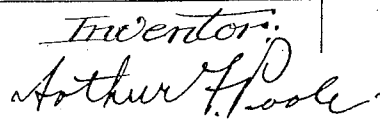


CALCULATING MACHINE.

Patented Oct. 29, 1918.

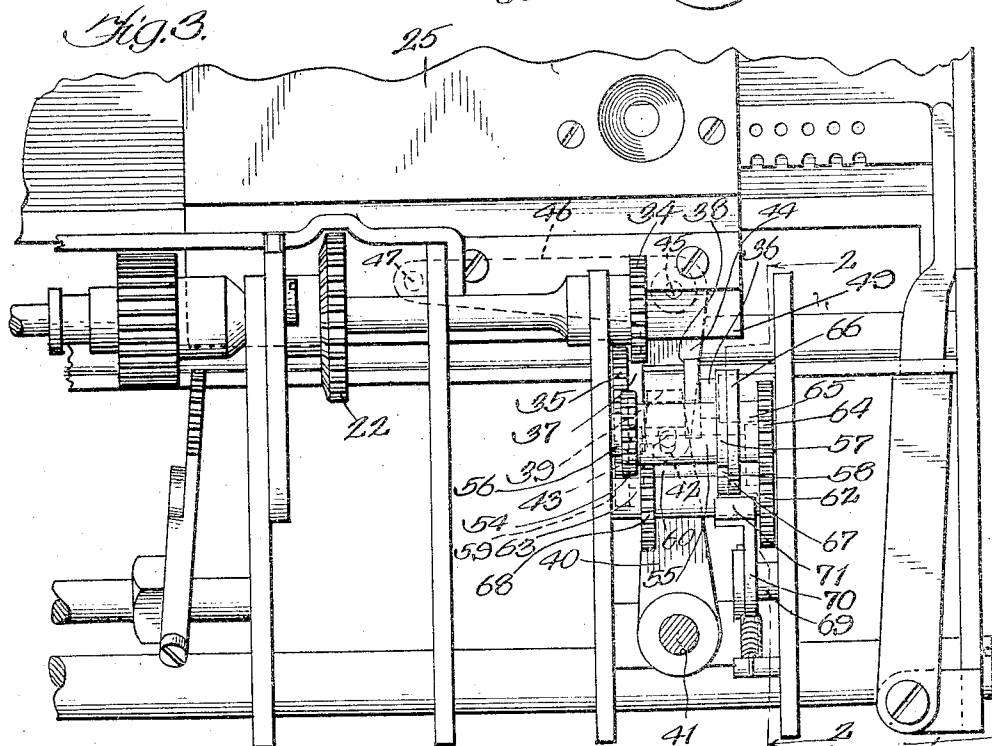
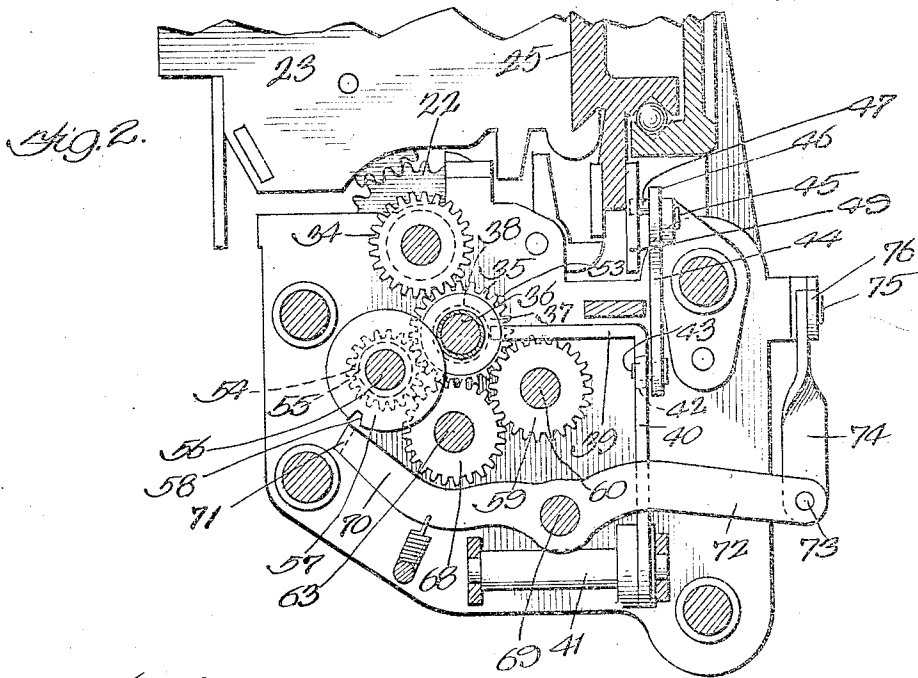
1,283,293.



A. F. POOLE.
 CALCULATING MACHINE.
 APPLICATION FILED SEPT. 9, 1916.

1,283,293.

Patented Oct. 29, 1918.
 5 SHEETS—SHEET 2.

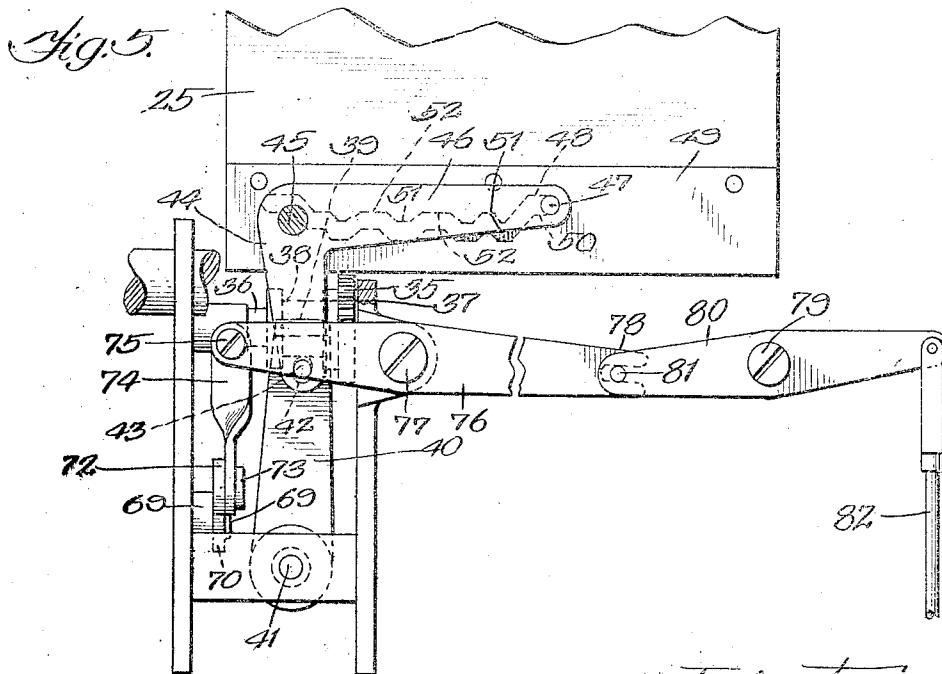
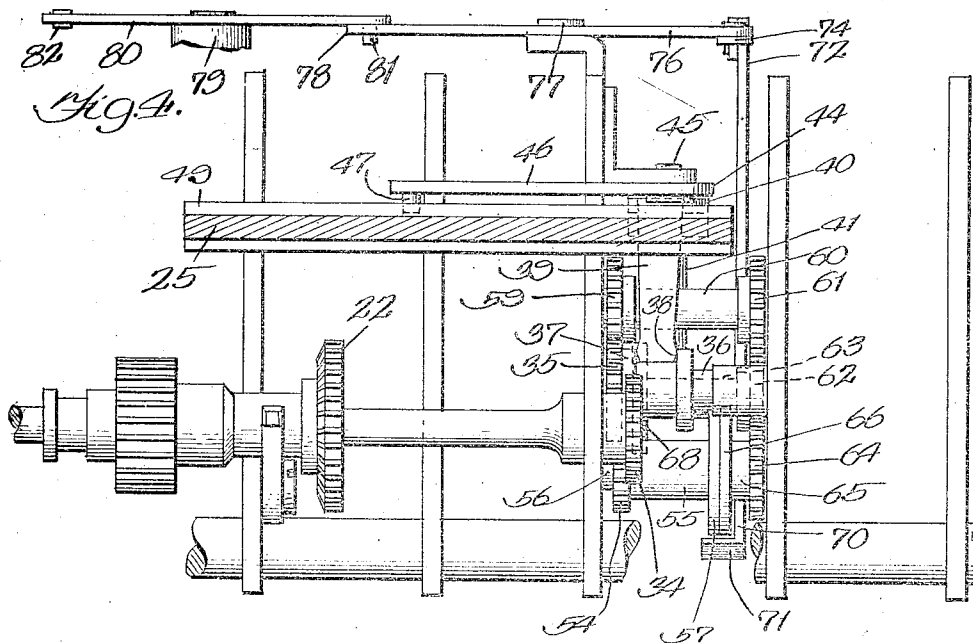


