Feb. 17, 1931. E. KUHRT 1,792,644

CALCULATING MACHINE

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FIG. 1.

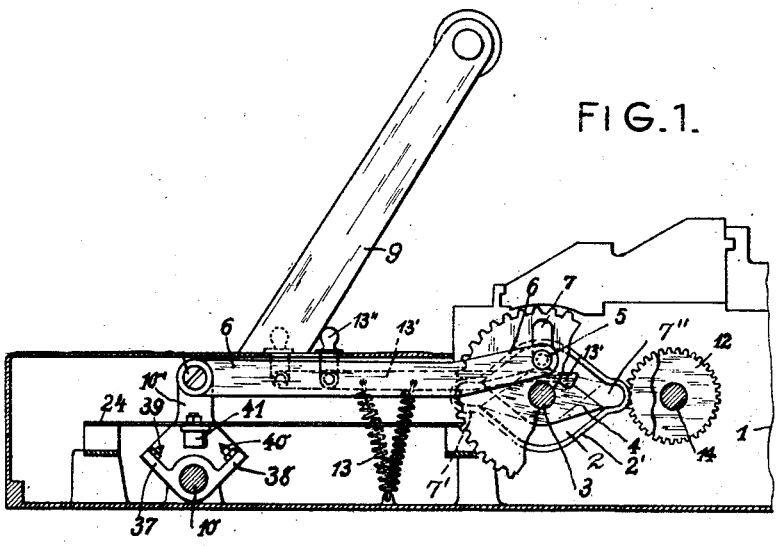


FIG. 4.

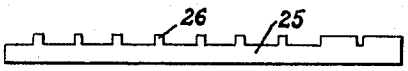


FIG. 5.

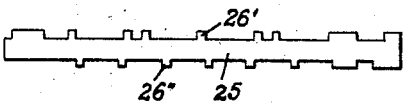


FIG. 6.

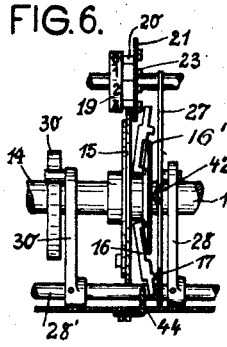


FIG. 7.

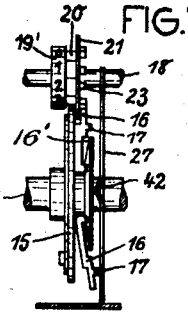
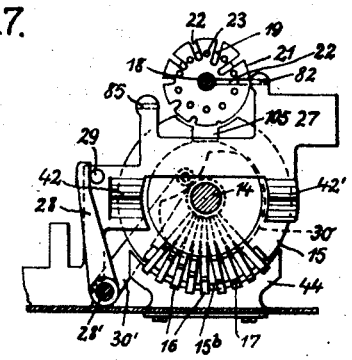


FIG. 8.



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CALCULATING MACHINE

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FIG. 2.

