Oct. 7, 1930. K. V. RUDIN 1,777,898

TRANSFER MECHANISM

Filed July 7, 1925 3 Sheets-Sheet 1

*Fig. 1.*

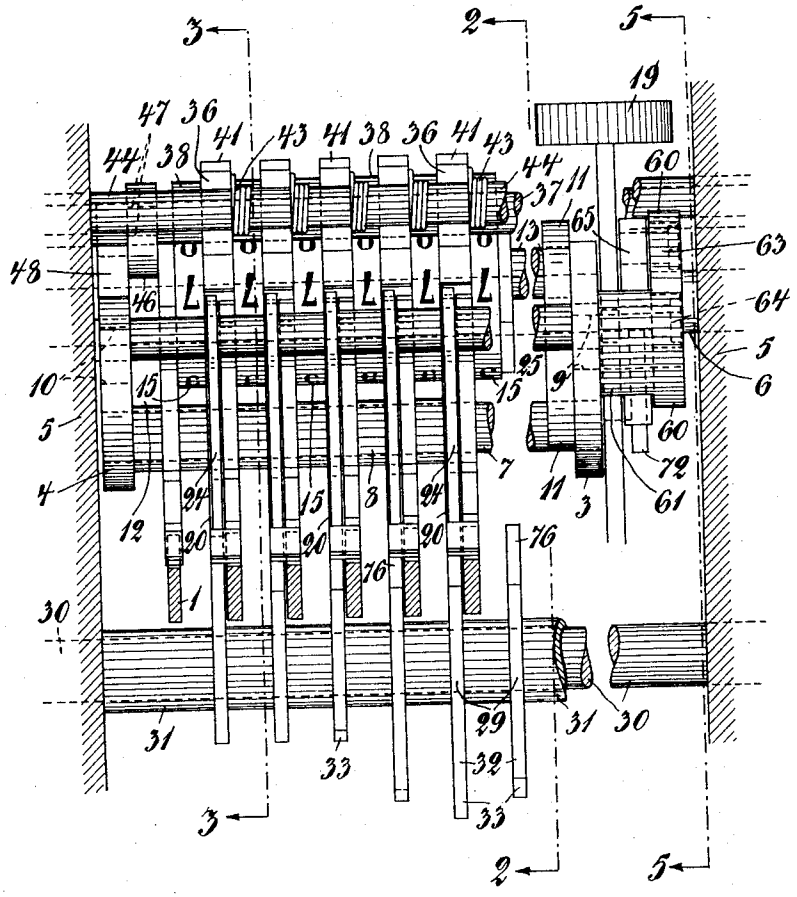


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Fig. 2.

