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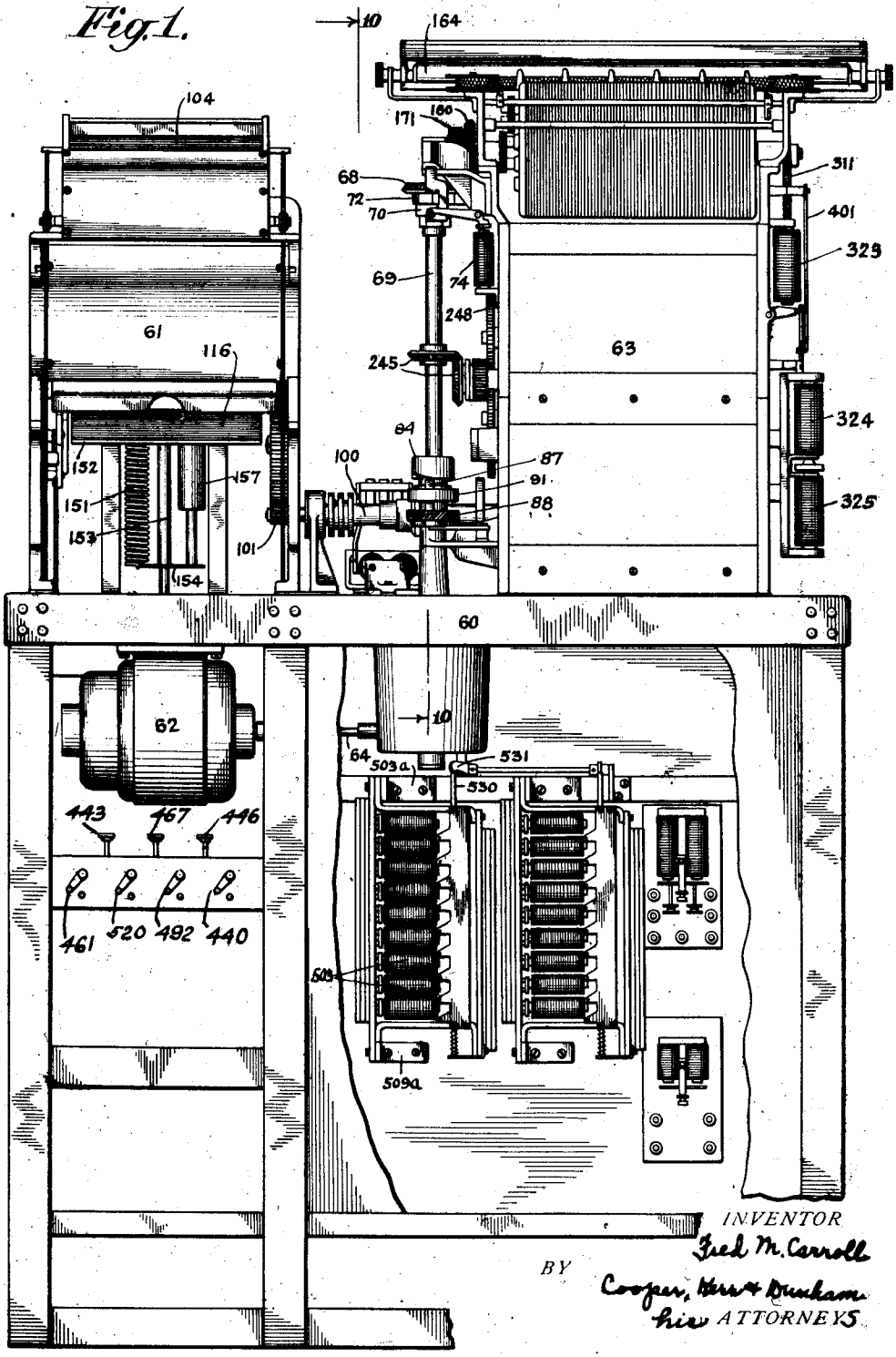
Fig. 1.



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TABULATING MACHINE

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Fig. 2.

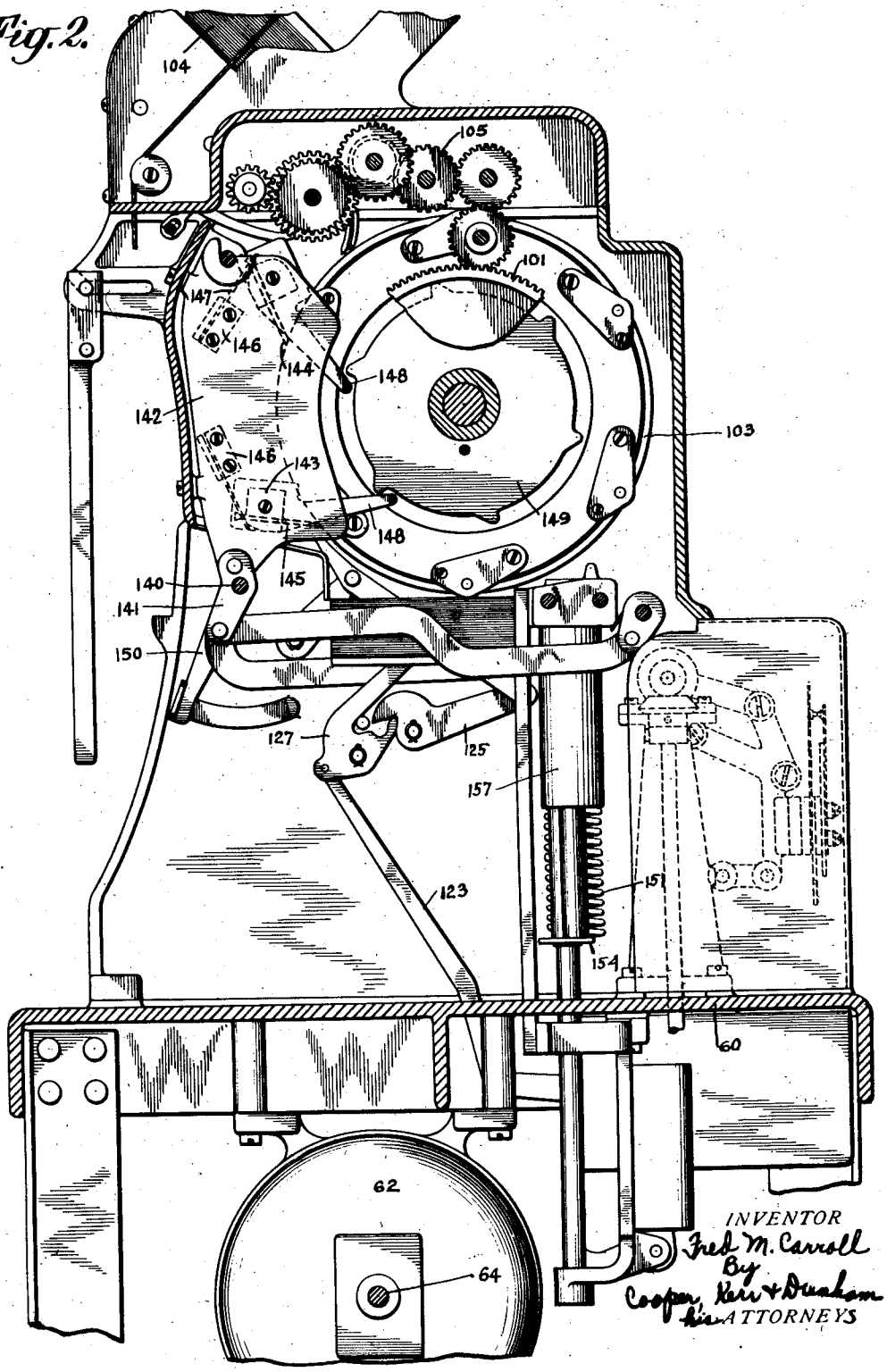

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Fig. 3.

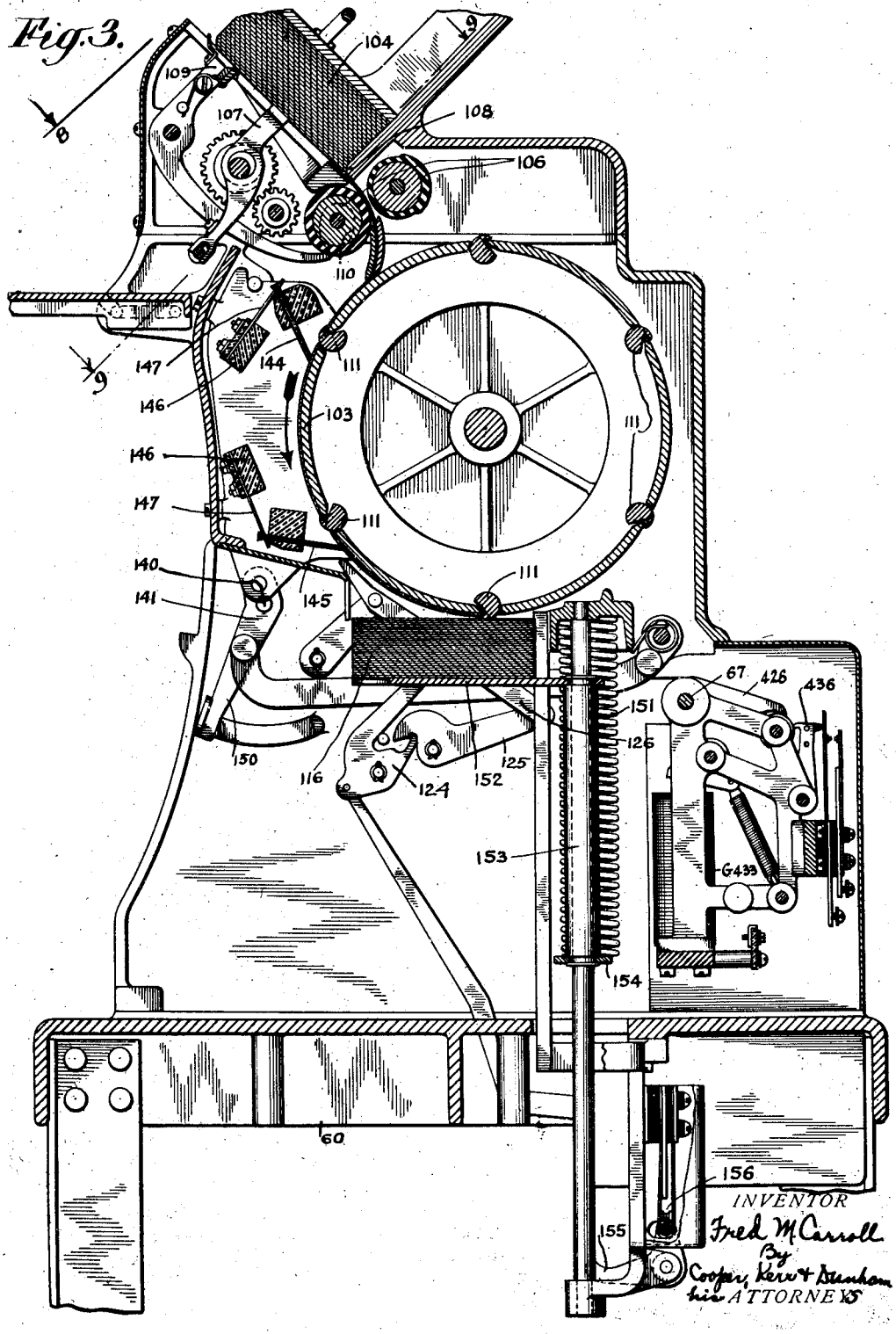

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Fig. 4.

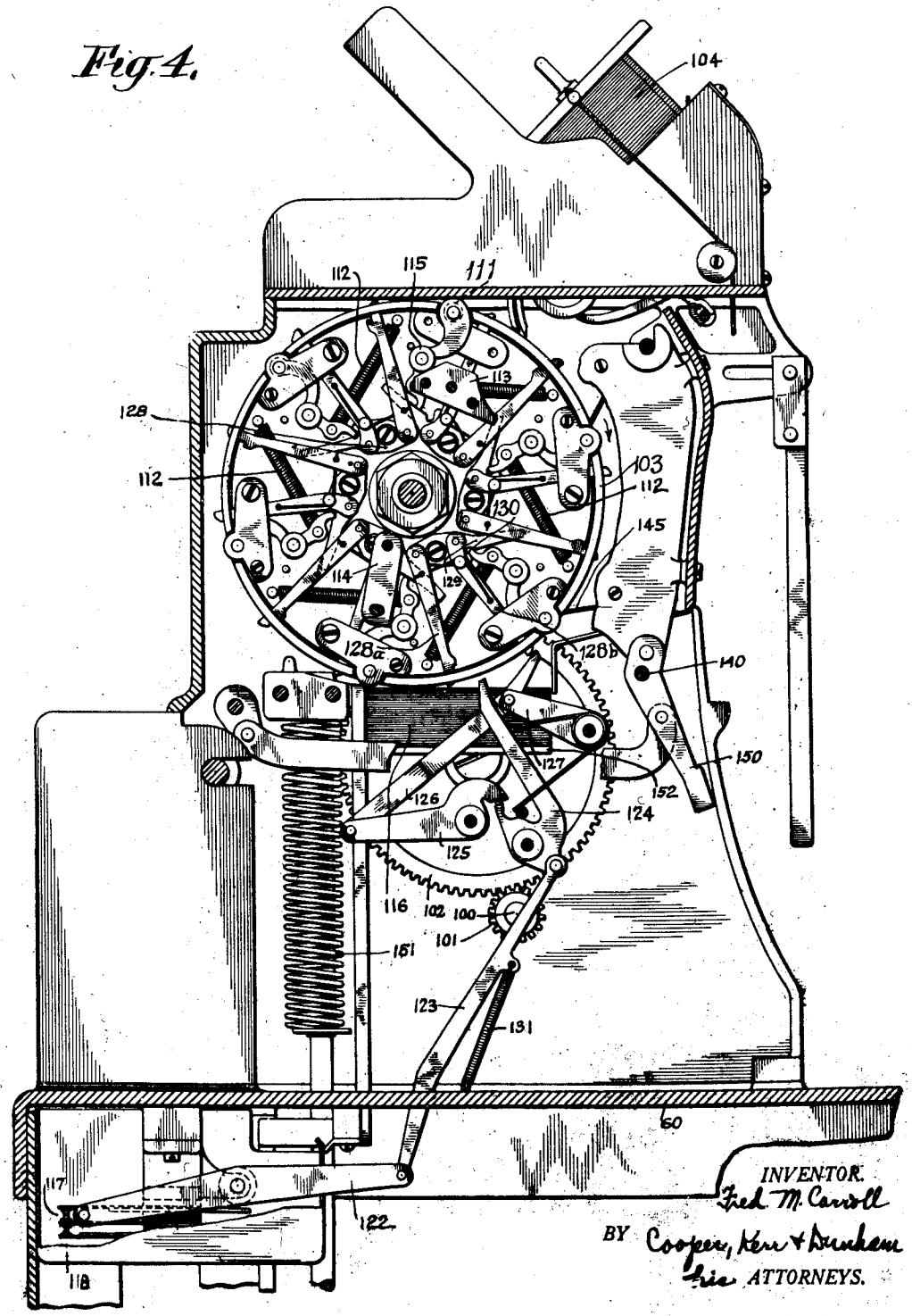

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Fig. 5.

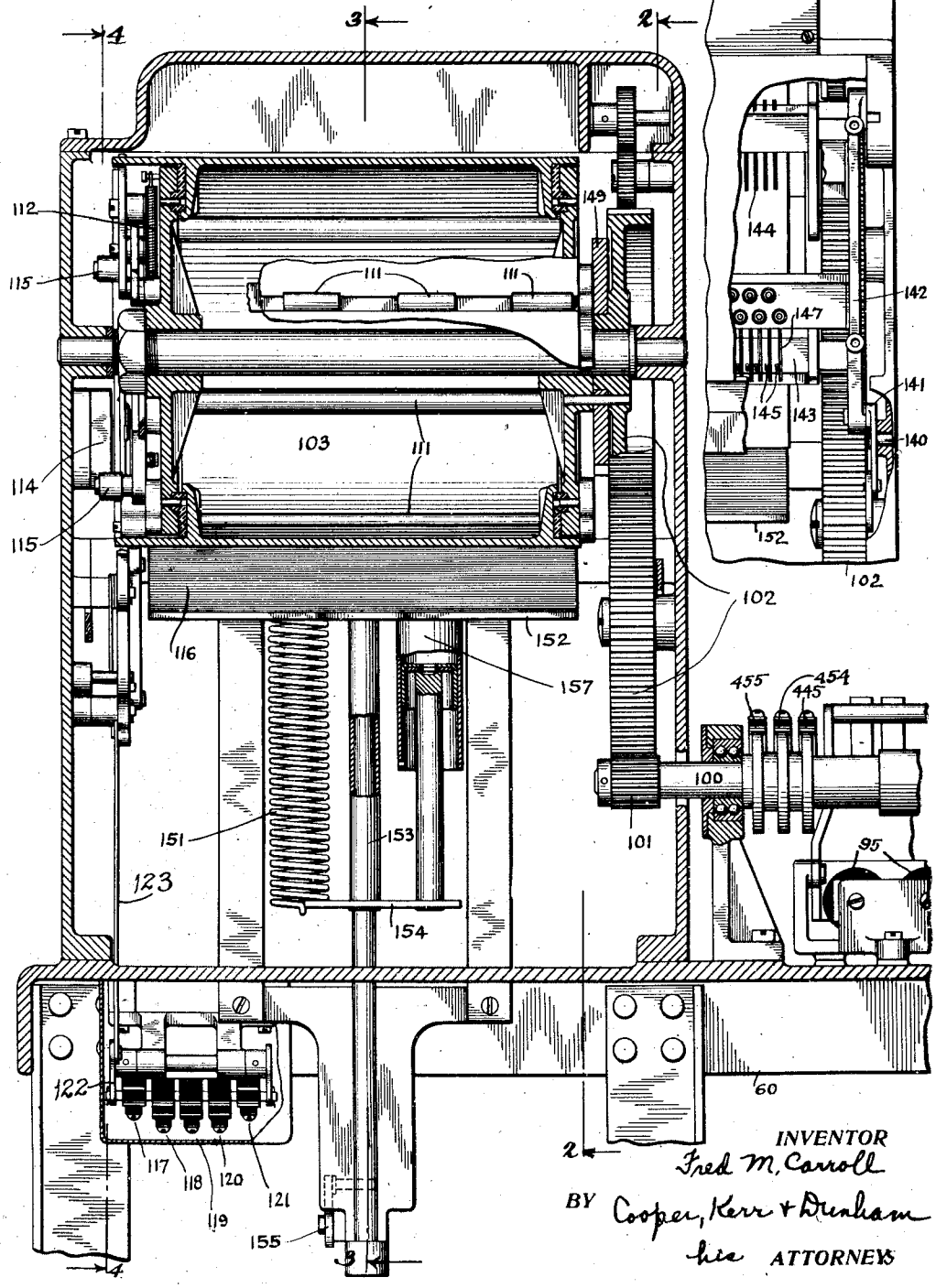

Fig. 6.

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Fig. 7.

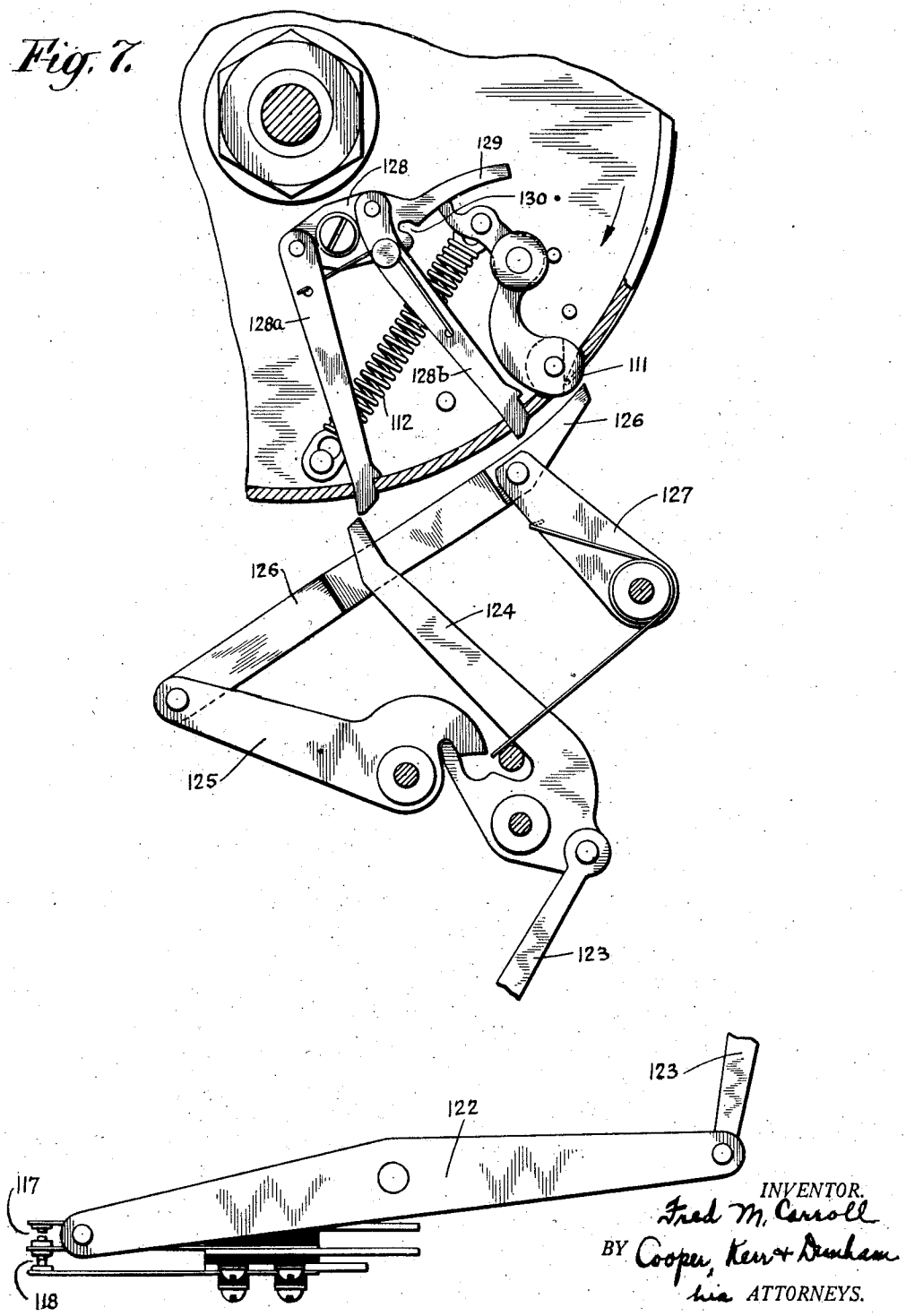

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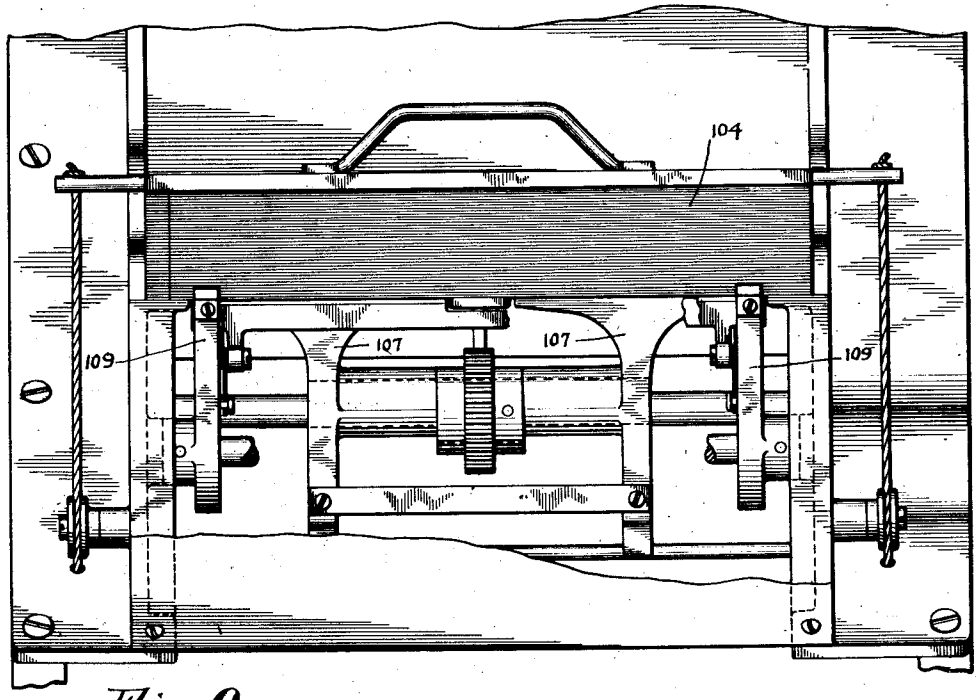
Fig. 8.



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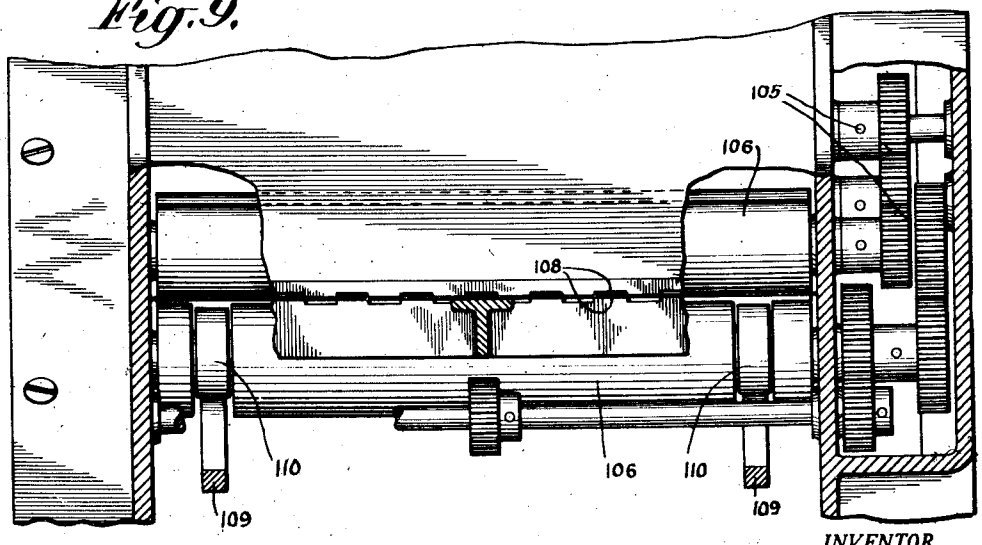

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Fig. 10.

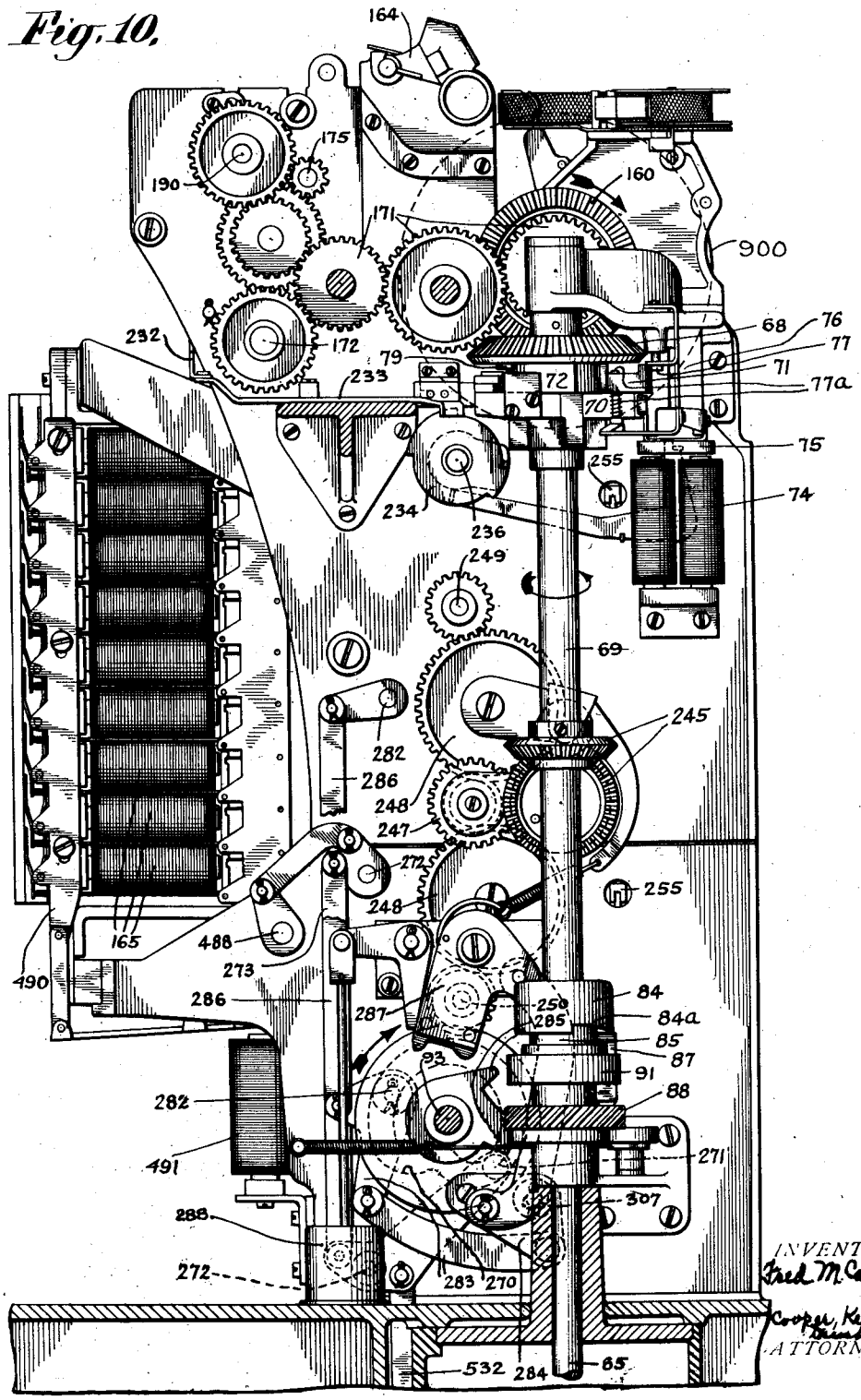

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Fig. 11.

