AMENDED SPECIFICATION

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PATENT SPECIFICATION

737,050

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COMPLETE SPECIFICATION

Computing Machine

We, ING. C. OLIVETTI & C. S.p.a., a body corporate under the Laws of Italy, of 12 Via Jervis, Ivrea (Aosta), Italy, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to computing machines.

Computing machines generally comprise an indexing mechanism such as a pin carriage or a keyboard, two amount representing devices and two sets of differential members, the two amount representing devices being associated with the two sets of differential members and one of said amount representing devices having type carriers such as type bars, type wheels or the like, for printing the amount entered into the other of said amount representing devices or the amount taken as a total by clearing the other of said amount representing devices.

The cycle of operation of previous known computing machines has necessarily had to be effected at a slow speed since, due to the general arrangement of the two sets of differential members and the amount representing devices of these known machines, the inertia and rebound of parts of the machines subjected to rapid movement and abrupt stopping by the reciprocation of the differential members, induced relatively heavy loads in the machines.

An object of the present invention is to provide an improved general arrangement of the component parts of computing machines in order to permit said machines to be operated at a higher speed.

According to the invention there is provided a computing machine having an indexing mechanism, a first amount representing device, a first set of differential members associated with said device and differentially movable under the control of said indexing mechanism during amount entering operations, a second amount representing device, and a second set of differential members associated with said second device and differentially movable under the control of the differential members of the first set, one of said devices including register wheels engageable by the associated differential members in amount entering operations for entering an amount therein, the other device including type carriers for printing the amounts entered into said register wheels as well as the totals taken therefrom, characterised in that in total taking operations the register wheels are engageable by the differential members associated with the type carriers.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:—

Fig. 1 is a longitudinal sectional view through a computing machine according to the invention;

Fig. 2 is a plan view of a keyboard of said machine;

Fig. 3 is a partial longitudinal sectional view through the machine, and

Fig. 4 is a partial plan view of a detail of the machine.

The computing machine shown in the drawings is of the well known ten-key keyboard type but it is to be understood that the invention may be applied to other types of computing machines, such as the full keyboard type.

As shown in Fig. 1, the machine comprises an index mechanism in the form of the usual pin carriage 4 which is movable transversely on fixed shafts 67 and 70 and which carries

[*Price 3s. 0d.*]

rows of pins 3 and 3^1 adapted to be shifted to the left of Fig. 1 in a known manner, not described, by the digit keys of the ten-key keyboard shown in Fig.s 2 and 3.

A set of differential members hereinafter referred to as slides 5 is arranged on the left hand side of the pin carriage 4, each slide 5 being provided with rack teeth 6 for engaging a pinion of an amount representing device or register 17^1 hereinafter described. The slides 5 are vertically movable in slots in a fixed frame 7 and are guided by a fixed bar 8. Each slide 5 is urged upwardly by a spring 9. A restoring bar 10, carried by a restoring bail 11 secured to a shaft 12, normally holds all the slides 5 in their lowest position.

Each slide is provided with a projection 13 on which the pins of the pin carriage 4 may act as stops.

More particularly, the pins 3^1 act as zero stops, the eight rows of pins 3 act as stops for the digits from 1 to 8 and the teeth of a comb 47, protruding from the frame of the pin carriage 4, act as stops for the digit 9. A comb 46 acts as zero stop for the slides 5 of the higher orders, as is known in the art.

Each slide 5 is associated with a further amount representing device comprising a gear wheel 15 and a type carrier 16 which is described later.

17^1 designates the register arranged on the right hand side of the slides 5, as shown in Fig. 1. In the present example this register is of the well known type comprising two sets of pinions 18 and 19 which are in constant mesh with each other and which are supported by a suitable cradle. Each pinion has ten teeth and also a transfer tooth 20.

