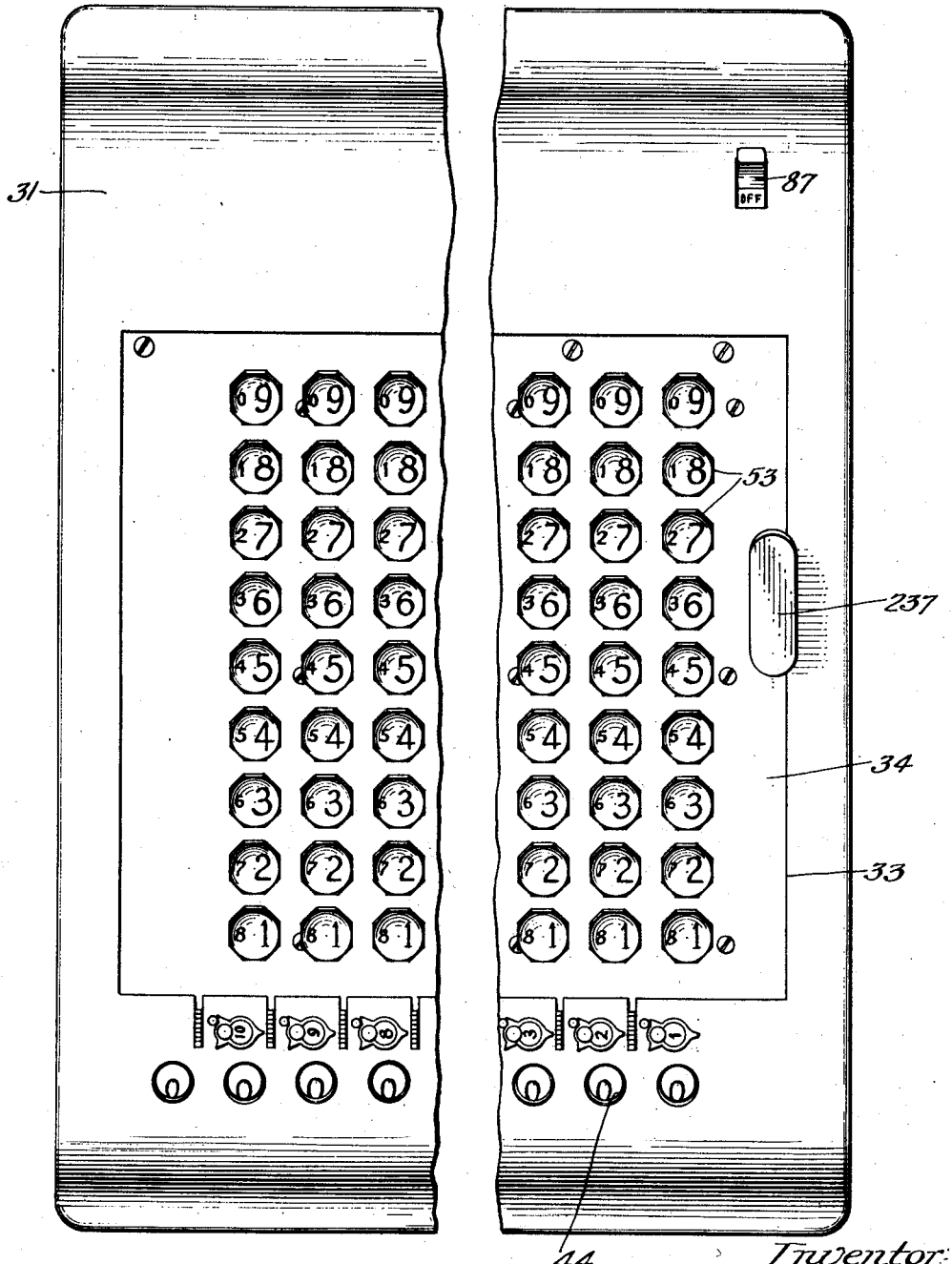
Dec. 15, 1936. J. A. V. TURCK 2,063,962

KEY RESPONSIVE CALCULATING MACHINE

Filed May 22, 1929 8 Sheets-Sheet 1

Fig. 1



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KEY RESPONSIVE CALCULATING MACHINE

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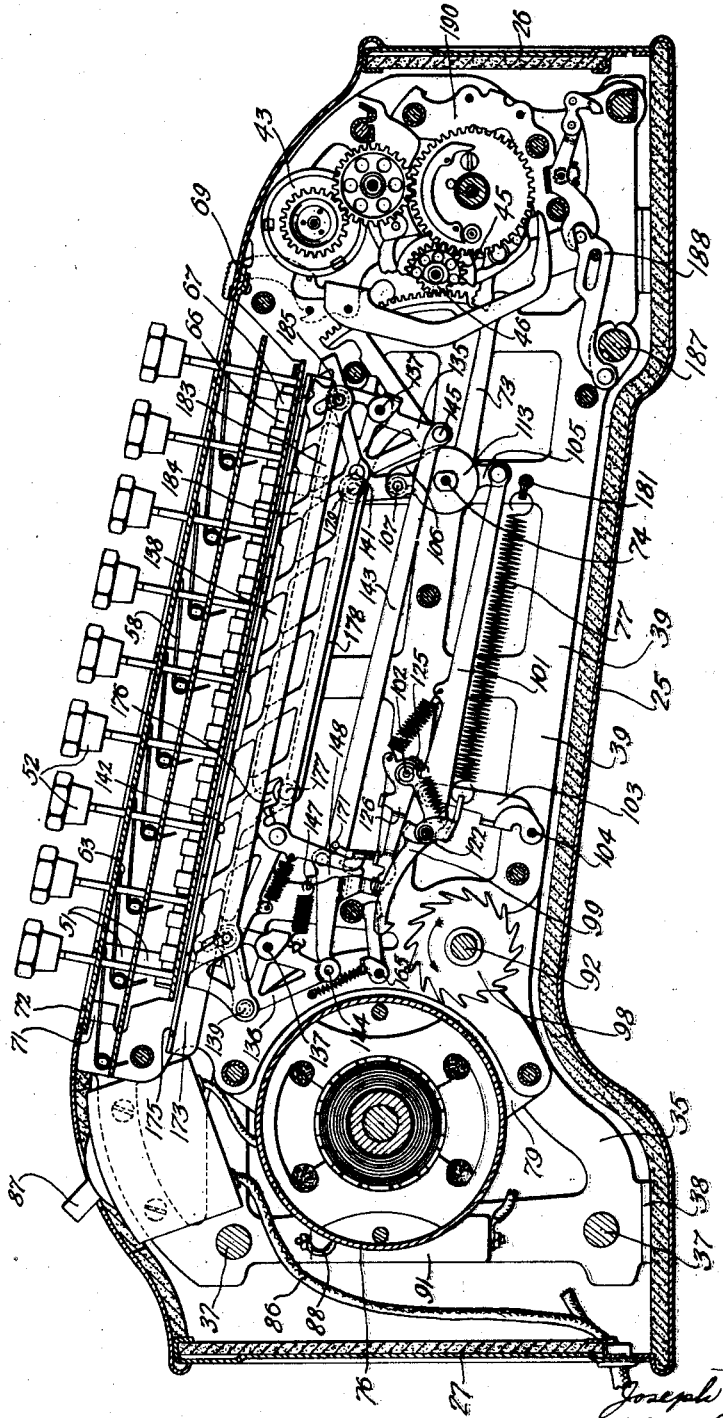
Fig. 2



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KEY RESPONSIVE CALCULATING MACHINE

