H. C. PETERS.

CALCULATING MACHINE.

APPLICATION FILED NOV. 25, 1913.

1,255,567.

Patented Feb. 5, 1918.

7 SHEETS—SHEET 1.

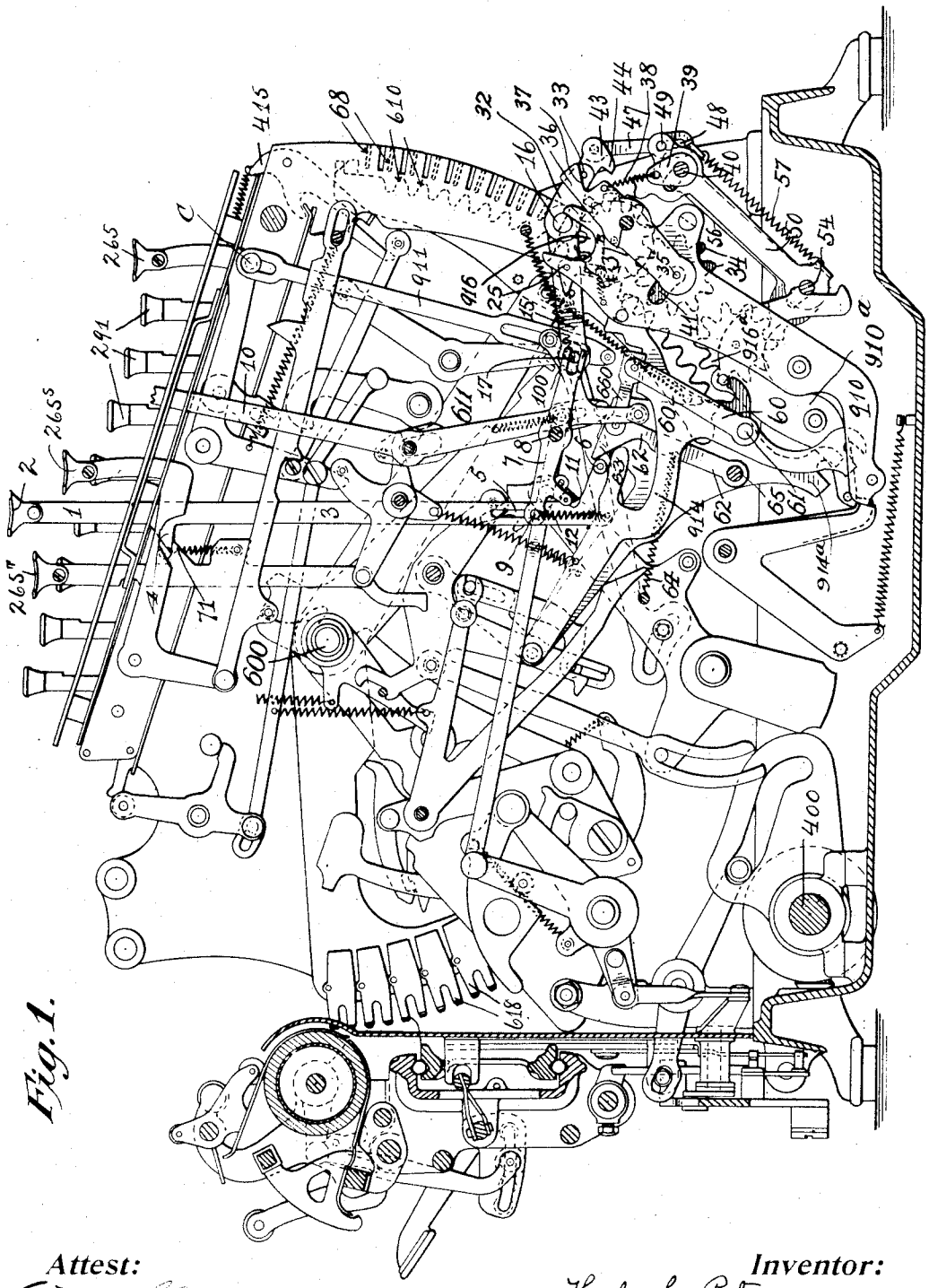


Fig. 1.

Attest:

Edgeworth Greene

T. M. McGinn

Inventor:

Heber C. Peters

William R. Baird

by his Atty

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7 SHEETS—SHEET 2.

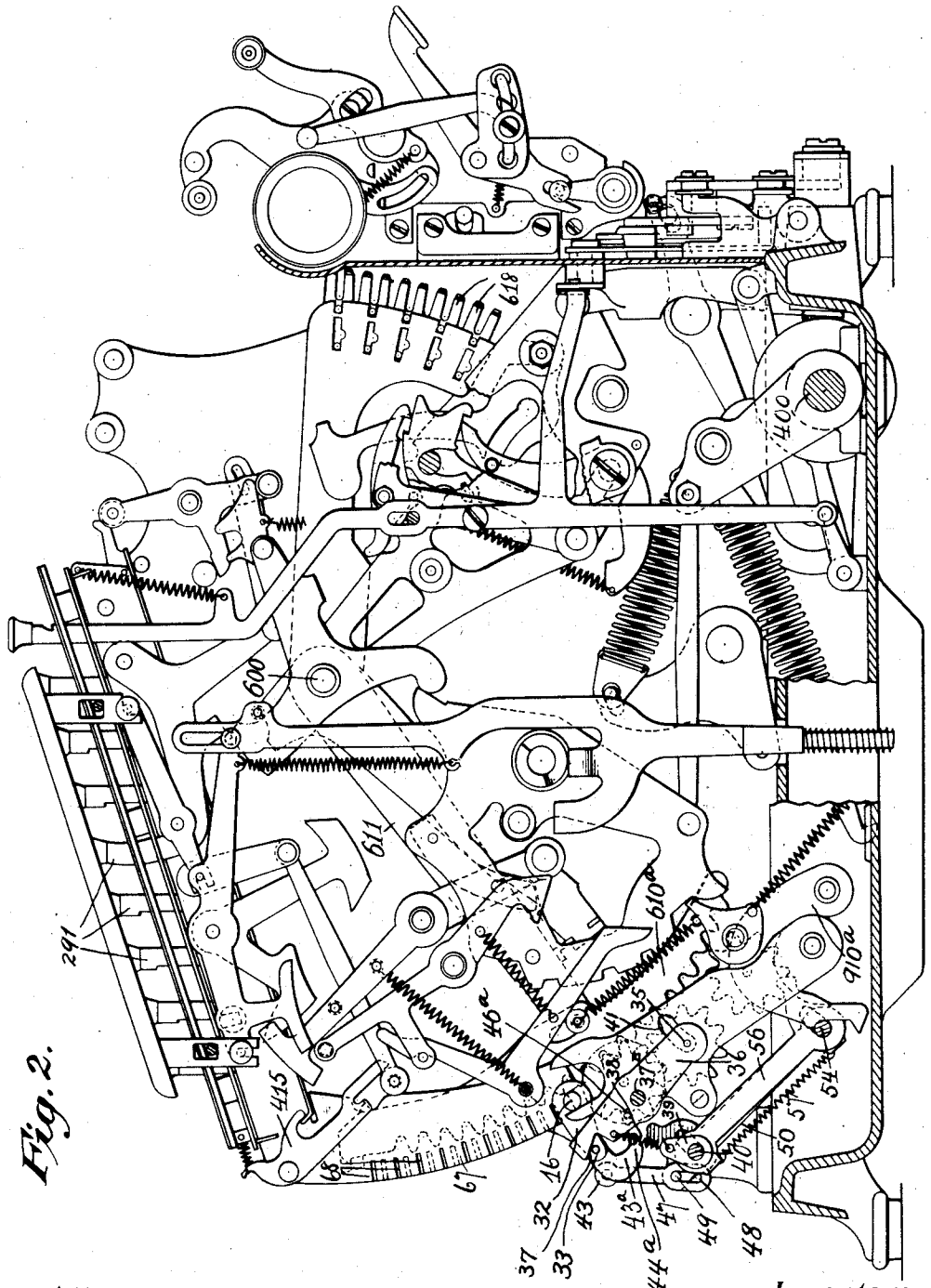


Fig. 2.

