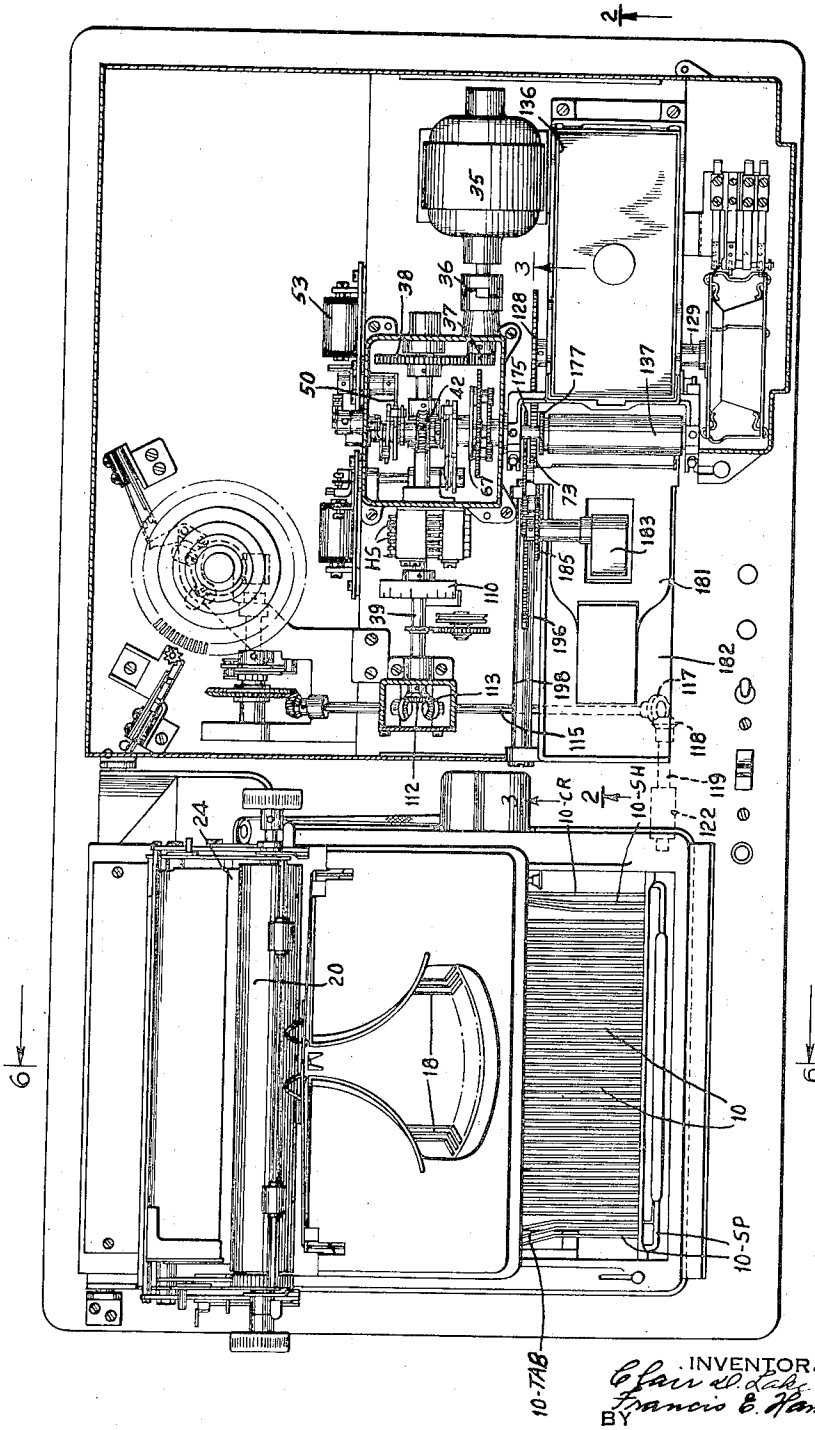
March 11, 1941. C. D. LAKE ET AL 2,234,263

DATA CHECKING MEANS

Original Filed Aug. 31, 1938 11 Sheets-Sheet 1

FIG. 1



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DATA CHECKING MEANS

Original Filed Aug. 31, 1938 11 Sheets-Sheet 2

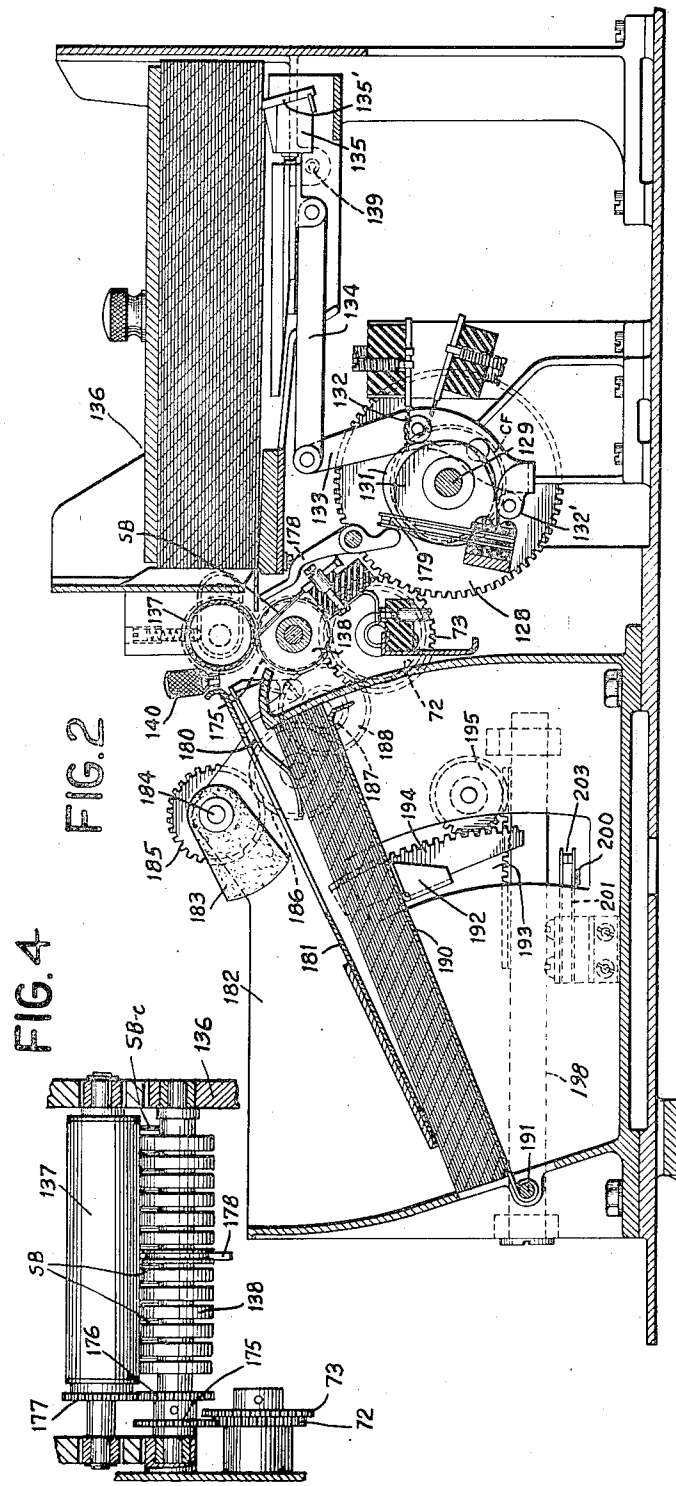

FIG. 2

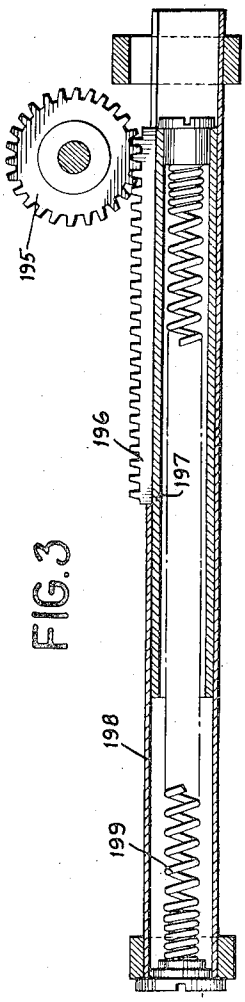

FIG. 3

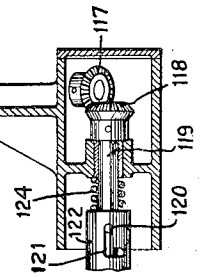

FIG. 4

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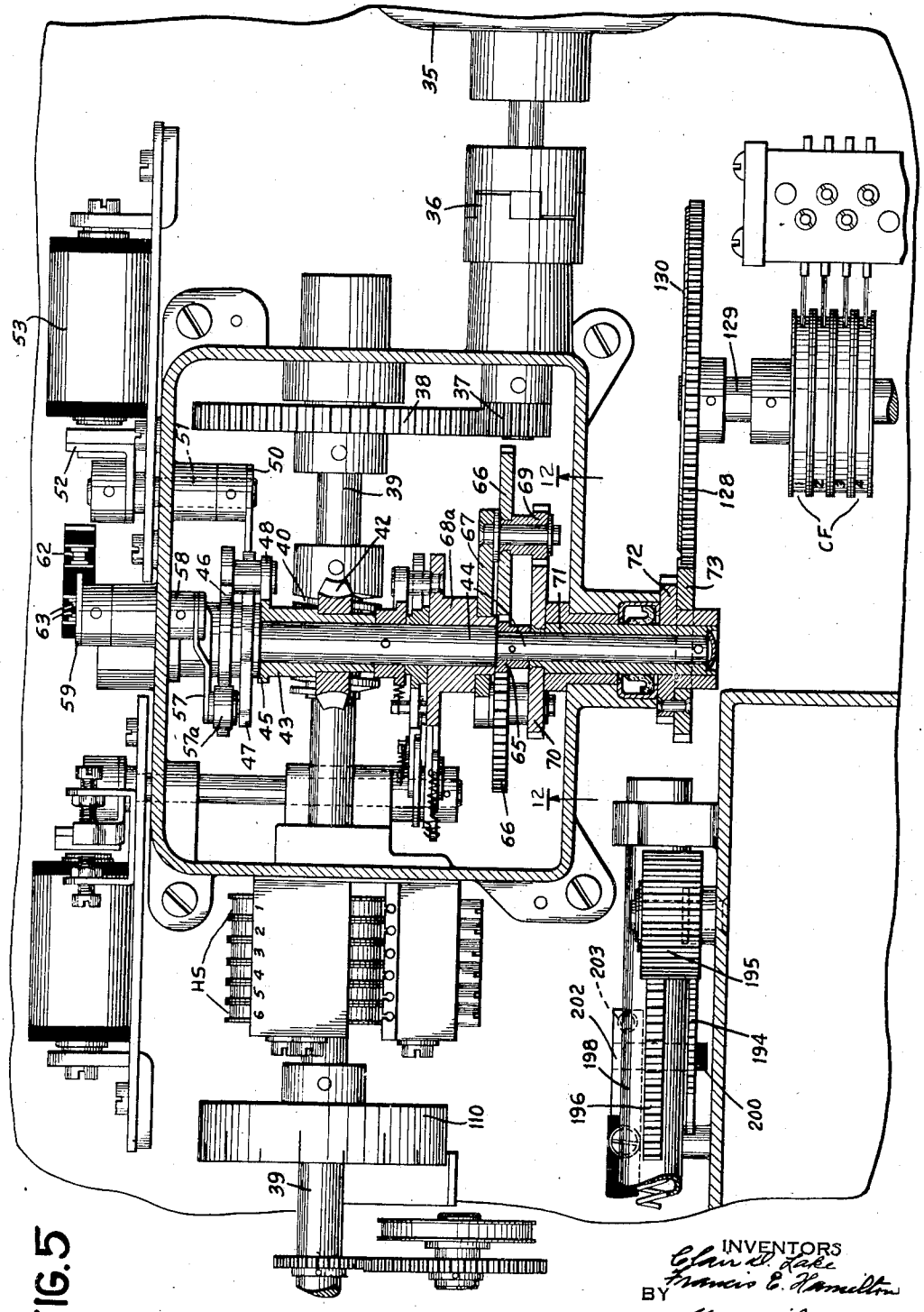