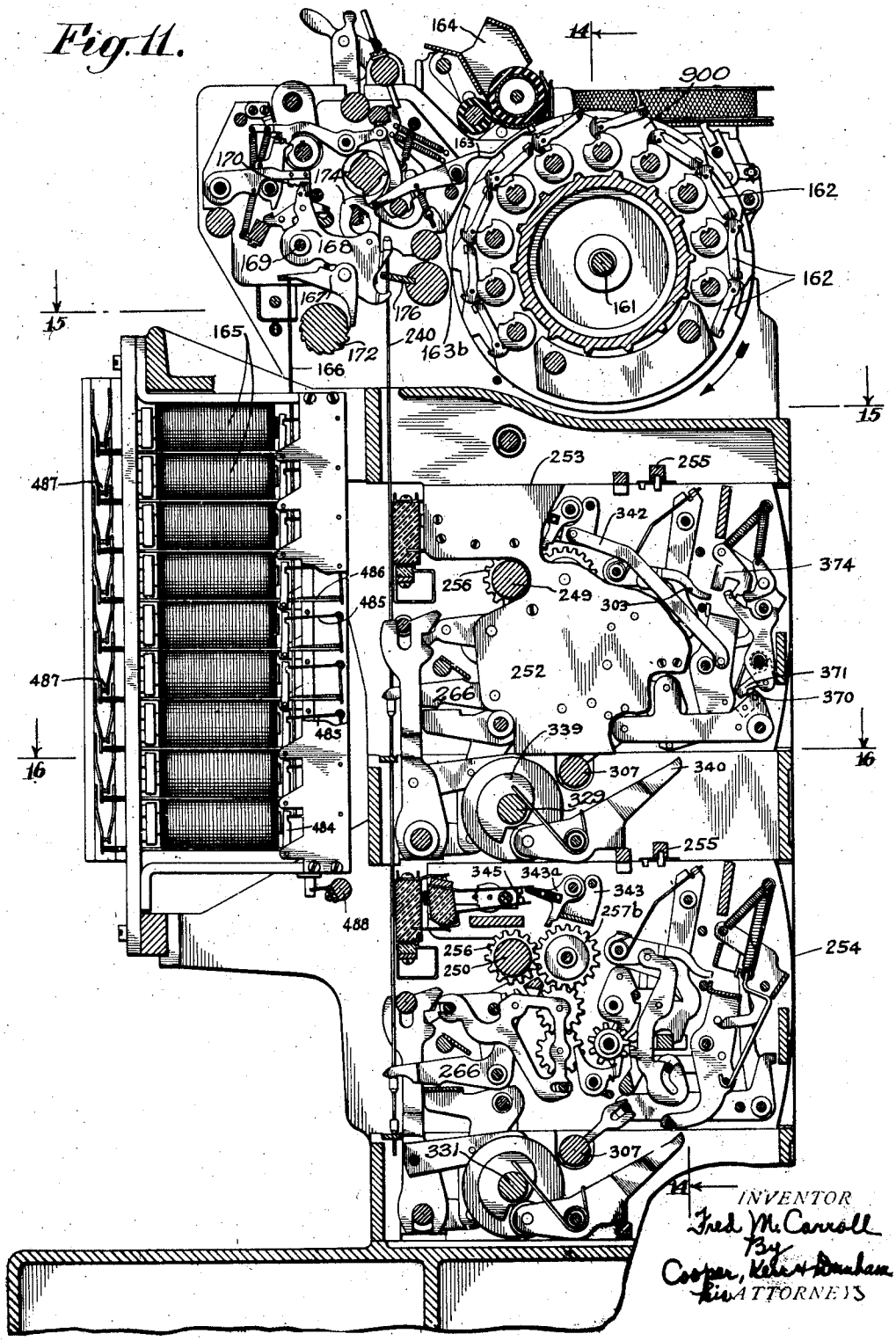

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Fig. 12.

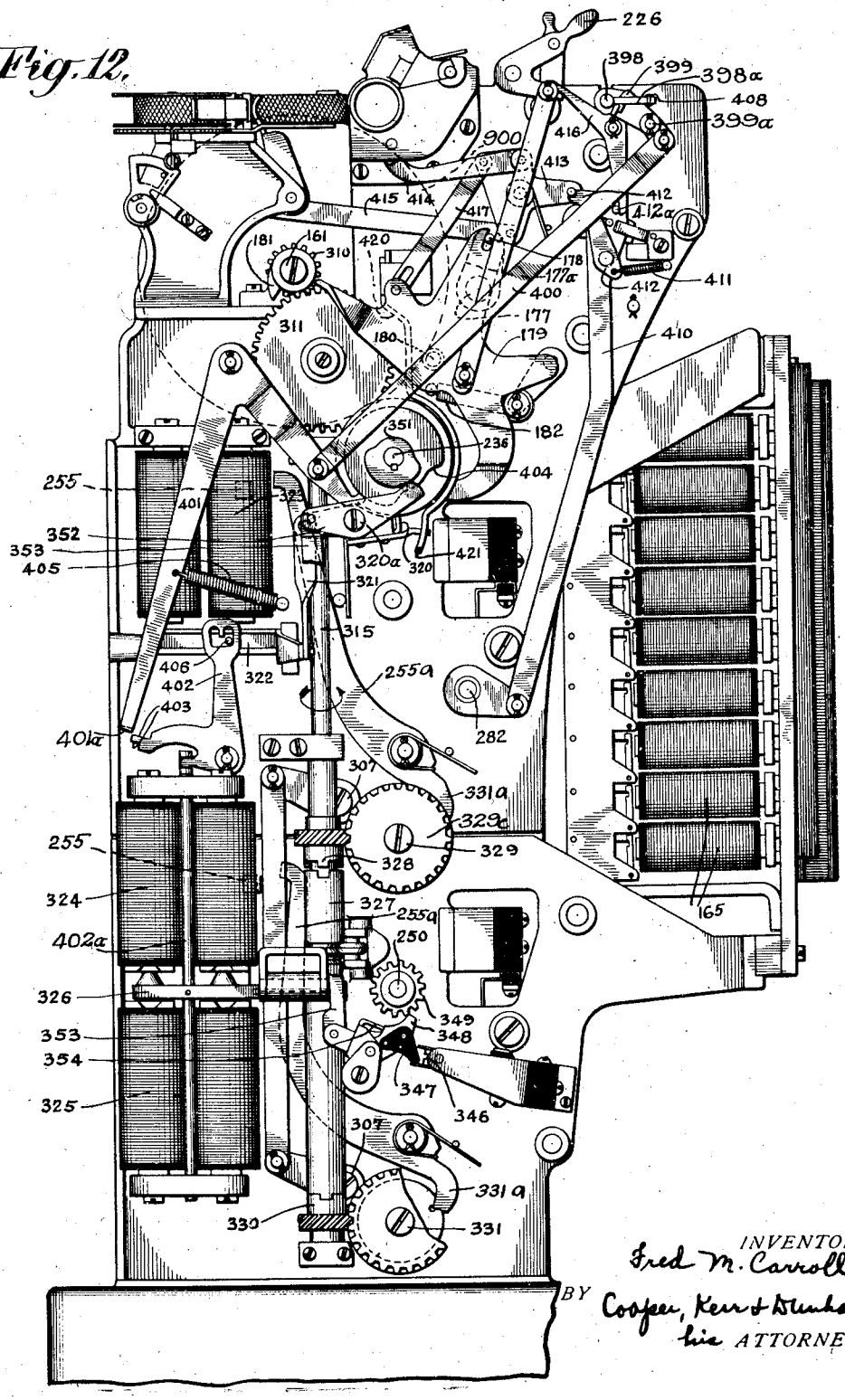

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Fig 13.

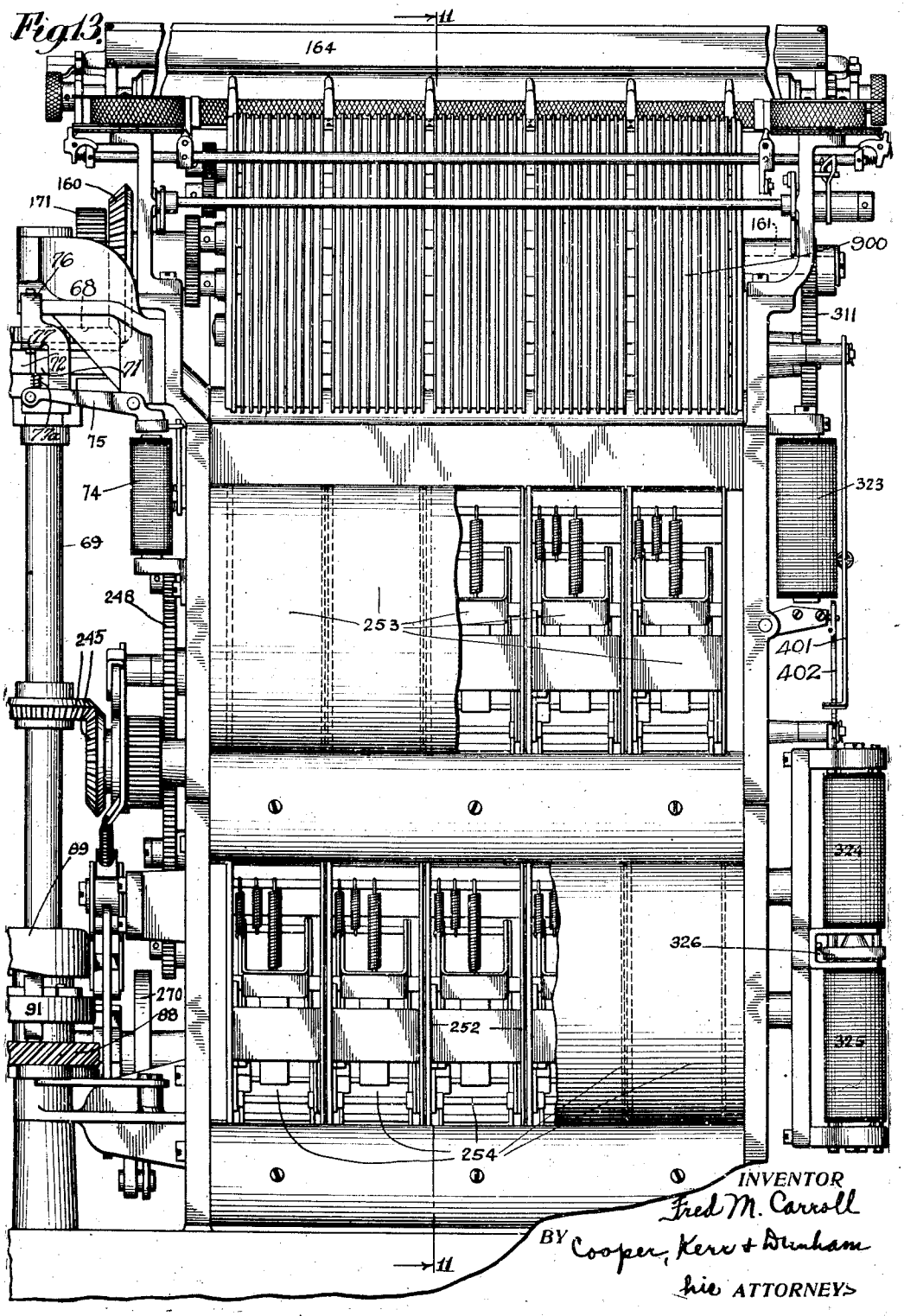

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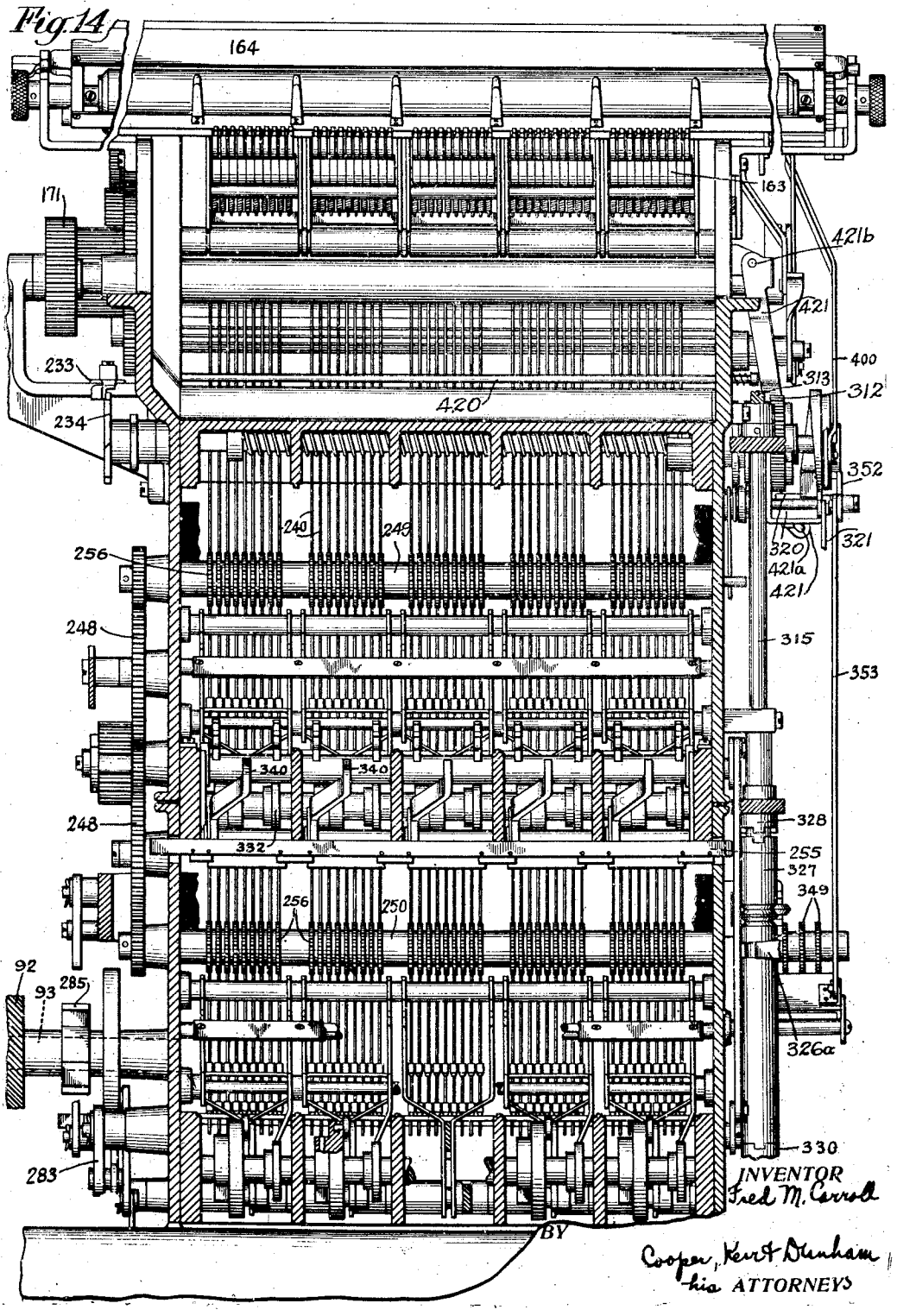
Fig. 14



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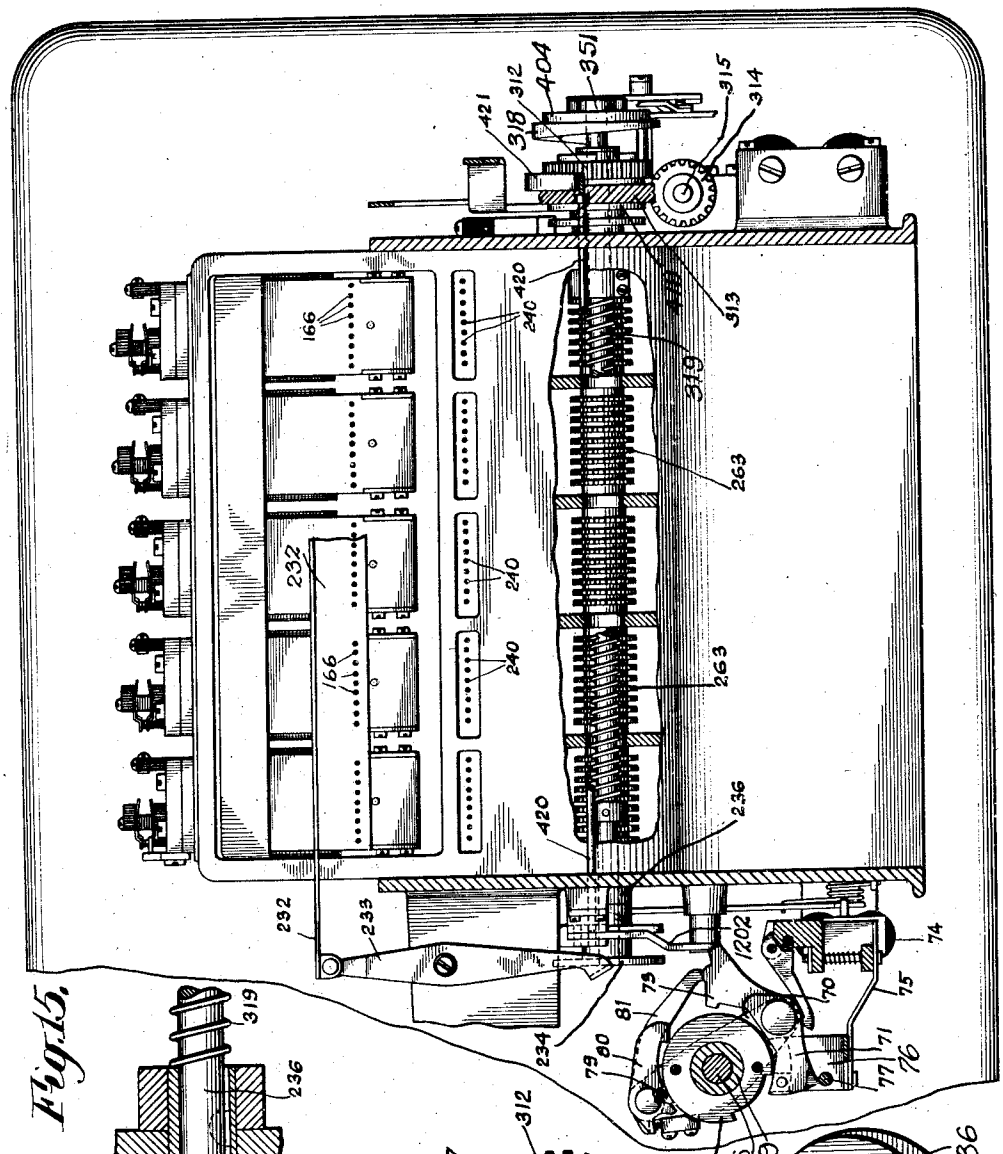

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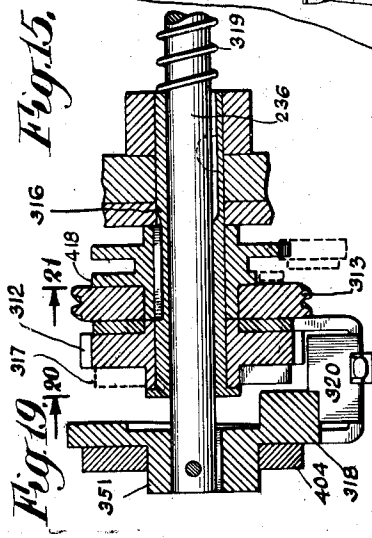

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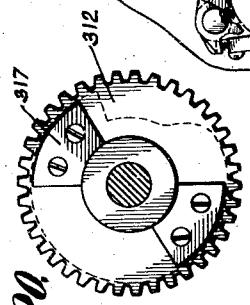

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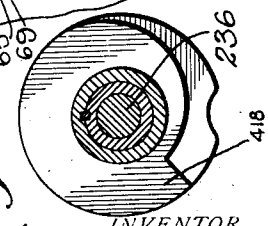

Fig. 21.

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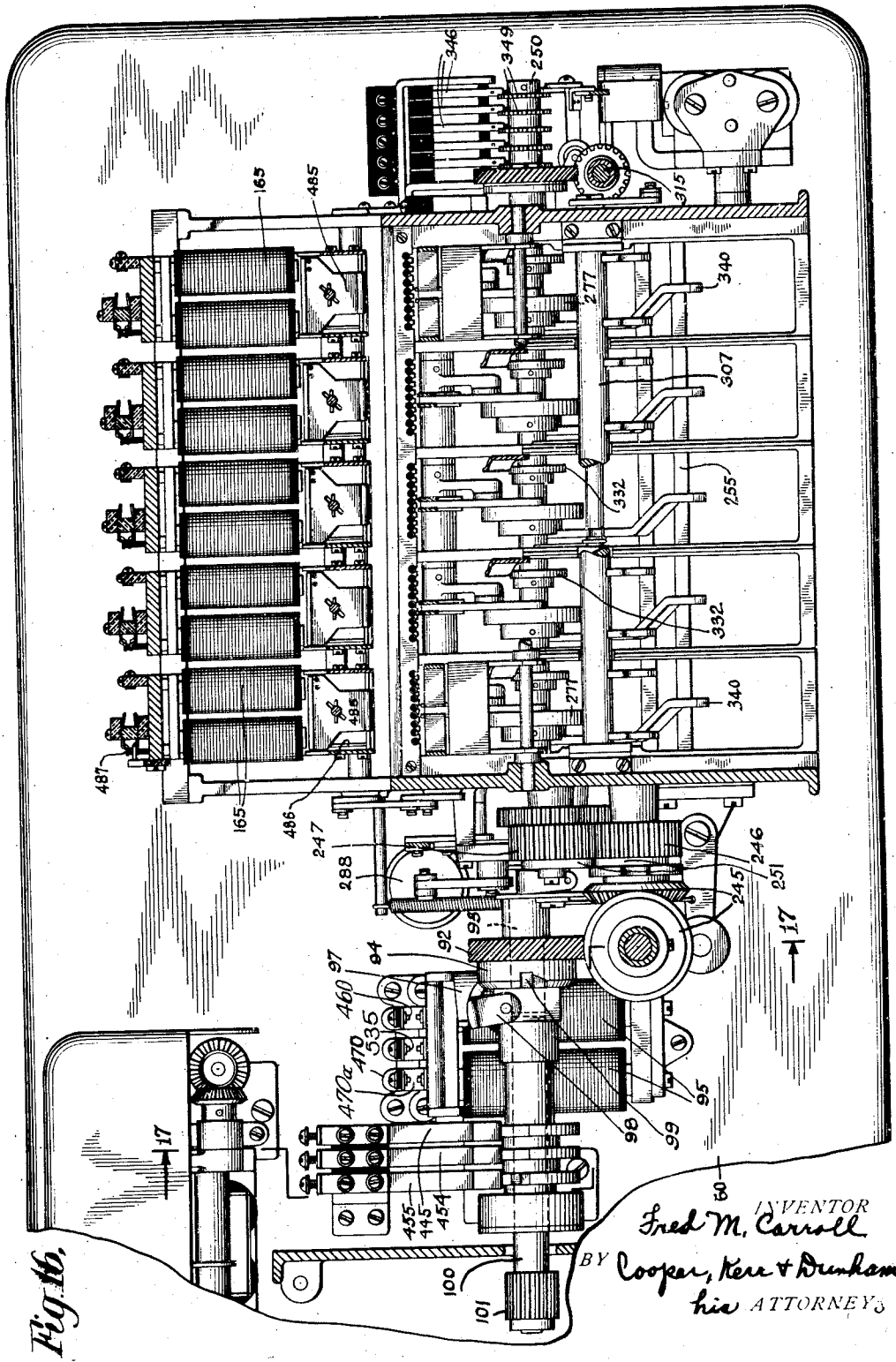

Fig. 16.

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Fig. 18.

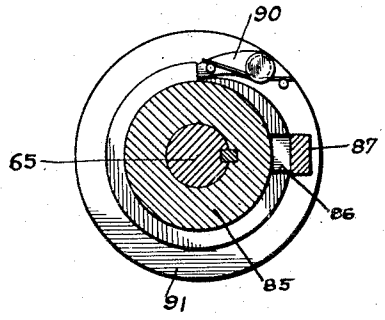

Fig. 17.

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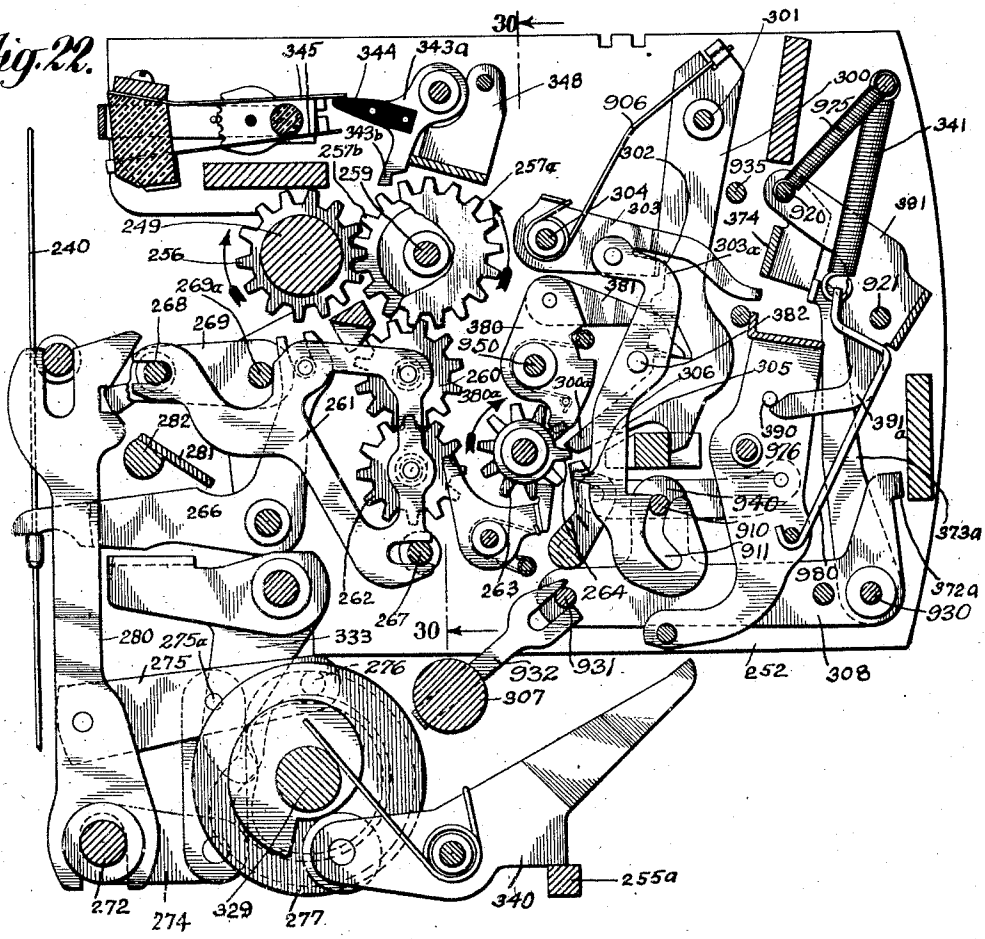
Fig. 22.



