Dec. 22, 1925 1,566,961

C. HAMANN

AUTOMATIC CALCULATING MACHINE

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Fig. 1.

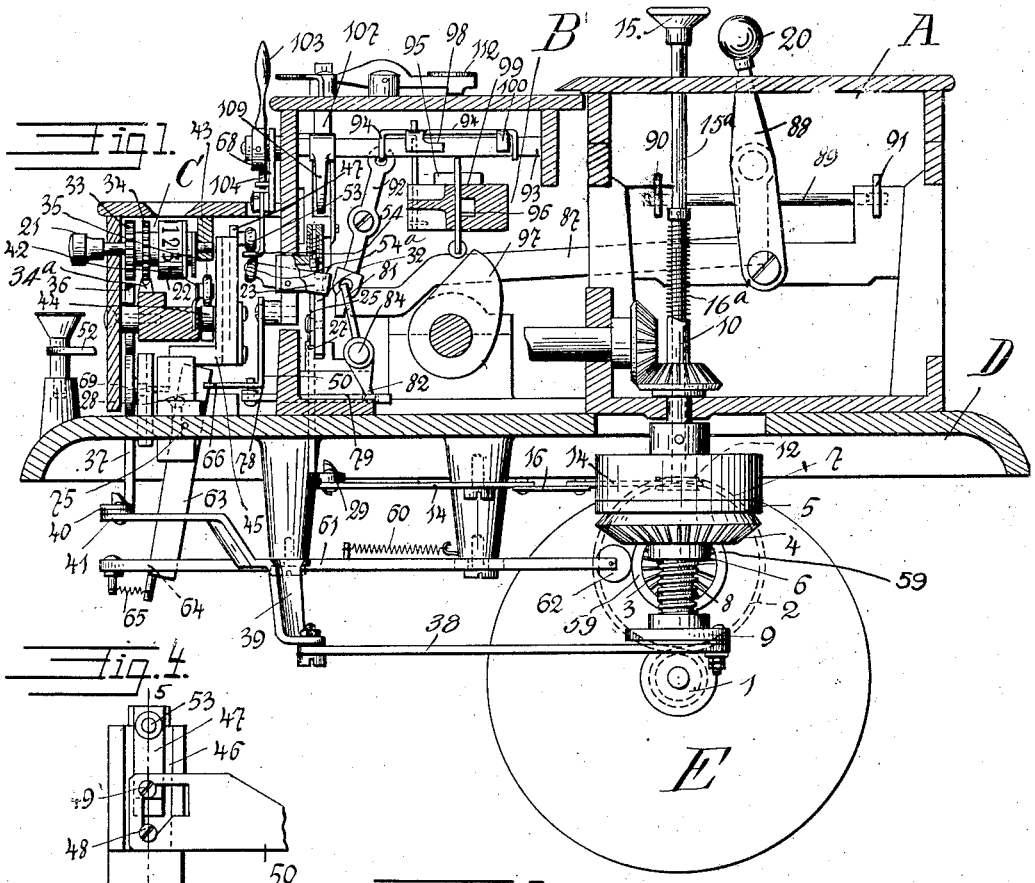


Fig. 4.

Fig. 5.

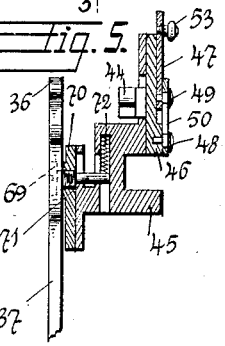


Fig. 6.

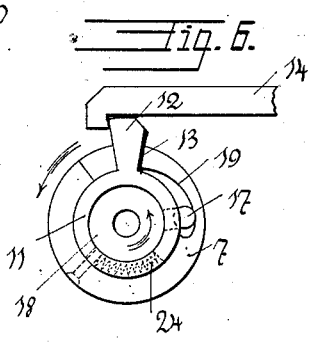
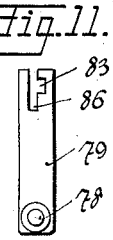


Fig. 11.



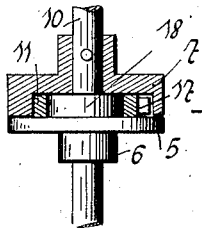


Fig. 7.

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AUTOMATIC CALCULATING MACHINE

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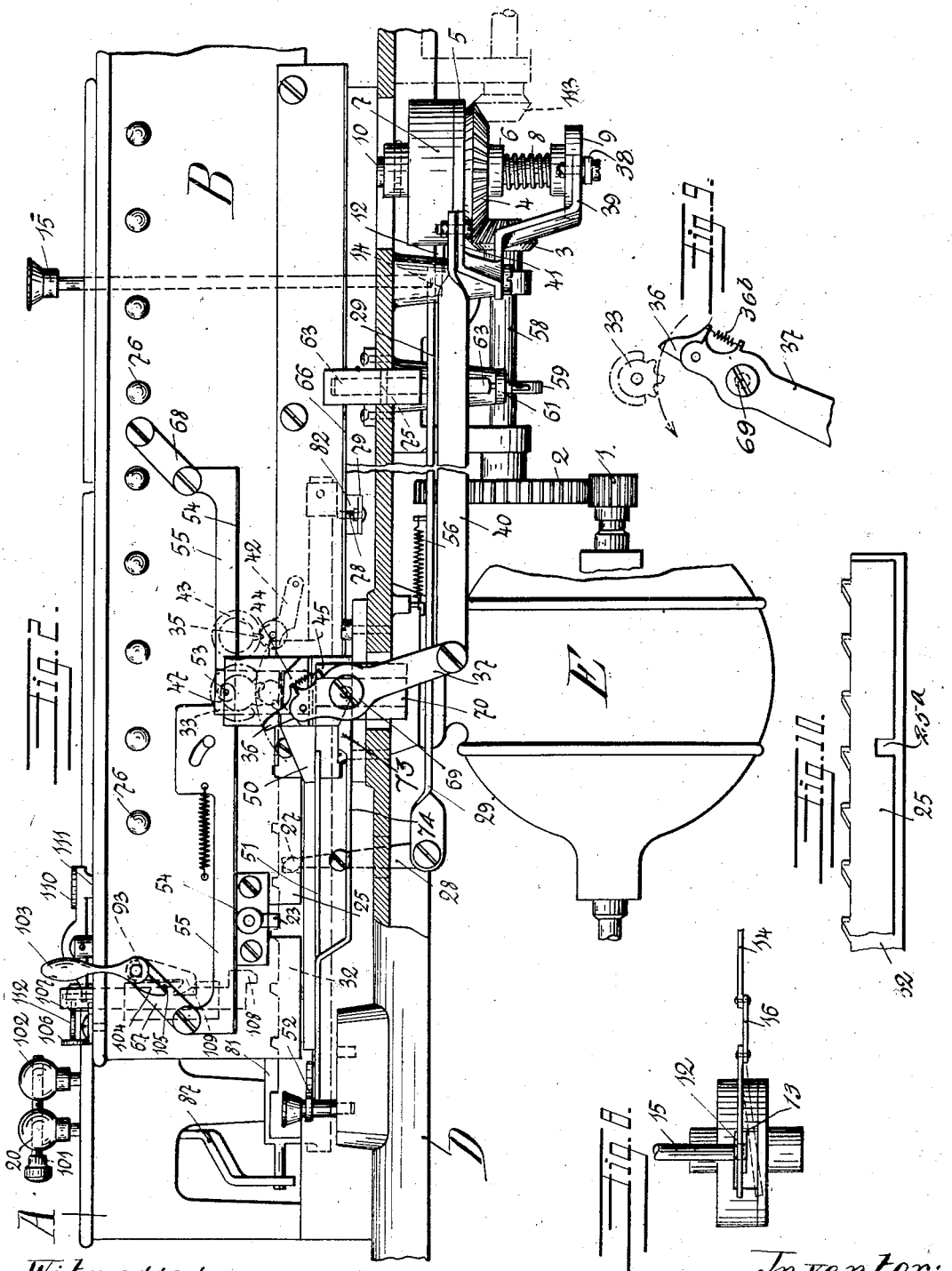

