March 24, 1931. L. M. NIELSEN 1,797,995

CALCULATING MACHINE

Original Filed Aug. 14, 1924 3 Sheets-Sheet 1

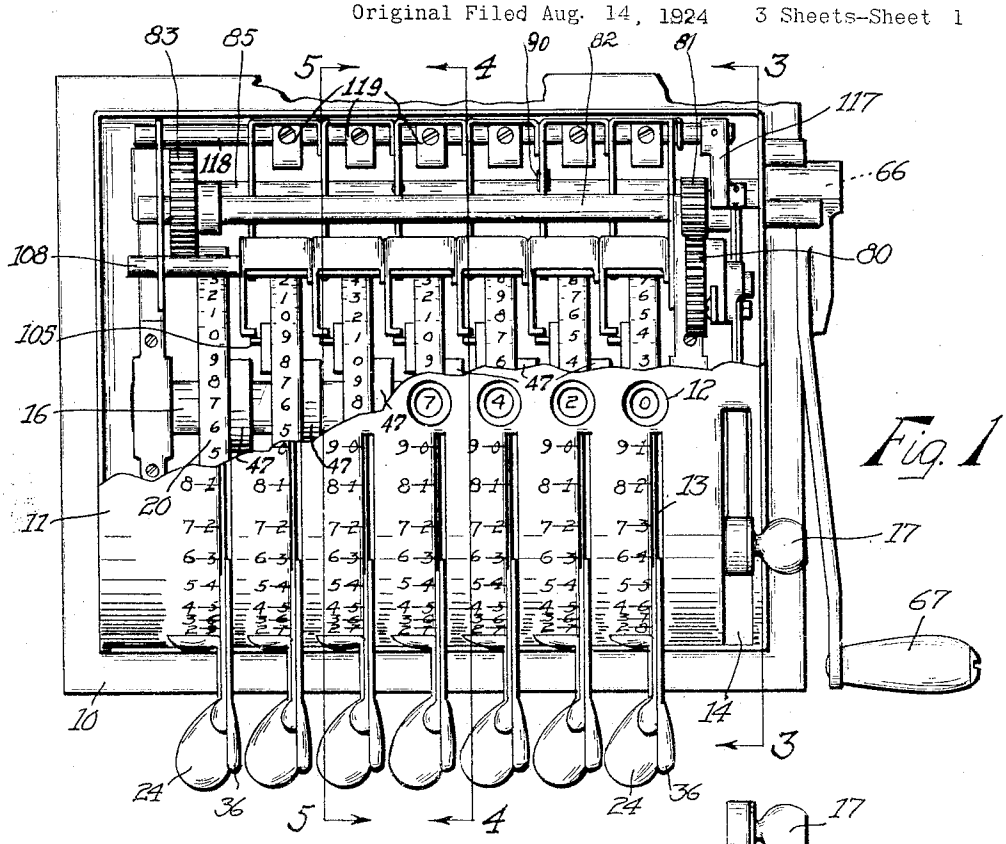


Fig. 1

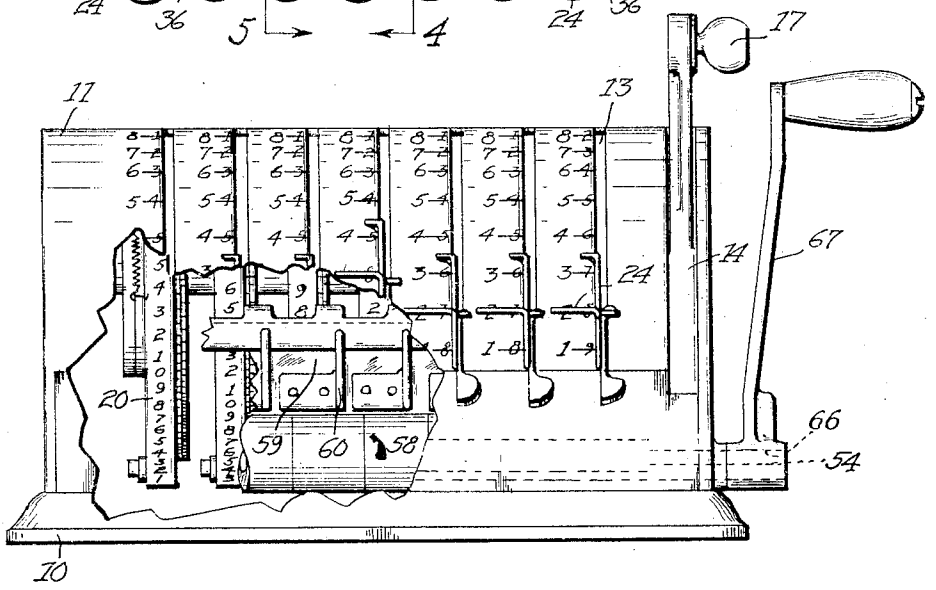


Fig. 2

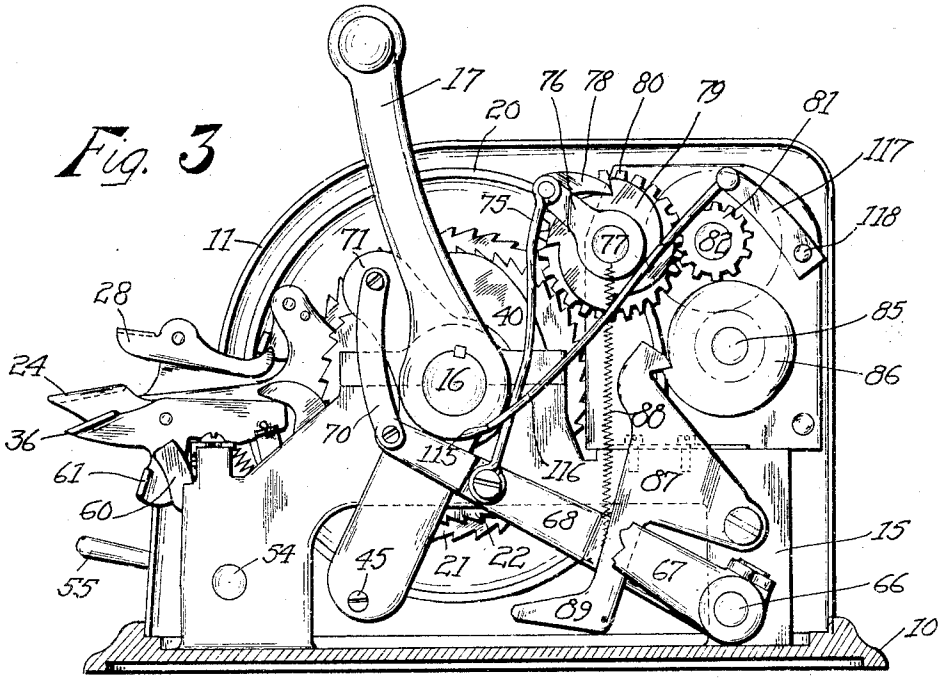
Inventor
L. M. Nielsen