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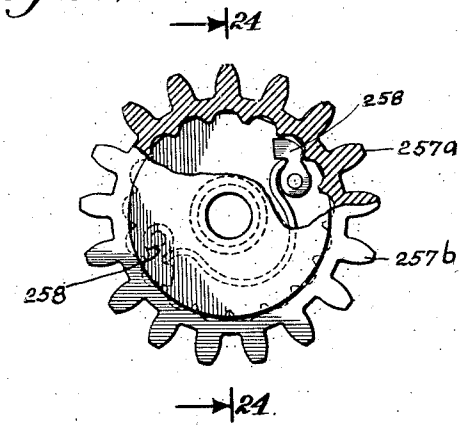

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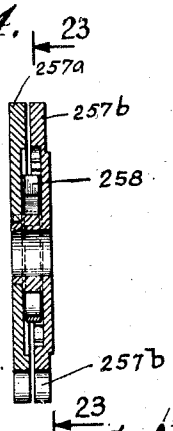

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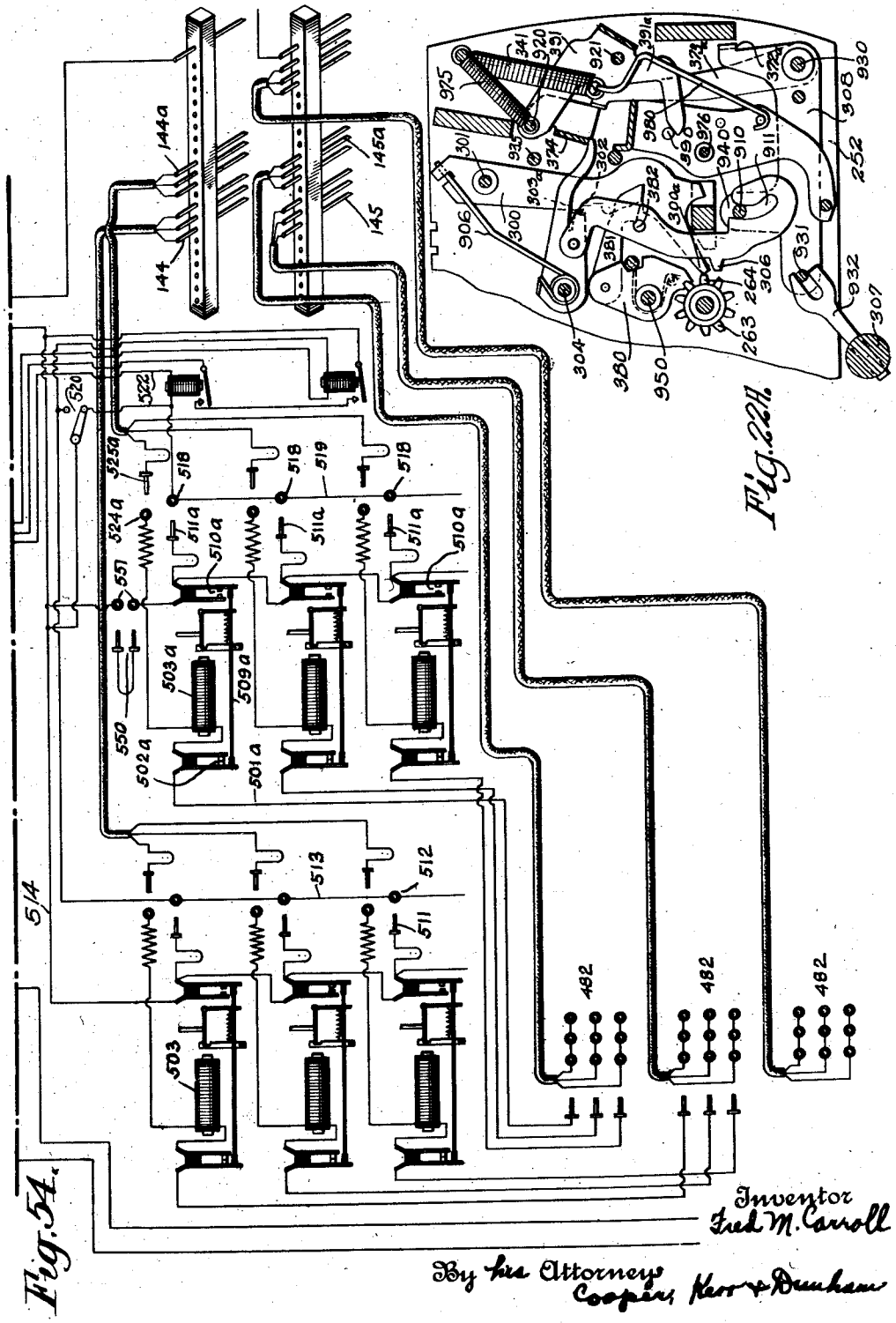

Fig. 22H.

Fig. 5A.

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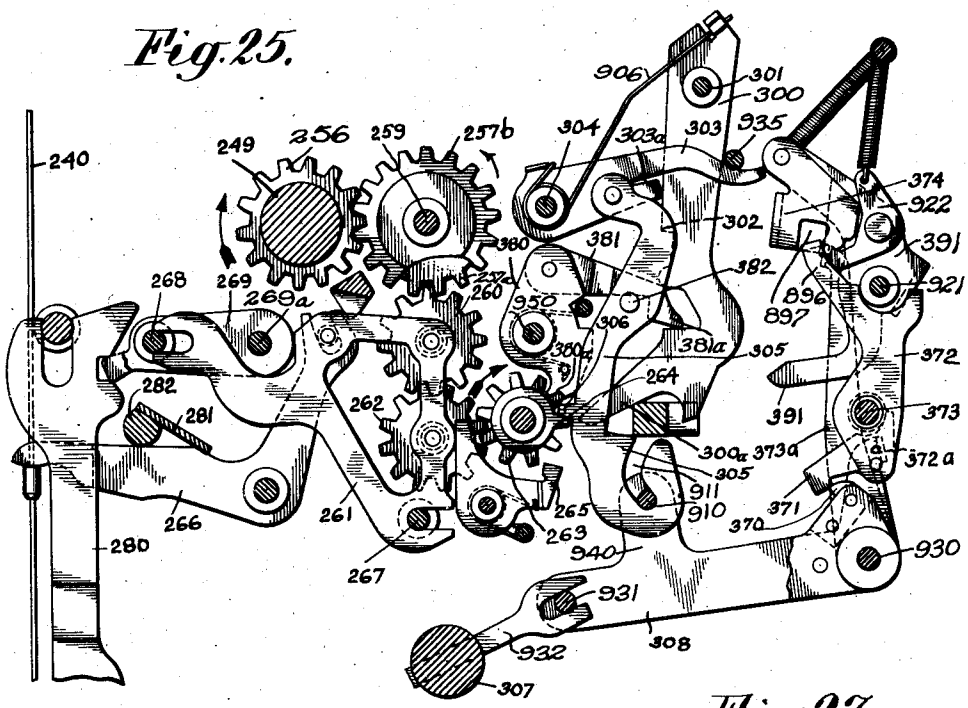
Fig. 25.



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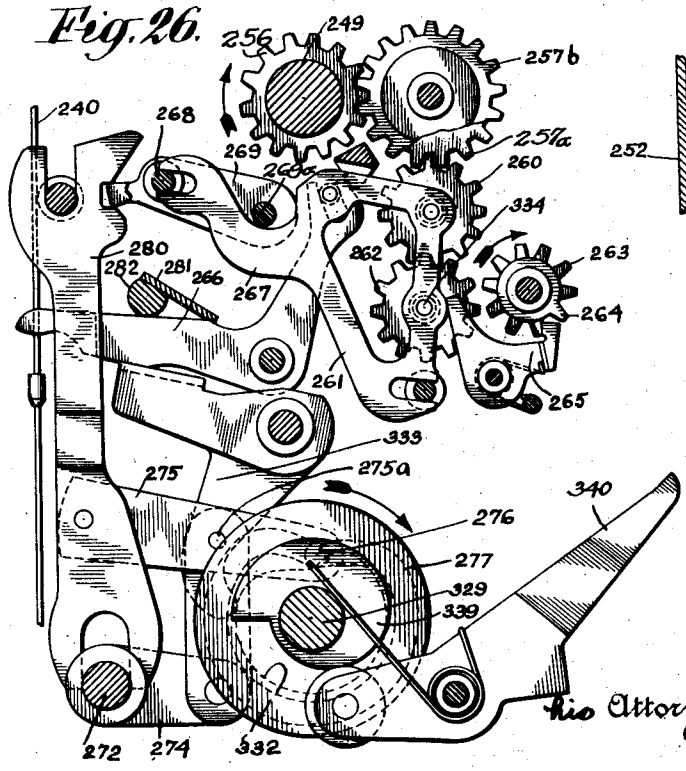

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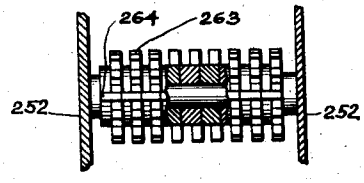

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Fig. 31.

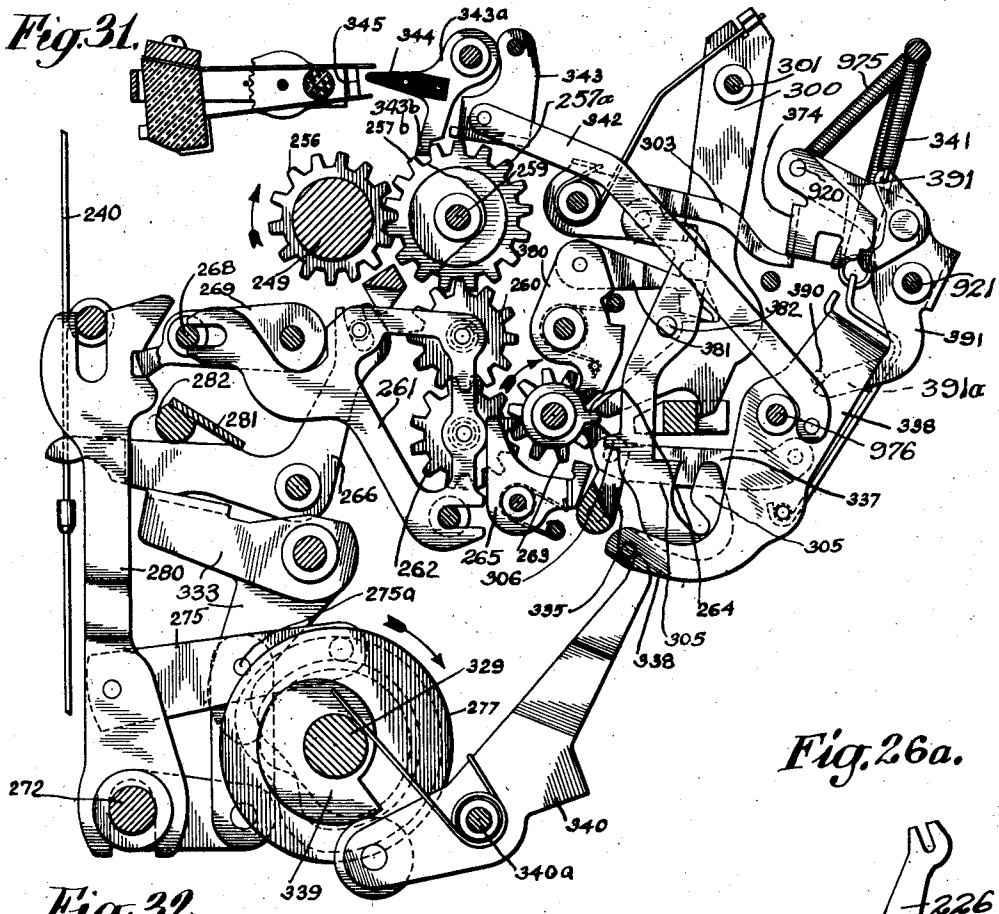
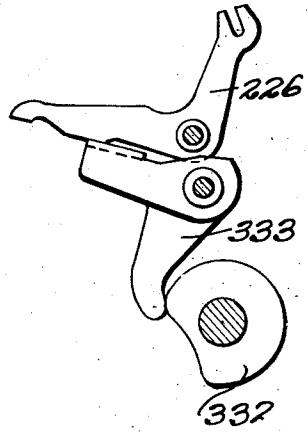


Fig. 26a.



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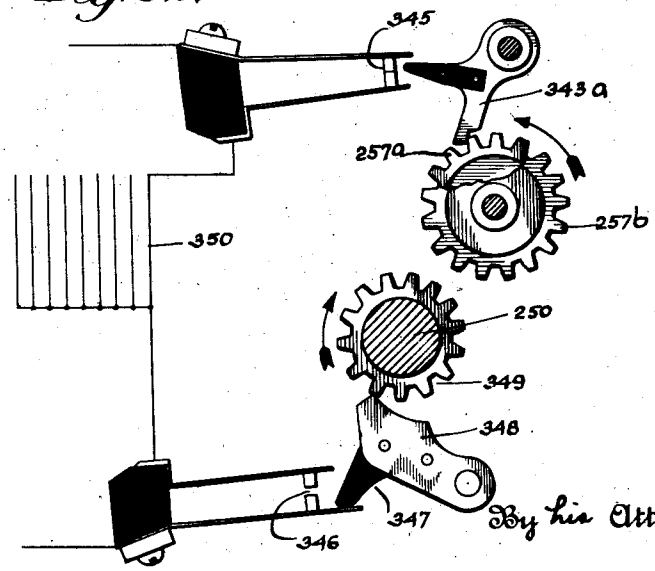

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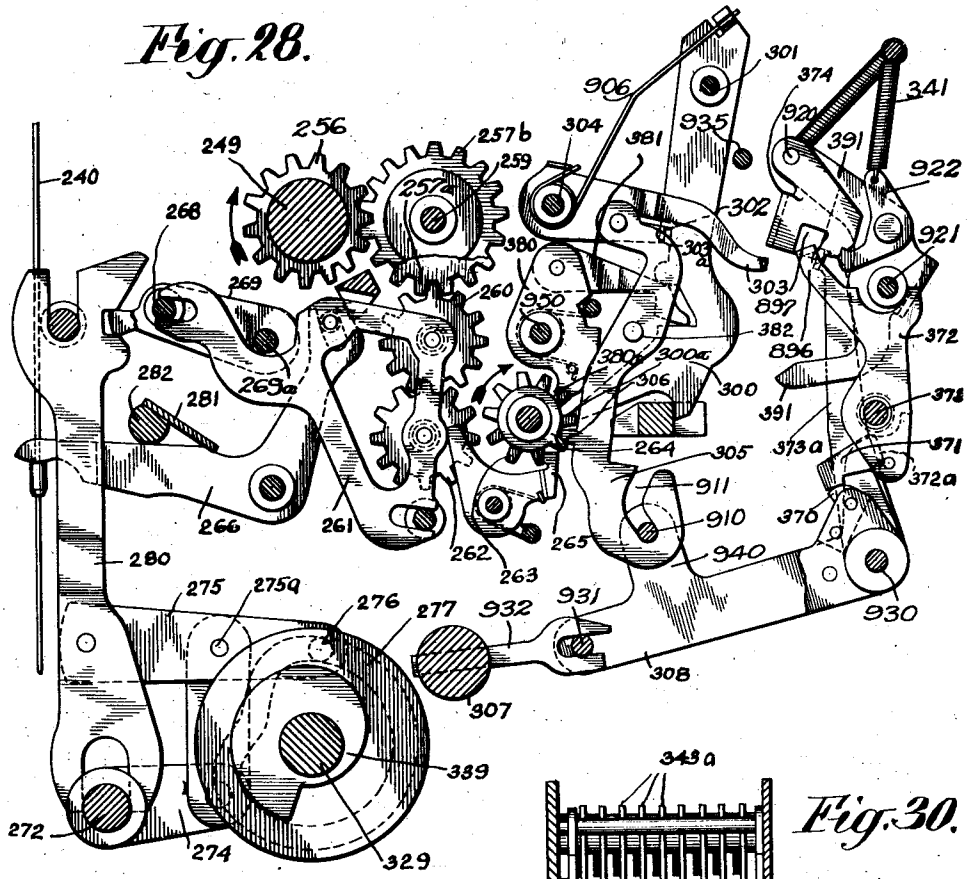
Fig. 28.



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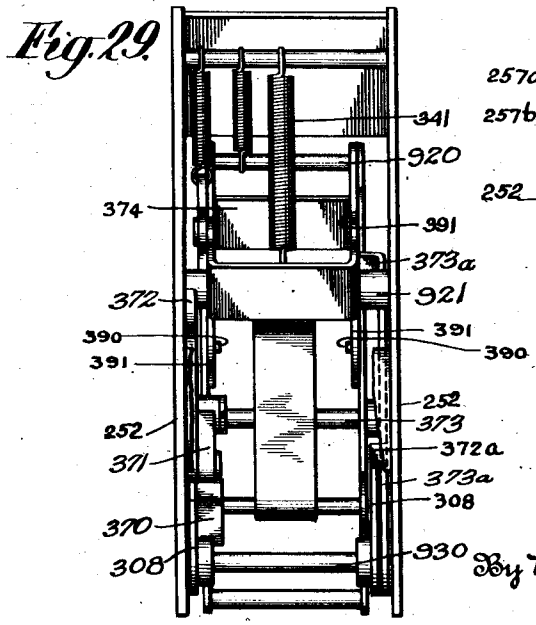

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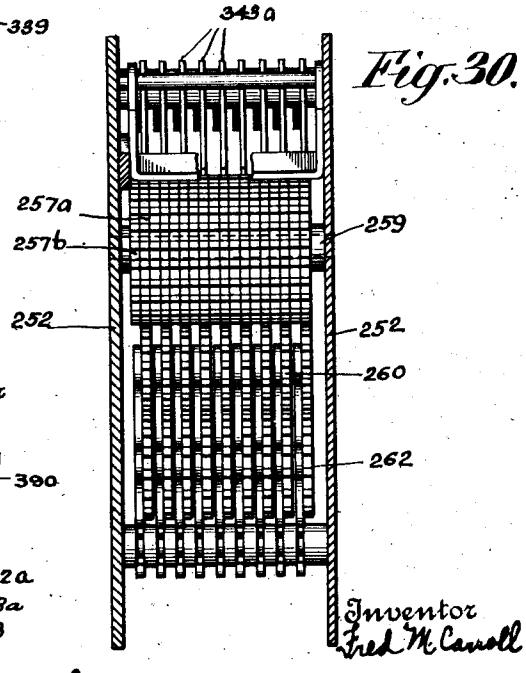

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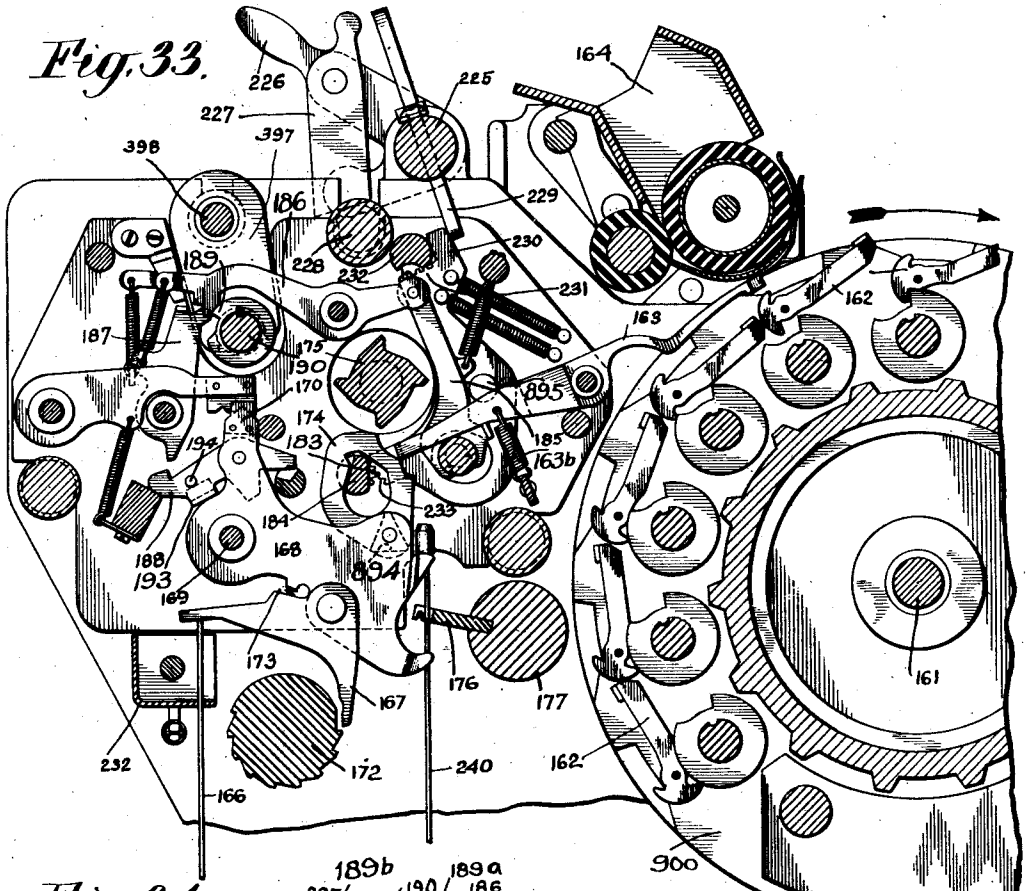
Fig. 33.



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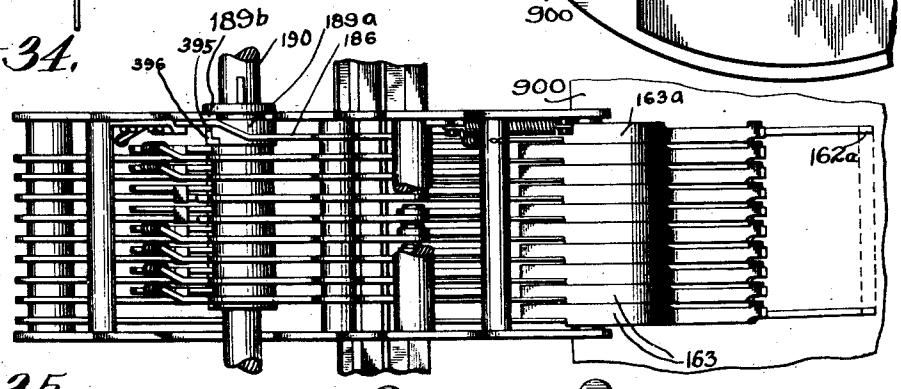

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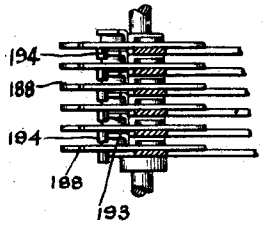

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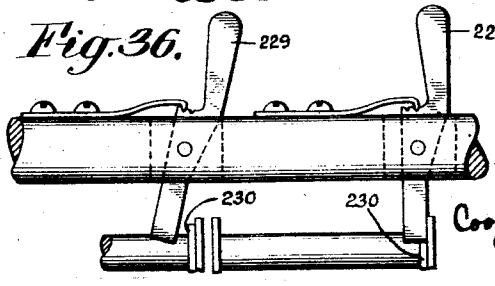

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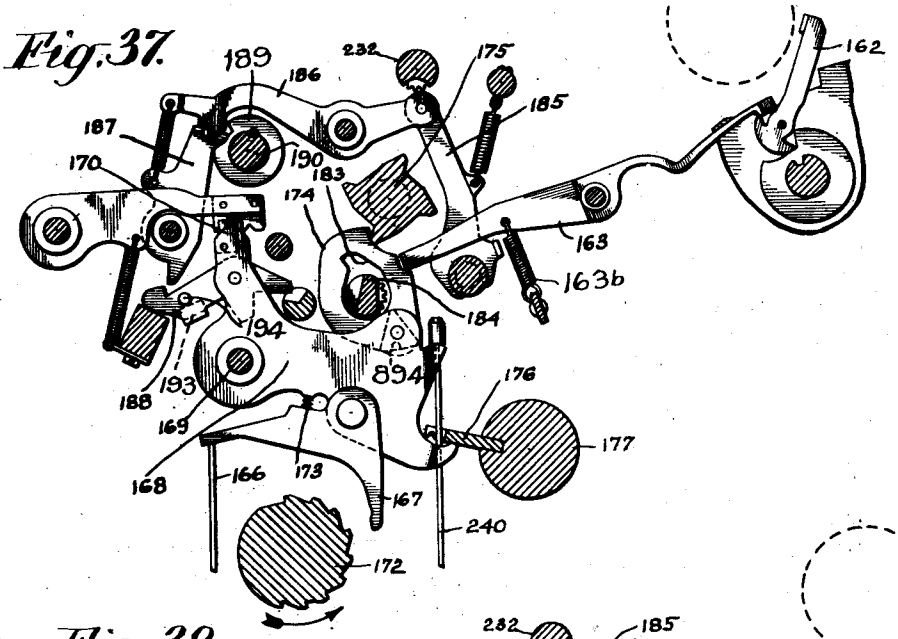
Fig. 37.



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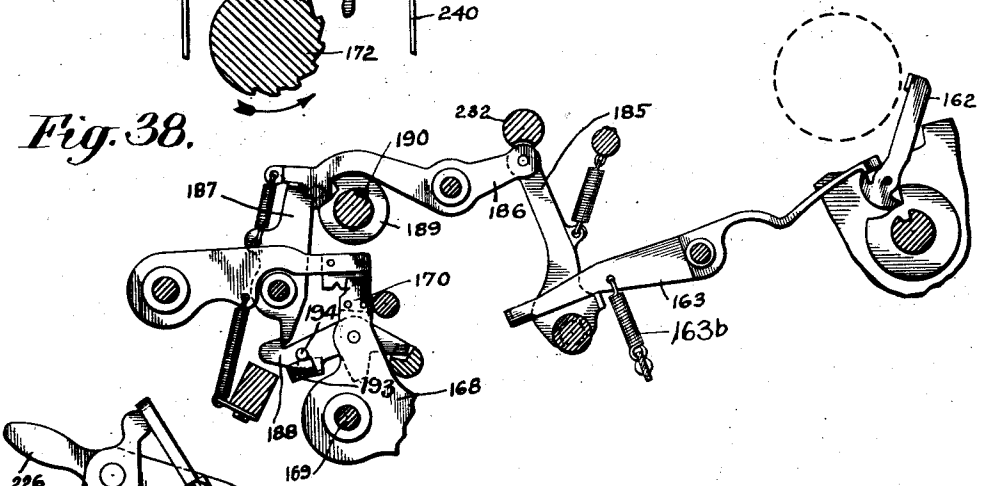

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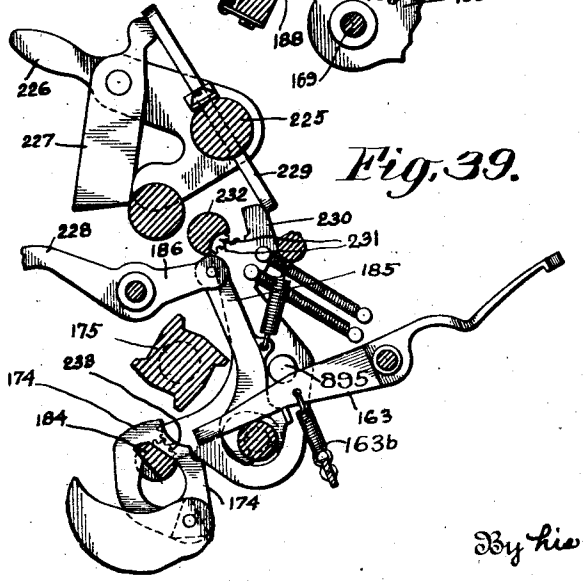

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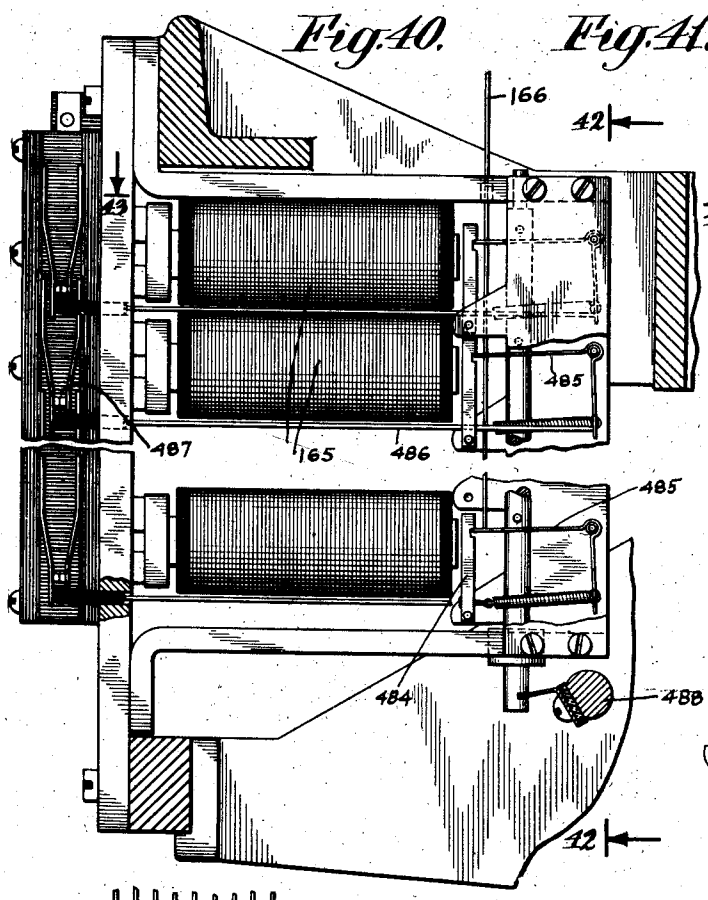
Fig. 40.