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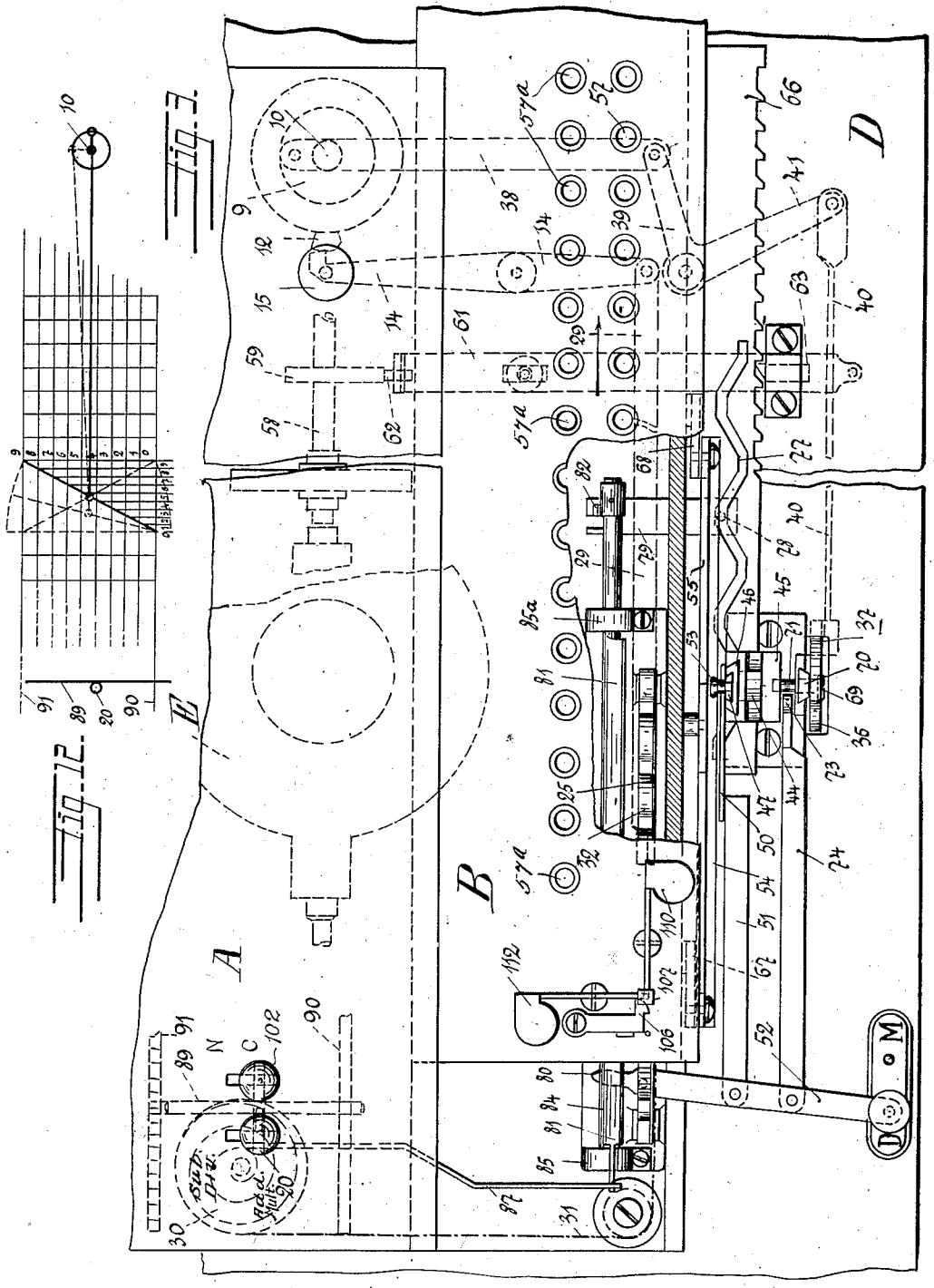

Witnesses:
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Fig. 13.

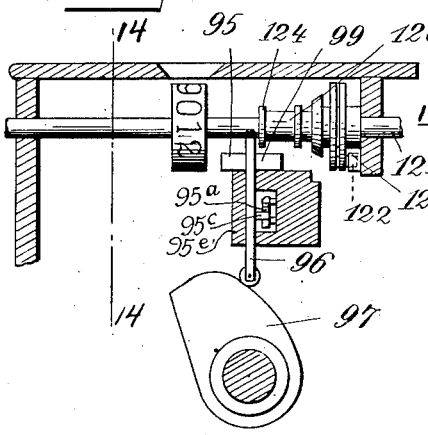


Fig. 14.

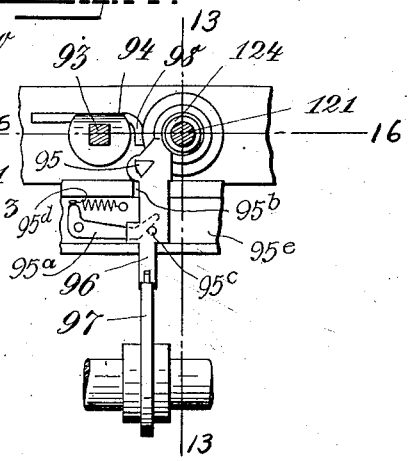


Fig. 18.

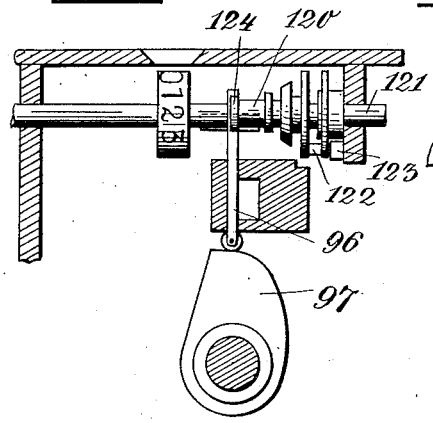


Fig. 15.

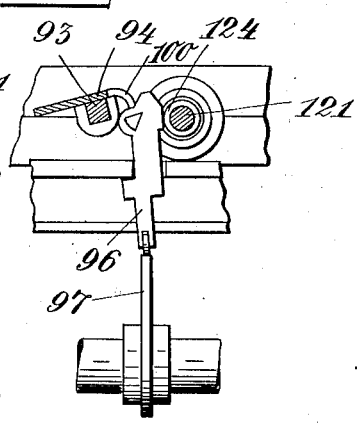


Fig. 16.

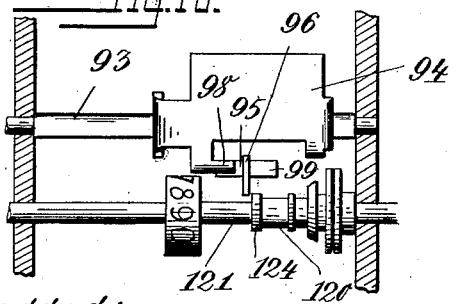
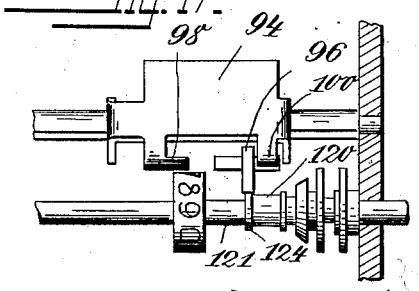


Fig. 17.



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AUTOMATIC CALCULATING MACHINE

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Fig. 19.

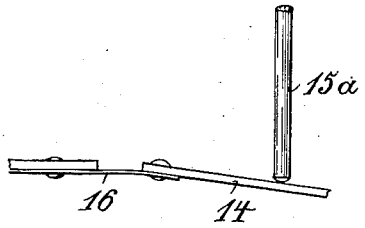


Fig. 20.

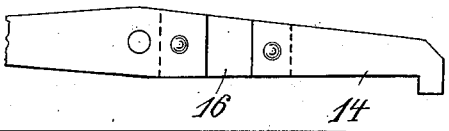


Fig. 23.

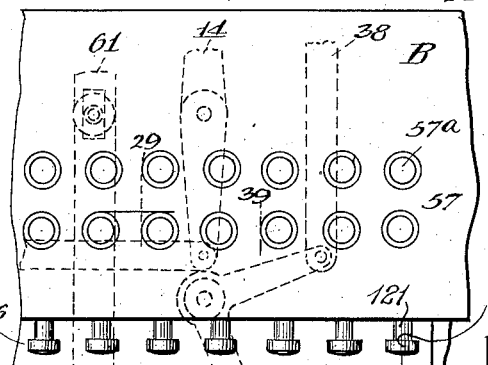


Fig. 21.

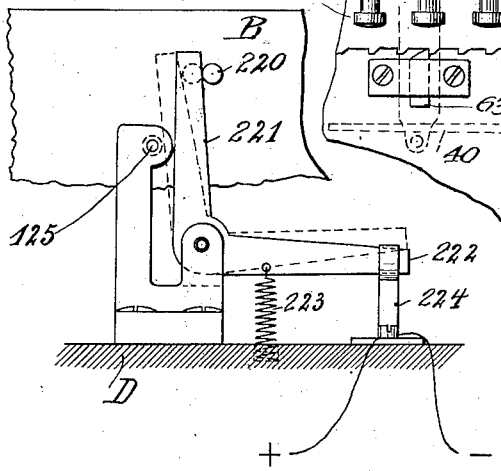


Fig. 22.

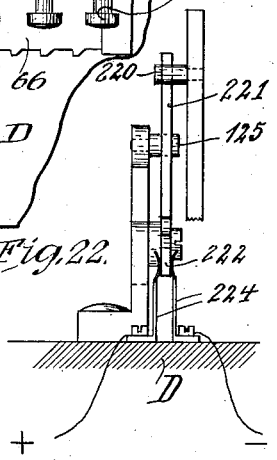
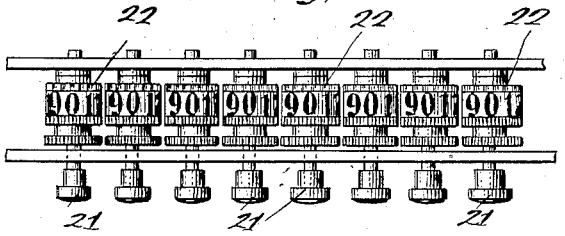