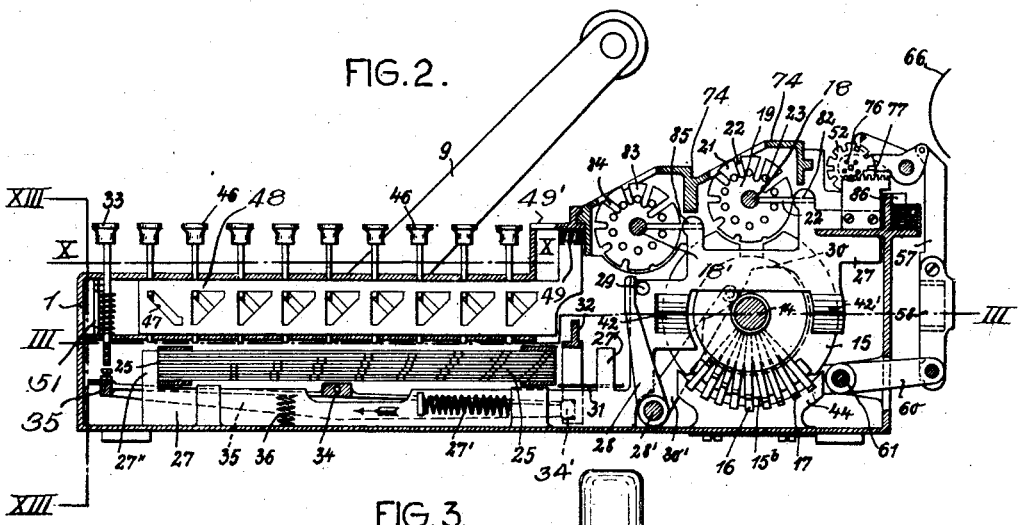
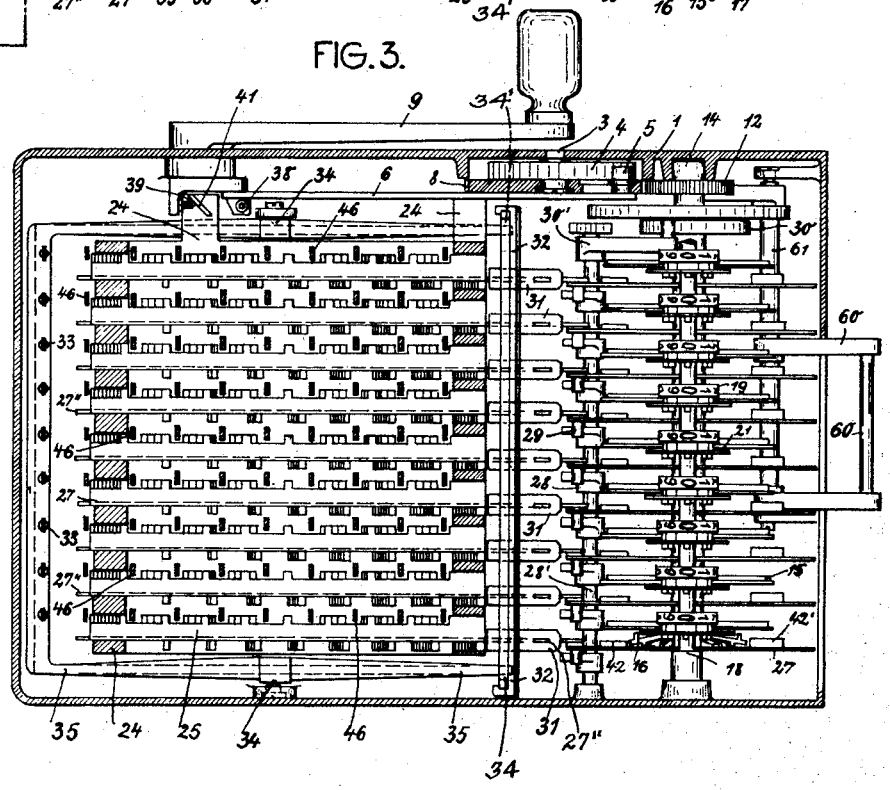


FIG. 3.



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CALCULATING MACHINE

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FIG.9.

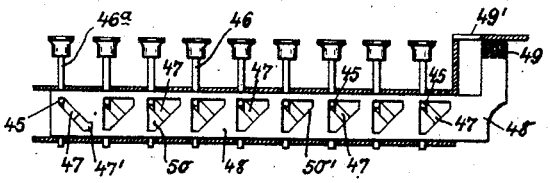
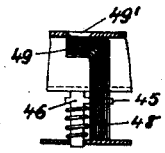


FIG.11.



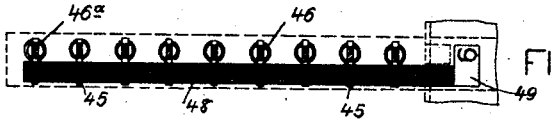


FIG.10.

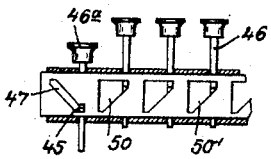
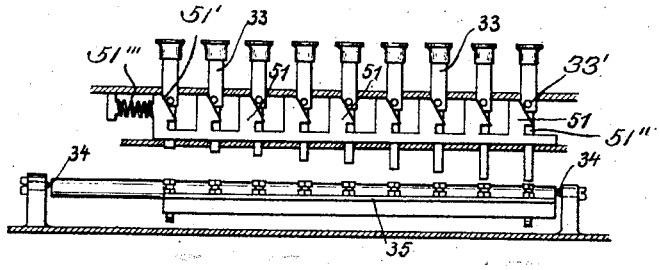


FIG.12.

FIG.13.



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Ernst Kuhrt

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Patented Feb. 17, 1931

1,792,644

UNITED STATES PATENT OFFICE

ERNST KUHRT, OF BERLIN-STEGLITZ, GERMANY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE FIRM BRUNSVIGA-MASCHINENWERKE GRIMME, NATALIS & CO., A.-G., OF BRUNSWICK, GERMANY

CALCULATING MACHINE

Application filed September 11, 1920, Serial No. 409,748, and in Germany September 13, 1919.

My invention relates to calculating machines and more particularly to machines of that type which is known as "universal," that is, in which not only the four species of calculation, to wit, addition, multiplication, division and subtraction, may be performed but to which also a printing mechanism may readily be adapted and it is an object of my invention to provide a machine of this type which, though it may thus be readily combined with a printing mechanism, is notwithstanding independent of such mechanism, that is, may be used as a calculating machine pure and simple, or as a combined calculating and printing or typewriting machine.