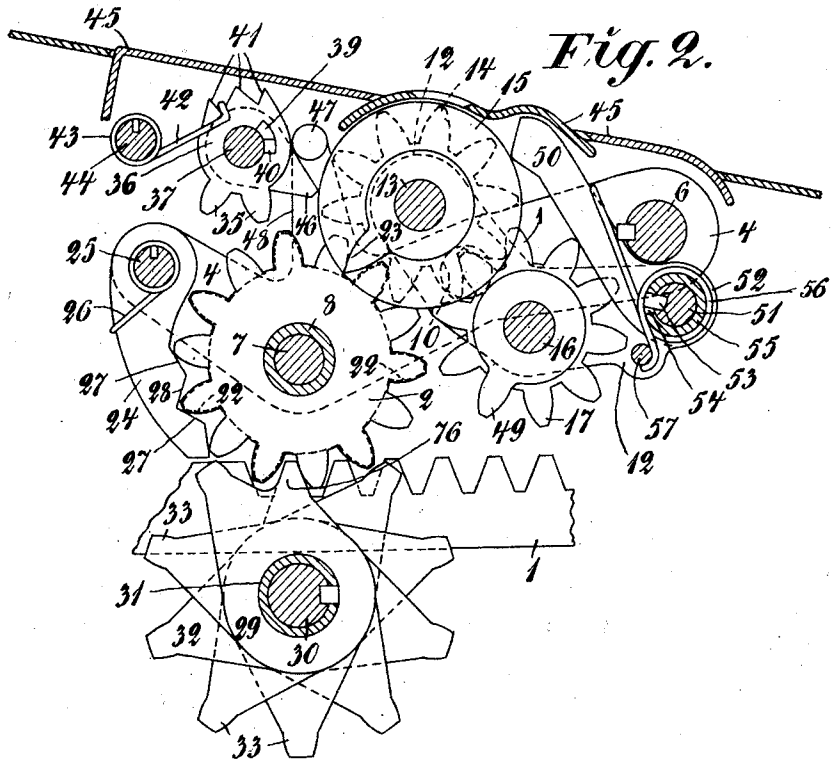


Fig. 3.

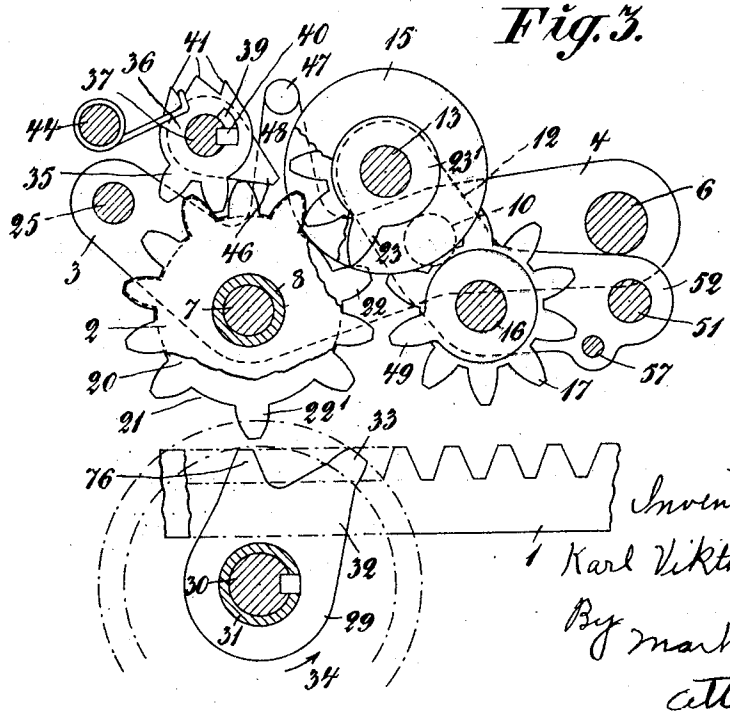


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*Fig. 4.*

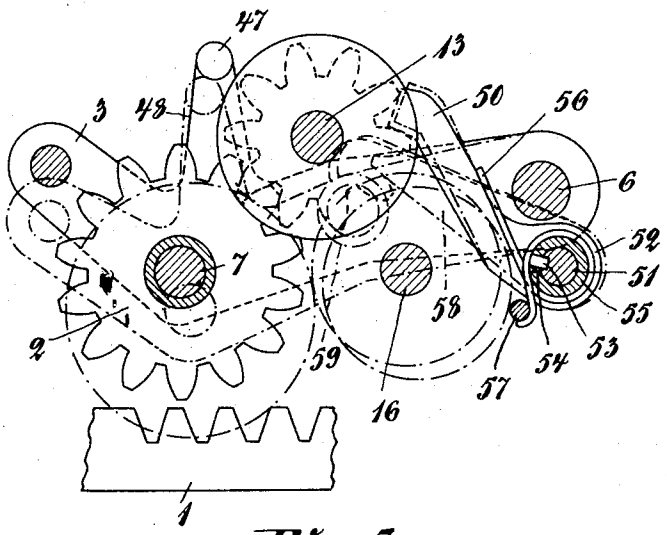
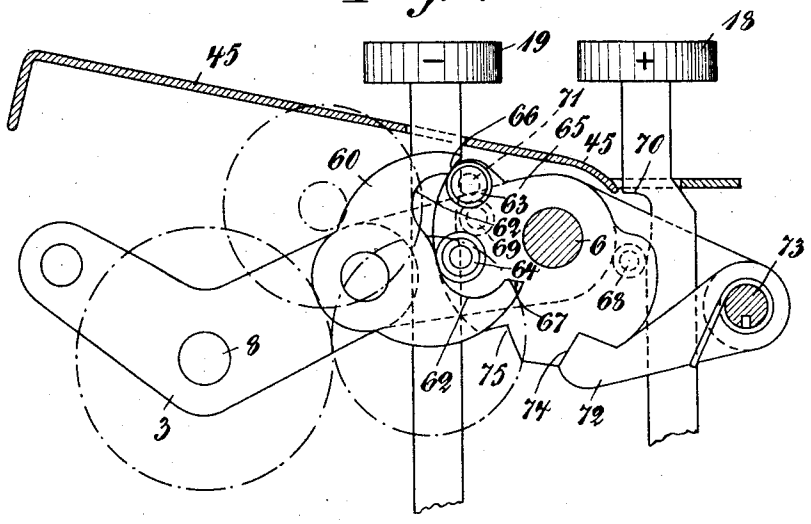