FIG. 5

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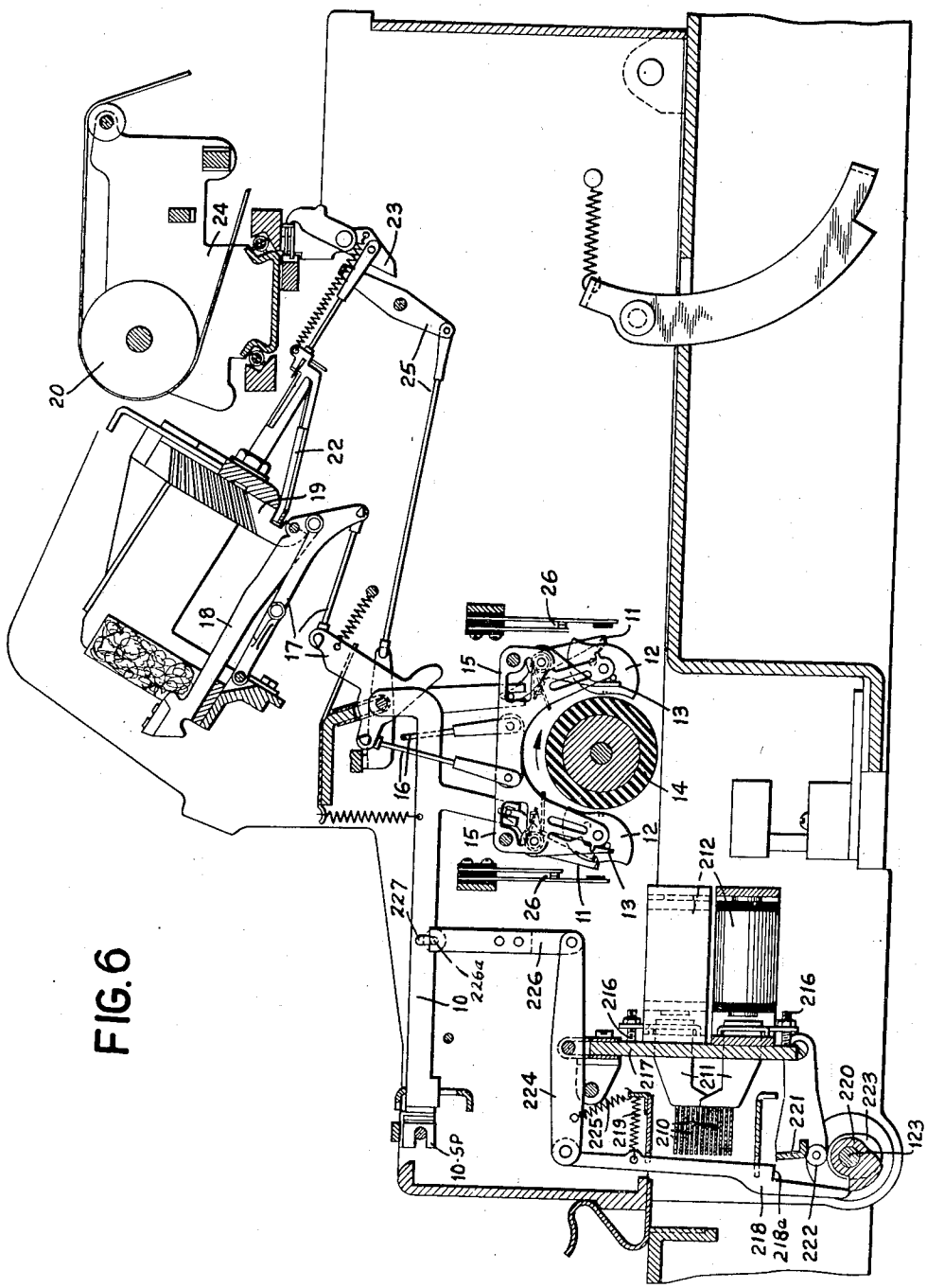

FIG. 6

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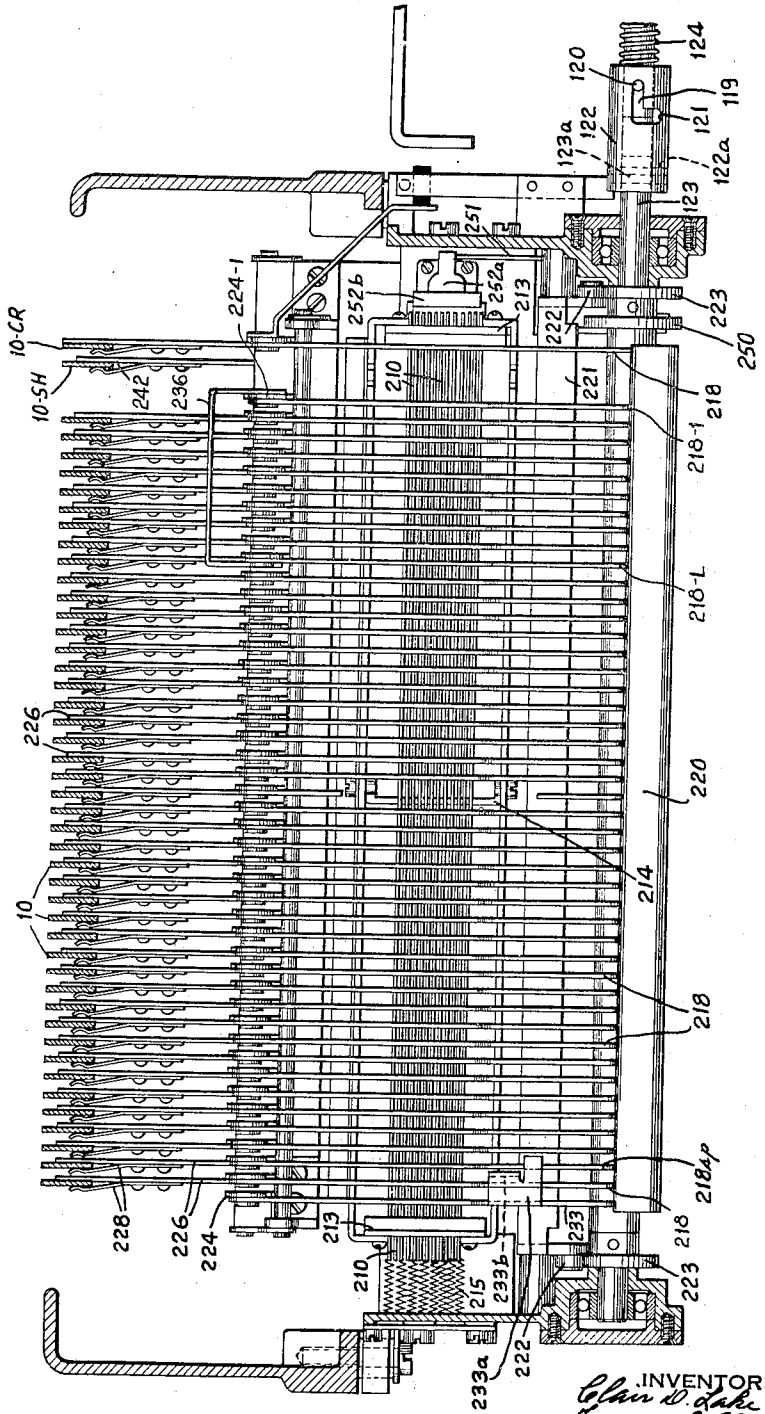
FIG. 7



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DATA CHECKING MEANS

Original Filed Aug. 31, 1938 11 Sheets-Sheet 6

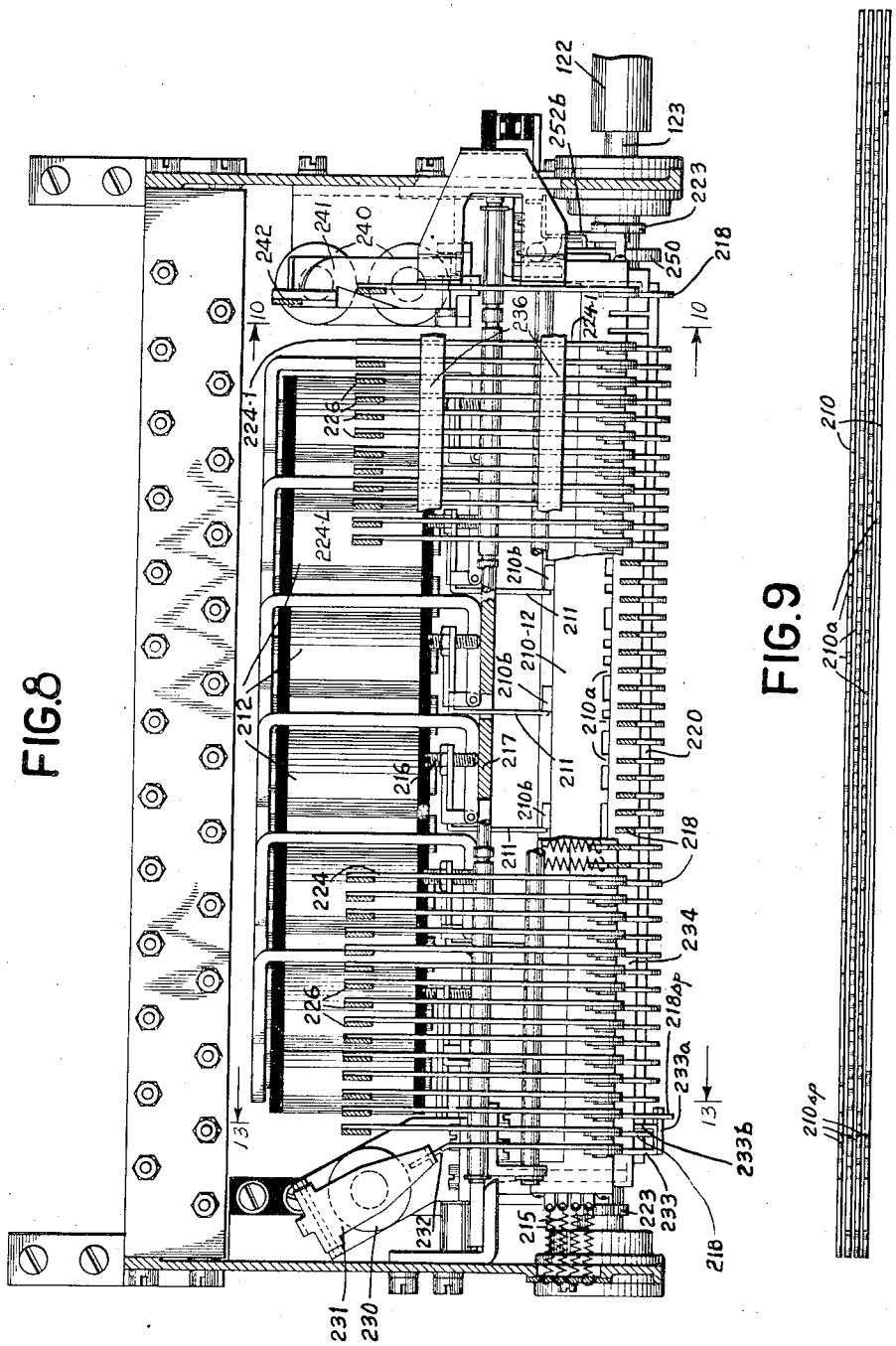

FIG.8

FIG.9

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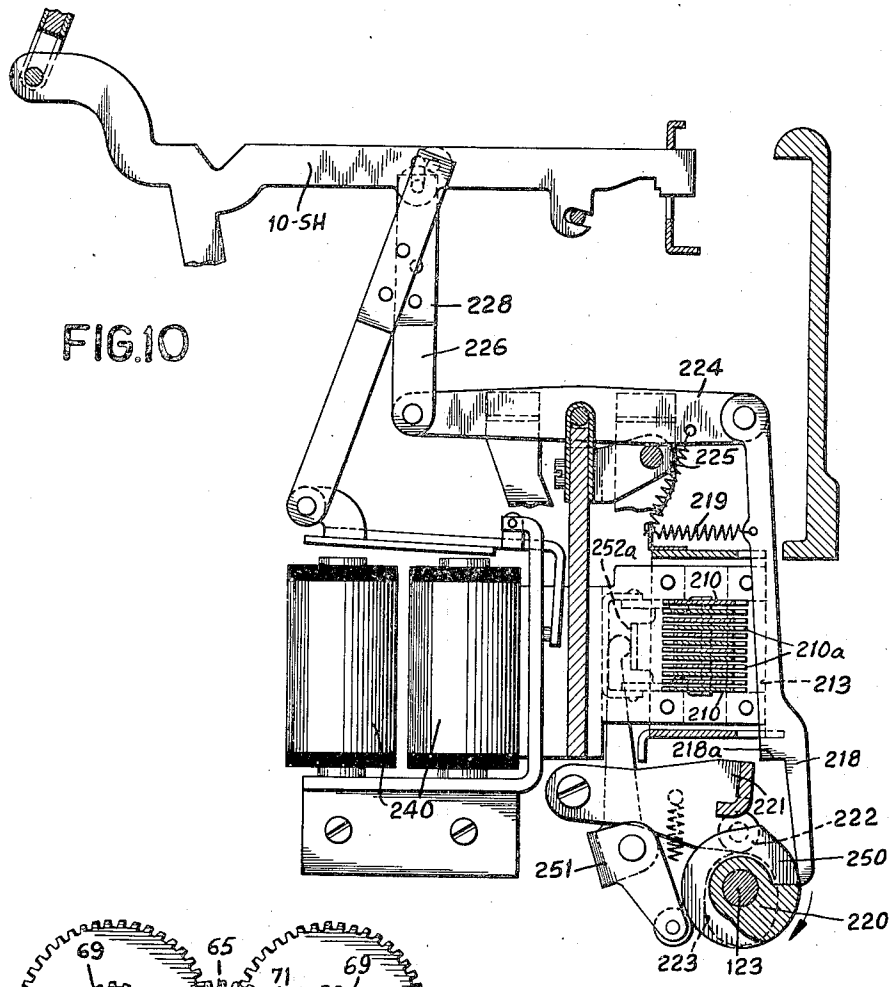

