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COMPLETE SPECIFICATION

Improvements in Calculating Machines for performing Multiplication
and Division

We, MERCEDES BÜROMASCHINEN-
WERKE AKTIENGESELLSCHAFT, of Ben-
shausen, Prussia, and of Zella-Mehlis,
Thuringia, both in Germany, a Company
5 organized under the Laws of Germany, do
hereby declare the nature of this inven-
tion and in what manner the same is to
be performed, to be particularly described
and ascertained in and by the following
10 statement:—

This invention relates to calculating
machines for performing multiplication
and division, and to the type of such
machines in which multiplication is per-
15 formed by repeated addition and division
by repeated subtraction.

It is known in calculating machines to
set the multiplicand and the multiplier
after one another in one and the same
20 keyboard, and also to set the multiplicand
and the multiplier side by side in separate
keyboards. In the former case a stop car-
riage was used in conjunction with the
keyboard, while in the latter case sepa-
25 rate mechanisms were used for the trans-
mission of the factors set in each key-
board. These machines, however, were
expensive to produce in consequence of
these features and the departure thereby
30 entailed of the whole construction from
the usual construction.

The object of the invention is to pro-
vide an improved calculating machine of
the type indicated above having simpli-
35 fied control mechanism.

According to the invention, a setting up
mechanism combined with differential
mechanism is provided for the simulta-
neous setting of multiplier and multi-
40 plicand or divisor and dividend, and the
transmission of the set-up multiplier or
dividend to the multiplier setting mecha-
nism or totalizer respectively is automati-
cally controlled by a member which also
45 controls automatically the remaining
operations of the machine for completing

[Price 1/-]

the multiplication or division operation.

By these measures, it is possible to re-
tain in the machine known setting-up
mechanism, differential mechanism and
50 totalizers without any change of the ex-
ternal dimensions of the machine.

Further, the advantage is obtained that
not only the multiplier but also the divi-
55 dend is set in one and the same setting-up
mechanism and transmitted automatically
to the multiplier setting mechanism or
totalizer respectively by the same differen-
tial mechanism.

In the drawings one form of construc-
60 tion of the invention is illustrated by way
of example, for a Mercedes-Euclid calcu-
lating machine.

Figure 1 shows in perspective a front
elevation of the machine. 65

Figure 2 shows a front elevation in per-
spective of the machine according to
Figure 1, the totalizer carriage being,
however, raised up and the cover plate
70 partially removed.

Figure 3 shows a rear elevation in per-
spective of the machine with the cover
plate removed.

Figure 4 shows an elevation of the main
driving shaft with the carriage shift
75 coupling, the differential mechanism
actuating coupling and the zeroizing
coupling.

Figure 5 shows a side elevation of
Figure 4 viewed in the direction of the
80 arrow "a."

Figure 6 shows an elevation similar to
Figure 4 with the coupling lever for the
carriage shift and differential mechanism
actuating coupling as well as the zeroizing
85 coupling.

Figure 7 shows an elevation in perspec-
tive of the main drive shaft, with the
three couplings, the view being taken in
the direction of the arrow "b" of Figure
90 3 and the parts being illustrated as drawn
out from one another.

Price 4s 6d

Figure 8 shows a plan in the rest position of the totalizer driving coupling for the transmission of the value set up in the setting-up mechanism to the numeral wheels of the result totalizer, including the eccentric shaft for the same and driving parts of the eccentric shaft.

Figure 9 shows a partial side elevation according to Figure 8 viewed in the direction of the arrow "c."

Figure 10 shows the draw-key coupling for the driving gear of the actuating and tens transfer shaft of the revolutions-register, in which for purposes of illustration the shafts of the wheels are represented as drawn out from one another.

Figure 11 shows a plan of the driving gear for the actuating and tens transfer shaft of the revolutions-register, in which for purposes of illustration the shafts of the wheels are represented as drawn out from one another.

Figure 11a shows a section on an enlarged scale through the driving gear for the revolutions-register.

Figure 12 shows in perspective an elevation with the parts drawn out from one another of the draw-key coupling for the driving gear for the totalizer carriage shift, including control parts, and viewed in the direction of the arrow "b" in Figure 3.

Figure 13 shows in elevation a certain position of the carriage shift pawl, viewed in the opposite direction to that of the arrow "a" shown in Figure 12.

Figure 14 shows an elevation taken from the front, right-hand side of the machine of the control members of the carriage shift device in the initial position.

Figure 15 shows a front elevation of the actuating and tens transfer shaft for the revolutions-register.

Figure 16 shows a development of the circumference of the actuating and tens transfer shaft according to Figure 15.

Figure 17 shows a plan of the numeral wheels of the revolutions-register with the tens transfer cams displaced in layers.

Figure 18 shows a detail of Figure 15, on an enlarged scale.

Figure 19 shows an elevation in perspective taken from the front right-hand side of the machine, of the key for releasing depressed amount keys and of the keys controlling the zeroizing of the result totalizer and of the revolutions-register and their mechanisms, in which the zeroizing coupling for purposes of illustration is drawn out to the right.

Figure 19a shows an elevation in perspective taken from the front right-hand side of the machine of several details of Figure 19 on an enlarged scale.

Figure 20 shows a detail of Figure 19.

Figure 20a shows an elevation in perspective taken from the front right-hand side of the machine of several details of Figure 19 on an enlarged scale.

Figure 21 shows an elevation in perspective taken from the front right hand side of the machine, of the key for releasing depressed amount keys, of the keys controlling the zeroizing of the result totalizer and of the revolutions-register and of the key for three-factor multiplication as well as the mechanism for the latter, in which view for purposes of illustration different parts are represented drawn out from one another.

Figure 22 shows a detail of Figure 21.

Figure 23 likewise shows a detail of Figure 21 viewed in the direction of the arrow "d."

Figure 24 shows an elevation in perspective taken from the front right-hand side of the machine, of the mechanism controlled by the addition key and the subtraction key, including the motor contacts and the driving motor.

Figure 24a shows an elevation in perspective taken from the front right hand side of the machine, of several details of Figure 24 on an enlarged scale.

Figure 24b shows an elevation in perspective taken from the front right-hand side of the machine of several details of Figure 24 on an enlarged scale, in which view for purposes of illustration the parts are represented drawn out from one another.

Figure 25 shows an elevation in perspective of automatic mechanism for releasing depressed amount keys controlled by the addition and subtraction keys.

Figure 25a shows an elevation in perspective taken from the front right-hand side of the machine of several details of Figure 25 on an enlarged scale, the parts being illustrated in the normal position.

Figure 25b shows an elevation in perspective according to Figure 25a, the parts being in the operative position.

Figure 26 shows a perspective representation taken from the front right-hand side of the machine of the set of operation keys located on the left-hand side of the machine for multiplication and for division as well as the revolutions-register control key.

Figure 26a shows a schematic plan view of the levers shown in Figure 26, illustrating how the same are arranged in reality.

Figure 27 shows an elevation in perspective of the multiplication and division keys according to Figure 26 with the multiplication key depressed, whereby the lever for the interruption of the multipli-

cation process is in an operative position.

Figure 27a shows a perspective view according to Figure 27, but wherein the multiplication key is shown in its non-depressed position, while the lever for the interruption of the multiplication process is illustrated in its front position whereby the lever for the interruption of the multiplication process has not yet taken up an operative position.

Figure 27b shows a perspective view according to Figure 27, but wherein the multiplication key is depressed and the lever for the interruption for the multiplication process is not yet in its operative position.

Figure 28 shows an elevation in perspective taken from the front right-hand side of the machine, of the multiplication key lever and of the shift lever for changing over from positive to negative multiplication and vice versa, as well as the mechanisms controlled by them.

Figure 28a shows a front elevation of a detail of Figure 28.

Figure 29 shows a perspective elevation taken from the right-hand front of the machine of the multiplication mechanism and the setting of the individual mechanisms by the multiplier setting mechanism, when this stands in the zero position and the totalizer carriage stands in its initial position i.e. in left-hand end position.

Figure 30 shows a perspective illustration of the multiplication mechanisms taken from the right-hand front of the machine in which, however, both the left hand places of the multiplier setting mechanism are set and are correspondingly displaced to the corresponding mechanisms actuated by them. The actuating and tens transfer shaft besides, is illustrated in that position in which it is about to actuate the carriage shift mechanism.

Figure 31 shows a perspective elevation according to Figure 30, only with the difference that the totalizer carriage has been shifted one place to the right, and the multiplication has not yet begun.

Figure 32 shows a perspective elevation according to Figure 30, with totalizer carriage drawn one place to the right in which the second place from the right of the multiplier setting mechanism has already been worked off.

Figure 33 shows a perspective elevation according to Figure 30, in which the totalizer carriage has already taken up its initial position again, but the right-hand place of the multiplier setting mechanism is still set on the set value.

Fig. 34 shows an elevation in perspective taken from the front left-hand side of

the control shaft as well as other multiplication mechanisms.

Fig. 35 shows a diagrammatic illustration of the control shaft locked in the initial position.

Figures 36 to 38 show elevations according to Fig. 35 in different positions, viz.:

Fig. 36 shows the control shaft displaced to the right by depression of the multiplication key.

Fig. 37 shows the control shaft displaced to the right by the depression of the multiplication key shortly before the completion of its revolution.

Fig. 38 shows the control shaft displaced to the left by depression of the division key.

Fig. 39 shows a perspective representation taken from the front right hand side of the machine, of a part of the division mechanism in the rest position.

Fig. 39a shows a perspective view of separate details of Fig. 39.

Fig. 40 shows a side elevation of a section of the totalizer carriage, lying along the line I—I of Fig. 42 viewed in the direction of the arrow "c."

Fig. 41 shows a side elevation according to Fig. 40 viewed in the direction of the arrow "c" of Fig. 42 and according to the section line II—II.

Fig. 42 shows a section through the totalizer carriage along the lines III—III (a—a) IV—IV (b—b) and V—V (c—c) of Figure 41 viewed in the direction of the arrow "a."

Fig. 43 and 44 show on an enlarged scale a section and two different positions of an overshooting lock for the zeroizing device of the revolutions-register along the line III—III of Figure 41; seen in the opposite direction of the arrow "a" immediately after completed zeroizing.

Fig. 45 shows a side elevation of a detail of Figure 42 viewed in the opposite direction of the arrow "c."

Figures 46 to 50 show different positions of the control lever for the draw-key coupling of the drive for the revolutions-register viz.:

Figure 46 shows the position in the normal addition process.

Figure 47 shows the position in the normal subtraction process.

Figure 48 shows the position in the addition process with previously depressed revolution-register control key.

Fig. 49 shows the position in the subtraction process with previously depressed revolutions-register control key.

Fig. 50 shows the position with the revolutions-register cut out.

The Mercedes-Euclid calculating machine consists as known of a setting up mechanism A (Figures 1 and 2), a totali-

zer carriage B movable along the same and a housing C.

Over the setting up mechanism A is arranged the set of keys T. The motor D (Figures 3 and 24) is arranged on the rear side of the machine so as to be readily exchangeable. The revolutions of the motor D are transferred by means of a worm, 1 (Figure 24) and a wormwheel, 2, to a main driving or coupling shaft, 3 (Figures 4, 5, 7 and 24).

On the right-hand side of the machine (Figures 1, 2 and 24) an addition key, 4, a subtraction key, 5, a key, 6, (L^{III}) (Figures 1, 2 and 21) for releasing depressed amount keys, a key, 7, (L^{II}) for zeroizing the result totalizer, a key, 8, (L^I) for zeroizing the revolutions-register, a three-factor multiplication key, 9, ($3x$ Mult.) as well as an accumulator key, 10, (S) are arranged.

On the left-hand side of the machine, the multiplication key, 11, (Mult.) (Figures 1, 2, 26 and 27), the division key, 12, (Div.), the revolutions-register control key, 13, (Cor.), the shift lever, 14, for changing over from positive to negative multiplication and division and vice versa as well as the multiplication interruption lever, 15, (Figures 1 and 27) are arranged.

On the right-hand side of the machine a lever, 17, (Figures 1 and 2) is arranged by means of which the addition and subtraction keys, 4 and 5, are controllable, so that according to its position in each case, they release only one revolution (Position A) (Figure 1) of the main driving shaft 3, or maintain this in rotation (Position M, Figure 1) so long as either of the keys, 4 or 5, is held depressed. The lever, 16, serves for the zeroizing of the revolutions-register U in three-factor multiplication.

In order to be able to readily overcome disturbances in the driving mechanisms incidental to incompetent handling of the machine, a rotatable knob, 18, (Figure 1) is arranged on the shaft 19 (Figures 1, 2, 8, 29 to 33). This rotatable knob, 18, may be replaced by a crank handle in order that the machine can be driven by hand in the event of trouble with the motor or on failure of the current.

The main driving shaft, 3, (Figures 4, 5, 6, 7 and 24) as already mentioned, is driven in the direction of the arrow "e" (Figure 24) by the worm wheel 2, which is in engagement with the worm, 1. On the main driving shaft 3, a cam, 20, (Figures 4, 6, 7 and 24) is secured, which cam acts on an arm, 21, (Figure 24) of a two-armed contact lever, 22, the purpose of which will be later described in detail. The arm 21, lies in its rest position on the periphery, 24, of the cam, 20,

and is held in this position by a spring, 23a, which is attached on the one hand to a lug, 21a, of the arm, 21, of the lever, 22, and on the other hand is connected to a nose 22a, of a lever 23.

On the main driving shaft, 3, further, are rotatably mounted a toothed wheel, 25, (Figures 4, 6 and 7) and a coupling housing, 26, for the carriage shift coupling, rigidly connected to the wheel, 25. Within the coupling housing, 26, a cam, 27, is pinned to the shaft, 3, the side, 28, of the cam lying against the inner wall of the housing, 26. To a segment-like projection, 29 (Figure 7) of the coupling housing, 26, a ring, 33, is attached by means of the screws, 30 (Figure 6) at the points, 31 and 32 (Figure 7) which ring is provided with a sufficiently large bore in which the cam, 27, fixed on the shaft, 3, can freely rotate. Between the coupling housing, 26, and the ring, 33, and in the holes, 35 and 36, a pawl, 37, is pivotably mounted by means of a pin, 38. The pawl, 37, is acted on in the direction of the arrow "e" by means of a spring, 40, attached on the one hand to the nose, 39, of the pawl, 37, and on the other hand to a pin, 41, fixed on the inner side of the housing, 26. A nose, 42, of the pawl, 37, abuts on a surface, 43 (Figures 7 and 24) of a coupling lever, 44. On the periphery of the projection, 29, of the coupling housing, 26, a comb, 45, is formed, the purpose of which will be later explained.

On the pawl, 37, further, a coupling nose, 46 (Fig. 7) is arranged which co-acts with a nose, 47, of the cam, 27. In order to hold the coupling nose, 46, out of engagement with the nose, 47, of the cam, 27, the coupling housing 26, has on its outer periphery two grooves, 48 and 49, in which a pawl, 50, rests, which is fork-shaped at its other end, and this fork-shaped part is swingably mounted in a ring groove of a shaft, 51. By means of a spring, 50b, which on one hand engages with a nose, 50a, of the pawl, 50, and which on the other hand is connected to a shaft 50c, mounted in the machine housing, the pawl 50, is acted on round the shaft, 51, in the clockwise direction (seen in Figure 7). If the pawl, 50, has fallen into the groove, 49, of the coupling housing, 26, then the same is held in the rest position illustrated in Figure 7. If the pawl 50 were not provided, the action of the spring 40 on the coupling would prevent it closing.

Further, on the main driving shaft, 3, the coupling housing, 52, (Figures 4, 6 and 7) of the coupling for differential mechanism arranged as a proportional rack system is also fixed, which likewise

has a segment-like projection 52a. The coupling housing, 52, is by means of the cheeks, 54, joined on it and the two screws, 55, pressed tightly on a hub, 57, formed on a toothed wheel, 56, whereby the coupling housing, 52, is rigidly connected with the toothed wheel, 56, and in common with the same is rotatably mounted on the main driving shaft, 3. On the segment-like projection, 52a, of the coupling housing, 52, a ring, 58, is fixed, by means of the screws, 59, and 60, (Figure 4) which project through holes, 61, of the ring, 58, (in Figure 7, only one hole, 61, is visible), at the point 61a, on the coupling housing, 52, of the differential mechanism actuating coupling. This ring, 58, has a bore, 62, which is chosen so great that the cam, 27, can freely rotate therein. The cam, 27, lies with its side, 63, against the inner wall of the coupling housing, 52.

Between the coupling housing, 52, and the ring, 58, a pawl, 65, is swingably mounted by means of a pin, 66, in a hole, 64, of the ring, and in a hole (not shown) of the coupling housing, 52. This pawl, 65, is acted on in the direction of the arrow "e" by means of a spring, 69, which engages with a nose, 67, of the pawl, 65, and with a pin, 68, of the coupling housing, 52. A nose, 70, of the pawl, 65, rests likewise on the surface, 43 (Figures 7 and 24) of the coupling lever, 44, while a nose, 71, of the pawl, 65, is capable of engaging with the cam, 27. In order to hold the nose, 71, out of engagement with the cam, 27, grooves, 72 and 73, are formed in the coupling housing, 52. With the grooves, 72 and 73, a pawl, 74, is capable of engaging, which at its other end, is formed of fork-like shape and with this fork-shaped end is swingably arranged in a ring groove, 75, of the shaft, 51. By means of a spring, 76, which engages with a nose, 77, of the pawl, 74, the latter is acted on round the shaft, 51, in the clockwise direction (Figure 7). If the pawl, 74, has engaged with the groove, 72, of the coupling housing, 52, the latter is in its rest position.

The spur wheel, 56, united with the coupling housing 52, is in engagement with a spur wheel, 78, (Figures 4 and 8) on which a bevel wheel, 79, is formed.

The main driving shaft 3, is rotatably mounted in the rear wall, 80 (Figures 3 and 4) and in a hub, 81, of an intermediate wall, 82, (Figure 4) fixed in the machine housing.

On the main driving shaft, 3 (Figures 4, 5, 6, 7 and 19) is a third coupling, viz.: the zeroizing coupling, 83. This is rotatably mounted on the main driving

shaft, 3, while the cam, 84, which in contradistinction to the cam, 27, is only so long that it fits exactly between the coupling housing, 83, and a coupling disc, 85, fixed on the main driving shaft, 3. The coupling disc, 85, is fixed to the housing, 83, by means of screws, 86 (Figure 4) which engage through holes, 87, and is provided with a bore, 88, into which the shaft, 3, so far projects that it is flush with the outer face of the coupling disc, 85. In the coupling housing, 83, a coupling pawl, 89 (Figure 7) is swingably mounted between the coupling housing, 83, and the coupling disc, 85, by means of a pin, 90, in the holes, 91 and 92, and is acted on in the clockwise direction by means of a spring, 95, engaging with a nose, 93, of the pawl, 89, and with a pin, 94, of the housing, 83. Moreover, a nose, 96, of the pawl, 89, rests on a nose, 97 (Figure 19) (the coupling housing, 83, is here for purposes of illustration illustrated on the right) which is formed on an arm, 98, of a coupling lever, 100, pivotably mounted on a screw, 99. The nose, 101, (Figure 7) of the pawl, 89, is held out of engagement with the nose, 102, of the cam, 84, inasmuch as a pawl, 104, engages in a groove, 103, formed in the coupling housing, 83. The pawl, 104, at one of its ends is constructed of fork-shape, and is swingably mounted in a ring groove of the shaft, 51. By means of a spring, 105, which on one hand engages with a nose, 106, of the pawl, 104, and on the other hand is connected to a pin, 50c, arranged in the machine housing, the pawl, 104, is acted on in the clockwise direction (Figure 7). Further in the coupling housing, 83, a groove, 107, is formed and will be described later in detail. The coupling lever, 100, (Figure 19), is formed of U-shape at its rearwardly directed end as shown in Figure 19. A spring, 100a, which on the one hand is connected to the arm, 100b, of the coupling lever, 100, and on the other hand engages with a pin, 100c, (Figure 19) attached to the intermediate wall, 82, (Figure 7) causes the coupling lever, 100, to lie normally with the face, 100f, on the intermediate wall, 82, in which position of the coupling lever, 100, the same is held in its operative position with its nose, 97, adjacent the nose, 96, of the pawl, 89, of the zeroizing coupling, 83.

On the coupling disc, 85, (Figures 7 and 19) a pin, 108, is fixed, to which a rod, 109 (Figures 5 and 9) attached by means of a screw, 109a, engages the zeroizing device of the result totalizer and revolutions-register, R, and U (Figure 1).

On the coupling housing, 83, is formed a sector, 110, (Figures 7 and 19) which acts on a two-armed lever, 112, pivotable about the point, 111, on the machine housing. The lever, 112, is acted on in the clockwise direction (Figure 7) by means of a spring, 115, engaging with the nose, 113, of the lever, 112, and with a pin, 50c, fixed to the machine housing. In its rest position, it lies with the horizontal arm on two levers, 358 and 359, to be later described in detail, of the zeroizing mechanisms for the result totalizer and revolutions-register, R and U.

Vertically over and parallel to the main driving shaft, 3, (Figure 4) the driving shaft 116 (Figures 4 and 8) for the proportional rack system is rotatably mounted in the machine housing. The spur wheel, 78, fixed on the driving shaft, 116, and the bevel wheel, 79, formed on it, as well as the driving shaft, 116, itself, obtain their drive from the motor, D, through the parts, 1, 2, 3 (Fig. 24), the differential mechanism actuating coupling, 52, 65 (Figure 7) and the toothed wheel, 56, as already described and rotates them in the direction of the arrow "f" indicated in Figures 5 and 8.

On the driving shaft, 116, is fixed a crank arm, 117, (Figs. 4, 5 and 24) which is formed as a disc. On this disc a crank pin, 118, (Figure 5) is formed on which is arranged a connecting bearing capable of being adjusted to vary the throw. The bearing consists of a disc, 120, (Figures 4 and 5) provided with any desired number of grooves, 119, and on the disc, 120, a cone, 121, is formed laterally and serves as the inner ball bearing running ring. The disc, 120, and the cone, 121, are provided with a hole eccentrically disposed in relation to the cone, 121, and corresponding to the diameter of the crank pin, 118. On the disc-like crank arm, 117, a pin, 122, (Figure 5) is riveted which may be engaged in any desired groove, 119, of the disc, 120, and thereby prevents an automatic displacement of the ball bearing running ring, 119, 121, and at the same time determines the throw. Between the conical part, 121, of the ball bearing running ring, 119, 121, and the cylindrical inner running surface, 123, of the connecting rod head of the connecting rod, 124, the balls, 121a, are interposed. These are prevented from falling out by a cover disc, 125, which is pressed against the front of the cone, 121, by means of nuts, 126. The cover disc, 125, also acts to hold the connecting rod head of the connecting rod, 124, in its position. The connecting rod, 124, is connected to the proportional lever, described in detail in Patent

Specification No. 365,058 and indicated therein by the reference, 40. On the part 124, (Figures 4, 5 and 24) a nose, 124a, is arranged which acts on a part to be hereinafter described.

The crank disc, 117, (Figures 5 and 24) is provided with a stop, 127, into which projects a lug, 128, bent off at right angles on a lever, 130, which is arranged on the machine housing and is pivotally mounted on a pin, 129. The lever, 130, is rigidly connected by means of a bridge, 131, with the lever, 132, which is also pivotally mounted on the pin, 129. The lever 132 lies beneath a key locking bar, 322, to be later described in detail.

The bevel wheel, 79 (Figures 4 and 8) formed on the spur wheel, 78, is in engagement with a bevel wheel, 133, fixed on the eccentric shaft, 19, of the result totalizer, R. Further, on the shaft, 19, to the left of the bevel wheel, 133, a spur wheel, 134, is fixed, which is in engagement with a spur wheel, 135 (Figures 4 and 10) described hereinafter in detail, which is carried by means of a bush, 160, of the draw-key, 136 (Figure 10).

The eccentric shaft, 19 (Figures 8, 9 and 29 to 33) carries eccentrics, 137, which act on the tens transfer slides, 139, of the result totalizer, R, these slides being displaceably arranged on a beam, 138 (Figures 2, 40 and 41). On the left-hand side of the tens eccentric shaft 19 (Figures 8 and 9) a pin wheel, 140, is rigidly mounted. The same consists of two discs, 141 and 142, between the pins, 143 and 143a, of which two locking members 144 and 144a, are inserted. The pins, 143, and the locking member, 144, act on a four-part Maltese cross, 145, which is rotatably mounted on a shaft, 146, mounted in the machine housing. With the Maltese cross, 145, a toothed wheel, 147, is rigidly connected which is in engagement with an intermediate wheel, 149, rotatably mounted on a shaft, 148. The wheel, 149, is in engagement with a toothed wheel, 152, fixed on a pin, 150, of a frame, 151. The frame 151, consists of two end parts of which only the left-hand end part, 153, is shown in Figure 8, while the end part located on the right-hand side of the machine, which is similar in all respects to the left hand end part, is not illustrated. The two end parts are connected by bars, 154, and 156, between which the coupling wheels, 156, are rotatably mounted on the pins, 157. Adjacent the frame, 151, is provided a locking bar (not shown), having teeth which engage in the tooth spaces of the coupling wheels, 156, and in this manner prevents rotation of the same while in their uncoupled position in relation to the

toothed wheels, 158 and 159 (Figure 40).

The spur wheel, 134 (Figures 4, 5 and 8) is in engagement with the already mentioned toothed wheel, 135 (Figures 10, 11 and 11a) which is loosely rotatable on a draw-key bush, 160, and in which a groove, 161, is formed, and the hub, 162 of which, is provided with a larger bore, corresponding to the groove, 161. Further, on the draw-key bush, 160, a second toothed wheel, 163, is loosely rotatable which is provided with a greater bore corresponding to the groove, 161, and in the hub, 164, of which, a groove, 165, is formed. Between the two toothed wheels, 135 and 163, a disc, 166 (Figures 4, 10 and 11a) constructed of fork-shape, is arranged, which is provided with a groove, 167, and which with its fork-shaped end embraces the shaft, 168, (Figure 4). By this arrangement, it is possible to couple the toothed wheel, 169, at one time with the toothed wheel, 135, and at another time with the toothed wheel, 163, by means of the draw-key, 136, the part, 170 of which slides in the groove, 171, of the draw-key bush, 160. If the draw-key is in the middle position indicated in Figure 11a, then the toothed wheels, 135 and 163, without acting on the toothed wheel, 169, can freely rotate on the bush, 160. The draw-key bush, 160, is rotatably mounted at the right-hand in a casing, 172 (Figure 5) and at the left-hand by means of a projection, 173, in the bearing member, 174.

By means of an arm, 175, (Figures 2 and 10) of the angle lever 177, which is pivotally mounted on the machine housing by means of a pin, 176, and which engages with a ring groove, 136a, of the draw-key, 136, the latter is axially displaced, so that the part, 170, of the draw-key, 136, may sometimes come into the working position in relation to the toothed wheel, 135, and sometimes into the working position in relation to the toothed wheel, 163. On the left adjacent to the toothed wheel, 135, a toothed wheel, 169, is formed on the draw-key bush, 160, the wheel, 169, engaging with a toothed wheel, 179, rigidly mounted on the actuating and tens transfer shaft, 178, for the revolutions-register. The actuating and tens transfer shaft, 178, (Figures 4 and 15) is rotatably mounted in the machine housing, at the right and left by means of pins, 180.

The actuating and tens transfer shaft, 178, is held in its normal position by means of a pin 181, (Figure 15). The pin, 181, (Figure 15) is acted on in the upward direction by a spring, 182, which lies on the one hand against the shoulder, 183, of the pin, 181, and on the other

hand on the bearing part, 185. The pin, 181, is guided in a bearing part, 186, and engages in a groove, 187, of the actuating and tens transfer shaft, 178.

With the toothed wheel, 134 (Figure 11) engages a toothed wheel, 188, loosely rotatable on the already mentioned shaft, 168 (Figure 4), the toothed wheel, 188, being in rigid connection with the toothed wheel, 190, shown in Figure 11, by means of the sleeve, 189. The toothed wheel, 190, is, further, in engagement with the already mentioned toothed wheel, 163.

On the actuating and tens transfer shaft, 178 (Figures 15 and 16) transfer members 191 to 191j are formed. The transfer member, 191, on the extreme right does not act directly as such but on both its ends spring actuated slides 192 and 193, are provided, of which in the following only the slide 193 will be described in detail, which is illustrated with the actuating and tens transfer shaft, 178, represented in section on an enlarged scale in Figure 18. This slide 193, which on its lower part, 194, is cylindrical, is arranged to be vertically displaceable in a hole, 195, in the actuating and tens transfer shaft, 178. It is provided with a lug, 196, which is notched at 197, and lies in a groove, 198, (Figure 18) in front of the transfer member, 191. The transfer member, 191, is broadened by the lug, 196, (Figure 16) so that the inclined surface, 199, formed by the lug, 196, is approximately double as broad as the transfer member, 191a. In a second hole, 200, of the tens shift shaft, 178, a spring 202, is connected by means of a small bridge 201, the other end of the spring lying in a stop, 203, of a lever, 204. This is provided with a small pin, 205, which engages in a relatively wide hole, 206, so that the lever, 204, is able to perform swinging movements round the pin, 205, against the action of the spring, 202. The lever, 204, rests in a groove, 207, of the actuating and tens transfer shaft, 178 and its end, 208, engages with a recess, 209, of the slide, 193, and thus holds this in its normal position which is determined by the spring, 202, and the contact of the lever, 204, on the bottom of the groove. The inclined edge, 199, (Figure 16) of the slide 193, is so wide that it may rotate the spur wheel 210 (Figures 15 and 41) which at times lies opposite to it, for shifting one of the numeral wheels, 211 (Figures 15, 17 and 40) in the direction of the arrow "i" (Figure 15) a whole division or a whole unit further on an incidental rotation of the actuating tens transfer shaft, 178. In the rotation of the actuating and tens transfer shaft, 178, in the direction of the

arrow "g" the numeral wheels 211, of the revolutions-register, U, are moved forward in the direction of the arrow "i" in the additive sense. For this reason, all those inclined surfaces of the transfer members, 191 to 191d, and 191h to 191j (Figure 16) are provided with the index A (Addition) while those inclined surfaces of the transfer members, 191 to 191d and 191e to 191g, which on the rotation of the actuating and tens transfer shaft, 178, in the opposite direction of the arrow "g," rotate the numeral wheels, 211, in the subtractive sense, are indicated with the index S (Subtraction).

The slide, 192, is in its construction exactly the same as the slide, 193. On the rotation of the actuating and tens transfer shaft, 178, in the opposite direction of the arrow "g," the slide 192, acts in the opposite direction to the slide, 193, on the spur wheels, 210, i.e. the numeral wheels, 211, are rotated by it in the subtractive sense, therefore in the opposite direction to the arrow "i," through one unit.

The right-hand spur wheel, 210a (Figure 17) therefore, on each revolution of the actuating and tens transfer shaft, 178, moves the right-hand numeral wheel, 211 (Figures 15 and 17) through one unit by way of the toothed wheel, 212, (Figure 17) which, by means of a sleeve, 213, is rigidly connected to the spur wheel, 210 and engages with the toothed wheel, 214. By means of a double-toothed pawl, 215, (Figure 42) the toothed wheel, 212, is held in its rest position. On the movement from "9" to "0" or from "0" to "9" of the right-hand numeral wheel, 211, the numeral wheel, 211a, of the next higher place, is shifted through one half unit, by the tens transfer tooth, 217, (Figure 17), likewise in fixed connection with the spur wheel, 210a, and engaging with the toothed wheel, 216a, while the further shift through the remaining half unit is effected by the transfer members, 191 to 191g, in a manner to be hereinafter described in detail.

As the spur wheels, 210, with the numeral wheels 211, are mounted on the displaceable totalizer carriage, B, and the actuating and tens transfer shaft, 178, on the other hand is mounted in the machine housing, the slides, 192 and 193, obviously only act on the spur wheel, 210, which lies further to the right, when the totalizer carriage B, is in its extreme left position, i.e. in its rest position, as is the case in subtraction or addition. If the carriage, on the contrary, is displaced one place to the right, the slides 192 and 193, co-act obviously with the second spur

wheel, 210b (Figures 17 and 15) from the right.

The displacement of the totalizer carriage, B, is only possible in the rest position of the actuating and tens transfer shaft, 178, which position is determined by the stop pin, 181. In this position of the actuating and tens transfer shaft, 178, the line indicated by "x1" in Figure 16, lies opposite to the spur wheels, 210, so that the spur wheels, 210, on a displacement of the totalizer carriage, B, are able to move unimpeded between the transfer members, 191 to 191j.

The toothed wheel, 25, which is loosely rotatable on the shaft 3, (Figures 4 and 7) and which is rigidly connected to the coupling housing, 26, of the carriage shift coupling, engages with a toothed wheel, 219, (Figures 4 and 12) which is loosely rotatable on a draw-key bush, 218. Further, on the draw-key bush, 218, a second toothed wheel, 220, is arranged and is loosely rotatable thereon. In the draw-key bush, 218, there is formed a groove, 221, in the toothed wheel, 219, a groove, 222, and in the toothed wheel, 220, a groove 223. In the groove 221, of the draw-key bush, a nose, 224, of a draw-key, 225, displaceable axially in the draw-key bush, 218, slides and is able according to its position to engage with one of the grooves, 223 or 222. The toothed wheel, 220, is in engagement with a toothed wheel, 226 (Figure 4) which in turn is in engagement with the toothed wheel 25. The wheels, 25, 226, 220 and 219 form a reversing drive.

On the draw-key bush, 218, a disc, 227, is formed. On this, two pins, 228 and 229, are attached which engage in recesses, 230 (Figures 40, 41, 3 and 42) of a carriage shift rail provided on the rear side of the totalizer carriage B. Against the two pins, 228 and 229, there lies a lever, 233, which is acted on by the torsion spring, 232, (Figure 13) which lever is pivotally mounted on the machine housing by means of a screw, 234, and the purpose of which will be fully described hereinafter. The draw-key, 225, has on its end which does not co-operate with the draw-key bush, a ring groove, 235, in which engages a lever, 238, (Figures 14 and 12) constructed of U-shape and swingable round the points, 236 and 237, and this lever displaces the draw-key, 225, in an axial direction in a manner to be more fully described later, whereby the draw-key bush, 218, is capable of being coupled, at will with the toothed wheel, 219, or the toothed wheel 220. On the toothed wheel, 219, an eccentric, 239, is formed, the eccentric rod, 240, of which is bent off at right angles at its lower end. To

the right-angled bent-off part is jointed a lever, 242, fixed on the shaft 241. On the shaft, 241, a sleeve, 244, provided with a wedge-shaped projection, 243, is rigidly mounted. The projection, 243, is capable of entering a recess, 245, of a lever, 246, which is loosely rotatable on the shaft 241, which lever is normally held in the position illustrated in Figure 12, in relation to the part, 244, by means of a spring, 247, which on the one hand lies against the lever, 246, and on the other hand against a disc 248. The disc, 248, is prevented by the pin, 249, from being displaced axially. The parts, 244, 246, 247 and 248 thus form an overload coupling which in the process of division during the shift from subtraction to addition, is capable of coming into operation. To the lever, 246, a lever, 250, is jointed, which is fully described later.

On the eccentric shaft, 19, (Figures 8 and 40) a hub 252, provided with a nose, 251, is rigidly mounted, and this nose is capable of co-operating with a lug, 253, of a lever, 255, rotatably mounted at the point, 254, on the right hand side wall of the machine. The lug, 256, bent off at right angles to the two-armed lever, 255, is capable of co-acting, in a manner to be later described in detail, with a locking or return flap, 257, for the tens preparatory slide, which is pivotally mounted on a beam, 138, fixed in the totalizer carriage B.

To the arm, 259, (Figures 12 and 14) of the U-shaped lever, 238, a connecting rod, 260, is jointed by means of a screw, 259a, and at its other end is jointed to a lever 261, formed as in Figure 14, by means of a screw, 262. The lever, 261, is arranged on the rear side of the machine, so as to be capable of swinging round the point, 263, by means of a screw (not shown), and is provided with a cut-out portion, 264, into which a lever, 267, may project, the lever being rigidly mounted on the shaft, 265, by means of a screw, 266. Normally, the face 268, of the lever, 261, lies almost against the lever, 267. The lever, 267, is capable, in a manner to be later described, at one time to enter in the cut out portion, 270, formed by the tongue, 269, of the lever, 261, and at another time in the recess, 271. To the lever, 261, a connecting rod, 273, is jointed by means of a screw, 272, the other fork-shaped end of the connecting rod being capable of embracing a pin, 275 fixed to a lever, 274. The lever, 274, is pivotally mounted at the point, 276, by means of a screw, (not shown) on the rear wall of the machine. By means of a spring, 277, which engages with the lever, 274, and

which at its other end is connected to a pin (not shown) fixed in the rear wall of the machine housing, the lever, 274, is swung round the point, 276, in the clockwise direction, whereby its pin, 275, lies against the face, 278, of the fork-shaped lever, 273. In this manner, the lever, 261, is swung in the anti-clockwise direction round the point, 263, whereby the rod, 260, jointed to the lever, 261, is displaced to the right and moves with the right-angled upwardly bent-off part, 279, against a projection, 280, arranged on the machine housing, whereby the normal position of the parts, 274, 273, 261, 260, 238, is determined when the totalizer carriage B, is raised up for observation purposes for repairs or is wholly removed. If the totalizer carriage, B, however, is attached to the machine and is in its extreme left-hand position, then the lever, 274, is held swung in the anti-clockwise direction by the part, 282, which slides on the rear running rail, 281, mounted in the machine housing and which is arranged on the totalizer carriage B, whereby the surface, 268, of the lever, 261, almost comes into contact with the lever, 267, and the parts, 274, 273, 261, 260, 238, take up the normal position represented in Figure 14, in which the draw-key, 225, couples the wheel 220 (Figure 4) of the carriage shift driving gear with the draw-key bush, 218, so that if the machine is actuated, the carriage is moved to the right. By means of a spring, 283 (Figure 14) which is connected on the one hand to a pin, 284, on the lever, 274, and on the other hand engages with a screw stem, 272a, on the lever, 261, the levers, 274 and 261, are so acted upon that the edge, 278, of the connecting rod, 273, lies against the pin, 275, of the lever, 274, whereby their rest position in relation to one another is determined. The parts, 274, 273, 261, form in this manner a type of overloading coupling.

On the right-hand side of the machine housing, a guide plate, 285, (Figure 2) fixed, in the right-angled bent off horizontal limb of which the addition slide, 286, (Figures 2 and 24) is arranged, so as to be vertically slidable. To this slide, the addition key, 4, is fixed by means of screws (not shown). The downwardly directed end of the key slide, 286, is constructed of fork-shape (Figure 24), and embraces with this fork-shaped part a pin, 287, arranged on the machine frame so that the pin serves as a guide for the key slide, 286. On one of the fork arms, a nose, 288, is provided with which a spring, 289, engages, the other end of the spring being connected to the guide plate, 130

285, whereby the key slide, 286, is held in its rest position, which is determined by the striking of the face, 290, of a lug, 291, formed on the key slide, 286, against the under edge of the guide plate, 285. To this lug, 291, further, a pin, 292, is riveted which acts on a surface, 293, of a change-over lever, 294 for the driving gear of the actuating and tens transfer shaft, 178, (Figure 15), of the revolutions-register, U, the lever, 294, being arranged on the left close to the key slide, 286. The change-over lever, 294, (Figure 24a) is rotatably mounted on a shaft, 295, rigidly mounted in the machine housing, and has a surface, 296, the purpose of which will be described hereinafter. The change-over lever, 294, is constructed of fork-shape at its rearwardly directed part and embraces with the same a pin, 298, provided on a lever, 297. The lever, 297, is constructed of fork-shape at its lower end and by means of a screw, 299, is clamped to a shaft, 300.

On the shaft, 300, (Figures 2, 24, 28, 46 to 50) a control lever, 301, is rigidly mounted at the right-hand outer side of the machine, the lever being provided with two openings, 302 and 303 (Figures 24, 46 to 50). With the opening, 302, a lug, 305, (Figures 46 to 50) normally engages the lug being bent-off on the control rod, 304, constructed according to Figure 2, while with the opening, 303, a lug, 306 bent off on the rod, 304, is capable of engaging.

In the control rod, 304, an elongated hole, 307, is provided, into which projects a pin, 309, riveted to a lever, 308 (Figures 2 and 27). The lever, 308, is rigidly mounted on a rotatably mounted shaft, 310 (Figures 27, 24). The free rearwardly directed end of the rod, 304, (Figures 2 and 10) is jointed to the already mentioned swingable angle lever, 177 (Figure 10) which controls the draw key, 136, of the driving gear for the actuating and tens transfer shaft 178, of the revolutions-register, U. The control lever, 304, is on its forwardly directed end provided with an X-shaped opening, 311, (Figures 46 to 50) in which the stub-shaft 312, of the lever, 308, is capable of engaging.

On the lug, 291, (Figure 24) of the key slide, 286, there is, further, a pin, 313, arranged which acts on a surface 314, of a lever, 316, which lies immediately to the right adjacent to the key slide, 286. (in Figure 24) the parts are illustrated drawn out from one another) and is capable of swinging round a bearing pin, 315, in the clockwise direction. By means of a spring, 318, which on the one hand engages with a notch, 317, of the

lever, 316, and on the other hand is connected to a pin, (not shown) arranged on the machine housing, the lever, 316, is held in its normal position represented in Figure 24, which is determined by the striking of the face, 314, upwards against the pin, 313, of the key slide arm, 291. A lug, 319, formed on the lever, 316, is capable of acting on the lug, 320, of a lever, 321 (Figure 24) which is loosely rotatable on the shaft, 310, and which is attached to the key locking bar, 322.

On the fork-shaped and right-angled bent-off part of the lever 321 (Figure 24) the key locking bar, 322, (Figures 24, 25 and 27) is rigidly mounted as already mentioned. The latter, on the left-hand side of the machine, is fixed to a likewise fork-shaped and right-angled bent-off part of a lever, 323 (Figure 24). A screwed pin, 324, attached to the rearwardly directed part of the lever, 316 (Figure 24 and 24b) projects into a right-angled slot, 325, of a slide, 326. The latter in one of its end positions represented in Figure 24, lies with its lug, 327, on the already mentioned pin, 287, whereby the pin, 324, takes up the position indicated in Figure 24, in relation to the slot, 325, of the slide, 326, and the lever, 316, without acting on the slide, 326, can swing round the pin, 315, in the clockwise direction. The slide, 326, is at its forwardly directed end jointed by means of a pin, 329 to a lever, 328, constructed of U-shape. The pin, 329, is fixed on the one hand to a limb, 17, formed as a grip and on the other hand is rigidly fixed in a limb, 330, of the U-shaped lever, 328. This is pivotably mounted on the already mentioned pin, 315. By means of a leaf spring, 328g fixed on the underside of the guide plate, 285 (Figure 2) and having its free end of V-shape, the lever, 17, or the slide 326, is held in the set position for the time being, which on the removed cover plate is indicated by "M" and "A" (Figure 1). On the rearwardly directed end, 332, of the slide, 326, the nose, 124a, of the connecting rod, 124, acts, which in the rotation of the crank disc, 117, swings the slide, 326, and consequently the lever, 316, transversely to its proper plane of oscillation, so far that the edge, 314, of the lever, 316, comes out of engagement with the pin, 313, of the key slide, 286.

To this end, the bearing bore of the lever, 316, is chosen so great in relation to the diameter of the bearing pin, 315, that the lever, 316, is capable of performing such a sidewise movement. The direction of pull of the spring 318, is so chosen, that the lever, 316, is held with

its horizontal edge, 314, normally in contact with the underside of the pin, 313, and against the lug, 291, of the key stem, 286. The lug, 333, formed on the slide, 326, acts on a part to be hereinafter described in detail.

To the key locking rail 322, a lever 334, is fixed by means of its fork-shaped and right-angled bent-off part. To the downwardly directed end of the lever, 334, the connecting rod, 335, (Figure 24) is jointed, which at its other end is jointed to an arm, 336, of a two-armed lever, 339, having its U-shaped part 337, swingable round a shaft, 338, arranged in fixed bearing parts (not shown) in the machine frame. To the upwardly directed arm, 340, of the two-armed lever, 339, a pin, 341, is fixed, to which a spring, 342, is connected, the other end of the spring engaging with a pin, 343, of a lever, 344, constructed of U-shape. The U-shaped lever, 344, is fixed on the shaft, 265, by means of a screw, 345. By means of the spring, 342, the two levers, 339 and 344, are so held that the pin, 343, of the lever, 344, normally moves upwards against the edge, 346, of the two-armed lever, 339.

A lever, 347 (Figure 24) which is mounted on the shaft, 241, so as to be loosely swingable thereon, is in rigid connection by means of a bridge, 348, with a lever, 23, likewise swingable loosely on the shaft, 241. A spring, 350, which on the one hand engages with the pin, 349, of the lever, 347, and on the other hand is connected to the machine housing in any suitable manner, acts on the lever, 347, as well as the lever, 23, in the clockwise direction round the shaft 241. On the shaft, 241, further, a lever, 351, is loosely swingable, which is prevented from axial displacement in any suitable manner. The lever, 351, is provided with a recess, 352, into which a pin, 353, arranged on the lever, 347, is capable of projecting. By the contact of the edge, 354, of the lever, 351, with the face, 355, of the arm, 336, of the two-armed lever, 339, the normal position of the levers, 347 and 23 is determined. A roller, 356, arranged on the pin, 353, of the lever, 347, moves upwards against the face, 357, of a lever, 358, as well as against the face (not shown) of a lever, 359, which will be described in detail hereinafter. On the upwardly projecting right angled bent-off end of the lever, 23, the already mentioned two-armed lever, 22, is pivotably mounted. This acts with the downwardly projecting limb on a contact spring, 361, attached to an angle piece, 360. To the free end of the spring, 361, a contact pin, 362, is fixed, which co-acts with a contact pin, 364, fixed to an angle piece 363.

For the purpose of changing-over in the proportional rack system described in detail in Patent Specification No. 365,058, from addition to subtraction, a lever, 366, is fixed on the shaft, 300 (Figures 24, 28) by means of the screw, 365. It may be mentioned at this point, first of all, that as arises from Figure 1, the machine has sixteen denominations and just as many rows of keys, as is hereinafter described. As the machine has sixteen rows of keys, the racks indicated herein by 367, are constructed correspondingly longer than the racks Z_0 to Z_9 in the Patent Specification above referred to. Into the lever, 366, a headed screw, 368, is screwed. Round the head of the screw, 368, a two-armed lever, 369, with its elongated hole (not shown) is pivotably and displaceably mounted. On the arm, 370, of the two-armed lever, 369, (Figures 24, 28) a pin, 372, is jointed by means of a split pin, 371. On the arm, 373, a pin, 375, is similarly mounted by means of a split pin, 374. In addition, the pin, 375, is coupled with the rack, 367a, and in subtraction the pin, 372, is coupled with the rack 367b. Normally, the machine is always set for addition.

Round the head of the screw, 368 (Figures 24, 28) a connecting rod, 376, is jointed. The connecting rod, 376, is connected by its slot, 377, with a pin, 378, of a two-armed lever, 379. The connecting rod, 376, is provided still further with two slots, 380 and 381, which will be hereinafter described in detail. The two-armed lever, 379, is pivotably mounted by means of its fork-shaped part, 383, on the shaft, 382, which is mounted in any suitable manner in the machine housing. To the upwardly directed limb of the lever, 379, a pin, 384, is riveted, which projects into a mouth, 385, of the lug, 386, formed according to Figure 24, of a change-over flap, 387. The change-over flap, 387, is pivotably mounted on a shaft 388 (Figures 24, 28, 29 to 33 and 39) mounted in the machine housing in any suitable manner.

To the two-armed lever 379, (Figure 24), a pin, 389, is riveted, which is capable of co-acting with a mouth, 390, of the already mentioned lever, 250.

On the shaft, 310, a control lever, 391 (Figures 24, 26, 27) is loosely and pivotably mounted, by means of its U-shaped part, 392. By means of a spring, 393, which at one end is connected to a pin, 394, arranged on the control lever, 391, and at the other end engages with a pin, 395, which is riveted to a right-angled bent-off lug, 397, of the lever, 323, carrying the locking bar, 322, for the key board T, the control lever, 391, is

always so acted upon that normally its face, 396, lies against the lug, 397, which has already been mentioned and which is bent on the locking bar, 322.

5 By means of a spring, 398 (Figure 24, 26 and 27) which on one hand engages with a pin, 399, riveted to the control lever, 391, and on the other hand is connected to a pin, 400, of a lever, 401
10 (Figure 27) to be later described in detail, the control lever, 391, and the locking bar, 322, for the key-board are acted on in the clockwise direction round the shaft, 310, whereby the face, 402, of the slot, 403, of the control lever, 391, lies
15 against a pin, 405, riveted to the division key lever, 404, whereby the normal position of the parts, 391, and 392, as well as the parts connected therewith, is deter-
20 mined.

The key releasing mechanism which automatically comes into action on each revolution of the main driving shaft, 3, consists of the following parts.

25 The lug, 333, (Figures 24 and 25) formed on the slide, 326, acts on a lug, 406, of a connecting rod, 407. This rod as is shown in Figure 25, is jointed to a two-armed lever, 409, which is pivotably
30 mounted on the machine frame at the point 408. At the free upwardly directed end of the lever, 409, a lug, 410, is bent, on which acts a nose 411, of a driving disc, 412, rigidly mounted on the eccen-
35 tric shaft, 19, (Figure 8) of the result totalizer, R. With the connecting rod, 407, a spring, 413, engages which at its other end is connected to a lug, 414, of a guide member, 415 (Figure 2) fixed to the
40 machine housing. The angled lug, 406, on the connecting rod, 407, acts on an arm, 417 (Figure 19) of key releasing bar, 418, which is pivotably mounted on the shaft, 310. Further, the lug, 406, of the
45 connecting rod, 407, co-acts with the angle lever, 420, pivotably mounted on the shaft, 419, (Figures 25 and 25a). With a pin, 421, of the lever, 420, a spring, 422, engages, which at its other
50 end is connected to a pin, 423, fixed to the machine frame, and which acts on the lever, 420, so that it always contacts with a pin, 424a, mounted on the machine frame.

55 To the upwardly directed part of a subtraction slide, 424, (Figure 24) vertically displaceable in the guide plate, 285, (Figure 2), the key, 5, is fixed by means of a screw (not shown). The down-
60 wardly directed end of the key slide 424, is constructed of fork-shape, and its fork-shaped part embraces a screw (not shown) fixed in the machine housing, which screw serves for guiding the key slide,
65 424. A spring, 425, which engages a

nose, 426, of the key slide, 424, and is connected to the guide plate, 285, holds the key slide, 424, in its normal position, which is determined by contact of the face, 427, of the right-angled and down-
70 wardly bent-off part of the key slide, 424, with the lower edge of the guide plate, 285. On the left-hand side of the lug, 428, arranged on the key slide, 424, there is a pin, 429, riveted, which acts on the
75 face, 296, of the change-over lever, 294, for the actuating and tens transfer shaft, 178, of the revolutions-register U. On the right-hand side of the lug, 428, of the key slide, 424, there is provided
80 another pin, 430, which is capable of acting on the edge, 314, of the already mentioned lever, 316.

On the right-hand side of the machine besides the addition key slide, 286,
85 (Figure 1) and the subtraction key slide, 424, there are the mechanisms for clearing the depressed amount keys, for clearing the revolutions-register U, and for clearing the result totalizer R. These
90 mechanisms in the following will be described in detail.

The key, 6, for releasing depressed amount keys and clearing the keyboard carries the reference L^{III} (Figures 1, 2,
95 19 and 21) and is provided with a slide, 431, which is guided so as to be displaceable vertically in the guide plate, 285, by means of an elongated hole, 432. A spring, 433, engaging with the slide, 432,
100 holds the slide, 431, in its normal position which is determined by the contact of the face, 434, of the elongated hole, 432, against a screw which projects through the same (not shown). The face,
105 435, of the slide, 431, on the downward movement of the latter, acts on a right-angled bent-off lug, 436, of the arm, 437, of the key releasing bar, 418, which is capable of swinging on the shaft, 310.
110 The face, 438, (Figure 19) of the key releasing bar lies on projections, 439, of the known key locking bars, 440, (in Figure 19 only one locking bar, 440, is illustrated). The spring, 442, which
115 engages with the nose 441, (Figure 19) of the key locking bar, 440, and is connected to a pin (not shown) acts upon the key locking bar, 440, in such a manner that its projection, 439, as already mentioned,
120 lies against the key releasing bar 418.

The key, 7, (Figures 19 and 21) provided with the reference L^{II} , for zeroizing or clearing the result totalizer R, (Figure 1) is arranged on a key lever, 443, which
125 is pivotably mounted on a shaft, 444, mounted in the guide frame, 285. The lever, 443, is rigidly connected by means of a bridge, 445, with the lever, 446, which is likewise pivotably mounted on
130

the shaft, 444. On the lever, 446, a nose, 447, is formed, with which a spring, 448, engages, the spring on the other side being connected to a lug (not shown) of the guide plate, 285, whereby the lever, 443, is held in its rest position which is determined by the edge, 449, striking upwards against the guide plate, 285. To the downwardly directed limb, 450, of the lever, 443, there is jointed a connecting rod, 451, which again is jointed to a lever, 358, before mentioned. The lever, 358, is pivotably mounted at the point, 452, on a shaft (not shown). An arm, 453, of the lever, 358, acts by means of its parts, 454, upwards on an arm, 100b, of the two-armed coupling lever, 100. The nose, 97, of the arm, 98, of the lever, 100, is connected in the manner already described with coupling, 83. The face, 357, of the lever, 358 (Figure 19) acts in a manner to be later described, on the roller, 356, connected to the lever, 347, whereby the motor contact, 362, 364, is closed through the parts, 348, 23 and 22.

The lug, 455, of the coupling lever, 44, (Figure 24) can enter a recess, 458, (Figure 19) formed by the noses, 456 and 457, so that the lever, 358, can swing round the point, 452, on the depression of the key, 7, without acting upon the coupling lever, 44. The arm, 459, of the lever 358, acts on a two-armed U-shaped lever, 460, (Figures 19 and 20) which is swingable by means of its U-shaped part, 461, round a pin, 462, mounted in the machine housing. The arm, 463, of the two-armed lever, 460, bears with its nose, 464, upwards against a nose, 465, of a two-armed lever, 466, (Figure 20a), which is pivotably mounted with its U-shaped part, 466a, on the pin, 462. To the nose, 467, of the arm, 463, of the two-armed lever, 460, and to a nose, 468, of the lever, 466, a spring, 469, is connected, which acts upon the two levers, 466 and 460, in such a manner that their noses, 465 and 464, are normally in contact. In this manner a type of overload coupling is formed. The lever, 466, bears upwards against a face, 470, of a lever, 473, which is constructed of U-shape and is swingable round a screw, 471, on a lever, 472. To the lever, 472, a pin, 474, is riveted with which a spring, 475, engages, the spring at its other end being connected to a pin, 476, of the lever, 473.

The spring, 475, acts on the lever, 473, in the clockwise direction round the screw, 471. By contact of the face, 470, of the lever, 473, with the lever, 466, which is maintained in contact with the arm, 463, of the lever, 460, by means of the spring, 469, whereby the lever, 460,

bears upwards against the arm, 459, of the lever, 358, the normal position of the parts, 473, 466 and 460, is determined. The U-shaped end, 477, of the lever, 473, embraces a bar, 479, formed as shown in Figure 19, and fixed at the points, 478, on the machine housing.

The angled lug, 480, on the lever, 473, is capable of sliding on the bar, 470, in a manner to be later described in greater detail.

The already mentioned lever, 472, is rigidly mounted on the shaft, 481, which is rotatably mounted in the machine housing. On the other end of the shaft, 481, a further lever, 482, is fixed in a similar manner, which by means of a screw, 483, is in articulated connection with the rod, 109, of the zeroizing coupling, 83.

On depression of the key, 7, for zeroizing the result totalizer, R, the part, 477, of the lever, 473, constructed of U-shape, engages in the grooves, 485, (Figure 42) of a comb, 486, which is fixed to the zeroizing bar, 487, (Figures 40, 41 and 42) of the result totalizer, R, (Figures 1 and 2). The zeroizing bar 487, is displaceably mounted in grooves, 488, (Figure 45) of blocks 489, which are provided on the rear wall, Br, of the totalizer carriage, B. Further, the zeroizing bar, 487, is mounted by means of a screw, 490, in a ring-groove sleeve, 491, provided in the rear wall, Br, of the carriage, B, (Figures 40 and 42). By means of a spring, 493, which engages with a pin, 492, (Figure 42) of the comb, 486, of the zeroizing bar, 487, and which at its other end is connected to a pin, 495, arranged in an angle member, 494, (Figure 40) of the carriage, B, the zeroizing bar, 487, is held in the rest position illustrated in Figure 42. The teeth, 496, of the zeroizing bar, 487, are in engagement with the toothed wheels, 498, rotatably mounted on shafts, 497. The latter act on toothed wheels, 500, in known manner in case the numeral wheels, 499, of the result totalizer, R, do not stand at "0" and the zeroizing bar, 487, is operated, the toothed wheels, 500, being arranged rigidly on the numeral wheel shafts, 501, on which likewise the numeral wheels, 499, and the toothed wheels, 502, 503 and 158, are rigidly mounted. If the numeral wheels, 499, are located at zero, then the toothed wheels, 500, fixed on the numeral wheel shaft, 501, rest with their wide tooth spaces, 504, (Figure 42) arising from the removal from a tooth of half of its tooth breadth, opposite to tooth spaces, 505, likewise arising from the removal from a tooth of half its breadth on the toothed wheels, 498. By this means the result is attained that, as known, the wheels, 500, 130

can freely rotate without acting on the wheels, 498, and that likewise, the wheels, 500, remain uninfluenced on rotation of the wheels, 498, as soon as the numeral wheels, 499, are located at zero in which case the tooth spaces 504 and 505 lie opposite to one another as shown in Figure 42.