Fig. 24



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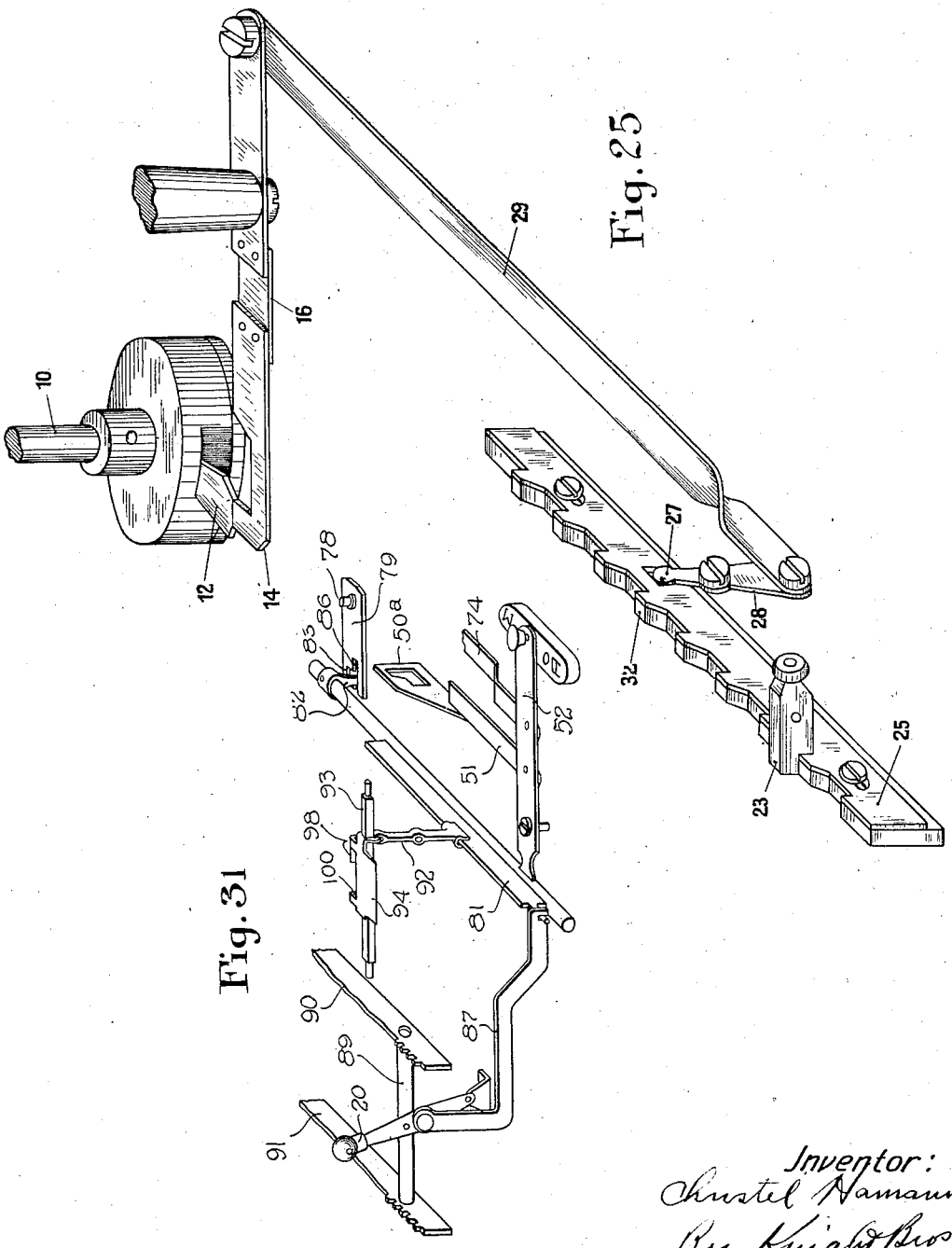

Fig. 25

Fig. 31

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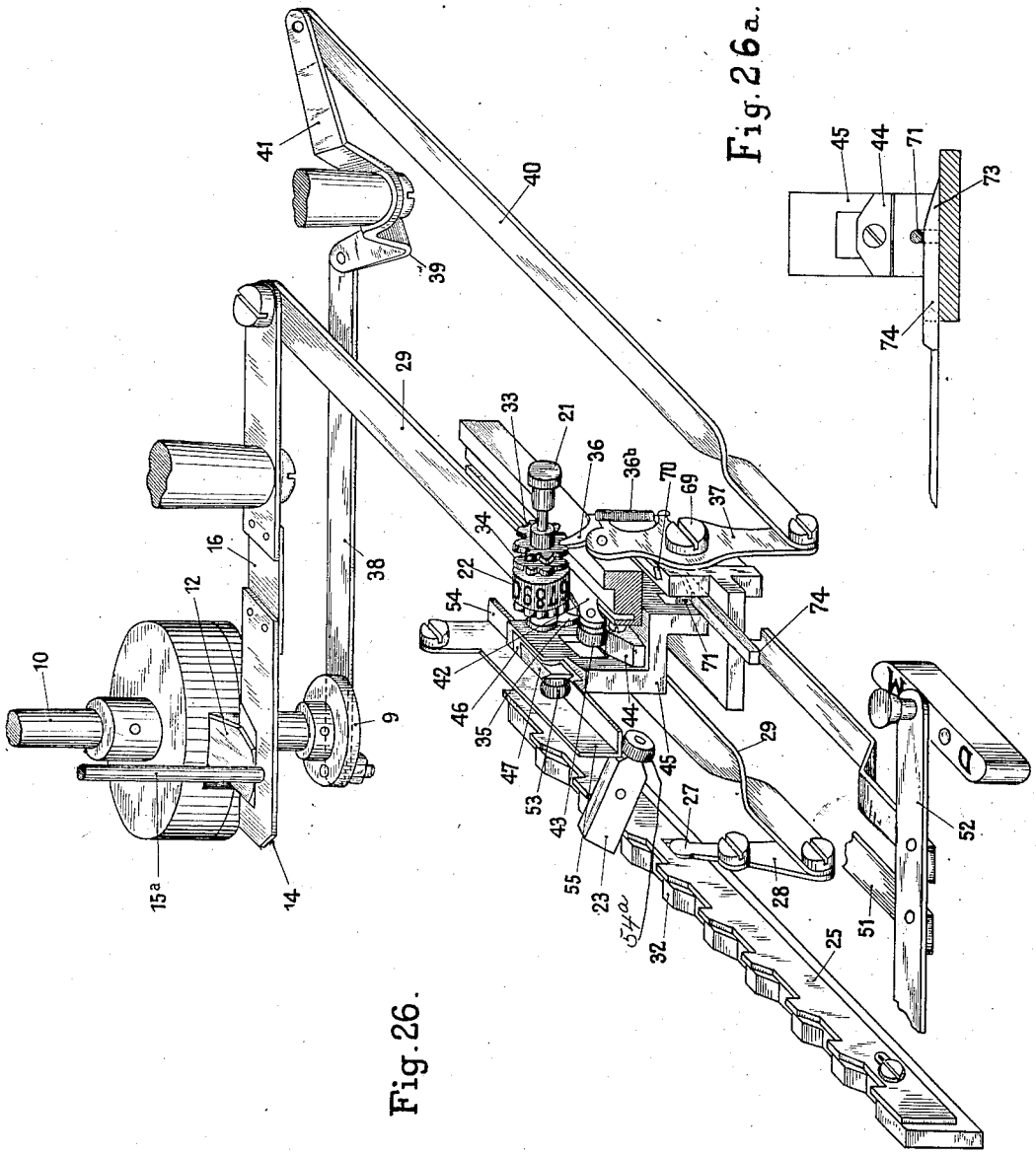

Fig. 26.

Fig. 26a.

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Fig.28.

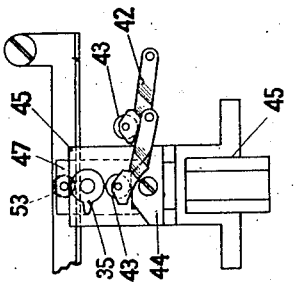


Fig.30.

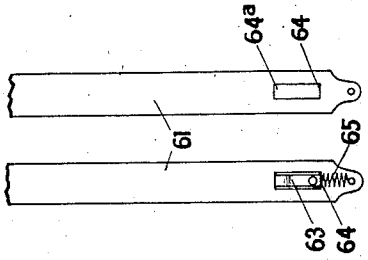


Fig.27.

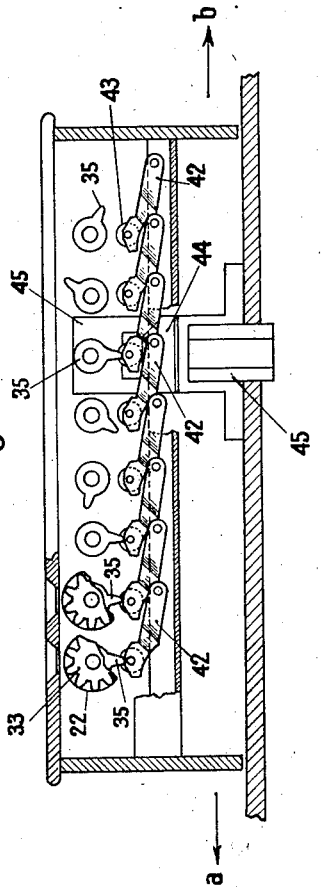
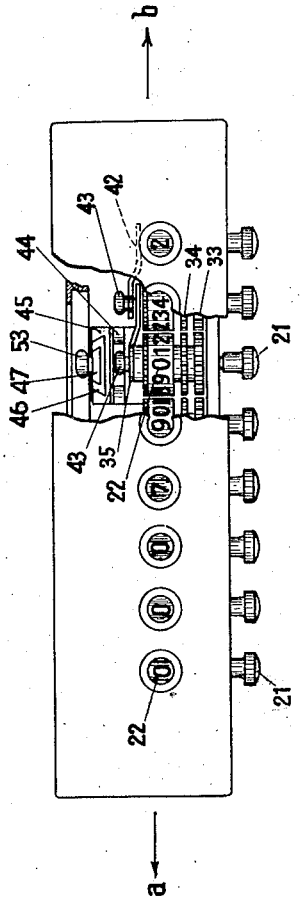


Fig.29.



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Patented Dec. 22, 1925. 1,566,961

UNITED STATES PATENT OFFICE.

CHRISTEL HAMANN, OF MEHLIS, GERMANY.

AUTOMATIC CALCULATING MACHINE.

Application filed February 15, 1915, Serial No. 293,339. Renewed April 28, 1919.

To all whom it may concern:

Be it known that I, CHRISTEL HAMANN, a subject of the Emperor of Germany, residing at Mehlis, Thuringia, Germany, have invented certain new and useful Improvements in Automatic Calculating Machines, of which the following is a specification.

Known computing machines operated by a power source, are sometimes found to work automatically, that is, the machines completely execute the calculation of a product or a quotient, after preliminary setting of the given values. The entire construction of such machines is, however, so complicated, that they until now have found no practical use. The automatic execution of division is moreover not perfect, because for each quotient place, two turnings have to be made, one for subtraction and one for addition, whereby the computing is considerably delayed.

The present machine which is equally useful for hand and power operation, is constructed in accordance with the present invention on the simplest principles and differs considerably from similar machines, particularly as regards division.