A further set of differential members hereinafter referred to as actuators 21 is arranged on the right hand side of the register, one actuator being provided for each order of the register, that is, for each slide 5. Each actuator 21 has rack teeth 22 for actuating the register pinions and is provided at its lower end with a fork 23 engaging an arm 24. Each arm 24 is provided with a spring 25 and the said arm 24 is held in the position shown in Fig. 1 by a restoring bar 26 which is carried by a bail 27 secured to a shaft 28.

The bail 27 is formed with a cam shaped arm 29, on which rests a roller 30 rotatably mounted on a bail 31. The bail 31 is loosely mounted upon a shaft 32 and is urged counterclockwise by the springs 25 secured to its transverse bar 33.

Normally, the springs 25 rotationally bias the arms 24 in a counterclockwise direction and the actuators 21 are thereby urged downwardly.

In the position shown in Fig. 1 each actuator 21 is arrested, in a manner well known *per se*, by a transfer trip lever 35 cooperating with an abutment 34 upon the actuator. Each transfer trip lever 35 is loosely mounted upon a shaft 36 and is rotationally biased in a counterclockwise direction by a spring 37. In the position shown in Fig. 1 the transfer trip lever 35 is arrested by a bent-over lug 38 of a lever 39 pivoted at 40 and rotationally biased in a clockwise direction by the spring 37 attached thereto. Each lever 39 is provided with a pawl 41^1 which is engageable, in a manner known *per se*, by the transfer tooth 20 of either of the pinions 18 or 19 of the next lower order of the register 17^1.

On the left hand side of the register there is provided a set of fixed stop plates 43, each having a stop lug 44^1 for arresting the transfer tooth 20 of either of the pinions 18 or 19 of the register, in total taking.

45 designates the main operating shaft of the machine. As is well known in the art, this shaft makes a full rotation at each cycle of the machine and by known means, not described, imparts a forward and then a return stroke to both shafts 12 and 28 during each cycle of the machine. More particularly, shaft 12 rocks first counterclockwise and then clockwise and shaft 28 rocks first clockwise and then counterclockwise.

Assume now that an amount has been set into the pin carriage 4 and that, by hand or by motor drive, an operating cycle is started. Shaft 12 initiates its counterclockwise rotation and the restoring bar 10 is lifted. The slides 5 are drawn upwardly by the springs 9, until arrested by the pin carriage in the manner previously described.

The movement of the slides 5 is transmitted to the type carriers 16 in a manner described later.

The shaft 28 initiates its clockwise rotation at the same time as shaft 12 initiates its counterclockwise rotation. During the initial rotation of shaft 28 the arms 24 are permitted by the bar 26 to rotate counterclockwise around their upper contact point with the forks 23 until they contact the shaft 28. Upon further rotation of shaft 28, the arms 24 are rotated clockwise around the shaft 28 by their spring 25, thereby lifting the actuators 21. Each actuator 21 moves until arrested by an arm 48 projecting from its co-operating slide 5.

It will thus be apparent that at the end of the forward stroke the elements of each pair of differential members, that is a slide 5 and actuator 21 have both moved the same distance, said distance being determined by the corresponding digit set into the pin carriage 4.

The amount represented by the type carriers 16 is then printed, as described later, and the register 17^1 is shifted to the right, thereby engaging the adding pinions 18 with the actuators 21, as is well known *per se*.

During the return stroke of the shafts 12 and 28 the slides 5 and the actuators 21 are restored to their initial position, thereby entering the amount represented by the actuators

21 into the register which is engaged therewith. The register is then disengaged from the actuators, as is known in the art, and resumes its central inactive position shown in Fig. 1. The register engaging and disengaging mechanism may be of a known type and is therefore not described.

In the present structure the slide 5 and actuator 21 are normally disconnected from and move independently of each other until the actuator 21 contacts the slide 5 when it is stopped by the pin carriage. It will thus be apparent that the masses concerned are the single mass of slide 5 at one side and the single mass of actuator 21 at the other side, the two masses pertaining to two distinct and independent dynamical systems. Owing to the low inertia of each system the machine may, therefore, be operated at a high speed.

