United States Patent

[11] 3,596,286

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[54] PUNCHING TIME RECORDER
39 Claims, 30 Drawing Figs.

[52] U.S. Cl. 346/86
[51] Int. Cl. G07c 1/08
[50] Field of Search 346/82, 83, 86, 91

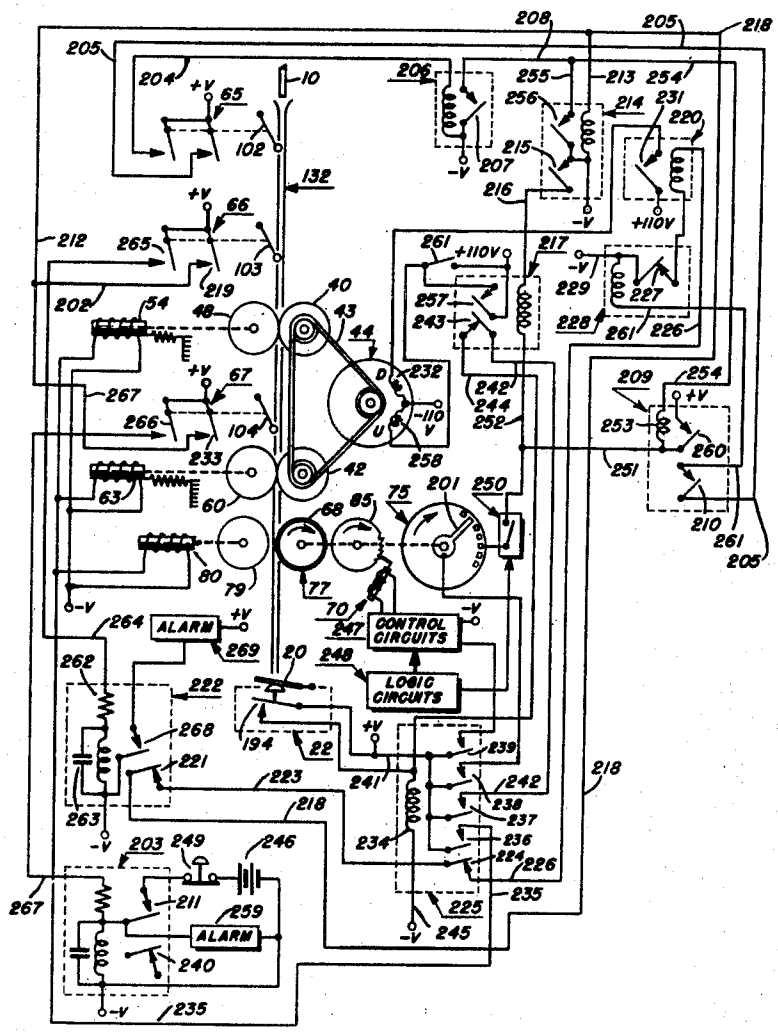
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Primary Examiner—Joseph W. Hartary
Attorney—Rudolph J. Jurick

ABSTRACT: A time recorder for punching employee arrival and departure times into a data processing card, which apparatus comprises a card positioner, a photoelectric card reader, a time generator, logic circuits and a punching mechanism. The card positioner aligns the card to the current day and time period, the card reader reads into the logic circuits employee work shift and lunch period identification which has been prepunched in the card, and the time generator introduces into the logic circuits current time information. Upon compiling such information, the logic circuits make a decision and cause actuation of the punching mechanism, after which the card positioner ejects the card.



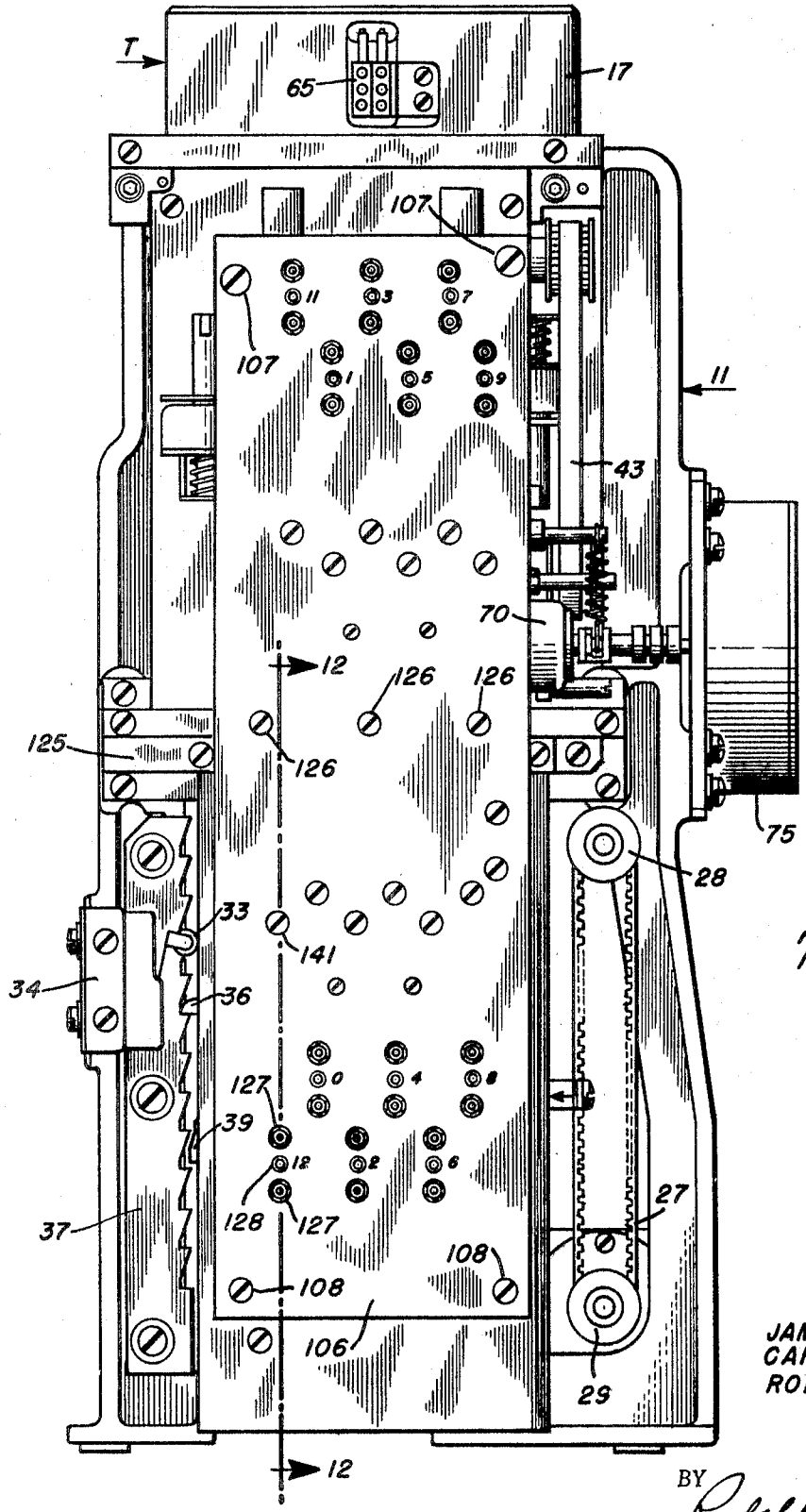


Fig-1

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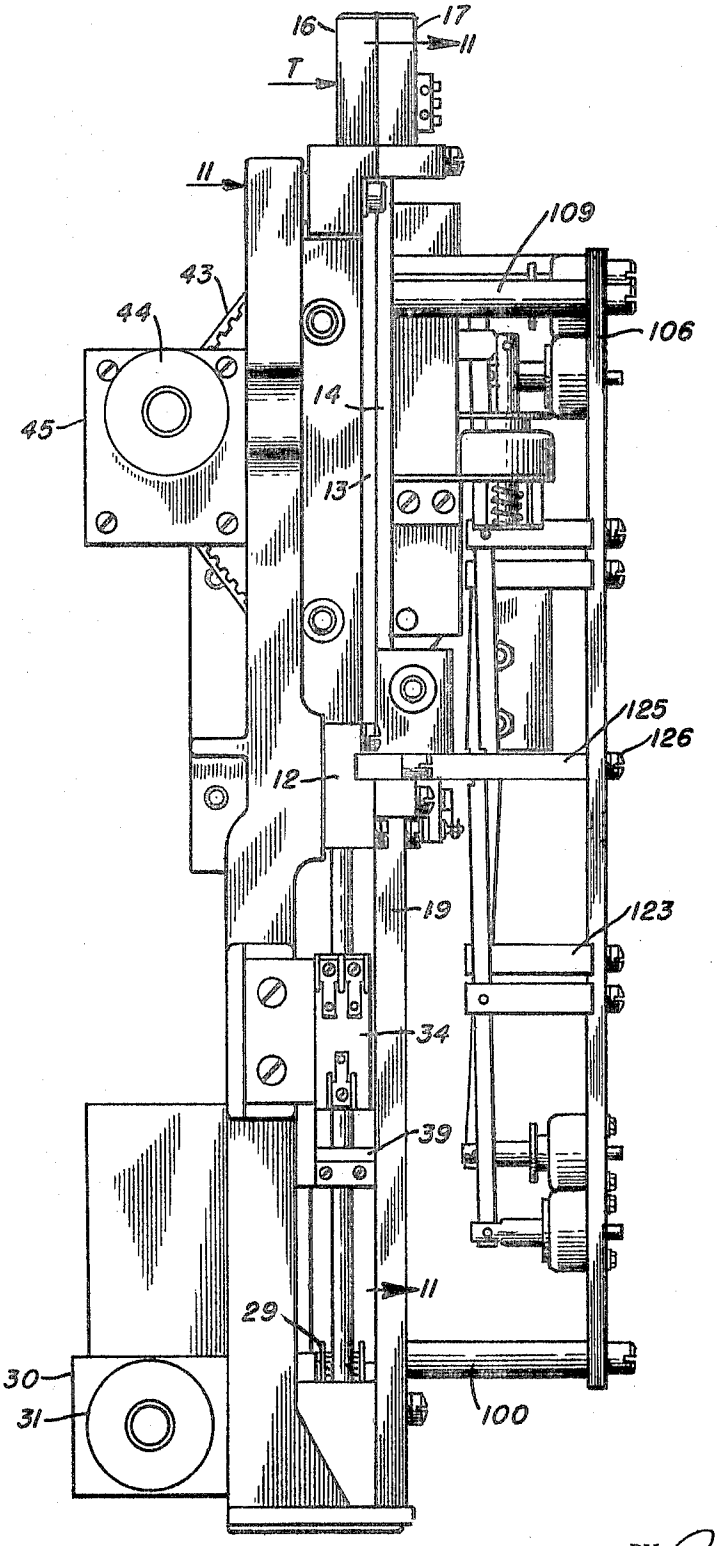


Fig-2

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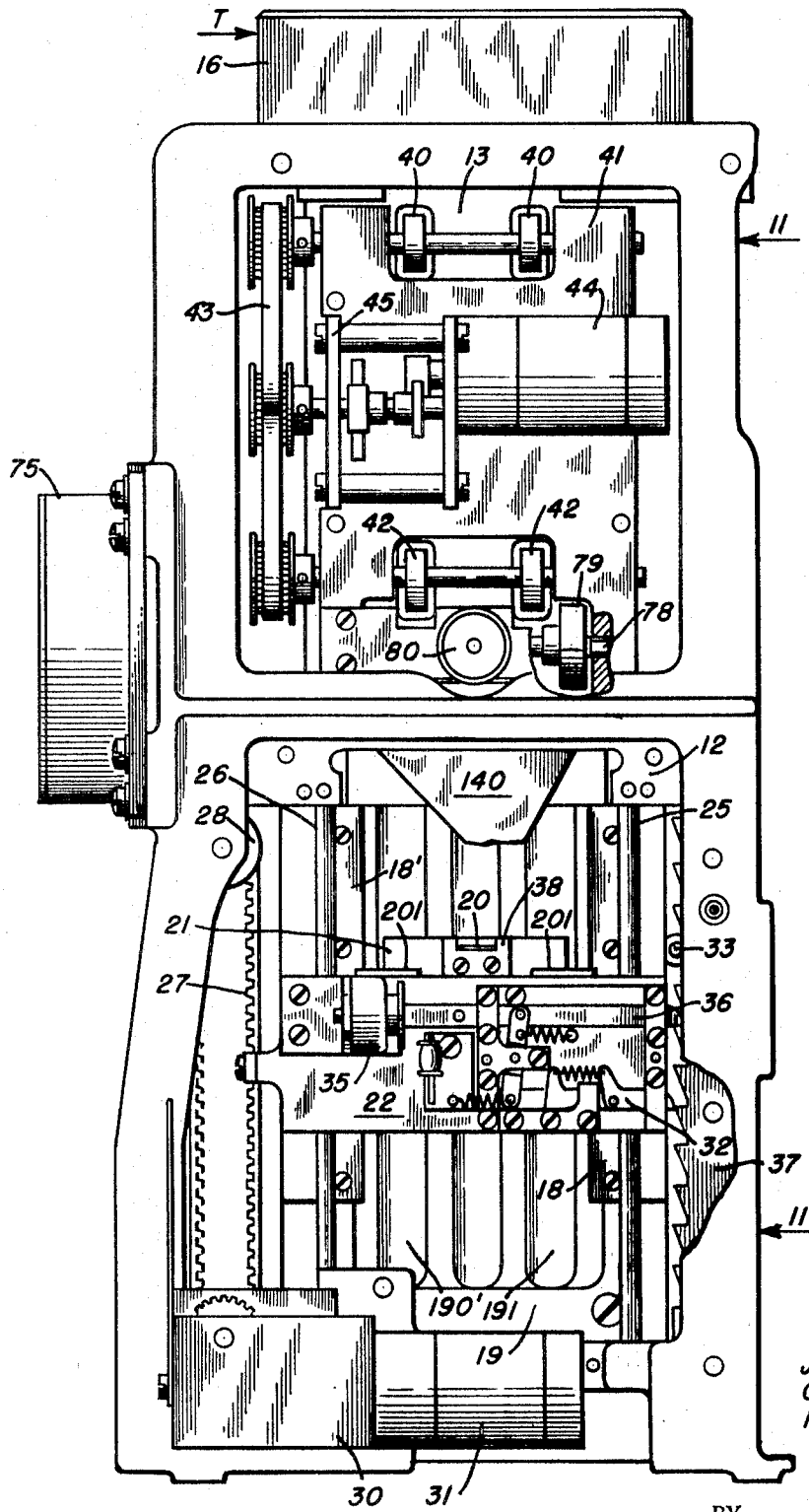


Fig-3

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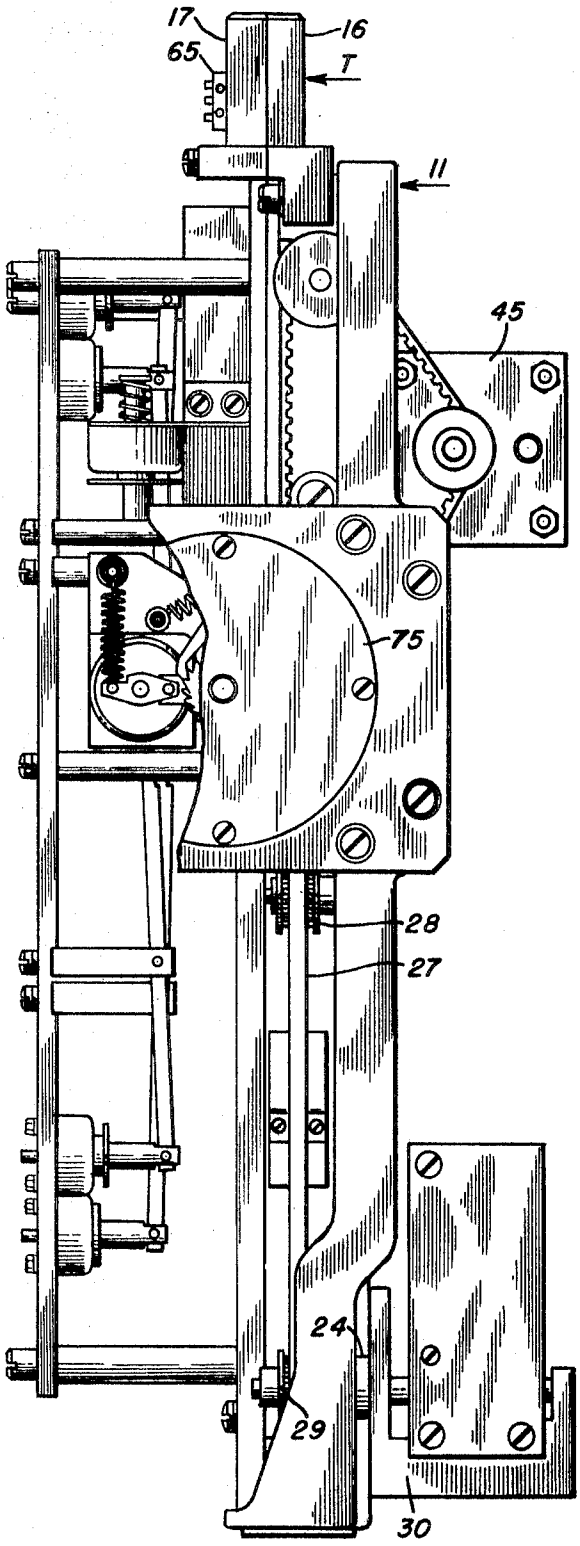


FIG-4

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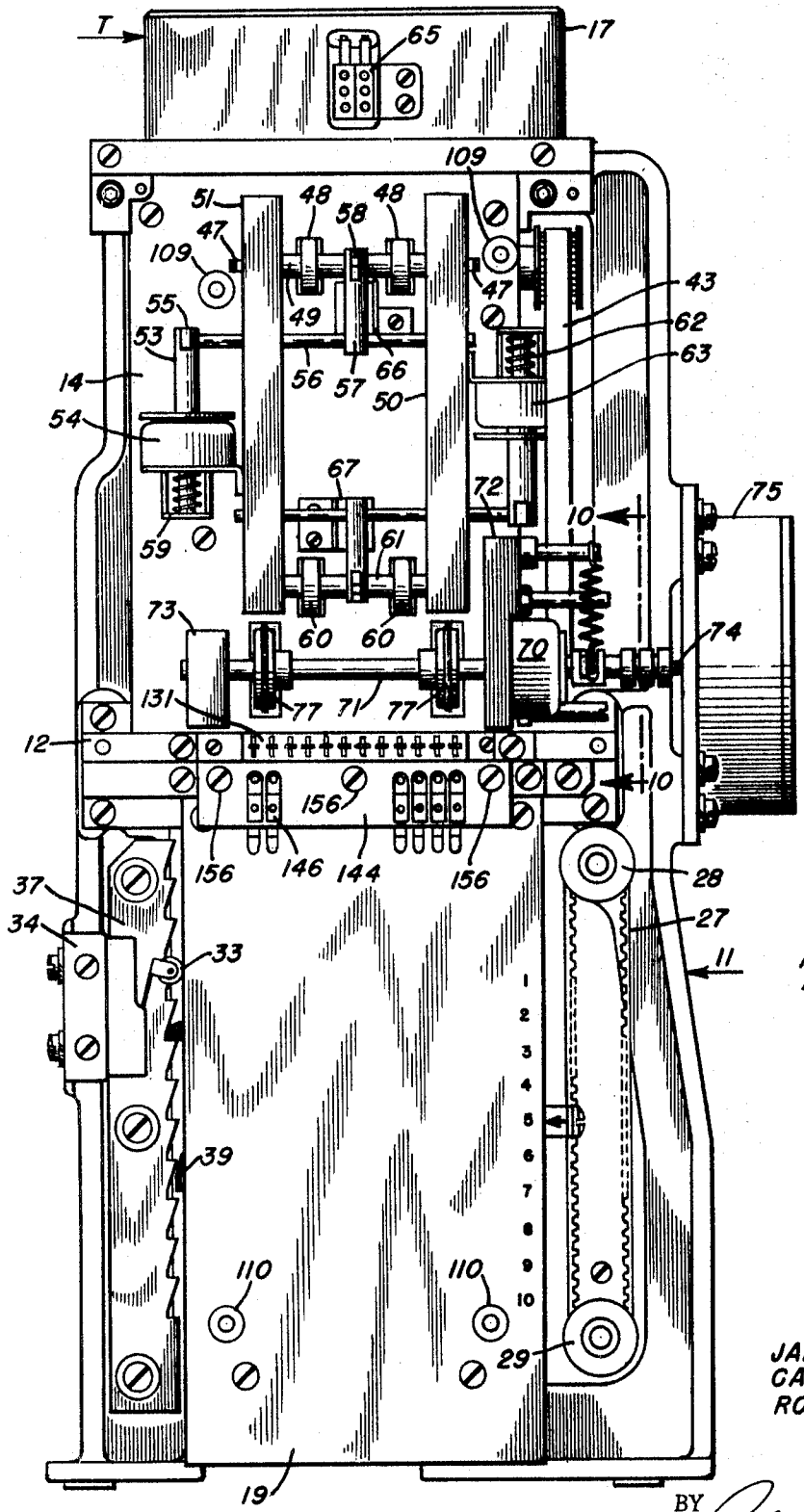


Fig-5

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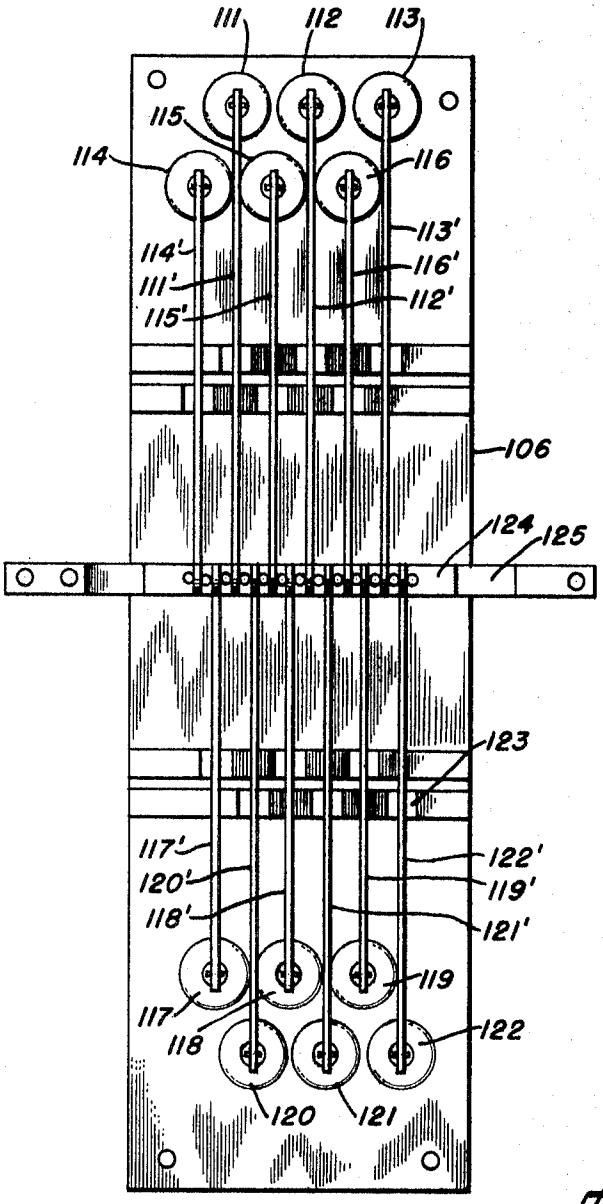


Fig - 6

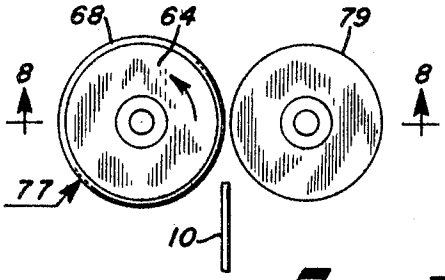


Fig - 7

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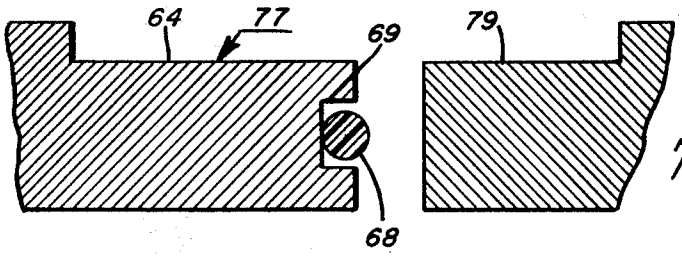


