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PROVISIONAL SPECIFICATION

No. 36920 A.D. 1938.

Improvements relating to Calculating Machines

I, CHRISTOPHER FREDERICK WEBB, a British Subject, of The Island, Uxbridge, Middlesex, do hereby declare the nature of this invention to be as follows:—

5 This invention relates to calculating machines of the key controlled multiple bank type and has for its object to provide improved means for locking the keys of the machine subsequent to a failure on the part of the operator to depress a key to its full extent.

10 In one manner of carrying the invention into effect the keys of the machine are arranged to move through slots in the usual top plate and each key comprises a key top and stem, the latter being provided with a shoulder and a hole arranged immediately above the shoulder and being shaped at its lower end in the form of a fork. Extending longitudinally below the keys in each line or bank of keys is a main driving bar, the latter being provided with a series of hook-shaped projections equal in number to the keys in the line. The main driving bar is arranged for movement in a vertical plane and its mounting is such that during its vertical movement it also moves longitudinally through a small amount.

30 Below the main driving bar and extending parallel thereto is a stop bar, the latter being associated with the driving bar in such a manner that when the driving bar moves downwardly the stop bar moves longitudinally in a direction towards the front of the machine. The stop bar is formed in its upper side with a series of recesses, one for each key with the exception of key No. 1 and each recess terminates in a vertical abutment surface arranged to contact with a depressed key stem as hereinafter described to limit the depression of the key. The abutment surface for key No. 1 is constituted by the front end of the stop bar. Also the stop bar is formed at its lower side and near its rear end with a tooth engageable by a pawl in the circumstances and for the purpose described below, the end of the pawl

being held under spring influence against the underside of the stop bar.

The figure wheel associated with the line of keys is rotated by a rack member of the kind described and claimed in my 55 co-pending application No. 15977/38 (Serial No. 514,289) and 15978/38 (Serial No. 514,290), the rack receiving movement from the main driving bar through the intermediary of suitable linkages. As 60 described in my co-pending applications aforesaid the rack is normally out of engagement with the pinion associated with the figure wheel and on depression of a key the rack is swung upwardly 65 while remaining out of engagement with the pinion to a preselected position and is moved into mesh with the pinion on the engagement of the lower end of the key with a rotatable bar when the key reaches 70 its fully depressed position, the rack being restored to initial position to rotate the figure wheel when the depressed key is finger released by the operator.

75 With the present construction, when a key is depressed its shoulder aforesaid engages the main driving bar at a position immediately behind the corresponding hook and as the key and driving bar continue to move downwardly the end of the hook enters the hole in the key stem. If the key is depressed to its full extent the rotatable bar aforesaid is actuated by the lower end of the key stem to release 80 the rack which is now in its preselected position, to permit it to move into engagement with the figure wheel pinion, downward movement of the key and driving bar being finally arrested by the engagement of the abutment surface of 85 the corresponding recess in the stop bar with the key stem. The fork shaped end of the key stem is arranged to straddle the stop bar and the abutment surface engages the key stem at a position above 90 the fork. Also when the rotatable bar is engaged by the key stem the pawl is moved into a position wherein it cannot engage the tooth on the underside of the stop bar during return movement of the 100

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latter. When the depressed key is released by the finger the parts of the mechanism restore to their initial positions under the influence of a spring, the rack rotating the figure wheel during such return movement. During restoration of the said parts the pawl is held in the position wherein it cannot engage the tooth aforesaid but when the parts reach their initial positions the pawl is released and re-engages the underside of the stop bar.

If, as sometimes occurs during depression of a key, an adjacent key in the same line is accidentally carried down by the operator's finger, the said adjacent key will be permitted to move freely and will in no way affect the calculation or influence the locking mechanism. This is by reason of the fact that initial depression of the correct key will have moved the driving bar to a position wherein the hook corresponding to the said adjacent key lies below the latter and hence when the adjacent key moves downwardly as a result of the accidental depression its shoulder will ride on the top of the hook and the key stem can never reach a sufficiently depressed position to release the rack. Hence the leading correct key is the only one which will influence the figure wheel.

When a key is incompletely depressed and released the pawl, which will now not have been moved by the rotatable bar, engages in the tooth on the underside of the stop bar during the return movement of the latter, the pawl being thereby moved to release a series of retaining members, one in each line of keys in the machine, to lock the various stop bars against further movement with the sole exception of the bar in the line containing the incompletely depressed key, the said bar being held by the pawl in a position intermediate its extreme positions. Hence therefore all the keys of the machine are locked against further depression with the exception of the keys in the line containing the incompletely depressed key and moreover as the stop bar and therefore the driving bar in this line have not restored to initial position the incorrectly depressed key is held by its corresponding hook on the driving bar in a position below its normal position and is thus immediately identifiable. It will be apparent that as the incorrectly depressed key had not reached the bottom of its stroke the rotatable bar was not actuated to release the rack and hence no rotation of the figure wheel has occurred.

To correct the error the operator now depresses fully the key which had previously been incorrectly actuated and

this has the effect of moving the rotatable bar to release the rack and also withdraw the pawl from the tooth on the underside of the stop bar, the latter then returning towards its initial position on finger release of the key but being prevented from restoring completely by its retaining member which engages the bar to lock the same against further movement. However the stop bar has returned a sufficient distance to permit the rack to rotate the figure wheel and hence the full value of the key has been transmitted to the figure wheel and the error has had no effect on the calculation. As however the stop bar in the line containing the incorrectly depressed key has not completely restored, the said key will be held in a position slightly below its normal position even after the error is corrected. As the stop bar in the line containing the key which was incompletely depressed is now also held against movement all the keys of the machine are now locked against further depression, the keys in the other lines having remained locked during correction of the error.

The retaining members are restored to initial position to release the stop bars and permit depression of the keys, by means of a common bar under the control of a special push button or key. When this button or key is depressed the entire keyboard is unlocked and the key which had been incompletely depressed and which had been held slightly below its normal level now restores to its normal position.

If subsequent to the incomplete depression and the locking of the keys in the other lines in the machine the operator depresses a key, in the line containing the mal-operated key, of a value higher than that of the said latter key, the key of higher value will engage the top of its corresponding hook and depress the driving bar to cause the mal-operated key to be carried down by its hook to release the rack and withdraw the pawl from the tooth on the stop bar, the latter being subsequently permitted, on release of the key depressed, to return towards its initial position but being prevented from fully restoring as previously described. Hence therefore depression of a key of higher value than that of the incompletely depressed key merely serves to transmit to the figure wheel a value corresponding to that of the incompletely depressed key and the effect of depressing the key of higher value is exactly the same as if the incompletely depressed key had been struck.

Depression of a key of lower value than that of the incompletely depressed key

has no effect on the figure wheel by reason of the fact that it engages the top of its corresponding hook during its depression so that the abutment surface of the recess in the stop bar engages the key stem to arrest downward movement of the driving bar before the key reaches its lowermost position. Hence the key is arrested before it is able to actuate the rotatable bar and the rack is not released nor is the pawl withdrawn from the underside of the stop bar, the latter being again arrested by the pawl in the position intermediate its extreme positions when the bar returns after release of the key depressed. Thus the figure wheel is not affected by depressing a key of lower value than the incompletely depressed key and the parts of the mechanism are returned to the positions they occupied prior to such depression.

It will thus be apparent that when a key is incompletely depressed and the keys become locked with the exception of the keys in the line containing the incompletely depressed key no figure other than the missing figure can be added to the machine since depression of keys of lower value than the incompletely depressed key merely leave the mechanism in exactly the same condition as it was before the depression of such keys and keys of higher value merely serve to add the value of the incompletely depressed key.

The invention is not limited to the example above described as subordinate details of construction may be varied to suit different requirements.

Dated the 19th day of December, 1938.

R. H. TANN,

Agent for the Applicant.

PROVISIONAL SPECIFICATION

No. 3196 A.D. 1939.

Improvements relating to Calculating Machines

I, CHRISTOPHER FREDERICK WEBB, a British Subject, of The Island, Uxbridge, Middlesex, do hereby declare the nature of this invention to be as follows:—

This invention relates to calculating machines of the key controlled multiple bank type and is a modification of the calculating machine described in the specification of my co-pending application No. 36920/38 (Serial No. 522,721).

In my said co-pending application I describe a calculating machine in which each line or bank of keys is provided with a main driving bar extending longitudinally below all the keys in the said line or bank, the bar being mounted for downward and rearward movement and being formed with a series of hook-shaped projections each arranged to enter a hole in the stem of the corresponding key on depression of the latter. The arrangement described is such that when a key is incompletely depressed and finger released the main driving bar is prevented from restoring fully to initial position by the arrest of a stop bar associated therewith and the key which has not been fully depressed is retained by its hook on the driving bar in a position below its normal position, no rotation having been communicated to the corresponding figure wheel. Also the keys of the machine become locked with the exception of those in the line containing the incompletely depressed key. Subsequent full depression of the incompletely depressed key or any key of higher value in the same line

or bank then serves to correct the error by recording the value of the incompletely depressed key and the entire keyboard then becomes locked but depression of a key of lower value in the same line has no effect on the mechanism other than to communicate idle movement thereto.

In the calculating machine according to the present invention the incomplete depression of a key causes the locking of all the keys of the machine with the sole exception of that key which was not completely depressed and hence that key and that key alone is capable of subsequent depression to correct the error.

The machine of the present invention is the same in all respects as that described in the specification of my aforesaid co-pending application with the exception of the shape of the hooks on the main driving bar. In the present instance the end of each hook is shaped to form an upper abutment surface and below this surface a projection extending beyond the said surface, the projection being arranged to enter the hole in the key stem when the key is depressed.

If a key is incompletely depressed and released by the finger the stop bar is arrested as described in my aforesaid co-pending application so as to prevent the return of the main driving bar to initial position, the key then being held by the projection below its normal position and retaining members in the remaining lines in the machine being released to lock the keys in the said remaining lines. The

location of the main driving bar when the stop bar is arrested is such that the projections are now in the path of movement of the remaining keys in the line containing the incompletely depressed key and hence when any of these keys is depressed it engages the upper side of the projection on its corresponding hook. Such engagement causes the driving bar to move downwardly a very small distance after which by reason of the rearward movement of the driving bar simultaneously with its downward movement, the abutment surface on the hook above the projection engages the key stem to prevent further depression of the key. The

extremely small depression of the key which has thus been permitted has had no effect on the figure wheel and hence the key may be regarded as having been locked.