It may further be observed that, due to the actuator 21 stopping against the slide 5 after the slide 5 has been arrested by the pin or tooth of the pin carriage, as hereinbefore described, any rebounding of the slide 5 is prevented since the actuator 21 acts as a locking member for the slide 5.

It may also be observed that, owing to the beam-like construction of the arms 24, each spring 25 has a double function, namely to urge the actuators 21 downwardly from the position shown in Fig. 1 for the purposes of transfer and then, after the initial clockwise rotation of shaft 28, to urge the actuators 21 upwardly. In accomplishing the first function the spring 25 has the same action as the spring normally stretched between each slide and its co-operating actuator member, as is known in the art.

Finally, it will be apparent that in operations of repeated addition or subtraction, as in multiplication or division operations, the slides 5 may be locked at the end of the forward stroke of the first cycle and, during the following repeat cycles, the actuators 21 may be reciprocated without moving the slides 5. In this way the speed of the machine may be further increased.

If the operation to be performed is a subtraction, the register cradle is rotated 180° about a central axis, in a manner well known *per se*, and the subtracting pinions 19 are then put into engagement with the actuators 21. The register reversing mechanism may be of a known type and is therefore not described.

For taking a positive total the register which is to be cleared is shifted to the left engaging the pinions 19 with the slides 5. If, however, the total is negative, the register cradle is rotated 180° about a central axis, and the register then shifted to the left engaging the pinions 18 with the slides 5.

Prior to total taking the pin carriage 4 is shifted transversely to the machine by one half step, as is known in the art, thereby permitting the projections 13 of slides 5 to pass between the teeth of the comb 46 and between the pins 3 and 3^1 which have previously been set in the carriage. Instead of shifting the pin carriage 4 by one half step, the pin carriage may be restored to normal, as is known in the art, and the comb 46 may be shifted to the right of Fig. 1 independently of the pin carriage, or otherwise moved into such a position as not to interfere with the projections 13.

During the forward stroke of the total taking cycle each slide 5 moves upwardly until the transfer tooth 20 of the register pinion engaging therewith is arrested by the stop lug 44^1 of the stop plate 43. Therefore, at the end of the forward stroke the slides 5 assume the position corresponding to the total taken from the register and the type carriers 16 can then print said total. At the end of the forward stroke the register is disengaged from the slides 5, as is known *per se*. However, if the total to be taken is a sub-total, the register is held engaged during the return stroke, as is well known in the art.

During the return stroke the restoring bar 10 restores the slides 5 to normal.

In comparing the invention with the known structures it will be seen that, in total taking, instead of being engaged by the actuators 21, as is usual in the art, the register to be cleared is put into engagement with the slides 5. It will thus be apparent that in a total taking cycle the register to be cleared may immediately engage the slides 5, without waiting for the restoration of the actuators 21 which in these known structures effect an additional downward travel from the position of Fig. 1 for the purposes of transfer. The speed of the machine may therefore be further increased.

It may further be observed that in shifting the register to be cleared into engagement with the slides 5 the transfer teeth 20 are engaged by the stop lugs of the fixed stop plates 43, thereby overcoming the disadvantages in known structures of having the register pinions arrested by the transfer pawls acting as zero stops, and of having the stop plates shifted into engagement with the register pinions at each total taking cycle.

It will be apparent also that in total taking the actuators 21 may be held locked in their position of rest as shown in Fig. 1.

The machine may be fitted with more than one register and in the present example there is provided a second register designated as 17^{11}. The transfer mechanism 35, 39 described above, may also be utilized for a second register and to this end each lever 39 is provided with a second pawl 41^{11}. It may be observed that the machine differs from similar constructions known in the art in that the operating conditions of the transfer teeth 20 of the two registers 17^1 and 17^{11} are identical, irrespective of the pawl that is operated,

the pawls 41^{1} and 41^{11} being arranged in such a manner with respect to the common fulcrum 40 that said transfer teeth co-operate with similar lever arms. This may be observed from Fig. 1, bearing in mind that the right hand pinion of each register rotates nine steps from the position shown in Fig. 1 before contacting the upper face of the pawls 41^{1} and 41^{11}, respectively.

