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BY A. P. C.

R. ANSCHUTZ ET AL
TOTAL-TAKING MECHANISM
Filed July 13, 1938

Serial No.
219,076
15 Sheets-Sheet 1

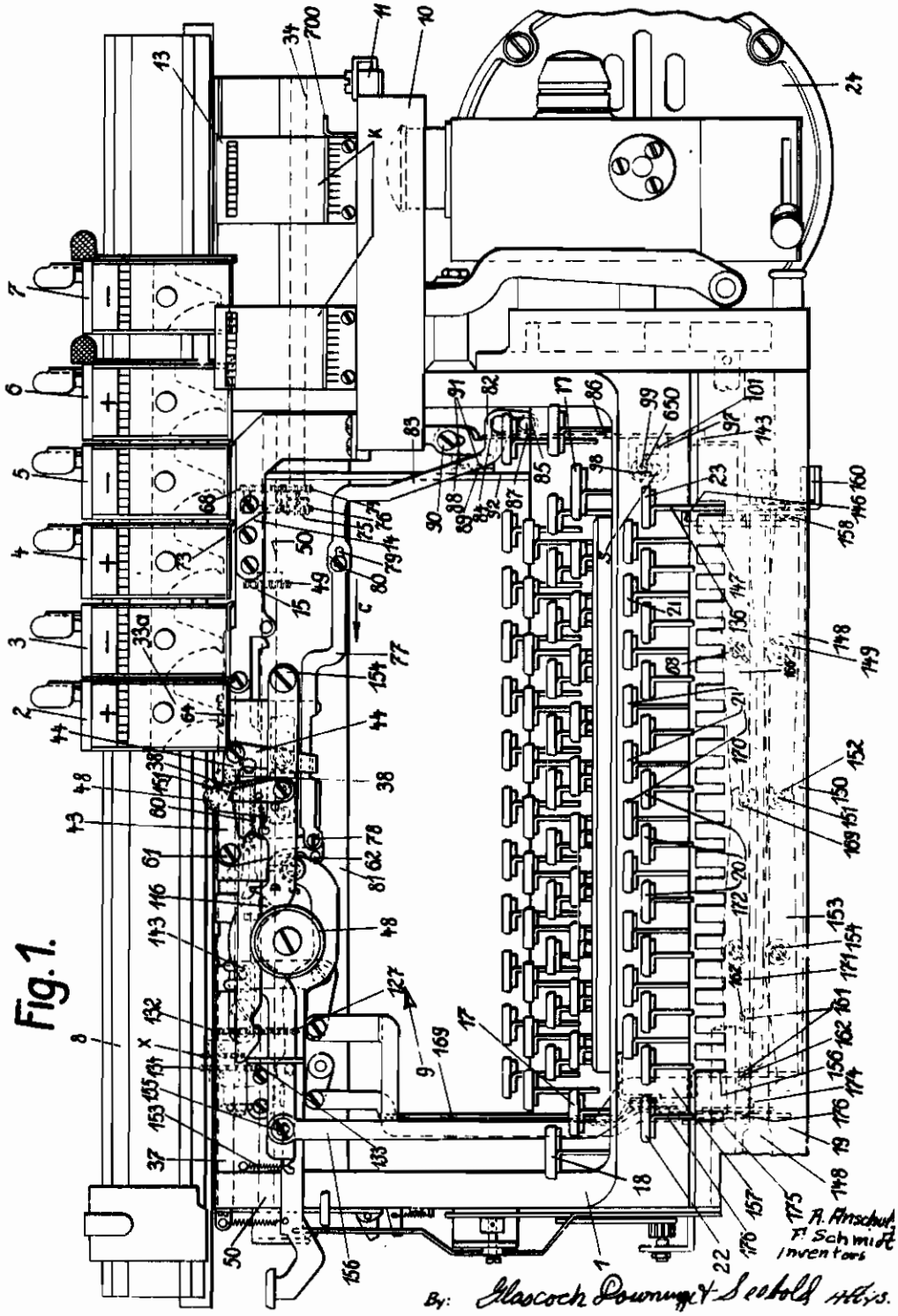

Fig. 1.

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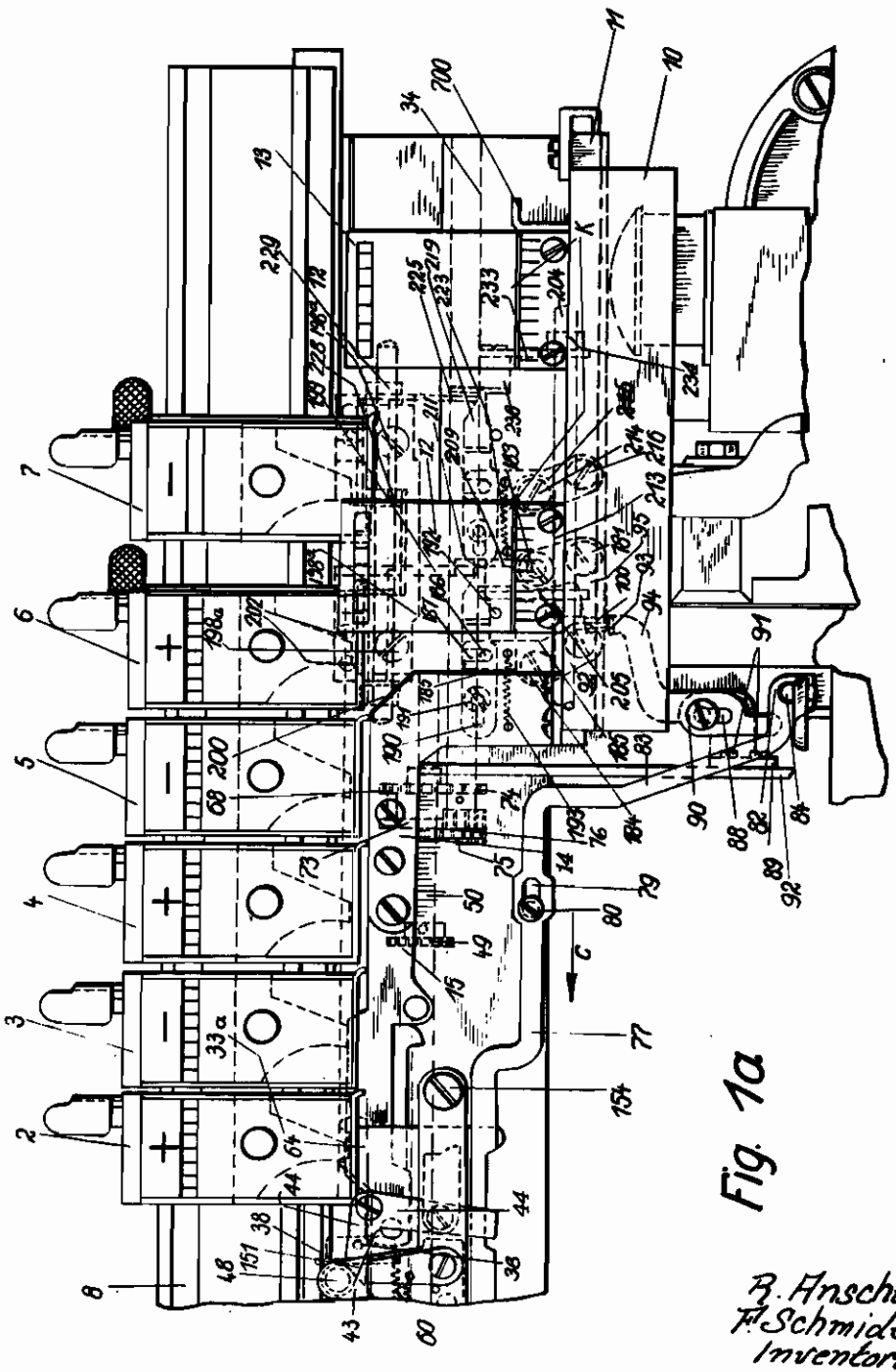

Fig. 1a

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Fig. 2

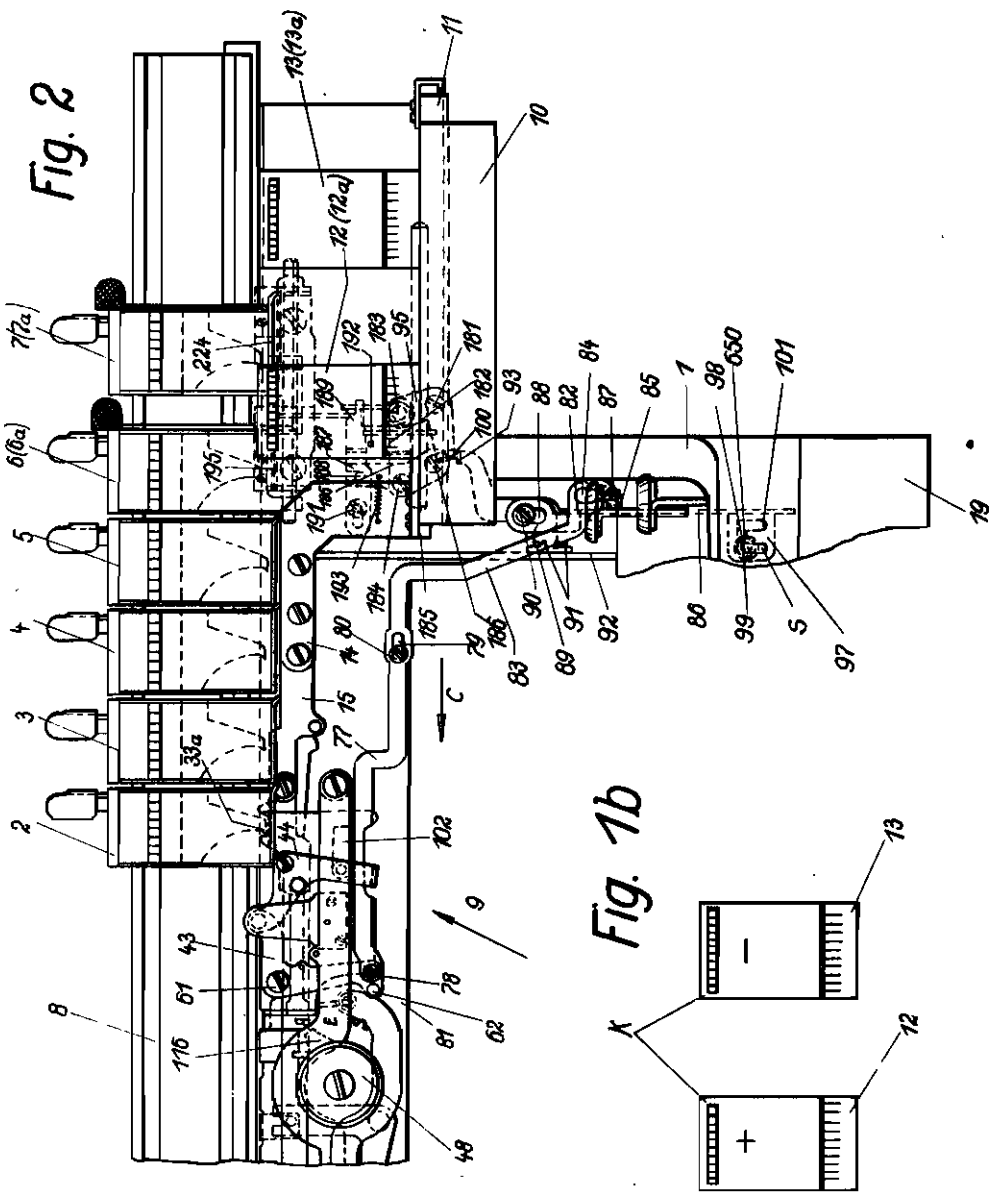

Fig. 1b

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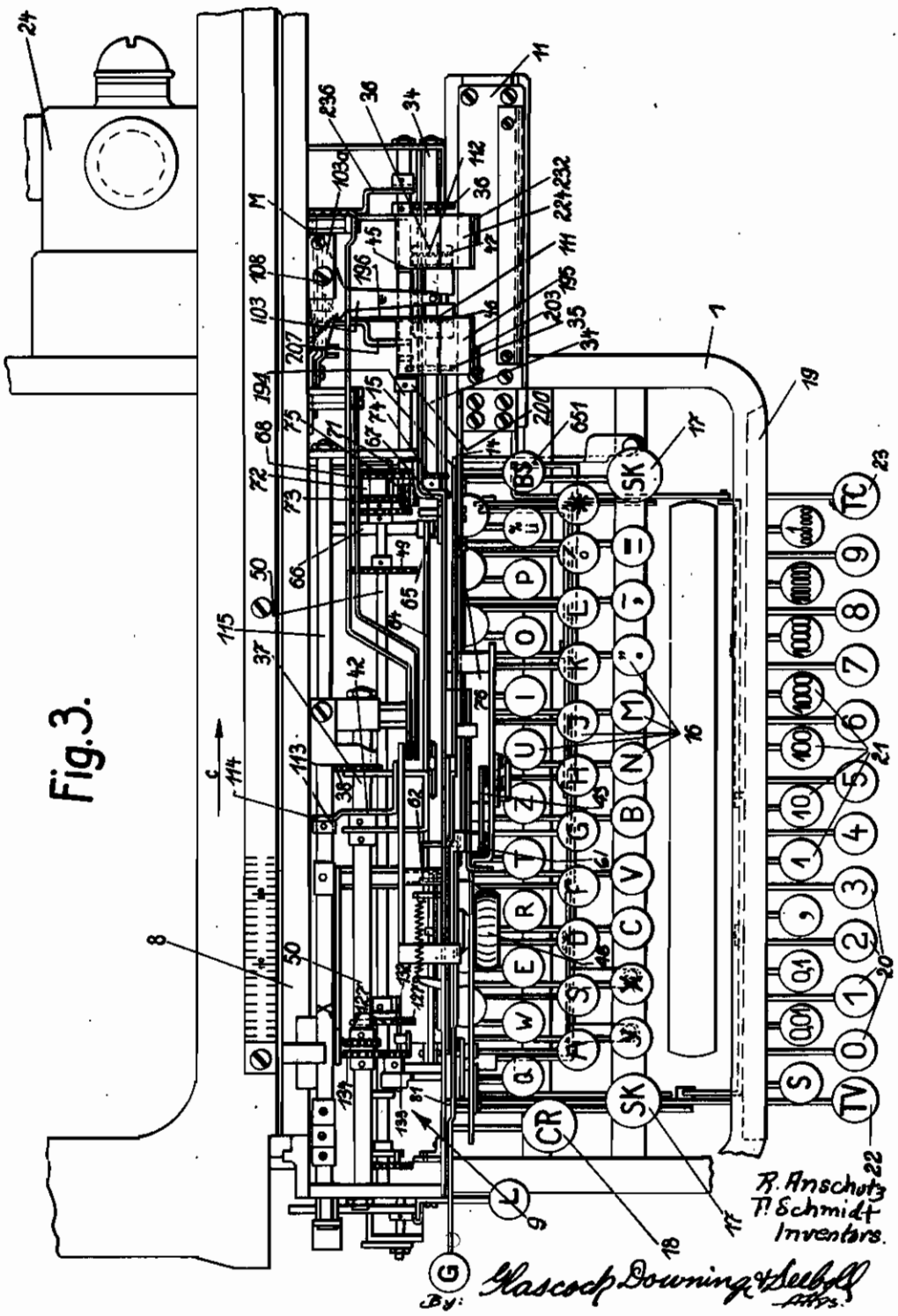

Fig. 3.