If on the contrary, the numeral wheels, 499, (Figures 40 and 41) of the result totalizer are not located at zero and if the zeroizing bar, 487, (Figure 42) is displaced in the direction of arrow "c", then the heels, 500, and consequently the numeral wheel shafts, 501, are rotated by the toothed wheels, 498, in the direction of arrow "i" (Figures 41 and 42). An over-running of the numeral wheel shafts, 501, or the numeral wheels, 499, in the direction of the arrow "i" past zero, is prevented by striking of the usual tens transfer teeth, 506, (Figures 40 and 41) against the noses, 507, of the tens preparatory slide, 508. The prevention of over-running is of special importance with power-operated zeroizing mechanism.

Adjacent to the key, 7, (Figures 19 and 21) for zeroizing the result totalizer, R, there is arranged the key, 8, (L') for zeroizing the revolutions-register, U. This is connected to a key lever, 508, which is pivotably mounted on the shaft, 444. By means of a bridge, 509, the key lever, 508, is in fixed connection with the lever, 510, which is likewise pivotably mounted on the shaft, 444. By means of a spring, 511, which on one hand engages with a lug, 512, formed on the bridge, 509, and on the other hand is connected to a lug, 513, of the guide plate, 285, the key lever, 508, is acted upon in the anti-clockwise direction and held in its rest position which is determined by the edge, 514, of the key lever, 508, striking upwards against the guide plate, 285.

On the downwardly directed limb, 515, of the lever, 508, a connecting rod, 516, (Figure 19) is jointed, which is jointed to a lever, 359, pivotably mounted at a point, 517. The arm part 519, of the lever 359, acts upwards on the arm, 100b, of the coupling lever, 100. Into the recess formed by the noses, 520 and 521, the lug, 455, already mentioned, of the coupling lever, 44, (Figure 24) is capable of entering, so that the lever, 359, on the depression of the key, 8, can swing in the anti-clockwise direction round the point, 517, without being hindered by the lug, 455, of the coupling lever, 44.

The arm, 523, of the lever, 359, (Figures 19 and 20) acts on an arm, 524, of a two-armed lever, 525, which is arranged so as to be swingable round a screw, 526, in the machine frame. On the screw, 526, another two-armed lever, 527, is swingably arranged. By means of a spring, 528, which on the one hand engages with a nose, 529, of the arm, 530, of the lever, 525, and on the other hand with a nose, 531, of an arm, 532, of the lever, 527, the lever, 525, is acted upon in the anti-clockwise direction and the lever, 527, in the clockwise direction, whereby the lug, 533, of the arm, 532, of the lever, 527, lies against a right-angled bent-off lug, 534, of the arm 530, of the lever, 525, whereby the normal position of the two levers, 527 and 525, in relation to one another, is determined.

At the free end of the arm, 535, (Figure 19) of the lever, 527, there is a lug, 536, bent off at right angles which bears upwards against a lever, 538, swingable round a screw, 537, on the lever, 472. By means of a spring, 539, which on one hand engages with a pin, 474, of the lever, 472, and on the other hand is connected to the lever 538, the lever, 538, is acted on round the screw, 537, in the clockwise direction, whereby the lever, 538, lies on the lug, 536, of the lever, 527. Its normal position is thus determined.

The end, 540, constructed of U-shape (Figure 19) of the lever, 538, embraces a bar, 542, which is constructed as shown in Figure 19 and which by means of screws (not shown) is fixed at the points, 541, on the machine housing. The lug, 543, formed on the lever, 538, is capable of sliding on the bar, 542, in a manner to be later described, whereby the part, 540, which is constructed of U-shape is capable of entering into grooves, 544, (Figure 42) of the zeroizing bar, 545, for the revolutions-register, U, and moves this bar to and fro. The zeroizing bar, 545, is displaceably mounted in grooves, 546 (Figure 43) of the two blocks, 489 (Figure 42) and is supported by parts, 548, attached by means of screws, 547. By means of a spring, 549, which on the one hand engages with a pin, 550, (Figure 42) connected to the zeroizing bar, 545, (Figure 12) and on the other hand is connected to the left-hand block, 489, the zeroizing bar, 545, is held in its normal position which is determined by the striking of the face, 551, of the zeroizing bar, 545, against the edge, 548a, of the part, 548, provided in the left hand block, 489.

The teeth, 552 of the zeroizing bar, 545, are in engagement with twelve-toothed toothed wheels, 553 (Figures 41 and 42) in which for the formation of a large tooth space, 554, a tooth is cut out.

The toothed wheels, 553, arranged on the shafts, 553a, are able to engage with the ten-toothed tooth wheels, 556, rotat-

ably mounted on the shafts, 497, on which latter wheels, a large tooth space, 557, is formed likewise by the removal of a tooth.

On the wheels 556, there are cams, 558, (Figure 41) fixed, which are capable of moving freely in half-round recesses, 559, (Figures 44 and 43) of the hubs, 560, of the wheels, 553 insofar as they take up their normal position illustrated in Figure 43. With the wheels, 556, the already mentioned wheels, 212, are rigidly connected by hubs, 561, (Figure 41) which latter wheels on their part are in engagement with the wheels, 214, etc. (Figure 41) which are loosely rotatable on the numeral wheel shafts 501 and together with the wheels, 214, 215 (Figure 17) and the numeral wheels, 211, 211a, etc. of the revolutions-register, U, form a whole. With the wheels, 212, further, the tens transfer teeth, 217, 217a, etc. are rigidly connected, and through the sleeves, 213, the spur wheels, 210, 210a, etc. so that the parts 210, 213, 212, 217, 561, 556, 558 and 559 always rotate in common.

If these parts are rotated by the spur wheels, 210, then the toothed wheels 556, (Figure 43) together with the cams 558 are capable of rotating in each direction without acting upon the zero position members, 553.

If, however, the zeroizing bar, 545, is displaced from the position illustrated in Figure 43, into the position illustrated in Figure 44, and if the tooth spaces 557 are opposite to the zero position wheels, 553, as is always the case when the numeral wheels, 211, of the revolutions-register, U, are at zero, then the zero position wheels, 553, are capable of rotating without acting on the wheels, 556.

If the numeral wheels, 211, of the revolutions-register, U, on the contrary, do not stand at zero, and if the zeroizing bar, 545, is displaced from the position according to Figure 43, into the position according to Figure 44, then the wheels 556 rotate until their tooth spaces, 557, are opposite to the wheels, 553.

It was mentioned that the toothed wheels, 553, have twelve teeth and the toothed wheels, 556, ten teeth. This has as its object to avoid over-running of the numeral wheels, 211, of the revolutions-register in the following manner:—

The stroke of the zeroizing bar, 545, is only of such length as to be capable of rotating the wheels, 553, through ten teeth in the position illustrated in Figure 44. On this displacement of the zeroizing bar, 545, the wheels 556, are always rotated in the direction of arrow "r" whereby as soon as their tooth spaces, 557, lie opposite to the wheels according to Figure 44, an over-running of the wheels

could result in the direction of the arrow "r". This is prevented, however, by the cams, 558, fixed to the wheels, 556, striking against the hubs, 560, of the wheels, 553, as is shown in Figure 44. This over-running lock in combination with power driven zeroizing mechanism is very important.

On the right hand side of the machine, the key lever 563, (Figure 21) carrying the key 5x Mult.) for three-factor multiplication, is arranged to the right of the zeroizing key lever, 514, for the revolutions-register, U. The key lever, 563, which has the form illustrated in Figure 22, is provided with a slot, 564, into which projects a pin, 565, (Figures 21, 22) riveted to a lug (not shown) on the frame, 285, whereby the key lever, 563, is guided. The key lever, 563, is likewise arranged so as to be swingable around the already mentioned shaft, 444, and is provided with a downwardly directed arm, 566, which is capable of co-acting with a locking flap, 322, in a manner to be later described. A part, 568, which is pivotably mounted on the key lever, 563, by means of the screw, 567, (Figure 22) is formed of U-shape as shown in Figure 22, the slot, 569, of which is capable of co-acting with a pin, 570, arranged on the key lever, 443, for zeroizing the result totalizer, R. The rear side of the part, 568a, of the U-shaped part, 568, is capable of co-acting in a manner to be later described, with the pin, 565.

If the key "3x Mult."-key 9, is depressed and consequently the key lever, 563, swung round the shaft, 444, in the clockwise direction then the part 568b of the U-shaped part, 568, is capable of acting on the pin, 570, arranged on the key lever, 443, and consequently the key lever, 443, is swung likewise in the clockwise direction round the shaft, 444. If the key lever, 563, is in its upper position then the part, 568, lies on the pin, 565, under the action of the spring, 568s. In this position, the part, 568, releases the pin, 570, of the key lever, 443, for the result totalizer to such an extent that the key, 7, can be freely depressed.

On the key lever, 563, still another lever, 16, already mentioned, is pivotably mounted by means of a screw, 571, the nose, 573, of the lever, 16, according to the setting of the lever, 16, is capable of acting at one time on the bridge 509, of the lever, 508, 510, for zeroizing the revolutions-register, U, and at another time, does not act on the bridge 509. The two positions of the lever, 16, are determined by a recess, 572a, of the lever, 16, and by two notches, 572b, in the lever,

563.

At the point, 574, on the key lever, 563, there is jointed a downwardly directed connecting rod, 575, which at its free end is jointed to a lever, 576, which by means of a screw, 577, is rigidly mounted on a shaft, 578, mounted in the machine housing in any suitable manner. On the left hand end of the shaft, 578, a further lever, 580, is rigidly fixed by means of the screw, 579, which lever bears upwards against a right-angled bent-off lug, 581, of two-armed lever, 582. The lever, 582, is pivotably mounted on a shaft, 583, which is mounted in the machine housing. By means of a bridge, 584, the two-armed levers, 582, is connected to the lever, 585, which is pivotably mounted on the shaft, 583. By means of a spring, 586, connected to the lever, 585, and to a pin (not shown) arranged in the machine housing, the parts 585, 584, 582, are held swung in an anti-clockwise direction, whereby the lug, 581, of the lever, 582, is held in contact with the lever, 580, whereby the normal position of these parts is determined. The lever, 585, is capable of contacting with a cam, 588, fixed on the shaft, 587, in a manner to be hereinafter described in detail. The upwardly directed limb of the two-armed lever, 582, (Figure 21) is constructed of fork-shape at its free end and with this fork-shaped mouth, 589, embraces a pin, 591, arranged on the lever, 590. The two-armed lever, 590, is rigidly connected with the lever, 593, by means of a bridge, 592. Both the levers, 590 and 593, are swingable loosely around the already mentioned shaft, 388.

The upwardly directed limb, 590a, of the two-armed lever, 590, is capable of co-acting with a lug, 594, bent-off at right angles on a lever, 596, which is pivotably mounted on the totalizer carriage, B, on the screw, 595. The lug, 597, which is bent-off at right angles on the lever, 596, is capable of co-acting with a downwardly directed lug, 598, of a flap, 601, which is swingably mounted on the pins, 599 and 600, in the totalizer carriage, B. The flap, 601, is provided with holes which are of sufficiently large size that when the shafts, 497 project therethrough, a swinging movement of the flap, 601, nevertheless is possible without hindrance.

The upwardly directed end of the flap 601, is capable of engaging in a ring groove, 603 (Figures 21 and 23) of a sleeve, 604, which is mounted in such a manner as to be axially displaceable on the numeral wheel shafts, 501. On the right-hand end of the sleeves, 604 (seen

in Figure 21) a toothed wheel, 605, is rigidly mounted, which on axial displacement of the sleeve, 604, constantly engages with the broad toothed wheel, 606, which lies under it and which is rigidly mounted on the shaft, 497, the toothed wheel, 606, being held by means of a spring, 606a, in its set position for the time being. On the left hand end of the sleeve, 604, a toothed wheel, 607, (seen in Figure 21) is rigidly mounted, which is capable of engaging with the teeth, 608 (Figure 23) of the internal gear of the numeral wheels, 499 M, on axial displacement of the sleeve, 604. The numeral wheels, 499, for the result totalizer, R, are provided with two series of numbers viz., 499 R, (Figure 23) which on rotation of the numeral wheels, 499, are carried round in the anti-clockwise direction from "0" to "9", and 499 M, for the complement value which, in the same rotation of the number rollers, 499, are carried round in the reverse direction from "9" to "0". At this point it may be mentioned that the parts, 604, 605, 607, 601, are provided only for the eight denominations on the left.

Each of the already mentioned toothed wheels, 606, is provided with a tooth space, 609, (Figure 23) in which a lever, 610 (Figures 21, 23 and 24) is capable of engaging. This is guided by means of a screw, 611, which projects through the elongated hole, 612, of the lever, 610, to a rear wall (not shown) of the machine housing. By means of a spring, 613, the lever, 610, is constantly acted upon in such a manner that it lies opposite to a tooth space, 609, of the toothed wheels, 606, as is represented by the full lines in Figure 23. By means of the already mentioned bridge, 592, of the yoke, 590, 592, 593, it is swung into the position represented by dotted lines in Figure 23, on grounds to be later described in greater detail, so that it is not capable of co-acting with the teeth of the toothed wheels, 606.

The lever, 610, obtains its drive from an eccentric (not shown). The eccentric is rigidly connected to a toothed wheel, 614 (Figure 34) which is rotatably mounted by means of a screw, 615, on the rear wall of the machine housing. With this toothed wheel, 614, engages a further toothed wheel, 617, mounted by means of a screw, 616, on the rear wall of the machine. The latter is in engagement with a toothed wheel, 618, which is loosely rotatable on the shaft, 587, which is arranged in any suitable manner in the machine housing, so as to be rotatable and axially displaceable. The toothed wheel, 130

618, again is in engagement with a toothed wheel, 619, rigidly mounted on the eccentric shaft 19, and obtains its drive from this shaft.

5 The toothed wheel, 618, is provided with two holes, 620, into which, according to its position and according to whether the shaft, 587, is displaced to the right or to the left, may enter at one time, a
10 pin, 621, which is attached to a block, 622, rigidly mounted on the shaft, 587, and at another time a pin, 623, which is attached to the block, 624, rigidly mounted on the shaft, 587. The toothed wheel,
15 618, is guided by two parts, 625 and 626, formed as shown in Figure 34, and fixed in the machine housing in any suitable manner, so that it cannot participate in the axial displacement of the shaft, 587.
20 On each of the shafts, 497, (Figures 3, 29, to 33) outside the totalizer carriage, B, on the rear wall, a zero cam, 627, is rigidly fixed, which is provided with a recess, 628. The recess, 628, of the
25 extreme left zero cam, 627, (seen in Figure 3) is not so deep as those of the remaining zero cams, 627. Projections, 629, of lyre-shaped levers, 630, formed as shown in Figures 3 and 29 to 33, are
30 capable of engaging in the recesses, 628, of the zero cams, 627. The parts, 630, are pivotably mounted by means of pins, 631, (Figure 3) on a bar, 633, which is fastened to the rear side of the carriage
35 B, by means of screws, 632, and lie scale-like over one another. The parts, 630, are capable of co-acting with the parts to be described later.

On the left-hand side of the machine,
40 the multiplication key lever, 634, (Figures 27, 28 and 26) which carries the multiplication key, 11, is pivotably mounted on a shaft, 636, rigidly mounted in a supporting frame, 635. By means
45 of a bridge, 637, the key lever, 634, is rigidly connected with the lever, 401, which is similarly pivotably mounted on the shaft, 636. With the lever, 401, a spring, 398, already mentioned, engages,
50 which, at its other end is connected to a control lever, 391, and which acts upon the parts, 401, 637, 634, in the clockwise direction round the shaft, 636, whereby the key lever, 634, lies upwards with the
55 projection, 638, against the supporting frame, 635, whereby the normal position of the parts is determined. A pin, 639, riveted to the key lever, 634, is capable of co-acting with a slot, 640, of the control lever, 391, in a manner to be described later.
60

The pin, 641, (Figure 26) riveted on the key lever, 634, for multiplication, co-acts with a slot, 642, of a control lever,
65 644, pivotably mounted on the shaft, 643,

which is rigidly fixed in the said supporting frame, 635. The control lever, 644, is united by means of a bridge, 645, with a lever, 646, which is similarly pivotably mounted on the shaft, 643. The lever,
70 646, with its rearwardly, directed part, 647, formed as shown in Figure 26, engages in a mouth, 648, of the lever, 649. The lever, 649, is rigidly fixed by means of a screw, 650, to a shaft, 651, which is pivotably mounted in plummer block, 669, (Figure 34) to be later described, on the front wall, and in an intermediate wall of the machine. On the shaft, 651,
75 moreover, a lever, 653, is rigidly mounted by means of a screw, 652. On the lever, 653, there is fixed a part, 655, by means of a screw 654, the part, 655, being formed with a downwardly directed end of fork-shape which embraces the shaft,
80 651, so that it can participate in the swinging movement of the lever, 653. The spring, 656, which is arranged between the head of the screw, 654, and the part, 655, permits, moreover, of a
85 lateral swinging movement of the part, 655. The upwardly directed end of the part, 655, which is constructed correspondingly to Figure 26, is capable of engaging in a recess, 657, of a sleeve,
90 658, which is rigidly attached to the shaft 587 (Figures 26 and 34) the sleeve being in fixed connection by means of its reduced part, 659, with a disc, 660. Into a recess, 661, of the disc, 660, the end,
95 662a, of a part, 662, rigidly mounted on the rear wall of the machine, can enter in the rest position of the shaft, 587, whereby the shaft, 587, and the parts, 853, 723, 588, 680, 622, 624, arranged on
100 it are prevented from unintentional rotation.

On the shaft, 651, (Figure 34) furthermore, is fixed a lever 663, by means of a screw, 664, which lever with its fork-shaped upwardly directed mouth, 665,
110 embraces a rod 666, which is swingable by means of a screw, 667, on an angle member, 669, which is rigidly attached to the front side of the machine at the
115 points 668. The rearwardly directed end of the rod, 666, is capable of engaging in a hole, 670, of the already mentioned releasing bar part, 418A, of the releasing bar, 418, and to displace this to the right
120 or left in a manner to be later described.

The releasing bar, 418, is as is obvious from Figure 34, separated into two parts, namely, 418A and 418B. The part,
125 418A, of the releasing bar, 418, is riveted at the left hand end to a lever, 671, which is swingably mounted on the shaft, 310, and at its right hand end, to a lever 672, which is swingably mounted on the shaft, 310. The downwardly extended lever, 130

672, is provided with a slot, 673, into which a pin, 675a, riveted to the connecting rod, 674, is capable of entering. On the other end of the connecting rod, 674, there is jointed a lever, 675, which is swingably mounted on the shaft, 583, which lever again is in rigid connection, by means of a bridge, 676, with a lever, 677, which is likewise capable of swinging on the shaft, 583. The lever, 677, may, in a manner to be later described in detail, according to the position of the shaft, 587, co-act at one time with the part, 678, and at another time with the part, 679, of a control cam, 680, which is rigidly mounted on the shaft, 587.

The releasing bar, 418B, is riveted at its left hand end to a lever, 681, which is pivotably mounted on the shaft, 310, and at its right hand end, to the already mentioned lever, 437 (Figure 19). On the releasing bar part, 418B, of the releasing bar, 418, a lug 682, is formed which lies in front of the releasing bar part, 418A (Fig. 34) and in a manner to be later described is capable of co-acting with the latter.

On the right-hand side of the multiplication key lever, 634, a pin, 683, is riveted (Figures 26, 27, 28) which projects into a mouth, 684 (Figure 28) of a lever, 685. The lever, 685, is by means of its U-shaped part, 686, swingably mounted on a shaft 687a rigidly mounted in the supporting frame, 635. To the downwardly directed limb, 685a, of the lever, 685, is jointed a control rod, 687, which on its rearwardly directed end is provided with a slot, 688, formed as shown in Figure 28, which slot embraces a screw, 690, attached to the yoke, 689, 698, 699. The control rod, 687, is provided with a lug 687p (Figure 28) against which a lever 692, which is pivotably mounted by means of the screw, 690, on the lever, 689, rests under the action of a spring, 695, engaging with the pin, 693, and with a pin, 694, of the lever, 689. Further, the lever, 692, is capable of bearing upwards against the control rod, 687, by means of its lug, 696, which is bent off at right angles. The face, 697, of the lever, 692, acts, furthermore, against the lower edge of the bridge, 698, which on the one hand is rigidly connected to the lever, 689, and on the other hand, with the lever, 699, and together with them, is arranged so as to be loosely swingable around the shaft, 583, whereby the edge, 700 (Figure 29) of the right-angled bent-off part, 724, of the lever, 699, is capable of bearing against an intermediate wall (not shown).

To the bridge, 698, (Figures 29 to 33) there is a lug, 701, riveted, against which

in the normal position, the fork-shaped part, 702, of a slide 703, displaceably arranged on the shaft, 583, is capable of lying. The slide, 703, is provided at its rearwardly directed free end with an elongated hole, 704, in which a pin, 706, arranged on the lever, 705, is capable of engaging. By means of a spring, 709, which is connected to the pin, 707, of the slide, 703, and to the pin, 708, the slide, 703, is normally acted upon in such a manner, that the edge, 710, (Figure 30) of its elongated hole, 704, lies against the pin, 706, of the lever, 705. The lever, 705 is loosely swingable on the already mentioned shaft, 388. To the right-angled bent-off upwardly directed arm, 711, of the lever, 705, there is riveted a bar, 712, which is riveted to a lever, 713, loosely swingable on the shaft, 388, and which consequently is swingable with these two levers, 713 and 705, around the shaft, 388. A spring, 715, engages the pin, 714, riveted to the lever 713, the spring at its other end being connected to a pin (not shown) riveted to an intermediate wall of the machine. By means of this spring, 715, the parts, 705, 712, 713 are normally held swung in the anti-clockwise direction around the shaft, 388. The projections, 717, of the already mentioned lyre-shaped levers, 630, rest on the right angled bent-off part, 716, of the bar, 712.

Around the pin, 718 (Figures 29 to 33) riveted to the lever, 699, there is swingably mounted, a pawl, 719. By means of a torsion spring, 720, which on the one hand rests on the lever, 699, and on the other hand rests on the lug, 721, of the pawl, 719, this pawl, 719, is acted upon in the anti-clockwise direction around the pin, 718, whereby it normally lies against the projection, 701, of the bridge, 698.

The part, 722, of the lever, 699, is capable in a manner to be described later of co-acting with a shift cam, 723, rigidly mounted on the shaft, 587.

In one of the working positions of the parts, 689, 698 and 699, a right-angled bent-off lug, 725, of a two-armed lever, 727, swingable on a screw, 726, arranged on the intermediate wall of the machine, lies against the right-angled rearwardly bent-off part, 724, of the lever, 699. The lever, 727, furthermore, is guided by its mouth, 728, which embraces a screw (not shown) which is screwed into the intermediate wall of the machine. By means of a spring, 729 (Figures 29 to 33) which engages the lever, 727, and at its other end is connected to a lever, 728 (Figure 39) to be hereinafter described, the lever, 727, is constantly acted upon in the

clockwise direction round the screw, 726, whereby as already mentioned, its lug, 725, may rest at one time on the part, 724, of the lever, 699, and if the yoke, 689, 698 and 699, is in the working position, may rest with its mouth, 728, against a screw (not shown). Further, the lever, 727, is held swung in the anti-clockwise direction and against the action of the spring, 729, by the guide member, 730, of the totalizer carriage, B, arranged on the front running rail, 730a, which member is capable of acting on the nose, 731, of the lever, 727, when the totalizer carriage, B, is in its normal position, whereby the positions of the lever, 727, are determined.

The right-angled bent-off lug, 732, (Figures 29 to 33) under the action of a spring, 735, which engages with it, and at its other end is connected to the nose, 733, of a slide, 734, is capable of co-acting with the edge, 736, of the slide, 734, in a manner to be later described. The slide 734, is displaceably arranged by means of its fork-shaped part, 737, on the shaft, 588. The rearwardly directed free end of the slide, 734, is jointed to a downwardly directed arm, 738, of a flap, 739, which is pivotably mounted on the shaft, 388. The flap, 739, is capable, in a manner to be later described in detail, of co-acting by means of its bent-off part, 740, formed as shown in Figure 29, with the lyre-shaped levers, 630.

To the slide, 734, there is riveted a pin 741, which is capable of engaging with an elongated hole, 742, of a lever, 743. The lever, 743, is jointed by means of a screw, 744, to a lever, 746, rigidly attached to the shaft, 265, by means of a screw, 745. The projection, 747, located on the upwardly directed end of the lever, 743, is capable of co-acting with a right-angled bent-off lug, 748, of an angle member, 750, riveted to the lever, 749. The levers, 749, is swingably mounted by means of its U-shaped part, 752, (in Figures 29 to 33 for the sake of clearness only partially represented) on a shaft, 751, fixed in a bearing part attached to the rear wall. By means of a spring, 754, which engages with a pin, 753, and at its other end is connected to a pin (not shown) riveted to the rear wall, the lever, 749, and with it the angle member, 750, are constantly swung round the pin, 751, in the clockwise direction, whereby the roller, 755, arranged on the lever, 749, is held in contact with a cam, 756, rigidly mounted on the shaft, 19.

Moreover, by means of the screw, 744, (Figures 29 to 33) there is jointed to the lever, 746, a lever, 757, which is guided by the pin, 703m, rigidly fixed to the

slide, 703, and projecting through its elongated hole, 758. The lever, 757, is likewise capable, in a manner to be described more fully hereinafter, of co-acting in a similar manner to the lever, 743, with the lug, 748, of the angle member, 750, riveted to the lever, 749. The right angled bent-off lug, 759, on the slide, 734, is capable of co-acting in a manner to be later described with a recess, 760, of the pawl, 719.

A pawl, 762, is pivotably mounted by means of a screw, 761, (Figure 28) on an intermediate wall (not shown). By means of a spring, 762a, which on the one hand engages with a pin, 764, of the pawl, 762, and on the other hand is connected to a pin, (not shown) riveted to the intermediate wall, the pawl, 762, is swung round the screw, 761, in the clockwise direction, whereby the normal position of the same is determined by contact of the nose, 763, bent-off on the pawl, 762, with the edge of an opening (not shown) in the intermediate wall of the machine. The nose, 762g, of the pawl, 762, is capable of co-acting with the slide rod, 687, in a manner to be hereinafter described.

A lever, 15, for the interruption of the multiplication is swingably and displaceably mounted by means of a headed rivet, 765, (Figures 26, 27). The rivet, 765, projects through an elongated hole, 766, of the lever, 15. In the normal position of the lever, 15, the same is held in contact with a lug, 768, bent-off at right angles on the multiplication lever, by means of a torsion spring, 767. In the working position of the lever, 15, this lever, under the action of the torsion spring 767, rests on a right-angled bent-off lug, 769, of the multiplication lever, 634, whereby the downwardly directed nose, 770 (Figure 26) moves into the working position (Figure 27) in relation to the locking bar, 322, of the keyboard.

On the left-hand side of the machine, as already mentioned, there is arranged the key lever, 404 (Figures 26 and 27) carrying the division key, 12. This lever is swingably mounted by means of its rearwardly-directed U-shaped part, 771, on the already mentioned shaft 636. By means of a spring, 774, which engages with the pin, 772, of the downwardly directed limb, 773, of the division key lever, 404, and at its other end is connected to a pin (not shown) riveted to the supporting frame, 635, the division lever, 404, is held in its normal position which is determined by the projection, 775, of the division key lever, 404, striking upwards against the supporting frame, 635. At this point it may be mentioned for facilitating the understanding of Figure 130

26, that the division key lever, 404, lies between the multiplication key lever, 634, and the control disc, 644, while in Figure 26, for the sake of clearness, the 5 division key lever has been drawn out at the left.

The pin, 776, (Figures 26 and 27) riveted to the key lever, 404, is capable of co-acting, in a manner to be later described in detail, with a slot, 777, of the control disc, 644, the actual relative positions of the key lever and control disc being shown in Figure 26a. Further, the pin, 776, of the division key lever, 404, 10 acts on the lever, 778, which is swingably mounted on the pin, 643. The lever, 778, is rigidly connected by means of a bridge, 779, with the lever, 780 (Figures 26 and 28) which is likewise loosely swingable 15 round the pin, 643. A connecting rod, 781, is jointed to the lever, 780, the connecting rod again being jointed to a lever, 782, which is swingably mounted on the shaft, 388. A nose, 781b, is 20 arranged on the connecting rod, 718, and to this nose, a spring, 781a, is connected which at its other end is connected to a pin (not shown) arranged on the machine housing. By means of this spring, 781a, 25 the connecting rod 781, is acted upon in the direction of the arrow "a" whereby the lever, 782, jointed to the connecting rod, 781, strikes the rear wall of the machine and the normal position of the 30 parts, 778, 780, 781, 782, 783, is thus determined. The lever, 782, at its upwardly directed end, is bent off at right angles and formed as shown in Figure 28. The right-angled bent-off part, 783, 35 which is formed as a flap, is at its other end, bent-off at right angles in a similar manner, and arranged on the shaft, 388, so as to be loosely swingable thereon. The lug, 784, bent-off on the flap, 783, is capable in a manner to be hereinafter described, of co-acting with a flap, 785 40 (Figure 39).

A yoke, 786, is arranged on the shaft, 382 (Figure 28) so as to be loosely swingable thereon by means of its two arms, 45 787 and 787a. The pin, 787g, riveted to the limb, 787, of the yoke, 786, lies against the lever, 782. By means of the spring 788, which on the one hand engages with the pin, 788a, of the limb, 787, 50 of the yoke, 786, and on the other hand is connected to the rear wall of the machine in any suitable manner, the yoke, 785, is held swung round the shaft, 60 382, in the clockwise direction, and the lever, 782, and the flap, 783, in the anti-clockwise direction round the shaft, 388, whereby the lever, 782, contacts with the rear wall of the machine, and the normal 65 position of the parts, 786, 787, 782, 783,

781, 788, 789, 778, is thereby determined.

A lever, 790, is swingably mounted on a pin, 789, fixed in the totalizer carriage, B (Figure 28). The lever, 790, is rigidly 70 connected by means of a bridge, 791, with a lever, 792, which is likewise swingably mounted on the pin, 789, the lower fork-shaped end of the lever, 792, embracing the change-over flap, 387, while the lever, 790, engages with its upwardly directed 75 fork-shaped end, the right hand lug, 793a, of the capacity shift flap, 793, which is swingably and displaceably mounted on a shaft, 794, fixed in the carriage, B. On the shift flap, 793, there 80 is a lug, 795, bent off at an angle, which in a manner to be later described, co-acts with a nose, 796, of the left-hand tens slide, 139. The bent end, 798, of the shift-flap, 793, lies on a bent lug, 799, of 85 a slide, 800, which is arranged so as to be displaceable vertically on the rear wall of the carriage, B, on the one hand, by means of a screw 801a which projects through an elongated hole, 801, and on 90 the other hand, by means of a bolt, 803, which is fixed on the back (or rear) wall of the carriage, and which is provided with a recess, 802, in which the slide, 800, is guided (Figure 28a). The slide, 95 800, is further provided with an elongated hole, 804, through which the shaft, 794, projects. By means of a spring, 806, which on the one hand is connected to the pin, 789, and on the other hand en- 100 gages with a right-angled bent-off lug, 805, of the slide, 800, the slide, 800, and the shift flap, 793, are held in their rest position, which is determined by the contact of the downwardly bent end, 798, of 105 the shift flap, 793, with the pin, 807, provided on the left hand side wall of the carriage B.

On the division key lever, 404 (Figure 26) a lever, 808, is swingably mounted at 110 the point, 810a, by means of its U-shaped part, 809. The lever, 808, is provided with an elongated hole, 810, into which a pin, 811, arranged on the lever, 14, is capable of projecting, and acts upon the 115 lever, 808, in a manner to be later described in detail.

On the lever, 808, a nose, 812, is formed which is capable of co-acting with a right-angled bent-off lug, 813, of a 120 lever, 814, swingably mounted on the shaft, 636. To a downwardly projecting part, 815, of the lever, 814, there is a pin, 816, riveted to which a spring, 817, is connected which at its other end en- 125 gages with a pin, 820, riveted to the part, 818, of the lever, 819, of the revolutions-register control key whereby the lever, 814, is held in its rest position which is determined by the projection 829, 130

arranged on the lever, 814, striking upwards against the revolutions-register control key lever, 819.

The revolutions-register control key lever, 819, is swingably mounted on the shaft, 636, to the left of the division key lever 404 (Figure 26). The revolutions-register control key lever, 819, is held in its upper normal position by means of the already mentioned spring, 817, which position is determined by the edge, 825, of the key lever, 819, striking upward against the supporting frame, 635. The revolutions-register control key lever 819, is provided with three recesses, 826, 827, 828, which render possible three different positions of the key lever, 819, which will be more fully described hereinafter. The revolutions-register control key lever, 819, is capable of co-acting with a right angled bent-off lug, 829, on the lever, 814, in a manner to be later described in detail.

On the left hand side of the machine there is, further, a lever, 14, which is swingably mounted on a screw, 830 (Figures 26 to 28) screwed into the supporting frame, 635. To the downwardly directed part of the lever, 14, there is a pin, 831, riveted which according to the position of lever, 14, is capable of co-acting at one time with the stop, 832, and at another time with the stop, 833, of a lever, 834, which is pivotally mounted on the pin, 643. The lever, 834, is arranged so as to be swingable on the pin, 643, by means of a U-shaped part, 835. The forwardly directed end of the lever, 834, is provided with a nose, 836, with which a spring, 837, engages which at its other end is connected to a pin, 838, riveted to the supporting frame, 635, and the spring, 837, acts upon the lever, 834, in such a manner that it always embraces the pin, 831, of the lever, 14, with one of its stops 832 or 833.

A two armed lever, 839, is capable of co-acting with the pin, 831, of the lever, 14, by means of its recess, 840 (Figures 26, 28). The two-armed lever 839, is by means of its U-shaped part, 841, constructed as shown in Figure 28, pivotally mounted on a pin, 844, fixed to a lever, 842, which is rigidly mounted upon the shaft, 300, by means of a screw, 843. The two-armed lever, 839, is always held swung round the pin, 844, in its anti-clockwise direction, by means of a spring, 847, which, on the one hand engages the pin, 845, of the lever 839, (Figure 28) and on the other hand is connected to the pin, 846, of the already mentioned lever, 689, whereby the edge, 848, of the lever, 839, bears upwards against a pin, 849, riveted to the lever, 689, and its normal position is thereby determined. Further,

another spring, 850, engages with the pin, 849, of the lever, 689, the spring at its other end being connected to an intermediate wall (not shown) of the machine.

The yoke, 851, (Figure 28) is swingably mounted on the shaft, 583, the arm, 852, of the yoke being capable of co-acting with a cam, 853, rigidly mounted on the shaft, 587. To the arm, 854, of the yoke, 851, there is riveted a pin, 855, which projects into the slot, 380, already mentioned, of the control rod, 376, and is capable of co-acting with this in a manner to be fully described hereinafter. To a pin, 856, (Figure 28), riveted to the arm, 854, of the yoke, 851, there is connected a spring, 857, which at its other end is connected to a pin, 857g, riveted to the control rod, 376, and this spring acts upon the yoke, 851, in such a manner that the pin, 855, is held normally in contact with the edge, 858, of the slot, 380, of the control rod, 376. Another spring, 859, engages the pin, 856, of the arm, 854, the spring, 859, at its other end being connected to the machine housing in any suitable manner. This spring, 859, acts upon the yoke, 851, in the clockwise direction round the shaft, 583, in such a manner that the arm, 860, of the yoke, 851, lies with its face, 861, against an intermediate wall (not shown) arranged in the machine, whereby the normal position of the yoke, 851, is determined.

Into the slot, 381, of the control rod, 376, (Figure 28) there projects a pin, 863, riveted to the lever, 862, and the lever, 862, is jointed by means of a screw, 864, to a lever, 866, formed correspondingly to that in Figure 28, which is rigidly mounted on the shaft 265, by means of the screw, 865. A right-angled bent-off lug, 867, is formed on the downwardly directed end of the lever, 862, and this lug is capable of acting with a part, 868, of a part, 869, which is fixed in the machine frame in any suitable manner.

The already mentioned yoke, 786 (Figure 28) is capable of co-acting with a nose, 870, of a lever, 871 (Figures 28 and 29) which is formed of U-shape and is loosely swingable on the shaft, 583. By means of a screw, 872, which is screwed into the hole, 873 (Figure 39) of the lever, 871, and projects into the elongated hole, 874, (Figure 28) of the lever 876, which is jointed to the lever, 250, by means of the screw, 875, the lever, 876, is displaceably mounted on the lever, 871. The lever, 876, is acted upon in such a manner, by the spring, 877, which is connected at one hand to the screw, 872, and at the other hand to a pin, 878, riveted to the lever, 876, that it lies with

the upper edge of the elongated hole, 874, against the screw, 872, whereby the normal position of the lever, 876, in relation to the lever, 871, is determined.

- 5 The lever, 871, is rigidly connected by means of a bridge 879, (Figure 39) with the angle lever, 880, the limb, 881, of which is capable of co-acting with the already mentioned cam, 723. A pin, 883, is riveted to the downwardly directed U-shaped limb, 882, of the lever, 880, and to this pin, a spring, 884, is connected which, at its other end, is attached to an intermediate wall (not shown) of the machine, which spring holds the parts, 15 882, 880, 879, 871, swung in the anti-clockwise direction on the shaft, 583.

- Further, there is a pin, 885, riveted to the lever, 882, and this pin projects into the fork-shaped end, 886, of the lever, 888, which is loosely swingable on the shaft, 241, by means of its U-shaped part, 887.

- A pin, 890, is riveted to the upwardly directed projection, 889, of the lever, 25 888, and this pin projects into a recess, 891, of a slide, 892. The slide, 892, is swingably and displaceably mounted by means of its fork-shaped upwardly directed end, 893, which embraces the shaft, 265, and by means of the pin, 894, riveted on to it which projects through an elongated hole, 895, of a two-armed lever, 896. The lever 896, is by means of its U-shaped part, 897, swingably 35 mounted on the shaft 265. The mouth, 898, formed on the upwardly directed end of the two-armed lever, 896, embraces a pin, 900, riveted to the part, 899. The part, 899, is riveted to the already mentioned flap, 785. The right-angled bent-off lug, 901, of the lever, 892, is capable of co-acting with the right-angled bent-off lug, 902, of the lever, 904, rigidly 45 mounted on the shaft 265, by means of the screw, 903. The projection, 905, of the lever, 904 (Figure 39) co-acts with the right-angled bent-off lug, 906, of a part 907, constructed as shown in Figures 50 39 and 39a. The two lugs, 908 and 909 formed on the part, 907, embrace the shaft, 265, and the part 907 is acted on in the clockwise direction round the shaft 265, by means of a spring, 910, which on the one hand engages with the pin, 911, riveted to the part, 907 and on the other hand is connected to a pin (not shown) which is fixed to the intermediate wall, 912, whereby the part, 907, by means of 60 the nose, 913, formed on it, bears upward against the machine intermediate wall, 912, and its normal position is thus determined. The face, 914, of the lever, 907, is capable of co-acting with a right-hand bent-off lug, 915, of the U-shaped arm,

882, of the lever, 880. The lugs, 908 and 909, of the part, 907, rest on one side against a disc, 916, arranged loosely rotatable on the shaft, 265, and on the other side against the lever, 904.

The lever, 907 (Figure 39) is provided with a projection, 917, formed as shown in Figure 39, which is embraced by a fork-shaped end, 918, of a lever, 728, which is swingably mounted by means of a screw, 919, on an intermediate wall (not shown) of the machine. The lever, 728, further, is provided with an elongated hole, 920, through which projects a screw (not shown) which serves for the better guiding of the lever, 728. The face, 921, of the lever, 728, is capable of co-acting with the guide part, 730, arranged on the front running rail, 730a, of the totalizer carriage B.

On the shaft, 587 (Figure 34) a disc, 923, is rigidly mounted. Two levers, 925 and 926, which are formed as shown in Figure 34, are swingably mounted by means of a screw, 924, which is screwed into an intermediate member (not shown) of the machine. The levers, 925 and 926, are always brought into contact with the disc, 923, by means of a spring, 927, which on the one hand engages with the pin, 928, of the lever, 926, and on the other hand with a pin, 929, of the lever, 925. To the said intermediate member, there is further rigidly attached a pin, 930, against which the noses, 931, 932, of the levers, 925 and 926, lie in their rest position, that is in the rest position of the shaft, 587, which as already mentioned, can be displaced to the left as well as to the right.

A lever, 933, (Figure 24) is rigidly mounted on the shaft 310, and to the free downwardly directed end of this lever, a rod, 934, is jointed, which, at its U-shaped rearwardly directed end is displaceably mounted in a recess (not shown) of an intermediate wall of the machine. The rod, 934, is further guided on a fork-shaped part, 935, which is rigidly mounted on an intermediate wall of the machine. The part, 936, of the U-shaped rod, 934, is provided with recesses, 937, 938, 939, into which a lever, 940, rigidly mounted by means of a screw, 940a, on the shaft, 265, is capable of engaging by means of its right-angled bent-off lug, 941. The rod, 934, is constantly acted upon in such a manner by means of a spring, 942, which engages with the rod, and on the other hand is connected to the part, 935, that it rests with its recess, 937, above the lug, 941, of the lever, 940.

In the following the operation of the individual mechanisms for the different types of calculation will now be described

in detail.

ADDITION:

For the purpose of performing addition, the item is first of all set up in the keyboard T (Figures 1 and 2) whereby the wheels indicated with, R1 to R5, in Patent Specification No. 365,058 are brought into engagement with the racks of the proportional rack system, which correspond to the denominations of the item.

Now in order to obtain on depression of the addition key, 4, (Figures 1, 2 and 24) in each case only one revolution, it is first of all necessary to swing the lever 17, out of the position illustrated in Figure 24, into the position represented in Figure 1, that is, on to the mark "A." In this operation, the rod, 326, jointed to the lever, 17, by means of the pin, 329, is forwardly displaced, whereby the pin, 324, of the rod, 316, enters into the closed end of the slot, 325a, so that on a downward movement of the rod, 316, the rod, 326, is also taken downwards along with it. If the setting of the lever, 17, has taken place, the addition key, 4, is depressed.

On the depression of the addition key, 4, the pin, 313, riveted to the lug, 291, of the key lever, 286, acts on the edge, 314, of the lever, 316, and swings the same in the clockwise direction against the action of the spring, 318, whereby the pin, 324, in consequence of the setting of the rod, 326, or of the slot, 325a, in relation to the pin 324, through the swinging movement of the lever, 17, in the direction of the arrow indicated in Figure 24, acts on the face, 325b, of the slot, 325a, of the lever, 326, which is accordingly also swung in the clockwise direction round the pin, 329, so that the part, 332 (Figure 24) enters into the path of movement of the part, 124a, of the connecting rod head, 124b, of the connecting rod, 124.

On the swinging movement of the lever, 316, (Figure 24) in the clockwise direction round the pin, 315, the projection, 316a, of the lever, 316, moves in front of the edge, 322a, of the key locking bar, 322, and to the right of the lever, 321. The projection, 319, of the lever, 316, on the depression of the key, 4, acts, on the lug, 320, of the lever, 321, whereby the lever, 321, is swung around the shaft, 310, in the anti-clockwise direction. Hereby the tension spring 398 is tensioned through the intermediary of the parts 397, 391, 399. In this swinging movement, the key locking bar, 322, also participates, without being prevented in this movement by the projection, 316a, of the lever 316. This locking bar besides,

is spaced apart with a small amount of play from the projection, 316a. The lever, 334, attached to the key locking bar, 322, and swingable on the shaft, 310, participates in the swinging movement of the locking bar, 322, in the anti-clockwise direction, whereby the connecting rod, 335, jointed to this bar, swings the lever, 336, and the parts, 340 and 337 connected with it, likewise in the anti-clockwise direction round the shaft, 338.

In the swinging movement of the lever, 336, in the anti-clockwise direction, the face, 355, of the lever, 336, acts on the face, 354, of the lever, 351, which is mounted so as to be loosely swingable on the shaft, 241 and swings the same in the anti-clockwise direction. As the pin, 353, rigidly mounted on the lever, 347, projects into the mouth, 352, of the lever, 351, the lever, 347, also participates in the swinging movement of the lever, 351, against the action of the spring, 350. Consequently, the lever, 23, connected with the lever, 347, by means of the bridge, 348, is also swung round the shaft, 241, in the anti-clockwise direction, against the action of the spring, 350; whereby the contact lever, 22, is moved forward and the arm, 21, of the lever, 22, which normally through the action of the spring, 23a, is brought into contact with the peripheral surface, 24, of the cam, 20, slides off this surface. The contact lever, 22, under the action of the spring, 23a, can now swing in the anti-clockwise direction round the point, 23g, whereby under the action of the contact spring, 361, the motor contact, 362, 364, is closed. The motor, D, now commences to rotate in the direction of the arrow "k" and rotates the shaft, 3, engaging therewith in the direction of the arrow "e" by means of the worm 1, mounted on the motor shaft, and the worm wheel, 2.

At this point, the spring, 342, which engages with the arm, 340, of the lever, 339, (Figure 24) swings the lever, 344, rigidly mounted on the shaft 265, by means of a screw 345, as well as the shaft, 265, itself, in the clockwise direction. In this swinging movement, the coupling lever, 44, which is rigidly mounted on the shaft, 265, likewise participates, whereby the nose, 70, of the differential mechanism actuating coupling, 52 (Figure 7) is released. The coupling pawl, 65, under the action of the spring, 69, is thus brought by means of its nose, 71, into engagement with the tooth, 47, of the coupling cam, 27, fixed on the driving shaft, 3, whereby the cam, 27, the pawl, 65, and consequently the coupling housing, 52, in which the pawl, 65,

is mounted by means of the pin, 66, are taken along with the driving shaft in the direction of arrow "e." The coupling lever, 44, (Fig. 6, 7 and 24) in this movement is prevented from moving backward by the comb, 52x, of the differential mechanism actuating coupling, 52. The toothed wheel, 56 (Figure 7) which is rigidly connected by means of the screw, 55, with the coupling, 52, is consequently rotated in the direction of the arrow "e."

The spur wheel, 78 (Figures 4 and 8) which is disposed vertically above the toothed wheel, 56, and is in engagement with it, is thus rotated in the direction of the arrow "f." As the bevel wheel, 79, formed on the spur wheel, 78, is in engagement with the bevel wheel, 133, so the bevel wheel, 133, is rotated in the direction of the arrow "m." In this rotation, the spur wheel, 134, rigidly mounted on the eccentric shaft, 19, likewise participates. This transmits the rotational movement through the toothed wheel, 188 (Figures 5 and 11) and through the toothed wheel, 190, which is in rigid connection with the toothed wheel, 188, by means of the sleeve, 189, to the toothed wheel, 163, which, as the mechanisms are set for additive calculation is coupled by the draw key, 136, 170, with the draw key bush, 160, so that consequently, the toothed wheel, 169, rigidly connected with this, is rotated in the direction of the arrow "x." As the toothed wheel, 169, again is in engagement with the toothed wheel, 179 (Figures 15 and 16) fixed on the actuating and tens transfer shaft, 178, the actuating and tens transfer shaft, 178, of the revolutions-register, U, is rotated in the direction of the arrow "g" (Figures 10 and 15). With this, the inclined surface, 199, (Figures 15 and 16) of the lug, 196, (Figures 15 and 16) acts on the tooth, 210x, (Figure 15) on the spur wheel 210 (Figure 17) which is located on the extreme right in the totalizer carriage, B, (Figure 2) and rotates this wheel in the direction of the arrow "h" (Figure 15) into the position of the tooth 210x, i.e. through a complete division. Immediately after this rotational movement, the transfer member, 191, enters into the tooth space now lying opposite to it, of the spur wheel, 210, whereby this is secured against further rotation. By this rotational movement of the spur wheel, 210, through one division, the toothed wheel, 212 (Figure 17) which is in fixed relation with this spur wheel, is likewise rotated in the direction of the arrow "h" and as the wheel, 212, is in engagement with the toothed wheel, 214 (Figure 17) fixed to the numeral wheel, 211, of the revolu-

tions-register U, so the toothed wheel, 214, and consequently the numeral wheel, 211, are rotated in the direction of the arrow "i", i.e. rotated in the additive sense through a whole unit. At the end of the rotation of the shaft, 178, the subtraction lug, 192, which at this point stands in the way, is pressed back by the action of the already shifted tooth, 210y, which now takes up the position of the tooth, 210x, on the notch, 192a, of the lug, 192, corresponding to the notch, 197 (Figure 18) against the action of its spring. Rotation of the spur wheel, 210, cannot then take place in consequence of the positive guiding of the already shifted spur wheel 210a, given by the notch 192, and the transfer member, 191.

If now the numeral wheel, 211, located on the extreme right of the revolutions-register U, has arrived at the value "9", so in the passage of the same from "9" to "0" a tens transfer to the next numeral wheel, 211a, on the left must be effected. This is effected in the following manner:—

On the passage from "9" to "0" of the numeral wheel "211" located on the extreme right, a tens transfer tooth, 217, (Figures 17 and 41) attached to a sleeve, 213, (Figures 17 and 41) acts on a toothed wheel, 216a, which is rigidly connected with the next higher numeral wheel, 211a. The numeral wheel, 211a, at this point is nevertheless only rotated through half of one unit and similarly the toothed wheel 214a, which is rigidly connected with the numeral wheel, 211a. As the toothed wheel, 214a, is in engagement with the toothed wheel, 212a, which is rigidly connected with the spur wheel, 210b, associated with the next higher place, so naturally this is also rotated through one half of one unit. In this position set on half division, the spur wheel, 210b, is held by the engagement of a double-toothed pawl, 215a (Figure 42), in the tooth spaces of the toothed wheel, 212a. In this rotation of the toothed wheel, 210b, through one half unit, the tooth, 210c (Figure 15) of the same, enters the rotational path of the inclined surface, 191aA (Figure 16) of the transfer member, 191a, whereby in the rotation of the actuating and tens transfer shaft, 178, the spur wheel, 210b, as well as the numeral wheel, 211a, are further shifted through the half unit which is lacking. In the same manner obviously the tens transfer to each of the next higher numeral wheels is effected.

After describing the drive of the revolutions-register, U, on the depression of the addition key, 4, the drive of the proportionally moved rack system described

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in detail in Patent Specification No. 365,058 will now be shortly explained.

As already mentioned, on the depression of the addition key, 4, the shaft, 116 (Figures 4, 8 and 24) is rotated in the direction of the arrow "f", whereby through the crank disc, 117, fixed on the shaft, 116, and the connecting rod, 124, jointed to the crank disc, the proportional lever, indicated by "40" in Patent Specification No. 365,058 but not illustrated herein, is swung out and moves the proportional rack system.

The movements of these racks are then transmitted by the wheels indicated in the said patent by R1 to R5, to the shafts 159a, (Figure 40), the wheels being brought into engagement with the racks by means of the item keys T, whereby the wheels 159, which are also fixed on these shafts, are rotated forwards and backwards corresponding to the set value. In order, however, to transmit only the forward rotational movement of the toothed wheels, 158, of the numeral wheel shafts, 501, and thereby to the numeral wheels, 499R, of the result totalizer, R, there is a coupling interposed between the wheels, 159, and the wheels, 158, and the manner of operation of this coupling in the following will be briefly explained.

On the left hand side of the machine, the pin wheel, 140, is rigidly mounted on the eccentric shaft, 19, (Figure 8) and this pin wheel is rotated correspondingly to the rotation of the eccentric shaft, 19, likewise in the direction of the arrow "m". The pin wheel, 140, now rotates the Maltese Cross 145, to such an extent by means of the pins, 143, (Figure 9) in the direction of the arrow "x" until the locking member, 144a, of the pin wheel, 140, acts on the locking face, 145a, of the Maltese Cross, 145. The pin wheel, 140, rotates further in the direction of the arrow "m", without, however, acting upon the Maltese Cross, 149, in consequence of the action of the locking member 144a, on the face, 145a, of the Maltese Cross, 145. Now the pins, 143a, of the pin wheel, on the further rotation of the same, come into operation on the Maltese Cross, and rotate the same once more in the direction of the arrow "x" until the locking member 144, co-acts with the face, 145b, of the Maltese Cross, 145. Besides, the pins, 143, of the pin wheel, 140, are still in operation on the Maltese Cross, 145, and rotate the same into the position illustrated in Figure 9. At this point, the pin wheel, 140, has made one revolution, while the Maltese Cross, 145, has moved through one half of one revolution. In the rotation, the toothed wheel, 147, formed on

the Maltese Cross, 145, participates as well as the toothed wheel, 149, which is in engagement with the toothed wheel, 147, and the toothed wheel, 152, which is in engagement with the toothed wheel, 149. Hereupon the frame, 151, rigidly connected to the toothed wheel, 152, and carrying the coupling wheels, 156, (Figures 8 and 9) is rotated in the direction of the arrow "x2" (Figures 9 and 40) whereby the coupling wheels, 155, come into engagement with the driving toothed wheels, 158, (Figure 40), and the toothed wheels, 159, of the differential mechanism. After this driving connection is established, the racks of the proportional rack system transmit through the shafts, 159a, wheels, 159, coupling wheels 156, and wheels 158, the amount set up in the keys to the numeral wheels, 499R of the result totalizer R.

The eccentrics, 137, which are fixed on the eccentric shaft, 19 (Figures 8, 9 and 29 to 33) and are arranged thereon in the form of a spiral, act in a known manner for the tens transfer in the result totalizer R.

As already described on the depression of the addition key, 4, the key locking bar, 322 (Figure 24) is swung in the anti-clockwise direction, whereby it comes into contact with the projection, 439, of the key locking bars, 440 (Figure 25) and it is rendered impossible to depress any of the keys, T. Now, in order, during the calculating process to maintain this locking action independently of holding the addition key, 4, in the depressed position the following arrangement is provided.

In the swinging movement of the shaft, 265, in the clockwise direction, the lever, 940, is also swung in the same direction, whereby the lug, 941, of this lever enters into the recess, 937, of the part, 936, of the rod 934, whereby the change gear 135, 165 for the revolutions-register U is locked. By this means, if the operator unintentionally depresses the revolutions-register control key 13, a wrong amount is prevented from being registered in the revolutions-register.

After the depression of the addition key, 4, the periphery of the crank disc, 117, (Figure 24), acts on the lug, 128, of the lever, 130, and swings the same, and also the lever, 132, which is in rigid connection therewith, in the clockwise direction, round the shaft, 129. Herewith, the lever, 132, moves upwards into contact with the key locking rail, 322, and thus prevents depression of the keys T taking place during the calculating process.

On the rotation of the eccentric shaft, 19 (Figures 8 and 40) in the direction of

the arrow " *m* ", a nose, 251, of a disc, 252, rigidly fixed on the eccentric shaft, 19, releases a lug, 253, of a lever, 255, whereby the lever, 255, under the pull of the spring, 257a, which is secured on the tens preparation return flap, 257, is swung in the anti-clockwise direction round the pin, 254, and remains in contact with the tens preparation return flap, 257. Now, the tens preparation return flap, 257, under the pull of its spring, 257a, can swing round its pin, 257b, in the anti-clockwise direction, whereby, in this manner, it releases the tens preparation slide, 508.

As already described, the lever, 316 (Fig. 24) on the depression of the key, 4, is swung against the action of its spring, 318, in the clockwise direction. As, through this swinging movement, the differential mechanism actuating coupling, 52, is closed through the parts, 319, 321, 322, 334, 335, 336, 339, 340, 342, 344, 265 and 44 (Figure 24), and through the parts 336, 351, 353, 347, 23 and 22, the motor contact, 362, 364, is also closed, so these parts would naturally remain closed so long as the key, 4, is held in the depressed position, which would have the result that the item unintentionally is registered several times in the totalizer. In order to avoid this, precautions are taken so that on retaining the key, 4, in the depressed position, the machine performs only one revolution. To this end, the levers, 316 and 326, as already mentioned, are so positioned that, approximately after one-half of one revolution of the crank disc, 117, as is shown in Figure 24, they are pushed towards the right (considered from the front of the machine) by the connecting rod, 124, to such an extent that under the pull of the spring, 318, engaging with the lever, 316, the levers 316 and 326 can lift laterally of the pin, 313, of the key lever, 286. The projection 316a, of the lever, 316, slides likewise along laterally of the edge, 332a, of the key locking bar, 332.

Now, as soon as the nose, 128, of the lever, 130, (Figure 24), can again fall into the stop, 127, of the crank disc, 117, the key locking bar, 322, can return to its rest position under its own weight and by the action of the spring, 398, on the lug, 397, whereby the parts, 321, 322, 334, 335, 339, 344, 265 and 44, can also return to their rest position. Herewith the coupling lever, 44, comes again into the path of the nose, 70, with the coupling lever, 44, and opens the coupling after one revolution.

If the face, 355, of the arm, 336, of the three-armed lever, 339, has released the face, 354, of the lever 351, then the parts,

353, 347, 23, 22, return to the rest position under the action of the spring, 350, as soon as the arm, 21, of the lever, 22, at an appropriate moment, slides up, on the face, 20h, (Figures 24) at 20g. When this occurs, the face, 20h, swings the lever, 22, in the clockwise direction and against the action of the springs 23a, whereby the contact springs, 361, are pressed together and the contact, 362, 364, is opened, so that the motor D also again comes to rest. If the face 20h, completely swings the lever, 22, then the lever slides up under the action of the spring, 23a, on to the periphery of the cam 20.