Attest:

Edgeworth Bruce

W. McGinn

Inventor:

Heber C. Peters

by William R. Baird

his Atty

H. C. PETERS.

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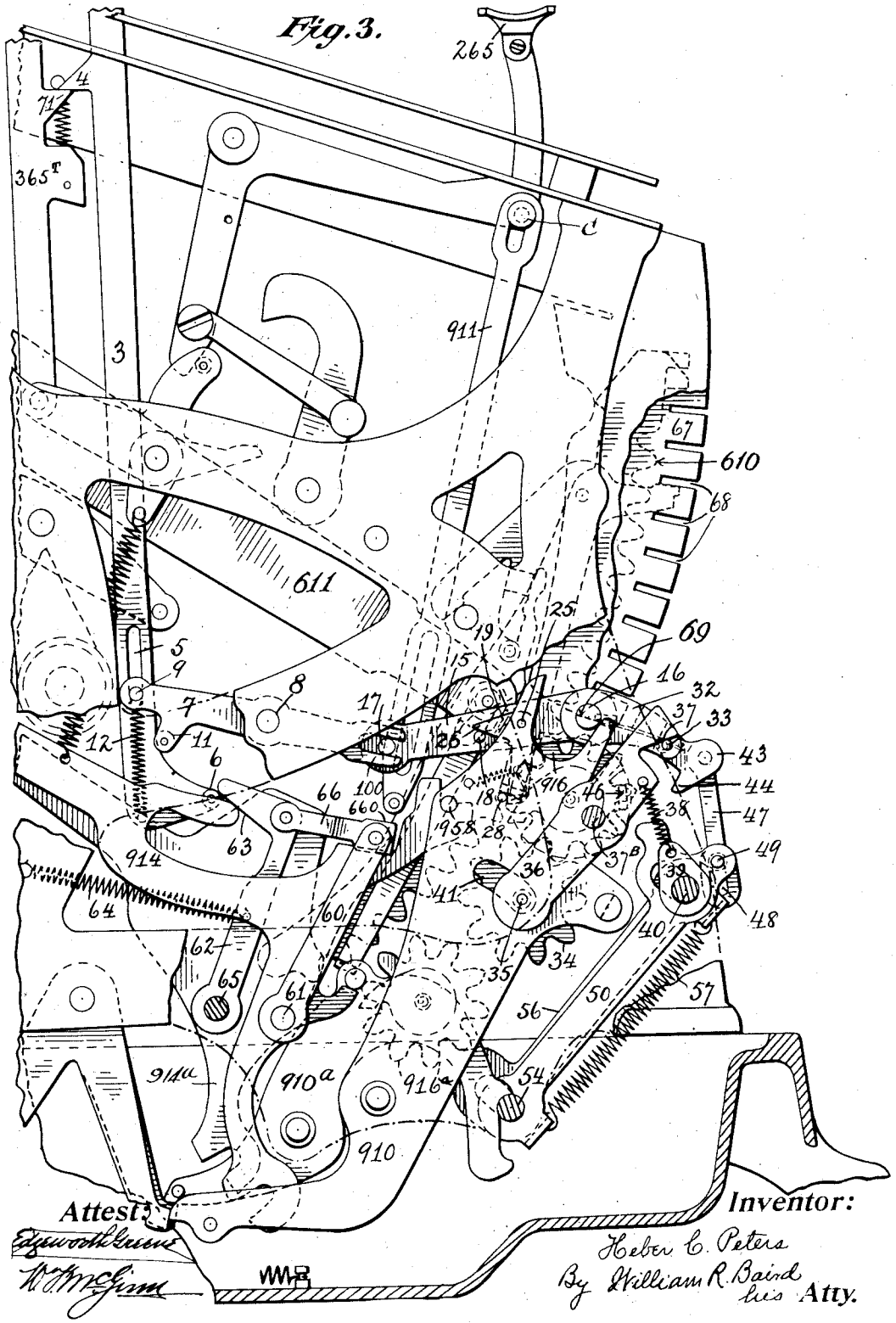
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7 SHEETS—SHEET 3.

Fig. 3.



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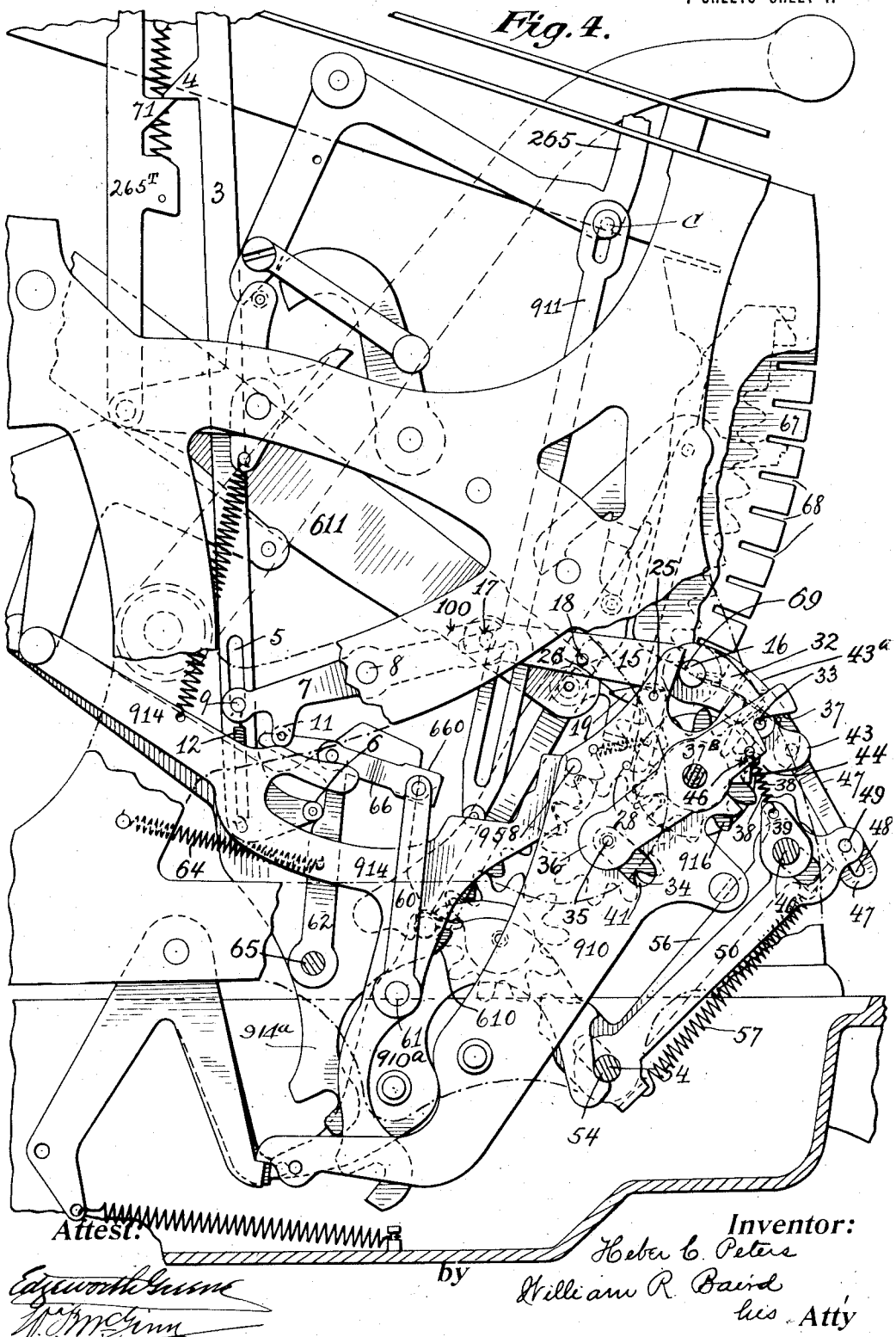
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7 SHEETS—SHEET 4.