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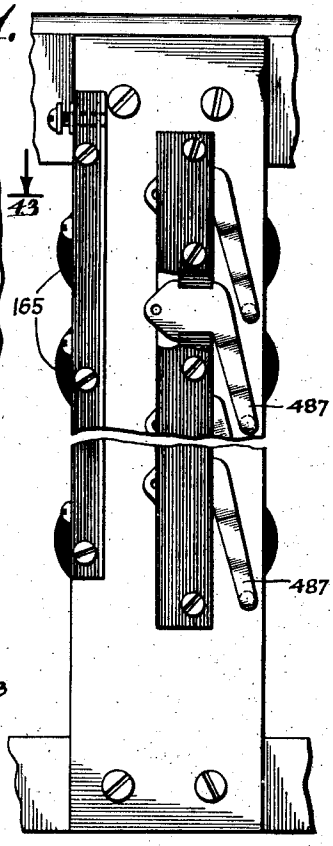

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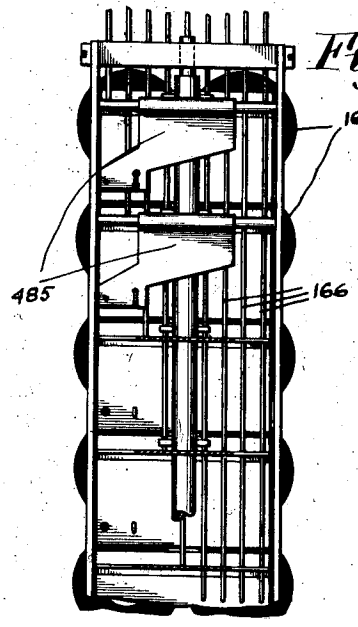

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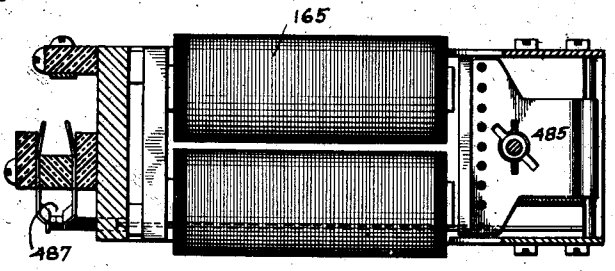

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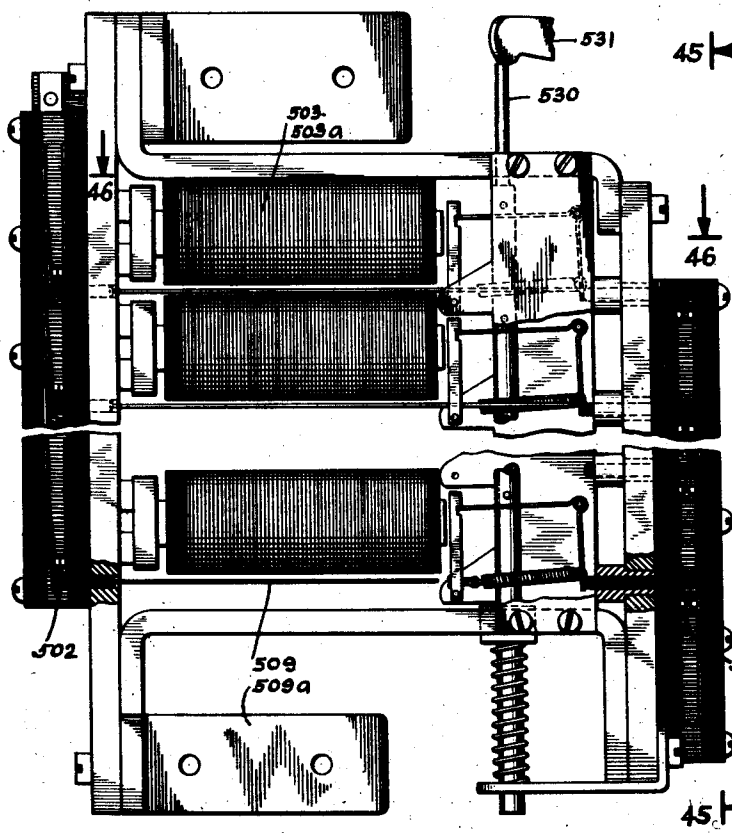
Fig. 44.



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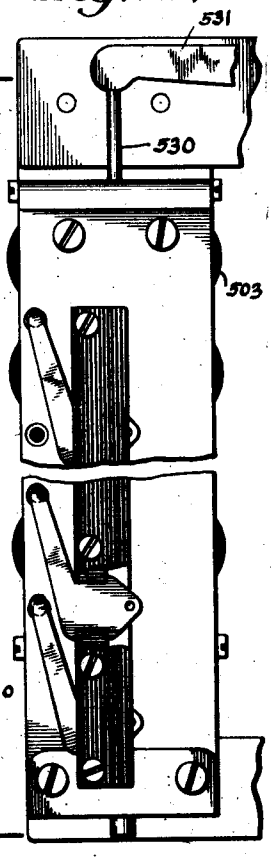

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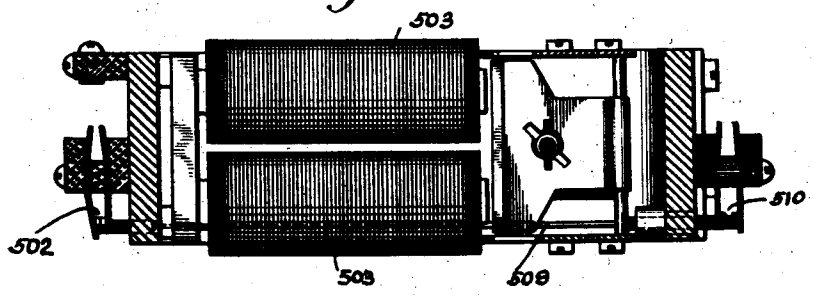

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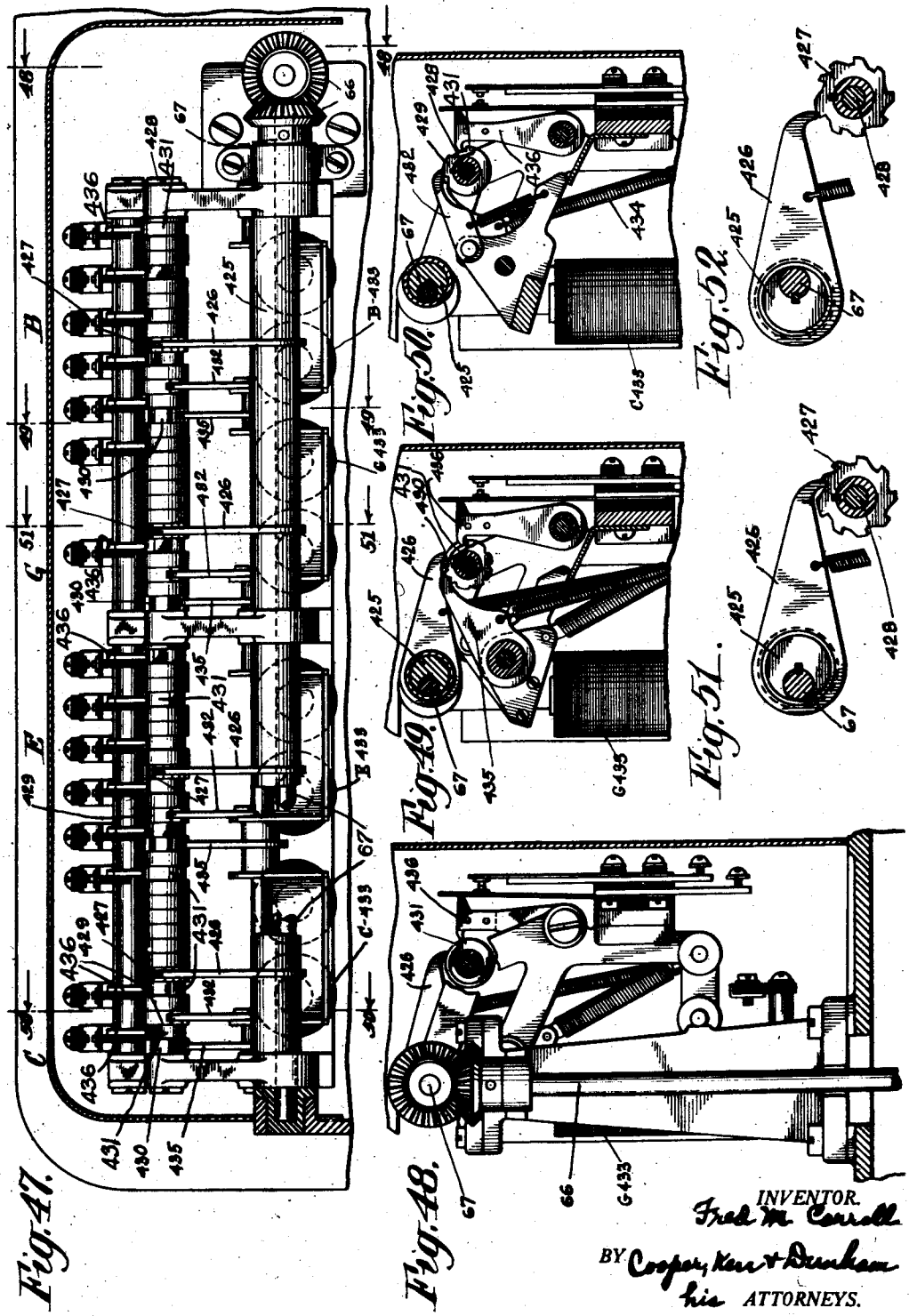

Fig. 47.

Fig. 48.

Fig. 49.

Fig. 50.

Fig. 51.

Fig. 52.

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TABULATING MACHINE

Filed Dec. 19, 1922 28 Sheets-Sheet 26

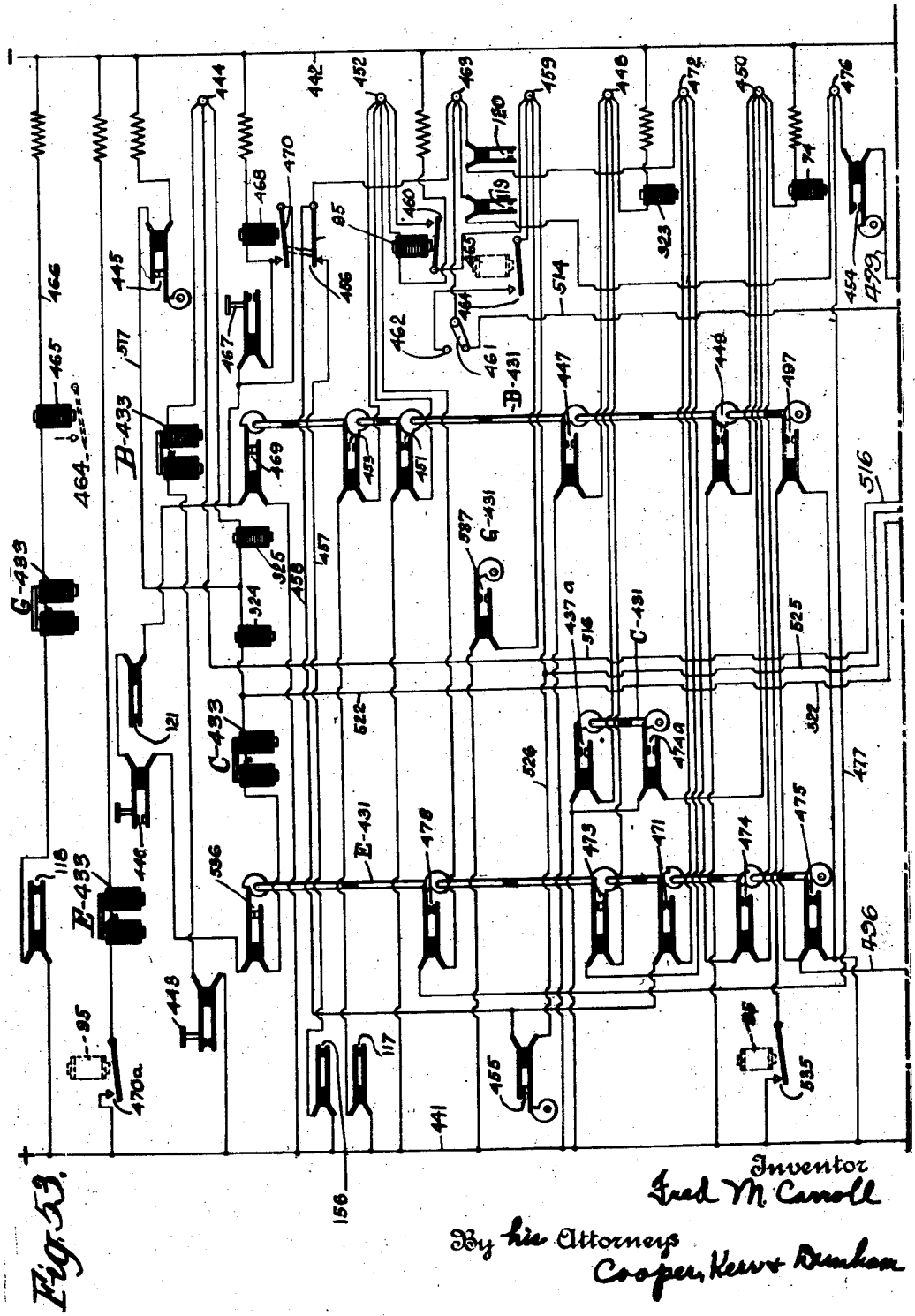

Fig. 53.

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TABULATING MACHINE

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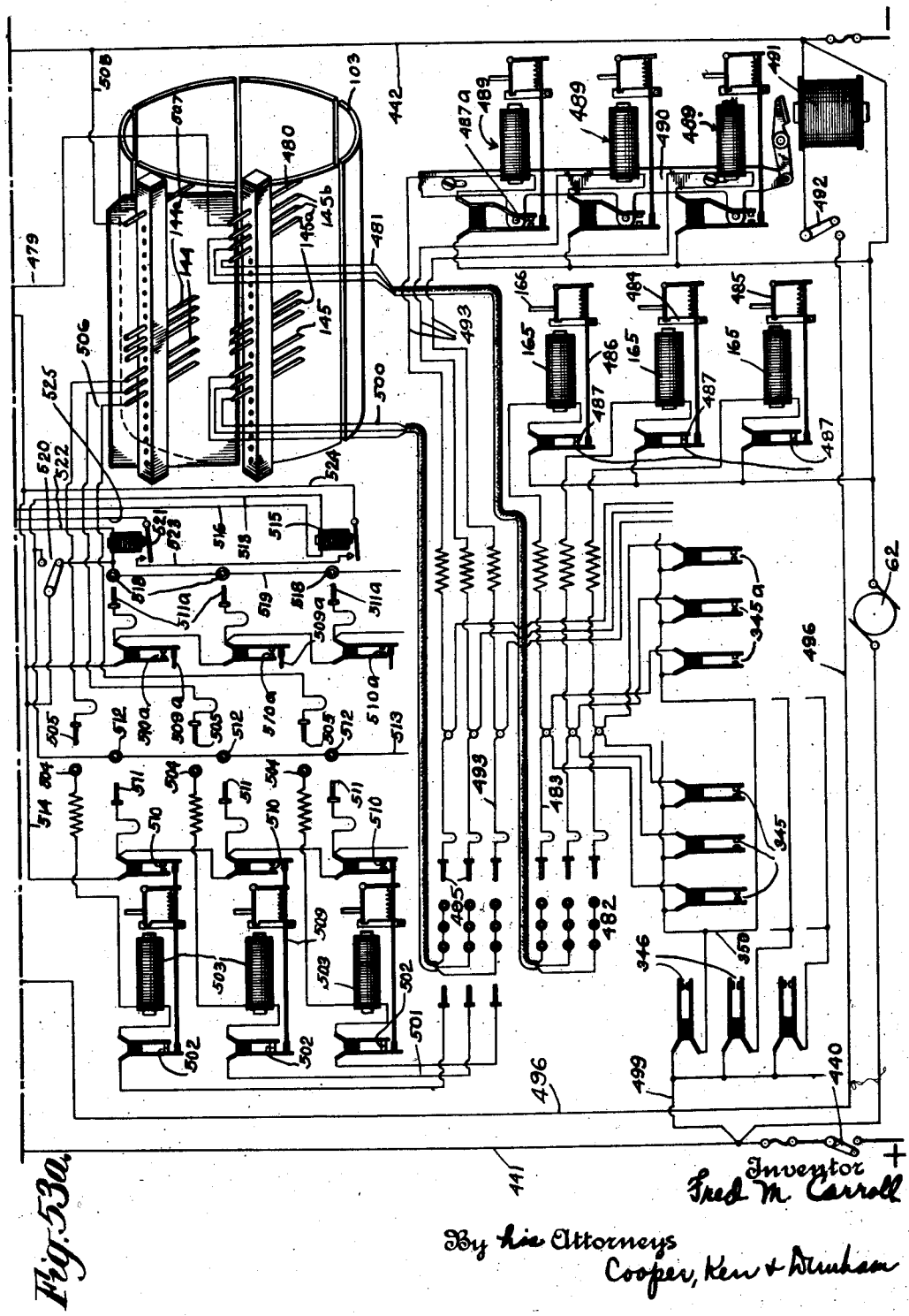

Fig. 530.

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TABULATING MACHINE

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Fig. 55.

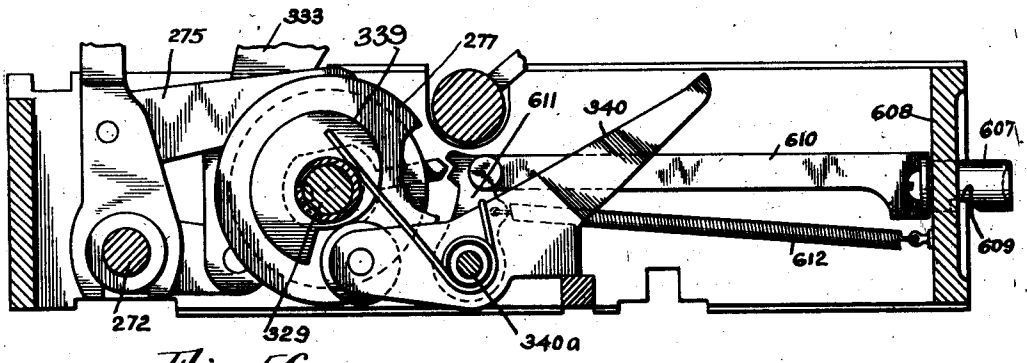


Fig. 56.

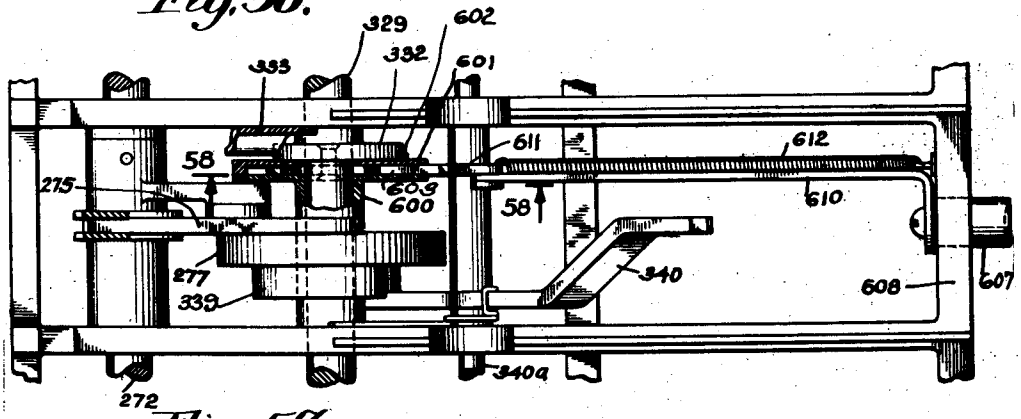
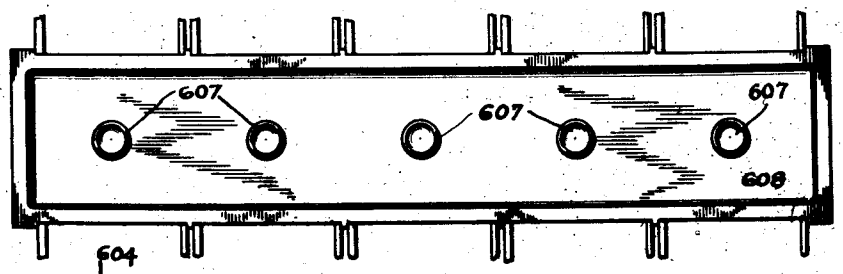


Fig. 57.



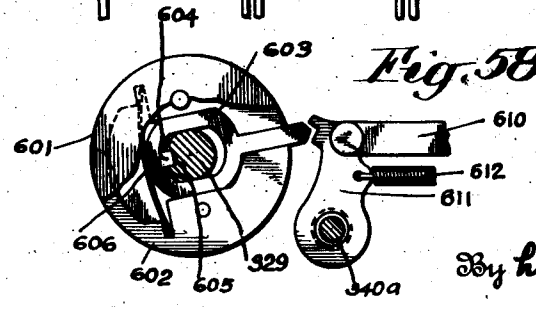


Fig. 58

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UNITED STATES PATENT OFFICE

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TABULATING MACHINE

Application filed December 19, 1922. Serial No. 607,847.

In the tabulating machine art it has been the practice to perforate record cards with the desired data. Thereafter the perforated cards are usually sorted into groups, each group containing all the cards having a common designating characteristic. Such cards after being sorted are placed in a so-called tabulating machine which successively advances the cards therethrough, senses the data upon the cards, and accumulates certain data upon registers. Part or all of the card data may be printed upon a suitable record sheet. When the last card of a group has passed through the machine, the total or totals of the amounts accumulated may be printed as well as a designating group number. Subsequently the tabulation of a new group is commenced and the operation carried on as before.

Such tabulating machines usually include a card feeding means, a sensing or perforation reading means, accumulating devices, printing devices, and a plurality of controlling means, including manual and automatic devices which bring about certain machine operations.

The control devices furthermore are usually adapted to control the sequence of operations of the machine and such control is in part under the influence of the perforations of the record cards and in part under the direct control of the operator.

The present invention is directed, first, to the general improvement of tabulating machines as a whole, to the general end that the machine may be made simpler, and more effectively accomplish the usual functions of a tabulating machine.

A further object of the present invention resides in the provision of a number of improvements which permit the machine to perform certain functions not heretofore possible with machines of this general class.

Another object of the present invention resides in a novel form of accumulator in which the counter gears are differentially driven from a constantly rotating shaft and in which the engagement or disengagement of the counter gears is effected by radially intermeshing gears instead of axially displaceable clutches as heretofore employed.

Other improvements in the counter or accumulators reside in a novel means of resetting the accumulator to zero and the reading of the amount standing thereon. This improvement obviates the use of the separate resetting shaft and motor heretofore employed and permits the resetting to be effected by the rotating drive shaft which differentially sets up the amount upon the counter.

A further object of the present invention resides in a novel combination of accumulator device and printing mechanism to the general end that more rapid operations may be secured. The accumulator is both positioned and restored by a forward advancing movement. The printing device continuously advances and items may be printed by the printing device to designate the items added or to designate the amounts standing upon the accumulator and such last mentioned control of the printing device is effected by the time when the individual accumulator wheels are restored to their normal home positions after their forward restoring movement. By the above arrangement means is provided for obviating idle restoring cycles in either or both of the adding and printing mechanisms. These idle restoring cycles have heretofore limited the speed of operation of accounting machines and by the present improvements the speed of operating may be greatly increased. A further object of the present invention resides in an arrangement of accumulator and printing mechanism and intercooperating controlling devices whereby totals may be printed at the usual listing or item printing speed and furthermore such item printing speed may be greatly increased over that of machines now in use.

Another object of the present invention resides in the improvement of the accumulating section of the machine to the general end that subtotals and grand totals may be taken of like card data in the same record fields.

A further object of the present invention resides in the improvement of the controlling unit for automatically initiating various operations of the machine.

A further object of the present invention resides in the provision of an improved control device for effecting a change in the operation of the machine when record groups change. In the present embodiment provision is made for automatically initiating total printing and clearing upon the change of record groups.

A further object of the present invention resides in the improvement in the so-called automatic control devices which are controlled by record group changes, for effecting a subtotal printing operation from one or more of the subtotal registers or accumulators when there is a change of the subsidiary record card groups, and for also effecting a grand total printing operation upon the change of a major record card group.

Further objects of the invention reside in the provision of selecting devices for controlling the machine operation to permit the same to be run under automatic control or not and also in certain other selecting devices which determine whether sub or grand totals will be taken.

A further object of the present invention resides in the provision of a combined printer and tabulator in which printing and tabulating operations and total printing operations can be performed in the minimum of time without injurious shock to the parts of the machine.

A further object resides in the provision of the construction in which the various cycles of operations are most efficiently utilized to permit the tabulating and printing at high speed and the taking of a total at high speeds without the necessity of delays in the cycle such as have heretofore been necessary in machines of this class.

A further object of the present invention resides in the provision of a novel form of counter mechanism in which the counters may be readily detached or substituted one for the other or replaced with other counters to facilitate the operation of the machine in the field and the substitution of one counter for another.

A further object of the present invention resides in the provision of a compact arrangement of the counter and printing units to the general end that the counter and printer section of the machine can be of substantially the same width thus diminishing the over-all size of the machine.

Further and more detailed objects and advantages of the present invention will be hereafter set forth in the accompanying specification and claims and shown in the drawings which, by way of illustration, show one embodiment of the invention.

In the drawings,

Fig. 1 is a front elevation of the machine with certain parts of the housing broken away.

Fig. 2 is a sectional view of a card feeding section of the machine, the section being taken on line 2—2 of Fig. 5.

Fig. 3 is a vertical section of the card feeding drum at another point, the section being taken on line 3—3 of Fig. 5.

Fig. 4 is an end view of the card feeding drum and associated devices and is a vertical section taken on line 4—4 of Fig. 5.

Fig. 5 is a central vertical sectional view of the card feeding drum.

Fig. 6 is a fragmentary detail view of the card feeding drum and sensing brushes and also shows the driving gear for the drum.

Fig. 7 is an enlarged detail view of finger members for controlling the card contacts according to the presence or absence of a card under the grippers of the card feeding drum.

Figs. 8 and 9 are detail views taken respectively on lines 8—8 and 9—9 of Fig. 3.

Fig. 10 is an end view of the tabulating section of the machine taken on lines 10—10 of Fig. 1 looking in the direction of the arrow.

Fig. 11 is a central vertical section of the tabulating and printing section of the machine, the section being taken on line 11—11 of Fig. 13.

Fig. 12 is a vertical elevation of the parts of the tabulating and printing section of the machine and a view looking from the right upon the parts shown in Fig. 13.

Fig. 13 is an enlarged rear elevation of the tabulating section of the machine.

Fig. 14 is a vertical section of the tabulating section of the machine taken on the lines 14—14 of Fig. 11.

Fig. 15 is a detail view taken on line 15—15 of Fig. 11.

Fig. 16 is a similar detail view taken on line 16—16 of Fig. 11.

Fig. 17 is a vertical detail sectional view of the driving shaft shown in the side elevation of Fig. 10.

Fig. 18 is a detail sectional view of one of the clutch elements on the shaft shown in the preceding figure. The section is taken on line 18—18 of Fig. 17.

Fig. 19 is a detail view of one of the controlling clutches on the end of the shaft shown extending longitudinally across Fig. 15.

Figs. 20 and 21 are respectively sectional detail views taken on lines 20—20 and 21—21 of Fig. 19.

Fig. 22 is a detail view of one of the tabulating counters showing the normal position of the parts before adding is started.

Fig. 22A is a detail view similar to that shown in Fig. 22 but with certain parts omitted and others in different positions to illustrate an intermediate step in transferring.

Fig. 23 is a detail of one of the intermediate gears used in the counter and

Fig. 24 is a sectional view of this gear taken on line 24—24 of Fig. 23.

Fig. 25 is another large detail view of the counter and shows the gears in mesh for adding preliminary to being withdrawn.

Fig. 26 shows a part of the counter with the gears in a preliminary position for taking a total.

Fig. 26A is a detail showing certain parts in Fig. 26 as they are positioned in total taking.

Fig. 27 is a detail of the counter gear assembly.

Fig. 28 is another view of the counter showing the position of the gears after adding.

Fig. 29 is a rear view of a single counter unit.

Fig. 30 is a sectional view of the counter unit taken on line 30—30 of Fig. 22.

Fig. 31 is a detail view of the counter assembly showing the position of the parts after the intermediate gears have restored the accumulating gears to normal or zero position after a total has been taken therefrom.

Fig. 32 is a diagrammatic view of the contact controlling devices for taking totals.

Fig. 33 is an enlarged detail view of the printing drum and associated type controlling parts.

Fig. 34 is a top plan view of certain of the parts shown in Fig. 33.

Figs. 35 and 36 are detail views of certain of the parts shown in Figs. 33 and 34.

Figs. 37, 38 and 39 show detail views of the printing type controlling mechanism in various operative and displaced positions.

Figs. 40 to 43 inclusive are detail views of the counter and group indicator magnets.

Figs. 44 to 46 inclusive are detail views of the automatic control magnets.

Fig. 47 is a top plan view of the control unit.

Figs. 48 to 50 are sectional views of the same taken on the respective section lines 48—48, 49—49 and 50—50 of Fig. 47.