FIG.10

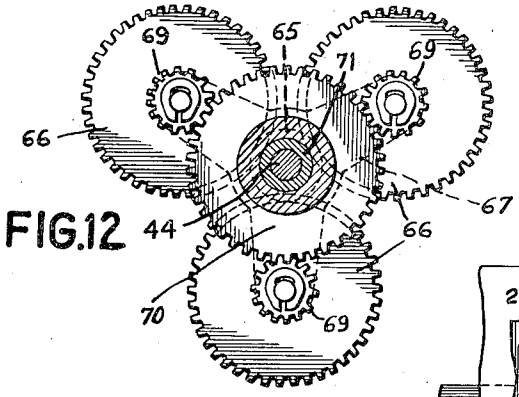

FIG.12

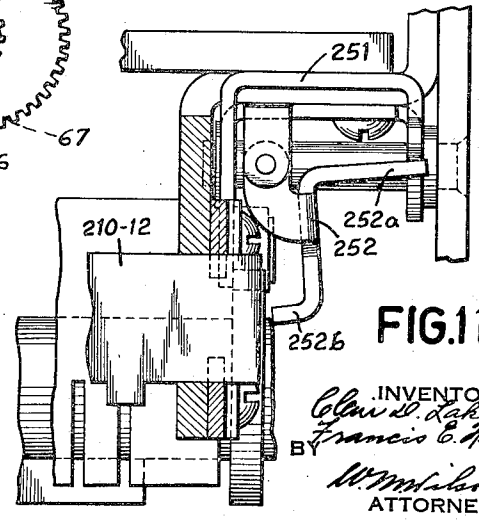

FIG.11

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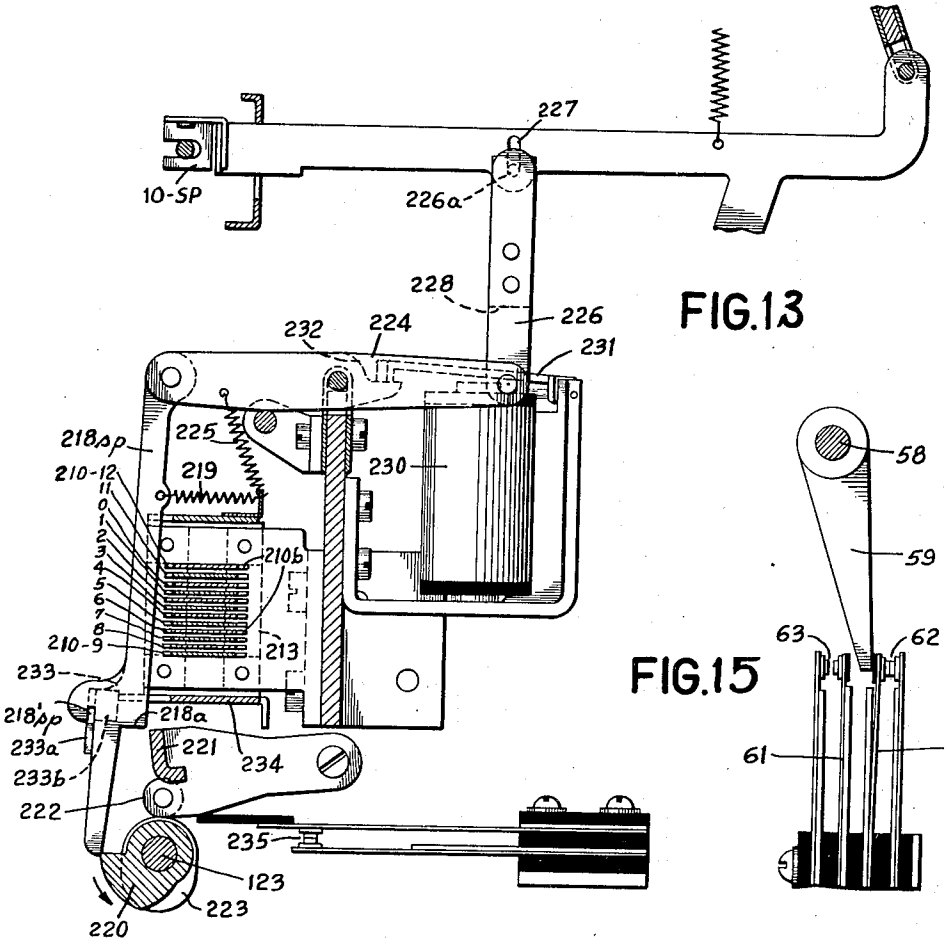

FIG.13

FIG.15

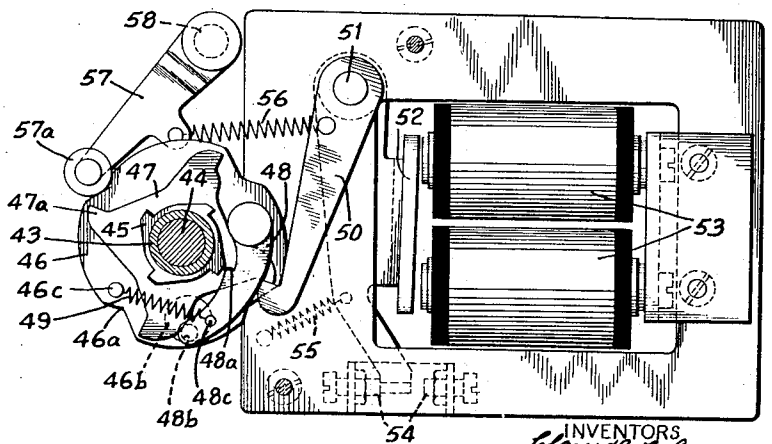

FIG.14

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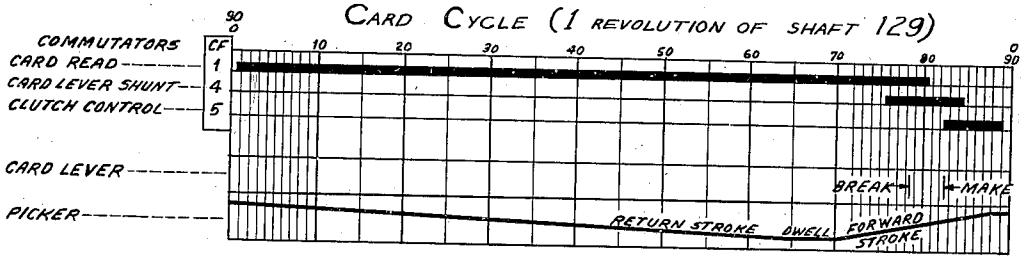

