

July 16, 1935.

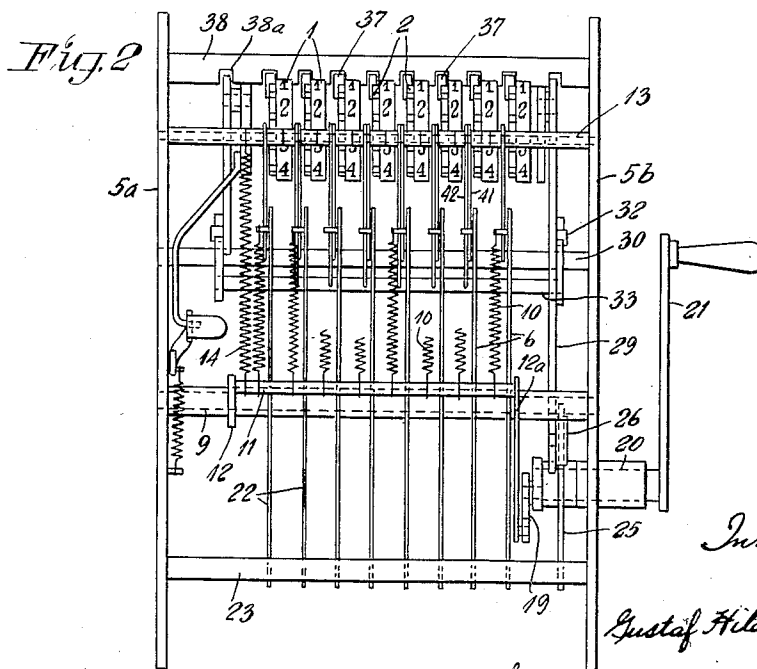
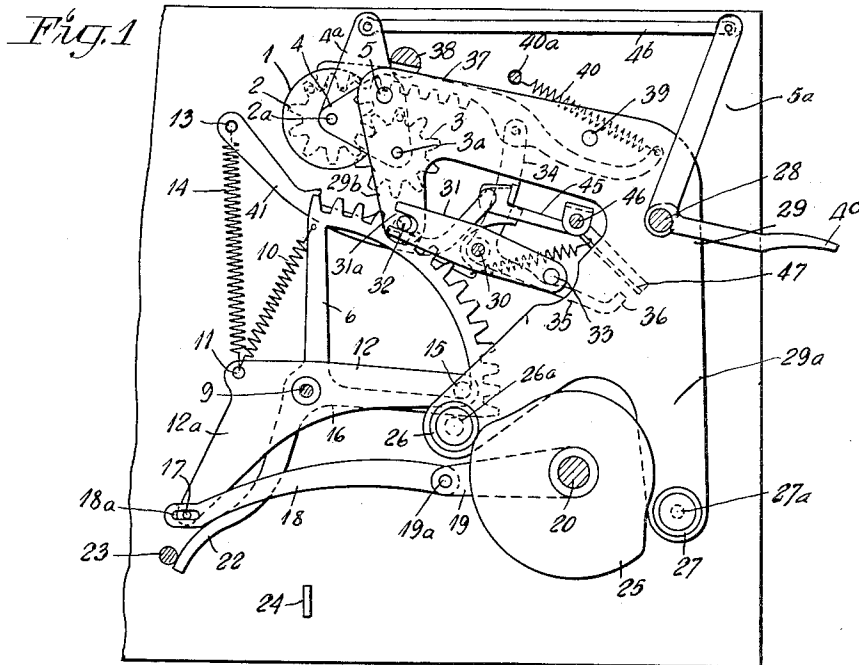
G. H. HELLGREN

2,008,355

TENS CARRYING MECHANISM FOR CALCULATING MACHINES AND THE LIKE APPARATUS

Filed Nov. 14, 1931

4 Sheets-Sheet 1



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July 16, 1935.