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 CALCULATING MACHINE.
 APPLICATION FILED SEPT. 5, 1916.

1,283,293.

Patented Oct. 29, 1918.
 5 SHEETS—SHEET 3.



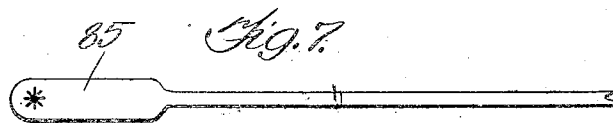
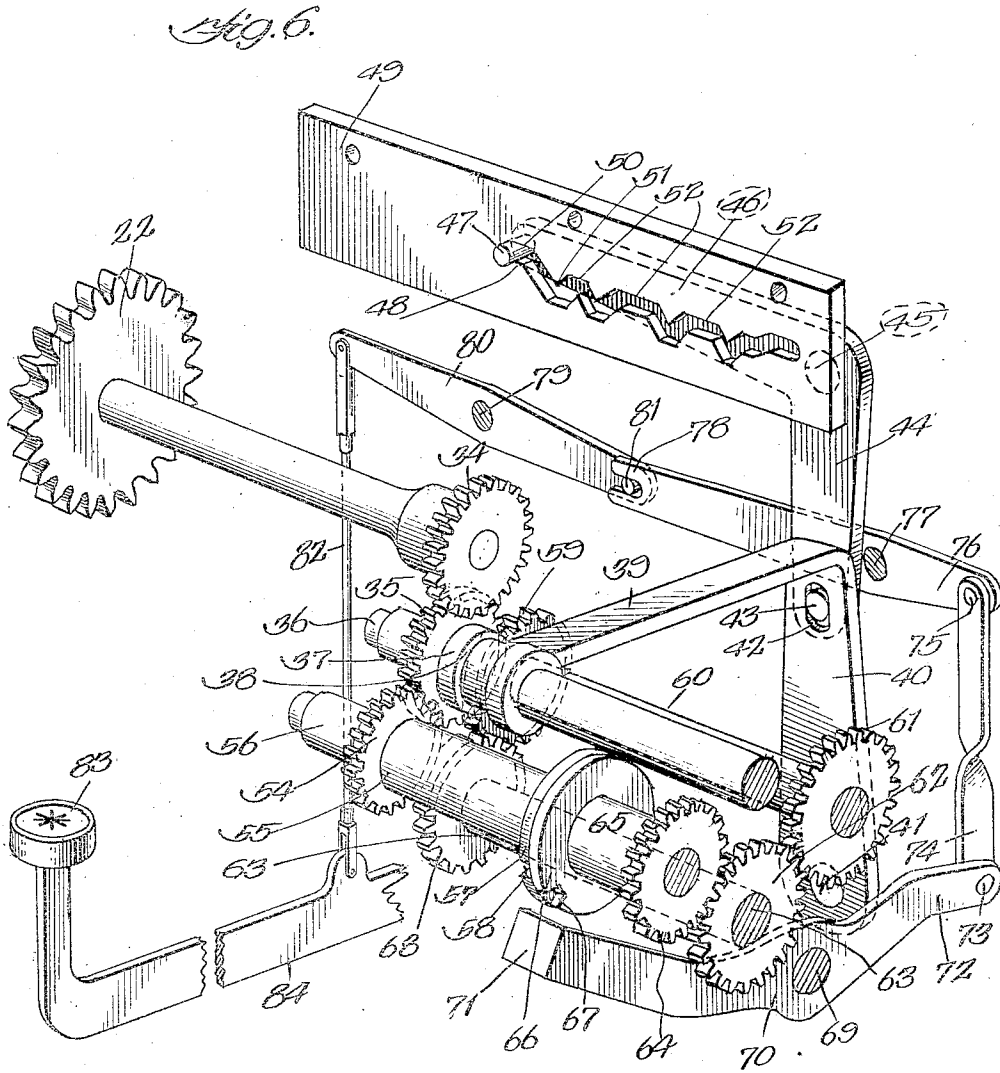
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 APPLICATION FILED SEPT. 5, 1916.

1,283,293.

Patented Oct. 29, 1918.