*Fig. 5.*

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# UNITED STATES PATENT OFFICE

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## TRANSFER MECHANISM

Application filed July 7, 1925, Serial No. 42,081, and in Sweden July 18, 1924.

The present invention relates to calculating machines provided with tens carrying members in the form of wheels or like rotating members each of which is adapted to be rotated for a certain angle by the actuation of the tens carrying tooth on the corresponding number wheel, being thereby brought into operative position relatively to a driving mechanism from which it is subsequently rotated for another angle in the same direction. The second rotation constitutes the carrying motion transferring the ten to the number wheel of next higher order, at the same time restoring the carrying wheel to inoperative position in which it is exposed to new action of the tens carrying tooth on its own number wheel.

The main object of this invention is to provide a carrying mechanism of the kind in question in which the direction of rotation of the tens carrying wheels is independent of the kind of calculating operation (adding, subtracting and so on) thus considerably simplifying the carrying mechanism. Further simplification of the machine is attained by other features of the invention as will be seen from the following specification.

The invention will be described with reference to the accompanying drawings illustrating by way of example one embodiment of the invention in connection with a special kind of adding machine. However, the invention may also be used in connection with other calculating machines.

Fig. 1 is a rear view of the totalizer and the carrying mechanism, the middle parts thereof being broken away and the figure being contracted in axial direction. Fig. 2 is a section on line 2—2 in Fig. 1. Fig. 3 is a section on line 3—3 in Fig. 1. Fig. 4 is the same section as Fig. 3, some of the parts shown in Fig. 3 being, however, omitted in Fig. 4 for the sake of clearness. Fig. 5 is a section on line 5—5 of Fig. 1.

The adding machine shown in the drawings is of the kind in which each item is first set up by means of setting wheels or the like assembled in a setting mechanism (not shown on the drawings) from which the item set up is subsequently transferred to the totalizer by means of transfer members consisting in the present case of reciprocating racks 1 meshing with transmission wheels 2 which in turn are in engagement, either directly or through the medium of intermediate gears, with the numeral wheels of the totalizer. The latter is adapted to be thrown out of mesh with the system of racks after the item transfer has been accomplished, thus allowing the said racks to be restored to their initial positions by idle motion. For this purpose the totalizer as a whole including the transmission wheels 2 is supported by rocking arms 3, 4 provided each at one end of the totalizer, said arms being keyed on a shaft 6 pivotally mounted in the frame 5 of the machine. In order to cause the transmission wheels 2 to mesh with the racks 1 during the item transfer operation the arms 3, 4 are swung down toward the system of racks, the totalizer then occupying the position shown in Fig. 2. The said item transfer operation is performed by the action of the driving means of the machine. By the further action of the said driving means a certain rotating movement will be imparted to the shaft 6 causing the arms 3, 4 and the totalizer to be swung into an upper position, as shown in Fig. 3, the transmission wheels 2 being then out of mesh with the racks 1. The said upper position is occupied by the totalizer during the tens carrying operation. The displacing movements of the totalizer may in addition be utilized, according to this invention, to operate certain new means for preventing overthrow and other accidental movements of the tens carrying wheels as well as other devices described in the following. The totalizer is covered by a sheet metal plate 45 forming part of the protecting cover of the machine, said plate being rigidly connected with the totalizer supporting arms 3, 4 and adapted to partake in the rocking movements thereof. The driving mechanism of the machine operating the rocking shaft 6 of the totalizer as well as the reciprocating racks 1 and other driving members described below may be of any known kind and need not be described.