Hence, with the construction according to the present modification, incomplete depression of a key causes the locking of the entire keyboard with the single exception of the key which has been mal-operated, a subsequent full depression of this key then serving to lock it also.

Dated the 30th day of January, 1939.

R. H. TANN,
Agent for the Applicant.

COMPLETE SPECIFICATION

Improvements relating to Calculating Machines

I, CHRISTOPHER FREDERICK WEBB, a British Subject, of The Island, Uxbridge, Middlesex, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to calculating machines of the key controlled multiple bank type and has for its object to provide improved means for locking the keys of the machine subsequent to a failure on the part of the operator to depress a key to its full extent.

The invention comprises a calculating machine of the type aforesaid which is so constructed that if a plurality of keys is simultaneously or substantially simultaneously depressed and released and at least one of said keys receives an incomplete depression, all of the said keys are prevented from restoring fully to normal position and all keys except the key or keys incompletely actuated are locked against further depression.

The accompanying drawings show one manner of carrying the invention into effect.

Figure 1 is a perspective view showing part of a calculating machine constructed in accordance with the invention.

Figure 2 is a cross section through the machine showing the mechanism associated with each bank or line of keys, the mechanism being in the "at rest" position and certain parts of the key locking arrangement being omitted.

Figure 3 is a view similar to Fig. 2 but showing the 9 key depressed almost to its fullest extent and the driving rack about to engage the figure wheel pinion.

Figure 4 is a view similar to Figs. 2 and 3 showing the 9 key depressed to its

fullest extent and the driving rack in engagement with the figure wheel pinion.

Figures 5 and 6 are detail cross-sections respectively on the lines V—V and VI—VI Fig. 2.

Figures 7 to 10 show the driving rack at various stages of its operative movement.

Figure 11 is a side elevation showing the mechanism at the rear of each bank or line for causing locking of the keys on a false key stroke, the 9 key being shown in the fully depressed position.

Figure 12 is a view similar to Fig. 11 but showing the parts of the mechanism in the positions which they occupy after an incomplete depression and release of a key.

Figure 13 is a view similar to Figs. 11 and 12 showing the parts in the positions they occupy when a key which has received an incomplete depression is subsequently depressed to its full extent.

Figure 14 is a view similar to Fig. 13 showing in interrupted lines the position to which the key restores after depression to the position shown in Fig. 13 and in full lines its restoration to correct initial position on actuation of a clearing handle.

Figures 15 and 16 are cross-sections respectively on the lines XV—XV and XVI—XVI Fig. 12.

Figures 17 and 18 are respectively a side and rear view of the clearing handle with its associated parts.

Referring to the drawings the calculating machine comprises an outer case having the keys arranged at its upper side. The front of the case is inclined as shown in Fig. 1 and in this front is formed an elongated aperture through which the numbers on the figure wheels 21 can be viewed. In the example shown a facia

strip 22 is provided in the aforesaid aperture the strip 22 being formed with holes for viewing the numbers and having a glass strip covering its outer side. Each bank or line contains 9 keys numbered 1—9, as many lines as desired being provided, and each line is associated with a system of linkages directly operable by any of the keys in the line in question to rotate the figure wheel associated with that line.

A line of keys and associated linkages is illustrated in Figs. 2—4 and as shown each key comprises a stem 23 arranged to slide in a slot in a cover plate 24, the stem being provided with the usual key top 25 and with a shoulder 26 for engaging a driving bar 27 extending longitudinally of the line below all the keys therein. The lower portion of each key stem 23 is guided in a slot in a plate 28 secured to or formed integrally with a frame plate 29 which serves to separate the line from the adjacent line. Each key is also provided as best shown in figures 15 and 16 with a hole 30 situated immediately above the shoulder 26 and is shaped at its lower end to the form of a fork 31 as shown in Fig. 5. Also each key stem is associated with a spring 32 for restoring the key to its normal position after depression, the upward movement of the key being limited by abutment of a second shoulder 33 on the key stem against a part (not shown) at the under side of the top plate 24. When the keys are in their rest positions their lower ends are at the same horizontal level as shown in Fig. 2.

The driving bar 27 is arranged for movement in a vertical plane and is mounted in such a manner that during its vertical movement it also moves longitudinally through a small distance in a rearward direction. In the example shown the bar 27 is pivotally connected at its rear end at 34 to one arm of a bell crank 35 rotatably mounted on a fixed spindle 36 extending transversely through all the lines in the machine. Near its front end the driving bar 27 is supported by a T-shaped member 37 rotatably mounted on a fixed spindle 38 extending parallel to the spindle 36 transversely through the machine, one arm of the T-shaped member 37 being pivotally connected as shown with the bar 27 through the intermediary of a short link 39. The driving bar is also formed as shown clearly in Figs. 2—4 with a series of hook-shaped projections 40, one for each key, each hook being shaped to form an upper abutment surface 41 and below this surface a protuberance 42. The mounting of the bar 27 is such that on depression of a key the bar moves rearwardly through a short distance to cause the appropriate protuberance 42 to move into the hole 30 in the stem of the key depressed, the object of this engagement of the protuberance in the hole being hereinafter explained.

Below the driving bar 27 and extending parallel thereto is a stop bar 43, the latter being pivotally connected at its rear end by means of a pin 44 to the lower arm of the bell crank 35 and being pivotally connected near its front end at 45 to an arm of the T-shaped member 37, also the pin 44 projects beyond the bell crank 35 for a purpose explained below. The arrangement is therefore such that when the driving bar 27 is depressed on actuation of a key the stop bar 43 moves forwardly in a direction towards the figure wheel 21. The keys are so arranged that during the latter part of their downward movement their forked lower ends 31 straddle the stop bar 43. Also the stop bar is formed in its upper side with a series of recesses 46 terminating in vertical abutment surfaces 47 arranged to contact with a depressed key stem as hereinafter described to limit depression of the key and movement of the driving bar 27 and stop bar 43. A recess 46 is provided for each key with the exception of key No. 1, the abutment surface for this key being constituted by the front end of the stop bar. Also the stop bar 43 is formed at its lower side and near its rear end with a tooth 48 engageable by a pawl 49 in the circumstances and for the purpose described below, the pawl 49 being pivotally mounted at its rear end on a pin 50 Figs. 11—14 carried in the upper ends of the arms of a U-piece 51 rotatably mounted on a spindle 52 extending transversely through the machine. The U-piece 51 is also formed with a tail 53 of the shape shown in Figs. 11—14, the rear end of this tail being arranged to abut against the upper side of a bar 54 extending behind all the lines in the machine. The bar 54 is provided with bent ends 55 rotatably mounted on the spindle 52, the bar 54 being subjected to the action of a spring 56 tending to swing the bar in an upward direction. The pawl 49 is also associated with a spring 57 normally tending to hold the front end of the pawl against the underside of the stop bar 43 as shown in interrupted lines in Fig. 2.

Pivotally mounted on a spindle 58 extending completely through the machine is a bell crank 59 having the end 60 of one arm shaped to the form shown in Figs. 11—14, the end 61 of its other arm being bent at right angles to the said

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arm. This bell crank is associated with a spring 62 tending to rotate the bell crank in a counter-clockwise direction as viewed in Figs. 11—14 and normally the bell crank is located in the position shown in Fig. 11 with its end 60 abutting against the front side of the bar 54. Also extending completely through the machine at the rear of each line therein is a releasing bar 63 pivotally mounted by means of its in-turned ends 64 on the spindle 52, one end 64 being provided with a handle 65, Figs. 1, 17, and 18, projecting through a slot 66 in the casework 20 of the machine, actuation of the handle 65 serving to swing the bar 63 in a counter-clockwise direction as viewed in Figs. 11—14 to move the same into engagement with the lower arm of the bell crank 59, for the purpose hereinafter described.

It will be understood that the bell crank 59 and the pawl 49 and its associated parts above described are reproduced in each line in the same way as are the driving bar 27, stop bar 43 and their associated parts.

The figure wheel 21 is rotated on actuation of a key by a rack 67 having 10 teeth adapted to engage and rotate a 10-tooth pinion 68 connected to the figure wheel. The rack 67 is formed at the front end of an arm 69 rotatably mounted at its rear end on a pin 70 carried in the lower ends of the arms of an inverted U-piece 71 rotatably mounted near its upper end on a spindle 72 extending completely through the machine. The arm 69 is formed near its front end with an open ended slot 73 of the configuration shown in which engages a roller 74 carried at the lower end of a part 75 pivotally mounted at its upper end on a spindle 76 extending transversely through the machine. The part 75 is connected by a link 77 with an arm of the T-shaped member 37, the arrangement being such that rotation of the T-shaped member in a clockwise direction around its spindle 38 serves to swing the part 75 in a counter-clockwise direction around its spindle 76 to cause the roller 74 to move into the slot 73 to swing the arm 69 in an upward direction. In the position of rest shown in Fig. 2, the location of the U-part 71 is such that the rack 67 is held away from the teeth of the pinion 68 and can be swung through an angle into the position shown in Fig. 3 without influencing the pinion.

Extending longitudinally of the line below all the keys therein is a bar 78 mounted for rotation about its longitudinal axis, the bar being provided with a number of laterally projecting parts 79

one of which is arranged directly below each key stem so as to be engageable by the latter during its downward movement. As illustrated in Figs. 2—4 the bar 78 is not arranged parallel to the driving bar 27 and the stop bar 43 but is inclined thereto the distance between the lower end of the stem of key No. 1 and the projection 79 situated below that key being a minimum and the corresponding distance for key No. 9 being a maximum. When a key is depressed the distance moved by the driving bar 27 and the stop bar 43 and hence the angle through which the rack 67 is swung before the lower end of the key stem engages its corresponding projection 79 will thus vary for each key. The bar 78 is associated with a spring 80 tending to rotate the bar in a direction to move the projections 79 in an upward direction. Also the bar is formed near its rear end with a projection 81 arranged to overlie the pawl 49 and to engage and depress the same under the conditions hereinafter described.

One arm of the inverted U-part 71 is formed with a right-angular shaped slot 82 as clearly shown in Figs. 7—10 and into this slot projects a part 83 secured to or formed integrally with the bar 78. The U-part 71 is also formed with a tail piece 84 to the end of which is secured one end of a spring 85, the other end of which is secured to a hook piece 86 carried on the pin 45 which serves to connect the lower arm of the T-shaped member 37 to the stop bar 43. The anchorages of the spring 85 are arranged as shown in the drawing with respect to the points of pivotation 38 and 72 for the purpose hereinafter described. Also the stop bar 43 is provided with a pin 87 arranged to engage the tail 84 under the conditions explained below.