Figs. 51 and 52 show one of the starting pawls used in the former controlling magnet, the former showing the feeding pawl in its advanced position and the latter showing it in its ineffective retracted position.

Figs. 53 and 53*a* represent, when combined, a circuit diagram of the machine.

Fig. 54 is a circuit diagram showing a part of the automatic control circuit which is shown in a fragmentary manner on the preceding Figs. 53, 53*a* on account of lack of space.

Fig. 55 is a vertical sectional view of the total shaft showing a modified form of clutch arrangement for the individual counters to permit the declutching of the same from the total shaft.

Fig. 56 is a plan view of the parts shown in Fig. 55.

Fig. 57 is a front elevation showing the frame of the machine and the various controlling buttons for five counters.

Fig. 58 is a detail sectional view taken on line 58—58 of Fig. 56.

In the drawings: 60 designates a supporting framework which is adapted to carry on one side thereof the card feeding and perforation sensing section of the machine designated generally as 61. The frame also supports the motor 62 and the adding and printing section designated generally as 63.

Motor drive and controlling clutches

The motor 62 (Fig. 1) through a shaft 64 by means of worm gearing (shown in Fig. 17) is adapted to drive a vertical shaft 65. From this shaft through suitable beveled gearing and shafting marked 66 a control unit shaft 67 is adapted to be constantly driven at all times when the motor is rotating. Shaft 65 extends upwardly and has pinned thereto at its upper end a beveled gear 68. Surrounding the shaft 65 is a sleeve member 69 which has keyed thereto at its upper end a double arm member 70 shown in dotted lines in Fig. 15. On one of the arms of this member there is pivoted a clutch dog 71. Fixed to the beveled gear 68 and turning in unison therewith is a notched disc 72. The notched portion of this disc is adapted to cooperate with a lug 73 on the dog 71 and when these parts are engaged the sleeve 69 will be driven in unison with the beveled gear 68. To engage the dog 71 with the notch in disc 72, the magnet 74 (Fig. 10) is provided. Upon the energization of magnet 74, the pivoted armature 75 (Figs. 10 and 13) elevates a bent metal member 76 to withdraw a knockout lug 77 carried thereby from a blocking position in the rear of the dog 71 (see Figs. 10 and 15). A pin 77*a* is also elevated by frame 76 into the path of a lug 79 (see Fig. 10) carried on gear 68 so that dog 71 will be rocked positively anticlockwise by the movement of gear 68 to force the lug 73 thereof into engagement with the notch in the disc 72. Subsequently, the parts will all rotate in unison. Supplementary latch pawls 80 and 81 are provided pivoted upon the member 70. Pawl 80 engages the notch in disk 72, furnishing, in combination with dog 71 a positive clutching action between disk 72 and double armed member 70. Pawl 81 serves to positively latch dog 71 in the notch in disk 72.

The sleeve 69 is now rotated in the direction shown by the arrow in Fig. 10. Keyed to the lower end of this sleeve is a jaw member 84 having a spiraled groove 84*a* terminating in a jaw on the lower edge thereof. Telescoping into this member there is provided an annular member 85 (Figs. 10 and 17) which is keyed to shaft 65 so as to rotate in unison therewith. The member 85 (Fig. 18) is provided with an annular collar which is notched at 86 to permit the passage therethrough of a plunger member 87, which plunger member

is carried by and spring-pressed upwardly from spiral gear 88. The plunger 87 (Fig. 18) is adapted to engage the spiral notch 84*a* in member 84. After riding up into notch 84*a* plunger 87 engages notch 86 and gear 88 rotates in unison with the sleeve 69. A spring-pressed pawl 90 (Fig. 18) mounted upon a disc 91 which guides the plunger 87, is adapted to properly align the member 85 with this plunger when the plunger is disengaged from jaw member 84.

The spiral gear 88 coacts with a spiral gear 92 (Fig. 17) which is fixed on a shaft 93 (Figs. 10 and 16) suitably journaled in the framework of the tabulating section, as shown in Figs. 14 and 16. Fixed to the end of the shaft 93 beyond gear 92 is a jaw member 94 of a one revolution clutch. The one revolution clutch is controlled by a magnet 95 (Fig. 16) which, upon the attraction of its armature 96 (Fig. 17), withdraws a cam lug 97 from engagement with a spring actuated clutch member 98 permitting the latter to engage the notch 99 in the jaw member 94. Subsequently, the shaft 100 rotates in unison with shaft 93. The principle of operation of this clutch is more fully set forth and described in my copending application, Serial No. 591,584 filed September 30, 1922 now issued as Patent No. 1,516,079, November 18, 1924.

Drive for card feeding devices

Mounted on the end of shaft 100 is a pinion 101 (Fig. 16) which through gearing 102 (Fig. 5) is adapted to rotate a drum 103. This drum is provided with card clip devices as will be hereafter described.

To feed cards one at a time from a supply stack 104 (Figs. 2 and 3) a train of gears indicated at 105 is provided. These gears are adapted to drive card feeding rolls 106 (Fig. 3) and also to drive the mechanism which feeds the cards from 104 to the feed rolls. The mechanism for feeding the cards from the stack comprises finger members 107 which extend into cooperation with the rear of the stack of cards and these members are eccentrically mounted upon one of the rotating shafts driven by the gear train 105. The rear ends of these finger members 107 are fixed against movement, as shown in Fig. 3, so that upon the rotation of the eccentrics the fingers will move at their forward ends with a back and forth motion to take the cards one by one from the stack and advance the same through the controlling throat 108 (see also Fig. 9) of the card magazine. After a single card is initially advanced by the fingers 107 a pivoted pusher member 109 (Fig. 3) swings in back of the rear edge of the card and advances the same into the grip of the rolls 106. The pusher 109 is suitably operated by cams 110 (Fig. 3 and Fig. 9) on the feed roll shaft. As shown in Fig. 3 the feed rolls 106 are so formed that they permit the feeding in of a card, subsequently grip the same and finally release the card when the latter is received by the card gripping devices 111. The throat 108 is provided with serrated edges, as shown in Fig. 9, to permit the passage therethrough of a card having some wavy edges. The throat will prevent the feeding of two cards at one time.

The card grippers 111 are pivotally mounted in the drum 103 and extend slightly through the periphery thereof, as best shown in Fig. 3. Suitable slots are provided in the drum to permit the projection of the grippers. The grippers 111 are provided with springs 112 (Fig. 4 and Fig. 7) which normally tend to rock the grippers to engage and hold a card to the rotating drum 103. To open the grippers at the proper time and to permit the subsequent spring closure thereof fixed cam members 113—114 are provided. These are carried by the frame of the machine, as shown in Figs. 4 and 5, and cooperate with suitable follower rollers 115 which are carried by the gripper structure. The grippers are timed to operate at the proper time to successively receive cards from the feed rolls and to deliver same to the storage stack 116 (Fig. 4).

In order to control certain electrical circuits differentially according to the absence or presence of a card upon the drum and properly engaged by the grippers certain controlling devices are provided which will now be described.

As shown in Fig. 5 there are five pairs of contact devices 117, 118, 119, 120 and 121. These contacts are adapted to be operated by a yoke or bail carried by a pivoted lever 122 which through link 123 (Fig. 4, Fig. 7) connects with a pivoted finger lever 124 having a portion engaging a notch upon pivoted arm 125. Arm 126 is connected to 125 and to a spring actuated link 127. Within the drum there are located a number of pivoted walking beam lever assemblies 128, one for each gripper. Each assembly carries a controlling plate 129 cooperating with a finger on the gripper assembly so as to be rocked to the position shown in Fig. 7 if a card is engaged by the gripper. If no card is gripped to the drum the gripper will engage in the notch 130 in plate 129 as indicated in Fig. 4. With a card in the grippers member 128*a* is projected. If cards are absent 128*b* is projected and 128*a* withdrawn. 128*a* when projected strikes 124 and elevates link 123 to effect the closure of the normally open contacts and the opening of those which are closed. On the other hand, 128*b* when projected strikes 126 and permits link 123 to be drawn down by spring 131 (Fig. 4) to reverse the contact conditions.

Brush devices

Pivoted on studs 140 in the frame of the machine are arms 141 which in turn are piv-

otally connected to a brush holder frame 142 (Figs. 2 and 6). Pivoted in the frame 142 are insulated brush holders 143 which respectively carry the upper and lower brushes 144 and 145. These brushes cooperate with the index point perforations of the record cards which are carried by the drum and sense the readings thereon. Two sets of brushes are provided which cooperate with two successive cards for the purpose of comparing the cards to detect group changes therein. To conduct current to the brushes and to permit the pivoting of the brush holders, fixed cross-bars 146 (Fig. 2 and Fig. 3) are provided with individual brushes 147 cooperating with the brushes 144—145 respectively. In order to prevent the bending of the brushes at the times the card gripping devices 111 pass thereunder the brush holders 143 are provided with fingers 148 (Fig. 2) which cooperate with a rotating cam 149 carried on the drum of the machine. These parts rock the brush holders each time the card gripping devices 111 pass under the brushes so as to provide clearance therefor. The machine is also timed to stop with the brushes elevated from the drum so back circuits at this time will be prevented. The entire brush holder assembly and frame can be displaced away from the drum for inspection by depressing the key 150 (Fig. 2) which through a suitable linkage displaces the entire brush holder assembly about the supporting pivoted studs 140.

The storage magazine comprises a suitable hopper 152 which is resiliently supported by the spring 151 (Fig. 3) through a medium of a sleeve 153. The cross member 154 connects with the lower end of this spring 151 and upon the filling of the magazine this cross-bar 154 is adapted to contact with the pivoted member 155 and open a pair of electrical contacts 156 to stop the operation of the machine. A dash pot 157 (Fig. 2) is also provided to prevent the upward slamming of the magazine when the cards are removed therefrom.

As previously mentioned the gear 68 rotates at all times when the motor 62 is rotating (Figs. 1 and 10). This gear 68 intermeshes with the beveled ring gear 160 which is fixed to the central drum shaft 161 (Figs. 10, 11 and 13). The printing drum 900 is mounted on shaft 161. This drum carries pivoted type carriers, the operation of which will be explained later. This type of printing mechanism is well known in the art and the details of construction of the drum are further set forth in my copending application and patent hereinbefore referred to. It is sufficient to state that the drum 900 carries a number of type members 162 (see Fig. 11), one row of type members being provided for each column on the card and the number of the type members about the drum periphery corresponding to the index point perforations in a given card column. These type members are adapted, when engaged by the controlling hook members 163, to cause the type to be thrown upwardly and through a suitable inking ribbon impress a record upon a paper sheet carried by the carriage 164. Details of this carriage are set forth in the application and patent above referred to.

To control the operation of the type members 162 (see Figs. 11 and 33) for listing items, call magnets 165 are provided with suitable individual armatures 484 which control the elevation of call wires 166 (Fig. 40) which extend upwardly and are connected to individual pawls 167. Fig. 33 shows the normal position of parts before printing. Each pawl 167 is pivoted upon a plate 168 which in turn is pivoted on stud 169 supported in suitable frame members.

To retain plate 168 in either its normal or its type selecting position an impositive lock 170 is provided. The rocking of the plate 168 in a counterclockwise direction is adapted to control the printing. This plate is not directly rocked by the elevation of the call wire 166 but is only controlled thereby. The actual rocking of plate 168 is effected by a rotating ratchet shaft 172. The ratchet teeth on this shaft are arranged to engage the tip of pawl 167 and to thereby rock plate 168 upon the rocking of pawl 167 slightly clockwise from the position shown in Fig. 33. The rotation of the ratchet shaft 172 is effected by the gear train 171, best shown in Fig. 10. When the impositive lock 170 has engaged with the left hand notch after plate 168 is rocked counterclockwise the pawl 167 will be thrown clear of the ratchet shaft 172 under the action of spring 173 (see Fig. 37). This spring 173 is compressed when the pawl 167 is rocked by call wire 166 and as soon as the pawl 167 is raised sufficiently by ratchet shaft 172 to permit it, the spring 173 expands and rocks pawl 167 counterclockwise clear of the ratchet shaft 172. Pivotally attached to plate 168 by a triangular friction spring 894 is a plate 174 having a notch to engage the hook member 163 which controls the individual type bars. Fig. 37 shows the hook 163 rocked clockwise to engage a type bar and to cause the type to be impelled against the paper. Directly after the type bar has been hooked, plate 174 is displaced counterclockwise by a ratchet shaft 175, which shaft is driven by the gear train shown in Fig. 10. The displacement of plate 174 releases hook member 163 which is restored to normal non-selecting position by its spring 163b. Subsequently, plate 168 is rocked clockwise to restore the parts for the next printing operation by a restoring bail 176 (Fig. 37) carried on shaft 177. The shaft 177 extends through to the opposite side of the machine and con-

nects to a crank arm 177*a* (shown in dotted lines in Fig. 12) carrying a pin 178 engaging in a plate 179 pivoted on stud 180. Plate 179 has a nose extending into cooperation with a cam 181 carried by the printing drum shaft 161 whereby the shaft 177 is periodically rocked at each operation of the machine. The plate 179 is kept in cooperation with cam 181 by means of a coiled spring 182. During the clockwise rocking of plate 168, a cam edge 183 (Fig. 37) on plate 174 engages the top of a shaft 184 and restores plate 174 to its normal position relative to plate 168 which position is shown in Fig. 33. In this position plate 174 is again in readiness to rock hook member 163 for a subsequent printing operation.

The above describes the sequence of operation for listing items from the record cards upon the record sheet. The electrical connections with the call magnets 165 to the controlling brushes will be hereafter described in connection with the circuit diagram.

In printing items, such as 2000, the record card only controls the printing of the characteristic 2. Supplemental means must be provided for automatically printing the zeros to the right of the 2 in such recording operations. For the purpose of printing the zeros, each hook 163 is provided with a zero controlling link 185 (Fig. 38) which is normally held in ineffective position by the parts 186, 187 and 188 assuming the position shown in Fig. 37 during the number printing operations. Each plate 168 carries an automatic naught controlling finger 188, which finger is provided with a pin 194 on one side and a lug 193 on the other side. The pin 194 on each finger overlies the lug 193 on the adjacent finger to the right. Thus upon rocking of any one plate 168 all the fingers 188 to the right, whose plates 168 have not been rocked, will be rocked from the position shown in Fig. 33 to that of Fig. 38. The rocked fingers 188 will engage pivoted members 187 holding them in the position shown in Fig. 38 and so prevent parts 187 dropping in the notches in cams 189. However, parts 186 drop into the cam notches and at the proper time to elevate members 185 to cause the hooks 163 to engage the type and print zeros. The cam members 189 are carried on shaft 190, which shaft is rotated in unison with the machine cycle by means of the gear train shown in Fig. 10.

Means is provided for locking out groups of type members or locking all of them out so that no printing will be effected. This part of the machine corresponds to the well known hammer locks used in accounting machines and comprises the parts shown in Figs. 39, 33 and 36.

Referring to Fig. 33 a rock shaft 225 is suitably mounted to rock in the machine frame, which shaft carries at one end a handle 226 provided with a latch plate 227 normally engaging shaft 228 to prevent the rocking of shaft 225. By displacing latch 227 to the left, as shown in Fig. 33, the shaft 225 may be rocked counterclockwise thereby swinging fingers 229 carried by the shaft counterclockwise and permitting pivoted plate 230 to swing counterclockwise about its pivot 895 thereby through gearing 231 rocking shaft 232 into a locking relation to members 186 to thereby prevent any displacement of the type controlling hooks 163 through the zero printing mechanism. To prevent displacement of the hooks 163 by engagement with the notched plate 174, plate 230 is likewise provided with gear teeth 233 (see also Fig. 39) which rock the shaft 184 to thereby displace plate 174 out of the path of hooks 163.

If it is desired to lock out an individual group of type members the setting devices shown in Fig. 36 are manipulated. These setting devices include the fingers 229 of which one is provided for each group of type and can be displaced to the right or left into or out of the path of plates 230 to thereby permit the plate 230 to move to blocking or non-blocking position for each group of type.

During a part of the total-taking operations the call wires are rendered ineffective so as not to actuate pawls 167. For this purpose provision is made for shifting the upper ends of the call wires 166 to one side of the pawls 167 at the proper time in the machine cycle. This is effected by sliding a perforated plate 232 endwise (in and at Fig. 33), which displacement is secured by a pivoted lever 233 operated by a cam 234 (Fig. 15) on shaft 236. The operation of this shaft will be hereafter described.

Actuation of the counter

As previously explained, plates 168 are rocked counterclockwise each time a perforation passes under the sensing brush. The elevation of the call wires 166 is accordingly in time with the machine cycle. To control the actuation of the register wheels I provide supplementary call wires 240 (Fig. 33), which call wires are adapted to be elevated upon the rocking of plates 168 by their call wires. Before describing the control of the action by the call wires 240 the drive for the various counters will be described.

Referring now to Fig. 10 the sleeve 69 through beveled gearing 245 is adapted to drive a stud shaft carrying a mutilated gear 246 (see Figs. 16 and 17). The mutilated gear enmeshes with the second mutilated gear 247 which in turn has fixed thereto a small pinion meshing with gears 248 which in turn through pinions drive the two counter drive shafts 249 and 250. The mutilated gears 246, 247 are arranged to be brought into rotation

at a proper time after a dwell by means of a Geneva stop motion 251, best shown in Fig. 17. The shafts 249 and 250 rotate during a certain part of the card cycle and remain idle during the period intervening between the controlling perforations of two successive cards. In the present machine provision is made for taking totals and subtotals from the same record cards. The upper shaft 249 (Fig. 11) drives the grand total counter and the lower shaft 250 drives the subtotal counter. These counters in their general construction are substantially similar except for the controlling devices for taking off totals therefrom. I preferably arrange the counters for ready detachment from the machine and accordingly carry the counter mechanism itself on side plates 252 (Fig. 11). Fig. 13 shows the arrangement of the counters in the machine frame. Here there are shown five upper counters designated generally 253 and five lower counters designated generally as 254. Any individual counter can be withdrawn from the machine by sliding the same rearwardly after withdrawing the locking bars 255 (Figs. 14, 10, 11 and 12). Supplementary spring pressed locking levers 255*a* are provided and controlled by members 331*a* to prevent the withdrawal of the counters when the same are being reset or otherwise adjusted. By constructing the counters as units in this manner it is possible to replace any counter should occasion therefor arise. The shafts 249, 250 are provided with a plurality of counter driving gears 256 (Figs. 11 and 14) preferably made integral with the shaft.

The counters are operated by call wires 240 (Figs. 11 and 33), previously mentioned in connection with printing. These call wires 240 are attached at their upper ends to plate 168 and are elevated by this plate whenever it rocks counterclockwise to effect listing. As shown in Fig. 11 the call wires 240 are attached at their middle portions to operating mechanism (consisting of frames 266) of the upper counters and at their lower portions to operating mechanism of the lower counters.

Referring now to Figs. 22, 23, 24 and 30 which show the position of the parts before an adding operation is commenced, meshing with the intermediate gears 256 are gears 257*b*. Each gear 257*b* has alongside of it a companion gear 257*a* which, however, does not mesh with gear 256. Gears 257*a* and 257*b* tend to rotate together by reason of a spring pawl construction 258 (Fig. 23). The gears can rotate, however, independently if conditions demand. Gears 257*a* and 257*b* are mounted to freely rotate upon a shaft 259 supported in the counter frame, as shown in Fig. 30. Gear 257*a* is enmeshed with an intermediate gear 260 carried on a stud supported by the frame 261 (Fig. 22). Gear 260 in turn intermeshes with gear 262 similarly pivotally mounted on frame 261. Slightly spaced from and normally unmeshed with gear 262 is the counter gear wheel 263. The counter gear assembly is shown in Fig. 27, in which counter gear 263 has alongside of it and integral therewith a single tooth transfer controlling gear 264. When the counter gears 263, 264 are disengaged from the intermediate counter driving gear 262, as for example in the position shown in Fig. 22, provision is made for locking the gears 263, 264 to prevent the rotation of same. Rocking pawls 265 are spring-pressed into engagement with the teeth of gears 263. During adding operations, pawls 265 are disengaged by the abutting engagement of the frame 261 therewith (see Fig. 25).

As heretofore explained the call wires 240 are elevated under the control of the call magnets which also control the printing operation and by means driven in unison with the operation of the machine. The elevation of the call wires 240 is arranged to intermesh the counter gears with the gear train and thus add on to the counter gears the amount represented by the index point perforations on the record card. To effect such enmeshment the call wire 240 is adapted to rock a bell crank 266 clockwise, which bell crank through pin and slot connections shifts frame 261 laterally to the right from the position shown in Fig. 22 to that shown in Fig. 25. The frame 261 is guided for horizontal movement on a fixed stud 267 and upon a stud 268 carried on link 269. Upon the elevation of the call wire, the frame 261 is translated laterally to the right and during this movement gear 260, being in mesh with gear 257*a* which is rotating in the direction of the arrow, may remain stationary since the relative rotational forward movement of gear 257*b* may be counteracted by the relative anticlockwise movement caused by the lateral translation of the supporting frame. The relative sizes and speeds of the several parts are so chosen that gear 262 will be stationary at the time it enmeshes with the stationary counter gear 263. Subsequently, upon the cessation of lateral movement of the supporting frame rotational movements will occur throughout the train and intermediate gear 256 will drive the counter gears 263 to the desired extent. At a fixed time in the machine cycle gear 262 is unmeshed from the counter gear 263 as will now be described.

Referring to Fig. 10, a cam 270 is fixed to shaft 93, which cam through a follower 271 is adapted to rock two shafts 272, one being provided for the upper and one for the lower counter units. A suitable interconnecting link 273 operates the shafts 272 in unison. The rocking of shafts 272 occurs once per card cycle at the D position. The D position of a tabulating machine is the normal or home position of the parts. Usually some moving

shaft of the machine is provided with a wheel having a mark upon it, which mark cooperates with an index or pointer when the parts are in normal or starting position. This position on the index is commonly referred to as the D position.

Referring now to Figs. 22 and 28, the shaft 272 through crank and link connection 274 is adapted to elevate an arm 275 which is fulcrumed on roller 276 within a slot in box cam 277. At this time in the cycle, cam 277 is stationary. The elevation of arm 275 in turn elevates a slide 280 which is provided with a notch at the upper end engaging a lug on the arm 269. Upon the rocking of arm 269 about its pivot point 269*a*, pin 268 is elevated thereby rocking the frame assembly 261 in a general clockwise direction. This motion is utilized to disengage gears 262 and 263. After this disengagement provision must be made for restoring frame 261 to its normal position. This is secured by a concurrent actuation of the frame 261 by the bell crank levers 266, which bell cranks are rocked counterclockwise by a bail 281 carried on shaft 282. Eventually the parts will assume the position of Fig. 22.

During the transition of the parts from the position shown in Fig. 28 to that of Fig. 22 there may be a relative movement of the intermediate gears and driving pinion. At such times, however, these intermediate gears are out of mesh with the counter gears and therefore this relative movement is immaterial. To rock the bails 281 for both grand and subtotal counters the bail shafts 282 (Figs. 28 and 10) are suitably interconnected by a link 286. A linkage 283 connects to a pivoted plate 284 mounted on shaft 307. Plate 284 through a pin and link connection connects with a rocking arm 287 which has two high points cooperating with the double high point 285 which is carried by shaft 93. This linkage imparts a two stage rocking movement to shafts 282 and shaft 307. The first rocking movement is primarily intended to rock shaft 307 and the second step moves both shafts. Dash pot 288 is adapted to minimize the shock during the return movement of the parts.

Transfer mechanism

The transfer operation may be understood by reference to Figs. 22, 22A, 25, 28, and 29. Referring first to Fig. 22 which shows the parts in normal position, a plate 300 is pivoted at 301 and has a toe portion 300*a*, adapted to extend into the path of the tooth on single tooth transfer gear 264. A transfer latch 303 is pivoted at 304 and has a bent-over portion 303*a* extending into a notch 302 in plate 300. A spring 906 urges the plate 300 clockwise so that its toe portion 300*a* extends into the path of the tooth on transfer gear 264. The same spring 906 urges the transfer latch 303 counterclockwise, although movement of it is normally prevented by the latching action between notch 302 in plate 300 and bent-over portion 303*a* of latch 303. The actual transferring member 305 is pivotally suspended from latch 303 and has a projection 306, in the form of a gear tooth, which lies in the plane of the adjacent counter wheel 263 to the left. Normally this projection 306 lies slightly below the center line of the counter gears 263 as shown in Fig. 22. When, during an adding operation, any counter gear 263 passes through zero, the tooth of its transfer gear 264, encounters the toe portion 300*a* of plate 300 and rocks this plate counterclockwise, thereby releasing bent-over portion 303*a* of transfer latch 303 from slot 302 and permitting the latch to move counterclockwise until its end encounters a bail 374. The movement of latch 303 slightly raises the transfer member 305, suspended therefrom. The parts have now assumed the positions illustrated in Fig. 22A and they remain in this position until towards the end of the machine cycle after the entering operations are complete.

As a complete understanding of the ensuing operations of the transferring mechanisms requires a knowledge of the construction of the bail 374 and its associated parts, the structure of these parts will be briefly described. Referring particularly to Figs. 22, 28, and 29, the bail 374 comprises a box-like frame, pivoted on a rod 920 supported by another frame 391, which in turn is pivoted at 921. By means of an impositive latch 922, which may cooperate with either of two notches in bail frame 374, the bail may be held in either of two positions on frame 391, one of these positions being illustrated in Fig. 28 and the other in Fig. 25. The bail 374 may be rocked from the relative position shown in Fig. 28 to that shown in Fig. 25 by a plate member 372, pivoted at 373, which has an extension 896 at its upper end cooperating with a notch 897 in bail 374. The plate member 372 has a pawl 371, pivoted to its lower end through which it may be rocked, as will now be explained, during the later stages of the transferring operation.

Towards the end of the machine cycle, after entering operations are completed, a yoke assembly 308 is rocked counterclockwise in two steps by a shaft 307, the first step preparing the parts for actual transfer and the second step causing them to actually effect the transfer. The yoke assembly 308 consists of two parallel arms pivoted on shaft 930 and joined at their free ends by a rod 931. One arm of yoke assembly 308 (Figs. 25 and 28) has an upward extension carrying a nose piece 370 to cooperate with pawl 371. The other arm of the assembly (Figs. 22A and 23) has an upward projection with a sidewise exten-

sion 372a, which overlies an arm 373a, pivoted on shaft 930, and whose upper end is in the plane of the edge of bail frame 374. Each arm of yoke assembly 308 has an upward extension or ear 940 and these are joined by the rod 910, which as previously mentioned cooperates with curved slot 911 in transfer member 305. An arm 932 fixed to shaft 307 has a forked end which straddles rod 931, joining the two arms of yoke assembly 308, and serves to rock this assembly as will now be explained.

It will be recalled that during the entering portion of the cycle, the parts associated with any order which is to transfer will have assumed the positions shown in Fig. 22A. It will also be recalled that, after the entering portion of the cycle, shaft 307 is rocked clockwise in two steps. This shaft 307, for the upper bank of counters, extends through the counter section and (see also Fig. 12) is connected by arms and linkage to a similar shaft 307 for the lower bank of counters. This latter shaft, at its other end (see Fig. 10), has a triangular plate 284 fixed to it. The plate 284 is connected by linkage to rocking arm 287 which has projections extending into the path of two cam extensions 285 fixed to shaft 93, which latter shaft rotates once each adding cycle. The operation of these mechanisms cause shafts 307 to rock in two steps. Returning to Fig. 22A the initial rocking of shaft 307 shifts yoke assembly 308 from the position in that figure to the position shown in Fig. 25. During this initial movement nose piece 370 on the yoke assembly 308 engages pawl 371 and rocks plate member 372 clockwise, whereupon its extension 896 cooperating with slot 897, rocks bail 374 from the position shown in Fig. 22A to that shown in Fig. 25. Toward the end of this movement, incidentally, nose piece 370 slips out of engagement with pawl 371. Bail 374 is thus rocked clear of transfer latch 303 and the latter moves counterclockwise, under the influence of spring 906 until it engages a fixed stop 935. The movement of transfer latch 303 raises transfer member 305 and, as the latter rises, the coaction of slot 911, in its lower part, with pin 910 causes it to move upward for a distance and then swing to the left, so that, eventually, its projection 306 meshes with the teeth of adjacent counter gear 263. At this time, also, rod 910 lies at the bottom of slot 911. At the end of this initial rocking of shaft 307 the parts have assumed the positions shown in Fig. 25.

The shaft 307 now rocks further in a counterclockwise direction, also rocking yoke assembly 308 to the position shown in Fig. 28. During this movement, the rod 910 pulls down the transfer member 305 and the attached transfer latch 303. As the member 305 moves downward its projection 306 turns counter gear 263 one step to effect transfer. The extension 303a on the transfer latch 303 moves into slot 302 in plate 300 to permit relatching. During the latter part of this movement of shaft 307 and yoke assembly 308, the sidewise extension 372a on one of the arms of the yoke assembly (see also Fig. 22) engages arm 373a and moves it counterclockwise whereupon the upper end of this arm rocks bail frame 374 clockwise, back to its normal position as in Fig. 28. Finally the shaft 307 and yoke assembly 308 rock back to normal position as shown in Fig. 22 but the transfer devices, now being latched, remain, as shown in this figure, ready for a subsequent transferring operation.