The transmission wheels 2 are loosely mounted on a common shaft 7 supported by the arms 3, 4, the hubs of the wheels at the same time serving to space the wheels apart. Applied to the inner sides of the arms 3, 4 are bearing pieces 11 and 12 respectively said pieces being pivotally mounted on the arms by means of shafts or journals 9 and 10 respectively. The said pieces serve as supports for the totalizer, the common shaft 13 of the totalizer wheels, each of which is composed in the usual manner of a gear wheel 14 and a digit wheel 15. The shaft 13 is journaled in the pieces 11 and 12 above their pivots 9 and 10, while the common shaft 16 of the intermediate gear 17 is similarly supported in these pieces below their pivots. As usual the totalizer wheels as well as the intermediate gears are loosely mounted on their shafts. As will be seen, the whole system of totalizing wheels and intermediate gears is swingably mounted in the rocking frame formed by the shaft 6 and the arms 3 and 4, said system being thus adjustable relatively to the transmission wheels 2 which are mounted directly in the said frame. By this arrangement the transmission wheels 2 may at will be brought into mesh with the totalizer wheels 14, 15 or with the intermediate gears 17, the first adjustment being intended to be used for adding (multiplying) operations, while the second adjustment is to be used for subtraction (division). The said adjustments are performed by means of adjusting keys 18 and 19 respectively.

The adjustable tens carrying wheels consist of toothed wheels 20, loosely mounted on the shaft 7 of the transmission wheels 2, each of the carrying wheels 20 being disposed close to the transmission wheel 2 allotted to the number wheel of next higher order. The addendum circle, pitch circle and root circle of the carrying wheels 20 are substantially of the same diameters, as those of the transmission wheels 2, alternate teeth of the latter being, however, removed so as to form enlarged tooth spaces 21. In Fig. 2 the teeth 22 of the carrying wheels 20 are indicated by dotted lines. Each of the totalizer wheels 14, 15 except that of the highest order is provided with a tens carrying tooth 23 projecting from a plate 23′ secured to that side of the digit wheel 15 which is adjacent to the number wheel of the next higher order. The tens carryings teeth 23 are intended to cooperate with the tens carrying wheels 20 in the adding position of the totalizer shown in Fig. 2. Each of said teeth in the moment of change from the 9-position (shown in Fig. 2) of the number wheel to the 0-position will actuate that tooth of the pertaining carrying wheel 20 which stands in the path thereof, thereby rotating said carrying wheel for an angle corresponding to the pitch of the transmission wheel 2 and thus corresponding to half of the pitch of the carrying wheel 20. The latter is thus caused to occupy the position shown in Fig. 3. To hold the carrying wheels 20 in their normal or prepared positions respectively there is provided a corresponding number of holding pawls 24, which are mounted on a common shaft 25 supported by the arms 3, 4. Each of the holding pawls is pressed against the pertaining carrying wheel by means of a spring 26 so as to engage one of the teeth 22 of the carrying wheel by means of a notch 28, provided that the wheel stands in normal position as in Fig. 2, while in the adjusted position of the carrying wheel two oblique locking edges 27 on the holding pawl will engage the opposed faces of two adjacent teeth 22.