The operation of the mechanism is as follows:—

Normally the parts occupy the positions shown in Fig. 2 with the projection 83 lying in the vertical arm of the slot 82 the rack 67 being held in its lowermost position and away from the pinion 68; also the roller 74 is located at the front end of the slot 73. Additionally the front end of the pawl 49 is engaging the underside of the stop bar 43 and the end of the tail 53 is resting on the upper side of the bar 54 with the end 60 of the bell crank 59 abutting against the front side of the said bar as shown in Fig. 11.

When a key, for example the 9 key, is depressed its shoulder 26 engages the driving bar 27 to move the latter downwardly and the stop bar 43 longitudinally

in a forward direction, the rearward motion of the driving bar 27 which also occurs serving to engage the protuberance 42 on the hook 40 corresponding to the 9
 5 key in the hole 30 in the stem of the said key. Immediately before the lower end of the key stem engages its corresponding projection 79 on the bar 78 the parts occupy the positions shown in Fig. 3, the
 10 rack having been swung in an upward direction while remaining out of engagement with the pinion 68 and the spring 85 being now in an extended condition by reason of the forward movement of the
 15 hook 86, the tail 84 and U-part 71 being retained in their original positions by the engagement of the part 83 in the vertical arm of the slot 82. Also the end of the pawl 49 still abuts against the underside
 20 of the stop bar 43, the tooth 48 on the stop bar having passed over the end of the pawl during forward movement of the bar.

At the completion of the downward
 25 stroke of the key the lower end of the stem engages its projection 79 to rotate the bar 78 in a direction to move the part 83 downwardly out of the upper end of the vertical arm of the slot 82, the U-
 30 part 71 being thereupon released and being swung in a clockwise direction through a small angle by the spring 85 acting through the tail 84 to move the rack 67 into engagement with the pinion
 35 68. The depth of engagement of the teeth of the rack with those of the pinion is limited by abutment of the rear end of the slot 82 against the part 83, and the parts now occupy the positions shown in
 40 Fig. 4. Rotation of the bar 78 by the key stem also causes the projection 81 to engage the pawl 49 and depress the same away from the stop bar 43, the engagement of the pawl by the projection 81
 45 serving merely to rotate the pawl about its pivot 50 without influencing the remaining parts of the locking mechanism.

When the key is released the spring 85
 50 acts to rotate the T-member 37 in a counter-clockwise direction to swing the rack 67 through the various stages shown in Figs. 7—10, the rack remaining in engagement with the pinion and thus
 55 rotating the figure wheel during its return stroke. The figure wheel is therefore rotated during the up-stroke of the key. After the rack reaches the bottom of its stroke as shown in full lines in
 60 Fig. 10, the pin 87 carried by the stop bar 43, which latter has been moving in a rearward direction during the return stroke of the rack, engages the tail 84 as shown in interrupted lines in Fig. 4 to
 65 restore the U-part 71 to its original posi-

tion, such return of the U-part 71 serving to withdraw the rack 67 from the pinion 68 and the spring 80 serving to rotate the bar 78 to reposition the part 83
 70 in the upper end of the vertical arm of the slot 82. Restoration of the U-part 71 through engagement of the tail 84 by the pin 87 is effected by reason of the fact that the force tending to move the bar 43
 75 in a rearward direction is greater than the force exerted by the spring 85 on the tail 84, this difference in the opposing forces being achieved by the arrangement shown in the drawings of the dimensions and disposition of the parts concerned
 80 and of the anchorages of the front and rear ends of the spring 85. Resetting of the bar 78 also permits the pawl 49 to spring upwardly into engagement with the underside of the stop bar 46, the end
 85 of the pawl engaging such underside at a position in front of the tooth 48. The parts have therefore once again assumed the positions shown in Fig. 2.

As previously explained and as will be
 90 apparent from the foregoing the angle through which the rack 67 is swung before it is moved into engagement with the pinion, and therefore the angle through
 95 which the figure wheel is rotated during the return stroke of the rack, will vary according to the key depressed. In effect each key serves to pre-select the rack through a predetermined distance before
 100 moving it into engagement with the pinion and the parts are so arranged that actuation of the first key rotates the figure wheel through an angle of 36° , the second key 72° , and so on up to the ninth key
 105 which rotates the figure wheel through an angle of 324° .

Also the arrangement is such that the angular velocity of the figure wheel is reduced to zero or substantially to zero by suitable deceleration of the rack before
 110 the latter disengages the pinion. This has the effect of preventing over-throw of the wheel, the latter in the present instance being brought to rest in its correct position before it is freed by the
 115 rack. The rack is decelerated towards the end of its stroke by shaping the slot 73 to the configuration shown in the drawings, such a shape of the slot causing the rack to be accelerated during the initial
 120 stages of its return stroke but when the roller 74 reaches approximately the position shown in Fig. 9 the rack commences to decelerate until eventually it comes to rest momentarily in the position shown in
 125 full lines in Fig. 10. The rack reaches this latter position immediately before the pin 87 engages the tail 84 so that the rack is moved out of engagement with the pinion 68 only after the latter, and there-
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fore the figure wheel 21, has been brought to rest.

If desired the roller 74 may be replaced by a pair of rollers or pins at the end of the part 75 arranged to move along opposite sides of a bar or the like formed integrally with the arm 69, such bar or the like being shaped to produce the effect provided by the roller 74 and slot 73.

If the operator fails inadvertently to depress a key to its fullest extent the key stem does not engage its corresponding projection 79 on the bar 78 and the rack 67 is therefore not released into engagement with the pinion. The bar 78 does not therefore cause the pawl 49 to be moved away from the stop bar 43 and hence when the key is released and the stop bar 43 starts to move rearwardly the pawl 49 is engaged by the tooth 48 as shown in Fig. 12 and is moved bodily in a rearward direction to swing the part 51 in a clockwise direction around its pivot 52 into the position shown in Fig. 12, the tail 53 depressing the bar 54 against the influence of its spring 56 into contact with a stop edge 90 and the parts coming to rest with the stop bar 43 held against further rearward movement and away from its normal rest position. As the driving bar 27, has failed to return to initial position the key which has been depressed is unable to restore fully owing to the engagement of the appropriate protuberance 42 in the hole 30 in the key stem, the key being held in the position indicated in full lines in Fig. 12. In the latter figure the normal rest position of the key is shown in interrupted lines and the lowest position to which the key was depressed during the false key stroke is also shown in interrupted lines.

As will be clearly apparent from Fig. 12 if an attempt is now made to depress another key in the line containing the incompletely depressed key the shoulder 26 of the said other key will engage the upper side of its corresponding protuberance 42 and will move the driving bar 27 downwardly an extremely small amount only, the abutment surface 41 above the said protuberance 42 engaging the key stem of the other key after a very small downward movement of the driving bar 27 by reason of the rearward movement of the bar. Such abutment of the surface 41 against the key stem will therefore serve to prevent downward movement of the said other key so that to all intents and purposes the said other key can be regarded as locked. Hence therefore after a key has been incompletely depressed and released the remaining keys in the line containing that key are locked against depression.

Also movement of the bar 54 downwardly from the position shown in Fig. 11 to that shown in Fig. 12 will permit the bell crank 59 to be swung in a counterclockwise direction by its spring 62, such movement of the bell crank serving to move the bent end 61 into a position behind the pin 44 at the rear end of the stop bar 43. Such movement of the bell crank 59 is limited by abutment of its lower arm against the release bar 63. Downward movement of the bar 54 also however serves to release the bell cranks 59 in all the remaining lines of the machine and each of these bell cranks rotates into a position wherein its bent end 61 lies in front of the pin 44 on the corresponding stop bar 43 so as to hold the stop bar against forward movement; hence therefore all the keys in the remaining lines in the machine are locked against depression. Thus failure of the operator to depress a key to its fullest extent results in the locking up against further movement of the entire keyboard with the exception of that particular key which was incorrectly actuated. Additionally the top of the key in question is held at a position below that which it normally occupies so that the key is capable of immediate visual identification.

After the false stroke the key can then be depressed to its full extent and released, this serving to record the correct figure on the figure wheel. Full depression of the key to the position shown in full lines in Fig. 13 will now cause the bar 78 to be actuated to release the rack 67 into engagement with the pinion 68 and also to move the pawl 49 out of engagement with the underside of the stop bar 43. When the key is released subsequent to the full depression the rack 67 is swung in a downward direction to rotate the figure wheel and the stop bar 43 moves rearwardly until it is arrested by engagement of its pin 44 against the bent end 61 of the bell crank lever 59 as shown in dotted lines in Fig. 13. Such arrest of the stop bar 43 occurs immediately before the pin 87 is due to engage the tail 84 and therefore when the stop bar is arrested the rack 67 is still in engagement with the pinion 68 although it has completed rotation of the same. Hence any other attempt to depress the key will tend to rotate the pinion in a direction opposite to that in which it is rotated during the normal operative stroke of the rack and as this pinion is associated with the usual non-return pawl (not shown) no further downward movement of the key is permitted and therefore the entire keyboard is now locked. However, as the

stop bar 43 in the line containing the incompletely depressed key is not fully restored to normal position the said key will again be retained on its release in a position below its normal position by reason of the engagement of the appropriate protuberance 42 in the hole 30 in its key stem.

It will be apparent that the false stroke has had no influence on the calculation since the rack was not moved into engagement with the pinion on release of the key subsequent to the false stroke; hence the subsequent correct depression of the key on which the false stroke was made will bring the calculation to exactly the same condition as if the false stroke had never occurred.

The keys of the machine are unlocked after correction of the error and to permit the calculation to be proceeded with, by actuating the handle 65 in a forward direction, such actuation serving to move the bar 63 to rotate the bell cranks 59 in a clockwise direction as viewed in Figs. 11-14. Such movement of the bell cranks will now permit the bar 54 to be restored to its original position under the influence of its spring 56 and furthermore the stop bar 43 which has been held out of its rest position is now permitted to return to such position so as to permit restoration to its original position of the key which was incorrectly depressed. The machine is now in a condition wherein the calculation can be proceeded with, the error having been corrected without the necessity of zeroising the figure-wheel and starting the calculation afresh.

