PATENT SPECIFICATION

Application Date: May 28, 1938. No. 15978/38. **514,290**

Complete Specification Accepted: Nov. 3, 1939.

COMPLETE SPECIFICATION

Improvements relating to Calculating Machines

I, CHRISTOPHER FREDERICK WEBB, a British Subject, of 24, Deane Way, Eastcote, 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 particularly to machines of this type in which a series of pinions associated one with each bank of keys and serving to revolve figure bearing wheels or alternatively so-called totalizing mechanism are rotated by a corresponding series of oscillatory racks or toothed segments whose extents of movement are made to vary in accordance with the particular keys depressed.

In machines of this type hitherto proposed the construction is such that the rack, immediately prior to the end of its operative stroke, is moving at a comparatively high velocity, the figure or other wheel which is revolved by the pinion moving into its final position at considerable speed. This gives rise to the well known fault of wheel overthrow and in machines at present in use elaborate precautions have often to be taken in an endeavour to prevent such overthrow consequent on the sudden arrest of the rapidly rotating wheel. In machines of the kind in which the rack is constantly in engagement with the pinion, movement being transmitted from the latter to the wheel through ratchet or other one-way mechanism, special means are necessary for avoiding overrun of the wheel relatively to the pinion, while in machines of the kind wherein the rack disengages the pinion at the end of its operative stroke separate means must be provided for preventing overthrow of the wheel and the pinion after the latter has been freed by the rack.

By this invention all possibility of overthrow of the wheel is prevented in a very simple and convenient manner and without the use of special braking or other means.

The present invention comprises a rack which is decelerated to zero velocity or substantially to zero velocity at the end of its operative stroke in a comparatively gradual manner so as to bring the wheel gently to rest in its correct position in contradistinction to a sudden arrest.

By " operative stroke " is meant that portion of the movement of the rack wherein the latter engages and rotates the pinion.

In particular the invention comprises a rack which is arranged to bring the pinion to rest or substantially to rest in the correct position before being completely disengaged therefrom and restored to initial position.

The accompanying drawings illustrate one manner of applying the invention to a calculating machine of the kind in which depression of a key directly actuates a system of linkages which through the intermediary of a rack and pinion serve to rotate a wheel bearing figures visible from the exterior of the machine.

In the drawings:

Fig. 1 is a perspective view showing part of the calculating machine.

Fig. 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.

Fig. 3 is a view similar to Fig. 2 showing the " 9 " key depressed almost to its fullest extent and the rack about to engage its pinion.

Fig. 4 is a view similar to Fig. 3 showing the mechanism immediately after the rack has moved into engagement with the pinion.

Figs. 5, 6 and 7 are detail cross sections respectively on the lines A—A Fig. 2, B—B Fig. 4, and C—C Fig. 3.

Figs. 8—11 show the rack at various stages of its movement.

Referring to the drawings, the calculating machine comprises an outer case 20 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 19 can be observed. In the example shown a facia strip 21 is provided in the

aforesaid aperture, the strip 21 being formed with holes for viewing the numbers and having a strip of glass covering its outer side. Each bank or "line" contains nine 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 22 arranged to slide in a slot in a cover plate 23, the stem being provided with the usual key top 24 and with a shoulder 25 for engaging a main driving bar 26 extending longitudinally of the line below all the keys therein. The lower end of each key stem 22 is guided in a slot in a part 27 secured to or formed integrally with a frame plate 28 which serves to separate the line from the adjoining line and each stem is acted upon by a spring 29 for restoring the key to its normal position after depression thereof. The upward movement of the key stem is limited by abutment of the lower hook shaped end of the stem against the underside of the part 27 as shown in Fig. 5, the lower ends of the key stems being arranged at the same horizontal level when the keys are in their fully raised positions.

The driving bar 26 is mounted for substantially parallel movement in a vertical plane, being supported at its rear end by a **V**-shaped link having arms 30, 31 and near its front end by a link 32 of the configuration shown. The arm 31 of the **V**-shaped link is rotatably mounted at its upper end on a spindle 33 extending completely through the machine and the arm 30 is pivotally connected at its upper end by a pin 34 to the bar 26, the lower portion 35 of the **V**-link being bent transversely of the link into a **U**-form to embrace a pair of ears 36 on opposite sides of a channel-shaped member 37 extending longitudinally of the line of keys parallel to the driving bar 26, the **U**-shaped portion 35 being pivotally connected to the ears 36 by a pin 38.

The link 32 is rotatably mounted on a spindle 42 extending through the machine parallel to the spindle 33 and consists of an inverted **T**-shaped part having a tail 39 for a purpose hereinafter described, one end of the bar of the **T**-part normally abutting as shown in Fig. 2 against the underside of a flange 40 at the upper side of the bar 26 and the other end of the bar of the **T**-part being pivotally connected by a pin 41 to an ear on the channel shaped member 37 near the front end thereof. The driving bar 26 is also provided with a pin or other projection 43 adapted to engage the inverted **T**-part under the conditions referred to below and in the upper side of the bar 26 are formed three recesses 44, 45, 46 for engagement respectively with the spindles 33, 42 and a transverse bush 47 as shown in Fig. 2 so as to limit the upward movement of the bar 26.