On the release of the addition key, 4, the lever, 316, (Figure 24) under the simultaneous laterally acting pull of the spring, 318, slides under the pin, 313, of the lug, 291, of the key slide, 286. The value set up in the keyboard consequently appears in the result totalizer, R, and in the revolutions-register, U, a "1" is visible.

The releasing mechanism for the set keys acts in the following manner.

On depression of the addition key, 4, the bent lug, 333 (Figures 24 and 25) on the lever, 326, acts on a lug, 406, of the lever, 407. The lever, 407, is hereupon swung, whereby the lug, 406, slides along the edge, 437a, of the lever, 437. A release bar, 418, (Figure 25) connected with the lever, 437, strikes, however, on the projections, 439, of the key locking bars, 400, whereby as the springs, 442, engaging with the key locking bars are together stronger than the spring, 413, engaging with the lever, 407 (Figures 25 and 25a), the lever, 407, is displaced against the action of its spring 413, into the position indicated in dotted lines in Figure 25. On this downward sliding movement, the lug, 406, swings the locking lever, 420, in the clockwise direction against the action of the spring, 422. When the lug, 406, lies beneath the locking lever, 420, then the lever, 420, is swung by the spring, 422, in the anti-clockwise direction and rests over the lug 406, whereby the lever, 407, is held in its position indicated in Figure 25, in dotted lines, even if the lug, 333, of the lever, 326, releases the lug, 406. By the movement of the lever, 407, to the front, the lever, 409, jointed to it has been swung into the position indicated by dotted lines, so that its nose, 410, is located in the path of the nose, 411, of the cam disc, 412, which rotates in the direction of the arrow " *m* ".

Towards the end of the revolution of the cam disc, 412, (Figure 25) the lever, 409, jointed to the lever, 407, is acted

upon in the anti-clockwise direction, by the nose, 411, of the cam disc, 412, whereby the rod, 407, is taken along to the rear. As the locking lever, 420, in consequence of its contact with the pin 424, does not permit the nose, 406, of the lever, 407, to escape upwards, so the arm, 417, is swung by the nose, 406, in the clockwise direction and consequently also the key releasing bar, 418 (Figure 25) which on its part acts on the projection, 439, of the key locking bar, 440, and displaces this against the action of its spring 442, whereby the set keys, after one revolution of the differential mechanism actuating coupling 52, as soon as the projections, 439, are released by the locking bar, 322, are also likewise released. As soon then as the nose, 406, has moved past the locking lever, 420, the lever, 407, is returned by its spring, 413, into the normal position represented in full lines in Figure 25.

If the item is to be transmitted several times to the totalizer, then it is necessary to swing the lever, 17, (Figure 24) into the position represented in Figure 24, whereby the lever, 326, jointed to the lever, 17, likewise takes up the position represented in this figure in relation to the pin, 324, of the lever, 316. When the pin, 313, of the key slide, 286, acts on the lever, 316, on depression of the addition key 4, then the lever, 316, is swung in the clockwise direction around the pin, 315, against the action of the spring, 318. Hereupon, the pin, 324, of the lever, 316, is capable of sliding in-operatively in the slot, 325, of the lever, 326. The lug, 327, of the lever, 326, hereupon rests on the pin, 287, so that it is held in its rest position illustrated in Figure 24, and the face, 332, does not extend into the path of movement of the part, 124, of the head, 124b, of the connecting rod, 124. Consequently, so long as the addition key is held depressed, the item is transmitted at each revolution into the totalizer. Release of the keys T, likewise cannot take place as the lug, 333, of the lever, 326, could not come into operation on the lug, 406, of the rod, 407 (Fig. 25).

After therefore describing the movements which occur on depression of the addition key 4, in the following shall now be described the locking movements which take place herein of other parts.

It may be first mentioned, that on depression of the addition key 4, a depression of the subtraction key, 5, (Figure 24) is not possible, as the pin, 429, of the subtraction key slide, 424, abuts on the face, 296, of the change-over lever, 294, which is held swung in the anti-clockwise direction through the

addition key, 4.

As already mentioned, on the depression of the addition key, 4, the lever, 321, as well as the locking bar, 322, were swung in the anti-clockwise direction round the shaft, 310, by the action of the projection, 319, of the lever, 316, (Figure 24). As the lug, 397 (Figures 24 and 26) of the lever 323, rigidly mounted on the locking bar, 322, simultaneously participates in this swinging movement, so the lug, 397, of the lever, 323, acts on the control lever, 391, and swings the same in the anti-clockwise direction round the shaft, 310, against the spring, 398, connected to it, whereby the face, 391a, of the control lever, 391, comes to rest underneath the pin, 405, of the division key lever, 404 (Fig. 26) and the face, 391b, of the control lever, 391, underneath the pin, 639, of the multiplication key lever, 634. If now the multiplication key, 11, or the division key, 12, are subjected to pressure unintentionally, it is not possible to depress them as the pin, 405, of the division key lever, 404, acts on the face, 391a, of the control lever, 391, and the pin, 639, of the multiplication key lever, 634, on the face, 391b, of the control lever, 391. The control lever, 391, as it rests against the lug, 397, of the lever, 323, of the key locking bar, 322, and the latter rests on the lever, 132, which through the action of the crank disc, 117, on the lug, 128, of the lever, 130, is held swung in the clockwise direction, as was already explained at an earlier place herein, cannot yield to the action of the pin, 402, or 639, of the division key lever, 404, or of the multiplication key lever, 634, and swing around the shaft, 310, in the clockwise direction, so that in this manner the multiplication key, 11, and the division key, 12, are locked.

A depression of the revolutions-register control key, 13, is not possible, as on pressure being applied to the same, the key lever, 825, acts on the lug, 829 (Figure 26) bent on the lever, 814. This cannot, however, be swung downwards round the shaft, 636, as the pin, 821, riveted to the lever, 814, acts on the face, 824a, of the lever, 824, rigidly mounted on the shaft, 310, and the shaft, 310, cannot be rotated, as the lever, 940, arranged on the shaft, 265, (Fig. 24) on swinging of the shaft, 265, in the clockwise direction in consequence of the depression of the addition key, 4, has moved so that its lug, 941, has entered into the recess, 937, of the part, 936, of the rod, 934, which is in articulated connection with the lever, 933, rigidly mounted on the shaft, 310.

A swinging movement of the change-over lever, 14, (Fig. 26) for changing over from positive to negative multiplication or division as well as vice versa is possible, as the lever, 14, operates no mechanism during the addition process, which could influence the addition process, and this is clearly brought out in the multiplication process to be later described. On the same grounds a swinging movement of the multiplication interruption lever, 15, is possible.

As already described, on the depression of the addition key, 4, the coupling lever, 44 (Figure 24) is swung in the clockwise direction, whereby the lug, 455, of the coupling lever, lies in front of the noses, 456 and 520, of the levers, 358 and 359. If it is then attempted to depress one of the keys 7 and 8, (Figure 1) for zeroizing the result totalizer and for zeroizing the revolutions-register, depression of the same would not be possible as the lug, 455, of the coupling lever, 44, in consequence of the contact of the lever edge with the comb, 52x (Figures 6 and 24) of the differential mechanism actuating coupling 52, does not permit a swinging movement of the levers, 358 and 359, in the clockwise direction.

If it is attempted to depress the "3x Mult." key, 9, (Figures 21 and 22) depression would not be possible, as on depression of the same, the lug, 568b, of the part, 568, pivotably mounted by means of the screw, 567, on the key lever, 563, acts on the pin, 570, arranged on the result totalizer zeroizing key lever, 443. The zeroizing key lever, 443, however, cannot be swung round the shaft, 444, in the clockwise direction, as the lug, 455 (Figure 24) of the coupling lever, 44, as hereinbefore described in detail, rests in front of the nose, 456, of the lever, 358, and in this manner a swinging movement of the lever, 358, and the parts connected to it, is prevented.

A swinging movement of the lever, 16, during the addition process is possible, as this does not influence any of the mechanisms which are operative during the addition process, and the part 443, co-acting with it, is locked in the manner above described.

On an attempt to move the lever, 17, rearwards during the addition process when the lever is in its position illustrated in Figure 1 is not possible, as on depression of the addition key, 4, in consequence of the action of the pin, 313, on the edge, 314, of the lever, 316, and the swinging of the lever, 326, round the pin, 329, in the clockwise direction, and in consequence of the action of the pin, 324,

of the lever, 316, on the edge, 325b, of the slot, 325a, of the lever, 326, the lug, 327 (Figure 24) of the lever, 326, lies in front of the pin, 287, rigidly mounted on the machine housing, so that a displacement of the rod, 326, rearwardly and consequently the shifting of the lever, 17, into the position illustrated in Figure 24, is prevented.

If the lever, 17, is in the position illustrated in Figure 24, then a swinging movement of the same into the position illustrated in Figure 1, during the addition process is not possible, as the pin, 324, of the lever, 316, swingable round the pin, 315, then lies against the edge, 325c, of the slot, 325, in which manner a swinging movement of the lever, 17, is prevented.

In the swinging of the shaft, 265, in the clockwise direction the lever, 940, is also swung in the same direction, whereby this lever with its lug, 941, enters the recess, 937, of the part, 936, of the rod, 934, and the change gear for the revolutions-register, U, is locked.

SUBTRACTION:

The processes in subtraction are substantially the same as in addition. They are differentiated from addition only in this, that on depression of the subtraction key, 5, Figure 24, the pin, 429, acts on the face, 296, of the change-over lever, 294, and swings this round the pin, 295, in the clockwise direction. The fork-shaped part of the change-over lever, 294, which embraces the pin, 298, of the lever, 297, which is rigidly mounted on the shaft, 300, acts on the lever, 297, in an anti-clockwise direction and simultaneously swings the shaft, 300, and the control lever, 301, in the same rotational direction and into the position illustrated in Figure 47. The control lever, 301, now acts with its stop, 301a, on the bent lug, 305, on the control rod, 304, whereby the lug, 306, of the control rod, 304, and the face, 303a, of the recess, 303, move in relation to one another and come into contact with one another. Further, the face, 304a, of the recess, 311, of the control rod, 304, moves on the shaft stump, 312, of the lever, 308, and takes up the position illustrated in Figure 47, in relation to the stump, 312. The pin, 309, riveted to the lever, 308, on the displacement of the rod, 304, lies at the right end of the slot, 307, of the control lever, 304, as is evident from Figure 47.

The control rod, 304, is displaced in the opposite direction to the arrow "a", and the angle lever, 177, (Figure 10) is rotated in the clockwise direction into the position illustrated in Figure 10, and thereby through the ring groove, 136a, 130

now couples the draw key, 136, 170, with the toothed wheel, 135, by means of the draw key bush, 160, while the tooth wheel, 163 rotates inoperatively on the draw key bush, 160, of the toothed wheel, 169. The spur wheel, 134, mounted on the eccentric shaft, 19, now transmits the rotational movement directly through the toothed wheels, 135, and 169 to the toothed wheel, 179 and the actuating and tens transfer shaft, 178, while the toothed wheels, 188, 190 and 163 run idly. By this, the actuating and tens transfer shaft, 178, (Figure 15) is rotated in the opposite direction to the arrow "g", i.e., in the opposite direction to which it rotates in addition, whereby the revolutions-register, U, operates in the subtractive sense.

On this rotation of the actuating and tens transfer shaft, 178, the inclined face, 191S, of the shift lug, 192, (Figures 16) now acts on the tooth, 210y, of the spur wheel, 210a, positioned at the extreme right in the totalizer carriage B and rotates this in the opposite direction of the arrow "h" through a whole division. The toothed wheel, 212, (Figure 17) which is in fixed relation with the toothed wheel, 210a, is thereby likewise rotated in the opposite direction of the arrow "h", and as this toothed wheel is in engagement with the toothed wheel, 214, attached to the numeral wheel, 211, of the revolution-register U, so the toothed wheel, 214, and consequently the numeral wheel, 211, are rotated in the opposite direction of the arrow "i", i.e. in the subtractive sense through a whole unit.

The addition lug, 193, which here stands in the way at the end of the complete revolution of the actuating and tens transfer shaft, 178, is pressed back against the action of its spring, 200, by the action of the tooth, 210x, which then takes up the position of the tooth, 210y, on the notch, 197, of the lug, 193.

A rotation of the spur wheel, 210, therewith cannot take place, in consequence of the positive guiding of the spur wheel, 210, by the notch, 197, and the transfer member 191.

Since the tens transfer in the revolutions-register, U, has already been exhaustively described under the heading "Addition", a repeated description of the same at this point may be dispensed with. It may be here mentioned that in subtraction the inclined faces indicated with the indices, S, of the transfer members, 191a to 191g, act so that, generally, all rotational movements take place in the reverse direction to those in addition.

As the mechanisms of the machine are normally set for additive calculations by

the spring, 859, (Figure 28), which is secured on the arm, 854, of the bail, 851, the purpose of which will be described later, and after a subtractive calculation are always set for additive calculation then as has already been above described the lever, 297, (Figure 24) connected to the change-over lever, 294, was swung in the anti-clockwise direction on depression of the subtraction key, and the shaft, 300, and the lever, 366, rigidly fixed to it also participate in this swinging movement. Here, the lever, 369, is displaced in the direction of the arrow "a", whereby the pin, 375, is withdrawn from the hole of the rack, 367a, and the pin, 372, enters the hole, 367g, of the rack, 367b, so that the proportional rack system described in Patent Specification No. 365,058 is set for subtractive operation. Consequently, the subtraction process is then effected in the result totalizer "R" by addition of the complement of the subtrahend.

On depression of the subtraction key, 5, there are still further different mechanisms operated which are in connection with the lever, 366, (Figure 24), which mechanisms as they have no influence on the subtractive process at this point shall not be discussed.

Obviously, on depression of the subtraction key in subtraction, and in exactly the same manner as in addition, only one or any desired number of reciprocal movements of the proportional rack system can be effected according to the duration of the depression of the key, and according as the lever 17 is set at "A" or "M", such movement or movements are performed without the necessity of manually holding the key depressed.

On the depression of the subtraction key, 5, the individual locking operations act as follows: As already described, in this operation the change-over lever, 294, as well, is swung in the clockwise direction round the shaft, 295, whereby the pin, 292, of the addition slide, 286, bears on the face, 293, of the change-over lever, 294, so that depression of the addition key, 4, is impossible.

A depression of the multiplication key, 11, or the division key, 12, or the zeroizing keys, 7 and 8, for the result totalizer, R, and the revolutions-register, U, or the "3x Mult." key, or the revolutions-register control key, 13, as well as a swinging movement of the lever, 17, is not possible for the reason already described in detail in addition, whilst for the reasons similarly described in addition, a swinging movement of the lever, 14, for changing-over from positive to

negative multiplication and division and vice-versa as well as a swinging movement of the levers, 15 and 16, is possible since these do not influence the subtraction mechanism.

Before proceeding to describe multiplication and division, the zeroizing mechanism for the result totalizer R, and for the revolutions-register, U, will be shortly explained.

ZEROIZING MECHANISM FOR THE RESULT TOTALIZER R.

The key lever, 443 (Figure 19) on the depression of the zeroizing key, (L¹¹), for the result totalizer, R, is swung round the shaft, 444, in the clockwise direction, against the action of the spring, 448, engaging with the lever, 446, which, by means of the bridge, 445, is in connection with the key lever, 443. The connecting rod 451, jointed to its downwardly projecting limb, 450, then moves in the opposite direction of the arrow "a". This swings the lever, 358, jointed to it, round the point, 452, in the clockwise direction, whereby the part, 454, of the arm, 453, acts upwards against the arm, 100b, of the coupling lever, 100, and consequently swings it round the screw, 99, in the clockwise direction. Hereby the nose, 97, of the arm, 98, of the coupling lever, 100, releases the nose, 96, of the pawl, 89 (Figure 7) of the zeroizing coupling, 83. The coupling pawl, 89, (Figure 7) under the action of its spring, 95, is thereby positioned so that its nose, 101, engages with a tooth, 102, of the coupling cam, 84, fixed to the driving shaft, 3, whereby the cam, 84, the pawl, 89, and consequently also the coupling housing, 83, in which the pawl 89, is mounted by means of the pin, 90, are all rotated in the direction of the arrow "c." In the swinging movement of the lever, 358, in the clockwise direction round the point, 452, (Figure 19), the arm, 459, of the lever, 358, acts on the lever, 460, and swings the same round the pin, 462, in the clockwise direction, in which swinging movement, the lever 463, which is rigidly connected by means of a bridge, 461, with the lever, 460, also participates. Consequently, the spring, 469, which engages with the nose, 467, of the lever, 463, and is connected to the nose, 468, of the lever, 466, causes the lever 466, to be likewise swung round the pin, 462, in the clockwise direction, whereby the lever, 466, acts upwards on the edge, 470, of the lever, 473 and swings the same in the anti-clockwise direction round the screw, 471, against the action of the spring, 475.

Hereupon, the U-shaped end, 477, of

the lever, 483, engages in the groove, 485 (Figure 42) which lies directly opposite to it, of the zeroizing bar, 486, 487. In the swinging movement of the lever, 358, (Figure 19) the face, 357, acts upon the roller, 356, attached to the lever, 347, and closes by means of the parts, 348, 23, 22, already described in detail, the motor contact, 362, 364, whereby the motor, D, now commences to rotate, in the direction of the arrow K.

As now the motor contact, 362, 364, and the zeroizing coupling, 83, (Figures 19 and 7) were closed by the release of the nose, 96, of the pawl, 89, through the coupling lever, 100, the coupling, 83, rotates in the direction of the arrow "c," whereby the pin, 108, fixed to the coupling disc, 85, (Figure 7) moves the lever, 473 (Figure 19) backwards and forwards through the parts, 109, 482, 481, 472, whereby the lug, 480, slides on the face, 479a, of the part, 479, while the U-shaped part, 540, of the lever, 538, which is jointed to the lever, 472, by means of a screw, 537, slides on the face, 542a, of the part, 542, without exercising any action on any of the parts.

As already described, the lever, 473, (Figure 19) is moved to and fro and positively held in engagement with the adjacent groove, 485, of the zeroizing bar, 486, 487, (Figure 42), in consequence of which, this bar is also moved to and fro and at the beginning in the direction of the arrow "c." Consequently, the zero position wheels 498, are rotated in the anti-clockwise direction on the shafts, 497. These rotate now, in known manner, the toothed wheels, 500, which are not in the zero position, in the clockwise direction and consequently the numeral wheels, 499, (Figure 41) associated with them, to zero.

Holding the result totalizer zeroizing key, 7, depressed for a longer period, does no harm, as here merely the zero position wheels, 498, are moved idly to and fro by means of the rack, 487, since in consequence of the tooth spaces, 504 (Figure 2) which now lie opposite to them, the toothed wheels, 498, are no longer capable of exercising any action on the toothed wheels, 500.

On swinging the lever, 358, (Figure 19) round the point, 452, in the clockwise direction, the nose, 358a, of the lever, 358, acts on the angle lever, 112, lying normally before the nose 358a of the lever 358 and before the nose 359h of the lever, 359, and swings the lever 112 round its pivot, 111, against the action of the spring, 115, in the clockwise direction. If the nose, 358a, has now released the lever, 112, again then the lever moves

under the action of its spring, 115, behind the nose, 358a, of the lever, 358, and consequently holds this in its out-swung position.

5 Approximately, after one-half revolution of the zeroizing coupling, 83, the part, 110, (Figure 7) of the zeroizing coupling, 83, acts on the arm, 112a, of the lever, 112, and swings this
10 in the clockwise direction against the action of the spring, 115. Hereby, the lever, 112, releases the nose, 358a, of the lever, 358, whereby under the action of the spring, 448, engaging with the arm,
15 446, of the key lever, 443, the lever, 358, as well as the remaining mechanisms return into the rest position. This arrangement has for its purpose on too short striking of the result totalizer zeroizing
20 key, 7, to hold the lever, 473, swung out until the lug, 480, of the lever, 473, has run up on the bar, 479.

The locking operations which come into operation on depression of the key, 7 for zeroizing the result totalizer R, are as follows:—

As already described, the lever, 358, (Figure 19) has been swung in the clockwise direction. Hereby the lug, 455, (Figure 24) of the coupling lever, 44, for the differential mechanism actuating coupling, 52, has entered the stop, 458, (Figure 19) of the lever, 358, whereby on the depression of any one of the operating
35 keys, the coupling lever, 44, cannot swing, and in this way neither the differential mechanism actuating coupling, 52, nor the carriage shift coupling, 26, can close. The revolutions-register control
40 key, 13, obviously can be freely depressed, since it is not associated with the zeroizing mechanism. Further, the multiplication key, 11, and division key, 12, can be depressed and the lever, 14, for changing over from negative to positive multiplication and division and vice-versa, the
45 lever, 17, as well as the lever, 15, can be freely swung, as the coupling lever, 44, as described, is locked. On the depression of the subtraction key, 5, or the division
50 key, 12, when the latter is set for additive calculation, only the driving gear for the revolutions-register will be changed over which, however, is without importance, as from the grounds above mentioned the differential mechanism actuating coupling, 52, cannot be closed.

ZEROIZING MECHANISM FOR THE REVOLUTIONS-REGISTER, U.

60 On the depression of the key, 8, (L') for zeroizing the revolutions-register U, the lever 508 (Figure 19) is swung round the shaft, 444, in the clockwise direction against the spring, 511, engaging with the bridge, 509. Hereby the connecting

rod, 516, jointed to its downwardly projecting limb, 515, moves in the opposite direction to the arrow "a." This swings the lever, 359, jointed to it, round the point, 517, in the clockwise direction,
70 whereby the part, 579, of the arm, 518, of the lever, 359, acts upwards against the arm, 100b, of the coupling lever, 100 and consequently this is swung round the screw, 99, in the clockwise direction,
75 against the action of the spring, 100a. Hereby the nose, 97, of the arm, 98, of the coupling lever, 100, releases the nose, 96, of the pawl, 89, of the zeroizing coupling, 83, and the zeroizing coupling, 83, is thereby closed in the manner already described.

The arm, 523, of the lever, 359 (Figure 19), acts on the swinging movement of the lever, 359, in the clockwise direction,
85 downwardly on the arm, 524, of the lever, 525, and swings this round the screw, 526, in the clockwise direction. The spring, 528, engaging with the arm, 530, of the lever, 525, and connected to the nose, 531, of the lever, 527, swings the lever, 527, likewise round the screw, 526, in the clockwise direction. Herewith the right-angled bent end, 536, of the arm, 535, of the lever, 527, acts upwards
95 against the lever, 538, swingably mounted on the lever, 472, by means of a screw, 537, and swings this in the anti-clockwise direction against the action of the spring, 539. Hereby the U-shaped part, 540, of
100 the lever, 538, engages with the groove, 544, lying directly opposite to it of the zeroizing bar, 545, Fig. 42.

In the swinging movement of the lever, 359, (Fig. 19) in the clockwise direction,
105 the face, 359g, acts on the roller, 356, mounted on the lever, 347, whereby by means of the previously described parts, 347, 348, 23, 22, the motor contact, 362, 364, is closed and the motor "D" commences to rotate in the direction of the
110 arrow "K."

Since the motor contact, 362, 364, and the zeroizing coupling, 83, (Figs. 19 and 7) are closed the coupling, 83, thus
115 rotates in the direction of the arrow "e," whereby the pin, 108, fixed to the coupling disc, 83, (Fig. 7) moves the lever, 538, (Fig. 19) to and fro through the parts, 109, 482, 481, 472, whereby the
120 lug, 543, slides on the face, 542a, of the part, 542, while the U-shaped part, 477, of the lever, 473, jointed to the lever, 472, by means of the screw, 471, slides on the face, 479a, of the part, 479, without exercising any influence on any of the parts.

As already mentioned, the lever, 538, (Fig. 19) is moved to and fro and positively held in engagement with the appro-
130

priate groove, 544, of the zeroizing bar, 545 (Fig. 42). In consequence of this the zeroizing bar is also moved to and fro and at the commencement always in the direction of the arrow "c." Hereby the zero position wheels 553 (Fig. 42) are rotated from the position illustrated in Fig. 44 into that illustrated in Fig. 43, and in this movement take along with them all of the toothed wheels, 556, which do not stand at zero so far in the opposite direction to that of the arrow "r" until the tooth spaces, 557, of the same lie opposite to the wheels, 553, which is always the case when the zeroizing bar 545 has taken up the position shown in Fig. 44. Since the wheels, 556, (Fig. 41) are rigidly connected by means of sleeves, 561, with the wheels, 212, and these are in engagement with the wheels, 214, so these are rotated in the direction of the arrow "i" and rotate to zero the numeral wheels, 211, rigidly connected with them of the revolutions-register "U." An overrunning movement of the numeral wheels, 211, past zero is prevented by striking of the cams, 558, (Fig. 43) against the hubs, 560, of the wheels, 553.

Holding of the revolutions-register zeroizing key, 8, longer in the depressed position does not hurt, as in this case the zero position wheels, 553, are merely moved idly to and fro by means of the rack, 545, as in consequence of the toothed spaces, 557, now lying opposite to them they can no longer exert any action on the toothed wheels, 556.

In the swinging movement of the lever, 359, (Fig. 10) in the clockwise direction, the angle lever, 112, is capable of moving behind the nose, 359h, of the lever, 359, and of holding this in its swung out position. After roughly one half revolution of the zeroizing coupling, 83, the part, 110, of the coupling, 83, acts on the arm, 112a, of the lever, 112, and swings this against the action of its spring, 115, whereby it releases the nose, 359h, of the lever, 359, so that the lever, 359, returns to its rest position under the action of the spring, 511, which engages with the bridge, 509, of the lever, 508.

This arrangement pursues the same end as described for the zeroizing key, 7, for the result totalizer R.

The locking operations which occur on the depression of the zeroizing key, 8, for the revolutions register, U, are the same as these described under the heading "Zeroizing Mechanism for the Result Totalizer R" and on this account will not be referred to in detail.

KEY-RELEASING MECHANISM FOR THE KEYBOARD.

If the key, 6, (L^{III}) for releasing de-

pressed amount keys is depressed, the key stem, 431, acts on the lug, 436, of the lever, 437, whereby the lever, 437, is swung in the clockwise direction round the shaft, 310. In this swinging movement the releasing bar, 418B, (Figure 34) fixed to the arm, 437a, of the lever, 437, participates as well as the releasing bar, 418A, as the releasing bar, 418B, can act on the releasing bar, 418A, by means of its lug, 682. The edges, 438, (Figure 19) of these releasing bars, 418A and 418B, act on the projection, 439, of the key locking bar, 440. The key locking bars are hereby moved against the action of their springs, 442, and the depressed keys are released.

AUTOMATIC MULTIPLICATION.

It may be first mentioned, that in the present machine sixteen denominational places are provided and for each denominational place a row of keys from "0" to "9" so that there are therefore 16 rows of keys in the keyboard of which the eight key rows "Mk" (Figure 1) at the left hand are for setting up the multiplier, and the eight right hand keyboard rows "Mu" are for setting up the multiplicand. The row of keys at the extreme right of the eight key rows "Mk" for the multiplier is by way of example provided with red keys which are represented in Figure 2, conventionally by inclined lines in order to facilitate the setting up of multiplier and multiplicand. As an example of calculation left 25×25 be chosen. The multiplier "25" is now set up in the two right hand rows of keys of the eight left hand places of the multiplier set of keys "Mk" and the multiplicand "25" in the two right hand rows of keys of the multiplicand set of keys "Mu." Further, at this point, care is to be taken that the lever, 14, if the machine is to undertake positive multiplication, is changed over to the rear, i.e. in the direction of the arrow *a* (Figure 1).

Now the multiplication key, 11, (Fig. 26) is depressed, whereby the multiplication key lever, 634, is swung in the anticlockwise direction round the shaft, 636, against the action of the spring, 398. Hereby, the pin, 683, riveted to the multiplication key lever, 634, acts on the two-armed lever, 685, (Fig. 28) and swings the same in the clockwise direction round the shaft, 687a, whereby the rod, 687, linked to its downwardly directed arm, 685a, is displaced in the opposite direction to the arrow "a." Hereupon the screwed-in-screw, 690, on the lever, 689, acts on the edge, 688p, of the slot, 688, of the rod 687, whereby this is swung somewhat upwards round its point of articulation, 687g. In conse-

quence of this, the edge, 687b, of the rod, 687, acts upwards on the edge, 762g, of the pawl, 762, and swings the same round the screw, 761, in the anti-clockwise direction against the action of its spring, 762a, until the rod, 687, is displaced forward to such an extent in the opposite direction to that of arrow "a" that the pawl, 762, under the action of the spring, 762a, snaps behind the edge, 687c, of the rod, 687, whereby the multiplication key, 11, is held in its depressed position. The multiplication key lever, 634, further in its swinging movement in the anti-clockwise direction, against the action of the spring, 398, around the shaft, 636, (Fig. 26) acts by means of the pin, 641, riveted to it, on the edge, 642a, of the slot, 642, of the control lever, 644, and consequently swings the same in the anti-clockwise direction round the shaft, 643, whereby the lever, 646, which by means of the bridge, 645, is rigidly connected to the control lever, 644, is swung in the same direction. As here, the part, 647, of the lever, 646, acts on the lever, 649, so the same is swung together with the shaft, 651, in fixed relationship therewith in the clockwise direction, in which swinging movement, the lever, 663, (Fig. 34) rigidly mounted on the shaft, 651, also participates. As the forked end of this lever embraces the lever, 666, then in the swinging movement of the lever, 663, in the clockwise direction, the lever, 666, likewise is swung round its screw, 667, in the clockwise direction, whereby the left part, 418A, of the key-releasing bar, 418B, 418A, is displaced towards the right (seen in Fig. 34), so that the edge, 418Aa, of the part, 418A, of the releasing bar lies against the edge, 418a, of the part, 418B, of the releasing bar, so that in this manner the releasing bar, 418A, remains now as before in contact with the projections, 439, of the eight left key locking bars, 440, Fig. 25. The displacement of the part, 418A, of the releasing bar is in this case significant.

In the swinging movement of the shaft, 651, in the clockwise direction the lever, 653, (Figs. 26 and 34) which is rigidly mounted on the shaft, 651, is swung in the clockwise direction, in which swinging movement the part, 655, mounted on the lever, 653, by means of the screw, 654, also participates. In consequence of the swinging movement of the part, 655, in the clockwise direction and in consequence of the engagement of the part, 655, with the part, 655a, in the recess, 657, (Fig. 26) of the sleeve, 658, rigidly mounted on the control shaft, 587, (Fig. 34), the shaft, 587, and all of the parts which are rigidly mounted on it, are dis-

placed to the right (seen in Fig. 34) whereby the pin, 621, (Fig. 34) of the part, 622, which is rigidly mounted on the control shaft, 587, enters the hole, 620, of the toothed wheel, 618, loosely mounted on the control shaft, 587, and thus couples the toothed wheel, 618, with the control shaft, 587.

In the displacement of the control shaft, 587, to the right (Fig. 34) the cam, 853, remains in the working position with the lever, 852, (Fig. 28), the cam, 723, rigidly mounted on the control shaft, 587, moves out of the operative position in relation to the lever, 881, and into the operative position in relation to the lever, 722, the end, 662a, of the part 622, arranged on the rear wall, 80, of the machine is disengaged from the recess, 661, of the disc, 660, of the sleeve, 658, which is rigidly attached to the control shaft, 587, (as is shown in Fig. 36) the disc, 588, rigidly mounted on the control lever, 587, moves into the working position with the lever, 585, and likewise the part, 678, of the cam, 680, with the lever, 677. The parts just described which, on the displacement of the control shaft, 587, come into and out of engagement, have only briefly been mentioned as at a later place the individual parts will be more accurately described in detail.

On the displacement of the control shaft, 587, to the right, the disc, 923, rigidly attached to the control shaft, 587, (Fig. 34), acts on the lever, 925, and swings the same round the screw, 924, in the clockwise direction against the action of the spring, 927, whereby the spring, 427, is tensioned as the lever, 926, cannot follow the pull of the spring, 927, in consequence of the engagement of the nose, 931, of the lever, 926, with a pin 930, rigidly mounted on an intermediate member of the machine.

As immediately after the depression of the multiplication key, 11, the control shaft, 587, also is rotated after closure of the contact, 362, 364, (Fig. 24) and coupling of the differential mechanism actuating coupling, 52, with the main driving shaft, 3, so the control shaft, 587, can no longer return into its rest position to the left (seen in Fig. 1) under the action of the tensioned spring, 927, which engages with the lever, 925, as it is held by the lever, 655, in this position in consequence of the multiplication key, 11, being held depressed until the part, 655a, of the part, 655, withdraws from the recess, 657, of the sleeve, 658, after approximately one quarter of a revolution of the control shaft, 587, whereby processes take place which will be later described in greater detail. If, however, the multi-

plication key, 11, is not depressed completely, by mistake, so that the same is not locked in its depressed position by the pawl, 762, (Figure 28), whereby the differential mechanism actuating coupling, 52, however, would be coupled with the main driving shaft, 3, and the motor contact, 362, 364 would be closed so that it is not possible that the control shaft, 587, returns into its normal position, as the control shaft, 587, has already rotated to a certain extent and in this case the disc, 660, of the sleeve, 658, lies with its edge, 660a, (Fig. 37) against the part, 662, and thus prevents the U-shaped part, 662a, of the part, 662, from entering into the recess, 661, of the disc, 660, of the sleeve, 658. This is very important, since, when the multiplication-key, 11, is not completely depressed, the differential mechanism actuating coupling, 52, Fig. 7, is again opened after one revolution and only the transmission of the value has taken place to the result totalizer R. In order to effect the transmission to the multiplier setting mechanism, 627, Fig. 21, it is only necessary to depress entirely the multiplication-key, 11, once more, whereupon the initiated process takes place normally as follows. In the following description it may be assumed that the multiplication key, 11, is correctly depressed.

Furthermore, on the depression of the multiplication key, 11, (Figs. 26 and 27) the pin, 639, rigidly mounted on the key lever, 634, acts on the edge, 640a, of the slot, 640, of the control lever, 391, which is loosely swingable on the shaft, 310, whereby the latter is swung in the anti-clockwise direction round the shaft, 310. By means of the spring, 393, which on the one hand engages with the pin, 394, of the control lever, 391, and on the other hand with the pin, 395, of the lug, 397, of the lever, 323, rigidly mounted on the locking bar 322, the locking bar, 322, is swung round the shaft, 310, in the anti-clockwise direction whereby it remains constantly in contact with the lever, 391. The lever, 334, (Figure 24) attached to the key locking bar, 322, in consequence of this is swung similarly in the anti-clockwise direction round the shaft, 310, whereby, through the parts 334, 335, 336, 337, 339, 340, 342, 344, 265 (Fig. 24), the coupling lever, 44, rigidly mounted on the shaft, 265, as already described under the heading "Addition" is likewise swung in the clockwise direction. Hereupon the coupling lever, 44, releases the nose, 70, of the pawl, 65, of the differential mechanism actuating coupling, 52, (Fig. 7) whereby the coupling pawl, 65, is brought into engagement with the

coupling cam, 27, and the differential mechanism actuating coupling, 52, in the manner already described under the heading "Addition" is caused to rotate in the direction of the arrow "e" after the motor contact 362, 364, is closed through the parts, 336, 351, 353, 347, 348, 23, 22, 21 (Fig. 24) in a manner to be hereinafter described.

In the swinging movement of the locking bar, 322, in the anti-clockwise direction around the shaft, 310, there is so much play between the lower edge of the locking bar, 322, (Fig. 24) and the upper edge of the lever, 132, that, when the shaft, 116, is caused to rotate in the direction of the arrow "f" and nose, 117g, of the cam, 117, acts on the lug, 128, of the lever, 130, then the levers, 132 and 130, have been so far swung out that the lever, 132, again lies directly under the locking bar, 322, and the lug, 128, of the lever, 130, slides on the periphery of the cam, 117.

In the swinging movement of the lever, 336, (Fig. 24) in the anti-clockwise direction around the shaft, 338, in consequence of the depression of the multiplication key, 11, the edge, 355, of the same acts on the face, 354, of the lever, 351, which is loosely swingable around the shaft, 241, and swings the same in the anti-clockwise direction around the shaft, 241, whereby through the pin, 353, which projects into the recess, 352, of the lever, 351, the lever, 347, is swung in the anti-clockwise direction against the action of the spring, 350, and the arm, 21, of the lever, 22, is caused to slide off from the surface, 24, of the cam, 20, through the parts, 348, 23, 22, so that the contact lever, 22, under the action of the spring, 23a, can swing round the point, 23g, in the anti-clockwise direction, whereby under the action of the contact spring, 361, the motor contact, 362, 364, is closed. The motor D now commences to rotate in the direction of the arrow "K," whereby the main driving shaft, 3, is rotated by the worm, 1, mounted on the motor shaft, through the worm wheel, 2, as already mentioned, in the direction of the arrow "e."

In the swinging movement of the shaft, 265, and of the coupling lever, 44, in the clockwise direction, the lever, 746 (Figures 29 to 33) rigidly mounted on the shaft, 265, likewise participates, whereby both of the levers, 743 and 757, jointed to the lever, 746, move upwards in their elongated holes, 742 and 758, in order to co-act with the part, 748, of the angle member, 750, attached on the lever, 749, in a manner to be hereinafter described.

It may again be mentioned at this point, that by the depression of the mul-

tiplication key, 11, the proportional rack system described in detail in Patent Specification 365,058 is not changed-over, as the machine is constantly set for additive operation by the spring, 859, which is secured to the pin, 856, of the lever, 854, and to a wall of the machine, or is set for additive operation automatically after being set for a subtractive operation. The same holds good for the revolutions-register, U.

Consequently, all the setting operations which are released by the depression of the multiplication key, 11, are completed, and the motor, D, commences to rotate after the motor contact, 362, 364 (Fig. 24) as hereinbefore described is closed. The processes which hereupon take place are as follows.

By the rotation of the wheel, 78, (Figure 4 and 8) in the direction of arrow "f" through the toothed wheel, 56, mounted on the main driving shaft, 3, the eccentric shaft, 19, is rotated through the bevel wheels, 79 and 133, (Fig. 8) in the direction of the arrow "m," and consequently the toothed wheel, 619, which drives the toothed wheel, 618, rotatably mounted on the control shaft, 587, rotates in the direction of the arrow "n." In consequence, however, of the already described coupling through the pin, 621, rigidly mounted on the control shaft, 587, the control shaft, 587, is driven along with the wheel, 618, in the direction of the arrow "n" in Figure 34. The toothed wheel, 618, rotates through the intermediate wheel, 617, the toothed wheel, 614, in the direction of the arrow "p" round the screw, 615, (Figure 40). By means of the eccentric (not shown) which, however, is formed on the toothed wheel, 614, the lever, 610, is acted upon upwardly, and is simultaneously swung round the screw, 611. As, however, the toothed wheel, 606, (Figure 40) up to the present has not yet been rotated, so the tooth spaces, 609, of the toothed wheel, 606, still stand opposite to the lever, 610, so that the same cannot co-operate with the teeth of the toothed wheels, 606.

At the beginning of the first out-movement of the proportional rack system the pin wheel, 140, (Fig. 8 and 9) which is arranged at the left hand side of the machine on the eccentric shaft, is now turned in the direction of the arrow "m" through the intermediary of the parts D, Fig. 24, 1, 2, 3, 56, Fig. 4, 78, 133, Fig. 8. Hereby the pin wheel, 140, turns the Maltese cross by means of the pins, 143, Fig. 9, in the direction of the arrow x_1 until the locking member, 144a, of the pin wheel, 140, comes into an operative position on the locking face 145a of

the Maltese cross, 145, whereby the coupling wheels, 156, Fig. 9 and 40, are turned through the intermediary of the wheels, 147, 149, 152, in the direction of the arrow " x_2 " until the same come in engagement with the wheels, 159, of the proportional rack system and with the wheels, 158, of the result totalizer R. Since now the toothed wheel, 56, which is mounted on the shaft, 3, Fig. 4, and which is in fixed relationship with the differential mechanism actuating coupling, 52, for the proportional rack system drives, during the turning of the main driving shaft, 3, the toothed wheel, 78, in engagement with it, in the direction of the arrow "f," the proportional rack system is actuated through the intermediary of the parts, 116, 117 and 124, Fig. 24, after coupling of the wheels, 158, 159. During this action the coupling of the wheels, 158, 159, is maintained, while the Maltese cross, 145, during the further turning of the pin wheel, 140, in the direction of the arrow "m" remains in the rest position in consequence of the influence of the locking member, 144a, of the pin wheel, 140, on the face, 145a, of the Maltese cross, and the transmission of the items, which are set up in the keyboard Mk and Mu, takes place to the result totalizer R, so that now the number 0000002500000025 is visible in the apertures of the result totalizer R consisting of sixteen denominations. During the half revolution of the pin wheel, 140, the control shaft, 587, Fig. 34, has made about a quarter of a revolution, after which the part, 655a, of the part, 655, moves out from the recess, 657, of the sleeve, 658, and slides on the further rotational movement of the control shaft, 587, on the periphery of the sleeve, 658. As soon as the part, 655a, of the part, 655, withdraws from the recess, 657, of the sleeve, 658, the control shaft, 587, under the pull of the spring, 927, acting through the lever, 925, on the disc, 923, rigidly mounted on the control shaft, 587, is moved to the left to such an extent that the part, 662a, of the U-shaped bearing part, 622, lies against the edge, 660a, of the disc, 660, of the sleeve, 658, as is shown in Fig. 37, whereby a further movement of the control shaft, 587, to the left under the action of the spring, 927, is avoided.

Before the out-movement is finished and until shortly after the beginning of the in movement of the first movement of the proportional rack system, the pins, 143a, of the pin wheel, 140, actuate the Maltese-cross, 145, whereby the same is again turned in the direction of the arrow x_1 until the locking member, 144, of the pin wheel, 140, co-operates with the face, 130

145b, of the Maltese-cross, 145, whereby the coupling wheels, 156, Fig. 40, are uncoupled from the wheels, 159, of the proportional rack system and from the wheels, 158, of the result register R, and are again in the position according to Fig. 40.

At the beginning of the return movement of the proportional rack system the cam-disc, 588, Fig. 34, has come into an operative position in relation to the lever, 585, in consequence of the further revolution of the control shaft, 587, whereby the yoke, 585, 584, Fig. 21, 582, is swung round the shaft, 583, in the clockwise direction against the action of the spring, 586, (seen in Fig. 21). Hereupon the mouth, 589, of the lever, 582, acts the pin, 591, of the lever, 590, whereby the latter and the parts, 592, 593, are swung round the shaft, 388, in the anti-clockwise direction. The upwardly directed arm, 590a, of the lever, 590, acts during the swinging movement in the anti-clockwise direction on the right angled bent-off lug, 594, of the two armed lever, 596, whereby the latter is swung round the screw, 595, in the clockwise direction. Hereupon the nose, 597, of the two-armed lever, 596, acts on the lug, 598, of the flap, 601, and swings the latter in this manner in the anti-clockwise direction (seen in Fig. 21) against the action of a spring (not shown). As the flap, 601, projects into the circumferential grooves, 603, of the sleeves, 604, rigidly mounted on the shafts, 501, the toothed wheels, 607, are moved and are coupled with the teeth, 608, of the numeral wheels, 499M. In the displacement of the sleeves, 604, and of the toothed wheels, 607, the toothed wheels, 605, obviously also participate and in this displacement nevertheless remain in engagement with the toothed wheels, 606, of the multiplier mechanism. This takes place before the tens-transfer cams 137, Fig. 40, of the 9th to 16th place of the register come into an operative position with respect to the tens slides 139.

During the rocking of the bail, 590, 593, 592, in the anti-clockwise direction around the shaft, 388, the bridge, 592, of the bail, 590, 592, 593, acts upon the lever, 610, whereby the same is moved against the action of the spring, 613, from its position, shown in Fig. 23 with solid lines, to the position shown in Fig. 23 with dotted lines, whereby the lever, 610, comes out of engagement with the toothed wheels, 606, of the multiplier setting mechanism.

Now during the return movement of the proportional rack system the cam, 853, rigidly mounted on the control shaft, 587,

operates the lever, 852, whereby the same and the lever, 854, connected with it by means of a bridge, 851, Figs. 28 and 34, are swung round the shaft, 583, in the anti-clockwise direction (seen in Fig. 28) against the action of the spring, 859. Hereby the bolt 855, riveted to the lever, 854, acts on the edge, 380a, of the slot, 380, of the bar, 376, whereby the rod, 376, is moved downwards round the screw, 368, and the spring, 857, is tensioned, while the pin, 372, comes into contact with the rack, 367b, (Figure 24) of the proportional rack system which has not yet returned into its normal position. During the rocking of the rod, 376, downwards round the screw, 368, at first the upper end, 381a, of the recess, 381, of the rod, 376, does not act on the bolt, 863, of the lever, 862, since the bolt, 862, is normally lying in the middle position of the recess, 381, of the rod, 376. As soon as the lever, 852, has attained the raised surface of the cam, 853, the pin, 855, has advanced up to the upper edge of the horizontal part of the slot, 380. Simultaneously, the edge, 381a, of the slot, 381, of the rod, 376, (Figure 28) acts on the pin, 863, of the lever 862 and draws the lever 862, which is lying on this side of the rigid projection, 868, during the additive calculation, so far downwards until the lug, 867, in the swinging movement of the lever, 862, in consequence of the changeover to negative calculation which will be described in detail later can be moved past underneath the abutment 868 to the rear. In the movement of the lever, 862, downwards the lever, 866, the shaft, 265, and the coupling lever, 44, are also naturally swung somewhat in the anti-clockwise direction, against the action of the spring, 342, which is possible, since after a half-revolution of the differential mechanism actuating coupling, 52, the comb, 52x, of the same has released the coupling lever, 44, which comes again to lie under the nose, 70, (Fig. 24) of the pawl, 65, of the coupling, 52, on the rocking in the anti-clockwise direction.

Since as has already been mentioned, the machine normally always operates in the additive sense, and in the first movement of the proportional rack system, the machine is set for positive operation, the revolutions-register naturally is also acted upon in the positive sense during the to and fro movement of the proportional rack system, and consequently shows in the right denominational position a "1."

As soon as the proportional rack system has completed its first to and fro movement, the parts, 376 (Fig. 28), 369, can

move further in the direction of the arrow "a" under the pull of the tension spring, 857, whereby the pin, 372, is coupled with the rack, 367b, and the pin, 375, is uncoupled from the rack, 367a, of the proportional rack system. Hereupon, the lever, 366, (Figure 28) rigidly mounted on the shaft, 300, also swings the shaft, 300, and the control lever, 301, for the kind of calculation of the revolutions-register U, in the anti-clockwise direction. Herewith the proportional rack system and the revolutions-register are set for subtractive calculation.

As soon as the parts, 376, 369, (Figure 28) can move to the right, the pin, 855, riveted to the lever, 854, again bears on to the edge, 858, of the slot, 380, of the rod, 376, under the pull of the tensioned spring, 857. In the movement of the rod, 376, in the direction of the arrow "a," the pin, 863, of the lever, 862, was projected upwards in the recess, 381, of the rod, 376, and the lever was moved in the anti-clockwise direction round the screw, 864, whereby the angled lug, 867, on the lever, 862, rests behind the projection, 869, rigidly mounted in the machine housing, by means of which the mechanisms, which in the second movement of the proportional rack system are changed over for subtractive operation are prevented by any undesired action from being changed over for additive operation before the proportional rack system commences its movement, and the differential mechanism actuating coupling, 52, for the proportional rack system is not released by the coupling lever, 44, (Fig. 4), until the reversing from "plus" to "minus" is finished.

Moreover, in the movement of the rod, 376, in the direction of the arrow "a," the two-armed lever, 379, the pin, 378, of which projects into the recess, 377, of the rod, 376, was rotated in the anti-clockwise direction, whereby the flap, 387, is swung round the shaft, 380, in the clockwise direction. The swing of the flap, 387, is without signification for the multiplication.

In the swinging movement of the control lever, 301, in the anti-clockwise direction, the edge, 301g, (Figures 46 and 47) of the recess, 301a, of the control lever, 301, acts on the lug, 305, of the rod, 304, and moves the same out of the position represented in Figure 46, into the position represented in Figure 47. In this movement of the rod, 304, the lever, 177, is swung round the point, 176, (Figure 10) in the clockwise direction, so that the toothed wheel, 135, is coupled with the toothed wheel, 169, whereby in the subsequent rotation of the shaft, 116, in the

direction of the arrow "f" to be hereinafter described, since the multiplication key, 11, is still depressed and in consequence of this, the differential mechanism actuating coupling, 52, is closed, in the manner hereinbefore described, the actuating and tens transfer shaft, 178, of the revolutions register U is driven in the negative sense through the toothed wheels, 56, 78, the bevel wheels, 79 and 133, and the toothed wheels, 134, 135, 169 and 179.

Since the multiplication key, 11, is still depressed the motor contact, 362, 364, is closed, through the parts 639 (Figure 26), 391, 322, 310, 334, (Figure 24), 335, 336, 351, 353, 347, 348, 23, 22 (Figure 24), and through the parts, 639, (Fig. 26), 391, 322 (Fig. 24), 334, 335, 336, 339, 340, 342, 344, 265, 44, the differential mechanism actuating coupling, 52, is coupled with main driving shaft, 3, so that the shaft, 3, can execute a further rotation in which the following processes take place.

The toothed wheel, 56, which on the shaft, 3 (Figure 4) is in fixed relation with the differential mechanism actuating coupling, 52, drives the toothed wheel, 78, engaging with it, whereby the connecting rod, 124, attached to the crank disc, 117, rigidly mounted on the shaft, 116, is acted upon in the direction of the arrow "f" (Figure 5 and 24), whereby the proportional rack system is operated, in the manner described in Patent Specification No. 365,058 in detail and the value "25" set up in the right-hand side in the multiplier set of keys, "Mk" and the value registered in the result totalizer, R, are brought out again from the result totalizer, R, since the machine, as above mentioned, was changed over to subtractive operation. Simultaneously, the value "25" set up in the two right-hand places of the multiplicand set of keys "Mu" and which was registered in the result totalizer, R, at the first movement of the differential mechanism is again brought out of the same, so that after the second movement of this mechanism the result totalizer, R, moves to "0." Simultaneously, since the machine, as described was changed over for subtractive operation, the number "1" registered in the right-hand numeral wheel, 211, of the revolutions-register is again withdrawn so that the right-hand numeral wheel, 211, of the revolutions-register is rotated to "0."

After finishing of the first revolution of the main-driving-shaft, the proportional rack system of the machine is, as already mentioned, shifted for subtraction and the differential mechanism actuating coup-

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ling, 52, for the proportional rack system is closed for a further revolution. During this second revolution of the main driving shaft the multiplier setting mechanism remains coupled with the numeral wheels, 499, of the result totalizer, R, whereby during the second revolution of the main driving shaft, 3, the multiplicand and the multiplier are subtracted in the result totalizer R, i.e. the complement value of the multiplier and multiplicand is added in the result totalizer R, since, as known, in the Mercedes Euclid calculating machine the subtraction process takes place by addition of the complement of the subtrahend. During this second revolution of the main driving shaft, 3, the toothed wheels, 607, of the multiplier setting mechanism are set to the complement of the set multiplier, 20 since the toothed wheel, 607, of the multiplier setting mechanism are coupled with the numeral wheels, 499, of the totalizer R, so that the correct multiplier is in the multiplier setting mechanism at 25 the end of this revolution. The process is also briefly, as follows:—

30 The result totalizer of sixteen denominations is on zero before beginning of a calculating operation reads 00000000 00000000

35 The multiplier "25" is, as already mentioned, set in the left half Mk of the keyboard T and the multiplicand "25" in the right half Mu of the keyboard T. At the first half additive movement of the proportional rack system therefore the amounts are introduced in the result totalizer R and the coupling of the result totalizer R with the multiplier setting mechanism is caused before transmission. 40 The totalizer then reads 00000025 00000025

45 During the second which is now a subtractive movement of the proportional rack system the complement value of 0000002500000025 is added in the result totalizer during the first half of the movement of the proportional rack system mechanism. This complement is 99999974 99999974

50 What is in the result totalizer R before tens transfer has taken place is thus:— 99999999 99999999

and in the multiplier setting mechanism before tens transfer has taken place is thus:— 11111136

55 During the second half of the movement of the proportional rack system the value introduced in the multiplier setting mechanism after tens transfer has taken places becomes 00000025

60 so that the correct multiplier is in the multiplier setting mechanism, while zeros are visible in the result totalizer R.

If, before introducing of the two factors "25," a value is already in the result totalizer, the multiplier is correctly introduced in the result totalizer R in consequence of the actuating and tens transfer as it is obvious of the following example:

	It is assumed, that a value is already in the result totalizer:—	37621578	26385796
5	At the first additive movement of the proportional rack system during the first half is introduced:—	+ 00000025	00000025
	The totalizer then reads:—	37621593	26385711
10	As it is evident tens transfers are prepared in the right hand and second denominational places from the right hand side, also in the ninth and tenth denominational places from the right hand side and are effected during the second half of the additive movement of the proportional rack system as follows:—	+ 11	11
15	Since, before the beginning of the second half of the additive movement of the proportional rack system or before the tens transfers, coupling of the result totalizer R with the multiplier setting mechanism		
20	takes place, the tens transfer which is caused in the result totalizer, is effected in the multiplier setting mechanism as well as on the result totalizer. The totalizer then reads:—	37621603	26385821
25	And multiplier setting mechanism reads:—	00000990	
30	At the second (which is now a subtractive) movement of the proportional rack system the complement value of 0000002500000025 is added during the first half of the same. The complement is:—	+ 99999974	99999974
	The result totalizer R before the tens transfer has taken place thus reads:—	26510577	15274795
35	And the multiplier setting mechanism before the tens transfer has taken place reads:—	11111026	
40	During the second half of the subtractive movement of the proportional rack system the tens transfer takes place	+ 11111 1	11111 1
	And in consequence the value which is visible in the result totalizer R is that which was contained at first in the same viz.,	37621578	2635796
45	and in the multiplier setting mechanism is visible:—	11111026 - 11111 1 00000025	

Shortly before completion of the revolution of the control shaft, 587, Fig. 34, the part, 678, of the cam, 680, comes into operation on the lever, 677, whereby the same and the lever, 675, connected therewith by means of the bridge, 676, are swung round the shaft, 583, in the anti-clockwise direction. Hereupon, the rod, 674, jointed to the lever, 675, is acted upon in the opposite direction to that of the arrow "a" whereby the pin, 675a, arranged on it, acts on edge, 673a, of the slot 673 of the lever, 672, and swings the lever, 672, round the shaft, 310, in the anti-clockwise direction (seen in Figure 34). In this swinging movement participates likewise the releasing bar part, 418A, of the releasing bar, 418, fixed to the lever, 672, which part on the other hand is fastened to the lever, 671, swingably mounted on the shaft, 310. In the swinging movement of the releasing bar part, 418A, in the anti-clockwise direction, the same acts on the projections, 439, of the locking bars, 440, of the left-hand multiplier set of keys "Mk," and moves these against the action of their springs, 442 (Figure 25), whereby the locking bars, 440, release the depressed keys, in the manner described in detail in Patent Specification No. 365,058, whereby these are cleared, and therefore return into their normal position, represented in Figures 1 and 2. The value "25" set up in the multiplier set of keys "Mk" (Figure 2) is therefore cancelled whilst the value "25" set up in the multiplicand set of keys "Mu" remains set up in the same. As soon as the part, 678, of the cam, 680, releases the lever, 677, all of the parts, 677, 676, 675, 672 and 418A, return into their rest position illustrated in Figure 34.

Immediately before the termination of the second movement of the proportional rack system or immediately before the termination of the first revolution of the control shaft, 587, (Fig. 34), the lever, 585, slides from the cam disc, 588, whereby the lever, 585, is swung round the shaft, 583, in the anti-clockwise direction. The lever, 582, participates in this swinging movement also through the bridge, 584. The lever 582, hereby swings the lever, 590, round the shaft, 388, in the clockwise direction. The lever, 610, can follow this movement under the action of its spring, 613, whereby it returns again into the working position in relation to the toothed wheels 606 (Fig. 23) and co-acts with them in a manner to be hereinafter described.

In the swinging movement of the lever, 590, round the shaft, 388, (Figure 21) in the clockwise direction, the arm 590a, of

the lever, 590, releases the lug, 594, of the lever 596, so that this under the action of a spring (not shown) which engages with the shift flap, 601, is swung in the anti-clockwise direction round the screw, 595. The nose, 597, of the lever, 596, remains in contact with the lug, 598, of the shift flap, 601. Through the swinging movement of the shift flap, 601, round the pins, 599 and 600 in the clockwise direction, the toothed wheels, 607 and 605, are displaced to the right on the shafts, 501, (seen in Figure 23), whereby the toothed wheel, 607, is disengaged from the teeth, 608, of the numeral wheels, 499M, the toothed wheels, 605, on their displacement, however, remaining in engagement with the toothed wheels, 606.

As the toothed wheels, 607, (Figure 21) were coupled with the teeth, 608, of the numeral wheels, 499M, in the manner already described above, on the withdrawal of the value "25," registered in the result totalizer R, and set up in the two right-hand places of the multiplier-setting-keyboard Mk, the complement value was brought into the toothed wheels, 606. In the revolution of the eccentric shaft, 19, in the direction of the arrow "m" indicated in Figure 29, the cam, 756, (Figure 29) rigidly mounted on the eccentric shaft, 19, participated in the revolution whereby the lever 749, under the pull of the spring, 754, engaging with its pin, 753, could swing around the shaft, 751, in the clockwise direction whereby the roller, 755, mounted on the lever, 749, could slide along on the face, 756a, of the cam disc, 756. Shortly before the completion of the first revolution of the eccentric shaft, 19, the face, 756b, of the cam, 756, acts on the roller, 755, of the lever, 749, whereby the latter and the angled member, 750, mounted on it, are swung in the anti-clockwise direction round the shaft, 751, and against the action of the spring, 754. Hereupon the lug, 748, of the angle member, 750, has no action on the levers, 743, 757. It moves therefore merely for a distance between the two levers, 743, 757.

