Sept. 21, 1926. 1,600,413

C. D. LAKE

AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 1

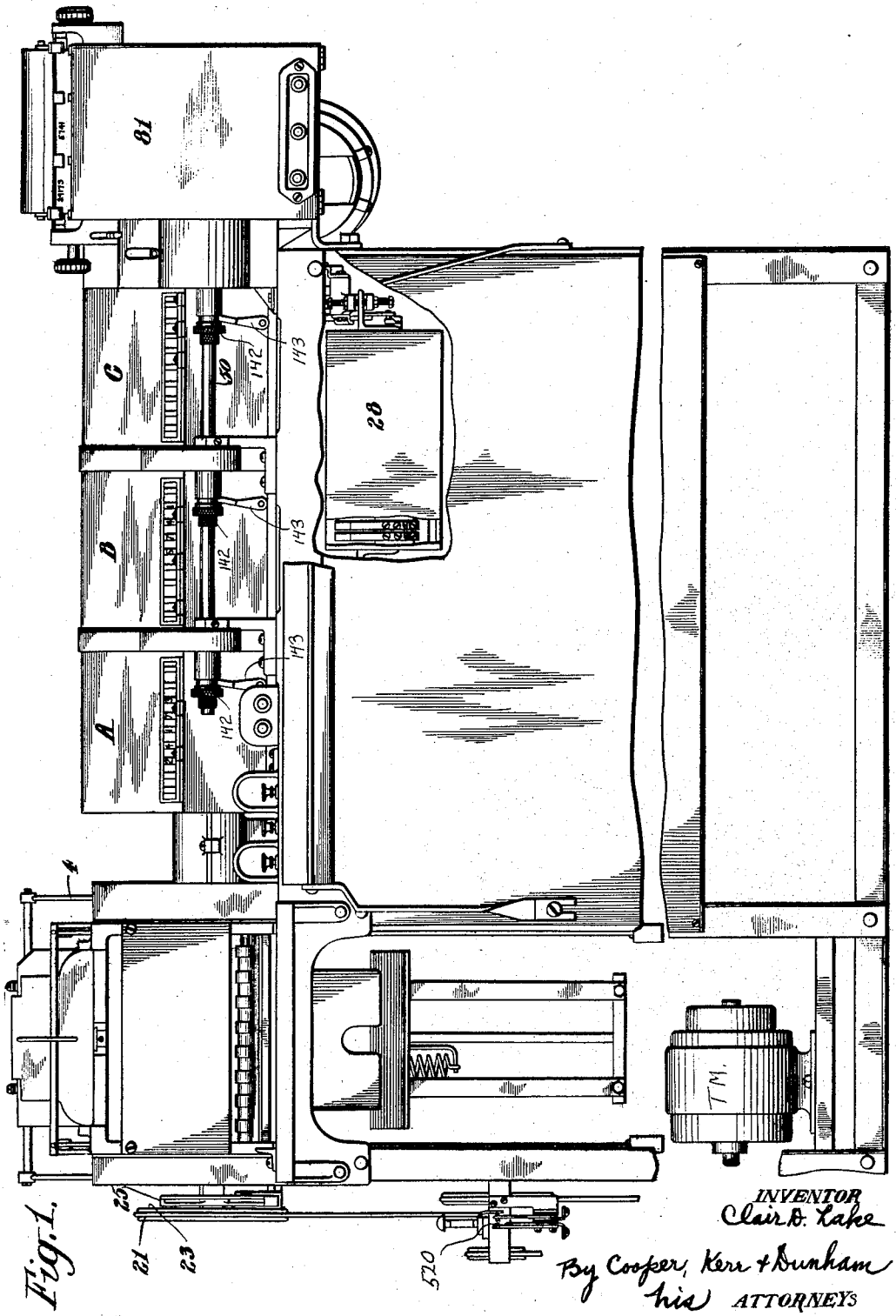



Fig. 1.

INVENTOR
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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 2

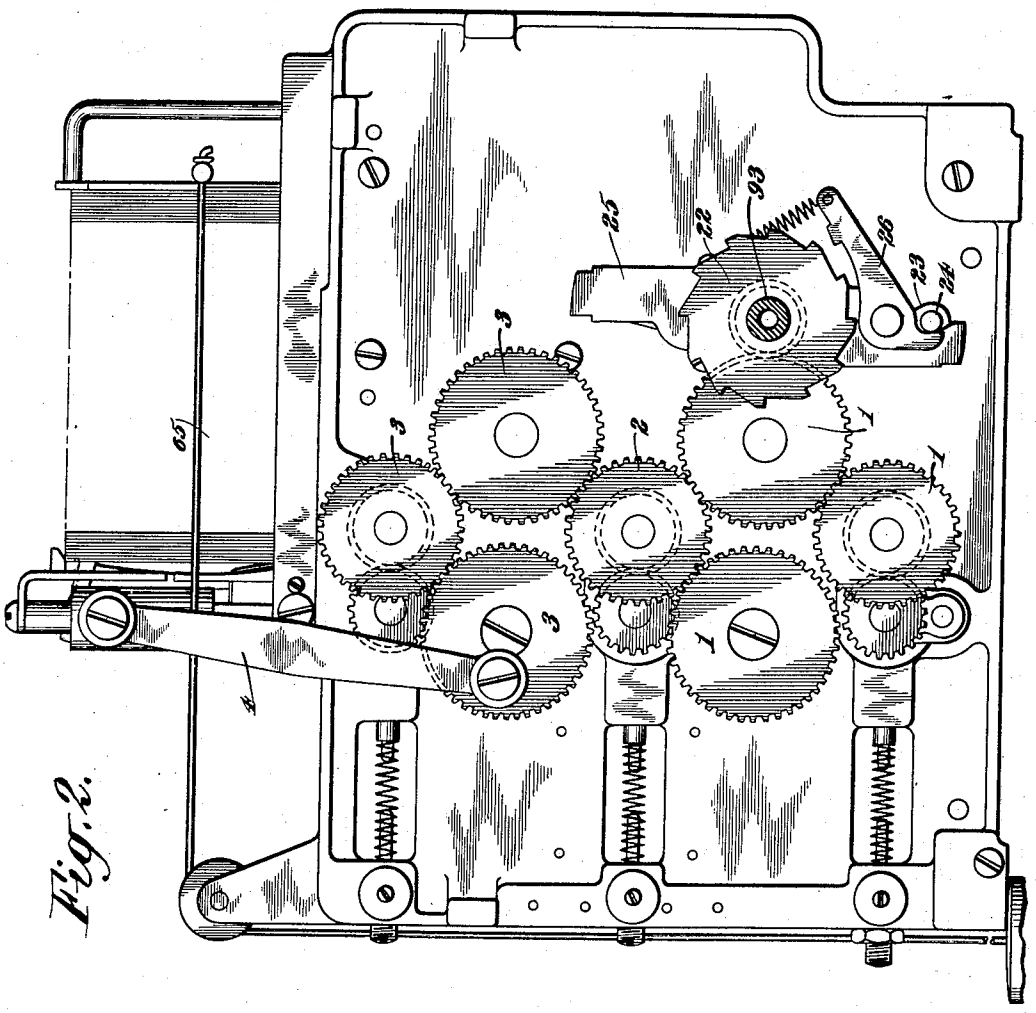



Fig. 2.

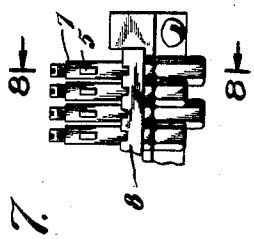



Fig. 7.

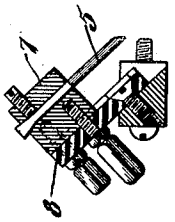



Fig. 8.

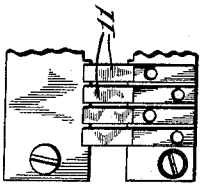



Fig. 9.

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C. D. LAKE

AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 3

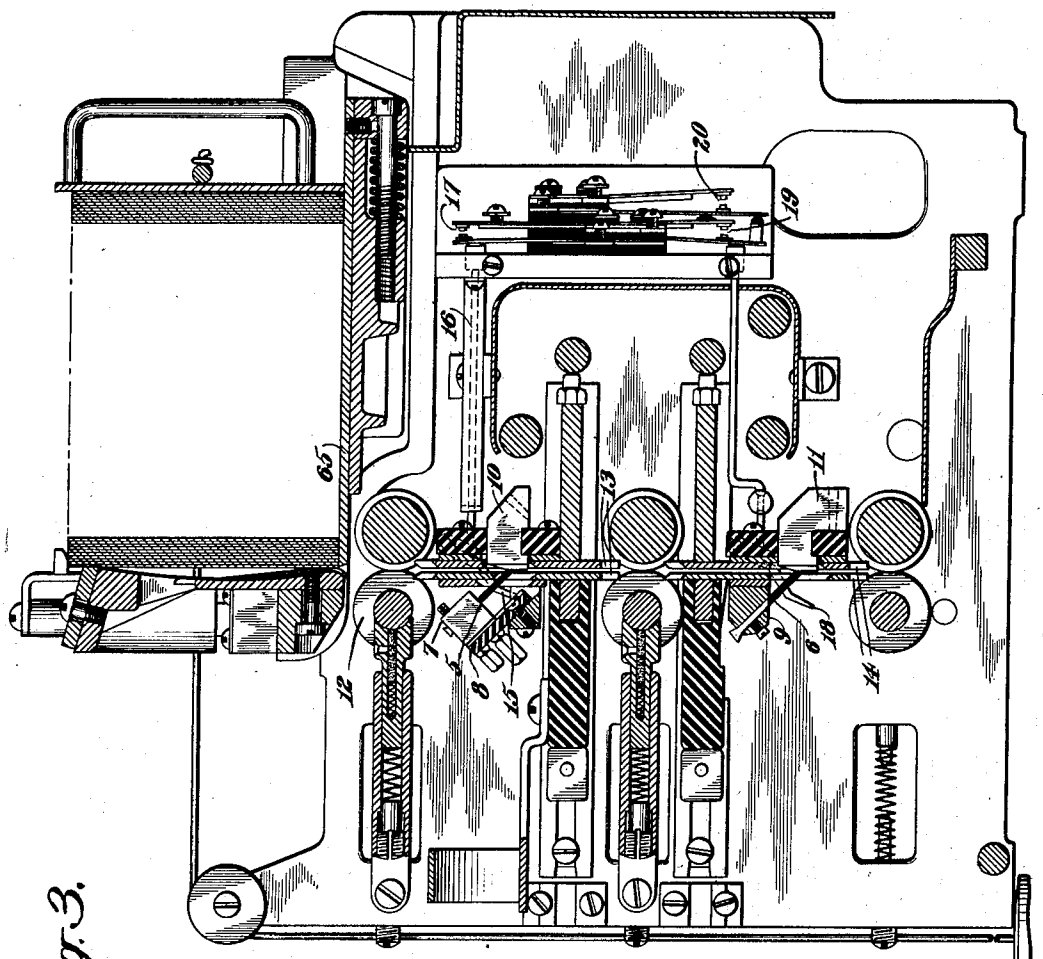



Fig. 3.

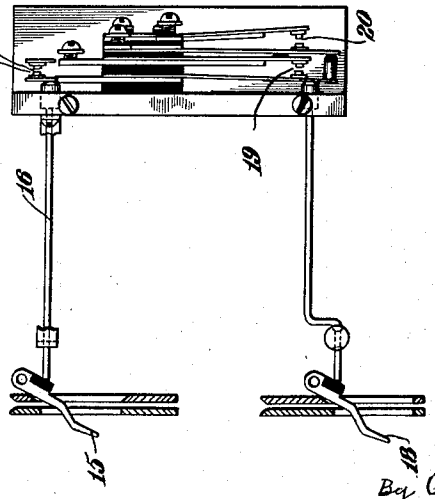



Fig. 10.