By Attorneys
Southgate & Southgate.

March 24, 1931. L. M. NIELSEN 1,797,995

CALCULATING MACHINE

Original Filed Aug. 14, 1924 3 Sheets-Sheet 2

Fig. 3



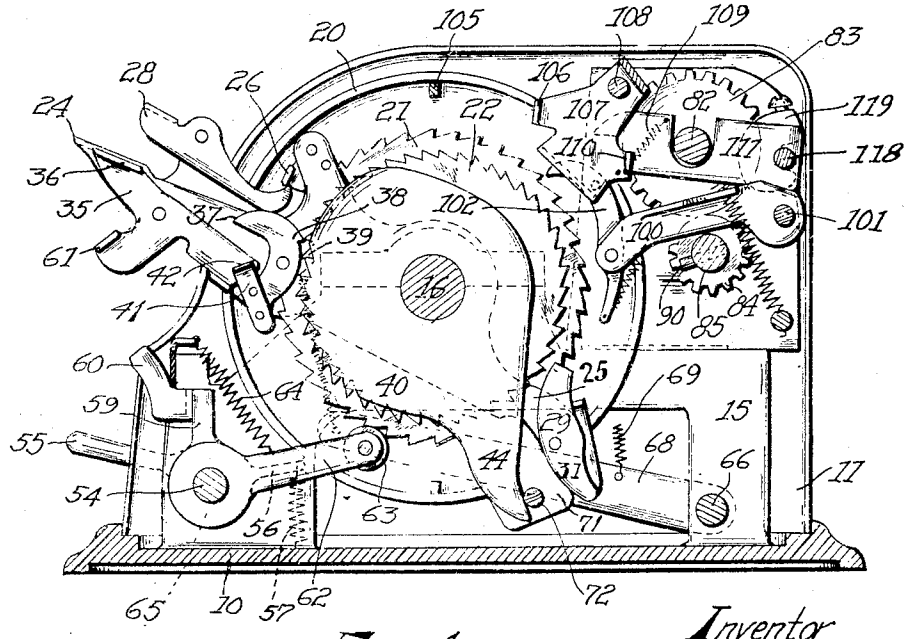


Fig. 4

Inventor
L. M. Nielsen
By Attorneys
Sandlyste & Sandlyste.