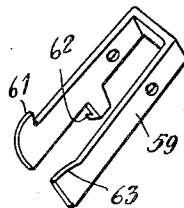
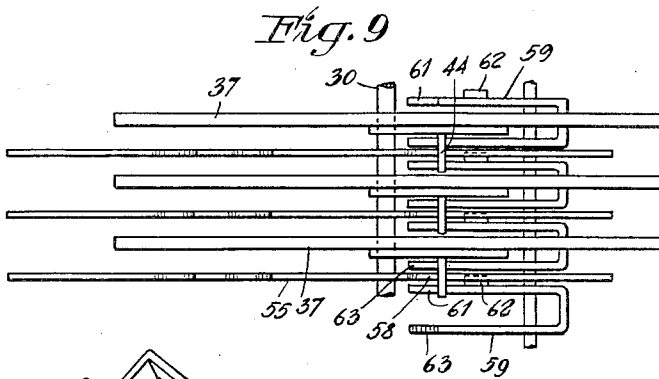
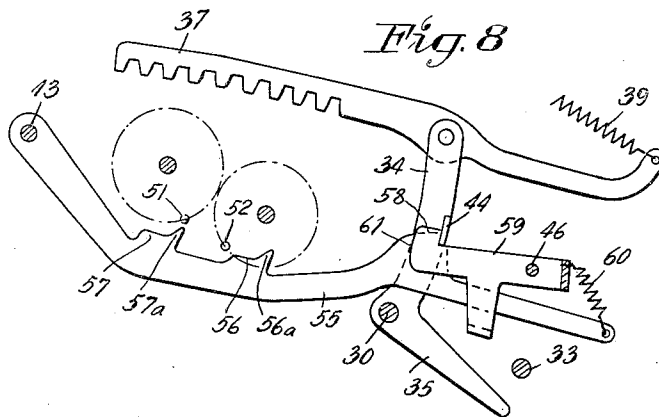
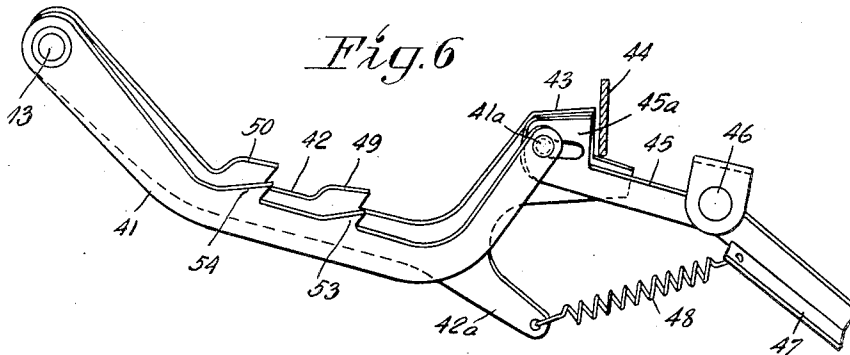
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TENS CARRYING MECHANISM FOR CALCULATING MACHINES AND THE LIKE APPARATUS

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4 Sheets-Sheet 3



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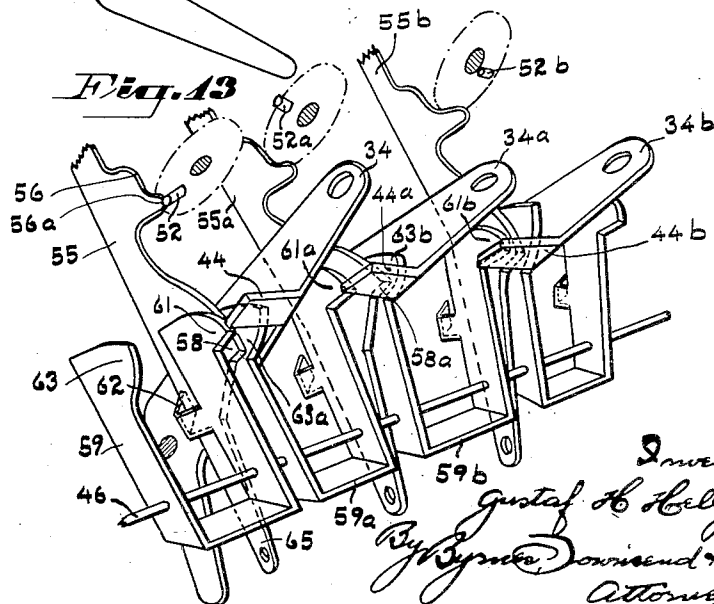
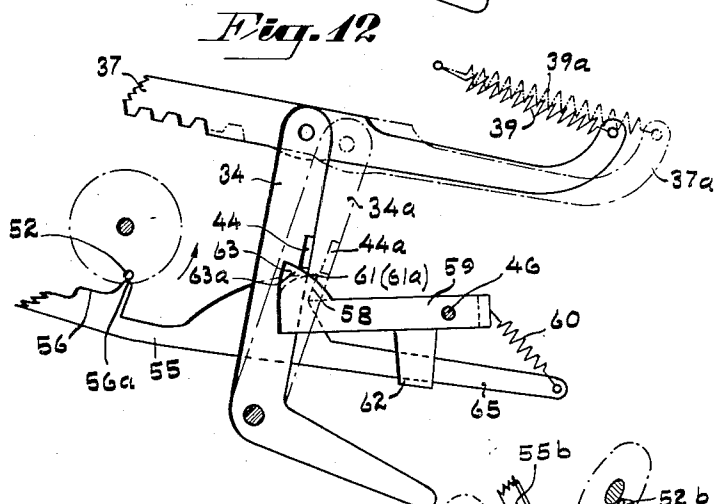
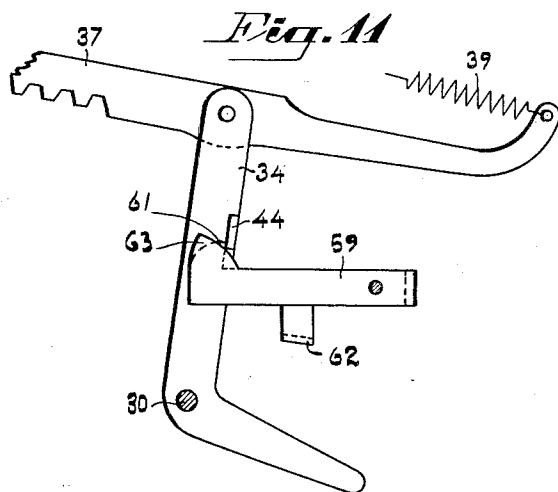
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TENS CARRYING MECHANISM FOR CALCULATING MACHINES AND THE LIKE APPARATUS