In total taking the transfer teeth of the lower register 17^{11} are arrested by the lower stop lug 44^{11} of the stop plate 43.

When operating with two registers, it is apparent from Fig. 1 that in order to enter into one register an amount cleared from the other register it is sufficient to engage the register to be cleared with the slides 5 during the forward stroke and to engage the other register with the actuators 21 on the return stroke. In this case, during the forward stroke the slides 5 clear the register engaging therewith and assume the position corresponding to the total taken and during the return stroke the actuators 21, which have followed the displacement of the corresponding slides 5, enter said total into the other register.

A similar operation may also be effected on certain known machines, wherein two registers are engageable with the same set of actuators. However, if the actuators in these known machines are movable an additional step for the purposes transfer, as is the case with the actuators 21, it is difficult to take a sub-total from one register and at the same time transfer it into the other register, since the transfers which may occur in the second register during the return stroke disturb the first register which is still engaged with the actuators for the reentering of the sub-total taken during the forward stroke.

This disadvantage is overcome with the machine according to the invention, since the transfer movements of the actuators 21 do not affect the slides 5.

In order to facilitate the simultaneous depression of the operation keys corresponding to different registers, these keys have been arranged according to the keyboard shown in Fig. 2. More particularly, the adding key 51^{1} and the subtracting key 52^{1} for the register 17^{1} are grouped together with the total key 49^{11} and the sub-total key 50^{11} for the register 17^{11}. Similarly, the adding and subtracting keys 51^{11} and 52^{11} for the register 17^{11} are grouped with the total and sub-total keys 49^{1} and 50^{1} for the register 17^{1}.

Although any suitable pin restoring plate may be used in co-operation with the pin carriage in order to restore the setting of the pins, as known to those skilled in the art, certain features of the restoring plate designed particularly for the present machine will now be described.

As shown in Fig. 3, an arm 208 is pivoted on a fixed shaft 207 and carries a plate 209 juxtaposed to the pin carriage 4. The plate 209 embraces all the pins 3 and 3^{1} of the pin carriage when this plate is in its home position.

A cam 149 carried by the main operating shaft 45 is adapted to engage a lug 210 protruding from the arm 208, and upon counterclockwise rotation of the shaft 45 the arm 208 is moved to the right in Fig. 3 thereby engaging the plate 209 with the pins 3 and 3^{1} and restoring them to their normal position, as shown in Fig. 3. Upon further rotation of the shaft 45 the cam is disengaged from the lug 210 and the plate 209 returns to the position shown in Fig. 3, under the action of the spring 211.

It will be apparent that, if it is desired to render the restoring plate 209 inoperative, the arm 208 need only be displaced along the shaft 207 until the lug 210 is brought out of the path of the cam 149.

Although any suitable printing mechanism may be used in conjunction with the slides 5, certain features of the printing mechanism designed particularly for this machine will now be described.

As shown in Fig. 1, a rack 14 is pivoted on each slide 5 and is in mesh with the gear wheel 15 rotatably mounted on a slide 83. The type wheel 16 is secured to the gear wheel 15. The slides 83 are movable horizontally on slotted plates 88 and 88^{1}. Each slide 83 is urged to the left by a spring 85 and is normally held in the position shown in Fig. 1 by a restoring bar 86 which co-operates with a bent-over lug 84 projecting laterally from each slide 83. The restoring bar 86 is supported by two links 87 pivoted on the bail 11.

At each forward stroke of the shaft 12 the bar 86 is moved to the left and slides 83 are also moved to the left under the action of their springs 85. However, after a short travel each slide is arrested by a latch 96. Thereafter the latches 96 corresponding to the orders in which a digit is to be printed are lowered, thereby unlatching the respective slides 83, which move to the left and effect printing. The restoring bar 86 and the latches 96 are known *per se*, and their mode of operation will not be described.

