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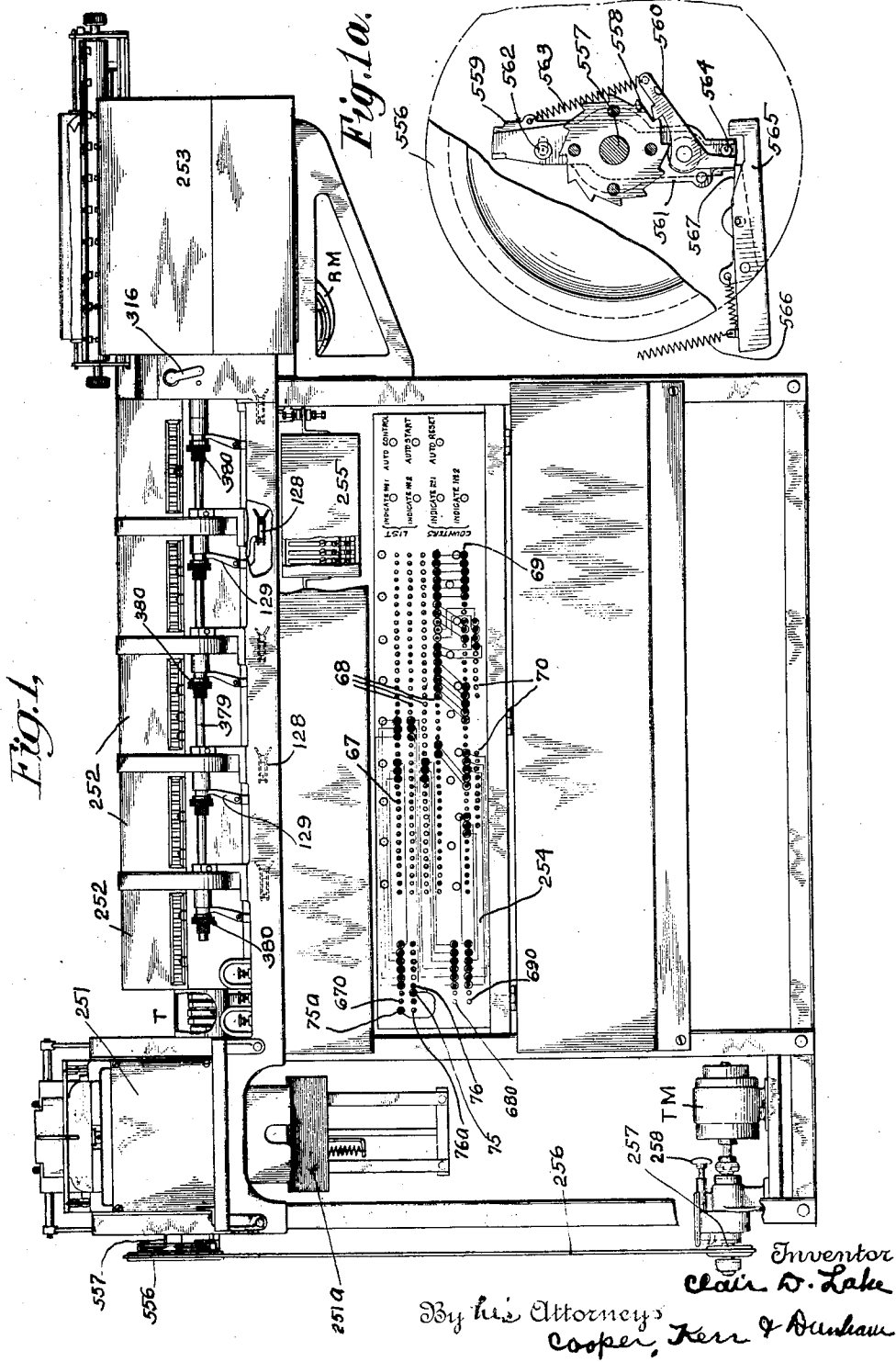
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1,822,594

TABULATING MACHINE

Filed May 15, 1923

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Fig. 2,

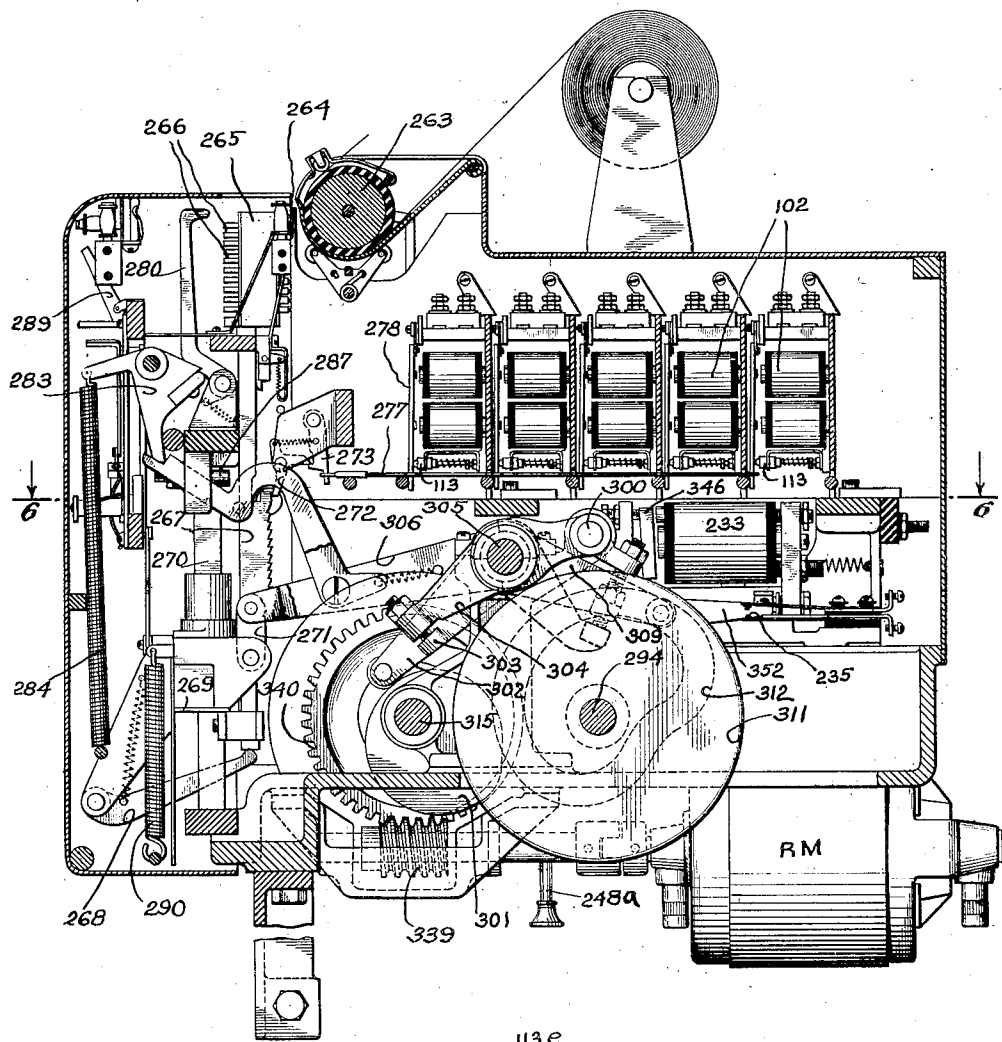
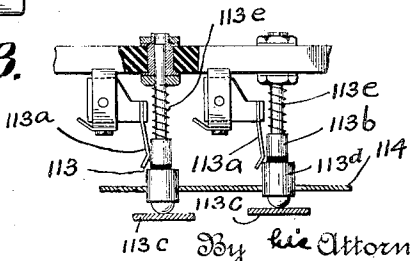


Fig. 8.



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Fig. 3,

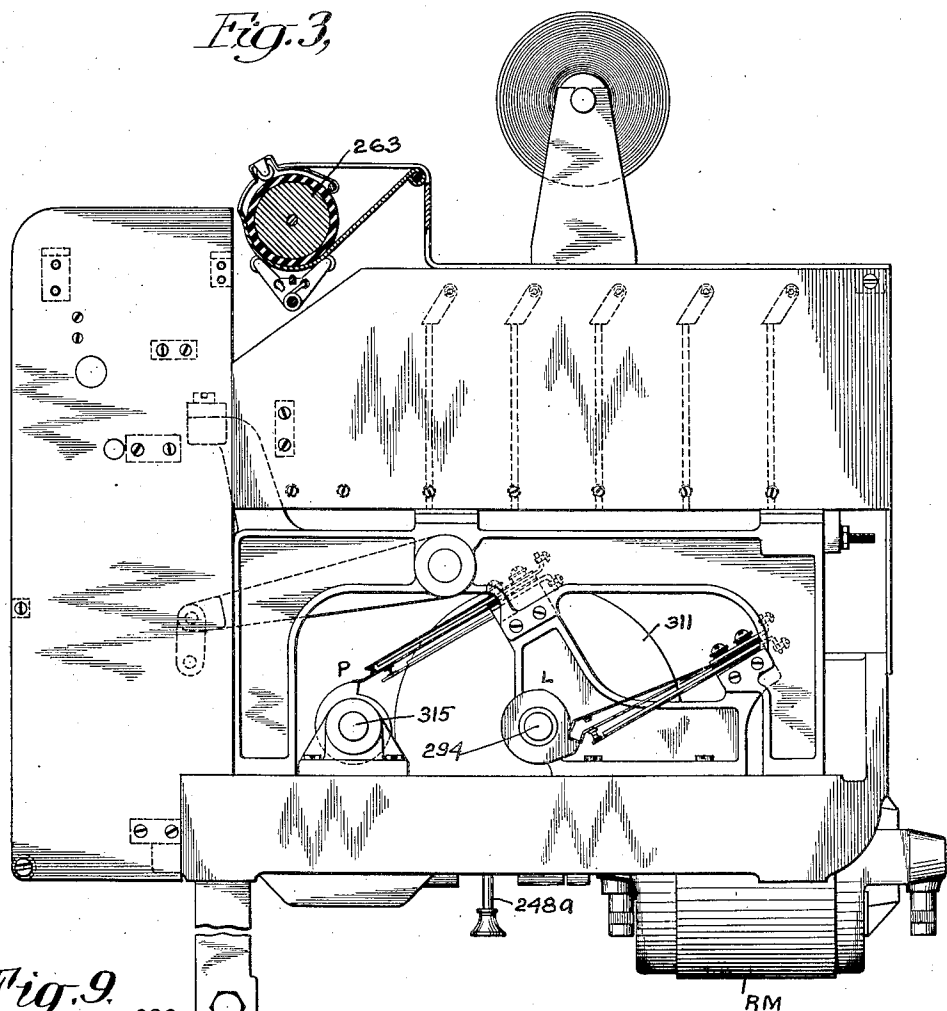
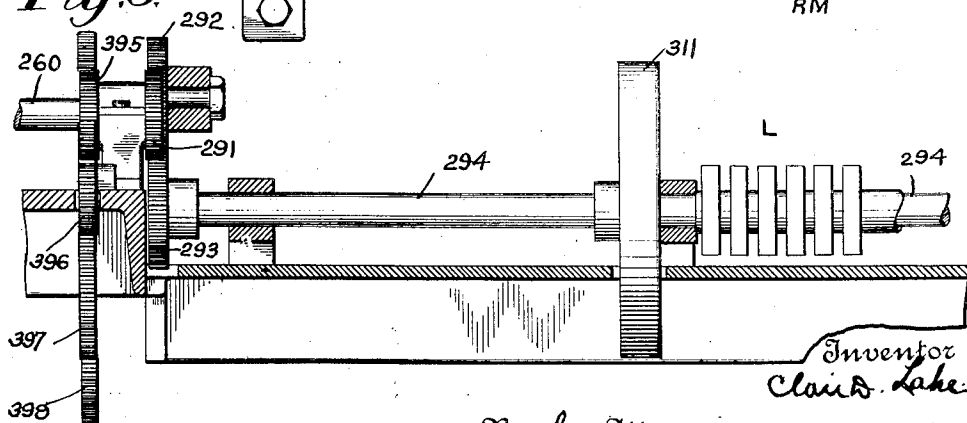


Fig. 9.



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Fig.4,

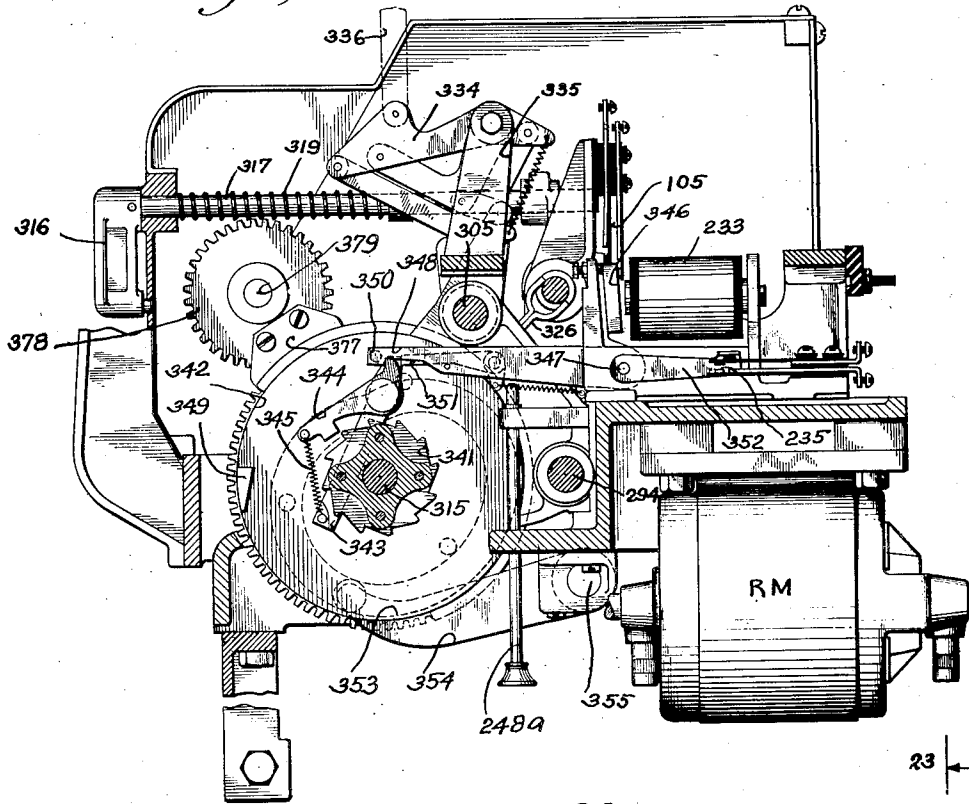


Fig. 22.