Although any known type of computing machines may be adapted to the present device, machines in which the division process takes place automatically as described in U. S. Patent 1,011,617 are preferred. As now the principal parts of the computing machine are known, such parts have in the accompanying drawings been only diagrammatically represented.

One embodiment of the present invention is illustrated in the accompanying drawings:—

Figure 1 shows a transverse section of the machine;

Figure 2 a front view, partly in section;

Figure 3 a top plan view, partly in section;

Figure 4 a shifting member in front view;

Figure 5 a section along line 5—5 of Figure 4;

Figure 6 a front view of a coupling;

Figure 7 a section of Figure 6;

Figures 8 to 11 details of parts;

Figure 12 a diagram of the fundamental principle of the invention;

Figure 13 is a section along line 13—13 of Figure 14 of the carrying mechanism.

Figure 14 is a section along line 14—14 of Figure 13;

Figure 15 a similar view to Figure 14 with the parts in a different position;

Figure 16 a horizontal section along line 16—16 of Figure 14;

Figure 17 a similar view to Figure 16 with the parts in different position and

Figure 18 a similar view to Figure 13 with the parts in different position;

Figures 19 to 22 are details of parts; Figure 20 being a side view of a part shown in Figure 19, and Figure 22 being an end view of Figure 21.

Figure 23 is a detail view of the setting means;

Figure 24 is a detail view of the setting device for the multipliers.

Fig. 25 is a perspective view showing the spindle and the operation of the tooth rack and pawl.

Fig. 26 is a similar perspective view and in addition to the foregoing shows the cooperation of the multiplier setting device.

Fig. 26^a is a detail of a trapezoid-shaped member.

Fig. 27 shows in vertical section the number rollers and their co-acting levers.

Fig. 28 shows in detail the actuation of the levers by the trapezoid-shaped member.

Fig. 29 is a top plan, with the cover partly broken away, of Fig. 27.

Fig. 30 is a detail showing the rail and lever for locking the number table and Fig. 31 shows the automatic control connection for the state control lever.

Referring now to Figures 1, 2 and 3, A denotes the fixed carrying device and B the number table movable along the former, and comprising together therewith the computing machine proper. The new part added to these is the setting device C, for setting the multipliers, the casing for which is rigidly connected with the number table B and seen in section in Figure 1. In Figures 2 and 3 the casing has been broken away in order to show some details. The machine is mounted on the foundation plate D. The foundation plate D rests with its edge on a flange of a

hollow, inclined stand, not shown, which conceals the gearing beneath the foundation plate, giving the machine the necessary inclination, also making it convenient for inspection.

Beneath the foundation plate, the easily interchangeable motor E is secured, its rotation being transmitted to the disk 5 through spur gears 1 and 2 and bevel gears 3 and 4 reducing the speed, the gear being rigidly connected with the disk 5.

This disk is freely revoluble on the driving spindle 10, but compression spring 8, pressing with one end against the cam disk 9, causes dragging of the disk 5 so that it turns with sufficient resistance on the spindle 10. With its upper side the disk 5 impinges against the drum 7, which is keyed to the spindle 10. See Figures 6 and 7. Within the drum is provided a ring 11, which carries a projection 12. In consequence of the friction set up between the disk 5 and the drum 7, the latter has a tendency to partake in the turning of the disk in the direction of the arrow, Figure 6, which turning continues after the spring 24 has been compressed, until the side 13 of the recess in the drum impinges against the projection 12. As soon as the projection 12 is held fast by the hook-shaped lever 14, the drum will be prevented from further turning. The motor, or the hand-drive, may therefore operate without interruption, and still not influence the driving spindle 10.

If the machine has to do work, the projection 12 is released, which in addition- and subtraction-work is effected by pressure on the key 15. By the lever 15^a of said key (see Figures 1 and 19) which generally is pressed upwards by the spiral spring 16^a, one end of the lever 14 will be bent downwards, said lever 14 not being formed of one single unflexible piece, but consisting of two halves flexibly jointed by a spring 16 (see Figures 19 and 20). After the displacement of the end of lever 14 effected hereby, the compression spring 24, turns the ring 11 a certain distance in the direction of the arrow, whereby the small cylindrical stud 17, carried by the ring, will be wedged between the eccentrically recessed wall 19 of the drum 7 and the cylinder 18, which latter is rigidly connected with the pulley 5 and the bevel gear 4.

There is now a positive connection between the bevel gear 4 and the driving spindle 10, so that the latter is made to rotate, and the machine operates. When the hooked lever 14 again enters the path of the projection 12, the latter will be held fast and the cylindrical stud 17 released from the wedging, so that the coupling is broken.

The above described coupling is well known, for instance in the carriage-wheel industry and its perfect action has been established.

The setting table A is equipped with proportionally slidable bars as described in Patent 1,011,617. Fig. 12 of the drawings in the present application illustrates the principle of this setting device. Referring to this figure it will be noted that ten slidable bars are provided of which the outer indicated as 90 and 91 can be selectively locked by means of the control 20. A cross bar is pivoted beneath all the slidable bars and this cross bar is rocked back and forth at each rotation of the operating shaft by means of a crank 10. In the drawing the bar 90 is indicated as locked by the sliding latch 89 and under this condition the bar 91 upon the actuation of the crank 10 will be carried to the right a distance corresponding to 9 units. As indicated in the drawing each of the intermediate bars receives a proportional movement and this movement is adapted to be transmitted to the number wheels beneath windows 57^a as is fully described in the patent referred to. If upon locking bar 90 the mechanism executes a substractive movement, upon locking bar 91 and freeing bar 90 an additive movement will be executed upon the actuation of the crank. It is to be noted that upon performing a subtractive operation nines will normally appear in all of the windows 57^a to the left of the number which has arrived therein.

Addition.

In the automatical working of the present machine, the addition- and subtraction-processes are of no importance so that it is neither intended nor necessary to give an exact description of the same. With regard to the said processes reference is made to the U. S. Patent No. 1,011,617. The setting of the machine to addition or subtraction is effected by the stud 20 (Figures 2, 3, 4 and 12) and results in the rack-arrangement 90, 91 receiving its alternating drive, (see schematical view in Figure 12). At the stud 20 the directions "Addition", "Multiplication", "Subtraction" and "Division" are provided.

If the machine is to be used for adding, the stud 20 is first set for addition, whereafter by suitable means such as slidable studs such as are shown at 14 in the carrying device A in U. S. Patent No. 1,011,617, the numbers are set. After setting of a number in the carrying device, the key 15 has to be depressed, whereupon the resulting sum may be read off through the windows 57^a. In setting the machine for adding or subtraction the number table B is arrested, that is it is not subjected to any displacement as in other automatic machines, i. e. the British Letters Patent 14,453/1905.

Subtraction.

After setting the stud 20 for subtraction

and putting the greater one of the numbers in the number table B by means of the knobs 76 in the windows 57ª and the lower one in the carrying device A, by means of the sliding studs as described in the U. S. patent referred to, the difference will appear in the windows 57ª after pressing the key 15. The setting of the minuend is accomplished in the same manner as described in U. S. Patent 1,011,617 and by the mechanism as shown for example in Fig. 6 thereof. Knobs 76 and windows 57ª mentioned above correspond respectively to knobs 45 and windows 71 of the patent.

Multiplication.

While the coupling between the source of power and the driving shaft has to be closed by hand by depressing a key for addition and substraction, this is done automatically for multiplication and division by the entry of the number table in another decade. The number table B, which is continuously subjected to a pull towards the left, see Figure 3, from a spring 30 through the intermediary of the chain 31, Figure 3, is now drawn against this spring action, so many places to the right, as there are places in the multiplier which has already been put down in the setting device C. The setting device C is rigidly connected with the number table B, and therefore partakes in the movements of the latter, which occur in the direction of the arrows *a*—*b*, Figs. 27 and 29. Through the vertically yieldable pawl 23, which grips behind the teeth of the fixed tooth-rack 32, the number table B experiences a resistance at each of these places. If, for instance, the number table B is drawn to the fifth place, the pawl 23 will engage behind the fifth tooth of the tooth-rack 32, so that the number table will be held there against the action of the spring. A second, thinner tooth-rack 25, see Figures 1, 3 and 10 lies flat against the tooth-rack 32, and this tooth-rack 25 is displaced a small amount to the right, see Figure 10, being movable this amount in its longitudinal direction. It engages, by means of a recess 25ª one end, 27 of the two-armed lever 28 (see Figs. 2, 25 and 26). Should now this movable tooth-rack 25 be displaced to the left, through the pressure from the pawl 23, which is connected with the number table, thereby bringing the teeth of the tooth-rack 25 to coincide with each of the teeth of the tooth-rack 32, then the push rod 29 will cause an oscillation of the hook-shaped lever 14 through the intermediary of the lever 28, see Figures 2, 25 and 26, whereby the projection 12 is released and the coupling 5 and 7 in previously described manner enters into action, and the machine is started. To perform a multiplication or a division, it is accordingly only necessary to draw the number table B to the right and thereupon release it. The machine then completes so many revolutions as the multiplier has units at the place where the pawl 23 has been arrested. Upon the release of the pawl after the machine has completed its operation in any decimal place, the carriage B is moved one place to the left under the influence of spring 30 through chain 31, Fig. 3. By the device described below the number of revolutions for each place of the multiplier is regulated.