Each slide 83 is provided with a lug 97 which acts as a guide for the rack 14 for the purpose of maintaining it constantly in mesh with the corresponding gear wheel 15. It will thus be apparent that, as distinct from known type wheel structures adopted in calculating machines, the type wheels 16 are constantly connected to their respective slides 5, resulting in a much simpler and lighter construction.

In taking a total in previous known machines the register pinions are arrested by the transfer pawls acting as zero stops and

the differential members move forward beyond their proper position by an amount equal to the amount of the clearance left between the transfer tooth of each register pinion and the transfer pawl, said clearance being provided in order to ensure that the engagement of the register with the differential members is not obstructed. A total is therefore printed above the ordinary line of printing.

In order to avoid this disadvantage in the present machine, the restoring bar 10 returns the slides 5 beyond their theoretical zero position by an amount equal to the clearance left between the transfer tooth 20 and the corresponding stop lug of the stop plate 43. It is in this position of the slides 5, which is the normal position as shown in Fig. 1, that the register to be cleared for total taking is put into engagement with the slides 5. During the following forward stroke of the slides 5 the type wheels 16 rotate an additional amount, before reaching their theoretical zero position, which is equal to the amount of the additional rotation accomplished by the register pinions due to the clearance previously mentioned. The total is therefore printed on the ordinary line of printing and this result is achieved without providing any extra aligning mechanism.

It may be observed that, due to the additional restoring movement of the slides 5 as described above, an equal clearance is left between the projections 13 and the teeth of the comb 46 thereby permitting the free transversal movement of the pin carriage 4.

The machine is provided with means, known *per se*, which render the printing mechanism inoperative, when desired. To this end a non print key 224 is provided on the keyboard shown in Fig. 2. The key 224, when shifted to the left into its operative position, enables an extra printing hammer to strike the paper and print a special sign each time a non printing cycle is effected, thereby providing a check on the intentional misuse of the machine.

The type for printing the special sign is carried by a three-armed lever 226, pivotally mounted on a fixed shaft. The left hand arm of the lever 226 terminates in a bent-over lug normally disposed above the upper arm 229 of a three-armed lever 215 pivotally mounted on a fixed shaft. The lower arm of the lever 215 terminates in a roller engageable by a cam 218 which is secured to the main operating shaft 45. A spring 216 biases the lever 226 in a counterclockwise direction.

Normally the lever 226 is arrested by a stud 227 fixed to the link 87. When the link 87 moves to the left, as described above, the lever 226 is free to rotate counterclockwise, until arrested by a plate 95 normally lying in the path of the lower arm of the lever 226, as shown in Fig. 4.

When the non print key 224 is moved to the left, a slide 220 which is connected to the key 224 in a known manner not described, is shifted downwardly, as shown in Fig. 4 within a slot 219 of the plate 95. The plate 95, which is slidably mounted by means of a bar 212 fixed thereto in a slot 213 of the machine frame, is thereby shifted to the right, so that a recess 243 comes into the path of the lower arm of the lever 226.

Therefore, during a non print cycle the rotation of the lever 226 is not obstructed by the plate 95 and the lever 226 rotates until its left hand arm is arrested by the upper arm 229 of the lever 215. When the cam 218 engages the roller of the lever 215 and rotates the lever 215 clockwise, the upper arm 229 releases the lever 226 and the sign carried by the said lever 226 is imprinted upon the paper.

From the foregoing description it will be understood that many changes may be made in the above construction, and different embodiments of the invention could be made without departing from the scope thereof. For example, the slides 5 could exchange their function with that of the actuators 21, whereby the set of slides directly controlled by the pin carriage would be utilized for amount entering operations and the other set of slides for total taking operations. It is, therefore, intended that all matter contained in the above description, or shown in the accompanying drawings, shall be interpreted as illustrative, and not in a limiting sense.