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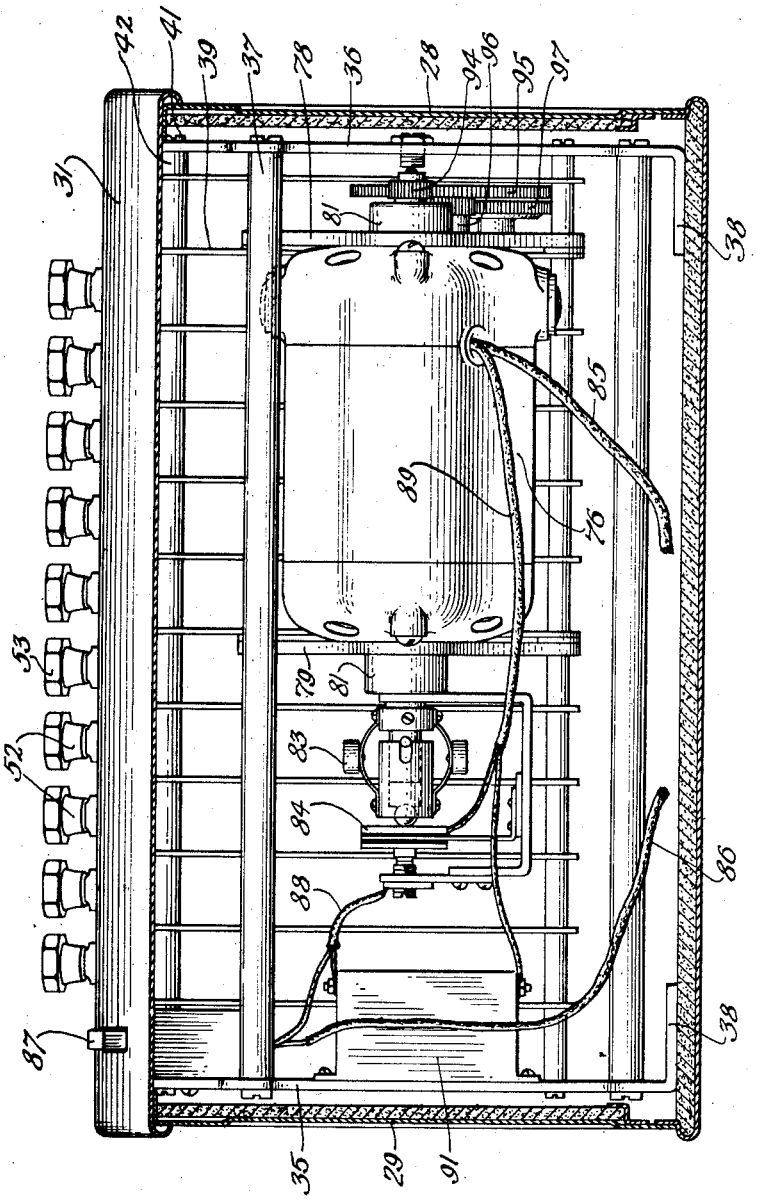
Fig. 3



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KEY RESPONSIVE CALCULATING MACHINE

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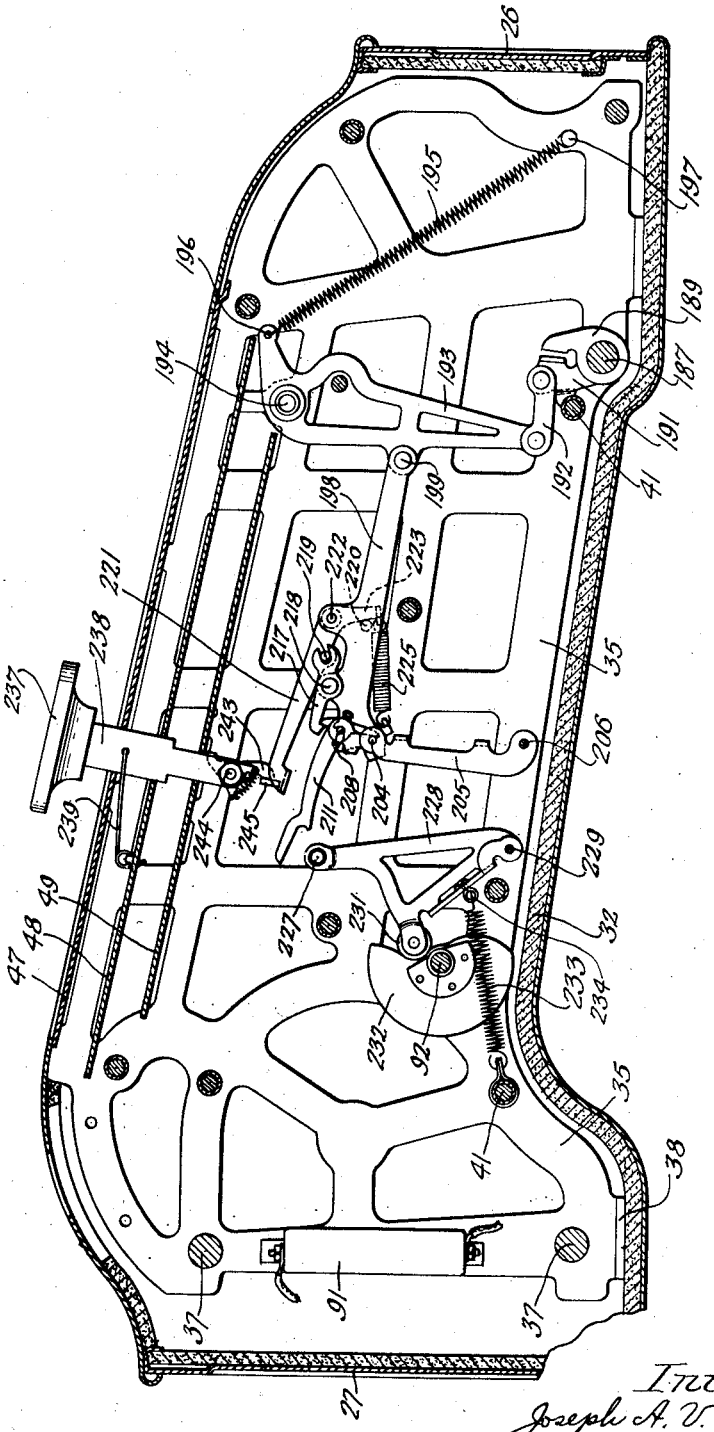
Fig. 4



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KEY RESPONSIVE CALCULATING MACHINE

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Fig. 6

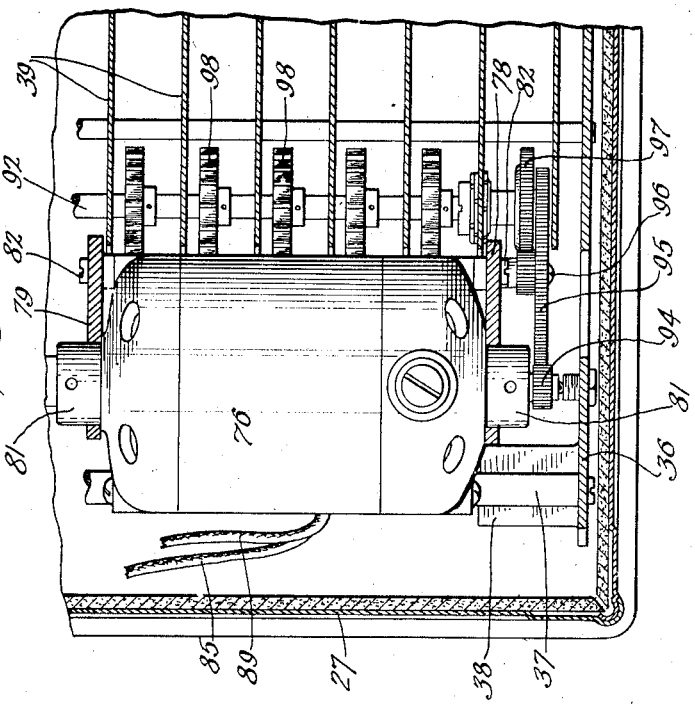
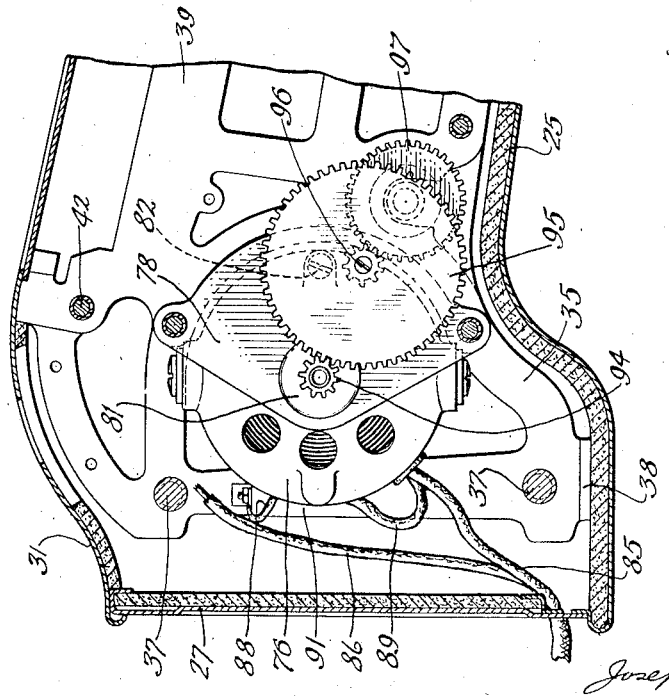


Fig. 5



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KEY RESPONSIVE CALCULATING MACHINE