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,008,355

TENS-CARRYING MECHANISM FOR CALCULATING MACHINES AND THE LIKE APPARATUS

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 In Germany November 21, 1930

12 Claims. (Cl. 235—137)

The present invention relates to a tens-carrying mechanism for calculating machines, cash-registers and similar machines having adding or subtracting counters, in which the various orders may be operated independently of the other orders, so that a tens-carrying operation may be carried out in each order separately. In general, the tendency is to carry out the tens-carrying operation in a compulsory manner, and for this purpose it has already been proposed to utilize special gearings in engagement with the gear wheels of the counters, special arrangements being provided, by means of which the gear wheels of the counters are kept under a certain tension, in order to eliminate the usual play between the teeth of the gears in engagement with each other. Such arrangements are, however, very complicated and in certain cases this arrangement is dependent on spring-power action. According to the present invention, the tens-carrying operation is effected for each single order in a compulsory manner and at the same time the third following order is prepared for performing a tens-carrying operation independently of movements of rotatable parts in the second order.

The chief feature of the invention thus consists in that on releasing the tens-carrying member for a second order by the preceding unit the tens-carrying member for the third order is set into a position from which it may be released or in certain cases is entirely released, independently of movements of rotatable parts of the second order. For this purpose the tens-carrying member associated with the second order and released by the preceding or first order, is adapted to act upon a locking device for the tens-carrying member of the third order in such a manner, that this latter member is set into position from which it may be released or in certain cases is entirely released. The locking device substantially consists of two locking levers, one of which releases, when the pertaining unit carries over from 9 to 0 (or vice versa from 0 to 9), the tens-carrying member for the following order, and the other lever releases said tens-carrying member, when the pertaining unit occupies the position 9 (during addition) or the position 0 (during subtraction), the first named lever also being arranged to be actuated by the tens-carrying member belonging to the preceding order.

Some forms of embodiment of the invention will be described in the following with reference to the accompanying drawings, in which—

Figure 1 is a lateral view of the apparatus ac-

cording to the invention in its initial position, one side wall being removed to clearly show the interior parts.

Fig. 2 is an end view of the apparatus shown in Fig. 1.

Fig. 3 shows certain parts of the apparatus in a different position.

Fig. 4 shows the parts of Fig. 3 seen from above.

Fig. 5 shows details of the tens-carrying mechanism in two different positions, one position showing the locking device in a released state.

Fig. 6 is a perspective view of the locking levers on a larger scale.

Fig. 7 is a diagrammatic view of a portion of the locking levers in two different positions.

Fig. 8 shows details of a tens-carrying mechanism of a modified form.

Fig. 9 shows a part of Fig. 8 seen from above.

Fig. 10 is a perspective view of a detail of the modified locking device.

Figs. 11 to 13 illustrate the apparatus so as to show the manner in which a rock lever of lower order actuates a member of the next higher order to partly free the transfer member.

In order to make the manner of operation of the tens-carrying mechanism understandable, the operation of the units of the calculating mechanism proper will now be explained in connection with a transmitting device. The counter proper consists of the numeral wheels 1 which in usual manner are integral each with a toothed wheel 2 which is in engagement with another toothed wheel 3, in order to render possible the carrying out of additions and also of subtractions. The toothed wheels are mounted on spindles 2a and 3a, respectively, journaled in two bridges 4. One of the bridges has an upward extension 4a which is connected by a link 4b to a bell crank lever 4c that is pivoted on a rod 28. By adjustment of the lever 4c, the bridges 4 may be rocked about studs 5 fixed to bridges 29 to be described later, so that either of the toothed wheels 2 or 3 may be brought into engagement with the calculating sectors 6, depending on the mode of calculation to be carried out. As will be seen from Fig. 3, when carrying out additions, the toothed wheel 3 will be in engagement with the toothed sector 6, the toothed wheels 2 and 3 rotating in the directions indicated by the arrows 8 and 7, respectively, when the toothed sector is rotated in clockwise direction. During subtractions the conditions are reversed, that is to say, the toothed wheel 2 will be directly in engagement with the toothed sector 6. The toothed sectors are jour-

naled side by side on a rod 9 and are influenced each by its own spring 10 which connects the sectors with a rod 11 fixed between two bridges 12, 12, the bridges also being journaled on the rod 9. To the side walls 5a and 5b is further attached a transverse rod 13 on which are journaled locking levers 41 and 42 to be described later. The rod 11 connecting the bridges 12, is connected with the rod 13 by means of a spring 14 which has the tendency to rotate the bridges 14 around the rod 9 in clockwise direction. At the opposite end of the bridges 12 with respect to the rod 9 the bridges are interconnected by a transverse rod 15 which extends through all toothed sectors 6 and normally is resting on one of the spokes 16 of the toothed sectors. One of the bridges 12 has further an arm 12a, at the free end of which is fixed a pin 17 surrounded by a longitudinal slot 18a at the end of a link 18 which is pivoted as at 19a, to a crank 19. This crank is securely fixed to the main shaft 20 of the apparatus. For the sake of simplicity the main shaft 20 is in the present case shown as provided with a crank 21 operable manually, but it is to be understood that the main shaft also may be driven by motor power.