The foregoing describes the effect produced by the incomplete depression of a single key, this key being the only one of the keyboard which is actuated. If, however, a plurality of keys is actuated simultaneously, one of which does not receive a full depression, all the keys which were actuated, including not only the key on which the false stroke was made but also the remaining keys which were fully depressed, are prevented on their release from fully restoring to their initial positions. This result is achieved by reason of the fact that the faulty key stroke serves, as previously described, to move the bar 54 downwardly to release the bell cranks 59 in all the lines in the machine which bell cranks thereupon swing in a counterclockwise direction and as this swinging movement is completed before the full restoration of the stop bars 43 in the lines containing the correctly depressed keys, the pins 44 on each of said stop bars are obstructed by the corresponding bent ends 61 of the bell cranks to prevent full restoration of the driving

bars. The latter are held in a position wherein their respective racks 67 have rotated the pinions 68 through the correct amounts but have not become disengaged therefrom so that the keys in the lines containing the correctly depressed keys become locked since any attempt to depress these keys will tend to rotate the pinions 68 in a counterclockwise direction which will be prevented by the non-return pawls aforementioned. As however the stop bars 43 in the lines containing the said correctly depressed keys have not completely restored to initial position each of the said keys is also prevented from being fully restored and the entire combination of keys which produced the faulty key becomes immediately apparent from a visual inspection of the keyboard. It will be apparent that the keys in the lines in which no key was depressed are also held locked by reason of the location of the bent ends 61 in front of the pins 44 so that in effect all the keys of the machine are locked with the exception of the incompletely depressed key.

If now the handle 65 is actuated the bell cranks 59 are swung in a clockwise direction and in all those lines in which the keys were properly depressed the stop bar 43 is permitted to restore to initial position thus allowing the key in that line to rise into its normal position. However the stop bar 43 in the line containing the incompletely depressed key will not be permitted to restore to initial position because of its engagement by the pawl 49 and hence actuation of the handle 65 will not affect the position of the key which received the false stroke. Hence therefore when a plurality of keys is simultaneously or substantially simultaneously depressed and released and one of these keys receives an incomplete depression all the said keys will fail to restore completely and if subsequently the handle 65 is actuated the keys which did receive a complete depression will restore to initial position while that key which was incorrectly actuated will remain in a depressed condition.

The above feature is of great advantage to the operator who is not only immediately notified of a false stroke by the locking up of the keyboard but can also see immediately the precise combination of keys during which the false stroke occurred. By subsequent actuation of the handle 65 the operator can then eliminate those keys which were completely actuated and correct the calculation by merely completely depressing the key which remains depressed after actuation of the handle 65. The feature of preventing the full restoration of not only the

key which received the false depression but also of the other keys which were actuated simultaneously avoids the operator having to remember the particular amount added into the machine when the fault occurred and this in practice is found to be of great utility as the operator may have moved her fingers on to another combination of keys or may have had her attention distracted between the making of the error and its discovery by a subsequent attempt to add in another amount. In machines now in use, if, as frequently occurs in practice, the operator is not sure of the precise combination of figures at which the error occurred the machine has to be zeroised and the calculation started afresh.

After the error has been corrected by depression of the key which was incorrectly actuated the calculation may be proceeded with as hereinbefore described after a further actuation of the handle 65 without the necessity of zeroising the machine.

It will be apparent that if during depression of a plurality of keys two or more fail to receive a complete depression all the latter keys will remain in a depressed condition after actuation of the handle 65 so as to enable the operator to detect the faulty keys and correct the calculation by a full depression of each. A subsequent further actuation of the handle 65 will then enable the calculation to be proceeded with.

In calculating machines which are intended for operation at high speed it sometimes occurs that during depression of a key an adjacent key in the same line, for example the key immediately below the key depressed, is accidentally touched and moved by the operator's finger and it is necessary that the machine should be so constructed that such accidental movement of the other key shall in no way affect the calculation. It will be apparent that the present machine complies with this requirement since initial depression of the correct key will have moved the driving bar 27 to a position wherein the hook 40 corresponding to the adjacent key which is accidentally touched lies below the said key and hence when the adjacent key moves downwardly as a result of the accidental depression its shoulder 26 will ride on the top of the hook and its key stem can therefore never reach a sufficiently depressed position to release the rack. Hence the leading correct key is the only one which will influence the figure wheel.

The invention is not limited to the example described as subordinate details

of construction may be varied to suit individual requirements. For example instead of providing the holes 30 in the key stems they may be formed in projections on the bar 27 and arranged to co-operate with projections on the key stems.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A calculating machine of the key controlled multiple bank type characterised in that if a plurality of keys is simultaneously or substantially simultaneously depressed and released and at least one of said keys receives an incomplete depression, all the said plurality of keys are prevented from restoring fully to normal position and all the keys in the machine with the exception of the key or keys incompletely actuated are locked against further depression.

2. A calculating machine as claimed in Claim 1 in which actuation of a part subsequent to the simultaneous depression and release of a plurality of keys at least one of which fails to receive a full depression, serves to permit the restoration to initial position of those keys which were completely depressed so as to enable visual identification of the key or keys which received a false stroke.

3. A calculating machine as claimed in Claim 1 in which each line of keys is associated with a member extending longitudinally below the keys in the line, depression of a plurality of keys each in a different line causing movement of the corresponding members and in the event of a key not receiving a full depression the member in the line containing that key being arrested before it fully restores, such arrest serving to release a series of parts one in each of the remaining lines of the machine which parts serve to prevent the full restoration of the members corresponding to the remaining keys actuated even though the said remaining keys may have received a full depression, the keys being so related to the said members that in the event of a member being prevented from fully restoring the key which caused movement of that member is retained in a position below its normal position.

4. A calculating machine as claimed in Claim 3 in which the said parts comprise hooked shaped members engageable with projections near one end of the said members, the said hooks being arranged in the event of a false stroke to move into position behind the projections on the members in those lines in which keys

other than that which received the false stroke, were actuated to prevent full restoration of those members, and the said hooks moving in front of the projections on the members in the lines in which no keys were actuated so as to hold the said members and their corresponding keys against movement.

5. A calculating machine as claimed in Claim 3 and in which each line includes a movable rack releasable at the end of its stroke from a corresponding pinion characterised in that when the members in those lines in which keys, other than that which received the false stroke, were actuated, are arrested out of their initial positions the corresponding racks, to which the members are connected, have completed their rotation of the pinions but have not been disengaged therefrom so that the members are held against movement by their keys which latter are therefore in effect locked.

6. A calculating machine as claimed in Claim 3 in which the longitudinal member is associated with a bar or the like engageable by all the keys in the line and provided with a series of projections one for each key, depression of the bar or the like by actuation of a key causing the appropriate projection to engage in a hole or recess in the key actuated and subsequent arrest of the longitudinal member out of its normal position serving to retain the said actuated key below its normal level by virtue of the engagement

of the appropriate projection on the bar in the hole or recess in the key.

7. A calculating machine as claimed in Claim 6 in which each projection is so shaped that when the bar or the like is held out of its normal position as the result of the arrest of the longitudinal member due to the incomplete depression of a key, so that the projections corresponding to the remaining keys in the line now lie directly below the said remaining keys, downward movement of any one of the said remaining keys is arrested immediately after it engages its corresponding projection.

8. A calculating machine as claimed in Claim 7 in which each projection comprises a protuberance and an upper abutment surface, the said protuberance being arranged to engage in the hole or recess in the depressed key and the arrangement being such that when a further key in the same line is depressed it engages the upper side of the protuberance to cause the abutment surface aforesaid to move into contact with the said further key and arrest downward movement of the latter.

9. A calculating machine comprising the combination and arrangement of parts substantially as described and illustrated in the accompanying drawings.

Dated this 4th day of October, 1939.

R. H. TANN,
Agent for the Applicant.

Fig. 1.

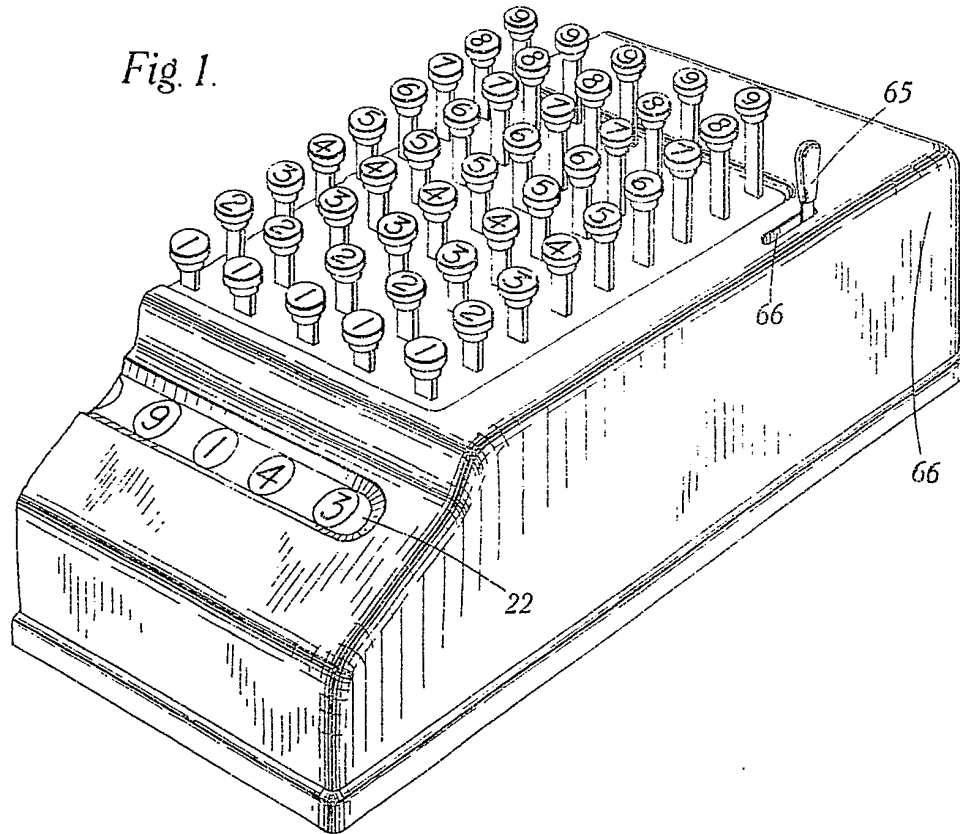


Fig. 17.