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Fig. 7

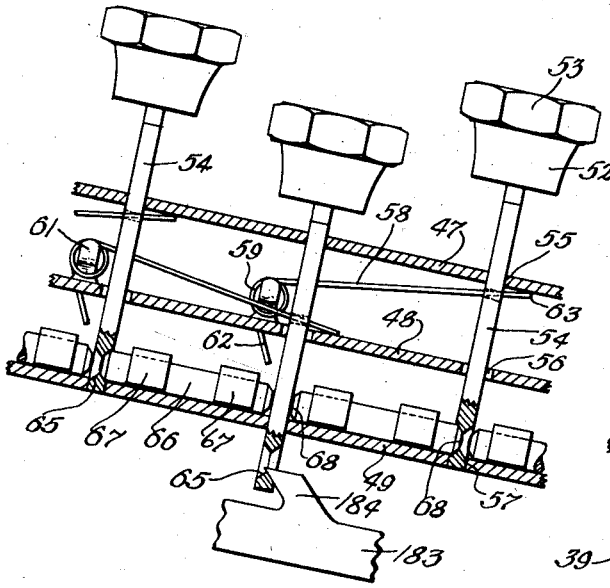


Fig. 8

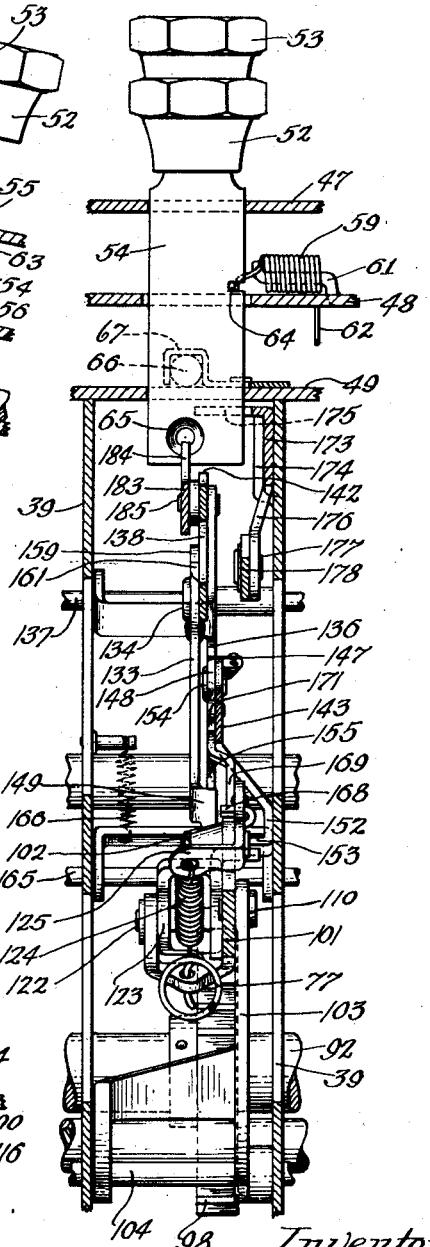


Fig. 9

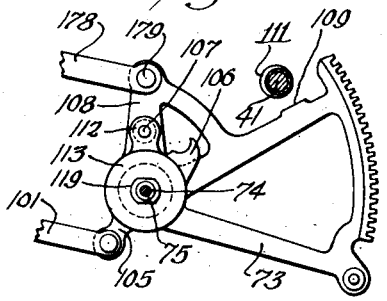


Fig. 10

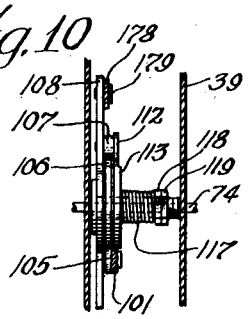
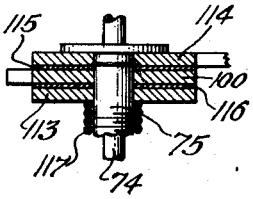


Fig. 11



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KEY RESPONSIVE CALCULATING MACHINE

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Fig. 12

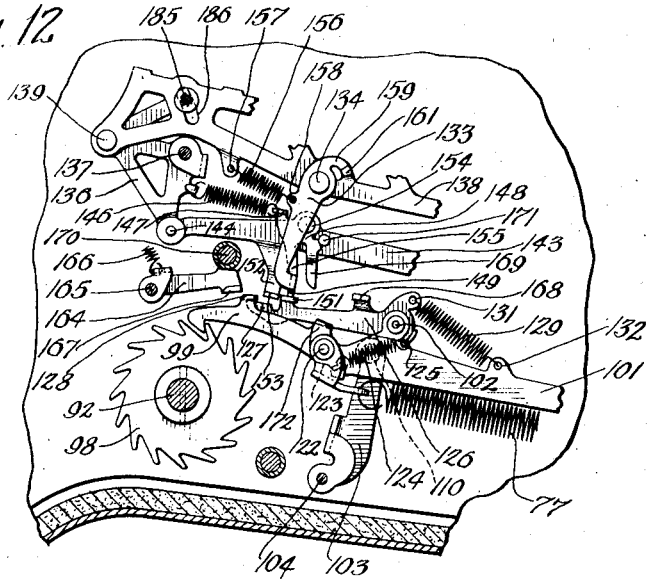


Fig. 13

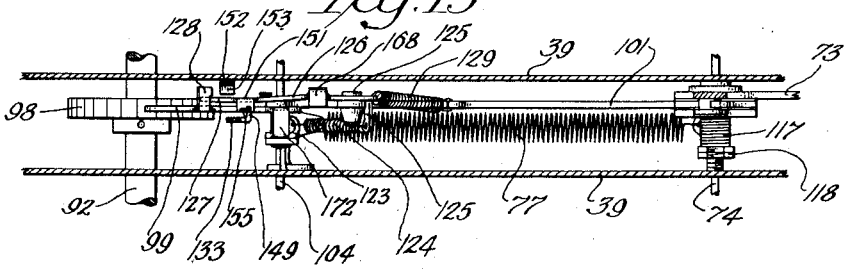
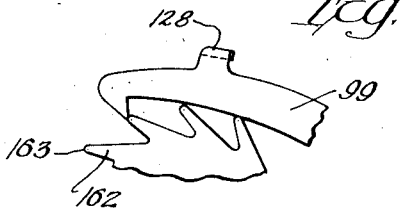


Fig. 14



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KEY RESPONSIVE CALCULATING MACHINE

Filed May 22, 1929 8 Sheets-Sheet 8

Fig. 15

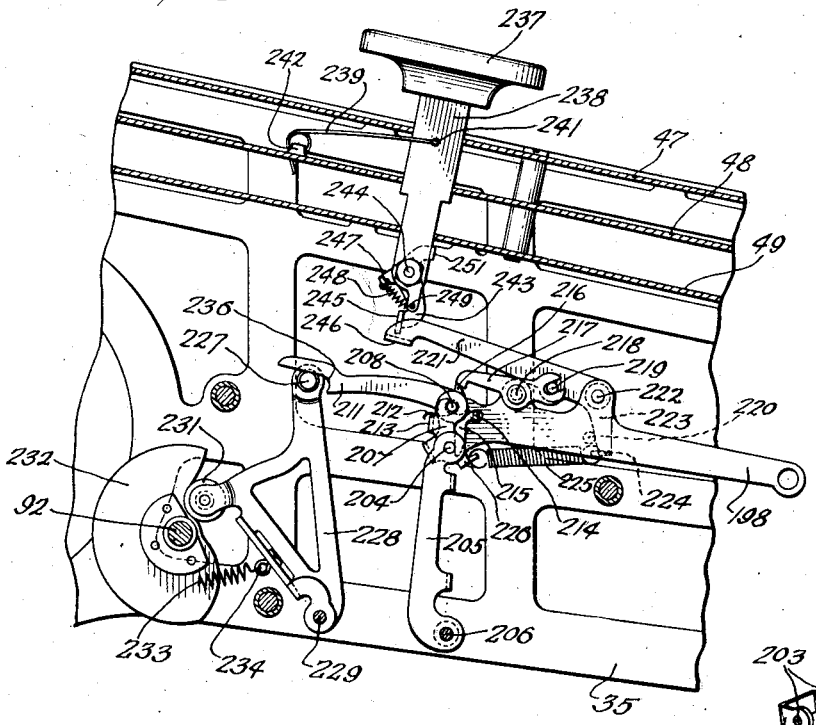


Fig. 17

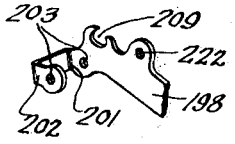


Fig. 16

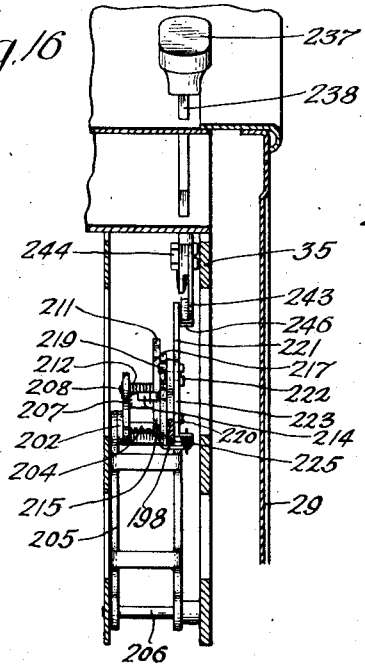
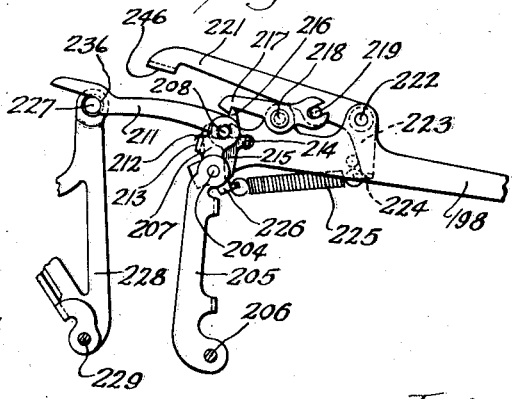


Fig. 18



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Patented Dec. 15, 1936 2,063,962

UNITED STATES PATENT OFFICE

2,063,962

KEY-RESPONSIVE CALCULATING MACHINE

Joseph A. V. Turck, Wilmette, Ill., assignor to Felt & Tarrant Manufacturing Company, Chicago, Ill., a corporation of Illinois

Application May 22, 1929, Serial No. 364,974

35 Claims. (Cl. 235—62)

This invention relates in general to improvements in calculating machines and while it has more particular reference to improvements in power operated, key-responsive calculating machines of the general character disclosed in United States Letters Patent No. 1,371,953 issued to my assignee, Felt & Tarrant Manufacturing Company of Chicago, Illinois, a corporation of Illinois, March 15, 1921, it will be apparent that certain features thereof have other and more general valuable application.