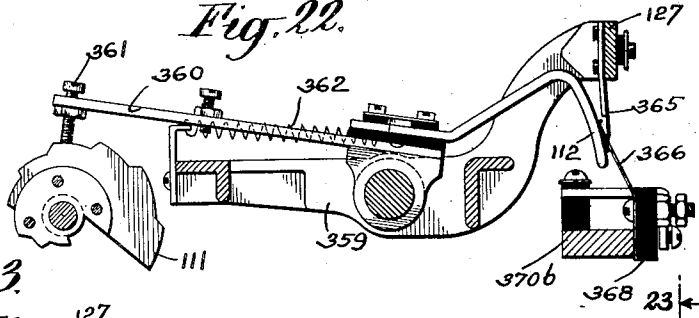
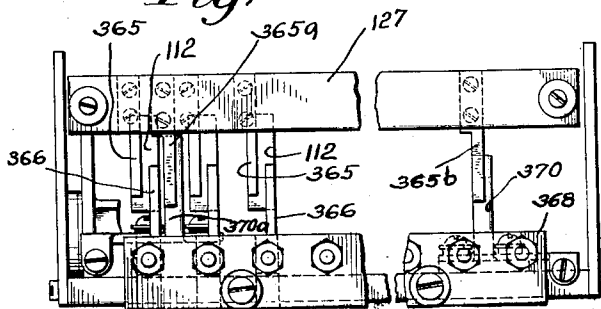


Fig. 23.



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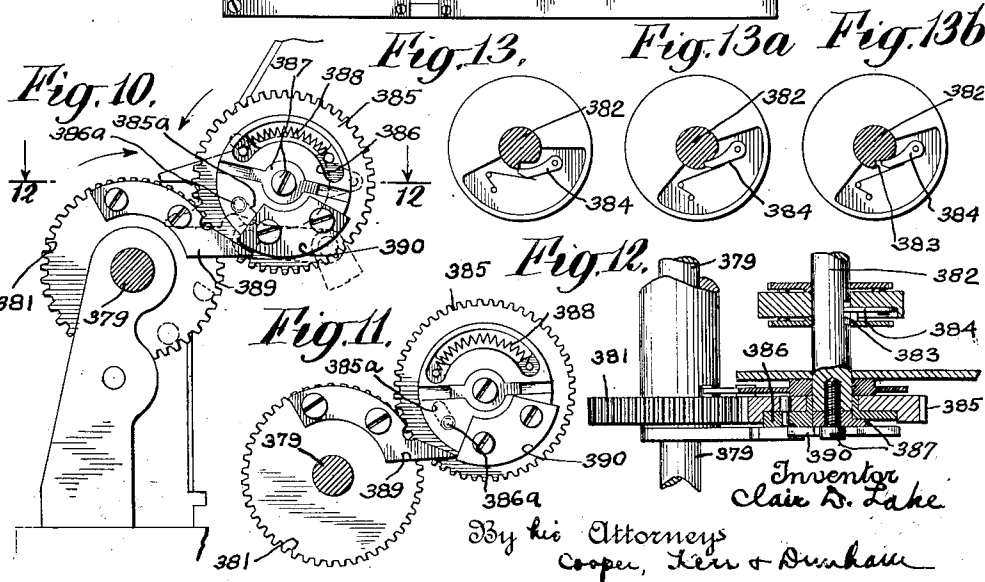
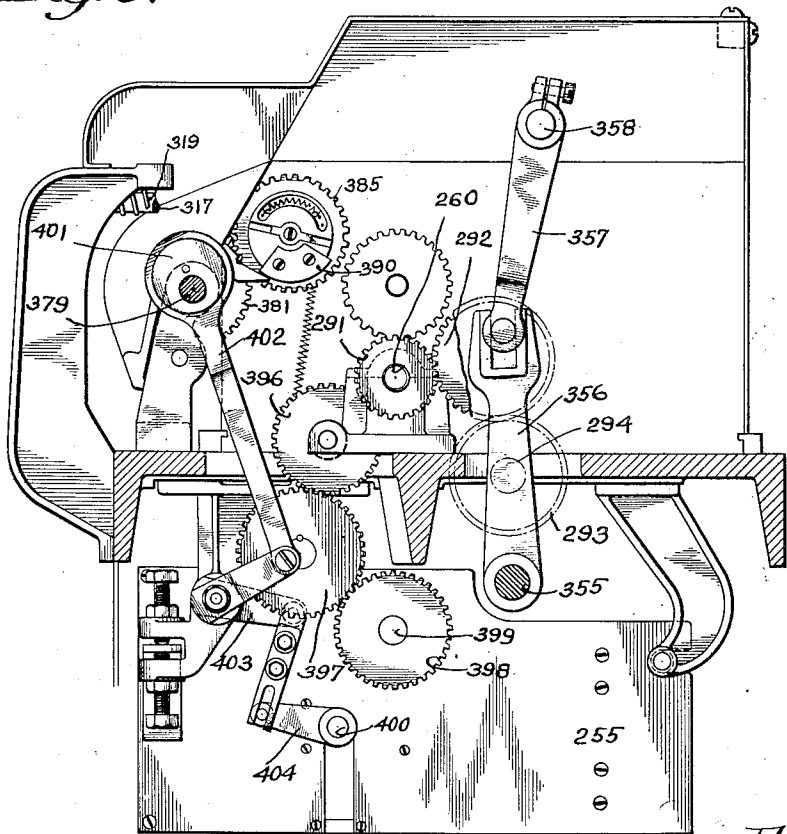
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Fig. 5.



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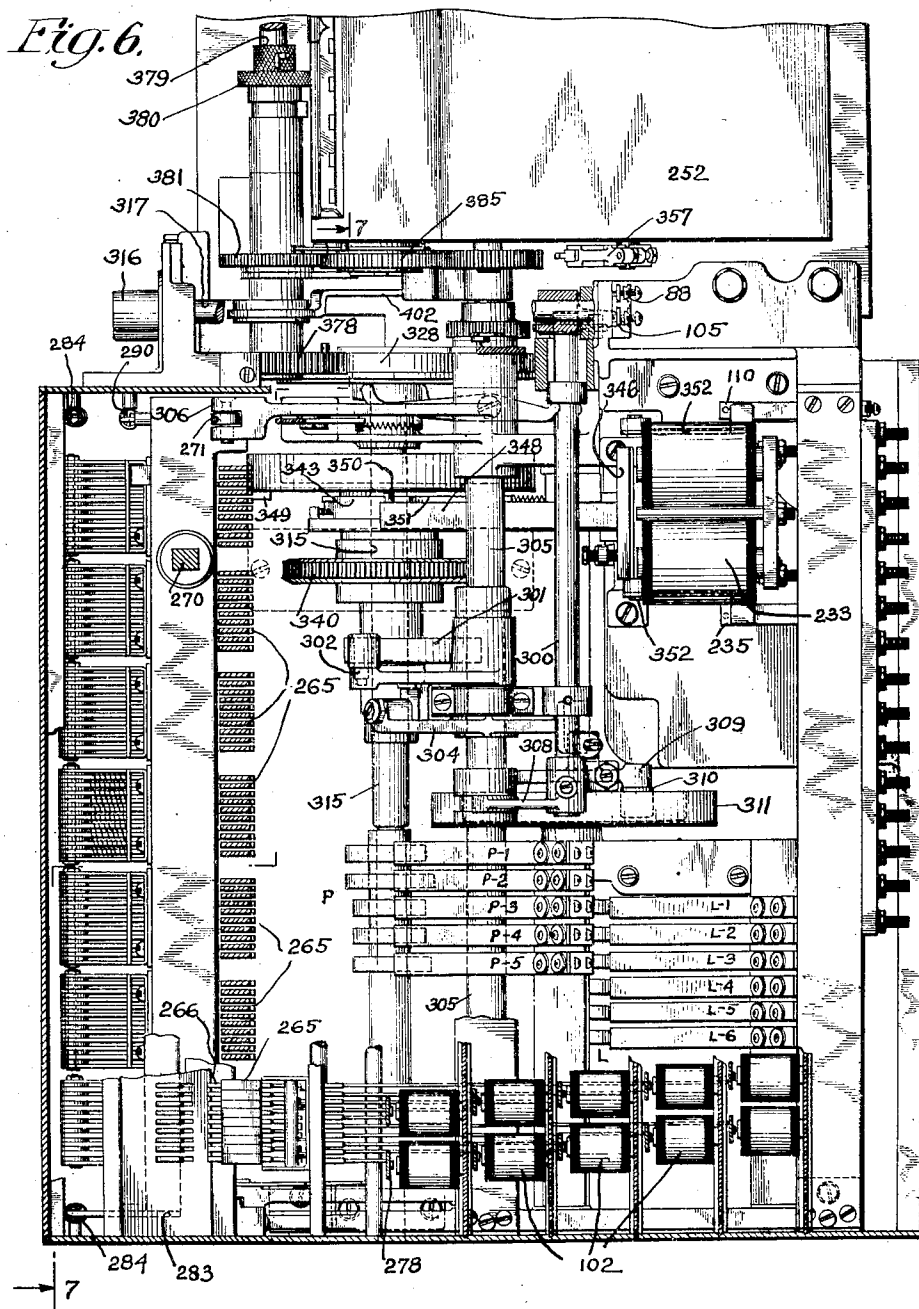
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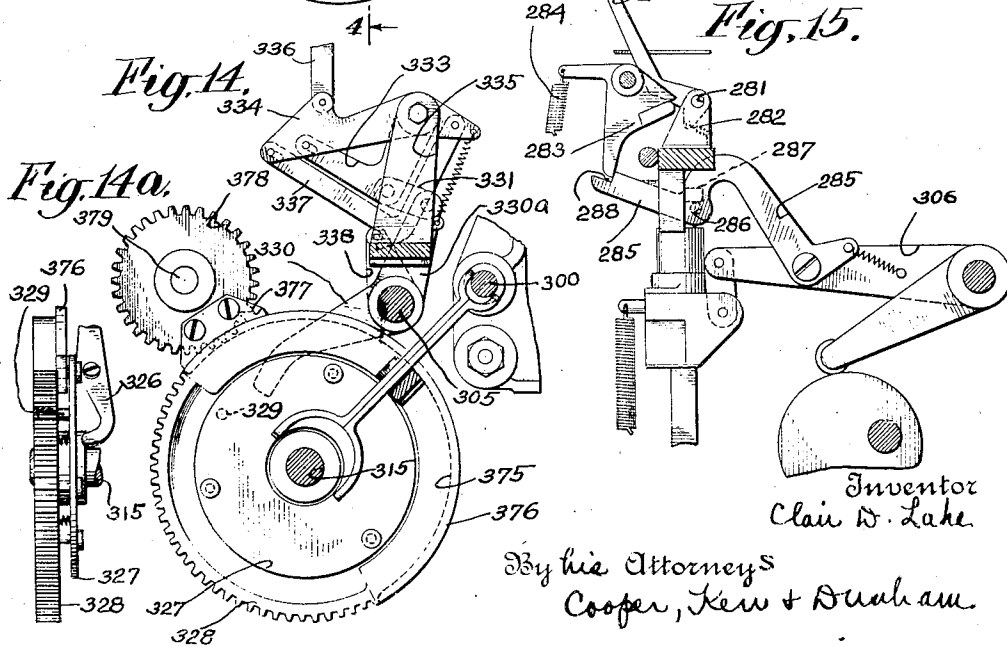
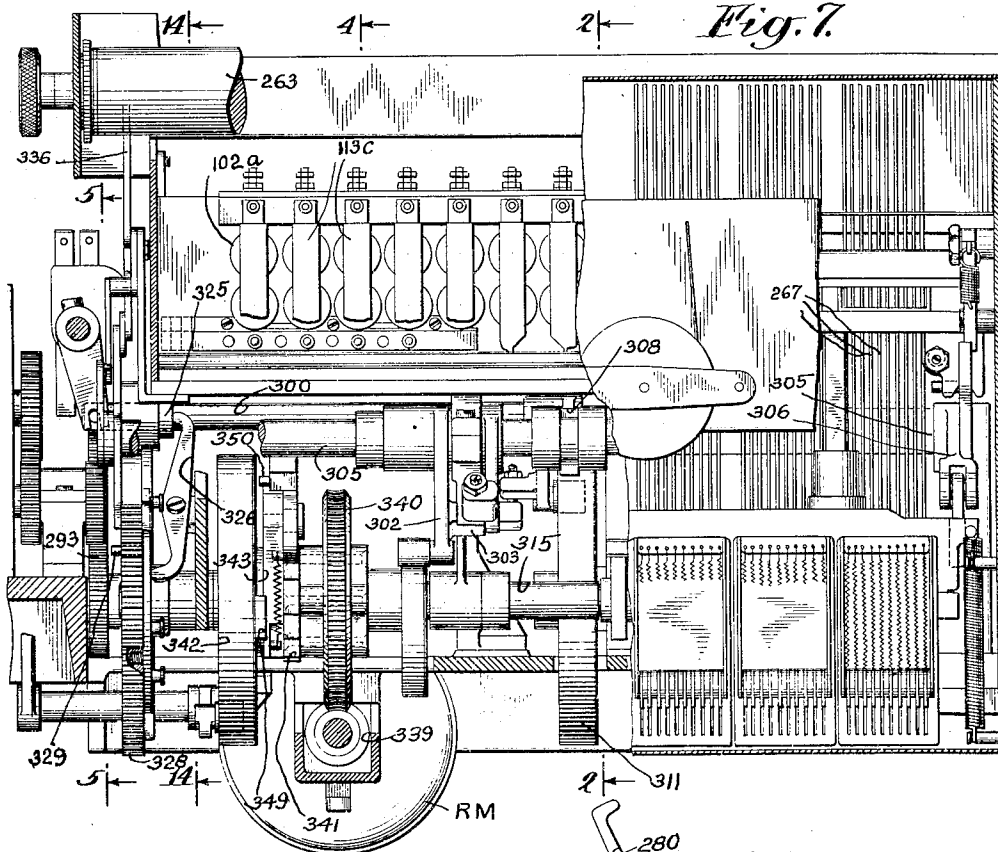
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Fig. 16.