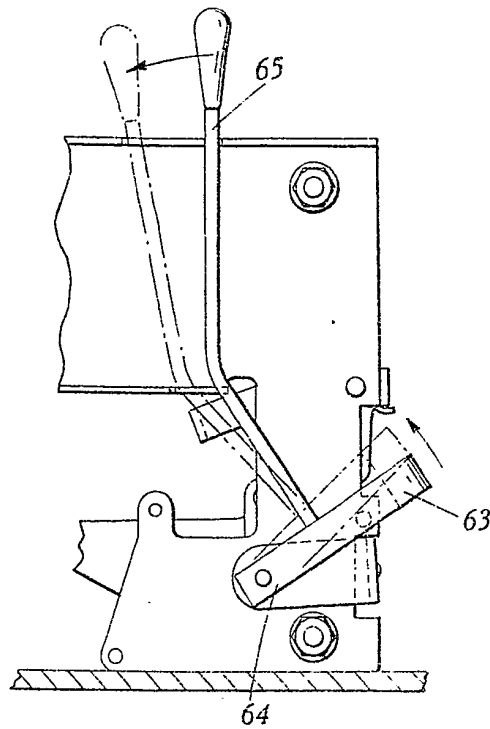
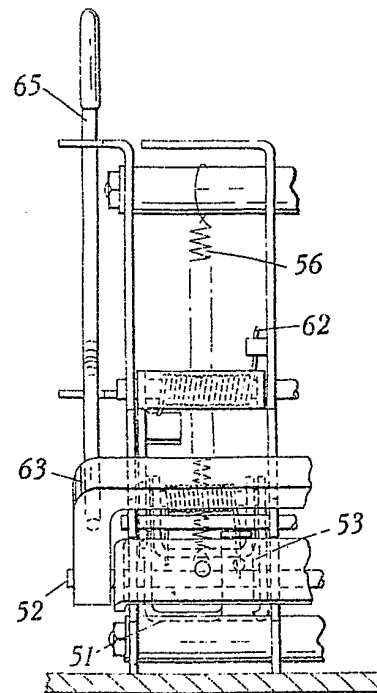


Fig. 18.



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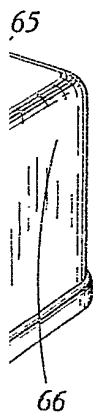


Fig. 7.

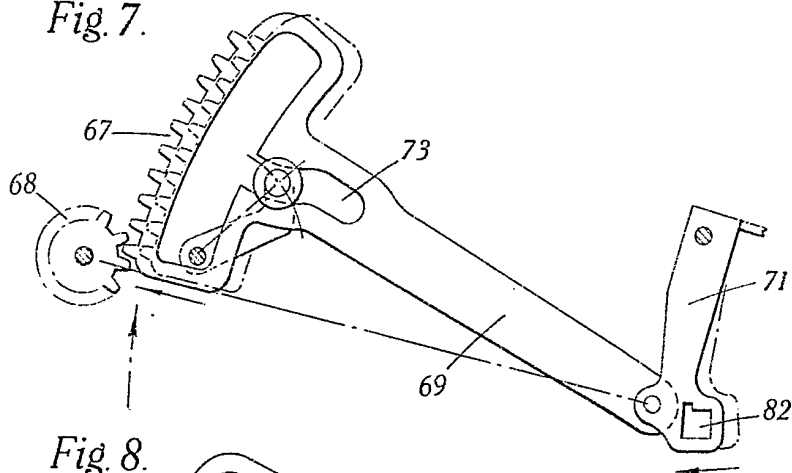


Fig. 8.

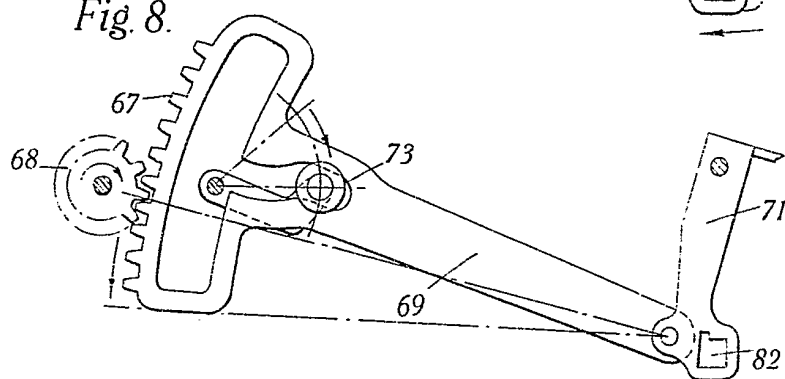


Fig. 9.

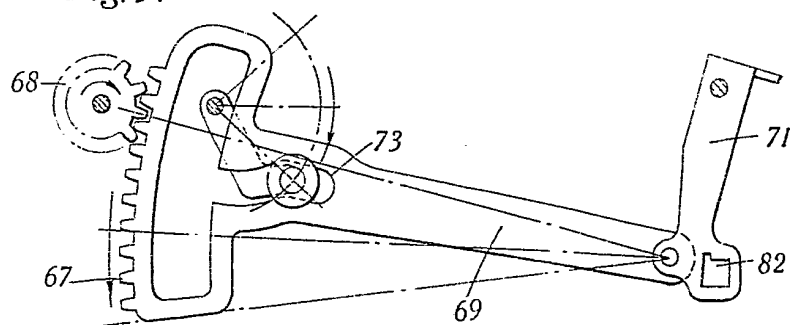
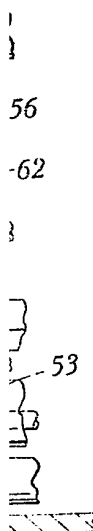
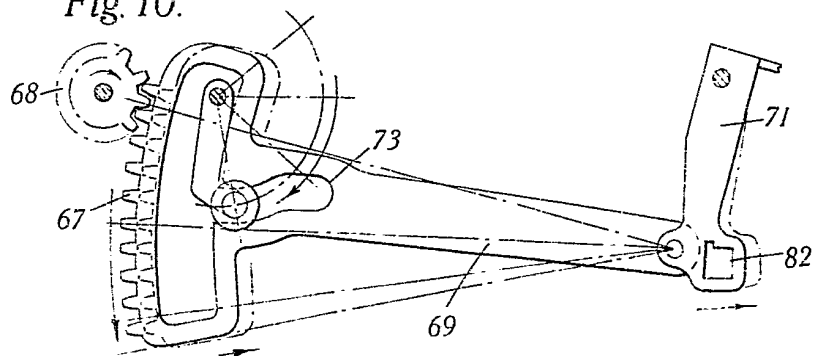


Fig. 10.



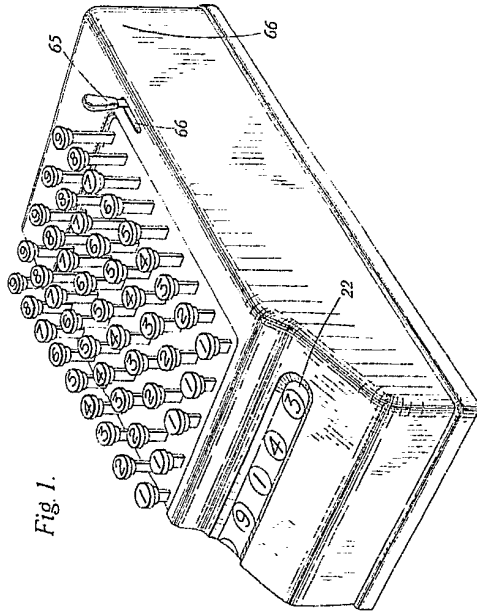


Fig. 17.

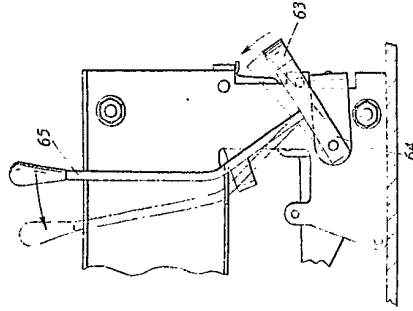


Fig. 18.

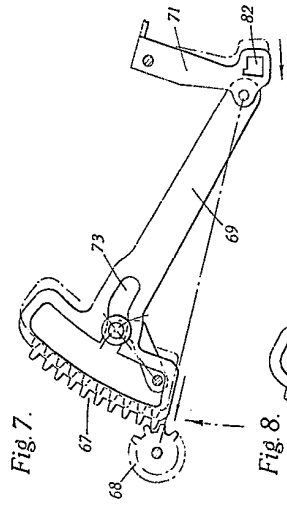
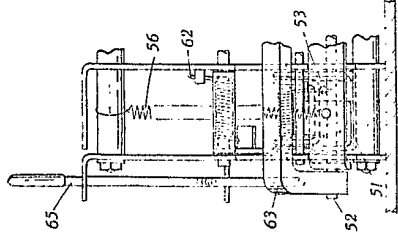


Fig. 8.

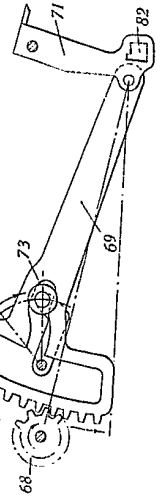


Fig. 9.

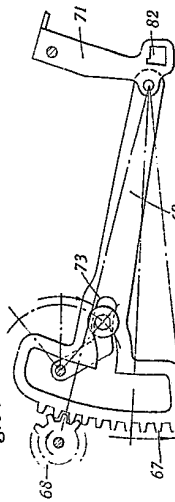
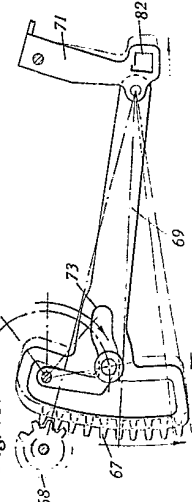


Fig. 10.



[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 2.