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 4

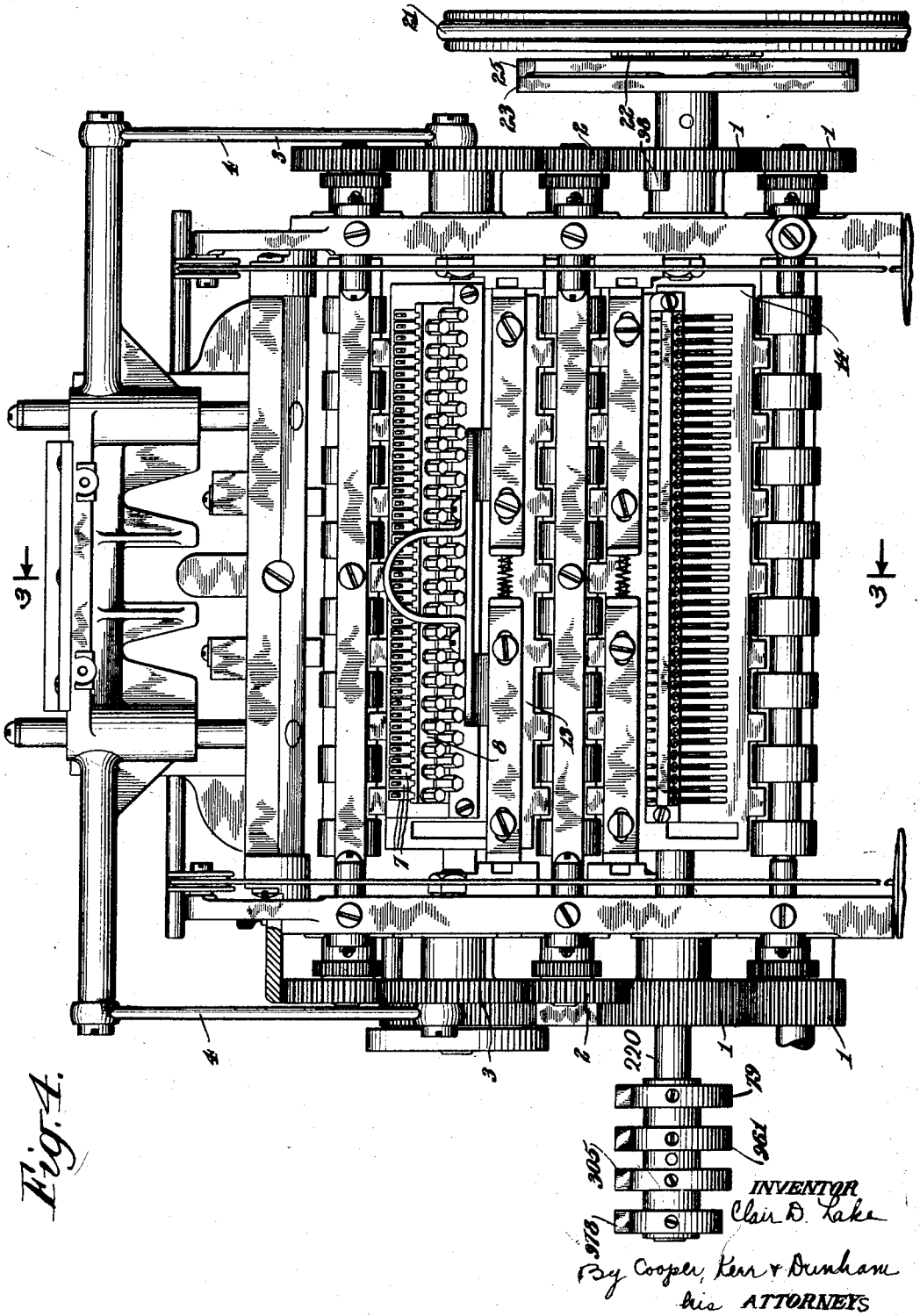



Fig. 4.

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 5

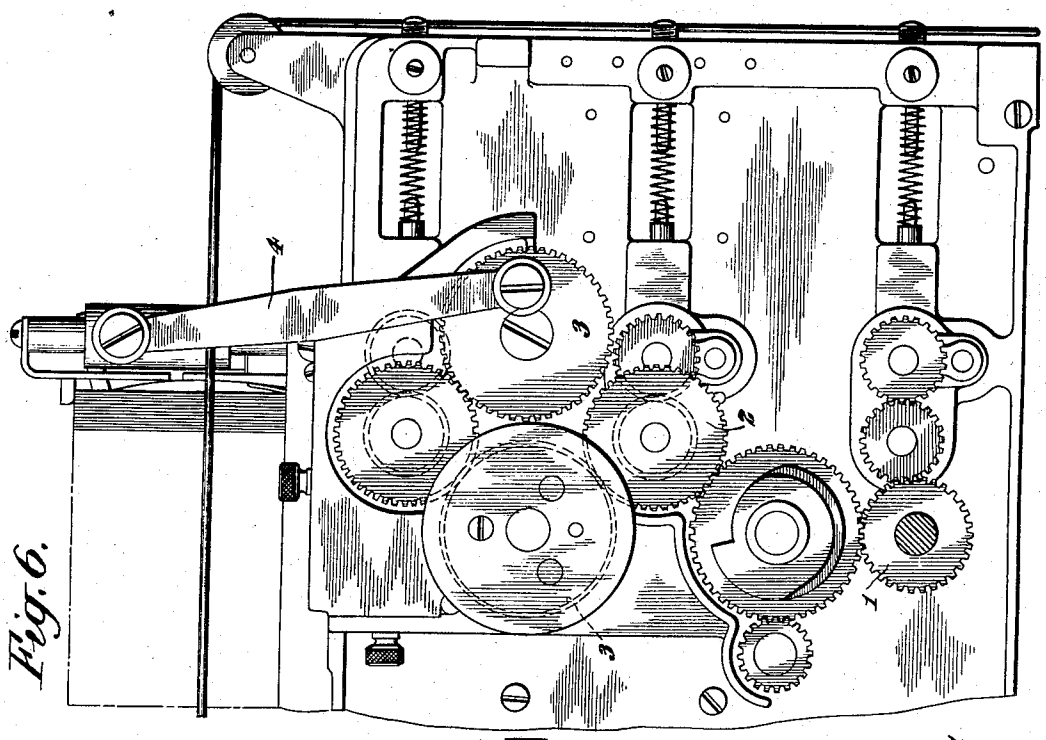



Fig. 6.

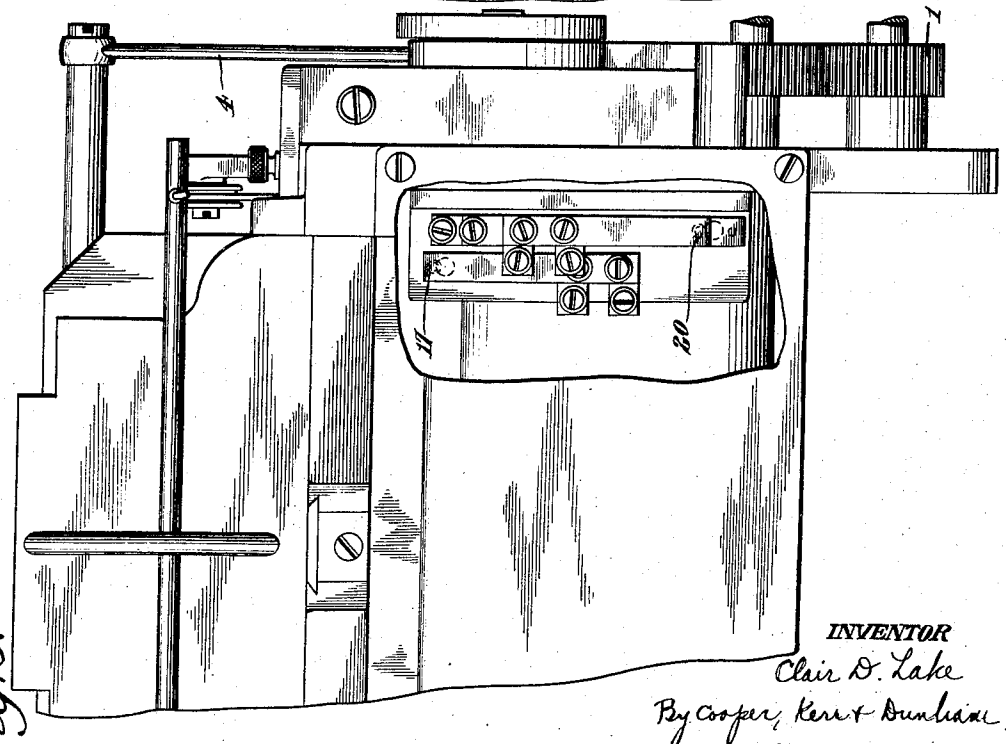



Fig. 5.

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 6

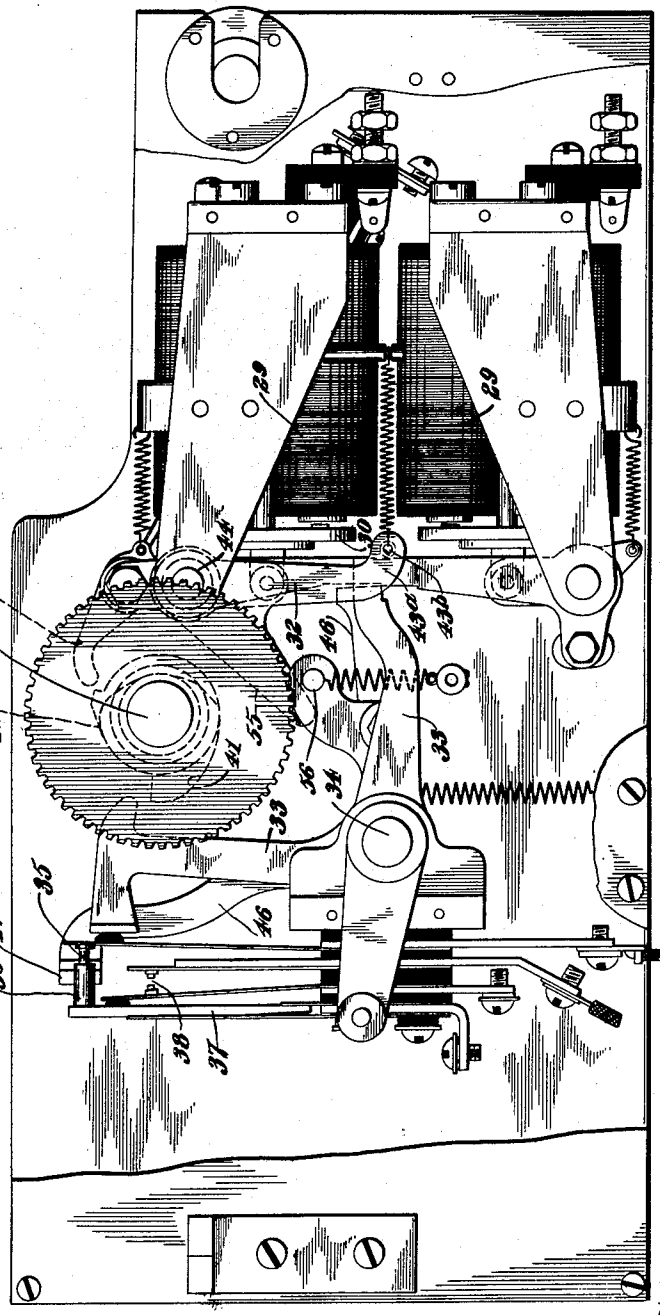



Fig. 11.

INVENTOR
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his ATTORNEY

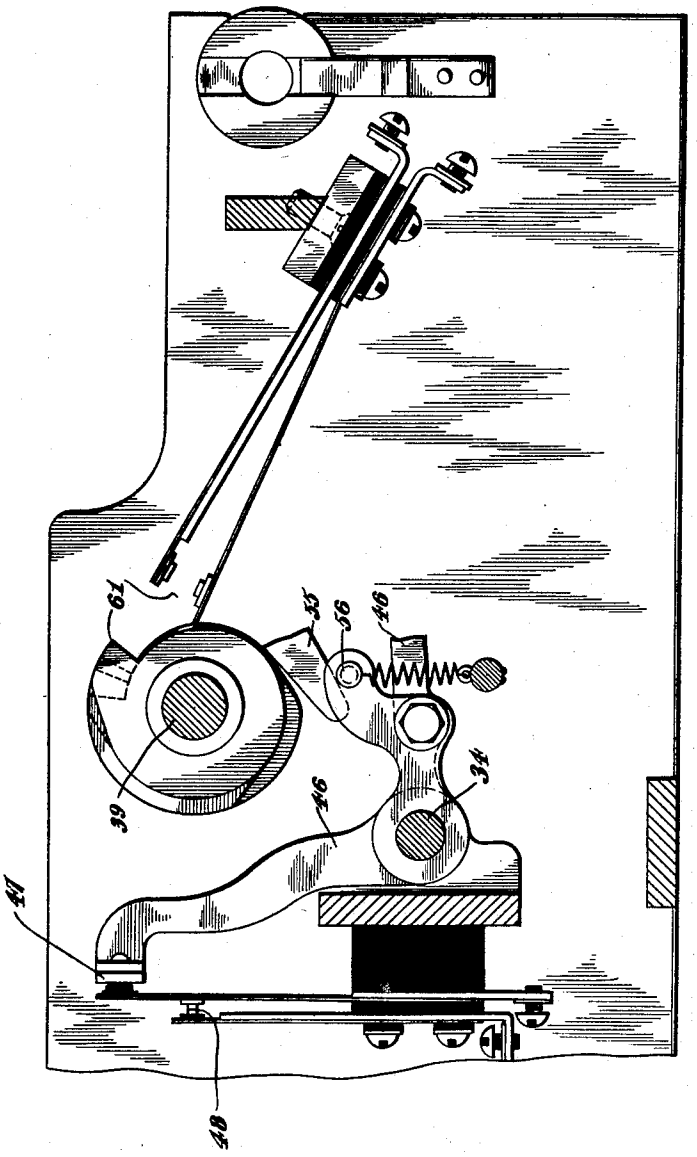
Sept. 21, 1926. 1,600,413

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

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Fig. 12.