Fig-8

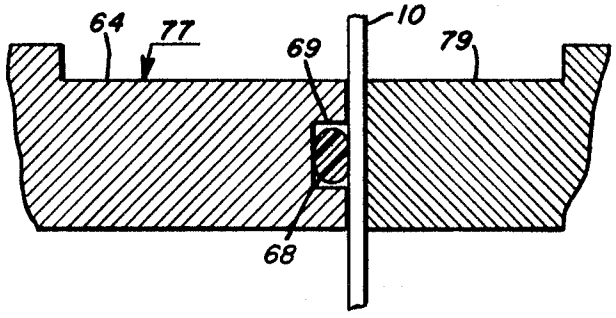


Fig-9

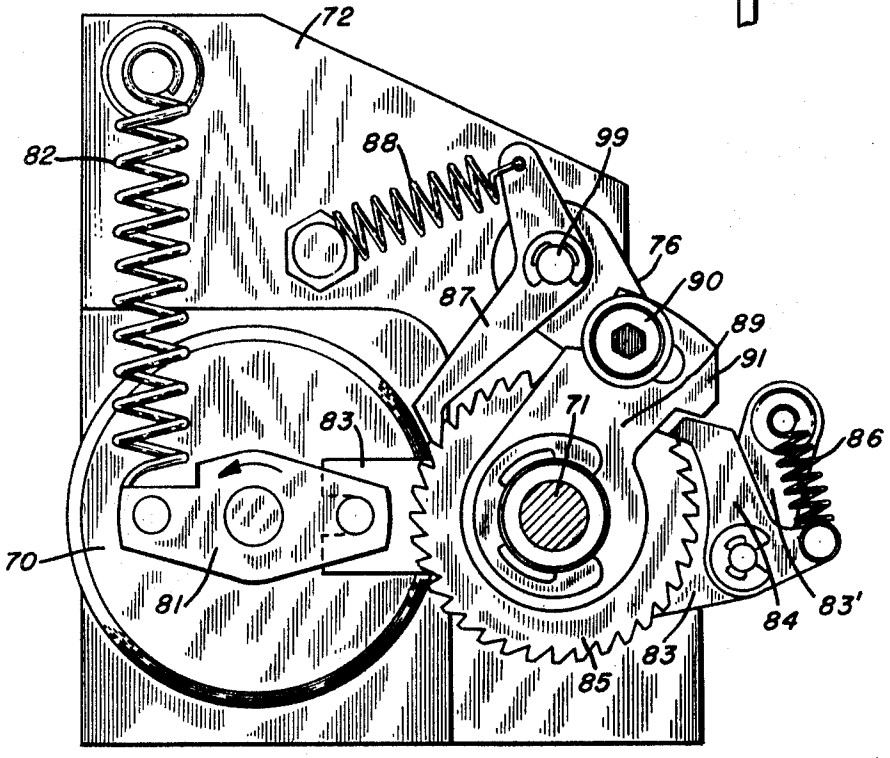


Fig-10

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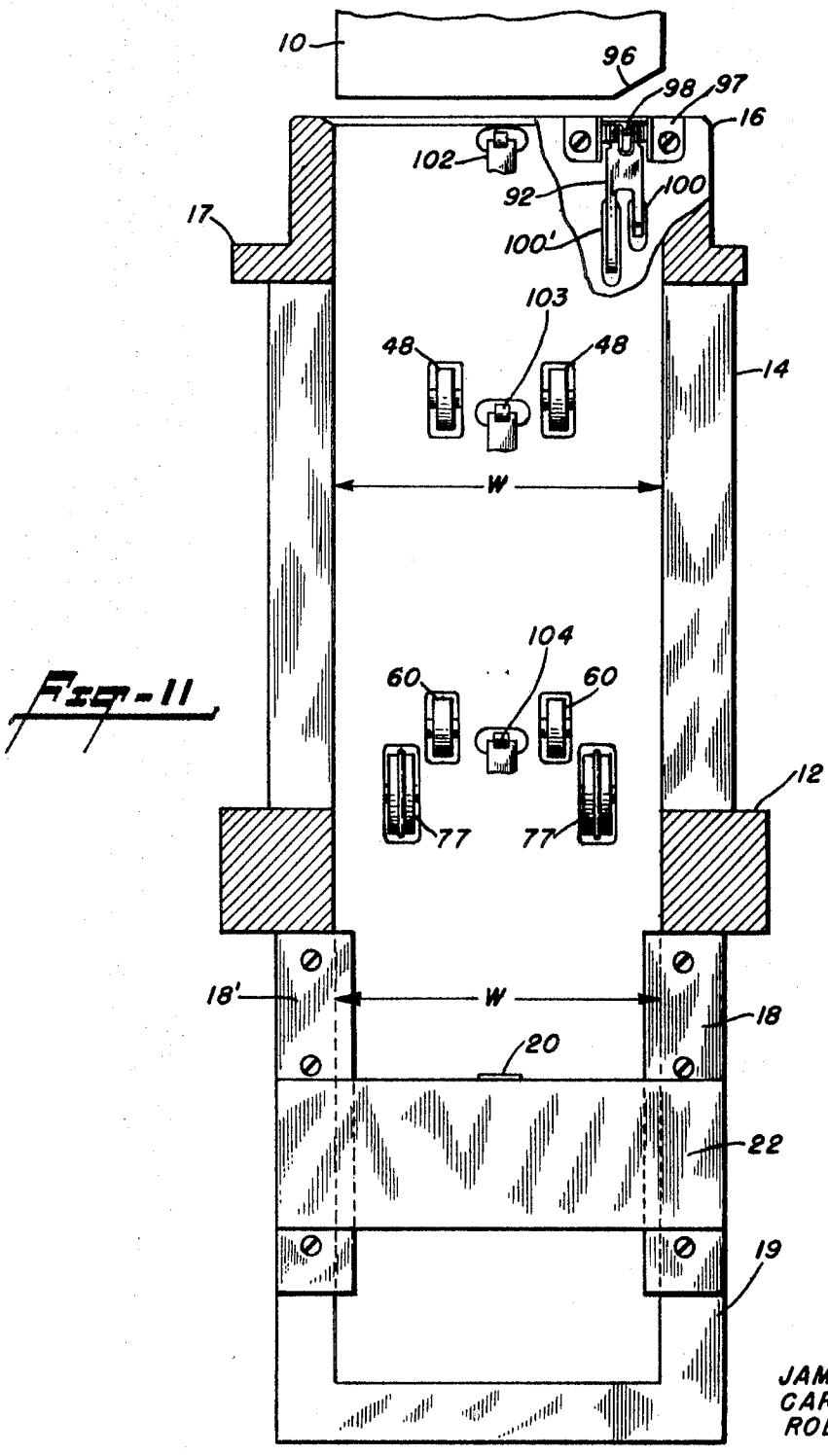


FIG-11

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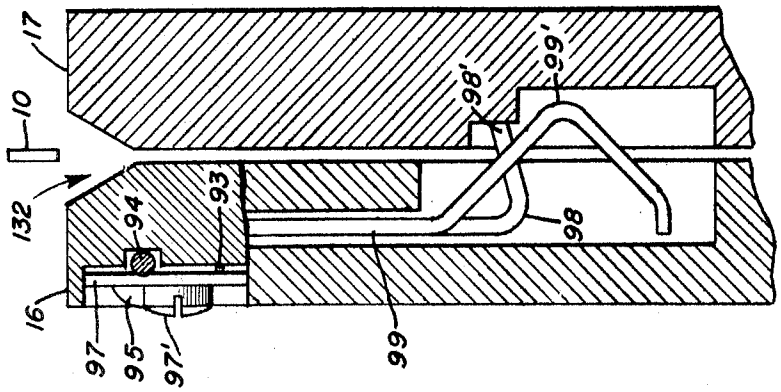


FIG-11B

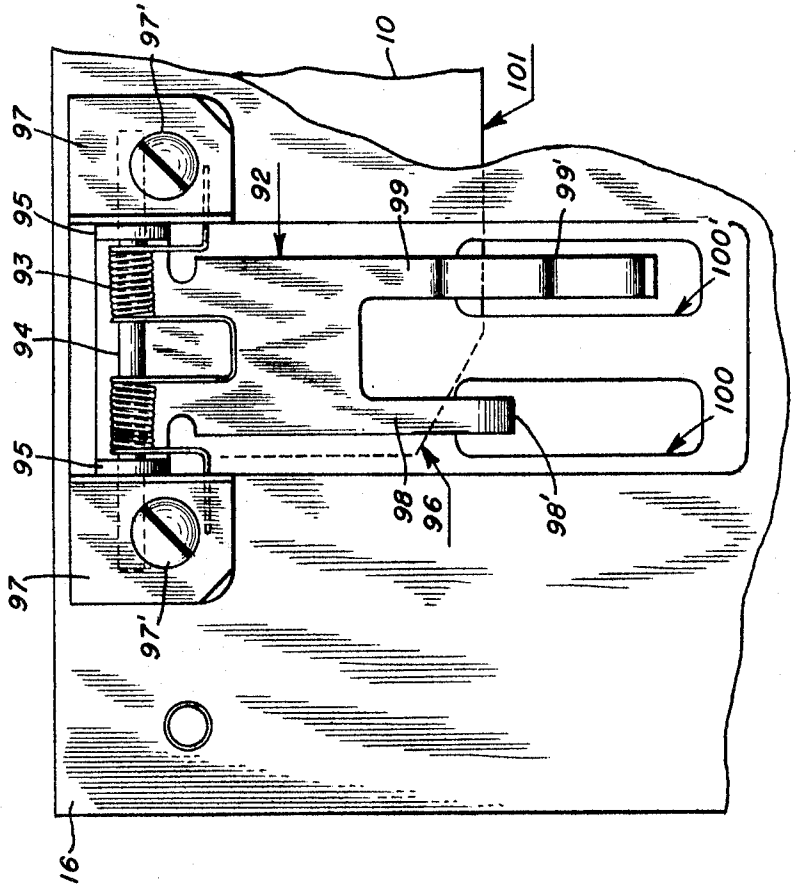


FIG-11A

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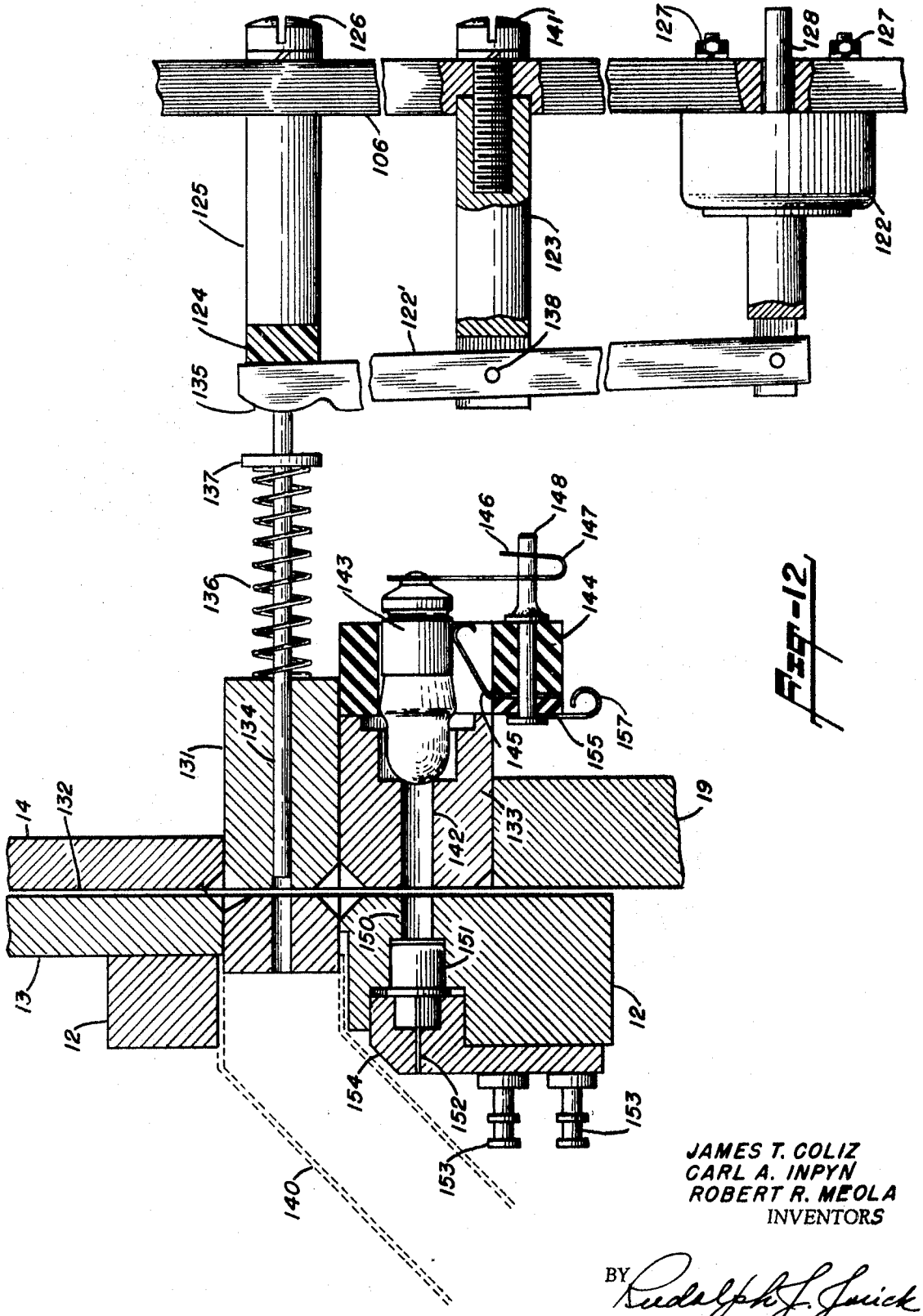


Fig-12

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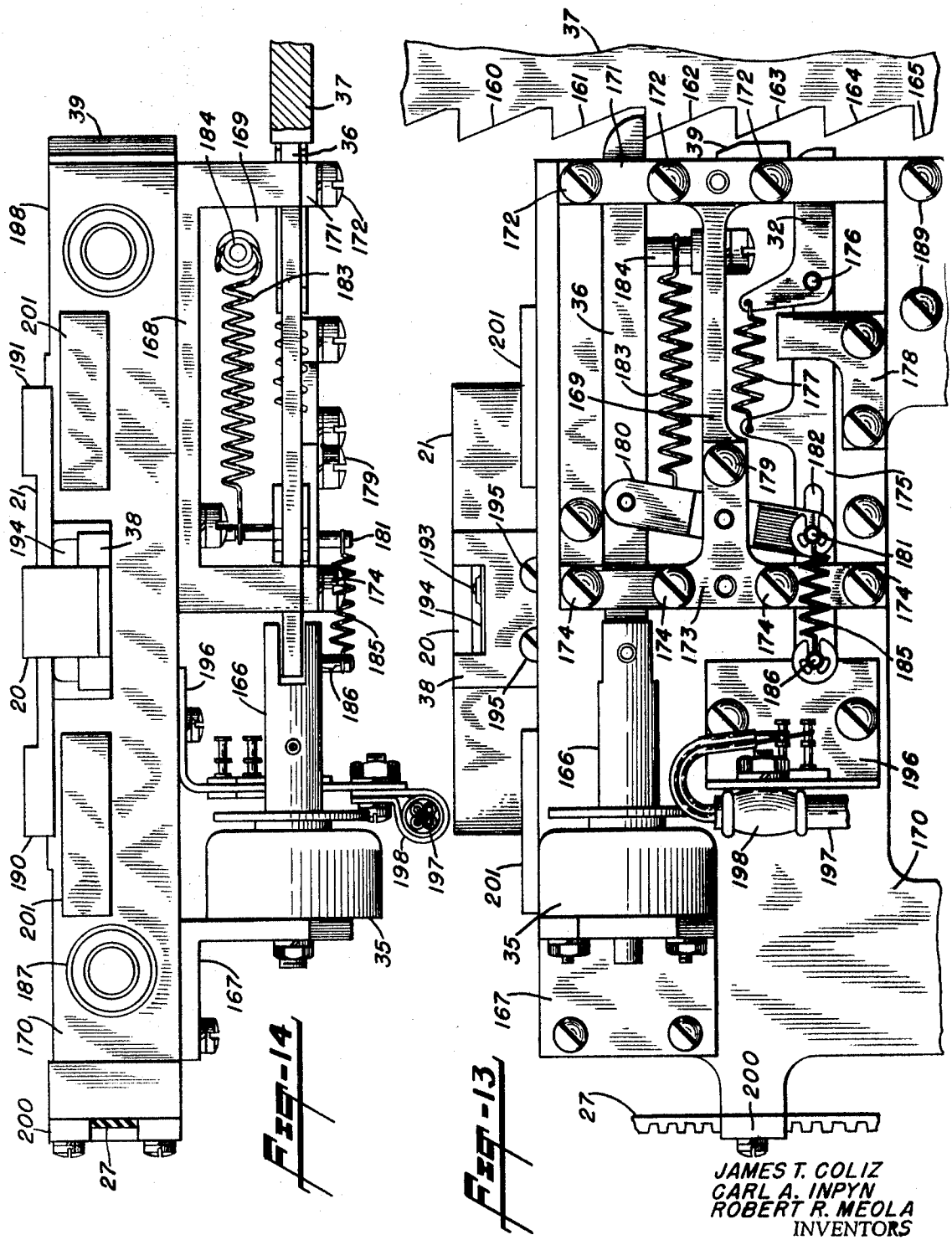


Fig-14

Fig-13

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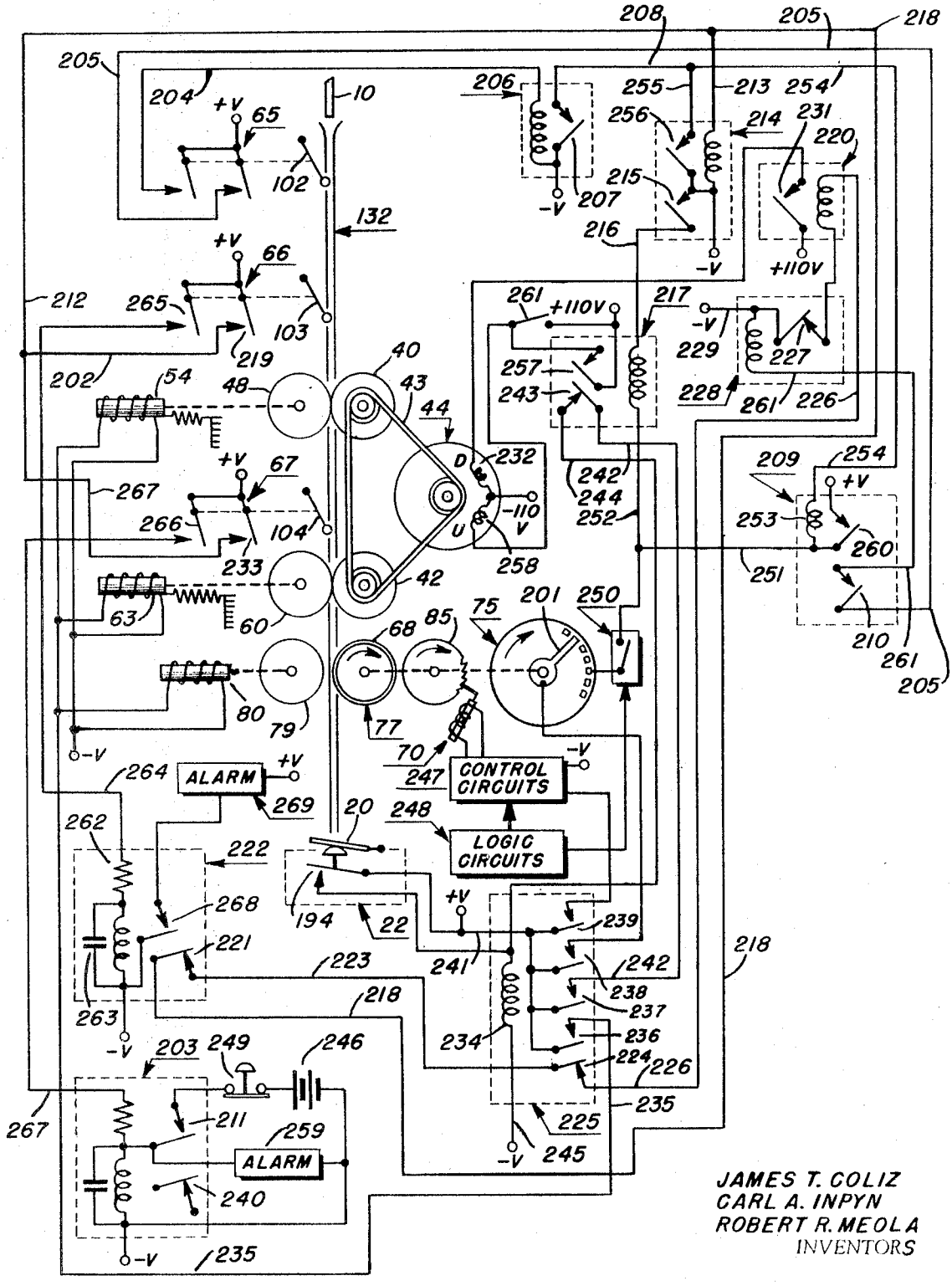


Fig-15

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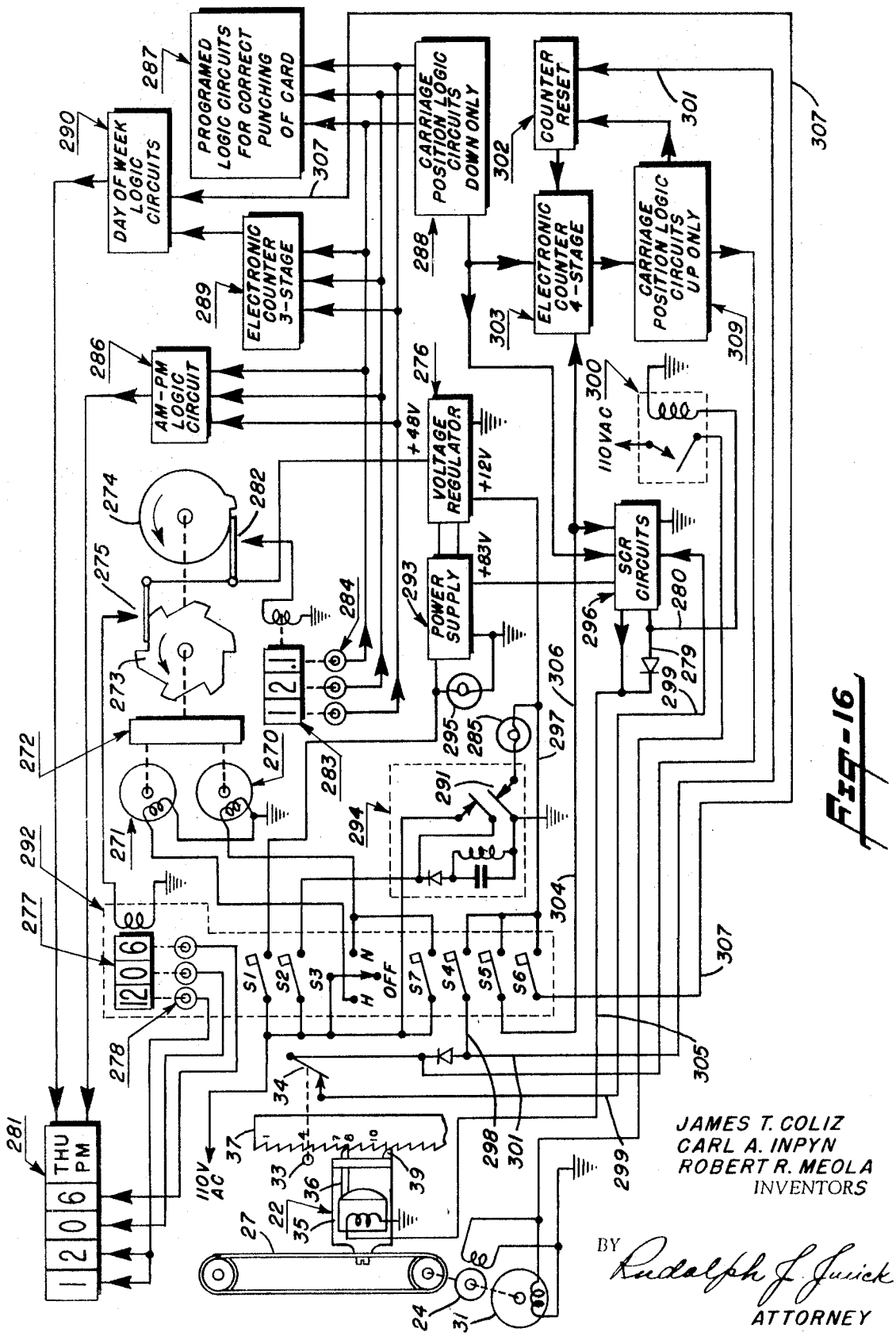


Fig-16

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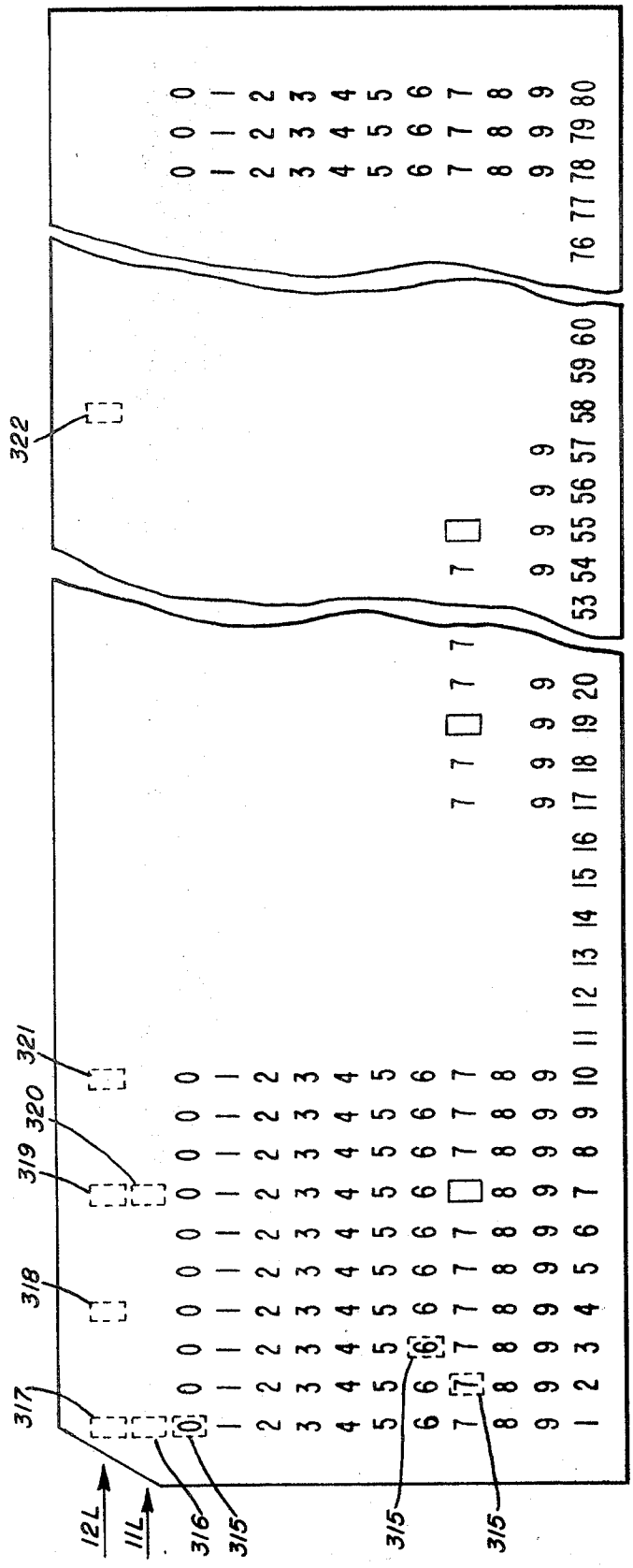