Fig. 4.



Attest:

Edgeworth Greene

W. M. McGinn

Inventor:

Heber C. Peters

by William R. Baird

his Atty

H. C. PETERS.

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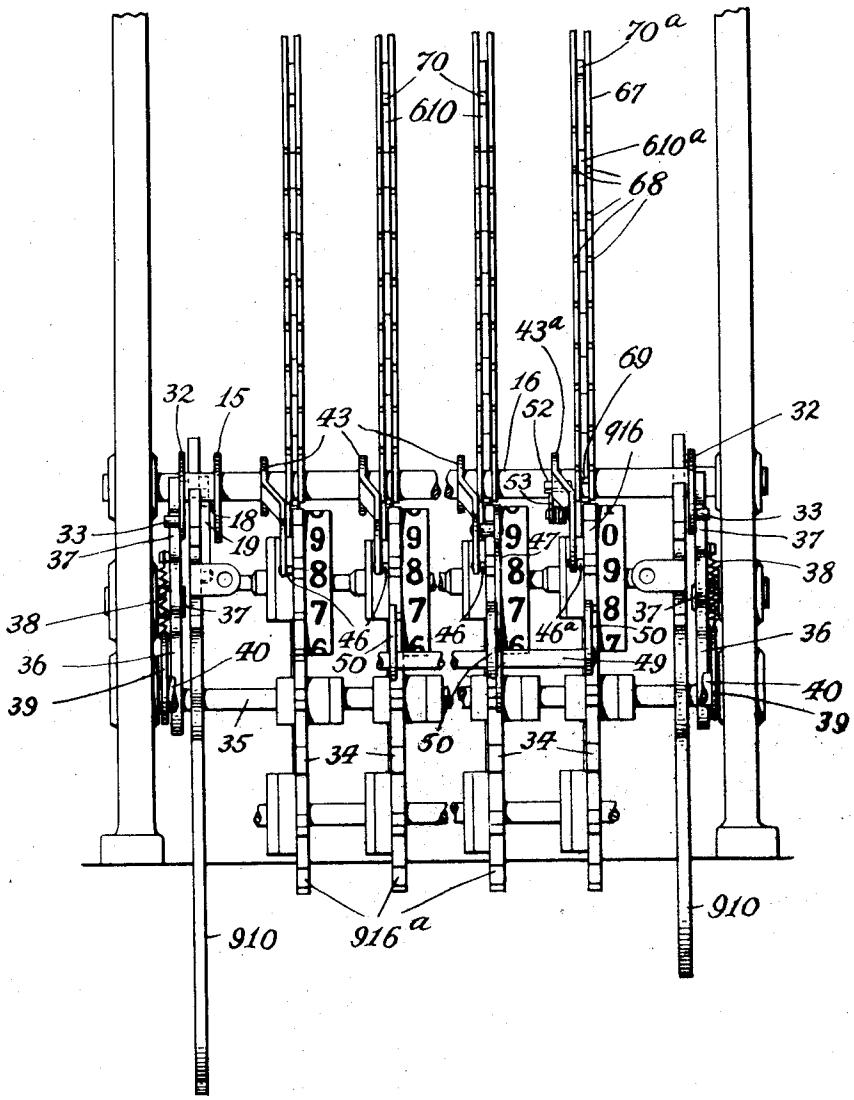
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7 SHEETS—SHEET 5.

Fig. 5.



Attest:

Edgworth Kinnie

W. J. McGinn

by

Inventor:

Heber C. Peters

William R. Baird

his Atty

H. C. PETERS.

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7 SHEETS—SHEET 6.

Fig. 7.

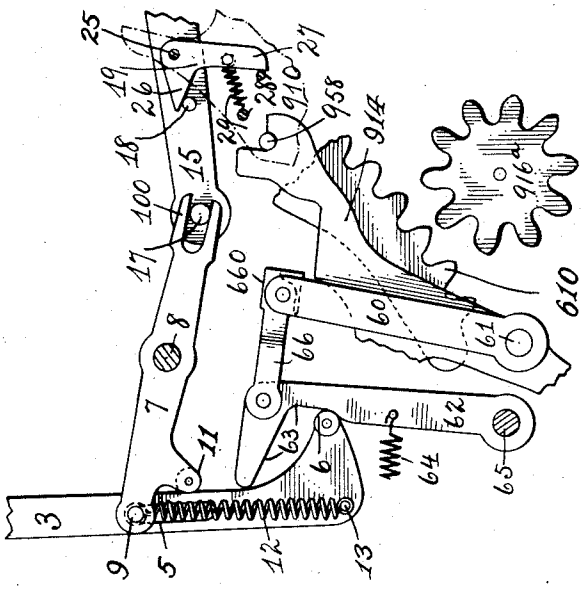
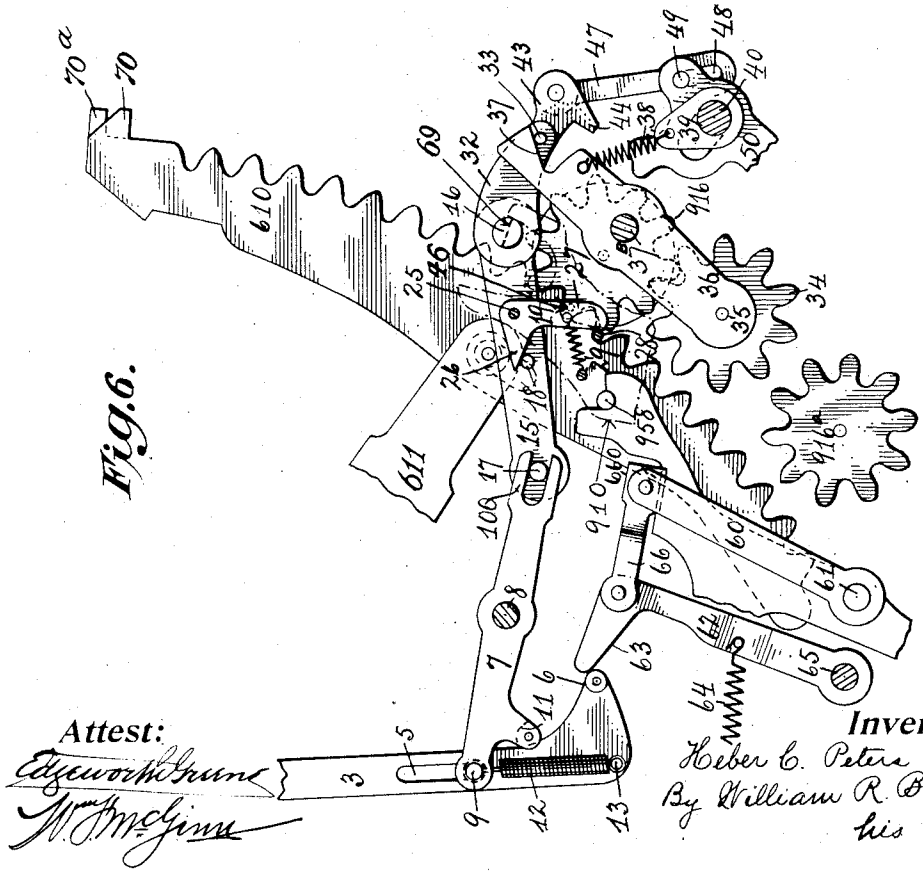


Fig. 6.



Attest:

Edgeworth Brune

W. Jno. McGinn

Inventor:

Heber C. Peters

By William R. Baird

his Atty.

H. C. PETERS.

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Patented Feb. 5, 1918.

7 SHEETS—SHEET 7.

Fig. 9.