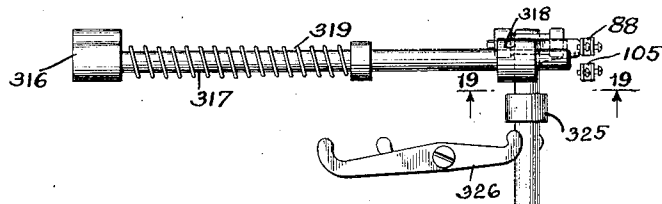


Fig. 17.

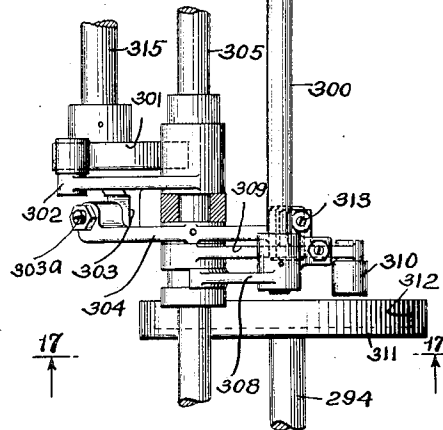
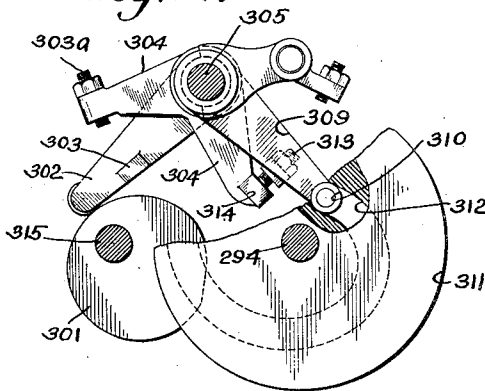


Fig. 18.

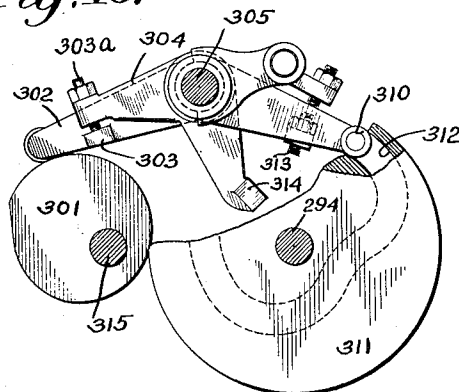
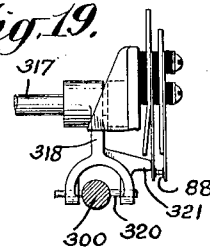


Fig. 19.



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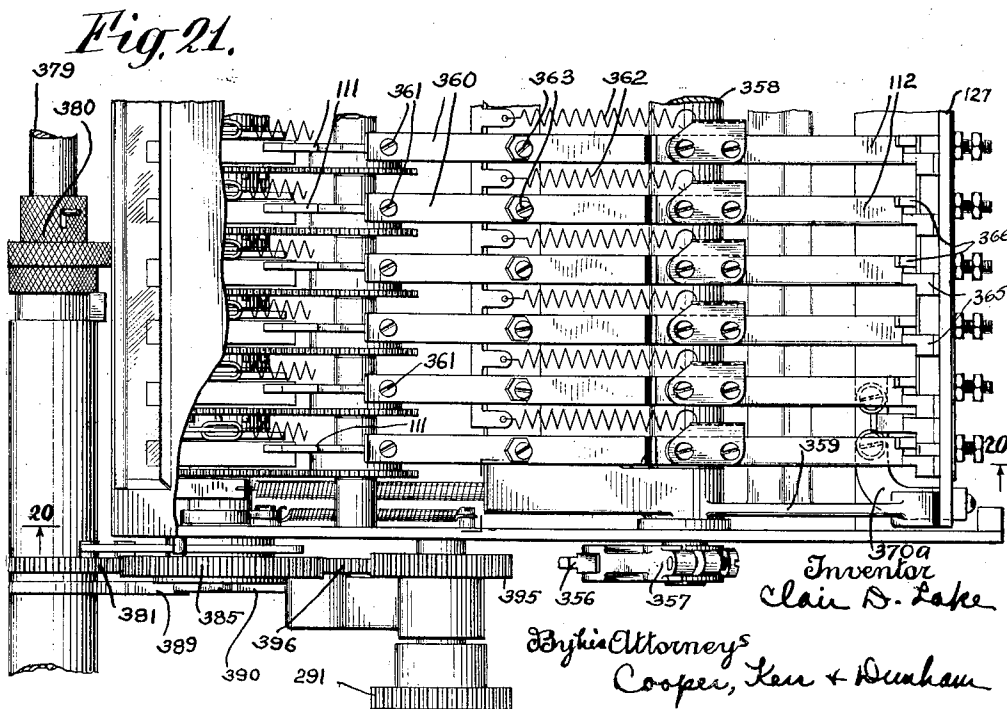
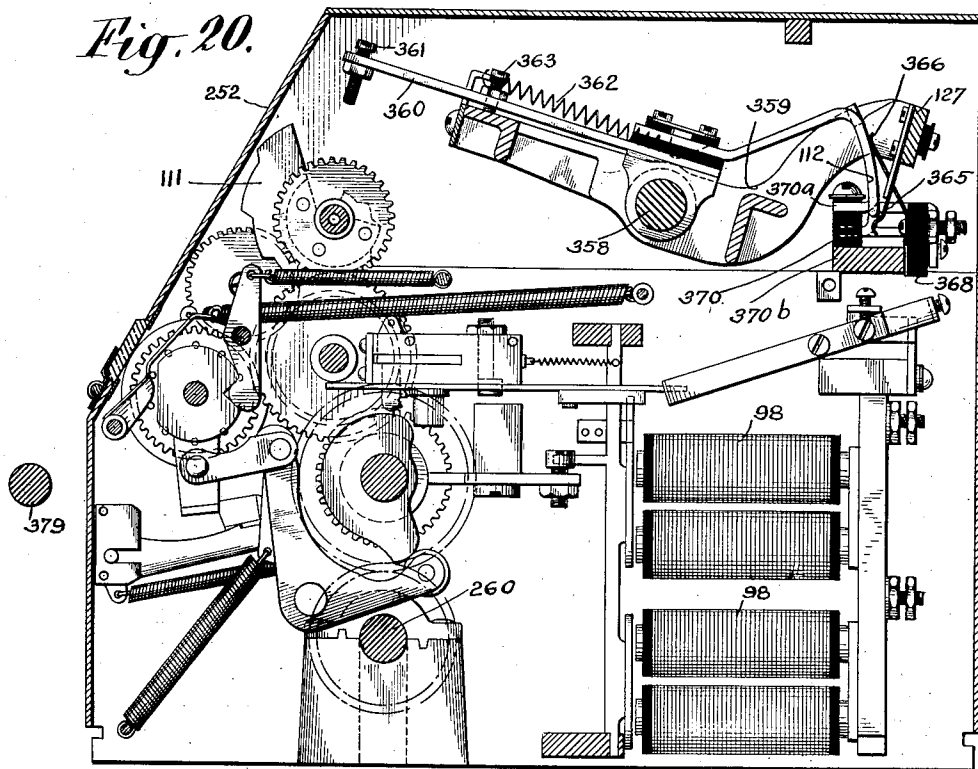
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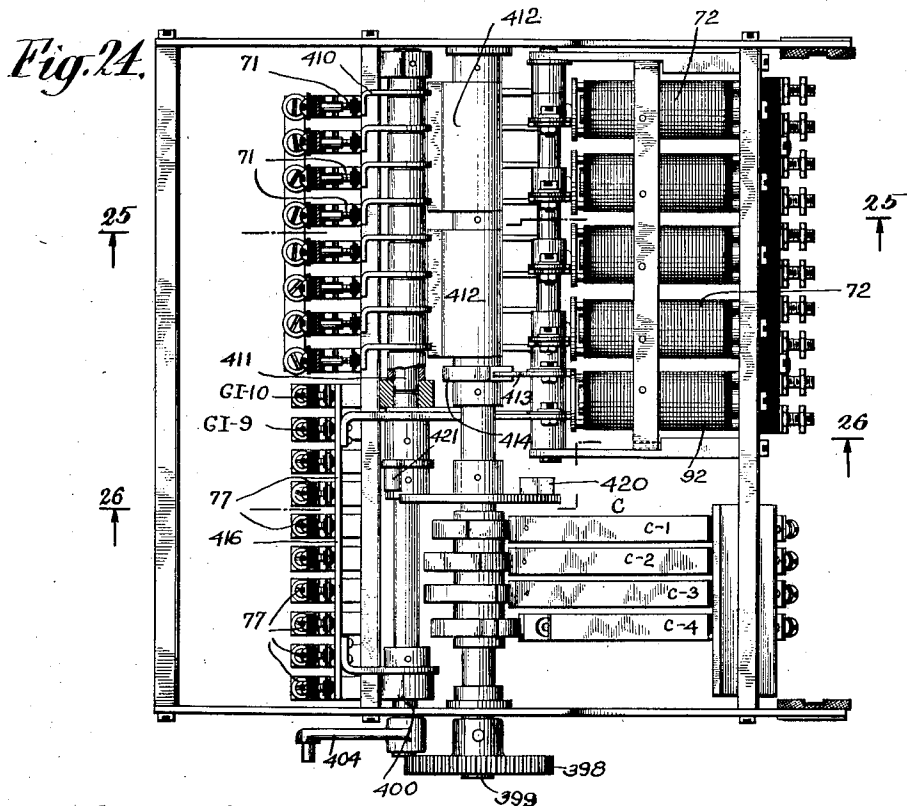
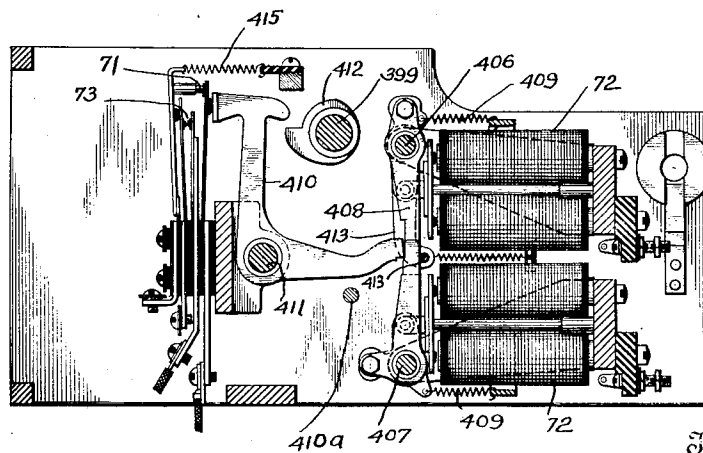


Fig. 25.



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Fig. 26.

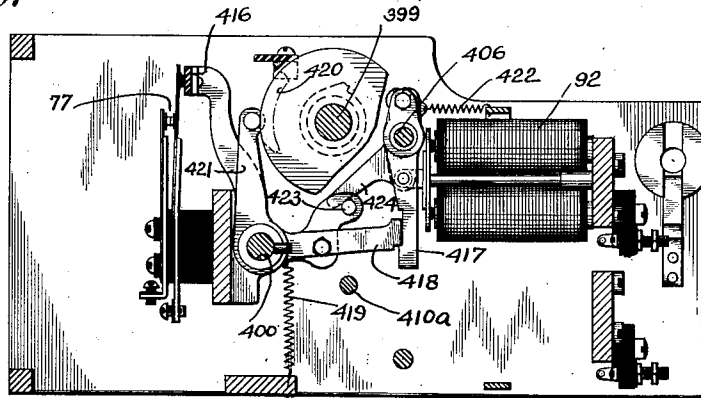


Fig. 27.

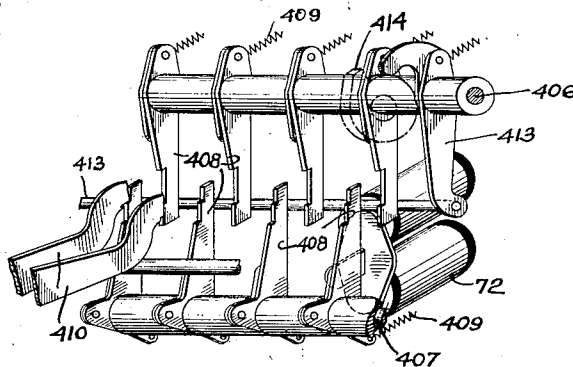


Fig. 28.