March 24, 1931. L. M. NIELSEN 1,797,995

CALCULATING MACHINE

Original Filed Aug. 14, 1924 3 Sheets-Sheet 3

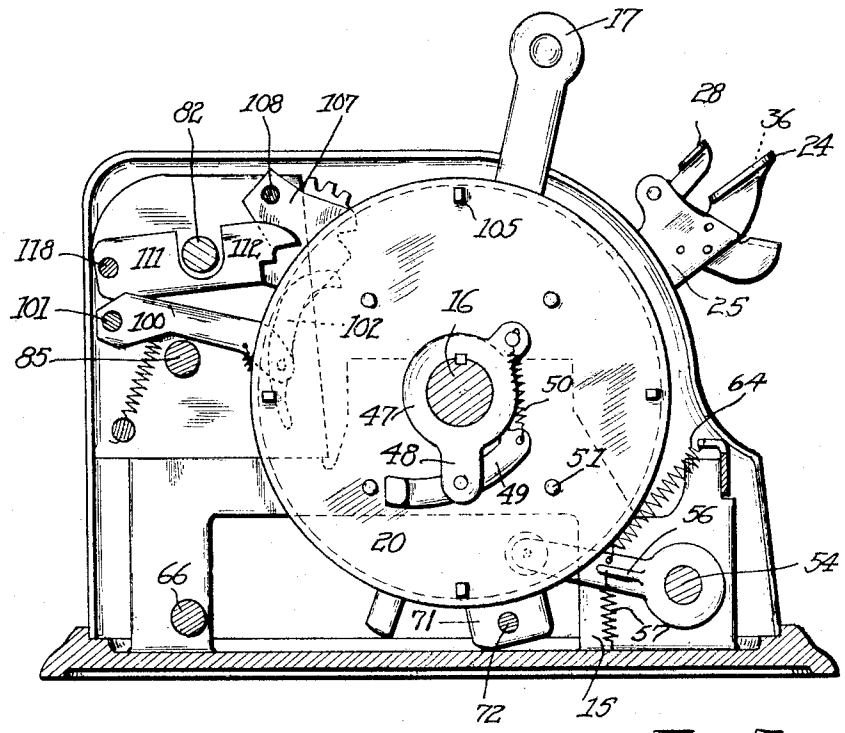


Fig. 5

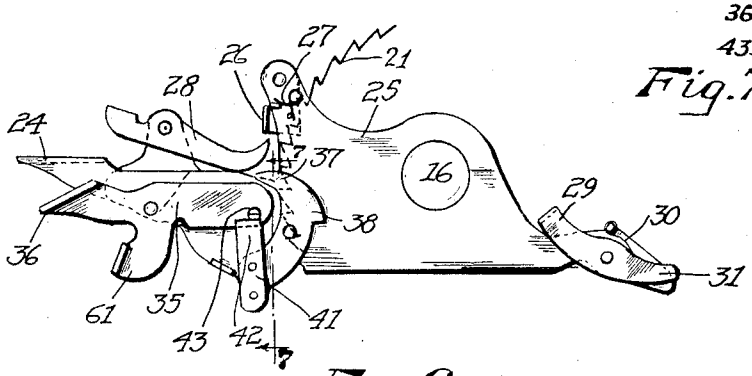


Fig. 6

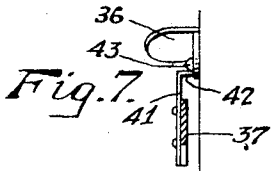


Fig. 7.

Inventor
L. M. Nielsen
By Attorneys
Southgate & Southgate

Patented Mar. 24, 1931 1,797,995

UNITED STATES PATENT OFFICE

LAURITS M. NIELSEN, OF FITCHBURG, MASSACHUSETTS, ASSIGNOR TO WIZARD ADDING MACHINE COMPANY, OF FITCHBURG, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS

CALCULATING MACHINE

Application filed August 14, 1924, Serial No. 732,036. Renewed November 22, 1928.