5 SHEETS—SHEET 4.

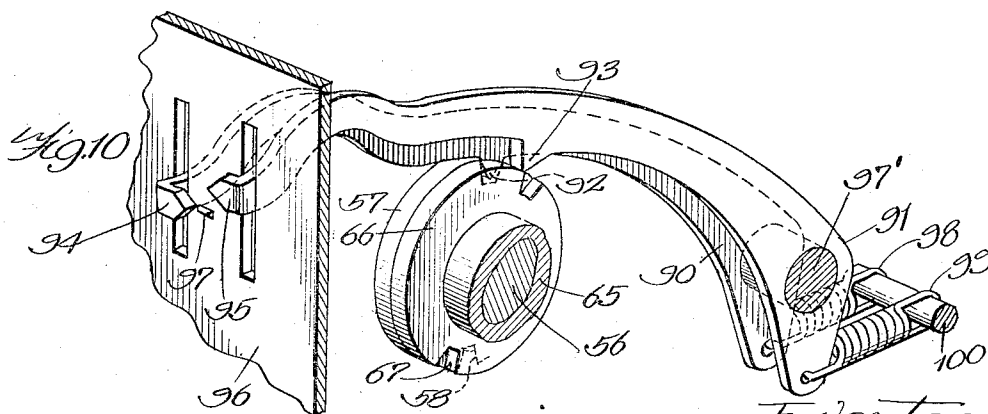
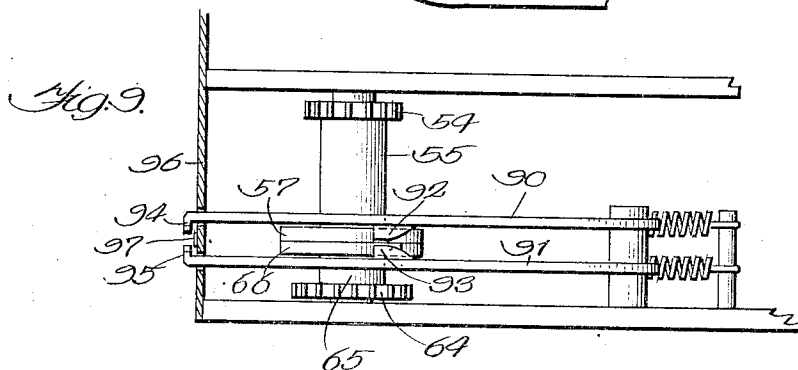
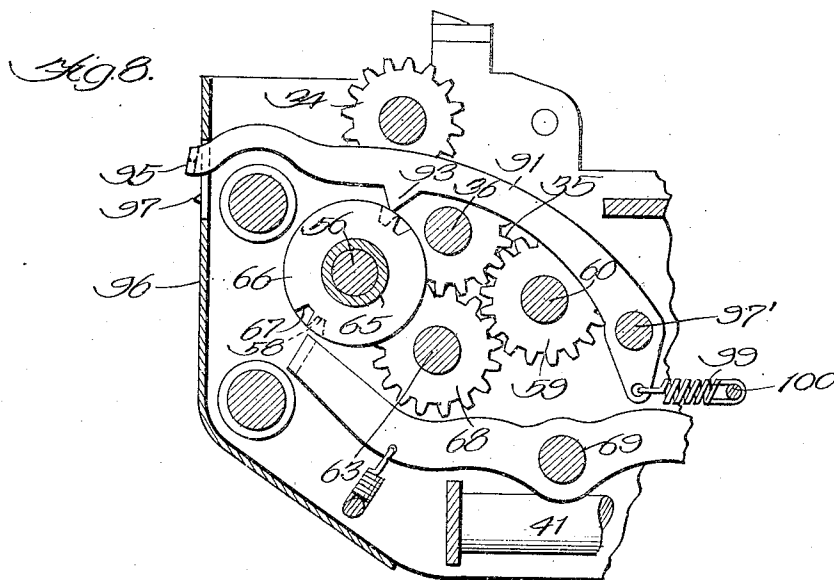


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1,283,293.

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CALCULATING MACHINE.
APPLICATION FILED SEPT. 5, 1916.

Patented Oct. 29, 1918.
5 SHEETS—SHEET 5.



Inventor:
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UNITED STATES PATENT OFFICE.

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CALCULATING-MACHINE.

1,283,293.

Specification of Letters Patent.

Patented Oct. 29, 1918.

Application filed September 5, 1916. Serial No. 118,378.

To all whom it may concern:

Be it known that I, ARTHUR F. POOLE, of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Calculating-Machines, of which the following is a specification.

My invention is a totalizer clear signal for calculating machines. It has for its object the giving of an indication to the operator that the total has been completely extracted from the machine and also to compute certain functions of the numbers entered into the calculating machine. It is especially applicable to calculating machines of the type shown in the issued patent to John C. Wahl, Number 893,719, and which machine has long been on the market in connection with the Remington typewriter under the name of the Wahl adding and subtracting machine.

One of the objects of my invention is the provision of a total clear signal which can be used with Wahl totalizers now in use without changing the structure of said totalizer in any particular.

Another object of my invention is the provision of a totalizer clear signal whose operation is independent of the totalizer itself and is governed entirely by the actuating mechanism used to insert numbers in said totalizer.

Another object of my invention is a totalizer clear signal which will give an indication in case the totalizer fails to operate properly. Such a condition, for instance, as would be caused by a broken tooth in one of the totalizer gear wheels, in which event the numbers entered into the totalizer by the actuating mechanism would not be correctly summed up.

A further object of my invention is the computation of certain herein defined functions of the numbers entered into the calculating machine.

Another object of my invention is the obtaining of the algebraic sum of the aforementioned function.

A further object of my invention is to provide a calculating machine having a reversible actuating mechanism or a mechanical equivalent thereof with a check to de-

termine that the algebraic sum of the numbers added and subtracted by said mechanism shall be zero or some multiple of a predetermined number, and this check to operate regardless of whether said actuating mechanism is operating a totalizer or not.

More particularly a further object of my invention is the provision of a mechanism to determine whether the algebraic sum of certain hereinafter defined functions of the numbers entered into a calculating machine is a multiple of 9 or 11 or of both.

A further object of my invention, incidental to the production of a totalizer clear signal, is the provision of mechanism which, independent of the condition of the operation of the totalizer, will sum up the digits entered in said totalizer by the actuating mechanism. These, and other objects of my invention, will be apparent to those skilled in the art and will be set forth in the following specification and claims.

Before entering upon a description of the construction of my mechanism I will first give a short discussion of the theory on which my invention is based. I believe that not only the mechanism necessary to carry out my invention but the theoretical considerations forming the basis thereof are broadly new in the calculating machine art, and that the structure and purpose of my invention will be much more readily understood in case one is first made acquainted with the theory of numbers according to which my improved machine operates.

It will first be necessary to define a certain kind of numbers, which I will call congruent numbers; these are defined as numbers which, when divided by a given base, will leave the same remainder: Example 12 and 22 are congruent to the base 10, since each will leave a remainder of 2 when divided by 10. Again, 8 and 71 are congruent to the base 9, since each will give a remainder of 8 when divided by 9.

Speaking generally, the two numbers $na+c$ and $ma+c$ are congruent to the base a , since it is obvious that when either one of these numbers is divided by a , c will be the remainder. If a and b are congruent to a certain base and c and d are congruent to the

same base, then $a+b$ will be congruent to $c+d$ and also $a-b$ will be congruent to $c-d$. These propositions are easily seen to be true by noting that:

- 5 If n $a+c$ and m $a+c$ } are congruent to the base a
 $n_1 a+c_1$ and $m_1 a+c_1$ }
 $(n+n_1)a+(c+c_1)$ and $(m+m_1)a+(c+c_1)$ their sum and
 $(n-n_1)a+(c-c_1)$ and $(m-m_1)a+(c-c_1)$ their differences are
 also congruent to the base a .