Combined calculating and typewriting machines have already been proposed but in such machines the paper carriage of the typewriting unit is operatively connected with the totalizers of the calculating unit so that the totalizers cannot be operated without the paper carriage. In my invention, no such relation exists so that the machine may be used for recording the results of its calculations, that is, as a calculating machine independently of the printing mechanism, or it may cooperate with the printing mechanism but the operation of the calculating machine is not in any way dependent on, or interfered with, by the operation of the printing or typewriting mechanism.

The printing mechanism forms the subject matter of my co-pending application No. 230,553, and will not be described in detail.

My machine is of that type in which the number of effective teeth in the setting wheels is variable and the teeth of the setting wheels are so influenced by means of partial products plates embodying products by projections corresponding to units and tens of units, that the units and the tens transfers to the setting wheels are effected in succession.

The novel feature of my machine is that for each digit of the machine there is provided below each row at nine multiplicand keys a group of nine partial products plates corresponding to the multipliers from 1 to 9. By displacing the partial products plates laterally, their units and tens projections are alternately brought under the control of a given multiplicand key and under the control of a multiplicand key in the next lower order during a portion of the cycle of operation. Each set of partial products plates is connected with a slide which is temporarily operatively connected with the partial products plates and which slide has a differential movement determined by said partial products plates for adjusting the setting wheels in accordance with such movement.

Each slide is provided with two cams the length of which is equal to the added lengths of projections on the teeth of the setting wheels. The cams of each pair are pitched apart so that all teeth of the setting wheels are in operative position when the slides are stationary and the setting wheels are rotated. The direction of rotation of the setting wheels is so selected for the species of calculation which it is desired to perform that for each calculating operation the cams of the slides will place the teeth of the setting wheel in operative position beginning at one end of the set of teeth. The dial wheels are locked immediately against overthrowing by star wheels of known type.

The temporary operative connection of the slides with the partial products plates is effected by vertically adjustable plates the position of which is determined by the multiplier keys in accordance with the multiplier involved in a calculation, and the plates will operatively connect the slides with those partial products plates which correspond to a depressed multiplier key.

In the drawings affixed to this specification and forming part thereof a calculating machine embodying my invention is illustrated diagrammatically by way of example.

In the drawings

Fig. 1 is a partly sectional elevation illustrating the actuating mechanism of the machine,

Fig. 2 is a sectional elevation, the section being taken between two groups of partial products plates,

Fig. 3 is a sectional plan view of the machine,

Figs. 4 and 5 are plan views of two partial products plates,

Figs. 6 to 8 are details illustrating one of the setting wheels,

Figs. 6 and 7 being end elevations showing the wheels with its teeth in two different positions and

Fig. 8 being an elevation of the setting wheel viewed in the direction of the main driving shaft on which the setting wheels are secured, as also shown in Fig. 2,

Fig. 9 is a section corresponding to Fig. 2 and showing separately a set of multiplicand keys with their locking plates,

Fig. 10 is a section on the line X—X in Fig. 2, with the top plate of the keyboard removed,

Fig. 11 is an end elevation of the set of locking plates, viewed from the left in Fig. 9,

Fig. 12 is a detail view showing one of the multiplicand keys depressed and locked by its plate, and

Fig. 13 is a section on the line XIII—XIII in Fig. 2.

Referring now to the drawings and first to Figs. 1, 2, and 3, 1 is the frame of the machine, 10′ is an arm secured on a shaft 10 within the frame 1, 6 is a connecting rod pivoted to the arm 10′ at 9′, and 5 is a pin at the free end of the connecting rod 6 which is free to reciprocate in a slot 7 of a spur gear 8. The gear is free to rotate on a stud 3 in the frame 1. 4 is a cam which is loosely seated on the stud 3 in front of the spur gear 8, 2 is a camway constituted by a rib 2′ projecting on the inside from that wall of the frame 1 which is adjacent the crank 9 as will appear from Fig. 3. This rib 2′ is shaped on the inside in conformity with the face of the cam 4, that is, the camway 2 made up by the rib 2′ and the cam 4 is substantially elliptical except at its largest horizontal diameter where extensions 7′ and 7″ are provided for the reception of the pin 5 when the slot 7 in the gear 8 is registering with one of the extensions 7′, 7″. The spur gear 8 is rotated by means which will be described so as to move its slot 7 into registering relation with the slots 7′ and 7″. 14 is the main driving shaft of the machine on which the setting wheels 15 are arranged as best seen in Fig. 3, and 12 is a pinion on the end of the shaft 14 which is meshing with the spur gear 8.