This invention relates to an adding or calculating machine. The principal object of the invention is to provide a simple and inexpensive machine which can be put on the market at a very small figure so as to permit of its use in small stores and plants, and yet be capable of accurately performing all additions, subtractions, multiplications and divisions.

The invention involves the provision of simple and accurate means for connecting up any of the computing wheels to provide for multiplication, for disconnecting the latter mechanism on the turning down of the handle to register the mathematical compilation, and for restoring all of the wheels to the zero point whenever desired. Other objects and advantages of the invention will appear hereinafter.

Reference is to be had to the accompanying drawings in which

Fig. 1 is a plan of a machine constructed in accordance with this invention, partly broken away, to show interior construction;

Fig. 2 is a similar front view of the same;

Fig. 3 is an end view of the parts within the casing;

Fig. 4 is a sectional view through the shaft between any two of the discs, as for example, on the line 4—4 of Fig. 1;

Fig. 5 is a sectional view on the line 5—5 of Fig. 1 looking in the other direction;

Fig. 6 is a view of details of the invention shown in the same position as in Fig. 3; and

Fig. 7 is a sectional view on the line 7—7 of Fig. 6.

I have shown the machine as mounted on a solid base 10 and having a cover 11 of a lighter character, preferably, sheet metal. This cover is provided with a row of preferably circular openings 12 and with a series of parallel slots 13 and an end slot 14. These slots 13 and 14 extend all the way from a position adjacent to the openings 12 to near the lower edge of the front of the casing. At one side of each slot 13 are two series of digits, one running from 1 to 9. The digits in the other series are arranged in reverse order and all the columns except the units are arranged so that the sum of the adjacent numerals of the two series is 9, but in the units column it is 10 because the units column commences with 1 instead of zero as the other columns of the second series do.

The base 10 is provided with a pair of end frames 15 which preferably are cast integral with the base and which directly support all the parts of the machine except the casing. These end frames are provided with bearings for the main longitudinal shaft 16. On this shaft is keyed a zero setting handle 17 which passes through the slot 14 and is for the purpose of turning this shaft. On the shaft 16 are loosely mounted a series of computing wheels 20, each one of which is provided with numerals.

These wheels 20 are provided with cylindrical flanges giving them the form of cylinders on the exterior of which four series of digits from 0 to 9 are located. Each one of them also is provided with two ratchet wheels 21 and 22 both fixedly connected with the computing wheel and located radially inside the flange thereon. The teeth of one extend in one direction and the teeth of the other in the other direction. They are arranged so that they have the same number of teeth and they register with each other, also the number of teeth is equal to the total number of digits around the outside of the wheel.

Mounted at one side of each wheel is an adding lever 25 (Fig. 6) free to swing on the shaft 16. On the lever 25 a finger rest 24 for operating the whole lever is arranged rigidly. This lever is provided with a pivoted pawl 26 adapted to engage the teeth on the ratchet 21. A spring 27 holds this pawl yieldingly in contact with this ratchet wheel. On the lever 25 is pivoted a throw-out finger lever 28 which can be pressed down conveniently at the front. This presses up the rear end of this lever which is shaped to engage under the pawl 26 and draw it out from contact with the ratchet wheel 21 so that the lever 25 can be swung up or down without performing any operation. It will remain out of contact with the teeth as long as the front end of the lever 28 is kept depressed at the front, but as soon as it is released the lever will drop at the rear by gravity and the spring 27 will force

the pawl 26 back into position for engaging these teeth.

On the lever 25 and directly opposite the pawl 26 is a pawl 29 for engaging a tooth of the ratchet 22 in a position opposite the point of engagement of the pawl 26. This pawl has a spring 30 for normally holding it back out of position for engaging the teeth and its lower end 31 projects outwardly into a position in which it can be operated as will appear later for returning the levers 25 to normal position which simply prevents the ratchet 21 from spinning.

On the lever 25 near the finger rest 24 is a multiplying lever 35. This has a finger rest 36 normally arranged at the same level as the finger rest 24, as shown in Fig. 4, when the machine is not being used for multiplying. When it is to be used for multiplying this finger rest 36 is pushed down to the position shown in Fig. 6, turning the whole lever 35 with it of course. This results in moving the opposite end of the lever upwardly to swing a pawl 37 and hold it locked in the position to which it is moved. This pawl is provided with a tooth 38 adapted, when in the position shown in Fig. 6, to engage in one of a series of nine notches 39 on a lever or multiplying member 40 freely pivoted on the shaft 16.