- 10 It is a property of numbers that any number and the sum of its digits are congruent to the base 9. This may be readily seen from the fact that any number under 10,000 may be represented by $1000a+100b+10c+d$, where a, b, c and d are the digits in the several decimal places. Now, if from this number, $a+b+c+d$ (the sum of its digits) be subtracted, the result is $999a+99b+9c$, a number which is obviously exactly divisible by 9.

- 20 Let us now consider the example below:

642	12
735	15
763	16
509	14
619	16
3268=9×363+1	73=9×8+1

- 25 In the first column are set down a series of numbers and their sum 3268. In the second column is set down the sums of the digits of the numbers in the first column, *e. g.*, the sum of the digits of 642 is 12; that of 735 is 15, et cetera. Obviously any number in the first column is congruent to the sum of its digits, and the sum 3268 is congruent to the sum 73 in the second column, since 3238 divided by 9 gives a remainder of 1, and 73 divided by 9 also gives a remainder of 1. Consider now the congruent numbers 3268 and 73. If from 3268 we subtract 3268 the remainder is zero, and if from 73 we subtract the sum of the digits of the numbers 3268, or 19, the remainder is 54. Obviously 0 and 54 are exactly divisible by 9, since 9 will go into 0 exactly 0 times and into 54 exactly 6 times.

- 45 Therefore, as a general proposition, if S is the sum of a series of numbers, and D the sum of the digits of these numbers, and d , is the sum of the digits of S , then $D-d$, will be exactly divisible by 9.

- 50 Returning now to the consideration of the general number $1000a+100b+10c+d$, let us take the sum of the digits in the even decimal places, calling the tens place the second place and counting toward the left, and from this subtract the sum of the digits in the odd decimal places, counting the figure in the units decimal place the first and also counting toward the left; that is, add to the general number $a-b+c-d$, *e. g.*

$$\begin{array}{r} 1000a+100b+10c+d \\ a-b+c-d \\ \hline 1001a+99b+11c \end{array}$$

- 60 Since the remainder is obviously divisible by 11 it follows that a number and the dif-

ference between the sum of the digits in the odd and even decimal places counting from the right are congruent to the base 11.

I shall hereinafter often have occasion to refer to two different functions of the digits composing a number. The first function, which I will call the 9 function, is defined as the sum of all the digits in a number; example, 56497 has for its 9 function 31.

Second, the 11 function of a number is defined as the difference between the sums of the odd and even digits of the number, calling the digit in the units place the first odd unit and the digit in the tens place the first even digit; for example, the 11 function of 56497 is $+1$. $9+6-(7+4+5)=-1$. The 11 function of 103067 is $6+3+1-7=+3$.

With the above definition in mind my invention may be broadly described as a mechanism to obtain the algebraic sum of the 9 functions and the 11 functions of numbers entered into the totalizer and to determine when the algebraic sum of the 9 functions of the numbers entered into the totalizer is congruent to the sum of said numbers and also when the algebraic sum of the 11 functions of the numbers entered into the totalizer is congruent to the algebraic sum of said numbers. Both the numbers and their 9 and 11 function are to be taken algebraically; that is, when a number is added, both its 9 and 11 functions are added and when a number is subtracted, both its 9 and 11 functions are likewise subtracted.

In the Wahl machine numbers are added into the totalizer one digit at a time, and after a series of numbers have been accumulated the gear shift of the machine changes the relation between the keys and the actuating mechanism and the number appearing in the totalizer is printed out and simultaneously subtracted from the totalizer, leaving the totalizer at zero. In my improved machine, in order to compute the 9 functions of the numbers entered therein, I have geared a disk to the master wheel of the Wahl machine and have arranged this disk so that it will operate in a cycle of nine steps. As numbers are put into the machine this disk is turned according to the motion of the master wheel. Therefore, if we start in with the disk in a zero position and insert numbers the displacement of this disk represents the sum of all the digits which have been inserted into the machine. If now the total appearing in the totalizer is subtracted from the machine the disk will be turned backward through a number of steps corresponding to the sum of the digits of said total, and if said total has been completely extracted the total number of steps turned by the disk in one direction less the total number of steps turned by the disk in the contrary direction will be divisible by 9. I have, therefore, provided this disk

with a slot at every ninth step, and cooperating with said disk have provided a lever which is attached to a key on the typewriter, which key is adapted to print a star or other characteristic mark. If the slot in the disk is opposite said lever the star may be printed. If the slot is not opposite said lever the printing of this star will be prevented, thereby giving an indication to the operator that the correct total of the numbers added to the machine has not been subtracted therefrom.

In order to compute the 11 functions I have connected a second disk to the master wheel through a gear shift which rotates said disk either in the positive or negative direction, since it will be remembered that the 11 functions of a number is obtained by taking the difference between the sum of all the digits in the even decimal places and the sum of all the digits in the odd decimal places. On the decimal carriage which serves to determine the decimal place in which a particular digit is entered into the totalizer I have placed a cam, which controls said gear shift, thus the disk for the 11 test is made to revolve alternately in a positive and negative direction in order to compute the 11 functions of the number entered in the totalizer. In the disk are placed slots at a distance of 11 steps from each other, and the lever which cooperates with the 9 disk also cooperates with the 11 disk. The slots in the 11 disk are placed at 11 steps from each other; therefore, if, prior to the entry of a number into the totalizer, the slot in the 11 disk is opposite the lever, then, when the algebraic sum of the 11 functions of the numbers entered into the totalizer is divisible by 11 a slot will again be opposite this lever, and in case the slot in the 9 disk is also opposite said lever the star may be printed.

At this point, the question arises of why it is necessary to compute two functions, viz., the 9 function and the 11 function of the numbers entered into the totalizer. The answer is that it will be apparent that if the 9 function alone were present, and the totalizer stood at zero or at any multiple of 9 a slot in the 9 disk would be opposite the lever, and, therefore, the printing of the star would be permitted. From this it follows that if the operator, on clearing the totalizer, left a 9 in any of the decimal places or any combination of numbers whose sum is a multiple of 9 the star could be printed notwithstanding the fact that the totalizer was not clear. Similarly, if the 11 test alone were present and any multiple of 11 were left in the totalizer the star could be printed. However, by combining these two tests it is necessary that the number which is left in the totalizer be a multiple of both 11 and 9. Since these two numbers are

prime to each other the number left in the totalizer must be 99 or some multiple thereof in order for the star to be printed. The chances of the operator's leaving this particular combination in the totalizer, and thereby giving an erroneous clear signal, are so small as to be negligible in practice.

It may be argued that some multiple of 99 could be left in the totalizer purposely and an erroneous clear signal be obtained, but in this connection it is pointed out that inasmuch as the operator of the machine has to discover the error made by her in case her accounts do not balance the hypothesis of premeditated misoperation of the machine may be neglected, since by so doing the operator is simply making work for herself. I have found in practice that the two checks in combination afford ample protection for all commercial work.

Having now set forth the theory of my invention, I will give a description of the mechanical structure necessary to carry it into practice.

Figure 1 is a front elevation of a Wahl cross footing machine equipped with my invention.

Fig. 2 is a section through the lines 2—2 of Fig. 1.

Fig. 3 is a front view of part of the mechanism in the cross actuator.

Fig. 4 is a top view of the mechanism shown in Fig. 3.