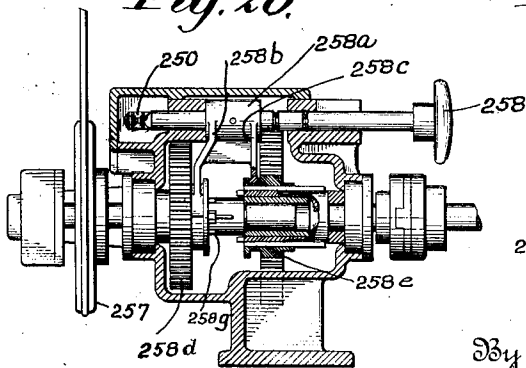
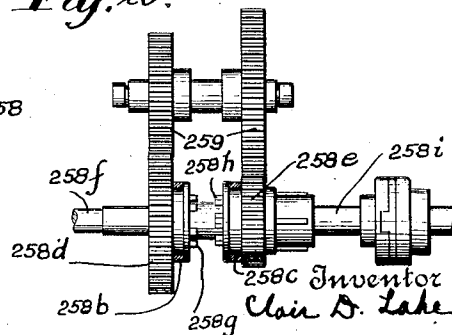


Fig. 29.



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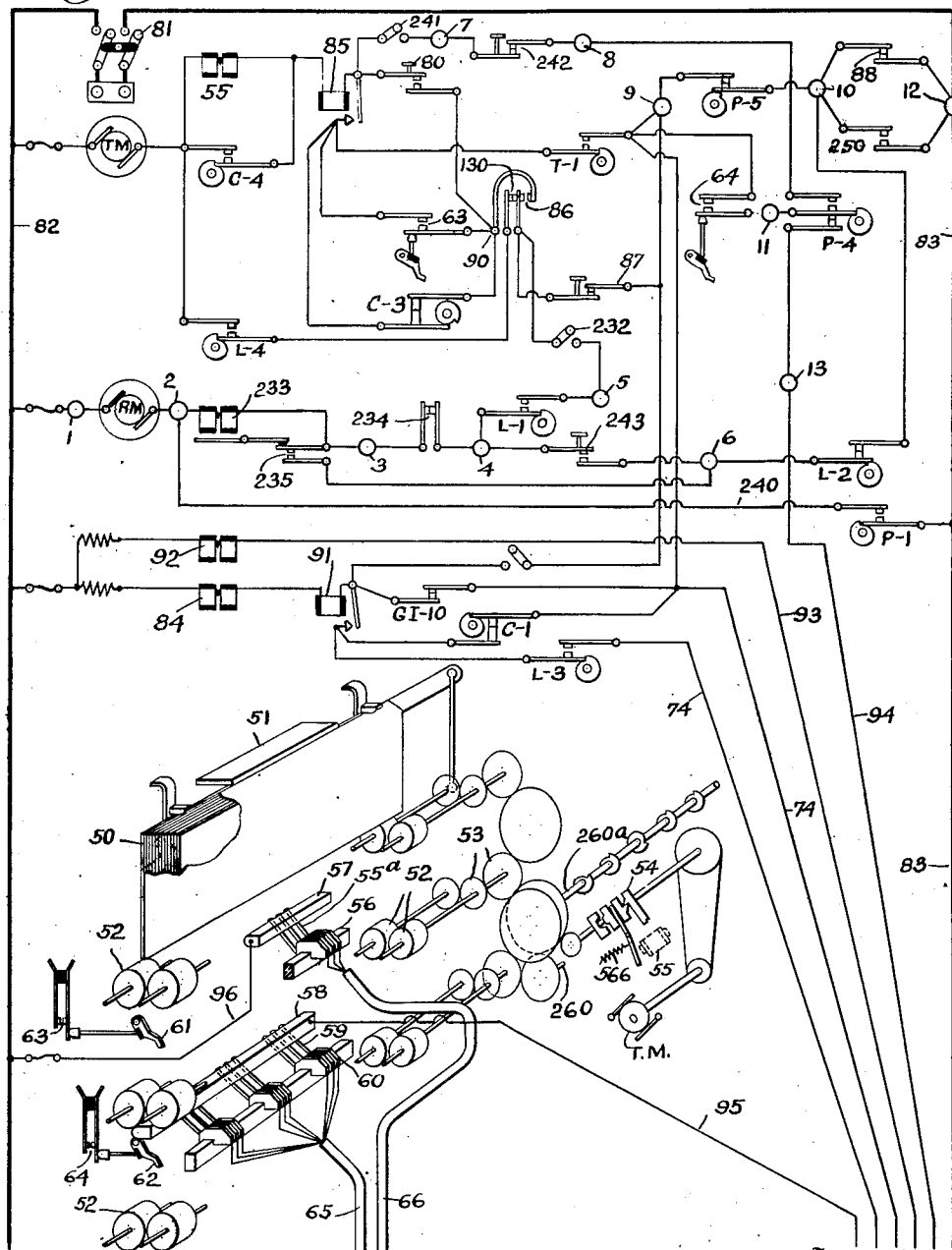
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Fig. 30.



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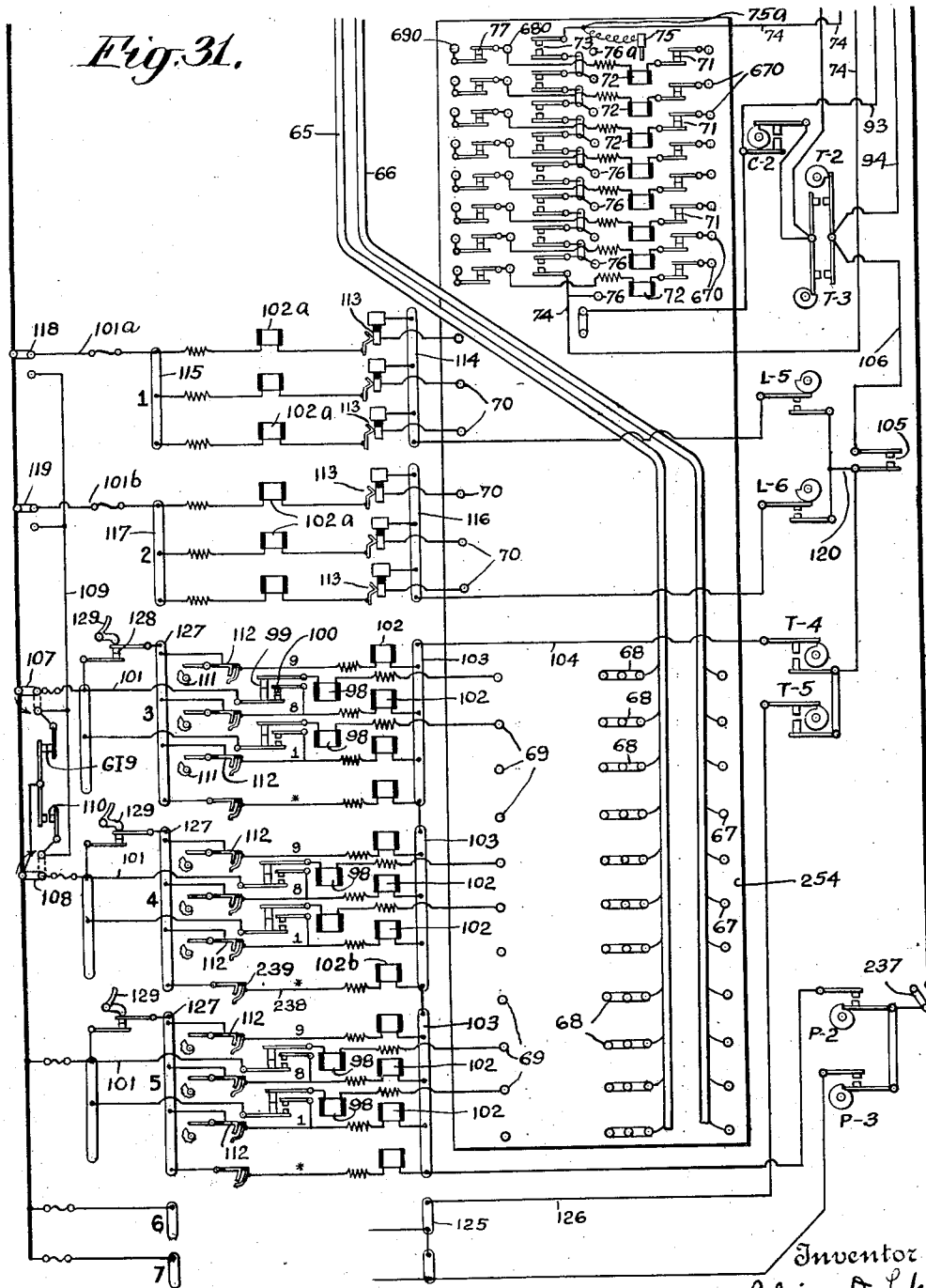
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UNITED STATES PATENT OFFICE

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TABULATING MACHINE

Application filed May 15, 1923. Serial No. 639,153.

This invention relates to automatic tabulating machines and more specifically to printing tabulators.

These machines, as is well known, analyze perforations in record cards. The perforations represent statistics and other information. The machine, after analyzing a card may print the data contained thereon or part thereof upon a sheet of paper. Or it may transmit the data from successive cards to accumulators, printing the totals of data contained on groups of cards. Or it may print data from each card and also the totals of such data for the separate groups of cards. It may also print with each item and total a designation of the group to which the data belongs. Numerous other combinations of this nature may be effected.

Among the objects of the present invention are the increase in flexibility with which these results may be effected and to improve in general upon the mechanism of the machine.

Another object is to overcome the possibility of inadvertently short-circuiting some of the electrical parts of the machine while performing the usual plugging operations.

Another object is to provide means for effecting a special line spacing of the paper upon which records are being printed when totals are printed.

Numerous other objects will appear in the specification and claims which follow.

In the drawings,

Fig. 1 is a front view of a tabulating machine embodying my invention.

Fig. 1a is a detail of the main tabulator clutch.

Fig. 2 is a sectional view taken through the printing section of the machine on line 2—2 of Fig. 7.

Fig. 3 is an end view looking from the right of Fig. 1.

Fig. 4 is a detail sectional view taken substantially on line 4—4 of Fig. 7.

Fig. 5 is a sectional view showing the driving parts outside one of the counters in the machine. This view is taken substantially on line 5—5 of Fig. 7 looking in the direction of the arrow.

Fig. 6 is a view showing a plan view of certain of the driving parts, other parts being shown in section. This view is taken substantially on line 6—6 of Fig. 2. Certain parts shown at the left in Fig. 6 are above the section line 6—6 of Fig. 2.

Fig. 7 is a front elevational view of the printer section of the machine, certain parts being broken away to show the interior construction.

Fig. 8 is a detail view of the switch contact devices which are used on certain of the listing magnets.

Fig. 9 is a detail view of certain of the driving gearing which is utilized in the machine.

Fig. 10 is an enlarged detail view of certain of the reset actuating devices.

Fig. 11 shows the same parts in a moved position.

Fig. 12 is a detail sectional view of these parts, the section being taken on line 12—12 of Fig. 10.

Figs. 13, 13a and 13b are detail views which show different conditions of the reset pawl with respect to the reset shaft.

Fig. 14 is a detail view of the ribbon feed devices. This is a sectional view taken on line 14—14 of Fig. 7.

Fig. 14a is an end view of the lower portion of the mechanism shown in Fig. 14.

Fig. 15 is a detail view of the hammer devices.

Fig. 16 is a detail view of the listing lever and the parts shifted thereby.

Figs. 17 and 18 are sectional views taken on line 17—17 of Fig. 16, showing the parts in different positions.

Fig. 19 is a sectional view taken on line 19—19 of Fig. 16 showing the contact devices which are shifted by the listing lever.

Fig. 20 is a sectional view of one of the counters, the section being taken substantially on line 20—20 of Fig. 21.

Fig. 21 is a top plan view of the counter mechanism showing the total-taking contact members. This is substantially a top view of the parts shown in Fig. 20 with the casing removed.

Fig. 22 is a detail view of one of the con-

tacts shown in Fig. 20 in a moved position in engagement with one of the stepped cams.

Fig. 23 is a view taken on line 23—23 of Fig. 22.

5 Fig. 24 is a top view of the parts in the control and group indicator unit. The cover plate is shown removed.

Fig. 25 is a detail sectional view taken line 25—25 of Fig. 24.

10 Fig. 26 is a detail sectional view taken on line 26—26 of Fig. 24.

Fig. 27 is a perspective view of the electromagnet-controlled latches shown in Figs. 24, 25 and 26.

15 Fig. 28 is a sectional detail view of the transmission and gear changing mechanism which is associated with the tabulating motor.

Fig. 29 is a detail top plan view of the gearing in this transmission device showing the gears in one driving relation.

Figs. 30 and 31 show the circuit diagram of the machine, Fig. 31 being a continuation of Fig. 30.

25 *Circuit diagram*

Before describing in detail the mechanical features of this tabulating machine a brief description will be given of the circuit diagram mentioning the operations which the tabulator is adapted to perform.

20 The operation of the mechanical parts of the tabulator is so inter-related that the energization of magnets and sequential operations of the circuit that an understanding of the operation of the machine may be best obtained from the circuit diagram. In connection with the disclosure of the circuit diagram certain mechanical parts will be diagrammatically illustrated and the operation of these will be briefly described.