13′ is a pawl the rounded end of which engages the cam 4, 13 is a spring which tends to pull the pawl toward the stud 3, and 13″ is a handle to which the end of the pawl is pivoted and which is adapted to be displaced in a slot in the top plate of the frame 1. When the crank 9 is rocked the pin 5 causes the spur gear 8 to rotate. For each operation of the machine the crank 9 is rocked away from its initial position in Fig. 1 in the direction of the arrow into its final position and is then returned to its initial position.

The pawl 13′ in the position illustrated in full lines in Fig. 1 tends to hold the cam 4 in its full-lines position. The cam is reversed when the pin 5 moves into the extension 7′ at the left of the camway 2, allowing the pawl 13′ to return the cam 4 to its initial position and barring the upper-left-hand reach of the camway 2 against re-entrance of the pin 5 so that the pin, upon the return stroke of the crank 9 moves in the lower reach of the camway 2. At the end of the reach it will force the cam 4 out of its way again and enter the extension 7″ at the right of the camway 2. The spur gear 8 therefore moves in the same direction for a full cycle of two reciprocations of the crank 9. When the pawl 13′ is reversed, that is, when its handle 13″ is moved into the dotted-lines position to the left in Fig. 1, it will tend to turn the cam 4 in anti-clockwise direction and the spur gear 8 will be reversed.

24 is a frame in which partial products plates 25 are arranged and which is adapted to be reciprocated transversely to the machine, that is, in parallel to the shaft 10 of the crank 9. The frame is shown without the plates in Fig. 1. Its reciprocation is effected by arms 37, 38 which are integral with the arm 10′ and provided with adjustable pins 39 and 40. These pins act on an inclined cam 41, Fig. 3, on an extension of the frame 24. When the crank 9 is rotated so as to bring the pin 39 to bear on the cam 41, the frame 24 is displaced to the left as viewed from the operator in Fig. 3, and when the crank 9 is rotated so as to bring the other pin, 40, to bear on the cam 41, the frame 24 is moved to the right. The partial products plates in the frame 24 are metal strips and two of them are shown in Figs. 4 and 5. As mentioned, a set of nine partial products plates correspond to each of the nine digits of the machine and the sets are arranged below the rows at nine multiplicand keys 46. It will be understood that the machine has nine sets of partial products plates at nine strips 25 each. The strips 25 are provided with projections on one of their longitudinal edges or on both edges, which projections are adapted to be brought under the control of the lower ends of the multiplicand keys 46 when any one of such keys is depressed. As nine multiplicand keys 46 are arranged in a row to cooperate with each of the nine sets of plates 25 the machine has 81 multiplicand keys in all.

Fig. 4 illustrates a partial products plate for the multiplier "1" and Fig. 5 illustrates a plate for the multiplier "7". At the left hand edge as viewed from the front of the machine, each plate 25 is provided with projections 26′ and, in addition to these, the plate corresponding to the multiplier "7", Fig. 5, is provided with projections 26″ at its right-hand edge while that edge in the plate in Fig. 4 is blank. This is because the plate in Fig. 4 requires only the projections 26′ as the

highest number obtained by multiplying the digits 1 to 9 with the multiplier "1" is 9. On the other hand, the plate for the multiplier "7" as shown in Fig. 5 requires, besides the projections 26′ for the unit digits 1, 2, 3, . . . 9 of the products 7, 14, 21, 28 . . . 63 on its left-hand edge, projections 26″ on its right-hand edge representing the ten-folds of these products.

Each set of partial products plates 25 is combined with a slide 27, Fig. 2, which is adapted to be reciprocated longitudinally in the frame 1 of the machine against the action of a spring 27′ and may engage the front end of its set of plates 25 by a projection 27″. A shaft 28′ is secured on the base plate of the machine and provided with an arm 30′, Fig. 3, which is controlled by a cam 30 on the main driving shaft 14 near the pinion 12 and held engaged with the cam 30 by a spring, not shown. The diameter of the pinion 12 is one-half of that of the gear 8 so that the pinion performs two revolutions for each revolution of the gear 8. An arm 28 is secured on the shaft 28′ for each slide 27, each arm engaging a pin 29 on the slide 27 so that the slide is held in the position illustrated in Fig. 2, unless the cam 30 forces the arms 28 in forward direction and allows the springs 27′ to move the slides 27 in the same direction.

