means to check the consecutive order of both sequences in respect to said one part of the sequence designations, and machine control means controlled by both the comparing means and checking means and rendered operative and inoperative all according to whether or not the sequences are complete in respect to said one part and identical in respect to said other part.

6. In a record controlled machine, means to check a continuous sequence of records designated by sequence designations, said means including record designation comparing devices for comparing pairs of records a predetermined sequential distance apart in said sequence to detect similar designations, said designations in the aggregate also having a constant sequential difference, said checking means including means to control the comparing means to sense the designations a predetermined distance apart to have the same effect as the similar designations, and sorting mechanism controlled by said comparing means for segregating from said sequence one of the records which lack the predetermined sequential difference apart.

7. In a machine of the class described, means to feed a sequence of records having sequence designations, means to sense successively the sequence designations of two records a predetermined sequential distance apart in said sequence, record comparing means settable under control of the sensing means to represent the sequential position of both records, a sequence counting device arranged to operate in step with the successive sensing of said records and automatically advanced to represent the actual sequential positions and sequential difference which said records should have in said sequence, means to set the comparing means under control of said device for comparison of the designations in the records with the representations of said device, and machine control means rendered operative when the designations in one of said records fails to agree with the representations of said device.

8. In a machine of the class described, means to feed a sequence of records having sequence designations, means to sense successively the sequence designations of two records a predetermined sequential distance apart in said sequence, record comparing means settable under control of the sensing means to represent the sequential position of both records, a sequence counting device arranged to operate in step with the successive sensing of said records and automatically advanced to represent the actual sequential positions and sequential difference which said records should have in said sequence, means to set the comparing means under control of said device for comparison of the designations in the records with the representations of said device, sorting mechanism rendered effective by said comparing means to segregate from said sequence the records which have designations disagreeing with the representations of said device.

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