Long transfers are required under certain conditions. These are transfers occasioned by the fact that a counter wheel which stands at "9", prior to the transferring operation and receives another unit by transfer from a lower order, must, itself, transfer to the next higher order. Transfers of this nature are taken care of by pivoted members 380, of which one is provided for each counter wheel. Each member 380 is pivoted at 950 and has an extension 380a in the path of travel of the single tooth of transfer gear 264. The extension 380a is so located that the member 380 will be rocked counterclockwise, and held rocked, by the transfer tooth, whenever counter gear 263 registers "9". A hook shaped member 381, pivoted on the upper end of member 380, has a downward extension 381a which is located in a notch in plate 300. This hook member 381 overlies a pin 382 on transfer member 305 of the next lower order. In the normal positions of member 380 and hook member 381, the pin 382 may pass to the left of the downward extension 381a, during transfer operations from the lower order, as shown in Fig. 25. But, if member 380 is rocked, due to the fact that its counter gear 263 stands at "9", it will pull hook member 381 to the left and position the lower edge of its downward extension 381a directly above the pin 382 on the lower adjacent order transfer member 305. Then, if this adjacent order transfer member 305 moves upwardly to effect a transfer (see Fig. 22A), the hook member 381 will be raised by pin 382 and, in rising, will cam plate 300 counterclockwise, due to a cam surface 381b, on its upper edge. This movement of plate 300 will release the transfer latch 303 and effect a transfer operation.

The above has described the adding in of an amount upon the counter wheels. When a total is to be taken off from the wheels the wheels are utilized to control the printing operation as will now be described.

Mounted on the end of the drum shaft 161 at the far side of the machine (Fig. 12) is a pinion 310 which meshes with an intermediate gear 311 and drives a spur gear 312 (Figs. 14, 15, 19, and 20).

The spur gear 312 (see Fig. 19) is freely

rotatable on a sleeve 316 and rotates constantly as long as the driving motor of the machine is operating. The sleeve 316 and shaft 236, to which it is splined in such a way as to permit relative longitudinal movement, are normally stationary but are clutched to gear 312 to be rotated thereby during total taking operations as will be explained. A spiral gear 313 is fixed on sleeve 316 and meshes with a spiral gear 314 (see Figs. 14 and 15) fixed on vertical shaft 315. Also fixed on sleeve 316 is a cam 418. The spur gear 312 (Figs. 19 and 20) has clutch elements 317 on its outer face and forms the driving member of the total clutch, the driven member of which consists of a disk 318 having on its face a clutch element 318*a* to cooperate with clutch elements 317. The clutch element 318*a* on disk 318 is in the form of a projection which has a flat surface, to cooperate with clutch elements 317, and which slopes gradually to the face of disk 318 to form a spiral face cam surface indicated at 318*b*. The clutch member or disk 318 is pinned to the shaft 236, which is free to slide in its bearings and is urged into position to effect engagement of clutch elements 317—318*a* by a spring 319, seated against sleeve 316 at one end and against a collar fixed on shaft 236 at the other end. The engagement of the clutch elements is normally prevented by a block 320, which (see also Fig. 12) is pivoted at 320*a* and has an extending lug connected to a link 321, which is connected to the armature structure of total clutch magnet 323. As shown in Fig. 19, this block 320 has a notch whose edge normally engages clutch element 318*a* of disk 318 and holds it and shaft 236 to the left, with the clutch elements 318*a* and 317 disengaged. A total taking operation is initiated (Fig. 12) by energizing magnet 323, which thereupon attracts its armature and raises link 321, causing block 320 to swing clockwise about its pivot 320*a* and release clutch disk 318. The shaft 236 is then (Fig. 19) forced to the right by spring 319, bringing clutch elements 318*a* and 317 into engagement. As gear 312, to which clutch elements 317 are fixed is rotating, disk 318 and shaft 236 also rotate and thereby, through the splined connection between shaft 236 and sleeve 316 cause the latter with its attached spiral gear 313 and cam 418 to rotate. The clutch 317—318*a* is of the one revolution type and shortly after it is engaged by energization of magnet 323, this magnet is deenergized permitting block 320 to move back to its normal position. By this time the high portion of extension 318*a* on disk 318 has cleared the block 320 and the edge of the notch in the latter (Fig. 19) engages the low portion of spiral cam face 318*b*. As shaft 236 rotates this spiral cam face, cooperating with block 320, gradually forces disk 318 to the left and at the end of a single revolution of shaft 236 disengages the clutch elements 317—318*a*, whereupon the total taking parts of the machine, which are driven by disk 318 and sleeve 316 come to rest.

The sleeve 316, on rotating drives vertical shaft 315 (Fig. 15) by means of the intermeshed spiral gears 313, 314. This shaft 315 (see Fig. 12) may drive either a shaft 329 associated with the grand total bank of counters or a shaft 331 associated with the subtotal bank of counters. The shaft 329 has a spiral gear 329*c* fixed to its end which meshes with a spiral gear on a clutch member 328 which is free on shaft 315. Shaft 331 is similarly connected to a clutch member 330 which is also free on shaft 315. During a grand total taking operation shaft 329 is driven by shaft 315 and during a subtotaling operation shaft 331 is driven by shaft 315. The selective drive of shafts 329 and 331 is controlled by a grand total selecting magnet 324 and a subtotal selecting magnet 325, these magnets lying below the total clutch magnet 323. The magnets 324 and 325 operate upon a common armature 326 which is operatively connected, by means of a member 326*a* (see also Fig. 14) to a common clutch member 327 splined to shaft 315, but which may slide thereon to engage either clutch member 328 to drive shaft 329 or clutch 330 to drive shaft 331. When magnet 324 is energized to attract armature 326 clutch member 327 is shifted to engage clutch member 328 and drive shaft 329 for grand total taking. When magnet 325 is energized clutch member 327 engages clutch member 330 to drive shaft 331 for subtotaling. The actual operation of taking a sub or grand total is essentially the same and for the purposes of description the grand total taking operation only will be described.

Just prior to a total taking operation the parts are in normal position as shown in Fig. 22. During a total-taking operation shaft 272 remains stationary whereas shaft 329 makes a complete revolution and a box cam 277 fixed to shaft 329 and having a cam slot into which a pin 276 on lever 275 projects, rocks lever 275 clockwise about point 275*a* as a center. The lever 275, thus rocked, elevates frame 280 rocking link 269 clockwise about its pivot 26*a* and causing the parts to be displaced to the position shown in Fig. 26. During this operation a cam 332 carried by shaft 329 (see also Fig. 26A) has actuated a bell crank member 333 clockwise into contact with the bell crank 266 and rocked the latter clockwise. The composite motion received from link 269 and bell crank 266 causes the intermediate counter gear assembly, comprising frame 261 and gears 260 and 262 to pivot about point 334 as a center. This is the preliminary position of the parts for taking a total. After the parts have assumed the position of Fig. 26, cam 277 and cam 332 continue to rotate. Cam 277, due to the configuration

of its cam slot lowers frame 280 but cam 332, due to its configuration, maintains bell crank 333 in rocked position. This causes the intermediate counter gearing assembly to be rocked about the meshing point of pinion 260 with pinion 257*a* to engage pinion 262 with the counter gearing 263. This position of parts is shown in Fig. 31. During this preliminary operation shafts 249 and 250 are stationary, since the clutch shown to the left in Fig. 15 and in Fig. 17, has been actuated to uncouple the sleeve 69 from the bevel gearing 68.

After the gears 262 and 263 are enmeshed the clutch is again engaged and main driving gears again drive the counter gears 263 forward until all of the counter gears are restored to zero or normal position. To stop the gears 263 when they have reached this zero position a zero stop pawl 335 (Fig. 31) is provided. This pawl cooperates with the single tooth transfer gear 264. The pawl is pivoted at 336 and is connected by a link 337 to a pivoted frame 338. The pawl 335 is thrown into the path of the single tooth 264 by means of a cam 339, which cam through a lever 340, pivoted on shaft 340*a*, strikes a cross pin carried by the frame 338 and displaces the frame 338 clockwise. In this way the link 337 forces the pawl into the path of the single tooth gear 264. After the counter gears have been brought against the fixed stop, as above set forth, the two part gear 257*a* and 257*b* permits the continued rotation of the driving gear 256 without further rotating the counter gears 263, 264. After the counter gears 263, 264 are thus restored to zero the gears 263, 262 are again unmeshed in the manner described for an ordinary adding cycle. As the counter gears reach zero position during total taking, the transfer gears 264 rock plates 300 and tend to trip the transfer devices. The transfer mechanism must therefore be rendered inoperative during total taking. This is also effected by the clockwise rocking of frame 338, which frame (see Figs. 22 and 31) carries a pin 390 against which an extension 391*a* of frame 391 is held by spring 975. As the frame 338 is rocked clockwise about its pivot 976 by lever 340, pin 390 rocks frame 391 counterclockwise about its pivot 921. The bail 374, pivoted on frame 391 is thereupon lowered into engagement with transfer latches 303, as shown in Fig. 31, and prevents upward movement of these latches during total taking. After gears 263, 264 are restored to normal position and after the high point of cam 339 has passed its follower on lever 340, the follower moves to the low point of the cam, under spring action, and the frame 338 will be restored to a normal position by means of a tension spring 341 which is connected to it (see Fig. 31) by a member 980. The oscillatory movements of the member 338 are utilized to control certain electric contact devices for electrically taking a total from the counter wheels during the resetting thereof. A link 342, pivoted at one end on frame 338 and at the other end on a rocking bail 343 (see Fig. 31), and shown in normal position in Fig. 11, normally holds the bail 343 in the position shown in Fig. 22. The bail 348 in this position rocks a pivoted member 343*a* clear of gear 257*a*. 343*a* also carries the insulated piece 344, which in the position shown in Fig. 22, opens contacts 345. Fig. 22 shows the contacts open and Fig. 31 shows the contacts closed. The member 343*a* rests upon the gear 257*a* which it will be remembered upon restoring of the counter wheels to zero, turns proportionally to the restoration of the counter wheels and then stops.

The contacts 345 are utilized to control a total taking circuit, which will be described in connection with the general circuit diagram, but whose specific operation will now be explained in connection with the detailed circuit diagram in Fig. 32. It will be recognized from the above explanation of contacts 345 that these contacts are held open at all times except during total taking, due to the fact that frame 338 is normally in the position shown in Fig. 22 and in this position, through link 342 and bail 348 holds pivoted member 343*a* in position to open contacts 345. During a total taking operation frame 338, being rocked to the position shown in Fig. 31, removes bail 343 from coaction with pivoted member 343*a* and permits this member to rest on gear 257*a* with a toe piece 343*b* tending to assume a position between the teeth of the gear. The gear 257*a* starts to rotate at the beginning of total taking and stops when it reaches zero and each tooth, as it passes under toe piece 343*b*, rocks pivoted member 343*a* and causes it to temporarily open contacts 345. The toe piece 343*a* drops into each space between teeth causing contacts 345 to close temporarily. Contacts 345 then, during total taking, open and close repeatedly and finally, as the gear 257*a* comes to rest at zero and the toe piece 343*b* drops into a space between two gear teeth, close and remain closed. The type carrying drum 900 is driven synchronously with the counters during total taking and is so timed that the "9" type is passing printing position one point after the gears 257*a* start to rotate; the "8" type is passing printing position two points after the gears 257*a* start to rotate and so on. Thus, if a gear registers "9", as it requires only one point of movement to reach zero, its contacts 345 will close and remain closed as the nine type is passing printing position. The closure of these contacts at this time effects energization of the type selecting magnet to select the "9" type for printing as will now be explained.

The total print circuit for one counter gear is indicated by 350 in Fig. 32. This circuit includes contacts 345, whose operation has

just been explained, in series with contacts 346. While one pair of contacts 345 is provided for each counter gear, one pair of contacts 346 may suffice for the whole counter. The contacts 346 are controlled by a pivoted member 348 which coacts with a gear wheel 349. The operation of contacts 346 is similar to that of contacts 345 in that they open when a tooth of gear 349 passes under the end of pivoted member 348 and close when the end of this member enters the spaces between teeth. Gear 349 is mounted on shaft 250 (see also Figs. 10, 12, and 15) which is the counter drive shaft for the lower bank of counters. The gears 257*a* and 349 rotate in unison but the parts are so constructed and the timing so arranged that either contacts 345 or contacts 346 are open, maintaining the circuit 350 open, as long as gear 257*a* is rotating. When gear 257*a* stops in zero position thereby effecting closing of contacts 345 for a protracted time interval, the next temporary closure of contacts 346 closes the circuit 350 and selects the proper type to print the total.

The total taking circuit is rendered positively ineffective during adding operations as an additional precaution. For this purpose a cam 351 (Fig. 12) is provided, fixed on the shaft 236, which cam during adding operations is adapted to actuate a follower 352 and linkage 353 to displace a bail member 354 clockwise to the position shown in Fig. 12 to swing the contactor member 348 out of cooperation with its gear 349 and thus maintain open the contacts 346.

When totals and subtotals are printed provision must be made for marking a designating characteristic on the record sheet indicative of whether the total is a sub or grand total. Characters such as G, T and S, T, may be utilized for this purpose.

The printing of such designating characters (see Fig. 34) is controlled by a hook member 163*a*, similar to hook members 163, but which is located opposite a circumferential row of type carriers 162*a* containing only two type carriers, one of which may carry a type for printing the letter T and the other a type for printing the letter S. If the letter T alone is printed it indicates a grand total and if the letter T is printed with the letter S superimposed on it, a subtotal is indicated. In the former case the hook 163*a* must trip the T type carrier alone and in the latter case it must trip both the T and S type carriers. The hook member 163*a* is controlled in a manner very similar to that in which the hook members 163 are controlled to effect zero printing, during totaling, which has been previously explained. The hook members 163*a* may be rocked into position to trip either one or both of the total designating type by elevating a cooperating link 185 (see also Fig. 33) through the rocking of a pivoted lever 186, as in zero printing, but instead of cooperating with a cam having only one notch, the levers 186, entering into special total designating character selection, coact with a cam 189*a* (see Fig. 34) having notches 395 and 396 of different dimensions. The cam 189*a* is splined to shaft 190 and may be shifted longitudinally thereof, as will be explained later, to bring either notch 395 or notch 396 opposite the end of lever 186. As in the case of zero printing, cam 189*a* is timed to present notches 395 and 396 to the end of lever 186 toward the end of the printing cycle when the special type carriers are in printing position. If notch 395 is opposite the end of lever 186, the end of this lever will be spring pulled into the notch to elevate link 185 and a projection on the latter, underlying hook member 163*a*, will rock the hook member clockwise to cause printing from the T type carrier. The dimension of notch 395 is such that, directly after printing by the T type carrier, the lever 186 will be cammed back to normal position. In this case, then, a T alone will be printed, indicating a grand total. If the cam 189*a* is shifted to bring notch 396 opposite the end of lever 186, the operation will be similar but notch 396 is of such dimensions that hook 163*a* will remain rocked long enough to select both the T type carrier and the S type carrier for printing, whereupon T, with S superimposed upon it will be printed, indicating a sub total.

The cam 189*a* is shifted on shaft 190, to which it is splined, to bring notches 395 and 396 opposite the end of lever 186, by means of a forked arm 397 (Fig. 33) fixed to shaft 398. The forked end of arm 397 extends into a circumferential groove 189*b* in cam 189*a* (Fig. 34) and when the shaft 398 is shifted lengthwise cam 189*a* will also be shifted. Shaft 398 is shifted (see Fig. 12) by means of a rockable cam member 399 having a cam surface on its outer face and pivoted at 399*a*. The cam member 399 coacts with a pin 398 fixed in the end of shaft 398. Member 398 is connected by a link 400 to a bell crank 401. One arm of the bell crank 401 is pressed against the periphery of a cam 404 by means of a spring 405 and the other arm coacts with a bell crank 402, which is settable to two positions under control of the sub and grand total selecting magnets 325 and 324. A rod 402*a* is connected to the common armature 326 of these magnets and when magnet 325 is energized, to effect a subtotaling operation, this rod causes the bell crank 402 to assume the position shown in Fig. 12, with a rather deep notch 403 in the upper edge of one of its arms opposite the turned-over end 401*a* of one arm of bell crank 401. The bell crank 401 is held in the position shown in Fig. 12 by a cam 404 on shaft 236 until the time arrives for special total designating printing during the total taking operation. At this time a low portion of cam 404 permits bell crank

401 to rock counterclockwise under action of a spring 405 until the turned-over end 401*a* seats in the rather long notch 403 in the upper edge of the cooperating arm of bell crank 402. Bell crank 401 in rocking, through link 400, rocks cam member 399 about its pivot 399*a* whereupon the cam surface on its face shifts pin 398*a* and shaft 398 against the action of spring 408. This shifting of shaft 398 also shifts cam 189*a* (Fig. 34) to position notch 396 therein opposite the end of lever 186. This slot, as previously explained, selects both the T and the S type for printing to indicate a subtotal.

The energization of magnet 324 (Fig. 12) to effect grand total printing shifts rod 402*a* upwardly and rocks bell crank 402 clockwise to position a notch 403 in the lower edge of the arm of this bell crank opposite the bent-over end 401*a* of bell crank 401. The action of the parts from this point on is entirely similar to that just explained but the lower notch 403 is relatively short and causes cam 189*a* to assume a position with notch 395 opposite lever 186. This slot as previously explained selects the T type only for printing, thus indicating a grand total.

Restoration of the parts is secured by means of the cam 404. The pin 406 is carried by the armature 322 and plays in a double slot in the member 402. This part of the device serves as an interlock to not only prevent shifting when magnet 323 is energized but also prevents the movement of the armature 322 when part 402 is in an intermediate position. Restoration of the shaft 398 is effected in any desired manner as by a spring 408 suitably connected to the frame of the machine.

It will be understood from the foregoing that the energization of one or more of the call magnets 165 under the control of the perforations in the record card is adapted to concurrently call one or more of the type 162 upon the continuously movable printing device into printing operation and to control devices which selectively engage one or more of the continuously movable differential actuators with the then stationary accumulator wheels 263. After a total has been accumulated, and it is desired to take a total from the accumulator the differential actuator comprising gears 262, 260, 257*a* and 257*b* is arranged to again come into operation to drive the accumulator wheels in the same forward direction in which they rotated in receiving items to be added. The movement of the wheels 263 in forward direction is continued until the wheels have obtained their zero setting and reached home position. It is in accordance with the time at which each wheel reaches its zero setting position that the total printing control circuits 350 are closed and the closure of their circuit energizes one or more of the call magnets 165 to call one or more of the printing type 162 into operation to print a total of the amount standing upon the accumulator before zero setting was initiated. It will be understood that the movement of both the printing mechanism and of the counter or accumulator devices are both in the nature of a continuous forward movement. In other words, the printing type continuously advance toward printing position without retrogression. Consequently the usual idle restoring movement of type carriers is obviated. The accumulator is advanced in a forward direction for adding and in total taking the zero setting of the wheels is effected by a forward motion of the wheels and total printing is effected at the instant the wheels reach their normal home position. Total printing at this instant is secured without stopping or changing the speed of the type carrier. All of the above factors contribute to speeding up accumulating and total printing operations since the usual reverse strokes heretofore needed in accumulators in cooperation with printers are eliminated.

For feeding the paper and the ribbons the rocking motion of the shaft 282 is utilized at each listing operation. This shaft, it will be recalled, rocks to restore the counter controlling parts to normal position after each adding operation. Referring to Fig. 12 the crank arm on the shaft 282 is connected to a link 410, which link is normally kept to the right by means of a spring 411 attached to a pawl 412 carried by the link. The spring 411 holds a pin 412*a* on the link 410 against the edge of one arm of a lever 416 whose other end rests against a part of print suppression handle 226. The lever 416 thus acts as a guide for the upper end of link 410. The pawl 412 at its nose contacts with a walking beam 413 which, through link 414, is adapted to feed the paper and through link 415 is adapted to advance the ribbon upon the rocking of the walking beam 413 by pawl 412. When print suppression handle 226 is depressed to suppress the printing entirely the lever 416 swings in a counter-clockwise direction under the influence of pin 412*a* and the spring 411 and permits the link 410 to move clockwise so that the pawl 412 may pass idly by the pin on the walking beam 413. During total-taking operations the paper and ribbon feed is effected by rocking the walking beam 413 through the instrumentality of plate 179 which is rocked during total-taking. This plate through a pin and slot connection connects with a link 417 which is in turn connected to the walking beam 413. The plate 179 during listing operations and adding operations is rocked clockwise from cam 181. During total-printing operations, on the other hand, this plate is rocked anticlockwise from the cam 418 on shaft 236 (see Fig. 19).

There are certain detailed interlocks and safety devices on the machine which need not be described in detail. One of these serves to prevent beginning of operation of the total clutch until the parts of the vertical clutch shown in the lower left hand corner of Fig. 15 have arrived in home position. The dog 71 in its home position, in which it is shown in Fig. 15, presses a slide member 1202 upward against the action of a light spring (not shown). In this position a hole in the slide member 1202 is alined with a slidable rod 420, so that this rod may be pushed to the left through the hole in the sliding member. When dog 71 leaves its home position, slide 1202 moves downwardly so that the hole in it no longer registers with rod 420 and the slide then prevents movement of rod 420 to the left. Rod 420 extends to the other side of the machine and a light spring forces its ends against a member 421 (see also Fig. 14) which is pivoted at 421*b* and which has an oblique slot 421*a* in its lower end. An extension on block 320 (see Fig. 12) of the total clutch extends into this slot 421 and when the block rocks clockwise, to permit engagement of the total clutch, the member 421 is rocked counterclockwise, as viewed in Fig. 14, thereby forcing rod 420 to the left. If movement of the rod 420 is prevented, due to the fact that dog 71 (Fig. 15) is not in home position and has not raised slide 1202 to cause the hole therein to register with the end of rod 420, the rod prevents movement of member 421 which in turn prevents movement of block 320 (Fig. 12) whereupon the total clutch cannot engage.

Control unit

As heretofore explained the shaft 67 (Fig. 17) is a constantly running shaft and rotates at all times when the motor is rotating. Shaft 67 is rotatably mounted in suitable vertical standards and is provided with a pair of eccentrics 425 (see Figs. 47 and 49). Each eccentric is in the form of an elongated cylinder with an eccentric, longitudinal bore to accommodate the shaft 67. One of these eccentrics and shaft 67 have been broken away in Fig. 47 to show the construction below. Attached to each eccentric are several feed pawls 426 which cooperate with ratchet discs 427 mounted upon a shaft 428. Each feed pawl 426 and ratchet disc 427 controls the starting of a control unit one of which will now be described in detail. As shown in Figs. 51 and 52, the arrangement of the feed pawl and ratchet is such that this feed pawl can play back and forth over an enlarged tooth of the ratchet without engaging the other ratchet teeth for feeding when the ratchet members are in normal home position. Grouped with each ratchet 427 and fixed for rotation in unison therewith are starting ratchets 429 (see Fig. 50), holding ratchets 430 and a number of contact cams 431. Cooperating with the starting ratchet 429 is a pawl 432 adapted to be brought into the single notch in the starting ratchet by the energization of a starting magnet 433. Upon the deenergization of this starting magnet a suitable spring 434 restores the magnet armature, urges the starting pawl 432 forwardly and advances the starting ratchet 429 sufficiently to permit the feed pawl 426 to engage in the feeding teeth of its feeding ratchet 427. The feeding ratchet then at each revolution of shaft 67 steps forward its particular group of contact cams and controls the operation of certain controlling circuits. Retrograde movement of any particular group of cam elements is prevented by retaining pawl 435. Cooperating with each group of contact cams 431 are pivotal contactor elements 436. The cams 431, it will be understood, are divided up in groups. All of the cams of any one group rotate in unison. One group shown to the extreme left in Fig. 47 having two controlling contacts is for convenience designated the C group; the next group having six controlling contacts is known as the E group, a single controlling contact next to the E group is identified by the letter G is known as the G group, the last group to the extreme right having six contacts is known as the B group. The numbering of these particular contacts will be hereafter referred to in detail in the accompanying specification.

For calling into action any one group of contacts there are four starter magnets heretofore numbered 433, which, for convenience, will hereafter be known as starter magnets B, G, E and C. It will be understood that the contacts are made at different times in the machine cycle as certain operating conditions demand under the control of the energization of the different starting magnets. Furthermore it may be explained that the contacts of any particular group may be made in successive machine cycles or revolutions.

Referring now to the circuit diagram (Figs. 53 and 53*a*) it will be assumed that a supply of cards are put in the supply stack and that the machine is ready for tabulating a run of cards. The first operation of the machine is to close the main supply switch 440 which connects supply lines 441 and 442 with a suitable source of current. Motor 62 now rotates causing the printing drum to rotate, rotating shafts 65 (Fig. 17) and the automatic control drive 67 constantly.

Prior to the initiation of a tabulating operation the machine is first operated to clear any totals which may be already remaining in the machine and to print the previous total (if any) upon the record sheet. If the machine is entirely clear there will be only a marking of the total marks on the sheet

with no numbers opposite the total marks indicating that the machine is in condition to receive a new tabulation or accumulation. The operator to clear the subtotal counters in the machine on starting operations depresses start key 443 which permits current to flow from left side of line through starter magnet B—433 to junction point 444, thence through subtotal magnet 325, through cam contacts 445, now closed, and back to the other side of line. The energization of magnet 325 selects the parts for a subtotal operation so that a further operation will clear the machine and print on the record sheet any subtotals standing on any of the subtotal counters.

If it is desired to clear the grand total counters the grand total key 446 would be depressed prior to the starting of the clearing by the start key 443. This operation will hereafter be described in connection with the taking of a grand total. It will be understood that after clearing by the depression of the start key 443 the machine will automatically commence its operation without further initiation by the operator. To effect such initiation the deenergization of starter magnet B—433, upon the release of the start key, sets a particular group of cam contact devices on the controlling unit of the machine into operation. In the circuit diagram the group of contacts which are initiated by the starter magnet B—433 are shown directly below it in the diagram. After starter magnet B—433 has initiated the stepping forward of the B group of cams 431, the first action of these cams is to close contacts 447 which allows current to flow from left side of line to junction 448, thence through total clutch controlling magnet 323 and back to the right side of line. The energization of the total clutch magnet 323 causes shaft 236 to make one revolution while the printing drum makes two revolutions. The first half revolution of shaft 236 sets the counter parts in condition for clearing and the second half revolution is employed for effecting the actual clearing operation and the printing of the totals. During the second half of the revolution of shaft 236 under control of total clutch magnet 323, contacts 449 are closed. The closure of these contacts permits current to flow from left side of line through the contacts to a junction point 450 and thence through vertical clutch magnet 74 to right side of line. The energization of the vertical clutch magnet 74 accomplishes the actual clearing of the counters and the taking of the totals therefrom. The further forward movement of the cam assembly B—431 closes the contacts 451 and establishes a circuit from left side of line through contacts 451 to junction point 452, thence through card feed clutch magnet 95 and thence to the right side of line. The energization of the card feed clutch magnet 95 clutches the card feeding devices to the driving shafts and starts cards feeding through the machine. Several machine cycles may ensue before cards finally arrive at the brushes. In fact, if the hopper is empty no such cards may arrive at the brushes. To maintain the energization of the card clutch magnet 95 under these conditions, cam contacts 453 close at a slightly later time in the cycle permitting current to flow from left side of line through card switch contacts 117 (now closed) through contacts 453 to junction 452 and thence through the clutch magnet as before. After contacts 453 open, current for the clutch magnet 95 is supplied from the left side of line through contacts 156, closed as long as the storage magazine is not full wire 457, contacts 456 normally closed, wire 458, through contacts 455 (now closed) to common junction point 459, thence through attracted relay arm 460 of clutch magnet 95, through junction point 452 and thence through the clutch magnet 95 to the other side of the line. Contacts 455 are operated by suitable cam members shown in Figs. 17 and 16. Contacts 455 open once per card cycle. Assuming the machine is running with non-automatic control and that interruption of the tabulating cycle is effected by means of the stop key or by the exhaustion of all the cards in the hopper, under these conditions, manual switch 461 is thrown to upward position to engage switch point 462. This gives a circuit traced as follows: From left side of line through line 457, contacts 456 (now closed) to common junction 463, thence through switch 461, switch point 462, relay arm 464, thence through 459 and back through the circuit previously traced through 460 to the other side of line. Relay 465 which attracts arm 464 has been previously energized by the closure of a circuit 466 through the closure of card controlled contacts 118, these contacts being closed after the cards pass under the brushes. The card feed clutch will remain energized during the feeding of cards until the relay 465 is deenergized by the opening of contacts 118 upon the passage of the last card past the brushes and off the feeding drum. The clutch magnet 95 may also be deenergized by the depressing of a stop key 467 which energizes stop magnet 468 and opens contacts 456 thereby interrupting the card feed clutch circuit. The stop magnet circuit is traced as follows: from left side of line through contacts 469 (now closed), stop key 467, stop magnet 468 to other side of line. After magnet 468 is energized relay arm 470 is attracted thereby establishing the holding circuit for the stop magnet. Upon the initiation of a new cycle and the stepping forward of the B cam devices, contacts 469 will be opened thereby interrupting the stop magnet circuit. The deenergization of the

card feed clutch magnet 95 opens contacts 470*a* causing a deenergization of starter magnet E—433 which starts the cam group E—431 into operation. The machine is now stopped and as the cam section E—431 is stepped forward contacts 471 are closed which establish a circuit from left side of line through contacts 156, 457, 456, 458, 471 (closed), to common junction 472 and back to contacts 473 which have now been closed permitting current to flow to common junction 448, thence through total clutch magnet 323 to right side of line. The energization of the total clutch magnet now effects the taking of a total as heretofore explained. During total-taking the vertical clutch magnet 74 must also be energized and this is effected at the proper time in the cycle by the closure of the contacts 474 which take current from common junction 472 supplying same to junction 450 and thence through vertical clutch magnet 74 to the right side of the line.