As mentioned above, the multiplier is put down to show in the windows of the setting device C by the number rollers 22 and the use of the buttons 21; the multiplier being readable in a straight line, there being a number roller for each window. The number rollers 22 are rigidly mounted on their shafts and are integral with the ten toothed gear wheels 33 and 34, as well as with the single tooth 35 registering with the zero mark. A ratchet cone 34ª (see Fig. 1) meshes with the gear wheel 34 in order to make the position positive, whilst each of the gear wheels 33 may be turned one tooth by the single acting ratchet pawl 36. The latter consists of a two-armed lever 37, which is mounted by means of a journal 69 in a bearing fixed relatively to the movable number table B, and carries at its upper end the single acting pawl 36 constantly drawn towards an abutment by a helical spring 36ᵇ see Figures 9 and 26. With the lever swung out, as in the initial position, the pawl 36 is so situated, that the teeth of the gear wheel 33, can pass by without interruption, when the number table B slides over it. If the hooked lever 14 has been turned away, that means that the machine is in operation, the cam disk 9 then turns with the driving shaft 10, to which it is keyed, causing the bell crank 39 to oscillate through the intermediary of the connecting rod 38, which is attached to one of the offset arms of the bell crank, the other arm 41 being connected to the pushing rod 40, which lastly oscillates the lever 37. Each revolution of the driving shaft 10 consequently causes an oscillation of the lever 37. During idle running of the pawl 36 from left to right, in the first half of operation of the machine, the pawl 36 snaps back without turning the number wheel 22 when the pawl hits a tooth, but on forward running, that is in the direction of the arrow in Figure 9, the wheel will be turned one tooth.

Supposing for instance, that the multiplier 79042 has been put down, the number table has then to be shifted to the fifth place, so that the place, having the value "7," stands opposite the fixed bearing 45. When now the machine is started after the pawl 23 has impinged against a tooth of the stationary tooth rack 32 and the movable rack 25 the pawl 36 will, during the first revolution of

the driving shaft 10 by means of the enumerated intermediary members, turn the number wheel 22, situated right opposite, from "7" to "6"; during the second revolution to "5" until on the last turn the numeral "0" is visible in the window, seven units having been thus set back gradually when finally the pawl 23 is released and the coupling broken, whereby the machine is again brought to rest.

The release of the pawl 23 has consequently always to take place when the place in question of the multiplier has been exhausted, that means when a "0" is visible in the window, this procedure being described below:

On the appearance of a "0" in the window, the single tooth 35 see Figures 1 and 2, encounters the double beveled end of a lever 42 situated beneath each of the number-rolls 22, which lever depresses the trapezoid shaped member 44 by means of its roller 43, see Figures 1, 2, 3 and 5, 26ª, 27, 28, 29. A lever 42 carrying the roller 43 is seated rotatively at the end opposite the roller in a block which is fastened to the housing C. If the number table B and the housing C connected with it is moved past the stationary bearing 45 in the direction of the arrows *a*—*b*, the rollers 43 of lever 42, in case no pawl 35 projects downwardly, that is in case no "0" is set up, will slide over the trapezoid-shaped member 44, whereby they are raised a slight degree. This condition is shown in Fig. 28 where the lever 42 does not bear against the trapezoid-shaped member. The member 44 is rigidly connected with a dove-tail slide 46 guided in the stationary bearing 45 Figures 1, 2, 3, 4 and 5, in which also another dove-tail slide 47 moves. In order that a pressure by the slide 47 on the trapezoid member 44 may set the slide in motion in this instance (but not in other instances as will be described later) a connecting bar 50ª, which with its shank 51 connects with the switch 52, is laid over two screws 48, 49 seated on the slides 46 and 47. This connecting bar 50ª grips at one time with its large opening over the two screws 48 and 49, see Figures 1, 4 and 5, and at other times with the small opening depending on the position of the switch 52 and the use of which will be described further on. During a multiplication process, the connecting bar 50ª grips with its smaller opening over the screws causing the slide 47 to partake in the movements of slide 46. The slide 47 carries at its upper end roller 53 by means of which it rests against the bent down side 54 of the linked parallelogram 55, 67, 68. This parallelogram comprises the bar 55 and the two arms 67 and 68 the latter having hinged connection with the wall of the number table B, and the arm 67 being revoluble on the shaft 93. The parallelogram bar 55 lies with its underside 54 on the roller 54ª of the already described pawl 23. If now a pressure is exerted on the trapezoid member by the roller 43 of the lever 42, (which will occur by means of the single tooth 35 of the number drum 22, on the appearance of "0" in the window), then the parallelogram side 54 will press the pawl downward which with its other end will disengage from the stationary tooth-rack 32, whereupon the number table can respond to the pull of the spring 30 and move to another place which will occur in the present example after seven revolutions. As soon as the pawl has left the tooth-rack 32, the narrow movable tooth-rack 25, influenced by the spring 56 (Fig. 2), which is seated partly on the connecting rod 29 and partly on the stand of the machine, will quickly move to the right through the intermediary of the lever 28, engaging a recess 25ª see Figures 2 and 10.

When now the connecting rod 29 travels to the left, the lever 14 swings into the path of the projection 12 holding it fast, whereby the driving shaft 10 will be disengaged and the machine set at rest.

The machine will now remain at rest until the number table moves into a new position namely: to the 4th place in which the pawl 23, which in the meantime has been released by the ledge 54 will now draw the tooth-rack 25 toward the left, releasing the projection 12 and again setting the machine in motion as many times as the value required by the new place of the multiplier. Its position will now be at fourth place opposite the bearing 45, so that the fourth line of numbers which contains nine units will be positioned on "0" by the oscillating ratchet 36 after nine revolutions. As soon as this has taken place, the pawl 23 will be again disengaged, and the number table again released travelling to the third place in which the multiplier already shows "0." The pawl 23 does not meet with a resistance from the tooth rack 32 in this place, because on the appearance of a "0" the single tooth 35, points downward thereby pressing the lever 42 with its roller 43, so that the latter on arriving in the third place will influence the parallelogram side 54 through the trapezoid member 44 together with the slide 47 and the roller 53; and as a consequence the pawl 23 will not be able to fall behind a tooth of the tooth-rack 32 but will instead directly enter the next, that is second place. As then pawl 23 did not enter in the third place of the tooth-rack 32, the narrow tooth-rack 25 will not be influenced and as a consequence the number table will not be arrested in this place and no driving of the machine will occur.

By entering the second place of the multiplier the value of which contains four units, the machine accomplishes four revolu-

tions whereupon the number table switches in to the first, that is, the unit place, and accomplishes still two more revolutions.

The multiplier 79042 which had arrived in the windows has now disappeared in its place appearing a row of zeros said number, however, now appearing in the windows 57 of the number table. Later on more exact explanations will be given of this arrangement.

The position of the various pawls 35 in Fig. 27 corresponds to the multiplier 79042 used as an example. In this position where "0's" occur, the pawls 35 show downwardly. In this position no lever 42 is raised. If its roller 43 slides over the trapezoid-shaped member 44, but since in this case the lever 42 cannot be moved, the trapezoid-shaped member 44 is forced downwardly, whereby, as stated, the pawl 23 is finally released so that in all of these positions, which show "0's", the number table B is not stopped.

Should a row of zeros appear in the multiplier or if a row of zeros should remain in the multiplier setting device C one depressed roller 43 after the other will slide over the trapezoid member 44 releasing the pawl 23 as many times as there are zeros unless it is not engaged that many times.

It is of the greatest importance that the number table B does not move out of its position before the machine has taken up its normal position, that is, until the tooth-racks 90 and 91 have entered their initial position, because shifting can only be made in the initial position which is the case with the present machine as well as every other computing machine.

In order that the number plate B may be movable only when the shaft 10 is in the normal position, a lever has been provided which during the rotation of the shaft enters a recess in a rail secured on the number table, this lever only disengaging when the crank stands normal. This arrangement although not new and therefore not claimed in this application has however been retained therein. It is fully described in the U. S. Patent above referred to and attention is called in particular to Fig. 41 of the drawings in that patent elements 145, 147, 148 and 149. As long as the driving shaft 10 stays out of its initial position and as long as the projection 12 does not impinge against the hook in the lever 14 the number table B is locked. The pawl 23 is prevented after its release from falling again behind the same tooth of the rack 32 by the tooth rack 25 which therefore has an additional function to the one already described. The tooth-rack moves rapidly toward the right at the instant when the pawl 23 is released, thereby bringing the hook 14 into the path of the projection 12 and partly filling the spaces of the tooth-rack 32. As a consequence the pawl cannot now enter behind the same tooth but instead remains on the tooth-rack 25 and for that reason permits the number table to travel into the next place when the machine attains its initial position.

In the present invention the switching of the carrying device has no influence whatever on the position of the number table. As soon as the different places in the multiplier have been exhausted, a row of zeros will appear (as has already been described) in the windows above the number rollers 22. In order now to show that the multiplier has been correctly placed, the multiplier will again appear, after the exhaustion of each individual place, in the number table situated below the windows 57, Figure 3. This number table, which is provided in most computing machines of this type, may be arranged in any desired manner. It is evident from the above description that the setting device C has controlled the movement of the number plate B so that the multiplicand originally set up on the carrying device A has been multiplied by the number set up in the setting device C. In accordance with the machine as described in Patent No. 1,011,617 the product will now appear in the windows 57^a while the multiplier will stand in the windows 57. It will be understood that each time the multiplicand is added to itself the acting digit of the multiplier in the setting device will be reduced by 1 and 1 will be added in the corresponding window 57 of the number table B. Multiplying by seven, for example, after the first revolution of the machine, 6 will appear in the setting device C in place of 7, the figure f will appear in the corresponding window 57 of the number table B while the multiplicand itself will appear in the windows 57^a as well as in the windows of the carrying device A. At the end of the operation consequently zero will appear in the setting device C in the place of 7, 7 will appear in the corresponding window 57, while the product will appear in the windows 57^a. The machine will now automatically pass to the next decimal place.

The machine is driven in the different decades according to the multiplier set by the knobs 21, that is with regard to the example already cited "79042", in the unit-place twice, in the first decade four times in the second decade not at all, in the third decade nine-times and in the fourth decade seven times the number roller too receives in the unit-place two drives in the first decade four drives, in the second decade no drive at all, that is zero and so on.

The said number table may be driven in

any suitable manner by a movable machine part and is also in known manner provided with a decimal carrying device, so that the multiplier may be added or subtracted as desired.