The pawl 37 is provided with a flat spring 41 yielding sideways and having an offset end 42 pressing against the lever 35 and that lever is provided with a pointed projection 43 beveled at its end in a direction to permit it to slip behind said projection 42 and therefore the pawl 37 is held in either of its extreme positions thereby. These two positions are shown in Figs. 4 and 6. In the former the pawl 38 is held out of contact with the teeth 39 and in Fig. 6 it is held in contact with them. This multiplying member 40 is provided with a tail 44 which projects down to be operated as will appear.

On the shaft 16 there are keyed a series of collars 47 (Fig. 5) each having a radial projection 48 for supporting a lever 49 which is held normally with its outer end as far from the center as possible by a spring 50. The outer end of this lever 49, when held in that position as shown in Fig. 5, is adapted to engage any one of four pins 51 on the side of the computing wheel opposite the ratchet wheels. If there are four series of numerals or digits around the circumference of the disc, there are four pins. The number of pins equals the number of series of digits.

As the collars 47 are positively keyed to the shaft it will be obvious that when the handle 17 is swung through a complete arc, that is a quarter circle, which is as far as it can go, any of the wheels which have been rotated out of normal position in the operation of the machine will be restored to normal or zero position by the operation of the corresponding lever 49 picking up one of the pins 51 and carrying it around to a certain point. Of course when they go in the opposite direction they pass over the pins without having any action on them.

Along the front of the machine is a shaft 54 parallel with the shaft 16 and having a finger piece 55 for operating it, and an arm 56 and spring 57 for holding it back in normal position. On this shaft are fixed two collars 58 with loose collars 65 between them. On these collars 58 is a longitudinal bar 59 having arms 60 projecting therefrom in position to engage plates 61 on the levers 35 and restore said levers to the normal position shown in Fig. 4. This is done when the arms 25 swing around until the plates 61 engage the projections 60 and turn the levers 35 from the position shown in Fig. 6 to that shown in Fig. 4. This is done to complete the action of the multiplication as will appear.

On each loose collar 65 is an arm 62 having a roller 63 engaging the ratchet wheel 21 for yieldingly holding the computing wheels 20 against accidental rotation. Springs 64 hold these rolls up in contact with the ratchet wheels. These rolls being engaged by the ratchet wheels will move out and in as the computing wheels are rotated.

At the back of the machine there is a third parallel shaft 66 provided with an operating handle 67 extending outside the casing. On this shaft at its ends just inside the casing there are two arms 68 held up by springs 69, and connected at their ends by links 70 with a pair of levers 71 freely pivoted on the shaft 16. These levers extend down toward the bottom of the machine and they are connected by rod 72 across the bottom. This rod is adapted to engage the projecting ends 31 of the pawls 29 and force these pawls positively against the teeth of the wheels 22. As the rod 72 is swung through a quarter circle at each depression of the handle 67 it will turn all the levers 25 that have been turned out of normal position clear around to their normal position in which the finger rests are located in horizontal alignment at the front of the machine. On its return stroke the rod 72 engages all the tails 44 that have been displaced and restores them to the zero position. This is used in multiplication.

Transfer mechanism

Pivotally connected with one of the arms 68 is a link 75 (Fig. 3) which is connected with an arm 76 loose on a stud 77 near the top of the machine at the right hand end. At the same point the arm 76 is provided with a spring latch 78 adapted to engage a ratchet wheel 79 having the same number of teeth as the number of series of numerals on the computing wheels, that is four, in the form shown above.

The operation of the handle 67 down and

back will on its backward motion turn the wheel 79 a quarter of a revolution. On this wheel is fixed a gear 80 meshing with a gear 81 on a longitudinal shaft 82. Therefore this shaft also is rotated. The gear 80 is twice the size of the gear 81 so that the shaft 82 will rotate a half revolution.

On this shaft 82 at the other end is a gear 83 (Figs. 1 and 4) meshing with and operating a gear 84 on a shaft 85. As the ratio between the last two gears is the same as that between the gears 80 and 81 the motion is multiplied again and the shaft 85 will rotate through a complete revolution. On its end near the operating handle the shaft 85 is provided with a stop wheel 86 (Fig. 3) having a single tooth thereon. A pawl 87 is pivoted at a convenient point and pressed by a spring 88 into contact with the surface of the wheel 86. On the pawl is a projection 89 which is engaged by the arm 68 at that end when it is pushed down to its lowest limit so as to pull the pawl out of contact with the wheel 86 and release the same so that it can be rotated through a complete revolution as stated. Before it finishes a revolution by the lifting of the lever 67 the pawl comes back to stop it exactly in the desired position.