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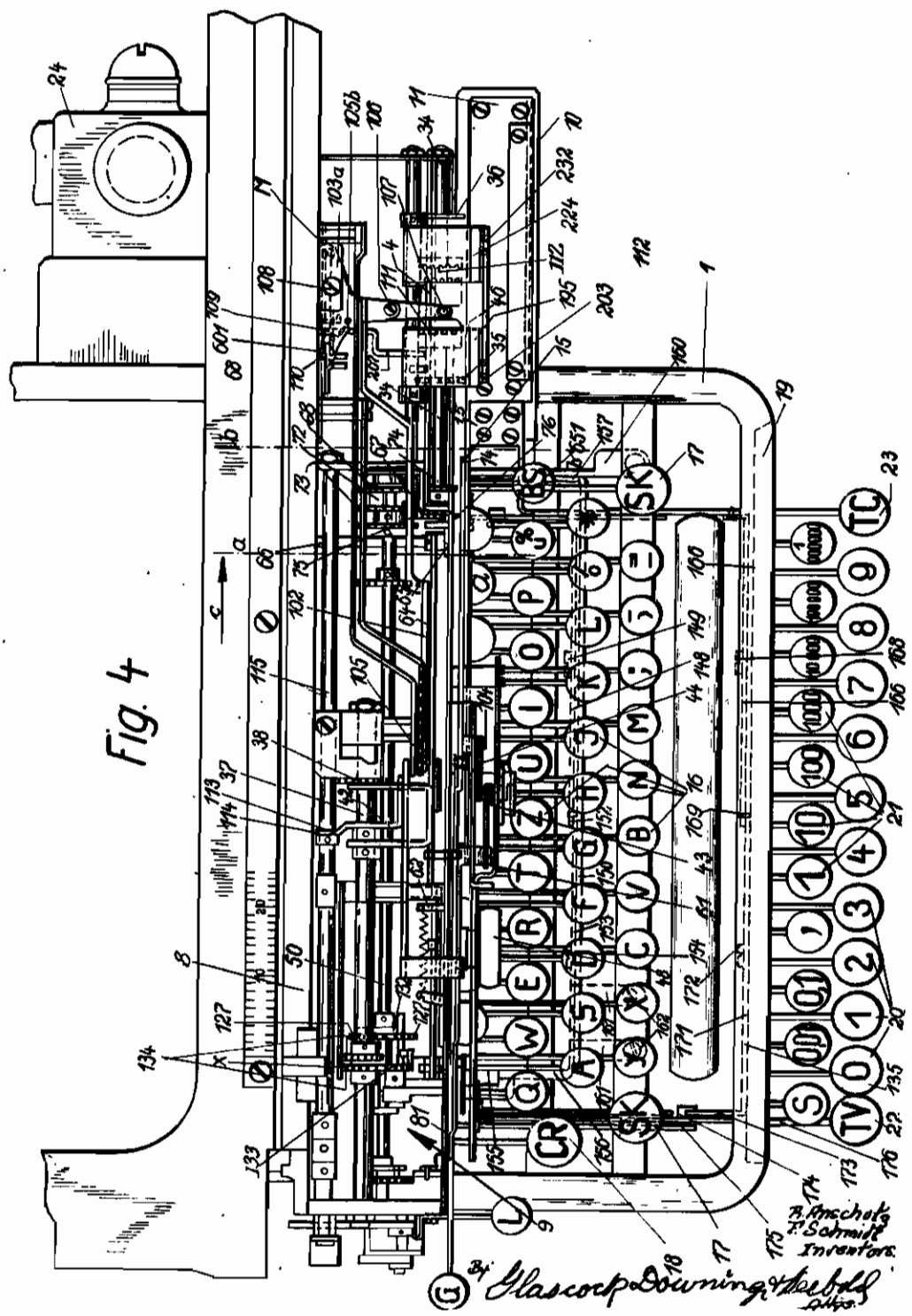

Fig. 4

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Fig. 5.

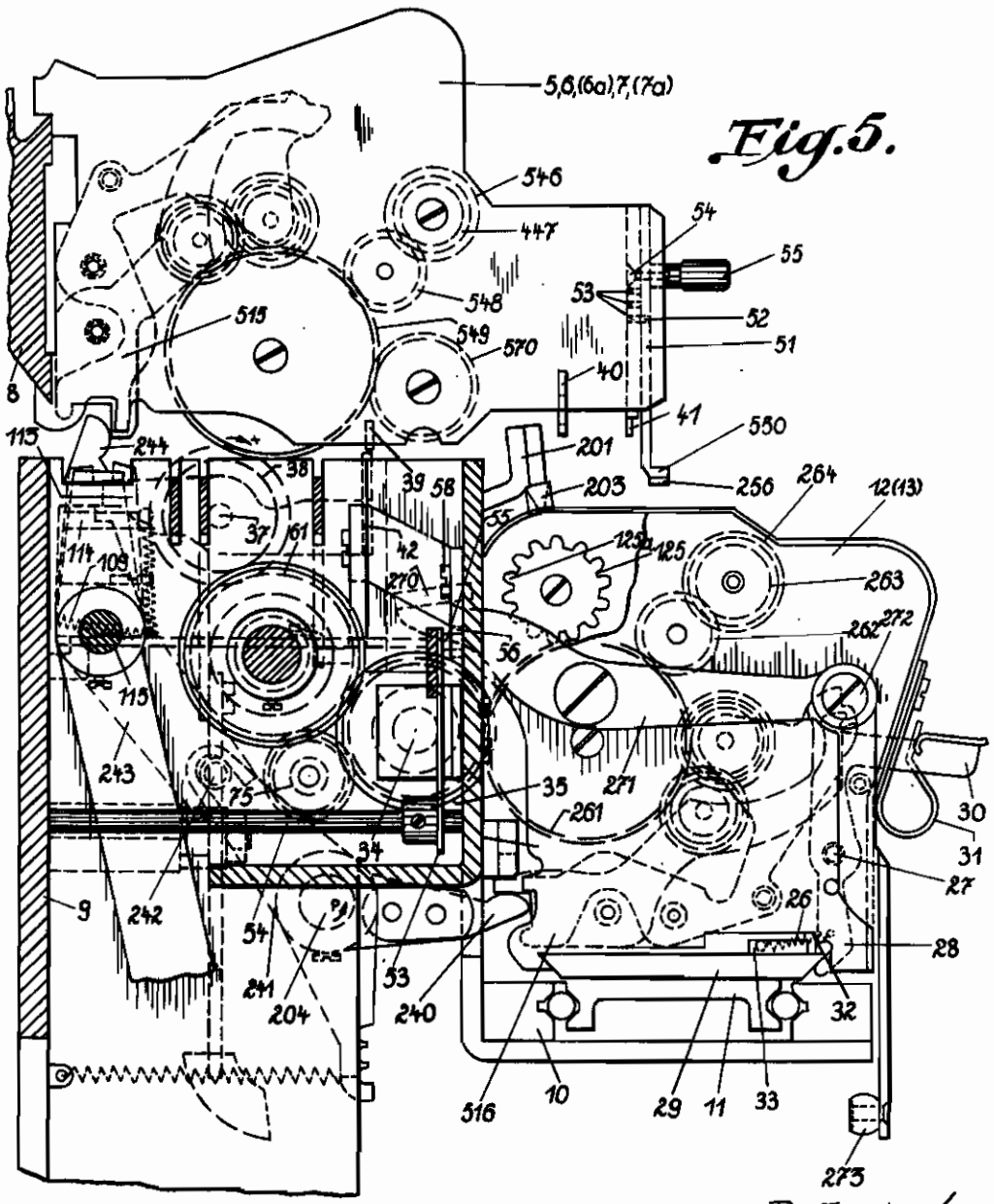

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Fig. 6

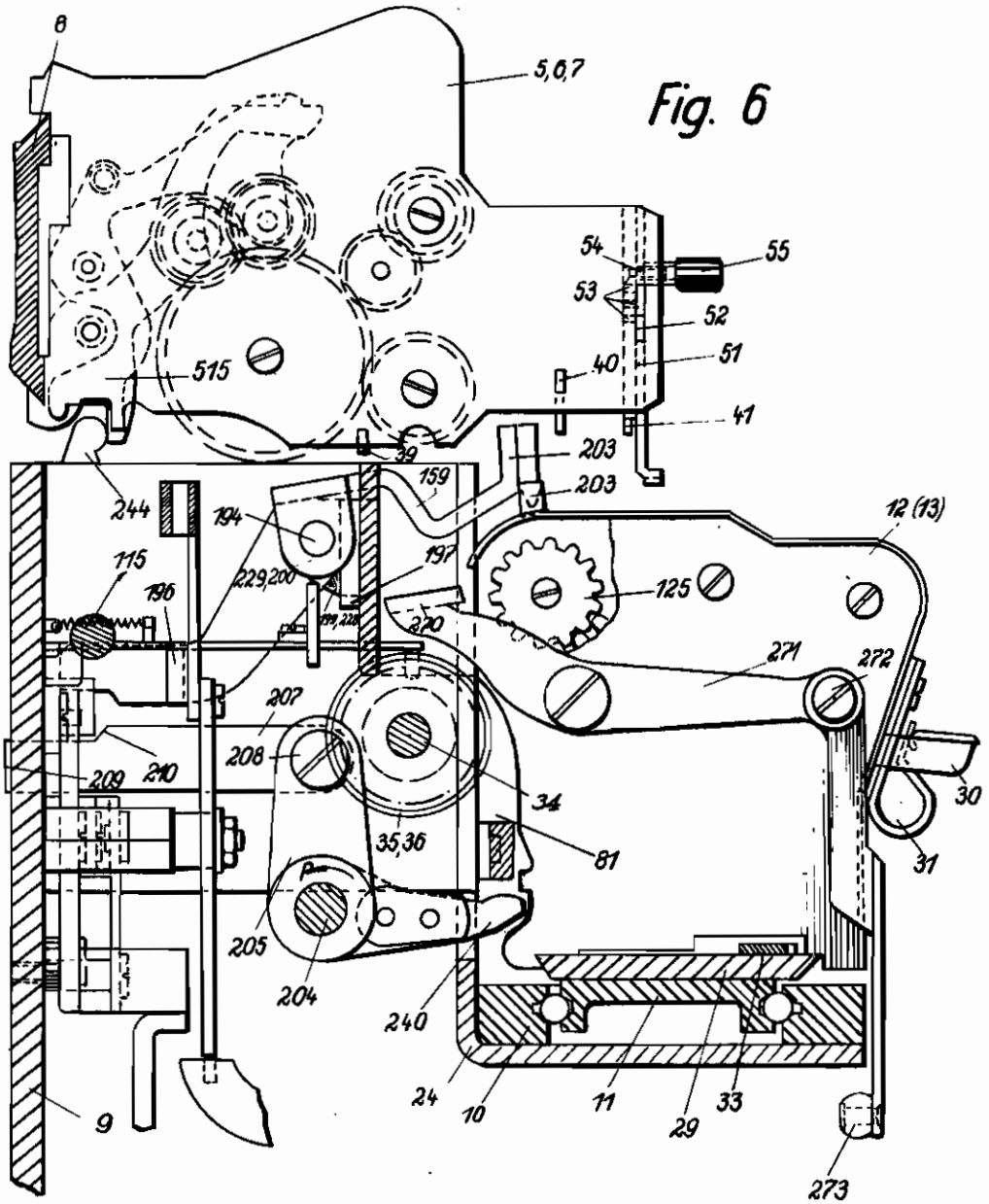

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Fig. 7.