A principal object of the present invention is the provision of a power-operated, key-responsive calculating machine wherein the variable adding and subtracting movements of the adding mechanism will be accomplished from the power member by even, equal and uniform power increments and by even, equal and uniform movements of the power member and the connection between it and the adding mechanism.

The invention contemplates the provision of simple clutching devices for engagement with the power member to effect the adding and subtracting movements.

Another important object of the invention is the provision of a calculating machine of the character described wherein the digitally controlled actuating devices for the adding mechanism are so constructed and arranged that when propelled by a power member they will receive a set regulated throw or increment of action from such power member and deliver only such increment of power and only such increment of action as are required to move the accumulator devices of the adding mechanism in the degrees digitally selected by the particular key depressed.

Another important object of the invention is the provision of a calculating machine of the key-responsive type wherein the power is delivered for the adding and subtracting movements by simple and sturdy parts unlikely to require frequent repair or replacement.

Another important object of the invention is the provision of new and simple devices for locking adjacent keys upon depression of a particular key against accidental depression by the brushing of the finger against such adjacent keys as an incident to the depression of said particular key.

Another important object of the invention is the provision in a calculating machine of the character described of simple clutching devices for connecting the power drive with the adding mechanism, which will deliver even and equal increments of power, requiring no variation to compensate for the usual varying degrees of actuation in accordance with the digital amounts selected for addition or subtraction, thereby eliminating complicated couplings or mechanism for controlling differential increments of power through engaging and disengaging the adding mechanism with the power member.

Another important object of the invention is the provision of mechanism of certain and positive action for insuring a positive and accurately timed engagement between the adding mechanism and the power member and the continuance of such engagement throughout the power stroke to make certain the accurate intended delivery of power increment and movement to the adding mechanism at each key stroke, thereby eliminating possibility of a partial or incomplete clutching action and insuring against errors in calculation.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which, when considered in connection with the accompanying drawings, illustrates a preferred embodiment thereof.

On the drawings,

Figure 1 is a top plan view, broken away centrally from front to back, of a calculating machine embodying my present invention;

Fig. 2 is a front to back vertical section taken through the calculating machine shown on Fig. 1 and on a plane arranged alongside a column or order of keys;

Fig. 3 is a transverse section taken at the rear of the same;

Fig. 4 is a front to back vertical section taken at the right of the calculating machine and showing certain details of the zeroizing or cancelling mechanism;

Fig. 5 is a partial vertical sectional view showing the motor and its gear connection to the power member;

Fig. 6 is a top plan view of the motor gearing and power member, parts of the calculating machine, housing and frame members being shown in section;

Fig. 7 is an enlarged detail view showing the key locking devices;

Fig. 8 is an enlarged detail section taken vertically and transversely of said calculating machine;

Fig. 9 is an enlarged detail view showing the connection between an adding sector and the control mechanism;

Fig. 10 is a rear or end view of the same, parts being shown in section;

Fig. 11 is a section taken through the hub of a said sector;

Fig. 12 is an enlarged detail view showing the connection between the power member and an order of adding mechanism;

Fig. 13 is a top plan view of the mechanism shown in Fig. 12;

Fig. 14 is a fragmentary view illustrating engagement and disengagement of the hook or member provided for connection with the power member;

Fig. 15 is a side elevation of the parts entering directly into the zeroizing or cancelling operation;

Fig. 16 is a front elevation of the mechanism shown in Fig. 15; and

Figs. 17 and 18 are detail views illustrating parts of the cancelling or zeroizing mechanism.

For the purpose of illustrating my present invention I have shown on the drawings a machine in which it is embodied. The working parts are mounted within a casing of any usual or preferred construction, such casing in the present instance comprising a base member **25**, a front end wall **26**, a rear end wall **27**, side walls **28** and **29** and a top wall **31**. These walls may be connected together in any desired manner and are preferably lined in whole or in part with sound deadening material **32**. The top wall of the casing is provided with an opening **33** within which is secured a key-carrying frame **34**. As will be presently explained more fully this frame is insertable into and removable from the housing as a unit and carries with it the keys for controlling and accomplishing the adding and subtracting movements, the key returning springs and the locking devices for preventing inadvertent or accidental depression of more than a single key.

The working parts of the calculating machine are carried in a frame arranged within the casing and consisting of a right hand supporting plate **35** viewed from the front of the machine, a left hand supporting plate **36** connected together by suitably arranged cross or tie rods **37**. These supporting plates are provided with feet **38** which are secured to the base member of the casing. Intermediate partition plates **39** are carried in the frame and are held in place by tie rods **41** secured at their ends in the supporting plates **35** and **36** and passing through the partition plates, spreader tubes **42** being arranged on the tie rods **41** to hold the partition plates accurately in desired position.

The accumulator mechanism, i. e. the adding and registering wheels and connection therebetween, is arranged in the front end of the casing and is carried in a rock frame which may be swung from an operative to an inoperative position for cancelling or zeroizing. The accumulator mechanism is constructed and arranged in the calculating machine shown on the drawings, as shown and described in Letters Patent of the United States No. 1,357,747 and 1,357,748, granted November 2, 1920 to my assignee, Felt & Tarrant Manufacturing Company, of Chicago, Illinois, an Illinois corporation. The accumulator mechanism need not be described in detail, it being pointed out, however, that it consists of a number of duplicated units, one associated with and controlled by each denominational order or column of keys.

Reference character **43** indicates the registry wheels which are visible through openings **44** arranged in the top wall of the casing near the front. Reference character **45** indicates the ratchet wheel provided for each denominational order of accumulator unit and this ratchet carries a pinion **46** adapted for actuation, as will be presently described, to accomplish each adding and subtracting accumulator movement, which movement is, of course, variable and determined in each instance by the digital value of the particular key depressed by the operator.

The keys are arranged in columns, as illustrated in Fig. 1, and each key carries a numeral index consisting of a number and its co-digit or complement to equal 9. As has been stated, the keys are carried in the key-carrying frame which is bodily removable from the casing, this frame consisting of a top plate **47**, an intermediate plate **48** and a bottom plate **49**, these plates being secured together by vertical tie rods extending through the three plates and embraced by spreading or spacing sleeves **51**. Each key, generally indicated by reference character **52**, comprises a finger head or button **53** and a rectangular flat shank **54**. The shanks **54** of the keys are arranged through registering openings **55**, **56** and **57** in the frame plates **47**, **48** and **49**. The keys are guided in their movement by the top and bottom frame plates **47** and **49** and moved freely through the plate **48**. The keys are normally held in elevated position by springs **58**, a said spring being provided for each key. Each spring **58** is of wire, having a coiled central spring body **59** which is threaded over and embraces a lug or finger **61** struck up from the central frame plate **48**. One end **62** of the spring is arranged through an appropriately located opening in this frame plate and the other end **63** is positioned in a slot **64** provided to receive it in the key shank. Each key shank is provided with an aperture **65** near its lower end, this aperture being formed by oppositely bevelled or conical faces as may be seen in Fig. 7.

Locking bolts or members **66** are arranged upon the lower frame plate **49** and between adjacent key shanks. Each of these locking bolts or members is embraced by keepers **67** fast upon the plate **49** and the length of each locking bolt is such that movement or depression of the key shank will thrust the locking bolts on each side into engagement with the presented cone faces of adjacent shank openings **65**. The locking bolts are preferably round in cross section and have conical faces **68** at the ends for engagement in the recesses **65**. When a key is depressed, as illustrated in Fig. 7, the adjacent locking bolts are moved endwise into locking engagement with the adjacent keys, preventing their depression until the intermediate key has returned to normal position to release the locking bolts.

The frame carrying the keys, springs **58** and the locking bolts, when in position in the casing, rests upon the tops of the partition plates **39** and top plate **47** at the front end is bent downward slightly at **69** and is engaged under the adjacent edge of the front portion of the casing top **31**. Threaded socket lugs **71** are provided at the top of the partition plates **39** to receive screws **72** arranged through the top frame part **47** to secure the frame in position in the casing.