When the bar 26 is forced downwardly by depression of any of the keys numbered 1—8 it will move substantially parallel to itself throughout its stroke, the movement being through a slight arc by reason of the mounting of the bar. Simultaneously the member 37 will be moved longitudinally in a forward direction (i.e. towards the figure wheel 19) also through a slight arc, the pin 38 swinging about the centre 33 and the pin 41 about the centre 42. When key No. 9 is depressed the movement will be substantially the same as above described except that the bar 26 will first swing through a small angle in a clockwise direction as viewed in Figs. 2—4 around the pivot 34 in view of the fact that the point of engagement of the key stem with the bar is now on the other side of the pivot 34, this rotation being eventually arrested by engagement of the pin 43 with the link 32. Subsequent to such engagement the bar 26 moves substantially parallel to itself into the positions illustrated in Figs. 3 and 4, the former figure showing the parts immediately before key No. 9 completes its downward stroke and the latter figure showing the key at the completion of such stroke.

The longitudinal member 37 is formed with a series of apertures arranged one below each key stem, the stem passing through its corresponding aperture when the key is depressed. Each aperture is elongated to permit forward movement of the member 37 relatively to the key stem and such forward movement of the member 37 is limited by engagement of the rear end of the aperture with the depressed key stem.

The member 37 forms part of an arrangement for locking the keys of the machine in the event of failure of the operator to depress a key to its fullest extent. This locking arrangement forms the subject of my co-pending application No. 15979/38 (Serial No. 514,291) and will not be further described herein.

The figure wheel 19 is rotated on actuation of a key by a rack 48 having ten teeth, adapted to engage and rotate a ten-toothed pinion 49 connected to the figure wheel. The rack 48 is provided at the end of an arm 50 rotatably mounted at

its other end on a pin 51 carried in a U-shaped part 52, the latter being pivotally mounted at its upper ends on a spindle 53 extending through the machine parallel to the aforementioned spindles 33, 42. The arm 50 is also formed with an elongated slot 54 of the configuration shown in which engages a roller 55 (or a pin) carried at the lower end of an arm 56, the latter being pivotally mounted at its upper end on a spindle 57 extending through the machine and being connected by a short link 58 to the pin 41 carried on the longitudinal member 37. In the position of rest shown in Fig. 2 the location of the U-shaped part 52 is such that the rack is held away from the teeth of the pinion 49 and can be swung through an angle into the position shown in Fig. 3 by forward movement of the member 37 without influencing the pinion.

Pivotally mounted on the spindle 33 carrying the V-shaped link 30, 31 is a three-armed lever 59, 60, 61, the arm 61 being formed with a slot 62 in which engages the pin 51 carried in the U-shaped part 52. The location of the slot 62 in the arm 61 is such that rotation of the three-armed lever in a clockwise direction serves to swing the U-part 52 in a clockwise direction and thus move the arm 50 in a direction longitudinally of itself. The arm 59 is connected to the tail 39 on the link 32 by a helical spring 63 which serves to move the rack 48 into engagement with the pinion 49 under the conditions described below and subsequently to return the parts of the mechanism to their initial positions after release of a depressed key, this spring being under a predetermined minimum tension when the mechanism is in the position of rest illustrated in Fig. 2. Also the distance between the centre 42 and the point of attachment of the spring 63 to the tail 39 is made greater than the distance between the centre 33 and the point of attachment of the spring to the arm 59 for the purpose hereinafter described. In addition the three-armed lever is provided with a tail 64 which is arranged for engagement by the pin 38, the end of the latter projecting laterally of the lower portion 35 of the V-link for this purpose.

The arm 60 forms part of the key locking arrangement described and claimed in my co-pending application No. 15979/38 (Serial No. 514,291) aforesaid.

The U-shaped part 52 is associated with a movable retaining arm 65 having its lower end bent laterally of the main vertical portion of the arm, this lateral end being stepped to form a pair of bearing surfaces 66, 67, best illustrated in Figs. 5 and 6, for one arm of the U-shaped part 52. Fig. 2 shows the U-part 52 separated from the surface 66 by a slight clearance and Fig. 3 shows the part directly abutting against the said surface while Figs. 4 and 6 show the U-part abutting against the surface 67. As shown in the drawings, the arm 65 is carried on a bar or rod 68 extending longitudinally of the line below all the keys therein, this bar being mounted for rotation about its longitudinal axis and being provided with a number of laterally projecting portions 69 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 68 is not arranged parallel to the driving bar 26 and the longitudinal member 37 but is inclined thereto, the distance between the lower end of the stem of key No. 1 and the projection 69 situated below that key being a minimum and the corresponding distance for key No. 9 being a maximum. When a key is depressed, the distances moved by the bar 26 and the longitudinal member 37, and hence the angle through which the rack 48 is swung, before the lower end of the key stem engages its corresponding projection 69, will thus vary for each key. The bar 68 is associated with a coil spring 70 tending to rotate the bar in a clockwise direction as viewed in Figs. 5 and 6, rotation of the bar in this direction being limited by the abutment of a lateral projection (see particularly Fig. 7) at the rear end of the bar against a suitable stop surface 72.