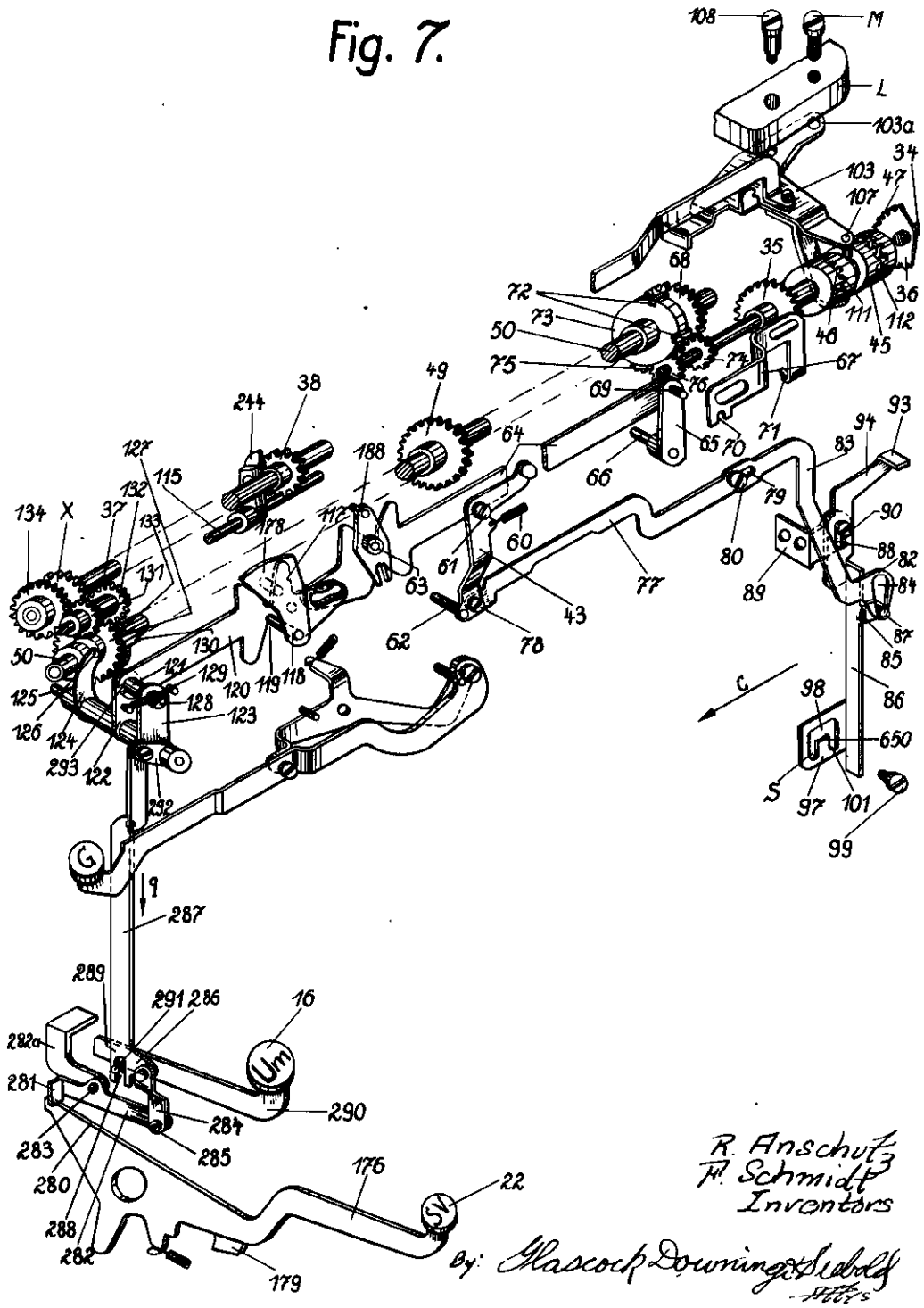

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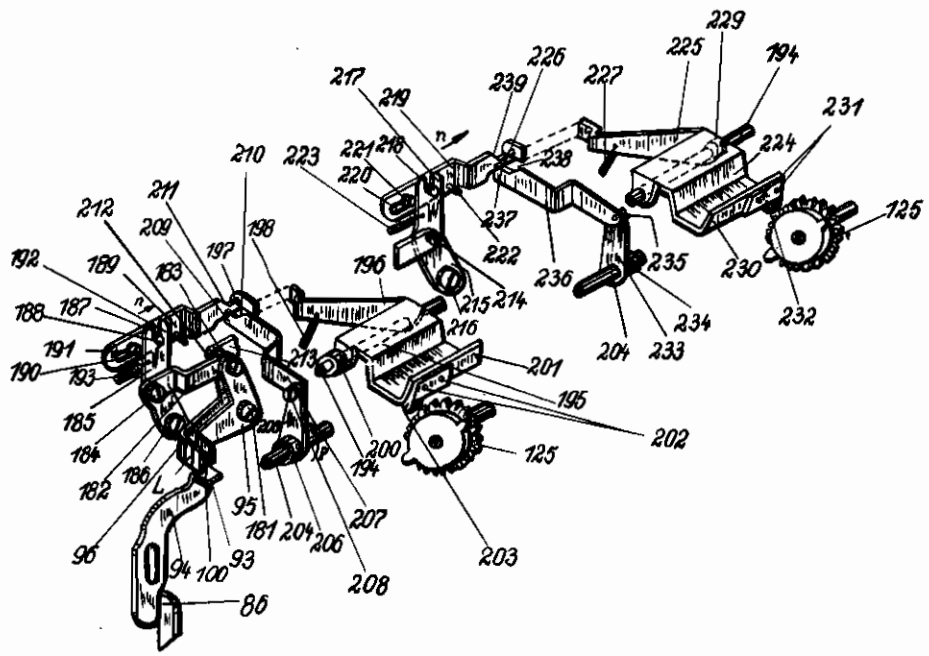
Fig. 8



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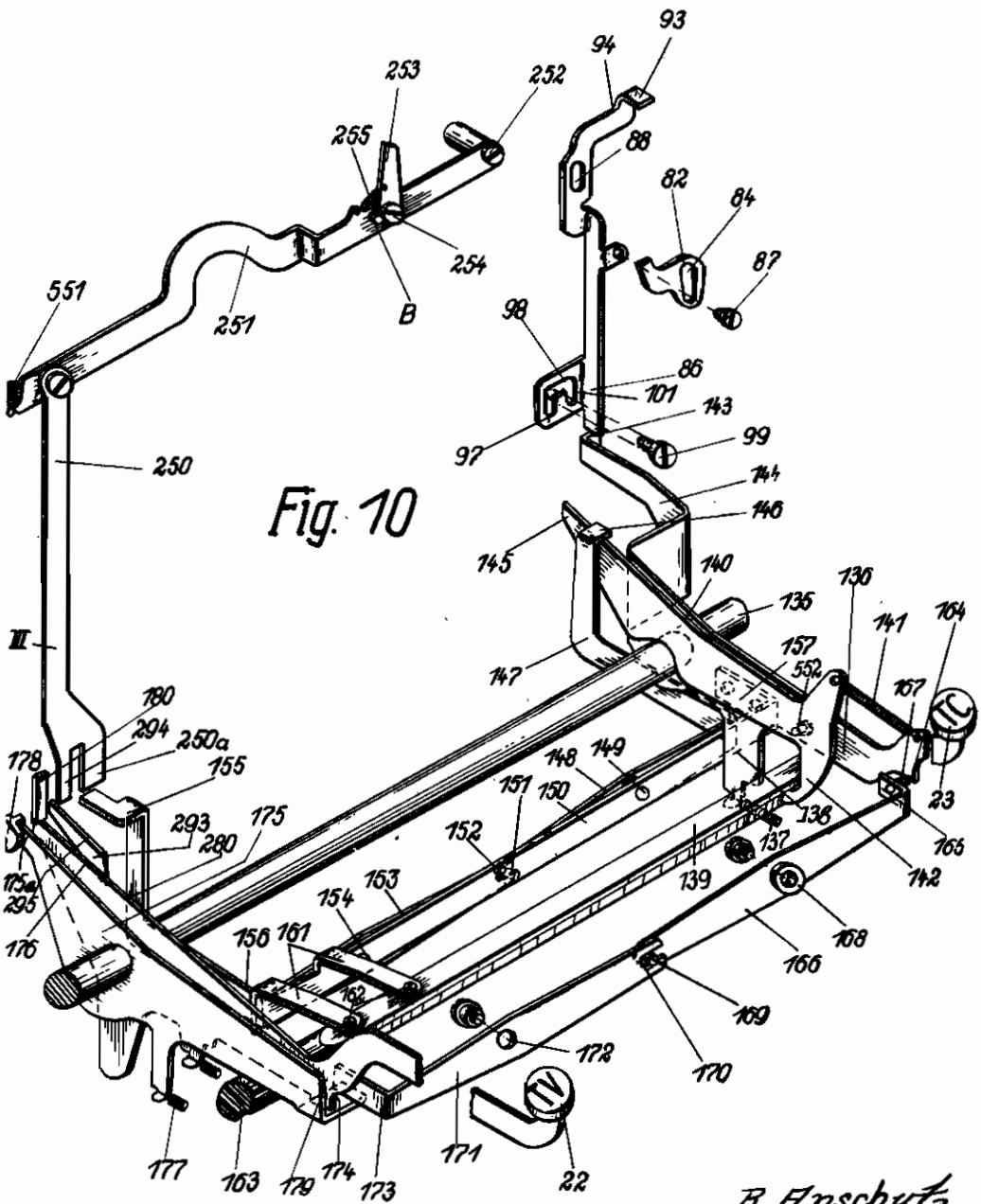