What we claim is:—

1. A computing machine having an indexing mechanism, a first amount representing device, a first set of differential members associated with said device and differentially movable under the control of said indexing mechanism during amount entering operations, a second amount representing device, and a second set of differential members associated with said second device and differentially movable under the control of the differential members of the first set, one of said devices including register wheels engageable by the associated differential members in amount entering operations for entering an amount therein, the other device including type carriers for printing the amounts entered into said register wheels as well as the totals taken therefrom, characterised in that in total taking operations the register wheels are engageable by the differential members associated with the type carriers.

2. A computing machine according to claim 1, having a main operating mechanism governing the movement of the differential members of the first set, characterised in that the movement of the differential members of the second set is governed by the main operating mechanism independently of the movement of the differential members of the first set.

3. A computing machine according to claim 1 or 2, wherein said type carriers are associated with the differential members of the first set, characterised in that in total taking operations the differential members of the second set may remain inoperative.

4. A computing machine according to any of claims 1 to 3, characterised in that each one of said type carriers is rotatably mounted on a slidable support.

5. A computing machine according to claim 4, characterised in that each type carrier is constantly connected to the associated differential member.

6. A computing machine according to claim 5, wherein a rotatable gear member is secured to each type carrier, characterised in that each gear member is geared with a rack pivoted on the associated differential member, holding means being provided for constantly holding the rack in mesh with the corresponding gear member.

7. A computing machine as claimed in any of the preceding claims, and having a set of stop means for limiting the travel in one direction of the second set of differential members, a set of springs adapted to move said second set of differential members in the opposite direction, a set of transfer means controlled by said second amount representing device and operative to release said stop means, thereby permitting an additional travel of the differential members of the second set, characterised by the provision of means for reversing the effect of said springs to move the differential members of the second set in the first named direction upon release of said stop means.

8. A computing machine as claimed in claim 7, wherein said means for reversing the effect of the springs comprises a set of beams, fixed and movable pivot elements, and an operating mechanism, each beam having one end portion in engagement with one of the differential members of the second set, its opposite end portion adapted to co-operate with a fixed pivot element, and a medial portion of the beam adapted to co-operate with a movable pivot element, one of said springs being attached to the beam between the portions adapted to engage the two pivot elements and biasing the beam into engagement with at least one of the said two elements, and the said operating means serving to impart reciprocating translational movement to said movable pivot element to effect alternate pivotal engagement of the beam with the two pivot elements, the arrangement being such that, when a differential member of the second set is engaged against its stop means at the commencement of a cycle of the machine, the said opposite end portion of the associated beam is spaced apart from the fixed pivot element a distance corresponding substantially to the said additional travel of the differential member.

9. A computing machine as claimed in any of the preceding claims, and having a keyboard and a third amount representing device including register wheels engageable by the differential members, characterised in that the amount entering operation keys provided for the said one device are grouped together with the total taking keys provided for the third device, and that the amount entering operation keys provided for the third device are grouped together with the total taking keys provided for the said one device.

10. A computing machine as claimed in any of the preceding claims, wherein said indexing mechanism comprises a pin carriage having setting pins, a restoring plate pivotally mounted relative to said carriage, and a cam adapted to rock said restoring plate into engagement with the pins and thereby simultaneously restore the pins to a neutral position, characterised in that the restoring plate is axially movable along its pivot out of engagement with the cam.

11. A computing machine as claimed in any of the preceding claims, and comprising a non-print key, an additional type carrier for printing a characteristic mark denoting a non-print cycle of the machine, spring means biasing said additional type carrier into a printing position, first stop means and second stop means preventing movement of said additional type carrier into a printing position, the said first means being released by the operating mechanism of the machine during a cycle of operations, the said second stop means being released by operation of the non-print key.