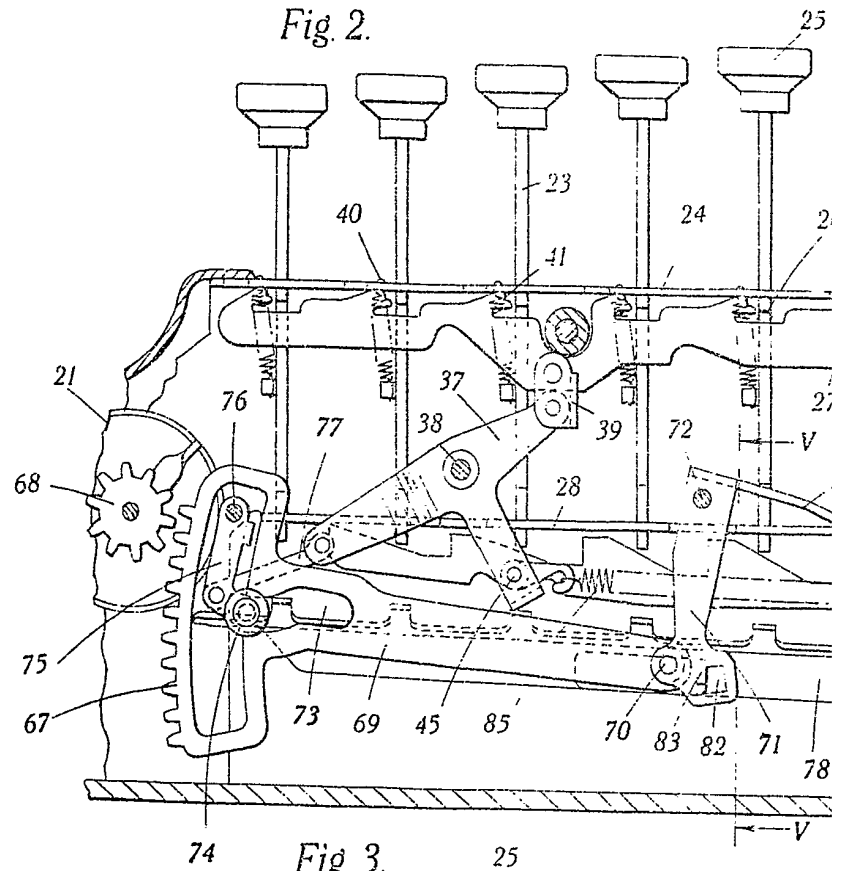
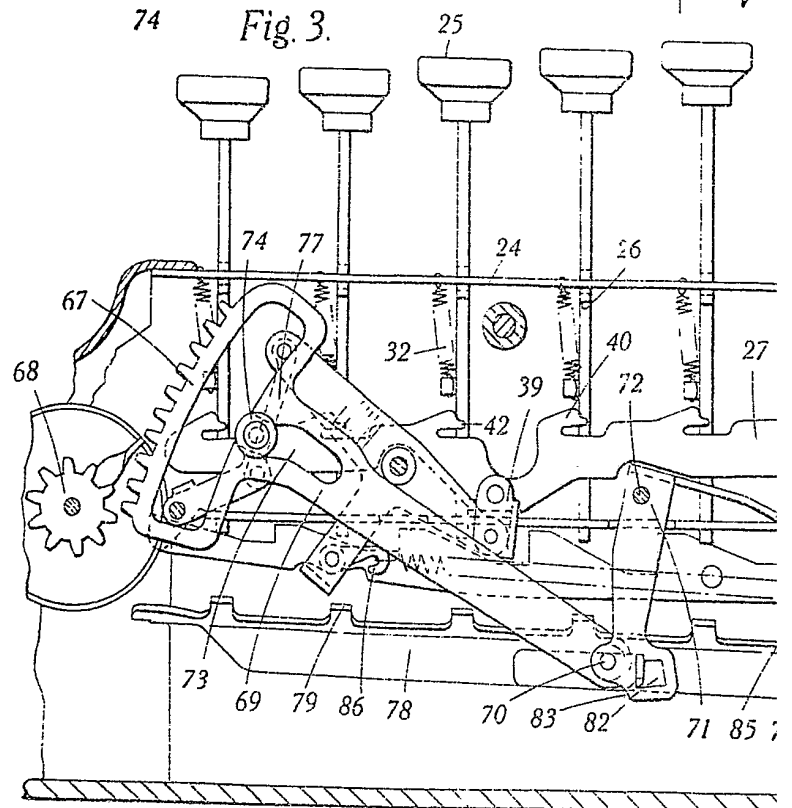
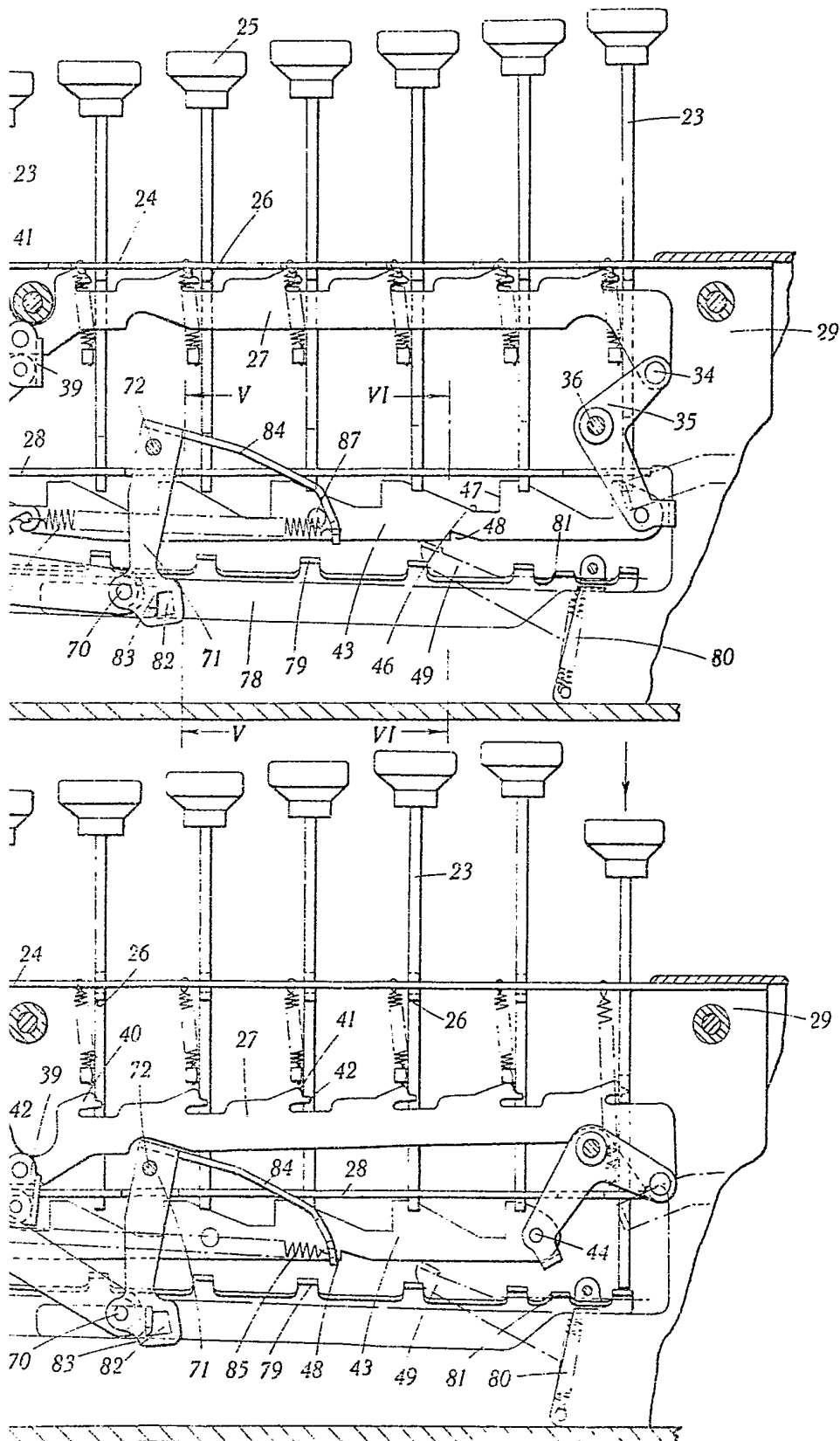


Fig. 3.



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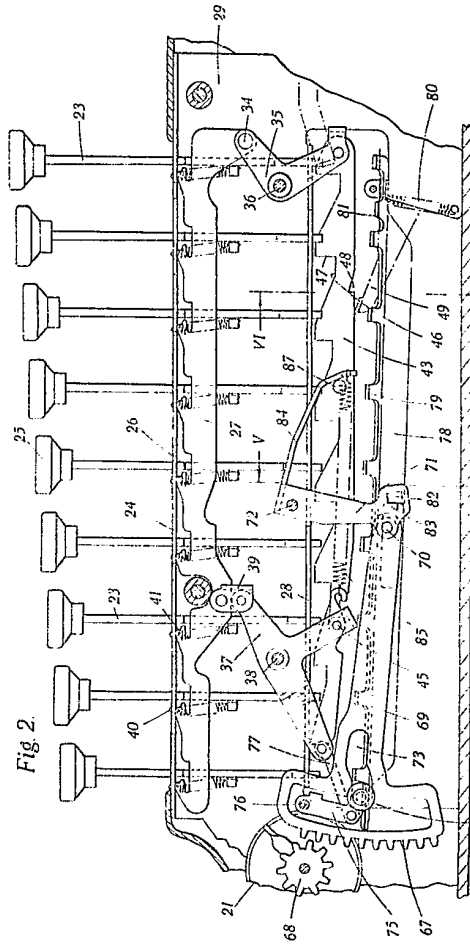


Fig. 2.

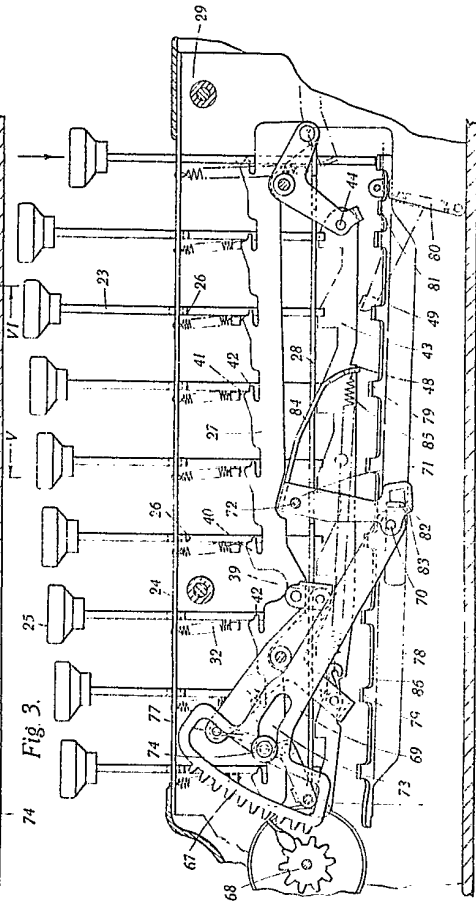


Fig. 3.