Fig. 10

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Fig. 9

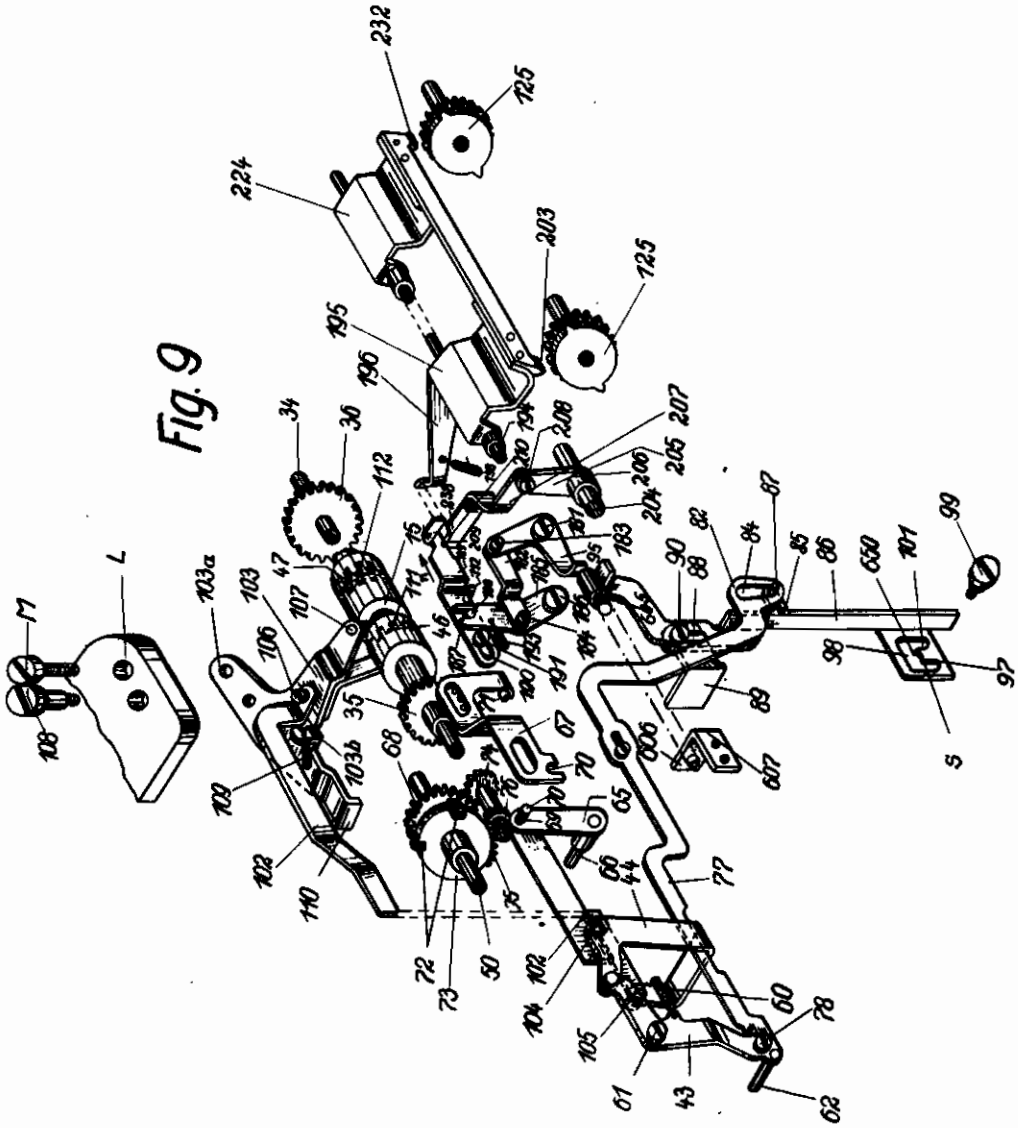

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Fig. 12

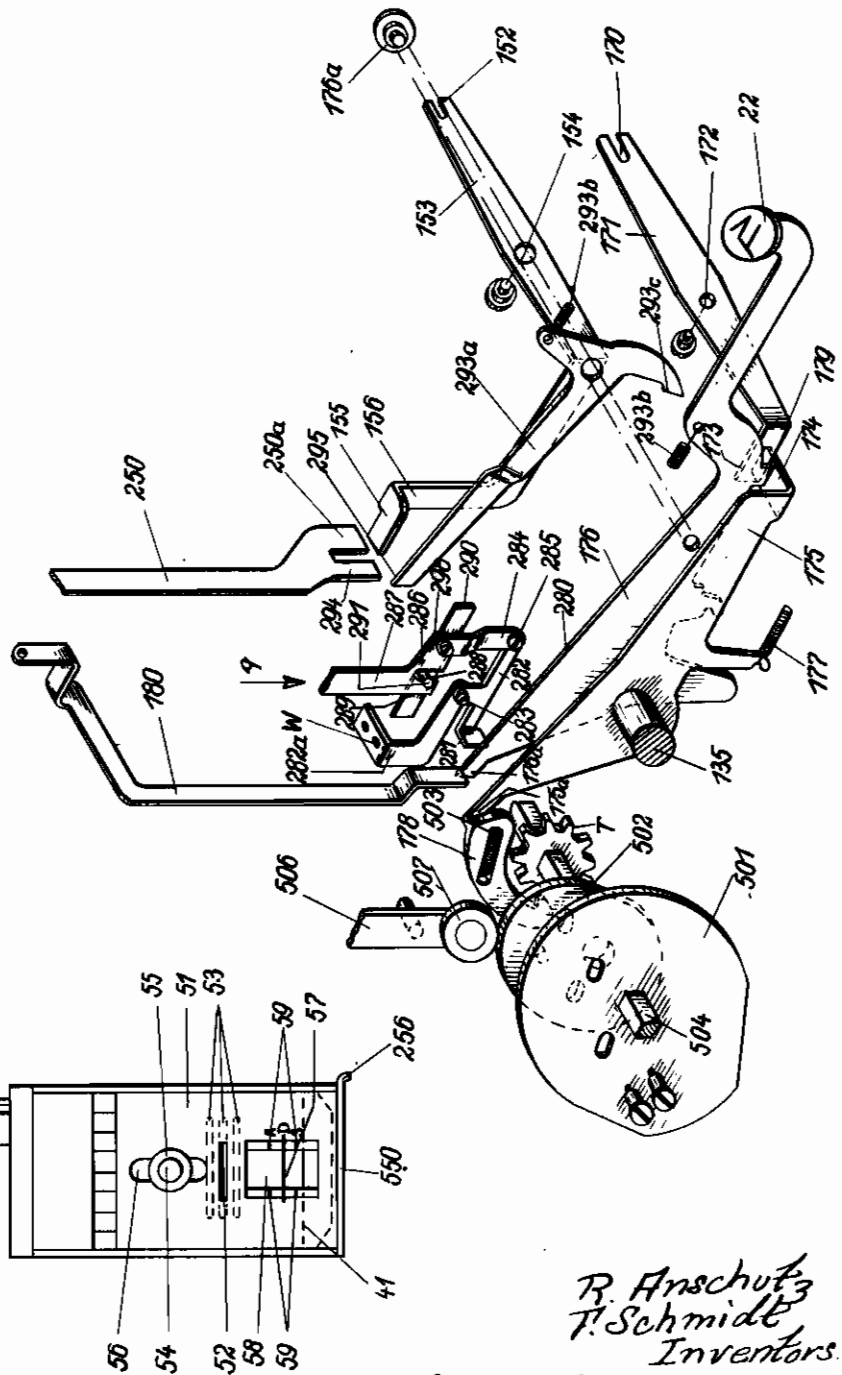

Fig. 11

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Fig. 13

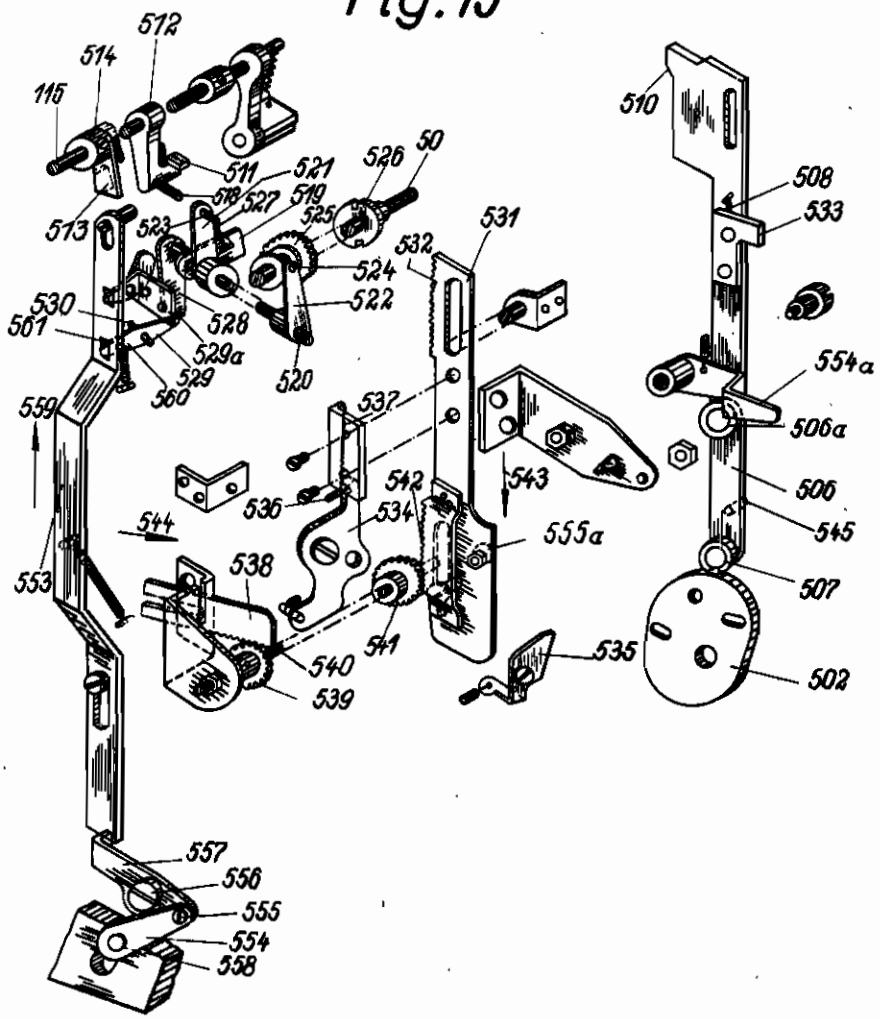

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Fig. 14

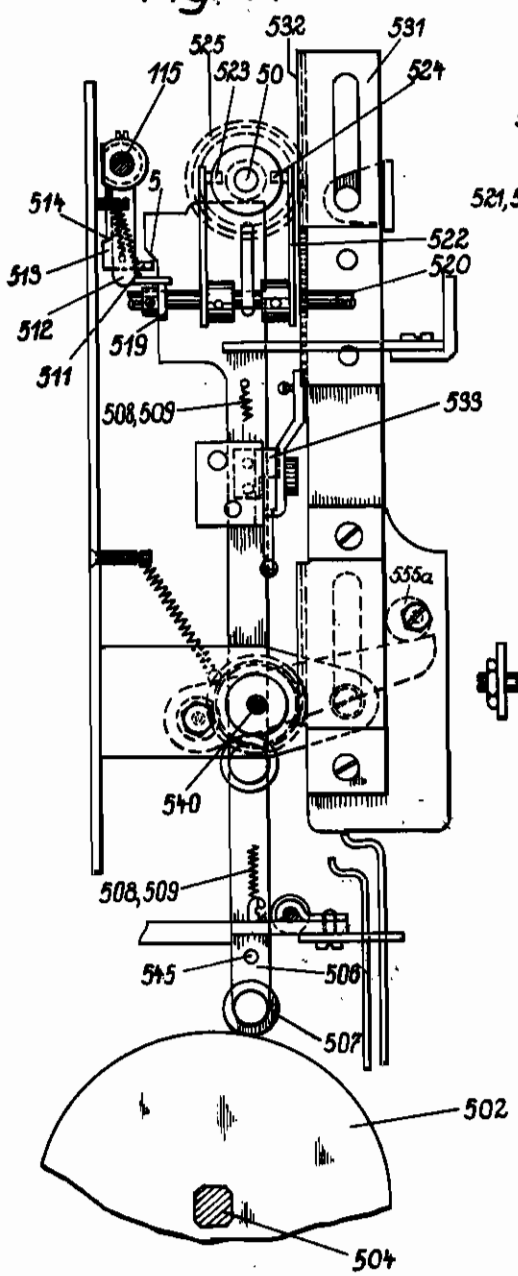
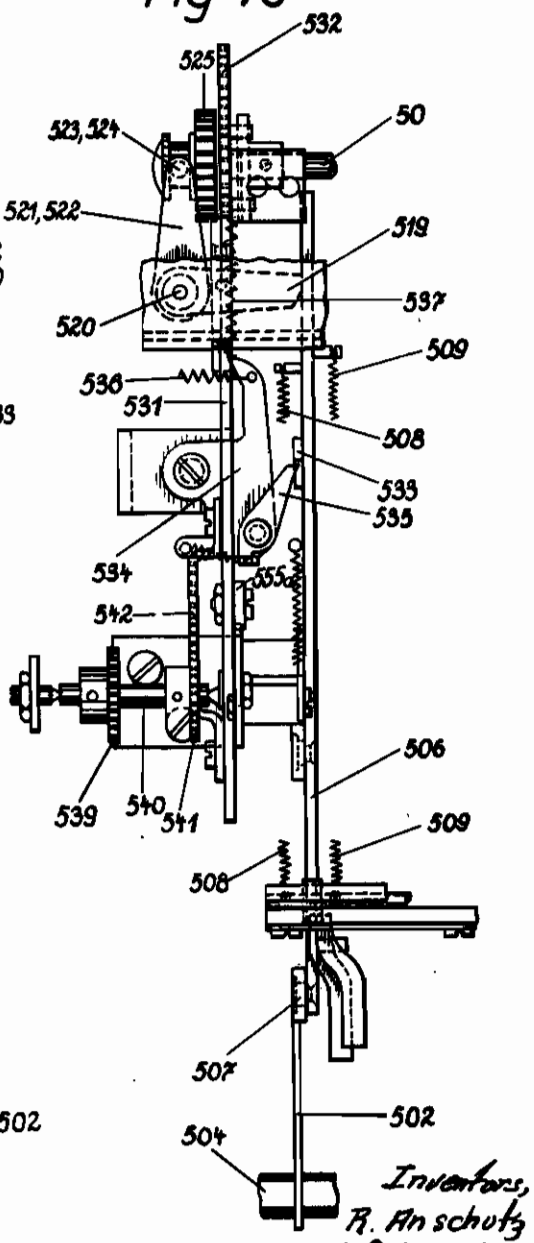


Fig 15



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TOTAL-TAKING MECHANISM

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Debit	Credit	Debit	Credit	Debit balance	Credit balance
220	40	25	80	125	
110	90	80	210		110
30	150	180	70		10
360	280	285	360	5	

25

I II III IV V VI

Fig. 16

600

Date	Section A		Section B.		Section A and B	
	Freight	Passenger	Freight	Passenger	Freight	Passenger
1.10	30	40	25	35	55	75
2.10	18	90	12	45	30	135
3.10	35	42	32	43	67	85
	83	172	69	123	152	295

I II III IV V VI

Fig. 17

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ALIEN PROPERTY CUSTODIAN

TOTAL-TAKING MECHANISM

Robert Anschutz and Fritz Schmidt, Zella-Mehlis, Thuringia, Germany; vested in the Alien Property Custodian

Application filed July 13, 1938

This invention relates to a total-taking mechanism for the automatic clear writing of column and cross totalisers by decimal places.

Such mechanisms have already become known but have the drawback that it is difficult to equip a machine for cross total taking which is constructed for vertical total taking only.

According to the invention, these drawbacks are eliminated as follows:

A manually operated controlling member for the cross totalisers, and a manually operated controlling member for the column totalisers, connect, through a universal member, a driving member which performs the total-taking operation, to a source of power, and locking members holding the controlling members in their active position are arranged to be moved into their active position with respect to a universal part which is preferably influenced by the movement of the paper carriage, when the controlling members are moved into such active position.

By providing the universal elements aforesaid, disassembling is facilitated.

In the drawings a contructional example of the invention is illustrated.

Fig. 1 is a front elevation of a typewriting-calculating machine equipped with the mechanism according to the invention, the paper carriage being omitted and only its suspension rail, with the column totalisers, being shown.

Fig. 1*a* is a partial view according to Fig. 1, on an enlarged scale, to give a better representation of the members arranged in this part of the machine.

Fig. 1*b* is a diagram of the cross totaliser unit illustrated in Fig. 1.

Fig. 2 is a portion of Fig. 1, showing a somewhat modified construction.

Fig. 3 is a plan view of Fig. 1, showing only the front portion of the machine, with the column and cross totalisers omitted.

Fig. 4 is a plan view of Fig. 2 in which the column and cross totalisers are also omitted.

Fig. 5 is a section through the calculating mechanism on the line *a*—*a* in Fig. 4, viewed in the direction of the arrow c, in which the column and cross totalisers are shown but other parts which are less important for the explanation of the invention, have been omitted.

Fig. 6 is a section through the calculating mechanism on the line *b*—*b* in Fig. 4, viewed in the direction of the arrow c, in which the column and cross totalisers are shown, and other parts omitted.

Fig. 7 is a perspective illustration showing control parts in the calculating mechanism which effect the automatic total taking from the column and cross totalisers, several parts being shown remote from each other for the sake of clearness.

Fig. 8 is a perspective illustration of parts which effect the total taking from the cross totalisers, parts being shown remote from each other.

Fig. 9 is a perspective illustration showing the parts illustrated in Fig. 8, as modified for the machine illustrated in Figs. 2 and 4.

Fig. 10 is a perspective illustration showing other parts effecting the total taking from the column and cross totalisers, viewed from the left and the front of the machine.

Fig. 11 is a front elevation of one of the column totalisers.

Fig. 12 is a perspective view supplementing Fig. 10 and showing the controlling member for the column totalisers, and other parts cooperating with the member, also viewed from the left and the front of the machine.

Fig. 13 is another perspective view supplementing Fig. 12, also viewed from the left and the front of the machine, and corresponding to Fig. 8 of Patent — — (patent application Serial No. 146,897).

Fig. 14 is a side elevation of the principal parts in Fig. 13.

Fig. 15 is a front elevation of the parts shown in Fig. 13.

Fig. 16 shows diagrammatically a portion of a form filled in with items to be booked by the machine.

Fig. 17 shows a portion of another form to be booked by the modification illustrated in Figs. 2 and 4.

General description of the machine

The principal parts of the machine are the frame 1 (Figs. 1 and 2) which supports the typewriting mechanism, and the paper carriage, not shown. On the suspension rail 8 which is secured to the paper carriage, the column totalisers 2 to 5 and the idle totalisers 8 and 7 (Figs. 1, 1*a*, 2, 5, and 6) are arranged. A wall 9 (Figs. 1 to 6) which supports a calculating mechanism, is arranged behind the keyboards of the machine. A slotted table 10 is arranged at the right-hand side of the machine, and secured by suitable means. A slide 11 is mounted to reciprocate longitudinally in the slot of the table. On this slide 11, the cross totalisers 12 and 13 are adjustably secured. The cross totalisers 12 and 13 are

moved by that column totaliser which is in active position at the time, by links 14, 15.

Mounted in the machine frame 1 (Figs. 1 and 3) are the keys 16 of a typewriting keyboard, with tabulator keys 17, and a carriage frame return key 18. A bearing frame 19 (Fig. 1) forms a further part of the machine, in which frame are mounted a calculating keyboard 20, a set of decimal tabulator keys 21, a column total taking key 22 (Figs. 1, 3 and 7), a cross total taking key 23 for the cross totalisers (Figs. 1, 3, and 10). A motor 24 secured to the right-hand side of the machine frame operates, through suitable gearing, the drive of the calculating camplate elements, not shown, of the typewriting mechanism, not shown either, and of the carriage return.

The normal calculating and typewriting operations for the entries required in columns I to IV of the form Fig. 16

For this operation, the column totalisers 2 to 7 are adjusted on the suspension rail 8 in positions corresponding to the columns I to VI of form 25 (Fig. 16). The tabulator riders allotted to the column totalisers but not shown are adjusted on the known rider bar.

At the same time, the cross totalisers 12 and 13 are put on the slide 11 in the required positions with respect to the column totalisers, or their driving gears, adjusted, and secured. The adjusting and securing operations, however, are not performed by screwing to the slide 11, but in the way which is usual already for the cross totalisers by the cooperation of a clip 28 which is swingable around a pivot 27 under the influence of a spring 28 (Fig. 5), with a prismatic bar 29 secured to the slide 11. The clip 28 is moved out of clamping position with respect to the prismatic bar in the usual manner by a handle 30 while the clip can be held in clamping position with respect to the cross totaliser after the cross totaliser has been placed in position, by a locking member 31 placed before the handle 30. A nose 32 formed at the handle 30 engages, in the clamping position of the clip 28, in that gap in a rack 33 secured on the slide 11 (Fig. 5) which is just opposite the nose, and thereby the cross totaliser, or cross totalisers, are held in their positions, as adjusted. For this purpose, the pitch of the rack is, as usually, selected in conformity with the steps of the carriage feed.