This shaft 85 is provided with a series of radial pins 90, one for each of the computing wheels except the units one. As this shaft rotates a complete revolution for each operation of the handle 67, each of these pins will go around a whole revolution at each operation. They are arranged at different angles so as to be staggered and not operate all at the same time, but each one of them, when it comes around to the top, engages an arm 100, which is pivoted on a longitudinal rod or shaft 101, and lifts it. To this arm 100 is pivoted a spring-pressed pawl 102 adapted to engage one of the teeth of the ratchet 21. Therefore if it is in engagement with the ratchet that wheel 20 will be rotated one space when the handle 67 is depressed and restored. This carries one.

On each of the wheels 20 at the side opposite the ratchet wheels, there are four pins 105 (Figs. 1, 4 and 5) near the circumference. The number four is chosen because there are four sets of numerals around the disc. As any one of these pins comes around it will engage the rear side of a projection 106 on a trip pawl 107. These pawls are freely and individually pivoted on a fixed longitudinal rod 108 and each is pulled back by a spring 109. Pawls 107 have bent-over edges engaging a pin on the levers 102 to lift them. When these pawls 107 are swung up the ends of the corresponding pawls 102 will engage in the ratchet wheels 21 the particular ratchet 21, being on the wheel 20 which is to the left of the one whose pin 105 has just actuated 107. Now the next complete rotation of the shaft 85 will lift each arm 100 and certain of the ratchet wheels will be advanced one step. This is for the purpose of carrying one into the next column.

Each of the pawls 107 is provided with a projection 110 normally holding up a pivoted latch arm 111 which is held down by a spring (not shown) and has two teeth 112 (Fig. 5) at its outer end, either one of which is adapted to rest on the projection 110. When a pin 105 engages the projection 106 and moves the pawl 102 into operative position, the projection 110 is swung out of the first tooth 112 into the second one, thus lowering the arm 111 and locking the pawl 107 up out of reach of the pins 105. These arms 111 are located directly over the arms 100 and adapted to be raised by them when the pins actuate the latter. This restores the arms 111 individually to operative position in the first tooth 112—after they have operated to carry one. It is to be noted also that when the handle 17 is operated, a projection 115 on its hub pushes a rod 116 connected with an arm 117 on a longitudinal shaft 118. On this shaft are fixed a series of blocks 119 so that they swing with it and raise the arms 111 and allow the springs 109 to pull the pawls 107 back down into normal position. This is an additional positive safety device for ensuring the restoring of the carrying mechanism to normal position.

Operation

In order to add, the numbers to be added are set up on the machine by moving up the several finger rests 24 to the necessary points. If, for example, the number indicated in Fig. 1 is the first one to be added, the fourth finger is set up to 7, the fifth one to 4 and the sixth one to 2. In setting them up it is not necessary to do anything except to move them up to the desired point and let go of them. If it so happens that one of them is accidentally set too high the lever 28 can be depressed and the whole lever 25 can then be moved back. It cannot be moved back at any other time without interfering with the setting of the device.

Now with the parts in this position the operating handle 67 is turned down. As it starts down it operates the rod 72 to engage the pawls 29 and brings the lever set at the highest number down enough spaces to bring it even with the next one and then carries those two along and finally all of them down to horizontal position. This turns the computing wheels that have been actuated around the proper number of spaces to register the number 7420 in the openings 12. They will necessarily turn just the right spaces to register the desired numbers. Ignoring the first three wheels the parts are now in the position shown in Fig. 1. Now the next number in the column of figures is

set up in the same way and the machine operated as stated. The sum of the several numbers will always appear in the openings 12.