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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 8

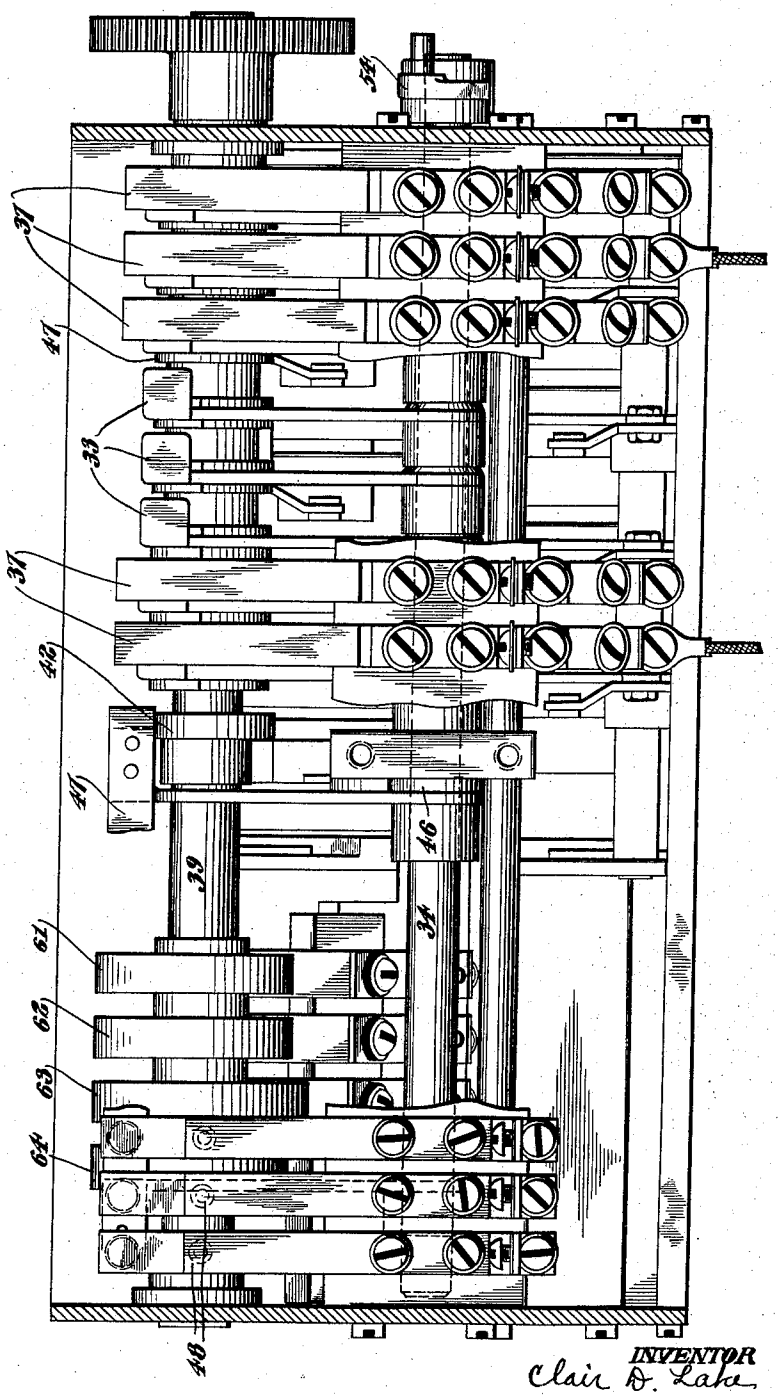



Fig. 13.

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C. D. LAKE

AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 9

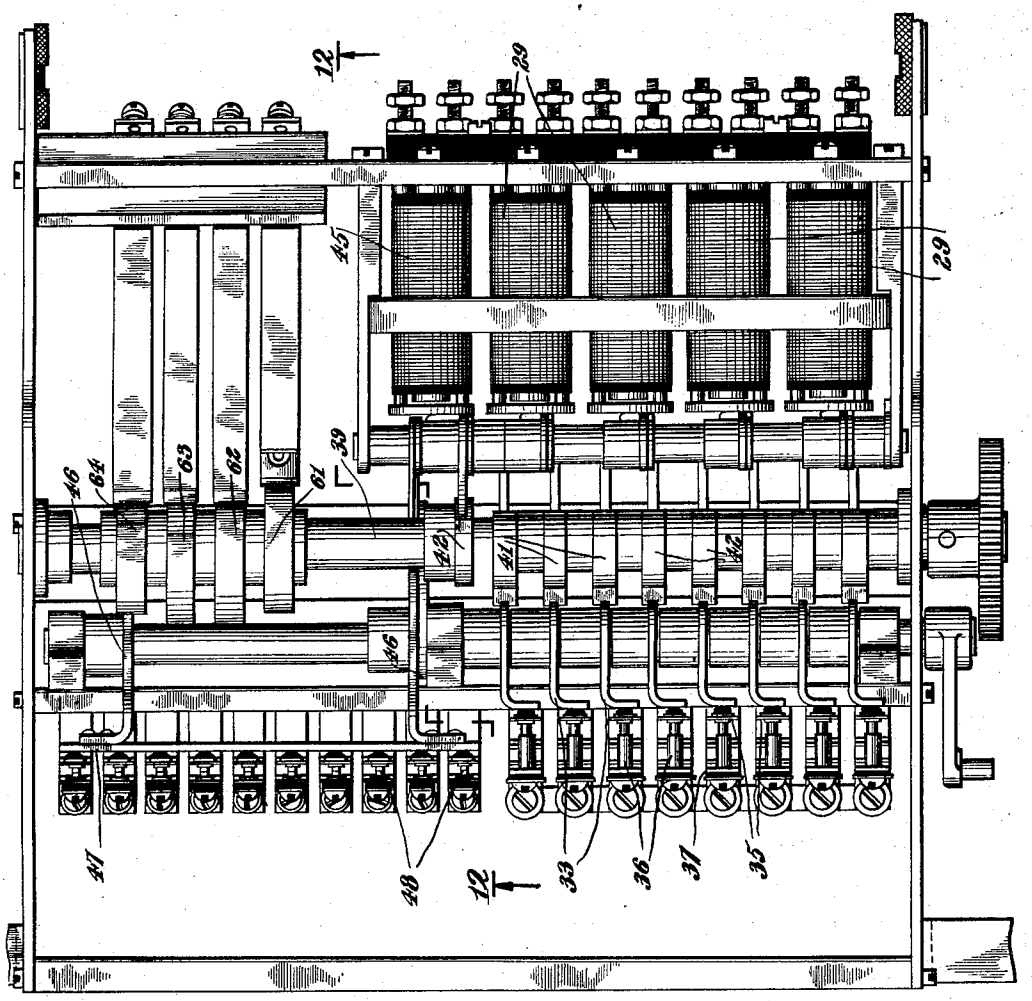



Fig. 14.

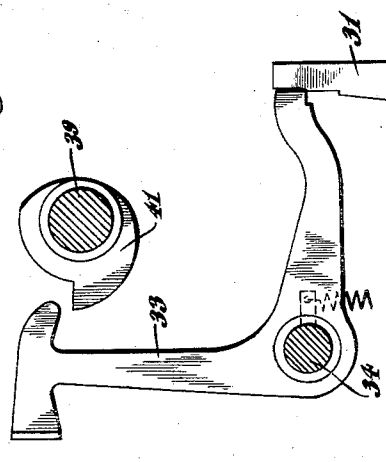



Fig. 15.

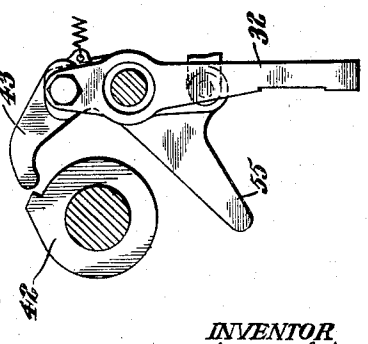



Fig. 16.

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 10

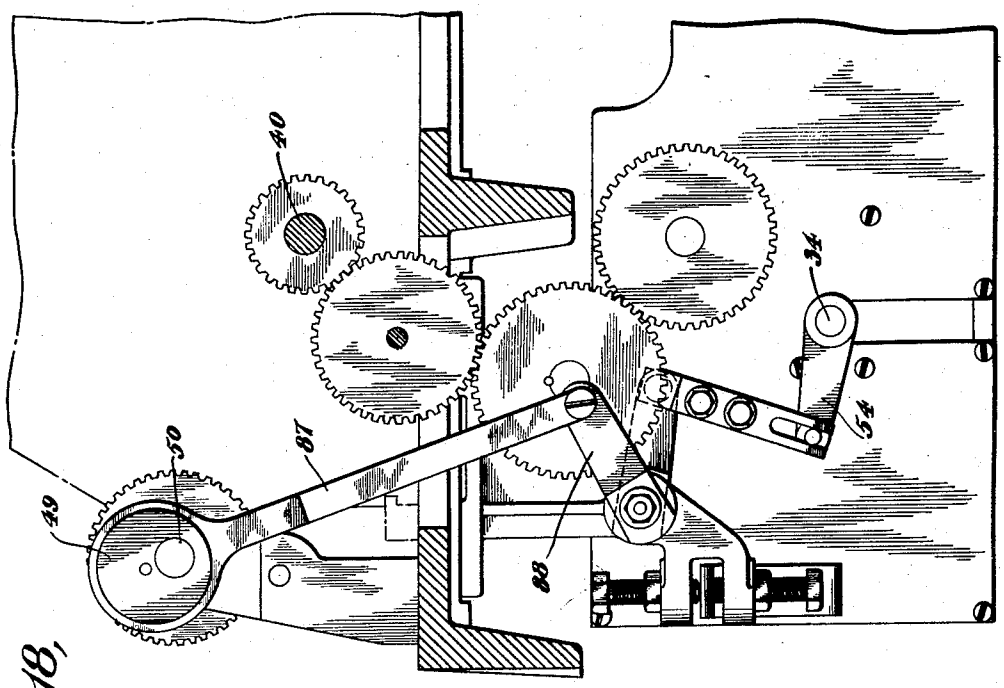



Fig. 18.

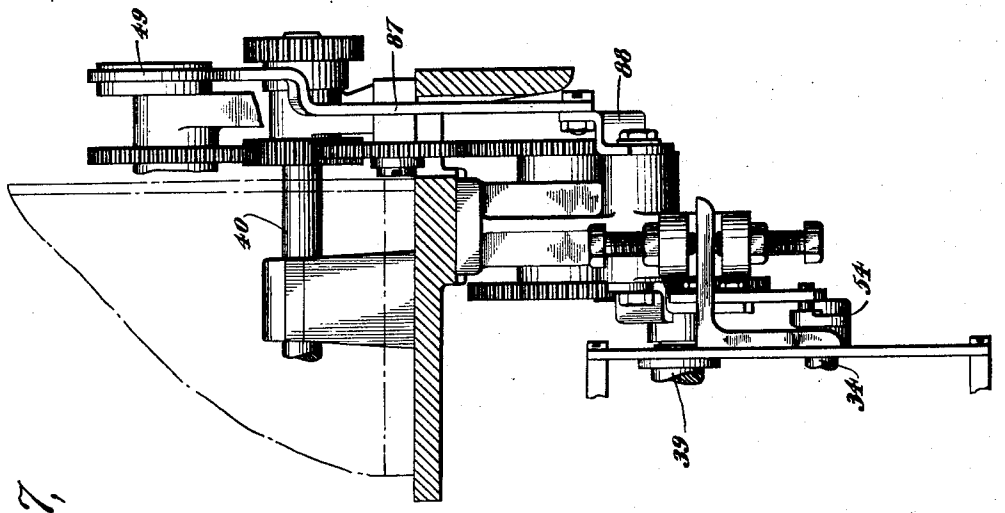



Fig. 17.

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C. D. LAKE

AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 11

Fig. 21.

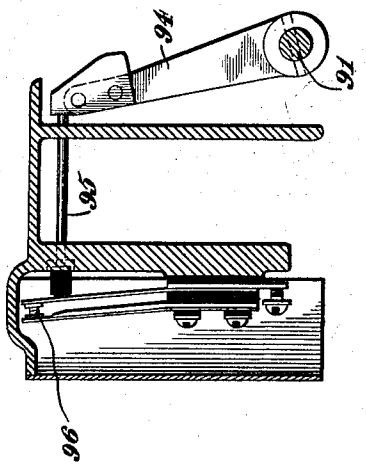



Fig. 19.