Nine multiplier keys 33 are provided in a transverse row at the front end of the machine, one multiplier key being at the end of each longitudinal row of multiplicand keys 46. 35 is a rectangular frame extending below the frame 24 and fulcrumed about pins 34 at its center, as will appear from Figs. 2 and 3. The front bar of the frame is adapted to be engaged by the multiplier keys as will appear from Fig. 13 and its rear end is provided with pins 34′ which engage suitable sockets in a transverse frame 32 which is substantially V-shaped. This frame supports a plate 31 for each set of partial products plates 25 which is mounted on the frame so as to partake in the vertical reciprocation imparted to it by the frame 35. Each plate 31 is slotted to engage the vertical projection 27″ on each of the slides 27. By depressing one of the multiplier keys 33, the plates 31 are all raised to a level which corresponds to the chararter of the multiplier key which has been depressed, and are placed opposite one of the partial products plates 25 in each set so that this plate will be operatively connected with the corresponding slide 27 through the medium of the plate 31 and the projection 27″. It will be understood that in this manner all the slides are connected with one of the partial products plates but only those slides will be prevented from returning to their initial position for which multiplicand keys have been depressed so that the partial products plates will be retained by these multiplicand keys and prevent the slides from returning to their initial position. Springs 36 are provided for returning the frame 35 to its initial position.

Nine setting wheels 15 are secured on the main driving shaft 14 and one of them is illustrated in Figs. 6, 7 and 8. Each wheel is provided with a set of nine radial teeth 16 which are arranged in radial slots in close vicinity at one side of the shaft 14. Their inner ends are hook-shaped and held in a plate 16′ on the shaft 14, their outer ends are provided with projection 17 at various radial distances from the shaft 14. The teeth are so held in their respective slots that they tend to remain in the position which has been imparted to them and, if desired, springs, not shown, may be provided for increasing the friction which holds the teeth in position. The projections 17 are adapted to be operated either by a cam 42 or by a cam 42′ on each slide 27 at opposite sides of the shaft 14. The width of either cam is equal to the added lengths of the projections 17. The cams 42 serve for a given species of operations, and the cams 42′ serve for the opposite species, for instance, the cams 42 become operative when the operations of multiplication and addition are performed and the cams 42′ become operative for the operations of division and subtraction, or vice versa. The position of the slides 27 with respect to the wheels 15 and to the projections 17 on the teeth 16 of such wheels which projections, as mentioned, are pitched at various radial distances from the axis of the shaft 14, determines the number of teeth that will be engaged by either the cams 42 or the cams 42′ upon rotation of the setting wheels in a given direction. In this manner, a given number of projections 17 will be engaged by the cams 42 when the setting wheels are rotated, for instance, in the direction corresponding to multiplication or addition, and a corresponding number of projections will be engaged by the cams 42′ when the setting wheels are rotated in the opposite direction for division or subtraction. Those teeth 16, the projections 17 of which have been engaged by either of the cams, will be forced against the body of their settting wheel 15, as shown in Fig. 7, above the shaft 14.

A frame 74 is slidably carried in the frame 1 of the machine as shown in Figs. 1 and 2, and supports shafts 18 and 18′ for a set of multiplication dial wheels 19 and a set of division dial wheels 83, respectively, either set being adapted to be operated by the teeth 16 of the setting wheels 15, in accordance with the calculation performed. The frame 74 is displaced by hand for setting the decades, and the dial wheels 19, 83 may also be displaced by hand through one decade by means, not shown, but which will be understood by those skilled in the art. The displacement of the dials is effected with the object of moving them into such positions that the move-

ment of the slides 27 which are coordinated to the several sets of partial products plates 25, is controlled by the dials, as will be described below.

The multiplication dials 19 are free to rotate on the shaft 18 in the frame 74. Each multiplication dial 19 is provided with a star wheel 20, Figs. 6, 7 and 8, and a disc 21 from which pins 23 project into the path of those teeth 16 which have been forced against the wheel 15 by the cams 42 or 42′, as described. Radial slots 22 of varying depth are formed in each pin disc 21 and adapted to be entered by a tongue 82 on the corresponding slide. A second tongue 85 is provided on each slide for cooperation with notches 84 in the pin discs of the division dial wheels 83. The teeth of each star wheel 20 are curved between the pins 23 on a radius equal to that of the corresponding wheel 15 so that they are held against rotation but do not interfere with the rotation of the wheel 15. Each wheel 15 is recessed at its perimeter at 15*b* where the teeth 16 are arranged so that each star wheel, its dial wheel and its pin disc are free to rotate when the star wheel registers with this recessed portion of the setting wheel. A plate 44 is arranged on the base of the machine frame for returning the teeth 16 to their initial position when they are moving past the plate as indicated in Fig. 6.

Each setting wheel is provided with an annular projection 104 on the face opposite to that on which the teeth 16 are carried. The annular projection extends as far as a notch 105 in each wheel where it is interrupted and is provided for operating the tens transfer which forms no part of the present invention and therefore has not been illustrated but will readily be understood from the following general description: L-shaped levers are pivoted on a pin extending in front of the shaft 18, one lever being provided for each dial. Springs tend to move the levers in upward direction. Each lever is provided with a check on its upper arm which is adapted to be engaged by a corresponding projection on the adjacent dial wheel 19 which is arranged between the digit "9" and "0". When the dial wheel is rotated past the digit "9" the corresponding L-shaped lever will be rocked on its pin. The lower end of each lever is provided with a spring catch which normally abuts on the face of the corresponding annular projection 104. However, when the lever has been swung downwardly by the check on the corresponding dial wheel 19, it is engaged by the inner face of the annular projection 104, and retained. In this position of the lever it causes the next dial wheel at the left on the dial wheel considered to be rotated and in this manner the tens transfer is effected.