When it is necessary to carry one this is done automatically by the action of the pins 105, one of which is placed in proper relation to the computing wheel to operate the corresponding pawl 107 and consequently set the pawl 102 into contact with the next ratchet wheel 21. This does not operate that wheel, though at that time. That wheel can be turned later without interfering with the carrying of the one but when all the numbers are set up and registered the handle 67 is operated in the same way as above stated, and has all the actions above stated, but in addition the ratchet wheel 79 is actuated and consequently the shaft 85 is turned around a complete revolution when the handle 67 is raised. All the pins 90 on the shaft 85 actuate all the arms 100. These all act idly except those whose pawls 102 have been pushed down into contact with their respective ratchet wheels 21 by the action of pins 105 and pawls 107. In those cases the raising of the arms 100 will push the corresponding ratchet wheels 21 around one space and add one to that column of figures. This leaves these particular pawls 102 in contact with the ratchet wheels. They are held there by the arm 111 and one of its teeth 112. To restore these parts to the position shown in Fig. 4 upward motion of the arm 100 just described raises the arm 111 so that the lower tooth instead of the upper tooth 112 co-acts with the projection 110 on the pawl 107. This lets the pawl back into the position shown in Fig. 4. This also restores the projection 106 on that pawl to a position in the path of the pins 105 so that they can actuate it if required the next time around.

For the purpose of subtracting the minuend is set up on the machine the same way as described above and then the subtrahend is set up on the machine by the use of the small numerals at the right of each column instead of the principal numerals which are used for addition, multiplication, etc. All the levers 25 at the left of the number to be subtracted are set up to the top or the zeros of their respective columns. Then the machine is operated in the same way and the result produced is the remainder left from this subtraction. Of course this is really a process of addition in which a complementary number is added instead of the real number being subtracted.

For the purpose of multiplication the multiplicand is set up on the machine in the usual way but the several finger rests 36 on all the levers 25 that have been moved are set down into the position shown in Fig. 6. This brings their respective teeth 38 into one of the notches 39 of each multiplying lever 40. Now the machine is operated by the handle 67 to perform the multiplication. If the number is to be multiplied by 5 this lever is operated five times. The tooth 38 locks the lever 25 to the lever 40 so that each time the handle 67 is operated the machine sets itself back to its original position and each of the computing wheels is turned five times, each time a distance representing the multiplicand. The carrying is done in the same way as in addition, of course, and the result is equally accurate. Just before the fifth or last motion of the handle 67 the operator presses down on the finger rest 55 and holds it down until the handle 67 is lowered. The result of this is that the projections 60 are located by this action in such position as to engage the projections 61 on the levers 35 and force these levers back to the position shown in Fig. 4 and withdraw all the teeth 38 from the toothed members on the levers 40. This sets the machine back to normal position ready for any other operation. It is to be noted that wherever the multiplying levers are moved by the action of the levers 25 the tails 44 are in a position to be engaged by the rod 72 and brought back to zero position at each operation of the handle 67.

It will be seen that this machine, while not capable of operation with exactly the same speed as some of the more complicated machines, is very much simpler and less expensive. It involves comparatively few parts and these parts are arranged compactly. The machine is designed not to be used by the largest plants but to occupy a field in which there is a demand for calculating machines but in which the cost of the ordinary machines is too great to warrant their purchase. In stores and small plants this machine is a very practical one for performing all the desired calculating operations.

Although I have illustrated and described only a single form of the invention, I am aware of the fact that modifications can be made therein by any person skilled in the art without departing from the scope of the invention as expressed in the claims. Therefore I do not wish to be limited to all the details of construction herein shown and described but what I do claim is:—

1. In an adding machine, the combination of a computing wheel loosely mounted and having a series of digits arranged in order at its circumference, a ratchet wheel fixed to said computing wheel, a lever pivoted adjacent to the computing wheel having a pawl for engagement with the teeth of a ratchet wheel, and a throw-out lever pivoted on said lever and having means for holding the pawl out of operative position so that the first named lever can be moved without setting the machine.

2. In an adding machine, the combination of a computing wheel, a ratchet wheel fixed to

said computing wheel, a lever pivoted adjacent to the computing wheel, a spring-pressed pawl for engagement with the teeth of the ratchet wheel, and a throw-out lever pivoted on said lever and having a projection for engaging the pawl to hold it out of operative position, the spring of the pawl being arranged to force the pawl and the throw-out lever back into position for the pawl to engage the ratchet.

3. In an adding machine, the combination of a computing wheel, a ratchet wheel fixed to said computing wheel, a lever pivoted adjacent to the computing wheel, a spring-pressed pawl for engagement with the teeth of the ratchet wheel, and a lever pivoted on said lever and having means for holding the pawl out of operative position, the first named lever having a finger piece on the end for operating the same and the last named lever having a finger piece above the corresponding first named finger piece and adjacent to it.