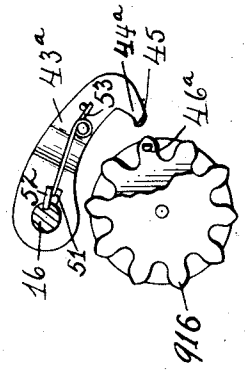


Fig. 10.

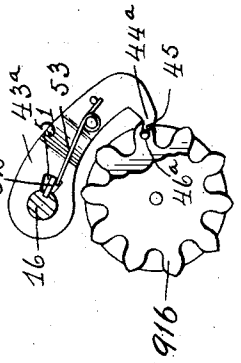


Fig. 11.

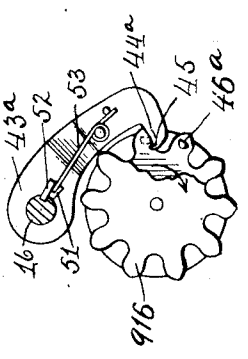
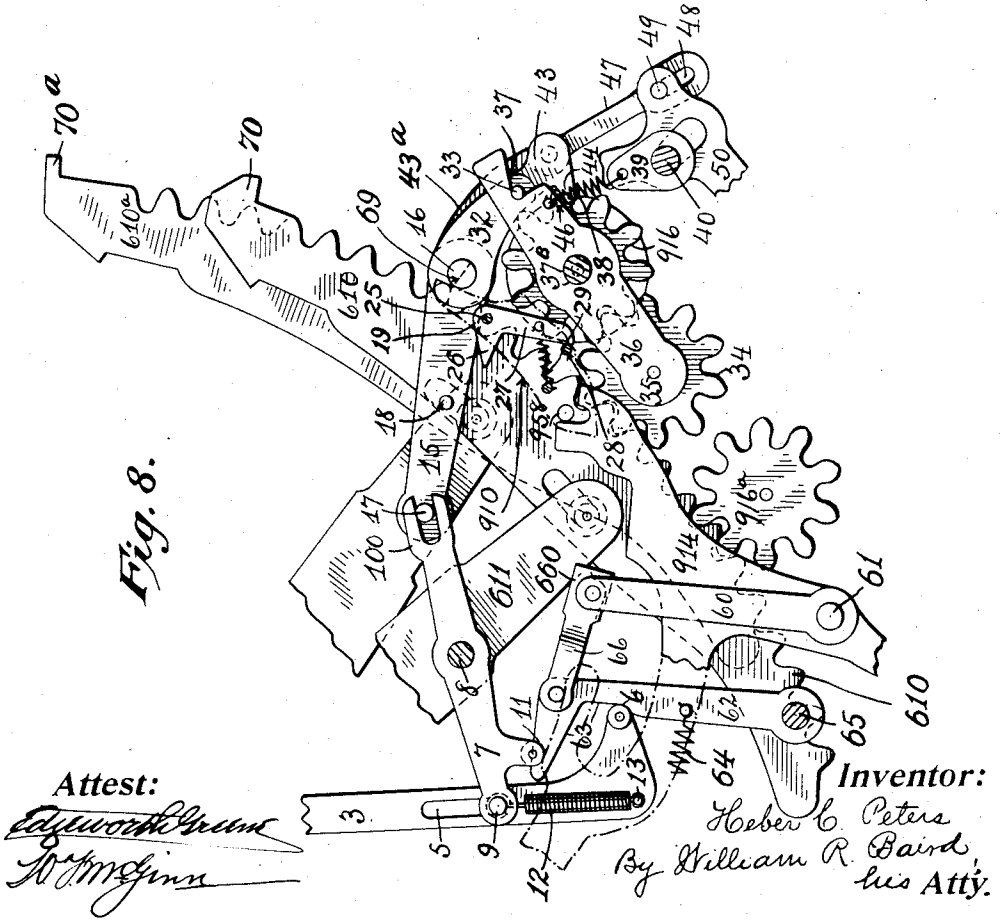


Fig. 8.



Attest:

Edgeworth Greene

D. F. McGinn

Inventor:

Heber C. Peters

By William R. Baird,

his Atty.

UNITED STATES PATENT OFFICE.

HEBER C. PETERS, OF NEW YORK, N. Y.

CALCULATING-MACHINE.

1,255,567. Specification of Letters Patent. Patented Feb. 5, 1918.

Application filed November 25, 1913. Serial No. 802,911.

To all whom it may concern:

Be it known that I, HEBER C. PETERS, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Calculating-Machines, of which the following is a specification

This invention relates to improvements in calculating machines and more particularly to mechanism whereby the operation of subtraction is readily and directly performed, without interfering with the other usual operations of the machine.

There is a form of adding and listing machine, now on the market and to some extent in general use, which provides means for controlling the accumulators whereby either of two accumulators can be used at will for the purpose of successively accumulating items and whereby a total of such accumulated items on either set of accumulators can be struck leaving such wheels either at zero or retaining the accumulation for addition thereto of further items, if desired. Provision is further made for transferring an accumulation at will from either accumulator to the other, and in the same operation printing the transferred accumulation. Then any total of successively transferred accumulations can be printed with or without leaving the wheels at zero. The machine referred to is of the kind described in the U. S. patent to Vincent and White, No. 919,656 issued April 27, 1909, and is known as the "Burroughs Duplex adding and listing" machine.

It will be understood that the machine is equipped with the appropriate frames and sub-frames, the depressible numeral keys and rack sectors, accumulating wheels, carrying, totalizing and zero resetting mechanism; also with the usual listing and printing devices and connections thereto, an appropriate paper carriage, and the like. Reference is made to the patent above referred to for a description of the details of such mechanism and their mode of operation which are now well understood in the art. In order to simplify the following description, it has been restricted as much as possible to the novel or altered parts of the device by means of which my invention is practised, a familiarity with the prior art as embodied in the Burroughs Duplex machine being assumed.

The principle upon which my invention is based is the familiar one in adding machine practice that the true difference between any two numbers may be obtained by subtracting the lesser number from an amount larger by one unit than the maximum accumulating capacity of the machine, and adding the remainder so obtained to the greater number. I utilize this principle in the machine referred to by accumulating or setting up the minuend in one of the two sets of accumulators, with which the machine is provided, and accumulating or setting up the subtrahend in the other set of accumulators, and then, by the manipulation of a subtraction key, automatically create the complementary number in the racks, which complementary number is later registered through the medium of the racks in the other set of accumulators, by the usual operation and mechanism of the machine. On this last set of accumulators will then appear the true difference between the minuend and the subtrahend.

The broad principle of operation of the machine described in this specification, whereby subtraction of amounts accumulated upon an accumulator is secured by adding to said accumulation, the complement of another amount accumulated upon the other accumulator, is also embodied in the machines described in my copending applications, Serial Nos. 844,150, filed June 10th, 1914, and 31,825, filed June 3, 1915. Said applications disclose and claim other variations or embodiments of the broad principle described and claimed herein.

The details of the particular mechanism which I have chosen to embody in my invention will be found in the following description. In the drawings, Figure 1 is a side elevation, partly in section, of a portion of a calculating machine embodying my invention, showing the positions of the parts when the handle of the machine is in its rearward or normal position. Fig. 2 is a similar view of the same mechanism taken from the opposite side of the machine. Fig. 3 is an enlarged view of a portion of the mechanism shown in Fig. 1. Fig. 4 is a view similar to Fig. 3, but showing the positions of the parts when the subtraction key is de-

pressed and the handle of the machine has been drawn forward and is returning. Fig. 5 is a front elevation of a portion of the mechanism with the parts in the position shown in Fig. 3. Fig. 6 is a separate detail of some of the parts shown in Figs. 1 and 3. Fig. 7 is a view of some of the parts shown in Fig. 6 when the subtraction key has been depressed and the handle of the machine is in its rearward position. Fig. 8 is a separate detail of the position of some of the parts shown in Fig. 4 when the subtraction key has been depressed and the handle of the machine has been drawn forward and is returning. Figs. 9, 10 and 11 are details of the units wheel of the upper set of accumulators and its detent, in various positions.