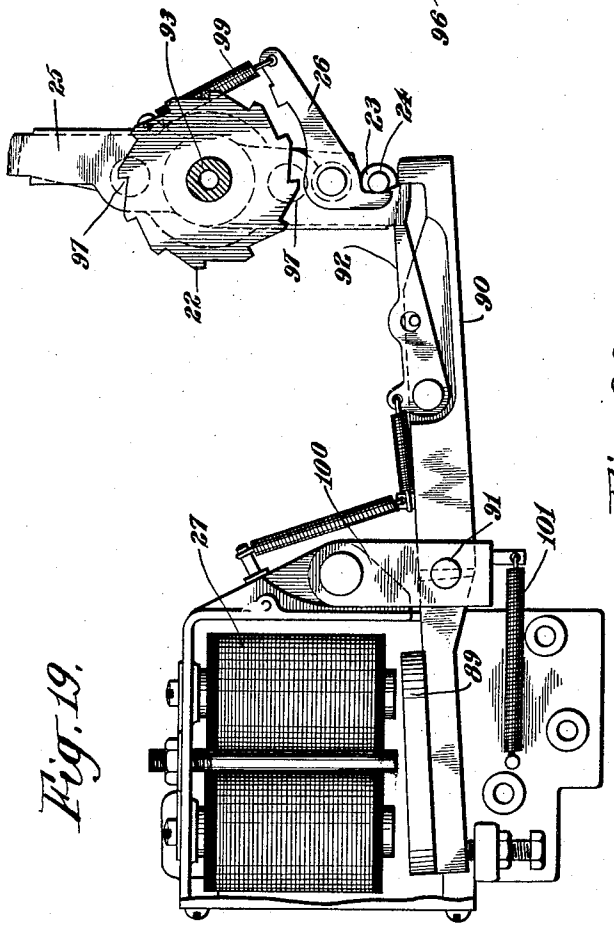
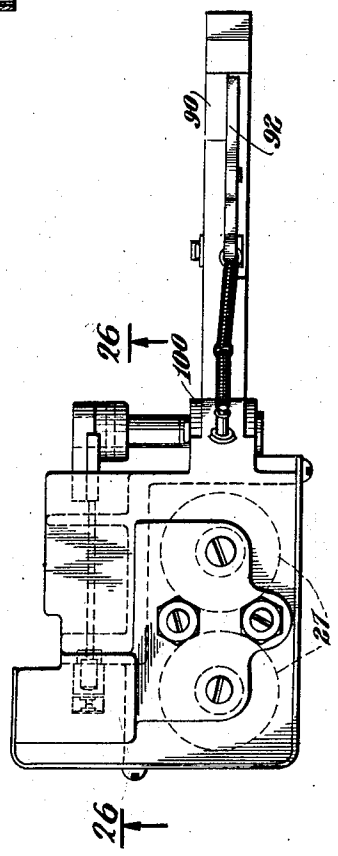



Fig. 20.




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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 12

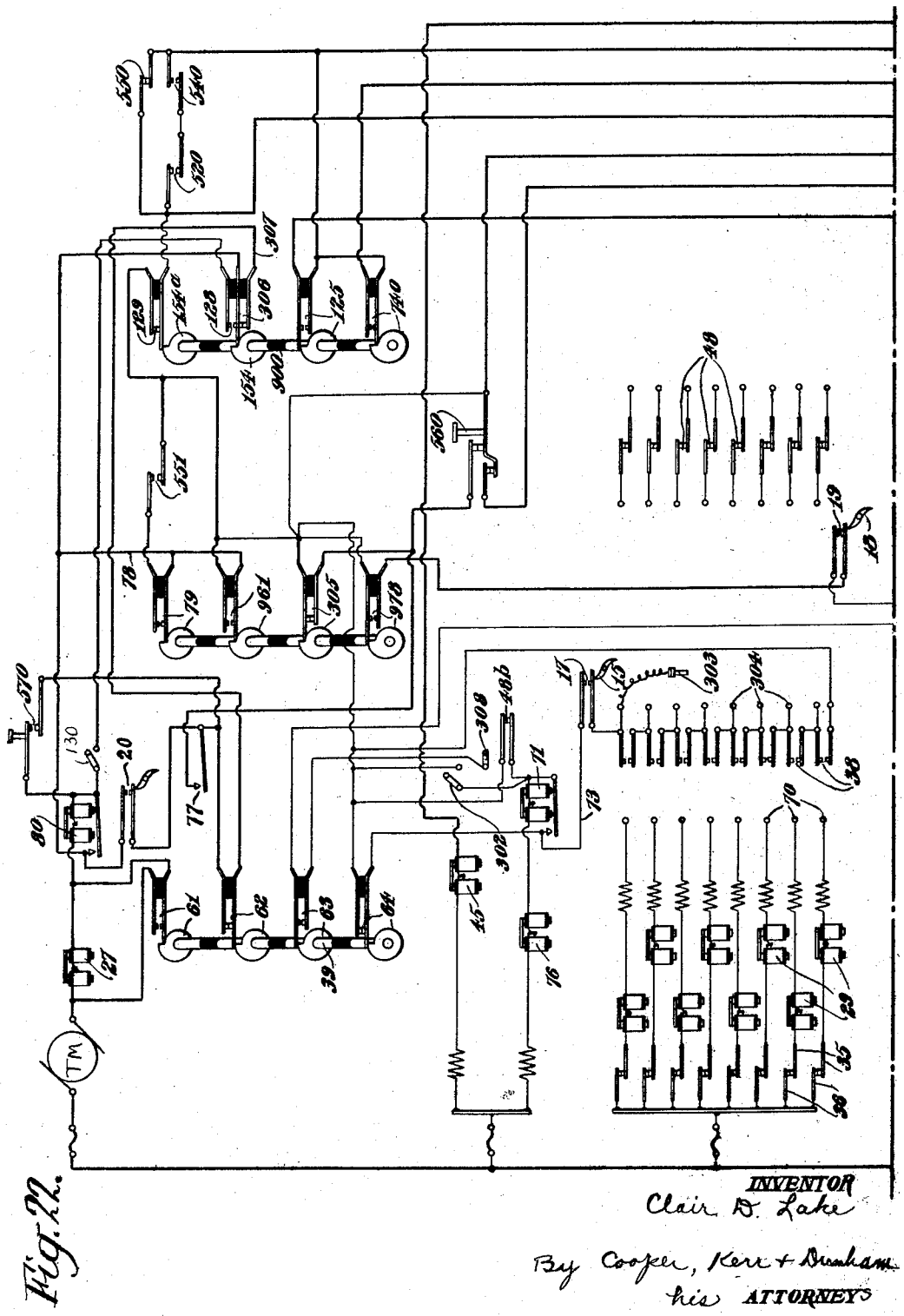



Fig. 12.

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AUTOMATICALLY CONTROLLED PRINTING TABULATOR

Original Filed April 30, 1921 13 Sheets-Sheet 13

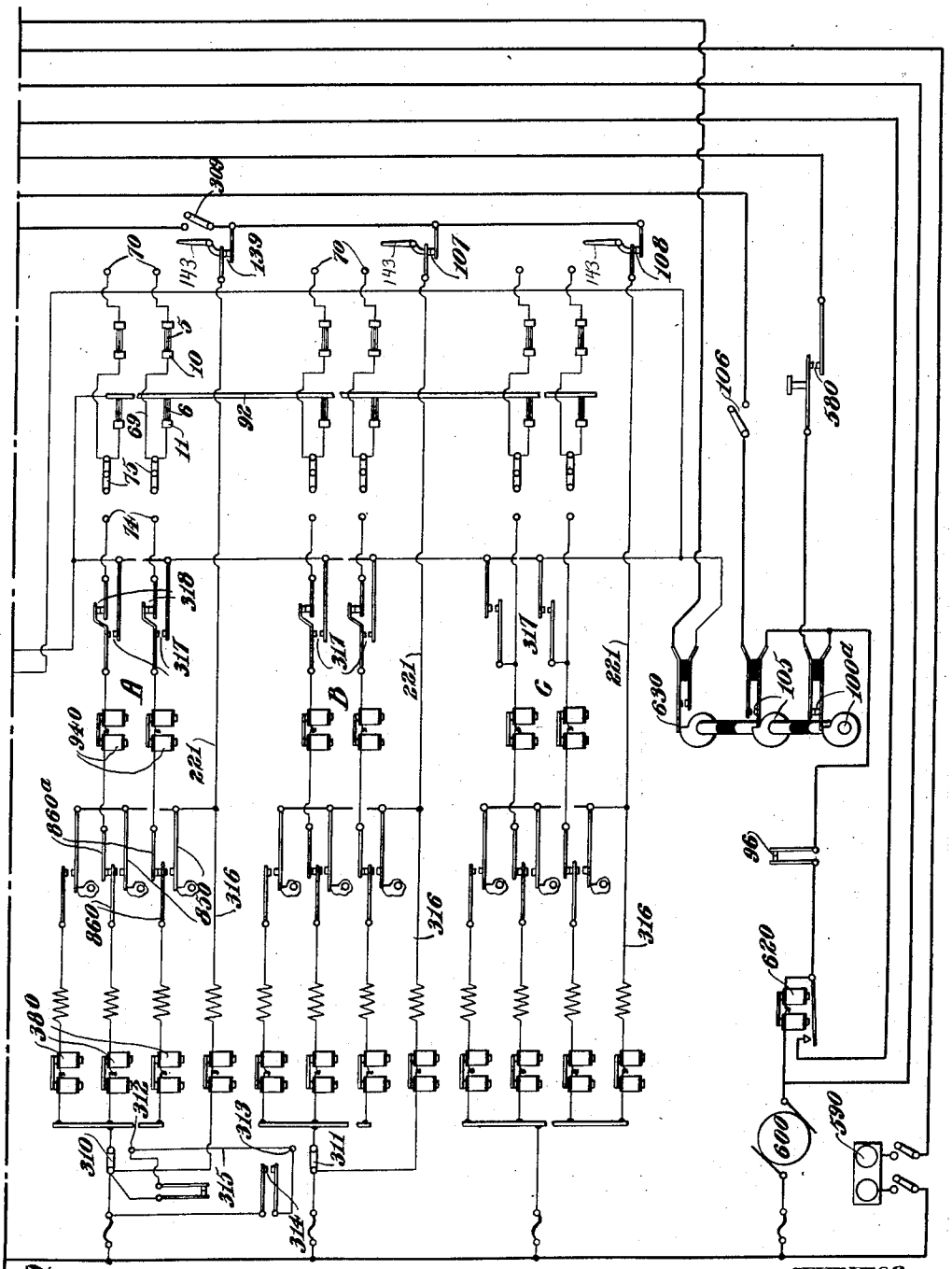



Fig. 22a.

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Patented Sept. 21, 1926. 1,600,413

# UNITED STATES PATENT OFFICE.

CLAIR D. LAKE, OF BINGHAMTON, NEW YORK, ASSIGNOR TO THE TABULATING MACHINE COMPANY, OF ENDICOTT, NEW YORK, A CORPORATION OF NEW JERSEY.

## AUTOMATICALLY-CONTROLLED PRINTING TABULATOR.

Original application filed April 30, 1921, Serial No. 465,868. Divided and this application filed December 6, 1921. Serial No. 520,271.

This application is a division of my copending application Serial No. 465,868, filed April 30, 1921, and an improvement upon my Patent No. 1,379,268, dated May 24, 1921.

In the patent above referred to I have shown a printing tabulator in which provision was made for automatically stopping the tabulator by means of a stop card when card groups change, then automatically taking a total of the items tabulated, and thereafter restarting the tabulating operation upon the succeeding card group.

The object of the present invention is to provide an improved automatic control device for a machine of this character which is adapted to automatically stop or otherwise modify the operation of the machine upon a change of a control or group member.

Broadly, the provision of an automatic control device is not new with me, but heretofore such devices have, when applied to a Hollerith type tabulator, utilized two sets of brushes, one broad and the other narrow, which brushes cooperate and compare two successive cards. In the present invention the use of wide and narrow brushes is obviated with the attendant necessity for careful timing of the controlling circuits. Furthermore the previous constructions have necessitated the employment of a comparatively large number of relays and in the present embodiment the number of these relays has been materially reduced and the general construction simplified.

A further object of the present invention resides in the provision of an automatic control device which is flexible so as to permit one or more card columns to be used for automatic controlling and further to provide a device of this character which may be cooperatively associated with a group indicating mechanism so that certain columns and counters may be used either for controlling and group indicating or for straight accumulating.

A further object of the present invention resides in the combination of the automatic control device with resetting devices and devices for restarting tabulating upon the next card group automatically after resetting is completed.

A further object of the present invention resides in the provision of a control device of such character that control may be effected upon one or a plurality of columns and in which the control or group numbers will be indicated; together with the provision of means for indicating group numbers in other columns which are not used for controlling the operation of the machine.

The present application is further directed to a construction in which the automatic control devices are adapted to automatically call into action the printing devices to take a total. Provision is also made for automatically restarting the tabulator upon the completion of the taking of the printed total or totals.

The detail arrangement of the printing device for taking the total is fully shown and described in the patent above referred to, and in the present application recourse will be had principally to the circuit diagram to show the modifications which are necessary in my former machine to effect the automatic taking of totals and the automatic resumption of tabulating operation under the control of the auto control device.

Another object of the present invention is to provide means for printing upon the record sheet the group number when the group changes and when a total is taken under the control of the auto control device. Provision is made for suppressing the printing of the group number except for the first listed item and when printing a total. If the machine is to be used for tabulating without listing, the group number may be printed for each group total.

Another object of the present invention is the provision of a control device of such character that the control may be effective upon one or a plurality of columns, in which the group will be indicated and printed as above, and in which other columns may be merely indicated and recorded without effecting the control over the stopping of the machine or of the automatic taking of a total.

Other objects of the invention reside in the provision of certain means which may be selectively operated to cut in or out of operation the group indicator and printer, the auto control devices, the automatic total taking devices, the automatic restart devices, and other elements of the system whereby an exceedingly flexible arrangement may be secured which will permit various combina-

tions of operations to be secured upon the same machine.

The accompanying drawings illustrate the complete control attachment and its method of operation.

Fig. 1 is a view in elevation of a Hollerith tabulating machine showing the manner of attaching the printing device thereto.

Fig. 2 is a side elevation of the feed mechanism of a tabulator which differs from the usual form of feed and is required for carrying out the present invention.

Fig. 3 is a central vertical section of the feed mechanism of the tabulator, on the line 3—3 of Fig. 4.

Fig. 4 is a rear view in elevation of the working parts within the case of the feed mechanism.

Fig. 5 is a front view in elevation of a portion of the feed device, a part of the exterior casing being removed.