FIG.16

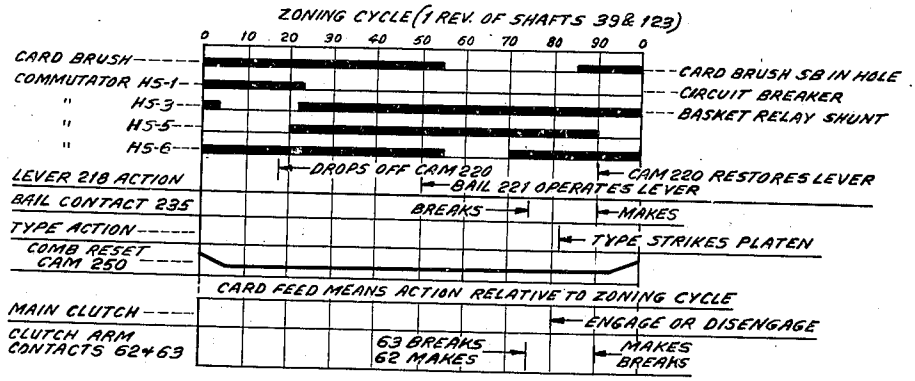

FIG.17

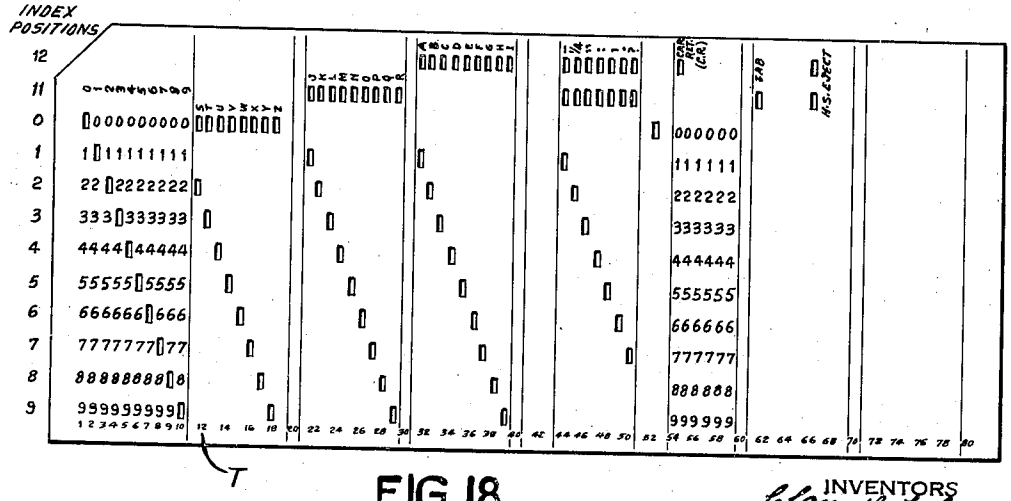

FIG.18

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FIG.19a

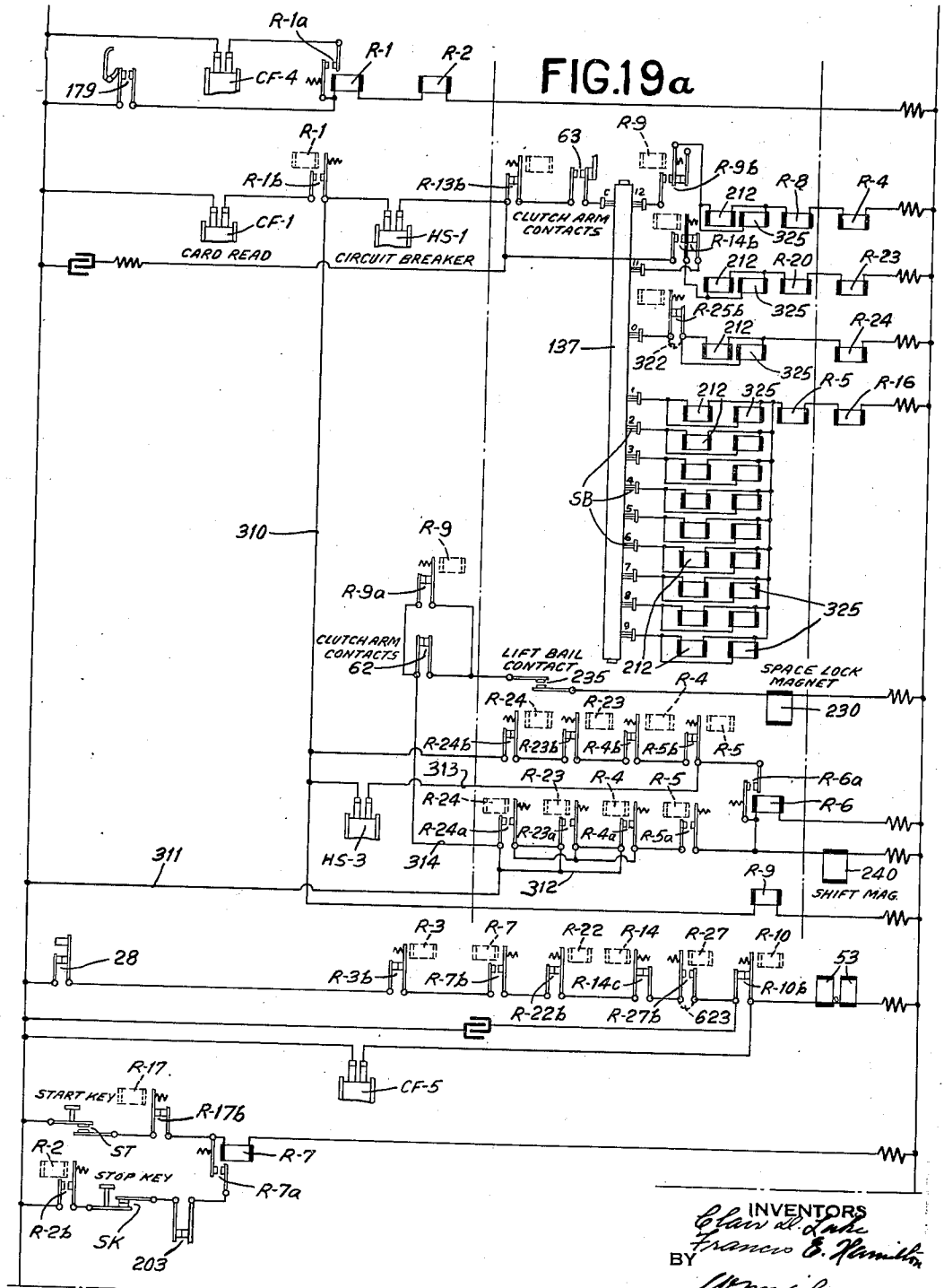

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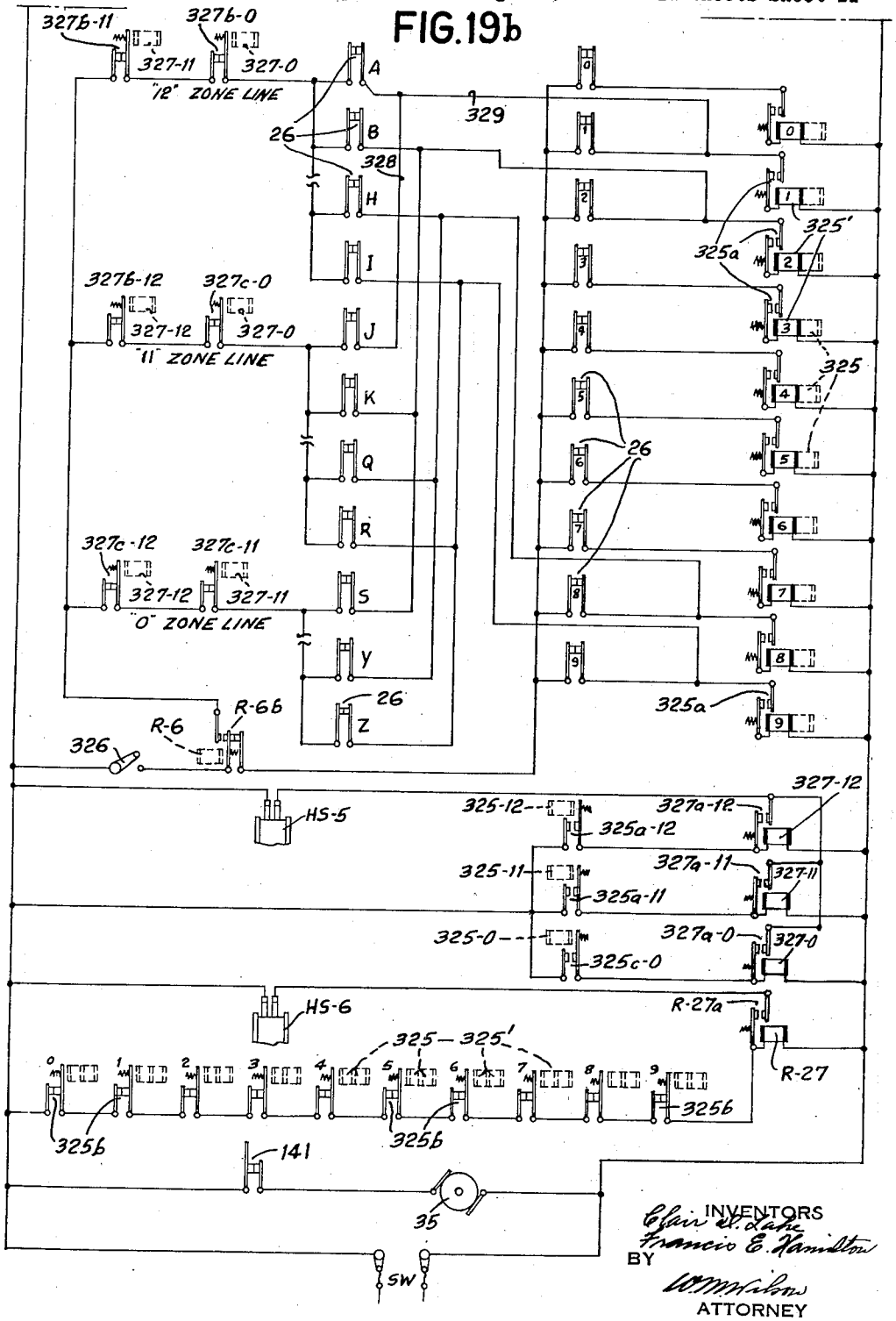
FIG. 19b



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Patented Mar. 11, 1941 2,234,263

UNITED STATES PATENT OFFICE

2,234,263

DATA CHECKING MEANS

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Original application August 31, 1938, Serial No. 227,784. Divided and this application June 14, 1939, Serial No. 279,014

13 Claims. (Cl. 197—20)

This case relates to automatic transcribing machines, and is a division of application Serial No. 227,784, filed August 31, 1938.

The present invention deals specifically with a recording machine controlled by tabulating cards bearing data and control indicia in the form of coded perforations or designations. It is to be understood, however, that this invention may be used in conjunction with data derived from a record tape or sheet, or from a remote source, either through electric, pneumatic, or equivalent circuit means, or through mechanical means.

The machine comprises a recording and transcribing unit which includes recording elements operated in accordance with the items received from a record source for recording the items on a receiving sheet carried in the recording unit. The operation of the recording elements is effected automatically under control of the corresponding designations received from the record source. The recording element selected for operation should correspond to the controlling code or item designation transmitted from the record source.

The primary object of the present invention is to counteract incorrect selection and operation of the transcribing and recording means by the record data.

The object may be stated as the provision of means for checking the accuracy of operation of a data transcribing apparatus in transcribing or interpreting the data designations derived from a record source such as record cards or the like.

The object of the invention is, more specifically, to manifest the failure to select and operate the recording element accurately corresponding to the controlling item designation.

It is contemplated, further, that the manifestation of an incorrect operation of the recording means be effected by interrupting operation of the controlling section of the machine, so as to prevent further control by record designations after an incorrect recording has taken place.

The object, further, is to provide means within the recording unit itself for coacting with the item designation transmitting means to check whether the recording element selected for operation is the one corresponding to the controlling designation.

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:

Fig. 1 is a plan view of the machine with the control section uncovered.

Figs. 2 and 3 are sections, respectively, along lines 2—2 and 3—3 of Fig. 1.

Fig. 4 is a sectional front view of the designation sensing means.

Fig. 5 is an enlarged plan view of the drive mechanism for the machine.

Fig. 6 is a section along line 6—6 of Fig. 1.

Fig. 7 is a front sectional view of the zoning system or translating means of the transcribing section of the machine.

Fig. 8 is a top sectional view of the zoning system.

Fig. 9 is a front view of the top four comb bars of the zoning system.

Fig. 10 is a section along line 10—10 of Fig. 8.

Fig. 11 is a detail sectional view of the restoring means for the comb bars of the zoning system.

Fig. 12 is a section along line 12—12 of Fig. 5.

Fig. 13 is a section along line 13—13 of Fig. 8.

Fig. 14 is a side sectional view of the main clutch.

Fig. 15 is a detail view of the clutch arm contacts.

Fig. 16 is a time chart of the card cycle.

Fig. 17 is a time chart of the zoning and recording cycle.

Fig. 18 shows the record card punched to indicate the various item and control codes.

Fig. 19*a* shows the upper part of the circuit diagram.

Fig. 19*b* is a continuation of Fig. 19*a*.

The Transcribing Unit

While the invention may make use of any suitable recording unit, it is preferred, for illustrative purposes, to disclose the invention herein in connection with a recording apparatus, the general principles of which are disclosed in Patents Nos. 1,777,055, and 1,873,512. Fig. 1 shows the arrangement of levers 10 for causing the operation of transcribing elements and related control devices. The several levers 10 may be distinguished by appending to the general reference character a supplementary reference character denoting the particular function or operation controlled by the operating lever. Thus, levers 10—A to Z, 0 to 9, cause operation of transcribing elements to record characters A—Z, 0 to 9; lever 10—TAB controls tabulating operations; lever 10—SH

controls case shift; lever 10—CR controls the carriage return operation; and lever 10—SP controls the operation of intra-line spacing means.

Referring to Fig. 6, depression of a lever 10 releases a latch 11 from a cam 12 permitting the latter to be forced by a lever 13 against a constantly rotating friction shaft 14. The latter rotates the cam, causing the carrier 15 of the cam to rock in a direction for depressing connected link 16. This link, through a linkage 17, propels a type bar 18, mounted on type basket 19, against the sheet of paper on the platen 20, thereby typing the character corresponding to the depressed lever 10. During the end of the stroke of type bar 18, it strikes a universal bar 22 to actuate the escapement control 23 for effecting a character or intra-line spacing operation of the carriage 24. Operation of the space lever 10—SP acts through associated elements 11, 12, 13, 15, and 16 to operate a linkage 25 for also actuating escapement control 23 to cause an intra-line spacing operation of carriage 24.

The carriage return means operated by lever 10—CR may be such as disclosed in Patent 1,955,614. As usual, the carriage return is preceded by a line spacing operation, and after the carriage has returned to the beginning of the line, repeat depressions of the lever 10—CR will effect repeat line spacing operations.

The tabulating means may be such as disclosed in Patent 1,935,436, and includes the usual settable tabular stops set in accordance with a desired lateral spacing of item lists and other information across the record sheet. Depression of the lever 10—TAB controls the tabular spacing as governed by the positions of the tab stops.

Peculiar to the present invention are the following:

Normally closed switches 26 (Fig. 6), one associated with each cam 12, are provided to be used in checking the accuracy of transcription of the card data, in a manner which will be explained later. When a lever 10 is depressed to cause release of the cam 12 associated therewith, the rotor 14 imparts half a turn to the cam to cause operation of the type bar. During this movement of cam 12, it rides past the long blade of the associated switch 26 and momentarily opens the switch.

Record Card and Code

The cord card T, as indicated in Fig. 18, has eighty designation columns, each with twelve index points or perforation-receiving positions known as the 9, 8—1, 0, 11, and 12 positions, and perforations in which are known as the 9, 8—1, 0, 11, and 12 perforations.

The columns of a card T are perforated according to the information to be listed or transcribed under control of the card, and the various codes designating the information are shown in Fig. 18. The codes may be considered as divided into several zones. The single point zone includes single perforations in any of the 9, 8—1, 0, 11, and 12 positions of a card column. The 9, 8—1, 0 perforations in this zone represent, respectively, these numerals, the 11 perforation represents a tabular operation, and the 12 perforation represents a carriage return operation. The 12 zone comprises a common 12 perforation plus one of the perforations 1 to 9 representing letters A to I. The 11 zone comprises the common 11 perforation plus one of the 1 to 9 perforations, representing letters J to R. The 0 zone comprises the common 0 perforation accompanied by a 2 to 9 perforation representing letters S to Z. The 11—12 zone comprises common 11—12 perforations plus a 1 to 7 perforation representing different symbols. The 11—12 code alone represents a high speed (H. S.) eject operation to be controlled by the card. In each combination hole code, the common zone perforation or perforations may be referred to as the zone distinguishing perforation, point, or characteristic. In the single point zone, the imperforate or solid portion of the column may be considered as the zone characteristic. The character or function distinguishing points of each zone are the 1 to 9 perforations which may be referred to as the intrazone points or characteristics.

Drive Mechanism

Referring to Figs. 1 and 5, the drive mechanism includes a motor 35. Motor 35 through a coupling 36 rotates a pinion 37 which drives a gear 38 on a shaft 39 carrying a worm 40. Worm 40 meshes with a worm wheel 42 on a sleeve shaft 43 rotatably mounted on a shaft 44.

Main clutch.—One end of the sleeve shaft 43 is provided with a driving clutch ratchet 45 (also see Fig. 14) having four teeth, ninety degrees apart. Fixed to shaft 44 adjacent driving ratchet 45 is a plate 46 formed with four equally spaced notches 46*a* ninety degrees apart. Loosely carried by shaft 44 adjacent plate 46, is a cam disk 47 with four cam teeth 47*a*, each adjacent one notch 46. Plate 46 pivotally carries a clutch pawl 48 having an intermediate tooth 48*a* to engage a tooth of driving ratchet 45. The free end of pawl 48 carries a stud 48*b* passing through a hole 46*b* in plate 46. Adjacent stud 48*b*, pawl 48 has a pin 48*c* connected by a spring 49 to a pin 46*c* on plate 46. The spring tends to move pawl 48 inwardly to engage its tooth 48*a* with a tooth of driving ratchet 45, but this action is prevented while the high cam portion of a tooth 47*a* of disk 47 is engaging stud 48*b* of the pawl. The disk 47 is held in such a declutching position by engagement of the flat side of one of its teeth 47*a* with the nose of a latch arm 50 fixed to one end of a shaft 51 which at the opposite end carries the armature lever 52 of main clutch magnet 53. The lower, free end of armature lever 52 is located between a pair of adjustable stop screws 54 which limit the retracted and attracted positions of the armature lever, its shaft 51, and latch arm 50. A spring 55 connected to armature lever 52 and a spring 56 connected to latch arm 50 combine to hold the armature lever in retracted position, with the latch arm in position to engage a tooth of disk 47. Spring 56 connects arm 50 to an impositive latch arm 57 provided with a roller 57*a* riding on the periphery of disk 46, and adapted to enter a notch 46*a* of plate 46 to detain, impositively, this plate in one of the four positions, ninety degrees apart, at which the declutching takes effect. Arm 57 is fast to a shaft 58 which carries a dependent arm 59 (Fig. 15) located between the adjacent spring blades 60 and 61 of a pair of switches 62 and 63 tending to open. When arm 57*a* is seated in a notch 46*a*, switch 62 is closed and switch 63 open. These switches may be referred to as the clutch arm contacts. During rotation of disk 46, arm 57 will be cammed out of notch 46*a*, causing arm 59 to close switch 63 and permit switch 62 to open. The arm 57 will move into a notch 46*a* every ninety degrees of rotation of plate 46, intermittently closing switch 62 and opening switch 63.

When main clutch magnet 53 is energized, it

rocks armature lever 52, shaft 51, and latch arm 50 counterclockwise (Fig. 14). The latch arm withdraws from an arm 47a, releasing cam disk 47 and enabling spring 49 to move stud 48b inwardly. The stud acts against the curved cam side of a tooth 47a of disk 47 to rock the disk clockwise, bringing the tooth 47a previously engaged by arm 50 below the nose of the latter. As pawl 48 was rocked inwardly by spring 49, its clutching tooth 48a engaged with a tooth of driving ratchet 45, thereby coupling the driven shaft 44 to the sleeve shaft 43 of the ratchet. With pawl 48 in its inner clutching position, stud 48b thereof is seated in the crotch between two teeth of cam disk 47, forcing the latter disk to rotate with the pawl. Upon deenergization of main clutch magnet 53, latch 50 intercepts one of the four teeth of disk 47, rocking the latter to cam the pawl 48 out of clutching engagement with ratchet 45. Referring to Figs. 5 and 12, driven shaft 44 rigidly carries a pinion 65, meshed with three sun gears 66 rotatably carried by the three arms of a carrier 67 which is fixed at its center to the reduced end of the hub sleeve 68a of a normally stationary disk 68. With disk 68 stationary, carrier 67 is at rest, and sun gears 66 are capable only of simple rotation by pinion 65. Rigid with each gear 66 is a pinion 69 meshed with a gear 70 fast to one end of a sleeve 71 surrounding shaft 44. To the opposite end of the sleeve 71 is fast a pair of gears 72 and 73. With shaft 44 coupled, as previously explained, to driving ratchet 45 for rotation, and with driven clutch disk 68 held against movement, pinion 65 of shaft 44 actuates gearing 66, 69, 70, 72, and 73 as a simple train of gearing. Gears 72 and 73 then rotate at normal speed.