In the drawings, 201 are the numeral keys, adapted to displace latches 415 and release segmental racks 610 which connect the levers 611 loose on a rock shaft 600 and which carries a restoring bail to lift the front ends of the levers, the rear ends of said levers carrying type plates 618 adapted to be moved against the usual platen of the printing section at the rear of the machine. 400 is the main shaft moved from the handle of the machine, 916 designates the upper set of accumulators, 916^a the lower set, with which my invention is more particularly associated. 910 is the frame in which the upper set of accumulators is carried. 910^a is the frame in which the lower set of accumulators is carried. 914 is the upper accumulating frame pitman. 914^a is the lower accumulating frame pitman. 265 is the total key and 911 a bar pivoted thereon at C. 265^s is the sub-total key, and 265^T the transfer key. 10 is the accumulator controlling lever.

Proceeding now to a detailed description of the embodiment shown in the drawings and referring to Figs. 1 and 3, 1 is a subtraction key having a finger piece 2 at its upper end and provided with a downwardly extending stem 3 having near its upper end a lug 4 and at its lower end a slot 5 and a toe 6. A lever 7 is supported in the main frame of the machine by a pivot 8, and is provided at its rear end with a stud 9, adapted to engage the slot 5, and at its front end with a fork 100. It is also provided with a roller 11 adapted to engage the upper surface of the pitman 914. A spring 12 is secured to the stud 9 and to a similar stud 13, Figs. 6 and 7, on the key stem 3. An arm 15 is secured to a rock shaft 16 and is provided with one stud 17 adapted to be engaged by the fork 100 of the lever 7 and a second stud 18 adapted to engage a stop 19 pivoted to the frame 910 at 25. The stop 19 has two arms 26 and 27. A stud 28 projecting from the frame 910 limits the movement of the arm 27, and a spring 29 secured to the frame 910 and to the arm 27 tends to draw the latter toward and normally in contact with the stud 28.

Secured to the rock shaft 16, one on each side of the machine, are two arms 32, Figs. 3, 4, 5 and 6, each supporting studs 33. A set of idler pinions 34 is loosely mounted on a shaft 35 arranged across the machine and which is secured on each side to arm 36 adapted to oscillate on stud bearings 37^B projecting inwardly from the frame of the machine. These idler pinions are always in mesh with the upper set of accumulating wheels 916, and there is one pinion for each such wheel. Each arm 36 is provided near its upper end with a cam surface 37 normally engaged by the stud 33 on the corresponding arm 32 to move the arm 36 in one direction. Springs 38, secured one to each arm 36 and to a link 39, of which there are two, each mounted on a transverse rod 40, serve to keep cam surface 37 in contact with stud 33. A slot 41 in each frame 910 permits of movement of the frames 910 and the shaft 35 without interference.

Mounted on the shaft 16 are detents 43, one for each accumulating wheel 916, the detent 43^a of the units wheel being of the special form shown in Figs. 9, 10 and 11. Each detent 43 has a finger 44 adapted to engage a stop 46 projecting laterally from its corresponding accumulating wheel, and the detent of the units wheel has a finger 44^A with an elevated tip 45 adapted to engage a stop 46^a on the units wheel. This stop 46^a is located so that the units wheel may always advance to 0 as distinguished from detent 46 of the wheels of higher order which is located so that these wheels advance to 9 only. A link 47 is pivoted to one of the detents 43 and is provided with a slot 48 which engages a transverse rod 49 and which rod forms a common connection for all of the detents 50 of the upper accumulating wheels which prevent accidental turning when the accumulating wheels 916 are disengaged from racks 610, 610^a. In the detent 43^a of the units wheel, which is loosely mounted on the rock shaft 16, there is a slot 51, and within it is a key 52 secured to the shaft 16. A spring 53 is secured to the detent 43^a and is adapted to engage the key 52. (See Figs. 9, 10 and 11). The purpose of making the detent 43^a of the units wheels of the upper accumulator different from the detents 43 of the other wheels of the series is to provide means for insuring a full revolution of the wheels if the number set up or accumulated in the upper accumulator has "0" in the units place. Obviously, if the detent 43 were employed the units wheel would be locked against rotation, since its stop 46^a is placed relatively one tooth back of the stops on the wheels of higher order, and the unit wheel could not be revolved. The parts are so proportioned that when the units wheel is at

"0," (see Fig. 10) and the shaft 16 is rocked and the series of detents moved to position, the tip of the detent 43ª strikes the pin 46ª instead of being underneath it, such contact being a yielding one by reason of the elasticity of the spring 53. Then when the units rack descends, the units wheel through the units idler wheel 34 will be free to rotate a complete revolution or 10 teeth.

The detents 50 of the upper accumulating wheels are pivoted in the frame of the machine on a transverse rod 54. The detents 56 of the lower accumulating wheels are pivoted on the transverse rod 40 above mentioned, and this rod 40 serves to limit the movement of the detents 50 while the rod 54 serves to limit the movement of the detents 56. The detents 50 and 56 are yieldingly connected by the usual springs indicated at 57 which serve to keep them in normal relation.

A swinging arm 60 is pivoted to pitman 914 at 61. A lever 62 having a cam surface 63 adapted to engage the toe 6 of the subtracting key stem 3, and provided also with a spring 64, is pivoted at 65 to the frame of the machine. Pivoted to the levers 60 and 62 is a connecting link 66 which serves, when desired, as an operative connection between the pitman 914 and the bar 911 depending from the total key, its end 660 being immediately beneath the lower end of the bar 911 and immediately above one part of the upper surface of the pitman 914 when the parts are in normal position. (See Figs. 1 and 3).

The units sector guide frame 67 is arranged with the usual stop guide slots 68, but there is an additional stop for the units sector 610ª (see Fig. 2) as distinguished from the guide frames of the other sectors. In the plane of the sector 610ª the shaft 16 is provided with a slot 69 (see Figs. 3 and 5) to form a tenth stop for the sector 610ª. Each of the sectors 610 is provided with a stop engaging lug 70 and the units sector 610ª is provided with a similar lug 70ª (see Figs. 5 and 8) but in a higher position to meet the conditions of the ten stop movement of this sector when required.

A lug 71 is provided on the stem of the transfer key 265ᵀ and is adapted to be engaged by the lug 4 on the stem of the subtraction key 1.

Before describing the successive movements of the parts that perform the operation of subtraction, it should be explained that the purpose of the mechanism is to set up or accumulate in the lower accumulator a number representing the minuend; to set up or accumulate in the upper accumulator a number representing the subtrahend—then to depress a subtracting key which throws into action a train of mechanism which, when the handle is moved forward in the usual manner, operates to cause the upper accumulator to be disengaged from, and the idlers to be simultaneously engaged with, the racks, and causes a series of detents (43 and 43ª) to move into the paths of the stops (#46 and 46ª) mounted on the upper accumulating wheels—the relation of these stops and the detents being such as to allow the units wheel of the upper accumulator to move in the adding direction to 0 and the wheels of all the higher orders to move in the adding direction to 9. The downward travel of the racks, which would normally rotate the accumulating wheels in a direction the reverse of adding, acting through the idlers, rotates the upper accumulating wheels in the adding direction to the above positions. The position of the racks will then indicate a number of the complementary character described above, the same as if it had been set up on the keyboard, so that when by the operation of the ordinary mechanism of the machine on the rearward stroke of the handle, the lower accumulator is moved into engagement with the racks and the number set up in the racks is registered thereon, there appears in the lower accumulator an amount which is the true difference between the numbers originally set up or accumulated on the upper and lower accumulators. When it is desired to prevent the printing of the complementary number while this operation is taking place it is assumed that the operator will tip the platen rearward out of contact with type plates 618 and hold during the forward movement of the handle.