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Fig. 4.

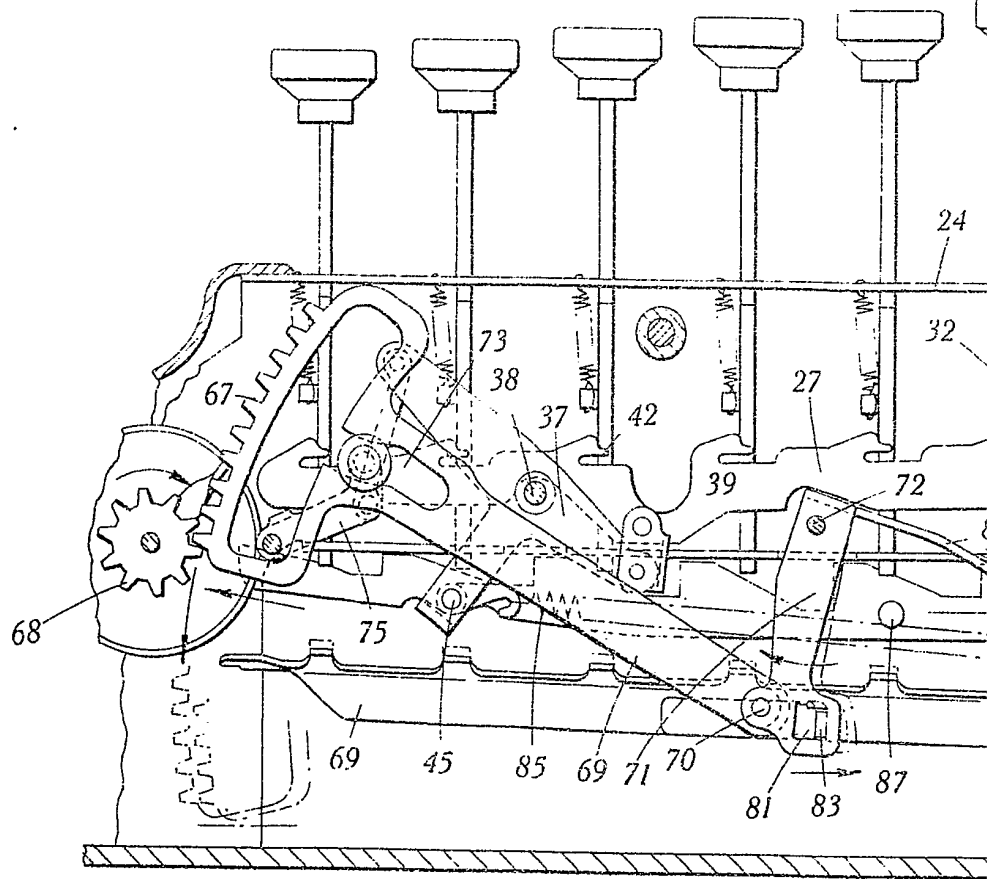
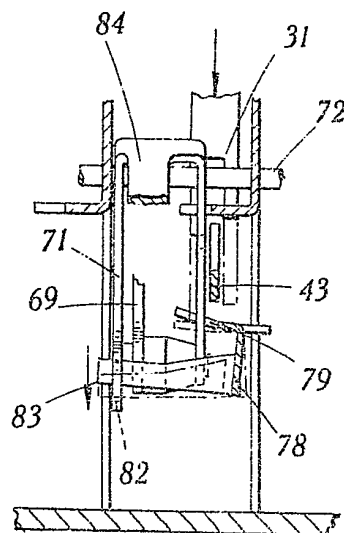


Fig. 5.



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Fig. 4.

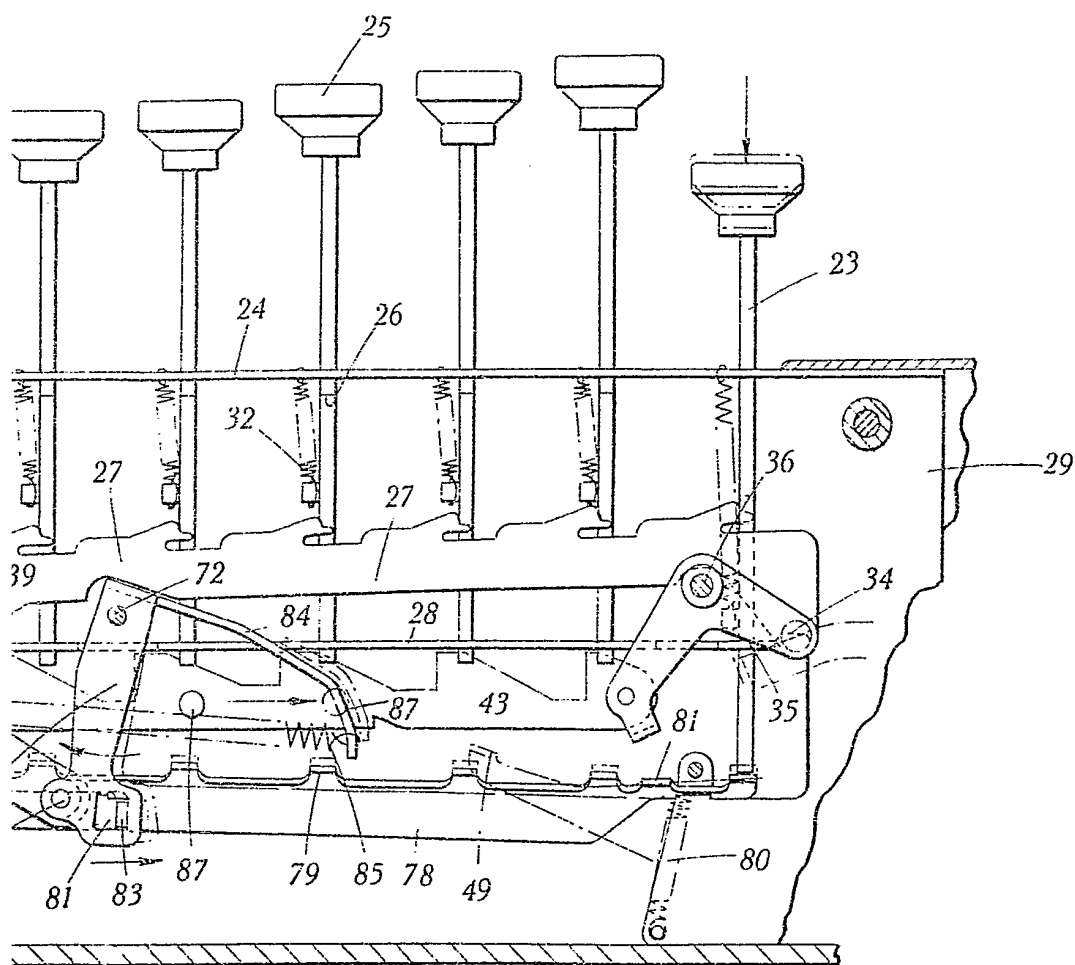


Fig. 6.

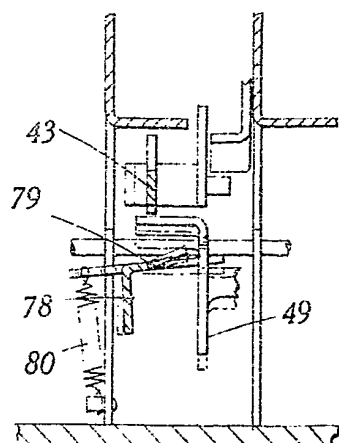


Fig 4.

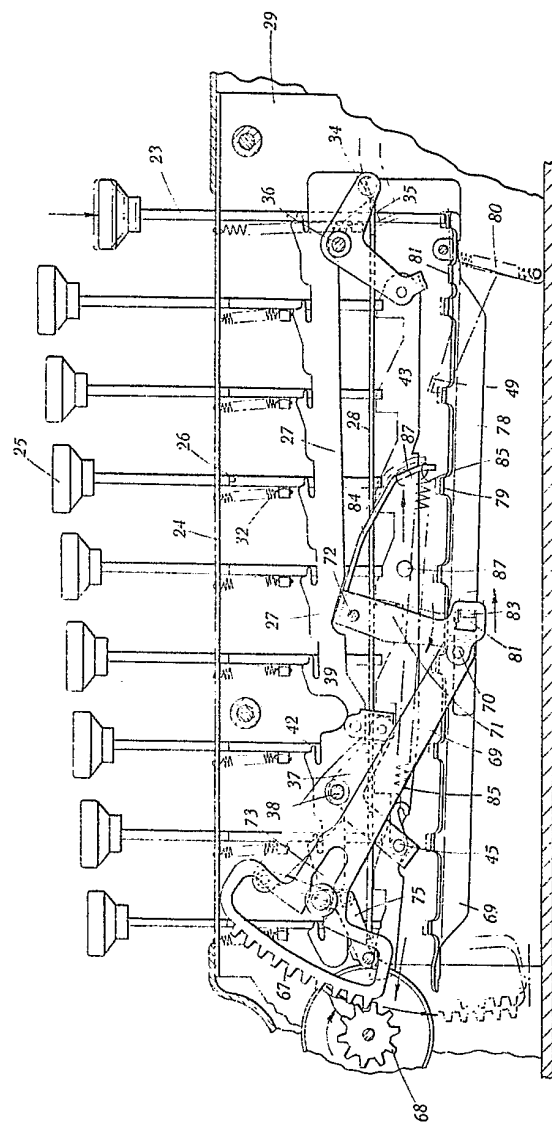


Fig 5.

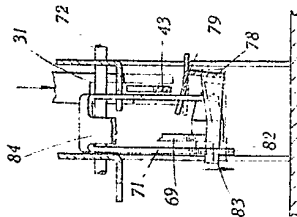
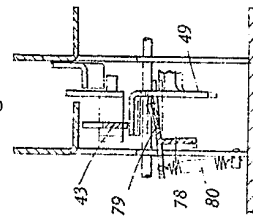


Fig 6.