The cross totalisers 12 and 13 make up together a complementary totaliser or unit K (Fig. 1a), as will be explained more fully below. To this end, the sequence of the numbers on the number rollers of the cross totaliser 12 is the reverse of that on the rollers of the cross totaliser 13. The cross totaliser 12 at the left is positive, and the totaliser at the right is negative. In consequence thereof, a total is taken by subtraction in the positive totaliser 12, and a total indicated in positive form is to be taken by addition in the negative totaliser 13.

The form 25 is placed on the platen in conformity with the position of the column totalisers 2 to 7, and placed in typewriting position with its first line. Thereupon, the paper carriage is moved into its final position at the right, for instance, by depressing the carriage return key 18.

In the booking example which will be described, the items of the same kind to be entered in the columns I and III of the form 25 which are indleated and added in the column totalisers 2 and 4, are calculated in positive form in the cross totaliser 12, and the corresponding complementary value appears in the cross totaliser 13. The values to be written down in the column II and IV of the form are transferred transversely in the opposite sense as before, i. e., subtractively, into the complementary unit K comprising the cross totalisers 12 and 13. At the same time, the items in column II and IV appear in positive form in the column totalisers 4 and 5. Due to the fact that the credit items in columns II and IV are introduced in opposite direction to the debit items in columns I and III, the balance is found which may appear on the debit or credit side, i. e., in the column V or VI of the form 25, in conformity with the ratio of the debit and credit items. That cross totaliser in which the balance then appears, is thereupon placed in cooperative position to the corresponding idle totaliser 6 or 7, in a manner to be described more fully, by operating that decimal tabulator key 21 which corresponds to the amount of this balance, whereupon the automatic clear writing of the corresponding cross totaliser 12 or 13 forming part of the complementary totaliser unit K can be begun. The balance is now written down in the column V or VI of the form.

In order to effect the bookings in the columns I to IV of the form 25, for example, in its first line, it is necessary to move the paper carriage with respect to the totalisers 2 to 5, or the columns I to IV, into the operative position required at the time. This is effected by depressing the tabulator key 21 corresponding to the item to be booked. During the thereupon occurring movement of the carriage to the left, and therewith of the totalisers 2 to 7, the cross totalizers 12 and 13 which make up the complementary totaliser unit K, are automatically coupled to a dog 33a (Fig. 1) of that cross totaliser 2 to 7 which moves into active position at the time, by means of the links 14, 15 (Fig. 3) of the slide 11 (Figs. 1 to 6) which carries the two cross totalizers 12 and 13, so that these partake in the movement to the left. In this operation the cross totalisers 12 and 13 are each time moved into driving connection with driving gears 35 and 36 which are mounted to turn on a driving shaft 34 (Figs. 1 and 3 to 7) but are held against axial displacement. That column or idle totaliser which is thereby moved into calculating position, comes into driving connection with a driving gear 38 coordinated to all totalisers (Figs. 3, 4, and 7) and secured on another driving shaft 37. When the paper carriage, or the totalisers 2 to 7, and the cross totalisers 12 and 13, move into active position, each totaliser, through controlling plates 39, 40 and 41, secured to the totaliser as required, acts on controlling levers 42 (Fig. 4), 43, (Fig. 9), and 44. Thereby, in a manner to be described more in detail in connection with the total taking operation, the calculating mechanism is unlocked and the species in the cross totalisers is selected. The controlling lever 44 serves for the alternately moving into engagement of coupling teeth 111 and 112 of a coupling sleeve 45 mounted to slide axially on the driving shaft 45, with coupling teeth 46 and 47 of the driving gears 35 and 36 which are also arranged on the shaft 34. A link 102 pivotally connecting the controlling lever 44 to a coupling arm 103 (Figs. 4 and 9) serves for transmitting the movement imparted to the controlling lever 44 from the totalisers 2 to 7, to the coupling sleeve 45. In the case of the present booking operation, the teeth 111 and 112 of the coupling sleeve

45 must be engaged with the driving gears 35 and 38 at the same time, and therefore the link 102 is removed and the controlling lever 44 is rendered inactive. The coupling arm 103 which controls the sleeve 45, and is fulcrumed about a screw 108 in the casing of the calculating mechanism, is held in neutral position by a screw M inserted in a hole of its extension 103a and secured in a bracket L (Fig. 7) on the casing of the calculating mechanism.

Before a tabulator key is depressed for releasing the carriage so that it moves to the left, as described, the species of calculation to be performed in the column totalisers 2 to 5 is selected by means of knob 48 (Figs. 1 to 4). Usually, the species is addition, and so the knob 48 is turned so that its index 116 (Fig. 1) is on the mark "A" in the front wall 81 of the calculating mechanism. A tilting member 117 (Fig. 7) is positively connected to the knob 48 and transmits the movement of the knob to a rod 120 through a pin 118 engaging in a notch 119 in the rod. The rod is connected to parts 121 to 127, an arm 122 being equipped with a pin 121 at its upper end, and a slot 295 in the rod 120 engaging over the pin. A spring 128 attached to the arm 122 effects a connection which is positive in one direction, and yielding in the other.

When the knob 48 is turned as described, an intermediate spur gear 127 is moved into the position illustrated in Fig. 7, as follows: The spur gear 127 is connected to a shaft 50 by claws 130 and a clutch disk 131 secured on the shaft, so that it can be displaced on the shaft but is held against rotation with respect thereto, and, in position illustrated in Fig. 7, the totaliser driving gear 38 is rotated through the driving shaft 37 to which rotation is imparted by a train of gears 127, 132, 133, and 134, and this rotation corresponds to addition.

For accounting and writing the items to be booked in columns I to IV, the corresponding calculating keys 20 are depressed, and the value introduced are transferred to that column totaliser 2 to 5 which is in calculating position at the time, through the medium of a spur gear 49 on the shaft 50 (Figs. 1, 1a, 3, and 4), and through the driving gear 38 on the shaft 37, in conformity with the position of the species knob 48. The operative connection of the shafts 50 and 37 is effected by a change-speed gear, as will be described below with reference to total taking.

The mechanism for automatic total taking

The balances calculated from columns I to IV of the form 25 (Fig. 16) in the cross totalisers 12 and 13 which make up the complementary unit K (Fig. 1a) will now be withdrawn by automatic total taking and typewritten in the columns V and VI of the form 25. Let it be assumed that first the item "125" in the cross totaliser 12 is withdrawn and written in the first line of column V of the form 25. At the same time, the cross totaliser 13 which indicates the complementary value 9999 875, must be automatically returned to zero. The complementary value must obviously not be written on the form.

In order that the cross totaliser 12 can be written clear, the idle totaliser 8 must be moved into the corresponding active position, since it controls the cross totaliser 12. This is effected by depressing the "100" tabulator 21. The movement of the carriage to the left which is started thereby, is limited by the tabulator rider (not shown) which is co-ordinated to the idle totaliser 8, engaging the column selector lever (not shown) co-ordinated to the depressed tabulator key. In this position, the cross totalisers 12 and 13 which have been moved by the dog 33a of the idle totaliser 8 (Fig. 1) and the links 14, 15, are engaged by the driving gears 35 and 36 (Figs. 3 and 7) with their 100 places.

The control plates 41 (Figs. 5, 6, and 11) of the column totalisers 2 to 7 serve for the selection of the species. The plate 41 is mounted to slide at the inner side of a front plate 51 of each totaliser 2 to 7 and arranged to occupy three distinct positions. A rib 52 projecting inwardly from the front plate 51 (Figs. 5 and 11) engages in one of three grooves 53 in the cam plate 41. For the purpose of adjusting the plate 41, a clamping screw 54, with a knurled handle 55, (Fig. 5) extends through a slot 56 in the front plate 51 (Fig. 11). The position of the control plate 41 is indicated by a mark 57 on the plate, and marks 59 at both sides of a hole 58 in the front plate 51. The three positions of the plate are: Addition, marked "A", release, marked "E", and subtraction, marked "S."

Since in the present example the value indicated in the cross totaliser 12 is additive, it must be withdrawn by subtraction. Therefore, the control plate 41 of the idle totaliser 6 is adjusted for subtraction, "S." When the paper carriage returns, the control plate 41 of this idle totaliser 6 engages the lever 43 (Figs. 3 and 7) which is a bellcrank. The control plate 41 turns the bellcrank 43 clockwise about its fulcrum 51 against the action of a spring 60 (Figs. 1 and 7) and a pin 62 at the lower end of the bellcrank engages a tilting member 63 and a rod 64. The rod 64 is pivoted to a rocker 65 on a shaft 66, and the bellcrank 43, through the means described, turns the rocker anti-clockwise, and its movement is transmitted to a spur gear 65 by a slide 67, as follows: A pin 69 on the rocker 65 engages in a slot 70 of the slide, and a tooth 71 on the slide engages in a groove of the spur gear 68. The spur gear is mounted to slide on the shaft 50 and is held against rotation about the shaft by bars 72 engaging in grooves in the perimeter of a disk 73 which is keyed on the shaft.

When the spur gear 66 is shifted by the mechanism connected to the rocker—which turns anti-clockwise, as described,—it moves out of mesh with a pinion 74 on the shaft 34 and into mesh with a lay pinion 75 which is mounted to rotate in the casing of the calculating mechanism and meshes with a driving spur gear 76 secured on shaft 34.

The drive which for addition is from the shaft 60 to the shaft 34 through spur gear 68, pinion 74, and shaft 34, is now reversed for subtraction, since the shaft 58 now drives the shaft 34 through the spur gear 68, the lay pinion 75, and the spur gear 76.

One end of a rod 77 is pivoted to the lower end of the bellcrank 43 and slides on headed screw 80 at the front wall 81 (Figs. 5 and 6). The rod 77 is shifted by the swinging motion of bellcrank 43 in the direction of the arrow C. The lower end 82 of a downwardly extending arm 83 of rod 77 is connected to a selector lever 86 by means of a headed rivet 87 in a crooked portion 85 of the selector lever projecting into a slot 84 in the lower end 82. The selector lever 86 is mounted to swing and to be shifted upwardly by means of a slot 86 and a headed screw 90 extending through the slot. The screw 90 is secured in a bracket 89 and this is attached to a

part 92 of the casing for the calculating mechanism by screws 91 (Fig. 1). In its initial position, the selector lever 86 is supported by gravity, the upper end of its slot 88 resting on the headed screw 90. With a plate 83 at an arm 94 extending to the right, the selector lever 86 can be moved into active position with respect to two bellcranks 85, 96 (Figs. 1a and 8), as will be described below. The selector lever 86 in its lower end has a crooked lug 97 provided with a U-shaped hole 98. A headed screw 89 secured in the machine frame (Fig. 1) projects through the hole 98 whereby the selector lever is further guided. When the rod 77 is shifted as described, the selector lever 86 is swung clockwise about the bearing screw 90 by the pin-and-slot connection 87, 84. The selector lever 86 now moves into active position to a lug 100 (Figs. 1a, 8) of the bellcrank 95 with the plate 93 of its arm 94. The lug 97 of the selector lever 86 now moves into reach of the guiding screw 99 with the shank 101 of the U-shaped hole 99.

Since, as described in the paragraph "the normal calculating and typewriting operations . . ." etc., both driving gears 35 and 36 are driven together for the booking operation described, the control plate 40 which operates the sleeve 45 (Figs. 5 and 6) is not required in the idle totaliser 6 and is dispensed with, as well as the lever 44 and the link 102 illustrated in Fig. 9 and omitted in Fig. 7. When the idle totaliser 8 has moved into calculating position, its control plate 39 acts on the control lever 42 (Figs. 3 and 5) and releases a locking mechanism 113, 114, 115, and thereby the totaliser.

Preparation of the total taking operation upon depression of the controlling members for the cross totalisers

A bar 135 is secured in the bearing frame 19 at the right hand side of the machine (Fig. 10) and a controlling member 136 for the cross totalisers 12 and 13 is mounted to swing about the bar and held against axial displacement. The cross total taking key 23 for manual operation is secured to the front end of the controlling member 136. The bar 135 is secured to the bearing frame 19 in similar manner. A stepped extension projects from the lower side of the controlling member 136 at 136 for holding the member in its initial position and a spring 137 pulls the extension 138 against the rear side of a locking bar 139 which is also secured in the bearing frame 18.

A locking member 140 is fulcrumed on the controlling member 136 at the left about a screw 552 which prevents lateral displacement of the locking member. A spring 141 connecting the members 136 and 140 pulls a tongue 142 against the other side of the locking bar 139 and holds the locking member 140 in its initial position.

The tail end of the controlling member is crooked twice, at 143 and at 144, and the crook 143 engages the lower end of the lever 86 when the member is depressed. At the same time, the tail end 145 of the locking member 140 engages below a lug 146 at the top of the tail end 147 of a crooked lever 148 from which the end 147 projects in upward direction. The lever 148 is fulcrumed on a transverse bridge 150 by a headed screw 149, and its inner end is equipped with a pin 151 engaging in a slot 152 at the inner end of a lever 153 which is fulcrumed on the bridge 150 by headed screw 154. The tail end 156 of the lever 153 is crooked upwards and equipped with a lug 155 at its upper end for cooperation with parts to be described below. The bridge 150 has a lug 157 at one end which is secured to a bracket 160 in the bearing frame 19 by screws 156 (Fig. 1) and its other end is secured to the locking bar 139 by a pair of tongues 161 (Fig. 10) and screws 162.