At the commencement of the second revolution of the eccentric shaft, 19, during the second movement of the proportional rack system already described the lever, 749, and the angle member, 750, are again swung under the pull of the spring, 754, in the clockwise direction round the shaft, 751, whereby the roller, 755, of the lever, 749, slides along on the face, 756a, of the cam disc, 756, during the rotation of the same.

On transmitting the value "25" to the toothed wheels, 606, during the second movement of the proportional rack system

the zero discs, 627, of both the right hand places were brought simultaneously into the position illustrated in Fig. 30. Hereby the periphery of the two right zero discs, 5 627a, (Fig. 31) acted on their levers, 630a and 630x, whereby through the lever, 630, the flap, 712, is swung in the clockwise direction round the shaft, 388, so that the spring, 709, which on the one 10 hand engages with the pin 708, of the lever, 705, and on the other hand with the pin, 707, of the slide, 703, was tensioned, whereby the pin 706 of the lever 705 was moved to the left in the elongated hole 15 704 of the slide 703 (seen in Fig. 30). The slide 703 cannot follow the pull of the spring 709 since its edge 703h (Fig. 30) lies against the lug 701, riveted to the bridge, 698 of the yoke 699, 698, 689.

20 When the slide 703 rests with its edge 703h against the bridge 698 of the yoke 689, 698, 699 under the action of the spring 709, the slide has not yet moved so far to the front, that it could swing 25 the lever 757 so far in the anti-clockwise direction round the screw 744 by means of its bolt 703m, that the lever 757 would lie with its edge 757g in the path of the lug 750 of the lever 749.

30 If the zero-disc 627 of the outermost right hand denomination is turned into the position shown in Fig. 31, the periphery of the zero disc 627 of the right denomination acts upon the extreme right 35 hand lyre-shaped lever 630 and rocks the same in the anti-clockwise direction. Hereby the same acts on the flap 739 and rocks the latter in the clockwise-direction, whereby the slide 734 is moved in 40 the opposite direction to the arrow "a" and against the action of the spring 735, and whereby the slide 734 enters with the lug 759 in the recess 760 of the latch 719, which is rockably arranged on the lever 45 699.

Shortly before the completion of the second movement of the proportional rack system and shortly before the termination of a complete rotation of the control shaft, 50 587 (Figure 34), the cam 723, rigidly mounted on the control shaft 587, acts on the lever 722, and swings the same round the shaft, 583, in the clockwise direction (seen in Figure 29) in which 55 swinging movement also participates the lever 689, connected to the lever, 722, by means of the bridge 698. Hereupon the screw, 690, slides forwards in the slot 688, (Figure 28) of the rod, 687, and acts in this position on the edge, 688a of the slot, 60 680, of the rod, 687, whereby this is swung downwards in the clockwise direction round its point of articulation, 687g, and takes up, in relation to the lever, 65 689, the position illustrated in Figure 28.

Simultaneously, the lever, 692, jointed to the lever, 689, by means of the screw, 690, (Figures 28 and 29) is rocked in common with the yoke, 689, 698, 699, in the clockwise direction and simultaneously 70 moves in the opposite direction to the arrow "a." The lever, 692, lies in the rest position with its edge, 697, under the pull of the spring, 695, against the bridge, 698, of the yoke, 689, 698, 699. The lug, 75 696, of the lever, 692, hereby lies a substantial distance underneath the rod, 687. As soon as the edge, 697, slides off from the bridge, 698, of the yoke, 689, 698, 699, swinging round the shaft, 583, in the clockwise direction, it is further acted 80 upon in the clockwise direction round the screw, 690, under the pull of the spring, 695, until its lug, 696, bears upwards against the rod, 687. Simultaneously, it 85 moves behind the lug, 687p, of the rod, 687, since it is moved in the opposite direction to the arrow "a" during the swinging movement of the yoke, 689, 698 and 699. In this manner the multipli- 90 cation key, 11, is prevented from springing back into its normal position, when a lock, 130, 132 (Figure 24) to be herein- after described is released which would be possible, as in the swinging movement of 95 the yoke, 689, 698, 699, the screw, 690, acts also on the edge, 688a, of the rod, 687, and this moves so far downwards that the pawl, 762, which previously held the mechanisms locked, has no longer any 100 action on the rod, 687. The locking is obtained in the following manner, viz: that on one side the projection, 692g, of the lever, 692, lies against the edge, 687r, of the lug, 687p, of the rod, 687, and on 105 the other side, the screw, 690, of the lever, 689, lies against the edge, 688p, of the elongated hole, 688, of the rod, 687.

In the swinging movement of the yoke 699 (Figure 30), 698, 689, in the clock- 110 wise direction the latch 719, arranged on the yoke 699, 698, 689, was raised and could embrace with its recess 760 the lug 759 of the bar 734, which was moved in the direction of the arrow "a". 115

In consequence of the movement of the bars 703 and 734 in the opposite direction to the arrow "a" the two levers 757 and 743 are swung so far in the anti-clockwise direction round the point 744, through 120 the intermediary of the pin-slot-connection 703m, 758 and 741, 742, that the lever 757 with its nose 757g comes to lie in the path of the part 748 of the lever 749.

In the revolution of the eccentric shaft 19 in the direction of the arrow "m" indicated in Figure 30, the cam 756 rigidly mounted on the eccentric shaft 19 participates in the revolution, whereby 130

the lever 749 under the pull of the spring 754 engaging with its pin 753, tends to swing round the shaft 751 in the clockwise direction, whereby the roller 755 attached to the lever 749 glides along on the face 756a of the cam disc 756. Shortly before the completion of the first revolution of the eccentric shaft 19 the lever 749 therefore swings once in the anti-clockwise direction and against the action of the spring 754 round the shaft 751. The lug 748 of the angle piece 750, however, remains without influence on the levers 743, and 757 which have not yet been swung in the anti-clockwise direction. It is therefore moved only inoperatively through the space between both the levers 743 and 757.

Shortly before the completion, however, of the second revolution of the eccentric shaft 19, at the end of the already described second movement of the proportional rack system, the lever 749 and the angle piece 750, 748, are again swung according to Figure 30 by the cam 756 in the anti-clockwise direction, and now act on the nose, 757g, of the lever, 757.

Consequently, the lever, 757, is displaced downwards, whereby the lever, 746, (Figure 30) rigidly mounted on the shaft, 265, and the shaft, 265, itself are swung in the anti-clockwise direction. In this swinging the coupling lever, 44, also participates which hereby releases the nose, 42, of the pawl 37, of the carriage shift coupling, 26 (Figure 7) whereby the nose, 46, of the pawl, 37, under the pull of the spring 41, is coupled with the nose, 47, of the pawl, 27, whereby the carriage shift coupling, 26, is closed. Simultaneously, the coupling lever, 44, is laid with its edge, 43, in front of the nose, 70, of the pawl, 65, whereby the pawl, 65, is swung against the action of the spring, 69, whereby the nose, 71, of the pawl, 65, comes out of engagement with the nose, 47, of the cam, 27, and the differential mechanism actuating coupling, 52, is opened again.

In the swinging of the coupling lever, 44, (Figure 24) in the anti-clockwise direction the lever, 344, rigidly mounted on the shaft, 265, also participates, whereby the spring, 342, which, moreover, engages with the arm, 340, of the lever, 339, is strained, since the lever, 339, in consequence of the multiplication key, 11, being still held depressed, is held swung in the anti-clockwise direction round the shaft, 338, by way of the parts, 639 (Fig. 26) 391, 393, 322, 334 (Figure 24) 335, and cannot follow the pull of the spring, 342.

During the action of the cam disc, 756, (Figure 32) on the roller, 755, and the

action of the lug, 748, of the angle member, 750, in the manner already described, on the edge, 757g, of the lever, 757, as mentioned, the lever, 746, was swung round the shaft, 265, in the anti-clockwise direction. The lever, 866, (Figure 28) constructed as shown in Figure 28, and rigidly mounted on the shaft, 265, participates in this swinging movement whereby the lever, 862, jointed to the lever, 866, by means of the screw, 864, is moved downwards without, however, its pin, 863, acting on the rod, 376, which is possible in consequence of the elongated hole, 381, located in the rod, 376.

As soon as the control shaft, 587, (Figure 34) has finished one revolution, the part, 662a, of the part, 662, which is rigidly mounted on the machine frame, comes again to lie laterally of the recess, 661, of the disc, 660, which is secured on the sleeve, 658. Now the control shaft, 587, can be moved to the left hand side. Figure 34, under the pull of the tensioned spring, 927, which influences the lever, 925, in the anti-clockwise direction round the screw, 924, whereby the lever, 925, acts upon the disc, 923, rigidly mounted on the control shaft, 587. Hereby the bolt, 621, of the part, 622, comes out of engagement with the hole, 620, of the toothed wheel, 618, so that the control shaft, 587, is uncoupled with the toothed wheel, 618, in this manner. Consequently the control shaft, 587, cannot participate in the rotation of the eccentric shaft, 19.

As soon as the proportional rack system has terminated its second movement, the pin, 375, (Figs. 24 and 28) under the action of the spring, 859 (Fig. 28), enters into the hole, which has in the meantime moved opposite to it, of the rack, 367a, (Fig. 24) of the proportional rack system, while simultaneously the pin, 372, is withdrawn from the hole of the rack, 376b, whereby the rack, 376a, is therefore again coupled with the pin, 375, and the proportional rack system is again changed over for positive operation.

Since the cam, 853, rigidly mounted on the control shaft, 587, has released in the meantime the lever, 852, the pin, 375, could now, under the pull of the spring, 859, engaging the pin of the lever, 854 enter the hole of the rack, 367a, of the proportional rack system.

In the movement of the rod, 376, in the opposite direction of the arrow "a" (Figure 28), the lever, 366, was swung together with the shaft, 300, and the lever, 301, in the clockwise direction, whereby the recess, 301a (Figures 47, 46) acts on the lug, 305 of the rod, 304, and acts upon the same in the direction of the

arrow "a", whereby the parts, 301, 304, are returned from the position illustrated in Figure 47, into the position illustrated in Figure 46. Hereupon, through the angle lever, 177 (Figure 10) and by means of the draw key, 136, 170, the toothed wheel, 163, is again coupled with the toothed wheel, 169, so that in the succeeding revolution of the main drive shaft, 3, the rotation of the actuating and tens transfer shaft, 178, takes place in the positive direction through the parts, 56, 78, 79, 133, 134, 188, 190, 163, 169, 179, so that the revolutions-register, U, on the succeeding setting and actuating movement rotates again in the positive direction.

If the totalizer carriage, B, is located in its extreme left-hand position, then the projecting part, 282 (Figures 3 and 14), arranged on the carriage, B, has swung the lever, 274, round the point, 276, in the anti-clockwise direction whereby the lever, 261, is swung round the point, 263, in the clockwise direction under the pull of the spring, 283. Hereupon, the connecting rod, 260, jointed to the lever, 261, is displaced to the left (seen in Figure 14). Consequently the parts, 259, 238, 238a, were swung round the points, 236, 237, in the reverse direction of the arrow "u", whereby the draw key, 225, 224, is displaced to the left in the opposite direction to arrow "a" (seen in Fig. 14) whereby the draw key bush, 218, (Fig. 12), is coupled with the toothed wheel, 219.

As soon now as the carriage shift coupling, 26 (Fig. 7), in consequence of the release of the nose, 42, of the same by the coupling lever, 44, through the intermediary of the parts, 756, (Fig. 30), 755, 748, 757, 744, 746, 265, (Figure 24) is coupled with the main drive shaft, 3, the toothed wheel, 219, (Figs. 14 and 12) is turned. Since this now rotates in the direction of the arrow "S" indicated in Fig. 12, obviously also the draw key bush, 218, and the pin disc, 227, attached to it are rotated in the same direction through the draw key, 224, 225. At this point it may be remarked, that the transmission between the toothed wheel, 25 and 219, is so chosen that the toothed wheel, 219, in one revolution of the toothed wheel 25, only performs one half revolution. Consequently, the pin disc, 227, in each revolution of the toothed wheel, 25, only performs one half revolution. The toothed wheel, 220, which engages with the toothed wheel, 25, through the intermediate wheel, 226, (Fig. 4) also rotates idly in the opposite direction to the arrow "S" indicated in Fig. 12. The pins, 228, 229, of the disc, 227, engage in the

recesses, 230, (Fig. 42) of the carriage shift bar, 231, whereby the carriage B, is moved to the right in the direction of the arrow "c" (seen in Fig. 42).

On the swinging movement of the coupling lever, 44, in the anti-clockwise direction (Fig. 24) and the release of the nose, 42, of the pawl, 37, of the carriage shift coupling, 26, in the already described manner, the lever, 267, (Fig. 14) rigidly mounted on the shaft, 265, is also swung in the anti-clockwise direction, whereby it enters into the recess, 271, of the lever, 261. If the carriage B now moves to the right, the tongue, 269, of the lever, 261, under the action of the spring, 277, engaging with the lever, 274, lies so that the edge, 269a, of the tongue, 269, of the lever, 261, rests against the lever, 267, whereby the position of the parts, shown in Fig. 14, remains the same and therefore also the change gear for the carriage shift remains adjusted for right-hand travel.

During the movement of the carriage B to the right the two-armed lever, 727, (Fig. 30) can swing round the screw, 726, in the clockwise direction, whereby the right-angled bent-off lug, 725, of the two armed lever, 727, rests in front of the part, 724, of the lever, 699, as is shown in Fig. 31. Hereupon the two-armed lever, 727, swings so far in the clockwise direction round the screw, 726, until the edge, 727g, of the mouth, 728, of the same lies against a screw (not shown) screwed into an intermediate wall of the machine.

During the movement of the totalizer carriage B, to the right, the right lyre-shaped lever, 630x, slides away from the face, 740, of the flap, 739, whereby the same can swing so far in the anti-clockwise direction round the shaft, 388, under the action of the tensioned spring, 735, (Fig. 31) until the same is pressed by the next following lever, 630a, in the position shown in Fig. 31.

In the further movement to the right of the carriage B, the second lyre-shaped lever, 630a, acts on the face, 740, of the flap, 739, as in consequence of the rotational displacement of the zero disc, 627a, through two places it cannot swing upwards, whereby the flap, 739, is swung in the clockwise direction round the shaft, 388. Hereby the slide, 734, (Fig. 31) is moved in the opposite direction to the arrow "a" against the action of the spring, 735, whereby its lug, 759, enters again into the recess, 760, of the pawl, 719. These movements are not operative on any part, and have no influence on the further calculating process.

As already mentioned above, the coupling lever, 44, in consequence of the

action of the cam disc, 756, (Figure 29), on the lug, 748, of the angle member, 750, arranged on the lever, 749, was swung by means of the parts, 757g, 757, 746, 265, in the anti-clockwise direction. Since during the moving of the carriage B to the right the lyre-shaped lever, 630a, slides from the edge, 716, of the flap, 712, and since there is no value adjusted in any further place and therefore all the other zero discs, 627, are on zero, the flap, 712, can rock under the action of the spring, 715, in anti-clockwise direction. Hereby the slide, 703, is also moved under the action of the bolt, 706, which is arranged on the part, 705, of the flap, 712, and acts on the edge, 710, of the recess, 704, of the slide, 703, in the direction of the arrow "a", whereby the lever, 757, is rocked round the screw 744, in clockwise direction, in consequence of the action of the bolt, 703m, of the slide, 703, on the lever 757. Hereby the lever, 757, is moved out of the path of the lug, 748, of the part, 750, which is mounted on the lever, 749, during the rocking of the lever, 750, in clockwise direction under the action of the spring, 754, after closing of the carriage-shift coupling. As soon as the edge, 757g, of the lever, 757, slides off from the lug, 748, of the angle member, 750, the parts, 743, 757, 746, 265, (Figure 31) and the coupling lever, 44, (Figure 24) can be swung again in the clockwise direction until the coupling lever, 44, under the pull of the tension-spring, 342, through the parts, 344, 265, rests against the comb, 45, arranged on the carriage shift coupling, 26.

As soon as the comb, 45, of the carriage shift coupling 26 (Fig. 7) releases the coupling lever, 44, the latter swings in the clockwise direction under the pull of the tension spring, 342, in which swinging movement, naturally, the lever, 344, and the shaft, 265, also participate. In the swinging movement of the coupling lever, 44, in the clockwise direction, the same releases the nose, 70, of the pawl, 65, of the differential mechanism actuating coupling, 52, whereby this is again coupled with the driving shaft, 3. Since in consequence of the holding of the multiplication key, 11, in the depressed position, the motor contact, 362, 364, is also held closed through the parts, 639, 391, 393, 322 (Fig. 26) 334, 335, 336, 351, 353, 347, 348, 23, 22, the main drive shaft, 3, and the differential mechanism actuating coupling, 52, rotate continuously. Simultaneously therewith, in its swinging movement in the clockwise direction, the coupling lever, 44, moves in front of the nose, 42, of the pawl 37, of

the carriage shift coupling, 26, whereby this is uncoupled from the main driving shaft 3.

In the swinging movement of the shaft, 265, in the clockwise direction under the pull of the tensioned spring, 342, the lever, 267, (Fig. 14) is also swung in the clockwise direction whereby it releases the tongue, 269, of the lever, 261, through which the lever, 274, is swung still further around the point, 276, in the clockwise direction. Since the pin, 275, of the lever, 274, rests against the edge, 278, of the lever, 273, and is held in this position by means of the spring, 283, the lever, 261, is swung further in the anti-clockwise direction (Fig. 14) round the point, 263 (Fig. 14).

Hereby the connecting rod, 260, jointed to the lever, 261, is displaced to the right (seen in Fig. 14), whereby the parts, 259, 238, 238a, are swung in the clockwise direction round the points, 236 and 237, until the part, 224, of the draw key, 224, 225, moves so that it lies against the side face of the toothed wheel, 220, (Fig. 12) since the recess, 223, of the toothed wheel, 220, does not yet lie opposite to the part, 224, of the draw key, 224, 225, as the totalizer carriage B has not yet completed its movement to the right, and in consequence the toothed wheel, 220, has not yet completed its revolution. As soon as the totalizer carriage B has moved one place to the right the recess, 223, of the toothed wheel, 220, moves opposite to the part, 224, of the draw key, 224, 225. Hereby, the draw key, 224, 225, is disengaged from the toothed wheel, 219, and engaged with the toothed wheel, 220, by means of which in the succeeding carriage shift the totalizer carriage B, is moved to the left into its initial position.

Since, as already mentioned, after the right hand-movement of the carriage B by one place the differential mechanism actuating coupling, 52, is closed and the motor contact, 362, 364, remains closed, then the proportional rack system is driven through the wheel, 56, 78 (Fig. 4), the shaft, 116, and the connecting rod, 124. Through the rotation of the wheel, 78, (Fig. 8) the eccentric shaft, 19, is driven in the direction of the arrow "m" through the bevel wheels, 79, 133, and consequently the toothed wheel, 619 (Figs. 40, 34) which is mounted on it. The latter rotates the toothed wheel, 617, round the screw, 616, by means of the intermediate wheel, 618, which is uncoupled from the pin, 621, and the toothed wheel, 616, in turn rotates the toothed wheel, 614, round the screw, 615, in the direction of the arrow "p" indicated in Fig. 34. By means of the eccen-

tric (not shown) formed on the toothed wheel, 614, the lever, 610, is acted upon in the upward direction, and is simultaneously swung round the screw, 611, and acts at each revolution of the eccentric shaft, 19, on the toothed wheel, 606, (Fig. 40) which lies opposite to it, of the second calculating place from the right, and rotates back the same as well as the shaft, 497, and the zero disc, 627a, in the direction of the arrow shown in Fig. 21, according to the chosen example with the multiplier "25" from 2 to "0" i.e. until the toothed space 609 (Fig. 23) of the second toothed wheel 606, from the right, lies opposite to the lever 610. During the above described process, the proportional rack system twice performs a to and fro movement, whereby the value "25" set up in the multiplicand set of keys "Mu" is transferred twice into the result totalizer R through the toothed wheels, 159, 156 and 158, in the manner described in Patent Specification No. 365,058, whereby in the Result-Totalizer R, the value "500" is visible in the three right hand denominations. Since, during the working out of the multiplier "25" no change-over results, it is evident that the differential mechanism actuating coupling, 52, remains closed for both of the to and fro movements of the proportional rack system.

Shortly before the termination of the first to and fro movement of the proportional rack system, the cam disc, 756, (Fig. 32) arranged on the eccentric shaft, 19, acts on the roller, 755, of the lever, 749, whereby the same and the angle member, 750, mounted on it, are swung against the action of the spring, 754, in the anti-clockwise direction round the shaft, 751. Hereby, the part, 748, of the angle member, 750, was moved inoperatively up and down between the two levers, 743 and 757.

When now after finishing of the second to and fro movement of the proportional rack system the zero space, 609, of the toothed wheel, 606, of the second place from the right lies opposite to the lever, 610 (Fig. 21), the zero disc, 627a, (Fig. 32) of the same denominational place has also been rotated, until its recess, 628a, lies opposite to the nose, 629a, (Fig. 32) of the lyre shaped lever, 630a. At the same moment, the flap, 739, engaging with the slide, 734, can swing in the anti-clockwise direction under the pull of the tensioned spring, 735, from the position, shown in Fig. 31, into the position, shown in Fig. 32 since the nose, 629a, of the lyre-shaped lever, 630a, can move off the periphery of the zero disc, 627a, and can enter into the recess, 628a. On the dis-

placement of the slide, 734, in the direction of the arrow "a" the lug, 759, of the same moves out of the recess, 760, of the pawl, 719, which is of no importance, since the yoke, 689, 698, 699, is held still in its outswung position, as the lug, 725, of the two-armed lever, 727, lies still in front of the part, 724, of the lever, 699, of the yoke 689, 698, 699. Moreover on the displacement of the slide, 734, in the direction of the arrow "a" the lever, 743, is swung round the screw, 744, in the clockwise direction which is possible, in consequence of the engagement of the pin, 741, riveted to the slide, 734, with the elongated hole, 742, of the lever, 743. The edge, 743x, hereby moves so that it lies underneath the lug, 748, of the angle member, 750, rigidly mounted on the lever, 749, with which all the parts take up the position illustrated in Fig. 32.

At the end of the second to and fro movement of the proportional rack system and with it of the second revolution of the eccentric shaft, 19, and after the working off of the second denominational place from the right is finished, the face, 756b, of the cam disc, 756, rigidly mounted on this shaft, acts on the roller, 755, by means of which the lever, 749, and the angle member, 750, mounted on the eccentric shaft, 19, are swung in the anti-clockwise direction round the shaft, 751, against the action of the spring, 754. Hereby the lug, 748, of the angle member, 750, acts on the edge, 743x, of the lever, 743, (Fig. 32) which has been swung into its path of movement, and moves the same downwards, whereby the lever, 746, mounted on the lower end of the lever, 740, which is screwed on the shaft, 265, and the shaft, 265, itself are swung in the anti-clockwise direction against the spring, 342, engaging with the lever, 344. Consequently the coupling lever, 44, rigidly mounted on the shaft, 265, is also swung in the anti-clockwise direction. Hereby, it moves so that its edge, 43, is in the path of movement of the nose, 70, of the pawl, 65, of the differential mechanism actuating coupling, 52, and simultaneously releases the nose, 42, of the pawl, 37, of the carriage shift coupling, 26, whereby the differential mechanism actuating coupling, 52, is uncoupled from the main driving shaft, 3, in the manner already described, while the carriage shift coupling, 26, is coupled with the main driving shaft, 3.

In the swinging movement of the coupling lever, 44, in the anti-clockwise direction, the lever, 344, (Fig. 24) rigidly mounted on the shaft, 265, has also participated, whereby the spring, 342, engag-

ing with it and with the arm, 340, of the lever, 339, is tensioned, as the lever, 339, in consequence of the multiplication key, 11, being held in the depressed position cannot follow the pull of the tensioned spring, 342.

As the multiplication key, 11, is still depressed, the motor contact, 362, 364, remains closed through the parts, 639 (Fig. 26), 391, 322, 334, (Fig. 24), 335, 336, 351, 353, 347, 348, 23 and 22, while through the parts, 639, (Fig. 26), 391, 322, 334 (Fig. 24), 335, 336, 339, 340, 342, 344, 265, 44, the carriage shift coupling, 26, is coupled with the driving shaft, 3, as hereinbefore described. Consequently the toothed wheel, 25, (Fig. 4) which besides being in engagement with the toothed wheel, 219, is in engagement with the intermediate wheel, 226, rotates the toothed wheel, 220, through the toothed wheel, 226, and consequently the draw key bush, 218, coupled with it, and the disc, 227, in the reverse direction to the arrow "S" indicated in Fig. 12, whereby by means of the pins, 229, and 228, the carriage "B" is displaced one place to the left, i.e. into the normal position, since as already described above, the draw key, 224, 225, was coupled with the toothed wheel, 220, before the beginning of the multiplication process. The toothed wheel, 219, is moreover driven idly in the direction of the arrow "S" illustrated in Fig. 12.

During the movement to the left of the totalizer carriage B the lower nose, 630x, of the right hand lyre-shaped lever, 630, (Fig. 33) runs on to the face, 740, of the flap, 739, and since the lever, 630, cannot swing upwards, as it does not lie opposite the space, 628, of the extreme right hand zero disc, 627, the flap, 739, is swung round the shaft, 388, in the clockwise direction. Hereby, the arm, 738, (Fig. 33) which is downwardly directed on the flap 739 acts on the slide, 734, whereby this is displaced in the opposite direction of the arrow "a" against the action of the spring, 735. The lug, 759, of the slide, 734, hereby enters again into the recess, 760, of the pawl, 719, (Fig. 33) and moreover its pin, 741, acts on the elongated hole, 742, of the lever, 743, whereby the latter is swung in the anti-clockwise direction round the screw, 744, and in this manner its edge, 743x, comes out of engagement with the lug, 748, of the angle member 750, mounted on the lever, 749. Consequently the spring, 342, is again released through the intermediary of the parts, 743, 744, 746, 265, (Fig. 24) and 344, whereby the shaft, 265, is swung and also the coupling lever, 44, in the clockwise direction whereby it

releases the nose, 70, of the pawl, 65, of the differential mechanism actuating coupling, 52, and holds the nose, 42, of the pawl, 37, of the carriage coupling, 26, so that in the manner hereinbefore described, the differential mechanism actuating coupling, 52, is coupled with the main driving shaft, 3, and the carriage shift mechanism coupling, 26, is uncoupled from the main driving shaft, 3.

On the movement of the totalizer carriage B, into its left-hand position the part, 282, of the totalizer carriage B, has also acted on the lever, 274, and has swung the same in the anti-clockwise direction round the point, 276, against the action of the spring, 277, whereby the spring, 283, is tensioned. Because of the contact of the edge, 270a, (Fig. 14) of the tongue, 269, of the lever, 261, with the lever, 267, already swung through the already mentioned parts, 749 (Fig. 32) 748, 743, 746, 265, Fig. 33, in this movement in the anti-clockwise direction of the lever, 274, the lever, 261, cannot yet follow the lever, 274. As soon as the comb 45, of the carriage shift coupling 26, has released the coupling lever 44, in the manner already described and the latter is swung in the clockwise direction, the lever, 267, (Fig. 14) is also swung in the clockwise direction, whereby the parts, 261, 260, 259, 238, 238a, are moved so far under the action of the tensioned spring, 283, (Fig. 14) until the part, 224, of the draw key, 224, 225, lies against the rotating toothed wheel, 219, (Fig. 12), as the recess, 222, of the toothed wheel, 219, does not yet lie opposite to the part, 224, of the draw key, 224, 225. As soon as the carriage B is located in its left hand position, in which position the recess, 222, of the toothed wheel, 219, is opposite to the part 224, of the draw key, 224, 225, the parts, 260, 259, 238, 238a, 224, 225, return into their normal position illustrated in Fig. 14, as in the meanwhile the toothed wheels, 220, 219, have concluded their rotation, and the draw key, 224, 229, can enter into the recess, 222, Fig. 14, of the toothed wheel, 219.

Shortly before the totalizer carriage B has moved into its left hand position the guide member, 730, (Fig. 33) arranged on the totalizer carriage B acts on the two-armed lever, 727, and swings the lever, 727, round the screw, 726, in the anti-clockwise direction against the action of its spring 729, whereby the lug, 725, of the lever, 727, moves out of the path of movement of the part, 724, of the lever, 699. This and the parts, 698, 699, can now swing a little in the anti-clock-

wise direction round the shaft, 582, under the pull of the springs, 847, 850 (Fig. 28), whereby the recess, 760, of the pawl, 719, (Fig. 33) which is swingably arranged on the yoke consisting of the parts 699, 698 and 689, contacts with the lug, 759, of the slide, 734, as shown in Fig. 33. Now the pawl, 719, prevents the returning of the yoke, 689, 698, 699.

10 Since the multiplication key, 11, is still depressed as it has often hereinbefore been mentioned so the motor contact, 362, 364, is still closed so that the machine can carry out its operation further, and more-

15 over as above described, as the differential mechanism actuating coupling, 52, is coupled with the main driving shaft, 3, so the toothed wheel, 56, which is in fixed relationship with the differential mech-

20 anism actuating coupling, 52, drives the toothed wheel, 78, whereby the connecting rod, 124, attached to the disc, 117, rigidly mounted on the shaft, 116, is acted upon in the direction of the arrow "f" (Fig.

25 5) whereby the proportional rack system is operated in the manner described in Patent Specification No. 365,058. Through the rotation of the wheel, 78, (Fig. 8) the eccentric shaft 19, is also

30 driven in the direction of the arrow "m" through the bevel wheels, 79, and 133, and consequently also the toothed wheel, 619, (Figs. 40, 34) fixed to this shaft. The latter rotates through the intermedi-

35 ate toothed wheels, 618, 617, the toothed wheel, 614, round the screw, 615, in the direction of the arrow "p" indicated in Fig. 34. By means of the eccentric (not shown) formed on the toothed wheel, 614,

40 the lever, 610, is acted upon in the upward direction, whereby it is simultaneously swung round the screw, 611, and acts in each revolution of the eccen-

45 tric shaft, 19, on the toothed wheel, 606, which lies opposite to it, and rotates the same as well as the shaft, 497, and the zero disc, 627, of the right hand denomi-

50 national place in the direction of the arrow indicated in Fig. 21, according to the chosen example with the multiplier "25" from 5 to "0" i.e. until the tooth

55 space, 609, of the toothed wheel, 606, of the right hand denominational place, lies opposite to the lever, 610. During the process just described the proportional

60 rack system is moved five times to and fro, whereby the value "25" set up in the multiplicand set of keys "Mu" is transmitted five times through the

65 toothed wheels, 159, 156, 158, into the result totalizer R in the manner described in Patent Specification No. 365,058, whereby in the result totalizer R, the value "625" is visible in the three right hand denominational places.

Immediately after the commencement of the last movement of the differential mechanism, the zero disc, 627, of the right hand denominational place is rotated by the lever, 610, into the zero position illustrated in Figure 29, i.e. the normal position. Now, the flap, 739, can swing in the anti-clockwise direction round the shaft, 388, under the action of the tensioned springs, 735, 850, which act on the slide, 734, whereby the lug, 759, of the slide, 734, moves out of the recess, 760, of the pawl, 719, mounted on the lever, 699. This, however, cannot yet swing back round the shaft, 583, under the action of the springs, 735, 850, completely into the normal position, since the disc, 117, (Figure 24) with its full circumference holds the lever, 130, 131, 132, swung in the clockwise direction, whereby the rod, 687, is held displaced in the opposite direction of the arrow "a" by way of the parts, 322, 397, (Figure 26), 391, 640, 639, 634, 683 (Figure 28) and 685. Accordingly, since the part, 692, lies still with its lug, 692g, behind the lug, 687p, of the rod, 687, swinging of the yoke, 699, 698, 689, in the anti-clockwise direction is also prevented.

Since the recess, 628g, (Figure 33) of the right hand zero disc, 627, has not such a deep recess as the other zero discs, 627, the flap, 739, under the action of the tensioned spring, 735, can only swing rather a little in the anti-clockwise direction, whereby the edge, 743y, (Figure 32) of the lever, 743, comes to rest directly under the lug, 748, of the angle member, 750, mounted on the lever, 749, and co-operates in the last part of the movement of the proportional rack system, and in the last revolution of the eccentric shaft, 19, in the following manner.

The lug, 748, of the angle member, 750, in consequence of the action of the cam disc, 756, on the roller, 755, of the lever 749, presses on the edge, 743y, of the lever, 743, and swings the coupling lever, 44, through the parts, 746, 265, only so far in the anti-clockwise direction round the shaft, 265, against the action of the spring, 342, which in consequence of holding the multiplication key, 11, depressed was tensioned, that the coupling lever, 44, lies under both of the noses, 42 and 70, of the carriage shift coupling, 26, and of the differential mechanism actuating coupling, 52, and consequently these are uncoupled from the main driving shaft, 3, even though the multiplication key, 11, is held further depressed.

As mentioned previously, the rod, 687, (Fig. 28) in the swinging movement of the yoke, 689, 698, 699, in the clockwise

direction round the shaft, 583, has been moved downwards, whereby it has moved out of the working position in relation to the locking pawl, 762, and is only held
 5 in its working position by the lock formed on the one hand by the lever, 692, and on the other hand by the lock, consisting of the levers, 130, 132, (Fig. 24) through the intermediary of the parts, 322, 397,
 10 (Fig. 27) and 639, so that therefore the multiplication key, 11, is still held in its depressed position.

As soon as the disc, 117, (Fig. 24) has been rotated so far in its last revolution
 15 that the lug, 123, of the lever, 130, can fall into the recess, 127, of the disc, 117, which under the action of the spring, 398, engaging on the one hand with the part, 401, (Fig. 27) of the multiplication
 20 lever, 634, and on the other hand with the pin, 399, of the control lever, 391, is possible as the spring, 398, acts upon the control lever, 391, in the anti-clockwise direction round the shaft, 310, and
 25 upon the lever, 634, in the clockwise direction round the shaft, 636, and the locking bar, 322, is thus swung in the clockwise direction in consequence of the action of the control lever, 391, under
 30 the action of the spring, 398, against the lug, 397, of the lever, 323, rigidly mounted on the key locking bar, 322. The lever, 334, (Fig. 24) rigidly mounted
 35 on the locking bar, 332, (Fig. 24) likewise participates in this swinging movement, whereby the parts, 335, 336, 339, 340, 342, 344, return into their rest position.

In the swinging movement of the
 40 multiplication lever, 634, (Fig. 26) after release through the lock, 117, (Fig. 24) 130, 132, in the clockwise direction under the action of the spring, 398, (Fig. 26) the lever, 685, (Fig. 28) is swung in the
 45 anti-clockwise direction round the shaft, 687a, whereby the rod, 687, engaging with it, is displaced in the direction of the arrow "a". Simultaneously, the yoke, 689, 698, 699, (Fig. 23) under the
 50 action of the tensioned springs, 735 and 850, is swung round the shaft, 583, in the anti-clockwise direction, whereby the lower edge of the bridge, 698, of the yoke, 689, 698, 699, acts on the edge, 697, (Fig.
 55 23) of the lever, 692, which is jointed by means of a screw, 690, to the lever, 689, and swings this round the screw, 690, in the anti-clockwise direction against the action of the spring, 695. Hereby, the
 60 lug, 687p, of the rod, 687, is released by the projection, 692g, of the lever, 692, so that the parts, 692, 687, 685, 689, 698, 699, can swing back completely into their normal position. It is however not
 65 possible for the yoke, 689, 698, 699, to

return to its normal position without bringing back the bar, 687, and herewith the multiplication lever, 634, and vice versa.

In the above mentioned swinging move-
 70 ment of the lever, 339, (Fig. 24) in the clockwise direction round the shaft, 338, the parts, 351, 353, 347, return into their rest position under the action of the
 75 spring, 350, engaging with the lever, 347, as soon as the arm, 21, of the lever, 22, at an appropriate moment slides at, 20g, on to the curve, 20h, of the cam, 20. If
 80 this takes place the curve, 20h, then swings the lever, 22, in the clockwise direction round the point, 23g, whereby the contact springs, 361, are pressed together, and the contact 362, 364, is
 85 opened so that the motor D again comes to rest. When the curve, 20h, has swung the lever, 20, completely out, then it slides under the action of the spring, 350, again on to the periphery of the cam, 20, whereby all the mechanisms again take
 90 up their rest position and the multiplication calculation is finished.

On the return of the multiplication key
 lever, 634, (Fig. 26) into its rest position, the pin, 641, riveted to the multiplication
 95 lever, 634, acts on the control lever, 644, whereby the same through the parts, 645 (Fig. 26), 646, 649, 651, 663 (Fig. 34), 666, brings back the releasing bar
 100 part, 418A of the releasing bar 418, into the position illustrated in Fig. 34. Moreover, through the parts, 651, 653, 655, the part 655a, of the part, 655, is brought again into engagement with the recess,
 657, (Fig. 26) of the sleeve, 658, where-
 105 upon these parts also have again taken up their rest position.

It may be mentioned at this point, that as the lever, 14, (Fig. 26) is shifted rearwardly for positive multiplication the pin, 831, (Fig. 28) of the lever, 14, is
 110 therefore swung forwardly, and just the edge, 831g, (Fig. 26) of the lever, 839, swingable around the screw, 844, (Fig. 28) lies on the pin, 831, of the lever, 14, while the rearwardly directed end of the
 115 lever, 839, (Fig. 28) under the action of the spring, 847, bears upwards against a pin, 849, arranged on the lever, 689. If now, the lever, 839, is displaced in the direction of the arrow "a" through the
 120 lever, 842, rigidly mounted on the shaft, 300, which is the case when the proportional rack system before its second movement is changed over for subtractive operation, then the edge, 831g, (Fig. 26)
 125 slides along on the pin, 831, without the recess, 840, of the lever, 839, being capable of embracing the pin, 831, of the lever, 14. This arrangement is described under the heading automatic negative 130

division.

The locking operations which occur on depression of the multiplication key, 11, will now be described.

5 As already mentioned, on depression of the multiplication key, 11, (Figs. 1, 2), the control lever, 391, was swung in the anti-clockwise direction by means of the pin, 639, (Fig. 26) arranged on the lever, 634, whereby the face, 391a, moves under-
10 neath the pin, 405, arranged on the division lever, 404. If now pressure is applied to division key, 12, inadvertently it is not possible to depress it, as the pin, 405, of the division key lever, 404, lies
15 on the edge, 391a, of the control lever, 391.

Depression of the revolutions-register control key, 13, is likewise not possible as
20 this in the swinging movement acts on the bent lug, 829, (Fig. 26) on the lever, 814. This, however, cannot be swung downwards round the shaft, 636, as the pin, 821, riveted to the lever, 814, acts
25 on the face, 824a, of the lever, 824, mounted on the shaft, 310, and the shaft, 310, cannot be rotated, as the lug, 940a, on the lever, 940, (Fig. 24) which is rigidly mounted on the shaft, 265, in the
30 swinging movement of the shaft, 265, (Fig. 24) in the clockwise direction in consequence of the multiplication key being held in the depressed position, has entered into the recess, 937, of the part,
35 936, of the rod, 934, which is in articulated connection with the lever, 933, rigidly mounted on the shaft, 310.

On depression of the multiplication key, 11, as already mentioned, the locking
40 bar, 322, under the pull of the spring, 393, engaging with it, and with the control lever, 391, is swung in the anti-clockwise direction, whereby the same moves under the lug, 316a, (Fig. 24) of
45 the lever, 316. If now, it is attempted to depress the addition key, 4, or the subtraction key, 5, depression is not possible, as on the depression of the addition key, 4, the riveted pin, 313, acts on the edge,
50 314, of the lever, 316, and on the depression of the subtraction key, 3, the pin, 430, likewise acts on the edge, 314, of the lever, 316. The latter, obviously, cannot be swung round its pin, 315, as the lug,
55 316a, of the lever, 316, hereby lies on the edge, 322a, of the locking bar, 322, swung in the anti-clockwise direction, consequently depression of the subtraction key, 5, and of the addition key, 4, is not
60 possible.

Depression of one of the keys, 7 and 8, for zeroizing the result totalizer R, and the revolutions-register U, is not possible
65 ing "Addition" for which reason it will

not be again considered here. On the same ground the locking of the "3x Mult" key, 9, shall not be considered.

A swinging movement of the lever, 16, (Fig. 21) during the multiplication process is possible, as the parts acted on by it namely, the zeroizing keys, 7 and 8, for the result totalizer R and the revolutions-register U are themselves locked in the manner above described. A swinging
70 movement of the lever, 17, is likewise not possible, as the same in consequence of the addition key, 4, and the subtraction key, 3, being held locked can never be swung downwards. The lever, 14, is held
75 in its set position by means of a stop lever, 834, (Fig. 26).

AUTOMATIC "NEGATIVE" MULTIPLICATION.

In automatic "negative" multiplication it is first of all necessary to swing
80 the lever, 14, (Fig. 26) forwards round its screw, 830, whereby the pin, 831, riveted to the lower end of the lever, 14, moves out of the stop, 832, of the stop lever, 834, and into the stop, 833, of the
90 same. Simultaneously, it moves under the edge, 839a, of the lever, 839. Since the pin, 811, of the lever, 14, projects into the elongated hole, 810, of the lever, 808, swingably mounted on the division
95 key lever, 404, the same on the swinging movement of the lever, 14, round the screw 830, in the anti-clockwise direction is swung round its point of articulation 810a, in the clockwise direction, whereby
100 its nose 812, is moved away from the lug, 813, of the lever, 814. This, however, is without influence on the multiplication.

The negative multiplication will be explained by aid of the example (25×25)
105 $-(15 \times 25)$.

Let it now be assumed that the result "625" formed from the product of
"25 x 25" from the preceding multiplication is still in the result totalizer R. Now the multiplier "15" is set up in the two right-hand calculating places in the
110 left hand multiplier set of keys "Mk" and in the two right-hand calculating places of the multiplicand set of keys "Mu", the multiplicand "25" with the object of performing the second calculation— (15×25) .
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The multiplication key 11 is now depressed whereby the same mechanisms are
120 actuated as were described in detail in the preceding example. Now in the first movement of the proportional rack system as already described, the multiplier "15" and the multiplicand "25" are
125 transmitted in the result totalizer, R. Then follows the changing over already described of the proportional rack system to "Subtraction". During the second movement of the proportional rack system
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the cam 723, rigidly mounted on the control shaft 587 (Fig. 30) acts on the yoke 722, 699, 693, 689, and swings the same round the shaft, 583, in the clockwise direction. Hereby the pin, 849, (Fig. 28) arranged on the lever, 689, is likewise swung in the clockwise direction. As the lever, 839, is held in contact with the pin 849 of the lever 689, by means of the spring, 847, the lever 839, follows the movement of the pin 849, and consequently is swung round the screw 844, in the anti-clockwise direction, whereby its recess 840, embraces the pin, 831, of the lever 14, which is possible since the lever 839, during the changing-over of the proportional rack system prior to the second movement of the proportional rack system for subtractive operation was likewise displaced in the direction of the arrow "a" through the lever, 842, whereby the recess, 840, of the lever, 839, comes to rest over the pin, 831, of the lever, 14.

After the termination of the second movement of the proportional rack system in the previous example the changing over of the proportional rack system from subtraction to addition is effected automatically, in this case, however, the changing over cannot take place since the recess, 840, of the lever, 839, embraces the pin, 831, of the lever, 14, and a displacement of the parts, 839, 376, 369, in the opposite direction to that of the arrow "a" is thus prevented and consequently the rack, 367b, (Fig. 24) remains coupled with the pin, 372, so that therefore in the succeeding movement of the proportional rack system the machine operates in the negative sense.

Shortly before completing the last movement of the proportional rack system the yoke, 689, 698 and 699, as already mentioned in the preceding example, is again swung in the anti-clockwise direction. As the pin, 849, (Fig. 28) of the lever, 689, hereby acts on the lever, 839, the latter is thus swung in the clockwise direction round the screw, 844, whereby its recess, 840, releases the pin, 831, of the lever, 14. At the same instant the parts, 839, 369, 376, under the action of the spring, 859, engaging with the pin, 856, of the lever, 854, are displaced in the opposite direction to the arrow "a" whereby the proportional rack system is again changed over for addition. Otherwise, the same mechanisms are released as hereinbefore described in positive multiplication, for which reason the same at this place will not be further gone into.

MULTIPLICATION INTERRUPTION.

Multiplication interruption has the object of stopping the machine, after the introduction of the multiplier into the

result totalizer R, and the withdrawal of the same again from the result totalizer R, with simultaneous introduction into the multiplier mechanism. This comes into question when the multiplicand, for example, has more than eight places, and therefore must be set up partly in the multiplier set of keys "Mk", whereby a simultaneous setting of the multiplier and multiplicand is not possible, since after transmission of the multiplier, the multiplier set of keys "Mk" as already described under the heading "Automatic Multiplication" is cleared and thus a part of the multiplicand, if it has more than eight places, would be cancelled along with the multiplier. In the following the setting and processes only will be described which take place in the interruption of the multiplication.

To this end, first of all, the multiplier for example "25" is set up in the multiplier set, of keys "Mk" and the multiplication interruption lever, 15, (Fig. 26) is moved in the opposite direction to the arrow "a" from the position, shown in Fig. 26, into the position shown in Fig. 27a whereby the edge, 15a, of the lever, 15, is raised from the lug, 768, of the multiplication lever, 634, and the edge, 15b, of the multiplication interruption lever, 15, is moved on to the lug, 769, of the multiplication lever, 634, whereby it is held in this position by the torsion spring, 767. Now the multiplication key, 11, is depressed, whereby the multiplication interruption lever, 15, and the multiplication lever, 634, take up the position illustrated in Fig. 27b. Since in the depression of the multiplication key, 11, the same processes take place as described under the heading "Automatic Multiplication" in the following these will only be referred to as far as it is necessary for understanding the process of multiplication interruption.

On depression of the multiplication key 11, the forwardly shifted multiplication interruption lever 15 which likewise participates in the swinging movement of the multiplication lever, 634, is moved so that its nose, 770, (Fig. 27b) acts on the lug, 397, of the lever, 323, which is rigidly mounted on the key locking bar, 322.

On the depression of the multiplication key, 11, the motor contact, 362, 364, is now closed through the parts, 639 (Fig. 26), 391, 393, 397, 322 (Fig. 24), 310, 334, 335, 336, 351, 353, 347, 348, 23, 22, and the differential mechanism actuating coupling, 52, is coupled with the main driving shaft, 3, through the parts, 639, (Fig. 26) 391, 393, 397, 322, (Fig. 24), 310, 334, 335, 336, 339, 340, 342, 344, 265

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and 44, and the motor commences to rotate so that the machine can now perform both movements of the proportional rack system. In the first, the multiplier is transmitted into the result totalizer R, and in the second movement of the proportional rack system, it is withdrawn again with simultaneous introduction into the multiplier mechanism, whereby the processes described under the heading "Automatic Multiplication" take place. Shortly before the completion of the revolution of the control shaft, 587, (Fig. 34) the part, 678, of the cam, 680, comes into operation on the lever, 677, whereby the multiplier set of keys "Mk" is released through the parts, 676, 675, 674, 673, 418A. Hereby, the key locking bar, 322, is swung in the anti-clockwise direction against the action of the spring, 393, (seen in Fig. 34) which is possible, as shortly before the termination of the second movement of the proportional rack system the lug, 128, (Fig. 24) of the lever, 130, has entered into the recess, 127, of the disc, 117, that is the locking of the key locking bar, 322, is released. In the swinging movement of the key locking bar, 322, in the clockwise direction (as seen in Fig. 34) the lever, 334, obviously participates and swings the lever, 336, in the clockwise direction (seen in Fig. 24) round the shaft, 338, into its normal position by means of the rod, 335, whereby the tension of the spring, 342, is partly released, since shortly before the completion of the second revolution of the eccentric shaft, 19, (Fig. 30) the cam disc, 756, arranged on the same, acts on the roller, 755, of the lever, 749, and swings this and the angle member, 750, mounted on it in the anti-clockwise direction against the action of the spring, 754. Hereby the lug, 748, of the angle member, 750, acts on the edge, 757g, of the lever, 757, which swings the lever, 344, against the action of the spring, 342, (Fig. 24) by means of the parts, 746, 265, (Fig. 30), since the zero disc, 627, of the second denominational place from the right when the multiplier is "25" was rotated through two units during the introduction of the multiplier into the multiplier mechanism, and the slide, 703, was displaced through the part, 712, 705, in the opposite direction of the arrow "a", and in consequence of the pin slot connection, 703m, 758, the lever, 757, was swung round the screw, 744, in the anti-clockwise direction. In this swinging movement, obviously, the coupling lever, 44, also participates and releases the nose, 42, of the pawl, 37, of the carriage coupling, 26, (Fig. 7) and couples this with the main driving shaft, 3, whilst simul-

taneously, the differential mechanism actuating coupling, 52, is uncoupled from the main driving shaft, 3.

Now the first carriage step to the right is effected, whereby the lever, 630a, (Fig. 31) slides from off the face, 716, of the flap, 712, so that this since the other remaining zero discs, 637, stand at zero, can swing out in the anti-clockwise direction round the shaft, 388, under the action of the spring, 715, and can move the slide, 703, in the arrow direction "a", whereby in consequence of the pin slot connection, 703m, 758, the lever, 757, is swung in the clockwise direction round the screw, 744, and its nose, 757g, slides off from the lug, 748, of the angle member, 748, 750. Now the parts, 746, (Fig. 31) 265, (Fig. 24) 44, can return in the clockwise direction under the action of the tensioned spring, 342, into the normal position so that the pin, 346, lies against the part, 340, whereby the coupling lever, 44, moves under the nose, 70, of the pawl, 65, of the differential mechanism actuating coupling, 52, and also under the nose, 42, of the pawl, 37, of the carriage shift coupling, and uncouples these from the main driving shaft, 3.

Since as already described the motor contact, 362, 364, was opened through the swinging movement of the key locking bar, 322, (Fig. 24) in the clockwise direction, the machine comes to rest, as during the swinging movement of the key locking bar, 322, the edge, 770a, of the nose, 770, (Figs. 27b, 27) of the multiplication interruption lever, 15, under the action of the spring, 767, has moved in front of the lug, 397, of the lever, 323, (Fig. 27) attached to the locking bar, 322, and thus has not permitted the key locking bar, 322, to swing back in the anti-clockwise direction (seen in Fig. 26) so that the motor contact, 362, 364, cannot be closed and consequently also the differential mechanism actuating coupling, 52, cannot be coupled with the main driving shaft, 3, and consequently the machine comes to rest.

On the swinging movement of the key locking bar, 322, (Fig. 26) round the shaft, 310, against the action of the spring 393, the parts 391, 634, could not follow, since the lock hereinbefore described, formed by the parts 725 (Fig. 31), 724, 699, 698, 689 (Fig. 28), 692, 692g, 687p, 687, and 690, prevents an upward movement of the multiplication key lever by means of the parts, 685, 683. Now the multiplicand of more than 8 places is set up partly in the multiplicand set of keys "Mu" and partly in the multiplier set of keys "Mk." It is now only necessary to swing the lever, 15, in the

clockwise direction and then to move to the rear in order to set the machine again into operation.

On the swinging movement of the multiplication interruption lever, 15, in the clockwise direction the same is raised from the lug, 769, (Fig. 27) of the multiplication key lever, 634, and brought to rest on the lug, 768, as is evident from Fig. 26, whereby the multiplication key, 11, is held however in the depressed position as has been said above.

In this position, the multiplication interruption lever 15, is held by the torsion spring, 767. In this changing over of the multiplication interruption lever, 15, the nose, 770, of the same (Figs. 26, 27) releases the lug, 397, of the lever, 323, arranged on the key locking bar, 322, so that the same under the action of the spring, 393, can swing in the anti-clockwise direction round the shaft, 310. Hereby, the motor contact, 362, 364, is again closed through the parts, 310, 334, 335, 336, 351, 353, 347, 348, 23, 22 (Fig. 24), and the differential mechanism actuating coupling, 52, is coupled with the main driving shaft, 3, through the parts, 310, 334, 335, 336, 339, 340, 342, 344, 265, and the machine is thus set in operation.

Hereby the same processes are now released which were already described under the heading "Automatic Multiplication" on which account they will not be further gone into in detail here.

When the machine is set for minus multiplication and the multiplication interruption lever 15, is brought into the working position in order to interrupt multiplication, hereby the same processes then are enacted as above described, only with this difference, that the proportional rack system and revolutions-register as described with reference to minus multiplication operate in the negative sense. For this reason these shall not be further gone into.

When several calculations with interruption of the multiplication are to be performed it is only necessary after the machine has come to rest during the first calculation, after the introduction and withdrawal of the multiplier into and out of the result totalizer, R, to press the multiplication interruption lever, 15, downwards whereby the locking bar, 322, under the action of the spring, 393, as already mentioned, can swing out and set the machine into operation again. As soon as the multiplication lever, 15, has been released again, the same under the action of the spring, 767, is again swung round the point, 765, in the anti-clockwise direction, and its nose 770, comes into contact with the lug, 397, of the

locking bar, 322. When after the termination of the first calculation the multiplication key, 11, springs back into its normal position, the multiplication interruption lever, 15, is then, under the action of the spring, 767, brought into the position represented in Fig. 27 in relation to the multiplication key lever, 634, which has not yet been again depressed. After depression of the multiplication, key 11, for the purpose of working out the second example of calculation to be executed with multiplication interruption, the multiplication key lever, 634, and the multiplication interruption lever, 15, again take up the position represented in Fig. 27, and the processes already mentioned are enacted again. If the lever, 15, is swung fully to the rear, as already mentioned, multiplication without interruption is carried through to the end.

It is obvious without adding anything further, that the locking operations occurring in interruption of the multiplication of the remaining operation keys are the same as those described for multiplication, so that these also will not be described again at this place.

THREE-FACTOR MULTIPLICATION.

The manner of operation of the single operated mechanism in the "3x Mult." Multiplication will be described with the aid of an example, and it will be assumed that the example $25 \times 22 \times 12 = 6600$ is to be calculated by the machine. To this end, the lever, 15, is set forward at "Multiplication Interruption" and in the two right hand places of the multiplier set of keys "Mk" the multiplier "25" is set up.

Hereupon the multiplication key, 11, is depressed, whereby the multiplier "25" as described under the heading "interruption of the multiplication process" is introduced into the multiplier setting mechanism, the carriage is moved one denomination to the right hand side and the machine comes into its rest position.

Now the multiplier "22" is set up in the two right hand calculating places of the multiplier set of keys "Mk" and the multiplication interruption lever, 15, is swung rearwardly, whereby the machine again becomes operative.

In the swinging movement of the multiplication interruption lever, 15, in the clockwise direction and to the rear the same is raised from the lug, 769, of the multiplication lever, 634, and brought into contact with the lug, 768, as is evident from Fig. 26, whereby the multiplication key, 11, is held nevertheless in the depressed position, as has been mentioned. In this change-over of the multi-

plication interruption lever the nose, 770, or the same (Fig. 27) releases the lug, 397, of the lever, 323, mounted on the key locking bar, 322, whereby as already described under the heading "Multiplication", the motor contact, 362, 364, is again closed and the differential mechanism actuating coupling, 52, is again coupled with the main driving shaft, 3, and the machine is thus set into operation.

Hereby the same processes are released as already described under the heading "Automatic Multiplication" on account of which they will not be gone into in greater detail at this place. Hereby the carriage has moved into its normal position.

In the three right-hand calculating places of the result totalizer R, which lie opposite to the multiplier set of keys "Mk" the result "550" is consequently visible. This is now to be transmitted into the multiplier mechanism which end is obtained by depressing the "3x Mult" key, 9, whereby the following processes are enacted.

On the depression of the "3x Mult." key, 9, the lever, 563, (Fig. 21) is swung round the shaft, 444, in the clockwise direction, whereby the connecting rod, 575, jointed to it is moved downwards, whereby the lever, 576, jointed to the lower end of the connecting rod, 575, and rigidly mounted on the shaft 578, is swung in the anti-clockwise direction. In this swinging movement the shaft, 578, and the lever, 580, rigidly mounted on the shaft, 578, are swung in the anti-clockwise direction. Consequently the lever, 582, which lies on the lug, 581, of the lever, 580, is swung in the clockwise direction round the shaft, 583, against the spring, 586, engaging with the lever, 585, whereby the lever, 590, in consequence of the action of the mouth, 589, of the lever, 582, on the pin, 591, of the lever, 590, is swung in the anti-clockwise direction round the shaft, 388. Hereby the bridge, 592, of the yoke consisting of the parts, 590, 592, 593, acts on the lever, 610, and swings the same against the action of the spring, 613, into the position represented in dotted lines in Fig. 23, so that the lever, 610, moves out of the working position in relation to the toothed wheel, 606.

In the swinging movement of the lever, 590, in the anti-clockwise direction around the shaft, 388, the toothed wheels, 607, are coupled through the intermediary of the parts, 596, 601 and 604, with the internal gear, 608, of the numeral wheels, 499M.