Gears 72 and 73 on shaft 71 drive elements of the control section including card feed means which will be described later. During operation of these gears, the card is fed at a speed such that one column thereof traverses a given reference line during one-quarter turn of main clutch shaft 44. The period of such travel of a card column is equal to but not coincident with one cycle point of the card cycle indicated in Fig. 16. The card cycle may be considered as the interval between arrival at a reference line of similar points of successive cards. During eighty points of the card cycle, the eighty card columns of a card traverse analyzing means described subsequently. A gap of ten cycle points then occurs before the next card cycle begins on the next card.

Zoning cycle commutators.—Shaft 39 (Fig. 5) is driven continuously by the motor and carries commutators HS which may be referred to as the zoning cycle commutators. The speed of shaft 39 is four times that of main clutch shaft 44, so that one revolution of this shaft, as well as of its commutators HS, corresponds to a quarter turn of shaft 44 which, in turn, corresponds to one card cycle point. The revolution of shaft 39 may be referred to as the zoning cycle (Fig. 17).

Shaft 39 also carries a zoning cycle index wheel 110 to index the zoning cycle positions of shaft 39 and the elements actuated thereby.

Drive for zoning unit.—To the left end (Fig. 1) of shaft 39 is fixed a bevel gear 112 which meshes with a bevel gear 113 on a downwardly inclined shaft 115. This shaft at its lower end has a bevel gear 117 meshed with a bevel gear 118 on a horizontal shaft 119 (see Figs. 1, 2, and 7). Shaft 119 is provided with a pin 120 seated in the bayonet slot 121 of a sleeve coupling 122 mounted on the shaft. In line with shaft 119 is a shaft 123 which has a transverse, coupling pin 123a (Fig. 7) slidable into the open, end slots 122a of coupling 122. A spring 124 urges coupling 122 towards the left (Figs. 2 and 7) for maintaining the rear end of the horizontal portion of the bayonet slot 121 in engagement with pin 120. In this position, as indicated in Fig. 7, the slots 122a of the coupling sleeve 122 are receiving the pin 123a, thereby coupling shafts 119 and 123 for common rotation. To uncouple shaft 123 from shaft 119, coupling sleeve 122 is forced rearwardly until pin 121 is at the vertical portion of the bayonet slot, withdrawing slots 122a from pin 123a, and then the coupling sleeve is rotated to engage the pin 120 in the vertical portion of the bayonet slot, thereby maintaining the coupling sleeve in rear, release position.

With sleeve 122 in normal, coupling position, the shaft 39 drives shaft 123 one-to-one to make one revolution each zoning cycle. Shaft 123 is the actuating shaft of the zoning or code-translating system to be described later.

The control section (card handling section)

Referring to Figs. 1, 2, and 5, gears 72 and 73 of the clutch-driven shaft 71, operate the card reading or handling unit or control section. Gear 73 meshes with and drives a gear 128 fixed to a cross shaft 129 on which are mounted commutators CF which may be referred to as the card feed commutators. Shaft 129 and the parts mounted thereon and including commutators CF make one revolution for each card cycle. As shown in Fig. 5, a disk 130 is attached to gear 128. This disk 130 is suitably graduated to indicate the card cycle.

Card picker means.—Referring to Fig. 2, shaft 129 carries complementary cams 131 for engaging rollers 132 and 132' provided on opposite arms of a lever 133. Lever 133 is connected by a link 134 to a picker slide 135 provided at the rear with a picker knife 135' for engaging the rear edge of the bottom card T of the stack of cards in supply magazine 136. The cards are stacked in magazine 136 in the predetermined order in which their data are to be listed, and the cards lie lengthwise in the magazine, with the columns extending crosswise. During each card cycle or revolution of shaft 129, its cams 131, acting through lever 133, link 134, and slide 135, reciprocate the picker knife 135' to feed the bottom card out of the magazine 136 and into the grip of upper and lower feed rollers 137 and 138. Since shaft 129 makes one revolution each card cycle, one card is fed to feed rollers 137 and 138 each card cycle.

Card feed rolls and analyzer.—Gear 72 of the clutch-driven shaft 71 meshes with a gear 175 on the shaft of lower card feed roller 138 (see Figs. 1, 2 and 4). The shaft of the lower roller has a gear 176 meshed with a gear 177 on the shaft of upper feed roller 137, so that the upper and lower feed rollers rotate in unison. As previously described, picker blade 135' feeds a card T out of supply magazine 136 and into the grip of feed rollers 137 and 138 each card cycle. The feed rollers continue the feed of the card moving it at the rate of one column each cycle point.

Between the mouth of the supply magazine and feed rollers 137 and 138 is a card lever 178 (Fig. 2), cammed down by the card traveling to the feed rollers, for closing card lever contacts 179.

Upper feed roller 137 is a conductive roller acting as the common of the card sensing means.

Coacting with roller 137 are twelve sensing brushes SB—9 to 0, 11, 12, respectively to sense index positions 9 to 0, 11 and 12 of a card column, while another brush SB—*c* acts as a common return brush, being located to the side of the card and in constant engagement with roller 137 (see Fig. 4). Lower feed roller 138 is grooved to hold the free ends of the brushes in predetermined transverse spacing and enable the brushes to extend substantially in tangential engagement with the lowest part of the feed and contact roller 137 in order to sense the card.

The above described card analyzing means, SB—137, analyzes the perforations of the card columns in succession, one column after another, to control the decoding, interpreting or zoning system to be described later.

Card stacker.—As a card is fed by the rollers 137 and 138 past the analyzing means, it moves underneath a flexible plate 180, supported at the rear end, underneath a weighted plate 181 pivoted at its rear end, and into delivery magazine 182. Both plates 180 and 181 are cut out to permit a rubber arm 183 to rotate through and past the plates, so as to wipe the card and complete its ejection into the delivery magazine. Arm 183 is carried by a shaft 184 on which is a gear 185, driven through gears 186, 187, and 188 from gear 175 on the lower feed roll shaft. The gear ratio is such that arm 183 makes one revolution each card cycle to complete the ejection of the card analyzed during this cycle.

The stack of ejected cards in delivery magazine 182 rests on a bottom plate 190 hinged at its front end on a pivot 191. To the bottom of plate 190 is fast a bracket 192, passing through a slot 193 in the side wall of the magazine and rigidly provided outside the latter wall with a rack sector 194. Sector 194 meshes with a gear 195 (see Figs. 2 and 3) coacting with a horizontal rack 196 provided on a sleeve 197 which slides inside a fixed tube 198. The rack 196 passes through a narrow slot in tube 198, preventing rotation of the sleeve 197. Between tube 198 and sleeve 197 is a coil spring 199 tending to move the sleeve to the left (Fig. 3). With no cards on plate 190, spring 199 is holding sleeve 197 at its left hand limit. As the cards stack up on plate 190, their weight depresses rack sector 194 which, through gear 195 and rack 196, causes sleeve 197 to move to the right against resistance of a spring 199. When the delivery magazine is full, the weight of the stack has moved bottom plate 190 downwardly to an extent sufficient to engage the lower edge of bracket 192 with an insulating tab 200 fixed to the lower blade 201 of a switch 203, thereby opening such switch to interrupt operation of the card feed unit, in a manner which will be explained later.

Zoning Unit

The zoning unit includes twelve horizontal, parallel comb bars 210, disposed one above another, and located at a distance below the typewriter keyboard, as indicated in Figs. 6, 10, and 13. Each comb bar corresponds to a different index position of a card column and may be distinguished by referring to it as the comb bar of the corresponding index position. Thus, bars 210—9, 8—1, 0, 11, 12 correspond to index positions 9, 8—1, 0, 11, 12 and their positions are indicated in Fig. 13.

Each of the comb bars 210 is formed with front lugs 210*a* arranged for combination with lugs of the other combs to govern interpretation of a perforated designation code. Each comb bar has a single rear lug 210*b*, and the lugs 210*b* of the several combs are staggered horizontally to enable each lug to be engaged by the free end of one of the twelve staggered armature levers 211, as indicated in Figs. 6 and 8. Each armature lever 211 is operated by one of the twelve zone magnets 212, arranged in two horizontal layers and staggered to enable the armature levers to dispose their free ends in engagement with the staggered lugs 210*b* of the several combs 210. A pair of opposite, end guide combs 213 and a central guide comb 214 (Fig. 7) guide the combs 210 for horizontally slidable movement. A spring 215 connects to each comb 210 urges it towards the left to normal position determined by engagement of a screw 216 (Figs. 6 and 8), carried by the armature 211, with the frame plate 217. Upon energization of a zone magnet 212, it rocks its armature lever 211 counterclockwise (Fig. 8) causing the armature lever, by engagement with the associated lug 210*b*, to shift the corresponding comb bar 210 to the right.

Extending in front of the combs 210 are a plurality of spaced vertical levers 218 urged towards the combs by springs 219. The lower tip of each lever follows a cam 220 extending across the levers and fixed to shaft 123. As previously explained under the heading "Drive mechanism," shaft 123 is continuously rotated, through a coupling 122, from motor-driven continuously rotating shaft 119. Shaft 123 makes one revolution each zoning cycle (Fig. 17), as previously stated, and once each zoning cycle, cam 220 releases levers 218 for forward movement by springs 219. During each zoning cycle occurring between "1" and "80" of the card cycle, a column code analyzing period is provided during which analyzing means SB—137 is effective to analyze one card column for a designation or code. In accordance with the analysis, selected combs 210 are shifted to the right, to displace their front comb lugs 210*a* from in front of the lever 218 corresponding to the character or function represented by the analyzed perforated code in the active card column. There will be no other lugs 210*a* in front of the latter lever 218 but one or more lugs remain in front of the rest of the levers 218. Accordingly, when cam 220 releases lever 218 for inward movement, only one of these levers is enabled to move inwardly to a sufficient extent to bring the shoulder 218*a* of the lever above a common lift bail 221. Bail 221 extends across all the levers 218 and is provided with rollers 222 at each side following cams 223 fixed to zoning cycle shaft 123. Thus, for each cycle point or analysis of one card column, bail 221 is given one reciprocation. During the rise of the bail, by engagement with the shoulder 218*a* of that vertical lever 218 which has been released by the combs 210, the bail lifts the lever. The upper end of each lever 218 is pivotally connected to a lever 224 urged counterclockwise (Figs. 6 and 13) by a spring 225 and pivoted to a link 226. Each link 226 is provided at its upper end with a stud 226*a* freely passing through a vertically elongated slot 227 in an associated one of the horizontal, operating levers 10 of the transcribing unit. To maintain, releasably, the side of link 226 firmly against the side of the associated lever 10 and prevent accidental withdrawal of stud 226*a*, a flat spring 228 is fixed to the side of each link 227, the spring and link engaging the associated lever 10 between them.

When the lever 218, which has been selected

by combs 210, is lifted by bail 221, it rocks lever 224 clockwise (Fig. 6) against resistance of spring 225, thereby lowering link 226 to depress the corresponding operating lever 10. Depression of the lever 10 effects the recording or other function of the transcribing unit as denoted by the code in the analyzed card column.

As indicated in Fig. 9, the combs 210 have front lugs 210*sp*. The lugs 210*sp* of the twelve combs are in vertical alinement and located directly to the left (Figs. 7 and 8) of the vertical lever 218*sp*. No matter which designation is sensed on a card T, at least one of the combs 210 will be moved to the right, thereby placing its lug 210*sp* in front of lever 218*sp* to prevent its coaction with the lift bail 221. Lever 218*sp* is operatively connected with the intra-line space operating lever 10—SP. Thus, when any code is sensed and interpreted, causing actuation of one or more of the combs 210, lever 218*sp* will be blocked against operation, permitting the intra-line spacing of the carriage 24 (see Fig. 6) to occur only as the usual incident to the operation of the lever 10 corresponding to the character whose designation has been found in the analyzed card column.

When the card column traversing the analyzing means is blank, then an operation of intra-line space lever 10—SP is indicated. Thus, failure to sense any perforation in a card column leaves all the combs 210 in their normal positions, with all the lugs 210*sp* out of the path of lever 218*sp* which thereby is enabled to move forward to cooperate with lift bail 221 for operating space lever 10—SP to effect an intra-line spacing of the carriage 24.