The operation of the mechanism above described is as follows: —

Normally the parts occupy the positions shown in Fig. 2 with the U-part 52 separated by a slight clearance from the surface 66 on the arm 65, the rack being held in its lowermost position and away from the pinion 49. Also the roller 55 is located near the rear end of the slot 54 and the pin 38 is in engagement with the tail 64. When a key, for example the nine key, is depressed the driving bar 26 is forced downwardly and moves the member 37 longitudinally in a forward direction, this latter movement through the intermediary of the link 58 and arm 56 serving to swing the arm 50 carrying the rack 48 in a clockwise direction. Immediately before the lower end of the key stem engages its corresponding projection 69 on the bar 68 the parts occupy the positions shown in Fig. 3, with the rack still out of engagement with the pinion, the U-part 52 having moved into engagement with the surface 66 at the

commencement of the key stroke and having subsequently remained in engagement with said surface. Also during downward movement of the key the tension of the spring 63 is increased by reason of the fact that the link 32 is rotated in a clockwise direction while the arm 59 is held stationary, after its very small initial movement to engage the U-part with the surface 66.

At the completion of the downward stroke of the key the lower end of the stem engages its projection 69 to rotate the bar 68 from the position shown in Fig. 5 to that shown in Fig. 6, this movement serving to withdraw the surface 66 from engagemnt with the U-part 52. The latter is now swung through a small angle in a clockwise direction by the spring 63 acting through the arms 59, 61, the movement of the U-part 52 serving to engage the rack 48 with the pinion 49 and being limited by abutment of the said part against the surface 67. The parts now occupy the positions shown in Fig. 4.

When the key is released the spring 63 acts to rotate the link 52 in a counter-clockwise direction to swing the rack 48 through the various stages shown in full lines in Figs. 8—11, the rack remaining in engagement with the pinion and thus rotating the figure wheel during its return stroke. Thus the figure wheel is rotated during the up-stroke of the key. After the rack reaches the bottom of its stroke as shown in full lines in Fig. 11 the pin 38 carried by the longitudinal member 37, which latter has been moving in a rearward direction during the return stroke of the rack, engages the tail 64 to restore the three-armed lever 59, 60, 61 to its original position, the force exerted by the pin 38 on the tail 64, due to the spring 63 acting through the link 32 and member 37 serving to overcome the opposing force on the tail due to spring tension on the arm 59. This difference in the opposing forces is achieved by suitable arrangement of the dimensions and disposition of the parts concerned and by arranging the anchorage of the front end of the spring 63 at a distance from the centre 42 greater than the distance between the anchorage of the rear end of the spring and the centre 33. The re-setting of the three-armed lever causes the U-part 52 to be swung in a counter-clockwise direction to withdraw the rack 48 from engagement with the teeth of the pinion, the rack eventually moving back into its initial position shown in Fig. 2. The movement of the U-part 52 also permits the spring 70 to rotate the bar 68 in a clockwise direction as viewed in Figs. 5 and 6 and as the driving bar 26 and member 37 have in the meantime also been restored to their initial positions the parts of the mechanism once again assume the positions shown in Fig. 2.

As previously explained and as will be apparent from the foregoing the angle through which the rack 48 is swung before it is moved into engagement with the pinion, and therefore the angle through 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 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 which rotates the figure wheel through an angle of 324°. The movement of the rack in the manner above described forms the subject of my co-pending application No. 15977/38 (Serial No. 514,289).

According to the present invention the angular velocity of the figure wheel is reduced to zero or substantially to zero by suitable deceleration of the rack before 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 rack. The rack is decelerated towards the end of its stroke by shaping the slot 54 to the configuration shown in the drawings. As illustrated the slot 54 is made convex in an upward direction for the greater part of its length but towards its rear or right-hand end it changes direction, the rear portion being shaped substantially to the form of an arc having the spindle 57 as centre. With such an arrangement the rack is accelerated during the initial stages of its return stroke but when the roller 55 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 full lines in Fig. 11. The rack reaches this latter position before the pin 38 engages the tail 64 so that the rack is moved out of engagement with the pinion 49 only after the latter, and therefore the figure wheel 19, has been brought to rest.

If desired the roller 55 may be replaced by a pair of rollers or pins at the end of the arm 56 arranged to move along opposite sides of the arm 50, the latter being shaped to produce the effect provided by the roller 55 and slot 54.

The spindles 33, 42, 53 and 57 which support the various parts above referred to extend completely through the machine parallel to each other, and serve to support corresponding parts in the mechanisms associated with other lines of keys.

Also certain parts, particularly the driving bar 26, may be provided with holes or recesses for the purpose of reducing wieght.

The invention is not limited to the example above described as subordinate details of construction may be varied to meet different requirements. The invention may for example be incorporated in a machine in which the motive power is supplied by an electric motor, the keys in this case serving merely as selecting means.

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. In a calculating machine of the type referred to, a rack which is decelerated to zero velocity or substantially to zero velocity in a comparatively gradual manner at the end of its operative stroke so as to bring the wheel gently to rest in its correct position in contradistinction to a sudden arrest.

2. In a calculating machine of the type referred to, a rack which is arranged to bring the pinion to rest or substantially to rest in the correct position before being completely disengaged therefrom and restored to initial position.

3. A calculating machine as claimed in claim 1 or 2 in which the desired deceleration of the rack is governed by the engagement of a roller or pin in a suitably shaped slot.

4. A calculating machine as claimed in claim 3 in which the rack is provided at one end of an arm pivotally mounted at its other end, the slot being formed in the said arm at a position intermediate its ends.

5. In a calculating machine, a rack as claimed in claim 1 and constructed and adapted to operate substantially as described with reference to the accompanying drawings.