The above operation has taken a subtotal of the amount on the tabulator counters. In operating the machine, the subtotals will always be printed automatically. After a total is taken, as heretofore explained, the machine is given a supplementary clearing, printing only a subtotal mark designation upon the record sheet. For this purpose after E 431 has been advanced for effecting one printing of totals there is a reclosure of contacts 473, 471 and 474 to again energize the total and vertical clutch to effect the proper symbol printing. The further movement of shaft E 431 establishes a circuit from left side of line contacts 156, wire 457, 456, junction 463, card switch 119 (now closed), junction 476 back through line 477, through contacts 478 (now closed), thence through binding post 452 and through the card feed clutch magnet 95 to the right side of the line. Under these conditions card feed will be reestablished to permit the tabulating upon the next group of cards. If there is an absence of cards in the hopper the card controlled contacts 119 will be opened and prevent the reenergization of the card feed clutch magnet so that there will be no further rotation of the card feeding drum.

The so-called tabulating and listing circuits will now be traced. Starting from the junction point 476 which is supplied with current during the passage of cards, current flows through contacts 454, which are closed during the period in the cycle when the perforations are passing under the brushes, thence through line 479 to brush 480, thence to drum 103 and to the lower analyzing brushes 145*b* as the perforations in the record cards pass thereunder, through lines 481 to plugboard 482, thence through plug connections and through connected wiring 483 to counter magnets 165. The detailed construction of these counter magnets is shown in Figs. 40 to 43. The armatures 484 of the magnets 165, upon the energization of these magnets, are attracted and release latch plates 485 which rock, under the influence of their springs, impelling the call wires 166 upwardly. At the same time pins 486, one for each armature, are forced to the left, as shown in Fig. 40, to open normally closed contacts 487 and immediately interrupt the counter magnet circuit. At a suitable time in the cycle the latch plates 485 are relatched by means of a bail mounted on shaft 488, which shaft is operated at the proper time after the adding cycle by the linkage shown in Fig. 10 from shaft 272. The energization of the counter magnets controls the tabulating, listing and printing operations in the manner heretofore explained. The contacts 454 break once per card cycle after the time the last line of record perforations pass under the card and remain open until just before the first perforation positions of the succeeding card pass under the brushes 145*b*.

In tabulating machines it is the practice to run successive groups of cards through the machine, each group of cards having a particular group designation. In the present machine provision is made for sensing the different groups and for automatically performing certain predetermined operations when record cards change. For example, it may be desired to automatically take a total when record groups change. Provision is also made for printing the designating group number upon the record sheet. In order to effect such automatic control the upper and lower sets of brushes 144, 145 are provided and these brushes cooperate with two successive cards and compare the group designating characteristics thereof.

For indicating the group, a counter magnet frame is provided having magnets 489 similar to 165 and provided with a similar latch and call wire structure for controlling printing and entering amounts into a counter. The contacts 487*a* instead of being initially closed are all normally maintained open by means of a frame 490 which carries suitable pins engaging with the contacts. The frame 490 is adapted to be elevated by the energization of group indicator controlling magnet 491. To control the energization of the group indicator magnet 491 the manually operated switch 492 is thrown to closed position when group indicating is desired. Upon the energization of the group indicator magnet the group indicator magnet frame assembly 490 is elevated to permit the closure of contacts 487*a*. Leading to the individual group indicating magnets 489 are wires 493 which extend to plug connections 495, which in turn are plugged in at the proper points on plugboard 482. The points on which these plugs 495 are plugged in will depend upon

the particular column or columns in which group indicating is desired with group indicating operations. In group indicating printing operations, the group designation is printed when the first card of a group passes the lower analyzing brushes 145 and also when the totals are printed. To secure this result the group number is entered into a counter from the first card of a group and listed in the manner heretofore described for the adding and listing operation. The counter used for this purpose is cut out of operation automatically for the remaining cards of the group, so that at the end of the group the counter contains the group number. This group number is read out of the counter and printed during total taking in the same manner as the totals are. The group indicating magnet 491 is energized during the first cycle of each card group to raise frame assembly 490 thereby permitting closure of contacts 487*a*. This permits energization of magnets 489 under control of the analyzing brushes to print the group designating data from the first card and enter it into a counter. During the remaining adding cycles of the card group magnet 491 is deenergized to permit frame assembly 490 to lower and open contacts 487*a*, thereby preventing control of magnets 489 from the remaining cards of the group. The circuits for controlling group indicating magnet 491 will now be described. The circuit of magnet 491 extends through wire 496 to contacts 475 of the E group and to contacts 497 of the B group. In starting a run of cards contacts 497 on the B group first close. This permits the energization of the group indicator magnet 491 and allows the group number of the first group to be printed and to be set up on the counter. Subsequently, contacts 497 open and prevent the energization of the individual group indicator item and counter controlling magnets 489 until the time of printing the total. At the time of printing the total contacts 475 of the E group close and cause energization of the group indicator magnet 491, whereby frame assembly 490 is again raised to close contacts 489*a*. The magnets 489 may then be energized under the control of the counter to print in the same manner as heretofore explained for a total printing operation. In connection with the circuit diagram a line 499 leads from left side of line to the contacts 346 which are common to and operated in conjunction with both the subtotal contacts 345 and the grand total contacts 345*a*. Between contacts 346, 345*a* a common circuit 350 extends. Contacts 345 and 345*a* are in turn connected to the lines which lead to the counter magnets 165. This illustrates the total circuit arrangement previously explained in detail in connection with Fig. 82. It will be understood that contacts similar to 345, 345*a* are also provided for the group indicating magnets designated generally 489. For simplicity in illustration only three of these contacts 345, 345*a* are here shown.

When the machine is to be run for automatic control the switch 461 is in the position shown in the diagram.

Under automatic controlling conditions (assuming that automatic control is desired from the card columns containing the group designation numbers) current flows from the lower brushes 145 which cooperate with the designating group numbers through lines 500 to plugboard 482. Thence plug connections 501 in the plug sockets convey the current through normally closed contacts 502 to the automatic control magnets 503 which have leads extending to plug sockets 504. Cooperating with plug sockets 504 are plug connections 505 which are individually connected to leads 506 extending to the upper bushes 144. No current flows through this circuit just traced until the perforations in the cards passing under the upper brushes correspond with the perforations in the cards passing under the lower brushes. This correspondence takes place as soon as two similar cards having corresponding group designations are respectively under the upper and lower brushes. At this time magnets 503 are selectively energized. For the proper functioning of the automatic control mechanism the drum 103 is divided into six sections which are insulated from each other as indicated in the diagram. To connect the upper section with the line a single brush 507 is provided which has connected to it a wire 508 leading to the right side of line. The energization of magnets 503 through their armature latch mechanisms and the pins 509 is adapted to selectively close contacts 510, to which contact plug connections 511 are connected. Any one of these plugs, selected according to the number of columns upon which automatic control is to be effected, may be inserted in plug sockets 512 which are disposed in a line 513. The contacts 510 are all serially connected so that the breaking of any one contact, if plugged into the circuit, will interrupt the circuit to line 513. The contacts 510 are connected in the circuit 514 which extends to switch 461. With cards passing through the machine and magnets 503 energized current flows from left side of line through contacts 156, wire 457 and contacts 456 to common binding post 463, switch 461, line 514, through contacts 510, an inserted plug 511, 512, wire 513, relay 515, wire 516, common junction 444, magnet 325, wire 517, contacts 445 (now closed) to right side of line.

Supplementary to the plug sockets 512 in line 513 there is a secondary set of plug sockets 518 in a line 519 having plug connectors 511*a* disposed for cooperation therewith and extending to contacts 510*a*. The contacts

510*a* are operated by pins 509*a* which extend to the latch mechanism of magnets 503*a* and are controlled by contacts 502*a* having lines 501*a* which extend to the plug positions 482 (see Fig. 54). In other respects this circuit is the same as the previously described circuit and it has a similar mode of operation. The suffix (*a*) will indicate corresponding parts. This particular arrangement of the circuit is shown at Fig. 54 there not being sufficient space on the main diagram.

The purpose of providing a dual automatic control is as follows. In certain tabulating operations there may be a run of cards pass through the machine in which the group designations may have major and minor subdivisions and, for instance, may be based upon names of railroads in one field and the commodities in another. For every group change of commodities, as a sub group, it is desired to take automatically a sutotal and concurrently run up item accumulations on the grand total. Then when the railroad group designation characteristic changes, i. e., major groups change, it may be desired to automatically take a grand total of the previously accumulated commodity items for that particular railroad.

The system controlled by magnets 503 and the plug connections into line 513 are for automatic control of the card fields sensed by brush sections 144—145 and may be used for subtotals, and the system controlled by the parts marked with an (*a*) suffix are for automatic control of the record field sensed by brushes 144*a*, 145*a* and may be used for grand total controlling operations.

Furthermore by removing a plug connection 550 from sockets 551 and plugging in the lower plug 511 into the lower socket 551 both groups of magnets (i. e. 503 and 503*a*) may be used for automatically controlling of a group which includes the card field sensed by both the 144, 145 and 144*a*, 145*a* brushes. Under such a combined arrangement a selected plug 511*a* would be plugged into the sockets in either line 513 or 519, as desired.

When a dual control, as above described, is desired the switch 520 is placed in an intermediate position. If, however, the switch 520 is left in the position as shown on its lower contact automatic control will be effective only on the subtotal amounts. If the switch 520 is thrown to upper position the control will be solely from contacts 510*a* which will only effect automatic taking of grand totals. The automatic taking of subtotals only will now be described.

With the switch 520 in the position as shown, current is supplied through 514, through switch 520, through relay 521, through wire 522, through grand total selecting magnet 324 and back through wire 517 to the other side of line as previously traced. Energization of relay 521 attracts its armature and closes a circuit through wire 523 to the armature of relay 515 permitting current to flow from line 514, wire 524, relay arm of 515, wire 523, relay arm of 521, wire 525 to line 526, common junction 459, relay 460, common junction 452 and back through clutch magnet 95 to the right side of line. The circuit thus established maintains the energization of the card feed clutch magnet 95 each time the contacts 455 open once per card cycle. The maintaining of the feeding of the cards is now entirely under the control of magnet 515. The energization of this magnet 515 is maintained so long as contacts 510 remain closed and these contacts remain closed during the period of the breaking of contact 455 so as to maintain the clutch operation provided the card groups correspond. It will be noted that contacts 510 are all connected in series and that the plugs 511 are arranged so that by plugging a selected one of them to its socket 512 any number of contacts 510 may be arranged in series with the wire 514. If two columns are to be used for automatic controlling only the middle plug 511 (Fig. 53*a*) is inserted in its socket 512, thus connecting two pairs of contacts 510 in series in the controlling circuit. On the other hand, if three columns are to be used for controlling the lowest plug 511 will be inserted in its socket 512 thus connecting three pairs of contacts 510 in series in the controlling circuit. The result of this construction is that the deenergization of any one magnet 503 caused by a lack of correspondence of any two perforations in the two successive cards in the same column will cause the interruption of the circuit from magnet 515. Thereafter upon the opening of contacts 455 the clutch magnet 95 will be deenergized at the end of the card cycle and the card feed will stop.

The circuit for magnet 515 has been previously traced. It may be here stated that so long as the machine is running and successive cards correspond as far as their group designations are concerned, both magnets 521 and 515 will be energized. When a change in group occurs one or the other of these magnets 521, 515 will be deenergized, depending upon the position of switch 520, and also upon the respective plugging up of plugs 511 and 511*a*. The switch 520 has the function of suppressing the automatic control and maintaining energization of one or the other of the magnets 521 or 515 irrespective of the status of the automatic control circuit controlled by brushes 144, 144*a*, etc. It is the relay circuit marked 523 of these two magnets 515 and 521 which maintains the energization of the clutch magnet 95 at the time of opening contacts 455. Consequently, after the circuit 523 is broken by either relay the card feed clutch 95 will be-

come deenergized at the proper time in the cycle and subsequently a total or grand total will be taken depending upon the energization of the grand total and subtotal selecting magnets 324, 325. The energization of these selecting magnets 324, 325 in turn is controlled by the magnets 521 and 515 through circuits which will now be traced.

With the parts in the position shown and with switch 520 in lower position and with the bottom plug 511 plugged in its socket 512, current will flow from left side of line through wire 457, contacts 456, common junction 463, switch 461, wire 514, contacts 510 (closed so long as cards agree), plug 511, wire 513, relay magnet 515, line 516, common junction 444, through subtotal selecting magnet 325 and back through wire 517 and contacts 445 to line. During the running of cards there is also a circuit from line 514 through switch 520, magnet 521, wire 522, total magnet 324 and back through 517 to line. Under these conditions there will be an energization of both selecting magnets 324 and 325. However, at the time when the change of group occurs causing the deenergization of one or more of the magnets 503, the circuit from line 514 through the contacts 510 is interrupted, deenergizing line 513 and consequently deenergizing magnet 515. This deenergization of 515 also deenergizes selecting magnet 325, permitting magnet 324 which remains energized to select the parts for the taking of a grand total, which operation takes place automatically at the proper time in the cycle after the stoppage of the card feed. As heretofore explained the stoppage of the card feed is under the control of the deenergization of magnet 515. The actual operation of the taking of a total is under the control of total clutch magnet 323. The energization of this magnet is effected under the control of the E 431 cam group in the manner previously explained.

By placing switch 520 in upper position magnet 515 will be constantly energized and magnet 521 by properly plugging in one of the plugs 511*a* into sockets 518 in line 519 is placed under control of the changes in card groups. Under these conditions a change in card group will cause an opening of contacts 510*a*, deenergizing magnet 521, breaking the card feed clutch controlling circuit 523 and also deenergizes selecting magnet 324 leaving the magnet 325 energized. Under these conditions at the proper time in the cycle there will be a subsequent automatic taking of subtotals.

When a dual control is desired switch 520 is placed in an intermediate position. This places magnets 521 and 515 entirely respectively under the control of the automatic control circuits 519 and 513. When a change of group occurs one or the other of magnets 521 and 515 becomes deenergized thereby interrupting the card feed clutch holding circuit and also effecting a proper deenergization of one or the other of magnets 324, 325 to cause a selection of subtotal printing or grand total printing. It will be noted that when the machine is operating under dual control, if the sub and grand total group designations changed at the same time, both magnets 324 and 325 would be deenergized. But as these magnets operate upon a common armature one total would be lost. In such a case an extra card may be inserted at the end of the card group, this card being punched with zeros in its amount fields and with the old grand total group designation and the new sub total group designation. This would result in taking a sub total on the passage of this extra card followed by an adding cycle, in which, however, no actual adding would occur due to the presence of zeros in the amount fields of the extra card. A second total taking operation would follow this adding cycle in which the grand total would be taken.

Restoration of the armatures of the automatic control system is effected through a plunger rod 530 (shown in Fig. 44) which is operated by means of a lever 531 from a link 532 (Fig. 17) which extends to a suitable operating connection to rock shaft 272 (Fig. 10). It will be understood that this restoration is effected at a proper time in the cycle to permit the automatic control circuits to be functioned in the manner heretofore explained. The automatic control circuits are reset up for each card passing through the machine and maintain their control for the card feed clutch magnet until such control is taken over by the closure of contacts 455.

In further explanation of the operation after the deenergization of the card feed clutch magnet 95 it may be stated that the deenergization of card clutch magnet 95 opens contacts 470*a* thereby deenergizing starter magnet E—433 and setting the cam contact devices E 431 into step-by-step operation. It will be recalled (see Figs. 47 to 50) that the starter magnets for the control units, including magnet E—433 which controls the total taking control unit, must be energized and then deenergized to start the units into operation. At the time the card feed clutch magnet 95 (Fig. 53) is energized it closes contacts 470*a* to energize starter magnet E—433, and when the card feed clutch magnet 95 is deenergized at the end of the card group it opens contacts 470*a* and deenergizes starter magnet E—433 whereupon the pawl 432 (Fig. 50) connected to the armature of this magnet E—433 sets the E—431 unit into operation. These parts then function to take a subtotal or a grand total as the case may be. The deenergization of the clutch magnet 95 further opens contacts 535 which deenergizes vertical clutch mag-

net 74. The vertical clutch is subsequently reenergized under the control of the cam contact devices 431 as heretofore explained.

If it is desired to take a grand total at any time when the machine is at rest total key 446 may be depressed. The total or grand total key circuit is traced as follows: from left side of line to contacts 469 (now closed), through card switch contacts 121 (now closed), total key contacts, contacts 536 (now closed) and through starter magnet C—433 and total magnet 324 and thence back through contacts 445 to right side of line. The energization of magnet 324 effects a selection for a grand total operation. After magnet 324 is energized the total key may be released causing the deenergization of the starter magnet C and the initiation of the step-by-step forward movement of the C 431 cam contact devices. These contact devices comprise two contacts marked 437*a* and 474*a*, the former controlling the total clutch magnet 323 and the latter the vertical clutch magnet 74. The operation of these magnets and the control of the circuits is the same as heretofore described for contacts E—473 and E—474.

The above operation takes a grand total of the amount standing on the grand total counters.

To get the last card out of the machine and beyond the drum the contacts 118 are provided which, as heretofore explained (Fig. 7) are closed as long as cards are on the card drum 103 and open up after the passage of the last card. The opening of contacts 118 causes the deenergization of the starter magnet G, and card stop magnet 465. Starter magnet G initiates a stepping forward of the cam device G 431 and at the proper time in the cycle closes contacts 537 which form a shunt around the normal card feed clutch magnet circuit and maintain a flow of current through common junction 459 and through card feed clutch magnet 95 until a later point in the cycle when all the cards have passed into the storage stack. The circuit through the card feed clutch magnet extends from left side of line through contacts 537 to junction 459, to contacts 460 and junction 452, to card feed clutch magnet 95 to the right side of line.

If the switch 461 is in upper position on contact 462 the automatic control system is cut out of operation and the machine when started will continue in card feeding operation as long as there are any cards in the supply hopper to be operated upon. The contacts 464 in this case replace the automatic control circuit in the circuit of the card feed clutch magnet 95. In this case provision must be made for interrupting the circuit through contacts 464 to stop the machine after the passage of the last card. Upon the opening of the contacts 118 when the last card leaves the drum 103, magnet 465 is deenergized thereby opening contacts 464 to stop the machine.

As heretofore explained the clearing of the grand and subtotal counters to zero is effected by means of a rotation of shafts 329 and 331 (see Fig. 11). Under certain conditions it may be desirable to suppress the clearing of a particular counter or to suppress the printing of a total which takes place at the time of the clearing operation. For this purpose the arrangements shown in Figs. 55 to 58 are provided. In place of mounting cams 332, 277 and 339 and directly upon the shaft as shown in Figs. 26, 26A and 31, the latter two of these cams are mounted upon a sleeve 600, which sleeve carries upon its end an annular disc 601 to which is fastened by suitable rivets or screws at a slight distance therefrom a second disc 602. To this latter disc cam 332 is attached. Playing between the two halves of the annulus is a member 603 (Fig. 58) which surrounds the shaft 329 and is provided with a projection 604 adapted to engage in a notch 605 on the shaft 329. Engagement of these parts is normally maintained by a spring 606. With the parts thus engaged all of the cams rotate in unison with the shaft 329 and the counter is reset at each operation of the shaft 329. For selectively disengaging the counters, push buttons 607, one for each counter, are provided. These are slidably mounted in a suitable frame member 608 of the machine and each push button is notched as shown at 609 so that upon operation when pressed inwardly it will engage the rear face of the frame 608 and hold the button in depressed position until released by pressing the same upwardly. Attached to each push button is a rearwardly extending link 610 connecting to a pivoted member 611 mounted on shaft 340*a*. The end of the lever 611 is in alignment with the locking member 603 when the parts are in normal position so that by pushing a particular push button any selected one of clutches 603 may be operated. Upon the release of the push button, restoring spring 612 restores the parts to normal position. It will be understood that one of these clutch devices is provided for each counter; both sub and grand total, thereby permitting the suppressing of the resetting of any particular counter and the printing of a total at the will of the operator.

Certain features of the present invention relating to card handling devices are claimed in my Patent No. 1,826,992.

What I claim is:

1. In a high speed printing tabulator comprising card controlled accumulating mechanism including rotary driving devices for entering items therein, a rotary printing

mechanism, means for imparting rotation to said accumulator mechanism to reset the same to zero, and means concurrently operable with said resetting operation for controlling the printing operation to print the total of the amount standing on the accumulator before resetting, said printing being concurrently effected during the resetting cycle and completed upon the termination of the same, said rotary printing mechanism progressing toward a position for printing a new amount concurrently with the total printing cycle.

2. In a tabulating machine, an accumulator, printing mechanism, means for actuating said mechanism toward a starting point and means for restoring said accumulator to zero position and for causing said mechanism to print the amount standing upon said accumulator during the period that said mechanism is in motion and moving to said starting position.

3. In a tabulating machine, an accumulator, printing mechanism, means for actuating said mechanism to a starting point, means controlled by said accumulator for calling said mechanism into printing operation and means for resetting said accumulator, said actuating, and moving of the printing mechanism, printing and resetting being adapted to take place concurrently.

4. In a tabulating machine, a continuously rotating element, type carried by said element, an accumulator, means for restoring said accumulator to normal position, and means brought into operation when said accumulator reaches such position for selectively calling said type into printing operation.

5. In a tabulating machine, printing mechanism, an accumulator, means for continuously advancing said printing mechanism, means operable during the continuous advance of the said mechanism for restoring the accumulator to normal position, and means operable by the restoration of the accumulator to the normal position and during the continuous sustained movement of the printing mechanism for printing the amount standing upon the accumulator prior to the restoring of the same.

6. In a tabulator having a rotary printing mechanism having a progressive movement to bring type of various numerical value to printing position and to subsequently repeat the positioning of said type without retrograde movement, an accumulator having wheels adapted to advance for both adding and resetting operations and means operable during the advance of the wheels for resetting the same to zero for effecting control of the printing mechanism to print a record of the amount upon the accumulator wheels prior to resetting.

7. In a card-controlled tabulating machine, accumulator means, printing mechanism, separate card-controlled means operative upon a change in separate group designations for causing said mechanism to print the total standing upon said accumulator means, and means for uniting said separate card controlled means to act as one means.

8. In a card-controlled tabulating machine, an accumulator means, printing mechanism, a plurality of elements adapted to detect change in group designations on the cards for controlling the operation of said mechanism to print amounts standing upon said accumulator means, and means for splitting said elements into several groups to act upon several group designations.

9. In a record-controlled tabulating machine, a plurality of record-sensing elements adapted to sense changes in record group designations for controlling the operation of the machine, means for associating said elements together in groups to act upon several separate group designations and selective means for combining the several groups of elements to act upon a single composite group designation.

10. In a perforated card-controlled tabulating machine, a plurality of perforation sensing electric brushes adapted to sense changes in group designations for controlling the operation of the machine, means for associating said brushes together in groups to operate upon several separate group designations and selective means for combining the several groups of brushes to operate upon a single composite group designation.

11. In an accounting machine having normally stationary accumulator gear and means for moving the same, said means comprising a normally rotating gear arranged to enmesh with said first named gear to actuate the same, and means for causing said meshing, said last named means having provisions for automatically imparting to the rotating gear a relative rearward rotation of the determined extent necessary for neutralizing the forward rotation of gear during the period of enmeshing with the stationary gear.

12. In an accumulating apparatus, means for displacing an accumulator gear to differential extents for the purpose described comprising an accumulator gear, an actuating gear normally disengaged therefrom, a normally rotating gear meshing with said actuating gear and mechanically actuated means for adjusting the actuating gear into engagement with said accumulator gear in such direction and with such fixed timed ratio with respect to the position of and speed of rotation of the normally rotating gear as to neutralize the relative rotational effect thereof upon the stationary gear at the time of enmeshing of the same.

13. In a tabulating apparatus, in combination with a plurality of controlling magnets each controlling a particular cyclic op-

eration of the machine, a plurality of controlling contacts and circuits to said magnets including said contacts, a control unit for selectively controlling the action of said contacts, a normally ineffective ratchet device for operating said unit, and means for causing said device to become effective.

14. In a tabulating machine which includes a normally operative record controlled system for governing machine operation, a plurality of normally idle control units each adapted to cause a predetermined sequence of operations of the machine while the normal record controlled system is inoperative and record-controlled means for calling said units into operation.

15. In a tabulating machine which includes a normally operative record controlled system for governing machine operation, a plurality of normally idle control units each adapted to cause a predetermined sequence of operations of the machine while the normal record controlled system is inoperative, record-controlled means for automatically causing operation of one of said units, such unit being adapted at a predetermined time to cause operation of another of the units.

16. In a tabulating machine which includes a normally operative record controlled system for governing machine operation, a control unit for causing a predetermined sequence of operations of the machine while the normal record controlled system is inoperative, a normally ineffective ratchet device for actuating said unit, and record-controlled means for rendering said device effective.

17. In a tabulating machine which includes a normally operative record controlled system for governing machine operation, a plurality of normally idle control units each comprising a group of controlling elements, each group of elements when actuated being adapted to govern machine operation to the exclusion of the normal record controlled system and to effect a predetermined set and sequence of operations of the machine, means for independently operating the said groups of elements and means for selecting the group of controlling elements which are to be operated.

18. A control unit for a perforated record card apparatus comprising a constantly rotating shaft, a plurality of controlling elements arranged in groups for controlling the operation of different parts of the machine in a predetermined sequence, means for selectively advancing said groups of controlling elements in a step-by-step manner from the constantly rotating shaft and means for controlling the selection of the groups which are to be advanced by said shafts.

19. In a tabulating machine, in combination with printing devices, electro-magnetic control means therefor, accumulator wheels, and means for controlling the electro-magnetic means for effecting the printing of amounts standing upon the accumulator wheels, said means comprising contact devices adapted to be brought into cooperative operation upon the restoration of the accumulator wheels to their zero position to differentially establish the circuit to the electro-magnetic means.

20. In an accounting machine having an accumulator gear, means for restoring the same to zero position, means for reading the amount which stood upon said gear prior to its restoration, said means comprising electro-magnetically controlled printing devices and an electric circuit adapted to be closed at the time said accumulator gear is restored to zero.

21. In an accounting machine, record analyzing means, an accumulator controlled by said means and including a plurality of gears of different denominational orders and also a plurality of independent gear trains controlled by said analyzing means for differentially setting the aforesaid gears to enter items thereon, said gear trains also constituting resetting mechanism for the accumulator, and means also controlled by the analyzing means for determining from the controlling records whether items are to be entered into the accumulator from the records or whether the gear trains are to be called into operation to reset the accumulator gears by rotating them in the same direction in which they were rotating in entering items.

22. In an accounting machine having an electric circuit adapted, when closed, to control the printing of an amount, an accumulator gear differentially displaceable in accordance with various amounts, means for controlling the closure of the electric circuit differentially to thereby print the amount standing upon the accumulator gear, said means comprising resetting devices for the accumulator gear and contactor elements adapted for effective operation when the accumulator gear reaches its zero position.

23. In an accounting machine, an accumulator having gears adapted to be driven in one direction to receive items and to be driven forward in the same direction for resetting the gears to zero, means for reading the amounts standing upon the accumulator gears, comprising a plurality of contactor devices controlling each accumulator gear and periodically closing out of phase with each other until the accumulator gears assume their zero position, said contactors closing in phase with each other upon the accumulator gear reaching zero position, and an electric circuit including said contactor elements and controlled thereby, and printing mechanism controlled by said electric circuit.

24. In a tabulating machine, a printing mechanism, electric controlling means therefor including circuits, means for controlling

said circuits to differentially control the operation of the printing means in accordance with an amount standing upon an accumulator wheel, said means comprising a gear adapted to be differentially displaceable in accordance with the amount on said accumulator gear, said first mentioned gear upon assuming a position of rest adapted to control the establishment of the aforesaid circuit to effect the printing operation.

25. In an accumulator, a constantly rotating shaft, an accumulator gear, means for differentially driving said accumulator gear from said constantly rotating shaft, said means comprising an intermediate gear train, means for displacing the train to laterally enmesh one of the gears thereof with the accumulator gear, and means for effecting a relatively rearward rotational movement of certain of the gears of said train during said lateral displacement to secure a stationary condition of the enmeshing gear during enmeshing periods.

26. In an accounting machine, a constantly rotating shaft, an accumulator gear, means for coupling said accumulator gear with said shaft to differentially drive the said gear, said means comprising an intermediate gear device adapted for lateral enmeshment with the accumulator gear, and provisions in said intermediate gear device for providing a relative rearward movement of the enmeshing gear at the time of enmeshment to compensate for the forward rotational movement of same from said driving shaft.

27. In an accounting machine having an accumulator with differential driving devices therefor, said accumulator and driving devices comprising a normally stationary accumulator gear, a normally rotating gear adapted to be enmeshed with said stationary gear to actuate the same differentially and thus control the amount set up thereon, means for causing said enmeshing at different times in the adding cycle, said means having provisions for imparting to said rotating gear a relative rearward rotation to neutralize the relative rotation between the normally stationary gear and rotating gear at the time of enmeshment.