When the shaft 20 is rotated in clockwise direction, obviously the bridges 12, 12 with the extension 12a will, during the first half revolution of the shaft 20, be rotated in counter-clockwise direction, so that the rod 15 will be removed from the spokes 16 of the calculating sectors 6 which, influenced by the springs 10, also rotate in counter-clockwise direction about the rod 9. Each toothed sector 6 is provided with an arm 22 extending downwardly and normally abutting against a rod 23 fixed to the side walls 5a and 5b. When the sectors 6 are rotated in counter-clockwise direction, as just mentioned, they will abut against a stop device 24. The stop device 24 shown is one of a plurality of similar stop devices which in a manner similar to that as illustrated in Figs. 2 and 3 of the copending application Ser. No. 598,647 are set by means of keys on the key board into the path of movement of the arms 22, whereby the sectors are set to a position corresponding to the numeral key pressed down. It is to be understood that the invention is not limited to this kind of stop devices, and further the stop devices as such do not form a part of the present invention. On the shaft 20 having rotated 180° and when the shaft now is further rotated in clockwise direction to the position as shown in Fig. 1, obviously the bridges 12 will be rotated in clockwise direction, and the rod 15 fixed between the bridges carries along the sectors 6 to the initial position, whereby the numerals introduced by the keys pressed down into the machine, will be transferred to the numeral wheels 1 in a manner to be described later.

In order to bring the numeral wheels 1, that is to say one of the toothed wheels 2 or 3, into engagement with the toothed sectors 6 during the return stroke of the latter, provision has been made for the following arrangement. To the shaft 20 is securely fixed a cam disk 25 which co-operates with two rollers 26 and 27 which are journaled on studs 28a and 27a, respectively, fixed to the ends of an angular member 29a integral with a bridge 29 journaled on a rod 28 attached to the side walls 5a and 5b. A similar bridge is journaled on the other end of the rod 28 which, however, has no angular extension 29a and therefore no rollers 26 and 27. The pivots 5 about which the bridges 4 for the shafts 2a and 3a may

be rocked are fixed, as stated above, to the bridges 29. The cam disk 25 has such a form, that the roller 26, at the initial position of the parts, is pressed away from the shaft 20, so that none of the wheels 2 and 3 is in engagement with the sectors 6. As soon as the shaft 20 has been rotated an angle of about 180°, the enlarged part of the cam disk 25 will move away from the roller 26 and instead thereof will press against the roller 27, so that the wheel 3 (or as the case may be the wheel 2) will be brought into engagement with the sector 6, until finally, at the end of the rotation of the shaft 20, the bridges 29 are again rocked in clockwise direction, thereby bringing the wheel 3 (or the wheel 2) out of engagement with the sector 6. Fig. 3 shows the position of the parts, from which position the sector 6 will be rotated by the rod 15 in clockwise direction away from the stop device 24 to the initial position as shown in Fig. 1. The numeral wheel 1 will thus be rotated proportionally to the angular movement of the sector 6 during the return stroke of the latter.

To the side walls 5a and 5b is further attached a spindle 30 on which are journaled two double-armed levers 31. One arm of one of these levers is provided with an open slot 31a which surrounds a pin 32 fixed to a depending portion 29b of the bridge 29. The other arms of the levers 31 are connected with each other by a rod 33, which extends over the parts belonging to the tens-carrying mechanism. From the above it will be clear, that the lever 31 and thereby the rod 33 will be rotated about the rod 30 in the same direction, as the bridges 29 are rocked about the rod 28, that is to say, both parts will simultaneously rotate in clockwise direction or in counter-clockwise direction.

The tens-carrying mechanism consists of the following parts.

For each order of the counter there is provided a bell crank 34, 35 journaled on the rod 30. The arm 35 of the bell crank co-operates with the rod 33 attached to the levers 31 and is bent up at its free end to form a projection 36 which is adapted to co-operate with a locking device 47 to be described later. The free end of the other arm 34 is pivoted at 34a to a toothed rack 37. For guiding this toothed rack 37 there is provided a rod 38 which has transverse grooves 38a, through which the racks 37 extend. To the side walls 5a and 5b is further attached a rod 39, against which the toothed racks 37 rest (see Fig. 5), when they are moved forwards by the influence of springs 40 in a manner to be described later. The springs 40 are attached to an upright part 37a of the racks and to a rod 40a fixed to the side walls 5a and 5b. The bell crank 34, 35 is normally kept in its initial position by means of a locking device in such manner, that, when the toothed wheels 2 or 3 are moved out of engagement with the sector 6 in an upward direction (Fig. 1), the toothed wheel 2 or the toothed wheel 3 will come into engagement with the toothed rack 37, so that by this means the toothed wheels and thereby the numeral wheels 1 are locked.