4. In an adding machine, the combination with a main shaft, of a computing wheel mounted loosely on said shaft, a ratchet wheel fixed to said computing wheel, a lever loosely pivoted on said shaft, and having a spring-pressed pawl thereon for engaging the teeth of a ratchet wheel, another pawl mounted on said lever, a second ratchet wheel fixed to said computing wheel in which the last named pawl is adapted to engage, a spring for normally holding the last named pawl out of engagement with its ratchet wheel, and means for engaging the end of the last named pawl and moving it into contact with its ratchet wheel and preventing the wheel from rotating too far.

5. In an adding machine, the combination of a freely rotatable computing wheel, having a ratchet wheel rotatable therewith, means for setting the machine and turning the ratchet wheel to register the number of spaces through which it turns, a lever, a rod connected with said lever to swing about the same center as the computing wheel, a swinging lever for said wheel pivoted on the same axis, a pawl mounted on said lever for said ratchet wheel, said pawl having a projection extending out in a position to be operated by said rod when the lever is depressed to swing said pawl into engagement with its ratchet and prevent the computing wheel from turning too far by its momentum, and yielding means for normally holding said pawl out of engagement with its ratchet.

6. In a calculating machine, the combination with a main shaft, a computing wheel loosely mounted thereon and a corresponding finger lever for turning the wheel independently of the shaft, of an operating handle, a lever pivoted on said shaft, means connected with said handle for turning said lever when the handle is depressed, a rod extending across the machine under said wheel and supported at its end by said lever for operating the wheel to turn it in accordance with its setting by the operating handle, and a multiplying attachment for the wheel having a tail projecting in the path of said rod to be operated thereby for multiplying purposes.

7. In a multiplying machine, the combination with a computing wheel, means connected with the wheel for performing an adding operation and an operating handle having means connected with said adding means for operating it, of a multiplying toothed member oscillatable on the axis of said wheel, an adding lever for cooperation with the computing wheel to determine the multiplicand, and a pawl on said adding lever for engaging one of the teeth of the multiplying member, said adding lever being constructed to operate said pawl and hold the pawl in contact with the multiplying member, whereby when the operating handle is operated it will turn the computing wheel the required distance each time without change in the setting of the machine and perform the multiplying operation.

8. In a multiplying machine, the combination with a main shaft, a computing wheel loosely mounted thereon, an operating handle having means connected with said adding means for operating it, and an adding mechanism comprising a rod oscillatable about the circumference of the computing wheel and operated by the operating handle, of a toothed multiplying member loosely mounted on said shaft, an adding lever for cooperation with the computing wheel to set up the number to be multiplied, a multiplying lever on the adding lever, and a pawl on the adding lever for engaging one of the teeth of the multiplying member, said adding lever being constructed to operate said pawl and hold the pawl in contact with the member until released, the multiplying member having a projection located in the path of said rod, whereby the multiplying member will be turned back to its original position at each operation of the operating handle.

9. In a multiplying machine, the combination with a main shaft, a computing wheel loosely mounted thereon, a multiplying lever, and an operating handle having means connected with said multiplying lever for operating it, of a multiplying ratchet loosely mounted on said shaft, said ratchet being composed of nine teeth, an adding lever for cooperation with the computing wheel to set up the amount to be multiplied, and a pawl on the adding lever having a tooth for engaging one of the teeth of the multiplying ratchet, said multiplying lever being constructed to operate said pawl and hold the pawl in contact with the ratchet until released, and a spring, and the multiplying lever having a projection cooperating with the spring to hold the multiplying lever in either its op-

erative or inoperative position against being displaced by accident.

10. In a multiplying machine, the combination with a computing wheel, and an operating handle, of a multiplying ratchet having a projection tail, an adding lever for cooperation with the computing wheel, a multiplying lever on the adding lever, a pawl on the adding lever having a tooth for engaging one of the teeth of the multiplying ratchet, a shaft, two levers pivoted thereon and a rod carried by said arms and adapted to be moved to two positions in one of which it is in the path of the tail of said multiplying ratchet and will turn the multiplying ratchet back to neutral position.

11. In a multiplying machine, the combination with a computing wheel, and an operating handle, of a multiplying ratchet having a projecting tail, an adding lever for cooperation with the computing wheel, a pawl on said adding lever having a tooth for engaging one of the teeth of the multiplying ratchet, a shaft, two levers pivoted on the shaft, and a rod carried by said arms and adapted to be moved to two positions in one of which it is in the path of the tail of said multiplying ratchet and will turn the multiplying ratchet back to neutral position, and also will turn the adding lever back to neutral position.

In testimony whereof I have hereunto affixed my signature.

LAURITS M. NIELSEN.