Card feed and perforation reading means

25 In the diagram, Fig. 30, 50 designates a stack of record cards which are adapted to be advanced one at a time by means of a picker 51 into engagement with the upper of the feed rolls 52. The feed rolls thereafter advance the card in the usual manner to a discharge stack 251a shown in Fig. 1. Rolls 52 are driven by a gearing generally designated 53 which in turn is driven by a tabulating motor T. M. through the usual magnetically controlled clutch 54. This clutch is controlled by clutch magnet 55. The cards are advanced past upper brushes and contact plugs 55a—56, and thereafter pass lower brushes and contact plugs 59—60. Brushes 55a are carried by a common bar 57 and 30 brushes 59 by a common bar 58. The contact of brushes 55a and 59 with contact plugs 56 and 60 is made through the perforations in the cards. In the diagram only a few brushes are illustrated but it will be understood that these brushes may and usually extend entirely

across the card so as to cooperate with any desired columns therein. Upper and lower card levers 61—62 are provided, which card levers are respectively adapted to close upper and lower card lever contacts 63—64 during the passage of cards under the card levers. When cards are not under the levers these contacts are opened. Suitable wires here shown cabled and indicated at 65 and 66 respectively connect the lower and upper brushes with plug sockets on the tabulator plugboard 254. There is one set of sockets 67 for the various upper brush positions and in addition there are multiple sockets 68 for the lower brushes. The plugboard also includes plug sockets 69 which are connected to the counters and supplemental plug sockets 70 which are directly connected to certain magnets which are utilized solely for listing and which will hereafter be described. In the diagram the entire plugboard is not shown but several plug sockets are indicated to show the plugging operations which may be made. In addition at one end of the plugboard there is shown the circuit diagram of the automatic control and group indicator unit. When certain columns are to be used for automatic controlling, plug connections are inserted between selected sockets 67 and sockets 670 of the automatic control unit. If straight controlling is being performed without group indicating the connection is completed between plug sockets 680 and 68. On the other hand, if group indicating on any desired columns is desired connections may be made between the selected sockets 690 and plug sockets 69. On columns in which there is to be neither control nor group indicating but simply counter energization suitable plug connections are made directly between sockets 68 and 69. Sockets 70 which control listing control magnets may be directly plugged to any of the sockets 68. If desired, the selected sockets 68 may be utilized on columns which are plug connected for automatic controlling. In this case plug connections will be made between 67 and 670, 68 and 680, and 68 and 70. On the other hand, connections could be made from 67 to 670, 68 to 680 and from 690 to 70.

The above description briefly indicates some of the principal plugging operations which may be employed but it will be understood that other combinations may be used as will appeal to the individual operator of the machine or in accordance with the particular tabulating operation which is to be performed.

Control and group indicator unit

The so-called automatic control circuit between the upper and lower brushes when plugged in, as above described, includes contacts 71 and magnets 72. The function of

contacts 71 is to open after the energization of magnets 72 and take the arc from the upper brushes. The energization of magnets 72 is adapted to close corresponding contacts 73 to thereby establish the so-called control circuit 74 which extends the cycle serially through all the contacts 73. This circuit is established on each card cycle so long as cards do not change and when the control perforations in two successive cards agree. If all of the magnets 72 are not utilized such contacts 73 as are left out of circuit are bridged by a plug connection 75 extending from terminal 75a, which plug connection is inserted into one of the sockets 76 (see Fig. 1) which is connected to contacts 73. This enables any number of columns to be used for controlling. If all columns are to be used for controlling the plug 75 is inserted in the unwired plug socket 76a. Contacts 77 are the usual group indicator contacts which function to interrupt the counter circuit after the passage of the first card to suppress the adding in of further amounts upon the tabulating counter used for indicating only until the groups change. These contacts and their operation are common in tabulating machines and for further explanation reference may be made to Hollerith Patent No. 1,087,061.

General features of circuit diagram

It may be explained that in tabulating machines of this type it is common to utilize cam contact devices for controlling certain circuit operations. For clarity in the circuit diagram all cam contact devices which are operated in unison and on common shafts are given similar reference numerals. For instance, there are a group of contacts marked P—1, P—2, P—3, mounted on one shaft, another group marked C—1, C—2, C—3, etc., on another shaft and so on. All contact cams are insulated from each other and from the shaft upon which they are mounted. In placing these cams on the diagram they have been located without regard to their mounting upon common shafts in order to obviate the complications of the circuit connections. Similarly for clarity in the diagram it is necessary to place certain contacts at points remote from their controlling magnets. In this case the operating magnet, if possible, is indicated in dotted lines adjacent the contacts. In addition, on the diagram the tabulating motor marked T. M. has been duplicated. On the diagram there are also certain circles marked with numerals which indicate binding posts as actually utilized on the machine. These binding posts will be referred to in tracing the circuit connections. Current for the entire tabulator is supplied through a suitable source through switch 81 which, when closed, supplies current to left side of line 82 and right side of line 83.

Tabulator operation

It may be explained that prior to the starting up of the tabulator a resetting cycle must be carried out as will hereinafter be described. This resetting cycle which may have taken place at the end of the last card run has energized relay 84 which closes contacts 86. To start the tabulator in operation the operator depresses start key 80. A circuit is established from left side of line, through tabulating motor T. M., clutch magnet 55, motor relay 85, start key 80 now closed, relay contacts 86 now closed, emergency stop key 87 now closed, to binder post 9 thence through cam contacts P—5 now closed, binder post 10, tabulator contacts 88 now closed and to binder post 12 on right side of line. The above operation has started up the tabulating motor T. M. and energized clutch magnet 55 and engaged the one revolution clutch 54 to thereby cause cards to be fed through the machine as heretofore described.

After the initiation of the cycle by the start key, motor relay 85 attracts its armature and establishes a stick circuit to keep the motor in operation. From the contact made by the armature of relay 85 a line extends to the upper card lever contacts 63 and another line is connected to cam contacts T—1. After the machine has operated to a certain amount cam contacts T—1 close and establish a circuit to binder post 9. As soon as the upper card lever contacts are closed another holding circuit is established through these contacts to the terminal 90, thence through contacts 86, stop key 87 and to binder post 9. The card lever contacts 63 maintain the operation of the tabulator while contacts T—1 open once per card cycle provided relay 84 remains energized. In addition to the upper card lever circuit just described there is a circuit to the lower card lever contacts 64. These contacts 64 are connected to binder post 9 and also to binder post 11 and when closed by the passage of cards past the lower card lever establish certain control circuits to the cam contacts T—2 and T—3 which will be hereinafter described.

The tabulator is now in operation and cards successively pass the upper and lower brushes. As heretofore explained so long as these cards agree in their control perforations control circuit 74 is made at each card cycle. This circuit 74 is adapted to maintain the tabulator in operation so long as card groups agree. On the resetting operation contacts GI—10 (group indicator 10) make. Upon the closure of these contacts current flows from left side of line through relay 84, control relay 91, contacts GI—10 now closed, thence to binder post 9 and back to source at the right side of line. After control relay 91 is energized a stick circuit is established through the relay arma-

ture of 91, cam contacts C—1 and back to binder post 9. Cam contacts C—1 break once per card cycle but during the time these contacts break there is a second molding circuit through relay arm of 91 thence through contacts L—3, and through control circuit 74, through control contacts 73 and back through 74 to binder post 9. The circuit just traced including cam contacts C—1 and L—3 control the operation of the machine until card groups change. GI—10 open up after the first card has been tabulated. The circuit is then maintained at all times except for a fragmentary part of the cycle by cam contacts C—1. During the time that C—1 is opened L—3 is closed and if the control circuit 74 is energized at this time the operation of the machine continues. If it is not energized the operation is interrupted since the control relay 91 will be deenergized thereby deenergizing the motor control relay 84. Contacts GI—10 are controlled by a group indicator magnet 92. These contacts break the energization of this magnet which takes place during the initial part of the card cycle. The group indicator magnet 92 is controlled by a circuit traced as follows—from left side of line through magnet 92, wire 93, cam contacts C—2 to cam contacts T—2, T—3, connected in common through these contacts, through wire 94 to binder post 13, thence to lower part of contacts P—4 now closed, binder post 11, lower card lever contacts 64 now closed, and back through binder post 9 to right side of line. The cam contacts T—2 and T—3 are driven in unison with the tabulating motor while cards are feeding through the machine. These contacts establish the circuit just traced during a certain part of the card cycle. The contacts furthermore establish a current supply for the common bar 58 of the lower brushes by means of a connecting wire 95 which is provided for this purpose. The upper brushes 55 receive their current through a wire 96 which is connected direct from the common bar 57.

Counter section

The counter section of the machine is of the type shown in my copending application, Serial No. 569,078, filed June 17, 1922, now Patent Number 1,534,531. Each counter section includes counter magnets 98 which control the tabulating counters in the usual manner and which also upon being energized open contacts 99 and close contacts 100. Contacts 99 are connected by wires 101 to the left side of the line. Contacts 100, when closed, serve to supply current from left side of line through wires 101, through printer control magnets 102, common bars 103, wire 104, through common contacts T—4, contacts 105 which are only closed when listing and thence through wires 106 and 94 back to binder post 13. The contacts 105 are ar-

ranged to be closed only when listing. The purpose of the contacts is to prevent the operation of certain of the printer magnets 102 during times when straight tabulating operations are being performed and when there is no listing. This prevents the wearing out of the parts which are controlled by the magnets 102. In other words, during listing operations all of magnets 102 are adapted to actuate latch 273. But this is not necessary during tabulating operations only. To render these parts inoperative during tabulating operations the contacts 105 are opened.

Referring to the counter bank marked 3 it will be noticed that wire 101 leads to a switch member 107. On the 4th bank there is a similar switch member 108. If counters on the banks marked 3 and 4 are to be used for straight tabulating the switches are thrown direct to the left hand side of the line as shown. If, on the other hand, one or the other of these counters or both are to be used for group indicating, one or the other or both switches can be thrown to an opposite position, as indicated in dotted lines. With this position of the switches, wires 101 are connected to a line 109 from which connection is made from left side of line to contacts GI—9 or the reset magnet contacts 110. Contacts GI—9 are the group indicating contacts which will hereinafter be described and which close during the reset cycle and open after the passage of the first card as is usual with these group indicator constructions. Contacts 110, on the other hand, are utilized to supply current to the printer magnets during total-taking operations when amounts are to be taken off therefrom. These contacts come into action during group indicating operations or during total-taking operations when one or more of the counters are used as group indicators.

In taking off totals or group indicated items from the counters, stepped cams 111 are provided. Contacts designated generally 112, details of which will hereinafter be described, are controlled by these stepped cams. Contact devices rock into engagement with the stepped cams and depending upon the time of closure upon contact with the cams energize the printer magnets 102 at the proper time in the cycle to print the total standing on the counter.

In the present machine there are five counter sections and corresponding to these there are five banks of printing magnets 102 and associated parts in the printing attachment. In addition in the printing attachment there are two extra banks, here marked 1 and 2, on which there are no corresponding counters and by which only straight listing can be effected. The magnets for controlling these simple listing sections of the printer are designated 102a and plugged in as heretofore described. Provision must be made to take

the arc from the lower brushes when these magnets are plug-connected thereto. For this purpose the energization of any magnet 102a is arranged to individually shift the two part insulated switch 113 downwardly from the position shown in the diagram. This action cuts off the circuit to the lower brushes, i. e., from plug sockets 70, and places printing magnets 102a in the circuit between common bars 114 and 115 or 116 and 117. Bars 115 and 117 are connected to left side of line through the switches 118—119. These switches can furthermore be selectively swung to connect with the switch points on line 109. These will permit the group indicator contacts GI—9 to come into action so that the additional listing banks can be controlled so as to print only the record from the first card of the group and to thereafter suppress the printing until the group changes and until a new card of the next group passes through the machine. Bars 114 and 116 are respectively connected to the cam contacts L—5 and L—6. These contacts on the other side thereof are joined in common to a wire 120 which leads to contacts 105 and through these contacts when closed receives current through wire 106, wire 94, binder post 13, lower contacts P—4, binder post 11 and through the circuit previously traced. By reason of the contacts 105 being placed in the circuit just traced it is essential that these contacts be closed when listing is desired on the two additional banks.

By proper plugging and by manipulation of the switches 118—119 the extra listing banks marked 1 and 2 may be used for printing control numbers. This will permit any of the eight columns of the two extra banks to control the printing of control numbers upon the passage of the first card of the group, which number will not be repeated by reason of the group indicator contacts GI—9. If desired the extra listing banks can be used solely for control numbers and others of the counters 3 and 4 may be used for group indicator numbers. Still other counters can then be used for direct accumulation. At the bottom of the diagram there is indicated diagrammatically two extra counter banks. These banks have common bars 125 and control of current thereto is supplied through wire 126 from cam contact devices T—5.

The circuit for printing totals or group numbers concurrently with the totals is controlled from contacts 112. These contacts connect to common bars 127, which bars in turn are connected to wires 101 through contacts 128 which are in turn controlled by bell crank switch members 129. Contacts 128 are opened when the counters are disengaged from the resetting mechanism.

Cam contact C—3 is provided to maintain the tabulating motor T. M. in operation after

the opening of the card lever contacts 63 when the last card of a stack has passed the upper card lever. The function of these cam contact devices is to carry the last card of the stack down past the lower brushes in order to permit the accumulation or the printing of the amounts therefrom. Cam contacts C—3 operate in conjunction with cam contacts T—1 and are parallel with them.

Cam contacts C—4 serve to deenergize clutch magnet 55 once per card cycle by providing a short circuit path around same. This clutch magnet also causes the machine to stop at the well known D position.