Fig. 5 is a detail of the gear shift mechanism.

Fig. 6 is a perspective of the mechanism peculiar to my invention, and

Fig. 7 is a diagrammatic view of the type bar which operates the star or other characteristic mark.

Figs. 8, 9 and 10 are views of a device to indicate when the function computing mechanism is in its zero position.

I have shown my invention as applied to a Wahl cross footing machine, since it is very well adapted to work with said machine, and especially with the cross totalizer thereof. It is not necessary to go into an extended description of said Wahl machine, for they are well known on the market. I will, therefore, describe the operation of this machine in a very general way, reference being had to the commercial machine for the details of the mechanism to accomplish the various functions therein.

In Fig. 1 is shown said Wahl machine which is mounted on a Remington typewriter 10 equipped with a set or numeral keys 11, which are connected by a set of pull rods 12 to a vertical actuator 13. The mechanism in the vertical actuator serves to transform the vertical motion of any of the numerals keys 11 into a differential rotation of a vertical master wheel 14. The machine is provided with a vertical truck 15 which

travels step by step with the carriage 16 of the typewriter 10. On this truck are mounted the vertical totalizers 17, 18, 19 and 20, and the master wheel 14 serves to enter numbers in these totalizers digit by digit. For the sake of clearness I have left out quite a number of elements which are present in the typewriter, such as, for instance, the alphabetical keys, the tabulating mechanism, the space bar and the typewriter escapement mechanism, since these are all well known in the art and their delineation is not necessary for the understanding of my present invention. Connected to the vertical actuator is the cross actuator in which is the cross master wheel 22, which serves to enter numbers in the cross totalizer 23. There is a pick-up and release mechanism consisting of a pick-up beam 24 mounted on the cross truck 25, and this beam is held by a spring 26 in the path of a series of lugs (not shown) mounted on the vertical truck 15. A spring 27 serves to return the cross truck to its normal position when the same has been displaced therefrom in order to enter a number into the cross totalizer 23. The direction of rotation of the cross master wheel 22 is automatically controlled by a gear shift device (not shown), which is controlled by a set of cams 28, 29 and 30 mounted on the vertical totalizers and which serve to operate on arm 31 controlling the gear shift device for the cross totalizer. It is possible by different levels of the cams 28, 29 and 30 to determine that the cross master wheel 22 shall either add, subtract, or not operate in the cross totalizer 23.

The arrangement of the cross totalizer 23 is such that it acts as a jumping totalizer, well known in the art, and numbers are entered simultaneously in any one of the vertical totalizers 17, 18, 19 or 20, and the cross totalizer 23. After a number is entered in the vertical totalizer 17 further progress of the typewriter carriage brings the vertical totalizer 18 into cooperation with the vertical master wheel 14, and operation of the numeral keys will enter the same number into said vertical totalizer 18 and the cross totalizer 23. After the number has been entered into any of the vertical totalizers the cross totalizer is disconnected from the vertical truck by means of a pin 32 on the pick-up beam encountering a cam surface 33 fixed on the framework of the typewriter 10. After such disconnection, the cross totalizer 23 returns to its normal position under the influence of the spring 27 ready to be picked up by the next succeeding vertical totalizer. During a run of the vertical truck 15 the cross totalizer 23 makes as many reciprocations as there are connecting lugs mounted on the vertical truck 15, and since a predetermined program of calculation has been set up by the cams 28, 29 and 30, at the

end of the run the cross totalizer will show a total of the numbers written in horizontal arrangement on the work sheet. When this cross total is written on the work sheet the cross totalizer is thrown into subtraction by, for instance, the cam 30 and said total copied out. This returns the cross totalizer to 0 ready for a computation of the next horizontal line of numbers.

During a day's operation of the machine the cross totalizer 23 has computed a large number of horizontally written numbers, the totals of which have been cleared out at the end of each line, and it is desirable to have the totalizer clear signal device cooperating with the cross totalizer 23. The vertical totalizers are used to accumulate grand totals, and are cleared only at relatively infrequent intervals; therefore, a device of this kind is not particularly necessary in connection with them and in the machine illustrated I have shown my device as applied to a cross totalizer only. It is obvious that those skilled in the art would have no difficulty whatever in applying a similar device to the vertical master wheel, it only being necessary that either a separate star printing key be provided for said proposed vertical totalizer equipment or some equivalent means of avoiding interference with the clear signal used in connection with the cross totalizer 23.

From what has been said it will be apparent that the cross master wheel 22 revolves in one direction for the insertion of numbers in the cross totalizer and in a contrary direction for subtracting the numbers therefrom. It is, in fact, true that if one starts with the cross totalizer at 0, and adds and subtracts a series of numbers and then clears the cross totalizer by subtracting out the exhibited total that the number of steps taken by the master wheel 22 in a positive direction will not in general equal the number of steps taken by said master wheel in a negative direction, for any units accumulated in the cross totalizer 23 by the operation of carrying from one denomination to another would not be represented by rotation of said master wheel 22.

Rigid with the shaft of the cross master wheel 22 (Fig. 6) is a gear 34 having the same number of teeth as said cross master wheel 22. Adapted to mesh with the wheel 34 is a gear 35 rotatably and slidably mounted on a shaft 36 which is rotatably mounted in the framework, although said shaft 36 may be rigidly mounted on said framework if such construction is desirable. Rigid with the gear 35 is a collar 37 having a groove 38 therein, which is engaged by a shifter 39 which is the forwardly projecting end of a lever 40 pivotally mounted in the framework at 41 and having a slot 42 therein. The position of the gear shifter 39 is controlled

by a pin 43 in a lever 44 pivotally mounted on the framework at 45 and having an arm 46 in which is mounted a pin 47 which is guided by a cam slot 48 in a plate 49 mounted on the back of the cross truck 25 (Figs. 2, 3 and 6). The cam slot 48 has three different levels corresponding to three different positions of the shifter 39. These levels I have numbered 50, 51 and 52. As the cross truck 23 progresses step by step toward the left the shifter 39 is thrown into any one of three different positions, according to the levels of the cam 48. When the shifter 39 is in first position, which position corresponds to a nonoperative position of the function computing device the gear 35 is out of mesh with the gear 34 and is held from rotation by a pin 53 (Fig. 2) mounted in the framework and adapted to enter between the teeth of said gear 35. When the shifter 39 is in said first position rotation of the cross master wheel 22 will produce no effect on said gear 35. When the shifter 39 is in its second position, which position corresponds with the level 52 of the cam 48, said gear 35 serves to transmit the motion of the master wheel 22 and its rigidly connected gear 34 to two different chains of gearing; first, to a wide gear 54 of eighteen teeth (although any suitable multiple of 9 may be used, rotatably mounted on a shaft 56, which is rotatably mounted in the framework, and second to a gear 59 hereinafter to be described. The arrangement of the collar 55 and the gear 54 is such that said collar and gear, while rotatably mounted on the shaft 56, has no lateral motion with respect to said shaft. On the other end of the collar 55 is mounted the "9" disk 57 and this disk has in it a slot 58 and a second slot (not shown) located diametrically opposite the slot 58. The gear relation between the cross master wheel 22 and the disk 57 is such that eighteen steps of said master wheel will rotate the disk 57 through a complete revolution. Since said disk has two slots it will, therefore, require nine steps of the cross master wheel 22 to rotate said disk 57 through the angular distance between the slot 58 and its diametrically opposed one.