On the swinging movement of the key

lever, 563, round the shaft, 444, in the clockwise direction, the pawl, 568, mounted on the key lever, 563, is swung downwards (Fig. 22). Hereby, the pawl slides with the rear side of the bridge, 568a, on the pin, 565, rigidly mounted on the supporting frame, 285, whereby the pawl, 568, is swung around the screw, 567, in the anti-clockwise direction and against the action of the spring, 568p, engaging with the U-shaped part, 568b. Hereby the pin, 570, of the zeroizing key lever, 443, for the result totalizer R, is embraced by the recess, 569, of the pawl, 568, and this lever is likewise swung round the shaft 444, in the clockwise direction against the spring, 448, engaging with the bridge, 445. The downwardly projecting end, 450, of the zeroizing key lever, 443, thus draws the connecting rod, 451, (Fig. 19) in the opposite direction to that of the arrow "a", whereby as already described under the heading "Zeroizing" mechanism for the result totalizer R the result totalizer R is zeroized. Since now the coupling of the numeral wheels, 499R, of the result totalizer R was effected previously with the toothed wheels, 607, and consequently with the toothed wheels, 606, so the value "550" in the result totalizer R is transmitted to the multiplier mechanism, 606.

It may be mentioned at this place, that the numeral wheels, 499R, show the real value whilst the numeral wheels, 499M, show the complement value.

The bar, 113, (Figure 19) is already described under the heading "Zeroizing Mechanism for the Result Totalizer R" holds the lever, 358, during the first half revolution of the zeroizing coupling, 83, fast in the zeroizing position. The connecting rod, 451, is also thereby held in the forward drawn position. Since through depression of the key, 9, (Figure 21) the part, 568, was also moved downwards, the same had been swung by the pin, 565, in such a manner, that the pin, 570, of the key lever, 443, is embraced from above and below. In consequence of this the key lever, 563, is held in its depressed position through the key lever, 443, and the pin, 565, 568.

By this mechanism the toothed wheels, 606, of the multiplier mechanism are therefore held in coupled relationship with the numeral wheels, 499R, of the result totalizer R, until the transmission is effected, and the numeral wheels, 499R, are rotated back to zero, on which the pawl, 112, releases the lever, 358, and the parts can return into their rest position.

If it is desirable to zeroize the revolutions-register U upon depressing the key,

9, it is only necessary to adjust the lever, 16, which is mounted on the lever, 563, before the key, 9, is depressed so that its projection, 573, comes to lie over the bridge 509, of the bail, 514—509—510, of the key, 8, for zeroizing the revolutions-register U.

The lever, 16, is held in its adjusted position so that its swelling, 572a, enters in a corresponding hole, shown in Figure 21. In Figure 21, the lever, 16, is so adjusted that if the key, 9, is depressed, the revolutions-register zeroizing key, 8, is also moved downwards, whereby upon this the described zeroizing in the result totalizer R, and also the zeroizing of the revolutions register U take place simultaneously.

If zeroizing of the revolutions-register U is undesirable, the lever, 16, is rocked in the anti-clockwise direction, whereby its swelling enters into the hole, 572b, and its projection, 573, cannot act upon the bridge, 509, of the bail, 514—509—510, of the revolutions-register zeroizing key 8.

In the present case it may be assumed, that the revolutions-register U, in which after the multiplication 25×22 the multiplier "25" was contained, likewise was zeroized.

Now the third value "12" is set up in the two right hand places of the multiplicand set of keys "Mu" and the multiplication key, 11, depressed, whereby the processes take place which were described under the heading "Automatic Multiplication" and which will not be gone into here in detail. It may only be mentioned that in the first movement of the proportional rack system only the value "12" set up in the multiplicand set of keys "Mu" is brought into the result totalizer R, and in the second movement is again brought out of the result totalizer, R. Moreover it may be remarked, that in the first additive movement of the proportional rack system as no value is set up in the multiplier set of keys "Mk" the corresponding numeral wheels, 499R, of the result totalizer R, have not been rotated. These are, nevertheless, in the second subtractive movement of the proportional rack system rotated from "0" to "0", i.e. through a whole revolution. The toothed wheels, 606, of the multiplier mechanism coupled with the numeral wheels, 499, participate naturally in this rotational movement. Since now, all of these rotate through a complete revolution, in this manner no false values can be brought into the multiplier mechanism, 606. For the remainder as above mentioned the same processes take place. In the four right

hand calculating places of the result totalizer R, the result "6600" is now visible, and the multiplication is completed. Hereupon the multiplier "550" is visible in the revolutions-register U. REVOLUTIONS-REGISTER CONTROL KEY.

The revolutions-register control key, 13, (Fig. 1) influences the position of the control rod, 304, (Figs. 46 to 50) or the bent lugs, 305, 306, of the same in relation to the lever, 301. The lever, 301, in its different positions, in relation to the lugs, 305, 306, of the rod, 304, controls the driving gear, 135, 163, (Fig. 10) of the revolutions-register U, and is represented diagrammatically in Figs. 46 to 50.

In the normal position, or with depressed addition key, 4, and depressed multiplication key, 11, the control lever, 301, takes up in relation to the control rod, 304, the position represented in Fig. 46. If now for example the revolutions-register U for any reason is not to operate, then the revolutions-register control key, 13, is depressed so far round the shaft, 636, (Fig. 26) in the anti-clockwise direction until the guide plate, 635, (Fig. 26) is engaged in the stop, 827, of the key lever, 819, and the spring, 817, holds this in this position in consequence of the elongated hole, 825a.

In this swinging movement of the key lever, 819, the lower edge of the same acts on the bent lug, 829, of the lever, 814, whereby the lever, 814, is swung around the shaft, 636, in the anti-clockwise direction. Hereby the pin, 821, (Fig. 26) riveted to the lever, 814, acts on the edge, 824a, of the lever, 824, rigidly mounted on the shaft, 310, whereby this and the shaft, 310, are swung in the clockwise direction. In this swinging movement, also, the lever, 933, (Fig. 24) rigidly mounted on the shaft, 310, participates, whereby the rod, 934, is displaced in such a manner, that the recess, 938, of the same lies above the lug, 941, of the lever, 940, rigidly mounted on the shaft 265. When the lug, 941, of the lever, 940, after swinging of the same in the clockwise direction in consequence of the coupling of the differential mechanism actuating coupling, 52, with the main driving shaft, 3, after depression of one of the operation keys, enters into the recess, 938, of the part, 936, the parts, 934, 933, 310, 824, are held locked in position.

In the swinging of the shaft, 310, the lever, 308, which is rigidly mounted on the same, also participates. The pin, 309, of this lever, acts on the slot, 307, of the control rod, 304, and since in the downward movement of the control rod, 304,

into the position represented in Fig. 50 the inclined edge, 304g, slides along on the stub shaft, 312, the control rod, 304, is acted upon in the opposite direction of the arrow "a". The draw key, 136, 170, (Fig. 10), however, has been moved only so far to the left, through the angle lever, 177, that it takes up the position represented in Fig. 11a, whereby it is located neither in the groove, 161, of the toothed wheel, 135, nor in the groove, 165, of the toothed wheel, 163, that is, neither of the toothed wheels 135 or 163, have been coupled with the draw key bush, 160, so that no transmission to the actuating and tens transfer shaft, 178, can result, and consequently the numeral wheels of the revolutions-register U cannot make any revolutions. The revolutions-register U is consequently cut out which in many cases is very desirable. At the same time, it is entirely immaterial in which position the parts, 301, 304, on depression of the revolutions-register control key, 13, are exactly located. If, for example, they are located in the position represented in Fig. 47, then the edge, 304a, slides along on the stub shaft, 312, and effects the cutting out of the revolutions-register U. In Fig. 49, this is caused through the edge, 304h, and in Fig. 48, through the edge, 304m.

If now, the revolutions-register control key, 13, (Fig. 2) is fully depressed, in which position it is held by the engagement of the guide plate, 635, (Fig. 26) and its stop, 826, under the action of the spring, 817, then the control rod, 304, (Fig. 46 to 50) is moved through the described parts, 814, (Fig. 26) 821, 824, 310, (Fig. 26) 308, 309, (Fig. 49) by the stub shaft, 312, sliding along on the edge, 304g, into the position represented in Fig. 48, in which case the control rod, 304, moves the draw key, 136, 170, so far to the left through the angle lever, 177, (Fig. 10) that the draw key, 136, 170, couples the toothed wheel, 135, with the draw key bush 160, so that in consequence of this the revolutions-register U operates in the negative sense.

With depressed subtraction key, 5, the control lever, 301, takes up in relation to the control rod, 304, the position represented in Fig. 47. If now, the revolutions-register control key, 13, is once more half depressed, then the control lever, 301, and the control lever, 304, take up the position represented in Fig. 50, in which case as already described the revolutions-register U is cut out.

If this, however, is to operate in the additive sense, then the revolutions-register control key, 13, is fully depressed whereby the control lever, 301, takes up

the position illustrated in Fig. 49 in relation to the control rod, 304.

In automatic multiplication, the control lever, 301, with the revolutions-register control key, 13, half depressed, takes up, as in addition, the position represented in Fig. 50 and with fully depressed revolutions-register control key, 13, the position illustrated in Fig. 48 in relation to the control rod, 304, whereby the revolutions-register U is cut out or set for subtractive operation. As the processes are the same as described for addition, these shall not be further gone into.

With depressed revolutions-register control key, 13, (Fig. 26) all the other keys may naturally be depressed.

DIVISION.

On setting up the values in the keyboard for the purpose of performing division the dividend is set up in the seven left-hand places on the keyboard T of the division set of keys "Dt" and the divisor in the nine right-hand places on the keyboard T of the division set of keys "Dr" (Fig. 2).

Let it be now assumed that the example $390625 \div 625$ is to be performed by the machine. To this end, the dividend "390625" is set up in the six left-hand denominational places of the division set of keys "Dt" (Fig. 2) and the divisor "625" in the three left hand denominational places of the divisor set of keys "Dr". Then the division key, 12, is depressed, whereby the following process is carried out.

On depression of the division key, 12, (Fig. 26) the key lever, 404, is swung against the action of the spring, 774, round the shaft, 636, in the anti-clockwise direction. Hereby, the pin, 405, arranged on the division key lever, 404, acts on the edge, 777a, of the slot, 777, of the control lever, 644, whereby the latter is swung round the shaft, 643, in the clockwise direction, so that the lever, 646, which by means of the bridge, 645, is rigidly connected with the control lever, 644, is swung in the same direction. Since hereby the part, 647, of the lever, 646, acts on the lever, 649, then the same and the shaft, 651, in fixed relationship therewith are swung in the anti-clockwise direction in which swinging movement also the lever, 663, (Fig. 34) rigidly mounted on the shaft, 651, participates. Since the fork-shaped upwardly directed end of the lever, 663, embraces the lever, 666, then in the swinging movement of the lever, 663, in the anti-clockwise direction, the lever, 666, is likewise swung around the screw, 667, in the anti-clockwise direction, whereby the part, 418A, of the releasing bar, 418, is dis-

placed to the left (seen in Fig. 34), whereby the releasing bar, 418A, releases the projection, 439g, of the corresponding key locking bars, 440, which has the object that on the releasing of the dividend set of keys "Dt" (Fig. 2) after the first movement of the proportional rack system, which will be described later in detail, only the seven left-hand places of the division set of keys "Dt" are cleared while in multiplication, as was already described in detail, the eight left hand places of the keyboard T (the multiplier set of keys "Mk") were cleared.

On the swinging movement of the shaft, 651, in the anti-clockwise direction, also the lever, 653, (Figs. 26, 34) rigidly mounted on the shaft, 651, is swung in the anti-clockwise direction. In this swinging movement, the part, 655, which is mounted on the lever, 653, by means of the screw 654, participates. Since the part, 655a, of the part, 655, engages in the recess, 657, of the sleeve, 658, then the control shaft, 587, and the parts rigidly mounted on it, are displaced to the left (seen in Fig. 34), whereby the pin, 623, of the part, 624, rigidly mounted on the control shaft, 587, enters into the hole, 620, of the toothed wheel, 618, loosely rotatable on the control shaft, 587, and consequently couples this with control shaft, 587.

On the displacement of the control shaft, 587, to the left (Fig. 34) the cam, 723, remains in the working position with the lever, 881, and comes out of the working position with the lever, 722, and the end, 662a, of the part, 662, which is arranged on the rear wall of the machine, is disengaged from the recess, 661, of the disc, 660, on the sleeve, 658, rigidly mounted on the shaft, 587, as is illustrated in Fig. 38. The cam disc, 588, comes out of the working position with the lever, 585, (Fig. 34 and 38) since it is undesirable, that a transmission should take place to the multiplier setting mechanism. Moreover, on the displacement of the control shaft, 587, to the left the part, 679, of the cam, 680, has been moved so far to the left, that it, on rotation of the control shaft, 587, is capable of co-acting with the lever, 677. The parts fixed on the control shaft, 587, which on the displacement of the control shaft, 587, to the left come into or out of engagement shall be described in detail at a later place.

On the displacement of the control shaft, 587, to the left the disc, 923, rigidly mounted on the right hand end of the control shaft, 587, (Fig. 34) acts on the lever, 926, and swings the same against the action of the spring, 927, in

the anti-clockwise direction round the screw, 924, whereby the spring, 927, is tensioned since the nose, 932, of the lever, 925, lies against a pin, 930, mounted on an intermediate member (not shown) and for this reason cannot follow the pull of the spring, 927.

Since immediately after the depression of the division key, 12, the control shaft, 587, is rotated after closing of the motor contact, 362, 364, through parts still to be described and after coupling of the differential mechanism actuating coupling, 52, with the main driving shaft, 3, so that the control-shaft, 587, no longer can return into its rest position under the action of the tensioned spring, 927, as the control shaft has already rotated somewhat, and in consequence of this, the disc, 660, lies against the part, 662a, of the part, 662, and consequently the part, 662a, of the part, 662, can no longer enter into the recess, 661, of the disc, 660.

As hereinafter described the division key, 12, however is held depressed by the pawl 778 (Fig. 26) and the control shaft, 587, is held in the position illustrated in Fig. 38, until, after about one quarter of a revolution of the control shaft, 587, the part, 655a, of the part, 655, is withdrawn from the recess, 657, of the sleeve 658, (Fig. 26) and the control shaft, 587, then, under the action of the tensioned spring, 927, (Fig. 34) can again be displaced so far to the right until the edge, 660x, of the disc, 660, of the sleeve, 658, rests against the part, 662a, of the part, 662.

On the depression of the division key, 12, (Fig. 26), the nose, 812, of the lever, 808, which is jointed to the division key lever, 404, acts on the lug, 813, of the lever 814, whereby the same is swung round the shaft, 636, in the anti-clockwise direction, which is possible, since the lever, 14, is set for positive division, that is, is swung rearwards.

In the swinging movement of the lever, 814, (Fig. 26) round the shaft, 636, in the anti-clockwise direction the pin, 821, mounted on the lever, 814, acts on the edge, 824a, of the lever, 824, which is rigidly mounted on the shaft, 310, whereby the latter lever and the shaft, 310, are swung in the clockwise direction. In this swinging movement participates the lever, 933, (Fig. 24) rigidly mounted on the shaft, 310, whereby the rod, 934, is displaced, so that the recess, 939, of the same lies above the lug, 941, of the lever, 940, rigidly mounted on the shaft, 265. When the lug, 941, of the lever, 940, after swinging of the same in the clockwise direction in consequence of the coupling of the differential mechanism

actuating coupling, 52, with the main drive shaft, 3, after depression of one of the operation keys enters into the recess, 939, of the part, 936, the parts, 934, 933, 5 310, 824, are locked in position.

In the swinging movement of the shaft, 310, the lever, 308, rigidly mounted on the same (Figs. 46 to 50) participates. The pin, 309, of this lever acts on the slot, 307, of the control rod, 304, and since in the downward movement of the control rod, 304, the inclined edge, 304g, slides along on the stub axle, 312, the control rod is acted upon in the opposite direction to the arrow "a" in the position illustrated in Fig. 48. Hereby, the draw key, 136, 170 (Fig. 10), however, by means of the angle lever, 177, has moved so far to the left that the draw key, 136, 170, couples the toothed wheel, 135, with the draw key bush, 160, so that in consequence of this, the revolutions-register U operates in the negative sense. The control rod, 304, hereby takes up in relation to the levers, 308, and 301, the position illustrated in Fig. 48.

On depression of the division key, 12, (Fig. 26) the pin, 405, riveted to the division key lever, 404, acts on the edge, 402, of the slot, 403, of the control lever, 391, whereby the latter is swung round the shaft, 310, in the anti-clockwise direction. By means of a spring, 393, which engages on the one hand, with the pin, 394, on the control lever, 391, and on the other hand with the pin, 395, of the lug, 397, of the lever, 323, rigidly mounted on the locking bar, 322, the locking bar, 322, is swung round the shaft, 310, in the anti-clockwise direction whereby it always remains in contact with the lever, 391. The lever, 334, (Fig. 24) attached to the key locking bar, 322, in consequence of this is swung simultaneously in the anti-clockwise direction around the shaft, 310, whereby the coupling lever, 44, rigidly mounted on the shaft, 265, through the parts, 334, 335, 336, 337, 339, 340, 342, 344, 265 (Fig. 24), as already was described in "Addition," is likewise swung in the clockwise direction. Hereby the coupling lever, 44, releases the nose, 70, of the pawl, 65, of the differential mechanism actuating coupling, 52, (Fig. 7) whereby the coupling pawl, 65, is moved into engagement with the coupling cam, 27, and the differential mechanism actuating coupling, 52, is rotated in the manner already described under the heading "Addition" after the motor contact, 362, 364, is closed through the parts, 354, 353, 347, 348, 23, 22, 21. In the swinging movement of the locking bar, 322, in the anti-clockwise direction 65 round the shaft, 310, there is so much

play between the lower edge of the locking bar, 322, (Figure 24) and the upper edge of the lever, 132, that when the shaft, 116, is rotationally displaced in the direction of the arrow "f" and the nose, 117g, of the cam, 117, acts on the lug, 128, of the lever, 130, the levers, 132 and 130, are swung so far out that the lever, 132, again lies directly under the locking bar, 322, and the lug, 128, of the lever, 130, slides on the periphery of the cam, 117.

As already mentioned, in the swinging movement of the coupling lever, 44, in the clockwise direction, the lever 866, which is formed as shown in Figure 28, and is rigidly mounted on the shaft, 265, (Figure 28) likewise participates, whereby the lever, 862, jointed to it by means of the screw, 864, is moved upwards and its lug, 867, lies in front of the nose, 868, of the projection, 869, rigidly mounted on the machine housing, whereby the coupling lever, 44, is prevented from releasing the differential mechanism actuating coupling, 52, before the device for changing the kind of the calculation of the proportional rack system has moved into one of its end positions, and since the same is normally set for additive operation, in the first calculating process under any circumstances the proportional rack system is appropriately set before the calculating process begins. The lug, 867, of the lever, 862, is hereby positioned before the nose, 868.

On the swinging movement of the shaft, 265, in the clockwise direction, the lever, 904 (Fig. 39) rigidly mounted on the same, is likewise swung in the clockwise direction, whereby the edge, 902a, of the right angled bent lug, 902, of the lever, 904, lies in front of the edge, 901a, of the lug, 901, of the slide, 892, which lies in its upper position at this moment.

On depression of the division key, 12, (Figure 26) the pin, 776, riveted to the division key lever, 404, moreover, acts on the edge, 778a, of the lever, 778, whereby the latter, and the lever, 780, connected with it by means of the bridge, 779, are swung in the anti-clockwise direction round the shaft, 643.

Hereby, the connecting rod, 781, jointed to the lever, 780, is displaced in the opposite direction to that of the arrow "a" against the action of the spring, 781a, (Fig. 28). The lever, 782, (Figure 28) jointed to the other end of the connecting rod, 781, is consequently swung round the shaft, 388, in the clockwise direction. In the swinging of the lever, 782, the flap, 783, naturally participates. On the swinging movement of the lever, 130

782, (Fig. 28) in the clockwise direction, the lever, 782, acts on the pin, 787g, riveted to the lever, 787, whereby the yoke, 787, 786, 787a, is swung in the anti-clockwise direction round the shaft, 382, against the action of the spring, 788.

As soon as the pin, 776, (Fig. 26) of the division key lever 404, slides away from the edge, 778a of the lever 778, the parts, 778, 779, 780, 781, 782, (Fig. 28) 783, return to their normal position under the action of the spring, 781a, engaging with the connecting rod, 781, and the parts, 787, 786, 787a, under the action of the spring, 788, whereby the nose, 778b, of the lever, 778, (Fig. 26) engages over the pin, 776, of the division lever, 404, whereby the division key, 12, is held in its depressed position.

After all settings have been effected by depression of the division key, 12, the main driving shaft, 3, now commences to rotate by means of the motor, D, the motor shaft, the worm 1, and the worm wheel, 2.

The toothed wheel, 56, (Fig. 4) in fixed relation with the differential mechanism actuating coupling, 52, and mounted on the shaft, 3, has driven, as already described on the rotation of the shaft, 3, the toothed wheel, 78, (Fig. 8) which engages with it, whereby the shaft 116, is rotated in the direction of the arrow "f" (Fig. 8) in which revolution, the connecting rod, 124, (Fig. 24) also participates, whereby the proportional rack system is operated and the dividend 390625 set up on the right hand side of the dividend set of keys "Dt" and the divisor "625" set up on the right hand side of the divisor set of keys "Dr" are introduced into the result totalizer R through the parts, 159a, 159, 156, and 158 (Fig. 40). In the inspection apertures of the sixteen place result totalizer mechanism R, the number 3906250625000000 is now visible after the proportional rack system has terminated a to and fro movement.

By rotation of the wheel, 78, (Figure 8) in the direction of the arrow "f" through the toothed wheel, 56, arranged on the main driving shaft, 3, (Fig. 4) the eccentric shaft, 19, is rotated in the direction of the arrow "m" (Fig. 8) through the bevel wheels, 79 and 133, and, consequently, the toothed wheel, 618, (Fig. 34) driven from the same, whereby in consequence of the already described coupling through the pin, 623, rigidly mounted on the control shaft, 587, the said shaft, 587, is driven in the direction of the arrow "n" indicated in Figure 34. The toothed wheel, 618, rotates through the intermediate wheel, 617, the toothed wheel, 614, round the

screw, 615, in the direction of the arrow "p." By means of the eccentric (not shown) which, however, is formed on the toothed wheel, 614, the lever, 610, is acted upon upwardly, whereby it is simultaneously swung round the screw, 611. Since, however, the toothed wheels, 606 (Figure 40) were not rotated, the recesses, 609, of the toothed wheels, 606, still remain opposite to the lever, 610, so that the same cannot co-act with the teeth of the toothed wheel, 606, and remains inoperative. After approximately one quarter of a revolution of the control shaft, 587, (Figure 34) the part, 655a, of the part, 655, withdraws from the recess, 657, of the sleeve, 658, and in the further rotation of the control shaft, 587, slides on the surface of the sleeve, 658. As soon as the part, 655a, of the part, 655, withdraws from the recess, 657, of the cam, 658, the control shaft, 587, under the pull of the spring, 927, and under the action of the lever, 926, which acts on the disc, 923, rigidly mounted on the control shaft, 587, is moved so far to the right until the part, 662a, of the part, 662, lies against the edge, 660x, (Fig. 38) of the disc, 660, of the sleeve, 658, whereby a further movement of the control shaft, 587, to the right under the pull of the spring, 927, is avoided.

Now, during the rearward movement of the proportional rack system the cam, 853, rigidly mounted on the control shaft, 587, comes into action on the lever, 852, whereby the same, and the lever, 854, connected with it by means of the bridge, 851, (Figs. 28, 34) are swung in the anti-clockwise direction (seen in Fig. 28) round the shaft, 583, against the action of the spring, 859. Hereby, the pin, 855, riveted to the lever, 854, acts on the edge, 380a, of the slot, 380, of the rod, 376, whereby the rod, 376, is moved downward round the screw, 368, and the spring, 857, is tensioned since the pin, 372, comes into contact with the rack, 376b, (Fig. 24) of the proportional rack system, which has not yet returned into the normal position. As soon as the lever, 852, has run up on the raised surface of the cam, 853, the pin, 855, has moved forward up to the upper edge of the horizontal part of the slot, 380, but has not however entered into the same. Simultaneously, the edge, 381a, of the slot, 381, of the control rod, 376, (Fig. 28) acts on the pin, 863, of the lever, 862, and swings the same so far downwards until the lug, 867, in the swinging of the lever, 862, in consequence of being changed over for negative calculation hereinafter described in detail, can be moved past underneath the part, 868. On the move-

ment of the lever, 862, downwards the lever, 866, the shaft, 265, and the coupling lever, 44, are also obviously somewhat swung in the anti-clockwise direction, which is possible, since after a half revolution of the differential mechanism actuating coupling, 52, the comb, 52x, (Fig. 7) of the same has released the coupling lever, 44. Hereby the coupling of the proportional rack system is arrested.

As soon as the proportional rack system has terminated its first to and fro movement the part, 376, (Fig. 28) 369, can move further under the pull of the tensioned spring, 857, in the direction of the arrow "a", whereby the pin, 372, (Fig. 24) is coupled with the rack, 367b, and the pin, 375, is uncoupled from the rack, 367a, of the proportional rack system. Hereby, the lever, 366, (Fig. 28) rigidly mounted on the shaft, 300, and the control lever, 301, are swung in the anti-clockwise direction, according to Fig. 49.

On the swinging movement of the control lever, 301, in the anti-clockwise direction, in consequence of the displacement of the rod, 376, (Fig. 24) in the direction of the arrow "a", the edge, 303g, (Fig. 48) acts on the lug, 306, of the control rod, 304, and moves the same out of the position illustrated in Fig. 48, into the position illustrated in Fig. 49. The bar, 376, Fig. 28, is moved so far in the direction of the arrow "a", that the same comes to lie with the downward edge, 858, of the beveled slot, 380, against the bolt, 855, and hereby rocks the lever, 862, so far in the anti-clockwise direction that the lug, 867, can go freely upwards behind the rigid part, 868, and the lever, 866, may be turned with its shaft, 265, in the clockwise direction, whereby the pin, 863, may be moved upwards in the slot, 381, since the bar has been rocked round the point, 368, in the anti-clockwise direction. The lug, 867, of the lever, 862, lies now behind the abutment, 868, whereby the proportional rack system is set for subtraction. In the movement of the rod, 304, (Fig. 10) in the direction of the arrow "a", the lever, 177, (Fig. 10) is moved in the anti-clockwise direction, whereby the toothed wheel, 163, is coupled with the toothed wheel, 169, whereby in the succeeding rotation of the shaft, 116, in the direction of the arrow "f" still to be described, the actuating and tens transfer shaft, 178, (Fig. 15) of the revolutions-register U is driven in the positive direction through the toothed wheels, 78, (Fig. 8) the bevel wheels, 79 and 133, the toothed wheels, 134, 188, 189, 190, 163, 169, 179 (Fig. 11).

Shortly before the movement of the proportional rack system is finished, i.e., after a half revolution of the control shaft, 587, (Fig. 34) the part, 679, of the cam, 680, which is arranged on the control shaft, 587, acts on the lever, 677, whereby the same, and the lever, 675, interconnected with it by means of the bridge, 676, are swung in the anti-clockwise direction round the shaft, 583. Hereby, the rod, 674, jointed on the lever, 675, is acted upon in the opposite direction to that of the arrow "a" whereby the pin, 675a, arranged on it, acts on the edge, 673a, of the slot, 673, of the lever, 672, and swings the lever, 672, in the anti-clockwise direction (seen in Fig. 34) round the shaft, 310. In this swinging movement the releasing bar part, 418A, attached to the lever, 672, of the releasing bar, 418, likewise participates, which on the one side is moreover attached to the lever, 323, swingably mounted on the shaft 310.

In the swinging movement of the releasing bar part, 418A, in the anti-clockwise direction, the same acts on the projections, 439, on the locking bars, 440, of the left hand dividend set of keys "Dt" and move these against the action of their springs, 442, (Fig. 25) whereby the locking bars, 440, release the depressed keys in the manner described in detail in Patent Specification No. 365,058, whereby these are cleared, that is, they return into their normal position represented in Figs. 1 and 2. As soon as the part, 679, of the cam, 680, releases the lever, 677, all the parts, 677, 676, 675, 674, 672 and 418A, return into their rest position illustrated in Fig. 34.

Since the division key, 12, is still depressed, the motor contact, 362, 364, also remains closed through the parts, 405, (Fig. 26) 391, 393, 322, (Fig. 24) 334, 335, 336, 351, 353, 347, 348, 23, 22, (Fig. 24) and through the parts, 405, 391, (Fig. 26) 322, (Fig. 24) 334, 335, 336, 339, 340, 342, 344, 265 and 44, (Fig. 24) after the lug 867, Fig. 28, of the lever 862 could go upwards behind the abutment, 868, the differential mechanism actuating coupling, 52, under the action of the tensioned spring, 342, (Fig. 24) remains coupled with the main driving shaft, 3, so that the main driving shaft, 3, can perform a further revolution, whereby the following processes are enacted.

The toothed wheel, 56, on the main driving shaft, 3, (Fig. 4) standing in fixed relation with the differential mechanism actuating coupling, 52, on the rotation of the main driving shaft, 3, drives the toothed wheel, 78, which engages with it, whereby, the connecting

rod, 124, attached to the crank disc, 117, which is rigidly mounted on the shaft, 116, is acted upon in the direction of the arrow "f" (Fig. 5) whereby the proportional rack system is operated and the value "625" set up in the three left hand places of the division set of keys "Dr" and, on the first movement of the proportional rack system brought into the result totalizer R, is again brought out of the latter, whilst the value "390625" set up in the dividend set of keys "Dt" and introduced into the result totalizer R remains in the result totalizer R, since the value "390625" set up in the dividend set of keys "Dt" was already cleared at the end of the first movement of the proportional rack system. In the result totalizer R after the second movement of the proportional rack system the value 3906250000000000 is visible. Simultaneously, in the revolutions-register U, the right hand numeral wheel, 211, which on the first movement of the proportional rack system was rotated in the negative sense through one place, and which showed a "9", during the second movement of the proportional rack system in which the revolutions-register U operates in the positive sense, was again rotated forwards through one place so that now in the revolutions register U a "0" is again visible.

Shortly before the completion of the second movement of the proportional rack system and shortly before the termination of a complete revolution of the control shaft, 587, (Figure 34) the cam, 723, rigidly mounted on the control shaft, 587, acts on the lever, 881, and swings the same round the shaft, 583, in the clockwise direction against the action of the spring, 884, (Figure 39) in which swinging movement also participate the parts, 879, 871, 880 and 882. Hereby the edge, 870, acts on the bridge, 786, of the mentioned yoke, 787, 786, 787a, whereby the latter is swung round the shaft, 382, in the anti-clockwise direction against the action of the spring, 788, and finally at the end of the swinging movement of the lever, 871, lies with the edge, 786a, over the upper edge, 870a, of the lever, 871, and thus prevents the yoke, 871, 879, 882 from swinging back.

In the swinging movement of the yoke, 871, 879, 882, (Figure 39) the angled lug, 915, on the lever, 882, acts on the edge, 914, of the part, 907, whereby the same is swung round the shaft, 265, in the anti-clockwise direction. Hereby, the angle lug, 906, of the part, 907, acts on the nose, 905, of the lever, 904, so that the same is likewise swung in the anti-clockwise direction, and against the action of

the spring, 910. Since the lever, 904, is rigidly mounted on the shaft, 265, naturally, the shaft, 265, and the coupling lever, 44, rigidly fixed to it are also swung in the anti-clockwise direction, which is possible, as the comb, 52x, of the differential mechanism actuating coupling, 52, after one half revolution releases the coupling lever, 44. In this manner, the coupling lever, 44, (Fig. 24) moves in front of the nose, 70, of the pawl, 65, of the differential mechanism actuating coupling, 52, and releases the nose, 42, of the pawl, 37, of the carriage coupling, 26, so that the differential mechanism actuating coupling, 52, is uncoupled from the driving shaft, 3, and the carriage coupling, 26, is coupled with the main driving shaft, 3.

In the swinging movement of the shaft, 265, (Fig. 28) in the anti-clockwise direction the lever, 866, rigidly fixed to it, is also swung in the same direction, whereby the lever, 862, jointed to the lever, 866, is moved downwards. Hereby the pin, 863, riveted to the lever, 862, acts on the edge, 381b, of the slot, 381, of the control rod, 376, whereby this is also swung downwards around the screw, 368. Hereby the lug, 867, of the lever, 862, lies quite a distance underneath the part, 868, so that the shifting device for changing the kind of calculation of the proportional rack system is not locked, which is not necessary, since the proportional rack system does not operate. During the rocking of the bail, 871, (Fig. 39) 879, 880, 882 in the clockwise direction, further, the lever, 888, 887, is rocked in the anti-clockwise direction by the pin, 885, which projects into the slot, 886, of the lever, 888. Since this lever is in engagement with its pin, 890, with the slot, 891, of the slide, 892, the slide, 892, is moved downwards, whereby its lug, 901, comes into the path of movement of the arm, 902, of the lever, 904, which is rigidly arranged on the shaft, 265, and acts as hereinafter described. When the slide, 892, is moved downwards, this is guided with its pin, 894, in the slot, 895, of the lever, 896. Shortly before the completion of the full revolution of the control shaft, 587, the cam, 853, again releases the lever, 852, (Fig. 28) so that the yoke 852, 851, 854, under the action of the spring, 859, is acted upon in the clockwise direction round the shaft 583. It can, however only swing out so far until the pin, 855, lies against the inclined edge of the slot, 380, of the control rod, 376, since this cannot be moved in the opposite direction, as the hole of the rack, 367a, of the proportional rack system does not yet lie opposite to

the pin, 375. As soon as the second to and fro movement of the proportional rack system has terminated, the yoke, 852, 851, 854, the control rod, 376, and the parts, 369, 372, 375, can return under the action of the springs, 859, and 857, into their normal position, whereby the pin, 375, is coupled with the rack, 367a, (Fig. 24) of the proportional rack system and the pin, 372, is uncoupled from the rack, 367b, of the proportional rack system. In the swinging movement of the control lever, 301, in the clockwise direction, the edge, 303h, (Figs. 48 and 49) of the recess, 303, of the control lever, 301, acts on the lug, 306, of the rod, 304, and moves the same out of the position illustrated in Fig. 49 into the position illustrated in Fig. 48. In this movement of the rod, 304, the lever, 177, is swung round the point, 176, (Fig. 10) in the clockwise direction. Hereby the proportional rack system was changed over for positive operation whilst the revolutions-register U was changed over for negative operation.

The swinging movement of the yoke, 871, 879, 882, round the shaft 583 in the clockwise direction against the action of the spring, 884, (Fig. 39) cannot be followed by the lever, 876, (Fig. 28) under the pull of the spring, 877, which on the one hand engages a pin, 872, of the lever, 871, and on the other hand is connected to the pin, 878, of the lever, 876, since the lever 250, jointed to the lever, 876, rests with its edge, 250a, (Fig. 28) on the pin, 379g, riveted to the lever, 379, which has not yet been swung, whereby the spring, 877, is tensioned. As soon, now, as already above described in detail the rod, 376, is moved in the opposite direction to that of the arrow "a", then the lever, 379, the pin, 378, of which projects into the recess, 377, of the control rod, 376, is swung round the shaft, 382, in the clockwise direction. When the pin, 379g, of the lever, 379, moves underneath the recess, 390, of the lever, 250, then the lever, 250, can be swung round the screw, 246a, in the anti-clockwise direction under the action of the tensioned spring, 877, and its recess, 390, can embrace the pin, 379g, of the lever, 379.

Since as already mentioned, the driving gear, 219, (Fig. 12) 220, of the carriage shift is always set for carriage movement to the right, and the coupling for the carriage travel was closed, the totalizer carriage, B, is moved into its extreme right hand position. In the movement of the totalizer carriage, B, into its extreme right hand position, the proportional rack system is changed over

alternately from "Addition" to "Subtraction" through the eccentric, 239, acting through the parts, 240, 242, 241, 244, 246, 250, (Figure 28), 379g, 379, 378, 377, 376, 372, 375, 369, and through the parts, 366, 300, 301, (Figure 28) 304, (Fig. 49 and 10) 177, 136, 170, 160, the revolutions-register U, is simultaneously changed over from "Subtraction to Addition", until the totalizer carriage B, has taken up its extreme right hand position. This change over from "Addition" to "Subtraction" etc. in the movement of the carriage to the right, has no action on any part. When the totalizer carriage, B, is located in its extreme right hand position then the highest place of the divisor lies opposite to the highest place of the dividend, i.e. the highest place of the carriage lies opposite the highest place of the divisor key board Dr.

In the swinging movement of the coupling lever, 44, in the anti-clockwise direction (Figure 24) and the release of the nose, 42, of the pawl, 37, of the carriage shift coupling, 26, in the manner already hereinbefore described, the lever, 267, rigidly mounted on the shaft, 265, is also swung in the anti-clockwise direction, whereby it enters into the recess, 271, of the lever, 261. If now, the carriage B, moves to the right, then the lever, 244, is swung so far in the clockwise direction round the point, 246, and the lever, 261, so far round the point, 263, in the anti-clockwise direction under the action of the spring, 277, engaging with the lever, 274, until the tongue, 26j, of the lever, 261, rests with its edge, 269a, against the lever, 267, whereby only a small swinging movement of the parts, 274, 273 and 261, is permitted.

Hereby the carriage shift coupling, 26, remains coupled with the main driving shaft, 3, until the part, 730, of the totalizer carriage, B, (Figure 39) acts on the edge, 921, of the two-armed lever, 728, and swings this against the action of the spring, 729, in the clockwise direction round the screw, 919. Hereby, by means of the downwardly directed fork-shaped arm of the lever, 728, the part 907, is swung in the direction of the arrow "y" (Fig. 39) until the edge, 914, of the lever 907, slides away from the lug, 915, of the yoke, 882, 879, 871, against which it bears upwards under the action of the spring, 910. Hereby it swings so far in the clockwise direction round the shaft, 265, under the action of the spring, 910, until its nose, 913, bears upwards against an intermediate wall, 912, of the machine. In this swinging movement, the lever, 904, also participates, the for-

ward face of the lug, 902, of which now lies against the rear face of the lug, 901, of the part, 892.

In the swinging movement of the lever, 5 904, in the clockwise direction, obviously the shaft, 265, and the coupling lever, 44, participate, which releases the nose, 70, of the pawl, 65, of the differential mechanism actuating coupling, 52, and moves 10 so as to lie in front of the nose, 42, of the pawl, 57, (Fig. 24) of the carriage shift coupling, 26, so that the differential mechanism actuating coupling, 52, is 15 coupled with the main driving shaft, 3, and the carriage shift coupling, 26, is uncoupled from the main driving shaft, 3.

In the swinging movement of the shaft, 265, in the clockwise direction under the pull of the tensioned spring, 342, the 20 lever, 267, (Fig. 14) is swung in the clockwise direction, whereby it releases the tongue, 269, of the lever, 261, whereby the lever, 274, is swung still further 25 round the point, 276, in the clockwise direction. As the pin, 275, of the lever, 274, rests against the edge, 278, of the lever, 273, and is held in this position by means of the spring, 283, the lever, 261, is also swung further round the point, 263, 30 in the anti-clockwise direction (Figure 14).

Hereby the connecting rod, 260, jointed to the lever, 261, is displaced to the right (seen in Fig. 14) whereby the parts, 259, 35 238, 238a, are swung round the points, 236, 237, in the clockwise direction until the part, 224, of the draw key, 224, 225, contacts with the side face of the toothed wheel, 220, since the part, 40 224, of the draw key, 224, 225, does not yet lie opposite to the recess of the toothed wheel, 220, as the totalizer carriage, B, has not yet concluded its right hand movement and consequently the toothed wheel, 45 220, has not yet terminated its revolution. As soon as the totalizer carriage, B, has arrived in its right hand position, the recess, 223, of the toothed wheel, 220, moves opposite to the part, 224, of the draw key, 50 224, 225. Hereby the draw key, 224, 225, moves out of engagement with the toothed wheel, 219, and into engagement with the toothed wheel 220 whereby the change gear for the carriage is shifted for 55 carriage left hand travel and in the succeeding carriage shift the totalizer carriage, B, is moved to the left.

During the movement of the carriage B into its extreme right-hand position the 60 eccentric, 239, Fig. 12, of the wheel 219, comes into its lower position. Consequently the parts 242, 241, and 246, are rocked in the direction of the arrow α 1, Figure 12 and 28. Since the bar, 250, 65 which is arranged on the lever, 246, as

above mentioned, embraces with its recess, 390, the bolt, 379g, the bar, 250, is moved in the direction of the arrow "a" and consequently the lever, 379, is rocked 70 in the anti-clockwise direction. Hereby on the one hand the proportional rack system is shifted for subtraction through the intermediary of the parts, 378, 376, 369, and the revolutions-register U for addition 75 through the intermediary of the parts, 376, 366, 300 and 301, while on the other hand the flap, 387, which is connected to the lever, 379, at 384 is rocked in the clockwise direction, whereby the capacity shifting flap, 793, is moved forward 80 through the intermediary of the bar, 792, 791, 790, so that, as drawn in Figure 28, the projection, 795, of the capacity-shifting flap, 793, lies in the path of movement of the projection, 796, of the tens 85 transfer slide, 139, which is arranged on the left hand side of the highest numeral wheel of the result totalizer R.

After all adjustments are finished, and as above mentioned, during the movement 90 of the carriage into its right-hand end position the coupling of the proportional rack system was closed, the division-process proper begins, which takes place according the U.S. patent 1,566,961 and 95 in the following the important processes only are described.

Since in the selected numerical example in division $390625 \div 625$ during the first subtraction of the divisor a tens 100 transfer to the numeral wheel of the highest denomination of the result totalizer has not occurred, and the projection, 796, of the tens-slide, 139, lies opposite the projection, 795, of the capacity-shift- 105 ing-flap, 793, the capacity-shifting flap, 793, is rocked in the anti-clockwise direction at the lifting of the tens slide, 139, by the corresponding eccentric, 137, Fig. 40, of the eccentric shaft, 19, whereby the 110 part, 798, bent on the flap, 793, acts on the lug, 799, of the slide, 800, and displaces this downwards against the action of the spring, 806. Hereby the slide, 800, acts on the flap, 785 (Figure 39), 115 whereby the same is swung round the shaft, 388, in the clockwise direction. The pin, 900, riveted to the part, 899, of the flap, 785, hereby acts on the lever, 896, and swings the same in the anti-clockwise 120 direction round the shaft, 265. Since the pin, 894, of the part, 892, projects into the elongated hole, 895, of the lever, 896, the part, 892, is also swung in the anti-clockwise direction round the shaft, 265, 125 whereby the lug, 901, of the part, 892, in the manner hereinbefore described, moves so that it rests with its rearwardly directed face in front of the lug, 902, of the lever, 904, and acts on the lug, 902, 130

of the lever, 904, rigidly mounted on the shaft, 265. The lever, 904, is consequently swung in the anti-clockwise direction in which swinging movement, the shaft, 265, also participates. Hereby, the coupling lever, 44, rigidly mounted on the shaft, 265, is also swung in the anti-clockwise direction, whereby it releases the nose, 42, (Figure 24) of the pawl, 37, of the carriage shift mechanism coupling, 26, and moves so that it lies in front of the nose, 70, of the pawl, 65, of the differential mechanism actuating coupling, 52, so that in this manner the differential mechanism actuating coupling, 52, is uncoupled from the driving shaft, 3, and the carriage shift mechanism coupling, 26, is coupled with the main driving shaft, 3.

In the swinging movement of the coupling lever, 44, (Figure 24), the spring, 342, was tensioned since the lever, 344, rigidly mounted on the shaft, 265, participates in the swinging movement in the anti-clockwise direction, and the lever, 340, in consequence of the division key, 12, being held depressed is held swung in the anti-clockwise direction round the shaft, 338, whereby the coupling lever, 44, lies against the comb, 45, of the carriage shift mechanism coupling, 26.

Now the carriage step to the left commences, whereby the toothed wheel, 25, (Figure 4) which besides being in engagement with the toothed wheel, 219, is also in engagement with the toothed wheel, 226, rotates the toothed wheel, 220, through the toothed wheel, 226, and consequently the draw key bush, 218, coupled with it, and the disc, 227, in the opposite direction to the arrow "S" indicated in Figure 12, consequently the carriage B, is displaced by means of the pins, 229, 228, one place to the left, while the toothed wheel, 219, in the position represented in Figure 12, is idly driven.

During the carriage travel the eccentric, 239, Fig. 12, is again moved upwards into the position shown in Fig. 12, whereby the parts, 242, 241 and 246, are rocked in the opposite direction to the arrow α 1, (Fig. 12 and 28), through the intermediary of the bar, 240, so that the bar, 250, which is mounted on the lever, 246, was moved against the direction of the arrow "a." Consequently on the one hand the proportional rack system was shifted for addition through the intermediary of the parts, 379g, 379, 378, 376 and 369, and the revolutions-register for subtraction through the intermediary of the parts, 376, 366, 300 and 301, while on the other hand the flap 387, which is jointed to the lever, 379, at the point, 384, was rocked in the anti-clockwise

direction. Consequently the capacity-shifting flap, 793, was moved backwards through the intermediary of the lever, 792, 791, 790, so that the projection, 795a, of the capacity-shifting flap, 793, lies in a preparatory position in relation to the projection, 796, of the tens-transfer slide, 139.

Approximately after one half-revolution of the carriage shift coupling, 26, (Figure 7), the comb, 45, of the same releases the coupling lever, 44, so that the same is swung under the action of the tensioned spring, 342, (Figure 24) in the clockwise direction. Hereby it moves so that it lies again before the nose, 42, of the pawl, 37, of the carriage shift mechanism coupling, 26, and releases the nose, 70, of the pawl, 65, of the differential mechanism actuating coupling, 52, whereby the carriage shift coupling, 26, is uncoupled from the main driving shaft, 3, and the differential mechanism actuating coupling, 52, is coupled with the main driving shaft, 3.

Now, the differential mechanism actuating coupling 52 comes into operation whereby according to the selected numerical example four additions are made, whereupon a carriage travel takes place again and the proportional rack system is shifted for subtraction and the revolutions-register for addition. In the following, the processes just described are performed, until the carriage, B, has arrived in its extreme left-hand position. For this reason, these will not be further described.

Shortly before the totalizer carriage, B, moves into its extreme left-hand position, the part, 282, (Fig. 3, 14, 7) of the totalizer carriage, B, acts on the lever, 274, and swings the same in the anti-clockwise direction round the point, 276, against the action of the spring, 277, whereby the spring, 283, is tensioned, since the lever, 261, cannot follow the lever, 274, in consequence of the contact of the edge, 270a, (Figure 14) of the tongue, 269, of the lever, 261, with the lever, 274, which has been swung in the anti-clockwise direction. As soon as the comb, 45, of the carriage shift mechanism coupling, 26, has released the coupling lever, 44, in the manner already described and the shaft, 265, is swung in the clockwise direction, the lever, 267, is also swung in the clockwise direction, whereby the parts, 261, 260, 259, 238, 238a, under the action of the tensioned spring, 283, (Figure 14) are moved until the part, 224, of the draw key, 224, 225, lies against the rotating toothed wheel, 219, since the recess, 222, of the toothed wheel, 219, does not yet lie opposite to the part, 224, of the draw key,

224, 225. As soon as the carriage, B, is in its left-hand position in which position also the recess, 222, of the toothed wheel, 219, moves opposite to the part, 224, of the draw key, 224, 225, the parts, 260, 259, 238, 238a, 224, 225, return into their normal position represented in Figure 14, as in the meantime, the toothed wheels, 220, 219, have also completed their rotation and the draw key, 224, 225, could enter the recess, 220, (Figure 7) of the toothed wheel, 219.

Now, as soon as in the extreme left hand position of the carriage B overstepping of the capacity occurs, then the flap, 793, (Figure 28) is swung in the anti-clockwise direction round the shaft, 794, whereby the bent part, 798, on the flap, 793, acts on the lug, 799, of the slide, 800, and displaces this downwards against the action of the spring, 806. Hereby the slide, 800, acts on the flap, 783, whereby this is swung in the clockwise direction round the shaft, 388. Hereby the lever, 782, acts on the pin, 787g, of the lever, 787, whereby the yoke, 787, 786, 787a, is swung against the action of the spring, 788, round the shaft, 382, in the anti-clockwise direction. Hereby the bridge, 786, of the yoke, 787, 786, 787a, releases the edge, 870a, of the lever, 871, so that the yoke, 871, 879, 882, (Figures 29, 28) can return into its normal position illustrated in Figure 34, under the action of the spring, 884, whereon the parts, 892, (Fig. 39), 888, 876, (Fig. 28) 250, also participate.

In the swinging movement of the flap, 783, (Figure 28) in the clockwise direction round the shaft, 388, the rod, 781, jointed to the lever, 782, is displaced against the action of the spring, 781a, in the opposite direction to that of the arrow "a," whereby the lever, 780, jointed to the connecting rod, 781, and the lever, 778, connected to it by means of the bridge, 779, are swung round the shaft, 643, (Figure 26) in the anti-clockwise direction. Hereby the nose, 778b, releases the pin, 776, of the division key lever, 404, so that the same returns, under the action of the spring, 774, into its rest position. As soon as the disc, 117, (Figure 24) has been rotated in its last rotation to such an extent that the lug, 128, of the lever, 130, can fall into the recess, 127, of the disc, 117, and as this is possible under the action of the spring, 398, which is secured to the pin, 399, of the control lever, 391, since the spring 398 rocks the control lever, 391, in the clockwise direction, round the shaft, 310, simultaneously with the lever 404 being swung in the clockwise direction round the shaft, 636, by the spring, 774. Conse-

quently the locking bar, 322, is rocked in the clockwise direction in consequence of the action of the control lever, 391, through the intermediary of the lug, 397. In this swinging movement, the lever, 334, (Figure 24) rigidly mounted on the locking bar, 322, (Figure 24) participates, whereby the parts, 335, 336, 339, 340, 342, 344, return into their rest position. Hereby the coupling lever, 44, moves again into the path of the nose, 70, of the coupling pawl, 65, so that this on the striking of its nose, 70, on the coupling lever, 44, again opens the differential mechanism actuating coupling, 52.

In the swinging movement of the lever, 339, in the clockwise direction round the shaft, 338, the parts, 351, (Figure 24), 353, 347, also return into the rest position under the action of the spring, 350, engaging with the lever, 347, as soon as the arm, 21, of the lever, 22, at a suitable moment slides up at 20g, on the curve, 20h, of the cam, 20. When this has taken place, the curve, 20h, swings the lever, 22, in the clockwise direction round the point, 23g, whereby the contact spring, 361, is pressed together, and the contact, 362, 364, is opened so that the motor also again comes to rest. If the curve, 20h, has swung-out the lever, 20, fully, then it slides under the action of the spring, 350, again up on to the periphery of the cam, 20, wherewith all mechanisms again take up their rest positions, and the division has ended.

On the return of the division key, 404, (Figure 26) into its normal position, the pin, 776, rigidly mounted on it, acts on the control lever, 644, whereby the same returns the key-releasing bar into its position illustrated in Figure 34, through the parts, 645, 646, 649, 651, 663, (Figure 34) and 666. Moreover, the part, 655a, of the part, 655, is again brought into engagement with the recess, 657, (Figure 26) of the sleeve, 658, through the parts, 651, 653, 655, (Figure 34), wherewith also these parts have again taken up their rest position.

The lockings will now be described which occur on depression of the division key.

As already mentioned, in the depression of the division key, 12, (Figures 1, 2), the control lever, 391, is swung in the anti-clockwise direction, through the pin, 405, (Figure 26) arranged on the division key, whereby the face, 391b, lies underneath the pin, 639, mounted on the multiplication lever, 634. Now, if the multiplication key, 11, is touched unintentionally, depression of the key is not possible, as the pin, 639, of the multiplication key lever, 634, lies on the edge, 391b, 130

of the control lever, 391.

On the depression of the key lever, 12, as already described, the locking flap, 322, is swung in the anti-clockwise direction under the pull of the spring, 393, engaging with it and with the control lever, 391, whereby the same lies under the lug, 316a, (Figure 24) of the lever, 316. If it is now attempted to depress the addition key, 4, or the subtraction key, 5, depression is not possible as on depression of the addition key, 4, the riveted pin, 313, acts on the edge, 314, of the lever, 316, and on the depression of the subtraction key, 5, the pin, 430, likewise acts on the edge, 314, of the lever, 316. The latter, obviously, cannot be swung round its pin, 315, as hereby the lug, 316a, of the lever, 316, lies on the edge, 322a, of the locking bar, 322, which has been swung in the anti-clockwise direction, consequently depression of the subtraction key, 5, or of the addition key, 4, is not possible. Depression of either of the keys, 7 and 8, for zeroizing the result totalizer R, and for zeroizing the revolutions-register U is not possible for the reasons described under the heading, "Addition" on which account this shall not be further gone into here. On the same grounds also, the locking of the "3x Mult." key, 9, will not be gone into. A swinging movement of the lever, 16, is possible during the division process as the parts influenced by it, viz. the zeroizing keys, 7 and 8, are themselves locked in the above described manner. A swinging movement of the lever, 17, is likewise possible, as the same in consequence of holding the addition key, 4, locked, and also the subtraction key, 5, can never be swung downwards. The lever, 14, is held by means of the stop lever, 834, (Figure 26) in its set position. A depression of the revolutions-register control key, 13, during positive division is possible, since on the depression of the division key, 12, the lever, 814, was swung round the shaft, 636, as the nose, 812, of the lever, 808, which is mounted on the division key lever, 404, acts on the lug, 813, of the lever, 814. If the revolutions-register control key is now depressed, then the lug, 829, of the lever, 814, in consequence of the swinging out of the lever, 814, is no longer in front of it and it can therefore be depressed without influencing any part.

AUTOMATIC NEGATIVE DIVISION.

In automatic negative division it is first of all necessary to swing the lever, 14, forwards round its screw, 830, (Figure 26) whereby the pin, 831, riveted to the lower end of the lever 14, moves out of the stop, 832, of the stop lever, 834, and

enters into the stop, 833, of the same. Simultaneously, it moves under the edge, 839a, of the lever, 839. As the pin, 811, of the lever, 14, projects into the elongated hole, 810, of the lever, 808, swingably mounted on the division key lever, 404, so the same on the swinging of the lever, 14, round the screw, 830, in the anti-clockwise direction, is swung round its point of articulation, 810a, in the clockwise direction, whereby its nose, 812, moves away from the lug, 813, of the lever, 814.

Let it be assumed that the problem $(390625 \div 625) - (12500 \div 625)$ is to be solved. Here, the dividend "12500" is set up with its highest place in the second place from the left of the dividend set of keys "Dt" i.e. so that it lies opposite to the second highest place of the result totalizer, R. This is necessary in order that the unit places of the dividend and consequently the units places of quotient lie under one another as otherwise the correct difference of the quotients would not be obtained.

The calculation of the quotient resulting from the first bracketed expression shall not be again described here, as this was described already in "Division." It may be only pointed out in regard to this, that the divisor "625" after termination of the division of the bracketed expression $(390625 \div 625)$ is still in the set of keys so that the repeated setting of the divisor "625" of the second bracketed expression is unnecessary. Moreover, in the revolutions-register, U, is found the quotient "625" obtained from the division of the expression $(390625 \div 625)$ and its highest place is of course in the second place from the left in the revolutions-register, U. It may be mentioned at this place that when the carriage, B, is led into its right-hand position, the highest place of the dividend lies opposite to the second highest place of the divisor. After these preparatory settings, the calculation can now be commenced of the bracketed expression $(12500 \div 625)$. To this end, the division key, 12, is depressed, whereby the following processes are enacted.

In the depression of the division key, 12, the division key lever, 404, is swung round the shaft, 636, against the action of the spring, 774, in the anti-clockwise direction in which swinging movement, the lever, 808, also participates. As the lever 808 through the swinging of the lever, 14 forwards, was also swung round the point, 810a, in the clockwise direction, and the nose, 812, of the lever, 808, on the depression of the division key, 12, moves past the lug, 813, inoperatively, the lever, 814, is not swung in the anti-

clockwise direction round the shaft, 636, and consequently also the driving gear for the revolutions-register, U, is not changed over through the parts, 821, 824, 310, (Figure 26) 308, 304, (Figure 46) 177, 136, 170, (Figure 10). Moreover, on the depression of the division key, 12, up to the beginning of division proper, i.e. when the totalizer carriage B, has attained its extreme right-hand position, the same processes are enacted, on which account they will not here be further entered into.

As alternate working of the processes in the result totalizer mechanism, R, are exactly the same as in ordinary division, so in the following only the processes in the revolutions-register, U, will be entered into.

As already above mentioned the revolutions-register, U, has been set for subtraction. In the first revolution of the driving shaft, 116, consequently the numeral wheel of the highest place of the revolutions-register, U, standing at zero is rotated through one unit in the subtractive sense, so that the revolutions-register now shows the following value "96250000."

After the value "96250000" has appeared in the revolutions-register, U, there follows through the alternate operation of the couplings controlled by the capacity shift flap, 793, a carriage step to the left, whereby the revolutions-register, U, and the result totalizer, R, through the already mentioned parts are changed over to additive operation.

These processes are only performed for such time until the totalizer carriage B, has arrived into its extreme left-hand position and division has terminated, in which case in the revolutions-register, U, the result "0605000" is visible.

On the depression of the division key, 12, in negative division, the locking of the manual operation keys are the same as in division, with the exception, that when it is attempted to depress the revolutions-register control key, 13, depression is not possible, as in the swinging of the lever, 814, the lug, 813, of the lever, 814, lies on the edge, 808x, of the lever, 808, and depression of the revolutions-register control key 13, is thus avoided.