For the purpose of transmitting driving power from the driving means of the machine to the carrying wheels there is provided a corresponding number of driving disks 29 mounted on a common shaft 30 extending underneath the racks 1 and parallelly to the shafts of the totalizer, said shaft 30 being pivotally mounted in the frame of the machine. The hubs 31 of the disks are keyed to the shaft 30 at the same time serving as spacing members determining the proper positions of the disks in such a manner that each disk will be in alignment with the corresponding carrying wheel 20. Each of the driving disks 29 is provided with a rigid arm 32 the outer end of which forms a tooth 33. The different arms 32 are projecting in different angular directions, being distributed spirally round the shaft so as to produce progressive operation in the usual manner of the series of carrying wheels. Each disk 29 is further provided with a shorter arm the outer end of which forms a tooth 76 normally projecting upwardly into the opposed tooth space 21 of the corresponding carrying wheel 20 thus forming an abutment at which the carrying wheel is arrested after having accomplished the movement imparted to it by the carrying tooth 23 and consequently preventing overthrow of the wheel. When shifting the totalizer into its upper position, as in Fig. 3, on the other hand, all of the arresting teeth 76 will come out of path of the teeth 22 thus permitting the carrying wheels to be moved freely.

On account of the totalizer being shifted out of mesh with the racks 1 after the accomplishment of each item transfer operation the driving disks 29 must obviously be adapted to operate the carrying wheels 20 while the latter are occupying their elevated position, as in Fig. 3. In this elevated position each of the transmission wheels 2 is meshing with a coupling wheel 36 individual thereto, the object of which is to provide, during the tens carrying operation, a connection between the transmission wheel 2 and the carrying wheel 20 mounted closely thereto and

adapted to be made operative by the numeral wheel or the intermediate gear of the next lower order. To this end the width of tooth of the coupling wheel 36 is made equal to the sum of the tooth widths of the transmission wheel 2 and the carrying wheel 20 thus enabling the coupling wheel to engage both the transmission wheel and the carrying wheel at the same time. All of the coupling wheels 36 are rotatably mounted on a common shaft 37 which is pivotally mounted in the frame of the machine. The hub of each coupling wheel 36 which at the same time serves as a spacing sleeve is provided with an internal recess 39 in which projects a pin 40 rigidly secured to the shaft 39, the width of said recess being so chosen as to allow the coupling wheel of being rotated for an angle corresponding to the movement of the carrying wheel 20 under the influence of the driving tooth 33 but no more. The object of the pins 40 is to restore subsequently those of the coupling wheels which may have been rotated in connection with a tens carrying operation. Each of the coupling wheels is further provided with three ratchet teeth 41, the end 42 of a spiral spring 43 engaging one of the notches formed between the said teeth, thus holding the wheel in either of two distinct locking positions. All of the spiral springs 43 are wound on a common bar 44 secured to the frame of the machine.

The manner in which a tens carrying operation proceeds will now be described assuming that the register or totalizer is adjusted in the adding position shown in the drawings. In the case of performing a subtraction a carrying operation will take place which is quite analogous with that described below.

The angular position of the numeral wheel 15 in Fig. 2 corresponds to the digit value 9. The front of the carrying tooth 23 then contacts with the rear flank of one of the teeth 22 on the appertaining carrying wheel 20. Upon shifting the numeral wheel to the angular position which corresponds to the value 0 the tooth 23 will push the said tooth 22 forward thereby rotating the carrying wheel 20 for an angle corresponding to half of its pitch. While normally, as shown in Fig. 2, one of the enlarged tooth spaces 21 is opposite the shaft 30 of the driving disks 29 the carrying wheel is now adjusted, by the action of carrying tooth 23 in such position that a tooth 22′ will project downwardly toward the said shaft 30, as shown in Fig. 3 in which the digit wheel 15 is set in its 0-position. The tooth 76, which originally was bearing against the front flank of one of the teeth 22 on the carrying wheels referring to Figs. 1 and 2 in which the carrying wheel is assumed to have a clockwise rotary direction, is now in contact with the rear of the following tooth 22′, having served as a stopping abutment to prevent overthrow of the carrying wheel by the shock of the carrying tooth 23. After the transfer of item by means of the racks 1 has been completed, resulting in a number of carrying wheels 20 being adjusted by their corresponding carrying teeth 23 into the angular position shown in Fig. 3, the totalizer will be shifted to its upper position and, as a consequence, each pair of transmission wheel 2 and adjacent carrying wheel will be connected together by their coming in common into mesh with the appertaining coupling wheel 36, in that one of the teeth 35 of the latter will bear against the front of one of the teeth 22 on the carrying wheel 20 and, at the same time will engage a tooth space of the transmission wheel 2. At the same time the carrying wheel 20 has been released from the stopping tooth 76.