During the period of each cycle between the departure of one card from the analyzing means and the arrival of the next card, and whenever main clutch shaft 44 is at rest, none of the combs 210 is actuated. Accordingly, operation of intra-line space lever 10—SP would be effected, undesirably, under control of operating lever 218*sp* each cycle of shaft 123, unless provisions were made to the contrary. To lock out the operating lever 218*sp* under the above conditions, a space lock magnet 230 (Figs. 8 and 13) is provided, energization of which rocks its armature 231 downwardly, to rock a lever 232 clockwise (Fig. 13) against resistance of a spring similar to spring 225. Pivotally suspended from lever 232 is a lock arm 233 urged towards the right (Fig. 13) by a spring similar to spring 219. The lower end of arm 233 is formed with a bent lug 233*a*, from an intermediate portion of which a tab 233*b* projects parallel to the side of arm 233. The inward movement of arm 233 is limited by engagement of tab 233*b* thereof (see also Fig. 8) with the front of the bottom guide comb 234 of the operating levers 218. Thus, upon clockwise rocking of lever 232, effected by armature 231 upon energization of magnet 230, lock arm 233 will be moved vertically upward. The outer, reduced end of lug 233*a* of arm 233 overlaps operating lever 218*sp* and normally lies against the back of the lever, entirely below and out of a notch 218'*sp* formed on the space operating lever (see Fig. 13). When lock arm 233 is lifted as a result of energization of magnet 230, lug 233 moves upwardly into notch 218'*sp*, thereby locking lever 218*sp* against inward movement. Thus, even though none of combs 210 is actuated, if magnet 230 is energized, it will cause locking of the space bar operating lever 218*sp*.

To time the impulses to space lock magnet 230 for each column or cycle point, a switch 235 is provided which is closed by lift bail 221 when the bail is in lower position and which opens when bail 221 rises. Since bail 221 is given one reciprocation each cycle point, switch 235 will open and close once for each cycle point. It is to be understood, however, that switch 235 does not, of itself, close the circuit of magnet 230. The latter circuit will be traced hereinafter.

Both the digit 1 and the letter L are printed by the "L" type bar 18. The code for number 1 is a "1" perforation while the code for "L" is X—3 (see Fig. 18). Thus, when either of these two different codes is sensed, the same type bar 18 must operated. To accomplish this, the intermediate, horizontal lever 224—L connected to the "L" operating lever 218—L and the lever 224—1 connected to the "1" (numerical) operating lever 218—1 are rigidly bridged by bars 236 (Figs. 7 and 8). Only the lever 224 of the L linkage is connected by a link 226 to the "L" lever 10, while lever 224 of the numerical "1" linkage is not connected to any link 226. Accordingly, when an "L" code is analyzed, the "L" lever 218 will act through the connected lever 224 and link 226 to operate the "L" lever 10. When the "1" code is analyzed, the "1" lever 218, acting through its asociated lever 224 and bridge pieces 236 will rock the "L" lever 224 to effect operation of the "L" lever 10, just as when an "L" code is analyzed.

All the letters are preferably typed in upper case, as capitals, and all the numerals are typed in lower case. As may be understood from the showing of the codes in Fig. 30, all the alphabet codes A to Z are combinational codes which include an intrazone characteristic 1 to 9 and one of the zone characteristics O, X, or R, while the numerical codes 1 to 9 are single hole codes. The digit 0 (zero) is represented by a single perforation in the 0 position. As will be explained in detail in connection with the circuits, whenever zone and intrazone perforations occur together in a card column, denoting a letter of the alphabet, the analysis of these two perforations causes energization of a double coil shift magnet 240 (see Figs. 8 and 10). When only a single perforation, intrazone or zone, is analyzed in a card column, then the shift magnet remains de-energized. Thus, the numerical codes will be interpreted by lower case type bar operations while the alphabet codes will be interpreted by upper case type bar operations. Energization of magnet 240 rocks its armature 241 downwardly, and the armature acts through a link 242 to depress the right hand shift lever 10—SH, thereby effecting an upper case shift. This shift is timed to occur just before the operation of the lever 10 corresponding to the code in the analyzed column, as will be explained hereinafter. Thus, an alphabetic code not only controls the selection of the type bar for printing the letter represented thereby but also preliminary upper case shifting operation.

Towards the latter part of the revolution of shaft 123 of the zoning system, a cam 250 thereof (Figs. 7, 8, and 10) effects clockwise rocking (Fig. 10) of a lever 251. The upper end of lever 251 bears against the arm 252*a* of a knockoff bail 252 (also see Fig. 11), which has an arm 252*b* extending vertically across the right hand edges of all the combination combs 210. Upon clockwise rocking of lever 251 by cam 250, the upper end of the lever rocks bail 252 clockwise (Fig. 11), causing arm 252*b* thereof positively to engage and return all the combs 210 to the left. Thus, the

combs 210 and the armatures 211 are positively restored at a definite, latter portion of the cycle of shaft 223, after which the springs 215 connected to the combs yieldingly maintain the combs in their restored positions.

The mechanical features of the zoning system have been explained above. Further explanation of its operation will be given as an incident to the description of the circuits.

Circuits, Timing, and Operation

Referring to Fig. 19*b*, with main line switch SW closed, motor 35 is in operation, the motor circuit including safety contacts 141.

In the following description, it is assumed the parts are initially in 0 cycle position of the card cycle (see Fig. 16).

Having brought the first line of a sheet to printing position on platen 20 of the recording unit, and having placed the stack of cards T bearing the data for the bills in supply magazine 136, the operator may start operations by depressing the start key to close start key contacts ST, forming the following circuit (bottom of Fig. 19*a*):

Start key circuit.—From the left side, through contacts ST, normally closed relay contacts R—17*b*, relay coil R—7, to the right side.

Due to energization of coil R—7 by the start key circuit, relay contacts R—7*b* close to form the main clutch circuit (lower part of Fig. 19*a*):

Main clutch magnet circuit.—From the left side, through normally closed contacts 28, relay contacts R—3*b*, now-closed relay contacts R—7*b*, normally closed relay contacts R—22*b* and R—14*c*, relay contacts R—27*b* (now closed due to initial energization of a coil R—27, in a manner which will be explained later), normally closed relay contacts R—10*b*, main clutch magnet 53, and to the right side.

With clutch magnet 53 energized, shaft 71, through gears 72 and 73 (see Fig. 5), actuates the card feeding means. At the "0" cycle point, picker 135' (Fig. 2) is in advanced position, ready to begin its return stroke (see Fig. 16). As the machine is now set in operation for the first card cycle, the picker is moved through its return stroke, and at the end of this stroke, at about the 64th cycle point, the picker is at the rear of the bottom card T in magazine 136 (see Fig. 2). The picker then dwells until about "70" of the card cycle at which point it begins its forward stroke to feed the bottom card to the feed rollers 137 and 138.

The perforation field or width of the first card column or column 1 of the card reaches the line of sensing brushes SB shortly before the "1" cycle point of the card cycle, between the 80th and 90th divisions of the "0" cycle point, as indicated by the upper, "card brush" timing line, in the zoning cycle chart, Fig. 17. The "card brush" line indicates the periods of sensing of perforations in successive card columns by brushes SB. Between "0" and "55" of one zoning cycle, the greater and latter portion of a hole in one column is sensed and, during this period, commutator HS—1 is made so as to render the sensing effective to perform an analysis, as will be further explained hereinafter. After this effective analyzing period of one card column during one zoning cycle, the brushes SB sense, between "85" and the end of the zoning cycle, the first part of the perforation of the next column, but with HS—1 broken, this latter sensing is not effective to perform an analysis.

During the first card cycle, the picker started moving the first card out of magazine 136 and to feed rolls 137 and 138. On its way to the feed rolls, the card cams down card lever 178 to close card lever contacts 179 (Fig. 2) after the beginning of the 82nd cycle point. Closure of contacts 179 establishes the following circuit (top of Fig. 19*a*):

Card lever circuit.—From the left side, through contacts 179, relay coils R—1 and R—2, to the right side.

The operator need hold the start key depressed only until the first card closes card lever contacts 179 to form the card lever circuit energizing coils R—1 and R—2. Coil R—2 closes contacts R—2*b* (bottom of Fig. 19*a*), shunting start key contacts ST through the following shunt circuit:

Start key shunt circuit.—From the left side, through relay contacts R—2*b*, stop key contacts SK, stacker contacts 203, stick contacts R—7*a* (previously closed), relay coil R—7, and to the right side.

Coil R—7 remains energized until either no cards remain in supply magazine 136, or upon manual depression of the stop key to open contacts SK, or when, the stacker magazine 182 being full, contacts 203 open.

There is a gap between successive cards feeding from magazine 136, and the lagging edge of the leading card will leave card lever 178 and permit card lever contacts 179 to open at "78" of the card cycle, while the forward edge of the following card will not cause contacts 179 to make again till after "82" of the same card cycle. To maintain coils R—1 and R—2 energized during this open interval of card lever contacts 179, commutator CF—4 makes (see Fig. 16), shunting contacts 179 through the following path (the top of Fig. 19*a*):

Card lever shunt.—From the left side, through commutator CF—4, stick contacts R—1*a*, coils R—1, R—2, to the right side.

If the stack of cards is depleted, contacts 179 will not be reclosed, and when commutator CF—4 breaks at "84" of the card cycle, coils R—1, and R—2 will be deenergized. Contacts R—2*b* will open and the start key shunt circuit will break to deenergize coil R—7, with consequent opening of contacts R—7*b* to break the main clutch magnet circuit. Main clutch magnet 53 remains energized, however, till the end of the card cycle through a shunt circuit formed through commutator CF—5 (see Fig. 16), which makes at "82" and opens at "89." The making of commutator CF—5 shunts contacts 28, R—3*b*, R—7*b*, R—22*b*, R—14*c*, R—27*b* and R—10*b* of the main clutch magnet circuit, as indicated in Fig. 19*a*, permitting clutch magnet 53 to remain in effect until the beginning of the 89th cycle point. The main clutch is uncoupled, as a result, at the 80th division (see Fig. 17) of the 89th cycle point.

The analyzing or card reading period of a card cycle is indicated by the top line of Fig. 16 and extends from "1" through "80," during which period the card read commutator CF—1 is made. The card lever circuit has energized coil R—1 to close contacts R—1*b*, forming the following circuit during the card reading period (Fig. 19*a*):

Coil R—9 circuit.—From the left side, through commutator CF—1, contacts R—1*b*, wire 310, coil R—9, to the right side.

Coil R—9 now closes the left side of transfer

contacts R—9b (near the top, right of Fig. 19a) and opens the right side of these transfer contacts. This condition of the contacts R—9b endures through the card reading period under control of commutator CF—1 and is repeated every card cycle as long as cards continue to feed and, through the card lever circuit, maintain relay coil R—1 energized to hold contacts R—1b closed in the coil R—9 circuit.

During the passage of the card columns through the analyzing means SB—137, analyzing circuits are established in accordance with the perforations in the columns. Thus, if a column has a "12" perforation, the following circuit forms (Fig. 19a):

"12" zone analysis.—From the left side, through commutator CF—1, contacts R—1b, zoning commutator HS—1 (see Fig. 17), contacts R—13b, clutch arm contacts 63 (see Fig. 15 for construction and Fig. 17 for timing), common brush SB—c, contact roll 137, brush SB—12, the left, now closed, side of transfer contacts R—9b, through the "12" comb magnet 212, a pickup coil 325 in parallel with magnet 212, and relay coils R—8 and R—4, to the right side.

The "11" analyzing circuit is as follows:

"11" zone analysis.—Beginning as in the above circuit and proceeding from contact roll 137 through brush SB—11, the normally closed side of contacts R—14b, comb magnet 212—11, magnet 325 in parallel therewith, and through relay coils R—20 and R—23 to the right side.

The "0" analyzing circuit is as follows:

"0" digit or zone analysis.—Beginning as in the previous analyzing circuits and proceeding from roll 137 through brush SB—0, normally closed contacts R—25b, comb magnet 212—0, the magnet 325 in parallel therewith, and through coil R—24, to the right side.

The analysis of an intrazone perforation 1 to 9 forms a circuit as follows (Fig. 19a):

Intrazone analysis.—From the left side, through CF—1, R—1b, HS—1, R—13b, 63, brush SB—c, common roller 137, the active one of the brushes SB—1 to 9 sensing the intrazone perforation 1 to 9, the comb magnet 212 in series with the active brush, the coil 325 in parallel with the comb magnet, and through common intrazone circuit relay coils R—5 and R—16 to the right side.

As indicated by the above analyzing circuits and by reference to the card cycle time chart (Fig. 16), commutator CF—1 times the card reading period, so that after the 80th or last card column has passed the analyzing means, the wiping of the brushes SB on the bare contact roll 137 will have no effect. When the main clutch is at rest at "80" of a zoning cycle (Fig. 17), clutch arm contacts 63 are open to prevent the making of any analyzing circuits.

When a card column passing through the analyzing means has only a single perforation, then only one of the above analyzing circuits is established, resulting in energization of only one magnet 212. Thus, if the single perforation is one of the intrazone points, indicating a digit 1 to 9, then an intrazone analysis circuit forms to cause the recording of the designated digit. If only a 0 perforation is analyzed, indicating the digit 0, then the 0 analysis circuit is formed resulting in the recording of the digit 0. If the single point in the column is an 11 perforation, then the 11 analyzing circuit is established to cause operation of the tabular means. The sensing of only a 12 perforation results in a 12 analysis circuit to cause a carriage return operation. When a column passing through the analyzing means has a zone perforation plus an intrazone perforation, indicating an alphabetic character, then both an intrazone analyzing circuit and one of the zone circuits are simultaneously formed.

When a single analyzing circuit is established, only one comb magnet 212 is energized to shift its associated comb 210. When both intrazone and zone analyzing circuits are formed simultaneously, then two of the magnets 212 are energized to shift their associated combs 210. Whether one or more of the combs 210 is shifted, only a single one of the levers 218, corresponding to the character or function in the sensed column, is selected thereby for operation. The operation of the selected lever 218 does not occur until the high point of cam 220 rides off the levers 218 shortly before "20" of the zoning cycle (Fig. 17). All the levers 218 then move forward to sense comb lugs 210a (see Fig. 9). The comb lugs, however, are now set according to the analysis, to permit release and full forward movement only of the selected lever 218 which corresponds to the analyzed character. This selected lever moves forwardly between lugs 210a of the combs, thereby locating its shoulder 218a above lift bail 221 (Figs. 10 and 13). At about "24" of the zoning cycle, circuit breaker HS—1, which times the duration of the analysis of a column perforation, opens and breaks the analyzing circuits to deenergize the comb magnets 212. Springs 215 (Figs. 7 and 8) now tend to return the previously actuated combs 210 but this is prevented at this time by engagement of sides of lugs 210a thereof with the selected lever 218 which has moved forwardly between these lugs.