Fig-17

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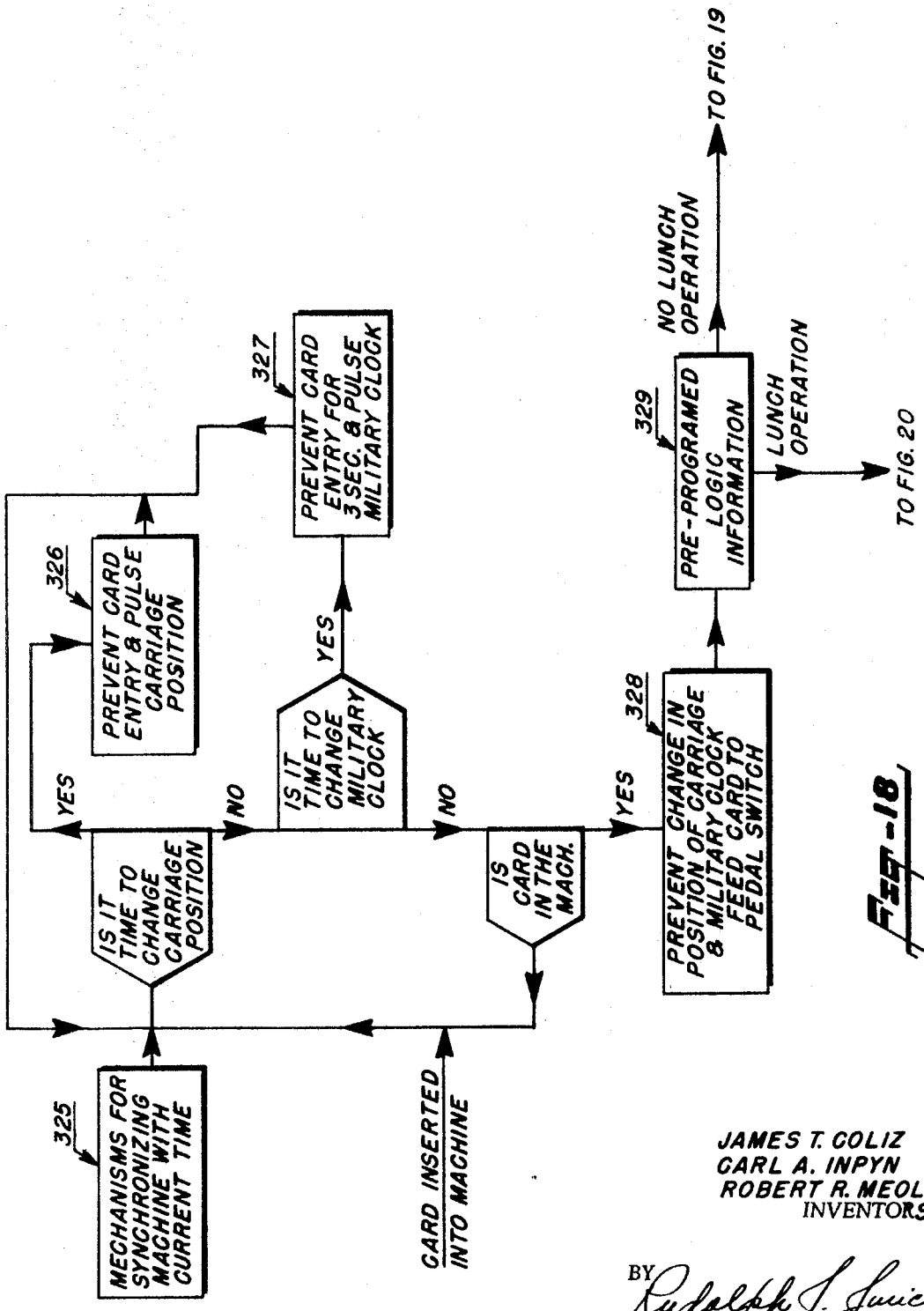


FIG-18

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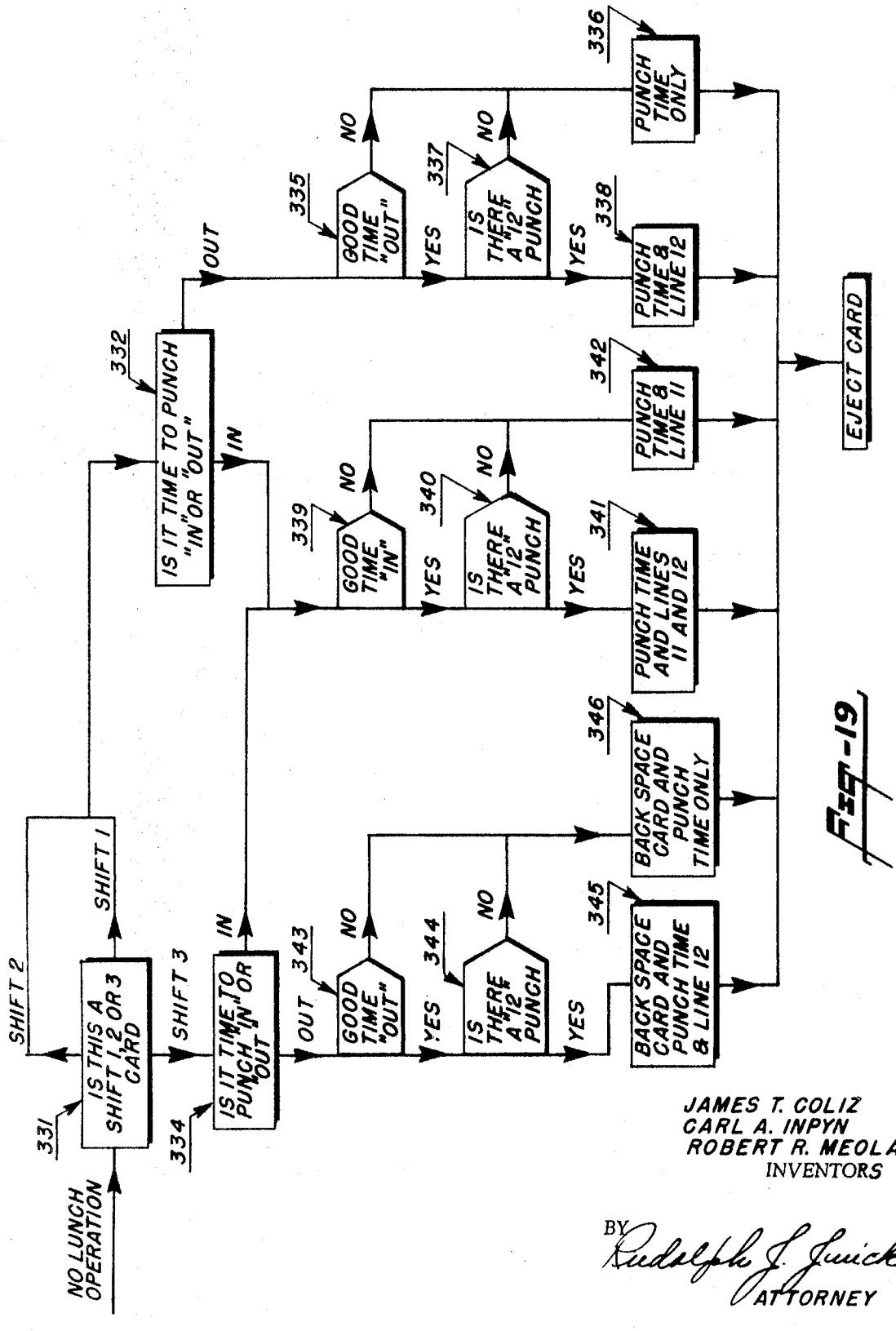
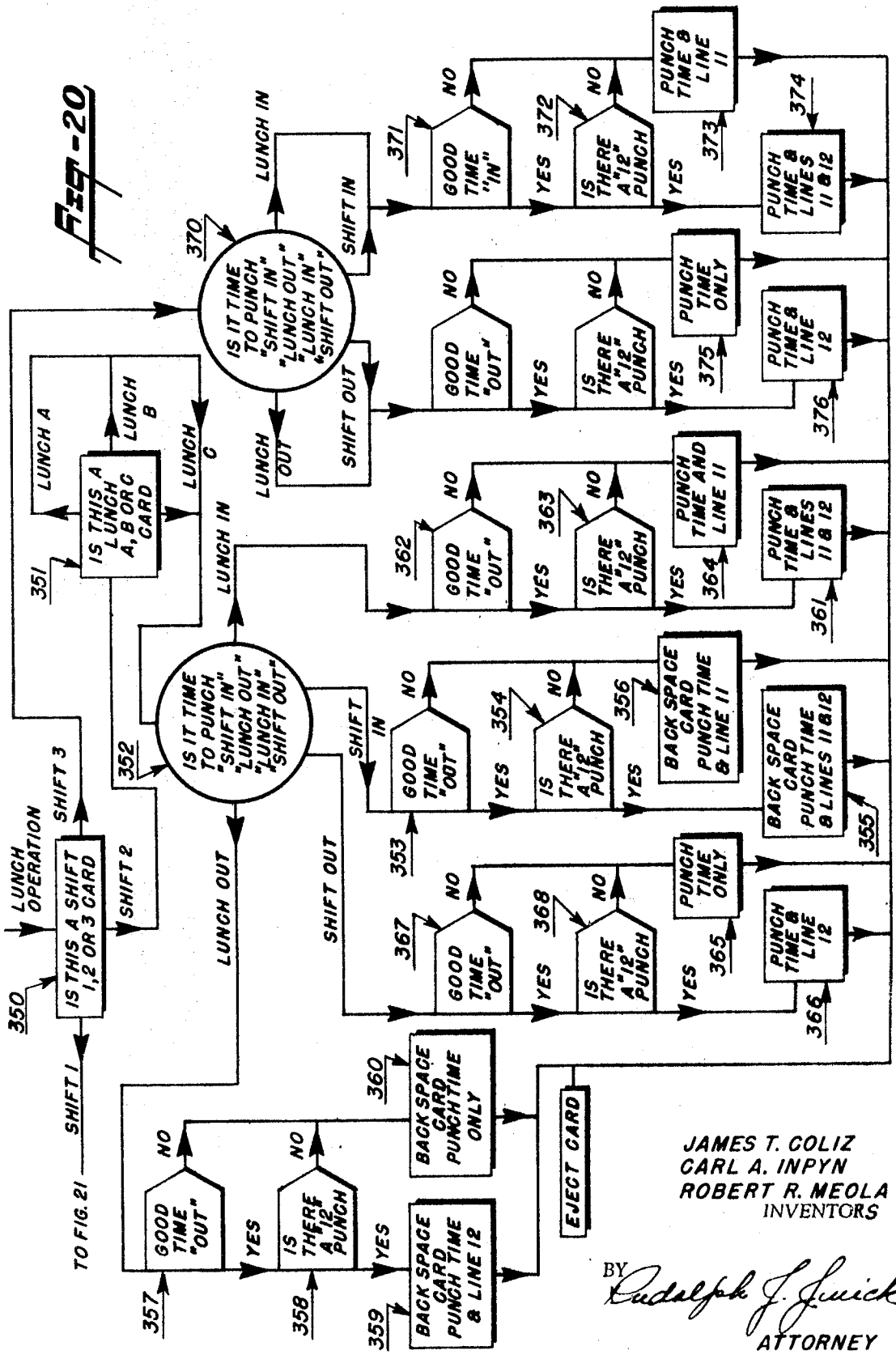


FIG-19

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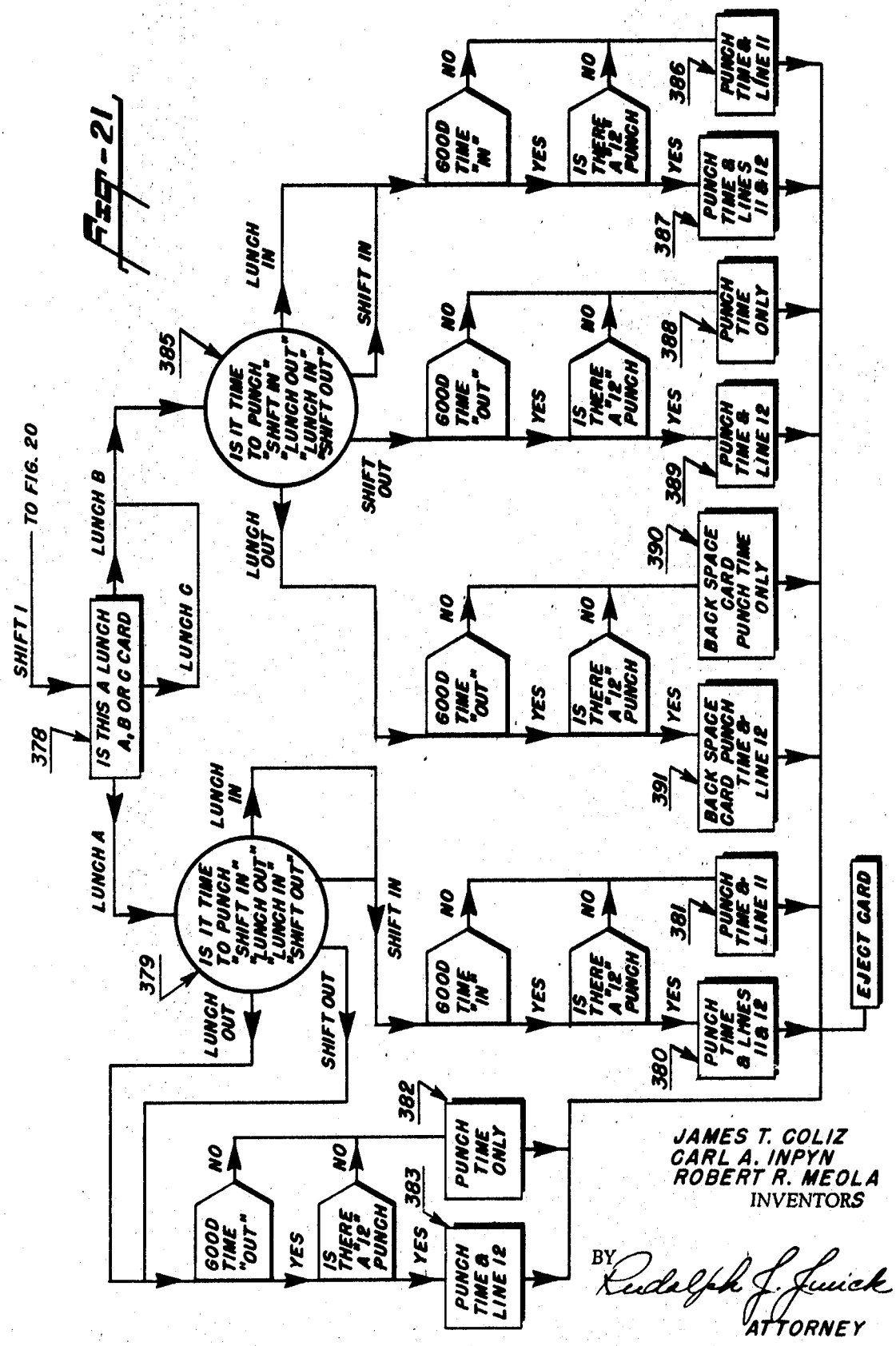
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Fig-20



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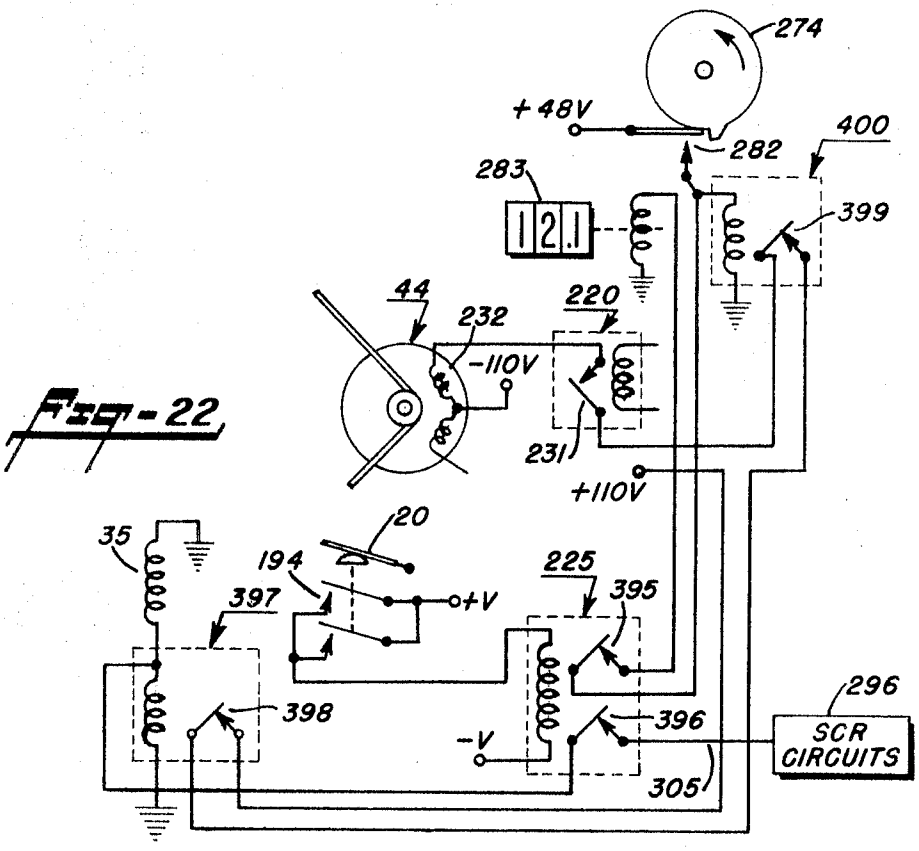


Fig-22

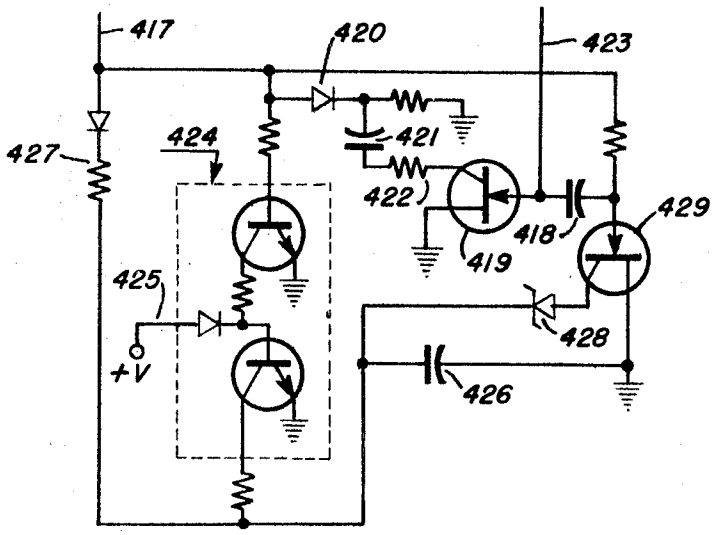


Fig-24

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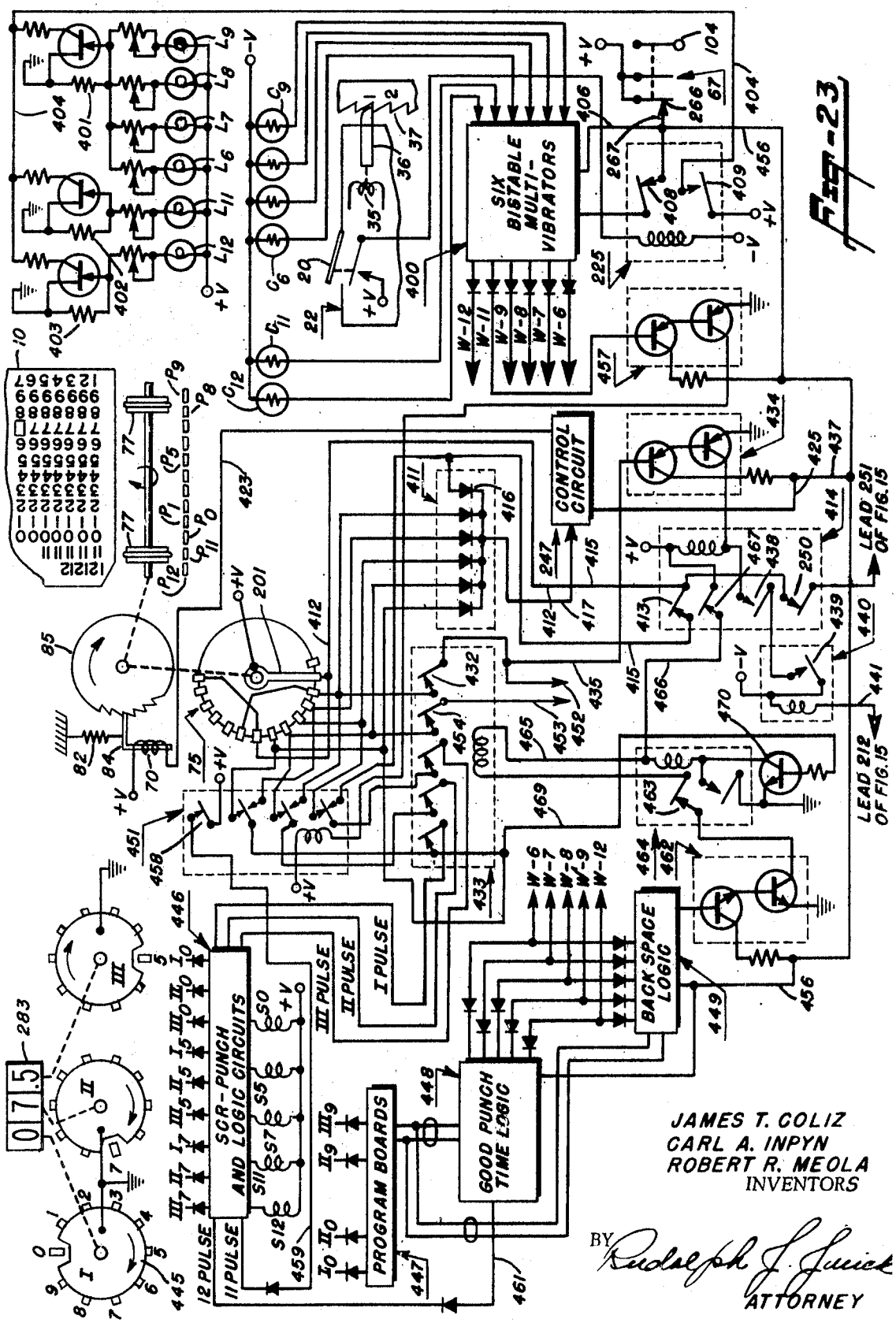
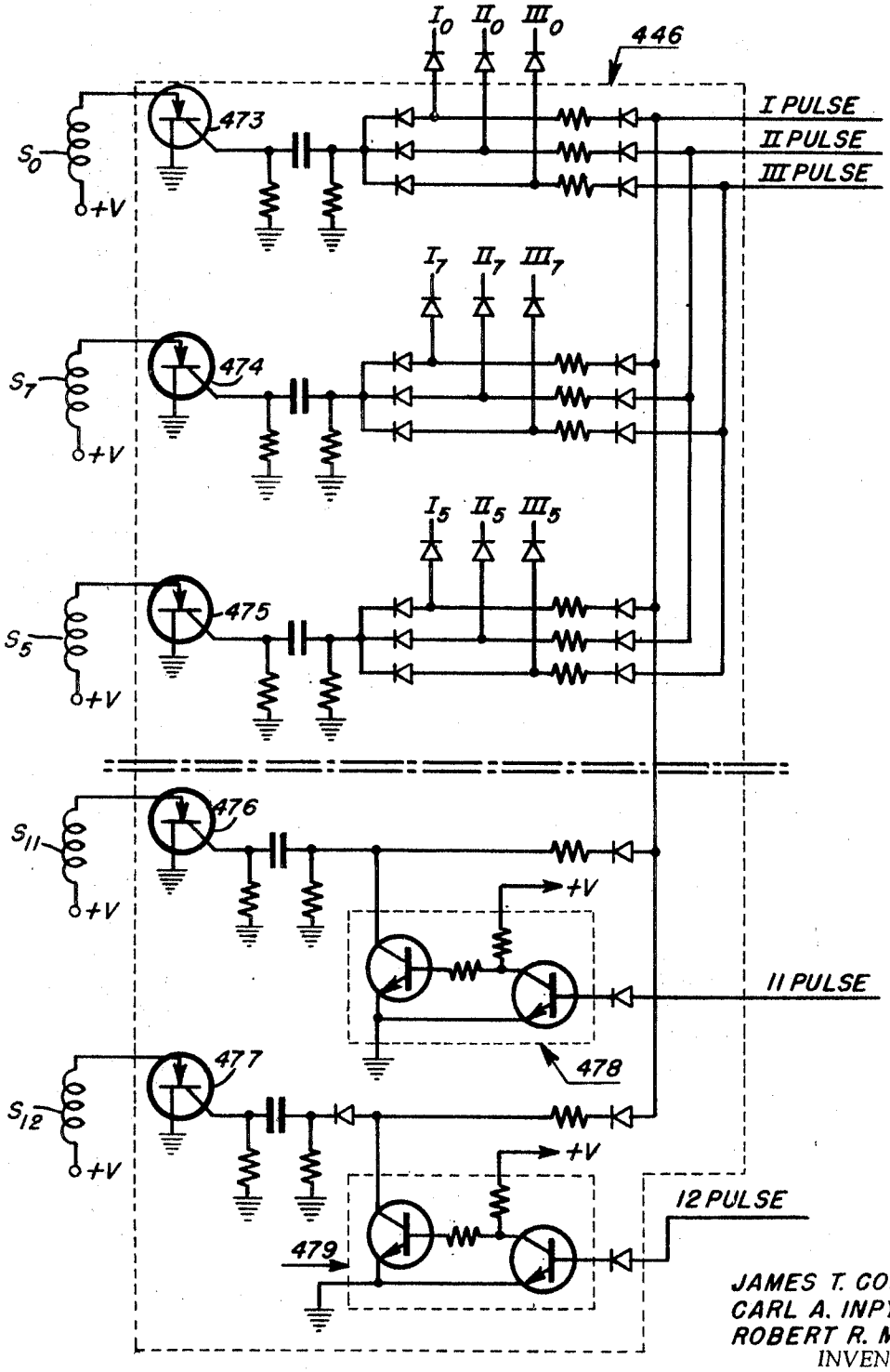

SIX BISTABLE MULTI-VIBRATORS
CONTROL CIRCUIT
SCR-PUNCH AND LOGIC CIRCUITS
I PULSE
II PULSE
III PULSE
12 PULSE
11 PULSE
PROGRAM BOARDS
GOOD PUNCH TIME LOGIC
BACK SPACE LOGIC
LEAD 251 OF FIG. 15
LEAD 212 OF FIG. 15
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FIG-23