In practice, the machine being operated in the usual manner, the amount of the minuend is set up or accumulated in the lower accumulating wheels 916ª, the controlling lever 10 being set in its "lower" position (as explained in Patent No. 919,656). This lever is then shifted to its "upper" position and the amount of the subtrahend is then set up or accumulated in the upper accumulating wheels 916. If now in the well known Burroughs Duplex machine the transfer total key were depressed and the handle operated through a complete stroke, the amount registered in the upper accumulator would be transferred to the lower accumulator and the upper accumulator left clear. Since, however, in my subtraction device it is desired to register in the lower accumulator not the number appearing in the upper accumulator but one bearing a complementary relation thereto, it is necessary to interrupt the normal operation of the machine (which is clearly and fully described in Patent 919,656, page 5, lines 95 to 130) and I therefore arrange that when the subtraction key is depressed and through its lug 4 the transfer total key 265ᵀ is also depressed, the normal action

of the bar 911 in relation to the pitman 914 shall be prevented by removing the interference surface 660 of the link 66. (See Fig. 4.) This allows the pitman 914 to still engage the stud 958 (see Fig. 6) so that with the initial forward movement of the handle the upper accumulator will be rocked out of engagement with the racks instead of remaining engaged therewith, and the train of mechanism set ready for action by the depression of the subtraction key will simultaneously throw into mesh with the racks the idler wheels 34 and also move the detents 50 to the position shown in Fig. 8, in which position they no longer prevent the free rotation of the accumulating wheels 916. The roll 11 on the arm 7 also makes contact with the pitman 914 and depresses pitman 914 to the extent that on its rearward movement the pitman 914 will not engage the stud 958 (see Fig. 8) and thus the upper accumulator will remain disengaged from the racks and the idler wheels will be engaged with the racks during the complete forward and rearward movement of the handle. With the depression of the subtraction key 1, the lever 7 remains locked because its fork 100 cannot lift the arm 15 as the stud 18 on this arm is held by the arm 26 of the stop 19 pivoted on the frame 910, the stop 19 being held immovable by contact of its arm 27 with the stud 28. (See Figs. 6 and 7.) The rock shaft 16 can not oscillate and consequently the detents 43 and 43^a will not be moved. But the spring 12 will be stretched and placed under tension (see Fig. 7) so that when the lever 7 is allowed to move it will be rocked on its pivot 8. The depression of the key 1 lowers the toe 6 of its stem 3 out of engagement with the cam surface 63 of the lever 62, and the spring 64 will then move this lever 62 to the rear (from the position shown in Fig. 6 to that shown in Fig. 7). This in turn will move the link 66 to the rear so that its forward end 660 will be moved from beneath the key stem 911, allowing the latter to move idly downward without touching the pitman 914. In other words, the depression of the subtraction key serves to interrupt temporarily the function of the total key.

The handle of the machine is then moved forward. During its initial movement it oscillates the main shaft 400 in the usual manner and, through the well known mechanism moves the frame 910 forward, (from the position shown in Fig. 3 to that shown in Fig. 4), and moves the upper accumulating wheels 916 out of engagement with their respective racks 610 and 610^a. This same movement moves the stop 19 out of engagement with the stud 18 and ceases to hold the arm 15. The lever 7 being thus left free to move, it is pulled downward at its rear end by the spring 12, and through its fork 100 rocks the shaft 16 and moves the detents 43 and 43^a of the upper accumulating wheels into the circular paths of the pins 46 and 46^a. The movement of the lever 7 acts also to bring the roller 11 into contact with the upper surface of the pitman 914, and moves the latter downward and out of such engagement with a stud 958 on the frame 910 (see Figs. 4 and 8) so that when moved rearwardly pitman 914 cannot rock the frame 910 and move the wheels 916 back into mesh with the racks. Also, at the same time, the arms 32 being rocked from the shaft 16 the studs 33 slide along the cam surface 37 of the arm 36, and allow the springs 38 to swing these arms 36 on their bearings 37^B to bodily move the series of idler wheels 34 into mesh with the racks 610 (from the position shown in Fig. 6 to that shown in Fig. 8). In other words, this initial movement of the handle moves the upper accumulating wheels out of engagement with their racks 610 and 610^a, puts the detents 43 and 43^a of these wheels into position to stop the units wheel at "0" and wheels of all higher orders at 9 when the wheels are rotated, and swings the idler wheels 34 into mesh with the racks 610 and 610^a without, however, disengaging such idler wheels 34 from the upper accumulating wheels 916. (See Fig. 8.)

As the forward movement of the handle of the machine continues, through the well known mechanism with which the Burroughs Duplex machine is provided, the sector racks 610 and 610^a are permitted to descend under the influence of their respective springs, and during such descent the idler wheels 34 being in mesh with the racks are rotated and they in turn rotate the upper accumulating wheels in the adding direction although the racks themselves are moving in a direction the reverse of adding. But as soon as these latter wheels 916 bring their respective stops 46 and 46^a against the fingers 44 and 44^a of their detents, their movement is stopped. And, as they are all stopped at "9" except the units wheel which is stopped at "0," it follows that the extent of the rotation of each idler wheel 34 is the difference between the number originally set up or accumulated in its corresponding upper accumulating wheel and "9" or "10," as the case may be. In other words, the extent of the rotation of the idler wheels and the movement of the respective racks in mesh therewith bears a precise relation to the number originally set up or accumulated in the upper accumulating wheels, and, although the subtrahend is the number which was actually set up or accumulated in the upper accumulator, the number which has been set up in the racks is different but bears an exact complementary relation thereto.

At the beginning of the return stroke of

the handle since the transfer key 265T has been depressed with the depression of the subtraction key 1, the further effect upon the mechanism, as the parts are now positioned, is the same as in the unaltered Duplex machine. The lower accumulators will be moved into engagement with the racks and the complementary number will, therefore, during the return stroke, be registered in the lower accumulator by the upward movement of the racks and the resulting total in the lower accumulator will be the true difference between the original minuend and subtrahend.

As a concrete example of what takes place, consider that in the lower accumulator a minuend 2175 has been set up or accumulated; that in the upper accumulator a subtrahend of 1175 has been set up or accumulated. The wheels of the upper accumulator in a machine of nine banks capacity will show as follows 000001175. If now the units wheel in the upper accumulator be advanced to 0 and all wheels of higher order to 9 by the means already explained, the units rack, in rotating the units wheel will travel five teeth. The tens racks will travel 2 teeth, the hundreds racks 8 teeth and the thousands rack 8 teeth. All racks of higher order will travel 9 teeth. The racks will then have assumed a position the same as if 999998825 had been set up on the keyboard and the handle moved through its forward stroke. This complementary number, it will be seen, is the remainder obtained by increasing by one unit the maximum accumulating capacity of the machine (viz: 1+999,999,999= 1,000,000,000) and subtracting therefrom 1175 the number representing the subtrahend. If now the complementary number 999998825 be added to the minuend 2175, by the means and in the manner provided in my device, the accumulating wheels of the lower accumulator after such addition stand as follows, 000001000, the excess digit to the left having disappeared because the maximum accumulating capacity of the machine has been exceeded. The amount remaining on the lower accumulating wheels will, therefore, indicate 1000 which is the true difference between 2175 and 1175.

In the usual operation of the Burroughs Duplex machine the parts are restored to their original positions in the manner described in the patent referred to, and such description need not be repeated here. The restoration of the particular mechanism of this machine, which takes place as the handle is completing its rearward movement, occurs as follows:

As the transfer key 265T rises, the lug 71 engages the lug 4 on the subtraction key stem lifting it and moving it to its original position. This movement lifts the stem 3. The lower part of the slot 5 acting on the stud 9 rocks the lever 7 and through its fork 100 moves the arm 15 and shaft 16 to their original positions. The rocking of the shaft 16 moves the arm 32 and the studs 33 acting on the cam surfaces 37 of the arms 36, move the latter back to position, taking the idler wheels 34 out of mesh with their respective rack sectors 610 and 610a. The same movement causes the disengagement of the detent fingers 44 and 44a from the stops 46 and 46a and moves the link 47, permitting the locking detents 50 to return to their normal positions under the influence of their respective springs 57. Also, as the key stem 3 moves upwardly the toe 6 reëngages the cam surface 63 of the lever 62 and restores the link 66 to its original position, at the same time stretching the spring 64. As soon as the link 66 is restored, its end 660 is in the downward path of the bar 911 depending from the total key, the latter having been lifted, and if the machine is operated as a regular Duplex machine, this end affords a connection from the bar 911 to the pitman 914 beneath it.