According to a preferred embodiment of the invention, the locking device for the bell crank comprises the following parts: On the rod 13 are journaled two locking levers 41 and 42 (Fig. 6). The locking lever 42 has a locking hook 43 which engages a projection 44 bent at right angles from the material of the arm 34 of the bell crank. The other locking lever 41 is pivoted at 41a to a double-armed lever 45 which is journaled on a

rod 46 attached to the side walls 5a and 5b. One arm of this lever 45 has a locking hook 45a to engage with said projection and the other arm of the lever 45 has an edge 47 bent at right angles with respect to the plane of the lever 45, and further the arm with this angular part 47 is bent about a vertical plane in such a manner, that the part 47 is in the path of movement of the projection 36 on the bell crank 34, 35 belonging to the preceding unit. The locking lever 42 has a downward extension 42a, and between this extension and the angular part 47 is attached a spring 48. The locking lever 42 has a projection 49 for additions and a similar projection 50 for subtractions. The toothed wheels 2 and 3 are provided with pins 51 and 52, respectively, extending at right angles thereto (see Figs. 3 and 5) which are adapted to co-operate with said projections 50 and 49 respectively. The levers 41 are provided with projections 54 and 53 of a different shape than the projections 50 and 49 and also adapted to co-operate with the pins 51 and 52 on the wheels 2 and 3, respectively.

In Fig. 7 is diagrammatically shown, in which manner the pin 52 on the wheel 3 co-operates with the projections 49 and 53 on the levers 42 and 41. It is presumed that the pin 52 shown with full lines to the left of Fig. 7 is moving in the direction of the arrow 7 and assumes successively the positions 52a, 52c and 52b shown with dash-dotted lines. When the pin is in the position designated with 52a, the numeral wheel 2 will be in a position showing the numeral 9. In this position the lever 42 will be moved downwards from the position shown with full lines to the position shown with dash-dotted lines, and this to such an extent, that the hook 43 will release the projection 44 on the bell-crank 34, 35. As, however, a hook 45a on the lever 45 pivoted to the lever 41 is still in the path of movement of the projection 44 on the bell crank 34, 35, the bell crank and thereby the toothed rack 37 are not yet entirely released. Now, when the pin moves from the position 52a to the position 52b, that is, when the numeral wheel moves from 9 to 0, the pin will, when it reaches the position 52c, press against the projection 53 on the lever 41 and move the lever 41 from the position shown with full lines to the position shown with dash-dotted lines, whereby the hook 45a will be removed from the projection 44 on the bell crank 34, 35, so that the toothed rack 37 influenced by its spring 40 will snap forwards a distance corresponding to one tooth of the toothed wheel 2. The toothed rack 37 is thus moved from the position shown with dash-dotted lines in Fig. 5 to the position shown with full lines, the rod 39 preventing the toothed rack 37 from coming into engagement with the toothed wheel 2, before this toothed wheel 2 has finished its rotation emanating from the return stroke of the toothed sector 6. The forward movement of the toothed rack 37 is limited by the bell crank 34, 35 engaging the rod 33 with its arm 35 (see Fig. 5). At the same time as the bell crank 34, 35 rocks about the rod 30, the projection 36 on the arm 35 lifts the angular plate 47 belonging to the following unit, that is to say, the hook 45a Fig. 6 is removed from the projection 44 on the bell crank 34, 35 of the next following unit, so that this next unit is prepared for carrying out a tens-carrying operation, if this should be required. By this arrangement, the movement of the number wheel of one order from 9 to zero releases the hook 45a that controls the carrying

rack 37 of the next or second order, and the resulting forward movement of the rack 37 of the second order rocks its associated bell crank 34, 35 to move the lever 45 to release the hook 45a of the control mechanism for the rack 37 of the third order. This release of the hook 45a of the third order control is thus effected whenever a number is to be carried into the second order and whether or not the number wheel of the second order stands at nine at the beginning of the tens-carrying operation. It is clear, that a similar action will be obtained, when the pin 51 on the toothed wheel 2 is co-operating with the projections 50 and 54, in case the apparatus is set for subtractions, that is to say when the bridges 4 are rocked about the studs 5 and provided said second order stands at naught.

As stated above, the calculating mechanism proper is operatively connected with the levers 31 through the intermediary of the cam disk 25 and the bridges 29 in such a manner, that the rod 33 engages the arm 35, as soon as the sector 6 has reached its initial position and the wheels 3 or 2, respectively, has been brought out of engagement with the sector 6. The rod 33 will then press the arm 35 downwards and thereby move the toothed racks 37 backwards, whereby the numeral wheel 1 will be rotated one tooth in the same direction, as when the sector 6 has been in engagement with the toothed wheel 3, and at the same time the projection 44 will be moved behind the hooks 43 and 45a on the levers 42 and 45 respectively. The spring 42 has been mounted between the angular plate 47 and the extension 42a on the lever 42 in such a manner, that it has the tendency to rotate the levers 41 and 42 in counter-clockwise direction about the rod 13. From the above it will be clear, that the tens-carrying operation is carried out compulsorily and on the other hand is effected, after the numeral wheels in the various units have been operated by the calculating mechanism proper, and thirdly that at the same time the tens-carrying operation has been prepared for the next following unit, without being dependent on rotating parts.