The dial wheels 83 of the division set are operated by means, not shown, which are similar to those operating the multiplication dial wheels 19 and their pin discs, as mentioned, are provided with slots adapted to be entered by the tongue 85 on each corresponding slide 27. A multiplier which has been set by means of the keys 33 is transferred to the set of division dial wheels 83 by a very simple device which is not shown as it does not constitute a part of the present invention, and comprises a rack and a stepped pinion in the connection with the set of division dial wheels 83. The rack is reciprocated for each reciprocation of the crank 9 and meshes with a vertical pinion which is adapted to cooperate with a bevel gear on the shaft of the set of division dial wheels 83. Means are provided for operating this mechanism in conformity with the reciprocation of the frame 35.

The displacement of the dial wheels 19 and 83 is effected with the object of releasing certain slides 27 for displacement by their tongues 82 and 85 being able to enter the radial slots of the pin discs of the multiplication and division dial wheels 19 and 83, respectively. Those slides the tongues 82 of which are free to enter a slot in a pin disc, will be free to move to the extent permitted by the length of the slot under the action of their springs 27′.

Each slide 27 at its upper rear end is provided with a rack 77, Fig. 2, for operating a printing mechanism having type wheels 52 with pins 76 adapted to be engaged by the corresponding rack 77, a printing roller 66, and operating mechanism comprising a cam plate, not shown, a lever 62, Fig. 3, on a shaft 61, a frame-shaped lever 60 and connecting rods 57, 58 as described in my copending patent application No. 230,553.

The key board, as mentioned, comprises eighty-one multiplicand keys 46 which cooperate with the partial products plates 25 in the frame 24 and nine multiplier keys 33 which cooperate with the front bar of the rocking frame 35. The multiplicand keys 46 are operated against the action of springs as shown in Fig. 11 which tend to return them to their initial position, and are provided with lateral members 45 which cooperate with a set of nine locking plates 48 for each row at nine keys. An inclined camway 47 with a short parallel extension 47′ at its lower end is provided in each locking plate for the corresponding multiplicand key as shown in Fig. 9 for the key 46*a*, and the plates are cut out at 50, 50 so as not to interfere with the members 45 of the other locking plates, the cut-out portions having edges 50′ inclined oppositely to the camways 47. Each plate is provided with a tongue 49 bearing a number, and this will appear below a hole 49′ in the top plate of the machine when a key is depressed, as shown for the multiplicand "9" in Fig. 10.

Similar locking means are provided for the nine multiplier keys 33 as will appear from Fig. 13, 51 is a locking plate which for each multiplier key has a cam 51′ adapted to be engaged by a member 33′ on the corresponding key 33, 51″ is a recess below each cam 51′ and 51‴ is a compression spring which tends to move the locking plate 51 to the right. When any one of the keys 33 is depressed, its member 33′ pushes back the locking plate 51 by the cam 51′ until the member 33′ has entered the recess 51″ when the key is retained by the spring 51‴ moving the locking plate 51 into its initial position. The keys 33 are of various lengths, the key at the left being the shortest.

Assume that one of the multiplier keys 33 has been depressed and retained by the plate 51, and that one of the multiplicand keys 46 is thereupon also depressed. The operation of the key 33 causes all the plates 31 to be raised to a given position in accordance with the character of the key 33 which has been depressed. This effects operative connection of all the slides 27 with one of the partial products plates 25 as described. Notwithstanding this slides 27 are free to return to their initial position except that slide which corresponds to the depressed multiplicand key 46. This slide will be arrested on its return movement, and so will any other slides be for which other multiplicand keys 46 may have been depressed, these slides being permitted to perform only a portion of their return movement. Those slides for which multiplicand keys have not been depressed, are free to return to their initial position.