When it is desired to perform division with a dividend the number of places of which amount to more than seven, then it is only necessary to set up the same in the dividend set of keys "Dt" and partly in the divisor set of keys "Dr." Then the dividend, through the depression of the addition key, 4, is brought into the result totalizer, R, in the manner described under the heading "Addition." In order

hereby, to obtain no revolution of the revolutions-register, this is cut out in the manner already described through half-depression of the revolutions-register control key, 13. After the introduction of the dividend into the result totalizer, R, it is necessary, if the lever, 17 (Figure 1) did not stand on the mark "A" i.e. the position for automatic clearing of the keyboard, to clear the dividend through depression of the key, 6 (L¹¹¹) for releasing depressed amount keys. Then the divisor is set up in the divisor set of keys "Dr." and the division key, 12, depressed, whereby the same processes are enacted, as have been described in detail under the heading "Division."

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A calculating machine for performing multiplication and division by repeated addition and subtraction, characterized in that a setting up mechanism combined with differential mechanism is provided for the simultaneous setting of multiplier and multiplicand or divisor and dividend, and the transmission of the set-up multiplier or dividend to the multiplier setting mechanism or totalizer respectively is automatically controlled by a member (shaft 587) which also controls automatically the remaining operations of the machine for completing the multiplication or division operation.

2. A calculating machine for performing multiplication and division according to claim 1, characterized in that the coupling and uncoupling of the result totalizer (R) with the multiplier setting mechanism (M) and the control of the part (610) for the step-wise movement towards zero of the multiplier setting mechanism (M) are effected by a cam (583) on the control shaft (587) whereas the opening of the differential mechanism actuating coupling, the changing over of the differential mechanism for the kind of calculation and the closing of the differential mechanism actuating coupling are effected through a common member (853) on the control shaft (587), the differential mechanism being set by spring power (859) automatically for one kind of calculation (addition) and the closing of the motor contact and the closing of the differential mechanism actuating coupling for the first time being effected through a control lever (391) common to the multiplication and division levers (634 and 604).

3. A calculating machine for performing multiplication and division according to

to claims 1 and 2, characterized in that the control shaft (587) is capable of being coupled with the main driving shaft (3) through the multiplication key (11) or the division key (12) which initiate the operations of the main driving shaft (3).

4. A calculating machine for performing multiplication and division according to claims 1 to 3, characterized in that the setting up mechanism (A) has at least the same number of denominations as the result totalizer (R) and a part (Mk or Dt) of the setting-up mechanism is capable of being zeroized through the control shaft (587).

5. A calculating machine for performing multiplication and division according to claims 1 to 4, characterized in that the number of denominations of the part (Mk or Dt) of the setting up mechanism (A) capable of being zeroized through the control shaft (587) corresponds at least to the number of denominations of the multiplier setting mechanism (606).

6. A calculating machine for performing multiplication and division according to claims 1 to 5, characterized in that the coupling (622, 618, 624) arranged between the main driving shaft (3) and the control shaft (587) consists of a one-revolution coupling controllable by the control shaft (587) itself.

7. A calculating machine for performing multiplication and division according to claims 1 to 6, characterized in that the control shaft (587) is displaceably and rotatably mounted and normally takes up a middle position from which it is displaceable through the multiplication key (11) into one end position and through the division key (12) into the other end position.

8. A calculating machine for performing multiplication and division according to claims 1 to 7, characterized in that the control shaft (587) carries a number of control cams which in one of the end positions of the control shaft (587) control the setting up mechanism and operations for multiplication and in the other end position of the control shaft (587), control the setting up mechanism and operations for division.

9. A calculating machine for performing multiplication and division according to claims 1 to 8, characterized by two control levers (644, 391) common to the multiplication key (11) and the division key (12) of which the lever (644) controls the control shaft (587) and the other lever (391) closes the motor contact (362, 364) and the differential mechanism actuating coupling (52), and both of the control levers (644, 391) on the operation of the multiplication key (11) or the division key

(12) lock the other key member.

10. A calculating machine for performing multiplication and division, according to claims 1 to 9, characterized in that certain control cams (853 and 723) are formed of such width that they come into operation in both end positions of the control shaft (587).

11. A calculating machine for performing multiplication and division according to claims 1 and 3 to 9 characterized in that a device is provided which consists of controlling parts (563, 564, 570) which automatically connect and disconnect the control lever (443) of the zeroizing device and the flap (601) of the coupling between the result totalizer and the multiplier setting mechanism.

12. A calculating machine for performing multiplication and division, according to claims 1 and 3 to 9 and 11, characterized in that to the controlling parts (563, 564, 570) which connect and disconnect the parts (443, 601) is jointed an U-shaped part (568) connecting the control lever (443) of the zeroizing device, which U-shaped part automatically uncouples the control lever (443) of the zeroizing device in the initial position of the control lever (563) and on the actuation of the control lever (563) automatically effects the connection between this and the control lever (443).

13. A calculating machine for performing multiplication and division according to claims 1 and 3 to 9 and 11, 12, characterized in that the device (563, 564, 570) connecting the coupling (607, 608) between the result totalizer and the multiplier setting mechanism with the zeroizing device (514) for the revolutions-register (U) is capable of being brought at will into the operative position.

14. A calculating machine for performing multiplication and division, according to claims 1 and 3 to 9 and 11 to 13, characterized in that a member (16, 573) establishes at will a coupling between the control lever (563) and the zeroizing means of the revolutions-register U.

15. A calculating machine for performing multiplication and division, according to claims 1 and 3 to 9 and 11 to 14, characterized in that the connecting device (563, 564, 570) is arranged between the control lever (563) of the said connecting device and the zeroizing lever (443) of the result totalizer (R) and that the coupling (16, 573, 509) which is capable of being brought at will into the working position, is arranged between the control lever (563) of the connecting device and the zeroizing lever (514) for the revolutions-register (U).

16. A calculating machine for performing multiplication and division, according to claims 1 and 3 to 9 and 11 to 15, characterized in that the coupling (607, 808) between the result totalizer and the multiplier setting mechanism is of the internally toothed type. 70
17. A calculating machine for performing multiplication and division, according to claims 1 and 3 to 9 and 11 to 16, characterized by a locking arm (566) arranged between the control lever (563) of the connecting device and the members (367a, 367b or 322) actuated by the main driving shaft (116, 117) which locking arm (566) prevents an actuation of the control lever (563) during the calculating process. 75
18. A calculating machine for performing multiplication and division, according to claims 1 to 17, characterized in that the control shaft (587) and the lever (610) which step-wise actuates the multiplier setting mechanism are capable of being driven through a common driving member (618) formed as a coupling for the control shaft (587). 80
19. A calculating machine for performing multiplication and division, according to claims 1 to 18, characterized in that the control shaft (587) is normally uncoupled from the driving member (618) and through a control lever (644) common to the multiplication and division key levers (634 and 404) is capable of being set in two end positions in addition to its uncoupling position in which end positions it is capable of being coupled automatically with the driving member (618). 85
20. A calculating machine for performing multiplication and division, according to claims 1 to 19, characterized in that the control lever (644) common to the multiplication and division key levers (634 and 404) simultaneously and automatically regulates the zeroizing zone (releasing bar 418A) of the setting up mechanism. 90
21. A calculating machine for performing multiplication and division, according to claims 1 to 20, characterized in that the control lever (644) which is influenced by the division key lever (404) reduces the zeroizing zone of a part of the setting up mechanism. 95
22. A calculating machine for performing multiplication and division, according to claims 1 to 21, characterized in that the displacement movement of the control shaft (587) produced by the control lever (644) is transmitted to the shaft (587) through a connection (655a, 657) which automatically releases itself during its rotation. 100
23. A calculating machine according to claims 1 to 22 characterized in that the middle position of the control shaft (587) is ensured by a pair of spring tongs (925, 926, 927) and both of the end positions by abutments (662a, 660) brought into contact under the action of the spring tongs. 105
24. A calculating machine for performing multiplication and division, according to claims 1 to 23, characterized in that the control cams (588, 853, 678, 723) coming into operation in the one end position (multiplication) of the control shaft (587) are so distributed and arranged on the rotation of the control shaft (587) that the control cams seriatim (a) after introduction of the factors into the result totalizer (R), before the tens transfer of the same becomes operative, couple the multiplied toothed wheels (606) of the multiplier setting mechanism with the numeral wheels (499) of the result totalizer (R) and render inoperative the lever (610) which stepwise actuates the multiplier toothed wheels (606) and maintain this condition until the succeeding subtraction process is effected, (control cam 588). 110
- (b) open the differential mechanism actuating coupling after the addition process, change over the proportional rack system for subtraction and close the differential mechanism actuating coupling for the subtraction process, control cam 853). 115
- (c) zeroize a part of the proportional rack-system or setting up mechanism (control cam 678). 120
- (d) bring the holding members (699, 698, 689, 692) for the lever (634) for the multiplier setting mechanism into the working position (control cam 723). 125
25. A calculating machine for performing multiplication and division, according to claims 1 to 24, characterized in that the multiplier setting cams (627) by their setting bring into the operative position slides (703, 734) for the holding members (699, 698, 689, 692) of the multiplication key lever (634) and control members (757, 743) for the carriage shift coupling (26). 130
26. A calculating machine for performing multiplication and division according to claims 1 to 25, characterized in that the control members (757, 743) for the carriage shift coupling (26) are controlled through the locking slides (703, 734). 135
27. A calculating machine for performing multiplication and division according to claims 1 to 26, characterized 140

in that one (703) of the locking slides (703, 734) is controllable through a member (712) common to all of the multiplier setting cams (627) lying to the left of the units denomination while the other locking slide (734) on occasion is controllable only by one of the multiplier setting cams (627).

28. A calculating machine for performing multiplication and division according to claims 1 to 27, characterized in that the control members (757, 743) for the carriage shift coupling are capable of being driven by the members (19, 756, 749, 748) driven by the differential mechanism actuating coupling (52).

29. A calculating machine for performing multiplication and division according to claims 1 to 28, characterized in that the control member (757) for the carriage shift coupling controlled by the common member (712) is capable of being brought by set multiplier setting cams (627) into the path of movement of the member (756, 749, 748) driven by the differential mechanism actuating coupling and closes the carriage shift coupling (26) only during the movement of the carriage to the right, whereas the control member (743) controlled by the actual multiplier setting cam (627) is capable of being brought only by a zeroized multiplier setting cam (627) into the path of movement of the members (756, 749, 748) driven by the differential mechanism actuating coupling while said control member (743) closes the carriage shift coupling only in the carriage left-hand movement.

30. A calculating machine for performing multiplication and division according to claims 1 to 29, characterized in that the member (743, 743x, 743y) controlled by the multiplier setting cams (627) is provided with two steps (743x, 743y) and that its lower step (743y) may be brought into the path of movement of the members (756, 749, 748) driven by the differential mechanism actuating coupling only by the multiplier setting cam (627) of the lowest denomination, whereby the carriage shift coupling is held in the opened position.

31. A calculating machine for performing multiplication and division, according to claims 1 to 30, characterized in that the control members (757, 743) for the carriage shift coupling are held scissor-like in relation to one another through multiplier setting cams (627) set at zero by the common member (712) and on occasion through a multiplier setting cam (627) lying on the outside of the same in such a manner that the member (749, 748) driven by the differential mechanism actuating coupling remains inoperative on

the control members (757, 743).

32. A calculating machine for performing multiplication and division, according to claims 1 to 31, characterized in that a member (699, 698, 689) holding the multiplier key lever (634) in its depressed position is held in its working position by a lock (727, 725) brought into the operative position by the movement of the carriage to the left.

33. A calculating machine for performing multiplication and division, according to claims 1 to 32, characterized in that the shaft (300) for changing over the kind of calculation of the proportional rack system and the revolutions-register after its shift effected through the control cam 853 for subtractive operation of the proportional rack system and the revolutions-register is capable of being locked by the holding members (699, 698, 689) in the subtraction position by means of a connecting member (839) arranged between a shift lever (14) and the holding member (699, 698, 689) for the multiplier key lever (634).

34. A calculating machine for performing multiplication and division, according to claims 1 to 33, characterized in that the locking bar (322, 397) controlling the differential mechanism actuating coupling (52) and the motor contact is capable of being locked in one of the two end positions of a lever (15), capable of being brought into two end positions, as soon as the part (678) of the control cam (680) zeroizing a part of the setting up mechanism or the proportional rack system is operative on the locking bar (322).

35. A calculating machine for performing multiplication and division, according to claims 1 to 34, characterized in that the part (678) of the control cam (680) zeroizing a part of the setting up mechanism or the proportional rack system influences the locking bar (322, 397) in the opening sense for the differential mechanism actuating coupling and the motor contact.

36. A calculating machine for performing multiplication and division, according to claims 1 to 35, characterized in that the lever (15) locking the locking bar (322, 397) in one of its end positions, is mounted on the multiplication key lever (634).

37. A calculating machine for performing multiplication and division, according to claims 1 to 36, characterized in that the member (585, 584, 582) which effects the coupling of the result totalizer (R) with the multiplier setting mechanism (M) and renders inoperative the part which brings the setting members (606, 130

- 627) of the multiplier setting mechanism to zero besides being capable of being influenced by the control member (587, 588) is also capable of being influenced by the control lever (563) closing the differential mechanism actuating coupling and the motor contact.
38. A calculating machine for performing multiplication and division, according to claims 1 to 37, characterized in that the member (16) is capable of being pre-set in two end positions and in one of these positions the operation of the control lever (563) controls the zeroizing of the result totalizer (R) and also the zeroizing of the revolutions-register (U).
39. A calculating machine for performing multiplication and division, according to claims 1 to 38, characterized in that the sense of rotation of the counting members (606, 627) of the multiplier setting mechanism (M) is in the reverse direction to the rotation of the numeral wheels (499R) of the result totalizer (R).
40. A calculating machine for performing multiplication and division according to claims 1 to 8, characterized in that between the control cam (756) which controls the carriage movement to the right and the member (746) controlling the carriage shift coupling is positioned the control member (757) controllable by the setting cams (627) of the multiplier setting mechanism (M).
41. A calculating machine for performing multiplication and division, according to claims 1 to 8 and 40, characterized in that the control member (757) is controllable through the member (712) which in its turn is controllable by members (630) transmitting the zero position from the multiplier setting members.
42. A calculating machine for performing multiplication and division according to claims 1 to 8 and 40, characterized in that between the member (699, 698) actuated by the control cam (723) which holds the multiplication mechanisms in the coupled position and the member (712) which tests the position of the multiplier setting members is interposed a locking mechanism (703h, 701a, and 719, 759) which holds the member (699, 698, 639) in its working position determined by the control cam (723).
43. A calculating machine for performing multiplication and division, according to claims 1 to 8 and 40 to 42, characterized in that zero spaces (628) are provided on the multiplier setting members and control the coupling lever (44) for the differential mechanism actuating coupling and the carriage shift coupling, and of these zero spaces the space (628g) of the units denomination multiplier setting member is not so deep as the zero spaces of the remaining multiplier setting members, for the purpose of preventing a closing of the coupling in the initial position of the totalizer carriage (B) when the multiplier setting mechanism (606) is brought on zero.
44. A calculating machine for performing multiplication and division according to claims 1 to 8 and 40 to 43, characterized in that the member for releasing depressed amount keys is divided and the one part (418B), as usual, is capable of being influenced by the automatic zeroizing (437a, 406) during the addition process and by a zeroizing key (6) while the other part (418A) is capable of being influenced independently of the part (418B) of the releasing bar (418) by the control cam (678, 680, 679).
45. A calculating machine for performing multiplication and division according to claims 1 to 8 and 10, characterized in that the division key (12) is in connection with the key-releasing bar (418A) actuated by the control cams (678, 680, 679) in such a manner that on depression of the division key (12) the key releasing bar (418A) is displaced on to a key row of next higher denomination.
46. A calculating machine for performing multiplication and division according to claims 1 to 45, characterized in that the control cams (853 and 723) according to claim 24 which cams in the other end position (division) of the control shaft (587) come into an operative position and which are also common to the multiplication process, and the part (679) of the control cam (680) in relation to the control cams (853 and 723) are so distributed and arranged on the rotation of the control member (587) that they seriatim
- (a) open the differential mechanism actuating coupling after the addition process, change-over the proportional rack system for subtraction and close the differential mechanism actuating coupling (52) for the subtraction process (control cam 853).
 - (b) after the introduction of the dividend and divisor into the result totalizer has been effected but before the beginning of the subtraction process zeroize a part of the setting up mechanism (control cam 679).
 - (c) after the subtraction process has been effected close the carriage shift coupling (control cam 723).
47. A calculating machine for performing multiplication and division according to claims 2, 18 to 23 and 46,

characterized in that a member (907) is arranged on the shaft (265) so as to be loosely swingable in directions at right angles to one another which member is

5 swingable in one direction by the carriage running movement and in the other direction by the control cam (723).

48. A calculating machine for performing multiplication and division, according to claims 2, 18 to 23, 46 and 47, characterized in that the member (907) swingable in directions at right angles to one another is loosely held between on the one side a part (904) rigidly mounted on the shaft 265 and on the other side, an actuating lever (871, 879, 880, 882) influenced by the control cam (723) and is coupled with the part (904) in the operative direction of the actuating lever (871, 879, 880, 882).

49. A calculating machine for performing multiplication and division, according to claims 1, 2, 18 to 23, 46 to 48, characterised in that the actuating lever (871, 879, 880, 882) brought into the working position by the control cam (723), is capable of being locked in its working position by locking bail (787a, 786, 787) which is capable of being influenced by the capacity shift flap (793) in the unlocking sense.

50. A calculating machine for performing multiplication and division, according to claims 2, 18 to 23, 46 to 49, characterized in that the locking position of the locking bail (787a, 786, 787) and the locking position of the division key may be made inoperative at will manually through the part (800).

51. A calculating machine for performing multiplication and division according to claims 2, 18 to 23, 46 to 50, characterized in that the actuating lever (881, 879, 880, 882) on being influenced through the control cam (723) shifts a coupling lever (250) controlled in dependence upon the carriage movement, into coupling (390, 379g) relation to the change over device for the kind of calculation.

52. A calculating machine for performing multiplication and division, according to claims 2, 18 to 23, 48 to 51, characterized in that the driving connection lying between the actuating lever (871, 879, 880, 882) and the swingable

member (907) is capable of being released through the carriage movement to the right in the right hand end position of the carriage.

53. A calculating machine for performing multiplication and division, according to claims 1, 2, 18 to 23, 46 to 52, characterized in that a coupling slide (892) controllable by the actuating lever (871, 879, 880, 882) is interposed between the flap (785), actuated by the capacity shift flap (798) and the part (904) rigidly mounted on the control shaft (265).

54. A calculating machine for performing multiplication and division according to claims 2, 18 to 23, 46 to 53, characterized in that the slide (892) is transmitted into its coupling position by the actuating lever (871, 879, 880, 882).

55. A calculating machine for performing multiplication and division, according to claims 2, 18 to 23, 46 to 54, characterized in that the lever (808) controllable through the lever (14) is arranged between the division key lever (404) and the member (814) which is capable of being influenced through a revolutions-register control key (13) for setting the revolutions register for the kind of calculations.

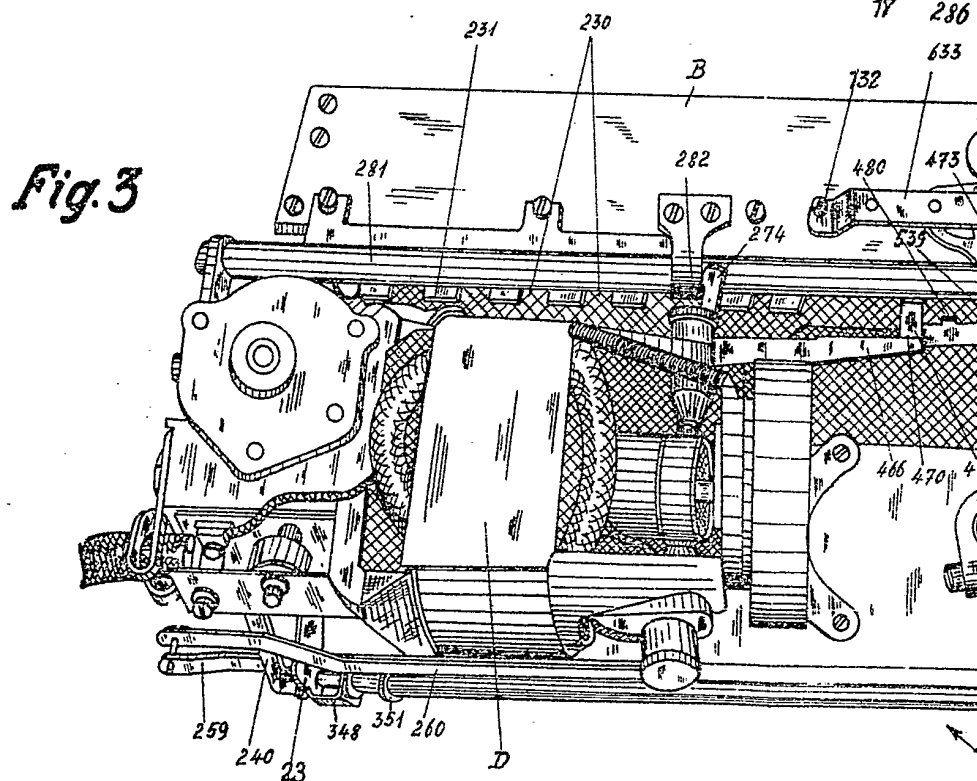
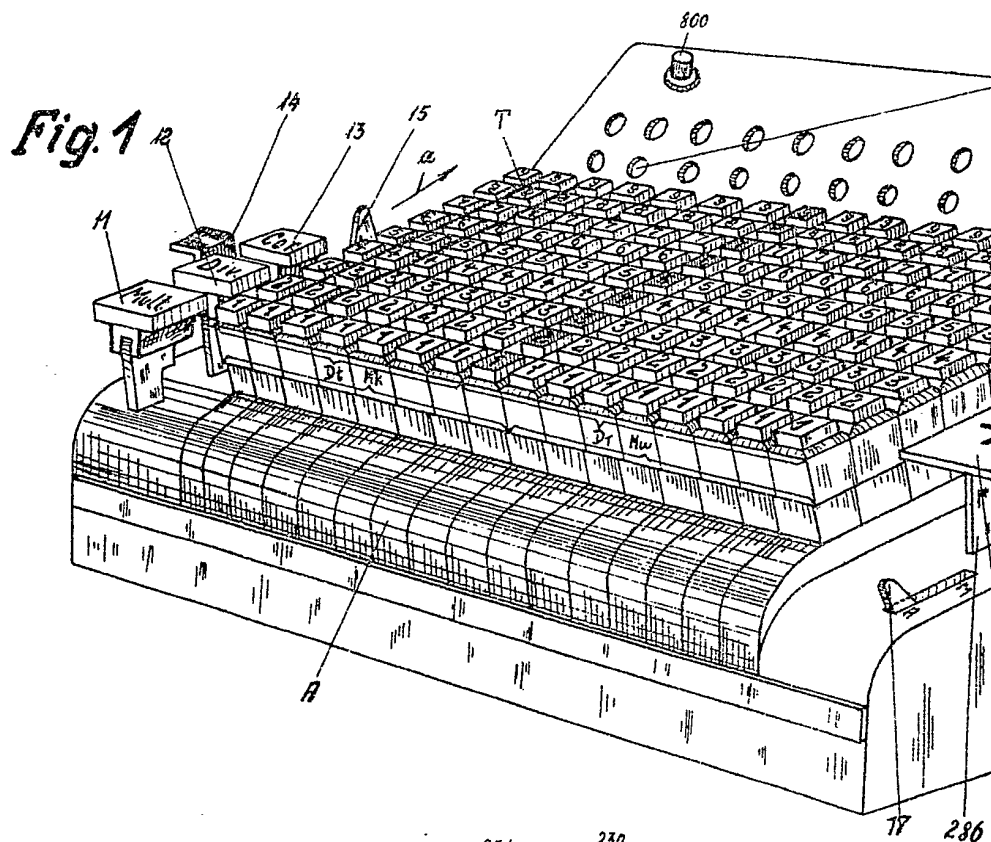
56. A calculating machine for performing multiplication and division according to claims 2, 18 to 23, 46 to 55, characterized in that the lever (808) is influenced in the uncoupling sense on setting the lever (14) on subtraction.

57. A calculating machine for performing multiplication and division, according to claims 2, 18 to 24, 34, 35, 46, characterized in that the locking bar (322) controlling the differential mechanism actuating coupling and the motor contact is connected yieldingly (spring 395) with the control lever (391) governed by the multiplication and division key lever.

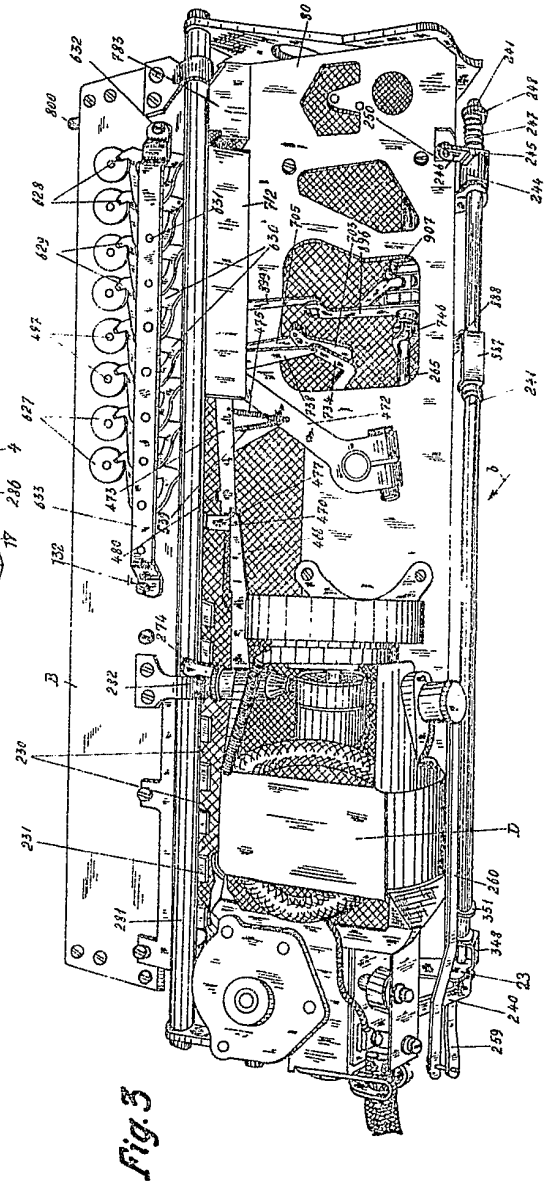
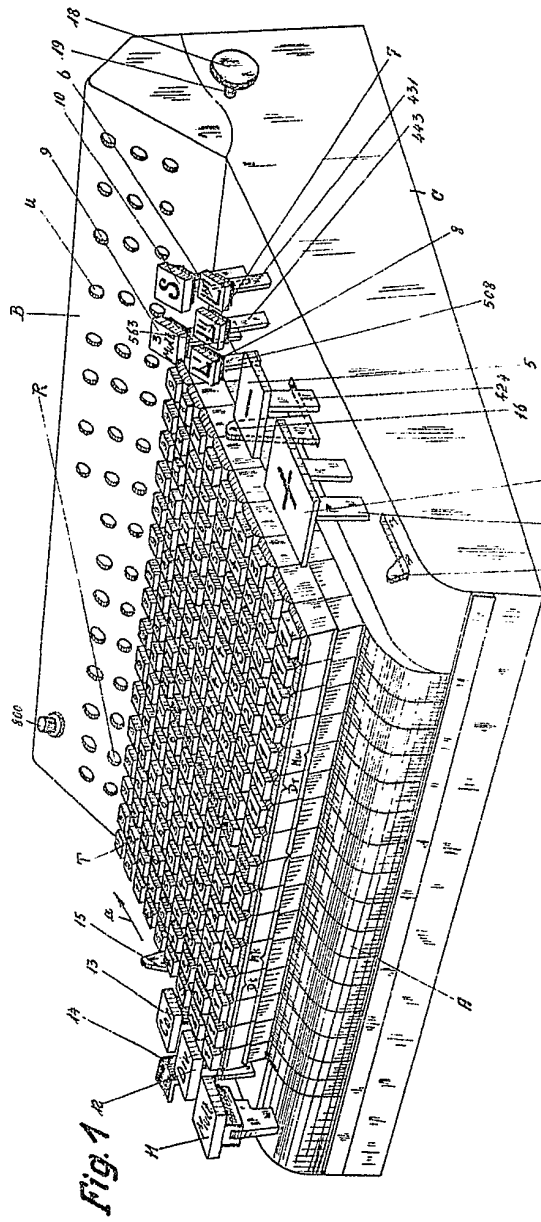
58. Improved calculating machine for performing multiplication and division, operating and constructed substantially as hereinbefore described and illustrated by the accompanying drawings.

Dated the 10th day of May, 1934.

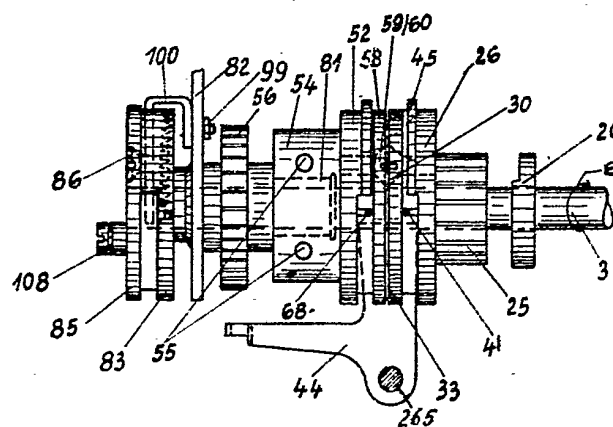
WILLIAM BRYSON,
Chartered Patent Agent,
29, Southampton Buildings, London,
W.C.2.



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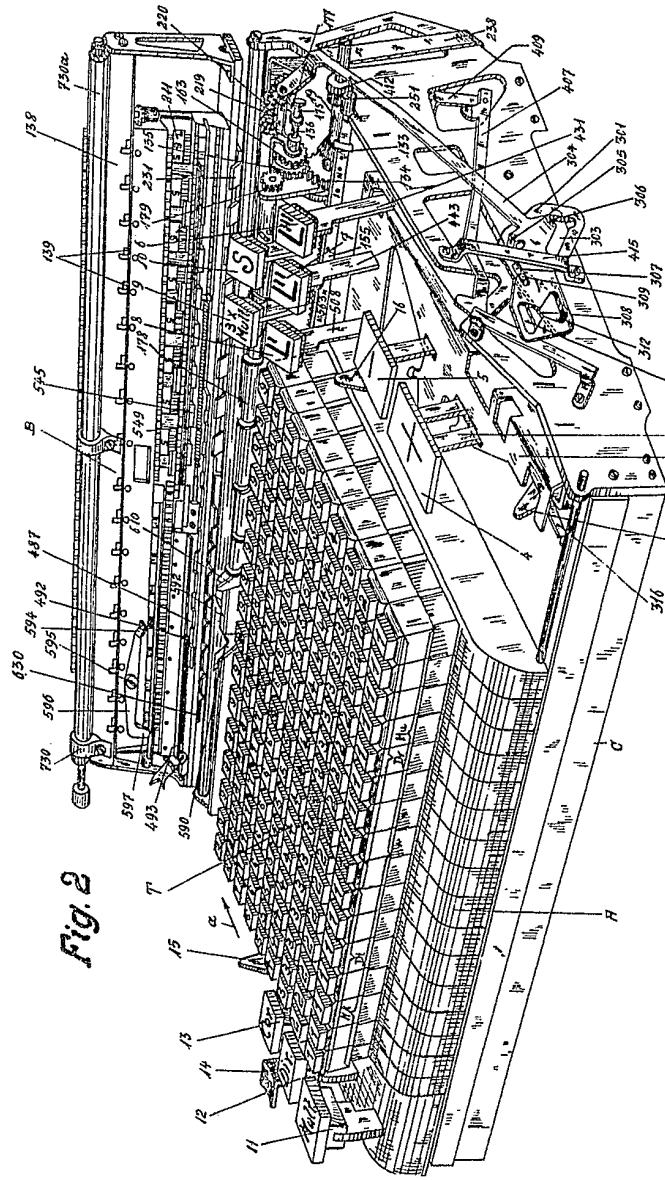


Fig. 2

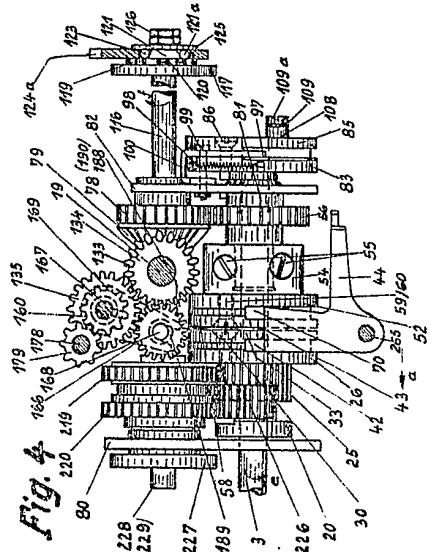
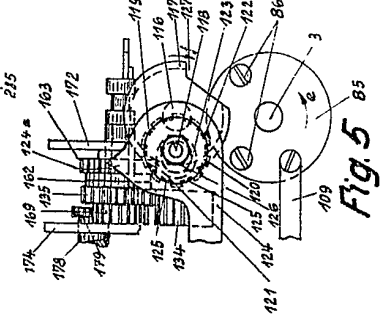


Fig. 4



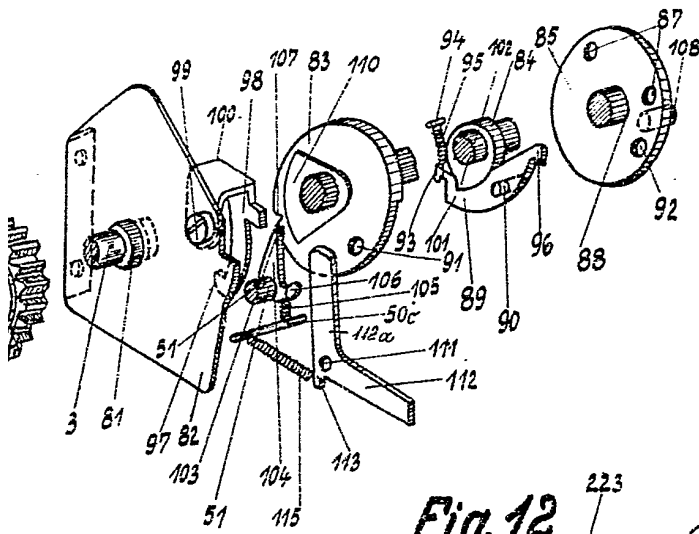


Fig. 12

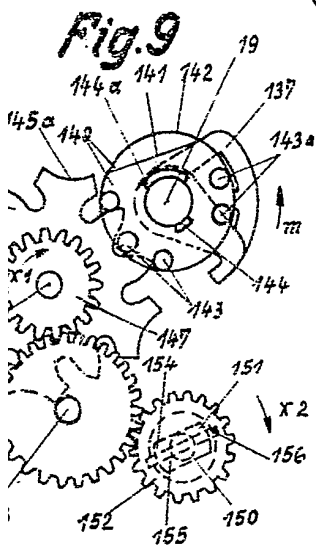


Fig. 9

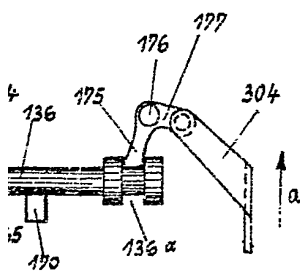
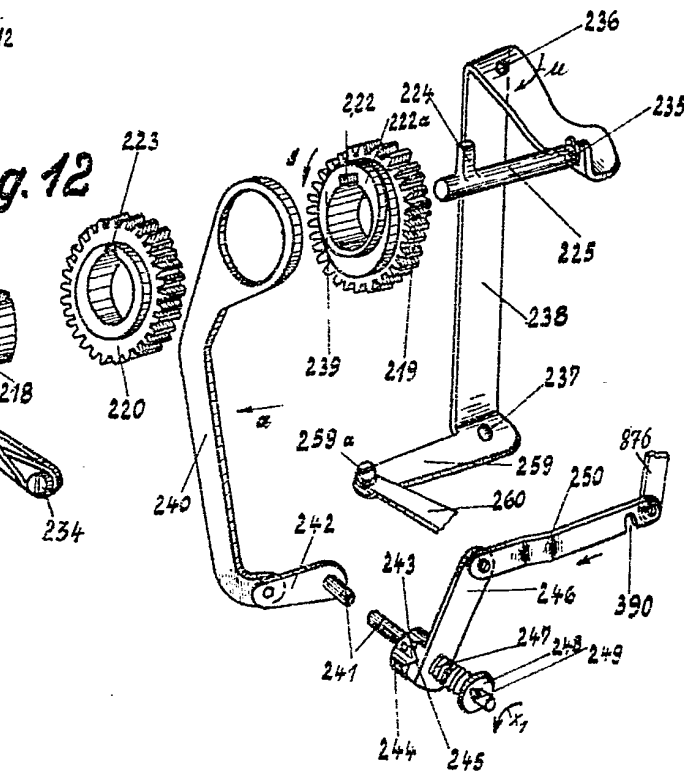
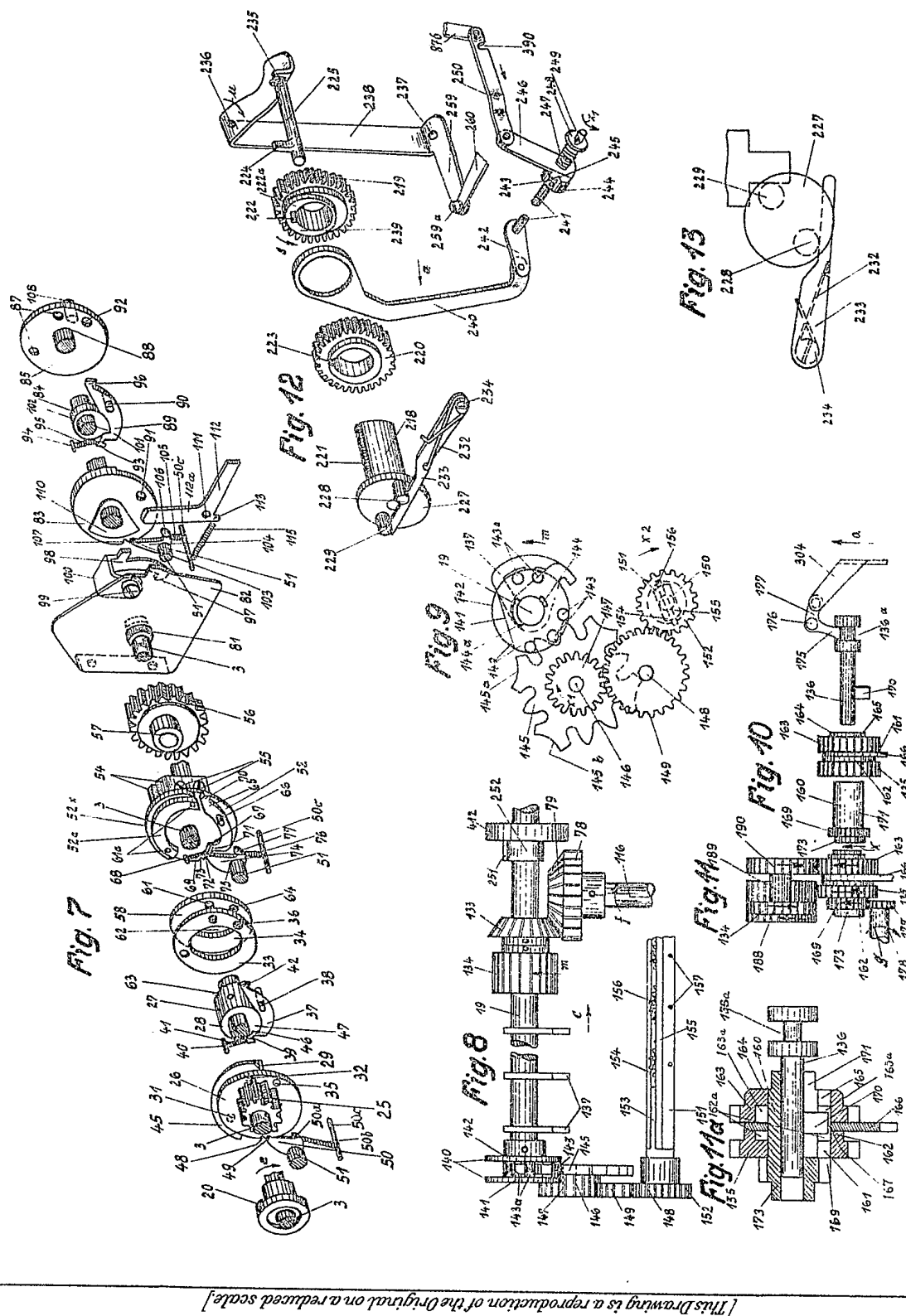


Fig. 13





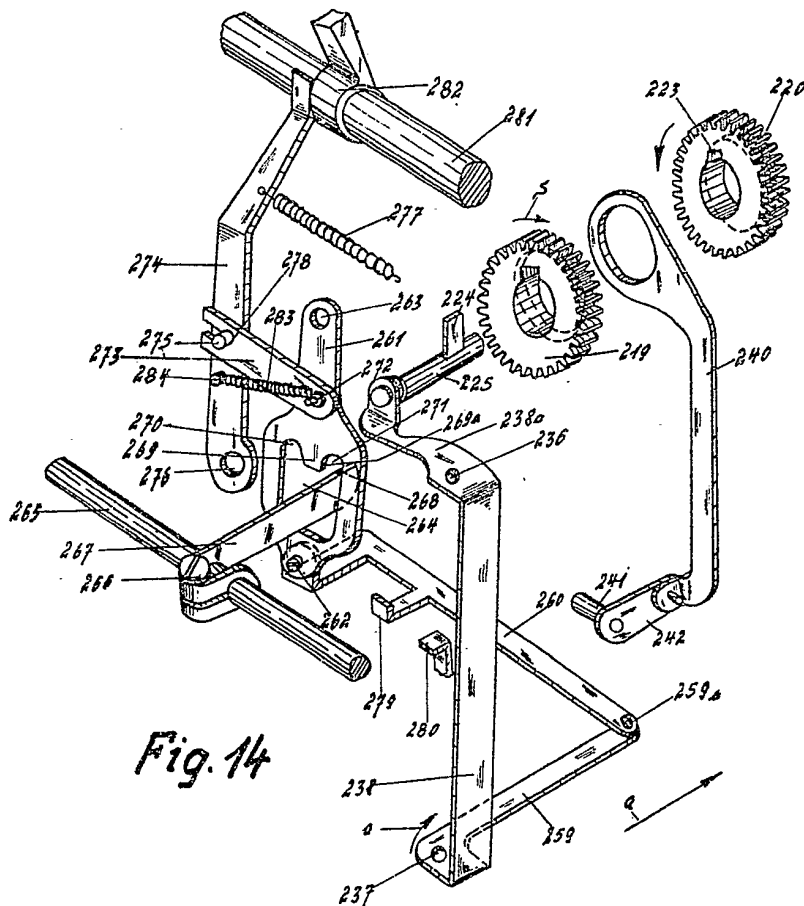
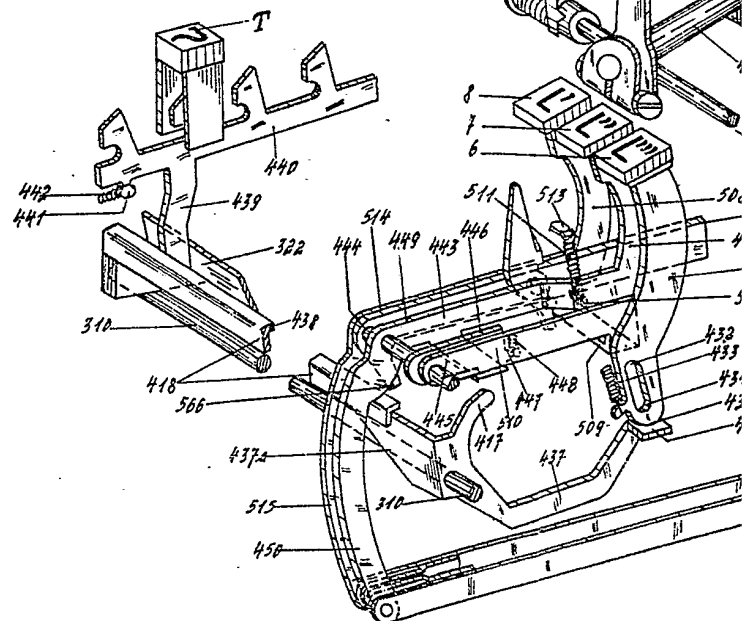


Fig. 14



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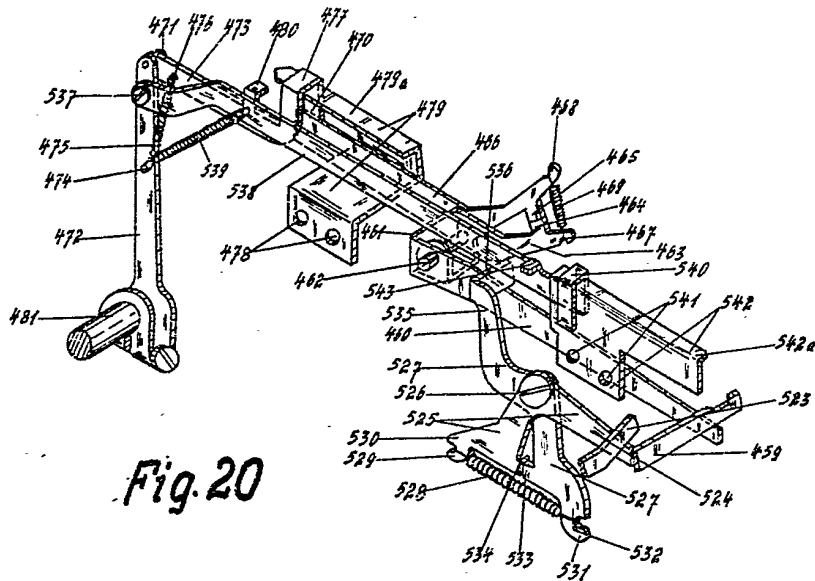


Fig. 20

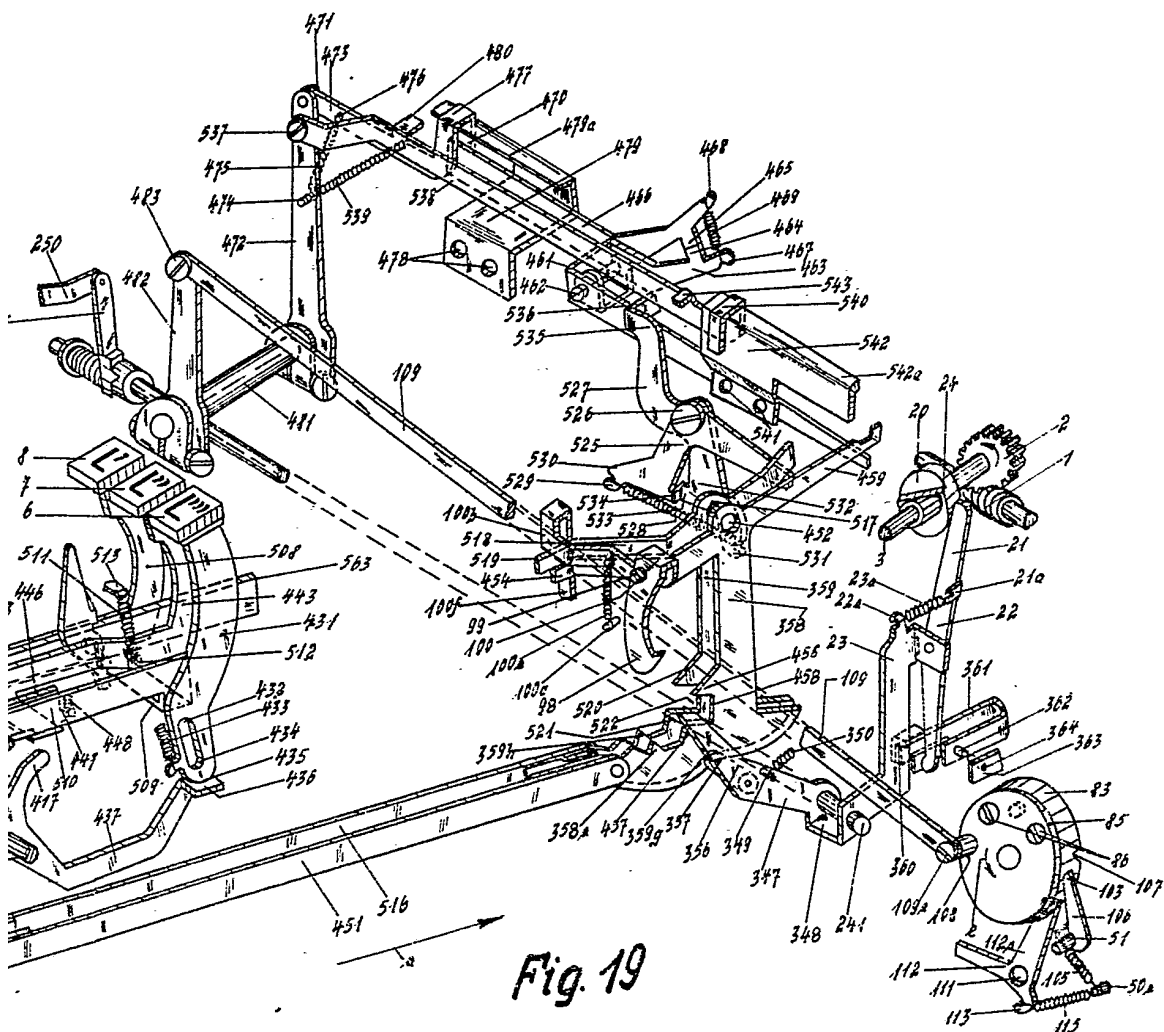


Fig. 19

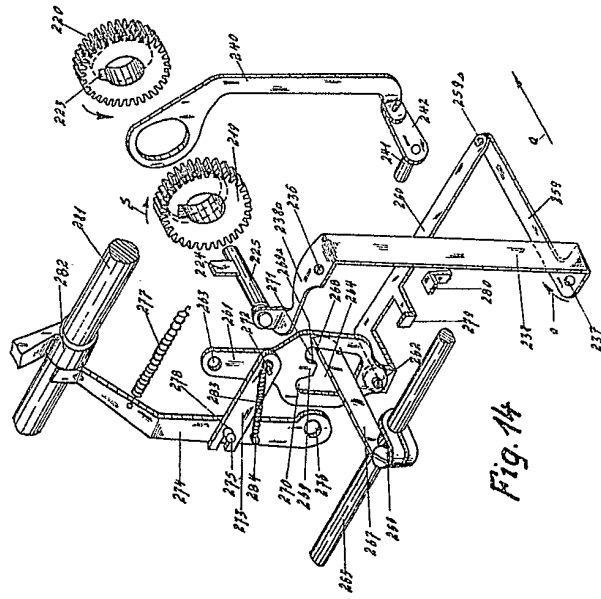


Fig. 14

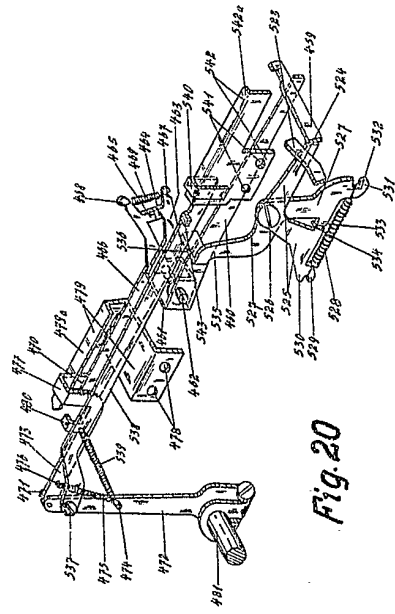


Fig. 20

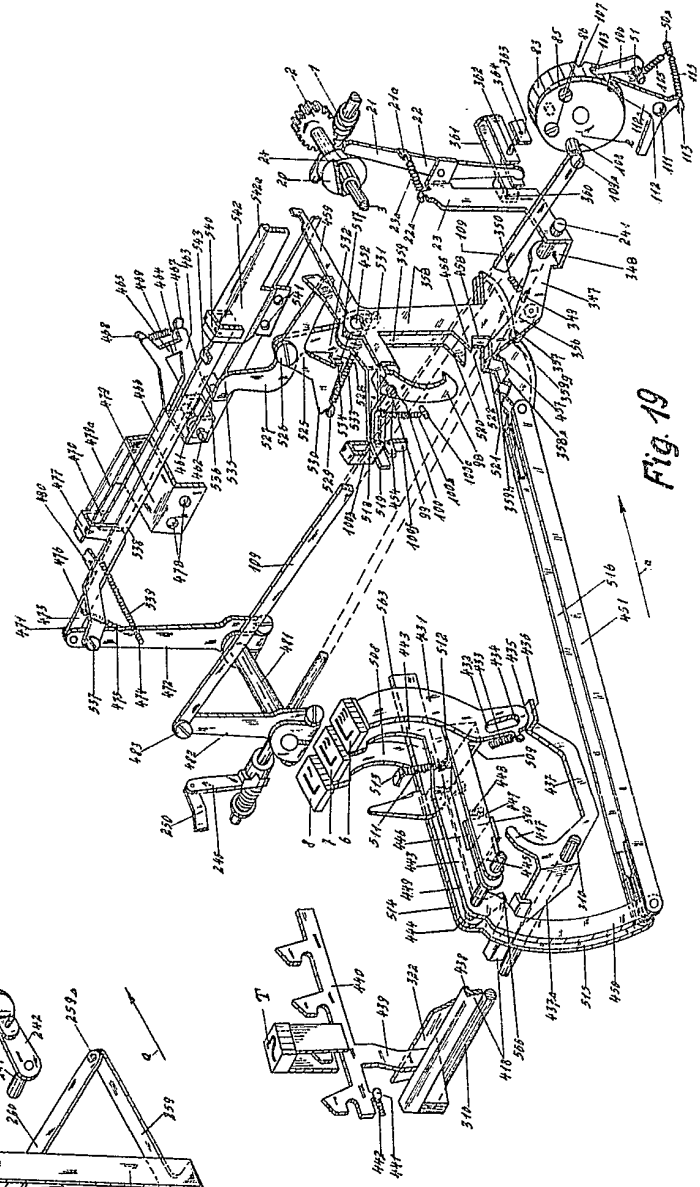


Fig. 19

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Fig. 17

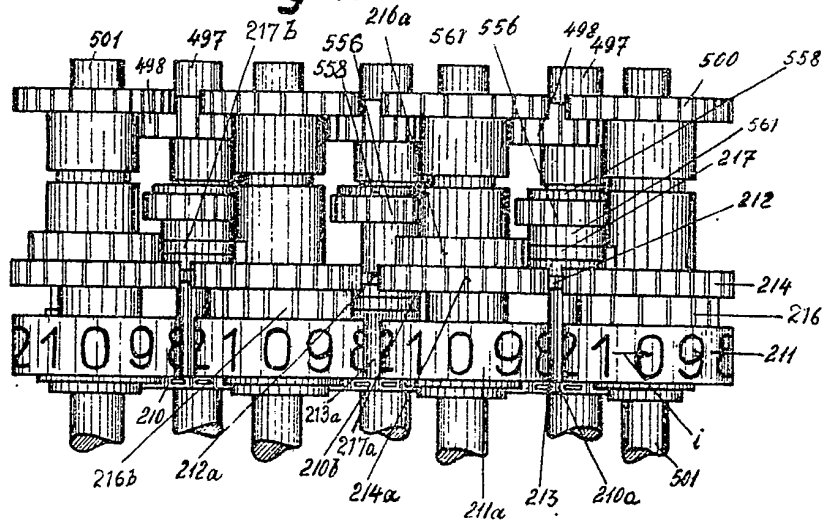


Fig. 18

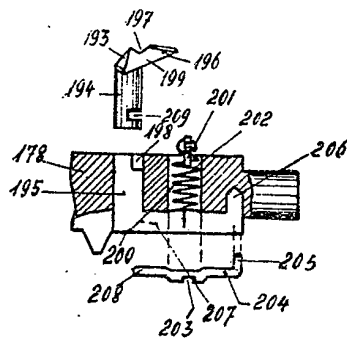
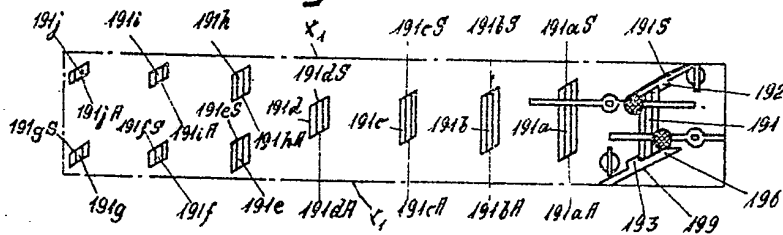


Fig. 16



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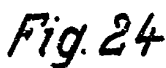
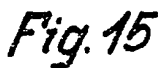