The adding is accomplished upon depression of desired keys and corresponding depression of rack sectors **73** which are in mesh with pinions **46** of the accumulator units, a said rack sector being arranged at each pinion **46** and associated therefor with each accumulator unit in association with its controlling column of keys. The

rack sectors and the control and actuating mechanisms for them are duplicated for each denominational order of the calculating machine and a description of a single set of such mechanism will be sufficient for an understanding of them all except that they have to be arranged and adapted to cooperate selectively and collectively with the power members.

The rack sectors are mounted upon a shaft 74 which extends through the partitions and are adapted to be moved downwardly (viewing Fig. 2) on an idle or setting stroke in amount determined by the particular key of the column depressed, this amount increasing in graduating steps from one to nine. The downward movement of each sector is accomplished by an electric motor, generally indicated at 76, and is returned on its adding stroke by a spring 77 all through mechanisms which will now be described.

The motor 76 is mounted at the rear of the machine, being supported by plates 78 and 79 carried by tie rods 41, the bearings 81 for the armature shaft being arranged through these plates. A screw 82 is arranged through each plate 78 and 79 for holding the motor against rotation. This motor may be of any usual or preferred type, a fractional horsepower universal motor being satisfactory. It is provided with a governor 83 controlling contacts 84 in the feed circuit. Conductor leads 85 and 86 are let in through the rear wall of the casing, one lead 85 going to the motor and the other lead 86 being connected to a switch 87. From the switch 87 a wire 88 leads to the contact device 84 and from this a wire 89 connects to the motor. A fixed condenser 91, connected respectively to wires 88 and 89, is or may be provided to prevent excessive sparking.

A main power shaft 92 is arranged in bearings 93 in the partition plates 39. Thus arranged, the main power shaft extends across the machine near its rear and is continuously driven by a reducing gearing comprising a pinion 94 on the armature shaft of the motor, a combined gear and pinion 95 on a stud shaft 96, the gear of said combined gear and pinion being in mesh with pinion 94. The pinion of combined gear and pinion 95 is in mesh with a gear 97 fixed on the power shaft 92.

A toothed wheel 98 is fixed upon the power shaft 92 for each denominational order or column of keys and such said toothed wheel is adapted to be engaged by a hook 99 pivoted, as will be presently more fully explained, to an end of a bar 101, said bar being pivoted adjacent its latch or hook 99 at 110 to an upstanding arm 103 in turn pivoted on a cross-shaft or pivot member 104 extending through the partition plates 39. The bar 101 is pivoted at its other or front end to one arm 105 extending out from a disk 100 mounted upon the hub 75 of the sector rack 73. The disk 100 has a second arm 106 adapted for engagement with a stop 107 arranged between an arm 108 of the sector rack and an arm 112 extending out from a disk 113 also mounted on sector hub 75. The arrangement is such that upon movement of the sector rack the variable amount desired to set the parts for adding, the sector rack and the disks move together, being frictionally connected and until the sector is in set position, thereafter the sector is held in this position throughout the remainder of the stroke, the frictional engagement between disk 100 and the sector rack and disk 113 permitting slipping of the parts.

The sector rack is provided with a disk portion 114 at its hub and friction washers 115 and 116 are inserted respectively between the disk portion 114 of the sector and disk 100 and between disk 100 and disk 113. A coil spring 117 is arranged on sector hub 75 and presses against disk 113 and a holding adjustable nut 118 is threaded on to the hub, a locking nut 119 being also preferably provided to hold the parts in desired frictional relation. It will be noted that the spring causes the disks and friction members to press against each other in desired firmness.

Referring to Fig. 2, depression of any key of the column causes the hook 99 to be depressed into engagement with the toothed wheel 98 to move, through the disks and associated parts, the sector into set position. The hook 99 is pivoted at 122 in the bent-back end of bar 101 and is provided with a tail 123 which is connected by a spring 124 to a bent-over tail piece 125 of a spring-lifted lever 126 mounted on a pivot 102 carried by the bar 101.

Referring more particularly to Figs. 2 and 12 to 14, it will be noted that the spring-lifted lever 126 is provided with a flat face or edge portion 127 at its free end which engages under a laterally extending lug or shelf 128 formed on the hook or latch 99. A spring 129 engaged at one end with an arm 131 on lever 126 and at the other in a lug 132 on bar 101 tends to lift the free end of lever 126 upwardly to sustain the hook 99 normally out of contact with the toothed wheel 98.

The lever 126 is adapted to be moved downwardly by the depression of any of the keys of its column to permit the dropping of the hook into engagement with its toothed wheel 98. This downward movement of the spring-lifted lever 126 is accomplished by a dog 133 pivoted at 134 on a parallel motion device, the top member of which is bodily depressed upon the depression of any one of the keys of the order. This parallel motion device comprises front and back levers 135 and 136 pivoted upon cross-shafts 137 appropriately arranged through the partition plates 39. The top member of each parallel motion device consists of a skeleton bar 138 pivoted at 139 to lever 136 and at 141 to lever 135. This skeleton bar is provided with abutments or shoulders 142 arranged along its top edge and directly beneath the several key stems so that depression of any one of the keys will move the top bar of the parallel motion device downwardly. The bottom bar of the parallel motion device consists of the member indicated by reference character 143 which is pivoted to lever 136 at 144 and to lever 135 at 145. A spring 146, attached to lever 136 and to a tail piece 147 of a latch member 148 carried by the bar 143, normally holds the parallel motion device in elevated position and also holds latch member 148 in forward position for a purpose which will be presently explained.

The dog 133, which is pivoted at 134 on the parallel motion bar or skeleton member 138, is provided with a laterally extending lug 149, which is adapted for engagement with a lug or shelf 151 on spring-lifted lever 126. Depression of the parallel motion device carries dog 133 downwardly and therefore results in depression of lever 126.

Means are provided, however, for delaying engagement of the hook with the toothed wheel for a definite small period of time after depression of a key, this being for the purpose of insuring time for the lever 126 to be pushed down to a position below the lowermost position of shoulder 128 and to provide the proper tensioning of spring

124, so that when the hook 99 drops it will make full engagement with the presented tooth of wheel 98. An arm 152 extends down from bar 143 and is provided with a laterally extending lip or end 153 normally spaced a short distance under lug or shelf 128 on hook 99 and adapted to engage the under side of lug 128 upon the dropping of hook 99. Depression of the parallel motion device results in movement of bar 143 toward the front of the machine and the hook 99 drops a short distance and then, to effect the required delay, is held up out of wheel engaging position by the engagement of lip 153 and lug 128 until the lip 153 has moved out from under lug 128. The dog 133 prior to this, however, has pushed lever 126 downwardly so that upon disengagement of lug 128 from lip 153 the hook may be dropped down into engagement with the teeth of the wheel 98, this drop being accelerated by tensioning spring 124. It will be noted that the action of spring 124 is similar to that of a flexible link connecting the respective tail portions of lever 126 and hook 99. When lever 126 is pushed downwardly by the key action, the hook drops only a short distance, and then the dropping of the hook is delayed as already described, and then the continued depression of lever 126 gives an upward movement of the tail piece of said lever 126 and thereby properly tensions spring 124 to accelerate the subsequent dropping of the hook and yet flexibly leave the hook free to ride up and over the rounded apex of any tooth of toothed wheel 98, that it does not enter far enough to be positively held in operative engagement by the under-hooking of the undercut forward face of the wheel-tooth with the undercut tooth-face of the hook.

Means are provided to prevent return movement of the dog 133 under sharp or staccato stroke before the hook 99 has opportunity to engage the toothed wheel, which means comprise latch member 148 which is pivoted at 154 on bar 143. This latch member has an engaging arm 155 which is adapted to engage upon the laterally projecting end 149 of the dog to hold the dog down against return upward movement and the parallel motion device in depressed condition. A spring 156 attached at one end to a lug 157 on upper skeleton bar 138 and at the other end to a lug 158 on the dog yieldingly holds a stop shoulder 159 on the dog against a companion stop shoulder 161 on parallel motion device skeleton top member 138.

The toothed wheel in the present embodiment of the invention is provided with rearwardly extending elongated teeth 162, the ends of which are rounded at 163 to produce a half round surface, this serving like a reinforced pin or lantern wheel. The round surface turning in the grip of the hook 99 until a following tooth engages the under side of the shank of the hook 99 when the half-pin shaped surface of the tooth again serves to reduce the friction of prying the hook off of the tooth. It may be readily observed from Figs. 12 and 14 that the ends 163 of the teeth succeeding the hook-engaged tooth ride or engage the under edge of the shank or body of the hook 99, as the hook is drawn rearwardly, to lift or cam the hook upwardly and positively disconnect the hook from the engaged tooth by the mere riding of the hook shank itself over the following tooth of the toothed wheel itself. Reference character 164 indicates a pivoted arm mounted upon an appropriately arranged shaft at 165 and held by a spring 166 up against the spacer on a tie rod 170, as indicated in Fig. 12. Upon forward movement of the hook with the wheel the laterally extending shelf or shoulder 128 engages under a shelf or shoulder 167 on arm 164 if the hook is not in full engagement with a tooth of the wheel 92, the shelf 167 acting as a guard against partial or improper engagement. The shelf or shoulder 167 is bevelled or inclined slightly and on the return stroke projection 128 rides over and above projection 167, the arm 164 being firmly but not rigidly held by the spring 166 serving to produce a flexible camming effect to assist and enforce the lifting of hook 99 to its normal level before it returns to its normal forward position.