To complete the tens carrying operation a full revolution is imparted to the common shaft 30 of the driving disks 29, the rotary direction being indicated in Fig. 3 by the arrow 34. During the revolution the teeth 33 will successively pass their uppermost positions in which they are turned towards the pertaining carrying wheels 20. Those of the carrying wheels which have not been actuated by their carrying teeth 23 are still in inoperative position relatively to the driving mechanism, presenting opposite the shaft 30 an enlarged tooth space 21 through which the corresponding driving tooth 33 will pass without engaging. Each carrying wheel, on the other hand, which has been adjusted by the pertaining carrying tooth 23 into operative position, as in Fig. 3, having a tooth 22′ projecting downwardly in the path of the driving tooth 33 will be operated by the latter, being again rotated in the same direction and for an equal angle as before. On account of each pair of wheels 2, 20 being interconnected by the pertaining coupling wheel 36 the said pair of wheels will rotate as a unit and, as a consequence, the numeral wheel 14, 15 meshing with the transmission wheel 2 will also be rotated, its digit value being increased one unit. The coupling wheel 36 which is changed by the action of the carrying wheel 20 from its normal locking position is held in its new locking position by the pawl 42 now engaging the other one of the notches 41 (the right one in Figs. 2, 3). That one of the coupling wheels which is first changed from normal position will in turn rotate the common shaft 37, on account of one of the shoulders formed by the recess 39 engaging the pin 40 projecting into said recess. The other coupling wheels are not influenced by said rotation of shaft 37, in that the corresponding pins 40 will move freely in the recesses 39. Each of the carrying wheels 20 will obviously by the action of the driving mechanism again be brought into inoperative position relatively to the latter,

turning a tooth space 21 toward the shaft 30.

After the completion of the carrying operation the shaft 37 must obviously be restored to its normal position. To this end the said shaft is provided at its right end with a rigid arm 46 adapted to co-operate with a pin 47 provided at the outer end of a finger 48 projecting from the rocking arm 4. By the rotation of the shaft 37 from its normal position caused by the influence of the carrying wheel first operated the said arm 46 is turned to bear against the pin 47. Upon subsequently returning the register or totalizer to its lower position the arm 46 is operated by the pin 47 so as to restore the shaft 37 to normal position, said shaft in turn restoring the coupling wheels which may have been displaced during the carrying operation, in that the pins 40 projecting from the shaft will then serve as zeroizing pins. A further object of the pin 47 is to form a stopping abutment serving to limit the rotation of the shaft 37 to an extent corresponding to the angular displacement which is normally imparted to a coupling wheel 36 from its pertaining carrying wheel. The pins 40 secured to the shaft 37 will in turn serve as stopping abutment to prevent the corresponding coupling wheels from surpassing the proper angular positions. As will be seen, the possibility of overthrow of the carrying wheels is completely excluded, in that the stopping teeth 76, as mentioned above, serve to limit the angular displacements imparted to the carrying wheels from the carrying tooth 23 during the item transfer operation, while on the other hand the pins 40 and the stopping pin 47 exclude the possibility of the carrying wheels being overthrown by the action of the driving disks 29. For this reason the springs 26 of the holding pawls 24 may be made relatively weak.