The parts are now all in their original positions except the upper accumulating wheels. An idle stroke of the machine is therefore taken. This moves the pitman 914 forward again when it reëngages the stud 958 and on the rearward stroke of the handle oscillates the frame 910 so that the upper accumulating wheels 916 are again placed in engagement with the racks 610.

The word "complement" which is used for brevity and convenience in the claims in defining the invention refers to the amount obtained by increasing by one unit the maximum adding capacity of the machine and subtracting therefrom the number whose "complement" is desired. Thus in a machine of nine banks capacity viz: 999,999,999 the word "complement" refers to an amount which is the difference between a number and 1,000,000,000.

It will be understood that while I have shown my invention as applied to the adding and listing machine of the Burroughs type and have referred particularly to the patent in which the so-called Duplex mechanism is described, yet my invention is not limited to this particular embodiment of it, as its essential features can be incorporated in adding and listing machines of a modified or different type. Also, while the described mechanism is particularly well adapted to perform the functions attributed to it, nevertheless, it is apparent that modifications may be made in such construction within the scope of the invention.

What I claim is:

1. In an adding machine, a rack and two units wheels operating to engage said rack, in combination with means operating on occasion to move the rack under control of

one units wheel one point beyond its normal maximum movement and means to engage the other units wheel with the rack to receive a registration corresponding with this movement of the rack.

2. In an adding machine, a rack and two units wheels operating to engage said rack in combination with means operating on occasion to move the rack, under control of one units wheel disengaged from the rack, one point beyond its normal maximum movement and means to engage the other units wheel with the rack to receive a registration corresponding with this movement of the rack.

3. In a calculating machine, the combination of two sets of counters and a rack system common to both with means controlling the rotation of the units wheel of one counter which allows the units rack on occasion to move one point in excess of its normal maximum movement and means for engaging the units wheel of the other counter with the units rack to receive a registration corresponding with such movement of the units rack.

4. In an adding machine operating to handle the decimal system the combination of a rack, two units wheels, and means permitting a ten point travel of the rack while controlled by one units wheel, said rack operating to register this travel on the other units wheel.

5. A calculating machine embodying a series of racks, two sets of accumulating wheels each adapted to be engaged with and disengaged from said racks, numeral keys, stops operated by said numeral keys for controlling the travel of said racks, one of said sets of accumulating wheels coöperating with said racks for setting up therein, independent of said numeral key stops, the true complement of an accumulation in said set of wheels, and means for engaging the other set of wheels with said racks, to receive a registration corresponding with the complementary number set up in the racks.

6. In a calculating machine, the combination with two sets of accumulating wheels, of racks for registering a number in each set independently, numeral keys, stops operated by said numeral keys for controlling the travel of said racks, and controlling mechanism coöperating with one set of accumulating wheels, independent of the numeral key stops, for controlling the racks so as to register in one set of wheels the true complement of the number appearing in the other set of wheels.

7. A calculating machine embodying two sets of accumulating wheels and means for accumulating independent totals in each set, said means including a rack system adapted to rotate all the wheels of one set in the direction of adding after a total has been accumulated therein, said racks rotating the units wheel to 0 and all other wheels to 9, and means for moving the other set of wheels into engagement with the racks to receive a registration corresponding with the extent of said movement of the racks.

8. A calculating machine, embodying two sets of accumulating wheels and means for accumulating independent totals in each set, said means including a set of racks common to both and devices for throwing each set of wheels into and out of engagement with the racks, said racks operating to rotate in the adding direction all of the wheels in one set after a number has been set up or accumulated therein, such rotation of the wheels of the aforesaid set limiting the movement of the racks so that there is set up in the racks the true complement of the number originally set up in the rotated wheels.

9. A calculating machine embodying two sets of accumulating wheels and means for accumulating independent totals in each set, said means including a set of racks common to both and devices for throwing each set of wheels into and out of engagement with the racks, said racks operating to rotate in the adding direction all of the wheels in one set after a number has been set up or accumulated therein, such rotation of the wheels limiting the movement of the racks so that there is set up in the racks the true complement of the number originally set up in the wheels and means engaging the other set of wheels with the racks to receive a registration corresponding to such complementary number.

10. A calculating machine embodying a series of racks, two series of accumulating wheels adapted to be placed into and out of engagement with the racks, and a separate set of pinions movable into and out of engagement with the racks, said separate set of pinions being normally in mesh with one set of accumulating wheels, said racks coöperating with said set of pinions for setting up in the racks the true complement of a number appearing on the set of accumulating wheels normally in mesh with the pinions.

11. In a calculating machine, the combination of a minuend accumulator, a subtrahend accumulator, and means controlled by the latter for adding in the minuend accumulator a single amount which is the true complement of the subtrahend.

12. In an adding machine two sets of counters and actuating means for setting up a minuend in one set of counters, said actuating means operating to set up in the second set of counters a subtrahend, a set of intermediate wheels meshing with the second set of counters and operating to be rotated an extent equal to the true complement of

the subtrahend, and means for engaging the intermediate wheels with the actuating means and rotating the subtrahend wheels this complementary distance.

13. In an adding machine, two sets of counters, and actuating means for setting up a minuend in one, said actuating means being adapted to set up in the second set of counters a subtrahend, in combination with a set of intermediate wheels engaging the second set of counters, means for engaging the intermediate wheels with the actuating means, said actuating means operating to rotate the second set of counters an extent equal to the true complement of the subtrahend, and means for engaging the first set of counters with the actuating means to receive a registration corresponding to the complement of the subtrahend thereon.

14. In an adding machine, two sets of counters in each of which a number may be set up or accumulated, a series of detents, a key controlled mechanism for moving the detents into the paths of one set of counters, a series of racks operating to rotate the counters into contact with said detents, and means for moving the racks an extent corresponding to the extent of the predetermined rotation of the counters, said racks coöperating with the counter restrained by the detents for setting up in the racks the true complement of the number appearing on said counter.

15. In an adding machine, two sets of counters in each of which a number may be set up or accumulated, a series of detents, a key controlled mechanism for moving the detents into the paths of one set of counters, a series of racks for rotating the counters into contact with the detents, means for moving the racks an extent corresponding to the predetermined rotation of the counters, and means for engaging the racks with the other set of counters for accumulating the total.

16. In a machine of the character described, a subtraction key, a series of counter wheels, and a series of detents, operating under control of the subtraction key, to be interposed in the paths of the counter wheels to stop said counter wheels at predetermined positions, whereby the counter wheels when rotated in the adding direction will move a distance equivalent to that required to register in said counter wheels the true complement of the number appearing on said counter wheels.

17. In an adding machine, two sets of counters in which amounts may be independently accumulated, a series of racks, means for engaging the counters with or disengaging the counters from the racks, and mechanism operating to transmit the motion of the racks to one set of counters while said counters are disengaged from the racks, this motion of the racks operating to set up in the racks themselves the true complement of the number appearing on said set of counters.

18. In an adding machine, two sets of counters in which amounts may be independently accumulated, a series of racks, means for engaging the counters with or disengaging them from said racks, and mechanism for transmitting the motion of the racks to the wheels in one counter whereby the wheels in that counter may be rotated in the adding direction while the racks are moving in a direction the reverse of adding, said motion of the racks operating to set up in the racks themselves the true complement of a number appearing on the counter disengaged from the racks.