When the controlling member 136 is depressed the tongue 142 of the locking member 140 engages in a groove 163 in the locking bar 139 under the action of the spring 141, holding the locking member 140 and the controlling member 136 in depressed position. When the controlling member 136 is depressed, a shoulder 164 on the member engages a pin 167 riveted into a bent-over lug 165 at one end of a lever 166. The lever 168 which is fulcrumed on the inner side of the front traverse bar of the bearing frame 19, about a headed screw 168 (Figs. 1 and 10), is operatively connected to another lever 171 (Figs. 1, 10, and 12). This lever which is also fulcrumed on the inner side of the front traverse bar of the bearing frame 19 about a headed screw 172, can act on a plate 174 of a lever 175 with a bent lug 173. The lever, or universal member, 175 is arranged at the left-hand side of the controlling member 176 (Fig. 12) for the total taking from the column totalisers 2 to 5 on the bar 135. By a spring 177, the universal member 175 is permanently urged anti-clockwise about the bar 135, and the tail end 175a of the universal member 175 cooperates with a clutching arm 178 whereby the camplate element, here designated 501, 502 is held disengaged from a permanently rotating shaft 504. The total taking controlling member 176 (Fig. 12) for the total taking from the column totalisers 2 to 5 is different in so far, as it cannot act directly on the clutching arm 178 with its tail end, but only through the universal member 175, for which purpose the member has a lug 179 acting on the plate 174 of the universal member 175. However, the tail end of the controlling member 176 can act on a slide 180 which has been shown only partly and on a lever 282, Fig. 12, as will be described.

When the key plate 23 (Fig. 10) for the cross totalisers is depressed, the controlling member 136 is swung about the bar 135 clockwise against the action of its spring 137, and the locking member 140 is moved in the same direction by the spring 141. The tongue 142 of the locking member 140 slides off the locking bar 139 and then, at the end of the swinging movement, engages in the groove 163 of the locking bar 139 under the pull of spring 141. By these means, the controlling and locking members 136 and 140 are held in their swung-out positions.

During the swinging of the members, the tail end 145 of the locking member moves into active position with respect to the lug 146 on the lever 146 by which it is influenced toward the close of the total taking operation, as will be described. The crooked tail end 143 of the depressed controlling member 136 bears against the lower end of the lever 86 which, as described, has already been turned clockwise, and raises it. The plate 93 (Figs. 7 and 8) at the upper end of the lever 86 now engages the lug 100 of the bellcrank 95 and the bellcrank together with mechanism under its control, are operated as will be described. If, however, the control plate 41 in one of the column totalisers 2 to 5 has been shifted to "E," and this totaliser is in calculating position, the edge 650 (Figs. 1, 2, 7, and 9) of the hole 98 in the lug 97 of the lever 86 engages the head of screw 99 and

prevents further depression of the controlling member **136**.

At the same time, the shoulder **164** on the depression controlling member **136** engages the pin **167** at the outer end of the lever **166**. The lever is swung clockwise about its screw **168**. The lever **171** is swung anticlockwise about its screw **172** and its lug **173** engages the plate **174** at the front end of the universal member **175**. The universal member is now swung about the bar **135** clockwise against the spring **177**, and its tail end **175***a* moves clear of the clutching arm **178**. The arm is now operated and the camplate unit **501**, **502** is coupled with the clutch gear T (Fig. 12) and the shaft **504** which is permanently rotated from the motor **24**.

The zero stop mechanism for the cross totaliser 12

The bellcrank **95** (Figs. 1*a* and 8) is fulcrumed on the casing of the calculating mechanism by a headed screw at **181**. A rod **162** is pivoted to the upper arm of the bellcrank by a rivet **183** at one end, its other end being connected to a screw **194** on a lever **185**. The lever **185** is fulcrumed on the rear wall of the calculating mechanism casing about a screw **186** and its forked upper end **187** engages a pin **169** on a slide **189**. The slide is slotted at **190** and a screw **191** in the rear wall engages in the slot for guiding the slide which is supported by a pin **192** in the rear wall. A spring **193** turns the lever **185** about its screw **186** in anti-clockwise direction and the lever moves the slide **189** to the left. This movement is limited by the end of the slot **190** bearing against the screw **191** and defining the initial position of the corresponding parts.

A flap **195** is mounted to turn about a shaft **194** but held against axial displacement and its tail end **196** is engaged by the inner end **197** of the slide **189**. A spring **198** holds the tail **196** against the end of the slide **169** and, in turn, pushes the slide against its supporting pin **192**. The shaft **194** is supported by a bracket **197***a* (Fig. 1*a*) which is secured to the front wall **81** of the calculating mechanism by screws **198***a*. The flap is held against lateral displacement on the shaft **194** between a flange **199** of the bracket **197** and an annular check **200** on the shaft **194**. A zero stop **203** is secured on an upwardly directed portion **201** of the flap **195** by screws **202** which acts on parts of the cross totaliser **12** in a manner to be described below.

A lever **205** (Figs. 6 and 8) is keyed on a shaft **204** arranged suitably in the calculating mechanism by its boss **206**. A push rod **207** is pivotally connected to the free end of the lever **205** by a screw **208**. The free end **209** of the push rod is reduced and engages below the slide **189**. An inclined face **210** is formed on the push rod for cooperation with the slide **189**, for a purpose which will be described. The end **209** is guided in, and supported by, a recess in the rear wall of the calculating mechanism. An inclined face **211** on the slide **189** cooperates with the tail end **196** of the flap **195** for a purpose to be described below.

The zero stop mechanism for the totaliser 13

A bellcrank **96** which is similar to the bellcrank **95**, is fulcrumed about the same headed screw **181** (Fig. 8) in the calculating mechanism. At the upwardly projected arm of the bellcrank lever **96** is pivoted a rod **213** by a headed rivet **212** and the other end of the rod is pivoted to a lever **215** by a headed screw **214**. The lever **215** which is fulcrumed on a headed screw **216** in the rear wall of the calculating mechanism embraces a pin **218** on a slide **219** with its upper forked end, **217**. The slide **219** is mounted for longitudinal displacement along the rear wall of the calculating mechanism by a slot **220** and a screw **221** secured in the rear wall. It is further guided by a pin **222** secured in the rear wall. A spring **223** engaging the lever **215** swings the lever **215** permanently against clockwise rotation about its fulcrum screw **216**, and the lever pushes the slide **219** to the left. These movements are limited by the end of the slot **222** bearing against the screw **221** in which position the parts mentioned and the members connected to them are in their initial positions. Another flap **224** is mounted to swing about, but held against axial displacement on, the shaft **194** and its tail end **225** is in one-sided operative connection with a nose **226** of the slide **219**. A spring **227** engaging the tail end **225** of the flap **224** holds the tail end permanently against the nose **226** of the slide **219** and by these means the slide **219** is permanently held against the supporting pin **222**. Between a flange **229** (Fig. 1*a*) of the bracket **197***a* and an annular check **229** secured on the shaft **194**, the flap **224** is held against lateral displacement on the shaft **194**. A zero stop **232** is secured on an upwardly extending front portion of the flap **224** by screws **231**, which stop can act on parts of the mechanism of the cross totaliser **13**, as will be described. A lever **233** is secured with its boss **234** on the shaft **204** which has been described in the paragraph "The zero stop mechanism for the cross totaliser **12**." A push rod **236** is pivotally connected to the free end of the lever **233** by a screw **235**. The free end **237** of the push rod is reduced and engages below the slide **219**. An inclined face **238** is formed on the push rod **236** for cooperation with the slide **219**, for a purpose which will be described. The push rod **238** is guided in, and supported by, a recess in the rear wall of the calculating mechanism. An inclined face **239** on the slide **219** cooperates with the tail end **225** of the flap **224** for a purpose to be described below.

The shaft **204** on which are mounted the usual unlocking levers **240** (Figs. 5 and 6) for the unlocking of the cross totalisers **12** and **13** is operatively connected to the unlocking shaft **115** by levers **241** and **243** and a pin-and-slot connection **242**. The calculating mechanism unlocking lever **244** for the column totalisers is keyed on the shaft **115**.

Operation upon depression of the cross total taking key plate 23

When the cross total taking key plate **23** (Figs. 3 and 10) is depressed as described, the locking member **140** which is coordinated to the controlling member **136**, raises the lug **155** at the tail end of the lever **153** through the medium of its own tail end **145** and the parts **146**, **147**, **148**, **151**, and **152**, and the lug bears slightly against a tooth **250***a* (Figs. 10 and 12) at the lower end of a universal part **250**, this being a forked rod suspended from one end of an arm **251** whose other end is fulcrumed about a screw **252** in the rear wall of the calculating mechanism. A pawl **253** is pivoted on the arm **251** about a screw **254**. The operation of the pawl will be described below. A spring **255** is connected to the pawl **253** at one end and secured in an eye of the arm

251 at its other end, pulling the pawl against a check B on the arm 251.

As mentioned, the controlling member 136 for cross total taking operates the selector lever 86 which in turn operates the bellcrank 95 (Fig. 8). The bellcrank is pivotally connected to the rod 182 and so turns the lever 185 in the same direction and the slide 189 is shifted in the direction of the arrow *n* until the left-hand end of its slot 190 is arrested by the screw 191. During this movement, the inclined face 211 of the slide moves below the tail end 198 of the flap 195 and turns the flap clockwise. By these means the zero stop 203 is moved into slight engagement with the zero setting wheel 125 (Figs. 5 and 6) of the cross totalizer 12 at its 100 place which has previously been moved into writing and calculating position.

While these operations are performed the cross total taking controlling member 136 (Fig. 10) engages the pin 167 of the lever 166 with its shoulder 164, turning the lever clockwise. The lever 166, through the pin-and-slot connection 169, 170 (Fig. 12), turns the lever 171 in opposite direction and its lug 173 engages the plate 174 of the universal member 175. The universal member is now turned clockwise but does not influence the column total taking controlling member 176. The tail end 175*a* of the universal member now moves away from the clutching arm 178 of the camplate unit 501, 502. The arm now turns under the action of its spring 503 (Fig. 12) and so its tooth 178*a* engages between the teeth of the driving wheel T. This wheel is rigidly connected to the driving shaft 504 while the camplates 501 and 502 are rigidly connected to each other but are free to turn on the shaft 504.

The camplates now rotate with the driving shaft 504. The camplate 502 controls an unlocking slide 506 (Figs. 12, 13, 14, and 15) whose lower end supports a roller 507. Springs 508 and 509 (Figs. 12 to 15) hold the roller against the edge of the camplate 502. As the elevated portion of the camplate 502 recedes, the unlocking slide descends. An inclined edge 510 on the slide 506 engages a catch 511 of an arm 512 which is free to turn on the unlocking shaft 115 (Figs. 5, 13, and 14), turning the arm clockwise. The arm 512 engages a lug 513 of an arm 514 which is keyed on the shaft 115 and the shaft is turned, unlocking the calculating mechanism. The turning movement of the unlocking shaft 115 is transmitted to the unlocking levers 240 through the parts 243, 242, 241 and the shaft 204. The cross totaliser 12 is now unlocked through a member 516 and the cross totaliser 13 is unlocked by another finger.

The shaft 204 which turns in the direction of the arrow *p* (Figs. 5 and 8) when the cross totalisers are unlocked, moves the push rod 207 to the rear through its lever 205 (Figs. 6 and 8) and the inclined face 210 slides below the slide 189, elevating it. The slide 189, through the tail end 196 of flap 195, finally causes the zero stop 203 to engage in the zero setting wheel 125 of the 100 place of the cross totaliser 12.

When the unlocking shaft is turned as described, a pin 518 (Figs. 13 and 14) on the arm 512 engages the upper edge of a lever 519 on a shaft 520 mounted to rotate in the front and rear walls of the calculating mechanism. Levers 521 and 522 are keyed on this shaft. Pins 523 and 524 riveted in the levers engage in the grooved boss of a spur gear 525 mounted to turn freely on shaft 50. Clutching members on the spur gear engage in suitable notches in a flange 526 which is keyed on the shaft 50.

The shaft 520 is turned clockwise by the pin 518 on the arm 512 against the pull of a spring 527. A third lever 528 on the rear end of the shaft 520 is equipped with a tooth at its free end with which it engages, and is locked by a tooth 529*a* of a rocker 529 which is fulcrumed at 530. The turning movement of the shaft 520 is transmitted to the spur gear 525 which is now engaged with the teeth 532 of a zero setting slide 531 which is mounted to slide vertically in the left hand portion of the calculating mechanism.

Upon the further downward movement of the unlocking slide 506, a dog 533 on the slide engages a pawl 535 which is pivoted to a catch 534, and turns the pawl. A lug at the end of the pawl 535 engages the catch 534 and turns it clockwise against a spring 538, withdrawing a tooth at the end of the catch from a rack 537 on the zero setting slide 531, and a rack 538, under the pull of a spring, not shown, now moves the slide down, arrow 543, through pinion 539, shaft 540, pinion 541 and rack 542 on the slide. The rack 538 moves in the direction of the arrow 544 and, together with a pin 545 on the still descending unlocking slide 506, effect in sequence the typewriting of the value to be withdrawn from the cross totaliser 12.

The total taking operation from the positive cross totalizer 12 in the complementary unit K

The zero setting wheels 125 of the cross totaliser 12 (Fig. 5) mesh with driving wheels 261 which, through intermediate pinions 262, turn the spur gears 263 of the number rollers 264. As described in the preceding paragraph "The zero stop mechanism for the cross totaliser 12" and elsewhere, the 100 place roller 264 in the present example is connected to the spur gear 35 keyed on the shaft 34 through its driving wheel 261 (Figs. 3 and 7), and the spur gear 35 is connected to the shaft 50 through the train of gears 76, 75, 68 (Fig. 7) and the shaft 50 is connected to the zero setting slide 531 by the spur gear 525. (Fig. 13).

The zero setting slide 531 which has now been released from the camplate 502 (Figs. 12, 13, and 14) through the unlocking slide 506 now rotates the driving wheel 261 (Fig. 5) of the 100 place in in the cross totaliser 12, through the mechanism described. The driving wheel 261 is turned until the distance of the zero setting tooth of the zero setting wheel 125 has become exhausted. This distance is determined by the value to be canceled—in the present instance "1"—and is equal to one pitch from the zero stop 203. As soon as the zero setting tooth of the zero setting wheel 125 has engaged the zero stop 203 (Fig. 8), the corresponding number roller 264 (Fig. 5) displays "0" in the window of the cross totaliser 12. The descent of the zero setting slide 531 (Fig. 13) is now completed.

The writing of the number "1" in the first line, column V of form 25 which has been prepared by the zero setting slide 531 is now effected by the pin 545 on the unlocking slide 506 (Fig. 13) acting on mechanism which has not been shown.

Previously after the unlocking slide had completed its descent, a slide 553 at the left of the calculating mechanism (Fig. 13) was shifted in the direction of the arrow 559 through mechanism 554, 555, 558, 557 from the camplate 501 through a bolt 550 belonging to the typewriting mechanism by means not illustrated. The rocker 529 whose left arm 560 extends into a slot 561 in

the slide **553**, is turned clockwise and the locking arm **528** is released. The arms **521** and **522**, under the action of the spring **527**, shift the spur gear **525** to the left and away from the rack **532** of the zero setting slide **531**.