If a zero appears in the multiplier, as, for instance, in the number 79042 upon the zeroizing of the 9, the table B will travel directly to the fourth place of the number inasmuch as the zero appearing in the third place has kept the rail 54 depressed and hence pawl 23 released. The machine has thus traveled two decimal places and has gained considerable momentum so that upon the re-engagement of the pawl 23 with the rack a considerable shock will result. In order to avoid this disadvantage a special arrangement has been provided so that the number table will be moved gradually; and this arrangement is constructed as follows (see Figs. 1 and 30):

On the transmission shaft 58, an eccentric 59 is rigidly mounted and against this eccentric lies a roller 62 which is mounted on the rail 61 actuated by a spring 60 Figure 1. By turning the eccentric 59, which is done continuously even when the machine stands still, the rail 61 accomplishes movements in its longitudinal direction thereby bringing the two-armed lever 63 which is fulcrumed at point 75, into rapid oscillation. The rail 61 grips the lower end of lever 63 by means of a slot, the spring 65 continuously urging 63 against the notch 64, Figure 1. If now the slide moves to the right, the lever will be positively actuated but the movement of the lever to the left will on the other hand be done by means of the spring 65. The function of this spring will be further explained here below. The lever 63 engages through its upper end with the angular tooth-rack 66 situated in the housing of the number table and will therefore momentarily arrest the number table B and subsequently again release it when the lever becomes disengaged and the number table continues on its way. As, however, the inertia of the number table on account of its great mass is quite considerable, it will only travel so short a distance that it again is arrested by the upper end of the lever, when the latter engages behind another tooth of the tooth-rack 66. The number table B consequently travels the length of the space between the teeth of the tooth-rack 66 by steps. As has already been described the number-table is drawn toward the right before the starting of a new multiplication which the lever 63 will prevent if it were securely connected with the rail 61 and if it accidentally had the position illustrated in Figure 1. As however the lever yields on account of spring 65 the teeth of the tooth-rack 66 which are bevelled on one side will now be able to push the lever back. It is moreover possible that on account of its inertia the number table might move only a distance of two teeth, when the lever 63 if securely fastened would be unable to engage with the tooth-rack 66 which also might cause interruptions. Obviously these disadvantages have been avoided by the insertion of spring 65. Most of the parts provided for carrying out automatic multiplication are not necessary for automatic division and are therefore thrown out on changing the switch 52 to division. The question is now how to avoid, during the process of division, the driving of the wheels 33 and the number wheels 22. This is accomplished by having the pawl 36 with the lever 37 lowered so far that the pawl no longer impinges with the wheel 33. The retaining screw 69 serving as fulcrum for oscillating lever 37 is threaded in the slide 70 which fits with its dove-tail in the bearing 45, this screw penetrating the latter with its neck 71 see Figures 1, 3 and 5. A compression spring 72 rests against the neck 71, pressing the slide and also the lever 37 downwards. If the switch 52 is positioned on letter M see Figures 3 and 26, the inclined face 73 on the end of the rail 74 which is connected with the switch, will enter beneath the neck 71 thereby raising the slide 70 so high that the pawl 36 impinges with the wheel 33. Should, however, the switch be placed on letter D the slide falls and the wheel 33 will not be influenced. Through this switching the connecting bar 50 seated on the rail 51 will take the position indicated in Figure 4, so that no connection will occur between the trapezoid member 44 and the roller 53 in consequence of the greater opening with which the bar now engages with the screws 48 and 49. As no multiplier is placed during division, the zeros will remain in the windows and the single tooth 35 for actuating the lever 42 as well as the roller 43 will be ineffective.

Automatic division.

In the following description of the operation of automatic division, reference is made to computing machines of the prior art, such as mentioned in the preamble of this specification and forming the foundation of the present invention, and such for instance as that disclosed in U. S. Patent No. 1,011,617. In said machines the division is accomplished by regularly alternating subtraction and addition, and at each change from one system of computation to the other, the number table has to be shifted one place. In the present case the process is the same, only reversed, as in the known devices the number table is shifted one place by moving a switch by hand, in the present device the

switch 20 is actuated by the movement of the carriage.

In the following, the functions of known machines according to U. S. Patent No. 1,011,617 will be repeated where necessary for cooperation with the new device.

After setting the dividend by means of the knobs 76, mounted on shafts 121 (Figures 2, 13 to 18 and 20), this being effected by hand as usual in all computing machines, in such a manner that the said dividend appears in the windows 57ª and hereafter setting the divisor by means of studs on the carrying device A just as would be done with a number or multiplier in all other known computing machines the highest places of said dividend and divisor will be positioned opposite each other, which is accomplished in this case in the same manner as in all other computing machines, that is by displacement of the number table. As the latter is now locked in the position it has received, a successive subtraction will now take place through a greater or smaller number of revolutions of the machine, which continue until one revolution more than necessary has been made. The number table now proceeds to the next decade, whereby the machine is simultaneously switched from subtraction to addition. As soon as it has completely reached the new position, a further addition of the divisor to the negative part dividends takes place, which is repeated until zeros appear at the left of the dividend.

The value, resulting from this combination procedure and appearing in the quotient, does however not yet give the correct quotient, but it has an exact relation thereto. The correct quotient will not be produced however unless positive revolutions are made in the quotient register during the negative working of the carrying device, and negative revolutions are made during the positive working of the carrying device. Thus when the divisor is being subtracted the quotient register is being actuated positively and when on the shifting of the machine the divisor is being added the quotient register is being negatively operated. Thus if the divisor has been added once the quotient register will pass from zero back to 9 whereby the tens transfer mechanism will be actuated thus subtracting 1 from the next higher place. The mechanism for accompanying these functions has been described in the patent to which reference has been made.

The shifting of the quotient register takes place in connection with the reversing of the carrying device, which will be more fully described further on.

The following should have particular notice:

Each division commences with subtraction, that is the switch 20 for the carrying device is placed on subtraction and the switch 102 for the quotient register is placed in its normal position, that means, that in this position the counting will be advancing in the quotient register or from 9 to "0".

The operation will now be illustrated by the following example:

$$390{,}695 \div 625 = x.$$

As described in the patent the dividend then is placed in the table B so that it appears in windows 57ª while the divisor is set up in the setting device A. By displacement of the number table B the highest places of the dividend and divisor are now brought opposite each other. During its movement whether from left to right, or from right to left, the switch 20 has been given a back and forth movement by means of the following mechanism: A pin 78 secured in the slide 79 engages with zig zag curve 77 in the tooth-rack 66 see Figure 3, in such a manner that the slide 79, in moving the number table, travels back and forth in its longitudinal direction. On setting the switch 52 on D the tongue 80 thereof has pushed the flap 81 to the right, whereby the connecting rod 82 will enter the aperture 83 in the slide 79 see Figures 3 and 11. The flap 81 as well as the connecting rod 82 are rigidly secured on the shaft 84, which is rockable and slidable in the bearings 85 and 85ª. When the switch 52 is placed on D, the flap 81 will thus oscillate back and forth but on pressing the switch on M this does not take place, because the connecting rod 82 in consequence of the aperture 86 will not be affected see Figure 11. The rocking of the flap 81 is communicated by means of the link 87 to the switch lever 88 (knob 20) which is thus rocked back and forth alternately locking racks 90 and 91 by means of the sliding pin 89 (see Fig. 12). It will be evident from the above that the machine executes addition or subtraction when one or the other of the tooth-racks 90 or 91 is held fast by the pin 89.

A two armed lever 92 grips the flap 81 with its lower fork-shaped end and a flap 94 slidable on a square sectioned shaft 93 with its upper fork-shaped end. In this manner the rocking of the flap 81 is communicated to the flap 94. After the number table has been drawn entirely to the right, the switch 20 for the carrying device points to subtraction and the switch 102 for the quotient register, with which it is connected by means of a pin 101, points to normal. If now the number table is released to the tension of the spring 30 or while in this position, the coupling will be disengaged as has already

been described during multiplication through the tooth-rack 25, and the machine begins its subtraction in the manner shown in this example:

$$\begin{array}{r} 390625 \\ -625 \\ \hline 765625 \end{array}$$

As the machine in the prior art (as disclosed in the U. S. Patent No. 1,011,617) selected in this case for illustration cannot make a direct subtraction but accomplishes this through addition in the complement values, the rest remaining in the windows does not produce a negative number. Instead of the device subtracting 625 its complement number 375 will be added. In that case a carrying from 9 to "0" will not occur in the highest place as is usual in the ordinary subtraction. The sleeve 120, see Figure 13 which serves to prepare the carrying of the tens remains uninfluenced in its position and slide 96 which has been moved outward by the machine driven cam member 97, impinges by means of its pin 95 against the projection 98 of the flap 94 whereby the latter together with the square shaft 93 will be tilted see Figure 14. The handle 103 reaching through the wall of the housing of the number table is keyed to the end of the square shaft 93 see Figs. 1 and 2 which handle rests by means of its finger 104 against the pin 105 provided in the arm 67 operating as a single acting connection. By pressing on the bar 54 the shaft 93 will therefore not be actuated, the arm 67 however will now be actuated through the connecting rod. This arm will be made to swing outward on tilting the flap 94 through the turning of the square shaft 93, and the rail 55 will be depressed, whereby the pawl 23 as already described in the process of multiplication is released and as a consequence the coupling will be broken and the number table brought into another position. Through this entering into another position and through the intermediary of the curve 77, the switches 18, 20 and 102 as well as the flap 94 will be reversed so that a positive connecting will take place in the number table and a negative counting in the quotient. In the machine the computation is carried out in the following example:

$$\begin{array}{rr} & 390625:625=+1-4 \\ -1\times625= & -625 \\ & \overline{765625} \\ +4\times625 & +2500 \\ & \overline{015625} \end{array}$$

Through the four turnings a "0" will now appear in the last window of the number table. Now the same thing will happen as when a "9" appeared during subtraction. During the first three revolutions the slide 96 was able to move perpendicularly. Between each two shafts 76 of the number table B are slides 96 seated in a rail 95^e extending from end to end of the number table housing B. In Figures 1 and 13 to 18 the last slide 96 of the series is represented. In addition to a vertical reciprocating motion a lateral rocking of the slide is permitted and for this purpose the upper guide slot at 95^b, Fig. 14, is made broader. Figs. 15 and 17 show how the slide 96 is swung out laterally. In the hollow space of the bearing the lever 95^a is pivotally disposed and its beveled end rests on a pin 95^c on the slide 96 whereby by means of the spring 95^d connected to the plate on the pawl, the slide 96 is normally pressed to the right. This pawl and spring assure that the slide 96 will travel vertically unless it is forced from this position. If it is forced out of its vertical travel it is rocked to the left and assumes the position of Figure 15 since the beveling of the resilient lever 25^a permits motion along the two components of the force. On changing from "9" to "0" in the last place the sleeve 120 experiences an axial displacement, see Figure 13, through the bevelled pin 122 connected therewith when said pin slides over the bevelled pin 123 seated on the housing of the machine. Since the cam member 97 on the displacement of the sleeve 120 still has the position shown in Figure 13 the slide 96 is still in its position of rest, Figure 14, so that the ring 124 of the sleeve 120 can pass unobstructed over the beveled head of the slide 96 and assume the position shown in Figures 17 and 18.