Fig. 6 is a view in elevation of a portion of the gearing and parts of the feed mechanism, viewed from the opposite side to Fig. 2.

Fig. 7 is a detail view of parts of the upper brush holder.

Fig. 8 is a sectional view of the same on the line 8—8 of Fig. 7.

Fig. 9 is a front view of the lower contact blocks.

Fig. 10 is a detail view of the upper and lower card levers and associated parts shown in Fig. 3.

Fig. 11 is a view in elevation of an electromagnet and circuit controller forming part of the control unit or apparatus.

Fig. 12 is a sectional detail of a cam and circuit controllers, taken on the line 12—12 of Fig. 14.

Fig. 13 is a front view of the parts shown in Fig. 11 taken on the line 13—13 of that figure.

Fig. 14 is a plan view of the controlling magnets and associated parts of the controlling unit.

Fig. 15 is a detail of the latch mechanism associated with the control magnets.

Fig. 16 shows a mechanical release for the control magnet armatures.

Figs. 17 and 18 are end and side views of driving parts of the controlling unit, tabulator and attached parts.

Fig. 19 is a view in elevation of a clutch-controlling magnet and its associated parts.

Fig. 20 is a top plan view of the same.

Fig. 21 is a sectional view of the circuit-controller operated by the clutch magnet.

Figs. 22 and 22ª together constitute the wiring diagram of the apparatus shown in the preceding figures.

So far as it is possible to do so without confusion, I have used the same numerals to designate corresponding parts in all of the above-described figures.

To accomplish the objects of this invention, I add to the tabulator a control mechanism or unit, and add to the card feed mechanism of the tabulator proper an extra set of brushes. That is to say, in addition to the usual brushes always employed, I employ an upper set of brushes whose function is to cooperate with the lower set to effect a comparison of two cards and bring about the desired control thereby. The two sets of brushes are at such distance apart that they will register with corresponding hole positions on two consecutive cards as they pass through the machine. Under this arrangement, if both sets of brushes make a simultaneous contact with control holes of the same numerical value, nothing results to interfere with the normal running of the machine. But if the control or group number changes on any card and is not the same on the upper as on the lower card then the control circuit is affected and the tabulating operation interrupted.

I will first describe such mechanical devices as I have devised and which are necessary for the purpose of effecting such control, and afterwards more fully set forth the operation in connection with the circuit diagram figures.

In Fig. 2 which shows the feed mechanism, the lower gear wheels 1 are a part of the train of gears commonly used in tabulators for feeding the cards. In this device I use the driving gear wheel 2 in addition to its usual function, to operate the upper set of wheels 3. The connecting rod 4, from wheels 3, is similar to that ordinarily used in tabulators for drawing the cards singly from a pack into the machine where they are engaged by the feed rolls.

There are two sets of brushes, 5 the upper and 6 the lower. The upper brushes 5 are carried by metal plates 7, Fig. 8, secured to an insulating base plate 8, each brush being insulated from all the others. The lower brushes 6 are carried by a metal bar 9 (Fig. 3) which is common to all of them, and both upper and lower brushes when a perforation passes under them, make contact with corresponding individual, separate blocks 10 and 11 respectively, each of said blocks being insulated from any other block. The cards are drawn down to the upper rolls 12, and are passed by these and similar pairs of rolls below them through the chute 13 for the upper brushes and then through the chute 14 for the lower brushes. In all other respects than those noted the construction and arrangement of the device is the same as in the ordinary tabulator with the single exception, perhaps, that an upper lever 15 extends across the upper chute in the path of the cards which, when a card passes, shifts a pin 16 that brings together two contacts 17, while a second or lower

card lever 18 is similarly placed in the lower chute that, when a card is passing, closes two sets of contacts 19 and 20.

The feed mechanism is driven by a belt and pulley 21, Fig. 4, to which pulley is fixed a ratchet wheel 22, shown also in Figs. 2 and 19. On the drive shaft 93 is fixed a clutch arm or bar 25, and loose upon this arm is a second arm 23. Pins 97 in bar 25 enter enlarged holes, not shown, in the bar 23 and limit its sidewise play. A pin 24 is set in clutch bar 23 and is to knock out and hold the pawl 26 free from engagement with the ratchet 22. This pawl is pivoted to bar 25 and when engaging with the ratchet 22, it carries the two bars 23 and 25 around with the driving pulley.

On the completion of the circuit to the tabulator motor, in a manner to be hereafter explained, the current passes through and energizes a clutch magnet 27, Fig. 19, causing it to attract the armature 89 thereby imparting motion to the clutch lever 90 to which said armature is fixed, and drawing it away from engagement with the clutch bars 23 and 25.

When the energized magnet 27 has, through the instrumentality of clutch lever 90, released the bars 23 and 25, the pawl 26 is pulled into engagement with the ratchet 22 by its springs 99, and this causes the clutch bar 23 to travel around slightly in advance of the bar 25.

During each cycle a pin 98, Fig. 4, secured to the gear wheel 1, comes into engagement with a knock off lever 94, Fig. 21, which is secured to shaft 91. As clutch lever 90 is also pinned to this shaft, it tends to knock off the armature 89, and at such time the clutch magnet shunt contacts, as will be more fully understood by subsequent description, are made in order to break the magnetism of the said magnet. However, if the motor circuit has not been broken, the clutch magnet will again be energized, when these contacts are made again, and thus prevent the stopping of the machine.

As will also be more fully set forth, should the motor circuit be broken by the change of a control number in a card, by the depression of the stop key or by the last card of a group, the clutch magnet 27 will not be energized, and after the knocking off by the pin 98 of its armature the latter will not return, and the end of the clutch lever 90 will be in a position to engage the ends of the clutch bars 23 and 25. This engagement is so timed as to bring the machine to a positive stop in a predetermined position.

As explained above, the clutch bar 23 in its running position is slightly in advance of the bar 25, so that when the end of the clutch lever 90 rises into its path, the arm 25 strikes first the pin 24, working against the tail of the pawl 26, and pulls the latter out from engagement with the ratchet 22 and allows the over-run of the motor to be taken up by the now loose pulley wheel. Latch 92 drops in behind arm 25 to take the rebound of the machine. The shaft 91 is mounted in pivoted bearing plates 100 and is held against the magnet box by the spring 101. This provides for the overthrow or momentum of the machine being cushioned.

Actuated by the knock off lever 94 is a plunger 95 which operates a pair of contacts 96. When magnet 27 is energized, these contacts break the circuit to the reset mechanism and prevent its starting during the tabulating cycle. When the tabulator stops, however, and the clutch is latched up these contacts are made and the machine may be reset either manually or automatically. The operations of total taking, resetting, and restarting the tabulator will be set forth later.

The control unit which I have illustrated herein is arbitrarily designed for the control of eight columns of a tabulator card. This number may be greater or less if so desired. It is enclosed in a suitable box or casing 28 and secured in any convenient position and manner to the frame of the tabulator, preferably as shown in Fig. 1. The casing contains, in this case, eight column control magnets 29, Figs. 11, 14, 22 and 22$^a$, each having an armature 30 that is connected to a pivoted overlapping latch lever 31 or 32. When a magnet is energized and attracts its armature the latch lever releases a spring-actuated lever 33, pivoted at 34, which falls away or to the right from a contact 35, normally in engagement with a contact pin 36 carried by a spring-actuated arm 37. This results in the separation of the contacts 35 and 36 and permits the arm 37 to close contacts 38 which are normally open.

In the control unit is a shaft 39 which receives motion by gears from the counter drive shaft 40 (see Fig. 18) and this shaft carries cams 41 (Fig. 11) having high points which at a given instant in each cycle engage the cam ends of levers 33 and close the contacts 35 and 36, and relatch said levers with the latch levers 31 and 32. This operation takes place once in each cycle.

On the same shaft 39 is a cam 42 which, towards the end of each cycle, engages the end of a lever 43 pivoted at 44, the lower end 43$^a$ of which carries a cross rod or bail 43$^b$ which in its movement knocks off the attracted armatures 30 by striking the overlapping levers 31 and 32 and insures the reengagement of these levers 31 and 32 with the lever 33.

Passing now to Figs. 12 and 14: As stated above, there are eight column or control magnets 29, and in addition there is a group

indicator magnet 45, which operates one of the latch levers 32 to release a lever 46 fast on shaft 34, and operating a bail 47 which controls all of a set of ten contacts 48, which are known as group indicator contacts. During the reset of the machine the shaft 34 is rotated through a short arc by means of an eccentric cam 49 (Fig. 18) on the reset to zero shaft 50 of the tabulator which is connected by linkage 87—88 with a fixed arm 54 which rocks the shaft 34. This movement of the shaft rocks the lever 46 (Fig. 12) and permits it to relatch with the latch lever 32, and at the same time to close contacts 48. The same movement rocks a lever 55 by the engagement therewith of a pin 56, and thereby knocks off the armature 30 of the group indicator magnet (see Fig. 11).

In the diagram Fig. 22 are shown four cam contact devices 61, 62, 63 and 64. The cams of these contact devices are fast on the shaft 39 and are insulated from it and from each other.

In further explanation of the invention, let it be assumed that a sorted group of cards, or two or more groups of different cards, are passed through the tabulator which is to record or display the totals of the values represented by item holes punched in these cards. Each group of cards is distinguished by control holes punched in one, two or according to the provision made in this particular machine, eight different columns at the same time. The cards are placed in the hopper 65 and the tabulating machine started in operation in the usual manner by depressing start key 570.

Referring now to the diagram Figs. 22 and 22ª, depression of the tabulator start key 570 closes the circuit from the line through tabulating motor T M, clutch magnet 27, motor relay 80, start key 570, motor control relay contacts 77, through cam contact devices 305 now closed, through cam contact devices 129, through contacts 550, to the other side of the line. If a listing operation is to be performed, the same circuit is closed as before, with the exception of the fact that current flows from cam contacts 129 through the contacts 520 and 540, to the other side of the line, which insure the machine being driven at the lower listing speed, as in my prior patent previously referred to. It may be here explained that the cam contact devices 61 to 64, inclusive, are all driven by a shaft 39 which is driven in unison with the tabulator. Cam contact devices 305 are driven by a shaft 220 which is shown in Fig. 4. This shaft is driven in unison with the tabulator card feeding devices as shown in Fig. 2, and corresponds with the identical shaft in my previous patent.

The cam contact devices 129 are driven by a shaft 900 in the printing attachment. During normal tabulating operations this shaft is stationary and is only set in operation upon the taking of totals and the resetting of the tabulator counters to zero, as in my previous patent.

Having now described how the tabulator is set into operation, I will set forth in more complete detail the automatic control devices whose function is to interrupt the tabulating operation at the end of a card group or when successive cards do not correspond in their group characteristics.

In the automatic control unit as shown there are eight group indicator contacts 48 and two extra contacts 48ª and 48ᵇ, one, 48ᵇ, for setting up the control relay 71 and the other for completing the circuit when using the counters for plain indicating without controlling. The first of the last two contacts mentioned above, when all the contacts are closed, energizes the relay 71, which is held closed by the action of cam-controlled contacts 64, to be hereinafter further referred to.

The feed mechanism is started either automatically or by the operation of the tabulator start key 570 in the manner previously explained, and the cards begin to travel through the machine, as the clutch magnet 27 connects the feed mechanism with the drive. As the cards pass one by one down through the chutes 13 and 14 nothing happens until the first card passes under the lower brushes 6, and thereby closes contacts 19 and 20, the contacts 17 having already been closed by the upper card lever 15.

Assuming that only cards which are all in the same group are passing through the machine, the control numbered holes pass under both upper and lower brushes at the same instant of time. This permits a circuit to be completed from any given lower brush 6, Figs. 22 and 22ª, to contact block 11 and thence by wire 69 to the contact block 10 of the corresponding upper brush, and from thence to the brush 5 itself. From the upper brush the circuit is continued to the plug board and for convenience of reference, the particular plug holes connected together in advance, are both marked 70 in the diagram, one plug connection being used for each column, and as many used as desired. This permits the current to pass through one of the column control magnets 29 and back to the source. The control magnet thus energized, breaks contacts 35 and 36 for the purpose of taking the arc from the brushes, and makes contacts 38 (see Fig. 11) which complete a part of the shunt containing the control relay 71. The same result follows from the passage of the brushes over all the other holes in the control columns which may have been plugged in, i. e., 70—70 etc., and the shunt circuit is thereby completed. During the card cycle cam contacts 64 are momentarily separated but this does not affect the

relay 71 because the circuit 73 through the contacts 38 is closed, otherwise the circuit through the relay would thus be broken. The plug 303 can be plugged into any of the plug sockets 304 to cut out of action one or more column control circuits when less than the full number of columns are being used for controlling.

Near the end of the passage of the first card under the lower brushes, cam controlled contacts 630 are closed and this directs a current through the group indicator magnet 45 and this releases the lever 46 and permits the bail 47 to fall away from and open all of the contacts 48, and so long as no interruption to the running of the machine occurs, these contacts remain open. It may here be pointed out that the group indicator contacts 48 are plugged in between the points 74 and 75, that is, between the brush plugs and the counters for preventing the establishment of circuits after the first card has passed through, and after the first number has been set up upon the counter.

From the above it will appear that so long as the successive cards contain corresponding control holes, the necessary circuits are maintained complete and the normal operation of the machine continues.