The modified form of embodiment of the invention shown in Figs. 8-13 differs from the first example with respect to the following parts. Each order has only one lever 55 journaled on the rod 13 and provided with projections 56, 56a for additions and 57, 57a for subtractions. The projections consist in this case of a combination of the projections 49, 53 and 50, 54, respectively, that is to say, the portion 56 corresponds to the projection 49 in Fig. 6 and the portion 56a corresponds to the portion 53. The same is the case with respect to the projection 57, 57a. When the pin 52 (compare Fig. 7) is in the position corresponding to the numeral 9 on the numeral wheel, it will be on the portion 56, whereby the lever 55 is pressed down so much, that its hook 58 is released from the projection 44 on the bell crank 34, 35. Instead of the lever 41 with the double-armed lever 45 pivoted thereto, a special bow 59 has been provided, which is journaled on the rod 46 and is connected with the lever 55 by means of a spring 60. The shape of the bow 59 is more clearly shown in Fig. 10. One leg of this bow has a locking hook 61 which co-operates with the same projection 44 which is arrested by the locking hook 58. On the same leg is arranged a lateral projection 62 which extends underneath the lever 55. The other leg of the bow is provided with an inclined control sur-

face 63 which has the purpose, when a bell crank has been released, to press down the bow of the next following order, so that also in this case the tens-carrying mechanism for the third order is prepared by the first order through the intermediary of the second order. When the pin 52 thereafter moves to a position corresponding to the movement of the numeral wheel from 9 to 0, the pin engages the projection 56a, whereby the lever 55 is further pressed down and engages the lateral projection 62 on the bow 59, so that the locking hook 61 on this bow is removed from the projection 44 on the bell crank 34, 35, thus releasing the bell crank, whereby the toothed rack 37 influenced by its spring 39 will snap forwards in the same manner as described in connection with the first example.

The function of this tens-carrying mechanism is more clearly illustrated in Figs. 11-13, Fig. 11 showing the parts in their normal position. When, as shown in Fig. 12, the gear wheel with the pin 52 moves from "9" to "0", that is at the moment when the pin 52 rides on top of the projection 56a, the lever 55 is pressed down to such extent that its prolongation 65 operates the bow 59 which is turned about its pivot 46 in counter-clockwise direction, so that its hook 61 is freed from the projection 44 on the bell crank 34 belonging to the next higher order. Inasmuch as the hook 58 on the lever 55 has already been removed from the same projection 44, the rack 37 is now displaced one step in forward direction by the action of the spring 39. By this movement of the bell crank 34 with the rack 37, the projection 44 cooperates with the inclined surface 63a on the bow 59 of the third order under consideration, so that this bow is rocked about its pivot and its hook 61a is removed from the projection 44a on the bell crank 34a of said third order, the bell crank 34a with the projection 44a and the rack 37a being shown with dash-dotted lines in Fig. 12.

Referring to Fig. 13, it is assumed that the numeral wheel of the unit order moves from "9" to "0" and its pin 52 is just on top of the projection 56a of the lever 55, the tens order being in the "7" position, pin 52a, and the hundreds order being in the "2" position, pin 52b. The lever 55, 65 is pressed down, its hook 58 and also the hook 61 on the bow 59 are removed from the path of the projection 44 on the bell crank 34 belonging to the tens order. This bell crank 34 moves forwards and its projection 44 glides on the inclined surface 63a and thereby brings the bow 59a of the tens order to rock about its pivot 46 in counter-clockwise direction with the consequence that its hook 61a is freed from the projection 44a on the bell crank 34a of the hundreds order. As, however, the numeral wheel of the tens order stands in the "7" position, the pertaining pin 52a does not affect the lever 55a and therefore the hook 58a detains the projection 44a on said bell crank 34a, so that a transfer to the hundreds order does not take place. Should the numeral wheel of the tens order also be moved to the "9" position or beyond this position, then the hook 58a frees said projection 44a and the bell crank 34a snaps forwards with the consequence that the bow 59b belonging to the hundreds order is rocked through the intermediary of the projection 44a and the inclined surface 63b. In this case the hook 61b is removed from the projection 44b on the bell crank 34b belonging to the thousands order, thus preparing this order for a transfer.

In the description of the two examples, reference has been made to a first, second and third order. This, however, does not mean, that only the first three orders of a counter come into consideration, but it is the question of three successive orders; and these orders may be any of a counter, for instance the three last orders of a counter. In the example shown in Fig. 2 the counter has nine orders, and of these units any three orders situated side by side will be operated in the manner above referred to. It is further to be observed, inasmuch as always any three orders of a counter are concerned, that the tens-carrying operation may thus be carried out on all orders simultaneously and compulsorily. This arrangement is of great importance in counters having a great number of orders, especially when all orders are simultaneously moved from the numeral 9 to the numeral 0. The construction according to the present invention, therefore, is not only suitable for calculating machines, cash registers and the like, but may with the same advantage also be applied to any counter whatsoever, in which the first order only is operated, for by the special arrangement of preparing not only the second order but also the third and the following orders, counters having a great number of orders will be simultaneously prepared for a tens-carrying operation in all orders and also the tens-carrying operation will be carried out in all orders, so that a play between the teeth of the gearings will have no effect on the proper function of the tens-carrying mechanisms. The invention is further not limited to the details described and shown on the drawings, and the details may be modified without thereby limiting the scope of the invention. Thus, for instance, the toothed rack 37 may have the form of a sector or of a toothed wheel, and the spring influencing the various parts may be of another form or may be arranged in another manner than shown on the drawings.