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Fig-25

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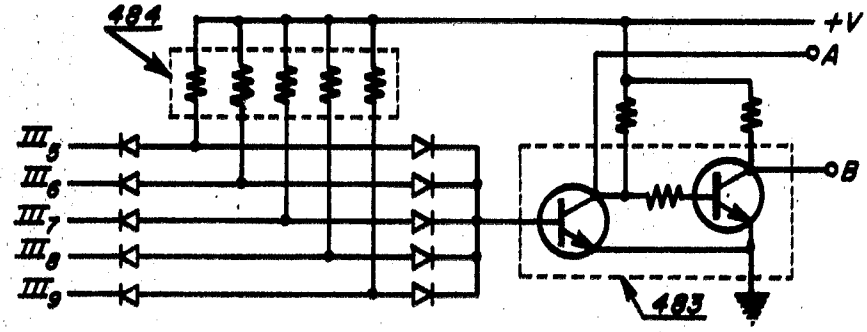


Fig-26

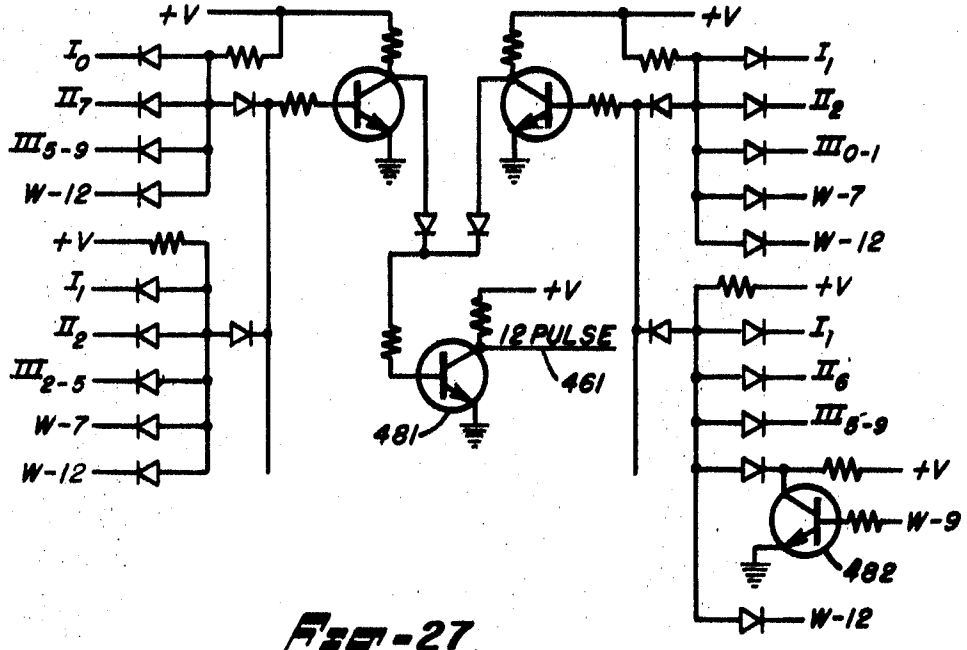


Fig-27

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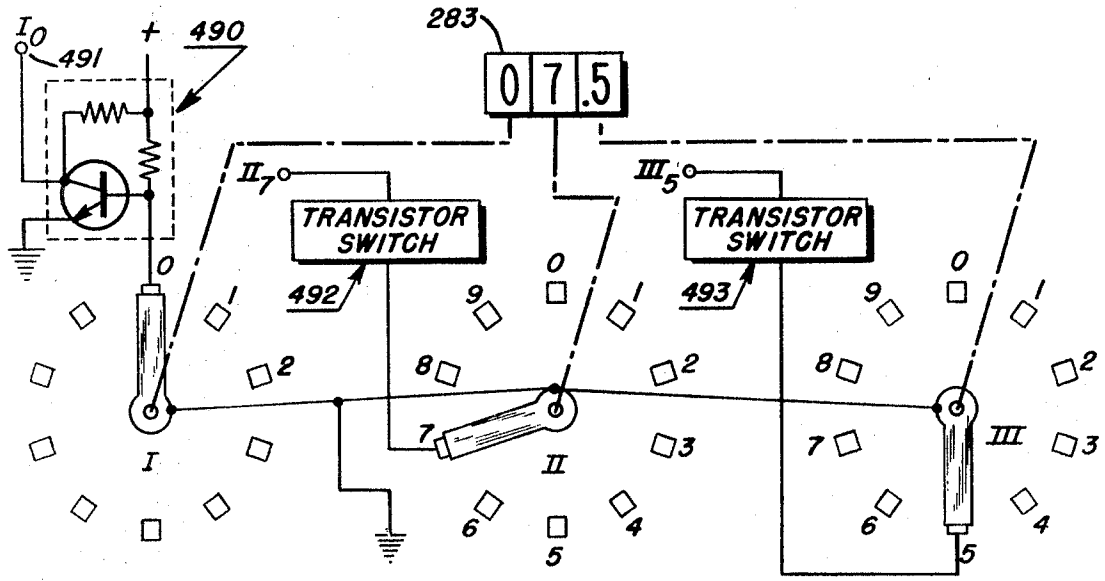


Fig-28

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PUNCHING TIME RECORDER

BACKGROUND OF THE INVENTION

The invention relates to apparatus for recording employee attendance which, by definition, means the documentation of the arrival and departure times of an employee during a work day and, generally, including the time taken out for a lunch period. These two, or four, registrations on a time card are recorded by conventional attendance clock in various ways, the clock printing the IN and OUT times in a predetermined sequence either horizontally across the card or vertically down along the card. For each IN and OUT registration, the clock prints the current time on the time card. Such printed records require all registrations on the time card to be scanned by a payroll clerk for an irregular recording such as a late arrival, early departure or absence of a recording. These irregular cards are then calculated by hand to determine the payroll hours. A data processing card then is keypunched for each employee indicating the total number of hours worked by that employee for the pay period. Conservatively, the scanning, calculating and keypunching of a 1,000 man payroll involves some 50 man hours of time per week.

Instead of printing IN and OUT current time on a conventional time card, apparatus made in accordance with this invention punches these times into a data processing card.

Various clocks that punch time into a data processing card are presently available. However, the prior devices, which punch time in 24 hours and tenths or hundredths of hours, or 24 hours and minutes, are arranged to punch only a single IN and a single OUT punch per card, whereby a new card must be used for each day. Although tabulating equipment can perform arithmetrical calculations, it is very slow and has an extremely limited storage or memory capacity. For this reason, a large number of tabulating equipment users cannot use a punching time recorder which only punches a single arrival and a single departure time in one card.

It is common practice, in data processing procedure, to keypunch and print the employees name on his attendance card prior to placing the card at the location of the time recorder. Such prepunching of the card with this and other pertinent data specific to the particular employee, such as the specific work shift and lunch hour period, permits the user of the present invention to fully automate the entire payroll procedure, because the same source document used by the employee to record the arrival and departure times can be introduced directly into data processing equipment, as all information is encoded in data processing language. This completely eliminates the human element in payroll preparation.

Once the punched data processing card is introduced into data processing equipment it is necessary for such equipment, through its program, to read the times punched, make a time calculation, determine if the hours are standard, and add each total daily calculation to that of each previous day, thereby to arrive at total hours worked for the pay period. This calculation can become immensely complicated if a company has staggered work shifts and/or staggered lunch periods. It is thus necessary for each time punched into the card to be related back to the individual employees work schedule by the data processing unit. While this calculation procedure is almost instantaneous for a computer, it is enormously cumbersome and time consuming for tabulating equipment. Generally, over a given work period, the average employee work force has only approximately a 15 percent exception factor, that is, people who are tardy, absent, etc. The punching time recorder made in accordance with this invention is constructed and arranged to code these exceptions for recognition and calculation by the data processing equipment, whereby 85 percent of the work involved is ascertaining total employee hours worked is eliminated. Furthermore, a single punching time recorder can serve in a master-slave relationship with other similar recorders without the addition of other components and expense, other than wiring.

SUMMARY OF THE INVENTION

The punching time recorder comprises a carriage automatically set to predetermined reference positions by a time synchronized control circuit, each such reference position corresponding to a particular day of the week and either an AM or PM time period. A data processing card, prepunched in accordance with the particular employees work schedule, is insertable into the throat of the recorder whereby spaced sets of drive rollers are set into rotation, said drive rollers and cooperating pinch rollers driving the card downwardly to a position wherein it is supported by the carriage. A photoelectric card reader reads into logic circuits the prepunched information. The logic circuits compare the prepunched information with a preset time schedule and initiate the actuation of a stepping mechanism for vertically displacing the card relative to the carriage, thereby to align the card with a series of punches in correspondence with the particular work schedule. This mechanism includes a pair of drive rollers and cooperating pinch rollers, which drive rollers are rotated in a step-by-step manner, each discrete rotation of the rollers displacing the card a distance equal to the spacing of the columns printed on the card. Current time information is introduced into the logic circuits, whereby the logic circuits effect the actuation of appropriate punches. The time is punched into the card in hours and tenths of hours, military time. After the punching operation, the carriage is returned to its previous reference position and the spaced sets of drive rollers are rotated in a reverse direction, thereby ejecting the card from the recorder.

Manually operable synchronizing means are provided for initially resetting the carriage to the correct reference position corresponding to the current day and AN or PM time period. Also, means are provided so that the card must be properly oriented before it can enter the recorder, as well as lockout means preventing a second operation of the recorder unless the punched card is first removed therefrom.

An object of this invention is the provision of a recorder for punching employee arrival and departure times for an entire work week into a data processing card prepunched in accordance with the employees work schedule.

An object of this invention is the provision of a recorder for punching IN and OUT time over a work week in a data processing card prepunched in accordance with an empoyee's assigned work schedule, which recorder punches current time in the card as a multidigit entry, punches the card to identify each time entry as an IN or an OUT time, and punches the card at the end of the work week when all of the time entries correspond to the work schedule.

An object of this invention is the provision of a punching time recorder constructed and arranged to punch current time as a multiple digit time entry into a data processing card, which recorder automatically positions the card relative to a series of punches in accordance with an employees work schedule which has been coded on the card.

An object of this invention is the provision of a punching recorder comprising automatic means for positioning a prepunched data card in an initial reference position corresponding to the current day and AM or PM time period, automatic means further positioning the card with reference to a series of punches in accordance with the prepunched data, and means actuating the punches to punch a multidigit time entry into the card.

An object of this invention is the provision of a recorder for punching military time, in hours and tenths of hours, into a data processing card prepunched in accordance with an employee's work schedule, which recorder comprises a photoelectric card reader for reading the information which previously has been punched into the card, logic circuits comparing the information obtained from the card reader with a time schedule which has been programmed into the logic circuits, card positioning means controlled by the logic circuits for positioning the card with respect to a punching mechanism, a time pulse generator introducing into the logic circuits current military time information, and means con-

trolled by the logic circuits for actuating the punching mechanism to punch a three digit time entry into the card.

The above-stated and other objects and advantages of the invention will become apparent from the following description when taken with the accompanying drawings. It will be understood, however, that the drawings are for purposes of illustration and are not to be construed as defining the scope or limits of the invention, reference being had for the latter purpose to the claims appended hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings wherein like reference characters denote like parts in the several views:

FIG. 1 is a front elevational view of a card positioning and punching machine made in accordance with this invention;

FIG. 2 is a left side elevational view thereof;

FIG. 3 is a rear elevational view thereof;

FIG. 4 is a right side elevational view thereof;

FIG. 5 is a front elevational view corresponding to FIG. 1 but with the punch assembly removed;

FIG. 6 is a rear elevational view of the punch assembly;

FIG. 7 is an end elevational view showing one of the drive rollers and the associated pinch roller for effecting an upward displacement of the card relative to the carriage of the machine;

FIG. 8 is a fragmentary, cross-sectional view taken along the line 8–8 of FIG. 7 and drawn to an enlarge scale;

FIG. 9 is a similar view but showing the card pressed against the drive roller by the pinch roller;

FIG. 10 is an elevational view taken along plane identified by the line 10–10 of FIG. 5 and drawn to an enlarged scale;

FIG. 11 is a vertical, cross-sectional view taken along the line 11–11 of FIG. 2, that is, through the median plane of the passageway for the card;

FIG. 11*a* is an enlarged rear elevational view showing the finger member which prevents entry of a card into the machine if such card is not oriented properly;

FIG. 11*b* is a corresponding end elevational view;

FIG. 12 is a fragmentary, vertical, cross-sectional view taken along the line 12–12 of FIG. 1 and drawn to an enlarged scale;

FIG. 13 is a rear elevational view of the carriage;

FIG. 14 is a top plan view of the carriage;

FIG. 15 is a diagrammatic representation showing the mechanisms and associated circuitry for moving the card downwardly and upwardly in the machine;

FIG. 16 is a diagrammatic representation showing the components and associated circuitry for synchronizing the machine with current time;

FIG. 17 shows a data card for use with the machine;

FIGS. 18—21 are flow charts showing the functional operation of the complete apparatus;

FIG. 22 is a diagram of the circuits for preventing entry of the card into the machine when a change is about to be made in the military clock or the position of the carriage;

FIG. 23 is a diagrammatic representation showing the components and circuitry for punching the card;

FIG. 24 is a circuit diagram of the silicon controlled rectifier circuit for controlling the energization and deenergization of the stepping ratchet solenoid;

FIG. 25 shows representative circuitry of the punch and logic circuits shown in FIG. 23;

FIG. 26 shows representative circuits involved in the good punch time logic shown in FIG. 23;

FIG. 27 shows representative circuits for producing a punch in line 12 of the card; and

FIG. 28 is a representative circuit diagram showing another arrangement for introducing current time information into the logic circuits controlling the operation of the punches.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring particularly to the elevational views of FIGS. 2, 3 and 5, the machine for receiving, positioning, punching and ejecting a data card is supported on a generally rectangular, vertical frame 11 having upper and lower openings formed therein. The ends of a relatively heavy mounting block 12 are secured to the vertical legs of the frame, said block being located in a precise position by means of locating pins carried by the frame legs. Positioned at the upper portion of the frame is a rear plate 13 and a front plate 14, these plates being in flush surface contact with each other. Secured to the top of the frame are a pair of throat blocks 16 and 17 terminating in matching, integral extensions constituting a throat T. The upper ends of the plates 13 and 14 are secured to the respective throat blocks 16 and 17 and the lower ends of these plates are secured to the mounting block 12. Formed in the facing surfaces of the plates 13 and 14 are full length, vertical, matching channels constituting a portion of a vertical passageway for the data card, such passageway having width and thickness dimensions slightly greater than the corresponding dimensions slightly greater than the corresponding dimensions of the card, thereby to permit free vertical movement of the card within the passageway with a minimum sidewise displacement thereof while at the same time, preventing the entry of two cards into the machine at the same time. Similar channels also are formed in the facing surfaces of the throat blocks, which channels are aligned with the channels formed in the plates 13 and 14. Preferably, the walls defining the channels of the throat blocks terminate in bevelled upper edges, thereby to facilitate insertion of the card into the passageway. A similar aligned passageway is formed through the mounting block 12. Positioned at the lower portion of the frame is a guide plate 19, the upper end of this plate being secured to the mounting block 12 and the lower end of this plate being secured to the bottom of the frame 11. This plate also has a vertical channel formed therein, which channel is aligned with the channel in the front plate 14 and is open to the rear of the machine. A pair of vertically disposed plates 18 and 18', (see particularly FIG. 3), are secured to the guide plates 19 and overhang the sidewalls of the channel, thereby to form inwardly facing trackways for slidably receiving that portion of the data card which projects below the mounting block 12. Thus, the card may be inserted into the throat of the machine and moved downwardly until its lower edge strikes a pivoted pedal 20 mounted in a recess formed in the upper end of a plate 21, said plate being secured to a carriage 22 and extending into the channel of the guide plate 19.

The construction and operation of the carriage will be described in detail hereinbelow. For the present it is pointed out that the carriage is provided with sleeve bearings slidable along the guide rods 25 and 26 secured in fixed positions and spaced from the guide plate 19. As best shown in FIGS. 1, 3 and 5, the carriage is secured to a timing belt 27 passing over an upper idler pulley 28 and a lower drive pulley 29, the latter pulley being coupled to the output shaft of a gear reducer 30 through an electromagnetic clutch 24, said gear reducer being secured in fixed position to the frame 11 and driven by a DC motor 31. Upon energization of the motor 31, the carriage is moved upwardly to a predetermined, starting position, wherein a fixed dog 39 secured to the side of the carriage, (see FIG. 1) depresses the free end of the actuating lever 33 of a normally closed microswitch 34, (see also FIG. 2), said switch being connected in series with a manually operable switch controlling energization of the motor. A linearly displaceable dog 36 (FIG. 3), is pin-coupled to the armature of a solenoid 35 and is mechanically coupled to a linearly and angularly displaceable dog 32 by a linkage mechanism. A rack 37 is secured to a leg of the machine frame (see also FIG. 5), said rack having 12 teeth projecting into the path of travel of the dogs 32 and 36. Upon momentary energization of the solenoid 35, the upper dog 36 is drawn out of engagement with the supporting rack tooth, and, simultaneously, the lower dog 32 is

conditioned to permit the carriage to drop to the next lower tooth. This action of the two dogs will be described in detail hereinbelow with reference to FIGS. 13 and 14. The described upward and downward movements of the carriage are controllable manually for the purpose of initially setting the carriage in proper operating position in correspondence with the morning or afternoon period of a particular day in the week, thereby conditioning the apparatus for the proper punching of the card. When the carriage has been set to a particular operating position, further movements of the carriage are automatically synchronized with respect to time, all of which will be described in detail hereinbelow. The carriage may occupy one of 10 vertical reference positions, it being noted that the dogs 32 and 36 span two teeth of the rack 37. These reference positions of the carriage are identified by the numerals 1 through 10 marked along the right edge on the front of the guide plate 19 as shown in FIG. 5. Irrespective of the reference position of the carriage, the data card, when once inserted into the throat of the machine, is moved downwardly by two sets of rollers until its lower edge strikes the pivoted pedal 20, which pedal actuates a normally open microswitch carried by the U-shaped member 38 of the carriage.

With continued reference to the rear elevational view of FIG. 3, an upper pair of metal drive rollers 40, are secured to a shaft passing through aligned holes formed in a generally H-shaped casting 41 secured in fixed position to the rear plate 13. A lower, similar pair of drive rollers 42 are secured to a shaft which also is rotatable in aligned holes formed in the casting. The rollers 40 and 42 are rotatable in one or the other direction by means of a timing belt 43 driven by a reversible motor 44 through a gear reducer 45. The peripheral surfaces of all four rollers extend into the path of travel of the punch card as it moves through the passageway already described, the rear plate 13 being provided with suitable openings for this purpose.

Each pair of the described drive rollers 40 and 42 are aligned with cooperating pairs of displaceable pinch rollers shown in the front elevation view of FIG. 5, to which reference now is made. The upper pair of metal pinch rollers 48 are freely rotatable about a shaft 49 and have peripheral surfaces extending into the card passageway through clearance openings formed in the front plate 14, said shaft having flat ends slidable within aligned rectangular slots formed in the inner surfaces of the vertical bars 50 and 51 secured in fixed position to the said plate. These slots are normal to the plate 14. The armature 53, of the solenoid 54, has a bifurcated end which is pin-coupled to a forwardly extending arm 55, said solenoid being supported by means of a mounting bracket secured to the side of the vertical bar 51. The other end of the arm 55 is secured to a shaft 56 journaled for rotation in aligned holes formed in the bars 50 and 51. A vertically extending arm 57 has its lower end secured to the shaft 56, while the upper, bifurcated end of this arm carries a pin extending through a slot formed in the forward end of a second, forwardly extending arm 58. A semicircular groove is formed in the other end of the arm 58 thereby forming an open yoke, and this yoke is slidable within a peripheral groove formed in the shaft 49. A pair of pins 47 are secured to the outer sides of the vertical bars 50 and 51 at points aligned with the described rectangular slots of these bars. Individual tension springs are connected between these pins and the underlying, flat ends of the shaft 49, such springs at all times biasing the shaft into engagement with the yoke end of the forwardly extending arm 58. The described arrangement permits a limited rocking movement of the shaft 49 in a plane normal to the plate 14. Normally, the solenoid armature 53 is biased upwardly by means of the coiled spring 59, thereby applying a force to the forwardly extending arm 58, coupled to the shaft 49, and consequently, pressing the peripheral surfaces of the pinch rollers into engagement with the cooperating, drive rollers 40 shown in FIG. 3. The described rocking action results in an automatically equalization of the pressure between the individual pinch rollers and the cooperating drive rollers. Consequently, when the data card is inserted between the two sets of rollers, equal pressures are exerted against the card at points equidistant from the card center line, thereby eliminating undesirable sidewise canting of the card within the passageway as it is driven in one or the other direction by the rollers.

A second pair of similar pinch rollers 60, (FIG. 5), are freely rotatable on the shaft 61 having flat ends passing through aligned rectangular slots formed at the lower ends of the vertical bars 50 and 51. These pinch rollers normally are pressure-biased into engagement with the cooperating drive rollers 42 (see FIG. 3) by means of the coiled spring 62 of the solenoid 63, the connecting arms between the shaft 61 and the solenoid armature being of the same construction and arrangement as those already described with reference to the upper pinch rollers 48. Consequently, the rocking action of the shaft 61 automatically equalizes the pressure applied to the card by the pinch rollers 60 and the associated drive rollers. Visible in FIG. 5 are three, vertically spaced microswitches 65, 66 and 67 secured in fixed positions to the plate 14. The associated switch-actuating levers pass through suitable openings formed in the plate 14, each actuating lever carrying a conventional roller extending into the path of travel of the data card as it moves up or down within the card passageway.

With continued reference to FIG. 5, a stepping ratchet solenoid 70 rotates a shaft 71 passing through aligned bearing holes formed in the bearing blocks 72, 73 which are secured in fixed positions to the plate 14. The left end of the shaft 74, of a 36 position ratchet switch 75, is mechanically coupled to the right end of the shaft 71 by means of a conventional, self-aligning coupling. The ratchet drive assembly operatively associated with the stepping ratchet solenoid 70 and the shaft 71 will be described hereinbelow with reference to FIG. 10. Secured to the shaft 71 are a pair of drive rollers 77, each roller extending into the card passageway through openings formed in the plate 14, and each roller having a peripheral groove accommodating a rubber O-ring. Cooperating with these drive rollers are a pair of pinch rollers similar to those visible in FIG. 5. Referring now to FIG. 3, the pinch rollers associated with the drive rollers carrying O-rings, are freely rotatable about a shaft 78 having flat ends extending through aligned, horizontal, rectangular slots formed in the casting 41, a portion of this casting being broken away to show a portion of the shaft 78 and one of the pinch rollers 79. The shaft 78 has a peripheral groove formed midway of its ends. A solenoid 80, secured in fixed position to the casting 41, has an armature extending toward the shaft 78, said armature having a flat, vertically disposed free end. A semicircular groove is formed in the end wall of the armature, whereby the free end of the armature constitutes an open yoke. This yoke is slidably disposed within the peripheral groove of the shaft 78. The described arrangement is somewhat similar to that described hereinabove with reference to the pinch rollers 48 and 60 shown in FIG. 5. Thus, the shaft 78, (FIG. 3), has a limited rocking action relative to the solenoid armature and in a horizontal plane. The pinch rollers carried by the shaft 78 extend into the card passageway through openings formed in the plate 14. Normally, these pinch rollers are spaced from the associated drive rollers. At an appropriate time in the machine operating cycle, the solenoid 80 is energized, whereby these pinch rollers press the data card firmly against the associated drive rollers carrying the rubber O-rings. Due to the described rocking action of the shaft 78, there is an equalization of the pressures applied to the card by the individual pinch rollers.

The machine is designed for use with a standard data processing card and will punch three digits per time entry in accordance with industry standards. Such card has 80 vertical columns, each column having 12 punching positions. A maximum of 60 columns is used in the present system to record a five day work week. Such card also has a standard corner cut at the upper left-hand corner (see FIG. 17). The function of the two sets of drive rollers 40 and 42, FIG. 3, is to drive an inserted data card downwardly in a continuous motion until the lower edge of the card depresses the pivoted pedal 20 on the

carriage 22. Upon depression of this pedal the associated microswitch is closed, thereby initiating operation of a control system to properly position the card for the punching operation. Upon the completion of the punching operation, the pinch rollers 48 and 60 (FIG. 5) press the card against the drive rollers 40 and 42 (FIG. 3) said drive rollers being driven in a reverse direction to eject the card from the machine. The proper positioning of the card for the punching operation may require upward displacement of the card relative to the carriage. As stated hereinabove, the carriage may occupy any one of 10 reference positions. With the carriage in any particular reference position, it is necessary to move the card upwardly relative to the carriage in either six or 12 equal steps, as will be described hereinbelow. These upward, step-by-step displacements of the card must be controlled within close tolerance. The drive rollers 77, carrying the O-rings, (FIG. 5), and the cooperating pinch rollers, effect such step-by-step, upward displacements of the card relative to the carriage, the shaft 71 being rotated 10° upon each actuation of the ratchet stepping solenoid 70. Upon each 10° rotation of this shaft, the drive rollers 77 must elevate the card a distance equal to the linear spacing between adjacent columns on the card. Consequently, not only is it necessary to provide a positive frictional engagement between the rollers 77 and the card, but, also, the effective diameter of these rollers must remain constant throughout each and every displacement of the card. These requirements are met by constructing the drive rollers as shown in FIG. 7—9.

The end elevational view of FIG. 7 shows a drive roller 77 comprising the metal roller 64 having a peripheral groove within which the rubber O-ring 68 is disposed. Under normal conditions the associated pinch roller 79 is spaced from the drive roller so as to permit free passage of a card 10 therebetween. As shown in the fragmentary, enlarged cross-sectional view of FIG. 8, taken along the line 8–8 of FIG. 7, the O-ring 68 normally has a circular cross-sectional configuration and extends beyond the peripheral surface of the metal roller 64, while the groove 69 has a rectangular cross-sectional configuration. With the data card positioned between the two rollers and the pinch roller 79 pressed against the card, as shown in FIG. 9, the O-ring 68 is compressed into a generally oblong configuration and into firm engagement with the bottom wall of the groove 69 and the surface of the card 10, it being noted that the groove cross-sectional area exceeds that of the O-ring. The card is pressed into firm engagement with the peripheral surface of the metal roller 64. Thus, the compressed O-ring maintains a frictional pressure on the card. At the same time, the contact pressure between the O-ring and the bottom wall of the groove 69 prevents relative angular displacement between the O-ring and the roller 64. Consequently, the linear movement imparted to the card corresponds precisely to the angular movement of the metal roller 64. The diameter of the metal roller 64 is machined to a precise dimension so that for every 10° rotation of its supporting shaft, the linear movement of the card equals the spacing between the vertical columns on the card. Referring back to FIG. 5, the shaft 71, carrying the drive rollers 77, is rotated 10° upon each energization of the ratchet stepping solenoid 70. The shaft of the 36 position ratchet switch 75 rotates simultaneous with the shaft 71. As will be described hereinbelow, the contacts of the ratchet switch 75 are connected in a control circuit operating in a manner such that the card may or may not be punched at any of its step-by-step upward excursions relative to the carriage.