The ascending portion of the camplate **502** now raises the roller **507** (Figs. 13, 14, and 15) at the lower end of the unlocking slide **506** and the inclined edge **510** of the slide releases the catch **811**. The unlocking levers **240** and **244** (Fig. 5) now return the members **515**, **516** into their initial positions, and the cross totaliser **12** is locked again. At the same time, the shaft **204** is turned against the arrow *p* by the parts **243**, **242**, and **241**, and the inclined edge **210** of the push rod **207** (Fig. 8) which is pivoted to the arm **205**, is withdrawn from the slide **186**. A roller **506***a* on the unlocking slide **506** engages a lever **554***a* fulcrumed in the calculating mechanism which is elevated and, through an eccentric screw **555***a* in the zero setting slide **531** returns the slide into its upper final position, the rack **537** moving idly past the tooth at the upper end of the catch **534**.

Obviously during the operation described, the 100 place of the cross totaliser **13** has also been turned for one unit, that is, from "8" to "9", so that now the value "25" is in the totaliser **12**, and "9999,975" is in the totaliser **13**. The zero setting wheels of the cross totaliser **13** are free to turn as the corresponding zero stop **232** (Fig. 8) was not moved into active position.

When the type bar—not shown—returns, the carriage performs the step to the 10 place of the cross totaliser **12** in which place the same operations are performed, that is, in the 10 place the "2" is withdrawn from the cross totaliser **12** while the 10 place in the cross totaliser **13** moves from "7" to "9", so that now only the value "5" is read at the totaliser **12**, and "9999,995" at the totaliser **13**. The value "2" is written and the totalisers now move to the units place. Here, a similar operation occurs, the value "5" being withdrawn from the totaliser **12**. In the totaliser **13**, the "5" adds to "5" there, and the unit place moves to "0". Upon the transit from "9" to "0" a tens transfer occurs and all higher places move from "9" to "0". Now, both cross totalisers **12** and **13** are at "0".

When all number rollers **264** of the cross totaliser **12** (Fig. 5) are at "0", the half-high-teeth—not shown—of all zero setting wheels **125** by which the clear sign printing device is controlled, are aligned. Under these conditions, a control rail **270** (Fig. 5) can be influenced by the clear sign printing device **273**, **272**, **271**, of known type, which partly surrounds the cross totaliser **12**. The rail **270** engages the half-high teeth of the zero setting wheels, and the clear sign printing is begun.

When the cross totaliser **12** is returned to "0" in all places, and the canceled value "125" has been printed in the first line, column V of the form **25**, as described, a hook **256** at one side of a plate **560** by which the idle totaliser **6** is closed at the bottom and which is bent at right angles at its lower end (Figs. 5 and 11) engages the pawl **253** on the arm **251** (Fig. 10) which has been described in the paragraph "Operation upon depression . . .". Since the pawl is in contact with the check B it cannot swing independently but swings the arm **251** anti-clockwise against the action of its spring **551**. The universal part **250** (Fig. 10) which is pivoted to the arm **251** descends, engages the lug **155** at the tail end **153** of the lever **156** and turns the lever anti-clockwise, like the arm **251**. The movement of the lever **155** is transmitted to the lever **148** through the pin-and-slot connection **151**, **152** (Fig. 10) and the lever **148**, turning about its screw **149**, turns the tail end **145** of the locking member **140** anti-clockwise by its lug **146**. The locking member swings about its screw **552** and is disengaged from the locking bar **139**. The cross total taking controlling member **136** is now free to return into its initial position under the pull of its spring **137**, and clears the pin **167** of the lever **166** which is now turned anti-clockwise under the pull of the spring **177** through members **175**, **171**, **169**, and **170**. By these means, the tail end of the universal member **175** returns into the path of the clutching arm **178** (Figs. 10 and 12) and the camplate unit **801**, **502** is again disengaged from the driving wheel T on the driving shaft **504**.

Upon its return into initial position, the cross total taking controlling member **136** releases the selector lever **96** which now descends by gravity and its lug **93** releases the lug **100** of the bellcrank **95**. Under the action of its spring **188** (Fig. 8) acting on the lever **185**, the bellcrank **95** returns into its initial position and moves the slide **189** against the arrow *n* through the rod **182**. Before this occurs the control plate **39** (Fig. 5) of the idle totaliser **6** has released the control lever **42** and the calculating mechanism is locked again. The flap **195** (Fig. 8) now returns into its initial position under the pull of spring **198** and the zero stop **203** moves clear of the zero setting teeth of the wheels **125** in the cross totaliser **12**.

At the same time as the control plate **39** releases the lever **42**, the control plate **41** of the idle totaliser releases the control bellcrank **43** (Fig. 7) and has returned the species of the cross totalisers to addition, and the selector **66** under the control of rod **71** returns into the initial position shown in Fig. 1.

The total taking operation from the negative cross totaliser 13 of the complementary unit K

In the first line of the form **25** (Fig. 16) there was a positive balance "125" in the cross totaliser **12** of the complementary cross totaliser unit K, in the calculation described by way of example. Correspondingly the other cross totaliser **13** of the unit K showed the complement "999,875". This was automatically cancelled when totalising from the cross totaliser **12** by the driving spur gears **35** and **36** which, as described, are connected to each other and at the same time engage with the same places of both cross totalisers.

The example illustrated in the second line of the form **25** shows a negative balance "110" in column VI. Assume that this balance has been calculated in the cross totaliser **13** of the unit K, and is to be written in the second line, column VI.

To this end the control plate **41** of the idle totaliser **7** is adjusted to "A", as, see the paragraph "The normal calculating . . ." the sequence of the numbers on the number rollers **264** of the cross totaliser **13** is the reverse of the cross totaliser **12**.

The "100" decimal tabulator key **21** is now depressed, corresponding to the number "110". The idle totaliser **7** moves the cross totalisers **12** and **13** in the same direction by means of the links **14**, **15** (Fig. 1*a*). By these means, the cross totalisers **12** and **13** are operatively connected to

the driving spur gears **35** and **36** with their 100 places. At the same time, the control plate **41** of the idle totaliser **7** moves over the control bellcrank **43** but this is not operated, since the control plate has been moved to "A". The selector lever **86** remains in its initial position, as described in the preceding paragraph, and shown in Fig. 1, and the recesses S of its hole **98** is below the head of the screw **99**. As the bellcrank **43** is not operated, the operation in the cross totaliser **13** is addition. The driving wheels **261** (Fig. 5) of the cross totalisers **12** and **13** are now operatively connected to the shaft **50** through **36** (Fig. 7), **35**, **45**, **34**, **74**, and **68**. Furthermore, the unlocking shaft **115** of the calculating mechanism is unlocked by the control plate **39** of the idle totaliser **7** (Fig. 5) acting on the locking lever **42**.

When the cross-totalising controlling member **138** is depressed (Fig. 10), the cam plates **501**, **502** (Fig. 12) are reconnected to the driving shaft **504** by means of the parts **167**, **165**, **166**, **169**, **170**, **171**, **174**, and **175**, and the tail end **175***a* of the universal member **175** releases the clutching arm **178** which now engages between the teeth of the driving wheel T on the driving shaft **504**. The tail end **145** (Fig. 10) of the locking member **140** which is pivoted on the controlling member **136**, engages the lug **146** of the lever **148** and turns the lever anti-clockwise. The movement of the lever **148** is transmitted to the lever **153** by the pin-and-slot connection **151**, **152** which now bears slightly against the tooth **250***a* of the universal part **250** suspended from the arm **251**, but without raising the universal part. The tail end **143** of the controlling member **136** shifts the selector lever **86** in upward direction, so that the lug **93** of the selector lever **86** acts on the lug L (Fig. 8) of the bellcrank **96** and turns the bellcrank clockwise. This movement is transmitted to the swinging lever **215** by rod **213** pivoted to it. The swinging lever **215** shifts the slide **219** in the direction of the arrow *n* and the inclined edge **238** of the slide engages below the tail end **225** of the flap **224**, moving its zero stop **232** into slight engagement with the zero setting wheel **125** of the 100 place of the cross totaliser **13**. When the controlling member **136** has arrived in its lowermost position, it is locked by the tooth **142** of its locking member **140** engaging in the groove **163** of the locking bar **139** where it is held by the spring **141** (Fig. 10).

The camplate **502** (Fig. 12) now allows the roller **507** (Figs. 13 to 15) at the lower end of the unlocking slide **506** to descend and the slide now operates the catch **511** and, through this, turns the unlocking levers **240** in the direction of the arrow *p* (Fig. 5) and the levers now unlock the cross totalisers **12** and **13** through their members **516**, as described in the paragraph "The total taking operation from the positive cross totaliser **12** in the complementary unit K."

Simultaneously with the unlocking of the cross totalisers, the arm **233** (Fig. 8) which is keyed on the shaft **204**, is turned and the slide **236** which is pivoted to the arm, engages below the slide **219** with its incline **238**, elevates the slide and turns the flap **224** further in clockwise direction. The zero stop **232** is now moved into positive engagement with the zero setting wheel **125** in the 100 place of the cross totaliser **13**.

A lug **533** on the unlocking slide **506** (Fig. 13) unlocks the zero setting slide **531** by acting on a pawl **535** on the slide. The zero setting slide whose rack has previously been engaged at **532** by the pinion **525** under the action of the locking lever **512**, now descends and rotates the shaft **50** which in turn rotates the driving wheels **261** of the 100 place in the cross totalisers **12** and **13** through the train of gears **68** (Fig. 7), **74**, **36**, and **35**. When the zero setting tooth of the zero setting wheel **125** of the 100 place of the cross totaliser **13** engages the zero stop **232**, the corresponding number roller **264** displays "0" in the window of the cross totaliser **13**. This arrests the descent of the zero setting slide **531** (Fig. 13), and at the same time the complementary number "8" which corresponds to the complementary value 999,980, in conformity with the value "1" of the 100 place of the cross totaliser **13**, is brought to "9" in the cross totaliser **12** by spur gear **35** (Fig. 7).

The value "1" is now written in the second line, column VI of the form **25** in the same manner as in the cross totaliser **12** (Fig. 16). The carriage is now moved from the 100 place into the 10 place, etc. Here also, totals are taken in the manner described, and in the cross totaliser **12** tens transfer occurs from the 10 place into the 100 place, so that a tens transfer occurs in each higher place and the corresponding number rollers are brought to "0". When all number rollers **264** of the cross totaliser **13** display "0," all zero setting wheels **125** are aligned with their half-high teeth for clear sign printing whereupon printing is effected as described in the preceding paragraph.

After the total taking from the cross totaliser **13** has been completed, the cam plate **502** (Fig. 12) has returned the unlocking slide **506** into its initial position. The parts connected to the unlocking slide, for instance, the zero setting slide **531**, return into their initial positions. The controlling member **136** is now unlocked in the manner described with respect to the total taking from the cross totaliser **12**, and the complete unit **501**, **502** is uncoupled from the driving shaft **504**.

Total taking from the column totalisers 2 to 5

The column-total taking controlling member **176** (Figs. 7 and 12) is arranged to act on a lug **281** of a double-armed lever **282** with the upper edge **280** of its tail end. The double-armed lever **282** is fulcrumed at **283** about a screw on a bracket **282***a* connected to the lower side of the machine frame. A crooked connecting rod **284** is pivoted to the front arm of the double-armed lever **282** by a screw **285**. The other end of the connecting rod **284** is pivoted to a link **287** at **286**. An open slot **288** at the lower end **289** of the link **287** is placed about a pin **291** on the bar **290** of a changing-over key **16**. There is a slight clearance between the pin and the upper end of the slot, so that the bar **280** can partake in the depression of the controlling member **176**. On the other hand, the controlling member is not influenced by the bar **290**.

The upper end of the link **287** is pivotally connected to a lever **292** keyed on the shaft **125**.

When, after the booking of the first three lines of the form **25** (Fig. 16) the column totals of the debit and credit items in columns I to IV are to be found and written, this is done by writing the values accumulated in the column totalisers **2** to **5**. To this end the carriage return key **18** is operated and thereupon the decimal tabulator key **21**/"**100**" is depressed so that the principal driving wheel **38** of the calculating mechanism is first connected to the driving gear **549** of the 100 place of the column totaliser **2** which corresponds to the value **360**, the total in column I. The dog **33***a*

of the column totaliser 2 moves the cross totalisers 12 and 13 into engagement with the driving gears 35 and 36 in places corresponding to the position of the column totaliser 2, by means of the links 14, 15. The control plate 39 (Fig. 5) of the column totaliser 2 acts on the control lever 42 and unlocks the mechanisms connected to the unlocking shaft 115 of the calculating mechanism. At the same time, the zero setting flap for the column totalisers—which has not been shown—is placed in its preparatory position.

The vertical column total taking controlling member 176 is now depressed (Figs. 7 and 12) and its upper edge 280 acts on a rod 180 which brings the zero stop—not shown—fully into engagement with the zero setting wheels 570 (Fig. 5), as also described in the said patent.

The upper edge 280 of the controlling member 176 also acts on the double armed lever 282 and moves the link 287 in the direction of the arrow "q" in Fig. 7. The upper end of the slot 288 in the link 287 now engages the pin 291 and depresses the bar 290 of the carriage return key, changing over the carriage. The link moving in the direction of the arrow q turns the lever 292 anti-clockwise and the levers 123, 122, and 124 partake in this movement. The lever 124 engages in the groove of the coupling sleeve of the gear wheel 127 with its pin 126 and moves the gear wheel 127 into mesh with a gear wheel x keyed on the driving shaft 37. The pin 121 of the lever 122 slides in the open longitudinal slot 293 of the slide 120 but does not influence the slide.

A locking member 293a is pivoted to the controlling member 176 by a screw 176a. The locking member partakes in the depression of the controlling member and, turning clockwise under the action of a spring 293b, engages in the groove 193 of the locking bar 139 with a tooth 293c (Fig. 10), where it remains. The upper edge 295 of the tail end of locking member 293a now bears slightly against a second tooth 294 on the lower end of the universal part 250 but does not raise the part.

A shoulder 179 at the lower side of the controlling member 176 (Fig. 12) acts on the plate 174 of the universal member 175 so that the member is turned and its tail end 175a releases the clutching arm 178 whereby the cam plate unit 501, 502 which serves for total taking and booking of the totals, is coupled to the driving shaft 504. The unlocking slide 506 is now released and unlocks the column totaliser 2 while the known zero stop moves into active position whereupon the zero setting slide 531 is released and effects subtractive total taking from the 100 place of the column totaliser 2.