What I claim is:—

1. Transfer mechanism for counters adapted for carrying and borrowing operations, comprising a plurality of sets of two gear wheels meshing with each other, actuating means therefor, transfer means for each set of gear wheels except that of the units denomination, means to bring either of said gear wheels into and out of engagement with its transfer means, two sets of detent means for retaining each of said transfer means, means including one of said gear wheels for actuating said detent means of the next adjacent denomination to free the transfer means thereof.

2. Transfer mechanism for counters adapted for carrying and borrowing operations, comprising counter mechanism for each denomination including two gear wheels meshing with each other, a reciprocating transfer member for each denomination except units, two sets of means to detain each of the transfer members in inoperative position, means to bring either gear wheel into and out of engagement with its transfer member, each gear wheel being provided with means to operate the detaining means of the next adjacent denomination to release its transfer member when the latter is out of engagement with its gear wheels, and means to return said released transfer member to its initial position to effect a transfer.

3. Transfer mechanism for counters adapted for carrying and borrowing operations, comprising two gear wheels meshing with each other and

cooperating with the respective counter wheels of a plurality of denominations, a reciprocating transfer member for each denomination except units, two sets of means to detain each of the transfer members in inoperative position, means to bring either gear wheel into and out of engagement with its transfer member, each gear wheel being provided with means to operate the detaining means controlling the transfer member of the order next higher than that of said each gear wheel, to release said transfer member when the latter is out of engagement with its gear wheels, means to return said released transfer member to its initial position to effect a transfer, and means to couple one of said detaining means controlling the transfer member of each other denomination with the transfer member of the next lower denomination.

4. Transfer mechanism for counters adapted for carrying and borrowing operations, comprising a plurality of sets of two gear wheels meshing with each other, a denomination wheel actuated by each set of gear wheels; a reciprocating transfer member for each denomination except the units, means to bring either gear wheel into and out of engagement with its transfer member, two detaining members to detain the transfer members in inoperative position, each gear wheel being provided with means operative when the transfer members are out of engagement with the pertaining gear wheels to actuate one detaining member to partly free the transfer member of the denomination next higher than that of the actuating gear wheel when the denomination wheel of said actuating gear wheel stands at respectively "9" or "0" and to operate the associated second detaining member to wholly free the transfer member when the said denomination wheel moves respectively from "9" to "0" or from "0" to "9", and means to return a released transfer member to its initial position to effect a transfer.

5. Transfer mechanism for counters adapted for carrying and borrowing operations, comprising a plurality of sets of two gear wheels meshing with each other, a denomination wheel actuated by each of said sets, a reciprocating transfer member for each denomination except the units, means to bring either gear wheel into and out of engagement with its transfer member, two detaining members to detain each transfer member in inoperative position, each gear wheel being provided with means operative, when the transfer members are out of engagement with the pertaining gear wheels, to actuate one of said detaining members to partly free the transfer member of the denomination next higher than that of the actuating gear wheel when the denomination wheel of said actuating gear wheel stands at respectively "9" or "0" and to operate the associated second detaining member to wholly free said transfer member when the said denomination wheel moves respectively from "9" to "0" or from "0" to "9", means to return a released transfer member to its initial position to effect a transfer, and means to couple said second detaining member for detaining the transfer member of any one denomination with the transfer member of the next lower denomination.

6. Transfer mechanism for counters adapted for carrying and borrowing operations, comprising a plurality of sets of two gear wheels meshing with each other, a denomination wheel actuated by each of said sets, a reciprocating transfer

member for each denomination except units, means to bring either gear wheel into and out of engagement with its transfer member, two detaining members to detain each transfer member in inoperative position, the gear wheels being provided with means operative, when the transfer members are out of engagement with the pertaining gear wheels, to actuate one of the detaining members to partly free the transfer member of the denomination next higher than that of the said actuating gear wheel when the denomination wheel of the said actuating gear wheel stands at respectively "9" or "0" and to further actuate the same said detaining member when the said denomination wheel moves respectively from "9" to "0" or from "0" to "9", the said one detaining member adapted to operate its associated second detaining member to wholly free said transfer member when the first-named detaining member is wholly operated, and means to return said released transfer member to its initial position to effect a transfer.

7. Transfer mechanism for counters adapted for carrying and borrowing operations, comprising a plurality of sets of two gear wheels meshing with each other, a denomination wheel actuated by each of said sets, a reciprocating transfer member for each denomination except the units, means to bring either gear wheel into and out of engagement with its transfer member, two detaining members to detain each transfer member in inoperative position, each set of gear wheels being provided with means operative, when the transfer members are out of engagement with the pertaining gear wheels, to actuate one of the detaining members to partly free said transfer member of the denomination next higher than that of the actuating gear wheel when the denomination wheel of the said actuating set of gear wheels stands at respectively "9" or "0" and to further actuate the same said detaining member when the denomination wheel moves respectively from "9" to "0" or from "0" to "9", its associated one detaining member adapted to operate the associated second detaining member to wholly free said transfer member when the first-named detaining member is wholly operated, means to return said released transfer member to its initial position to effect a transfer, and means to couple said second detaining member for detaining the transfer member of any one denomination with the transfer member of the next lower denomination.