The stepping ratchet solenoid 70 (FIG. 5), rotates the shaft 71 (carrying the drive rollers 77) in a step-by-step manner through a ratchet drive arrangement shown in FIG. 10 which is an end elevational view taken along a vertical plane identified by the line 10–10 on FIG. 5. An arm 81 is attached to the rotatable armature of the solenoid 70 which is secured to the bearing block 72, (see also FIG. 5), said arm 81 being rotated in a counterclockwise direction when the solenoid is energized. The ends of the spring 82 are looped about a pin carried by the arm 81 and a post secured to the block 72, said spring serving to return the armature to the normal or zero position when the solenoid is deenergized. In FIG. 10 the arm 81 is shown in its mid position of travel. A second pin, carried by the arm 81, extends through a slot formed in the crank 83, said crank being rotatable about the shaft 71 and having an integral upstanding ear 83'. Pivotally secured to the crank is a pawl 84 having an end biased into engagement with a ratchet wheel 85 by a spring 86, said spring having one end looped about a pin secured to the dog and the other end looped about a pin secured to the ear of the crank. The ratchet wheel is secured to the shaft 71 and has 36 teeth. A second pawl 87 is pivotally supported on the end of an eccentric post 99, carried by the block 72, and has an end biased into engagement with the ratchet wheel by a spring 88. The eccentric post provides a means for adjustment of the pawl 87 with respect to the ratchet wheel. The shaft 71 passes through a clearance hole formed in an arm 89 which is secured in a desired fixed angular position by a bolt 90, said bolt passing through an elongated slot formed in the arm and being threaded into a hole formed in an underlying arm 76 attached to the post 99. That portion of the arm 89 which overlies the ratchet wheel is relatively thin and is spaced from the underlying surface of the wheel by a suitable collar. However, the offset portion of the arm 89, identified by the numeral 91, is of increased thickness and has a flat wall spaced from the upper sidewall of the offset end of the pawl 84. Upon energization of the solenoid, the crank 83 is rotated in a clockwise direction, thereby resulting in a corresponding downward displacement of the pawl 84 so that its free end is transferred into engagement with the next lower tooth on the wheel 85. During the clockwise rotation of the crank, back motion of the ratchet wheel is prevented by the pawl 87. When the solenoid now is deenergized, the return spring 82 imparts a clockwise rotation to the arm 81 and a corresponding counterclockwise rotation to the crank 83, whereby the pawl 84 now advances the ratchet wheel 85 an angular distance corresponding to that of a single tooth, specifically, 10°. Overtravel of the crank, upon its return movement, is prevented by angular orientation of the arm 89 so that the flat wall of its offset portion 91 is engaged by the offset end of the pawl 84. It will be apparent, therefore, that each time the solenoid is energized and deenergized the shaft 71 is rotated 10° in a counterclockwise direction as viewed in FIG. 10 and that such rotation of the shaft results in a corresponding rotation of the drive rollers 77 (FIG. 5) in a direction to move the data card upwardly relative to the carriage.

Reference now is made to FIG. 11 which is a vertical cross-sectional view taken essentially along the line 11–11 of FIG. 2, that is, through the median plane of the passageway for the card. The width (W) of the aligned channels formed in the throat block 17, the front plate 14, the main mounting block 12 and the guide plate 19 is slightly greater than that of the punch card 10. One corner of the card 10 is cut at an angle of approximately 30° forming an oblique edge 96. Superposed upon FIG. 11 is a portion of the rear throat block 16, which throat block has appropriate recesses formed in the inner surface thereof for accommodating a spring-biased finger member 92 having a pair of fingers extending into the card passageway. One or the other of each fingers are engaged by the lower edge of the card as it is inserted into the passageway. The assembly and operation of the finger member will best be understood by reference to the rear and left end elevational views of FIGS. 11*a* and 11*b*, respectively. A formed spring 93, having a central portion of generally rectangular configuration, is carried by a pivot pin 94 which extends through aligned holes formed in the upstanding, integral ears 95 of the finger member 92. The ends of the spring and the pivot pin are secured in fixed positions by means of the clamps 97 and the fastening screws 97', said screws being threaded into holes provided in the throat block 16. The short finger 98 has an offset, upturned end 98' and the long finger 99 includes a reverse bend 99'. The spring 93 biases the finger member in a

direction such that the upturned end 98' and the bend 99' normally project through openings 100 and 100' (formed in the throat block 16) and extend across the card passageway denoted by the numeral 132 in FIG. 11*b*. In this normal position of the finger member, the end 98' abuts the wall of a recess formed in the front throat block 17 and the two fingers cross each other along a horizontal line lying in a vertical plane containing the center line of the card passageway. When properly oriented, the cut corner 96, of the card, will be spaced from the end 98' of the short finger when the lower edge 101 of the card engages the upper portion of the bend 99' of the long finger. A small downward pressure applied to the card produces a camming action, resulting in a clockwise rotation of the finger member, as viewed in FIG. 11*b*, until the lower edge of the card just passes beyond the bend 99'. At this point, the end 98', of the short finger, has been moved out of the path of travel of the card, thereby permitting further movement of the card into the machine. If the card is not properly oriented, its lower edge 101 engages the end 98' of the short finger and, in view of the upwardly inclined disposition of such end, the force component applied thereto is predominately vertical, whereby the finger member cannot be rotated and the card cannot be forced further into the machine. When the card is ejected from the machine, its upper edge engages the lower portion of the bend 99', thereby again producing a camming action to move the end 98' out of the path of travel of the card.

Also superimposed on FIG. 11 are the end portions of the actuating levers 102, 103 and 104, which levers are associated, respectively, with the microswitches 65, 66 and 67 shown in FIG. 5. The rollers carried by such levers extend across the card passageway and normally rest in shallow cavities formed in the rear plate 13. As the card is inserted into the passageway it first depresses the actuating lever 102 resulting in a closure of the associated microswitch. However, at this stage of the card movement, the closure of this microswitch merely conditions the control circuit of the apparatus for a subsequent operation, as will be described hereinbelow. As the card is pressed further into the passage its lower edge passes between the pinch rollers 48 and their associated drive rollers and then depresses the actuating lever 103 resulting in the closure of the microswitch 66 (see FIG. 5), which energizes the card-drive motor 44, (see FIG. 3). The pinch rollers 48, together with their associated drive rollers, now drive the card downwardly causing it to depress the actuating lever 104 of the microswitch 67, (FIG. 5) and to enter between the pinch rollers 60 and their associated drive rollers. The two microswitches 66 and 67 (FIG. 5) have sets of normally open contacts connected in parallel. Therefore, after the upper end of the card passes below the actuating lever 103 and the rollers 48, the card will continue to be driven downwardly by the pinch rollers 60 cooperating with the drive rollers. Such continuous, downward movement of the card continues until the lower edge of the card depresses the pedal lever 20 carried by the carriage 22. That portion of the card which extends below the mounting block 12 is prevented from curling outwardly by the overhanging portions of the plates 18 and 18'. Depression of the pedal lever 20 closes a normally open microswitch carried by the carriage, thereby energizing a relay which deenergizes the card-driving motor. Even when the carriage is in its' lowermost reference position, the upper edge of the card lies above the pinch rollers 60 and retains the actuating lever 104 in the depressed position. The card now is positioned at what may be termed an initial reference position as determined by the position of the carriage. An upward step-by-step displacement of the card relative to the carriage is effected by means of the drive rollers 77 and their cooperating pinch rollers, thereby to set the card in predetermined positions for the card punching cycles. During that portion of the machine operating cycle when the card is subject to upward displacement relative to the carriage, the pinch rollers 48 and 60 are withdrawn from engagement with the card by the respective solenoids 54 and 63 shown in FIG. 5. During the upward displacement of the card, the microswitch actuated by the pedal lever 20 is rendered ineffective and a control circuit, controlled by the ratchet switch 75 (FIG. 5), is conditioned to apply a reverse voltage to the card-driving motor through the microswitches having the actuating levers 103 and 104, whereby the pinch roller 60 and 48 and their cooperating drive rollers, now drive the card upwardly until the lower edge of the card passes above the actuating lever 103. The opening of the microswitch associated with the operating lever 103 opens the circuit to the card-drive motor and the card now may be manually withdrawn from the machine. Importantly, however, until the card is completely withdrawn from the throat of the machine, the actuating lever 102 remains depressed and retains the associated microswitch in the closed position. The control circuit is so arranged that when this microswitch is closed by the card upon its upward, or ejecting, movement, the card-drive motor can again be energized only after such microswitch has been opened. This requires removal of the card from the machine throat before another punching cycle can be set into operation, thereby preventing spurious operation of the machine either accidentally or deliberately. As described above, the finger member 92 is so shaped that it rotates out of the card passageway as it is engaged by the upper edge of the card being ejected from the machine.

The solenoids and levers of the punch assembly are carried by a plate 106, see FIG. 1, which plate is secured in place by means of two upper bolts 107 and two lower bolts 108, the upper bolts 107 being threaded into spacer bushings 109 secured to the plate 14 (see FIG. 5) and the lower bolts 108 being threaded into the spacer bushings 110 secured to the guide plate 19. The solenoid and lever assembly is best shown in the rear elevational view of FIG. 6 to which reference now is made. Twelve solenoids 111—122, divided into upper and lower sets of six each, are secured to the plate 106. The armatures of these solenoids have bifurcated ends which are pin-coupled to ends of the respective operating levers 111'—122'. These levers are pivotally supported by individual posts secured to the plate 106, only the one post associated with the lever 122' being identified by the numeral 123. Such post carries a pin extending through a clearance hole formed in the lever 122' intermediate of the lever ends. Normally, the operating levers are spring-biased to the position wherein the free ends of the levers abut against a hard rubber pad 124, (as will be described hereinbelow with reference to FIG. 12), said pad being cemented to a transverse bar 125, which bar is secured to the plate 106, by the screws 126 seen in FIG. 1. Referring specifically to the solenoid 122 (FIG. 6), such solenoid is secured to the plate 106 by means of two nuts 127 as seen in FIG. 1, and the solenoid armature 128 has a reduced-diameter end slidable in a clearance hole formed in this plate. It will be noted that the front surface of the plate 106 is marked with the numerals 0 through 12, each such numeral being associated with one of the solenoids.

Twelve punches are carried by a punch block 131 (FIG. 5), which punch block is secured to the main mounting block 12. The construction and arrangement of a single punch assembly is shown in FIG. 12 which is a fragmentary vertical sectional view taken along the line 12–12 of FIG. 1 and drawn to an enlarged scale. In FIG. 12, the passageway for the punch card is identified by the numeral 132, it being noted that this passageway comprises the facing channels formed in the plates 13 and 14, a vertical slot formed in the punch block 131, a space between the main mounting block 12 and a lamp-receiving block 133, and the channel formed in the guide plate 19. The rectangular punch 134 is slidable within a rectangular slot formed in the punch block 131 and is biased into engagement with the arcuate end 135 of the associated lever 122' by a spring 136 compressed between the punch block and a pin 137 carried by the punch. The lever 122' is pivoted at its midpoint by a pin 138 carried by the slotted end of the square post 123, said post having an end disposed within a transverse channel formed in the inner surface of the plate 106 and being secured to such plate by the screw 141, see also FIG. 1. The

lower end of the lever 122' is pin-coupled to the slotted end of the armature 128 of the solenoid 122 secured to the plate 106 by the nuts 127. Normally, the upper end of the lever rests against the hard rubber pad 124 carried by the rectangular transverse bar 125 which extends completely across the plate 106 and is secured thereto by the screws 126, (see also FIG. 1). Upon energization of the solenoid, the lever 122' drives the punch through the data card, the chad falling into a tapered chute 140 secured to the mounting block 12 (see also FIG. 3). Although not shown in FIG. 3, a flexible tube is attached to the lower end of the chute for directing the chad into a suitable receptacle located at the bottom of the machine. All of the 12 punches, levers and solenoids are constructed and arranged as described with reference to FIG. 12. Thus, when the plate 106 is mounted on the machine, energization of a particular solenoid results in the punching of a rectangular hole in a specific line of the card. Such hole will be punched in a specific column of the card depending upon the position of the card at the moment, the precise positioning of the card with respect to current time being determined by the circuit controlling the position of the carriage 22 (FIG. 3) and the step-by-step rotation of the drive rollers 77 by the stepping ratchet solenoid 70 (see FIG. 5).

With continued reference to FIG. 12, the lamp receiving block 133 has formed therein a horizontal hole 142 terminating in an enlarged-diameter bore, said bore accommodating the envelope of the lamp 143. An insulator bar 144 is secured to the lamp-receiving block 133 and carries an elongated contact strip 145, made of a spring material, and a backing bar 155. The contact strip has a plurality of integral, upwardly extending terminals for contact with all of the lamps of the readout device, such as the terminal 145 engaging the shell of the lamp 143. The other contact for this lamp comprises the spring terminal 146 formed into a loop 147. The shank of a metal stud 148 is pressed through aligned holes formed in the insulator bars 144 and 155 and passes through a clearance hole formed in the contact strip having the integral terminal 145. A soldering terminal 157 is positioned on the stud shank after which the end of the shank is riveted over to secure the parts in place. The loop 147, of the terminal 146, is provided with clearance holes for the projecting shank of the stud, which holes are out of alignment when the loop is in its normal expanded position. These holes can be brought into alignment by compressing the loop with ones fingers, thereby to attach the terminal to the stud. Upon releasing the loop, it tends to expand, thereby securing the terminal to the stud. The hole 142 in the lamp-receiving block 133, is aligned with a similar hole 150 formed in the main mounting block 12, said hole 150 terminating in an enlarged-diameter bore within which a photocell 151 is disposed. Leads from the photocell pass through a hole 152 and are soldered to pin terminals 153 carried by an insulator block 154 which is secured to the main mounting block 12. As is apparent in FIG. 12, the lamp and photocell are vertically aligned with the punch 134. The lamp receiving block 133 and the terminal block 144 are secured to the main mounting block 12 by the three screws 156 seen in FIG. 5. Also seen in FIG. 5 is the lamp terminal 146 and the punch block 131 carrying a series of 12 punches. It is here pointed out that a set of two lamps and photocells are aligned with the left two punches, and a set of four lamps and photocells are aligned with the right four punches, for purposes which will be described hereinbelow.

The construction and operation of the carriage will now be described with reference to the rear elevational and top plan views of FIGS. 13 and 14 respectively. Added to these views is a portion of the rack 37 with the dog 36 shown resting on the tooth 162. The left end of the upper dog 36 is pin-connected to the end of the armature 166 of the solenoid 35 which is secured to the carriage base 170 by means of an L-shaped bracket 167. The dog 36 is slidable within guide slots formed in the arms of a U-shaped block 168 secured in fixed position to the carriage base 170. A vertical, rectangular bar 171 is secured to the right arm of the block 168, by the three screws 172, and the arm of a T-shaped bracket 173 is secured to the left arm of this block by the four screws 174. The leg of the T-shaped bracket is secured to the integral horizontal arm 169 by the screw 179, said arm spanning the arms of the U-shaped block 168. The lower dog 32 is pivotally connected to a slidebar 175 by a pin 176, said dog and slidebar each having integral, upstanding ears provided with holes for receiving the ends of a spring 177. The dog 32 passes through a clearance area provided between the right leg of the U-shaped block 168 and the overlying bar 171, while the slidebar 175 is slidable within aligned slots formed in the left leg of the U-shaped block and in an L-shaped block underlying the L-shaped bracket 178. Normally, the spring 177 biases the dog 32 in a counterclockwise direction about the pivot pin 176 with the upper side of the dog abutting the wall of the clearance area formed between the bar 171 and the underlying leg of the U-shaped block, whereby the dog normally is in axial alignment with the slidebar. The center of a crossbar 180 is pivotally coupled to the leg of the T-shaped bracket 173, the upper end of the crossbar being pivotally connected to the upper dog 36, and the lower end of the crossbar carrying a pin 181 extending through an elongated slot 182 formed in the slidebar. In the normal, at rest position of the carriage, the pin 181 is in engagement with the left wall of the slot, thereby limiting the outward excursion of the dog 32 to the position illustrated, that is, spaced somewhat from the edge of the tooth 164 of the rack 37. The crossbar is biased in a clockwise direction about its center pivot point by a spring 183 having one end hooked around a pin secured to the crossbar and the other end looped around a post 184 secured to the horizontal arm 169. Another spring 185 passes over the T-shaped bracket 173, the left end of the spring being secured to a forwardly extending post 186 secured to the slidebar 175 and the right end of this spring being secured to an extended portion of the pin 181 comprising the pivot connection between the slidebar and the crossbar 180. A pair of vertically spaced sleeve bushings are press-fitted into a vertical hole formed in the carriage base 170, the upper sleeve bushing 187 being visible in FIG. 14. A bearing block 188 is positioned within a vertical slot formed in the rear surface of the carriage base at the right end thereof, said bearing block being provided with four tapped holes for receiving fastening screws, such as the lower screws 189 visible in FIG. 13. The sleeve bushings and the bearing block are slidable along the guide rods 25 and 26 shown in FIG. 3, which guide rods are secured in fixed positions with a predetermined centerline spacing therebetween. The fastening screws for the bearing block 188 pass through slightly oversized holes formed in the carriage base, whereby the centerline spacing between the sleeve bushings and the bearing block can be adjusted precisely to the center spacing of the two guide bars.

A vertical plate 21 is secured to the rear surface of the carriage base, the central portion of this plate being relieved to provide the vertical guides 190 and 191, which guides are slidable within vertical channels 190' and 191', formed in the guide plate 19 as seen in FIG. 3. The pedal lever 20 is pivotally supported by the spaced arms of the bracket 38, secured to the vertical plate 21, and rests upon the actuating pin 193 of a normally open microswitch 194 secured to the bracket by the countersunk screws 195. Leads from the microswitch and the solenoid are soldered to pin terminals carried by an L-shaped bracket 196. The ends of a multiconductor, coiled, flexible cable 197 also are soldered to the pin terminals, said cable being anchored to the bracket 196 by a strain relief member 198. As has been described hereinabove, the pedal lever 20 lies in the path of travel of the data card and is depressed by the lower edge of the card as it is driven downwardly by the drive rollers 40 and 42 seen in FIG. 3. Upon depressing the pedal lever to effect a closure of the microswitch, the lower end of the punch card rests upon the upper surface of the plate 21. Cemented to the upper surface of the carriage base are two rubber pads 201. These pads are positioned to strike the main mounting block 12 when the carriage is driven upwardly by the motor 31 (see FIG. 3), thereby cushioning the shock

and preventing damage to the carriage and/or the mounting block.

Referring particularly to FIG. 13, it will be noted that when the upper dog 36 is fully extended and rests upon the horizontal wall of the tooth 162, the lower dog 32 extends below the horizontal wall of the tooth 164 and is spaced therefrom. The two dogs are spaced apart by a distance somewhat greater than the spacing between two teeth. In order to lower the carriage, the solenoid 35 is energized, thereby withdrawing the dog 36 to the left and out of engagement with the tooth 162. As the dog 36 moves to the left, a corresponding counterclockwise rotation is imparted to the crossbar 180, thus moving the pin 181 to the right in the slot 182 and permitting the spring 185 to move the slidebar and the dog 32 to the right. Consequently, the two dogs move simultaneously in opposite directions. At the moment when the dog 36 is free of the tooth 162 the dog 32 abuts against the edge of the tooth 164. Thus, as the carriage drops, the dog 32 will come to rest on the horizontal wall of the tooth 165, due to the spring 185 biasing the slidebar 175 which, in turn, biases the dog 32. When the lower dog is in this position, the upper dog 36 will be spaced from and be somewhat above the horizontal wall of the tooth 163. Upon deenergization of the solenoid the upper dog is moved to the right into engagement with the vertical, inclined wall of the tooth 162 by action of the spring 183. During such return movement of the dog 36, the pin 181 comes into engagement with the left wall of the slot 182 and withdraws the dog 32 from engagement with the tooth 165. The carriage now drops an additional small distance, that is, until the upper dog 36 comes to rest upon the horizontal wall of the tooth 163. It will be apparent, then, that upon each energization and deenergization of the solenoid 35 the carriage drops down to the next lower tooth, but the carriage is positively prevented from dropping more than one tooth per actuation of the solenoid.

The carriage is fastened to the timing belt 27 by a suitable clamp 200, said timing belt being driven by the carriage-drive motor 31 visible in FIG. 3. In order to effect an upward movement of the carriage, the carriage-drive motor and the solenoid 35 (FIG. 13) are energized simultaneously. Assuming the carriage to be in the position shown in FIG. 13, energization of the solenoid results in the movement of the dog 36 away from the rack at the moment the belt 27 starts the upward movement of the carriage. At the time when the dog 36 is clear of the tooth 161, the lower dog has been moved to the right and rests against the edge of the tooth 163. However, the dog 32 is rotatable in a clockwise direction about the pivot pin 176. Consequently, this dog is rotated to the extent necessary to slide past the edge of each tooth encountered upon continuous, upward movement of the carriage. Secured to the right side of the carriage base 170 is the fixed dog 39, (see also FIGS. 1 and 2). Referring to FIG. 1, the roller carried by the operating lever 33 of the microswitch 34 lies in the path of travel of the dog 39, the normally closed contacts of this microswitch being connected in series with a circuit controlling the simultaneous energization of the carriage-drive motor and the solenoid carried by the carriage. The microswitch is supported in such position that when its contacts are opened by the dog 39, (thereby deenergizing the carriage-drive motor and the carriage solenoid), the carriage will be stopped by the rubber pads 201 striking the main mounting block 12 (see FIG. 3). At the instant that the carriage is stopped, the upper dog 36 will be slightly above the uppermost tooth of the rack 37. Thereafter, the carriage drops, the dog 36 comes to rest upon the horizontal wall of the uppermost tooth of the rack, and the microswitch returns to its normal, closed contact position. This position of the carriage is denoted by the numeral 1 marked on the guide plate 19 (see FIG. 5) and corresponds to the time period Monday, a.m.

Reference now is made to FIG. 15 which is a diagrammatic representation showing the mechanisms and associated circuitry for moving the data card 10 downwardly and upwardly through the card passageway, said passageway being here identified by the numeral 132. It is here pointed out that in FIG. 15 power relays are shown for controlling the energization and deenergization of the various electrical components, whereas in the actual apparatus a combination of relays and solid state components are used for such purposes. Normally extending into the card passageway are the rollers carried by the free ends of the actuating levers 102, 103 and 104 of the respective microswitches 65, 66 and 67. Also extending into the card passageway are the peripheral surfaces of the vertically spaced drive rollers 40 and 42 and the drive roller 77 carrying the O-ring 68. The drive rollers 40 and 42 are rotated in one or the other direction by the reversible motor 44 through the timing belt 43, whereas the drive roller 77 is rotated in the indicated direction, in a step-by-step manner by the 36 tooth ratchet wheel 85 each time the solenoid 70 is energized and deenergized, as has been described hereinabove with reference to FIG. 10. The wheel 85 also is mechanically coupled to the rotatable arm 201 of the 36 position switch 75. Normally, the pinch rollers 48 and 60 are biases into engagement with the cooperating drive rollers 40 and 42 by the spring-biased armatures of the solenoids 54 and 63. On the other hand, the pinch roller 79 is free-floating and, at any given moment, such pinch roller may or may not be in engagement with the drive roller 77 when the solenoid 80 is deenergized. Although the pinch roller 79 may be in engagement with the drive roller, the card will pass between these rollers as it is driven downwardly by the drive rollers 40 and 42. In any event, the pinch roller 79 is pressed into engagement with the drive roller 77 by the armature of the solenoid 80, when such solenoid is energized, and the energization of this solenoid occurs only when the card actuates the pedal switch 20 on the carriage 22.

All of the power relays are shown in the normally deenergized positions. The terminals having associated therewith the legends +V and −V are connected to DC voltage sources of suitable magnitude. Upon the insertion of the card into the card passageway, it will first depress the actuating lever 102, thereby closing the contacts of the microswitch 65 and applying a + voltage on the leads 204 and 205. A + voltage on the lead 204 results in the energization of the operating coil of the relay 206 and the closure of its normally open contacts 207, whereby a − voltage now appears on the lead 208, which lead is connected to one end of the operating coil of the relay 209. This coil, however, remains deenergized since, at this point in the operating cycle, there is no connection between the other end of the coil and + voltage. Also, the appearance of + voltage on the lead 205 is of no effect at this point in the operating cycle as this lead is connected only to the normally open contacts 210 of the relay 209. Consequently, the first closure of the microswitch 65, as the card is inserted into the machine, does not initiate a control function. However, this microswitch serves to prevent a second operation of the machine until such time as the punched card is removed, as will be described below.

As the card is inserted further into the passageway, it will depress the actuating lever 103 resulting in the closure of the contacts of the microswitch 66. A + voltage now appears on the lead 202 which is connected to the lead 212, (said lead 212 also being connected to the lead 213), thereby resulting in the energization of the operating coil of the relay 214 and a closure of its normally open contacts 215. The closure of the contacts 215 applies a − voltage on the lead 216 which is connected to one end of the operating coil of the relay 217, but this coil remains deenergized since, at this point in the operating cycle, the other end of the coil is not connected to + voltage. The lead 212, of the microswitch 66, also is connected to the lead 218 and the + voltage on the lead 218 results in the energization of the motor-control relay 220, the circuit being traced as follows; closed contacts 219 of the microswitch 66, leads 212 and 218, the normally closed contacts 221 of a time-delay relay 222, lead 223, normally closed contacts 224 of the pedal relay 225, lead 226, operating coil of the motor-control relay 220, the normally closed contacts 227 of the relay 228,

and lead 229 which is connected to a − voltage. The energization of the coil of the motor-control relay 220 results in the closure of its normally open contacts 231, thereby connecting the 'down' winding 232 of the reversible motor 44 across 110 volts, which results in a counterclockwise rotation of the drive rollers 40 and 42. The end of the actuating lever 103, of the microswitch 66, is positioned close to the upper rollers 40 and 48 so that the microswitch is closed just prior to the engagement of the rollers by the lower edge of the card. The card now is driven downwardly, by the rotating rollers, toward the carriage 22.