The operation of my machine will best be understood from an example, as follows:

Assume that it is desired to multiply the figure "764" by "7". The multiplicand "764" is set by depressing the corresponding keys 46 and the multiplier 7 is set by depressing the multiplier key 33 which is marked "7". The operation of the multiplier key 33 causes the frame 35 to rock against the action of its springs 36 and to raise the plates 31 into a position in which they are facing those partial products plates 25 in the frame 24 which correspond to the multiplier 7. The projections 26′ on the plates are within reach of those multiplicand keys 46 which have been depressed. The crank 9 is now rotated, imparting rotation to the shaft 14, to the setting wheels 15 and to the cam 30 by the means described. The cam 30 through the medium of the arms 28 releases the slides 27 and the slides now return toward their initial position, but those slides for which any multiplicand keys 46 have been depressed are retained by engagement of the projections 26′ on those partial products plates 25 which have been engaged by the plates 31 of the corresponding slides 27. These slides are now arrested by the partial products plates abutting against the ends of the keys 46 while the other slides are free to return. The consequence is that for the first digit of the multiplicand, counting from the right, that is "4", the cam 42 of the slide which has been arrested by the cooperation of the multiplicand key "4" with the partial products plate 25 corresponding to the multiplier 7 in that slide causes eight teeth 16 of the corresponding setting wheel 15 to be placed in operative position, since 7 times 4 is 28, and consequently 8 units must be transferred to the corresponding dial wheel 19, which will then indicate "8" as the first digit, counting from the right. For the second digit, "6", the slide 27 is arrested by the multiplicand key "6" in such a position that two teeth 16 in the corresponding setting wheel are placed in operative position by the cam 42 of the corresponding slide 27, since 7 times 6 is 42, causing the second dial to be rotated to the number "2". For the third digit, "7", nine teeth are placed in operative position in the corresponding setting wheel as described, since 7 times 7 is 49 and therefore the third dial is rotated to the number "9". The result appearing in the sight openings of the dials will be "928". The crank has by this time completed its first stroke and has arrived in its final position at the left, Fig. 1, while the setting wheels 15 have completed their first revolution. Shortly before the crank reaches the final position at the left, the frame 24 is displaced to the right by the cam 41, causing the projections 26″ of the partial products plates 25 to come within the reach of the depressed multiplicand keys. When the crank 9 is now returned toward its initial position at the right as illustrated in Fig. 2, while the setting wheels 15 start for their second rotation, the slides 27 will again be displaced but will be arrested on their return movement by the projections 26″, and not by the projections 26′ of the partial products plates. Now the tens of the partial products of "764 times 7" are transferred. No transfer is made for the first digit counting from the right, as there are no more keys at the right of the first set of multiplicand keys so that the cam 42 of the first slide 27 is moved altogether out of the reach of the projections 17 on teeth 16 of the setting wheels 15 and consequently the first dial will remain at "8". For the second digit the "2" from the partial product "28" is transferred to the second dial so that it will indicate "4". For the third digit the "4" from the partial product "42" is transferred to the dial and, as 4+9=13, the digit "3" will appear on the third dial. By means of a tens transfer of known type in the counter the "1" from "3" is transferred to the fourth dial so that on the fourth dial there appears the digit "1". To this digit "1" the "4" from the partial product "49" is added and the fourth dial shows the digit "5", the result being "53—28"

This result can be printed as described in my said co-pending application.

For addition, the setting wheels rotate in the same direction as for multiplication. The amount to be added is set on the multiplicand keys 46 and thereupon the multiplier key 33 marked "1" is depressed so that only the single amount of the number to be added, and not a multiple thereof, is transferred at the setting wheels.

The operations of division and subtraction are performed similarly as multiplication and addition but in this case the pawl 13′ is moved to cause the gear wheels 8 and 12 to rotate in opposite direction as compared with multiplication and addition by throwing over the cam 4. For division and subtraction the cams 42′ of the slides 27 cooperate with the teeth 16 of the setting wheels 15 instead of the cams 42.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

I claim:

1. A calculating machine having rows of multiplicand keys, setting wheels, dial wheels operatively connected with said setting wheels, movable teeth in said setting wheels adapted to cooperate with said multiplicand keys, and partial products plates with units- and tens-projections for the product of the units, and comprising arranging said partial products plates in groups of nine each, corresponding to the multipliers 1–9, below each row of multiplicand keys, means for displacing transversely said groups of partial products plates so as to alternately move their units and tens-projections within reach of the row of multiplicand keys to which each group of partial products plates is allotted, and within reach of the preceding row of lower order, a slide surrounding each group of partial products plates, means for temporarily connecting each slide with one of the partial products plates of its group, and means on said slides for cooperating with the teeth of said setting wheels.

2. A calculating machine having rows of multiplicand keys, setting wheels, dial wheels operatively connected with said setting wheels, movable teeth in said setting wheels adapted to cooperate with said multiplicand keys, projections on said teeth, and partial products plates with units- and tens-projections for the product of the units, and comprising arranging said partial products plates in groups of nine each, corresponding to the multipliers 1–9, below each row of multiplicand keys, means for displacing transversely said groups of partial products plates so as to alternately move their units- and tens-projections within reach of the row of multiplicand keys to which each group of partial products plates is allotted, and within reach of the preceding row of lower order, a slide surrounding each group of partial products plates, means for temporarily connecting each slide with one of the partial products plates of its group, and two cams on each slide the length of each cam being equal to the total width of said projections on the teeth of said setting wheels, and said cams being pitched so that when said slides are stationary and said setting wheels rotate, all teeth of said setting wheels are moved into active position.