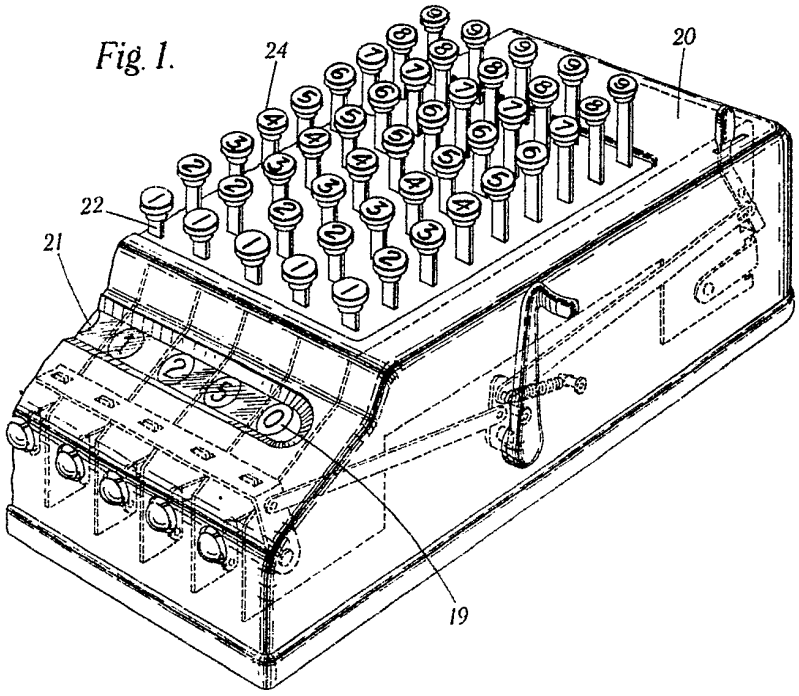
Dated this 28th day of May, 1938.

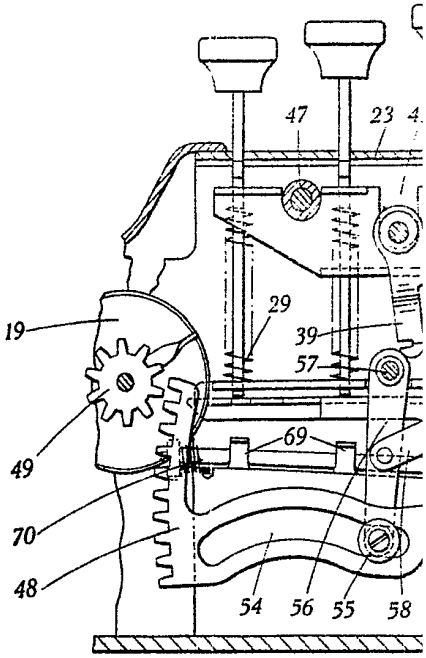
R. H. TANN,
Agent for the Applicant.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1939.

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

Fig. 1.





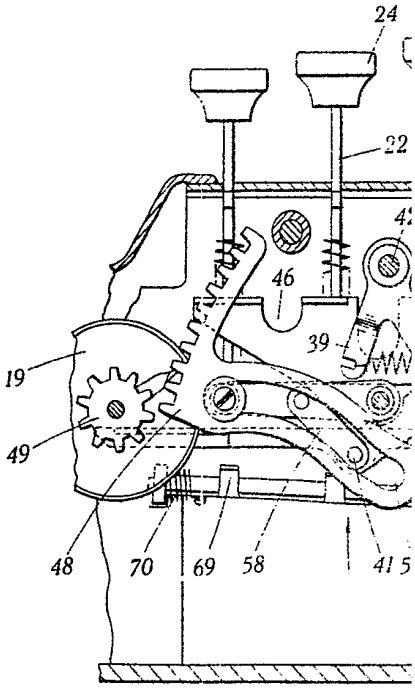


Fig. 2.