Now let it be assumed that the last card of a group has passed the upper brushes. When this card comes under the lower brushes the first card of the next group is under the upper brushes, but this card having one or more control holes of a different numerical value, which do not correspond to the control holes in the last card of the first group under consideration, the circuit is therefore interrupted between the upper contact brush 5 and its block 10, and this results in the breaking of the circuit 69 and the failure of the magnets 29 to become energized. This leaves contacts 38 open and interrupts the shunt circuit 73, which, on the opening of the contacts 64, de-energizes the relay magnet 71 and breaks the circuit of the motor relay 76 which allows contacts 77 to separate and breaks the circuit at that point. These contacts 77 are shunted by the circuits 78 through cam contacts 961 when tabulating, or cam contacts 79 when listing, which break towards the end of the cycle, de-energizing the motor relay 80 and the tabulator clutch magnet 27. This results in the positive stoppage of the machine, as will now be understood from the description of Fig. 2.

It is manifest from the above description that the presence of a misplaced card in any group of cards, which has a control hole that does not correspond with that or those in the other cards will result in the same operation, and will stop the machine.

The foregoing description has explained the method of automatically stopping the tabulating operation by means of the automatic control devices. It will now be assumed that it is desired to manually or automatically take a total. If a total is to be taken manually, switch 106 is opened as shown and reset key 580 is depressed. This allows current to flow from source 590 through contacts 550 when tabulating, or 540—520 when listing, therethrough through contacts 129, now closed, thence through conductors to the reset key 580, through reset key 580, contacts $100^a$, now closed, clutch magnet controlled contacts 96, reset magnet 620, reset motor 600 to the other side of line and back to source. It may be here explained that cam contacts $100^a$, 105 and 630 are disposed upon a shaft which is driven by the tabulator concurrently with the rotation of shafts 39 anl 220. The rotation of the reset motor 600 effects the printing of the total and the resetting of such counters as are selected to be reset, in the manner explained in my patent heretofore referred to. After initiating a totaling and reset operation by reset key 580, the flow of current through the reset motor is taken over by means of a relay arm controlled by magnet 620 which shunts out reset key 580. After the totaling and resetting operation is initiated, magnet 620 is short-circuited. Control of the printing and reset motor is taken over by contacts 740, which are mounted on shaft 900 and driven during the printing and resetting operation. These contacts at the end of the printing and resetting cycle break the circuit to motor 600 and stop further rotation thereof. The means for first taking a total and thereafter resetting is controlled by the magnet 620, in the manner explained in my previous patent. In addition, it may be here explained that the contacts 96 prevent the operating of printing and resetting when the tabulating motor (T M) is running and has energized clutch magnet 27 which opens contacts 96.

If it is desired to take a total automatically, switch 106 is closed. Then just before the tabulator comes to rest after its control by the auto control device, cam contacts 105 will be closed and these contacts will initiate the total printing and resetting operation which will then be completed in the manner heretofore described. It may be explained that the circuit to switch 106 extends to the contacts controlled by stop key 560. Therefore, if this emergency stop key is opened for any purpose, the machine will not automatically take a total until the stop key is again closed.

A total having been taken, either automatically or manually, the restarting of the tabulator upon the next card group may

be effected either automatically or manually. If the manual operation of restarting is desired, the operator merely depresses start key 570 which initiates a new tabulating operation, as previously described. However, if it is desired that the tabulator automatically start up and tabulate, a total switch 130 will have been previously closed. This switch establishes a new starting circuit traced as follows: From source 590 through tabulating motor (T M), clutch magnet 27, motor relay 80, switch 130, cam contacts 128, which are closed just at the end of the printing and resetting operation by cam 154, around motor relay 80 through lower card lever contacts 20 (now closed since there are cards in the machine), through motor control relay contacts 77 (now closed), thence either through cam contacts 305 or stop key control contacts through conductors to cam contacts 129 (now closed) through one or the other of contacts 550 or 520—540 to the other side of the line and back to source. This circuit initiates the tabulating cycle automatically. The tabulator then continues running by virtue of the closure of the contacts of motor relay 80 until stopped by the automatic control devices at the end of the next card group in the manner heretofore explained. The tablulator is then brought to rest and additional totals may be taken, automatically or manually, the counters reset, and the tabulator restarted again, automatically or manually, as desired.

It will be assumed that a card group has been tabulated and that there are no additional cards in the machine. Provision must be made for interrupting the automatic tabulator starting circuit. Under these conditions the lower card lever control contacts 20 will be interrupted upon the passage of the last card past the lower brushes and therefore will interrupt the automatic starting circuit previously traced and prevent the automatic restarting of the tabulator. It will also be appreciated that when there is no additional card group in the machine upon which the tabulator can start up, that provision must be made to pass the last card of the old group through the machine, since the items must be taken off this card, tabulated, listed, if desired, and a total taken. After the last card of the group passes the upper brushes, the control circuit previously explained as flowing through these brushes is made on all contact blocks and all upper brushes 5. This, in effect, energizes all control circuits plugged in, thereby alowing the card feed to continue and remain uninterrupted until the last card has passed the lower brushes 6 and lower card lever 18, thereby opening the contacts 19—20 controlled by this lever. Opening of contacts 19 opens the circuits to the upper and lower brushes.

By maintaining the control circuit 73 in this manner, relay 76 will keep contacts 77 closed for an extra card cycle after passing the lower brushes, thereby permitting the card feed to continue during that cycle, irrespective of the opening of cam contacts 64.

In this operation it is necessary to insure that the machine stop exactly at the position well known in the art as the D stop position, i. e. the normal home position of the parts of the machine, after the last card has passed out beyond the lower card lever 18. To do this the holding circuit 307 is provided which extends from cam contacts 154—306 to cam contacts 62 thence to relay contacts 77, and thence to the other side of the line through cam contacts 305, cam contacts 129 and contacts 550 which were traced. This holding circuit maintains the tabulator in operation until just before the D position is reached when the holding circuit will be broken by contacts 77 by the de-energization of relay magnet 76 which is effected by the breaking of contacts 64, which contacts are in the automatic control circuit. Just prior to the breaking of the contacts 77, another circuit will maintain the tabulator motor in operation. This circuit is marked 78 and allows current to flow through motor T M clutch magnet 27, motor relay 80, through 78 and one or the other of cam contacts 961 or 79, the former being used in straight tabulating and the latter in listing, thence through contacts 129 and through one or the other of contacts 520—540 or 550 to the other side of the line. Just before the D position is reached either cam contacts 961 or 79 open, thereby interrupting the tabulator motor circuit and bringing the machine to a stop at exactly D position.

Just before the tabulator has come to a stop, under these conditions, the total will be automatically taken and the machine reset under the control of the cam contact devices 105 in the manner previously explained. After this taking of the total and resetting, the machine will not restart on a new tabulating cycle, since the lower card lever contacts 20 are open due to the absence of cards and these open contacts thereby interrupt the entire circuit to the auto start cam contacts 128 thus preventing restarting of the tabulator automatically.

The purpose of the cam contacts 61 is to short circuit the clutch magnet 27 momentarily at the time the armature 89 is being knocked away from said magnet 27 mechanically by means of the pin 98, as previously explained. This insures a positive stopping of the machine and disengagement of the clutch.

Cam contacts 63 serve to control the count-

ing of cards which pass through the machine. These cards may be counted on in desired counter, a suitable plug connection being connected in at 308 which extends to any selected counter magnet plug socket 74.

Cam contacts 305 operate in conjunction with stop key 560 to insure that the machine will come to a stop at the D position when circuit connections are interrupted by the opening of the stop key 560 control contacts.

Cam contact devices 978 in connection with lower card lever contacts 19 serve to control the supply of current to the common plate 92 which is connected to the lower brushes 6. The purpose of this circuit and controlling contacts is to allow current to flow during the passage of a card past the brushes and to interrupt the flow of current at the intervals between the cards so that erroneous additions and printing will not be effected at such times.

The cam contacts 129 serve to open up the tabulator circuit during the totaling and resetting operations so that the tabulator cannot be restarted upon tabulating operations until total taking and resetting is substantially completed.

Cam contacts 100[a] in conjunction with contacts 96 controlled by clutch magnet 27 sreve to prevent the taking of a total or the resetting of the tabulator counters during tabulating operations. These devices are similar to corresponding devices in my previous patent.

The cam contacts 630 serve to control the supply of current to the group indicator magnet 45 at the proper time of the cycle. The purpose of these contacts is to make the circuit to the group indicator magnet after the first card of a group has passed and has set up the proper indication upon the counter wheels and also effected the proper type setting in the printing or listing attachment.

The cam contacts 125 serve to control the flow of current at the proper time to the circuits 221 which lead to the total taking contacts 850 and 860, the former being controlled by cams 840 in the manner described in my previous patent. In circuit with contacts 860 are the printing and listing magnets 380. Contacts 860 when in cooperation with 860[a] are used for listing and when in cooperation with 850 are used for total taking as in my previous patent.

To selectively control the printing of totals from the various counters, three switches, 108, 107 and 139, are provided. By the opening of these switches the printing circuits corresponding to one or the other or all of the counters may be cut out of the operation thereby preventing the taking of a printed total. If it is desired to cut out all the total printing magnets simultaneously, a switch 309 is opened thereby interrupting the circuit to cam contact devices 125.

It will be understood that in the present application, the listing magnets are permanently in circuit with the counter magnets 940 and that whenever registering occurs there will be corresponding energization of the listing magnets. Listing or non-listing will be controlled by the manipulation of the listing lever in the manner explained in my previous patent.

Switch 302, shown in the diagram, is thrown to close a circuit which entirely cuts the automatic control devices out of operation when the machine is to be used on straight tabulating without regard to automatic control when groups change.

Switches 310 and 311 when thrown to closed position, as shown, serve to permit straight tabulating, when switch 302 is thrown to closed position to cut out the automatic control devices. When switch 302 is opened, as shown, and switches 310 and 311 are closed, as shown, controlling will be secured on both counters A and B so far as the controlling columns are connected by plug connections. This is the position used when a counter is split to tabulate on certain wheels and control on other wheels or columns. If all of the wheels for the first counter are to be used for controlling, switch 310 may be either in the position shown or thrown to connect pole 312. In either of these positions the group number or characters will be indicated and printed when the first card passes through, when listing, and repeated when a total is taken. If, however, the counter marked A is to be split, using certain columns for controlling and other columns for indicating, it is necessary to throw the switch 310 to connect with pole 312. In this case, the columns of the counter which are connected and print the group number for the first passing card when listing, repeat the same when totaling and on the columns which are not connected for controlling, a similar group indication and printed record will be made. These latter columns, however, will have no effect in stopping the machine when groups change. Switch 311 is used in a similar manner on the second counter marked "B."

In the drawings I have shown two counters A and B and a third C, the former are to be used for group indicating and controlling, as previously explained. However, only eight of the sixteen columns in these two counters can be used for controlling purposes at any one time.

In taking a total with either or both of switches 311 and 310 thrown over into contact with poles 313 or 312, it is necessary to provide a path for the current flowing through the printing magnets, otherwise the group

number set up on the counters would not be printed. In order to secure a path for the group number printing circuit under these conditions, I provide contacts 314, which contacts are adapted to be closed by means of the armature of reset magnet 620 when this magnet is energized. It will be recalled that magnet 620 is energized during the total printing and resetting operation. Closure of contacts 314 permits the current to flow through a supplementary circuit 315 when switch 310 is thrown over into contact with pole 312. Circuit 315 includes contacts 314 and extends to left side of the line. This circuit permits a group designating number to be imprinted by the printer of counter A in taking a total. When, on the other hand, counter B is being employed and switch 311 is thrown into contact with pole 313, current flows to the line from the printing magnets of counter B through 311, pole 313, part of path 315 including closed contacts 314, to left side of line. This permits a group number to be printed by the printing magnets of the B counter when a total is being taken.

In printing totals it is of course desirable to print some identifying symbol, such as an asterisk (*) or like identifying character. To provide for such character I provide so-called asterisk circuits 316, one for each counter, which includes the usual printing magnet 380 and which extends directly to the left side of the line. The operation of these asterisk printing circuits is controlled directly by the total printing cam contacts 125. It will be understood that these asterisk circuits are not energized at all during the listing operations, since they are only controlled by the total taking contacts.

In the previous descriptions I have referred to counters A, B and C. These counters are of the usual Hollerith type and are contained within the housing similarly marked in Fig. 1. Each of the respective counters has printing elements in connection therewith and certain of the counters also have controlling circuits in connection therewith. These latter printing devices are located within the housing 81 shown to the right in Fig. 1. The controlling devices on the other hand are located within the housing 28 in this figure.

In a printing tabulator the counters not only set up and display the totals but also control the printing of the totals. The counter circuits also control the listing of the items. This requires that the counter magnets 940 which are energized by the punched holes to operate the counters shall, when energized, close a shunt circuit around the brushes and this shunt circuit is provided with contacts 317. The purpose of this arrangement is twofold, one is for taking the arc from the lower brush 6, and the other for maintaining the circuit through the counter magnets 940 and the printing magnets 380. This is in accordance with the regular use of a printing tabulator. Now when the control unit is used with this form of machine the same devices are used but it becomes necessary for the magnets 940 when energized to break the main circuit from the brushes through contacts 318 at the same time that the contacts 317 are closed to complete the shunt circuit. The purpose of breaking the circuits by contacts 318 is to prevent back circuits through the holes of the upper card, upon a comparison of group numbers.