Instead of providing irregularly formed coupling wheels 36, as in the example described, toothed wheels of regular form may also be used as coupling wheels, which in this case are suitably arranged to be turned in one direction only and provided with ordinary holding pawls engaging the tooth spaces. A special arrangement to restore the coupling wheels to normal position may then be dispensed with. However, in this case other stopping arrangements should be provided for the arresting function of the pin 47. To this end stopping teeth analogous to the teeth 76 on the driving disks 29 may be provided, said stopping teeth being arranged to project into the enlarged tooth spaces 21 of the carrying wheels, when the totalizer is in its lower position while on the other hand, being out of path of the teeth 22 of the carrying wheels when the totalizer is in its upper, normal position.

The carrying teeth 23 on the totalizer wheels 14, 15 are adapted to be operative only in the adding position of the totalizer. In order to adjust the totalizer for subtraction the bearing pieces 11, 12 are swung about the journals 9 and 10 respectively, the totalizing wheels 14, 15 being thereby brought out of mesh with the transmission wheels 2 and the intermediate gears 17 being instead thereof brought into mesh with said transmission wheels. The intermediate gears 17 are provided, according to this invention, with own carrying teeth 49, intended to perform in the case of subtracting, the function performed by the carrying teeth 23 in the adding operation and to perform said function in a quite similar manner. The rotary directions of the driving disks 29 and the carrying wheels 20 are not altered.

During the item transfer operation, each of the numeral wheels 14, 15 is positively connected with the corresponding rack 1 through the medium of the transmission wheel 2 or, in the case of subtraction, through the medium of the transmission wheel and the intermediate gear 17. Upon subsequently swinging the register or totalizer out of mesh with the racks 1 the wheels 2 will be brought to mesh with the coupling wheels 36, as described, being then held in proper positions by said coupling wheels. The register will thus be properly locked in either position. Furthermore, the gears of the numeral wheels are provided with ordinary holding pawls, which, in the example shown, are arranged to be brought out of engagement with said gears when the register is shifted to its item transfer position. For this purpose the following arrangement is provided for. The holding pawls 50 are mounted on a common shaft 51, supported by arms 52 projecting forwardly from the swingable bearing pieces 11, 12. In a longitudinal groove in the shaft 51 is disposed a key 53 projecting into recesses 54 provided internally in the hubs 55 of the holding pawls, the width of said recesses being so chosen as to just allow the pawls of snapping over the teeth when the numeral wheels are turned. Each of the holding pawls is actuated by a spiral spring 56 wound round the hub 55 and bearing with one end against the holding pawl while the other end thereof bears against a bar 57 extending underneath the arms 52. The shaft 51 is rigidly connected at its left end with an arm 58 which is permanently bearing by the influence of the springs 56 against a stationary shoulder 59, the device in question being so devised that the holding pawls 50 will be brought out of engagement with the gears of the numeral wheels when the register is shifted into its item transfer position. The said stationary shoulder 59 consists of a cylindrical pin, the axis of which coincides with the axis of rotation of the bearing pieces 11, 12 when the register occupies its upper position (tens carrying position, Fig. 3). In this case the pin 59 will maintain its position relatively to

register when the latter is swung about the shaft 9. When the register is occupying its item transfer position (Fig. 2), on the other hand, the pin 59 will not be co-axial with the axis of the shaft 9 and, as a consequence, the position of said pin relatively to the movable system in which the holding pawls are mounted will be altered when the register is shifted from adding position to subtracting position or vice versa. The said dislocation of the inoperative positions of the holding pawls relatively to the numeral wheels (Fig. 2) which may thus occur, may be prevented by means of giving the bearing surfaces of the pin 59 a suitable form.