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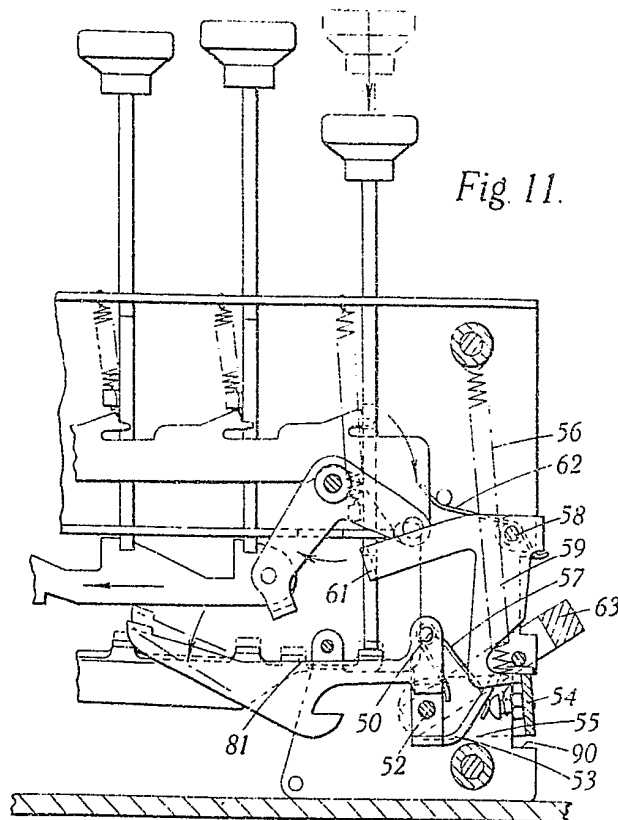


Fig. 11.

Fig. 15.

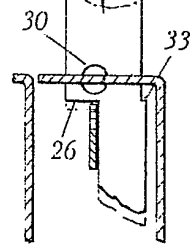


Fig. 12

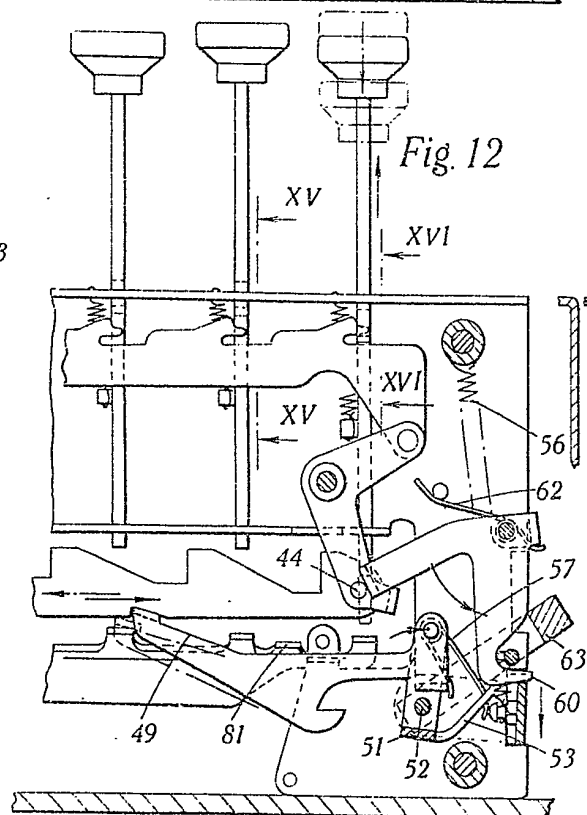
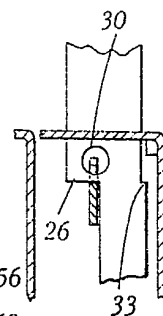
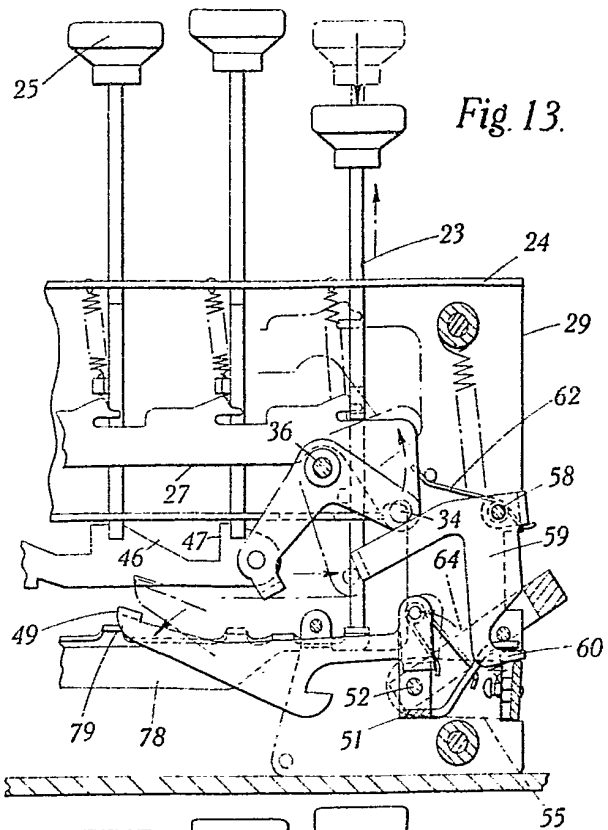
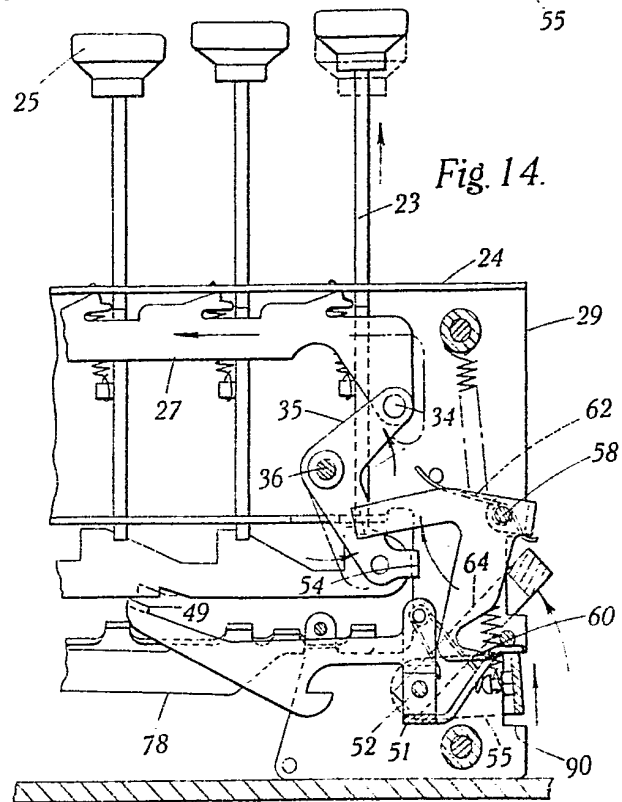
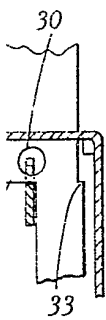


Fig. 16.



*Fig. 16.*

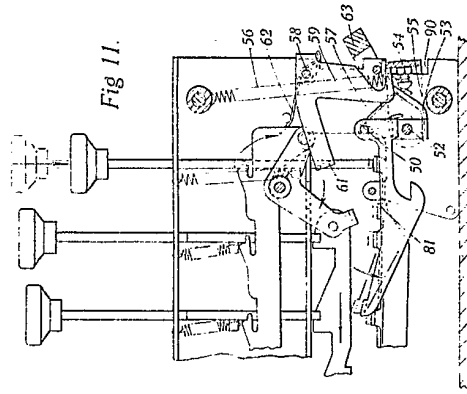


Fig. 11.

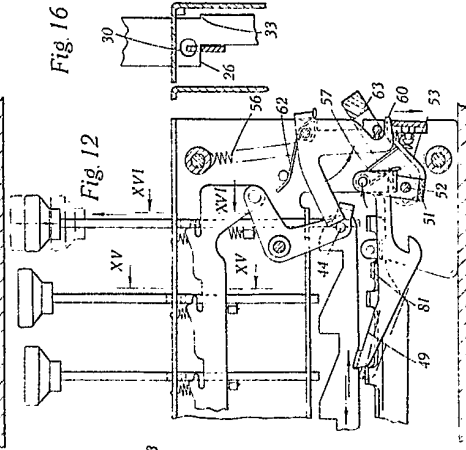


Fig. 12.

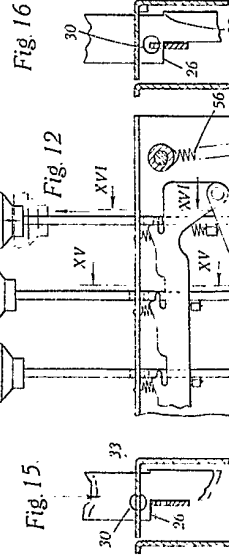


Fig. 15.

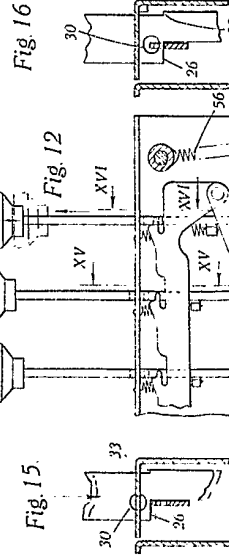


Fig. 16.

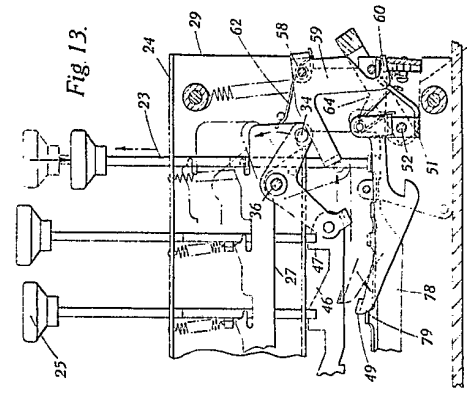


Fig. 13.

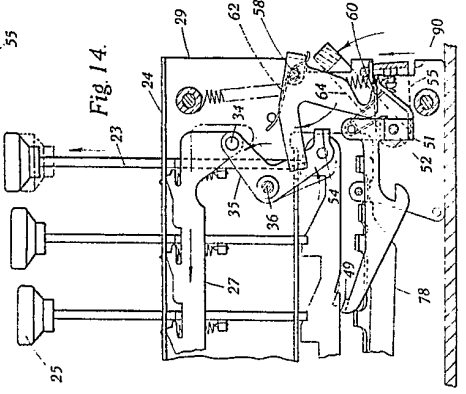


Fig. 14.

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