The sleeve 120 has now taken the position indicated in Figure 17 so that on the fourth revolution of the machine, wherein the cam member 97 partakes thereby pushing the slide 96 upwards this slide will then drive the sleeve 120 to one side through the intermediary of the ring 124 and the pin 99 will impinge with the projection 100 of the flap 94 bringing it into oscillation see Figure 15. Then, as before the coupling is broken, the number table proceeds into a new position, the carrying device is reversed into subtraction and the normal counting in the quotient now takes place. In the third decade the following will occur:

$$\begin{array}{rr} & 390625:625=+1-4+3 \\ -1\times625= & -625 \\ & \overline{765625} \\ +4\times625= & +2500 \\ & \overline{015625} \\ -3\times625= & -1875 \\ & \overline{996875} \end{array}$$

During the third revolution, the flap 94 will be tilted by the pin 95 and the number table then proceeds into addition while simulta-

neously the carrying device is reversed and the quotient is turned into negative counting, in the fourth decade when finally the example has the following appearance:

$$
\begin{array}{rl}
 & 390625:625=(+)1(-)4(+)3(-)5=625 \\
-1\times625=- & \underline{625} \qquad\qquad 0\quad 6\quad 2\quad 5 \\
 & 765625 \\
+4\times625= & \underline{2500} \\
 & 015625 \\
-3\times625=- & \underline{1875} \\
 & 996875 \\
+5\times625\ - & \underline{3125} \\
 & 000000
\end{array}
$$

From the above given example it will be evident that the automatic division is composed of alternate subtraction and addition and always changing decades. No excessive subtraction as is usual in numerous machines is therefore to be added in the same decade for the purpose of correction but instead in the next decade below.

Through the first revolution in the highest decade a "1" will appear in the quotient register by means of positive counting, in the following a "6" will appear through negative counting and so alternately. On account of the decimal carrying in the quotient register, the extra revolution caused by the one too many subtractions disappears when in the following, next lower place counting is executed negatively. The "1" in the highest place is again changed into a "0" and the "4" changed into a "6" and the "3" again diminished one unit while the "5," being the last value remains unaltered. Without the carrying of tens in the quotient as will be evident from this example the numbers 1, 4, 3 and 5 will appear in the windows of the quotient as will be evident from this example, through the carrying of the tens, each number appearing before a negative counting will be diminished one unit, that means, the "1" would disappear and the "3" changed into a "2." As the way of carrying the tens may be chosen at will and forms no subject-matter of the present invention, reference is made to the U. S. Patent No. 1,011,617 wherein said procedure is thoroughly explained.

As soon as the number table has reached its new position when the pawl 23 again impinges against a tooth of the tooth-rack 32, the coupling will again be connected through the tooth-rack 25 and the machine again started until the last decimal place of the number table B is reached. Hereafter the pawl 23 is released and the number table moves only to a little amount to the left, whereby the pin 220 (see Figures 21 and 22) provided in the front wall of the casing of the number table B abuts against one of the arms of the two-armed lever 221 and reverses the same into the position represented by dotted lines until it abuts against the stud 125 provided at the stationary machine frame D, whereby further movement of the number table is prevented. The lever 222 which must be electrically conductive at the point which is normally inserted between the arms of the contact fork 224 has thus been disengaged from these arms. The contact fork being connected in the motor circuit, the motor is thus automatically stopped when the number table reaches its limit position as described. As the movable tooth-rack 25 has been released, the coupling will be released as well. If now the number table B has been moved from its last position and is brought in another working position, so that the pawl 23 lies behind one of the teeth of the tooth-rack 32, the end 222 of the lever 221 engages by means of the spring 223 the contact-fork 224 whereby the circuit is closed to the motor. At the end of the computing procedure, the number-table B leaves its last position of work, interrupts hereby the coupling and consequently the electrical current. The machine remains at rest so long as the number table has not been brought into a new working position. This simple arrangement has been described by way of example. Many other different arrangements may be used to obtain the same result.

In accordance with the above given example it is necessary to reverse the quotient register in a corresponding manner so that an erroneous appearing "1" will be removed through the carrying of the tens. This is attained as has already been indicated through a connection between the switch 88 and the switch 102 for the quotient register, when the pin 101 is pushed through the switches 20 and 102.

Exchange of the number table and interruption of the drive by hand.

A handle 103 has been provided for the purpose of displacing the number table. If laid over to the left the ledge 54 will release the pawl 23 and the number table is now free to move in both directions. The running of the machine may also be interrupted

through the same movement, as for instance, when a division has been carried far enough, because through the disengagement of the pawl 23, the tooth-rack 25 will also continue toward the right and the coupling will be disengaged by means of the intervening members.

Multiplication accomplished partly by hand.

Some computations as for instance for root extraction require that the number table B is actuated by hand instead of automatically solving it as above. This can be accomplished at will through the handle 103 as has already been explained. Should it however be necessary to hold it in a certain place, the latch 106, Figures 1, 2, and 3, must then first be drawn back so that the square bar 107 may obey the pulling of a spring and fall downwards. This bar is at its lower end formed as a stud 108 and is generally prevented from falling through the hook 109 which rests in a groove. This hook 109 is rigidly secured on the square shaft 93 and is integral with the handle 103. If now the latter is actuated, the hook 109 will be disengaged and the stud 108 falls into the tooth rack 32, see Figure 2, thereby securing the number table. In order to prevent a connection of the coupling of the machine as would occur through engagement of the pawl 23, the stud 108 has been so shaped at its lower end that it only can engage with the tooth-rack 32 but not with the tooth-rack 25. Should now the number table have to be moved one place, a pressure on the key 110 will release the stud 108 but it will not throw the hook 109 into the groove of the bar 107, because the stroke of the key 110 is not sufficiently great being limited by the projection 111. The stud 108 will now rest against another tooth of the tooth-rack and the number table is shifted one place.

Caution against passing the place number.

The described device may also be used as a caution against passing the place number in the machine.

It will be supposed that the importance of such passing is already known and it will be evident from the description of the automatic division that the stud 94 will be tilted if, for instance in the last place in the machine the "nines" are again transformed into "0" and as the hook 109 as regards the direction of turning partakes in this movement the stud 108 will be disengaged and prevent a further traveling of the carriage. But as the pawl 23 would also be disengaged by means of the known gear members, the coupling will therefore be broken and the machine will be arrested for caution. After the passing has been noticed, the pressure on the key 112 will again disengage the stud 108 and, in opposition to the action of the key 110, permit the hook 109 to snap forward, which is possible on account of the larger stroke given to key 112 as compared with the key 110. When the machine is to be used for division, the bolt 106 is again engaged, in other cases the machine will be stopped for each operation of a part division.

It is of great importance that an automatic machine can be operated by hand as well as from some other source of power so that it may be independent, for instance, of electric energy and be secured against disturbance caused thereby. Moreover there will be no cost for operation, the machine will be cheaper to produce and may be operated anywhere.

For the purpose of selecting hand or power operation a bevel gear 113 is provided beside the bevel gear 3, the shaft in the former bevel gear carrying a crank, not shown. Through simply turning this crank the machine will then automatically perform its function.

I claim:

1. In a computing machine having a travelling number table, a driving shaft, a power source, a coupling between said shaft and said power source, a pawl on said number table, the combination of a slide with abutments in the path of the pawl, and a connection between said slide and said coupling whereby said coupling is engaged on the striking of the pawl against one of said abutments.

2. In a computing machine having a travelling number table, means tending to return said number table, a pawl on said number table, a plurality of abutments in the path of said pawl, said pawl being adapted to engage said abutments for restricting said number table against the influence of said return means, a parallelly movable horizontal bar operable on said pawl, and operating means arranged on a fixed machine part and operable on said bar on the opposite side thereof to said pawl for moving said bar and thereby releasing said pawl from said abutments.

3. In a computing machine having a travelling number table, a driving shaft, a power source, a coupling between said shaft and said power source, a pawl on said number table, the combination of a slide with abutments in the path of the pawl, and a connection between the slide and the coupling, said connection comprising a lever in connection with said slide, control means for said coupling, and a rod connecting said lever with said control means whereby said coupling is connected on the striking of the pawl against one of said abutments.

4. In a computing machine having a setting element for the multiplicand and a number table element for the product, one of

said elements being displaceable relative to the other, and a control switch the combination of a setting device for the multiplier, means tending to return the displaceable element, stop means preventing the return of said element, means for zeroizing a decimal place of the multiplier by units, means automatically actuated upon the zeroizing of the decimal place for releasing said stop means, and means for rendering said zeroizing means inoperative upon adjusting said switch to division.