As has been explained, the engagement of the hook with the wheel imparts the power stroke to the mechanism, and it is intended that for each adding operation a definite set power increment and power movement will be imparted to the bar 101, this increment of power and the power movement resulting being equal and uniform for all the variable settings of the sector racks as determined by the individual keys of the associated column. This movement in the present instance is accomplished when the hook has been pulled toward the rear of the machine by the power member until succeeding teeth engage its shank or body and lift the hook out of engagement as already described. This occurs after a travel more than is sufficient to impart the maximum down stroke to the sector racks. Just prior to the release of the hook, a shelf or projection 168 carried by lever 126 engages a finger 169 of latch 148 and frees the dog 133 so that the parallel motion device may return to normal position after operation. The engagement of the shelf or projection 168 with the finger 169 moves the latch 148 bodily to the left (viewing Fig. 12) away from a stop pin 171 against which it is normally held by spring 146, thereby releasing dog 133 and permitting the parts to return to normal position. The under-hooking action of the hook 99 which holds the hook 99 engaged after the lug 127 of the spring-lifted lever 126 has ridden out from under the depressing action of dog 133 having been released by disengagement of the hook at the end of a power action allows the spring 129 through its lever 126 to normally return the hook 99 to its normal level with its rear projecting stop arm against the U-shaped part of the bar 101 indicated at 123. Thus as the bar moves forward under the actuating spring 77 the hook and spring-lifted lever 126 return to their normal forward position.

The sector racks are set during the power stroke in varying positions and by variable travel in accordance with the particular keys of the denominational orders depressed. This is accomplished by a mechanism to be now described. A bar 173 is arranged to slide longitudinally of the columnar order of keys in keepers 174 stamped out of the adjacent partition plate 39. This bar is provided with laterally extending stop lugs 175 spaced progressively further back of the key shanks from the front to the rear of the machine, being stepped back a unit graduated step for each progressively higher key. That is to say, the stop lug 175 back of the 1-key is spaced one step back of the 1-key and the 9-unit key is spaced back nine steps.

The slide bar 173 is provided with a downwardly extending offset arm 176 located rearwardly of its center and this arm is connected at 177 to a link 178 which is in turn connected at 179

to the sector arm 108 (see Fig. 9). When the parts are in normal position, that is the position they assume between adding operations, a shoulder 109 on the sector rack 73 is in engagement with an eccentric bushing 111 mounted upon an appropriate tie rod extending between and through the partition plates 39. The lug or arm 106 of the disk 100 is in engagement with the stop 107 carried conjointly by the sector rack and outer disk 113. When a key is depressed the hook of its denominational order clutches into or engages the toothed wheel 92 of its power member and the link or bar 101 is pulled toward the rear of the machine, i. e. the left, viewing Fig. 2.

Upon movement of the link or bar 101 toward the rear of the machine and under the pull of the power member, the sector rack, the link 178 and bar 173 are pulled in their respective directions of movement until the appropriate stop lug 175 engages its depressed key shank. Thereupon movement of these parts ceases and the sector rack is arranged to add in the proper amount on its return or additive movement. The degree of movement of the sector rack is of course determined by the particular key depressed and this variable movement of the sector rack is accomplished by a uniform even and non-variable movement of the connection to the power member. When the sector has been stopped by engagement of the lug 175 with the key shank (if a key less than the 9-key be the one depressed) the disk 100 and the connections between it and the power member continue for the remainder of the power stroke. The construction and arrangement of the parts is preferably such that the disk 100 moves more than is necessary to move the sector racks down the maximum distance, i. e. the distance required to add nine into the accumulators. The friction connection between the disk 100 and the sector disk 114 and disk 113 compensate for the additional movement by permitting slipping of the parts to compensate for this difference in movements between the sector rack and the movement of the connection to the power member.

The sector rack, thus having been set in the position for adding determined by the particular key depressed, the adding is accomplished by the return or upward stroke of the sector rack. The spring 77, which is fast at 181 to a cross-pin or rod extending through the partition plates 39 and at the other end to a lug 182 which forms a part of bar 101, pulls this bar to the right (viewing Fig. 2) as soon as the hook 99 becomes disengaged from the power member at the end of the power stroke and after the power increment of the stroke has been stored in the spring 77 in extending it. Upon this return movement of the bar 101 the disk 100 is rotated in a counterclockwise direction (viewing Figs. 2 and 9), the arm 106 contacting with the stop 107 on the sector arm 108 and forcing the parts to normal position or until the lug 109 on the sector has engaged the eccentric bushing 111.

It is important that a key, upon being depressed, be held down until the stop lug 175 arranged behind it has moved forward into engagement with its key shank to set accumulator sector rack accurately in adding position. I accordingly provide a key lock for engaging the key shank when a key is depressed for holding the key down until after the rack sector has been brought to set position. This key lock consists of a bar 183 having rearwardly extending pointed locking lugs 184 for engaging in the conical openings 65 of the key shanks which have earlier been described.

Bar 183 pivoted upon studs 185 arranged respectively in the upper portions of levers 135 and 136 of the parallel motion device, these studs extending through slots 186 provided in the skeleton top bar 138. A locking lug 184 is positioned just forwardly of the downward path of travel of each key shank and when bar 138 is engaged and depressed by the key shank the upper ends of the levers 135 and 136 move rearwardly, shifting the locking lug 184 into locking position and engaging the particular key shank depressed, as seen in Fig. 7, holding it down until the parallel motion device is released and the parts returned to or toward normal position.

The zeroizing or cancelling of the registering mechanism is accomplished by disengaging gears of the trains between the ratchet gears 46 and the registry wheels 43. To this end a rock frame, generally indicated by reference character 190, is provided, as fully illustrated and described in the hereinbefore mentioned United States Letters Patent No. 1,357,747 and No. 1,357,748. In the calculating machines disclosed in these patents the cancelling or zeroizing operation is accomplished by a lever manually manipulated and controlled by the operator to furnish the power for the cancelling operation. In the calculating machine herein being described and embodying my present invention, the cancelling or zeroizing is accomplished from the main power member.

Referring first to Fig. 2, reference character 187 indicates a shaft arranged through the partition plates 39 in suitable bearings. This shaft is connected by linkage 188 with the rock frames 190. This linkage, the rock frame and the registry wheels are or may be constructed and mounted as disclosed in these earlier patents, description of them is not thought necessary to an understanding of the present invention, it being pointed out, however, that the swinging of the rock frames is accomplished by an oscillation of the cross-shaft 187 up and toward the front of the calculating machine.

At the right hand side of the machine shaft 187 is provided with an arm 189 fixed upon it and against independent rotation. A second arm 191 is loosely mounted about shaft 187 and in position to engage arm 189 to effect the oscillation of the shaft. The arm 191 is connected by a link 192 to the lower end of a vertically arranged lever 193 pivoted at 194 to the right hand end plate 35. The upper arm of lever 193 is engaged by a spring 195 secured at one end to the lever at 196 and at the other end to the adjacent frame plate 35 at 197. The spring 195 pulls the lever in a clockwise direction (viewing Fig. 4) and normally holds the arm 191 against the spreader on adjacently arranged tie rod 41.

A thrust link 198 is pivoted at 199 to lever 193 and between its axis of pivotal movement and link 192. The thrust link 198 has its opposite end bent at 201 (Fig. 17) and again at 202 to provide a channel end. This end of the thrust link is pierced at 203 for the reception of a pivot pin 204 arranged in the upper end of a double arm 205 pivoted at 206 upon the supporting plate 35, the pivot 206 being also engaged in the right hand supporting plate 35. A yoke member 207 is also mounted on pivot pin 204 and within the channel end of thrust link 198. A pivot pin 208 is arranged through the upper portion of the yoke member 207 and extends into a slot 209 formed in the end of thrust link 198 above the piercings 203. A hook or jaw member 211 is pivoted upon pivot

pin 208 and a spring 212 is arranged to engage the center or bridge member 213 of the yoke and a tail piece 214 of the hook member 211, this spring being coiled about the pivot pin 208 intermediate these points of engagement. The action of the spring 212 tends to raise the hook or jaw member 211 and this hook or jaw member is provided with a finger or end 215 normally held by the spring 212 against pivot pin 204.