When a card group changes the control circuit 74 is interrupted. Then upon the opening of the cam contacts C—1 control relay 91 and motor control relay 84 are deenergized. Thereafter the tabulating operation is carried on until a card reaches the D position by the contacts L—4 which close after motor control relay 84 has become deenergized thus allowing current to flow from the left side of line through the tabulating motor T. M., cam contacts L—4, center contacts 130 of relay 84 now closed, thence through stop key 87 closed, to binder post 9 and back to line. Slightly later in the cycle the contacts L—4 open and finally bring the tabulator to a stop at the D position. The contacts L—3 are in the nature of safety contacts and serve to prevent the blowing of fuses when the machine is being plugged up by opening the circuit through 74. Such blowing of fuses heretofore occurred when the plug 75 was touched against one of the plugs inserted in one of the sockets 670 when the tabulator was stopped and no cards in the machine. The cam contact devices L—5 and L—6 serve to take the arc from the switch devices 113 during the operation of the machine.

Resetting and printing operations

After the tabulation of the group is completed the resetting and printing of a total may be effected. This operation can be initiated manually or automatically. If automatic initiation is desired switch 232 is first closed. The cam contacts L—1 then automatically close just as the tabulator comes to rest to establish a circuit to the resetting motor RM traced as follows—from left side of line, through binder post 1, reset motor RM, binder post 2, reset clutch magnet 233, binder post 3, contacts 234 which are closed at all times when clutch magnets 55 are deenergized, binder post 4, contacts L—1, binder post 5, switch 232, stop key 87, back to binder post 9 to the other side of line. The energization of the reset clutch magnet 233 attracts its armature and closes contacts 235 which establish a holding circuit for the reset magnet 233 traced as follows—from binder post 2, reset clutch magnet 233, through con-

contacts 235, binder post 6, thence through contacts L—2 now closed, up to binder post 10 and back to the right side of line. While reset motor RM is rotating and reset magnet 233 energized, a suitable clutch member hereinafter described in detail will rotate a reset shaft and reset the counters to zero. Prior to such resetting the printing of the total standing upon the counters or the group numbers thereon is effected. For effecting this printing the stepped cams 111 heretofore mentioned are utilized. During such printing operations cam contacts P—2 and P—3 shown in the lower part of the diagram serve to supply current to the common bars 103 and 125 of the counter and printer magnet sections. The common circuit from the right side of line to the cam contact devices P—2 and P—3 leads through a non-total printing switch 237 which, when opened, suppresses the printing of totals. The actual printing operation is controlled from the stepped cams 111 previously mentioned. In addition to printing a total a supplementary asterisk circuit 238 is provided with an individual magnet 102b for each counter. Contacts 239 control this asterisk circuit to permit the energization of 102b at the times totals are printed. During resetting and total printing operations provision is made for preventing the starting up of the tabulator until the printing and resetting is completed. This is effected through cam contacts P—5 which interrupt the main circuit of the tabulator from binder post 9 to the right side of line.

The cam contacts P—1 serve at the proper time in the resetting cycle to establish a circuit 240 to binder post 2 to shunt out the reset magnet 233. These contacts serve to maintain the reset motor RM in operation until the end of the reset cycle and upon being opened interrupt the resetting operation bringing the reset motor to rest. Just before the resetting operation is completed upper contacts P—4 close. The closure of these contacts provided the automatic start switch 241 is previously closed establishes a circuit through motor relay 85 to restart the tabulating operation upon the next group. This circuit is traced as follows—from left side of line through tabulator motor TM, clutch magnet 55, relay 85, auto start switch 241 closed, binder post 7, emergency stop key 242, binder post 8, the upper of contacts P—4 now closed, binder post 11, lower card lever contacts 64 closed, if there are still cards in the machine, and thence back to binder post 9. The purpose of this circuit just traced is to permit the automatic starting of the tabulator if there are additional cards in the machine. If switch 241 is open the tabulator is not started automatically but may be restarted by depressing start key 80. The automatic start-up contacts, namely, the upper of contacts

P—4 break immediately after the usual holding circuits are established for the operation of the tabulator, and at the time the P group of cams come to rest these upper contacts are open, as shown.

If automatic total printing and resetting is not desired switch 232 may be opened and the initiation of resetting effected by the depression of the reset key 243. If at any time it is desired to stop the machine the emergency stop keys 87 or 242 are opened. In practice in the machine these keys are interlocked so that the opening of emergency stop key 87 will open stop key 242. The opening of the stop key 87 opens the circuit to contacts 86. Thereafter the machine will stop at the D position upon the opening of cam contacts T—1. If the emergency stop key by chance were pressed at the end of a card group and the tabulator were set for automatic starting up it might happen that the tabulator would automatically start up upon the closure of the emergency stop key. For this purpose the emergency stop key 242 with its control contacts are provided and these contacts are interlocked with a stop key 87 so as to interrupt the automatic start circuit under these conditions.

Contacts 250 are those commonly used in machines of this type for preventing the operation of the tabulating machines at its excessive speeds when listing. These contacts 250 are located in the transmission device which is interposed between the tabulating motor and the tabulating machine. The arrangement is such that when the machine is adjusted for listing contacts 88 are opened. It is then impossible to start up and operate the machine unless contacts 250 are closed and such closure can only be effected by adjusting the transmission device to operate the tabulator at the lower listing speed.

General arrangement of the machine

Fig. 1 shows the general arrangement of the machine. As with the usual tabulators of this sort the machine comprises a card feeding section 251, a counter section including in the present embodiment five counters indicated generally at 252, and to the right a printing section 253. Disposed below the counter section machine is the usual tabulator plug-board 254 and also within the inside of the lower part of the machine is a control box 255.

The tabulator is driven by tabulating motor T. M. through a belt 256, which belt cooperates with a suitable pulley on the tabulating machine and with the corresponding pulley on a transmission which is indicated at 257 in Fig. 1. This transmission is for the purpose of permitting the tabulator to be driven at a lower or higher speed. As shown in Figs. 28 and 29 it includes a shifter member 258 which, when thrown to the left, closes the contacts 250 and concurrently sets the gearing

so as to drive the tabulator at a reduced or listing speed. When the shifter lever 258 is moved to the right the gearing is so changed that the tabulator is driven at the higher or tabulating speed. Fixed on the stem of shifter member 258 is a bracket 258a having forked arms 258b, 258c engaging flanged collars on gears 258d, 258e. Gear 258d is splined on the driven shaft 258f and has fixed thereto a clutch member 258g adapted to engage a clutch member 258h fixed on the motor or driving shaft 258i. The gear 258e is splined on the clutch member 258h. Thus, when the shifter member 258 is moved to the right as viewed in Fig. 28 it disengages gears 258d, 258e from gears 259 and at the same time couples the clutch members 258g, 258h.

The usual tabulating clutch is provided which is magnetically operated and adapted to couple the motor T. M. with the card feeding section of the machine. The details of this clutch are shown in Fig. 1a. The pulley 556 which is driven by the belt 256 from the motor T. M. is mounted loosely on the shaft 557 and has fixed thereon a ratchet 558. Fixed on the shaft 557 is a double arm 559 carrying a pawl 560 adapted to cooperate with the ratchet. Adjacent arm 559 is a somewhat similar arm 561 loose on the shaft 557 and free to move within the limits of a pin and slot connection 562 with the arm 559. The pawl 560 is drawn into engagement with ratchet 558 by a spring 563 connected to the arm 559. The rear end of the pawl engages a pin 564 on the arm 561 and through the power of its spring 563 passes the arm 561 ahead of arm 559 a distance equal to the amount of play in the pin and slot 562. When the magnet 55 is de-energized the latch 565 is drawn by its spring 566 into the path of the rotating arms. The arm 561 being slightly in advance engages the latch first and is stopped, while the other parts tend to continue to turn. This relative movement causes pin 564 to press against the rear end of pawl 560, lifting the latter out of engagement with ratchet 558. This breaks the coupling between the pulley 556 and shaft 557. As soon as this has taken place, the arm 559 also engages the latch 565 and shaft 557 is brought to a positive stop. A locking pawl 567 carried by latch 565 serves to prevent rebound of the arms 559, 561 when they are stopped. When, in starting the machine, the magnet 55 is energized, it actuates the latch 565 to release arms 559, 561. The spring 563 then pulls pawl 560 into engagement with ratchet 558. This also causes arm 561 to turn slightly ahead of arm 559.

The main tabulator drive shaft 260 (Figs. 9, 20 and 30) extends transversely across the machine, makes more than one revolution per card cycle and is driven by a gear mounted on cam shaft 260a and operates the various counter devices and also parts in the print-

ing attachment 253. Cam shaft 260a makes one revolution per card cycle. Mounted on the cam shaft 260a are the so-called T group of cams, the location of which is indicated in Figs. 1 and 30. The counters utilized are all driven from this main shaft 260 by the usual gearing indicated diagrammatically in Fig. 30. These counters are of the usual type such as are shown and described in my Patent No. 1,307,740, and copending application, Serial No. 569,078, now Patent Number 1,534,531. Each counter includes the stepped cams 111 which are geared into the counter wheels in the manner described in my Patent No. 1,379,268.

Before describing the details of the printing mechanism the various printing and cycle operations will be first briefly explained.

First—For straight listing the printing devices are operated in unison with the tabulating devices so as to list selected data from each group. When running under these conditions the printing devices will be driven from the main tabulator drive shaft.

Second—After listing a number of items as set forth in the preceding paragraph it may be desired to take a total. In this case the tabulating end of the machine will be stopped and under these conditions drive for the printing section of the machine will be secured through a reset motor which will, upon the first part of the revolution, drive the printing devices and take a total or read an amount from one or more of the counters, and subsequently, during the second part of the revolution this same reset motor will reset such tabulator counters to zero as are selected for resetting.

In order to carry out the above cycle provision is made for actuating certain parts of the printing devices, namely, the type carriers, hammers and like mechanism, alternatively either from a so-called listing shaft which is driven by the tabulator or from a total-taking or reset shaft driven by the reset motor.

Third—There is a third condition of operation, namely, when the listing of individual cards is not desired in which a printing device is only operated at times when a total is to be taken. Under these conditions means is provided for disconnecting the printing devices from the listing shaft but for leaving the same in condition to be operated by the total shaft or reset shaft.

Printing mechanism

Referring now to Figs. 2 and 6, the printing mechanism comprises a printing carriage 263 of any desired form having suitable ribbon devices 264. This carriage is of the type commonly used in the typewriter art and requires no detail description.

Vertically slidable in suitable frame members of the machine are type carriers 265 each

carrying a plurality of type 266. As shown in Fig. 6 the type carriers are arranged in seven groups with ten carriers per group. The type carriers on their lower ends carry ratchet members 267. The individual type carriers are normally pressed upwardly by spring-drawn fingers 268. Such movement is prevented by a bail member 269 which is slidably mounted on guides 270. The bail member is adapted to be elevated by a link 271 which connects with a lever 306, which lever is operated in a manner to be hereinafter explained.

It will be understood that as the bail 269 rises all of the type carriers 265 are elevated in unison successively bringing the various type on the carriers past the printing line. To differentially determine the movement of the type carriers pawls 272 are provided, which pawls each cooperate with the ratchet tooth portion 267 of a particular type carrier. The pawls are spring-impelled into engagement with the ratchet tooth upon the tipping of a dog 273 which is provided for each pawl. These dogs 273 are in turn actuated by call wires 277 which connect to the proper armature 278 of the magnets 102 or 102a as the case may be. The parts are so timed that the type carriers elevate in unison with the passage of a card through the machine so that if the magnets 102 or 102a are energized by a passing hole in the card the pawl 272 will be released at a proper time to print the corresponding type upon the paper carried on the carriage. Similarly the magnets 102, 102a may be energized under the control of the counter devices and by the time of energization of these magnets the corresponding and proper type figure will be arrested at the proper line. After the various type carriers have been arrested the movement of the bail 269 continues in an upward direction leaving the type carriers behind. The further movement of the bail-operating lever 306 is utilized to effect the hammer operation.

Referring now to Figs. 2 and 15 the hammers proper comprise members 280, pivoted on a shaft 281 and drawn away from the type by springs 282. The hammers are adapted to be struck up by a striking bail 283 which is spring-actuated by a spring 284. The bail 283 is locked by means of a trip finger 285. This finger is pivoted upon the arm 306 and spring-connected thereto and provided with a pin 286 which, upon the elevation of the lever 306, engages with a coacting stop pin 287 fixed to the frame of the machine so as to trip off the notched end 288 of the lever 285 from the depending fingered end on bail 283. After notch 288 is completely disengaged the spring 284 swings the bail in a counter-clockwise direction and impels the hammers 280 against the type. In addition suitable hammer lock de-

vices are provided. These hammer details and hammer lock features are more fully shown and described in my copending application, Serial No. 541,347, filed March 6, 1922, now Patent Number 1 501,004.

The restoration of the bail 269 is preferably effected by means of restoring springs 290 (see Fig. 2).

The energization of magnets 102a as we have seen, shifts contacts 113. The manner in which this is done is shown in Figs. 2 and 8. The device comprises a leaf spring 113a resting normally on contact 113b. The armature 113c of magnet 102a will, when the magnet is energized, move the contacts 113d and 113b against the action of spring 113e so as to cause contact 113d to engage contact 113a. The construction of the parts is such that contacts 113a—113d make before contacts 113a—113b break.

Means for actuating the levers 306 during listing operations will now be described.

Referring to Figs. 9, 7 and 5: The tabulator drive shaft 260 on its end carries a pinion 291 which meshes with an intermediate pinion 292 which in turn meshes with the pinion 293. This latter pinion is fixed on a shaft 294 which will hereafter be termed the listing shaft of the machine. Shaft 294 carries a so-called listing cam 311 and also carries the cams of the L group.

The arms 306 which, when elevated, permit the type carriers to rise, are fixedly mounted upon a shaft 305 (Fig. 6). The cam 311 is of the box type and provided with a cam slot 312 (Figs. 16, 17 and 18) into which on listing operations a follower roller 310 projects. Follower roller 310 is carried upon an arm 309 (Figs. 16 and 17), upon which an adjustable screw 313 is attached, which screw is adapted to engage an abutment block 314 carried on a bell crank shaped member 304. Bell crank 304 is fixed to the shaft 305 whereby upon the rocking of 309 in a clockwise direction shaft 305 will be rocked clockwise to elevate the arms 306 previously referred to.