At "50" of the zoning cycle, lift bail 221 rises and by engagement with shoulder 218a of the forwardly positioned, selected lever 218, lifts the latter to operate the associated lever 10 for causing a type bar 18 (see Fig. 6) to strike platen 20 at about "81" of the zoning cycle to record the character corresponding to the analyzed designation. At "90" of the zoning cycle, cam 220 has withdrawn the selected lever 218 from all the lugs 210a of combs 210, thus releasing the previously actuated combs for restoration by their springs 215. Shortly thereafter, at about "95" of the zoning cycle, cam 250 (Figs. 7 and 10) operates lever 251 to cause bail 252 to positively restore and aline combs 210 in normal positions.

The above explanation indicates the operations and timing thereof occurring during a cycle of the zoning or transcribing system and which corresponds during normal card feed to a card cycle point. These operations cause the transcribing means to transcribe and record the character corresponding to the designation in the analyzed card column.

As previously explained, the failure of any of the combs 210 to be actuated allows the lever 218sp to move forward for controlling an intraline space operation. Any comb 210 when actuated interposes a lug 210sp (Fig. 9) in the path of the lever 218sp, preventing effective operation thereof. The absence of any perforation in a card column allows all the combs 210 to remain in normal position and permit the intra-line space lever 218sp (Figs. 7, 8, and 27), upon release by cam 220 at about "20" of the column cycle (Fig. 17), to move forward above lift bail 221. As a result, when a blank column passes the analyzing means, lever 218sp is effective to

operate lever 10—SP (Figs. 1 and 13) for effecting intra-line spacing.

Intra-line space lock.—As explained above, when none of the combs 210 is actuated, lever 218*sp* (Fig. 13) is normally free to move forward and operate lever 10*sp* to cause intra-line spacing of the recording unit carriage 24 (Fig. 6).

A gap of ten cycle points occurs between successive cards, during which none of the combs 210 is actuated, the analyzing circuit line being broken by commutator CF—1. During each of the zoning cycles or revolutions of shaft 123 occurring within said gap, when cam 220 releases lever 218*sp*, forward movement of the lever, while not blocked now by combs 210, will be prevented by energization of magnet 230.

It is desired also to lock the lever 218*sp* against operation if the main clutch is uncoupled during any zoning cycle, particularly during a zoning cycle corresponding to a cycle point occurring during the card reading period; "1" to "80" of a card cycle.

The manner in which the magnet 230 is energized, under above conditions, to lock the space lever 218*sp* will now be explained. The circuit for magnet 230 is as follows (middle of Fig. 19*a*):

Space lock magnet circuit.—From the left side, through lines 311, 314, through either contacts R—9*a* or the clutch arm contacts 62, through lift bail contacts 235 (also see Fig. 13), and space lock magnet 230, to the right side.

Contacts R—9*a* are opened by coil R—9 energized during the card reading period of a cycle by the previously traced coil R—9 circuit. Between card reading periods, coil R—9 is deenergized, permitting contacts R—9*a* to close. Thus, the space lock magnet circuit will be automatically established during the ten cycle point gap between successive cards or while the brushes SB are wiping the bare contact roll 137. During this gap, shaft 123 makes ten revolutions and none of the combs 210 is actuated, but lever 218*sp* remains locked by magnet 230 against operation by the lift bail 221. In above manner, under control of contacts R—9*a*, intra-line spacing of the recording unit is prevented between card reading periods.

If the main clutch is stopped, clutch arm contacts 62 make (see Fig. 15) and remain closed while the main clutch is at rest and while shaft 123 continues to rotate and perform zoning cycles. As the main clutch is at rest, the card feed has been interrupted and during this period, the circuit for magnet 230 forms through closed contacts 62. As indicated in the zoning cycle chart (Fig. 17), the main clutch disengages at "80" of the zoning cycle or after the operations under control of the last-anaylzed card column have been completed. Lift bail contacts 235 do not close till "90" of this zoning cycle. At this point, with contacts 62 closed, the space lock magnet circuit forms, energizing magnet 230 to prevent forward movement of lever 218*sp* above lift bail 221. This circuit remains in effect till "75" of the next zoning cycle, but by then the lift bail 221 has risen and even if lever 218*sp* were to move forward, it would be too late for the shoulder 218*a* thereof to coact with the lift bail. Thus, during the zoning cycle following disengagement of the main clutch, intra-line spacing is prevented. As long as the main clutch remains disengaged, contacts 62 stay closed and the above locking action is repeated each zoning cycle.

Incidental alphabetic code circuits.—As indicated previously, the intrazone analyzing circuits have coil R—5 in common, the "0" analyzing circuit includes a coil R—24, the "11" analyzing circuit includes a coil R—23, and the "12" analyzing circuit includes a coil R—4. When an alphabetic designation is sensed, an intrazone analyzing circuit and one of the zone analyzing circuits are simultaneously established, causing coil R—5 and either coil R—4, R—23, or R—24 to be energized. Coil R—5 closes contacts R—5*a* and coils R—4, R—23, or R—24 respectively, close contacts R—4*a*, R—23*a*, or R—24*a*. As a result, the following circuit is established (Fig. 19*a*):

Coil R—6 circuit.—From the left side, through lines 311, 312 through the closed one of the parallel relay contacts R—24*a*, R—23*a*, or R—4*a*, serially through contacts R—5*a*, and through shift magnet 240 and coil R—6, in parallel, to the right side.

If only an intrazone circuit has formed to close contacts R—5*a* alone and neither the 0, 11 or 12 analysis circuit has formed to close one of the contacts R—4*a*, R—23*a*, or R—24*a*, the coil R—6 circuit will not form. Also, if either the "12," "11," or "0" analysis alone has been made and an intrazone analysis circuit has not formed, then contacts R—5*a* will be open, preventing the closing of the coil R—6 circuit. Thus, only for a combination code, designating a letter, is the coil R—6 circuit formed and coil R—6 and shift magnet 240 energized. The energization of magnet 240 effects upper case shift to cause the alphabetic character to be typed in upper case. The analyzing circuits also have selected a type bar for printing the letter denoted by the combinational code. The analyzing circuits are timed by commutator HS—1 to make between "0" and about "24" of the zoning cycle and, by then, the shift magnet 240 is energized. The type strikes the platen after "80" of the zoning cycle; hence, the type basket 19 (Fig. 6) has been set under control of magnet 240 in upper case position before printing is effected.

The analyzing circuits break before "25" of the zoning cycle due to breaking of commutator HS—1, causing contacts R—24*a*, R—23*a*, and R—5*a* to open, but the shift magnet 240 must remain energized till after printing at "80." For this purpose, coil R—6 closes contacts R—6*a* to form the following holding circuit (Fig. 19*a*):

Coil R—6 holding circuit #1.—From the right side of the line, through magnet 240 and coil R—6, in parallel, through contacts R—6*a*, line 313, zoning commutator HS—3, line 310, contacts R—1*b*, commutator CF—1, and to the left side.

When the analyzing circuits broke, normally closed relay contacts R—24*b*, R—23*b*, R—4*b*, and R—5*b* returned to normal closed condition. Thus, a second holding circuit forms as follows:

Coil R—6 holding circuit #2.—From the right side, in parallel through magnet 240 and coil R—6, through contacts R—6*a*, contacts R—5*b*, R—4*b*, R—23*b*, R—24*b*, line 310, contacts R—1*b*, commutator CF—1, and to the left side.

Holding circuit #1 is timed by commutator HS—3 to form before "25" of the zoning cycle and to hold over till about "4" of the next zoning cycle. In the latter zoning cycle, a new card column is being analyzed, and the analysis is taking place while holding circuit #1 is still in effect. If the card column following the one which caused the upper case shift also has an alphabetic designation, the making of contacts R—5*a* and one of the contacts R—4*a*, R—23*a*, or R—24*a* will precede by a slight lag the open-

ing of contacts R—5*b* and R—4*a*, R—23*a*, or R—24*a*, causing the main circuit of coil R—6 and shift magnet 240 to be closed before the preceding holding circuit #2 breaks. If the analyzing circuits make before commutator HS—3 opens, holding circuit #1 will also continue uninterruptedly in effect.

If the card column succeeding the one which caused the case shift bears a numerical code or a code which does not include one of the perforations 1 to 9 in combination with one of the perforations "12," "11," or "0" then a combination of zone and intrazone analyzing circuits will not form, and the main circuit of coil R—6 and the shift magnet 240 is not closed. Hence, when commutator HS—3 breaks, holding circuit #1 of the magnet is broken and holding circuit #2 will also break due to opening of either of contacts R—5*b*, contacts R—4*b*, R—23*b*, or R—24*b*.

Checking Operations

It is intended to check and detect the accuracy of interpretation by the zoning system and the transcribing means of the analyzed codes in the card columns, and to stop card feed if a wrong interpretation and recording of a code have been made. For this purpose, the main clutch magnet circuit includes contacts R—27*b* controlled by a relay coil R—27 (lower right of Fig. 19*b*). Immediately upon closing of main switch SW, the coil R—27 is energized as follows:

Coil R—27 circuit.—From the right side, through coil R—27, the serially connected, normally closed relay points 325*b* of coils 325—0 to 9, to the left side.

Coil R—27 closes contacts R—27*a* to by-pass contacts 325*b* through zoning cycle commutator HS—6 (see Figs. 5 and 17) which is closed during each zoning cycle or revolution of shafts 123 or 39 except for a short interval between "55" and "70." During this open interval of commutator HS—6, the main circuit of coil R—27 must be effective through closed 325*b* contacts of coils 325—0 to 9, but if any of these contacts is open, the main circuit of coil R—27 does not close, and contacts R—27*b* open to break the main clutch magnet circuit causing the card feed to stop at "80" of the zoning cycle. Thus, commutator HS—6 breaks between "55" and "70" of each zoning cycle to enable detection of an open condition of any of contacts 325*b* of coils 325—9 to 0. Contacts 325*b* of coils 325—9 to 0 stay closed only if the transcription of a code in a card column has been accurately made. If the card column code is not accurately interpreted and recorded, one of contacts 325*b* of coils 325—9 to 0 will be open, with the result that upon opening of commutator HS—6 during the same zoning cycle in which the code was analyzed, coil R—27 is deenergized, contacts R—27*b* open and the main clutch magnet circuit breaks.

As brought out in the previous tracing of the analyzing circuits, there is a coil 325 in parallel with each comb magnet 212 and energized simultaneously therewith. Each of coils 325—9 to 0, of the intrazone analysis circuits is the pickup coil of a double coil relay having a holding coil 325' (right of Fig. 19*b*). Thus, upon formation of an intrazone analyzing circuit, one of the coils 325—9 to 0 will be energized to open the related *b* contacts in the main circuit of coil R—27. Coil 325 also closes related contacts 325*a* to close the circuit through the associated holding coil 325' as follows (Fig. 19*b*):

Holding coil 325' circuit.—From the right side, through the coil 325', contacts 325*a*, one of the contacts 26 (see also Fig. 6) of the recording unit, through the normally closed right side of transfer contacts R—6*b*, hand switch 326, and to the left side.

The energized holding coil 325' holds contacts 325*a* closed and 325*b* of the double coil relay open after the related pick-up coil 325 is deenergized by breaking of the analyzing circuit at about "24" of the zoning cycle. Thus, with contacts 325*a* maintained closed, the above holding coil circuit can be opened only by opening of the contacts 26 therein. Contacts R—6*b* are controlled by the coil R—6, which is energized only upon analysis of an alphabetic character code, as previously explained. Thus, during analysis of digit designations 0 to 9 the right side of contacts R—6*b* remains closed.

Each pair of contacts 26 is controlled by a cam 12 (see Fig. 6). As explained in the description of the zoning system, operation of a lever 10 unlatches a cam 12 for co-action with power shaft 14, and the shaft rocks the cam to cause the character corresponding to the operated lever 10 to be recorded. As cam 12 is rocked by shaft 14, it momentarily opens the related pair of contacts 26. If the zoning and recording means accurately transcribes the analyzed code, the cam 12 associated with the contacts 26 in the circuit of the energized holding coil 325' operates and opens the contacts as an incident to the correct recording operation. Accordingly, coil 325' will be deenergized, permitting its contacts 325*b* to reclose. The analyzing circuits formed under control of a code in a card column cause the release of one zoning lever 218 (Figs. 7 and 8) for operation by lift bail 221 (see also Figs. 6, 10, and 13). The lift bail elevates the released lever 218 at "50" of the zoning cycle (see Fig. 17), causing operation of the connected lever 10 to release the associated cam 12 for turning by shaft 14. At about "53" of the zoning cycle, the cam 12 has opened related contacts 26, and if the correct transcription of the analyzed code has been made, the correct cam 12 operates to cause the character accurately corresponding to the analyzed code to be recorded, and as an incident thereto opens the contacts 26 in the previously formed circuit of holding coil 325'. Consequently, the latter coil is deenergized to permit its contacts 325*b* to reclose, reestablishing the main circuit of coil R—27 before the commutator HS—6 breaks at "55" to open the stick circuit of the coil. Coil R—27, therefore, remains energized to keep its contacts R—27*b* of the main clutch magnet circuit closed, so that the card feed continues uninterruptedly.