The hook or jaw member 211 is provided with a tit or shoulder 216 extending upwardly and in position to be engaged by a latch 217 pivoted at 218 on thrust link 198, the other end of this latch having jaw engagement with a stud 219 mounted in a lever 221 which is pivoted at 222 in an arm or boss 223 extending up from the thrust link 198. The arm of the lever 221, which is disposed beyond the pivot 222, is connected at 224 to a spring 225 in turn connected at 226 to the yoke 207. This spring normally holds the lever in the elevated position shown (Fig. 15) and with its end in engagement with a stop 220 on link 198. The arrangement of these parts is such that the spring 225 tends to hold pivot pin 208 in the left hand end of slot 209 (viewing Fig. 17), the latch 217 holding the pivot 208 to the right hand end of this slot when engaging the tit or projection 216.

The hook or jaw member 211 is adapted for thrust engagement with a stud 227 carried at the upper end of a lever 228 of bell crank type and pivoted at 229 between plate 35 and adjacent partition plate 38. Lever 228 carries a cam roller 231 which is held in engagement with a cam 232 mounted upon the main power shaft 92 by a spring 233 fixed at 234 to lever 228 at one end and to a tie rod 41 at the other.

The construction and arrangement of the parts is such that, when the latch 217 is in engagement with the tit 216 of the hook or jaw member 211 and the pivot pin 208 is in the right hand end of slot 209 (viewing Fig. 17), the jaw member 211 is arranged above the path of movement of the stud 227 of lever 228. At this time the spring 225 is extended and, upon release from the holding influence of the latch 217, is adapted to pull the yoke 207 about its pivot 204 to arrange the pin 208 in the left hand end of the slot 209. This action causes the jaw member 211 to swing down into the path of movement of the stud 227 already described. If the lever 228 be at the left hand end of its stroke (viewing Fig. 15) the jaw is immediately engaged by stud 227 and through rotation of the cam 232 the jaw member 211 and the thrust link 198 are moved toward the front of the calculating machine to accomplish the zeroizing or cancelling, as will be readily understood. If, however, the lever 228 is in other position, the jaw member merely drops down upon the stud and the stud rides along its lower edge until into position for engagement in the jaw, this being permitted by the springs 212 and 225.

Immediately upon engagement of the stud 227 with the jaw member 211, the pivot pin 208 is moved to the forward end of slot 209 and into position permitting re-engagement of the latch 217 with the tit 216. The jaw, indicated by reference character 236, is curved to extend beneath the stud 227 so that engagement of these parts throughout the power stroke is insured. The spring 212 permits such pivoting of the jaw member 211 as is necessary to the maintenance of this engagement.

The control of the cancelling or zeroizing is accomplished by the depression of a zeroizing key 237, the shank 238 of which passes through suitable openings in the keyboard plates 47, 48 and 49, being normally held in elevated position by a spring 239 engaged with the key shank at 241 and held in spring position upon a tongue 242 arranged in the intermediate plate 48. This key upon being depressed is adapted to swing lever 221 in a counter-clockwise direction (viewing Fig. 15) to release latch 217 and permit the zeroizing or cancelling action. A three-arm trip lever 243 is pivoted at 244 to the lower end of the key shank 238. One arm of this lever extends downwardly and is provided with a lug 245 which is arranged to engage a shelf 246 on lever 221 when the parts assume the position shown in Fig. 15. A second arm of the lever 243 is engaged at 247 with a spring 248 in turn connected to the lower end of the key shank at 249. This spring serves to hold the trip lever 243 in operative position and with a stop 251 on the third arm of the lever in engagement with an edge or side of the key shank.

The arrangement is such, therefore, that if the key be depressed and held down the return movement of the thrust link after the zeroizing operation will cause the shelf 246 of lever 221 to move or swing the trip lever 243 about its pivot and prevent rearrangement of the parts in normal position until the zeroizing key is released.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages.

I claim:

1. In a key-responsive calculating machine, an accumulator, actuators for said accumulator, means for determining the differential positioning of said actuators, means for driving said actuators, power means, means for connecting said power means and said driving means, said connecting means cooperating with said power means to effect disconnection therefrom at an invariable point in the operative cycle of said driving means.

2. In a calculating machine, a numeral bearing element, an actuator for said numeral bearing element, means for determining the differential positioning of said actuator, means for driving said actuator, power means, means for connecting said power means with said driving means, said connecting means cooperating with said power means to effect disconnection therefrom at an invariable point in the operative cycle of said driving means.

3. In a key-responsive calculating machine, an accumulator, actuators for said accumulator, means for determining the differential positioning of said actuators, means for driving said actuators, power means, means normally ineffective for connecting said power means and said driving means and rendered effective by said determining means, said connecting means cooperating with said power means to effect disconnection therefrom at an invariable point in the operative cycle of said driving means.

4. In a calculating machine having an accumulator mechanism having several denominational orders of numeral wheels and an actuating mechanism for each of said orders interordinally controlling a carry from a lower order while delivering action to its own order wheel; manually manipulative means for determining the differ-

ential actuation of said actuating mechanism, means for driving said actuating mechanism, power means, normally ineffective connecting means between said power means and said driving means rendered effective by said manually manipulative means, said connecting means cooperating with said power means to effect disconnection therefrom after being moved an invariable distance by said power member.

5. In a key-responsive calculating machine, the combination of an accumulator, actuators for said accumulator, power means, means for driving said actuators, a key-control, and devices controlled by said key-control for connecting said power means and said driving means, said devices cooperating with said power means to effect disconnection therefrom at an invariable point in the operative cycle of said driving means.

6. In a key-responsive calculating machine having an accumulator mechanism having several denominational orders of numeral wheels and an actuating mechanism for each of said orders interordinally controlling a carry from a lower order while delivering action to its own order wheel; power driving mechanism for said actuating mechanism, connecting devices between said power mechanism and said actuating mechanism adapted to transmit an invariable increment of power from said power driving mechanism to said actuating mechanism, keys for controlling the digital actuation of said actuating mechanism, and a power trip mechanism actuated by any one of said keys to cause operation of said actuating mechanism by said power mechanism until said invariable increment of power has been transmitted.

7. In a key-responsive calculating machine the combination of an accumulator, actuating mechanism for said accumulator, continuously rotating power driving mechanism for said actuating mechanism, connecting devices between said power mechanism and said actuating mechanism for transmitting power from said power driving mechanism to said actuating mechanism, means urging said connecting devices into ineffective position, keys for controlling the digital actuation of the actuating mechanism, and means actuated by any one of said keys and acting to overcome said urging means to cause operation of said actuating mechanism by said power mechanism.

8. In a key-responsive calculating machine, an accumulator, actuating mechanism for said accumulator, continuously rotating power driving mechanism for said actuating mechanism, normally ineffective connecting devices between said power mechanism and said actuating mechanism for transmitting power from said power driving mechanism to said actuating mechanism, means urging said connecting devices into ineffective position, keys for controlling the digital actuation of the actuating mechanism, and a power trip mechanism actuated by any one of said keys and acting to overcome said urging means to render said connecting means effective.

9. In a calculating machine having an accumulator mechanism having several denominational orders of numeral wheels and an actuating mechanism for each of said orders interordinally controlling a carry from a lower order while delivering action to its own order wheel; continuously rotating power driving mechanism for said actuating mechanism, connecting devices between said power mechanism and said actuating mechanism for transmitting power from said power driving mechanism to said actuating mechanism, means urging said connecting devices into ineffective position, keys for controlling the digital actuation of said actuating mechanism, and a power trip mechanism actuated by any one of said keys and acting to overcome said urging means to cause operation of said actuating mechanism by said power mechanism.

10. In a key-responsive calculating machine, an accumulator, actuating mechanism for said accumulator, power driving mechanism for said actuating mechanism, connecting devices between said power mechanism and said actuating mechanism adapted to transmit an invariable increment of power from said power driving mechanism to said actuating mechanism, means urging said connecting devices into ineffective position, keys for controlling the digital actuation of the actuating mechanism, and a power trip mechanism actuated by any one of said keys and acting to overcome said urging means to cause operation of said actuating mechanism by said power mechanism until said invariable increment of power has been transmitted.

11. In a calculating machine having an accumulator mechanism having several denominational orders of numeral wheels and an actuating mechanism for each of said orders interordinally controlling a carry from a lower order while delivering action to its own order wheel; power driving mechanism for said actuating mechanism, normally ineffective connecting devices between said power mechanism and said actuating mechanism adapted to transmit an invariable increment of power from said power driving mechanism to said actuating mechanism, means urging said connecting devices into ineffective position, keys for controlling the digital actuation of said actuating mechanism, and means actuated by any one of said keys and acting to overcome said urging means to render said connecting means effective until said invariable increment of power has been transmitted.

12. In a key-responsive calculating machine, an accumulator, actuating mechanism for said accumulator, power driving mechanism for said actuating mechanism, connecting devices between said power mechanism and said actuating mechanism adapted to transmit an invariable increment of action from said power driving mechanism to said actuating mechanism, means urging said connecting devices into ineffective position, keys for controlling the digital actuation of said actuating mechanism, and a power trip mechanism actuated by any one of said keys and acting to overcome said urging means to render said connecting means effective, said connecting means cooperating with said power means to effect disconnection therefrom after said invariable increment of action has been transmitted.