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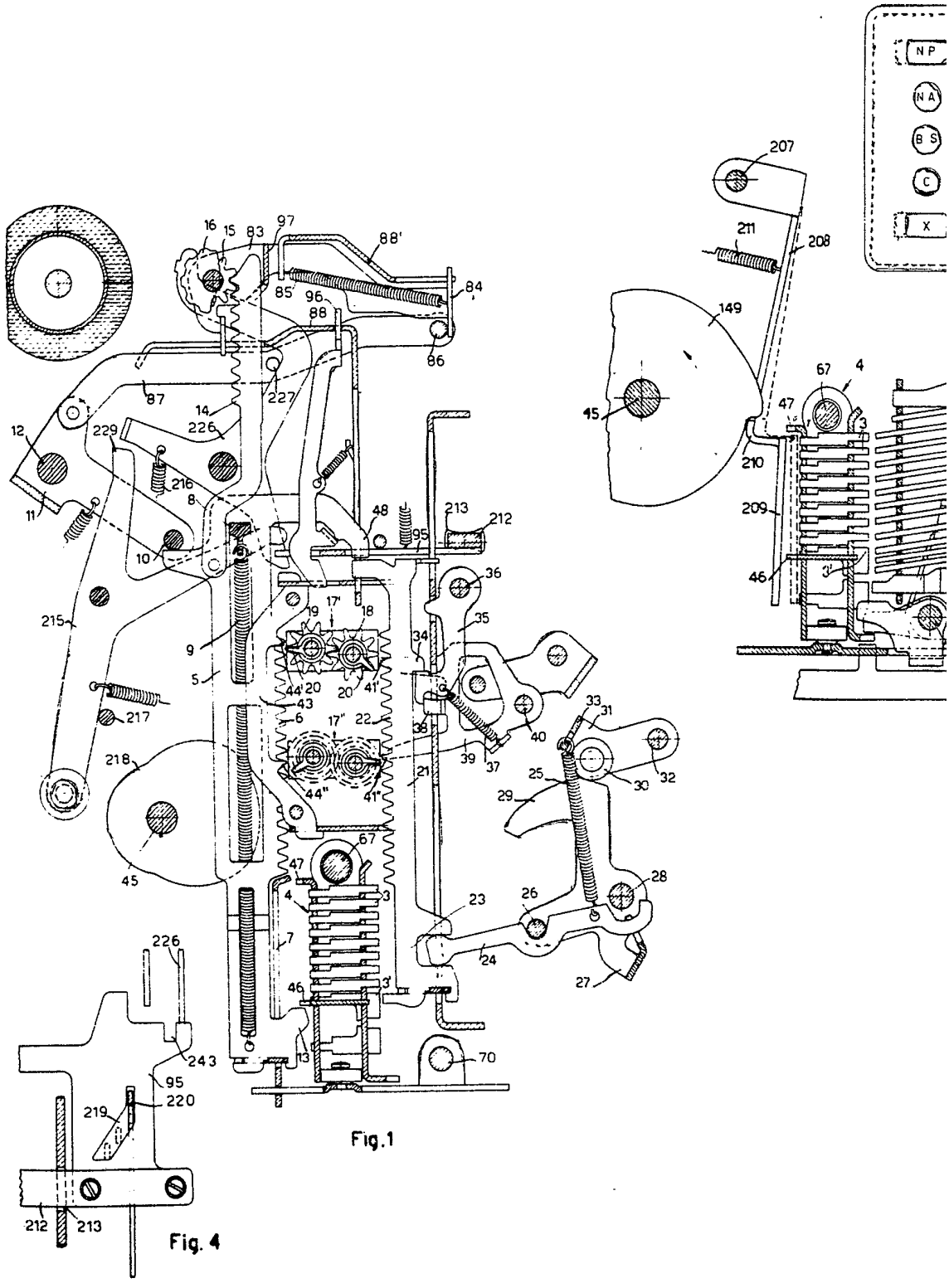
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Fig.1

Fig. 4

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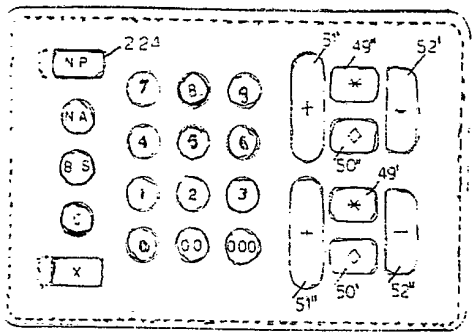