The above has described the operation of these parts for a so-called listing operation. If, after listing, the printing devices are to be operated to take a total, a cam 301 on the so-called total printing shaft 315 rotates causing elevation of an arm 302 carrying a cam follower. 302 is loosely mounted upon the shaft 305 and is provided with an abutment 303 which is adapted to contact with the suitable adjustment screw 303a carried on the bell crank lever 304 thus rocking bell crank 304 in a clockwise direction and similarly rocking shaft 305. As previously explained the printing section of the machine is adapted to be operated for straight listing, for listing and total printing and for total-printing alone. To change from a listing condition to a total-printing condition in

which no listing is carried out provision is made for shifting the cam follower 310 out of engagement with the cam slot 312 in listing cam 311. The means for effecting this adjustment comprises a listing lever 316 which projects through the front of the machine (see Fig. 1) and which is adapted to be drawn outward against the tension of a spring 319 (Fig. 16) and thence rocked to the left or right. The listing lever shaft 317, upon its rear end is provided with a fork 318 engaging a pin 320 carried by a transversely extending shaft 300 and is adapted to move the shaft 300 in either direction. By rocking the listing lever counterclockwise (Fig. 16) this fork member 318 will shift the shaft 300 downwardly from the position shown in Fig. 16. Carried upon the opposite end of the shaft 300 is a shifter fork 308 which engages a slot in the hub of a cam follower lever 309. In this manner the cam follower can be shifted downward from the position shown in Fig. 16 to cause the roller 310 to engage the slot 312 in cam 311. If, on the other hand, listing lever 316 is shifted in the opposite direction the follower 310 will be withdrawn from the cam slot and the parts will be in position for a total printing operation after listing the individual cards. Use is made of the shifting movements of the fork 318 to selectively open or close either of the two contacts 105 or 88 referred to heretofore in connection with the circuit diagram. A shoulder 321 is provided on the fork member 318 (see Fig. 19) which is adapted to selectively cooperate with either of the two contacts 105 or 88 thereby causing one pair of contacts to close and the other to open. The laterally shifting shaft 300 is also adapted to change the paper feed so that there will be an extra line feeding of the paper at the time of printing a total after listing of items. The mechanism for securing this result is shown in Figs. 7, 14 and 14a. In these figures shaft 300 is shown provided with a collar 325 which engages a bell crank lever 326 pivoted to a frame member in the machine, which lever is adapted to press inwardly a spring-pressed plate 327 which is slidably mounted on a gear 328 and provided with a pin 329 which is adapted to be projected through the gear and beyond the left face of the same as shown in Fig. 7 so that the pin 329 will engage a pawl 330 which forms part of the paper feeding mechanism. The gear 328 is rotated during total printing operations and under these conditions the pin 329 will impart an extra movement to the paper feed device. During ordinary listing operations this paper feed device is operated from the shaft 305 which is rocked each time an item is listed and when a total is printed. The paper feed devices are supported on bracket plate 335 which carries pivotally mounted plate 334 having connected thereto an up-

wardly extending rod 336, which, at its upper end, connects with the ratchet and pawl devices on the paper carriage. These ratchet and pawl devices are of the conventional type used on typewriter carriages. The paper feeding elements may be alternatively actuated either by the rocking of pawl 330 or by the rocking of shaft 305. If the parts are to be rocked by pawl 330 a tail 330a of the pawl is swung to the right thereby drawing forward a link 331, in turn drawing a bell crank member 333 to the right and finally rocking plate 334 counterclockwise and drawing down upon the connecting rod 336. On the other hand, if shaft 305 is to control the feeding operation an arm 338 fixed to this shaft is rocked clockwise thereby contacting against a shoulder on a bell crank member 337 thus rocking plate 334 counterclockwise and similarly drawing down the connecting rod 336. This paper feed mechanism provides for an extra spacing of the paper before or after printing a total when items are listed.

Resetting motor and drive of total printing mechanism

Referring to Figs. 2, 4, 6 and 7 the resetting motor RM through a suitable shaft and worm 339 drives a worm gear 340 which is loosely mounted on shaft 315. Fixed to the worm wheel 340 is a ratchet disk 341 (Figs. 4 and 7). Fast on shaft 315 is a so-called printing cam 342. Fast to this printing cam is a block 343 (Figs. 7 and 4) which in turn carries a clutch dog 344. This clutch dog overlies ratchet 341 and is normally drawn into engagement therewith by means of a spring 345. Engagement of the dog with the ratchet is permitted when the reset clutch magnet 233 (Fig. 4) is energized. The armature 346 of this magnet is pivoted at 347 and has connected to it an extended arm 348 which is notched to engage the tail of the one revolution clutch dog 344. Upon the energization of magnet 233 part 348 is elevated and spring 345 draws the clutch dog 344 into engagement with the ratchet 341. Subsequently to this engagement the printing cam and the printing shaft 315 rotate in unison with the ratchet making one revolution. Just before the single revolution of these parts is completed magnet 233 becomes deenergized permitting the notched arm 348 to reengage the clutch dog and disengage the same from the ratchet 341. To insure the armature 346 being released from the reset clutch magnet 233 a mechanical knock-off is provided which comprises a camming projection 349 which is mounted upon the face of the printing cam 342 (see Figs. 4 and 7). This camming projection 349 during the revolution of the printing cam 342 is adapted to engage a pin 350 which is disposed upon the end of the arm 348 to rock arm 348 downwardly and disen-

gage the armature 346 from its magnet. To prevent a possible rebound of the clutch dog 344 a supplementary pawl 351 is provided which is pivotally mounted upon the arm 348 and spring-pressed downwardly against a suitable stop. This pawl upon the revolution of the clutch dog is adapted to fall in behind the dog and prevent the rebounding of the same with the possible disengagement from control of the arm 348. At such times when reset clutch magnet 233 is energized provision is made for controlling a number of contact devices heretofore referred to. These contact devices 110 and 235 are shown in Figs. 4 and 6. A pair of crank arms 352 are provided which are fixed to the armature shaft 347. These crank arms have portions overlying the contacts 235 and 110 (see Fig. 6) so as to actuate the same to close the contacts upon the energization of the reset clutch magnet 233.

In order that the reset mechanism may be brought into operation by manual control I may provide a push rod 248a adapted to engage the arm 348 to raise the latter. This, it will be seen, will produce the same results as when the magnet 233 is energized.

The shaft 315 carries the so-called P cams heretofore referred to in connection with the circuit diagram.

The reset motor in its operation is adapted first to take a reading of the amount standing on one or more of the tabulator counters, then to print the reading and subsequently to reset such of the tabulator counters as are selected for resetting to zero. Consequently the resetting and total printing cycle may be considered in two parts, first, the printing cycle proper and, second, the counter resetting feature of the cycle. The printing cycle will first be explained.

The printing cam 342 is of the box type and is provided with a cam slot shown in dotted lines in Fig. 4 and marked 353. Co-operating with this cam slot is a follower roller carried on an arm 354 (Fig. 4) so that upon rotation of the total printing cam 342 so-called total print shaft 355 will be rocked. The total print shaft 355 carries a fork arm 356 which is interengaged with an arm 357 carried upon a finger shaft 358. This finger shaft extends above the counter units as shown in Fig. 20 and has fixed to it for each counter a rocking frame 359. Loosely mounted on the shaft 358 are a number of feeler fingers 360 provided with suitable adjusting screws 361 upon their ends. These feeler fingers are interconnected with the frame 359 by means of springs 362 and their adjustment relatively to the frame may be made by means of screws 363. Referring to Figs. 20 and 22, as the frame 359 rocks counterclockwise the feeler fingers follow the frame remaining in contact therewith until the adjustment screws 361 come into

contact with the stepped cams 111 which are associated with the counter wheels. Subsequently frame 359 continues its movement, the feeler fingers and associated parts remaining stationary. Attached to each feeler finger and insulated therefrom is a curved contact member 112. Disposed behind this contact member 112 are blade contacts 365 and 366, the former being carried by a common bar 127 attached to and insulated from the frame 359 and the latter being individually supported by a transverse insulating bar 368. Upon the downward rocking of the fingers 360 the blade contacts 365 will remain out of contact with the curved contact surface 112 until the feeler fingers are arrested. Immediately after, contact is made between 365 and 112 and thence to blade contact 366 which is always in contact with 112. These parts thus constitute a means for timing the closure of the circuits to the printer magnets when a total printing is to be taken. By reason of the arrangement of the curved surface 112 and the rubbing contact action the contacts are kept clean and bright and regularity of contact closure is insured. In addition to the contact blades described there is an additional contact blade 365a (Fig. 23) and a fixed contact bar 370a for controlling the printing of an asterisk and another contact 365b which merely serves to supply current to the common bar 127. 365b cooperates with a fixed contact bar 370. 370 and 370a are attached to but insulated from frame member 370b.

The resetting cycle takes place upon the second half revolution of the total printing shaft 315. Referring to Fig. 14 of the drawings it will be noted that the gear 328 has no teeth for one-half its periphery, as shown at 375. Gear 328 is further provided with a semicircular plate 376 which cooperates with a Geneva stop arcuate shaped element 377 fixed to a gear 378 on shaft 379. Upon the counterclockwise rotation of gear 328 the parts 376 and 377 prevent the turning of gear 378 until the blank section of the gear is passed. Thereafter the second half revolution of gear 328 effects one complete revolution of gear 378 and its shaft 379. Shaft 379 (Figs. 10 and 12) is the well known tabulator reset shaft and includes the reset clutches 380 which are adapted to selectively clutch gears 381 to the shaft 379. One gear 381 is provided for each counter and it is the rotation of this gear which resets the counter to zero. The resetting mechanism for the counter wheels is of the type commonly employed, in which the counter wheel shaft 382 is notched as shown at 383 to permit the reset pawl 384 to engage the same. By turning shaft 382 through a complete counterclockwise revolution one or more of the counter wheels are picked up when pawl 384 engages notch 383 and thereafter rotated

until the counter wheels are brought back to zero. With resetting devices of this character it is found that there is a possibility that the counter wheel will not stand exactly at the zero position so that the pawl will not engage the notch in the shaft but will remain on the top of the shoulder. This condition of the parts is indicated in Fig. 13 of the drawings. Fig. 13a shows the proper condition of the parts.

In order to prevent the objectionable condition of Fig. 13 arising, I provide means for imparting to the shaft 382 an amount of rotation which is slightly over one complete revolution. This permits the pawls 384 to properly clear and drop into the notches 383 as indicated in Fig. 13b of the drawings. Subsequently the shaft 382 is permitted to rock backward until the parts take the position of 13a.

Referring now to Figs. 10, 11, 12 and 13, gear 381 meshes with gear 385, which is hollowed out to receive the annular block 386 which block is securely fastened to shaft 382 by the key and screw devices 387. The annular block 386 and gear 385 are spring connected together by spring 388, but are normally rotated in unison by means of the pin 386a carried in block 386 and the slot 385a in gear 385 so that the rotation of gear 381 will drive shaft 382 in unison therewith. Just before the rotation of gear 381 is completed a pointed member 389, carried by this gear, engages a cam plate 390 carried by the annular block 386 and advances the same forwardly relative to gear 385 (see Fig. 11). This action turns shaft 382 to a slightly additional extent, then after 389 drops off 390 the spring 388 will cause the parts to re-align, as in Fig. 10, or, expressed otherwise, the annular block 386 will move clockwise relative to gear 385. This movement will cause the shaft 382 to move from the position shown in Fig. 13a to the position shown in Fig. 13b, and insure all resetting pawls dropping into the notches in the shaft.

The foregoing described arrangement of resetting devices obviates the necessity of careful adjustment of the resetting notches to secure accuracy in resetting. Unless accuracy is secured at the time of resetting the counter wheels there is a possibility of amounts standing on the counters at the time of the completion of the resetting operation, thus introducing errors in subsequent additions.

Referring now to Fig. 1 of the drawings, each resetting clutch 380 has associated with it a bell crank lever 129 which cooperates with the contacts 128 previously referred to in connection with the circuit diagram. As referred to before the object of these contacts is to suppress the printing of a total when the clutch elements 380 are shifted to the left to suppress resetting of a particular counter.

Automatic control, group indicator devices, and drive therefore

The automatic control and group indicator devices are contained in a box or housing 255 underneath the base of the machine, and for driving these devices two sets of driving connections must be utilized from the tabulating mechanism proper. One set includes gearing which is driven constantly at all times when the main tabulating drive shaft 260 is driven, and another set of driving devices includes a shaft which is rocked at a certain period during the reset cycle.

Referring now to Figs. 5 and 9 the tabulator shaft 260 is provided with a gear 395 which in turn meshes with the gear 396 which, through idler gear 397, drives a gear 398 which is mounted on shaft 399 which extends into the automatic control box. The shaft 400 in the automatic control and group indicator box is the shaft which is rocked during the resetting cycle. This shaft is rocked from the reset shaft 379 through an eccentric and strap 401, 402, which connect to a bell crank linkage 403. Linkage 403 has a lost motion pin slot connection with an arm 404 which is fixed on shaft 400 so as to rock the same at the proper time in the resetting cycle.