3. A calculating machine having rows of multiplicand keys, setting wheels, dial wheels operatively connected with said setting wheels, movable teeth in said setting wheels adapted to cooperate with said multiplicand keys, and partial products plates with units- and tens-projections for the product of the units, and comprising arranging said partial products plates in groups of nine each, corresponding to the multipliers 1–9, below each row of multiplicand keys, means for displacing transversely said groups of partial products plates so as to alternately move their units- and tens-projections within reach of the row of multiplicand keys to which each group of partial products plates is allotted, and within reach of the preceding row of lower order, a slide surrounding each group of partial products plates, a multiplier key for each decimal order, a movable plate on each side which is operatively connected with the corresponding multiplier key so as to be moved into registering relation with the partial products plate which corresponds to the multiplier key which has been operated, and means on said slides for cooperating with the teeth of said setting wheels.

4. A calculating machine having rows of multiplicand keys, setting wheels, dial wheels operatively connected with said setting wheels, movable teeth in said setting wheels adapted to cooperate with said multiplicand keys, projections on said teeth, and partial products plates with units- and tens-projections for the product of the units, and comprising arranging said projections on said setting-wheel teeth in such manner on the teeth that, starting from the perimeter of said wheel, they are pitched nearer the axis of said wheel for equal distances from tooth to tooth, and arranging said partial products plates in groups of nine each, corresponding to the multipliers 1–9, below each row of multiplicand keys, means for displacing transversely said groups of partial products plates so as to alternately move their units- and tens-projections within reach of the row of multiplicand keys to which each group of partial products plates is allotted, and within reach of the preceding row of lower order, a slide surrounding each group of partial products plates, means for temporarily connecting

each slide with one of the partial products plates of its group, and means on said slides for cooperating with the teeth of said setting wheels.

5. A calculating machine having an operating handle, rows of multiplicand keys, setting wheels, dial wheels operatively connected with said setting wheels, movable teeth in said setting wheels adapted to cooperate with said multiplicand keys, and partial products plates with units- and tens-projections for the product of the units, and comprising arranging said partial products plates in groups of nine each, corresponding to the multipliers 1–9, below each row of multiplicand keys, a frame on which all said groups of partial products plates are carried, a cam on said frame, two pins on said crank adapted to cooperate with said cam so as to alternately displace said frame in opposite directions, and to alternately move the units- and tens-projections of said partial products plates within reach of the row of multiplicand keys to which each group of partial products plates is allotted, and within reach of the preceding row of lower order, a slide surrounding each group of partial products plates, means for temporarily connecting each slide with one of the partial products plates of its group, and means on said slides for cooperating with the teeth of said setting wheels.

6. A calculating machine having rows of multiplicand keys, setting wheels, dial wheels operatively connected with said setting wheels, movable teeth in said setting wheels adapted to cooperate with said multiplicand keys, and partial products plates with units- and tens-projections for the product of the units, and comprising arranging said partial products plates in groups of nine each, corresponding to the multipliers 1–9, below each row of multiplicand keys, means for displacing transversely said groups of partial products plates so as to alternately move their units- and tens-projections within reach of the row of multiplicand keys to which each group of partial products plates is allotted, and within reach of the preceding row of lower order, a slide surrounding each group of partial products plates, means for temporarily connecting each slide with one of the partial products plates of its group, means on said slides for cooperating with the teeth of said setting wheels, a frame, a rocking crank shaft in said frame, a connecting rod pivotally connected with said crank shaft at one end, a pin at the other end of said rod, a cam way on said machine frame having parallel extensions at diametrically opposite ends thereof, a movable cam forming part of said cam way, means for displacing said movable cam so as to alternately connect one and the other of said extensions with said cam way, a stud in said machine frame, a gear wheel on said stud having a slot for the reception of said pin at the end of said connecting rod, said slot being adapted to register with either of the extensions of said cam way, a shaft in said machine frame on which said setting wheels are secured, and a pinion on said shaft meshing with said gear wheel on said stud.

7. A calcuating machine having rows of multiplicand keys, setting wheels, dial wheels operatively connected with said setting wheels, and movable teeth in said setting wheels adapted to cooperate with said multiplicand keys, and comprising a slide for each setting wheel, and two cams on each slide the length of each cam being equal to the total width of said projections on the teeth of said setting wheels, and said cams being pitched so that when said slides are stationary and said setting wheels rotate, those teeth of said setting wheels with which the multiplicand keys have cooperated, are moved into active position.

In testimony whereof I affix my signature.

ERNST KUHRT.