If the analyzed code has not been accurately transcribed, the wrong cam 12 will operate, and the contacts 26 in the previously formed circuit of the holding coil 325' will not open. Coil 325', therefore, will remain energized and hold its contacts 325*b* in the main circuit of coil R—27 open, and when commutator HS—6 breaks at "55," coil R—27 will be deenergized, causing contacts R—27*b* to open and break the main clutch magnet circuit. The main clutch will then disengage at "80" of the zoning cycle, interrupting card feed as a manifestation or indication of an inaccurate transcription.

As a specific example of the operation of the checking means, assume the digit "8" code is in the card column at the analyzing station. Analysis of the "8" hole results in energization of pick-up coil 325—8 and parallel comb magnet 212—8.

Coil 325—8 opens contacts 325*b*—8 in the main circuit of coil R—27 but the stick circuit thereof is still operative through commutator HS—6. Coil 325—8 also closes contacts 325*a*—8 to make the circuit of holding coil 325'—8 through contacts 26—8, and the latter coil maintains contacts 325*a*—8 closed and 325*b*—8 open. Comb magnet 212—8 has been energized to move comb 210—8 to the right. This releases one of levers 218 for operation by lift bail 221, as a result of which the associated lever 10 is depressed to cause related cam 12 to be rocked. At about "53" of the zoning cycle, the cam 12 opens the adjacent contacts 26 and then effects operation of the associated type bar 18. If the zoning system, including combs 210 and levers 218, has been properly operated, the lever 218 connected to the lever 10 which causes recording of the character "8" will have been released by the combs and will be operated by lift bail 221. Correspondingly, the "8" cam 12 will have been rocked, opening the "8" contacts 26, thereby breaking the circuit of coil 325'—8. The deenergization of coil 325'—8 permits contacts 325*b*—8 to reclose, so as to close the main circuit of coil R—27, continuing contacts R—27*b* closed during the open period of commutator HS—6. Thus, the main clutch magnet circuit will remain effective.

If the wrong lever 218 has been operated by the zoning system, then contacts 26—8 will not have been opened, and coil 325'—8 will remain effective to hold contacts 325*b*—8 open, thus causing coil R—27 to be deenergized at "55" of the zoning cycle, when commutator HS—6 breaks. Consequently, contacts R—27*b* open, breaking the circuit of main clutch magnet 53. Coil R—27 remains deenergized until contacts 328*b*—8 reclose, and, therefore, the main clutch magnet remains deenergized. To reclose contacts 328*b*—8, coil 325'—8 must be deenergized, and this may be done by manually back-spacing the typewriter carriage, erasing the incorrect figure, and manually operating the correct lever 10 to cause typing of the correct figure. As an incident thereto, contacts 26—8 open, breaking the circuit of coil 325'—8, causing contacts 325*b*—8 to reclose, and again resulting in energization of magnet R—27. The magnet R—27 thereupon recloses contacts R—27*b*, starting the main clutch in operation.

When an alphabetic, combination code, is sensed in a card column, a zone analyzing circuit and an intrazone analyzing circuit are formed. The "12," "11," and "0" analysis circuits respectively, cause pick-up coils 325—12, 11, and 0 to be energized. Coil 325—12 closes contacts 325*a*—12 (lower portion of Fig. 19*b*), coil 325—11 closes contacts 325*a*—11, and coil 325—0 closes contacts 325*c*—0, opens contacts 325*b*—0 (in the main circuit of coil R—27), and closes contacts 325*a*—0.

In addition to the zone analyzing circuit, an intrazone analyzing circuit is formed when an alphabetic code is sensed. The intrazone circuit energizes the intrazone pick-up coil 325 to close its contacts 325*a* and open its contacts 325*b*.

The zone and intrazone coils 325 operate in combination to check the accuracy of interpretation of the alphabetic code. As previously described, when an alphabetic code is analyzed, the coil R—6 circuit is formed, energizing coil R—6 and also the shift magnet 240 in order that the letter be printed in upper case. Energization of magnet 240 and coil R—6 is continued through the coil R—6 holding circuits #1 and #2. Coil R—6 also opens the right side of transfer contacts R—6*b* (Fig. 19*b*) and closes the left side of the latter. With the right side of contacts R—6*b* open, the previously traced holding coil 325' circuit cannot be formed. This forces the circuit of an intrazone coil 325'—1 to 9 to be routed through the switch 26 corresponding to the letter whose combination code has been analyzed. The magnet 325—12, 11, or 0 selects the route of the circuit for the intrazone holding coil 325' in accordance with the zone perforation combining with the intrazone perforation to form the alphabetic character code. If the character falls within the "12" zone, then coil 325—12 is energized and closes contacts 325*a*—12, forming a circuit through relay coil 327—12 (Fig. 19*b*) which is held through stick contacts 327*a*—12 and zoning cycle commutator HS—5 after the analyzing circuit breaks at about "24" (see Fig. 17). If the character is in the "11" zone, then similar circuits are formed through coil 327—11. If the character is within the "0" zone, then a circuit for coil 327—0 is established through contacts 325*c*—0, and held through contacts 327*a*—0 and commutator HS—5.

If coil 327—12 is energized, it opens contacts 327*b*—12 and 327*c*—12, respectively, in the "11" and "0" zone lines (upper left of Fig. 19*b*), preventing routing of the circuit of any intrazone coil 325' through the "11" or "0" zone lines. If coil 327—11 is energized, it opens contacts 327*b*—11 and 327*c*—11 breaking the "12" and "0" zone lines. If coil 327—0 is energized, it opens contacts 327*b*—0 and 327*c*—0, opening the "12" and "11" zone lines. Thus, in accordance with which code zone the character falls in, only the corresponding zone line will be closed for a circuit through the intrazone coil 325' corresponding to the intrazone characteristic of the alphabetic character.

Assume, as an example, that the "11" zone character "J" has been analyzed. The intrazone characteristic of this character is "1" (see Fig. 18). Accordingly, coils 325—11 and 325—1 are energized. Coil 325—11 closes contacts 325*a*—11, forming a circuit through coil 327—11 which is held by the stick circuit through HS—5. Coil 327—11 opens its contacts 327*b* and *c* to break the "12" and "0" zone lines, leaving only the "11" zone line unbroken. The circuit for the intrazone coil 325'—1 is now routed through the "11" zone line, as follows (Fig. 19*b*):

Alphabetic coil 325' circuit.—From the left side, through switch 326, the left, now closed side of contacts R—6*b*, the "11" zone line, the recording unit cam switch 26—J, lines 328, 329, contacts 325*a*—1 (closed by the coil 325 of the "1" interzone analyzing circuit), and coil 325'—1, to the right side.

Energized coil 325'—1 now acts, in the same manner as described in connection with the checking of a numerical character, to cause the card feed to stop if the cam 12—J has not been operated as it should be for correctly interpreting the analysis of the code 11—1 of character J.

While there has 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 as follows:

1. In combination, typing elements operable to type items in succession, means controlled by item designations for selecting and causing operation of the typing elements to type the corresponding items, selectively conditionable checking means including means responsive to the item designations and means responsive to operation of the typing elements acting in conjunction to determine different conditions of the checking means, one corresponding to agreement and another to non-agreement between the item designations and the operation of the elements in typing the items under control of the designations, and means effective under control of the checking means, when in the latter condition, for interrupting control of the typing elements by the first-named means according to the designations.

2. The combination as defined in claim 1, said checking means comprising electrical circuits and the means responsive to the item designations and the means responsive to the operation of the typing elements comprising electrical devices acting in conjunction to determine alternative conditions of the circuits depending on the aforesaid agreement or lack of agreement between the item designations and the operation of the typing elements, and the interrupting means including means electrically controlled by the circuits for interrupting control of the typing elements by the item designations when the circuits are in the condition indicative of lack of agreement between operation of the typing elements and the designations.

3. In combination; transcribing means, means responsive to controlling designations for causing operations of the transcribing means equivalent to the controlling designations, checking means for comparing the operation of the transcribing means with a controlling designation for true equivalency and including a checking circuit closed by the second-named means in response to the controlling designation, means controlled by the transcribing means upon operation thereof equivalent to the controlling designation for opening the checking circuit, and means controlled by the circuit when remaining closed, because of failure of the transcribing means to operate in accordance with the controlling designation, for manifesting such failure.

4. In combination; transcribing means, means responsive to controlling designations for causing operations of the transcribing means equivalent to the controlling designations, checking means including checking circuits, one of which is operated on under control of the second-named means in accordance with each controlling designation, means controlled by the transcribing means for operating on one of said circuits in accordance with the operation performed by the transcribing means, and means effective under control of said checking means upon failure of the transcribing means and the second-named means to operate on the same circuit for manifesting such failure.

5. In combination; individual recording devices, each to record a different item, means responsive to item designations for causing operation of the devices to record the corresponding items, checking means including circuits, one of which is closed under control of the first-named means in accordance with each item designation, switches, one for each device and opened by the device upon operation thereof to record an item, each switch being in one of said circuits, and means controlled by the selected circuit, upon failure of the switch associated with the closed circuit to open, for manifesting such failure.

6. In combination; individually operable devices to type different characters, means responsive to character designations for selecting one of said devices and causing operation thereof to type the character corresponding to a controlling designation, checking means for determining whether the correct device has been selected and operated, comprising a plurality of circuits, each corresponding to a different designation, means controlled by the first-named means for preliminarily closing the circuit corresponding to said controlling designation, closed switches, each opened under control of a different one of said devices upon typing operation thereof, each circuit corresponding to a character designation including the switch associated with the device for typing the designated character, whereby the preliminarily closed circuit will be broken by opening of the switch therein when the device corresponding to said controlling designation has been selected and operated and will remain in effect if the latter device has not operated, and means controlled by the circuit, when remaining in effect, for manifesting failure of the device corresponding to the controlling designation to have operated.

7. In combination, means responsive to item designations including intrazone characteristics alone or in combination with zone-distinguishing characteristics, recording means including individual structures controlled by the first-named means according to the designations for recording the corresponding items, switches, each opened by one of the structures when recording an item, checking means including a plurality of magnets, an intrazone circuit and a combination zone-distinguishing and intrazone circuit for energizing each of said magnets, the intrazone circuit including the switch opened by operation of the structure recording the item whose designation includes an intrazone characteristic alone and the other circuit including the switch opened by operation of the structure recording the item whose designation includes the same intrazone characteristic combined with a zone-distinguishing characteristic, means receptive to the item designations for closing one of said circuits depending on whether the item designation includes the intrazone characteristic alone or in combination with a zone-distinguishing characteristic, whereby, upon operation of the recording structure for recording the item corresponding to the designation, the related switch will be opened to break the closed circuit or, upon failure of the corresponding structure to operate, the switch in the closed circuit will remain closed to continue closure of the circuit and cause continued energization of the associated magnet, and means under control of the magnet, when continuing energized, for manifesting said failure.

8. In combination, designation translating means for translating designations of digits 0 to 9, a recording unit including therein devices controlled by the translating means for operations corresponding to the designations, selectively conditionable checking means, means responsive to the designations for placing the checking means in different conditions differentiating the digit designations 0 to 9, with each condition corresponding to a different one of said designations, means in the checking means operated by the de-

vices according to the designations to which the operations of the aforesaid devices under control of the translating means correspond, and means effective under control of the checking means, when the operation of the means therein fails to correspond with the same designation to which the condition of the checking means corresponds, for interrupting further control of the devices by the translating means.

9. In combination, a recording unit including means controlled by codal designations for causing recording of the equivalents of the designations, checking means including a checking circuit for each designation, means responsive to a designation for closing the corresponding checking circuit, a switch in this circuit opened by operation of the first-named means under control of the same designation, means for interrupting control of the recording unit by the codal designations, and means rendered effective by the circuit, when remaining closed due to failure of the switch therein to open, for causing operation of said interrupting means.

10. In combination, a recording unit including means controlled by codal designations for causing recording of the equivalents of the designations, checking means including a checking circuit for each designation, means responsive to a designation for placing the corresponding circuit in a certain checking condition, a switch in this circuit operated by the first-named means, when operating under control of the same designation, for supplementarily conditioning the latter circuit, and means controlled by this circuit, when the switch therein remains unoperated due to failure of the first-named means to operate properly under control of the designation, for manifesting said failure.

11. In combination, a recording unit including a plurality of cams and means for setting each cam in operation under control of a different one of a plurality of codal designations of items, a plurality of switches corresponding to the different designations, each switch operated by a different cam, means responsive to the codal designations, checking means including circuits jointly controlled by the designation-responsive means and by the switches for detecting failure of the switches to operate in accordance with the designations to which said designation-responsive means has responded, and means effective under control of said circuits for manifesting said failure.

12. In combination, means to sense codal designations on records, means to feed the records with respect to the sensing means, recording means including devices controlled by the sensing means for operations corresponding to the sensed designations, checking means jointly controlled by the sensing means according to the sensed designations and by the devices according to their operation for detecting failure of the latter operation to correspond to the sensed designations, and means effective under control of the checking means for interrupting operation of the feed means when said failure occurs.

13. In combination, means to sense codal designations of a record in succession, means to feed the record to bring the designations successively to the sensing means, recording means including devices controlled by the sensing means for successive operations corresponding to successively sensed designations, checking means jointly controlled by the sensing means according to a sensed designation and by said devices according to an operation thereof for detecting failure of the latter operation to correspond to the sensed designation, and means effective under control of the checking means when said failure occurs for interrupting operation of the feed means before the next designation is sensed.

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