Fig. 17

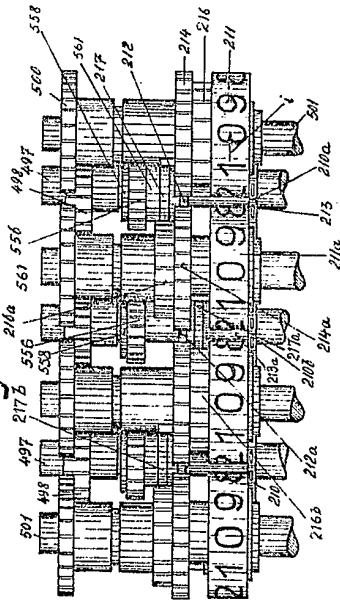


Fig. 15

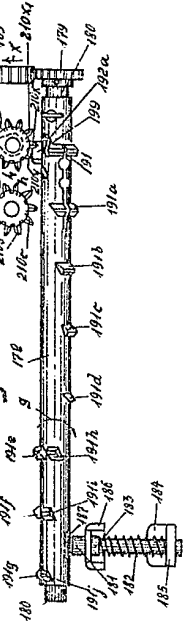


Fig. 18

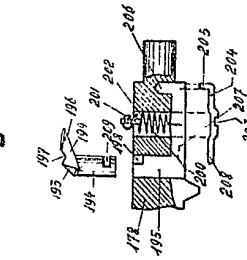
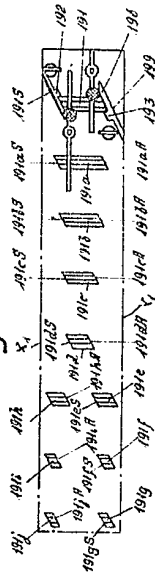


Fig. 16



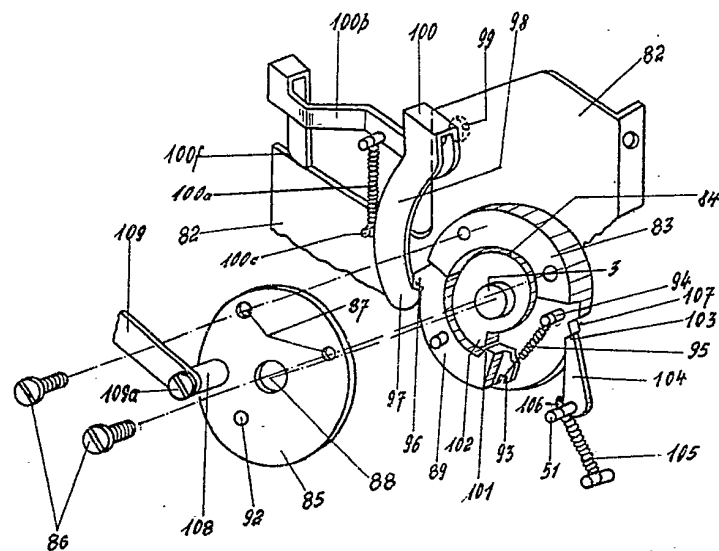


Fig. 19a

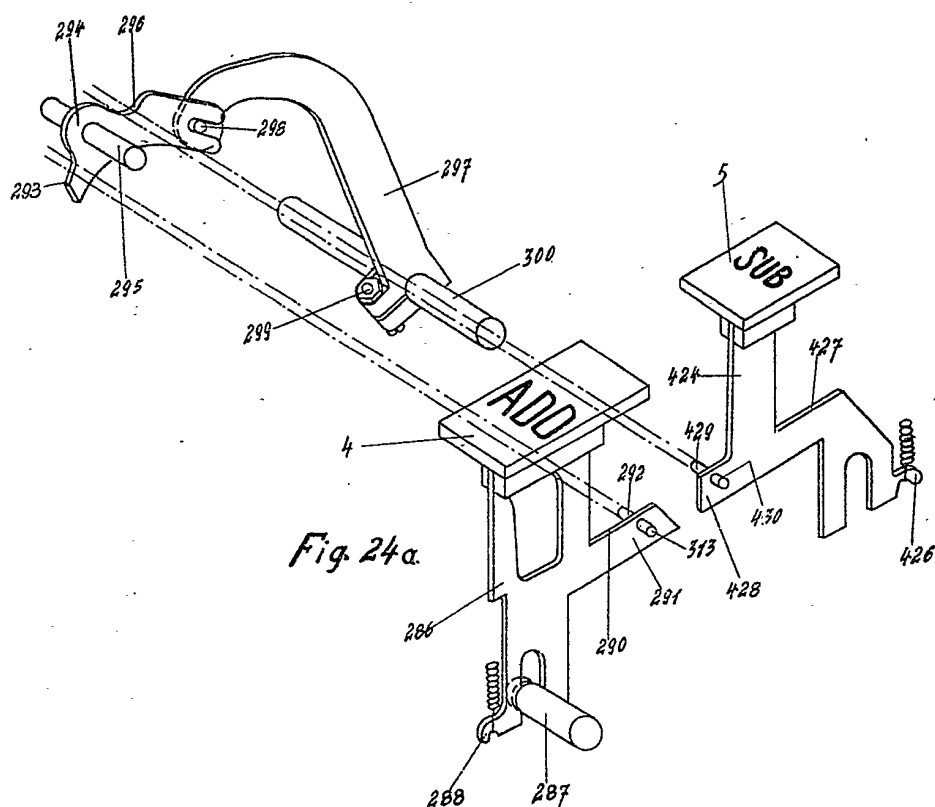


Fig. 24a

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Fig. 25a

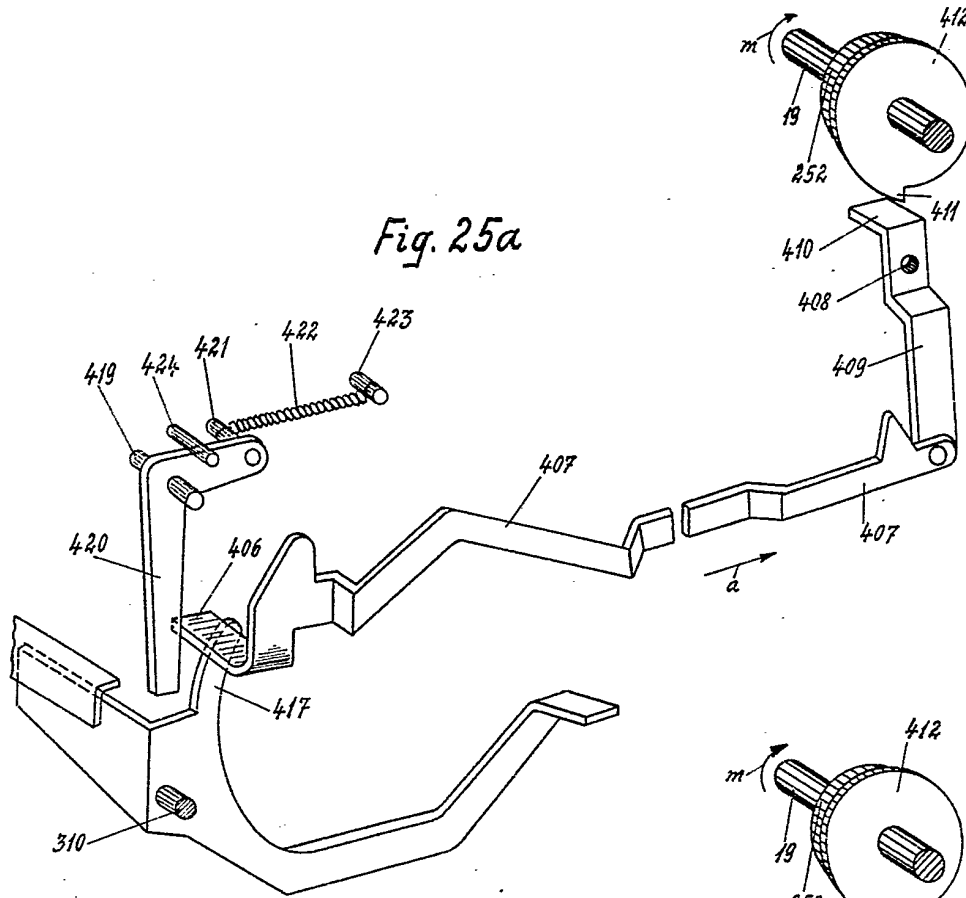
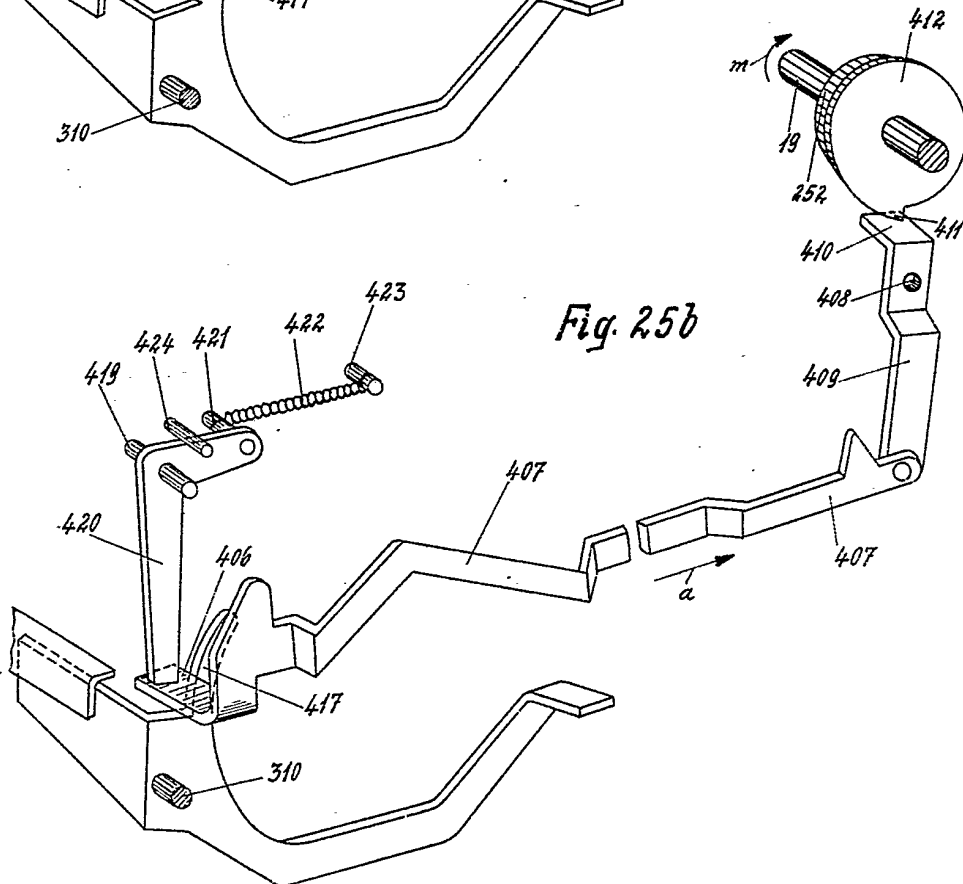


Fig. 25b



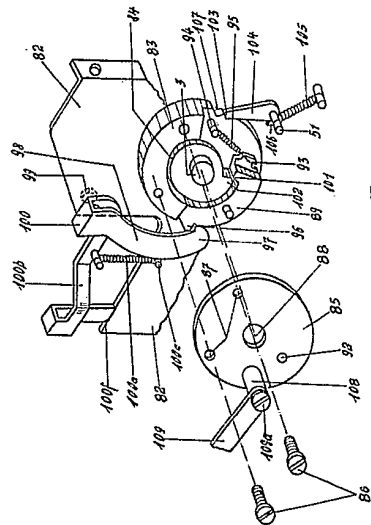


Fig. 19a

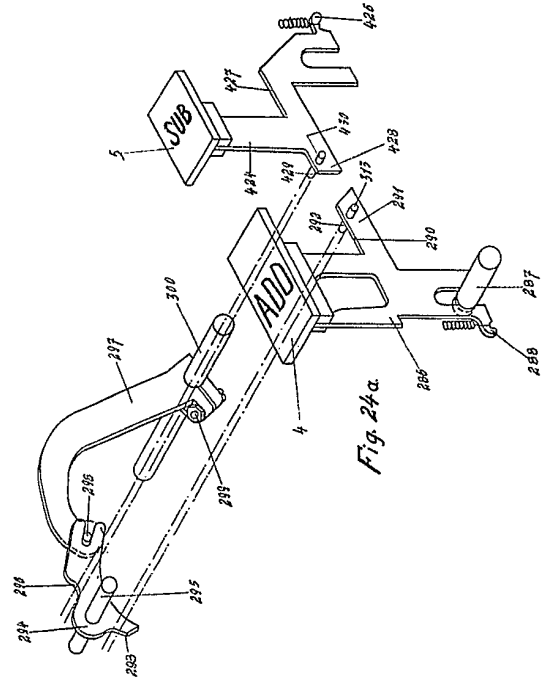


Fig. 24a

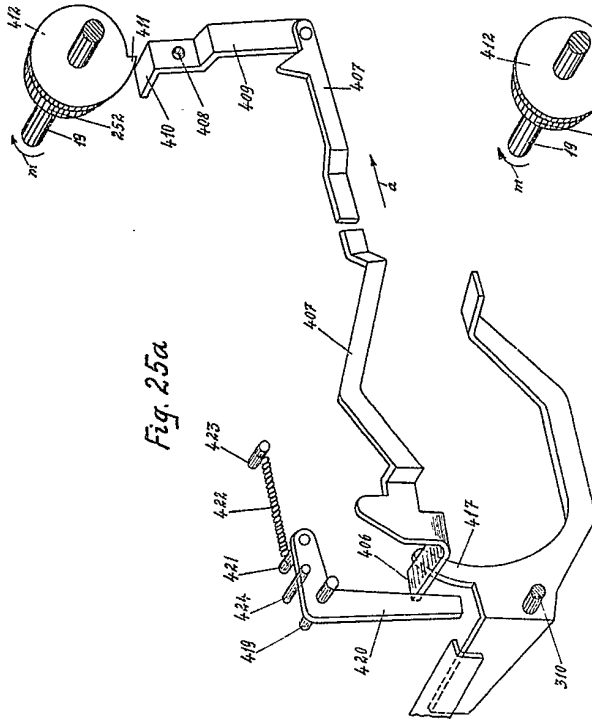


Fig. 25a

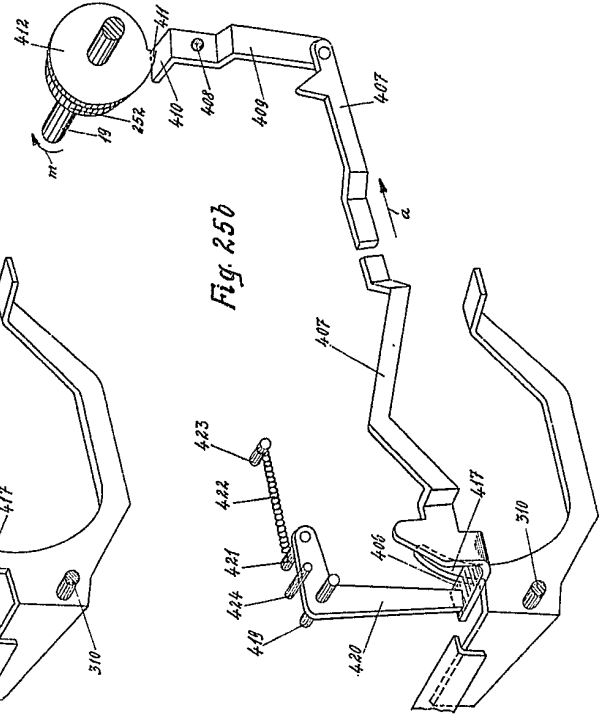
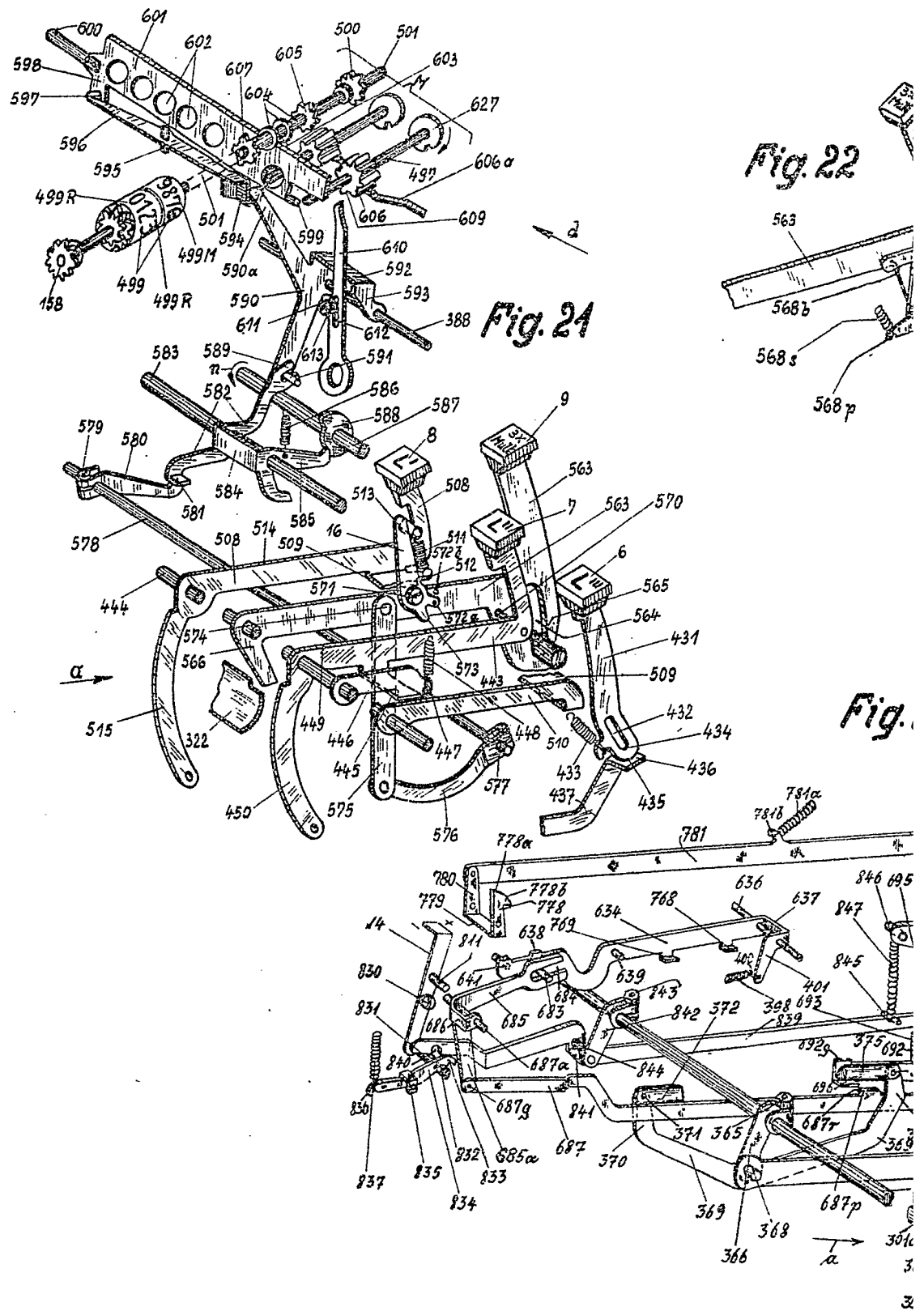
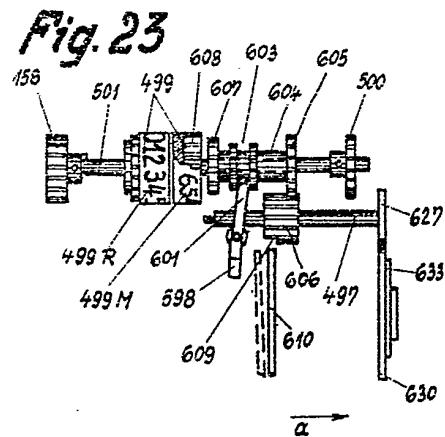
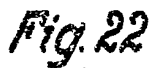


Fig. 25b

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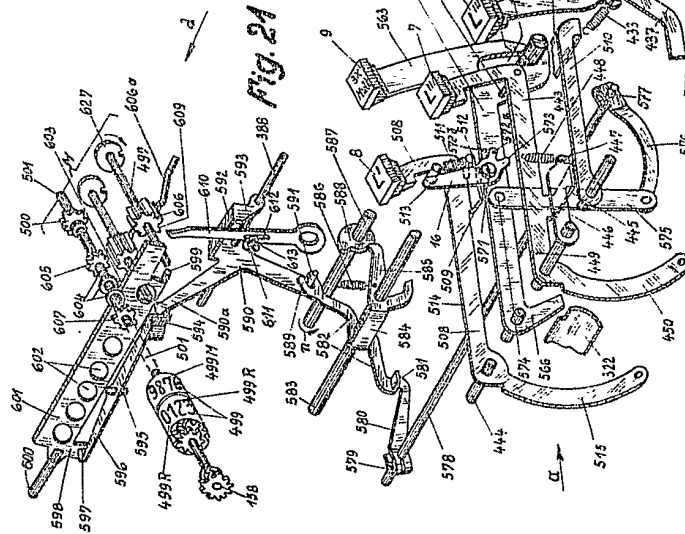


Fig. 21

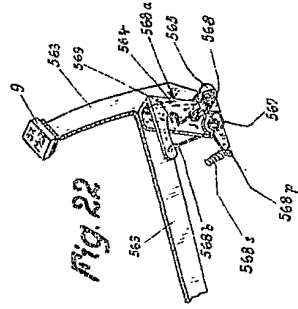


Fig. 22

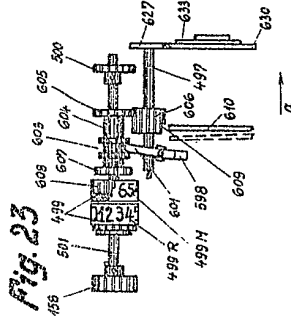


Fig. 23

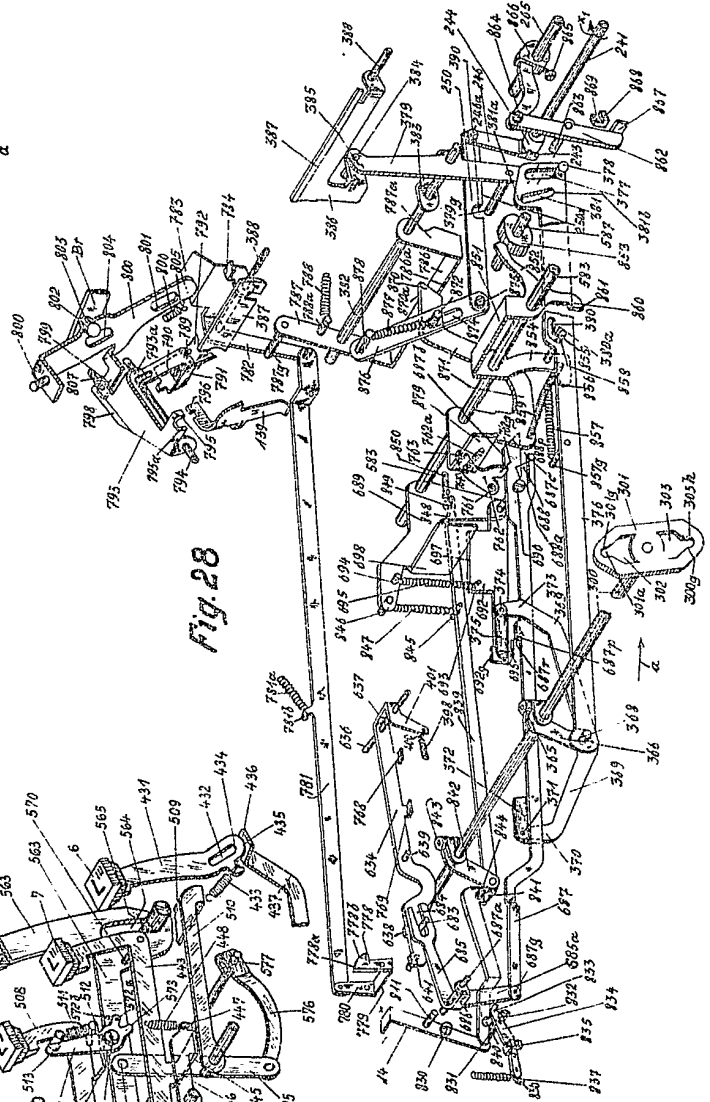


Fig. 28

Fig. 27

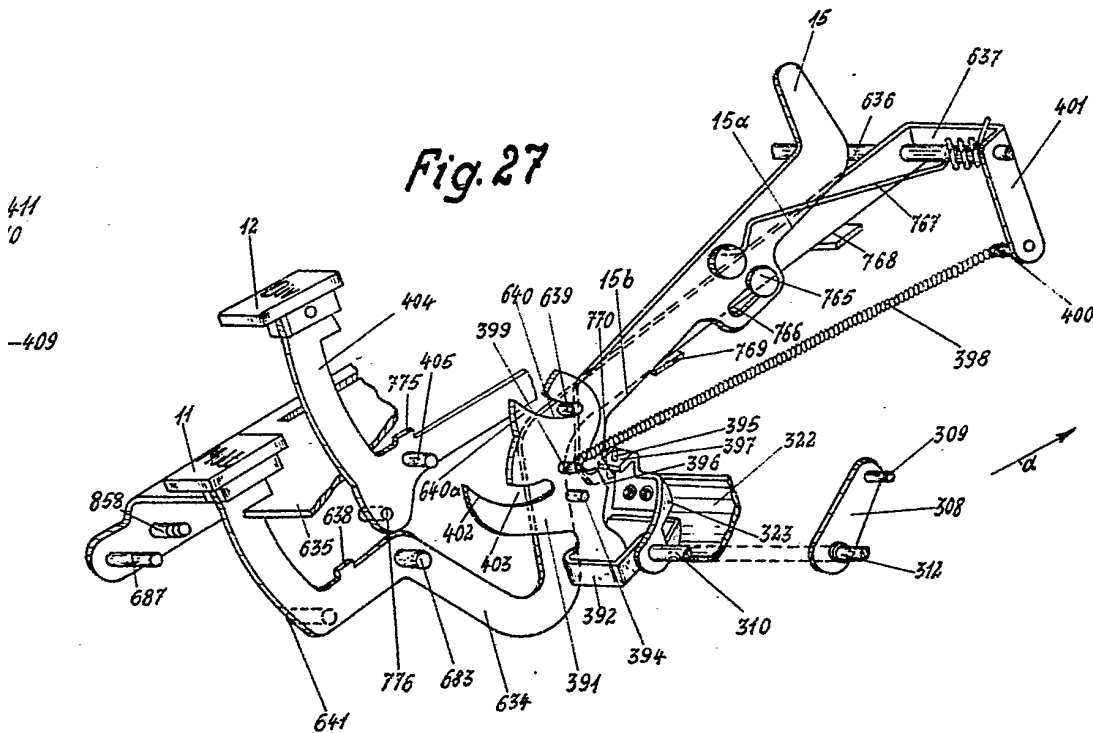
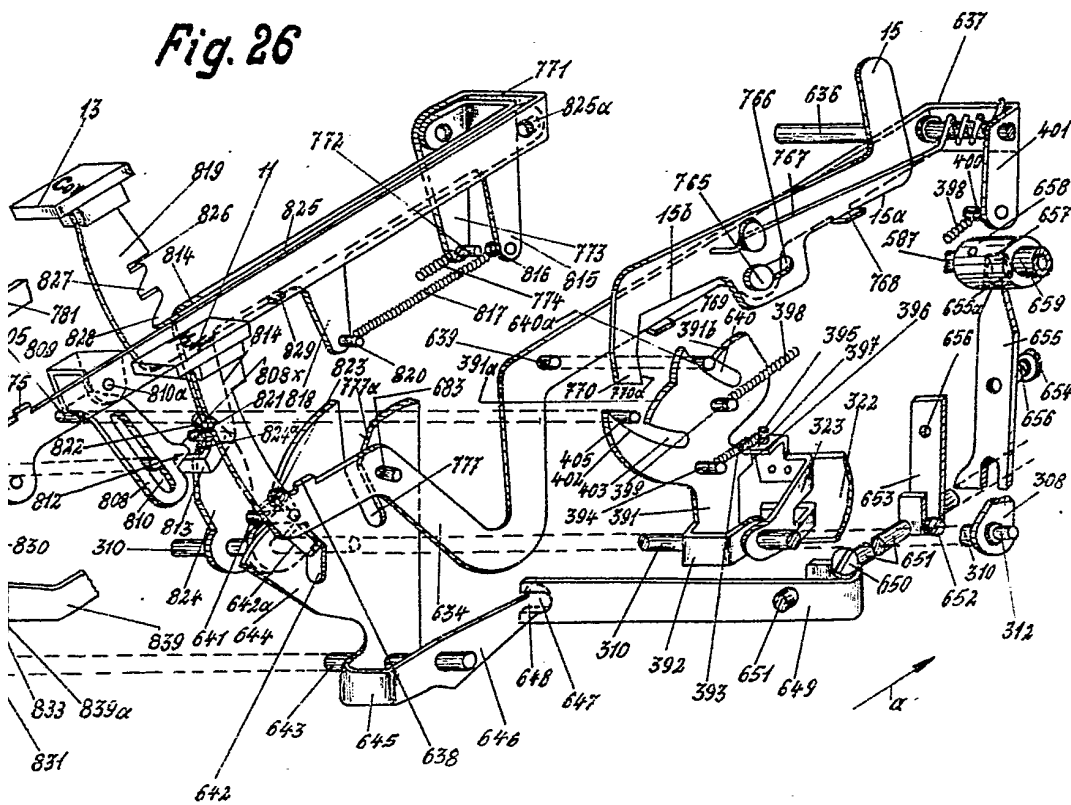


Fig. 26



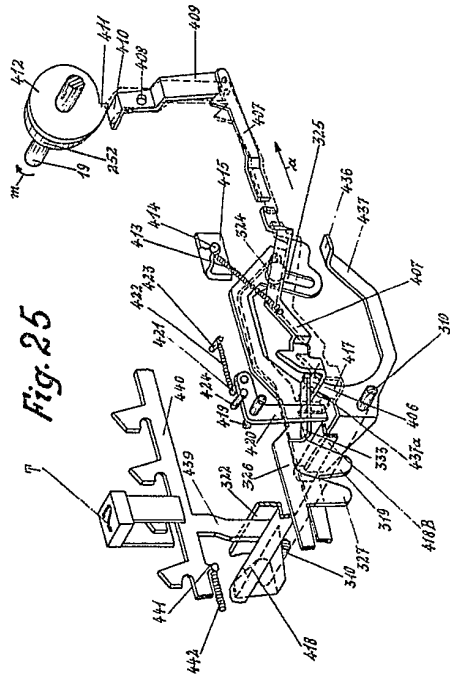


Fig. 25

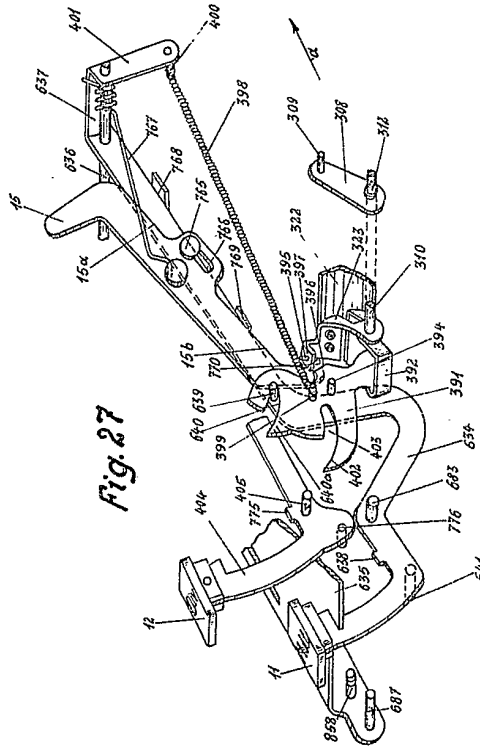


Fig. 27

Fig. 26a

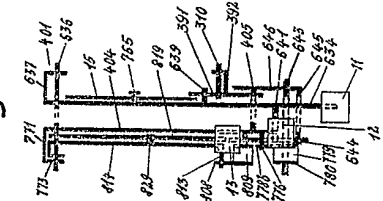
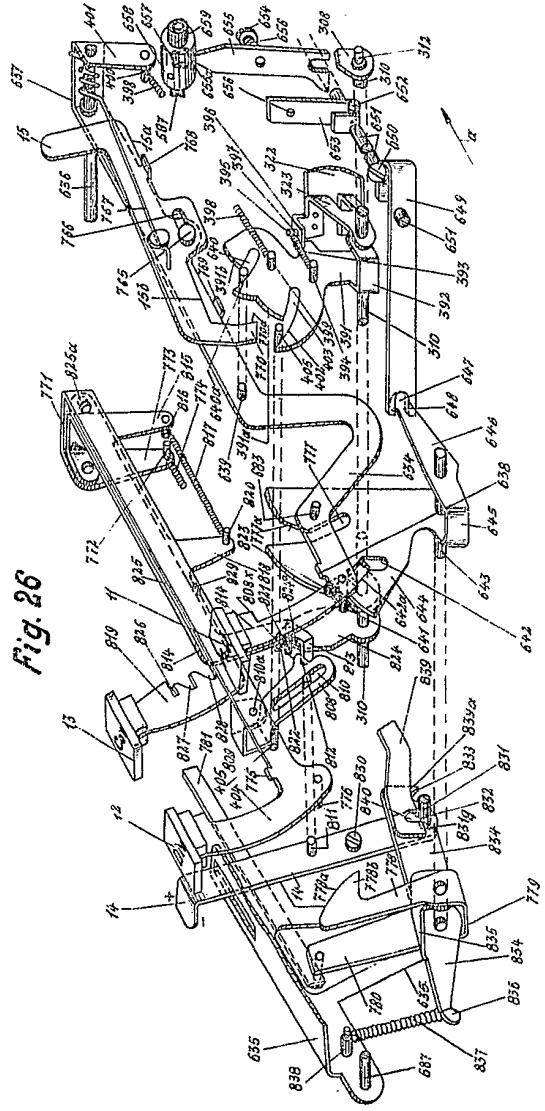
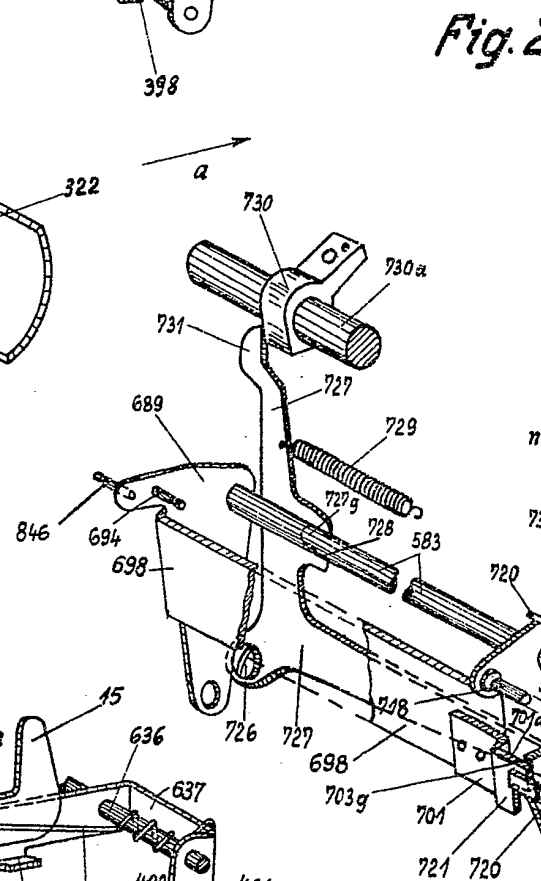
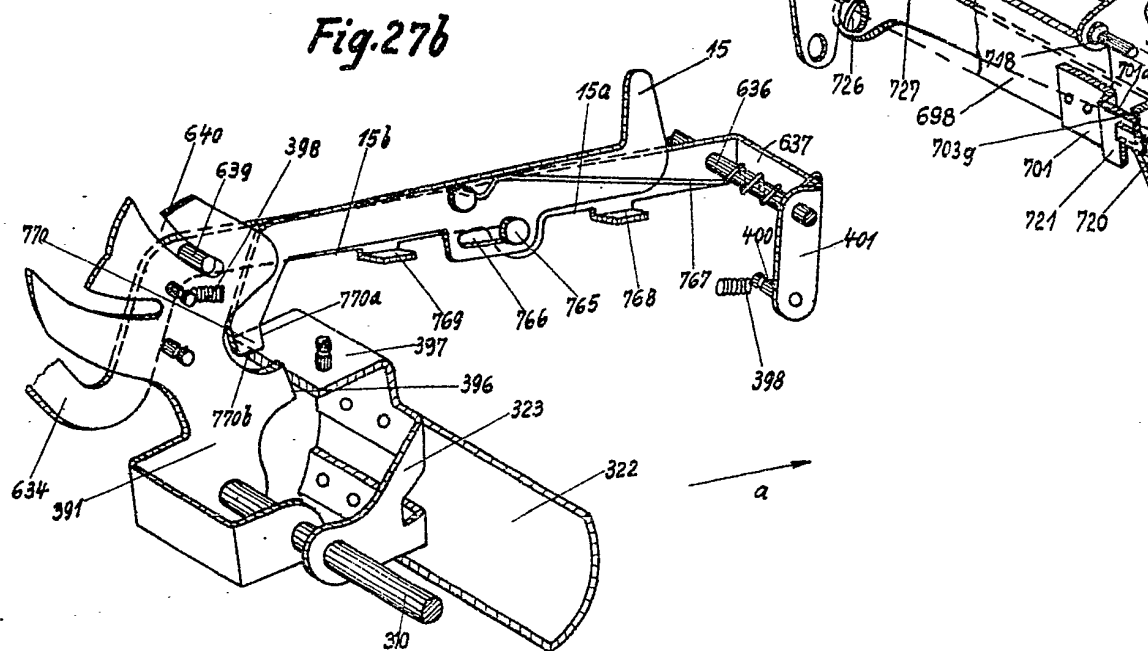
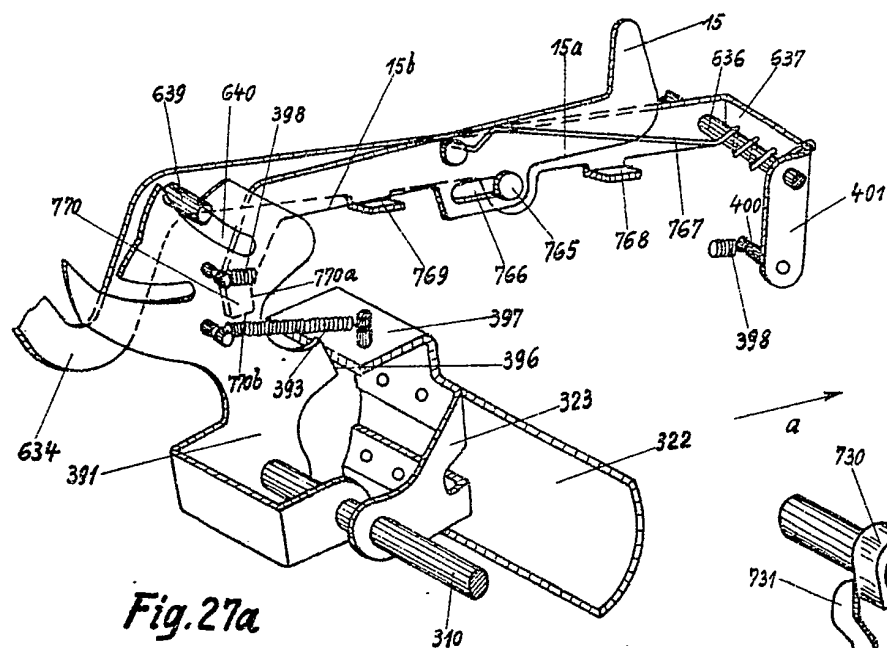


Fig. 26



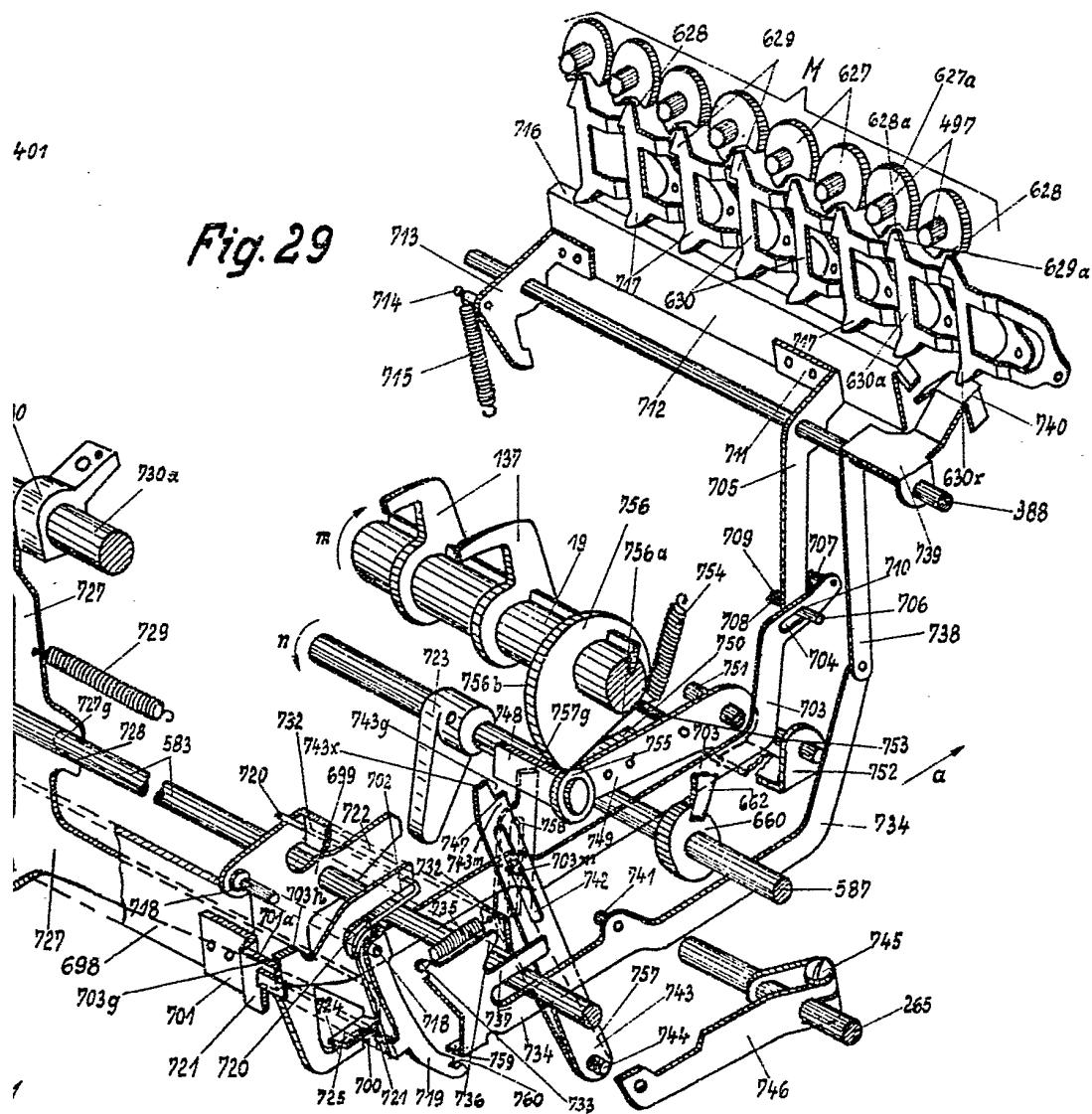
[This Drawing is a reproduction of the Original on a reduced scale.]



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

4-01

Fig. 29



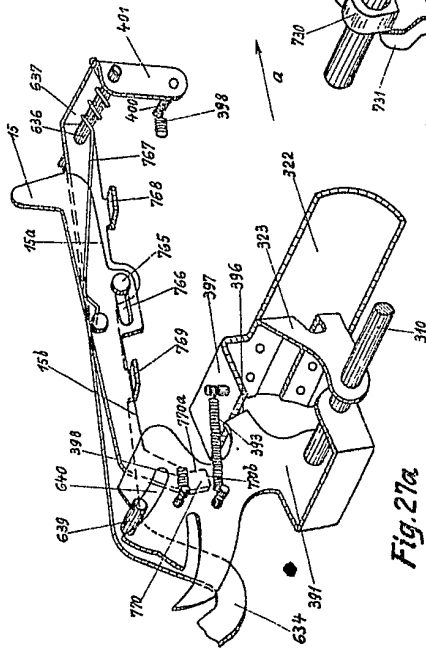


Fig. 27a

Fig. 27b

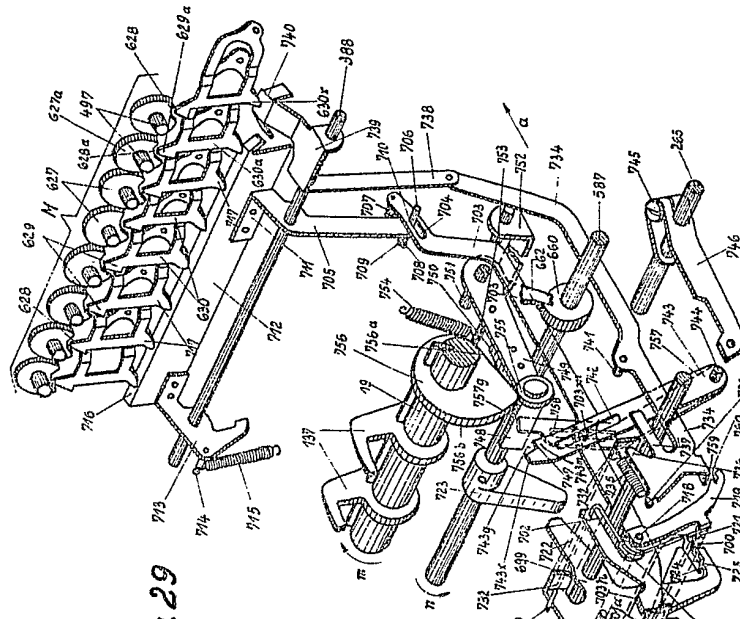
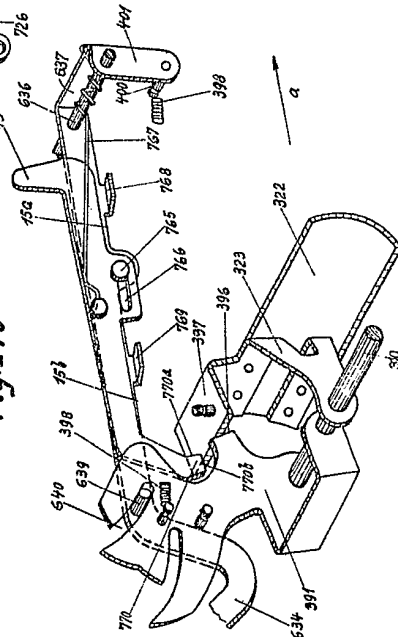


Fig. 29

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

Fig. 30

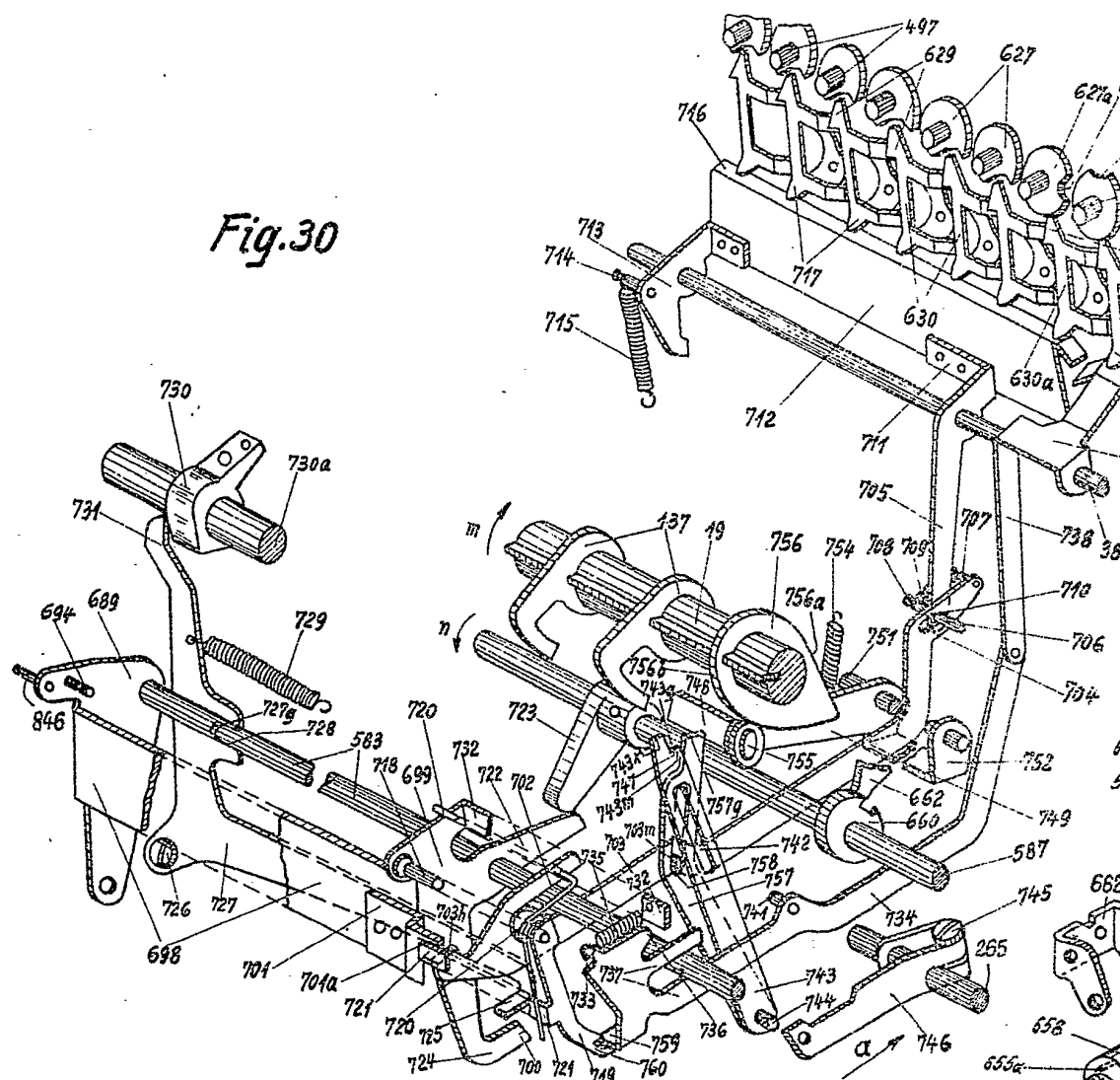


Fig. 35

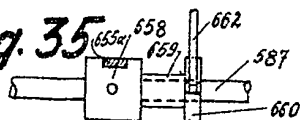


Fig. 36



Fig. 37

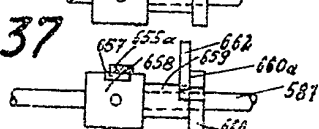
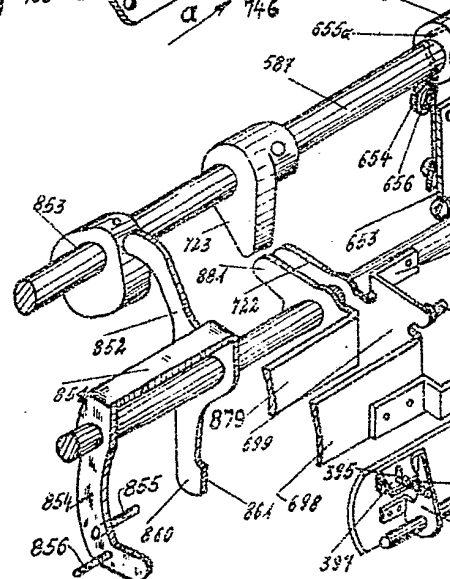
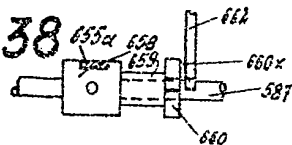


Fig. 38



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

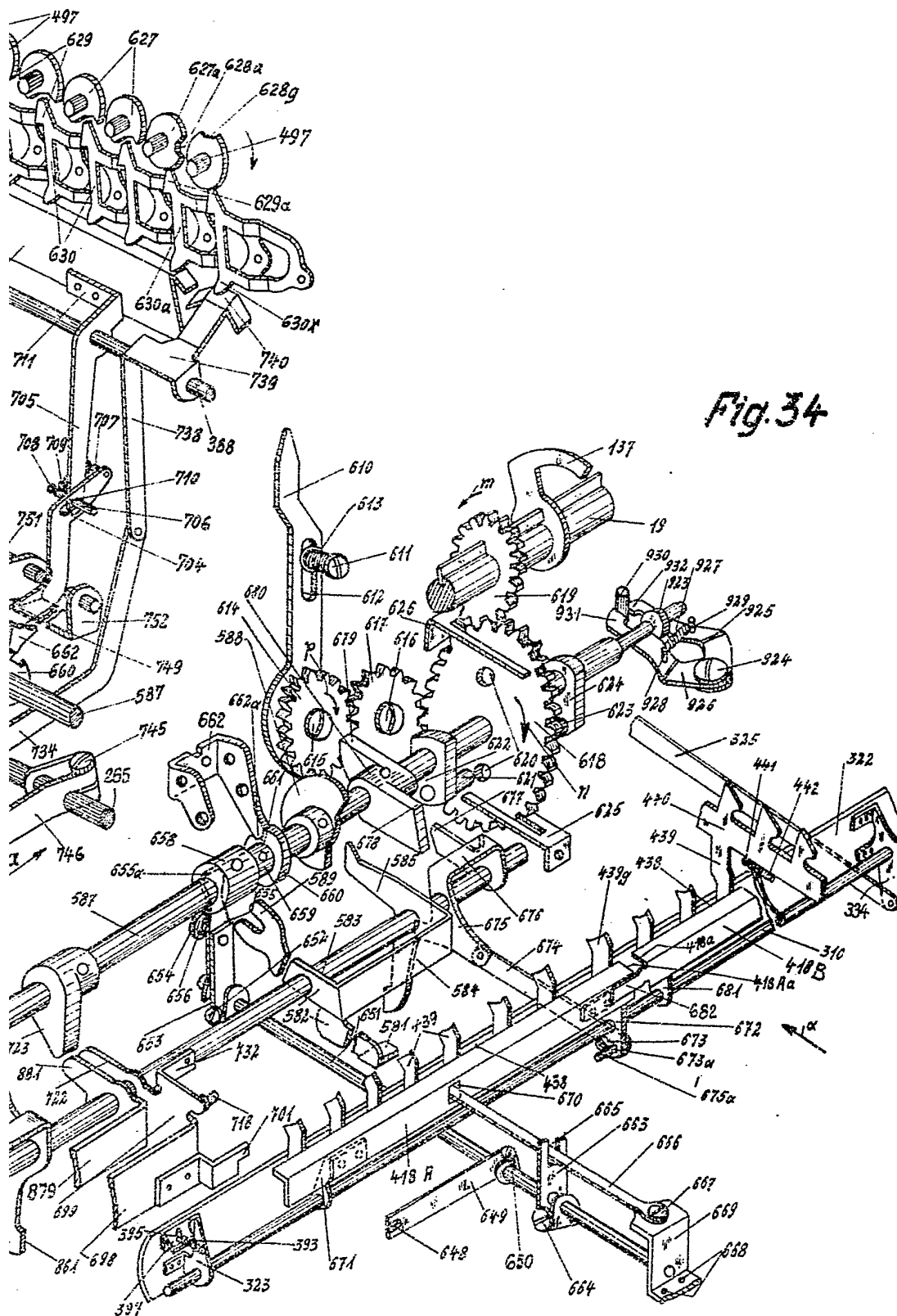


Fig. 34

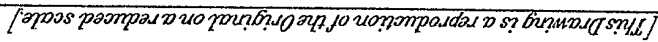
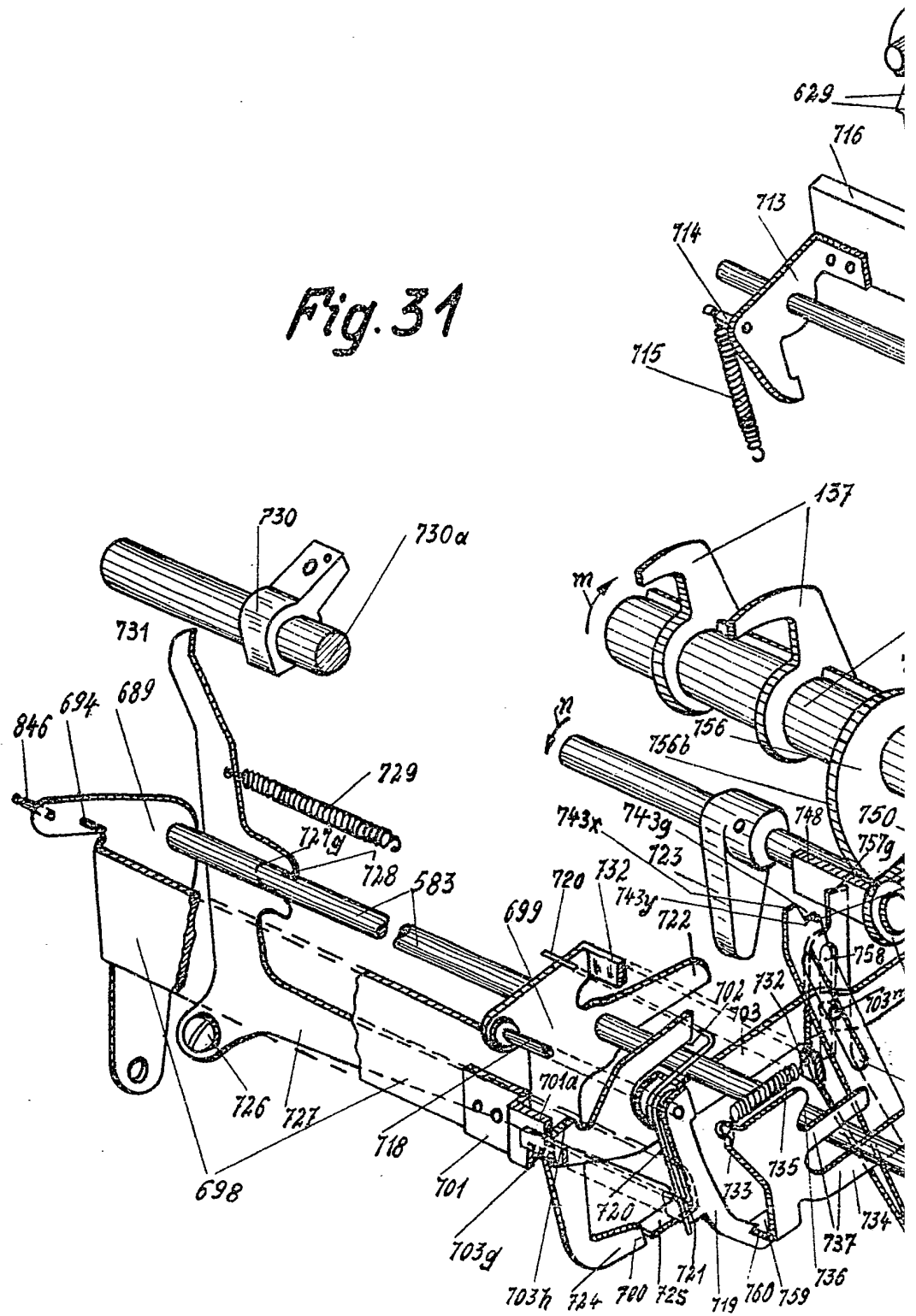


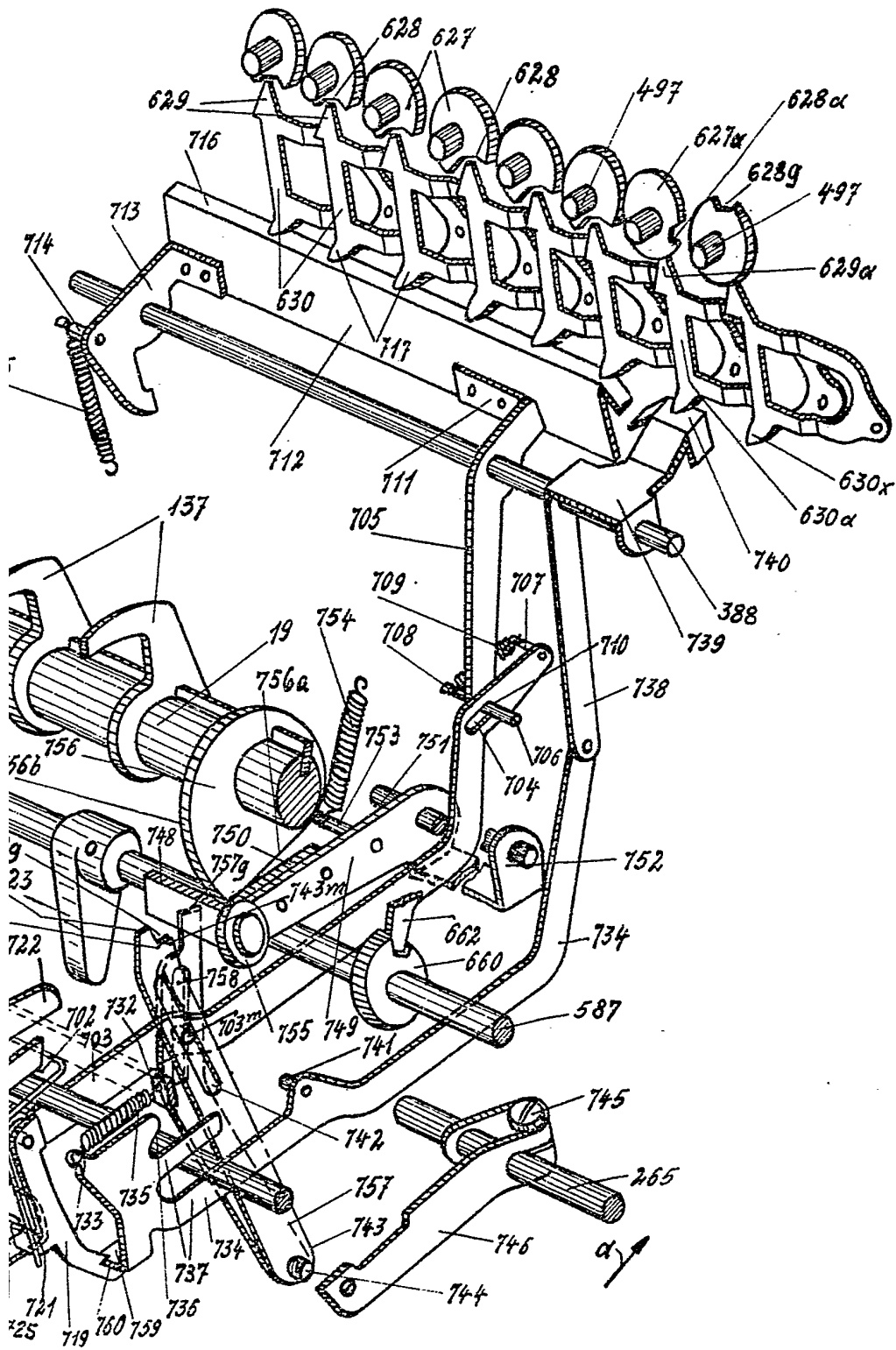
Fig. 34

Fig. 38

Fig. 31

[This Drawing is a full-size reproduction of the Original.]