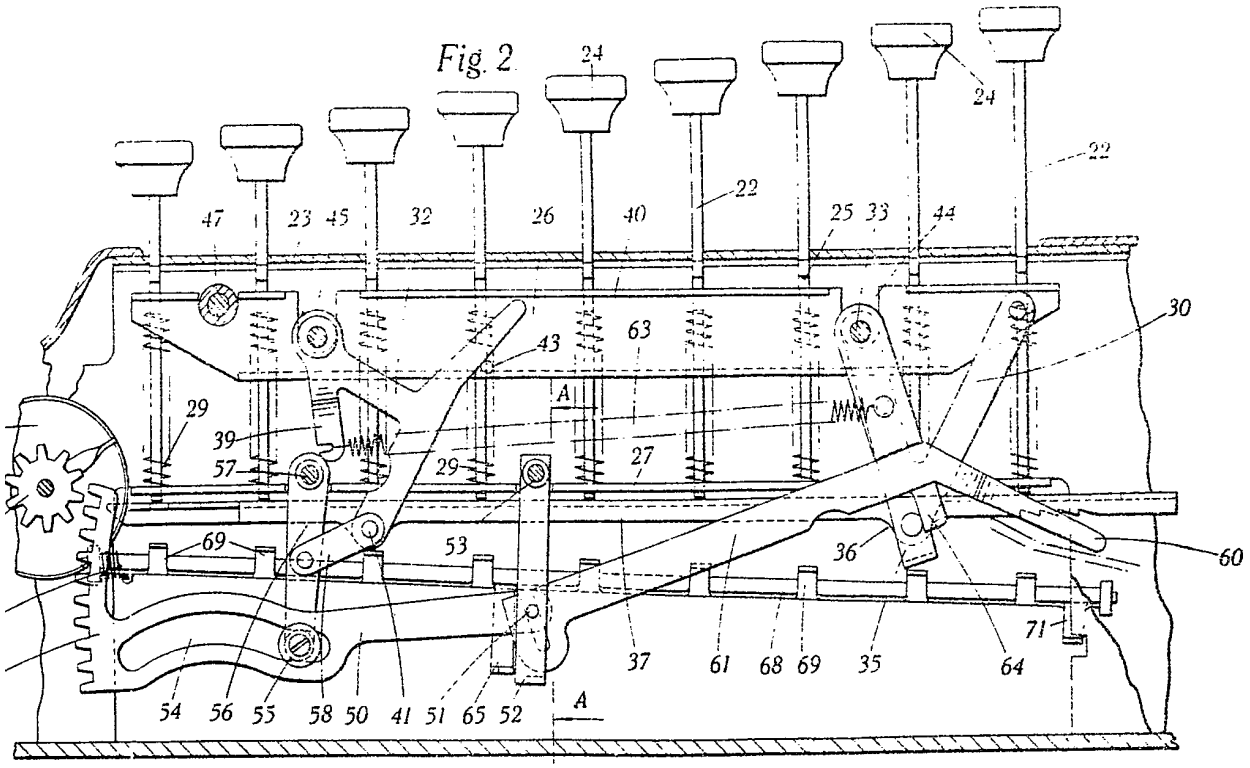
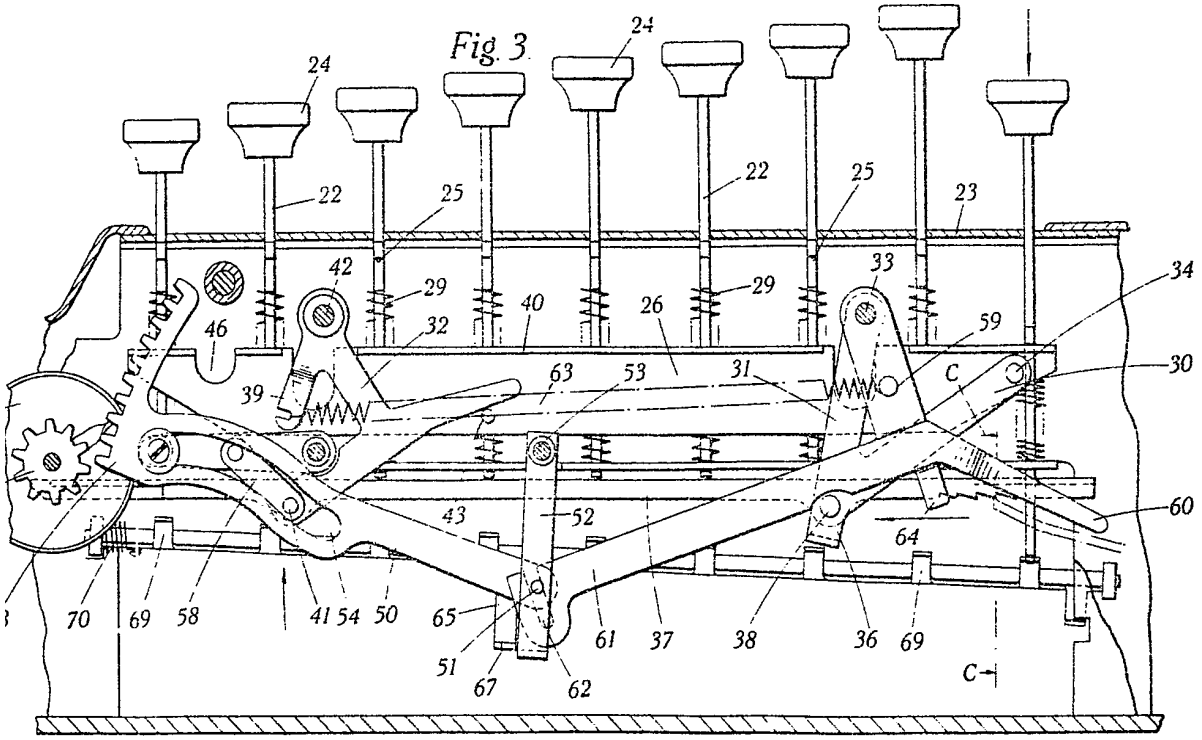


Fig. 3.



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4 SHEETS

SHEET 1

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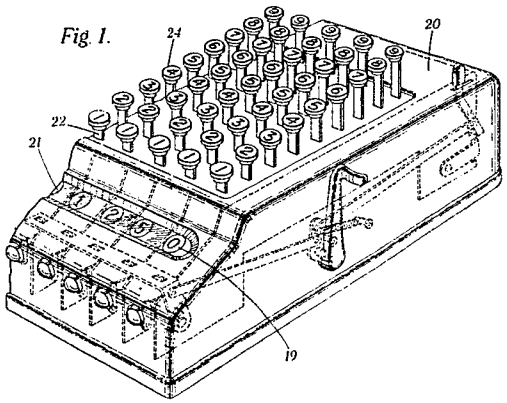
Fig. 1.