The ends of the microswitch actuating levers 103 and 104 are spaced-apart a distance less than the length of the card. Consequently, the lower portion of the card depresses the actuating lever 104 before the upper edge of the card passes below the actuating lever 103. Since the contacts 233, of the lower microswitch 67, are connected in parallel with the contacts 219, of the upper microswitch 66, the drive rollers 40 and 42 continue to drive the card downwardly until its lower edge depresses the pedal lever 20 carried by the carriage 22, said carriage occupying a reference position corresponding to the current day and AM or PM time period. Depression of the pedal lever causes a closure of the normally open contacts of a microswitch 194 also carried by the carriage, thereby resulting in the energization of the operating coil 234 of the pedal relay 225, whereby the normally closed relay contacts 224 now are opened and the normally open sets of contacts 236—239 now are closed. The closure of the contacts 237 locks-in the pedal relay, electrically, the circuit being traced as follows; lead 241 connected to + voltage, closed contacts 237, lead 242, normally closed contacts 243 of the relay 217, lead 244, pedal relay coil 234, and the lead 245 connected to − voltage. The opening of the normally closed, pedal relay contacts 224 opens the circuit to the operating coil of the motor-control relay 220, whereby its contacts 231 return to the normally open position and the motor winding 232 is deenergized. As has been described hereinabove, when the lower edge of the card rests upon the pedal lever, the upper edge of the card extends above the microswitch actuating lever 104, so that the microswitch 67 remains closed irrespective of the particular reference position occupied by the carriage. However, since the pedal relay contacts 224 are connected in series with the operating coil of the motor-control relay 220, this relay cannot be actuated as long as the pedal relay remains in the locked-in condition.

With the pedal relay locked-in, the closed pedal relay contacts 236 result in the simultaneous energization of the three solenoids 54, 63 and 80 through the lead 235. The pinch rollers 48 and 60 now are withdrawn from the associated drive rollers 40 and 42, thereby to permit unobstructed upward displacement of the card relative to the carriage upon step-by-step rotation of the drive roller 77, while the pinch roller 79 now presses the card against the drive roller 77. The closed pedal relay contacts 238 result in the application of + voltage to the rotatable arm 201 of the 36 position switch 75, while the closure of the pedal relay contacts 239 results in the energization of control circuits identified by the block 247, which control circuits apply electrical pulses to the solenoid 70 for ratcheting the 36 tooth wheel 85. Operation of the control circuits 247 is controlled by logic circuits 248 to effect an upward step-by-step movement of the card relative to the carriage in accordance with current time, the time schedule preprogrammed into the logic circuits and information obtained from the previous punches made in the card by the machine. The solenoid 70 is actuated either 6 or 12 times, depending upon the current time and preprogrammed information, and the card-punching operation can occur at any of the 6 or 12 positions of the card relative to the carriage, as will be described hereinbelow. After the 6 or 12 actuations of the solenoid have been completed, the logic circuits effect a momentary closure of a switch 250, whereby the + voltage on the rotatable arm 201, of the 36 position switch 75, momentarily appears on the leads 251 and 252. The momentary + voltage on the lead 251 results in the energization of the operating coil 253 of the relay 209, the other end of this coil being connected to − voltage by the lead 254, lead 255, and the closed contacts 256 of the relay 214, it here being pointed out that the relay 214 remains energized as long as the microswitch 67 remains in the closed position. Therefore, upon momentary energization of the operating coil 253, the relay 209 locks-in electrically through its contacts 260. The momentary + voltage appearing on the lead 252 results in a momentary energization of the operating coil of the relay 217, the other end of this coil being connected to − voltage by the lead 216 and the still-closed contacts 215 of the relay 214. Such momentary energization of the operating coil of the relay 217 results in the opening of its contacts 243 and a closing of its contacts 257, the closure of the contacts 257 connecting the 'up' winding 258 of the motor 44 across 110 volts and resulting in a clockwise rotation of the drive rollers 40 and 42. At the same time, the opening of the contacts 243 opens the locking circuit of the pedal relay 225 and such relay drops out, whereby the contacts of this relay return to the illustrated positions. Although the pedal relay now is in the deenergized state, the motor 44 continues to run as the lower end of the operating coil of the relay 217 is connected to +the voltage through the leads 252 and 251 and the now-closed contacts 260 of the locked-in relay 209. The now-open pedal relay contacts 236 result in deenergization of the solenoids 54, 63 and 80, permitting the spring-biased armatures of the solenoids 54 and 63 to press the pinch rollers 48 and 60 toward the drive rollers 40 and 42, whereby the card is driven upwardly by the rotating drive roller 42. Deenergization of the solenoid 80 releases the pressure applied to the card by the pinch roller 79.

As the card is driven upwardly, it will depress the upper actuating lever 103 before it releases the lower actuating lever 104 and, since the contacts 233 and 219, of the respective microswitches 67 and 66, are connected in parallel, the card continues to be driven upwardly until its lower end passes above the actuating lever 103, at which point the microswitch contacts 233 and 219 are open and the operating coil of the relay 214 is deenergized. The opening of the contacts 215, of the relay 214, opens the circuit to the operating coil of the relay 217 and deenergization of the 'up' motor winding 258, while the opening of the contacts 256, of the relay 214, breaks the connection between the lead 255 and the − voltage terminal connected to these contacts. At this point, however, the card retains the actuating lever 102 in the depressed position, whereby the operating coil of the relay 206 is energized through the closed contacts of the microswitch 65, and the closed contacts 207, of this relay, provide the connection to − voltage for the coil 253 of the relay 209. Hence, the relay 209 remains locked-in. At the same time, the closed contacts of the microswitch 65 result in the energization of the operating coil of the relay 228, the circuit being traced as follows; microswitch lead 205 (connected to + voltage), closed contacts 210 of relay 209, lead 261, operating coil of relay 228 and lead 229 (connected to − voltage). Since the now-open contacts 227, of relay 228, are connected in the circuit of the operating coil of the motor-control relay 220, the 'down' winding 232 of the motor 44, cannot be energized as long as the microswitch 65 is closed and the relay 209 is in the locked-in position. Once the card is removed from the machine, the contacts of the microswitch 65 open and the relays 206, 228 and 209 are deenergized, thereby conditioning the circuit for a repeat operation. It, therefore, is apparent that the microswitch 65, having the end of its actuating lever positioned as close as possible to the entrance to the machine throat, prevents a deliberate or accidental second operation of the machine unless and until the punched card is removed from the machine.

The described machine operating cycle normally is completed within a maximum time of 2 seconds. A first time-delay relay 222 has a time constant of approximately 5 seconds, that is, the relay is actuated approximately 5 seconds after a voltage is applied across its series connected resistor

262 and capacitor 263. Such voltage is applied to the relay through the lead 264 when the contacts 265 of the microswitch 66 are closed upon insertion of the card into the passageway. Assume a card has been inserted into the machine to the point where it depresses the actuating lever 103, or to the point where its' lower portion lies between the upper drive roller 40 and pinch roller 48, and the employee purposely holds on to the card to prevent its complete entry into the machine by the now rotating drive roller 40. In approximately 5 seconds, the time delay relay 222 is actuated, thereby opening its contacts 221 and closing its contacts 268. The opening of the contacts 221 opens the circuit to the operating coil of the motor-control relay 220 and the opening of the contacts 231, of the relay 220, deenergizes the 'down' winding 232 of the motor 44. At the same time, the closure of the time delay relay contacts 268 results in the actuation of a suitable alarm 269. Under normal conditions, the card is driven downwardly by the drive roller 40 and depresses the actuating lever 104 of the microswitch 67. The distance between the actuating lever 104 and the entrance of the machine throat exceeds the length of the card so that at this point the card is no longer accessible to the employee. Closure of the contacts 266, of the microswitch 67, results in the energization of a second time-delay relay 203 through the lead 267, said relay also having a time constant of approximately 5 seconds. As has been described hereinabove, when the lower edge of the card rests upon the pedal lever 20, its upper portion extends above the actuating lever 104. Consequently, an energizing voltage is applied to the time-delay relay 203 from the time the microswitch 66 is closed, (during downward movement of the card), until the microswitch returns to its normally open position after the ejection of the card. If, for any reason, the card remains in the machine for more than 5 seconds, this time-delay relay is actuated, thereby closing its contacts 211 and opening its contacts 240. Closure of the contacts 211 applies a voltage from the battery 246 across the relay operating coil through a normally closed pushbutton switch 249, whereby the relay locks-in electrically, and an alarm 259 is actuated, thereby indicating a card is hung-up in the machine. The time-delay relay contacts 240 are connected in the circuit of the power supply (not shown) in such manner that upon opening of these contacts 240, the DC voltages are removed from all of the terminals marked +V, together with the voltages for operation of the punches of the machine. Under this condition, the solenoid 80 is deenergized to release the pressure of the pinch roller 79 from the card and the solenoids 54 and 63 also are deenergized, whereby the pinch roller 60 applies pressure to the card and the pinch roller 48 is pressed against its' associated drive roller 40. The actuation of the time-delay relay 203 does not affect the power supply furnishing the 110 volt energizing voltage for the motor 44. Thus, a normally open switch 261, connected across the contacts 257, of the relay 217, can now be closed to energize the motor winding 258, thereby to eject the card from the machine. After the card has been ejected, the pushbutton switch 249 is opened, momentarily, thereby resetting the time-delay relay 203 and restoring the voltages for normal operation of the machine.

Reference now is made to FIG. 16 which is a diagrammatic representation showing the components and circuitry for setting the machine in synchronism with current time. All of the components are enclosed within a suitable housing having an opening providing access to the machine throat. Two synchronous motors 270 and 271 have their drive shafts coupled to a differential gear system 272 having an output shaft to which the cams 273 and 274 are secured, the cam 273 being provided with six lobes whereas the cam 274 is provided with a single lobe. When the motor 270, which is the motor used for normal operation of the apparatus, is energized, the two cams rotate at a precise speed of one-sixth r.p.m. On the other hand, when the motor 271 is energized the cams rotate at some higher speed as, for example 30 r.p.m., thereby to rapidly set the time-synchronized components to predetermined starting positions prior to placing the machine into operation, as will be described hereinbelow. Assuming the normal motor 270 is energized, each rotation of the cam 273 results in six momentary closures of the normally open switch 275 connected between the +48v. output terminal of the voltage regulator 276 and the actuating solenoid of a decade counter 277 providing a visual indication of civilian time. This decade counter is of convention construction and includes three rotary switches, here identified by the numeral 278, which control the energization of appropriate lamps of a conventional one-plane readout 281. Also, the decade counter is provided with manually operable pushbuttons for presetting the counter to a desired time indication. The cam 273 and the associated switch 275 function to advance the decade counter once each minute. The dials of the readout device are visible through an appropriate opening formed in the housing of the machine and, therefore, preferably this readout is of the 4-dial type to facilitate a reading thereof by the user of the apparatus.

The single lobe cam 274 and the associated switch 282 function to energize the actuating solenoid of a second decade counter 283 once every 6 minutes, said counter providing an indication of military time. This counter also is of conventional construction provided with manual reset buttons, and the rotary switches 284, of this counter, control the operation of the logic circuits 286, 287 and 288, as well as the operation of an electronic counter 289. A voltage output from the logic circuit 286 energizes one of two lamps of the readout 281, thereby presenting a visual indication of the current AM or PM period of each day. The 3-stage electronic counter 289 controls the operation of the day of week logic circuits 290 so that these logic circuits provide a voltage output for energizing appropriate lamps of the readout 281 to thereby present a visual indication of the current day of the week. The programmed logic circuits 287 control the correct punching of the card, as will be described hereinbelow.

Shown in FIG. 16 is the carriage 22 carrying the solenoid 35 and secured to the timing belt 27 driven by the motor 31 through the electromagnetic clutch 24, (see also FIGS. 3 and 4). The carriage dog 36 may rest upon any one of the upper 10 teeth of the rack 37, thereby to position the carriage in any one of 10 reference positions, each reference position corresponding to a particular day of the week and an AM or PM time period. If IN and OUT punching for lunch periods is not required, when the dog 36 rests upon tooth No. 1, the carriage is in the Monday position; when the dog rests upon tooth No. 2, the carriage is in the Tuesday position; when the dog rests upon tooth No. 3, the carriage is in the Wednesday position; and so forth. As has been described hereinabove, the carriage is lowered one tooth each time the carriage solenoid 35 is energized and deenergized. After the carriage has been lowered to tooth No. 7, corresponding to Sunday, it will thereafter be driven upwardly to the original starting position by the motor 31, which position corresponds to Monday. On the other hand, if IN and OUT punching for lunch is required, the uppermost position of the carriage corresponds to Monday, a.m.; when the dog 36 rests upon tooth No. 2, the carriage is in the Monday, p.m. position; when the dog rests upon tooth No. 3, the carriage is in the Tuesday, a.m. position; and so forth. After the carriage has been lowered to its lowermost position the dog 36 will rest on tooth No. 10, (corresponding to Friday, p.m.), and thereafter the carriage is raised to its uppermost position now corresponding to the Saturday, a.m. position. Over the weekend, the carriage will be lowered four positions and thereafter will again be returned to the Monday, a.m. starting position by the motor 31. The electromagnetic clutch 24 is energized simultaneously with the motor 31 so that the timing belt 27 is free to rotate about its supporting pulleys when the carriage is dropped. Disposed within the machine housing is a subpanel 292 carrying the decade counter 277 and the switches S1—S7.

The step-by-step procedure for setting the machine in synchronism with current time will now be described, it being

assumed, by way of example, that current time is Thursday 12:01

Step 1

Close the on-off line switch S1, thereby energizing the power supply 293 and the pilot light 295. At the same time, a flashing lamp 285 is energized by the 12 volt output of the voltage regulator 276, through the normally closed contacts 291 of the relay 294.

Step 2

Close pushbutton switch S2 momentarily, thereby energizing the operating coil of the relay 294 having a set of normally open and a set of normally closed contacts. Closure of the upper set of relay contacts locks-in the relay electrically and the opening of the contacts 291 deenergizes the flashing lamp 285. This relay has a capacitor connected across the operating coil and is arranged to dropout in approximately 5 seconds after the coil is deenergized for purposes described hereinbelow.

Step 3

Close the 3-position switch S3 to the H position, thereby energizing the synchronous motor 271 causing the cams 273 and 274 to rotate at 30 r.p.m. When the decade counter 283 just changes to the next indication, return switch S3 to the illustrated off position.

Step 4

Manually adjust the decade counter 277 to indicate the same time as that now indicated by the counter 283.

Step 5

Close switch S3 again to the H position, thereby again rotating the cams 273 and 274 at the higher speed. Now, when the decade counter 277 indicates approximately 4 minutes before current time, return switch S3 to the illustrated off position.

Step 6

Close the pushbutton switch S4 momentarily, thereby applying a +12 volt pulse to the firing circuit of a particular one of the silicon rectifier circuits identified by the block 296, the circuit being traced as follows; lead 297 (connected to the +12 volt output terminal of the voltage regulator 276), switch S4, lead 298, closed contacts of the microswitch 34 (secured to the carriage and having the end of its actuating lever 33 positioned in the path of travel of the fixed dog 39 secured to the side of the carriage), and the lead 299. This particular silicon controlled rectifier circuit includes a conventional holding circuit, whereby a continuous output voltage now is applied to leads 279 and 280 resulting in the energization of the carriage solenoid 35 and the operating coil of a power relay 300. The now-closed contacts of the relay 300 completes the 110 volt circuit to the carriage-drive motor 31 and the electromagnetic clutch 24, whereby the carriage is moved upwardly by the timing belt 27. When the dog 39 opens the microswitch 34, the silicon controlled rectifier circuit is reset, the solenoid 35, motor 31 and clutch 24 are deenergized. As has been described hereinabove, upon opening of the microswitch 34, the carriage drops down slightly, whereby the carriage dog 36 rests on tooth No. 1, of the rack 37, and the microswitch returns to the normally closed position. At this time, the pushbutton switch S4 is released. The initial momentary closure of the pushbutton switch S4 also applies a +12 volt pulse on the lead 301, connected to the lead 298, thereby actuating a counter reset 302 which resets the electronic counter 303 for purposes which will be described hereinbelow. The carriage now occupies a position corresponding to Monday, A.M.

Step 7

Close the pushbutton switch S5 momentarily, thereby applying a +12 volt pulse to another one of the silicon controlled rectifier circuits 296 through the lead 304, which rectifier circuit does not include a holding circuit. An output voltage pulse now appearing on the lead 305 energizes the carriage solenoid 35, thereby permitting the carriage to drop to the next lower tooth of the rack 37. The +12 volt pulse also is applied to the 4-stage electronic counter 303, through the lead 306, to keep the counter and the logic circuits 309 in step with the carriage position. The switch S5 is pulsed, manually, until the carriage occupies a position corresponding to the current day and time period. Specifically, the illustrated reference position No. 8 corresponding to Thursday, P.M.

Step 8

Close pushbutton switch S6 momentarily, thereby applying a +12 volt pulse to the day of week logic circuits 290 through the lead 307. Pulse operate this switch until the logic circuits effect energization of the THU (Thursday) lamp in the one-plane readout 281.

Step 9

Close the three position switch S3 to the H position to again rotate the cams 273 and 274 at the relatively high speed until the decade counter 277 indicates 1 minute beyond current time. Then return this switch to the off position.

Step 10

Close the pushbutton switch S7, thereby energizing the synchronous motor 270 and rotating the two cams 273 and 274 at normal speed. Hold this switch closed until civilian time, indicated on the decade counter 277, just changes to the next one minute indication as, for example, to the illustrated time 12:06, and then release the switch. At this point the indication of the decade counter will be less than 2 minutes beyond current time.

Step 11

When the current time reaches 12:06, as now indicated by the decade counter 277, close the 3-position switch S3 to the N position. This energizes the synchronous motor 270 and places the machine in operation with all components now synchronized with current time.

The machine now being in operation, the decade counter 283 feeds current military time information into the a.m.-p.m. logic circuit 286, thereby automatically changing the visual display of the readout 281 in correspondence with current morning or afternoon time periods. Simultaneously, this time information is fed to the carriage position logic circuits 288, which circuits are preprogrammed to control the lowering of the carriage at predetermined time periods. When current time corresponds to a preprogrammed time an output voltage pulse from these logic circuits is applied to the nonholding silicon controlled rectifier circuit (block 296), thereby resulting in the energization of the carriage solenoid 35 to drop the carriage one position. The output voltage pulse from the said logic circuits 288 also is applied to the carriage position logic circuits 309 through the electronic counter 303, said logic circuits 309 being preprogrammed to control the elevation of the carriage at predetermined time periods. When the number of voltage pulses applied to the logic circuits 309 corresponds to the preprogrammed time period, an output voltage pulse from these logic circuits is applied to the holding silicon controlled rectifier circuit, thereby effecting energization of the carriage solenoid, the carriage-drive motor 31 and the electromagnetic clutch 24 in the same manner as has been described hereinabove under Step No. 6 of the procedure for synchronizing the machine with current time.

As stated hereinabove, the relay 294 is arranged to drop out approximately 5 seconds after its operating coil is deenergized. An interruption and restoration of power within five seconds has no effect upon the operation of the machine. However, when the power is interrupted for more than 5 seconds, this relay drops out and the flashing lamp 285 is energized. Upon restoration of power, the machine continues in operation, but the flashing lamp now indicates the machine may no longer be in synchronism with current time. The steps for again synchronizing the machine with current time have been already described.

A representative time card for use with the machine is shown in FIG. 17, such card being a standard data processing card having 80 columns, each column consisting of 10 lines of the printed numerals 0, 1, 2—9. The upper left corner of the card is cut at an angle so that the card must be properly oriented before it can be inserted into the machine. The machine will punch current time in the card in hours and

tenths of hours, military time, each time punching being a three digit entry in adjacent columns. If IN and OUT punchings are not required for a lunch period, the machine will punch two time entries per day, whereas there will be four time entries punched per day if lunch period punching is required. A particular employees time card is prepunched in accordance with his assigned work shift and also, when desired, in accordance with his assigned lunch period. All such prepunchings of the card are made in columns **7, 19, 31, 43** and **55** of predetermined lines, as shown in the following tabulation;

	Lines prepunched		
	Shift 1	Shift 2	Shift 3
No lunch operation	None	9	8.
Lunch operation:			
Lunch A	do	9	8.
Lunch B	7	7 and 9	None.
Lunch C	6	6 and 9	Do.

Specifically, for No Lunch Operation, that is, when the machine is to punch only IN and OUT time at the beginning and end of a work shift, the Shift **1** card is not prepunched, the Shift **2** card is prepunched only in line **9**, and the Shift **3** card is prepunched only in line **8**. For Lunch Operation, that is, when the machine also is to punch IN and OUT for lunch periods, the Shift 1 card is not prepunched for Lunch A period, is prepunched in line **7** for Lunch B period, (as shown in FIG. **17**) and in line **6** for Lunch C period. The shift 2 cards are prepunched only in line **9** for lunch period A, in lines **7** and **9** for lunch period B, and lines **6** and **9** for lunch period C. The third work shift has a single, assigned lunch period. In the case of a Shift **3** card which is to be punched IN and OUT for lunch, such card is also prepunched in line **12**, column **4**, for purposes to be described hereinbelow.

For purposes of further discussion, it will be assumed the logic circuits are preprogrammed for specific work schedules as follows:

Shift 1 starts at 8:00 a.m. and ends at 4:00 p.m.,
Shift 2 starts at 4:00 p.m. and ends at 12:00 midnight,
Shift 3 starts at 12:00 midnight and ends at 8:00 a.m.,
Shift 1
Lunch Period A starts at 11:30 a.m. and ends at 12:00 noon,
Lunch Period B starts at 12:00 noon and ends at 12:30 p.m.,
Lunch Period C starts at 12:30 p.m. and ends at 1:00 p.m.,
Shift 2
Lunch Period A starts at 7:30 p.m. and ends at 8:00 p.m.
Lunch Period B starts at 8:00 p.m. and ends at 8:30 p.m.,
Lunch Period C starts at 8:30 p.m. and ends at 9.00 p.m.,
Shift 3
Single Lunch Period starts at 3:30 a.m. and ends at 4:00 a.m.

It is here pointed out that the spacing between adjacent teeth of the rack **37** (see FIG. **16**), is equal to six columns of the card and the carriage is moved automatically as determined by the time schedule preprogrammed into the logic circuits. For no lunch operation that is, IN and OUT lunch punchings are not to be made in the card, the carriage will be lowered one position in the middle of the Shift **3** time period. As has been described hereinabove with reference to FIG. **15**, the **36** tooth wheel **85** is ratcheted either **6** or **12** positions each time a time entry is to be punched in the card, such ratcheting of the wheel resulting in the displacement of the card **6** or **12** columns relative to the punching mechanism. For punching IN time in any cards which are not to be punched for lunch periods, the machine will operate in such manner that the card is ratcheted, that is, back spaced **6** positions and the time entry will be punched in the last **3** of such **6** positions. For punching OUT time in Shift 1 and Shift 2 cards, the card again, is ratcheted **6** positions, but the time entry now will be punched in the first **3** of such positions. Since the carriage has been lowered one position sometime during the Shift 3 period (in order to provide for proper IN punching for Shifts 1 and 2), the Shift **3** card must be ratcheted an additional **6** columns prior to the punching of an OUT time entry therein. From this point on, the term 'back space' or 'back spacing' will mean the displacement of the card for the above-stated **6** additional positions (columns), thereby to position the card where it otherwise would have been had the carriage not been lowered.

For lunch punching operation, that is, four time entries per day are to be made in the card, the carriage is lowered in the middle of Shift **1**, lunch A period and, also, in the middle of the Shift **3** lunch period. This automatically positions the carriage for proper punching of a Shift 1, Lunch Period A card. For punching all other cards, the carriage may or may not be in the proper position and, in the latter case, back spacing of the card is necessary and is controlled by the logic circuits **248** of FIG. **16**. In the case of a Shift 3 card to be punched for the lunch period, since the carriage has been lowered before the first time entry is to be punched on such card, it is necessary to prepunch line **12**, column **4**. This prepunch in the card is sensed by the card reader so that line **12** will be punched simultaneously with current time, provided current time corresponds to that preprogrammed into the logic circuits.

In addition to the ten lines printed on the standard card, the machine is arranged to punch two additional lines aligned with the arrows **11L** and **12L** shown on FIG. **17**. These additional lines, which are not printed on the card, will hereinafter be referred to as the **11** and **12** lines. The time punched in the card is identified as either an IN or an OUT time by punchings made by the machine in line **11**. Also, the machine will punch line **12** every time period when the employee punches IN AND OUT on time in accordance with the time schedule preprogrammed into the logic circuits.

Assuming the card shown in FIG. **17**, prepunched for Shift 1, Lunch Period B, is inserted into the machine at the beginning of the work week, the machine will punch current time in appropriate lines of adjacent columns **1, 2** and **3** as for example, the lines **0, 7** and **6** enclosed by dotted line rectangles **315**, indicating the employee arrived to work at 7:36 a.m. (7.6 military time). At the same time, the machine will punch Column **1**, line **11**, as shown by the dotted line rectangle **316**, thereby identifying the time entry as the time when the employee punched IN. If such time entry corresponds to the Shift **1** time preprogrammed into the logic circuits, the machine will also punch line **12**, as indicated by the dotted line rectangle **317**. When the card is inserted into the machine a second time, as when the employee departs for lunch, the machine will punch current time in columns **4, 5** and **6**, but the existence of the punch in Column **1**, line **11** is sensed by the photoelectric card reader which, through appropriate circuitry, prevents the machine from now punching line **11**. However, if the punched time entry corresponds to the preprogrammed Lunch B time schedule, a second punch **318** is made in column **4**, line **12**. Upon the employees return from lunch the machine punches current time, and, if such time corresponds to the preprogrammed time schedule, the machine will also punch column **7**, line **12**, as indicated by the dotted line rectangle **319**. However, since there is no punch in column **4**, line **11**, the machine now also punches column **7**, line **11**, as indicated by the dotted rectangle **320**. A final time entry for the day is made when the employee departs at the end of the work shift. The machine will now punch current time and column **10**, line **12**, (as indicated by the dotted line rectangle **321**), but will not punch line **11**. In summary, the punched time is identified as either an IN (arrival) time or an OUT (departure) time by punchings made by the machine in line **11**. The **12** line is punched each and every time period when the employee punches IN or OUT on time in accordance with the time schedule preprogrammed into the logic circuits. Thus, if the employee punches IN and OUT on time for the entire five-day work week, a final punch **322** will be made in column **58**, line **12**. On the other hand, if the employee is irregular, that is, he does not punch on time, or does not punch at all during the preprogrammed period, the machine will not punch column **12** for that time period, nor any other time period for the balance of the week. The existence or absence

of punches in line 12, columns 1 and 58, makes it possible to identify, or sort automatically, the regular and irregular time cards, thereby reducing to a minimum the burden of calculation of data processing equipment, it being known from experience that in a given work force only about 15 percent of the cards will be irregular.