8. Transfer mechanism for counters adapted for carrying and borrowing operations, comprising a plurality of sets of two gear wheels meshing with each other and provided with a transfer pin, a denomination wheel actuated by each of said sets of gear wheels, a spring actuated reciprocating transfer rack for each denomination except units, means to bring either gear wheel into and out of engagement with its transfer rack, a right angled lever for each transfer rack and pivoted at the angle, each transfer rack pivoted to one arm of its lever, a projection on each lever, pivoted latches normally engaging the said projections, the latch of each denomination being provided with cam surfaces to cooperate with either of said transfer pins of the gear wheels of the next lower denomination to free said projection when the pertaining numeral wheel stands at respectively "9" or "0", double armed latch levers, normally engaging the said projections of

the respective right-angled levers denomination, one arm of each said latch lever disposed in the path of movement of one arm of the right-angled lever of the next lower denomination, the other arm of each said latch lever by means of pin and slot pivoted to the end of a pivoted arm, each pivoted arm provided with cam surfaces to cooperate with either of said transfer pins of a set of gear wheels to free the projection which normally locks the right-angled lever and transfer rack of the next higher denomination when the numeral wheel of the set of gears cooperating with the said pivoted arm moves respectively from "9" to "0" or from "0" to "9", and a transverse rod to positively return said released transfer racks to their initial positions, whereby transfers are effected.

9. Transfer mechanism for counters adapted for carrying and borrowing operations, comprising a plurality of sets of two gear wheels meshing with each other and provided with a transfer pin, a denomination wheel actuated by each of said sets of gear wheels, a spring actuated reciprocating transfer rack for each denomination except units, means to bring either gear wheel of a set into and out of engagement with its transfer rack, a pivoted arm pivotally connected to each of said transfer racks, a projection on each said arm, two pivoted latches normally engaging each of the said projections, the first latch of each set being provided with a right-angled extension to cooperate with the second latch, said second latch of each set being provided with two double cam surfaces, the lower cam surfaces of the second latch associated with the projection on the pivoted arm cooperating with the transfer rack of one order being adapted to cooperate with either of said transfer pins of the gear wheels of the next lower order to free the said projection on the pivoted arm of the said one order from said second latch when the pertaining numeral wheel of said next lower order stands at respectively "9" or "0", the associated higher cam surfaces being adapted to cooperate with either of said transfer pins of the said next lower order to actuate said first-named latch to remove the same from said projection when the said pertaining numeral wheel moves respectively from "9" to "0" or from "0" to "9", said first-named latch provided with a cam surface adapted to cooperate with the said projection of the said next lower denomination, and a transverse rod to positively return said released transfer racks to their initial positions whereby transfers are effected.

10. In a calculating machine, the combination with a series of counter mechanisms, means for selectively setting said counter mechanisms, and operating means for simultaneously engaging said counter mechanisms to actuate the same, of transfer elements arranged between adjacent

counter mechanisms, means mounting said transfer elements for movement from inactive position to active position, means normally locking said transfer elements in inactive position, means actuated by the movement of one of said counter mechanisms through the nine-zero interval and while engaging said operating means, for releasing the locking means for the next higher (second order) transfer element and for simultaneously setting the locking means for the second higher (third order) transfer element for the release thereof by the operating-means-actuated movement of the second order counter mechanism into its nine position, and means actuated by the operating means for simultaneously returning to inactive position those of said transfer elements which were unlocked and moved to active position.

11. In a calculating machine, the combination with a series of counter mechanisms of a transfer mechanism between each pair of adjacent counter mechanisms, each of said transfer mechanisms comprising means for actuating the corresponding counter mechanism, means actuated by the movement of any given counter mechanism through the nine-zero interval for preparing the transfer mechanism of the next higher counter mechanism for a tens-transfer from the said given counter mechanism and for preliminarily preparing the transfer mechanism controlling the second higher counter mechanism for a tens-transfer to the said second higher counter mechanism, and means actuated by the movement of the said next higher counter mechanism into or through the nine position prior to the transfer operation to prepare the second higher transfer mechanism for a transfer thereto.

12. In a calculating machine, the combination with a series of order mechanisms each comprising a counter mechanism, actuating means therefor and means mounting said counter mechanism for movement into and out of engagement with said actuating mechanism, of a transfer mechanism between adjacent order mechanisms, operating means for actuating said mounting means to move said counter mechanism successively into engagement with said actuating means and said transfer means, two separate locks for normally rendering each transfer mechanism inactive, means actuated by the movement of the counter mechanism of one order to nine to release one lock of the transfer mechanism of the next higher order, and means actuated by the movement of the first counter mechanism through the 9-0 interval to release the second of said locks of the transfer mechanism of both the next and the second higher order.

GUSTAF HILARIUS HELLGREN.

CERTIFICATE OF CORRECTION

Patent No. 2,008,355.

July 16, 1935.

GUSTAF HILARIUS HELLGREN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, first column, line 1, claim 8, strike out the word "denomination"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of August, A. D. 1935.

(Seal)

Leslie Frazer
Acting Commissioner of Patents.

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