When the shifter 39 is in its second position the gear 35, as before noted serves also to transmit motion to a second gear chain as follows. In mesh with said gear is a gear 59 of twenty-two teeth rigidly mounted on a shaft 60 rotatably mounted in the framework and having rigidly mounted on it a gear 61 of twenty-two teeth which meshes in an equal sized gear 62 rigidly mounted on a shaft 63 rotatably mounted in the framework, and the gear 62 is in mesh with a similar gear of twenty-two teeth, which is mounted on a collar 65 rotatable on the shaft 56. An "11" function computing disk 66 is rigidly mounted on the collar 65 and

has in it a slot 67 and another slot (not shown) diametrically opposite. The 11 test disk 66 makes one complete revolution for every twenty-two steps of the cross master wheel 22, and, therefore, it requires eleven steps of the cross master wheel 22 to turn the 11 test disk from the slot 67 to its diametrically opposite slot (not shown).

When the gear shifter 39 is in its third position corresponding to the cam level 51 the gear 35 is in its third position also. Owing to the gear 54 being provided with a wide face said gear remains in mesh with the gear 35 when said gear is in its third position and, through it, with the gear 34. After the gear 35 has been thrown entirely out of mesh with the gear 59 due to the shifter 39 coming to its third position it is in mesh with a gear 68 rigid on the shaft 63 and, therefore, rigid with the gear 62.

Changing the gear shifter 39 from its second to its third position has the effect of changing the direction of rotation of the 11 disk 66 without changing the direction of the 9 disk 57, and since the cam 48 which controls these shifts advances step by step with the cross truck it is evident from the shape of said cam that the direction of the rotation of the 11 disk 66 will be changed at every alternate decimal place and, therefore, the 11 disk 66 will be displaced to compute the 11 function of the number entered by the cross master wheel 22 into the cross totalizer 23.

The structure of the gears 34, 35, 54, 59 and 68 is such that when the shifter passes from one of its positions to the other, thereby shifting the gear 35 into various positions, the disks 57 and 66 are always constrained. In its first position the gear 35 is out of mesh with the gear 34 and is in mesh with both the gears 54 and 59 and is also held locked by engaging the pin 53. When the shifter 39 moves the gear 35 to its second position, the gear 35 remains in mesh with the gears 54 and 59 and enters in mesh with the gear 34. When said gear 35 is moved by the shifter 39 to its third position the gears 35 and 34 remain in mesh as do also the gears 35 and 54 and the gear 35 enters into mesh with the gear 68 before it comes out of mesh with the gear 59. From this arrangement it follows that the disks 57 and 66 are at no time free to turn except as they are turned by the motion of the cross master wheel 22. When the shifter is in its first position these disks are, of course, held locked by reason of the gear 35 being locked on the stud 53. In passing from the second to the third position, the fact of the gear 35 remaining in mesh with the gear 55 until it enters on gear 68 prevents accidental displacement of either of said disks during the shift.

It is necessary at times to write numbers

in the machine which are not computed, such, for instance, as dates. For this reason the first or disconnect position of the shifter 39 is provided. When said shifter 39 is in its first position the gear 35, while in mesh with the gears 54 and 59, is out of mesh with the gear 34 and, therefore, rotation of the cross master wheel 22 is not transmitted to the disks 57 and 66.

10 Pivoted in the framework 69 is a lever 70. Projecting at right angles to the front arm of said lever is a test plate 71 which is adapted to enter the notches 58 and 67 when both of said notches are in register with said
15 plate. The rear end 72 of the lever 70 has a pivot 73 on which is mounted a twisted link 74 which is connected to a pivot 75 in the rear end of a lever pivoted in the framework at 77 and having in its front end a
20 fork 78. Pivoted on the framework at 79 is a lever 80, on one end of which is a pin 81 working in the fork 78, and on the other is pivoted a pull rod 82 which serves to connect the lever 80 to a star printing key 83
25 mounted on a type bar lever 84, which, through the usual mechanism, serves to operate a type bar 85 which is adapted to print a star or other characteristic mark to indicate a condition of the actuating mechanism
30 having subtracted from the totalizer the same number which was added into it.

As before noted, the cross master wheel 22 may be reversed and such reversal, when it occurs, will simultaneously reverse the direction of rotation of both the disks 57 and 66.
35 The operation of my device is as follows:

By an operation hereinafter to be described, the slots 58 and 67 are first brought into register with the test plate 71 and the
40 star is printed. The cross totalizer 23, which has previously been brought to zero, is then mounted on the cross truck. Numbers are entered into this totalizer by the keys in the usual manner and the disk 57
45 will compute the 9 function of said numbers and the disk 66 will compute the 11 function of said numbers, these functions being computed both in addition and in subtraction. At any time during the computation of the numbers entered into the totalizer the 9 disk will show the algebraic sum
50 of the 9 functions of the numbers entered into the machine and the disk 66 will show the algebraic sum of the 11 functions of the numbers entered into the machine.
55

As before noted, when the algebraic sum of the numbers entered by the actuating mechanism into the totalizer is 0 the algebraic sum of the 9 functions is either 0 or
60 some multiple of 9, and the algebraic sum of the 11 functions is either 0 or some multiple of 11. Consequently when the two slots 58 and 67 are again in register with the test plate 71 the algebraic sum of the
65 numbers entered into the cross totalizer by

the cross master wheel 22 will be either 0 or some multiple of 99. If the totalizer has functioned correctly during this operation it will stand either at clear or at some multiple of 99, and in either event the star
70 printing key 83 may be operated and the star being printed on the paper will indicate that said totalizer stands either at clear or at some multiple of 99, *e. g.* 99, 198, 297, 396, 495, et cetera.
75

It will be noticed (Figs. 5 and 6) that some of the levels 52 of the cam slot 48 are longer than others. These long levels 52 correspond to the decimal or pointing off
80 places of the cross totalizer 23. The Wahl totalizers are provided with a decimal lock which prevents the operation of the numeral keys in these pointing off places. It is, therefore, not necessary to throw the shifter
85 39 to its disconnect position, in these pointing off places, as would be the case were this decimal lock not provided, so the shifter is simply left in its second position, the operation of the numeral keys in the pointing off
90 places being prevented by the decimal lock above referred to.

It will, of course, be necessary to provide a plate 49 corresponding to the particular spacing of the totalizer which is used, both as to the width or capacity of said totalizer
95 and to the arrangement of its number wheels as regards to decimal or pointing off places. However, these plates can be made and sent out with the totalizer with which they are to be used so that for each totalizer there
100 will be provided a proper plate 49 to operate the shifter 39.