The operation of the apparatus in terms of functions will now be described with reference to the flow charts of FIGS. 18—21. Referring first to FIG. 18, the block 325 identifies the mechanisms for synchronizing the machine with current time, as has been described hereinabove with reference to FIG. 16. If the time card is inserted into the throat of the machine at the moment when the carriage is to be lowered to the next reference position, circuitry included within the block identified by the numeral 326 will prevent energization of the motor 44 (see FIG. 15) until after the carriage has been lowered. So too, if the military clock is about to advance at the moment the card is inserted into the machine throat, circuitry included within the block 327 will prevent energization of the motor 44 for approximately 3 seconds. Under the latter condition the total time for a machine operating cycle is increased correspondingly. Under any other conditions, this motor is energized and the card is driven downwardly into the machine until it depresses the pedal lever causing a closure of the microswitch 194 shown in FIG. 15. Upon energization of the motor 44, circuitry included within the block 328 is actuated to prevent a change in the carriage position or the military clock until the card is ejected from the machine. The circuits for preventing entry of the card into the machine and for preventing a change in the position of the carriage and the military clock, under the above-stated conditions, will be described hereinbelow with reference to FIG. 22. Information preprogrammed in the logic circuits determines whether lunch punchings are or are not to be made in the card, as denoted by the block 329.

The logic circuits are preprogrammed in accordance with a predetermined time schedule identifying the IN (arrival) and OUT (departure) times assigned to each specific work shift and each assigned lunch period. For no lunch operation, that is, IN and OUT time entries are not to be made for a specific, assigned lunch period, the apparatus functions as shown in the flow chart of FIG. 19. The card reader reads the prepunched holes to identify the assigned work shift, as denoted by the block 331, and senses the existence or absence of a punch in line 11, thereby to determined whether current time to be punched in the card is an IN time or an OUT time as denoted by the blocks 332 and 334. Assuming the card is a Shift 1 or Shift 2 card and the time entry to be made is an OUT time, the logic circuits determine whether current time is or is not a Good Time OUT, as denoted by the block 335, a Good Time Out corresponding to the time preprogrammed into the logic circuits for these particular work shifts. If current time is not a Good Time OUT (does not correspond to the preprogrammed time) the machine will punch only current time into the card, as denoted by the block 336, after which the card is ejected from the machine. Also, if current time is a Good Time OUT but the preceding time entry did not include a punch in line 12, as denoted by the block 337, the machine will only punch current time and eject the card. Under these conditions, the absence of a punch in line 11 will result in the machine punching an IN time upon the next insertion of the card into the machine, whereas the absence of a punch in line 12 will prevent the machine from punching line 12 for the balance of the week, thereby identifying the card as an irregular card. If, on the other hand, current time is a Good Time OUT, and a previous time entry included a punch in line 12, the machine will punch current time and line 12, as denoted by the block 338, and eject the card.

Assume now that an IN time is to be punched in the card. The absence of a punch in line 11, made simultaneously with the preceding time entry, identifies the time entry now to be made as an IN time. If current time is a Good Time IN, as denoted by the block 339 (that is, current time coincides with the preprogrammed time for the beginning of these work shifts), and the machine previously punched line 12, as denoted by the block 340, the machine will not punch current time, line 11 and line 12, as denoted by the block 341. The punch in line 11 identifies the time entry as an IN time and the punch in line 12 indicates the employee has punched IN and OUT on time to and including this time period. On the other hand, if current time is not a Good Time IN or if line 12 has not been punched along with the preceding time entry, the machine will punch current time and line 11, as denoted by the block 342. Under either condition, the punch in line 11 will result in the machine punching an OUT time upon the next insertion of the card into the machine. The absence of a punch in line 12 (see block 342) will prevent the machine from punching line 12 for the balance of the week, thereby identifying such card as an irregular card.

With continued reference to FIG. 19, assuming the card is a Shift 3 card, the card reader senses the presence or absence of a punch made in line 11 with the immediately preceding time entry, thereby to determine if the current time entry is to be an IN or an OUT time, block 334. If the time entry is to be an IN time, and current time is a Good Time IN, block 339, and line 12 has been punched with the preceding time entry, block 340, the machine will punch current time, line 11 and line 12, block 341. However, if current time is not a Good Time IN, or line 12 has not been punched with the preceding time entry, the machine will punch current time and line 11, block 342. On the other hand, if the time entry is to be an OUT time, and current time is a Good Time OUT, block 343 and line 12 has been punched with the preceding time entry, block 344, the machine will first back space the card and then punch current time and line 12, block 345. The back spacing of the card is to align the Shift 3 card with respect to the machine punching mechanism so that a proper OUT time entry will be made in the Shift 3 card in spite of the fact that the carriage has been dropped to the next lower reference position, by preprogramming, to prepare for the proper IN punching of the next shift (Shift 1). If, however, current time is not a Good Time OUT, or line 12 has not previously been punched, the card is back spaced and the machine will punch current time only, block 346.

If Lunch Operation is required, that is, IN and OUT time entries are to be made for a specific, assigned lunch period, the machine functions as shown in FIG. 20. The card reader senses the prepunched columns to identify the particular work shift, block 350. Assuming the card is a Shift 2 card, the card reader identifies the assigned lunch period, block 351, and, at the same time, the card reader senses the presence or absence of a punch in line 11 to determine whether the present time entry is to be an IN or an OUT time, as denoted by the circle 352. Assuming the employee is punching IN at the start of the work shift, the logic circuits determine whether current time is a Good Time IN, block 353, and the card reader determines if a punch was made in line 12 along with the immediately preceding time entry, block 354. If both conditions are affirmative, the machine will back space the card and then punch current time, line 11 and line 12, block 355. If, however, one or the other of these two conditions is negative, the machine will back space the card and then punch current time and line 11, block 356. Here again, the back spacing of the card is for the purpose of making the present entries in predetermined columns assigned to Shift 2. Upon the next insertion of the card into the machine, when the employee departs for lunch, the logic circuits determine whether current time is a Good Time OUT, block 357, and the card reader determines if a punch was made in line 12 along with the immediately preceding time entry, block 358. If both of these conditions are affirmative, the machine will back space the card and punch time and line 12, block 359. Otherwise, the machine will back space the card and punch time only, block 360. Upon the employees return from lunch, the machine will punch time and lines 11 and 12, block 361, if current time is a Good Time IN, block 362, and the immediately previous time entry includes a

punch in line 12, block 363. Otherwise, the machine will punch time and line 11, block 364. Similarly, at the end of the work shift, the machine will punch time only, block 365, or time and line 12, block 366, depending upon whether current time is a Good Time OUT, block 367, and the existence or absence of a previous punch in line 12, block 368.

With continued reference to FIG. 20, work shift 3 has a single, assigned lunch period, thereby eliminating the requirement for identifying a specific one of several assigned lunch periods. Thus, in the case of the Shift 3 card, the card reader senses the existence or absence of a punch in line 11 to determine whether the present time entry is to be an IN or an OUT time, block 370. If the time entry is to be an IN time, that is, the employee is punching IN at the start of Shift 3, or upon his return from lunch, the logic circuits determine whether current time is a Good Time IN, block 371, and the card reader determines if line 12 has been punched with the immediately preceding entry, block 372. Accordingly, the machine will either punch time and line 11, block 373, or time and lines 11 and 12, block 374. Similarly, if the entry to be made is an OUT time, the machine will punch either time only, block 375, or time and line 12, block 376.

In the case of a Shift 1 card, the machine functions as shown in FIG. 21. The card reader reads the prepunched columns to identify the particular lunch period, block 378. As has been described hereinabove, the card for Shift 1, lunch period A is not prepunched. Now, the card reader determines whether the time entry is to be an IN time or an OUT time, block 379, depending upon the existence or absence, respectively, of a punch in line 11 made along with the immediately preceding time entry. If the time entry is to be an IN time (arrival of the employee at the start of the work period or return of the employee from lunch) the machine will punch time and lines 11 and 12, block 380, if current time is a Good Time IN, and line 12 has been punched along with the immediately preceding time entry. Otherwise, the machine will punch time and line 11, block 381. Similarly, if the entry is to be an OUT time (departure of the employee for lunch or at the end of the work shift) the machine will punch either time only, block 382, or time and line 12, block 383. It will be noted that functioning of the machine with a Shift 1, lunch A card (FIG. 21) is the same as for a Shift 3 card, FIG. 20. Neither card is prepunched for a lunch period and the Shift 3 card is only prepunched in lines 8 and 12 thereby to code these cards for subsequent data processing.

With continued reference to FIG. 21, in the case of a Shift 1 card, prepunched for lunch periods B or C, the card reader determines whether the time entry to be made is an IN or an OUT time, block 385. For punching an IN time (arrival of the employee for Shift 1 or return of the employee from lunch), the machine will punch either time and line 11, block 386, or time and lines 11 and 12, block 387. For punching an OUT time at the end of the work shift, the machine will punch either time only, block 388, or time and line 12, block 389. However, for punching OUT time when the employee punches OUT for lunch, the machine will first back space the card and then either punch time only, block 390, or time and line 12, block 391. Here, again the card is back spaced with respect to the machine punching mechanism so that a proper OUT time entry will be entered for the lunch period C in spite of the fact that the carriage has been lowered to the next lower reference position before the end of the time for punching OUT on lunch period B.

As stated hereinabove, a maximum of 60 columns of the card are used for punching time entries irrespective of the three work shifts and three different lunch periods. The unused lines may be used for prepunching the cards with the particular employees identification. Consequently, complete information is encoded, in a single card, in data processing language, whereby the cards for the entire work force can be introduced directly into data processing equipment to fully automate the entire payroll procedure.

Reference now is made to FIG. 22 showing circuitry for preventing entry of the card into the machine at the time a change is about to be made in the military clock or the carriage position, and to prevent a change in the military clock and carriage position during the period when a card is in the machine. The pedal relay 225 (see also FIG. 15) has two additional sets of normally closed contacts 395 and 396, the contacts 395 being inserted in series between the actuating solenoid of the decade counter 283 (military clock) and the switch contacts 282 associated with the single lobe cam 274. The pedal relay contacts 396 are inserted in the output lead 305 of the silicon controlled rectifier circuits 296. As has been described hereinabove with reference to FIG. 16, a voltage pulse is applied to the carriage solenoid, through the lead 305, to lower the carriage to the next reference position, and, a continuous voltage appears on this lead when the carriage is driven upwardly to its initial reference position. The operating coil of a relay 397, having normally closed contacts 398, is connected in parallel with the carriage solenoid 35. These contacts and the normally closed contacts 399 of the relay 400 are connected between the normally open contacts 231, of the motor-control relay 220, and the 110 volt terminal supplying power for the motor 44. During the time period when the carriage solenoid 35 is energized to effect a change in the position of the carriage, the relay 397 is energized and its contacts 398 are open and, during the time period when the cam switch contacts are closed to effect an advance in the military clock, the relay 400 is energized and its contacts 399 are open. Under either of these conditions, the 110 volt line to the down winding 232, of the motor 44, is open, thereby preventing the entry of a card into the machine. Upon the opening of the cam switch contacts, or the deenergization of the carriage solenoid, the respective relays 400 and 397 are deenergized and the circuits are restored to normal operating condition. As has been described above with reference to FIG. 15, the pedal relay 225 is energized when the lower edge of the card depresses the pedal lever 20 causing closure of the microswitch contacts 194, said relay being locked-in electrically until the card is ejected from the machine after completion of the card punching operation. During the time periods when the pedal relay is deenergized, the military clock is advanced upon each revolution of the cam 274. However, during the time period when the pedal relay is energized, the pedal relay contacts 395 are open, thereby opening the circuit to the actuating solenoid of the decade counter 283 and preventing an advance in the military clock. Upon each revolution of the cam 274, the switch contacts 282 are closed for a time period corresponding to that of the machine operating cycle which, as stated above, is less than 2 seconds. Thus, if the pedal relay is energized immediately prior to closure of the cam switch contacts 282, the machine operating cycle will have been completed and the pedal relay contacts 395 will have returned to the normal, closed position before the cam switch contacts 282 are opened, thereby advancing the military clock to maintain synchronism with current time.

Reference now is made to FIG. 23 showing the components and circuitry involved for punching the card 10 which has been prepunched for work shift 1, lunch period B, said work shift starting at 8:00 a.m. and ending at 4:00 p.m. and said lunch shift extending from 12:00 noon to 12:30 p.m. All of the relays are here shown in the deenergized position. For purposes of reference, punching positions 11 and 12 on the card are here denoted by the respective numerals 11 and 12, although on the actual card these lines are blank. The twelve punches, positioned below the drive rollers 77, are here denoted by the reference characters P_0—P_9, P_{11} and P_{12}, each punch being aligned with a corresponding line of the card. Spaced below the punches is the row of six resistance type photocells C_{12}, C_{11} and C_6—C_9, the centerline spacing between the punches and the photocells being equal to five columns of the card. Although the photocells are shown laterally displaced relative to the punches, it will be understood that each photocell actually is aligned vertically with an associated punch. Specifically, the photocells C_{12} and C_{11}

are aligned with the punches P_{12} and P_{11}, respectively, and the series of four photocells C_6—C_9 are aligned respectively, with the punches P_6—P_9. One end of each photocell is connected to −V and the other ends are individually connected to 6 Bistable Multivibrators identified by the block **400**. Each of the lamps L_{12}, L_{11} and L_6—L_9 are aligned, horizontally, with corresponding photocells. As has been described hereinabove, the card is prepunched in one or more of the lines **6**—**9** in accordance with the employees assigned work shift and lunch period. Such prepunchings are sensed by the photocells C_6— C_9. On the other hand, machine-made punchings in lines **11** and **12** are sensed by the photocells C_{11} and C_{12}, respectively. The group of lamps L_6—L_9 are connected in parallel and energized by 12 volts through the series resistor **401**. The lamps L_{11} and L_{12} are individually energized through the series resistors **402** and **403**, respectively. Separate silicon controlled rectifiers are connected across these series resistors, which rectifiers, when fired, short out the associated resistor, thereby increasing the voltage across the lamps. Although not shown in FIG. **23**, each rectifier has associated therewith a conventional circuit which resets the rectifier at an appropriate time after it has been fired. It need only here be pointed out that the three rectifiers are fired simultaneously upon the application of + voltage on the lead **404**; the rectifier associated with the series resistor **401** is fired only momentarily; the rectifier associated with the series resistor **402** remains fired for a time period corresponding to the time required for the drive rollers **77** to displace the card upwardly relative to the carriage **22** a distance equal to one column of the card, and the rectifier associated with the series resistor **403** remains fired for a time period corresponding to the time required to so displace the card three columns, all for purposes to be described hereinbelow. Individual potentiometers are connected in the circuit of each lamp for adjusting the light beam intensity. Normally, the lamps are energized continuously at a lower than normal voltage, thereby to maintain the filaments in a preheated condition while at the same time, maintaining the intensities of the light beams at a relatively low level.

Referring back to FIG. **15**, the card is driven downwardly into the machine by the drive rollers **40** and **42** until the lower edge of the card depresses the pedal lever **20** and results in the energization of the pedal relay **225** through the microswitch contacts **194**. Irrespective of the reference position occupied by the carriage, the upper edge of the card lies above the actuating lever **104** of the microswitch **67**. The pedal relay remains locked-in electrically until the card is ejected from the machine after the completion of the card-punching operation. Thus, a + voltage appears on the lead **267** from the moment contacts **266**, of the microswitch **67**, are closed by the downwardly moving card, until these contacts are opened upon ejection of the card. For reference purposes, the microswitch **67**, lead **267** and the pedal relay **225** are shown in FIG. **23**. With continued reference to FIG. **23**, assuming the card **10** has been inserted into the machine, the card will first close the contacts **266** of the microswitch **67**, thereby applying energizing voltage to the multivibrators **400** through the lead **406**. Simultaneously, a resetting voltage is applied to the multivibrators through the normally closed contacts **408** of the still deenergized pedal relay **225**. When the lower edge of the card depresses the pedal lever **20**, the pedal relay becomes energized and the opening of the pedal relay contacts **408** removes the multivibrator resetting voltage. At the same time, closure of the pedal relay contacts **409** applies a firing voltage (through the lead **404**) to the silicon controlled rectifiers in the lamp circuits, thereby shorting out the series resistors **401**—**403** for the predetermined, individual time periods stated above. This results in the application of normal voltage to the lamps and the pre-heated lamp filaments now rapidly reach normal incondescense providing normal light beam intensities. At this moment, the card is supported by the carriage, the lamps are at normal brilliance, the multivibrators are energized and have been reset, the pedal relay is locked-in, and the machine now is in condition for performing the punching operations.

The carriage **22** is shown in reference position No. **1**, corresponding to the period Monday a.m., it here also being pointed out that the spacing between adjacent teeth on the rack **37** corresponds to the spacing of six columns on the card. With the card supported by the carriage, column **1** of the card is aligned with the photocells and column **6** is aligned with the punches. In this position, the card prevents any of the light beams from striking the associated photocells, it being noted that the only prepunch in a new card is in line **7** and that line **12**, column **1** lies above the cut corner of the card. As has been described hereinabove, a + voltage is applied to the rotatable contact arm **201** of the 36-position switch **75** when the pedal relay is energized (see FIG. **15**, pedal relay contacts **238**). In FIG. **23**, the contact arm **201** is shown in one of its starting, or home positions. Consequently, immediately upon actuation of the pedal relay, a + voltage, is applied to the control circuit **247**, (see also FIG. **15**), through a 6-diode OR gate **411**, the circuit being traced as follows; arm **201**, lead **412**, normally closed contacts **413** of relay **414**, lead **415**, diode **416** and lead **417**. The control circuit **247** is a time-delay silicon controlled rectifier circuit, which fires when a + voltage is applied to the lead **417** and which is then reset in a predetermined time. When fired, the silicon controlled rectifier circuit connects the lead **423** to ground, thereby resulting in the energization of the stepping ratchet solenoid **70** which causes the dog **84** to ratchet into engagement with the next tooth on the 36-tooth wheel **85**. Upon deenergization of the solenoid, the return spring **82** causes the dog to rotate the wheel one tooth in the clockwise direction as viewed in FIG. **23**, thereby rotating the contact arm **201** into engagement with the next stationary contact, and simultaneously, rotating the drive rollers **77** to elevate the card one column from the carriage, which actions have been described hereinabove with reference to FIG. **15**.

The silicon controlled rectifier circuit, identified by the numeral **247** in FIG. **23**, is shown in FIG. **24**, to which reference now is made. When a + voltage is applied to the lead **417**, the silicon controlled rectifier **419** is fired through the diode **420**, capacitor **421** and the resistor **422**, thereby connecting the lead **423** to ground. The + voltage also opens the transistor gate **424**, which gate is biased by a + voltage appearing on the lead **425** during the time the card is in the machine. Thus, the capacitor **426** starts to charge through the resistor **427** and when the voltage across this capacitor reaches the breakdown voltage of the zener diode **428**, the rectifier **429** is fired, thereby resetting the rectifier **419** through the capacitor **418**, whereby the ground connection to the lead **423** is opened. Upon removal of the voltage from the lead **417**, the capacitor **426** discharges through the now-closed transistor gate **424** and, also, the rectifier **429** is reset. This alternate firing and resetting of the rectifier **419** continues as the contact arm of the 36-position switch **75** (FIG. **23**) is ratcheted from one to the next contact thereof.

With continued reference to FIG. **23**, as soon as the contact arm **201** engages the next fixed contact, the control circuit **247** is again fired for the predetermined time period, but now the firing voltage is applied directly through the lead **417** instead of through the contacts **413** of the relay **414**. At the same time that the control circuit **247** is fired the second time, a + voltage appears on the lead connected to the normally closed contacts **432** of a relay **433**. Such + voltage is applied to the base of the input transistor of a transistor switch **434** through the lead **435**, thereby resulting in the energization of the operating coil of the relay **414**, it being noted that a biasing voltage is applied to collector of this input transistor by the lead **437** when the microswitch **67** is closed, that is, during the entire time that the card is in the machine. The closure of the contacts **438**, of the relay **414**, causes this relay to lock-in, electrically, through the now-closed contacts **439** of the relay **440**, the latter relay being energized when a + voltage appears on the lead **441**. This lead **441** is connected to the lead **212** of the circuit shown in FIG. **15**, and a + voltage appears on the

lead **212** whenever one of both of the microswitches **66** and **67** are closed, that is, during the time the card is in the machine. Consequently, relay **440**, (FIG. **23**), remains closed until the card is ejected from the machine. The alternate energization and deenergization of the stepping ratchet solenoid **70**, and the step-by-step advancement of the 36-position switch **75**, continues until the contact arm **201** is brought into engagement with the 7th fixed contact, counting the starting, or home contact as contact number **1**. The 7th fixed contact is connected electrically to the 1st fixed contact. Now, however, the silicon controlled rectifier of the control circuit **247** is not fired since the circuit to the diode **416**, of the OR gate **411**, is broken by the now-open contacts **413** of the still-energized relay **414**. The contact arm **201** now is again in a home position ready to actuate the control circuits **247** when the relay **414** is deenergized, which condition can only occur after the card has been ejected from the machine. As the contact arm **201** is advanced six positions, in the described step-by-step manner, the drive rollers **77** elevate the card six columns. In the case of a new Shift I, lunch period B card, here under discussion, the punching of the time entry into the card takes place as the card columns **3**, **2** and **1** are brought into alignment with the punches, as will be described hereinbelow.

Assuming current time is Monday 7:30 a.m., the carriage **22** is in the illustrated No. **1** reference position and the military clock **283** indicates 07.5. The three, 10-position rotary switches, individually rotatable with the associated dials of the clock, are here denoted by the Roman numerals I, II and III. Referring to the switch I, the rotatable contact arm **445** is connected to ground and shorts out nine of the fixed contacts. Each fixed contact is connected to the corresponding input gates of a silicon controlled rectifier Punch and Logic Circuit denoted by the block **446** and to corresponding output leads of Program Boards denoted by the block **447**. The rotary switches II and III are similarly constructed and connected. Specifically, the No. **0** fixed contacts of these rotary switches are connected to the Punch and Logic Circuits **446** by individual leads denoted by the related reference markings I_0, II_0 and III_0; the No. **5** fixed contacts of the switches are connected to the Punch and Logic Circuits **446** by individual leads denoted by the related reference markings I_5, II_5 and III_5; and the No. **7** fixed contacts of the switches are connected to the Punch and Logic Circuits by the individual leads denoted by the related reference markings I_7, II_7 and III_7. Actually, all of the thirty fixed contacts of the three switches are individually connected to the Punch and Logic Circuits, but only those necessary to an understanding of the circuit operation are shown in FIG. **23**. When current time is 7:30 a.m., all of the fixed contacts of the three switches are connected to ground, with the exception of the contacts I_0, II_7 and III_5. Representative circuits of the Punch and Logic Circuits **446**, the Good Punch Time Logic **448** and Back Space Logic **449** will be described hereinbelow with reference to FIGS. **25—27**. It need here only be pointed out that + voltage pulses are applied to the Punch and Logic Circuits **446** through the contacts of the relays **433** and **451** as the contact arm of the 36-position switch **75** engages certain of the fixed contacts thereof. These voltage pulses result in the energization of the individual solenoids which actuate the punches P_0—P_{12}, pertinent solenoids being here denoted by the related reference markings S_0, S_5, S_7, S_{11} and S_{12}. Also, when the contact arm **201** is moved into engagement with the 2nd fixed contact, a + voltage now appears on the lead **452** through the closed contacts **432** of relay **433**. This voltage is applied to the SCR circuit connected across the resistor **402** which is connected in series with the lamp L_{11}. Similarly, when the contact arm is brought into engagement with the 5th fixed contact, a + voltage appears on the lead **453** through the closed contacts **454** of this same relay **433**. This voltage is applied to the SCR circuit connected across the resistor **403** which is in series with the lamp L_{12}. These SCR circuits are generally similar to that shown in FIG. **24** and upon the application of the described + voltage thereto, these circuits are reset, thereby resulting in the energization of the associated lamps at the lower voltage. Thus, it is apparent that the lamp L_{11}, and L_{12} are returned to the standby, preheated level when the contact arm **201** comes into engagement with the 2nd and 5th fixed contacts, counting the home contact as contact No. **1**. The Program Boards **447** comprise a plurality of pin terminals which can be connected by leads to program the machine to meet the requirements of the particular user. A multiconductor cable connects the Program Boards to the Good Punch Time Logic Circuits **448** and to the Back Space Logic **449**, said logic circuits being energized by the + voltage appearing on the lead **456** during the time the card is in the machine. Further, the output leads of the multivibrator **400** are identified by the markings **W–6** through **W–9**, **W–11** and **W–12**. The leads **W–6** through **W–9** and the lead **W–12** are connected to both the Good Punch Time Logic **448** and the Back Space logic **449**, whereas the lead **W–11** is connected to the base of the input transistor of the transistor gate **457**. This description of FIG. **23** provides a sufficient basis for one skilled in this art to understand the card-punching operation, which will now be described.

When the new Shift 1, lunch B, card is inserted into the machine the following action takes place. After the card reaches the pedal lever **20**, all of the lamps are turned on to full brilliance by closure of the contacts **409** of the pedal relay **225**. However, the multivibrators **400** will not be set since there are no prepunches in the first column of the card to permit actuation of the photocells. The card will then be ratcheted (elevated from the carriage **22**) one column to its second position and the lamp L_{11} will be turned down by the + voltage appearing on the lead **452**, thereby leaving the associated multivibrator unset, the transistor gate **457** in open condition, and the relay **451** deenergized. This + voltage also appears on the lead **435** which closes the transistor switch **434** and energizes the relay **414**. The normally closed contacts **458**, of the relay **451**, maintain a + voltage on the lead **459** connected to the Punch and Logic Circuits **446**. The card will then be ratcheted one more column to its third position, in which the light from the lamp L_{12} will shine past the cut corner of the card, thereby actuating the photocell C_{12} and setting the associated multivibrator, whereby an output voltage now appears on the multivibrator output lead **W–12**. If the card has been inserted into the machine at the preprogrammed time, that is, some time before 8:00 a.m., the combination of the military clock information, through the Program Boards **447**, plus the output voltage on the multivibrator lead **W–22** will result in a + voltage on the lead **461** produced by the Good Punch Time Logic **448**. The card will then be ratcheted one more column to its fourth position. At this position of the 36-position switch **75**, a + voltage appears on the III Pulse input to the Punch and Logic Circuits **446**, thereby resulting in the energization of the solenoid S_5, since the No. **5** fixed contact of the rotary switch III is not shorted out. Energization of this solenoid actuates the punch P_5, thereby punching the III digit of the military clock in line **5**, column **3** of the card. At the same time, a voltage is applied to the lead **453** and the lamp L_{12} is turned down. The card will then be ratcheted one more column to its 5th position. At this position, a + voltage appears on the II Pulse input to the Punch and Logic Circuits **446**, which energizes solenoid S_7, thereby actuating the punch P_7 and punching the II digit of the military clock in line **7**, column **2** of the card. The card will then be ratcheted one more column to its sixth position. At this position, a + voltage appears on the I Pulse input to the Punch and Logic Circuits, which energizes solenoid S_0, thereby actuating punch P_0 and punching the I digit of the military clock in line **0**, column I of the card. Also, when an II Pulse and a **12** Pulse are present when the I Pulse input is applied to the Punch and Logic Circuits, the solenoids S_{11} and S_{12} are energized simultaneously with solenoid S_0, thereby punching lines **11** and **12**, column I simultaneously with line **0**, column **1**. The II punch in the card indicates the punched time entry is an IN time, and the **12**th punch indicates the employee punched in on time. Thereafter the card is ratcheted to the next column. In this home position

of the 36-position switch **75**, a + voltage appears on the lead **412** and also on the lead **251** through the still closed contacts **250** of the relay **414**. It is here pointed out that these relay contacts **250** correspond to the switch **250** shows in FIG. **15**. This voltage causes the card to be ejected from the machine, as has already been described with reference to FIG. **15**. The card having been ejected, contacts **266** of the microswitch **67**, (FIG. **23**) are open, thereby deenergizing the multivibrators **400**, opening the transistor gates **434** and **457**, and removing the energizing voltage from the Control Circuit **247**, Good Punch Time Logic **248** and Back Space Logic **249**.