Fig. 2

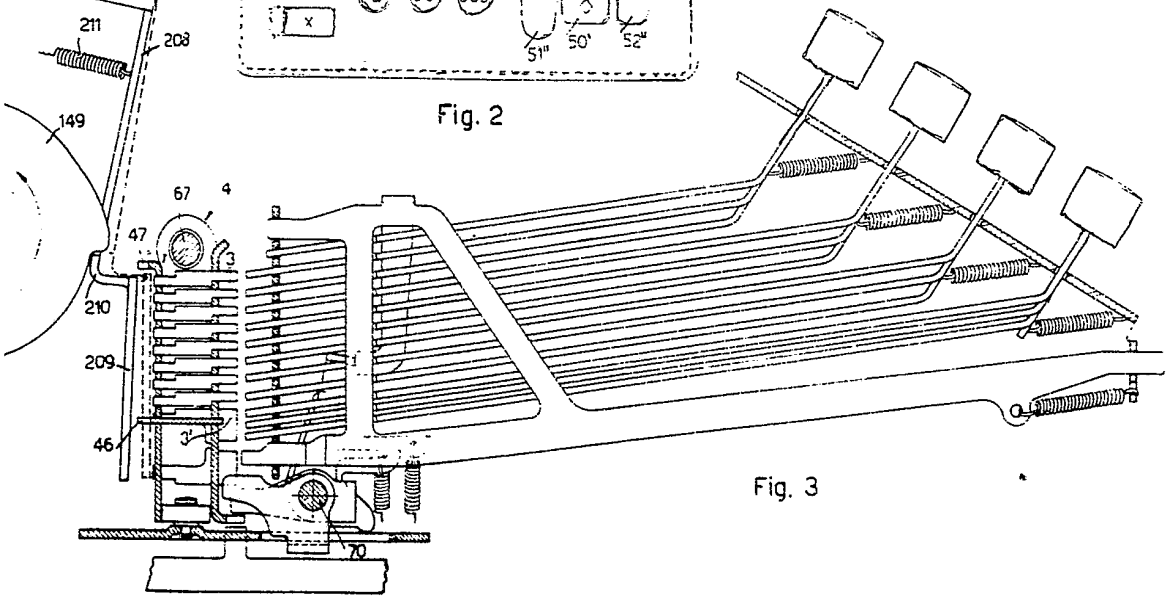

Fig. 3

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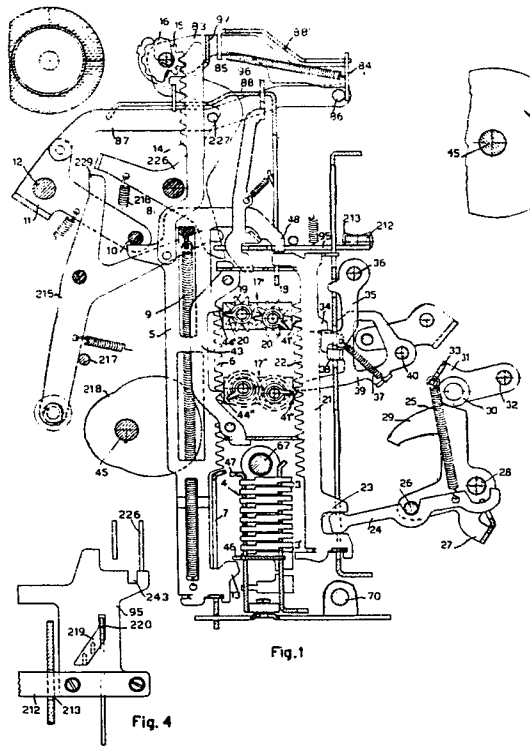

Fig. 1

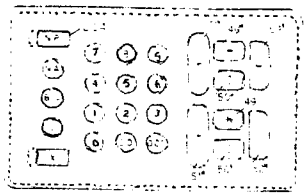

Fig. 2

Fig. 3

Fig. 4