I wish to call attention to the fact that this totalizer clear signal is adapted only to be used in connection with totalizers which calculate to the base 10. Obviously it is not
105 suited for use with totalizers calculating to any other base, such, for instance, as English money, in which the bases are 10, 20, 12 and 4.
110

I will now describe the method by which the slots 58 and 67 are brought into register with the test plate 71 before beginning to operate the machine. A hole is provided in the cover of the cross actuator so that the operator may observe the position of the
115 slots 58 and 67 with reference to the test plate 71. The cross decimal carriage is first moved to a position such that the shifter is in its second position. It is held in this position; that is, the typewriter is not allowed to escape, which may be easily done by holding the space bar depressed, and the
120 numeral key is successively operated until the slot 67 is brought into register with its plate 71. The cross truck 25 is then moved so as to bring the shifter to its third position and 1 is now inserted. The truck 25 is then moved so as to bring the shifter to its second position and 1 is inserted. The
125 130

net results of these two operations will be to leave the slot 67 in its original position and to advance the slot 58 two spaces. If said slot 58 is not yet in register with the plate 71 above described the operation is then repeated until the slot 58 is brought into register with the test plate 71.

This operation of bringing the slot 58 into register and leaving the position of the slot 67 unchanged must, of course, be done in cycles of two steps, but it is to be noted that the position of the slots 58 on the 9 disk 57 differ by nine steps and, therefore, it will always be possible, by means of the above described operation, to bring the two slots 58 and 67 into register with the test plate 71. When this is done the cross totalizer 23 may be placed in its position on the cross truck 25 and the computation started.

It is obvious that those skilled in the art could easily apply a pair of visible targets to act in conjunction with the disks 57 and 66, and thus obviate the necessity of having to observe directly the relative position of the test plate 71 and the slots 58 and 67. When these two slots are in register with the test plate it is evident that the slots in the respective disks diametrically opposite these slots are in register also, and each disk could be provided with a separate lever having its rear end entering the slots, and bearing on its front end a small target which could be observed through a hole in the actuator cover. The registry of the slots 58 and 67 with the test plate 71 would then be indicated by the appearance of both of these targets behind their respective sight openings in the cover. In Figs. 8, 9 and 10 I have illustrated the device just described. Reference to these figures will disclose that the disks 57 and 66 have acting in conjunction with them a pair of levers 90 and 91, said levers having projections 92 and 93 and terminating in indicating points 94 and 95, which project through the cover 96 and register with a zero mark 97 attached to said cover. The projections 92 and 93 are so shaped that they will be cammed out of the slots in the cooperating disks as said disks are revolved. The levers 90 and 91 are rotatably mounted on a stud 97' rigid in the framework and are given a tendency to rotate in a counterclockwise direction (Fig. 10) by springs 98 and 99 extending between said levers and a stud 100 mounted in the framework. The fact of the notches in the disks 57 and 66 being in alignment will be indicated by the indicators 94 and 95 being in line with the index mark 97.

A very convenient way of bringing the two notches into registry is to hold the space bar of the typewriter depressed and operate the one-key of the typewriter successively until the nine function computing disk 57 is brought into its zero position,

which fact will be indicated by the indicator 94 registering with the index 97. With the space bar still depressed, the nine-key is then operated until the indicator 95, co-operating with the eleven function disk 66 is brought into registry. It is to be observed that the operation of the nine-key will turn the disk 57 through nine spaces and hence not disturb its zero adjustment, since said disk operates in a cycle of nine spaces. In practice, after the disks 57 and 66 have been set to their zero position they will not be disturbed unless a computation was being made. When a computation is being made, that is, when numbers are inserted into the machine which do not go into the totalizer, the usual disconnect lever provided with the Wahl machine should be used. This, of course, will render the numeral keys inoperative on the disks 57 and 66 and said disks will remain undisturbed. It is also evident that the disks 57 and 66 could be made somewhat wider than shown and have distinguishing marks on the edges of these disks to denote their zero position.

I desire to call particular attention to the fact that my hereinbefore described function computing device operates entirely independent of the operation of the totalizer; consequently it will serve as a valuable check not only on the accuracy of the operator but on the accuracy of the computing done by the totalizer itself. If the totalizer has a broken tooth or for any reason whatever does not function properly; that is, does not correctly compute the numbers put into it, it is obvious that my herein described clear signal will give a warning of such error. It is only in case the error is a multiple of other than zero that confusion will occur, and the probability against such a confusion occurring is so great as to be negligible.

I believe I am broadly new in providing a totalizer clear signal which will detect a failure of the totalizer to function properly, and such a device will be of great value in machines of the kind in which the carrying is not done positively but is done by means of spring actuating levers. In all the totalizer clear signals with which I am acquainted the operation of this signal is controlled solely through the totalizer. The fact of the totalizer wheels being brought to zero will give a "clear" indication, regardless of whether or not the totalizer has correctly calculated the numbers entered therein.

It sometimes happens that a calculating machine is used with a so-called algebraic totalizer. A totalizer of this kind has two zero positions, viz. a zero position for positive numbers and a second zero position for negative numbers, and these two zero positions differ from each other by the extent of one step of the wheel in the lowest decimal place in the totalizer. I desire to call atten-

tion to the fact that my herein described function computing device, when it is used in its particular application of a totalizer clear signal, will work perfectly with an algebraic totalizer, since as a rule the additional step in such totalizer is inserted, not by the actuating mechanism, but, by some agency independent of the actuating mechanism, such as a closed carrying chain from the highest wheel, or by a separate handle to insert manually this extra digit whenever the totalizer passes through zero. Since an extra step inserted into the totalizer independent of the master mechanism makes the difference between the position of the totalizer mechanism for positive zero and that of negative zero, it is obvious that as far as the actuating mechanism is concerned these two zeros are mechanically equivalent, and, therefore, my herein described totalizer clear signal will give clear indications in case the totalizer is returned to negative zero, as well as if said totalizer is returned to positive zero. If, in any case, the mechanism was such that the extra unit is inserted by the actuating mechanism it would be necessary to prevent this extra unit from entering into the computation of either 9 or 11 functions.

I believe I am the first to show a mechanism for computing the 9 function of a number, the first to show a mechanism for computing the 11 function of a number and also the first to show a mechanism for computing these two functions in combination, and I wish to claim the same broadly.

In a number of the following claims I have used the term "number inserting mechanism," and I wish this to be understood as mechanism for inserting a number greater than nine. It is obvious that when a number consists of a single digit that the nine function or the eleven function of the number is identical with the number itself. From this it follows that it is possible to compute the nine functions of numbers less than nine and also to compute the sum of said function on certain calculating machines of the prior art, particularly in that shown in the patent to Wahl, Number 893,719, or in the machine shown in the British patent to Walter Wright, Number 8740 of 1909. I wish, therefore, to have the term "number inserting mechanism" when used in the following claims as defining mechanism which is adapted to insert numbers of more than one decimal place, and also when speaking of a "number" I limit myself to numbers greater than nine, and I am making this insertion in the specification for the purpose of avoiding the needless repetition of these facts in each of the following claims. It is obvious that in the cited machines of the prior art that when one inserts a number which is greater than nine that the mecha-

nism in said prior art machines will not compute the nine or eleven function of the inserted number but will compute the number itself.