Heretofore in the specification it has been explained that both registers A and B can be used for group indicating and controlling. In actual practice these registers usually contain eight counter-magnets and may therefore be termed as having eight sections which may be plugged in selectively to any columns of the record cards and the sections thereby controlled by the index points in said selected columns. Registers A and B can be split up in any desired manner to designate groups in certain section or sections on one or a plurality of registers. The registers may be similarly split and selectively utilized for automatic controlling. It is also possible to utilize both of these registers for straight accumulating operations or to split them in any desired manner utilizing certain sections in one or a plurality of them for automatic controlling, other sections for group designating or indicating and still other sections for accumulating. It may be explained that in stating that sections of the register are used for controlling that this does not imply that the register device itself is the automatic control. In this case, the section of the register which is utilized for controlling is simply used to set up the control number therein and the other devices heretofore explained in detail actually effect the automatic control. In this connection it may be stated that it is possible to automatically control without plugging in any register or section thereof. To secure such a result the operator directly plugs in from upper brush plug 70 to the control magnet plug 70 and sets switch 302 in the usual manner for controlling. No plug connection is made between 74 and 75 and inasmuch as the register is cut out the group indicator contacts are not plugged into circuit.

It is to be understood that switches 108, 107 and 139 which selectively control the printing of the totals from the various counters include bell crank members 143, the tops of which are shown in reversely illustrated position in Figure 1 of the drawings from the showing of these parts on the diagram. These bell crank members are

controlled in their operation by the reset clutches 142, as in my previous patent. When the resetting clutch of any counter is set to the left this will prevent the resetting of that counter and will also open the corresponding switch 108, 107 or 139 so as to prevent any printing of a total from the counter which is not being reset. On the other hand, if clutch members 142 are thrown in to the right the corresponding counters will be reset, the corresponding switch closed and a total printed of the amount on that counter. In some instances it may be desirable not to reset a counter and to print a total of the amounts thereon. This may be effected by pressing inward on the particular bell crank member 143, which corresponds to the counter which is not being reset whereby 143 can be disengaged from its groove in the knurled resetting clutch sleeve 142. The operator may then displace the selected bell crank member 143, to the right, as shown in Fig. 1, or to the left, as shown in Fig. 22ª, thus maintaining the contacts which are controlled thereby closed. Under these conditions the counter may not be reset but a total will be taken therefrom.

The detailed operation of the machine having been explained a brief statment will be given showing some of the results which can be accomplished upon this machine.

In the first place, the machine can be used as a straight tabulator without listing any items or printing the totals thereof. Usually in this operation the tabulator is driven at a higher tabulating speed and therefore the speed changing device is shifted over to high speed and contacts 520 are opened. The operator also opens non-total printing switch 309 which prevents the printing of totals. The tabulator may be operated now as a straight non-printing tabulator and during the tabulating of the individual items from the record cards the type carriers of the printer will be wholly ineffective. During resetting operations there will be an actuation of the parts of the printing attachment, but inasmuch as the controlling circuits are open there will be no printing of totals.

If it be desired to perform a tabulation of a run of groups of cards and print the totals, switch 309 will be closed thereby permitting a total to be printed at the end of each card group. During such a tabulating operation the listing of the individual items will be entirely suppressed and the only printing which will appear will be the totals of the accumulated items and the corresponding group numbers. By operating a tabulator in this manner it is possible to tabulate and print totals at a comparatively high speed since it is the actuation of the printing attachment which require time in a machine of this class and by suppressing the action of the printing attachment while individual cards are passing through the machine it is possible to operate the same at a much higher speed than if the printing cycle were carried out for each card.

The above operation may be carried out under fully automatic conditions or by partially automatic and partially manual operations. For example, a run of cards can be tabulated and if the automatic control switch 302 is opened in the position shown, the tabulating machine operation will be automatically interrupted when card groups change or when two successive cards differ in their group characteristics. A total-taking operation can now be initiated manually by depressing reset key 580, or if it is desired that this total-taking be initiated automatically, switch 106 is first closed. After total-taking, either automatically or by a manual initiation, the tabulator can be manually restarted upon a new card group or it can be started automatically at the completion of the total-taking operation. For manual restart it is simply necessary to press the start key 570 which initiates a new tabulating cycle. For such an operation the automatic restart switch 130 should be opened, as shown. If this switch is thrown to closed position the restarting of the new tabulating operation will be initiated automatically by the auto-restart cam contact devices.

It may be further explained that the present machine is also adapted to operate in connection with stop cards. If the well-known stop card is used, the tabulating operation will be interrupted when a stop card passes the card levers. Thereafter a total taking and resetting operation may be performed and the machine restarted upon the tabulation of the new group of cards in the manner heretofore explained. It may be mentioned that by placing a plain record card between the two groups of cards and setting the automatic control switch for controlling, the machine will automatically stop at the end of the group, take a total, and restart, since the blank card in effect is a change of designating group numbers in the record cards. A regular stop card placed in the card stack when controlling, acts in a similar manner as a blank card. With the automatic control off and a stop card inserted, it is necessary to turn the stop card upside down to cause the interruption of the tabulating operation and the automatic or manual initiation of total taking. If the total is manually initiated and the selecting device set for automatic restarting, the tabulating operation will automatically recommence on the next group. It may be further explained that when the machine is set for automatic controlling, and the stop card is inserted in the reverse man-

ner in the stack, the machine will automatically interrupt the tabulating operation and make a total, but will not automatically restart. This latter use of stop cards is sometimes of advantage when a grand total is being accumulated on one counter and the other counters are set so that the totals thereof are taken automatically.

If it is desired to list, the listing attachment is thrown into operation by means of the listing lever, as is explained in my previous patent. At the same time the speed control devices are adjusted so that the proper contacts are opened to compel the operation of the tabulator at the lower listing speed. It is now possible to both list the individual items making up an accumulation on any particular counter and to print a total thereof. It may be here explained that the listing of the group numbers differs from the construction of my former patent in that when these group numbers are used for controlling the operation of the tabulator and the taking of a total, the group numbers are not repeated for each tabulated item. In the present embodiment the group numbers when used for controlling, are printed alongside of the first listed item. Thereafter there is no printing of group numbers until the total is taken, when the group number appearing alongside of the first listed item of the group is repeated alongside of the total amount as printed on the record sheet.

In some particular cases it may be desirable to repeat the group number for each listed item when the group numbers are to be used for controlling. In this case it will not be possible to print the group number with the total. To secure this result the operator plugs in on the controlling counter direct from plugs 74 to 75 and omits entirely the plugging in of group indicator contacts 48. When this operation is carried out the switch 310 is thrown to the position shown in the diagram. In printing the record sheet, there will now be a group number printed for each of the items of the group. Controlling will be effected automatically at the end of the group but the group number will not be printed along with the total. When the group number is thus repeated it will be seen that the controlling counter is accumulating group numbers, and if a total is printed there will be a printed record made of the total of the group numbers. Inasmuch as this figure is of no value and only confusing, its printing is preferably suppressed by disconnecting the reset clutch 142 for this counter. This opens up the circuit through either switch 139 or 107, and prevents the printing of the group number totals.

Generally, in statistical work, it is preferable to show the group number at the beginning and end of the group. In some cases it may be desired to suppress the printing of the group number alongside the total. This can be effected by throwing open one or the other of the switches 107 or 139.

It is also possible to print sub-totals on one counter and a grand-total upon another counter. To carry out this operation, both counters which are accumulating items are plugged to the same brushes. The grand total counter clutch 142 is adjusted so that the counter will not be reset. In this way the printing in this counter will be suppresed until it is desired to take a grand total when the reset clutch is thrown in, thereby closing the printing circuit and allowing a grand total to be printed.

Furthermore by the use of the plug connections and by the proper manipulation of the resetting clutch members 142 and the bell cranks 143 and control switches, it is possible to obtain a wide variety of records. Various arrangements of sub-totals, grand totals and accumulative sub-totals may be secured in this manner.

I claim:

1. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means therein for successively and continuously feeding said cards therethrough, an automatic control device provided with means for comparing a pair of said cards and for interrupting the continuous card feed when two successive cards are unlike in their control perforations, a printing device, and means called into operation by said automatic control device for initiating a printing operation thereby.

2. In a card-controlled machine of the class described, in combination, a tabulating machine, a printing device, analyzing means for concurrently analyzing two record cards, automatic controlled means controlled by the aforesaid means for comparing the card readings and means for initiating a printing operation when said two cards which are concurrently analyzed have certain unlike perforations.

3. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a record card which is unlike the preceding record card or cards for interrupting the tabulating operation, a printing device for printing totals of items accumulated in said tabulating machine, and a manual and automatic means for initiating a total-printing operation, said last mentioned means including devices operable selectively at the will of the operator, to predetermine whether an automatic operation will occur or whether a manual operation will be required.

4. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a record card which is unlike the preceding record card for interrupting the tabulating operation, and a printing device controlled from the record card conjointly with the aforesaid means for printing the first group number and the successive item amounts of a group of cards, said printing device having provisions for printing the total of the items tabulated and for printing in correspondence therewith the group number of the items making up said total, said printing device having provisions for suppressing the printing of group numbers between the first card of a group and the total of said group.

5. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a record card which is unlike the preceding record card for interrupting the tabulating operation, a printing device controlled from the record card conjointly with the aforesaid means for printing the first group number and the successive item amounts of a group of cards, said printing device having provisions for printing the total of the items tabulated and for printing in correspondence therewith the group number of the items making up said total, said printing device having provisions for suppressing the printing of group numbers between the first card of a group and the total of said group, and means for initiating the total printing and corresponding group printing operation at the end of a card group.

6. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a record card which is unlike the preceding record card for interrupting the tabulating operation, a printing device controlled from the record card conjointly with the aforesaid means for printing the first group number and the successive item amounts of a group of cards, said printing device having provisions for printing the total of the items tabulated and for printing in correspondence therewith the group number of the items making up said total, said printing device having provisions for suppressing the printing of group numbers between the first card of a group and the total of said group, and automatic means for initiating a total and group printing operation at the end of a card group.

7. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a record card which is unlike the preceding record card for interrupting the tabulating operation, a printing device controlled from the record card conjointly with the aforesaid means for printing the first group number and the successive item amounts of a group of cards, said printing device having provisions for printing the total of the items tabulated and for printing in correspondence therewith the group number of the items making up said total, said printing device having provisions for suppressing the printing of group numbers between the first card of a group and the total of said group, means for initiating a total and group printing operation at the end of the card group, and means for thereafter initiating a tabulating operation upon the succeeding card group.

8. The invention set forth in claim 7 in which the means for initiating a restarting of the tabulator is automatically operable upon the completion of the total-printing operation.

9. The invention set forth in claim 7 in which both manual and automatic means are provided for initiating the total-printing operation at the end of a card group and in which settable means are provided to predetermine whether an automatic operation will occur or whether a manual initiation will be required.

10. The invention set forth in claim 7 in which both manual and automatic means are provided for initiating the restarting tabulating operation upon the completion of total-printing operation and in which settable means are provided to predetermine whether an automatic operation will occur or whether a manual initiation will be required.

11. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a card which is unlike the preceding record card for interrupting the tabulating operation, a printing device for printing totals of items accumulated in said tabulating machine, means for initiating the total-printing operation upon the interruption of the tabulating operation, means for manually or automatically initiating a new tabulating operation upon a new card group after the total-taking operation of the previous group and settable means to predetermine whether an automatic new tabulating operation will occur or whether such new tabulating operation must be manually initiated.

12. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a card which is unlike the preceding

record card for interrupting the tabulating operation, a printing device for printing totals of items accumulated in said tabulating machine, means for automatically initiating the total-printing operation upon the interruption of the tabulating operation without restarting the tabulator upon the succeeding card group.

13. The invention set forth in claim 12 in which means is provided for manually initiating a tabulating operation upon a new card group after the automatic total-taking of the previous group is completed.

14. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a card which is unlike the preceding record card for interrupting the tabulating operation, a printing device controlled from the record card conjointly with the aforesaid means for printing totals of items accumulated in said tabulating machine, means for automatically or manually initiating a total-printing operation upon the interruption of the tabulating operation and settable means to predetermine whether said total printing operation shall be initiated manually or automatically, and means for automatically initiating the tabulating operation of the next card group after the total-taking operation is completed for the previous group.

15. In a card-controlled machine of the class described, in combination, a tabulating machine for accumulating items from record cards, means called into action upon the arrival of a card which is unlike the preceding record card for interrupting the tabulating operation, a printing device controlled from the record card conjointly with the aforesaid means for printing totals of items accumulated in said tabulating machine, means for automatically or manually initiating a total-printing operation upon the interruption of the tabulating operation and settable means to predetermine whether said total printing operation shall be initiated manually or automatically, and means for manually initiating the resumption of tabulating operations upon the succeeding card group after the total is taken of the previous group.

16. In a card-controlled machine of the class described, in combination, a tabulating machine, a printing attachment including type carriers which are normally ineffective and idle during accumulating operations of the tabulating machine, an automatic control device for interrupting the tabulating operation when card groups change, and means for thereafter calling said printing attachment into operation to take a total of the items accumulated by the tabulator.

17. The invention set forth in claim 16 in which the means for calling the printing attachment into operation is automatically operable upon the interruption of the tabulating operation.