The arrangement serving to shift the register from adding to subtracting position is shown in Figs. 4 and 5. To the outer end of the journal 9, by means of which the bearing piece 11 is rotatably mounted on the rocking arm 3, is secured a bifurcated cam member 60, the hub 61 of which bears against the outer side of the arm 3. The shanks of the cam member form internally a guiding curve 62, which may be caused to co-operate at will with either of two guiding pins 63 or 64 respectively, said pins being secured to an adjusting disk 65 loosely mounted on the rocking shaft 6 of the register. The ends of the shanks of the bifurcated cam member 60 are formed as a circular arc 66 and 67 respectively the former of which has its centre upon the centre line of the shaft 6 when the register is in adding position while, in the subtracting position of the register, the centre of the arc 67 will lie on the said centre line. The adjusting disk 65 further supports two adjusting pins 68, 69 located in the path of shoulders 70 and 71 respectively, said shoulders being provided on the shanks of the adjusting keys 18 and 19 respectively. The adjusting disk is retained in either of two locking positions by a yielding pawl 72 mounted on a stationary journal 73 and engaging either of two locking notches 74 or 75 respectively provided in the edge of the adjusting disk.

Fig. 5 illustrates the position occupied by the adjusting disk 65 when the register is adjusted for adding operation, the pawl 72 then engaging the former one of the notches 74. This position of the disk has been attained upon depression of the adjusting key 18, resulting in the pin 68 being depressed by the shoulder 70 of the key so as to occupy a lower limiting position. At the same time the guiding pin 63 is caused to slide along the guiding curve 62 onto the circular arc 66, and in so doing turns the cam member 60 and the bearing pieces 11, 12. On account of the centre of the arc 66 being coincident with the centre line of shaft 6, the cam member will be locked in the adjusted position. Upon swinging the register about the shaft 6 the arc 66 will obviously slide against the pin 63 without causing the cam member and the bearing pieces 11, 12 to alter their positions relatively to the arms 3, 4.

The shifting of the register to subtracting position is effected by depressing the adjusting key 19, the shoulder 71 of which will then depress the adjusting pin 69 and cause the adjusting disk to be shifted to its other locking position in which the rear one of the notches 75 is engaged by the pawl. During this displacement the guiding pin 64 will slide along the curve 62 onto the locking curve 67, and in so doing turns the cam member 60, locking said member in its new position.

The embodiment of the tens carrying device described above may of course be modified, as it only serves as an example to develop the character of the invention.

I claim:

1. In a tens carrying mechanism in combination a totalizer including a plurality of number wheels, a carrying member consisting of a toothed wheel, means associated with a number wheel for rotating said carrying wheel into operative position, a transmission wheel arranged in engagement with a number wheel of the next higher order in relation to the number wheel first mentioned, normally disconnected coupling means for connecting together said carrying wheel and said transmission wheel, and a driving member for rotating the carrying wheel further from operative position so as to transfer carrying movement to the number wheel of higher order through the medium of the transmission wheel.

2. In a tens carrying mechanism in combination a totalizer including a plurality of number wheels, a carrying member consisting of a toothed wheel, means associated with a number wheel for rotating said carrying wheel into operative position, a transmission wheel mounted coaxially with said carrying wheel and arranged in engagement with a number wheel of the next higher order in relation to the number wheel first mentioned, normally disconnected coupling means for connecting together said carrying wheel and said transmission wheel, and a driving member for rotating the carrying wheel further from operative position in the same direction so as to transfer carrying movement to the number wheel of higher order through the medium of the transmission wheel.

3. In a tens carrying mechanism in combination a totalizer including a plurality of number wheels, a carrying member consisting of a toothed wheel, means associated with a number wheel for rotating said carrying wheel into operative position, a transmission wheel mounted coaxially with said carrying wheel and arranged in engagement with a number wheel of the next higher order in relation to the number wheel first mentioned, a rotatable coupling member, shiftable means

for bringing said coupling member into coupling engagement with the carrying wheel and the transmission wheel, and a driving member for rotating the carrying wheel further from operative position in the same direction so as to transfer carrying movement to the number wheel of higher order through the medium of the transmission wheel.

4. A carrying mechanism as claimed in claim 3, characterized by the said rotatable coupling member consisting of a toothed wheel.

5. A carrying mechanism as claimed in claim 1, characterized by the carrying wheel being adapted to be made operative by rotation for an angle substantially equivalent to half the tooth pitch.

In testimony whereof I affix my signature.

KARL VIKTOR RUDIN.