SHEET 2

Fig. 2.

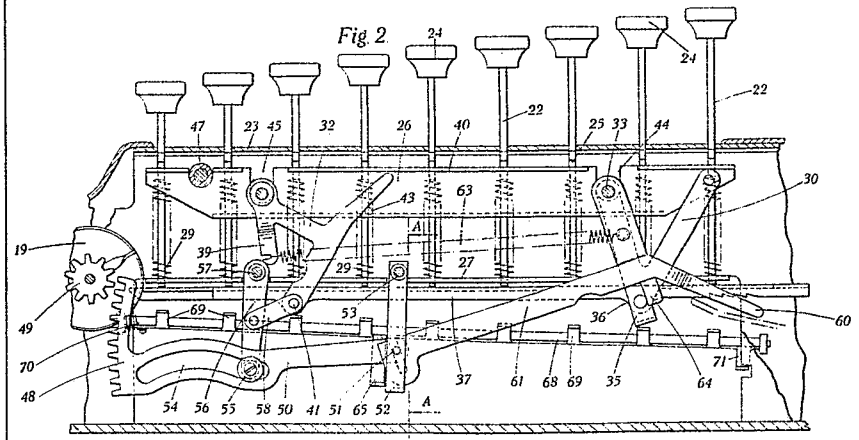


Fig 3

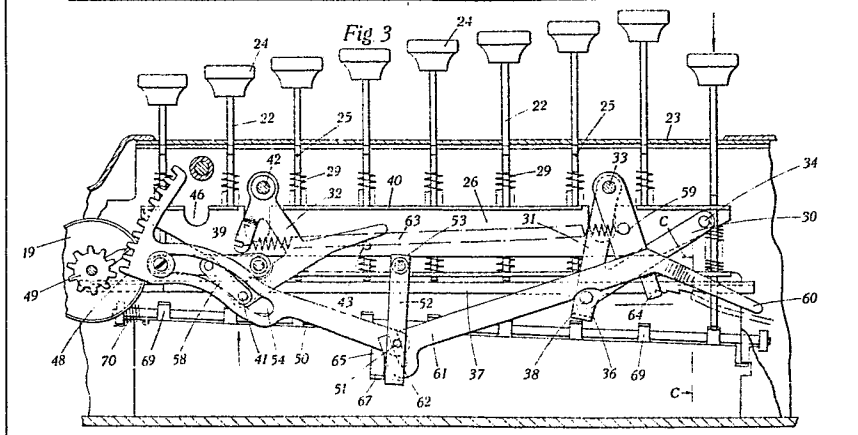


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Fig. 4.