19. In a machine of the character described, a series of counter wheels, a movable frame adapted to support same, a series of racks with which the wheels are normally in mesh, a series of idler wheels always in mesh with said counter wheels, a second movable frame adapted to support the idler wheels, and means for moving the idler wheels bodily into and out of engagement with the series of racks while maintaining their engagement with the counter wheels, said idler wheels coöperating with the racks for setting up in the racks the true complement of the number appearing on the counter wheels.

20. In a machine of the character described, a series of racks, a movable frame, a series of counter wheels bodily movable with such frame into and out of engagement with the racks, a second movable frame, a series of idler wheels bodily movable with such second frame into and out of engagement with the racks, said idler wheels cooperating with the racks for setting up in the racks the complement of the number appearing on the counter wheels, a subtraction key, and connections between said key and the idler wheel frame whereby when the handle of the machine is moved the idler wheel frame is moved.

21. In a calculating machine provided with an operating shaft, a series of racks, a series of counter wheels adapted to mesh therewith, a series of idler wheels adapted to mesh with both the wheels and the racks, a series of detents adapted to stop the counter wheels, at predetermined positions, means moved from the operating shaft to shift the counter wheels into and out of mesh with the racks, and independent means adapted to shift the idler wheels into and out of mesh with the racks, said idler wheels coöperating with the racks for setting up in the racks, the complement of the number appearing on the counter wheels.

22. In an adding machine the combination of two sets of counters operable inde-

pendently of each other and means for setting up a number on each, said setting up means being controlled by one counter for registering on the other counter the true complement of the number appearing in the first counter by rotating in the adding direction all the wheels of the first counter to "9" except the units wheel and rotating said units wheel to 0.

23. In a machine of the character described, the combination with a series of counter wheels and means for setting up a number thereon, said setting up means being controlled by one counter for registering on the other counter the true complement of the number appearing in the first counter by rotating in the adding direction each wheel except the units wheel to a relatively fixed point corresponding to the registration of "9", and for effecting a complete rotation of the units wheel to "0" provided zero is in the units series of the number set up.

24. In a machine of the character described, the combination with a series of counter wheels, of means for obtaining the complement of a number set up thereon by rotating each wheel, except the units wheel to a relatively fixed point corresponding to the registration of "9" and compelling a complete rotation of the units wheel to "0" provided zero is in the units series of the number set up, said last mentioned means including a detent which is yieldingly brought to bear against a stop on the units wheel when the latter is in the zero position.

25. A calculating machine embodying a series of racks, two sets of accumulating wheels operable independently of each other for obtaining separate totals of items listed, said racks operating to rotate one set of accumulating wheels in the adding direction while the racks are traveling in a direction the reverse of adding, whereby there is set up in the racks the true complement of the number appearing on said set of wheels, and means for moving the racks to register their travel on the other set of wheels.

26. In an adding machine, the combination with two sets of adding wheels in which amounts may be independently accumulated, a series of racks, and means for engaging the adding wheels with or disengaging the adding wheels from the racks, of mechanism whereby the rotated position of one set of adding wheels disengaged from the racks governs the travel of the racks.

27. In an adding machine, the combination with two sets of adding wheels in which amount may be independently accumulated, a series of racks, and means for engaging the adding wheels with or disengaging the adding wheels from the racks, of mechanism whereby the rotated position of one set of adding wheels disengaged from the racks governs the travel of said racks, and means for moving the racks to register their travel on the other set of adding wheels.

28. In a calculating machine, the combination with a plurality of accumulators, of mechanism positioned in coöperative relation to said accumulators and adapted to be positioned by one accumulator and to register upon the other accumulator in one operation a single amount which represents the difference between the number appearing on the first named accumulator and the maximum totaling capacity of the machine plus one.

29. In a calculating machine, the combination with a plurality of accumulators, and mechanism for operating said accumulators, of mechanism positioned in coöperative relation to said accumulators and said operating mechanism, operating to be positioned by one accumulator and to register upon the other accumulator, in one operation, a single amount which represents the difference between the number appearing on the first named accumulator and the maximum totaling capacity of the machine plus one.

30. In a calculating machine, two sets of accumulators, a series of movable racks common to both, and means for moving the accumulators into and out of engagement with the racks, in combination with mechanism coöperating with one accumulator enabling the movement of said racks to operate one accumulator and to be governed by the other accumulator whereby the true complement of the number appearing on one accumulator is automatically registered in one operation as a single amount on the other accumulator.

31. In a calculating machine, two sets of accumulators, a series of movable racks common to both, and means for moving the accumulators into and out of engagement with the racks, in combination with mechanism coöperating with the accumulators for indicating in the racks the true complement of a number registered on one accumulator while said racks are disengaged from both accumulators.

32. In a calculating machine, two sets of accumulators, a series of movable racks common to both, and means for moving the accumulators into and out of engagement with the racks, in combination with mechanism coöperating with the accumulators and the racks for indicating in the racks the true complement of a number registered on one accumulator while said racks are disengaged from both accumulators, said racks operating to register on the other accumulator the complement of the number set up in said racks.

33. In a calculating machine, the combi-

nation with a plurality of racks, of a counter coöperating therewith for setting up in said racks the true complement of a number registered on said counter, and a second counter operated by the racks to register on said second counter the true complement set up in the racks.

34. In a calculating machine the combination with a counter, of rack mechanism controlled by said counter, said rack mechanism while so controlled being movable in one direction for setting up therein the true complement of a number registered on said counter; and a second counter operated by the reverse movement of said rack mechanism, whereby there is accumulated on said second counter the true complement set up in the rack mechanism.

35. In a calculating machine, the combination with rack mechanism movable in one direction and then movable in an opposite direction, of a counter for controlling the rack mechanism while moving in the first direction so as to set up in said rack mechanism the true complement of the number registered in said counter, and a second counter controlled by the rack mechanism when moving in the second direction for registering on said second counter the true complement so set up in said rack mechanism.

36. In an adding machine a rack, two adding wheels of lowest order means for bringing said rack and said wheels into operative relation and means operating during a subtracting operation of the machine for moving said rack to rotate both of said wheels a complete revolution.

37. In an adding machine a rack movable in one direction and then movable in an opposite direction, two adding wheels of lowest order, and means for bringing said rack and said wheels into operative relation, said rack operating during a subtracting operation of the machine to rotate one of said wheels a complete revolution while moving in one direction and to rotate the other of said wheels a complete revolution while moving in the other direction.

38. In a calculating machine, the combination of a plurality of accumulators, of mechanism positioned in coöperative relation to said accumulators and adapted to be so positioned by one accumulator as to register upon the other accumulator a single amount which represents the difference between the number appearing on the first named accumulator and the maximum totaling capacity of the machine plus one.

39. In a calculating machine, two sets of accumulators, a series of movable racks common to both, and means for moving the accumulators into and out of engagement with the racks, in combination with mechanism enabling the movement of said racks to operate one accumulator and to be governed by the other accumulator whereby the complement of the number appearing on one accumulator is automatically registered on the other accumulator.

40. In a calculating machine, two sets of accumulators, a series of movable racks common to both, and means for moving the accumulators into and out of engagement with the racks in combination with mechanism enabling the movement of said racks to operate one accumulator and to be governed by the other accumulator whereby the complement of the number appearing on one accumulator is registered on the other accumulator.

41. In a machine of the class described, the combination with two sets of registering wheels and their transfer or carrying mechanisms; of means for passing to one such set of wheels the true complement of a registration standing upon the other set under control of the latter.

42. In a machine of the class described, the combination with a set of registering wheels and actuators and carrying mechanism therefor; of an additional set of wheels; carrying mechanism therefor; and means for effecting a registration on said additional set of wheels under true complemental control thereof by the first set.

43. In a machine of the class described, the combination of two sets of adding wheels; actuators therefor; means for measuring movements of the actuators by the registering condition of wheels of one set while disengaged from the actuators; and means for engaging the other set of wheels with the actuators; to receive a registration corresponding with their thus measured movement.

In testimony whereof I affix my signature in presence of two witnesses.

HEBER C. PETERS.

Witnesses:
CLARENCE G. CAMPBELL,
S. J. COX.