The control magnets 72 are preferably of the dual type and are arranged in upper and lower tiers as shown in Fig. 25. Disposed to one side of the magnets are shafts 406 and 407 which carry pivoted thereon upper and lower finger members 408 (see Fig. 27). Suitably connected to these finger members are the armatures of the control magnets 72 and the fingers are normally held away from the magnets by suitable springs 409. A shaft 411 which is suitably supported in the control unit in alignment with shaft 400 but entirely separate therefrom forms a support for a plurality of bell crank members 410. One arm of each bell crank member rests normally in a shoulder abutment on the finger member 408. The other arm bears against an insulated plug carried by one of the blades of the pair of spring contacts 71. Contacts 71 are normally closed. Upon the energization of any magnet 72 its corresponding finger 408 is rocked, releasing its cooperating bell crank member 410 and permitting the same to rock clockwise under the resiliency of the cooperating spring contact which normally tends to move to open position. The said bell crank member being arrested by rod 410a. This action causes contact 71 to open and permits the closing of contacts 73 under the influence of spring 415 which is insulated from the frame member. Contacts 71 when opened take the arc from the brushes and contacts 73 are the so-called automatic control contacts heretofore fully described in connection with the circuit diagram. Once per card cy-

cle cams 412 carried by shaft 399 contact with tail portions on the bell cranks 410 and rock the latter anticlockwise thus permitting the springs 409 to restore the armature fingers 408 which thereupon relatch the bell cranks 410. Any fingers not properly restored by the spring action are restored by a restoring bail 413 (Figs. 25 and 27), which is pivoted upon shaft 406 which is actuated at the proper time in the cycle by a cam 414 on shaft 399. At the completion of these operations the bell cranks 410 are relatched on the fingers 408 and are ready for the next card cycle, contacts 71 being closed and 73 opened.

The group indicator contacts 77, GI—9 and GI—10 cooperate with a bail 416 which is fixed to shaft 400 (see Figs. 24 and 26). These contacts all normally tend to open up under their own resiliency but they are restrained normally from opening by means of the bail 416. At such times in the cycle when these contacts are to open the bail 416 is released from its locked-up condition by means of the group indicator magnet 92 (Fig. 26). Upon the energization of this magnet a pivoted finger or latch member 417 is attracted which permits the release of an arm 418 which is attached to the bail 416. After 418 is released bail 416 is permitted to rock clockwise under the influence of a spring 419 and under the additional influence of the spring pressure of the contacts 77, GI—9 and GI—10. The bail 416 is arrested by its arm 418 abutting against the rod 410a. The combined spring pressure on the bail 416 is such that excessive friction is imparted to the latch 417. In order to lessen this friction so that the magnet 92 may function easily, I prefer to provide cam 420 fixed to shaft 399, which cam engages an arm 421 fixed to the bail 416 and to its shaft 400. Upon the engagement of the cam 420 and arm 421, shaft 400 is rocked slightly in an anticlockwise direction which tends to raise the beam 418 slightly and free the latch 417 which then may be readily withdrawn by the magnet 92. While the magnet 92 is energized and while the latch 417 is withdrawn the cam 420 releases the bail arm and permits the bail to be retracted, and permits the contacts 77, GI—9 and GI—10 then to open. Reclosure of the contacts 77, etc., is effected by the rocking of shaft 400 by a member 404. The means for rocking member 404 have heretofore been described. This rocking movement turns shaft 400 counterclockwise swinging bail 416 in like direction and relatching the same in lock condition by means of the coacting parts 418 and 417. Latch finger 417 is moved to locking position by a spring 422. If this spring fails to function properly or if residual magnetism in the magnet 92 keeps the latch 417 in displaced position the finger 417 will be swung slightly clockwise by a pin 423 carried on arm 418

which engages a projecting finger 424 which is fixed to the latch member 417.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. In an electrically controlled tabulating machine provided with an electrical control device, means for plugging up said device to various card columns, and means operable automatically by said tabulator for cutting off the supply of current to the control device when the tabulator is at rest whereby short-circuiting of the control device during plugging operations is prevented.
2. In a card-controlled machine, a plurality of printing elements, an accumulating device adapted to control certain of said elements, a non-accumulating device adapted to control others of said elements, means for causing printing of items from each of a plurality of cards, means for causing printing of the totals of such items, means for causing printing of a card group designation with each of such items and adapted to suppress printing of such designation when printing such totals.
3. In an electrically controlled tabulating machine, card feeding means, tabulating devices, means for variously connecting columns on a card with said devices, comprising a plug board having certain normally live terminals and means operated by said machine for automatically discontinuing the supply of current to said normally live terminals when said feeding means is not operating.
4. In a tabulating machine, emergency stop means for stopping the operation of the machine, means for causing automatic restarting of the machine, and means brought into operation by said stop means for rendering said restarting means ineffective.
5. In a tabulating machine, perforation sensing means, a printing bank, a group-designation controlled element, some of said means being adapted to be connected with said bank for listing and adapted also to be connected through said element to said bank for causing printing of group designations, and an accumulator connected with others of said sensing means and adapted to control said bank.
6. In a tabulating machine provided with an electrical control device, means for plugging said device with various card columns, and means brought into operation automatically by said machine for preventing short circuits in the control device during plugging operations.
7. In a tabulating machine, means for sensing perforations in a card, an accumulator controlled by some of said means, a printing bank adapted to print on a record sheet and controlled by said accumulator, a second printing bank adapted to print on the same

record sheet controlled by other of said means, and a group indicator-controlled device adapted to cause said second bank to print only at the beginning of a group of cards bearing a new group designation whereby a single group designation may be printed in juxtaposition to the accumulative data printing of each card group.

8. A tabulating machine having a control circuit with provisions controlled thereby for interrupting the operation of the machine when record groups change, and means for opening said circuit upon the concurrent absence of cards and the stoppage of the machine.

9. In a tabulating machine having an electric motor for actuating the same, a plurality of elements for independently maintaining a circuit through said motor, card-controlled means adapted after the passage of a last card to open the circuit through one of said elements, means for periodically opening the circuit through another of said elements, and means for opening the circuit through another of said elements at a predetermined time in the cycle of the machine.

10. In a card-controlled listing tabulator having paper feeding mechanism, means associated with said mechanism for automatically effecting a paper feed of predetermined spacing after each listing operation, and means controlled by a change of group in the cards for effecting a single paper feed of greater spacing between two successive groups of printed amounts.

11. In an accounting machine having a printing device and an accumulator, a reading out mechanism controlled by the accumulator to control the printing device to effect printing of the data on the accumulator including a plurality of contacts adapted when moved relatively to cause operation of said printing device, means for moving said contacts, and a stepped stop member positioned by said accumulator and adapted to stop one only of said contacts permitting another contact to continue its movement to effect wiping engagement with the stopped contact.

12. In a tabulating machine, a plurality of type elements movable with respect to a printing position, a pair of electric contacts, means for synchronously moving said elements and said contacts, means for differentially stopping one only of said contacts whereby the other contact passes over, and in wiping engagement with, such stopped contact, and means controlled by such engagement for causing a proper type to be aligned at the printing position.

13. In a tabulating machine, a plurality of type elements, a hammer therefor, a pair of contacts, means for moving said elements past said hammer and for moving said contacts synchronously with said elements, and means for differentially stopping one only of

said contacts whereby the other contact passes over and in wiping engagement with such stopped contact, and means responsive to such engagement for causing the corresponding type to be aligned with said hammer.

14. In a machine of the class described having printing elements, alternative means for actuating said elements, means for selectively calling said alternative means into operation, said selective means including a driving cam member, a follower therefor associated with said elements, and means for moving said follower into and out of connection with said member.

15. In a machine of the class described having printing elements, alternative means for actuating said elements, means for selectively calling said alternative means into operation, said selective means including a pair of driving cams and followers therefor associated with said elements, and means for moving at least one of said followers into and out of connection with its cam.

16. In a tabulating machine, data sensing means, printing elements, an accumulator associated with said means and adapted to control certain of said elements to effect printing on a record sheet, group-control means associated with said sensing means and adapted to control other of said elements for printing group designations on the same record sheet, said group-control means being adapted to change machine operation when the group changes.

17. In a tabulating machine, adapted to derive data from record cards having a plurality of columns, a plurality of groups of accumulators, a plurality of groups of printing sections constituting a printer bank, means for operatively associating certain of said printing sections with any desired record card column, certain other printing sections being permanently operatively associated with corresponding accumulator groups and means for optionally connecting said printer sections and their cooperating accumulator groups with any desired card columns.

18. In a tabulating machine adapted for tabulating and listing operations, a listing magnet, means for setting the machine for listing and non-listing operations, and means for rendering said magnet inoperative when the machine is set for non-listing operations.

19. In a tabulating machine, an accumulator, means for sensing data upon records and controlling said accumulator means for recording amounts standing upon said accumulator, said means including wiping contact devices and mechanism controlled by the accumulator according to the data thereon for effecting differentially timed wiping engagement of said contact devices for controlling the operation of said recording means.

20. In an accounting machine having an accumulator and a printing device, means for controlling the operation of said printing device to cause the same to print amounts standing upon the accumulator, said means comprising a plurality of rockable elements displaceable into contact with accumulator elements, each said rockable element comprising an arcuate contact element, blade contact elements for cooperation therewith, one of said elements being normally out of contact with the arcuate element and being brought into wiping engagement therewith by and upon the rockable element cooperating with an element of said accumulator.

21. In a tabulating machine having an accumulator and printing devices controlled thereby, means for controlling the said devices, comprising a fixed contact blade, a movable arcuate contact element cooperating therewith, another movable blade normally out of contact with said arcuate element but arranged to engage therewith with a wiping action, and means controlled by the amount standing upon the accumulator for bringing about the said engagement for the purpose described.

22. In a card controlled printing tabulating machine, a plurality of printing elements for printing on a common record sheet, accumulator means having devices adapted to receive items from cards and to control certain of said elements to print data from said accumulators, other of said elements solely controlled directly by record cards to print designation data pertaining to the accumulator entries, and means for suppressing the direct card control of said other elements after the passage of the first card of a group.

23. In a card controlled printing tabulating machine in combination a plurality of printing elements for printing on a common record sheet, card controlled accumulator means having devices therein set up in accordance with entries received from perforated record cards and adapted to control certain of said printing elements, card controlled means for causing the total standing upon the accumulator means to be printed on the record sheet by the correlated devices, other of said printing elements solely controlled directly from the perforated records to print on the record sheet and means for suppressing said direct card control after the first printing operation whereby an entry is printed at the head of each group and printing by said printing elements is suppressed thereafter until the next entry is to be printed thereby at the head of the next group.

24. In a tabulating machine having in combination a tabulator driving motor, a source of current supply therefor, and a main supply switch for controlling the supply of cur-

rent to said motor, a supplementary emergency stop means operable independently of said main switch, means including a restart circuit for initiating restarting operations of the tabulator motor and means for opening said restart circuit upon operation of the emergency stop means.

25. In a tabulating machine, an electrically controlled accumulator, a printing bank adapted to print on a record sheet and controlled by said accumulator for printing totals, and a listing bank of printing elements adapted to print on the same record sheet and controlled solely by means including sensing brushes cooperating with the record cards while the latter are in motion whereby the totals and listed items may be printed in juxtaposition on a common record sheet.

26. In a tabulating machine, accumulator mechanism, a plurality of groups of printing elements adapted to print on a common record sheet, one of said groups being associated with and controlled by both the accumulating mechanism and the record cards, another of said groups being controlled solely by the record cards, and means for controlling said second mentioned groups to print record group designations with one printing only for a group comprising a plurality of cards whereby a single group designation may be printed on a record sheet in juxtaposition to accumulative data printing on a common record sheet.

27. In an accounting machine which includes a printing device and an accumulating device, a reading out mechanism controlled by the accumulating device and controlling the printing device to effect printing of data on the accumulating device and comprising a plurality of normally open wiping contacts adapted when moved relatively to cause operation of said printing device; means for moving said contacts and a stepped stop member positioned by said accumulator and adapted to stop one only of said contacts.

28. In a tabulating machine, a plurality of type elements movable with respect to a printing position, a pair of wiping contacts, means for moving certain of said contacts synchronously with said type elements and means for differentially establishing said wiping contacts by interrupting the motion of one only of them and thereby differentially controlling and positioning the proper type at the printing position.

29. In a tabulating machine having a plurality of groups of printing elements adapted to print on a common record sheet, and accumulator means, one group of printing elements being associated with and controlled by said accumulator means as well as by a record card, a control unit brought into operation by a change in the controlling perforations of a plurality of record cards or modifying the cycle of operating of the machine,

a second group of printing elements controlled solely by the record cards which control the control unit and means for utilizing said second group of printing elements to print control numbers whereby the control numbers and accumulative data may be printed in juxtaposition on a common record sheet.

30. In a tabulating machine, means for tabulating items from controlling records and means for initiating operation of the same, means for clearing said first named means of accumulation of items therein and means controlled by the clearing means for preventing operation of said initiating means in the absence of a prior clearing operation.

31. In a tabulating machine, a plurality of accumulators and associated printing devices for listing items entered therein, call magnets for said printing devices and circuits therefor controlled by said accumulators, means for selecting listing or non-listing operation of the machine and means for preventing energization of said call magnets during non-listing machine operation.

32. In a tabulating machine, accumulating devices and printing devices with control mechanism therefor, means for selectively operating said machine for accumulating alone or for accumulating and listing and means controlled by the selective means for preventing operation of the printing control mechanism during non-listing machine operation.

33. In a tabulating machine accumulating devices and printing devices, separate control systems for said printing devices for listing and totaling, means for selectively operating said machine for accumulating alone or for accumulating and listing and means controlled by said selective means and by said totaling control system for preventing operation of said listing control system for preventing operation of said listing control system during non-listing machine operation and during totaling.

34. In a tabulating machine, a plurality of printing banks, a plurality of accumulating banks associated therewith and total printing means controlled by the latter for effecting operation of the former, group indicating mechanism for effecting operation of associated printing banks during an initial card cycle of a group and thereafter suppressing operation thereof and means for selectively associating each printing bank either with the total printing means or the group indicating mechanism.

In testimony whereof I hereto affix my signature.

CLAIR D. LAKE.