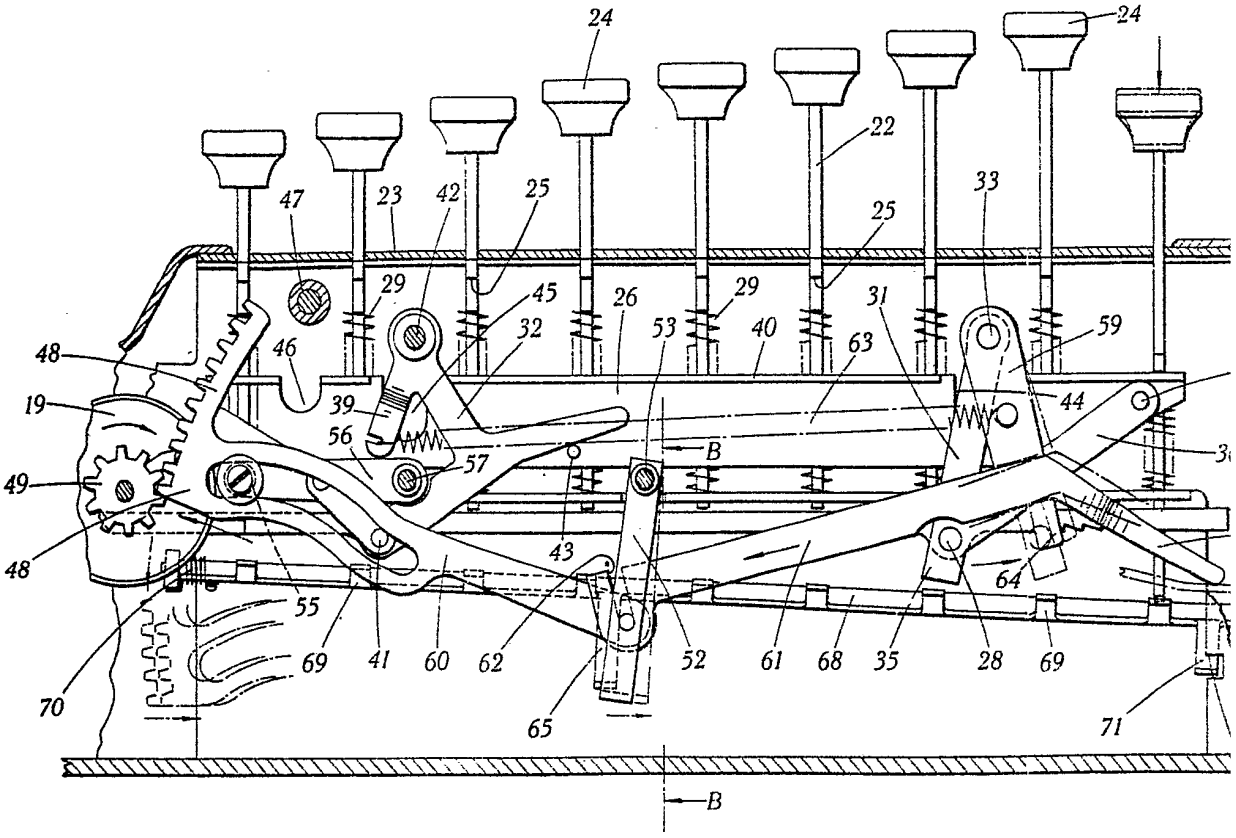


Fig. 5.

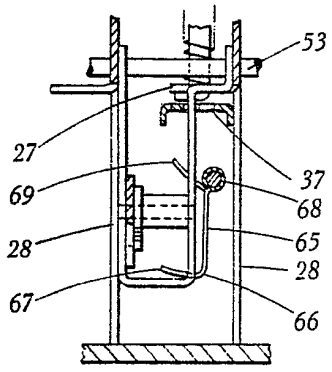


Fig. 6.

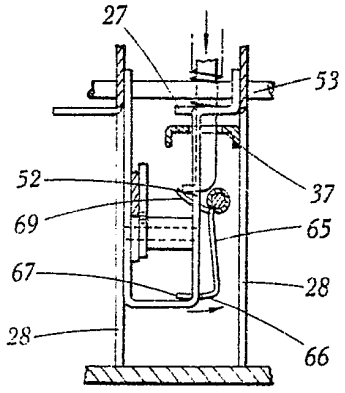
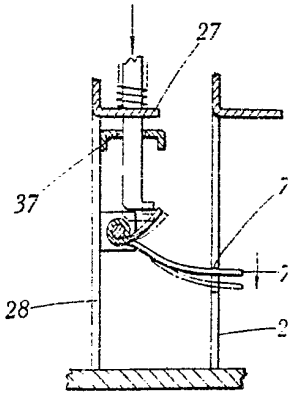


Fig. 7.



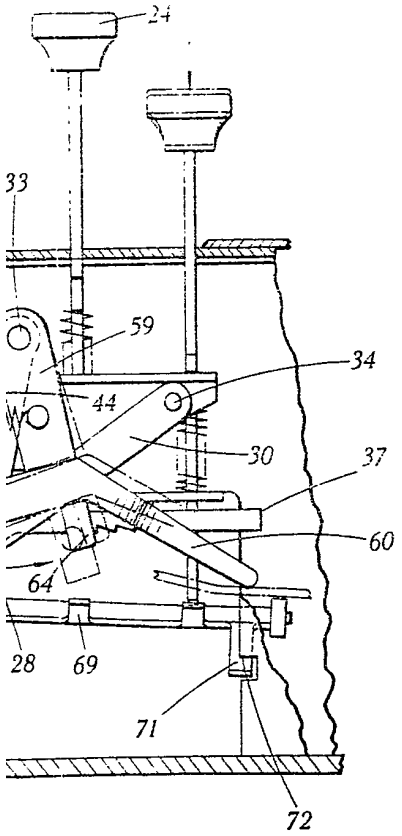
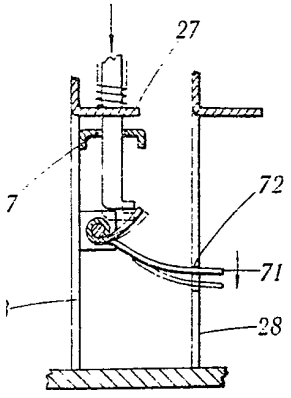


Fig. 7.



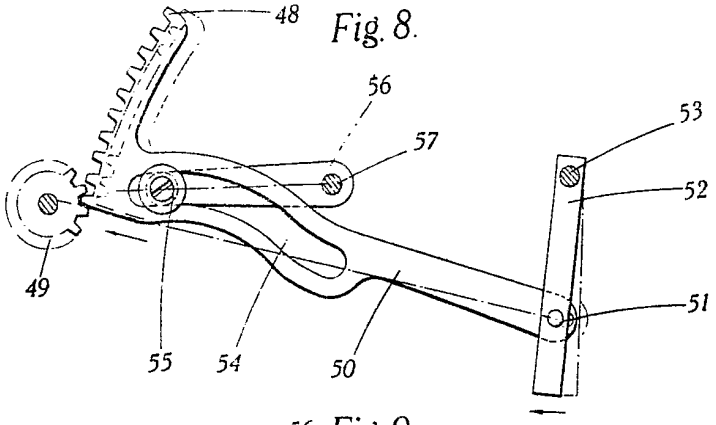


Fig. 8.

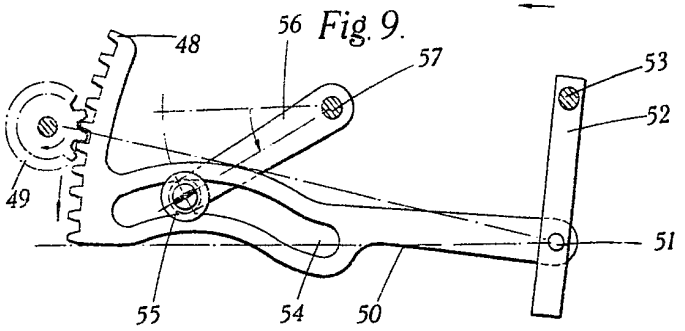


Fig. 9.