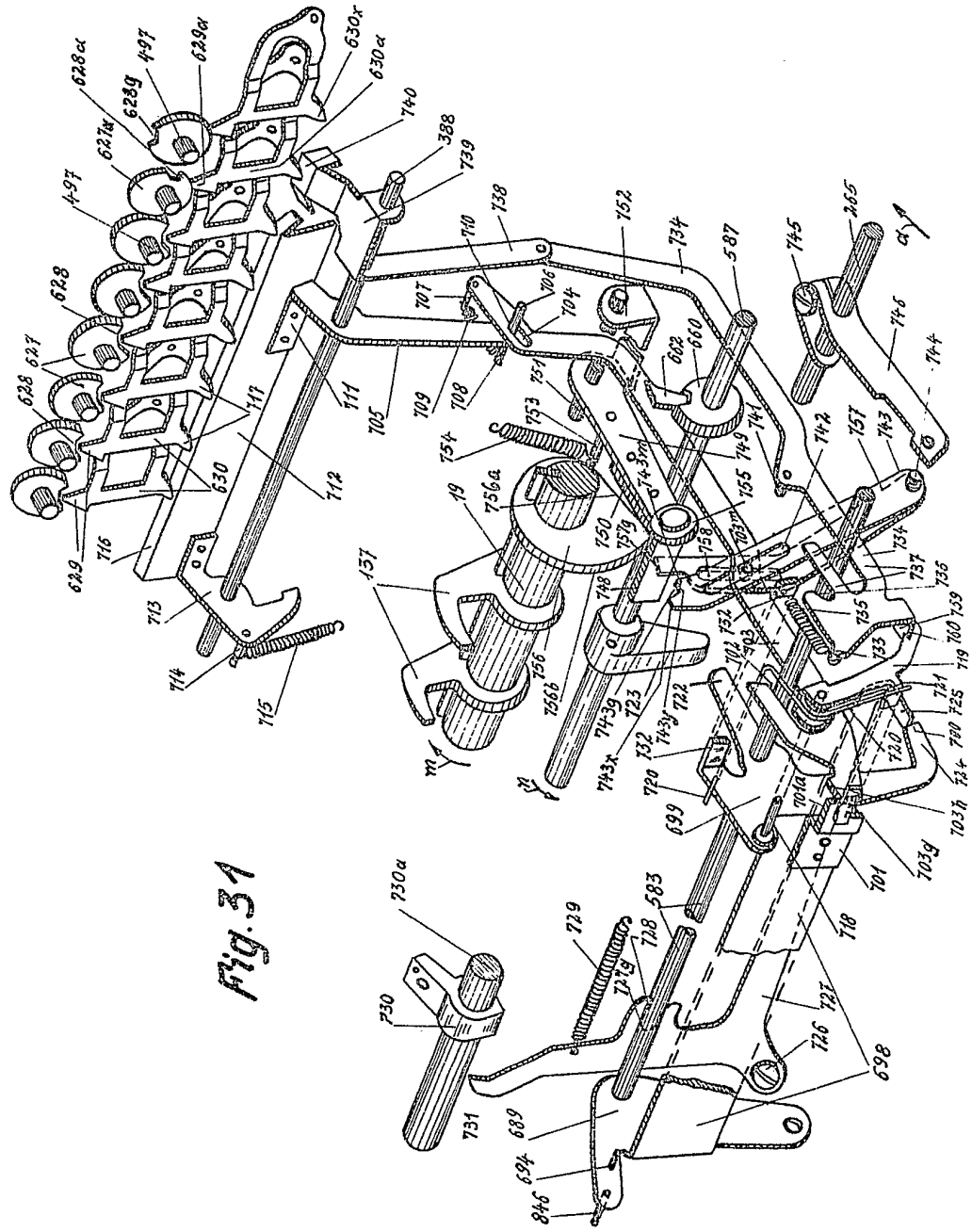
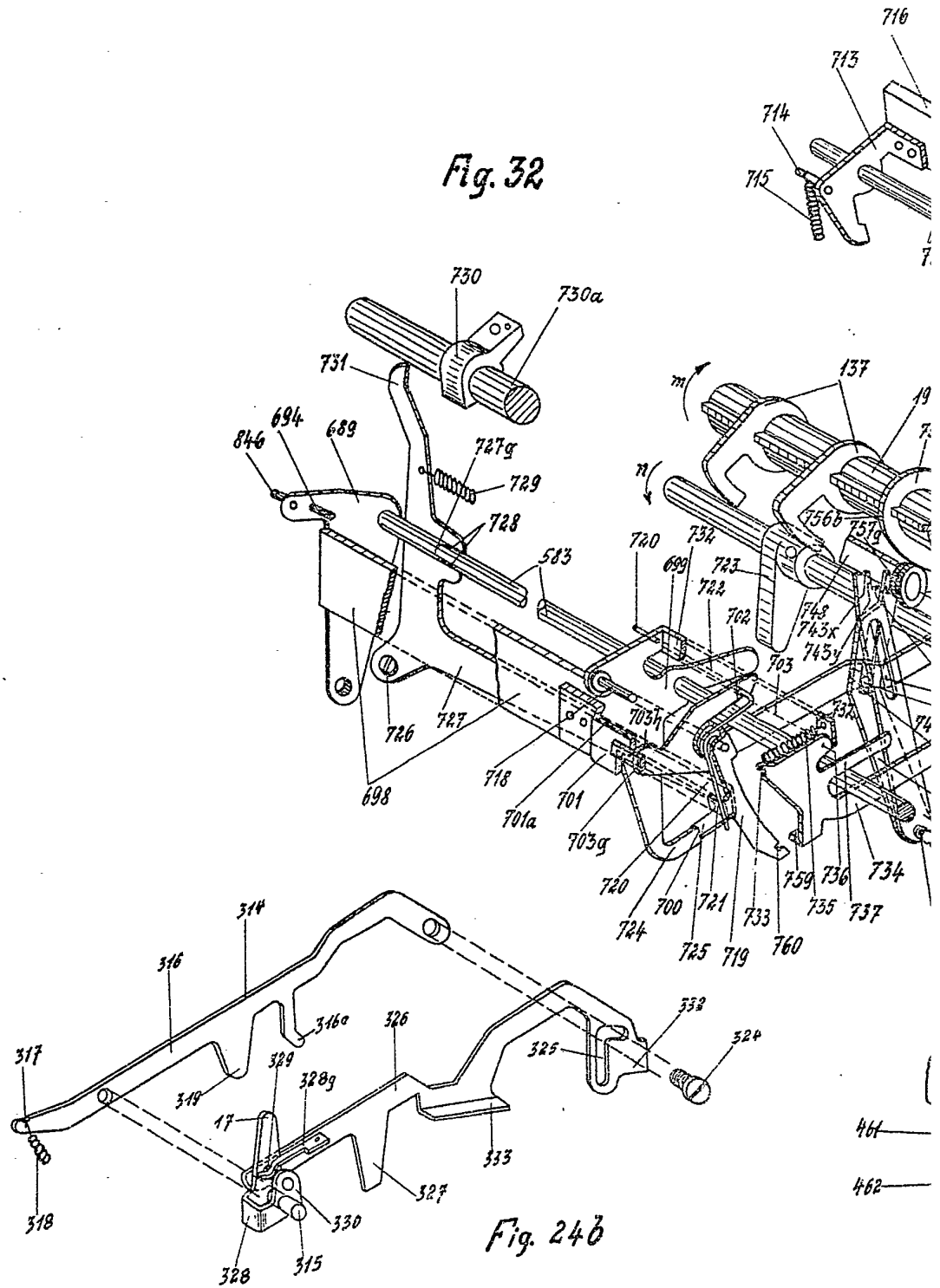


Fig. 31

[This Drawing is a full-size reproduction of the Original.]

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



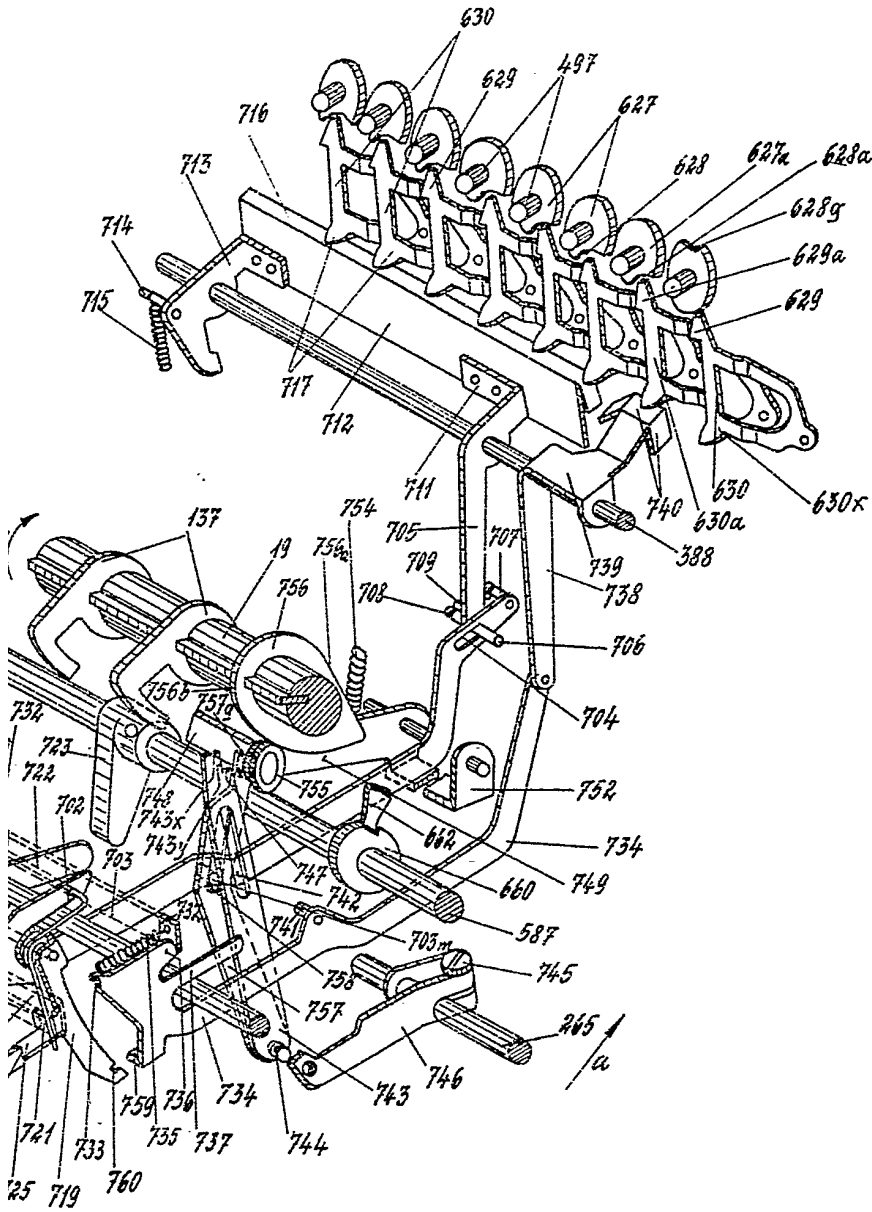


Fig. 20a

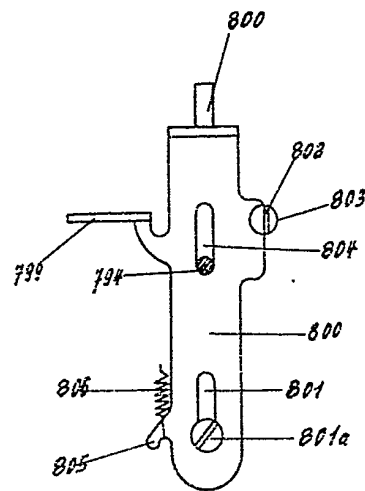


Fig. 28a

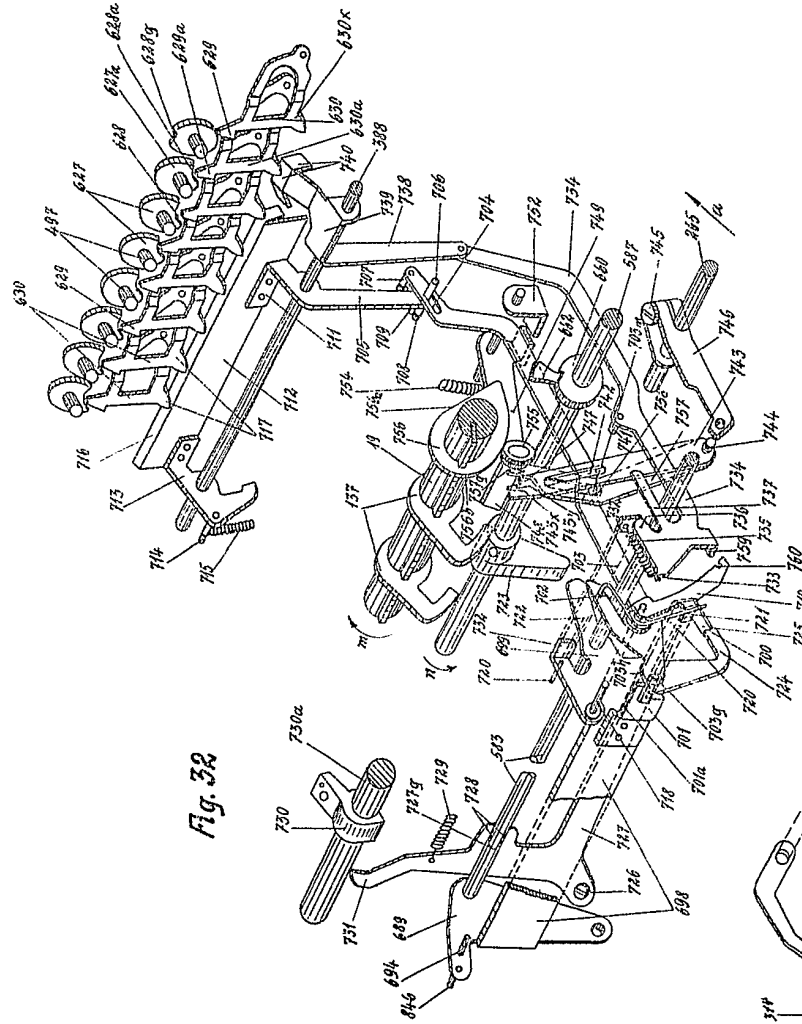


Fig. 32

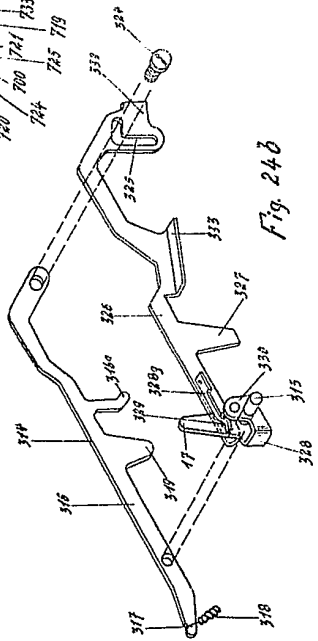


Fig. 24b

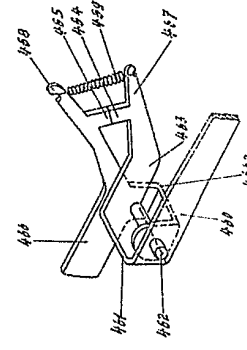


Fig. 20a

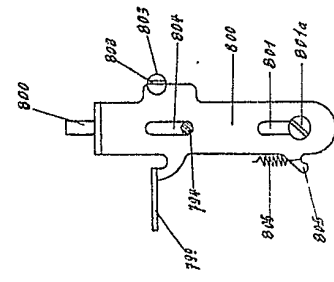


Fig. 28a

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

Fig. 46

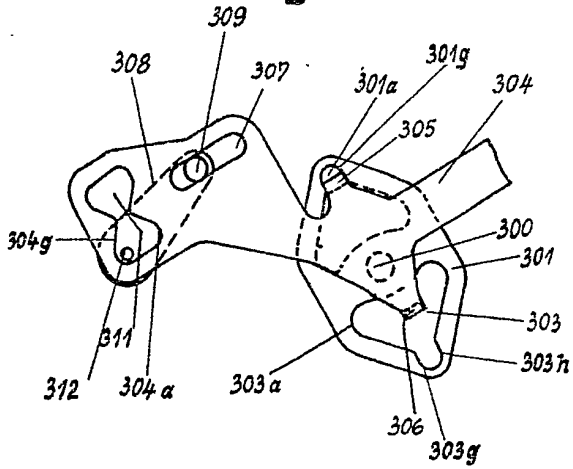


Fig. 47

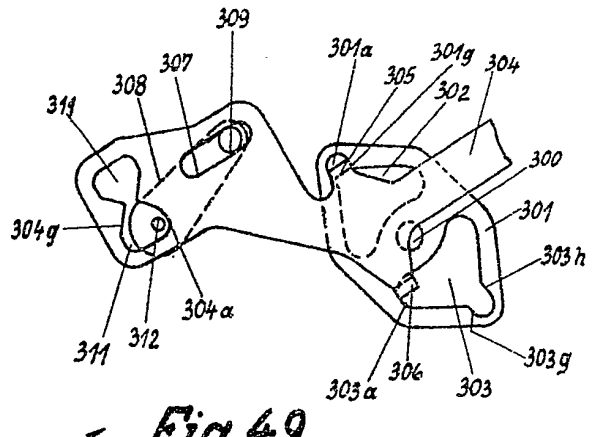


Fig. 48

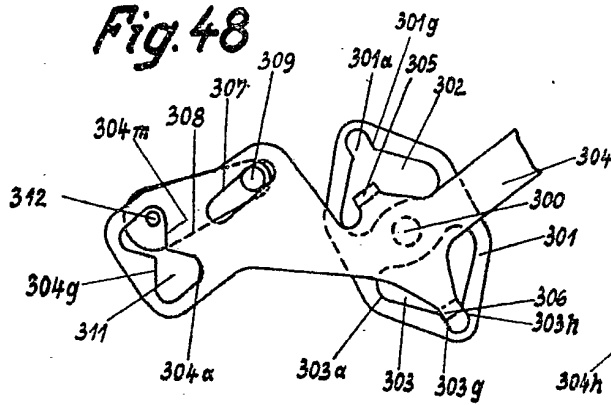


Fig. 49

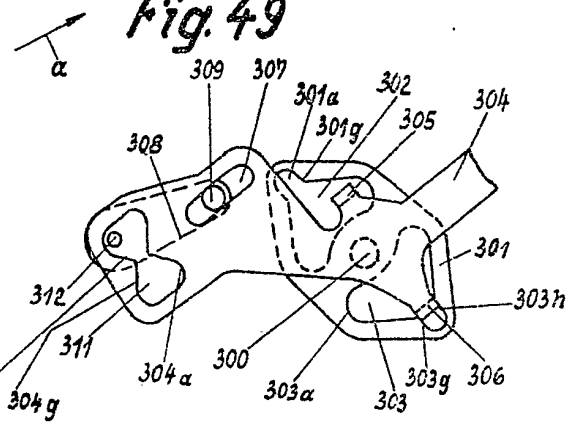
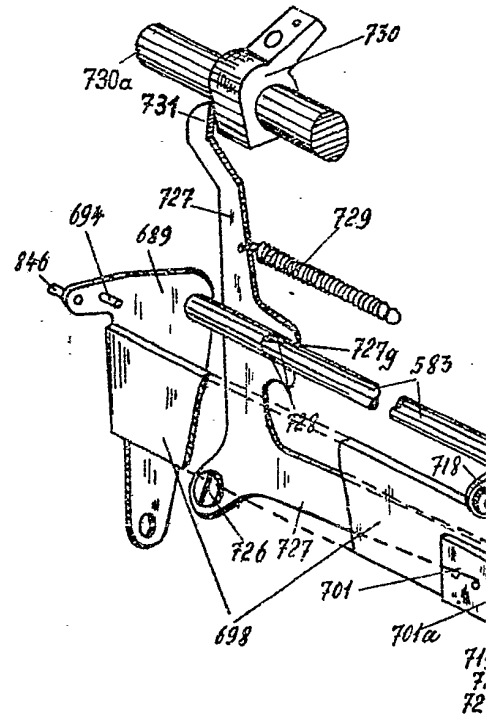
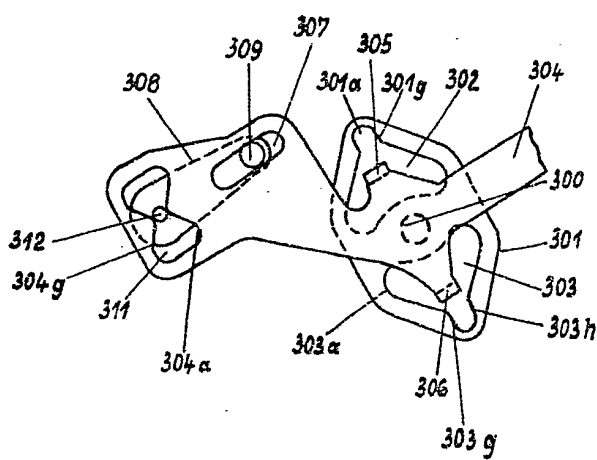


Fig. 50



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

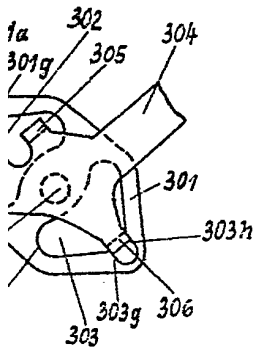


Fig. 33

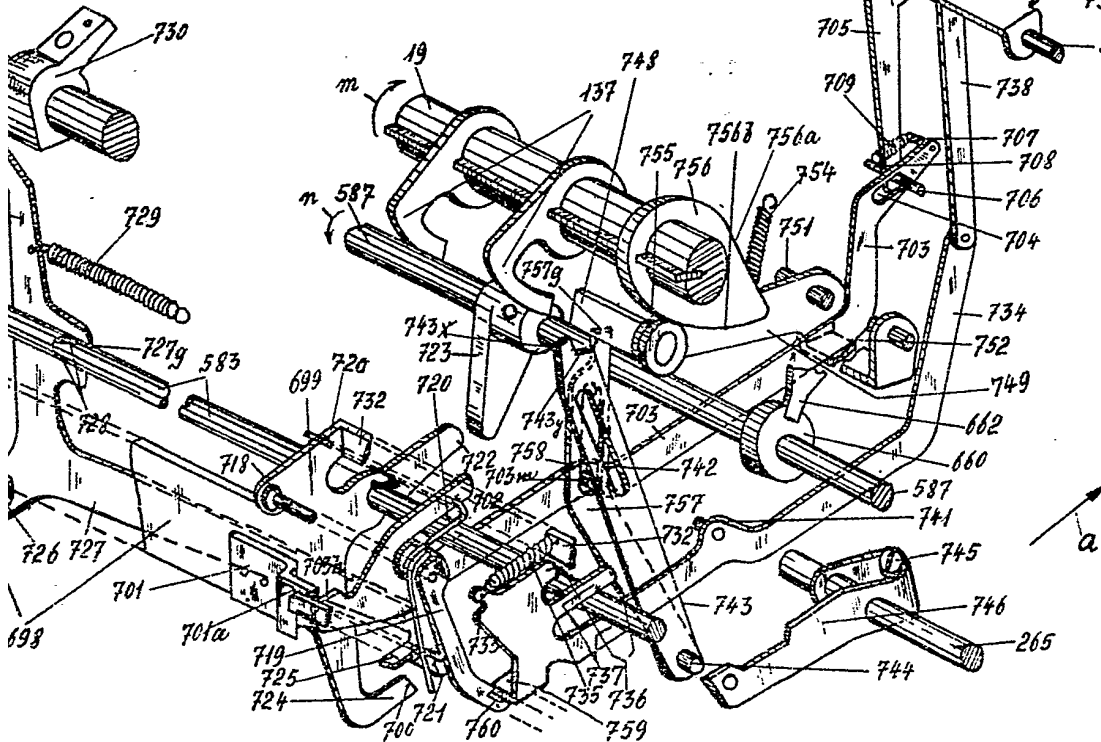
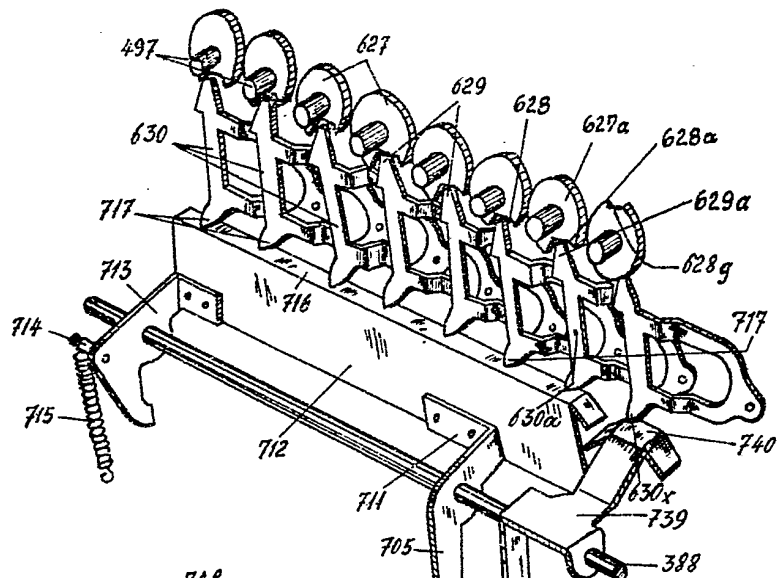


Fig. 46

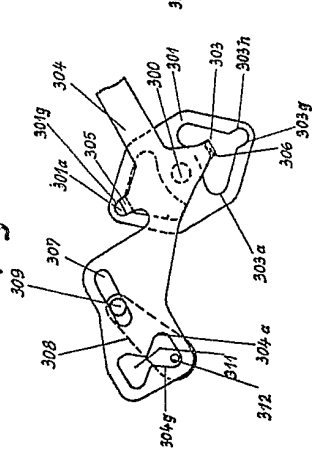


Fig. 47

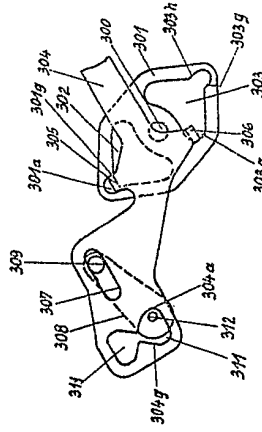
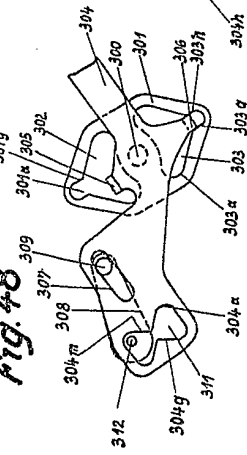
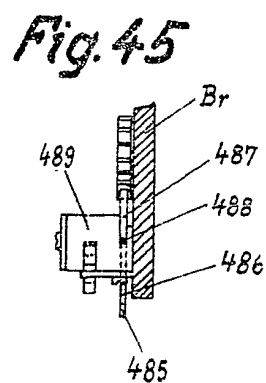
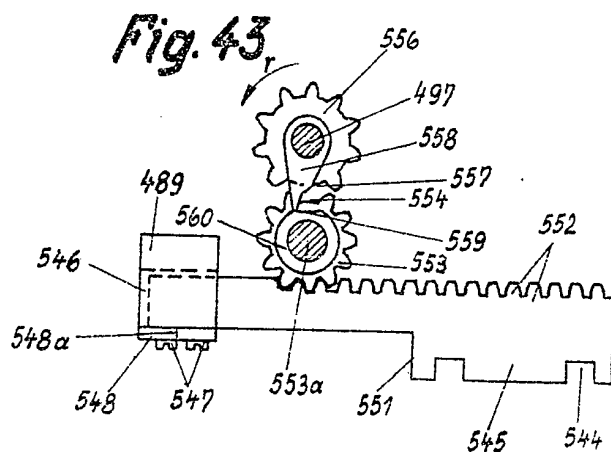
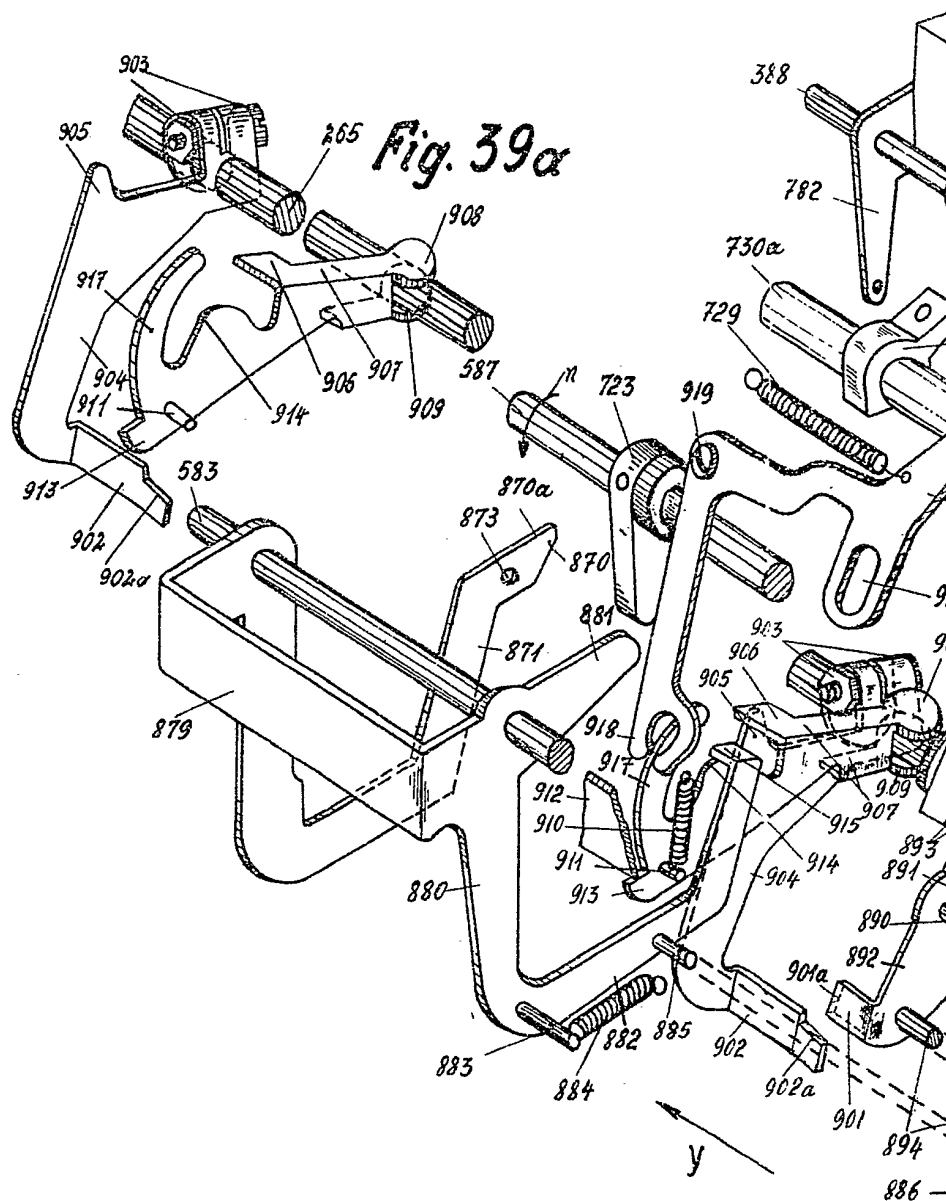
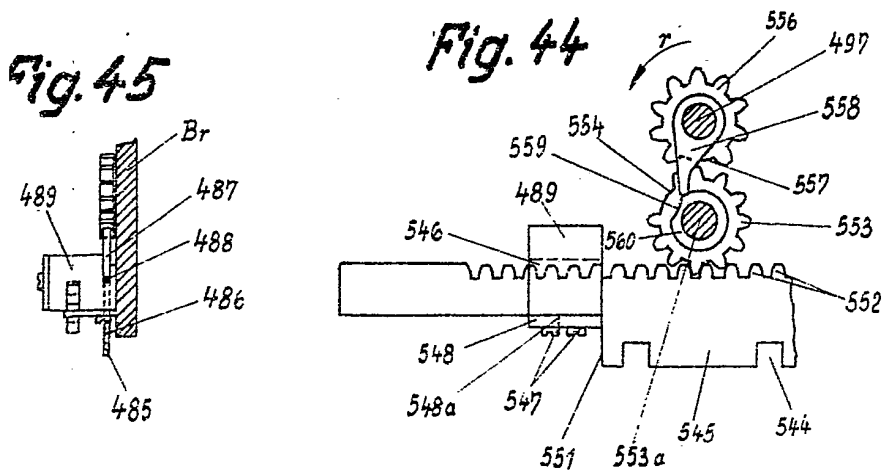
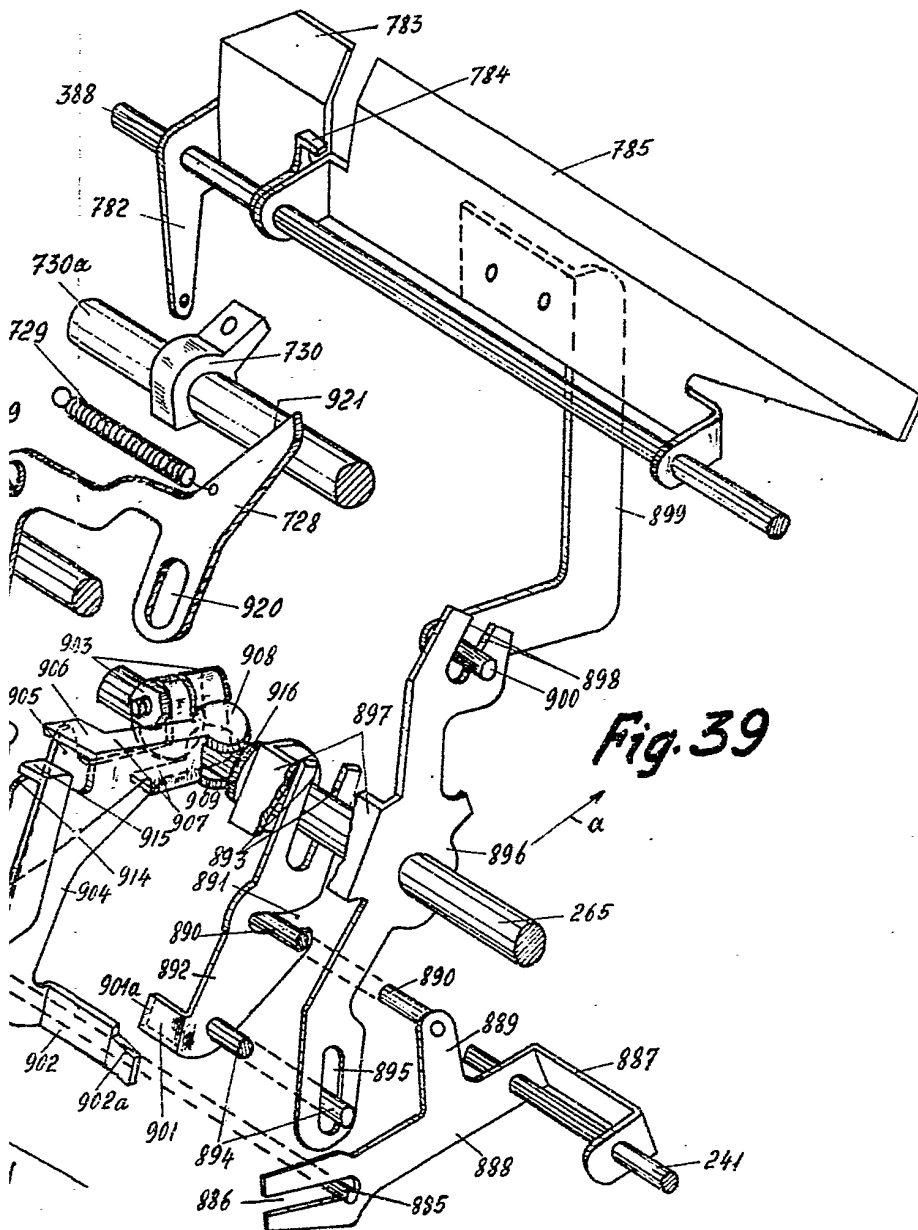


Fig. 48







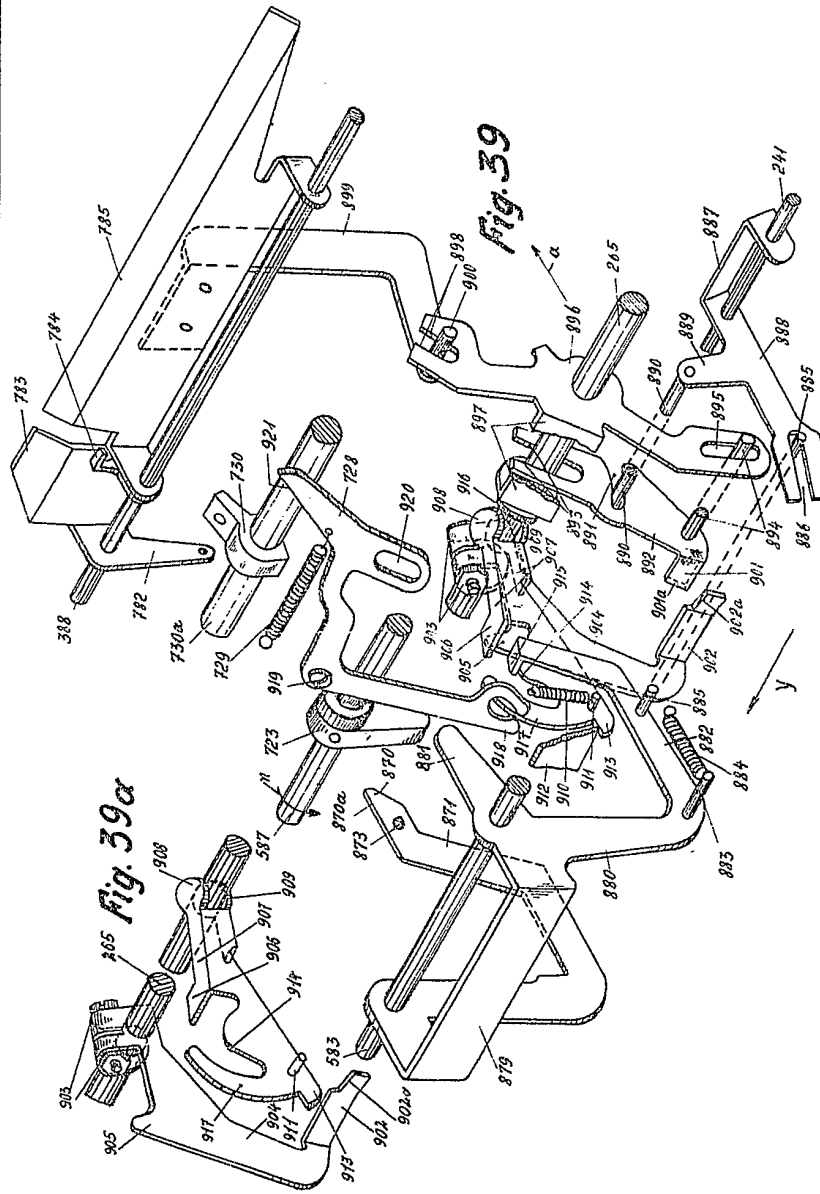


Fig. 39a

Fig. 39

Fig. 43

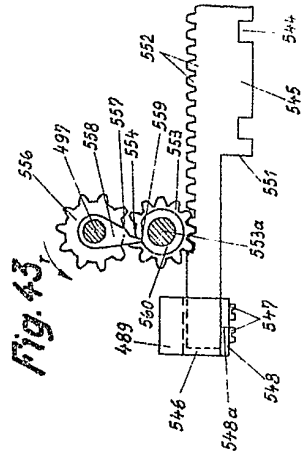
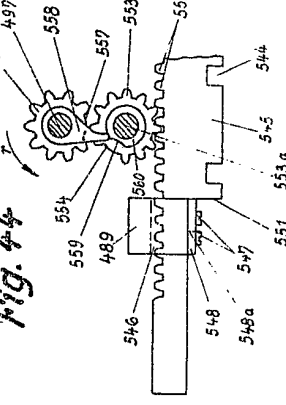


Fig. 45



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

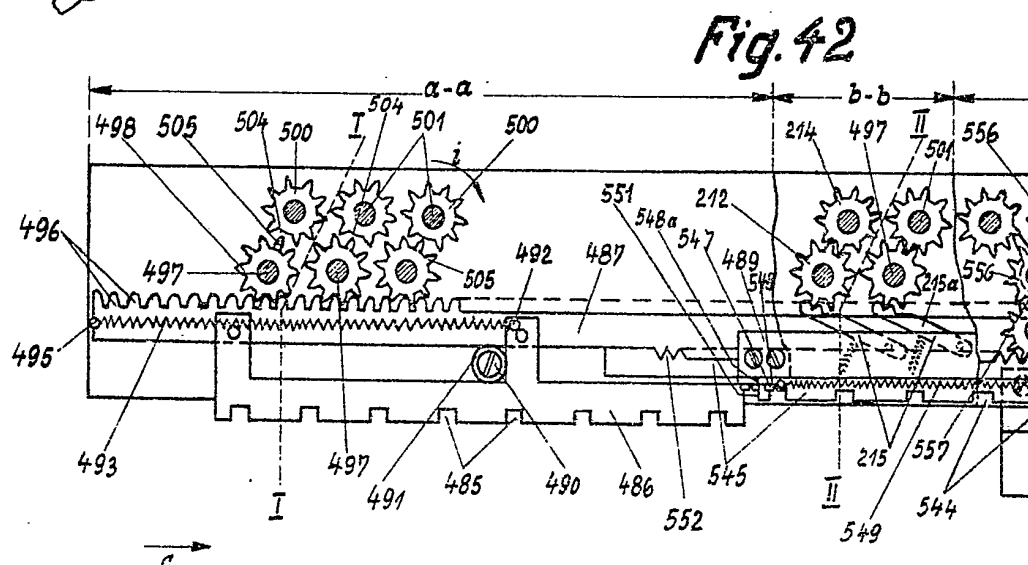
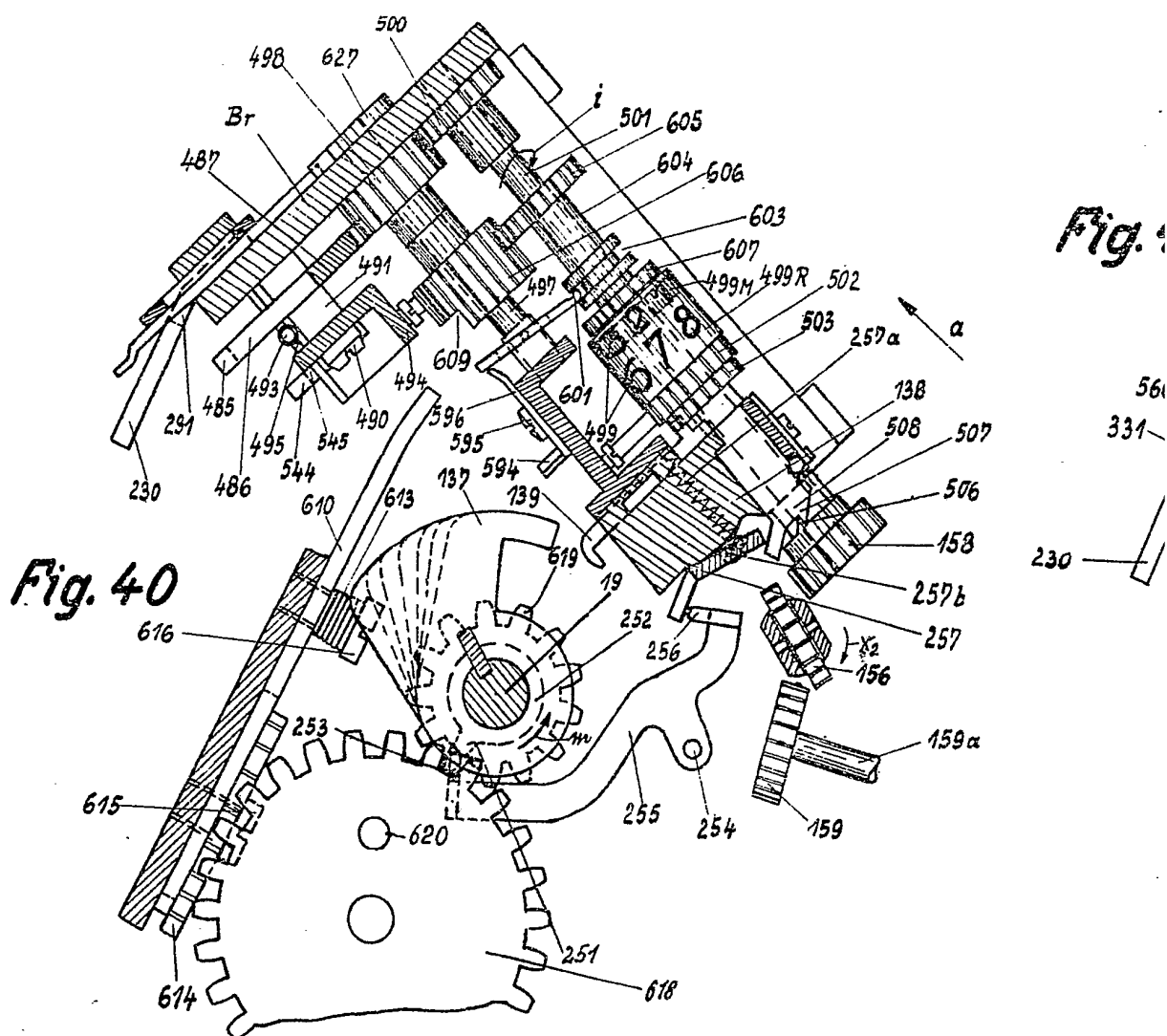


Fig. 41

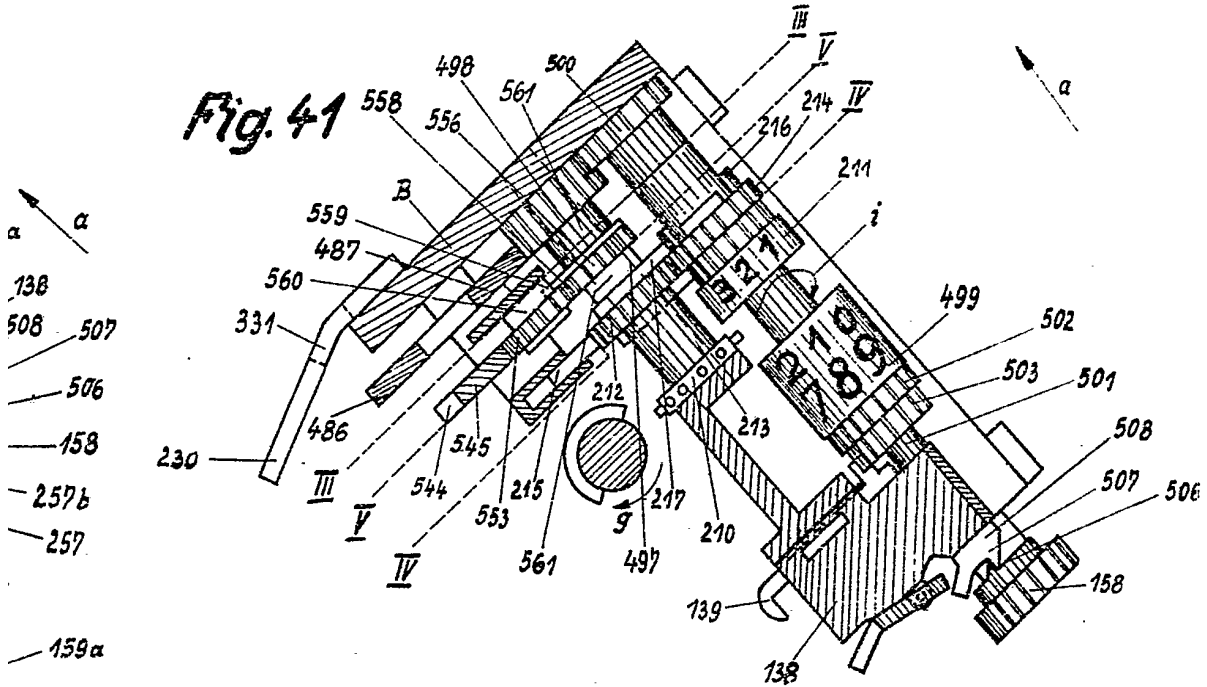
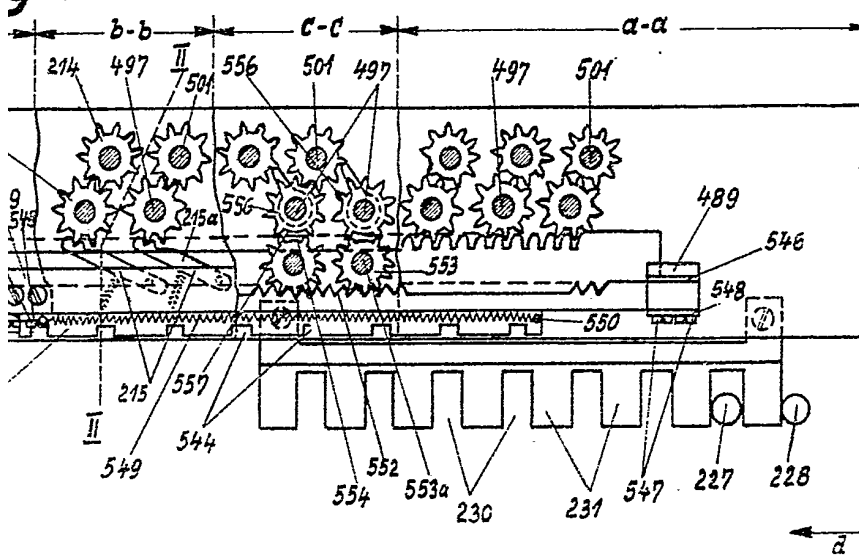
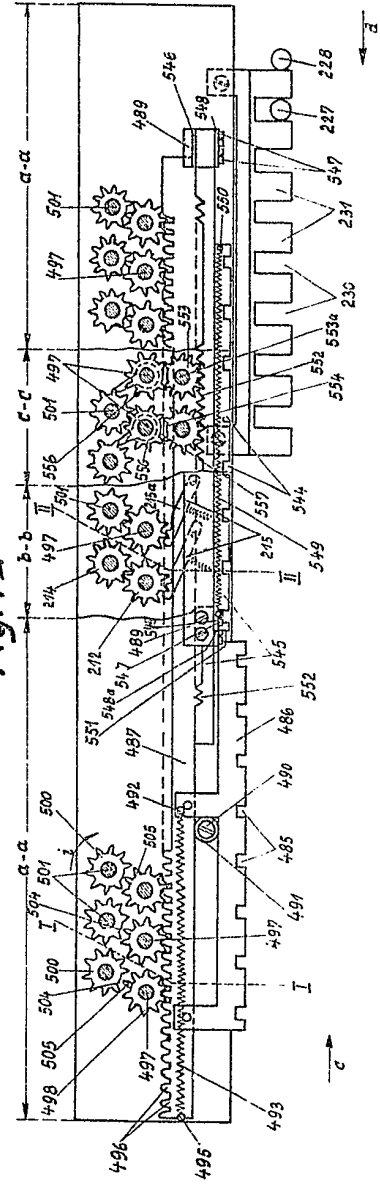
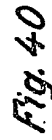


Fig. 42





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