Later that day, while the Shift 1, Lunch A, employees are out to lunch, the carriage **22** is lowered one position, corresponding to six columns of the card. When the Shift I, lunch B, card is inserted into the machine to punch OUT for lunch, column **7** of the card will be aligned with the lamps when the card rests upon the pedal lever **20**. Thus, when the pedal relay **225** is energized, the prepunch in column **7** will operate the corresponding multivibrator **400** by reason of the light from the lamp L_7 activating the corresponding photocell C_7. The voltage now appearing on the multivibrator output lead W–7, combined with the military clock information from the Program Boards **447**, operates the Back Space Logic **449**, to close the transistor gate **462**. Closure of the gate **462** results in the energization of the operating coil of the relay **433**, the circuit being traced as follows; closed gate **462**, normally closed contacts **463** of the relay **464**, coil of the relay **433**, leads **465** and **466** and the normally closed contacts **467**, of the relay **414**. Operation of the relay **433** removes the voltage from the leads **452** and **453**, from the transistor switch **434** and from the I Pulse, II Pulse and III Pulse inputs to the Punch and Logic Circuits **446**. Thus, for the first six ratchet operations, no punching operation can occur, a card-eject operation cannot occur, and the lamps L_{11} and L_{12} remain at full brilliance. Also, at the 6th position of the 36-position switch **75**, the relay **464** is actuated through the transistor switch **470** by reason of a + voltage appearing on the leads **468** and **469**. Relay **464** locks-in, electrically, and releases relay **433**, which prepares the circuit for normal punching operation for the next six ratchet operations. Thus, at the 7th ratchet operation, the lamps L_{11} and L_{12} set the corresponding multivibrators **400**, since the light from these lamps shine through the **11** and **12** punches previously made in the card. The output voltage on the multivibrator lead W–11 results in the energization of the operating coil of the relay **451** through the transistor gate **457**. Actuation of the relay **451** connects the I Pulse, II Pulse and III Pulse inputs of the Punch and Logic Circuits **446** to positions **7**, **8** and **9** of the ratchet switch **75** and, also, opens the II Pulse input circuit. As a result, at ratchet operation **7**, the III Pulse input to the Punch and Logic Circuits causes the III digit of the military clock to be punched into column **6** of the card. At the next ratchet position, the II Pulse input causes the II digit of the clock to be punched into column **5** of the card. At the same time, relay **414** operates releasing relay **464**, since the No. **8** fixed contact of the 36-position switch **75** is connected to the No. **2** fixed contact. At the next ratchet operation, the I Pulse input causes the I digit of the clock to be punched into column **4** along with a punch in line **12**. The punching of line **11** does not occur because the **11** Pulse input to the Punch and Logic Circuits has been opened by the relay **451**. Ratcheting of the card then continues with no other punching. After the 13th ratchet operation, the card ejecting action again is initiated, since the No. **13** fixed contact of the 36-position switch is connected to the No. **1** fixed contact.

When the Shift **1**, lunch B card is inserted into the machine to punch IN from lunch, the punches are again aligned with column **12** and the lamps are aligned with column **7**. The military clock information, plus the multivibrator information again combine to determine back spacing of the card is not necessary, and the absence of an output on multivibrator lead W–11 prevents the relay **451** from operating, thereby leaving the I Pulse, II Pulse and III Pulse inputs to the Punch and Logic Circuits **446** connected to Nos. **6**, **5** and **4** contacts of the switch **75**. Thus, on the 3rd ratchet operation, the photocell C_{12} is activated by light shining through the punch previously made in line **12**, column **4**. On the 4th ratchet operation, the III Pulse input produces the III digit of the clock in column **9** of the card. On the 5th ratchet operation, the II Pulse input produces the II digit of the clock in column **8**. On the 6th ratchet operation, the I Pulse input produces a simultaneous punching of line **11**, line **12** and the I digit of the clock, all in column **7**. On the 7th ratchet operation, the card is again ejected from the machine.

When the Shift I, lunch B card is inserted into the machine to punch out at the end of the work shift, the photocells C_{11} and C_{12} are activated by light shining through the previous punches made in lines **11** and **12**, column **7**. An output voltage on the multivibrator lead W–11 causes operation of the relay **451** which connects the I Pulse, II Pulse and II Pulse inputs to the 3rd, 2nd and 1st ratchet positions. Thus, as the ratcheting progresses, the III digit of the clock is punched in column **11** and a **12** punch along with the I digit of the clock is punched in column **10**.

When a new Shift III card is inserted into the machine the following action takes place. At the time of the first insertion, the carriage will be in the No. **2** reference position. Operation of the machine is such that the punching IN at the start of the work shift and OUT for the lunch period will be in columns **7** through **12**. Therefore, a prepunch in line **12**, column **4** is necessary so that if it is the proper time for punching IN, photocell C_{12} will be actuated and a **12** punch will be made in the card along with the I Pulse for the I digit of the clock. While the employee is out to lunch, the carriage is lowered to its No. **3** reference position and, therefore, the machine will punch IN for lunch and OUT at the end of the work shift in columns **13** through **18**. This process continues until Friday p.m. when the machine will punch IN at the beginning of the work shift and OUT at the beginning of the lunch period in columns **55** through **60**. While the employee is out to lunch, the carriage, which was in the No. **10** reference position, will be moved back to the No. **1** reference position. Thus, when the employee punches IN from lunch and OUT at the end of the work shift the punching will occur in columns **1** through **6**.

Representative circuits of the SCR Punch and Logic Circuits, identified by the block **446** in FIG. **23**, are shown in FIG. **25** to which reference now is made. Shown in FIG. **25** are only the particular punch-operating solenoids which are involved in the punching operation specifically described with reference to FIG. **23**, namely, the solenoids S_0, S_7, S_5, S_{11} and S_{12}. The energization and deenergization of such solenoids is controlled by the individual silicon controlled rectifiers **473**—**477**. Although not shown in FIG. **25**, each of these rectifiers has associated therewith a resetting circuit, such as that described hereinabove with reference to FIG. **24**, whereby each rectifier is reset within a predetermined time period after it has been fired. This time period is arranged to be approximately one-third of the time of energization of the stepping ratchet solenoid **70** shown in FIG. **23**, in order for each punch operation to be completed before the card is ratcheted to the next column. The leads identified by the marking I_0, II_0, III_0—I_7, II_7, III_7, etc., are individually connected to the fixed contacts of the rotary switches of the military clock. When a voltage appears at the III Pulse input to the logic circuits, all of the punch-operating solenoids could possibly be energized. However, when the III digit of the military clock displays the numeral **5**, only rectifier **475** will be fired since all other III digit pulses will be shorted to ground. Consequently, only the solenoid S_5 will be energized, momentarily, thereby operating the associated punch to punch the card in line **5**. Similarly, when a voltage appears on the II Pulse input, only the II digit showing on the military clock, namely, the numeral **7**, will be punched in line **7** of the card. So, also, when a voltage appears on the I Pulse input, only the I digit showing on the military clock, namely, the numeral **0**, will be punched in line **0** of the card. It will be noted that the voltage appearing on the I Pulse input is also applied to the circuits controlling operation of the sole-

noids S_{11} and S_{12}, which circuits include the transistor switches **478** and **479**, respectively. These switches prevent the I Pulse input voltage from firing the rectifiers **476** and **477** if a voltage is not present on the II Pulse and **12** Pulse inputs, respectively, at the same time that a voltage appears on the I pulse input. More specifically, if an II Pulse is present when the I Pulse appears, the II punch will be operated along with the I digit punch. Also, if a **12** Pulse is present when the I Pulse appears, the **12** punch will also be operated along with the I digit punch.

Involved in the Good Punch Time Logic and the Back Space Logic, identified, respectively, by the blocks **448** and **449** in FIG. **23**, are inputs which are to be produced by combinations of the military clock digits. FIG. **26** shows a representative circuit to generate a voltage pulse for specific combinations of such digits. This circuit is arranged so that there are five inputs each being connected to different fixed contacts of the III rotary switch of the military clock through the Program Boards. If any one of the numerals digits **5** through **9** appear on the clock, the current through one of the resistors within the block **484**, which otherwise is shorted to ground by the rotary switch, now operates the transistor switch **483**, whereby the voltage at point A will be low and the voltage at point B will be high. Conversely, if none of these digits appear on the clock, the voltage at point A will be high and the voltage at point B will be low. Thus, for the conditions shown in FIG. **26**, the voltage at point A will be high when the III digit clock displays the numerals **0** through **4**, and the voltage at point B will be high when the III digit clock displays the numerals **5** through **9**.

Representative circuits which produce a **12** Pulse from the Good Punch Time Logic **448**, shown in FIG. **23**, are shown in FIG. **27**. The circuits are so arranged that when the proper combinations of military clock information and multivibrator information are fed into the circuits, a **12** pulse will appear on the lead **461**. It is here pointed out that the military clock information shown in FIG. **27** is representative of the specific work schedule preprogrammed in the logic circuits, as has been specified hereinabove. For example, if the military clock displays I_0, and II_7 and III_5—$_9$, and a voltage from the multivibrator appears on the lead **W–9**, an output voltage appears on the lead **461** of the transistor **481**. The output voltage appearing at the point B, FIG. **26**, constitutes the input voltage applied to the inputs identified by III_5—$_9$ in FIG. **27**. Also, if the military clock displays I_1 and II_6 and III_5—$_9$, and the output voltages from the multivibrators is such that the lead **W–9** is at a low voltage and the lead **W–12** is at a high voltage, an output voltage will again appear on the lead **461**. It should be noted that the transistor switch **482** is connected between the lead **W–9** and the logic circuit input, whereby an output voltage can appear on the lead **461** only when a low voltage appears on the lead **W–9**. The output voltage on the lead **461** constitutes the **12** pulse input to the Punch and Logic Circuits **446** of FIG. **23**. The circuits of the BACK Space Logic **449** (FIG. **23**) are similar to those shown in FIG. **27**. Other digit combinations required as inputs to the Good Punch Time Logic and the Back Space Logic must be produced by circuits similar to those shown in FIG. **26**, said circuits being set up through the Program Boards **447**, (FIG. **23**), in accordance with the specific work schedules established for the particular work force.

In FIG. **23**, current time information is fed to the Punch and Logic Circuits **446** and the Program Boards **447** through the rotary switches identified by the numerals, I, II and III having all fixed contacts shorted to ground with the exception of those contacts which correspond to current time. The same information can be provided by the circuit shown in FIG. **28**. In FIG. **28**, the rotatable contact arms of the switches I, II and III are grounded but such arms engage only one of the associated fixed contacts at any given time. Referring specifically to the fixed contact No. **0** of the switch I, such contact is connected in the input circuit of a transistor switch **490**. When the input terminal of the transistor switch is connected to ground, the output terminal **491** is at a high potential which acts as an open circuit to the correspondingly identified terminals (I_0) of the Punch and Logic Circuits **446** and Program Boards **447** (FIG. **23**). Similarly, when the input terminal of the transistor switch is not grounded, its output terminal is at ground potential. Thus, when the contact arm of the switch I is in the position illustrated in FIG. **28**, the Punch and Logic Circuits are conditioned for the energization of the punch-actuating solenoid S_0 (FIG. **23**). Although not specifically shown in FIG. **28**, similar transistor switches are individually associated with the fixed contacts No. **1** and No. **2** of the switch **1**. Also, similar transistor switches are individually associated with the ten fixed contacts of each of the switches II and III, only two such transistor switches, identified by the blocks **492** and **493** being here shown. Thus, at the illustrated current time, the contact arms of the switches II and III occupy the illustrated positions, thereby also conditioning the Punch and Logic Circuits for the energization of the solenoids S_7 and S_5, respectively, (FIG. **23**).

From the above description it now is apparent that a data processing card, coded in accordance with a specific work schedule, is automatically positioned in an initial reference position determined by the position of the carriage relative to the punches. Upon reaching such reference position, the card is ratcheted in a step-by-step manner, thereby to position the card in proper position for the time punching operation. A photoelectric card reader reads the information coded in the card and supplies such information to logic circuits preprogrammed in accordance with a predetermined time schedule. A time pulse generator introduces current time into the logic circuits. The logic circuits control means effecting movement of the carriage, means actuating the punches to punch current time into the card as a multiple digit time entry, means for punching a first reference punch in the card along with the current time entry when such time entry corresponds with that preprogrammed in the logic circuits, and means for punching a second reference punch in the card along with alternate time entries to thereby distinguish IN and OUT time entries. Upon completion of the punching operation, the card is automatically ejected from the machine.

Having now described the invention, what we desire to secure by Letters Patent of the United States is set forth in the following claims.

1. Apparatus for punching current time in a standard data processing card, said apparatus comprising,

a. card-punching means positioned to punch individual lines of the card,

b. means defining an initial reference position of the card with respect to the card-punching means,

c. card-transport means operated upon insertion of the card into the apparatus and automatically moving the card to the said reference position,

d. control means actuated by the card when it reaches said reference position,

e. logic circuits,

f. a time generator introducing current time information into the logic circuits,

g. drive roller means and cooperating pinch roller means engaging the card when it is in said reference position,

h. ratcheting means mechanically coupled to said drive roller means and operated upon actuation of said control means, operation of the ratcheting means causing said drive roller means to displace the card from said initial reference position in a step-by-step manner,

i. a rotary switch having a plurality of fixed contacts and having a contact arm mechanically coupled to said drive roller means,

j. means including said rotary switch controlling the number of operations of said ratcheting means,

k. means including said rotary switch and logic circuits controlling operation of said card-punching means to punch current time as a multiple digit time entry in the card between the step-by-step displacements thereof by the

said drive roller means, and

l. means ejecting the card from the apparatus upon completion of the punching of the time entry therein.

2. The invention as recited in claim 1, including additional card-punching means positioned to provide a reference punch in a predetermined line of the card, and means operating the additional card-punching means simultaneously with alternate time entries punched in the card.

3. The invention as recited in claim 1, wherein the logic circuits are preprogrammed in accordance with a predetermined time schedule; and including additional card-punching means positioned to provide a reference punch in a predetermined line of the card, means controlled by the logic circuits and operating said additional card-punching means along with the punching of the time entry in the card when such time entry corresponds to that preprogrammed in the logic circuits, and means preventing operation of said additional card-punching means in the absence of a reference punch made in the card along with the previous time entry punched therein.

4. The invention as recited in claim 1, including means preventing manual removal of the card from the apparatus after the card has been positioned in the reference position.

5. The invention as recited in claim 1, wherein the means defining the initial reference position of the card comprises a carriage member carrying said control means; and including means supporting the carriage member in one of a plurality of fixed positions relative to the card-punching means, and means controlled by the time generator and logic circuits and moving the carriage member from one to another of said fixed positions.

6. The invention as recited in claim 1, including a resilient ring member positioned in an annular groove formed in the peripheral surface of said drive roller means, the outer peripheral surface of said ring member normally extending beyond the groove.

7. The invention as recited in claim 1, including a clock presenting a visual indication of time, and means maintaining said clock in synchronism with the time generator.

8. The invention as recited in claim 1, including means preventing a subsequent operation of said ratcheting means until the contact arm of said rotary switch has been rotated from one to the next fixed contact thereof.

9. The invention as recited in claim 1, including means preventing the operation of said card transport means for a predetermined time period when a time change is about to be made in the time generator.

10. The invention as recited in claim 1, including means effective upon actuation of said control means to prevent introduction into the logic circuits of a change in current time until the completion of the punching of the time entry in the card.

11. The invention as recited in claim 1, including means actuating an alarm when the card is not ejected from the apparatus within a predetermined time period after actuation of said control means.

12. The invention as recited in claim 1, including means actuating an alarm when power for operation of the apparatus has been disrupted for a predetermined time period.

13. The invention as recited in claim 1, including a control switch positioned to be actuated a first time by the card upon insertion thereof into the apparatus and a second time by the card when it is in the ejected position, and means preventing a second operation of said card transport means while the ejected card retains the said control switch in the actuated position.

14. The invention as recited in claim 1, wherein the card carries means defining a correct orientation of the card for insertion into the apparatus; and including means preventing operation of said card-transport means when the card is inserted into the apparatus in other than the correct orientation.

15. The invention as recited in claim 1, including means terminating operation of said card-transport means when said control means is not actuated within a predetermined time period.

16. Apparatus for punching time in standard data processing cards including means coding the cards in correspondence with predetermined time schedules, said apparatus comprising,

a. means forming a card passageway,

b. a series of punches positioned to punch individual lines of the card when the card is in the passageway,

c. a carriage member,

d. means supporting the carriage member in one of a plurality of fixed positions spaced from said punches,

e. first drive roller means and cooperating pinch roller means extending into said passageway for engagement with the card, said drive roller means being mechanically coupled to a reversible motor,

f. first control means actuated by he card upon partial insertion of the card into said passageway,

g. second control means carried by the carriage member and positioned for actuation by the card when it is in said passageway,

h. first motor control means energizing said motor for rotation in one direction upon actuation of said first control means, said first roller means now rotating to drive the card into said passageway to actuate said second control means,

i. means deenergizing said motor upon actuation of said second control means,

j. second drive roller means and cooperating pinch roller means extending into the passageway for engagement with the card,

k. a card reader reading information coded in the card,

l. storage means storing information from said card reader,

m. means applying the stored information to logic circuits preprogrammed in accordance with said predetermined time schedules,

n. a time generator introducing current time information into the logic circuits,

o. means moving the carriage member from one to another fixed position in accordance with a second time schedule,

p. a first rotary switch having a plurality of fixed contacts and having a contact arm mechanically coupled to the said second drive roller means,

q. ratcheting means mechanically-coupled to the said second drive roller means and operated upon actuation of said second control means, operation of said ratcheting means rotating the contact arm of said first rotary switch from one to the next fixed contacts thereof, and rotating the said second drive roller means in a step-by-step manner resulting in a corresponding step-by-step linear displacement of the card from the carriage member,

r. means including said first rotary switch and controlling the number of operations of said ratcheting means,

s. punch-operating means controlled by the said first rotary switch and logic circuits and operating selected of said punches to punch current time as a multiple digit time entry in the card between displacements thereof in the said step-by-step manner, and

t. second motor control means energizing said motor for rotation in the reverse direction after the time entry has been punched in he card, said first drive roller means now driving the card in a reverse direction in the passageway.

17. The invention as recited in claim 16, including an additional punch positioned to provide a reference punch in the card, and means controlled by said card reader and operating the additional punch along with alternate time entries punched in the card.

18. The invention as recited in claim 16, including an additional punch positioned to provide a reference punch in the card, means controlled by said logic circuits for operating said additional punch along with the multiple digit time entry made in the card when such time entry corresponds to the time schedule preprogrammed in the logic circuits, and means including said card reader to prevent operation of said addi-

tional punch in the absence of such first reference punch made in the card along with the previous time entry punched therein.

19. The invention as recited in claim 18, wherein the means coding the cards comprises prepunches made in predetermined columns and lines of the cards.

20. The invention as recited in claim 16, wherein said card reader comprises a plurality of photocells and associated lamps; and including means normally energizing the lamps at a predetermined low voltage, and means energizing the lamps at a predetermined higher voltage upon actuation of said second control means,

21. The invention as recited in claim 16, including a resilient ring member positioned in an annular groove formed in the peripheral surface of said second drive roller means, the outer peripheral surface of said ring member normally extending beyond the groove.

22. The invention as recited in claim 16, including a shaft carrying the pinch roller means cooperating with said second drive roller means, means mounting the shaft for lateral displacement relative to said second drive roller means, a solenoid having an armature positioned for engagement with said shaft, means energizing the solenoid upon actuation of said second control means, said armature now displacing said shaft so that the pinch roller means presses the card against the second drive roller means, and means deenergizing the solenoid simultaneously upon energization of said motor by the said second motor control means.

23. The invention as recited in claim 16, including a shaft carrying the pinch roller means cooperating with said first drive roller means, means mounting the shaft for lateral displacement relative to the first drive roller means, a solenoid having a spring-biased armature normally engaging said shaft and maintaining a pressure between the cooperating pinch roller means and drive roller means, means energizing the solenoid upon actuation of said second control means thereby relieving the pressure between said pinch roller means and drive roller means, and means deenergizing the said solenoid upon energization of said motor by the said second motor control means.

24. The invention as recited in claim 16, wherein the said first drive roller means and cooperating pinch roller means comprises a first pair of axially spaced drive rollers and cooperating pinch rollers and a second pair of axially spaced drive rollers and cooperating pinch rollers, said first and second pairs of drive rollers being spaced along the card passageway by a distance less than the card length; wherein the said first control means is a normally open switch proximate to the first pair of drive rollers; wherein the second pair of drive rollers is spaced from said second control means by a distance less than the card length irrespective of the fixed position occupied by the carriage member; and including a second normally open switch proximate to said second pair of drive rollers and connected in parallel with said first switch, said second switch being actuated by the card prior to its actuation of the said second control means.

25. The invention as recited in claim 16, including means operated upon actuation of said second control means and preventing introduction into the logic circuits of a change in current time information until said motor is energized by the said second motor control means.

26. The invention as recited in claim 16, including means operated upon actuation of said first control means and delaying the energization of said motor by said first motor control means for a predetermined time period as a time change is made in the time generator or in the position of the carriage member.

27. The invention as recited in claim 16, including means actuated upon the actuation of said first control means and operating an alarm when the time between energization of the said motor by said first motor control means and said second motor control means exceeds a predetermined time interval.

28. The invention as recited in claim 16, including means operating an alarm when electrical power to the apparatus has been disrupted for a predetermined time interval, means maintaining the alarm in operation, and manually operable means for terminating operation of said alarm.

29. The invention as recited in claim 16, including means actuated upon the actuation of said first control means and operating an alarm when the time between actuation of said first control means and the actuation of said second control means exceeds a predetermined time interval.

30. The invention as recited in claim 16, including a third control means positioned at the entrance of said passageway and actuated by the card after it has been driven in the said reverse direction, and means preventing a second energization of said motor by said first motor control means while the card retains said third control means in the actuated condition.

31. The invention as recited in claim 16, including means preventing a subsequent operation of said ratcheting means until the contact arm of said first rotary switch has been rotated from one to the next fixed contact thereof.

32. The invention as recited in claim 16, including a clock presenting a visual display of time, and means maintaining said clock in synchronism with the time generator.

33. The invention as recited in claim 16, wherein the said ratcheting means is operated a predetermined number of times before the punching of the time entry in the card, the predetermined number of operations of the ratcheting means being determined by the coded time schedule of the particular card inserted into the apparatus and read by the card reader.

34. The invention as recited in claim 16, wherein the said logic circuits comprise silicon controlled rectifiers; wherein the punch-operating means comprise solenoids in the output circuits of the rectifiers; wherein the time generator comprises a digital clock having a number of dials corresponding to the number of digits of the time entry to be punched in the card and a corresponding number of rotary switches having contact arms individually rotatable with an associated dial, each such rotary switch having a plurality of fixed contacts; and wherein the inputs to the rectifier are controlled by the said first rotary switch and the positions of the rotary switches associated with the dials of the clock.

35. The invention as recited in claim 34, wherein the contact arms of the rotary switches associated with the dials of the clock simultaneously engage all but one of the associated fixed contacts; wherein such contact arms are connected to one side of a voltage source; wherein the fixed contacts of such rotary switches are individually connected in the input circuits of the rectifiers; wherein the contact arm of the said first rotary switch is connected to the other side of the voltage source; and wherein the fixed contacts of the said first rotary switch are individually connected in the input circuits of the rectifiers.

36. The invention as recited in claim 34, wherein the contact arms of the rotary switches associated with the dials of the clock engage only one of the associated fixed contacts at a time; wherein such contact arms are connected to one side of a voltage source; wherein the fixed contacts of such rotary switches are individually connected in the input circuits of transistor switches, which transistor switches have output circuits individually connected in the input circuits of said rectifiers; wherein the contact arm of the said first rotary switch is connected to the other side of the voltage source; and wherein the fixed contacts of the said first rotary switch are individually connected to the input circuits of said rectifiers.

37. The invention as recited in claim 16, wherein the said card reader comprises a plurality of photocells and associated lamps; wherein the said storage means comprises a bistable multivibrator associated with each of the photocells; and including means applying an energizing and resetting voltage to all of the multivibrators upon actuation of the said first control means, means triggering a multivibrator when the light striking the associated photocell has a predetermined intensity, and means automatically deenergizing the multivibrators upon completion of the punching of the time entry in the card.

38. The invention as recited in claim 16, including a clock presenting a digital display of time, means maintaining the

clock in synchronism with the said time generator, an electronic counter operated by the time generator, solid state logic gates operated by the electronic counter, and means controlled by the said logic gates and presenting a visual display corresponding to the day of the week and the AM or PM period of the day.

39. The invention as recited in claim **16**, wherein the said means moving said carriage member from one to another fixed position comprises second logic circuits preprogrammed in accordance with said second predetermined time schedule, means introducing current time information from said time generator into said second logic circuits, means controlled by said second logic circuits and moving said carriage member from one to another fixed position in one direction, an electronic counter operated by said second logic circuits, third logic circuits preprogrammed in accordance with said second predetermined time schedule, and means operated by said third logic circuits and moving the carriage member from one to another position in the other direction.