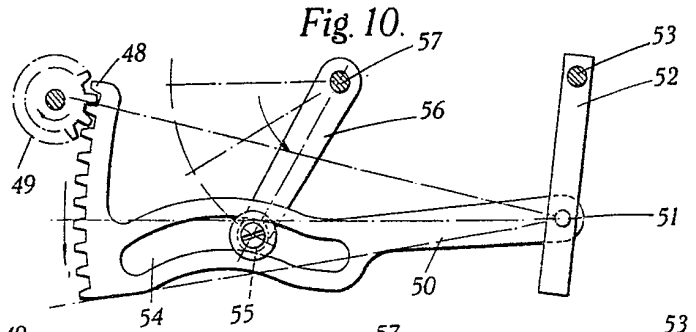


Fig. 10.

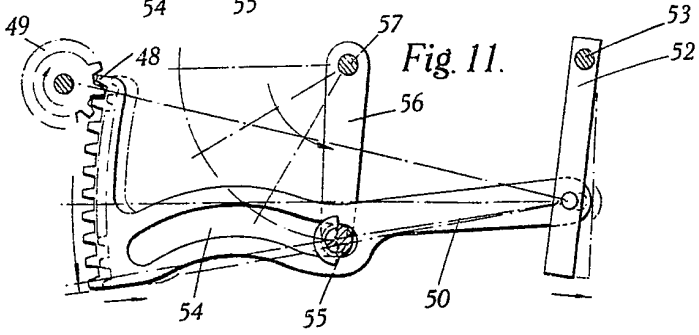


Fig. 11.

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SHEET 3

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Fig. 4.

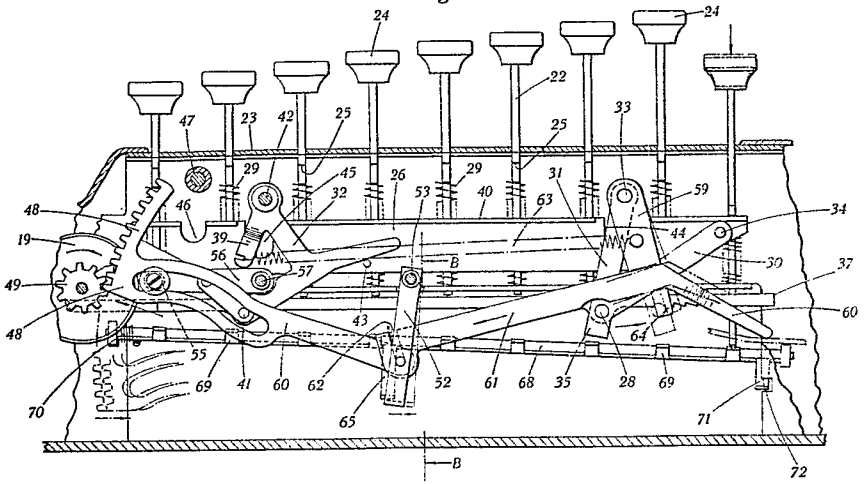

Fig. 5.

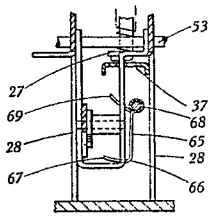

Fig. 6.

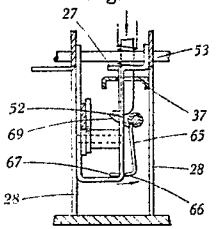

Fig. 7.

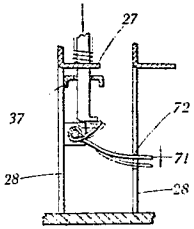

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Fig. 8.

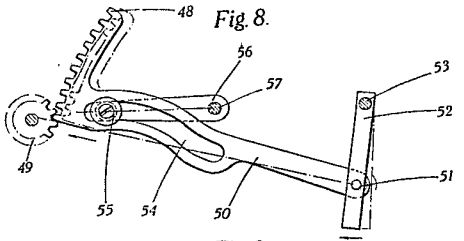


Fig. 9.

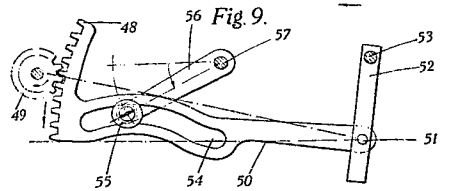


Fig. 10.

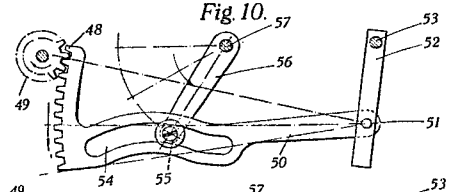
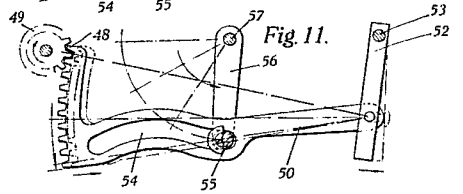


Fig. 11.



Malby & Sons, Photo-Lith.