13. In a calculating machine having an accumulator mechanism having several denominational orders of numeral wheels and an actuating mechanism for each of said orders interordinally controlling a carry from a lower order while delivering action to its own order wheel; power means, means for driving said actuating mechanism, a key-control, and means controlled by said key-control for connecting said power means and said driving means, said power means cooperating with said connecting means to effect disconnection therefrom after being moved an invariable distance by said power member.

14. In a key-responsive calculating machine,

an accumulator, actuators for said accumulator, power means, means for driving said actuators, means for determining the differential positioning of said actuators including keys, means normally ineffective for connecting said power means and said driving means, and devices controlled by said keys for rendering said connecting means effective, said connecting means cooperating with said power means to effect disconnection therefrom at an invariable point in the operative cycle of said driving means.

15. In a key-responsive calculating machine, an accumulator, actuators for said accumulator, power means, means for driving said actuators, means normally disconnected for connecting said power means and said driving means, and means for controlling said connecting means in the establishment of connection between said power means and said driving means and regulating the differential positioning of said actuators, said connecting means cooperating with said power means to effect disconnection therefrom at an invariable point in the operative cycle of said driving means.

16. In a calculating machine having an accumulator mechanism having several denominational orders of numeral wheels and an actuating mechanism for each of said orders interordinally controlling a carry from a lower order while delivering action to its own order wheel; power means, means for driving said actuating mechanism, normally ineffective means for connecting said driving means and said power means, and key manipulative devices for rendering said connecting means effective and determining the differential actuation of said actuating mechanism, said connecting means cooperating with said power means to effect disconnection therefrom after being moved an invariable distance by said power means.

17. In a key-responsive calculating machine, an accumulator, actuators for said accumulator, means for determining the differential positioning of said actuators, means for driving said actuators to differential positions, power means, means for connecting said power means and said driving means, said connecting means cooperating with said power means to effect disconnection therefrom at an invariable point in the operative cycle of said driving means, and means for returning said actuators to initial position.

18. In a key-responsive calculating machine, the combination of an accumulator, an actuator for said accumulator, means for driving said actuator, a power member adapted to furnish power to actuate said driving means, a device adapted to connect said power member and said driving means, and key-manipulative devices for controlling the differential positioning of said actuator and the operation of said device to connect said power member and said driving means, said connecting device cooperating with said power means to effect disconnection therefrom at an invariable point in the operative cycle of said driving means.

19. In a key-responsive calculating machine, the combination of an accumulator, actuators for said accumulator, means for determining the differential positioning of said actuators, means for driving said actuators, power means, means for connecting said power means and said driving means, said connecting means cooperating with said power means to effect disconnection therefrom after said driving means have been moved an invariable distance by said power means, and devices forming a part of said driving means for compensating for difference of action required in the differential positioning of said actuators and the invariable distance said driving means are moved by said power member.

20. In a calculating machine having an accumulator mechanism having several denominational orders of numeral wheels and an actuating mechanism for each of said orders interordinally controlling a carry from a lower order while delivering action to its own order wheel; means for determining the differential actuation of said actuating mechanism, means for driving said actuating mechanism, power means, manually controlled means for connecting said power means and said driving means, said connecting means cooperating with said power means to effect disconnection therefrom after said driving means has been moved an invariable distance by said power means, and devices forming a part of said driving means to compensate for the difference of action required in the differential actuation of said actuating mechanism and the invariable distance said driving means are moved.

21. In a key-responsive calculating machine, the combination of an accumulator, actuators for said accumulator having varying degrees of digital actuation in calculating movements, means for determining the differential positioning of said actuators, means for driving said actuators, power means, key controlled means for connecting said power means and said driving means, said driving means cooperating with said power means to effect disconnection therefrom after an invariable increment of action has been delivered to the driving means by said power member, and devices forming a part of said driving means to compensate for the action required to move the varying degrees of digital actuation and the invariable increments of action received.

22. In a key-responsive calculating machine, the combination of an accumulator, actuators for said accumulator, power means, means for driving said actuators, normally ineffective means for connecting said driving means and said power means, key manipulative devices for rendering said connecting means effective and determining the differential positioning of said actuators, said connecting means cooperating with said power means to effect disconnection therefrom after said driving means have received a set increment of movement from said power means, and devices forming a part of said driving means for compensating for the action required to move the actuators to differential positions and the set increment of movement imparted by said power means.

23. In a calculating machine, the combination of an accumulator, an actuator for said accumulator having varying degree of digital actuation, means for driving said actuator, a power member, a connecting device to connect said driving means with said power member adapted to deliver a set increment of action to drive said actuator, and a device forming a part of said driving means for compensating for the action required to move the said actuator in said varying degrees of digital actuation and the said set increment of action.

24. In a calculating machine, the combination of an accumulator, an actuator for said accumulator having varying degree of digital actuation, means for driving said actuator, a power member, a connecting device to connect said driving means with said power member and to

deliver a set increment of action to drive said actuator, said connecting device cooperating with said power member to effect disconnection therefrom when the said set increment of action is delivered, and a device forming a part of said driving means for compensating for the action required to move the said actuator in said varying degrees of digital actuation and the said set increment of action.

25. In a calculating machine, the combination of an accumulator, actuators for said accumulator, means for determining the differential positioning of said actuators, means for driving said actuators including a clutch, power means, means for connecting said power means and said driving means, said connecting means cooperating with said power means to effect disconnection therefrom after an invariable increment of movement has been delivered by said power member, said clutch compensating for the action required to differentially position said actuators and the invariable increment of movement delivered by the power member.

26. In a calculating machine, the combination of an accumulator, an actuator for said accumulator having varying degree of digital actuation, means for driving said actuator, a power member, a connecting device to connect said driving means with said power member adapted to deliver a set increment of action to drive said actuator, and a friction clutch forming a part of said driving means for compensating for the action required to move the said actuator in said varying degrees of digital actuation and the said set increment of action.

27. In a calculating machine, the combination of an accumulator, an actuator for said accumulator, means for driving said actuator, a continuously moving power member, a hook device for connecting said power member to said driving means, and means positively holding the hook of said hook connecting device into operative engagement with said power member during a portion only of the power stroke.

28. In a calculating machine, an accumulator, actuators for said accumulator having varying degree of digital actuation, means for driving said actuators, a spring associated with said driving means and arranged to impart the variable adding movements desired, a rotating power member, and means connecting said spring to said rotating power member to store a set and uniform increment of power in said spring for the accomplishment of said variable adding movements.

29. In a calculating machine, the combination of an accumulator, an actuator for said accumulator, means for driving said actuator, a continuously moving power member, a connecting device for connecting said power member to said driving means, and means positively holding said connecting device in operative engagement with said power member at the beginning only of the power stroke.

30. In a calculating machine, the combination of an accumulator, actuators for said accumulator, means for driving said actuators, a continuously moving power member, connecting devices for connecting said power member with said driving means and delivering a set increment of action from said power member to said driving means, and means positively holding said connecting devices in operative engagement with said power member at the beginning only of the power stroke.

31. In a calculating machine, the combination of an accumulator, actuators for said accumulator, means for driving said actuators, a continuously moving power member, key controlled connecting means between said power member and driving means, and a guard element projecting above the path through which said connecting means travels when in full engagement with said power member.

32. In a key-responsive calculating machine, an accumulator, actuators for said accumulator, means for driving said actuators, a continuously moving power member, key controlled connecting means between said power member and driving means, said connecting means including an element normally out of engagement with the continuously moving power member and adapted to be forced into engagement therewith upon actuation of any key, and a guard element projecting above the path through which said element travels when in full engagement with said power member.

33. In a key-responsive calculating machine, the combination of an accumulator, actuators for said accumulator, means for driving said actuators, a continuously moving power member, connecting means between said power member and said driving means, said connecting means including an element under control of any of the keys of a series of keys to engage the power member, and a guard in the path of said element for enforcing full engagement of said element with said power member upon initial engagement of said element with said power member.

34. In a key-responsive calculating machine, the combination of an accumulator, actuators for said accumulator, means for driving said actuators, a continuously moving power member, connecting means between said power member and said driving means, said connecting means including an element normally spring elevated above said power member, means under control of any key for forcing said element into engagement with said power member, said element cooperating with said power member to effect disconnection therefrom at an invariable point in the operative cycle of said driving means, and means for insuring the return of said element subsequent to its release to its normal spring elevated position relatively to the power member.

35. In a key-responsive calculating machine, the combination of an accumulator, actuators for said accumulator, means for driving said actuators, a continuously moving power member, connecting means between said power member and said driving means, said connecting means comprising a key controlled element normally spring elevated above said power member and adapted to be forced into engagement with said power member upon actuation of any key, means in the path of said element for enforcing full initial engagement between said element and the power member, said element cooperating with said power member to effect disconnection therefrom after said element has traveled an invariable distance, and means for enforcing full engagement between the element and power member being operative upon release of said element from the power member for insuring the return of said element to its normal spring elevated position relatively to the power member.

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