5. In a computing machine having a setting element for the multiplicand and a number table element for the product, one of said elements being displaceable relative to the other, and a control switch the combination of a setting device for the multiplier, displaceable in conjunction with the displaceable element, means tending to return the displaceable element, stop means preventing the return of the displaceable element, means for zeroizing a decimal place of the multiplier by units, means automatically actuated upon the zeroizing of the decimal place for releasing said stop means, and means for rendering said zeroizing means inoperative upon adjusting said switch to division.

6. In a computing machine having a travelling number table, a drive shaft, a power source, a clutch between said drive shaft and said power source, means automatically actuated upon the entrance of said number table into a new decimal place for closing said clutch, and manually operable means for closing said clutch independently of the position of said number table.

7. In a computing machine having a frame element, a travelling number table element and means tending to return said table element, the combination of a toothed rack fixed to one of said elements, a member arranged on the other of said elements and adapted to be brought rapidly into and out of engagement with the teeth of said rack, and means for actuating said member.

8. In a computing machine having a setting element for the multiplicand and a number table element for the product, one of said elements being displaceable relative to the other, and a control switch, the combination of a setting device for the multiplier, means tending to return the displaceable element, stop means preventing the return of the displaceable element, means for successively zeroizing the decimal places of the multiplier by units, means automatically actuated upon the zeroizing of a decimal place for releasing said stop means, and means for rendering said zeroizing means inoperative upon adjusting said switch to division.

9. In a computing machine having a setting element for the multiplicand and a number table element for the product, one of said elements being displaceable relative to the other, a control switch and a rotatable operating shaft, the combination of a setting device for the multiplier, means tending to return the displaceable element, stop means preventing the return of said element, means for zeroizing a decimal place of the multiplier by units steps, one step for each rotation of said operating shaft, means automatically actuated upon the zeroizing of the decimal place for releasing said stop means, and means for rendering said zeroizing means inoperative upon adjusting said control switch to division.

10. In a computing machine having a travelling number table, a driving shaft, a power source, a coupling between said shaft and said power source; a pawl on said number table, a slide with abutments in the path of the pawl, and a connection between the slide and the coupling whereby said coupling is connected on the striking of the pawl against one of said abutments, thus starting the driving shaft; a plurality of teeth on said number table corresponding to the number of its denominational places, and a manually operable member for selectively engaging any one of said teeth, thus holding said number table in a predetermined denominational place without releasing said coupling.

11. In a calculating machine, number wheels for setting a multiplier, a spur wheel on each of said number wheels, and a single-acting oscillating pawl adapted to cooperate with said spur wheels for reversely returning said number wheels to zero.

12. In a calculating machine having a travelling number table, step-by-step return means for said number table, and a pawl controlling the number table return, the combination of number wheels for setting a multiplier, a spur wheel on each of said number wheels, a single-acting oscillating pawl adapted to cooperate with said spur wheels for reversely returning said number wheels to zero, a lug in fixed connection with each of said number wheels in axial alignment with the zero mark thereof, and means whereby on the zeroizing of a number wheel its lug actuates said control pawl for permitting a return movement of said number table.

13. In a computing machine having a setting element for the divisor and a number table element for the dividend, one of said elements being displaceable relative to the other, a step-by-step return means for the displaceable element, and a state control lever for the setting element, means for automatically switching said lever at each return step of the displaceable element.

14. In a computing machine having a setting element for the divisor and a number table element for the dividend, one of said

elements being displaceable relative to the other, a quotient register, a state control lever for the setting element, a state control lever for the quotient register, and a step-by-step return means for the displaceable element, means for automatically switching both of said state control levers, one to "addition" and the other to "subtraction" position, at each return step of the displaceable element.

15. In a computing machine having a travelling number table, means tending to return said number table, a pawl on said number table, a plurality of abutments in the path of said pawl, said pawl being adapted to engage said abutments for restraining said number table against the influence of said return means, a parallelly movable horizontal bar operable on said pawl, operating means arranged on a fixed machine part and operable on said bar on the opposite side thereof to said pawl for moving said bar and thereby releasing said pawl from said abutments, and means for automatically actuating said operating means upon the conclusion of a calculating action in any denominational place.

16. In a computing machine having a travelling number table, means tending to return said number table, a pawl on said number table, a plurality of abutments in the path of said pawl, said pawl being adapted to engage said abutments for restraining said number table against the influence of said return means, a parallelly movable horizontal bar operable on said pawl, operating means arranged on a fixed machine part and operable on said bar on the opposite side thereof to said pawl for moving said bar and thereby releasing said pawl from said abutments, means for automatically actuating said operating means upon the conclusion of a calculating action in any denominational place, and manual means for actuating said operating means independently of said automatic means.

17. In an electrically operated computing machine having a travelling number table, a control-circuit, a switch in said circuit, an operating arm for said switch, and means on said number table for abutting said arm on the completion of a computation whereby said switch is opened.

18. In a computing machine having a travelling number table, a power source, a drive shaft, and a clutch between said source and said shaft, said clutch having a control lug projecting therefrom, the combination of a pivoted hook for engaging said lug, automatic means for swinging said hook into disengaging position relative to said lug upon the entrance of said number table into a new denominational place, and independent manually operable means for displacing said hook in a direction at right angles to its swinging direction for disengaging said hook from said lug.

19. In a computing machine having a travelling number table and means tending to return said table, the combination of a toothed rack on said number table, and an oscillating lever arranged on a fixed machine part and adapted to engage the teeth of said rack in one direction of oscillation.

20. In a computing machine having a travelling number table, a power source, a drive shaft, and a clutch between said power source and said drive shaft, the combination of a pawl on said number table, a slide having abutments in the path of said pawl, connecting means between said slide and said clutch, whereby upon the abutting of said pawl against one of said abutments on a return movement of said number table, said number table is arrested and said clutch is released, a slide in said number table and a plurality of fixed abutments in the path of said slide, said slide being adapted to engage one of said fixed abutments for maintaining said number table in any denominational position without affecting the coupling between said power source and said drive shaft.

21. In a calculating machine, number wheels for setting a multiplier, a spur wheel on each of said number wheels, a single-acting oscillating pawl adapted to cooperate with said spur wheels for reversely returning said number wheels to zero, a control switch alternatively settable for division and multiplication, and means operated on the setting of said switch for division for rendering said pawl inoperative relative to said spur wheels.

22. In a calculating machine, number wheels for setting a multiplier, a spur wheel on each of said number wheels, a single-acting oscillating pawl adapted to cooperate with said spur wheels for reversely returning said number wheels to zero, a control switch alternatively settable for division and multiplication, and means operated on the setting of said switch for division for displacing said pawl relative to said spur wheels for rendering it inoperative thereupon.

23. In an automatic computing machine having a carrying device and a travelling number table, means tending to return said number table, stop means for preventing the return of said number table, means for rendering said stop means inoperative, and means for controlling the travel of said number table by steps when said stop means is inoperative, said means comprising an oscillating lever, and a tooth rack on said number table and engaged by said lever in one direction of its oscillation.

24. In a computing machine having a

travelling number table, step-by-step return means for said number table, and a state control lever, the combination of a fixed member having a zig-zag slot extending in the direction of the number table travel, a transverse slide in said number table and having means engaging in said slot, whereby said slide is reciprocated during the return movements of said number table, and means for transmitting said reciprocating movement to said control lever for switching the latter alternately from one state to the other.

25. In a computing machine adapted to accomplish division by alternate subtraction and addition, and having a setting element for the divisor and a number table element for the dividend, one of said elements being displaceable relative to the other, means tending to return the displaceable element, stop means restraining the displaceable element, and a state control lever the combination of means for automatically releasing said stop means upon the appearance of "9" or "0" at the left of the number table element during subtraction or addition, respectively, and means operated upon the consequent return movement of said number table for switching said state control lever.

26. In a computing machine adapted to accomplish division by alternate subtraction and addition and having a setting element for the divisor, a number table element for the dividend, one of said elements being displaceable relative to the other, means tending to return the displaceable element, stop means restraining the displaceable element, and a drive shaft, the combination of a rock shaft journaled in said number table, a slidable flap on said rock shaft and non-rotatable relative thereto, said flap having spaced projections, a slide in said number table reciprocable transversely to said rock shaft at each revolution of said drive shaft, means for shifting said flap in accordance with the subtraction or addition position of the machine whereby one of said projections is brought into a potential path of said slide, and connecting means between said rock shaft and said number table restraining means, whereby upon the impingement of said slide with one of said projections, said restraining means is released.

27. In an automatic computing machine having a setting device, a number table, a quotient indicator, a state control lever for the setting device, and a state control lever for the quotient indicator, means for connecting said levers whereby they may be moved conjunctively.

28. In an automatic computing machine having a travelling number table, and means tending to return said table, the combination of a toothed rack fixed relative to the number table, a slidable rack beside said fixed rack and having teeth adapted to register with the teeth of the latter, yieldable means in connection with said slidable rack tending to force the latter out of register with said fixed rack, a pawl on said table adapted to engage a tooth of said slidable rack whereby the latter is brought into register with said fixed rack, and means for releasing said pawl from said racks whereupon said slidable rack is again displaced whereby said pawl is prevented from engaging behind the same tooth thereof.

29. In an automatic computing machine having a travelling number table, and means tending to return said table, the combination of a toothed rack fixed relative to the number table, a slidable rack beside said fixed rack and having teeth adapted to register with the teeth of the latter, yieldable means in connection with said slidable rack tending to force the latter out of register with said fixed rack, a pawl on said table adapted to engage a tooth of said slidable rack whereby the latter is brought into register with said fixed rack, and means for releasing said pawl from said racks whereupon said slidable rack is again displaced whereby said pawl is prevented from engaging behind the same tooth thereof, a driving shaft, a driven shaft, a clutch element between said shafts, and means whereby said clutch element is alternately closed and released in dependence upon the movements of said slidable rack.

In testimony whereof the foregoing specification is signed.

CHRISTEL HAMANN.