28. In an accounting machine, a gear, a second gear, actuating means for rotating said second gear at a determined speed, means for definitely moving said second gear into said first mentioned gear in a direction and at such speed as to set up in said second gear a movement of neutralizing rotation opposite to its actual rotation.

29. In an accounting machine, a counter gear, a train of constantly rotating gears, and means operating in timed relation to the speed of the rotating gears for bringing one of the gears of said train into operative relation with said counter gear by so moving said one of said gears with respect to the train as to neutralize its rotation relative to said counter gears.

30. In a record controlled apparatus including record analyzing means, and an accumulator controlled thereby comprising a plurality of wheels adapted to be differentially advanced to receive items from the records, means controlled by the analyzing means for differentially advancing the wheels for receiving items, resetting means for turning the said wheels forward in the item receiving direction to reset the wheels to zero, said item entering and resetting means both including common differential mechanism and means also controlled by the analyzing means for determining whether the common differential mechanism shall operate to enter items or shall operate to reset the wheels to zero.

31. An accumulator having individual wheels for various denominational orders, means for reading the amounts upon said wheels, said means comprising an electric circuit adapted to be closed by the restoration of the wheels to zero, said circuit by the timing of its closure being adapted to determine the operation of the said reading means.

32. An accumulator comprising a plurality of wheels adapted to be selectively coupled to a rotating shaft to differentially set up amounts thereon, said accumulator including selective coupling devices substantially in radial alignment with the individual wheels to couple the same to the rotating drive shaft and to thereby provide compact lateral spacing of said wheels.

33. In a card-controlled tabulating machine, the combination with accumulator wheels and means for printing the data standing thereon, of card feeding means, a control unit comprising a normally inactive step-by-step power actuated means adapted to cause stoppage of the card feeding, taking of total and restarting of card-feeding, and card-controlled means for controlling the operation of said step-by-step means.

34. In a card-controlled tabulating machine, the combination with accumulator wheels and means for printing the data standing thereon, of card feeding means, step-by-step power actuated electric contact-making means adapted to cause stoppage of the card feeding, taking of total and restarting of card-feeding, and card-controlled means for controlling the operation of said step-by-step means.

35. In a card-controlled tabulating machine which includes a normally operative record controlled system for governing machine operation, a movable member adapted when set in motion to govern machine operation to the exclusion of the normal record controlled system and to cause the machine to perform a predetermined series of operations, normally ineffective means for setting

said member in motion, and card-controlled means for rendering said means effective.

36. In a printing tabulator, the combination with a rotating member having one direction of rotation only and a plurality of type thereon, of card-controlled means for bringing said type into printing operation, and an accumulator also adapted to control operation of said type and card control selective means for determining whether the control of the type shall be by the aforesaid card control means or by the aforesaid accumulator means.

37. In a printing tabulator, in combination with a rotating type carrier having individual type thereon with provisions for effecting printing items or totals during a continuous uninterrupted forward movement of the carrier, accumulating means, card analyzing means and means under control of the analyzing means for conjointly selectively selecting the type upon said carrier for item listing printing operations and for controlling the entry of items into the accumulator, and means controlled by the accumulator for selectively calling the type upon the continuously rotating carrier into printing action for printing totals of items accumulated and card control means for determining whether the type and accumulator shall be conjointly controlled from the analyzing means or the type shall be controlled from the accumulator for total printing.

38. In a tabulating machine, a brush holder, data sensing brushes carried thereby, and means operable automatically and periodically in coordinated timed operation with the operation of the machine and during the operation of the machine for displacing the brushes out of position by swinging the holder therefor.

39. In a tabulating machine, a card carrying drum, perforation-sensing brushes operatively associated with said drum, and a holder for said brushes adapted to be moved into and out of operative position to displace the brushes out of cooperation with the drum.

40. In an accounting apparatus including an accumulator in which items are to be added, a printing mechanism for printing totals, means for restoring the accumulator wheels to normal home position by advancing the same in the direction which they have advanced in receiving items, and means called into action upon the accumulator wheels reaching their normal home position after such forward restoring movement for calling the printing device into operation to print a total representing the amounts standing upon the wheels prior to their restoration.

41. A tabulating machine comprising a printing mechanism, an accumulator mechanism, differential driving devices for said accumulator mechanism, means operated by said driving devices for restoring the accumulator to home position by advancing the same in the same direction in which it was advanced in receiving items, record card controlled means for controlling the entering of items into the accumulator, and record card controlled means for determining whether said differential driving devices shall operate to enter items or to restore the accumulator to home position.

42. An accounting machine comprising a plurality of accumulator wheels, printing mechanism, a plurality of continuously forwardly rotating differential actuators, means for differentially calling said actuators into operation for entering items into the accumulator wheels, means for concurrently calling said actuators into operation to reset the accumulator wheels by advancing the latter in the same forward direction in which they advanced in receiving items, and means controlled by the differential times at which the accumulator wheels reach their normal home position after such forward restoring movement for controlling the total printing operations.

43. An accounting machine comprising a continuously forwardly movable printing device and an accumulator device having wheels constructed to move forward for both receiving items and for the zero setting of the wheels and means for concurrently entering items into the accumulator and for calling the printing devices into operation to print items.

44. An accounting machine comprising a continuously forwardly movable printing device and an accumulator device having wheels and combined differential actuating and zero setting devices constructed to move said wheels in the same forward direction for receiving items and for zero setting, and means controlled by perforations in record cards for controlling said differential actuating device to enter items into said accumulator and for calling the printing devices into operation to print items.

45. In an accounting apparatus adapted for printing items and totals, an accumulator having accumulator wheels, printing mechanism, a common actuator means for differentially driving and for returning the accumulator wheels to zero with the same direction of rotation of said wheels and without retrograde movement thereof, means called into action when the actuator begins to drive the wheels for calling the printing mechanism into operation to print the individual amount added and means called into action when an accumulator wheel is restored to zero for controlling the printing mechanism to print the amount standing upon the wheels prior to the restoration thereof.

46. In a tabulating machine, in combination, card feeding and analyzing devices, a printing section, a registering section, a sin-

gle driving motor for all of said sections, a card feed clutch adapted to connect and disconnect the card feeding section from said driving motor, a clutch for controlling the drive for the registering section, and a total clutch adapted to connect said registering section with said driving motor during total-taking operations and to disconnect the same during registering operations.

47. In a tabulating machine in combination with a card feeding section, a registering section, a printing section, a driving motor, electro-magnetically controlled means for coupling said driving motor to the card feeding section of the machine, and electro-magnetically controlled means independent of said first mentioned means for coupling said driving motor with the registering section of the machine.

48. An accounting machine comprising a continuously forwardly movable printing device and an accumulator device having wheels and combined differential actuating and zero setting devices constructed to move said wheels in the same forward direction for receiving items and for zero setting, and means including brushes for sensing the index point perforations of record cards, electric circuits controlled thereby and magnet devices in said circuits for controlling the differential actuating devices to enter items into the accumulator and for calling the printing devices into operation to print items.

49. In a record-controlled tabulating machine, a plurality of record sensing elements adapted to sense changes in record group designations for controlling the operation of the machine, said sensing elements including a plurality of elements adapted to cooperate with major group designating perforations upon the record, said elements including a separate group of sensing elements adapted to cooperate with a separate minor group designation, and means for combining said separate groups of elements whereby the same may act as a unit upon a single group designation.

50. In a record-controlled apparatus in combination with adding mechanism, printing mechanism, card analyzing devices, electromagnetic devices controlled by said card analyzing devices, means operated by a common electromagnetic device for concurrently calling into operation the adding and printing mechanism, and means for automatically coordinating and effecting conjoint operation of the card analyzing devices, the adding mechanism and printing mechanism.

51. In a record card controlled apparatus in combination, with adding and printing mechanisms controlled by perforated record cards, magnetic devices for controlling the same, operating connections therefrom to the adding and printing mechanisms, and means for disabling one of said connections during certain operations of the machine.

52. In a card controlled tabulator having an adding and a printing mechanism, means including a magnet and an operating connection controlled thereby for controlling the operation of the adding mechanism, means for printing totals, and means operable during said total printing operations for disabling the connection between the magnet and its cooperating controlled adding mechanism.

53. In a tabulating machine having in combination means for automatically feeding the perforated record cards, a card analyzing means, a card controlled accumulating mechanism for accumulating subtotal items from a certain record card field, a second accumulating mechanism for accumulating grand totals of items from the same card field and a common printing means for printing both the sub and grand totals of the items accumulated in the same column upon a record sheet.

54. In a record card controlled apparatus including in combination, means for automatically feeding perforated record cards, a card analyzing means, a plurality of accumulators controlled by said card analyzing means, certain of said accumulators being adapted for accumulating sub-totals and other of said accumulators being adapted for accumulating grand totals, magnet devices for controlling the operation of said accumulators, and call wires operated by said magnet devices and common to both sub and grand total accumulator elements for controlling their operation.

55. A card-controlled accounting machine including a rotatable type carrier with a plurality of type thereon with provisions for continuously advancing the same with a unidirectional movement during tabulating and total-taking operations, common control means for said type operable for either item listing or total printing operations thereof, means for analyzing perforated record cards, means for calling the aforesaid control means for the said type upon said rotatable carrier into action to print items under the control of the analyzing means, means under the control of the analyzing means for accumulating items, and means controlled by the accumulating means for selectively calling the aforesaid control means for the said type upon the aforesaid carrier into action during the rotation of the carrier when totals are to be printed and record controlled means for determining whether the type shall be called under control of the analyzing means or under control of the accumulator.

56. In a tabulating machine including in combination devices for feeding record cards, devices for registering items and devices for printing items and totals, means for controlling various cyclic operations of the machine such as card feeding, registering and

total printing, said means comprising a control unit, electric contacts controlled thereby controlling electric circuits which in turn control alternative cyclic operations of the machine, and record controlled means for calling said control unit into operation.

57. An accumulator having individual wheels for various denominational orders, a printing device for printing the amounts which stood upon said wheels prior to the zero setting of the same, means for controlling the operation of said printing device whereby the latter may print the amounts which stood upon the wheels prior to resetting, said means comprising devices individually called into action by and at the time each accumulator wheel returns to its zero position.

58. In a printing tabulator, a rotatable member, a plurality of type carried thereby, a rotatable card carrying member, register devices, means adapted to cooperate with cards carried upon said card carrying member for sensing data thereon and means controlled by said data sensing means for concurrently calling said type into printing operation and for calling the registering devices into operation.

59. In a tabulating machine having grand and sub total counters, means for initiating a sub totaling printing operation upon the occurrence of record group changes, and means for initiating a grand total printing operation upon the occurrence of a different change of the record groups.

60. In a tabulating machine having an accumulator for accumulating amounts from a plurality of records of a single group, an accumulator for accumulating amounts derived from another group of different designation than the first mentioned group, means for automatically initiating a total taking operation of the amount on the first accumulator when the individual groups change, and means for automatically initiating a total taking operation of the amount upon the other accumulator when a group change occurs between other groups.

61. A tabulating machine, including means for handling perforated record cards, said cards being arranged in main and subsidiary groups, means for initiating a record making operation upon the occurrence of a change of the subsidiary groups, and means for initiating a different record making operation upon the change of the main groups.

62. In a printing tabulating machine, in combination, means including analyzing devices and accumulating means controlled thereby for accumulating sub and grand totals from perforated records and devices controlled by a change in the perforations of the records analyzed for selectively taking sub-totals only or grand totals only said means including devices for taking either sub or grand totals automatically by the operation of the machine.

63. In a printing tabulating machine, including sub and grand total registers controlled in their operation by perforated record cards, means for printing sub or grand totals, and means controlled by the record cards for automatically initiating either a sub or grand totaling printing operation depending upon the character of record group change.

64. In a printing tabulator having sub and grand total registers controlled by perforated record cards, total printing means, automatic means controlled by a change in record card groups for automatically initiating total printing operations and selective means for determining whether sub totals or grand totals will be printed.

65. In a printing tabulator having provisions for accumulating items from perforated record cards upon sub and grand total registers, means for printing said accumulations or totals, means controlled by a change in record groups for automatically initiating a total printing operation, and selective means for suppressing the printing of either the sub or grand total.

66. In a printing tabulator having provisions for accumulating items from perforated record cards upon sub and grand total registers, means for printing said accumulations or totals, means controlled by a change in record groups for automatically initiating a total printing operation, and selective means for determining whether sub totals or grand totals or either sub or grand totals will be printed.

67. In a tabulating machine having sub total and grand total accumulators controlled by perforated record cards, said sub total accumulators having provisions to accumulate items from individual sub groups and to be thereafter cleared automatically prior to receiving items from the next sub total group, and said grand total accumulators being adapted to automatically accumulate items from another group of designations different from the first and constituting a major group and to be thereafter cleared automatically prior to accumulating the items of the next major group.

68. In a tabulating machine, card controlled sub total accumulators and grand total accumulators, means for automatically initiating a clearing of the sub total accumulator upon the change of sub groups of record cards, and means for automatically initiating a clearing of the grand total accumulators upon a change of the major groups of record cards.

69. The invention set forth in claim 68, in which means is provided for rendering the clearing devices in-effective upon one or more of the accumulators.

70. The invention set forth in claim 68, in

which means is provided for printing totals on a clearing operation, and additional means is provided for suppressing the printing of totals from one or more of said accumulators.

71. In a card controlled apparatus, in combination with a plurality of clutches for selectively bringing into operation different portions of the machine, a control unit having a plurality of controlling sections, means for selecting the different sections for operation, and means controlled by the operation of the said sections for selectively controlling the action of said clutches.

72. In a printing tabulator, a rotatable member, means for imparting a continuous uninterrupted forward rotating movement thereto, a plurality of type carried thereby, record card sensing devices for sensing the perforations on the record cards, registering devices, and means controlled by said data sensing means for concurrently calling said type into printing operation and for calling the corresponding register wheel into registering operation.

73. In a printing tabulator in combination with card analyzing means, card feeding devices for successively presenting cards to the analzing devices, printing devices, registering devices, and a single electromagnet controlled by the analyzing devices for concurrently controlling the selection of the type in the printing devices and for selecting the registering devices for operation.

74. In a printing tabulator, in combination with record card sensing means, printing devices having various type for printing items and registering devices, a unitary electromagnetic means for calling into operation a particular printing type and for calling into operation at the proper differential time the corresponding element of the registering device, and means called into action at the time said registering devices is restored to zero for again operating the unitary electromagnetic means for calling the corresponding printing type into operation to print the amount standing upon said registering device prior to zero setting of the same.

75. In an accounting apparatus including an accumulator including wheels in which items are to be added, a printing mechanism including type for printing totals, means for restoring the accumulator wheels to normal home position by advancing the same in the direction in which they have advanced in receiving items, and means called into action upon the accumulator wheels reaching their normal home position after such forward restoring movement for selecting the proper type upon the printing mechanism for printing a total to represent the amounts standing upon the wheels prior to their restoration.

76. In a record controlled accounting machine, means for sensing amounts on the records, means controlled by the sensing means for accumulating totals of the amounts, and continuously forwardly rotatable means controlled by the accumulating means for printing accumulated totals.

77. In a record controlled accounting machine, record sensing means, means controlled thereby for accumulating totals of items, a printing mechanism including continuously moving type, and means for selectively and alternatively calling said type into printing action under the control of the sensing means for printing items or under the control of the accumulating means for printing totals and record controlled means for determining whether said type shall be called into operation under control of the sensing means or under control of the accumulating means.

78. The invention as set forth in claim 77 in which mechanically controlled means is provided for calling the type into action for listing items and for printing totals.

79. The invention as set forth in claim 77 in which mechanically controlled means control the accumulation of items under the control of the sensing means.

80. A record controlled tabulating machine including a single driving motor, a printing device driven continuously thereby, and an accumulating device also driven thereby, a total taking device, and means for interrupting the drive of the total taking device by said motor during accumulating operations.

81. A record controlled tabulating machine with means for accumulating items from the record, means for taking different kinds of totals of items accumulated, control means controlled in one way by a change in one kind of control designations upon the records and controlled in a different way by a change in another kind of control designations upon the records, and means controlled by said control means for selectively controlling the kind of total which is to be taken by said total taking means.

82. A tabulating machine including accumulating mechanism, printing mechanism, and card feeding mechanism and a single driving motor therefor, means for constantly driving said printing mechanism by the driving motor at all times, and means for selectively coupling the card feed and the accumulating mechanism to said driving motor.

83. An accounting machine having an accumulator with individual order adding elements, which are turned in a certain direction differentially to receive entries, means for further turning said elements in the same direction to reset the accumulator elements to zero, and printing mechanism having type controlled by the individual elements of the accumulator by and at the time said individual elements reached their zero position to print totals.

84. A record controlled tabulating ma-

chine with means for accumulating items from the record, means under the control of the records for taking automatically different kinds of totals from the accumulating means upon the change of one or another kind of designations of the records.

85. In a record controlled tabulating machine, means for accumulating items from the records, means to first take one total automatically therefrom upon the change of a control designation, means for thereafter resuming accumulating operations automatically, and means called into action by a change in another control designation upon the records for automatically taking a second total which includes the items composing the first total from the accumulating means.

86. A tabulating machine including an accumulating mechanism, printing mechanism and card feeding mechanism, a single driving motor for all of said mechanisms, magnetically controlled means for coupling the driving motor to the card feed and accumulating mechanisms during accumulating operations, and magnetically controlled means for uncoupling the card feed from said driving motor and for coupling the accumulating mechanism thereto during total printing operations of said printing mechanism.

87. A record controlled accounting machine, with record sensing means, printing mechanism and accumulating mechanism, and common magnetic means controlled by the sensing means for controlling the accumulating mechanism and the printing mechanism for printing items by the latter, and means for also controlling said common magnetic means by the accumulating mechanism for controlling the printing mechanism to print totals.

88. In an accounting machine, a plurality of accumulator wheels for adding items and mounted for rotation in the same direction for adding and restoring, a device for printing data represented by the position of said wheels, means for actuating said printing device comprising a differential for restoring the wheels to home position, and means controlled by said wheels on reaching home position after a restoring operation for actuating said printing devices to print the data represented by the position of the wheels at the initiation of the restoring operation.

89. In a record controlled tabulating machine, a plurality of normally idle control units each adapted to cause a predetermined sequence of operations of the machine of a distinctive type and means operable upon initiation of the several types of machine operation for calling the proper control unit into operation.

90. An accounting machine including accumulator elements movable in the same direction for entering and for resetting to zero, means for initiating movement of said elements at differential times to enter items therein, means for initiating movement of said elements simultaneously irrespective of their relative positions to effect resetting of the same, printing mechanism having common type for listing and total printing, means controlled by the first mentioned initiating means for calling said type into operation for listing at the times when the differentially timed movements of the accumulator elements are initiated, means controlled by the aforesaid accumulator elements for calling said type into operation for total printing at the differential times when the accumulator elements reach zero after movements of the same are simultaneously initiated for resetting and means for selectively determining which of said initiating means shall operate.

91. In an accounting machine including accumulator elements movable in the same direction for adding and resetting to zero, and common actuating means for operating the elements for both operations, means for calling said actuating means into operation at differential times to enter items on the accumulator elements, means for calling said actuating means into operation to initiate movement of said elements simultaneously irrespective of their relative positions to effect resetting of the same, printing mechanism having common type for listing and total printing, means controlled by the first mentioned initiating means for calling said type into operation for listing at the times when the differential entering movements of the accumulator elements are initiated, means controlled by the aforesaid accumulator elements for calling said type into operation for total printing at the differential times when the accumulator elements reach zero after they are simultaneously initiated for resetting and means for selectively determining which of said initiating means shall call said common actuating means into operation.

92. A cyclically operable accounting machine comprising means for automatically controlling the initial machine operation through a group of operating cycles fixed in number and sequence, means for controlling said first named means and means operated by the machine for removing the control of said first named means from its controlling means after its operation is once initiated.

93. A record controlled accounting machine comprising record analyzing means and means responsive to a record in cooperative relationship to said analyzing means for automatically controlling machine operation, additional means for controlling machine operation independently of the position of the controlling records and means controlled by the records for selecting said last named means for operation.

94. A record controlled accounting ma-

chine comprising record analyzing means and means responsive to a record in cooperative relationship to said analyzing means for automatically controlling machine operation, a plurality of additional controlling means for automatically controlling machine operation independently of the position of the controlling records and means operated by the controlling records for selecting one of said last named controlling means for operation.

95. A record controlled accounting machine comprising record analyzing means and electrically controlled record feeding means including a control magnet and a control circuit therefor, said circuit including a circuit actuator controlled by the controlling records, a second control circuit for said magnet including a circuit actuator operated by said machine for a plurality of cycles independently of the controlling records and means for manually initiating the operation of said last named actuator.

96. A record controlled accounting machine comprising record analyzing means and record feeding means, an automatic control system responsive to records in cooperative relationship with said analyzing means for maintaining said feeding means in operation, and additional automatic control means for said feeding means to maintain it in operation for a plurality of successive machine cycles on initiation of record feed and means for initiating operation of said last named automatic controlling means.

97. In a machine of the class described, in combination, a major group accumulator, a minor group accumulator, a resetting member common to both accumulators, a magnet, means operable to connect said resetting member with said major group accumulator when said magnet is energized, and means automatically and selectively operable during the operation of the machine for energizing said magnet or for maintaining said magnet deenergized.

98. In a record controlled apparatus in combination with card analyzing means, a common printing mechanism, means for automatically and successively presenting perforated record cards to said analyzing means, means controlled by said analyzing means for operating said printing mechanism to print data represented by the card perforations on a record sheet, means for operating said common printing mechanism to print sub and grand totals of an accumulation of items on said card on the record sheet, means controlled by the analyzing means under record control to determine whether said common printing mechanism shall print items or sub and grand totals and means controlled by said analyzing means for printing a distinctive mark upon the record sheet to designate whether a printed total is a sub or grand total.

99. An accumulator comprising a plurality of gear wheels, a main actuator which is constantly rotatable during adding operations and differential actuators intermediate the said main actuator and said wheels, said differential actuators comprising gear means which are constantly enmeshed with the main actuator and other gear means which are laterally enmeshed with the accumulator gear wheels during the driving of the latter by the main actuator and at differential times for the entry of amounts.

100. In an accounting machine including record analyzing mechanism, an accumulator comprising a plurality of gear wheels, a main actuator which is constantly rotatable during adding operations and differential actuators intermediate the main actuator and said wheels, said differential actuators comprising gear means which are constantly enmeshed with the main actuator and other gear means substantially in the planes of said wheels but normally demeshed therefrom and electromagnetic means under control of the analyzing mechanism for laterally enmeshing said last named gear means with the wheels at differential times for entering items thereon.

101. An accumulator comprising adding elements adapted to be differentially advanced concurrently in a single direction for both adding and restoring in combination with individual unidirectional moving differential actuators for the different adding elements for operating said wheels for both adding and restoring and means for operating said differential accumulators concurrently for either operation.

102. An accumulator comprising adding elements adapted to be differentially advanced concurrently in a single direction for both adding and restoring in combination with individual differential actuators for the elements whose movement is one of rotation as distinguished from oscillation, said actuators having provision for differentially advancing the various adding elements to receive entries and further being adapted by their forward rotation to restore the adding elements to zero and means for operating said differential accumulators concurrently for either operation.

103. An accumulator comprising a plurality of adding elements adapted to be differentially advanced concurrently to receive entries with means including individual differential actuators movable in an advancing direction only for entering items on said wheels in combination with resetting mechanism for said elements including the differential actuators and means for operating the differential actuators concurrently for either operation.

104. In a tabulating machine, card con-

trolled sub-total accumulators and grand total accumulators, means for automatically initiating a clearing of the sub-total accumulators upon a change of sub-groups of record cards, means for automatically initiating a clearing of the grand total accumulators upon a change of the major groups of record cards and printing mechanism controlled by the several accumulators on a clearing operation to print the totals which stood upon the accumulators prior to the clearing operation.

105. An electrically controlled accumulator including a plurality of entry receiving gears, a main actuator therefor comprising a rotatable gear means which rotates only in one direction, and differential devices for entering items upon said entry receiving gears said differential devices including a gear train formed of a plurality of gears of which one cooperates with the main actuator gear and the other of which cooperates with the entry receiving gears, and electro-magnetic means for effecting driving connections between the actuator gear and the entry receiving gear through said train by effecting a radial enmeshment between the gears which are to be brought into cooperation.

106. An accumulator for a high speed tabulator which is capable of receiving items and delivering a summation thereof at high speed, said accumulator comprising accumulator elements upon which items are entered and which are restored for delivering a summation by being advanced in the same direction, said accumulator also comprising a plurality of common differential actuators with means for rotating the same in one direction only and means for selectively associating said elements with the said differential actuators to cause the latter by their unidirectional motion to either enter items into the elements by rotating them in their advancing direction, or to reset said elements and deliver a summation therefrom by advancing them to home position in the same direction.

107. An accumulator device including a plurality of accumulator wheels and a plurality of continuously forwardly rotating differential actuators with means for differentially calling said actuators into operation for entering items into the accumulator wheels and means for concurrently calling said actuators into operation to reset the accumulator wheels by advancing the latter in the same forward direction in which they where advanced in receiving items.

108. In an accounting machine having an accumulator element, means for restoring the same to normal home position, means for reading the amount which stood on the element prior to its restoration, said means comprising electromagnetically controlled recording devices and an electrical circuit controlled through the accumulating mechanism and adapted to be closed at the time said accumulator element reaches home position.

109. In an accounting machine recording mechanism, an accumulator, means for restoring said accumulator to normal home position after displacement therefrom to represent data and means controlled by said accumulator on reaching home position after such displacement for selectively operating said recording mechanism at the time the accumulator reaches home position to record the data represented by such displacement of the accumulator.

110. In an accounting apparatus including an accumulator having denominational order elements on which items may be added, recording mechanism for recording data standing on said accumulator elements, means for restoring the accumulator elements to normal home position by advancing the same in the direction in which they advance to receive items, and means controlled by the elements and called into action upon the elements reaching normal home position after such forward restoring movement for calling the recording mechanism into operation to record the amount standing on the elements prior to their restoration.

111. An accounting machine comprising a plurality of accumulator wheels, recording mechanism, a plurality of continuously forwardly rotating differential actuators, means for differentially calling said actuators into operation for entering items into the accumulator wheels, means for concurrently calling said actuators into operation to reset the accumulator wheels by advancing the latter in the same forward direction in which they advanced in receiving items, and means controlled by the accumulator wheels in accordance with the differential times at which they reach their normal home position after such forward restoring movement for controlling operation of the recording mechanism to record the data standing on the wheels prior to such restoration.

112. In an accounting machine, a plurality of individual denominational order adding elements with transfer devices therebetween, an individual differential actuator for driving each denominational order element for adding and restoring operations in the same forward direction and means for positively driving the actuators in the same direction for both operations, means for effecting driving connection between the adding elements and their actuators at differential times for positive drive of the former by the latter and interrupting the driving connection concurrently to effect adding operations, means for effecting driving connection between the adding elements and their actuators concurrently for positive drive of the former by the latter and interrupting the driving connection at differential times to effect restor-

ing operations and means for rendering the transfer devices ineffective during restoring operations.

113. In an accounting machine a plurality of individual denominational order adding elements with transfer devices therebetween, common actuating mechanism for driving the elements in the same forward direction for both adding and restoring and means for positively driving the actuating mechanism through an unvarying cycle of operation for driving the elements from the actuating mechanism for both operations, means for effecting driving connection between the elements and the actuating mechanism at differential times and interrupting the driving connection concurrently to effect adding operations, means for effecting driving connection between the elements and the actuating mechanism concurrently and interrupting it at differential times for effecting restoring operations and means for rendering the transfer devices ineffective during restoring operations.

114. An accounting machine comprising an accumulator with multi-denominational elements and transfer devices therebetween, an actuator for the elements with means for positively driving the actuator to effect entry of an item, means for effecting driving engagement between the several elements and the actuator during positive drive of the latter at differential times to cause addition of different amounts and means for effecting driving engagement between the actuator and all elements concurrently during positive drive of the latter and including provision for interrupting the driving engagement at different times depending upon the initial setting of the several elements, and means for rendering the transfer ineffective when said last mentioned concurrent drive is effected.

115. In a machine of the class described, a plurality of adder units, printing means associated with said units and actuating mechanism for said printing means, means for operating said actuating mechanism at the initiation of an entering operation for printing items and means for operating said actuating mechanism at the termination of a clearing operation for printing totals.

116. In an accounting machine, recording mechanism and selective means for governing the operation thereof, an accumulator with means for restoring the same to normal home position after displacement therefrom to represent data, and means operated under control of said accumulator when the latter reaches normal home position to immediately operate said selective means to govern the operation of the recording means to record the data represented by such displacement of the accumulator.

117. In an accounting machine, a recording mechanism individual to a denominational order including a plurality of recording elements and a common element for selecting the several recording elements for operation, an accumulator element individual to the same denominational order with means for restoring the same to normal home position after displacement therefrom to represent data and means operated under control of said accumulator element when the latter reaches normal home position for immediately operating said common selecting element to select the recording elements for subsequent operation to record the data standing on the accumulator element prior to its restoration.

In testimony whereof I hereto affix my signature.

FRED M. CARROLL.