18. The invention set forth in claim 16 in which the means for setting the printing attachment into operation, comprises a manually operable member.

19. The invention set forth in claim 16 in which means is provided for initiating a new tabulating operation upon the completion of the total-taking operation.

20. The invention set forth in claim 16 in which automatic means is provided for initiating a new tabulating operation upon the completion of the total-taking.

21. The invention set forth in claim 16 in which both a manually and automatically operable means are provided for initiating the resumption of tabulating operations after total-taking, said last mentioned means selectively operable at the will of the operator.

22. In a card-controlled machine of the class described, in combination, a tabulating machine, analyzing means for perforated records, a printing attachment having driving connections, said attachment being controlled by said analyzing means, an automatic control device controlled conjointly with the printing attachment by the aforesaid analyzing means, said automatic control device having provisions for interrupting the tabulating operation when record groups change, and means operative by disabling the driving connections for said printing attachment for preventing movement and displacement of the printing attachment during tabulating operations.

23. In a card-controlled machine of the class described, in combination, a tabulating machine with provisions for accumulating items from record cards, a printing attachment therefor, automatic control devices adapted to interrupt the operation of the tabulating machine when record card groups change, means controlled by said tabulating machine for preventing the operation of the printing attachment during tabulating operations, and means controlled by the automatic control device and said tabulating machine for initiating a total-printing operation of said printing attachment.

24. In a card-controlled machine of the class described, in combination, a tabulating machine, card analyzing devices therein, means in said tabulating machine for accumulating and setting up therein items from record cards under the control of the aforesaid analyzing devices, a printing attachment having common means controlled by the aforesaid analyzing means for directly setting up items from said cards when listing, said means in the attachment being independent of the devices for setting up items upon the accumulator, independent provi-

sions for setting up upon said common means in said attachment items set up in said tabulator and automatic control devices also controlled by the card analyzing means for changing the operation of the tabulator when cards are analyzed having different controlling characteristics from preceding cards.

25. In a card-controlled machine of the class described, in combination, a tabulating machine, card analyzing devices therein, a printing attachment, common means in said attachment controlled by the aforesaid analyzer for directly setting up items from said cards when listing, independent provisions for setting up upon said common means in said attachment items set up in said tabulator, automatic control devices controlled by the aforesaid analyzer for interrupting the operation of the tabulator when cards are received therein having different controlling characteristics from preceding cards, and means operable after such interruption for initiating a total printing operation of the items accumulated in the tabulator.

26. In a card-controlled machine of the class described, in combination, a tabulating machine with provisions for accumulating items from record cards upon certain counters and setting up in other counters non-accumulative items, a printing attachment having provisions for setting up items directly from said cards for listing, and independent provisions for setting up therein the items accumulated or set up in said tabulator, automatic control devices for interrupting the operation of the tabulator when cards are received therein having different controlling characteristics from preceding cards, and means for initiating an operation of the printing attachment to effect the total printing of the items accumulated by the accumulating tabulator counter and concurrent printing of the items set up in the non-accumulating tabulator counter.

27. In a card-controlled machine of the class described, in combination, a tabulating machine with provisions for accumulating record card items in certain counters, and provisions for setting up other record card items in non-accumulating counters, a printing attachment having provisions setting up items directly from said cards for listing, and independent provisions for setting up therein the items in both the accumulating an non-accumulating tabulator counters, automatic control devices for initiating a printing operation of the accumulative and non-accumulative items set up in said tabulator counters when cards are received in the tabulator having different controlling characteristics from preceding cards.

28. The invention set forth in claim 27 in which means is provided for automatically initiating a new tabulating operation after the printing operation is completed.

29. The invention set forth in claim 27 in which means is provided for manually or automatically initiating a new tabulating operation upon the completion of the printing operation and in which settable means are provided to predetermine whether an automatic operation will occur or whether a manual initiation will be required.

30. In a card controlled machine, in combination, tabulating devices controlled by index points of record cards, printing devices therefor, group designating means adapted to set up and print a single group designation of a group of cards, means for accumulating said designating numbers from a plurality of groups, and means for printing the total thus accumulated.

31. In a tabulating machine, in combination, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record groups change, means for selectively utilizing certain sections of said register to accumulate items from certain card columns, means for utilizing other portions of said register for designating group numbers of items in certain card columns, means for utilizing other sections of said register and certain selected card columns for automatic controlling, and means for printing group numbers, control numbers and totals of accumulated items upon a record sheet.

32. In a tabulating machine, in combination, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record card groups change, manipulative means for utilizing at the will of the operator one or a plurality of said sections of said register and selected card columns for automatic controlling, and means for printing the control numbers upon a record sheet.

33. In a tabulating machine, in combination, a plurality of card controlled registers adapted to be set in accordance with the index points of a record card, an automatic control device for modifying the operation of said tabulating machine when record card groups change, means for selectively utilizing one or more sections in one or a plurality of said registers for automatic controlling, manipulative means for selectively utilizing one or more sections in one or a plurality of said registers for designating group numbers, manipulative means for selectively utilizing one or more sections in

one or a plurality of said registers for accumulating items from record cards, and means for printing upon a record sheet group numbers, control numbers and totals of items accumulated.

34. The invention set forth in claim 33 in which means is provided for printing at the will of the operator data such as control numbers, group numbers, or totals.

35. In a card controlled tabulating machine, in combination, registering devices controlled by record cards, means for feeding record cards therethrough, an emergency stop device for interrupting the tabulator operation at any time during tabulator operation, and means for selectively determining whether tabulating operations should thereafter be resumed to complete the tabulation of a card group or whether a total taking operation should be effected.

36. In a card-controlled tabulating machine, in combination, tabulating devices controlled by record cards, a printing device for printing tabulated card data, a card counting means with provisions for counting the number of cards, said provisions operating irrespective of the position of the location of the perforations in the cards, and means controlled by said counting device for printing card count data upon a record sheet.

37. The combination with a tabulator containing a supplemental set of control contact brushes for the cards so arranged relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, of control magnets, one for each control column on a card, circuits including such magnets under control of the two sets of brushes, contacts controlled by said magnets, a circuit including said contacts and adapted to be completed thereby only when the pairs of control brushes meet perforations in the same positions on two consecutive cards at the same instant, a clutch controlling the movement of the tabulator mechanism, a magnet for operating the same which is controlled in its operation by the said circuit containing the contacts, whereby the clutch will be operated and the tabulator stopped when holes in two consecutive cards under the control brushes are not in the same relative positions thereon.

38. The combination with a tabulator containing a supplemental set of control contact brushes for the cards so arranged relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, circuits adapted to be completed by the simultaneous passage of the corresponding upper and lower brushes over holes in the same relative positions on a card, control magnets, one for each control column on a card and included in such circuits, a motor controlling electromagnet, a circuit containing the same, contacts for making and breaking such circuit dependent for their operation upon that of the said control magnets and adapted to complete the motor control magnet circuit when the control magnets are energized but to break the same when any one or more of such magnets are not energized, whereby the failure of any control magnet to become energized will result in the stoppage of the driving motor.

39. The combination with a tabulator containing a supplemental set of control contact brushes for the card so arranged relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, of a motor control magnet, a circuit containing the same, which circuit is under the control of all of the contact brushes and completed only when pairs of such brushes meet corresponding holes in two consecutive cards at the same time, and is broken when any pair of brushes do not meet such holes at the same instant of time.

40. The combination with a tabulator containing a supplemental set of control contact brushes for the cards so arranged relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, of a motor control relay, a circuit therefor, a plurality of normally separated contacts therein each of which is under the control of one pair of brushes, and closed only when such brushes meet holes under them in the same relative position on two consecutive cards at the same instant, whereby that portion of the motor control relay circuit is completed only when all of said contacts are simultaneously closed by the brushes.

41. The combination with a tubulator containing a supplemental set of control contact brushes for the cards so arranged relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, of a motor control magnet, a circuit therefor which is completed only when all the pairs of operative brushes have passed simultaneously over perforations in the same relative positions on two consecutive cards, and broken when any brush is not over a perforation at such instant of time, and means for resetting the tubulator to zero and restarting the same in operation brought into play upon the stoppage of the tabulator by the said motor control magnet.

42. The combination with the driving mechanism of a tabulator, a clutch control magnet for stopping the same and a supplemental set of control brushes so arranged

relatively to the other brushes that both contact with corresponding points on two consecutive cards at the same instant of time, of an automatic control unit for attachment to the tabulator comprising a control magnet for each control column on the cards, circuit controllers operated by said magnets, a circuit containing said circuit controllers and adapted to be completed only when all of the same are closed by the control magnets, circuits through pairs of brushes including the control magnets and completed only when the two brushes of the several pairs are over perforations in two consecutive cards which are in the same relative positions therein and a motor control relay magnet adapted to operate the clutch control magnet when during any cycle of the apparatus any of the said circuit controllers are not closed and the circuit of the relay magnet not completed.

43. In a tabulating apparatus, in combination with a control device including a card circuit having a serial connection through the perforations of a plurality of cards, said circuit upon being interrupted by a card being adapted to modify the operation of the control device.

44. In a tubulating machine, means for feeding record cards, means for comparing two cards, said means comprising a circuit adapted to be completed serially through the perforations of both cards if said perforations agree and to be interrupted by one or the other of the cards if said perforations disagree.

45. In a tabulating apparatus of the kind described in claim 44, in combination therewith, a magnet in said circuit and contacts controlled by said magnet to control the operation of the machine.

46. In a record card controlled apparatus, a plurality of card reading devices for concurrently coacting with a plurality of record cards, a plurality of circuits each including serially a pair of said reading devices, a single controlling magnet in each of said circuits, and means controlled upon the failure of any single magnet to become energized for modifying the operation of the record card controlled apparatus.

47. In a card controlled machine of the class described, in combination, a tabulating machine to accumulate items from record cards, card analyzing devices in said machine with provisions for concurrently comparing two record cards, an automatic control device controlled by the aforesaid analyzing means for comparing two record cards and interrupting the operation of the machine when said cards are unlike, and selective means for rendering said automatic control device effective or ineffective.

48. In a tabulating machine in combination with a plurality of record controlled registers, an automatic control device for modifying the operation thereof upon the occurrence of group changes in the record cards, means for selectively adjusting the control device for control by the index points in one or a plurality of columns in the record cards and in correspondence with any one or a plurality of columns of said register or registers and manipulative means for selectively controlling any selected columns in said registers for setting up designations of record card groups, said columns being selectable by the operator from any one or a plurality of index point columns on the record cards.

49. In a tabulating machine, in combination, a plurality of record controlled registers, means for selectively coupling said registers for control by the index points in any of a plurality of combinations of columns on the controlling record cards, an automatic control device for changing the operation of said registering devices when card record groups change, means for selectively coupling said control device for control by the index points of one or more columns selected from a plurality of index point columns, means for controlling the operation of certain of said registers or portions thereof to set up and designate group numbers therein and maintain such designation until groups change, and manipulative means for selectively coupling said group designating registers or portions thereof to be determined by the index points of one or more columns selected from a combination of a plurality of columns.

50. In a tabulating machine, in combination, a plurality of card controlled registers adapted to be set in accordance with the index points of record cards, means for selectively utilizing at the will of the operator one or more sections of one or a plurality of said registers for designating the group numbers of record cards, and manipulative means for selectively utilizing at the will of the operator one or more sections in one or a plurality of said registers for accumulating items from said cards.

51. In a tabulating machine, in combination, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record groups change, manipulative means for selectively utilizing certain sections of said register to accumulate items from certain card columns, manipulative means for utilizing other portions of said register for designating group numbers of items in certain card columns, and manipulative means for utilizing other sections of said register and certain selected card columns for automatic controlling.

52. In a tabulating machine, in combina-

tion, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record card groups change, and manipulative means for utilizing one or a plurality of said sections of said register and selected card columns for automatic controlling.

53. In a tabulating machine, in combination, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record groups change, manipulative means for selectively utilizing one or more sections of said register for designating group numbers of items in selected card columns.

54. In a tabulating machine, in combination, a plurality of card controlled registers adapted to be set in accordance with the index points of a record card, an automatic control device for modifying the operation of said tabulating machine when record card groups change, means for selectively utilizing one or more sections in one or a plurality of said registers for automatic controlling, manipulative means for selectively utilizing one or more sections in one or a plurality of said registers for designating group numbers, and manipulative means for selectively utilizing one or more sections in one or a plurality of said registers for accumulating items from record cards.

55. In a tabulating machine in combination with a tabulating machine having a plurality of record controlled registers, and an automatic control device for modifying the operation thereof upon the occurrence of group changes, means for selectively adjusting the control device for control by the index points in any one or a plurality of columns in the record card and in correspondence with any one or a plurality of columns of said register or registers, and means for selectively controlling selected columns only in said register or registers for setting up designations of record card groups, other columns in said registers being available for other operations such as accumulating, the said columns being selectable from any one or a plurality of index point columns on the record card.

56. In a tabulating machine, in combination, a card controlled register having sections thereof adapted for independent control by the index points disposed in various columns of a record card, an automatic control device for modifying the operation of said tabulating machine when record groups change, manipulative means for selectively utilizing certain sections of said register to accumulate items from certain card columns, and manipulative means for selectively utilizing other sections of said register and certain selected card columns for automatic controlling.

In testimony whereof I hereto affix my signature.

CLAIR D. LAKE.