The number roller 546 of the column totaliser 2 (Fig. 5) is driven by the following train of gears: 547, 548, 549, 38 (Fig. 7), 37, x, and 127 from the shaft 50. This shaft also drives the number rollers 264 of the 100 places of the cross totalisers 12 and 13 through the train 68, 74, 35, 36, 261, 262, and 263. As the position of the column totalisers 2 to 5 is the same as for the calculations in the first three lines of the form, the value "3" is introduced positively in the cross totaliser 12.

When the number roller of the hundreds place in the column totaliser 2 has been returned to "0," the number "3" is written in the fourth line, column I of form 25 (Fig. 16). The carriage now moves to the tens place. After in this manner, progressing from the highest to the lowest place, the value "360" has been withdrawn from the column totaliser 2, transferred to the cross totalisers 12 and 13 of the complementary unit K, and written, the tooth 256 of the column totaliser 2 (Figs. 5 and 11) strikes the pawl 253 (Fig. 10) and, together with the pawl, turns the arm 251 anti-clockwise so that the universal part 250 descends. Its tooth 294 (Fig. 12) now engages the upper edge 295 of the tail end of the locking member 293a and releases the member which now returns into its initial position together with the column total taking controlling member 176. The universal member 175 is liberated and its spring 177 returns its tail end 175a into reach of the clutching arm 178, releasing the cam plate unit 501, 502.

Total taking is now performed in the column totalisers 3 to 5 in a similar manner as described and the corresponding amounts are transmitted to the complementary unit alternately in positive and negative direction, as is known in the art. The totals withdrawn from the column totalizers are written in italics which is effected by the changing over of the carriage, as described.

The completion of the booking operation

When the added totals of columns I to IV have been written down from the column totalisers 2 to 5, and transferred to the cross totalisers 12 and 13 of the complementary unit K, the balance which has been calculated in the unit in the meantime, is written down in the column V or VI and the booking is then finished. In the present instance, the cross totaliser 12 shows a positive value "5", and the cross totaliser 13 shows the corresponding complementary value 99999,995. The decimal tabulator key 21 for the value "5" is now depressed and the idle totaliser 6 moves the cross totalisers 12 and 13 with their unit places into mesh with the driving gear wheels 35 and 36. The permanent change over key 651 (Fig. 3) is now operated and the key plate 23 of the cross total taking controlling member is depressed whereupon the cross totaliser 12 is written clear, as mentioned, and returned to zero together with the cross totaliser 13. The value 5 is written in an italic in the fourth line of the column V.

When total taking has been completed, all parts involved return into their initial positions, as fully described above. The change over mechanism is returned into initial position by depressing the change over key 17.

The arrangement for two normal cross totalisers

By way of example, a booking and accounting operation has been described but the machine can also be used for other purpose, such as the calculation of pay, or the like.

As another example a form 600 is illustrated in Fig. 17 in which the freight and passenger trains of two railway lines A and B are booked separately, and added up separately after three days.

The numbers of freight trains in the columns I and III of form 600 are introduced in the column totalisers 2 and 4 and in the positive cross totaliser 12a (Fig. 2), and the numbers of passenger trains in the columns II and IV of the form are introduced in the column totalisers 3 and 5, and in the cross totaliser 13a which is also positive. Finally, each cross totaliser 12a and 13a is clear written independently, and one after the other, the corresponding values are transferred to column totalisers 6a and 7a replacing the idle totalisers 6 and 7, and written down in the columns V and VI of the form 600.

For this mode of calculation, certain modifica-

tions in the machine are necessary, as will now be described with reference to Figs. 2, 4, and 9.

The drive of the cross totalisers 12a and 13a

In order to rotate selectively the gear wheels 35 and 36 which operate the cross totalisers 12a and 13a (Figs. 2, 4, and 9) the screw M which holds the coupling lever 103 in its neutral position, (Figs. 3 and 7) is removed. The link 102 has an extension which is connected to the lever 103 by a screw 106 (Figs. 4 and 9) and its connection to the lever 44 is effected by a screw 105 in a U-shaped arm of the lever 44. A spring 109 is secured to a lug 103b on the coupling lever 103 and its other end is secured to an eye 001 in the rear wall of the calculating mechanism casing (Fig. 4). The spring 109 turns the coupling arm 103 clockwise until its extension 110 bears against the said rear wall. The coupling arm is now in its initial position. By its pin 107 engaging in the groove of the coupling sleeve 45, the coupling arm, when in this initial position, moves the teeth 111 of the sleeve into mesh with the teeth 46 on the boss of the driving wheel 35 and this wheel is now in driving position. The control lever 44 is arranged to be turned anti-clockwise by the control plates 40 (Fig. 5) in the column totalisers 3, 5, and 7.

The zero stop mechanism for the cross totalisers 12a and 13a

Since in the example now under discussion either the cross totaliser 13a or the cross totaliser 12a is to be clear written, the zero stop can be controlled in unison for both cross totalisers. This is effected by dispensing with the tail end 225 of the flap 224 (Fig. 8), and with the allotted parts 96, 213, 215, 219, 233, and 238, and by combining the zero stops 203 and 232 of the respective flaps 105 and 232 into a single member, as shown in Fig. 9.

As the values to be calculated in the cross totalisers 12a and 13a are introduced additively, the totals calculated in the cross totalisers must be withdrawn subtractively. To this end, the control plates 41 (Fig. 5) in the column totalisers 6a and 7a (Fig. 2) are adjusted to "S" and the control lever 43 is moved clockwise when one of the said column totalisers moves into calculating position. The selector lever 86 is caused to partake in the movement of the column totalisers, by the rod 77, whereby the slot 101 in the lug 97 of the selector lever 86 is positioned below the screw 89, and the plate 93 engaged below the lug 100 of the bellcrank 95. The bellcrank 95 can now be operated and the zero stop 203, 232 moves into the path of the zero setting wheels 125 in the cross totalisers 12a and 13. In all other positions the selector lever 86—which is operated by the key plate 23 of the controlling member 136—cannot be raised, as in this case its plate 93 strikes against a pin 605 (Figs. 2 and 9) from below. The pin 605 is secured in one arm 606 of an angle member 607 which is riveted to the inner side of the front wall 61 of the calculating mechanism. Consequently the controlling member 23 can only be operated if the cross totalisers 12a and 13a are clear written through subtraction.

The normal calculating and writing operation under the conditions given by the bookings in the columns I to VI of the form 600, Fig. 17

The column totalisers are adjusted, including their tabulator riders, and the cross totalisers are secured and moved, exactly as described in the paragraphs relating to the form 25 in Fig. 16.

At the beginning of a booking operation in the form 600, the carriage is moved into its final position at the right by depressing the carriage return key 18 (Figs. 1, 3, and 4). Thereupon the tens tabulator key 21 which corresponds to the value "30" in the first line, column I, of the form 600 is depressed and the column totaliser 2 (Fig. 2) is moved into calculating position with its tens place. The control plate 39 of the column totaliser 2 acts on the lever 42 and releases the locking of the unlocking shaft 115 by the parts 113 and 114 in Fig. 5, in manner per se known.

Since the column totaliser 2 is without the control plate 40, the lever 44 (Fig. 9) and the coupling sleeve 45 remain in active relation to the driving wheel 35. The controlling lever 43 which controls the change gear 68, 75, 78, 74, remains in its initial position, since the control plate 41 for the species of the cross totalisers 12a and 13a has been moved to "A" (Fig. 11). The change gear therefore remains in the addition position determined by the gears 68 and 74. When the value "30" is now calculated in known manner, it is transferred additively into the column totaliser 2 and into the cross totaliser 12a, since the knob 48 (Figs. 1, 3 and 4) has been adjusted to "A."

The column totaliser 3 is now moved into calculating position, in conformity with the value "40," first line in column II of form 600, by depressing the corresponding decimal tabulator key 21. In this position, the control plate 40 of the column totaliser 3 acts on the controlling lever 44 (Fig. 9) which is turned clockwise and, through link 102 and coupling arm 103, disengages the teeth 111 of the sleeve 45 from the teeth 46 of the driving gear 35 and engages the teeth 112 of the sleeve with the teeth 47 of the driving gear 36. During the calculating operation, the value "40" is also additively transferred to the column totaliser 3 and to the cross totaliser 13a, the other parts being operated as described with reference to the column totaliser 2. The column totalisers 4 and 5 are operated in the same manner as 2 and 3.

Total taking from cross totalisers 12a and 13a

When booking has been completed in column IV of the first line in the form 600, the cross totalisers 12a and 13a are clear written successively. The value "55" appears in the window of the cross totalizer 12a and the tabulator key 21 for the tens is operated accordingly. The column totaliser 6a and the cross totaliser 12a are moved into calculating position with their 10 places. The coupling sleeve 45 remains in connection with the driving gear 35 as the column totaliser 6a is without the controlling plate 40, however, the column totaliser 6a acts on the lever 43 with its control plate 41 previously adjusted to "S" and this control plate 41 swings the lever 43 clockwise. The change gear which determines the species of the cross totalisers is now set for subtraction through parts 62 (Fig. 7), 63, 64, 65, 69, 70, 67, 71, and the spur gear is operatively connected to the driving shaft 34 through pinions 75 and 76. The rod 77 is moved by the control lever 43 and, in turn, moves the selector lever 86 whose lug 93 engages below the lug 100 of the bellcrank 95 and whose slot 101 engages below the screw 89.

When the key plate 23 of the controlling member 136 is depressed, the lug 143 (Fig. 10) at its

tail end raises the selector lever **86**. The lug **93** of the selector lever acts on the bellcrank **95** (Fig. 9) which moves the slide **189** in the direction of the arrow *n* through parts **182**, **185**, **187**, and **188**. The incline **211** of the slide now engages below the tail end **198** of the flap **195**, and the flaps **195** and **224** are now turned clockwise, their zero stop **203**, **232** lightly engaging the zero setting wheels **125**, Fig. 5.

In the meantime, the clutching arm **178** by which the complete unit **501**, **502** (Fig. 12) is connected to the driving shaft **504** has been released by members **186**, **171**, and **175**, and the unlocking slide **508** (Fig. 13) is now free to descend. By its incline **510**, the slide unlocks the calculating mechanism, the tens place of the column totaliser **6***a*, and of the cross totalisers **12***a* and **13***a*, which is in calculating position, and the spur gear **525** is caused to mesh with the rack **532** of the zero setting slide **531**. Simultaneously with the unlocking of the calculating mechanism, the slide **207** is moved to the rear by parts **115** (Fig. 5), **243**, **241**, **204**, and **205** (Figs. 6 and 9). The incline **238** engages below the slide **189** which is elevated and swings the flap **224** further in clockwise direction. The zero stops **203** and **232** now come into full engagement with the zero setting wheels **125** of the cross totalisers **12***a* and **13***a*. The zero stop **232** which cooperates with the zero setting wheel of the cross totaliser **13***a*, is used for a purpose to be described below.

After the zero stops **203** and **232** have been swung, the zero setting slide **531** (Fig. 13) is unlocked by the unlocking slide **506** engaging the pawl **535** and the shaft **50** (Figs. 9 and 13) is rotated. The shaft, through parts **68**, **75**, **76**, and **35**, rotates the driving wheel **261** of the 10 place in the cross totaliser **12***a*. The rotation is completed when the zero stop belonging to the cross totaliser **12***a* on the zero setting wheel is struck, and the return of the number roller **264** to "0" is now completed. The value "5" which is to be withdrawn from the 10 place of the cross totaliser **12***a* is transferred additively to the column totaliser **6***a* from shaft **50** through parts **127** (Fig. 7), **132**, **133**, **134**, **37**, and **38** whereupon the number "5" is written down in the first line, column V, of the form. The carriage now moves from the tens to the unit place, after the unlocking slide **506** and the zero setting slide **531** (Figs. 13, 14, and 15) have been returned into their initial positions. Otherwise the total taking from the cross totaliser **12***a* is effected in the same manner as in the first example, and need not be described.

When the cross totaliser **12***a* has been clear written, the tens key of the tabulator **21** which corresponds to the value "75" is operated in conformity with the amount which is present in the cross totaliser **13***a*. The cross totaliser **13***a* and the column totaliser **7***a* are now moved into calculating position with their tens place. The controlling plate **40** in the column totaliser **7***a* swings the control lever **44** (Fig. 9) anti-clockwise, so that the link **102** which is pivoted to the lever **44**, and the coupling arm **103** place the coupling sleeve **45** into mesh with the teeth **47** of the driving spur gear **36** with its teeth **112**. At the same time, the connection between the sleeve **45** and the driving spur gear **35** is broken. The control plate **41** of the column totaliser **7***a* which is also set to "S" operates the control lever **43** and, through parts **68**, **75**, **76** and **36**, (Fig. 9) returns the change gear for operating the cross totalisers into its subtraction position. At the same time, the zero stops **203** and **232** are moved into their preliminary position and the selector lever **86** is swung into its active position. The key plate **23** of the controlling member **136** is now depressed, effecting the automatic clear writing of the cross totaliser **13***a*, as described above for the total taking from the cross totalisers **12** and **13**. The total taking is completed when the value "5" has been printed in the first line, column VI of form **600**. All parts involved in the total taking operation are returned into their initial positions, as described.

When the bookings have been performed in the first three lines of the form, and in columns I to VI, the amounts shown in the fourth line of the form **600** which are added in the column totalisers **2** to **5**, **6***a*, and **7***a*, are written out, as described in the paragraph "Total taking from the column totalisers **2** to **5**," and the booking operation on the form **600** (Fig. 7) is now completed. When writing out the amounts from the column totalisers **6***a* and **7***a*, the totalisers are placed in their left-hand final position where they are locked by a bolt **700** (Figs. 1 and 1*a*) so that no values can get into the cross totalisers **12***a* and **13***a* which have already been set to zero.

Although the locking members **140** and **293***a* are released in dependence of the carriage movement, as described, they might also be released from the camplate unit **501**, **502**, without departing from the gist of the invention. In this case, if, for instance, a figure having three numbers is to be written out, a slide is advanced for three units by the "100" decimal tabulator key and returned step by step into its initial position by a dog at the camplate unit **501**, **502**. In the zero position, the slide engages the locking members **140** and **293***a* and releases them, whereupon the total taking operation is completed.

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