In spite of repetition I will again define the 9 function of a number as the sum of all the digits of that number and will define the 11 function of a number as the difference between the sums of the alternate digits of a number. I shall use these terms in the claims for the purpose of conciseness and said terms are to be construed therein in accordance with the above definition.

In the accompanying claims I have spoken of a function computing device as distinguished from the ordinary totalizer of a calculating machine, said totalizer calculating functions of the digits of the various numbers combined with powers of ten. Obviously an ordinary totalizer does not compute a function of the digits of the numbers alone. It computes a function which is determined by the digits themselves combined with powers of ten taken in accordance with the decimal arrangement of the digits. I, of course, do not intend in any of the claims to authorize a construction of said claims which will read on the ordinary totalizer of a calculating machine. Obviously one can compute the nine and eleven functions here-in described of numbers greater than nine on a totalizer of a calculating machine, but such use is no more of an anticipation of my present invention than the use of a pencil and paper for computing these functions, for in order to compute said functions one has to enter not the numbers into the machine but the digits constituting said numbers.

Many changes and alterations of my device herein described may be made by those skilled in the art without departing from the spirit of my invention and many other uses will be found for it in addition to those herein described.

Having now described my invention, what I claim as new is:—

1. In a calculating machine, the combination of mechanism to enter a number in said machine, and means to compute the nine function of the number entered by said mechanism.

2. In a calculating machine, the combination of mechanism to enter a plurality of numbers in said machine, and means to compute the nine functions of said numbers and to sum said nine functions.

3. In a calculating machine, the combination of mechanism adapted to enter a series of numbers in said machine both positively and negatively, and means to obtain the algebraic sum of the nine functions of said entered numbers.

4. In a calculating machine, the combination of mechanism adapted to enter a series

of numbers in said machine both positively and negatively, and means to obtain the sum of the nine functions of said entered numbers.

5 5. In a calculating machine, the combination of mechanism to enter a number in said machine, and means to compute the eleven function of the number entered by said mechanism.

10 6. In a calculating machine, the combination of a mechanism to enter a number in said machine and mechanism to accumulate the sum of the digits of the numbers entered in the machine.

15 7. In a calculating machine, the combination of number entering mechanism, and mechanism to accumulate the difference between the sums of the alternate digits of numbers entered into the machine.

20 8. In a calculating machine, the combination of number entering mechanism, means to compute the nine function of the entered numbers and means to compute the eleven functions of said entered numbers, both of said computing means being actuated from a common source.

25 9. In a calculating machine, the combination of mechanism to enter a plurality of numbers in said machine, and means to compute the eleven functions of said numbers and to sum said eleven functions.

30 10. In a calculating machine, the combination of mechanism adapted to enter a series of numbers in said machine both positively and negatively, and means to obtain the algebraic sum of the eleven functions of said entered numbers.

35 11. In a calculating machine, the combination of mechanism adapted to enter a series of numbers in said machine both positively and negatively, and means to obtain the sum of the eleven functions of said entered numbers.

40 12. In a calculating machine, the combination of mechanism adapted to enter a number in said machine either positively or negatively, mechanism to compute the nine function of said number and a common reverse operative on both said number entering mechanisms, and said mechanism for computing the nine function simultaneously.

45 13. In a calculating machine, the combination of mechanism adapted to enter a number in said machine either positively or negatively, mechanism to compute the eleven function of said numbers and a common reverse to reverse the actuating mechanism, and mechanism for computing the eleven function simultaneously.

50 14. In a calculating machine, the combination of number actuating mechanism, eleven function computing mechanism, nine function computing mechanism, a common actuating means for the eleven function and
55 nine function computing mechanism, and a

reverse common to the actuating mechanism, the nine function and eleven function mechanism and the computing mechanism.

15. In a calculating machine, the combination of number computing mechanism, 70 eleven function computing mechanism, nine function computing mechanism, a common actuating means for the eleven and nine function computing mechanisms, and a common reverse for the number computing 75 mechanism and the nine and eleven function computing mechanism.

16. In a calculating machine, the combination of a totalizer, actuating mechanism adapted to insert a number therein *seriatim*, 80 and mechanism to compute the nine function of a number entered by the actuating mechanism.

17. In a calculating machine, the combination of a totalizer, actuating mechanism 85 adapted to insert a number therein *seriatim*, and mechanism to compute the eleven function of a number entered by the actuating mechanism.

18. In a calculating machine, the combination of a totalizer, actuating mechanism 90 adapted to insert a number therein *seriatim*, and mechanism to accumulate the sum of the digits of the numbers so entered.

19. In a calculating machine, the combination of a totalizer, actuating mechanism 95 adapted to insert a number therein *seriatim*, and mechanism to accumulate the difference between the sums of the alternate digits of numbers entered into the machine. 100

20. In a calculating machine, the combination of a totalizer, actuating mechanism adapted to insert a number therein *seriatim*, mechanism to compute the nine function of the entered numbers and mechanism to compute 105 the eleven functions of said entered numbers, both of said computing mechanisms being actuated from a common source.

21. In a calculating machine, the combination of a totalizer, actuating mechanism 110 adapted to insert a number therein *seriatim*, mechanism to compute the nine function of said numbers and a common reverse to reverse simultaneously the actuating mechanisms, and mechanism for computing the 115 nine function.

22. In a calculating machine, the combination of a totalizer, actuating mechanism adapted to insert a number therein *seriatim*, mechanism to compute the eleven function 120 of said numbers and a common reverse to reverse simultaneously the actuating mechanism, and the mechanism for computing the eleven function.

23. In a calculating machine, the combination of a totalizer, actuating mechanisms 125 adapted to insert a number therein *seriatim*, eleven function computing mechanism, nine function computing mechanism, a common actuating means for the eleven and nine 130

function computing mechanisms, and a common reverse for the actuating mechanism and the nine and eleven function computing mechanisms.

- 5 24. In a calculating machine, the combination of a totalizer, actuating mechanism adapted to insert a number therein *seriatim*, eleven function computing mechanism, a common actuating means for the eleven and
10 nine function computing mechanisms, and a common reverse for the number computing mechanism and the nine and eleven function computing mechanism.

25. In a calculating machine, the combination of a number inserting mechanism, means to accumulate the sum of the digits inserted by said number inserting mechanism, said accumulating mechanism being
15 arranged to operate in a cycle of nine steps, and mechanical means for determining when said computing mechanism has been displaced through a cycle of nine steps.

26. In a calculating machine, the combination of a number inserting mechanism, means to accumulate the sum of the digits inserted by said number inserting mechanism, said accumulating mechanism being
20 arranged to operate in a cycle of eleven steps, and means for determining when said computing mechanism has been displaced through a cycle of eleven steps.

27. In a calculating machine, the combination of a number inserting mechanism, mechanism working through a cycle of nine
25 steps to accumulate the sum of the nine functions of the numbers entered by said accumulating mechanism, mechanism to compute the sum of the eleven function of the numbers entered by said accumulating mechanism, and means operative jointly on
40 both the nine and eleven function computing mechanism to determine when said mechanisms have rotated through a complete cycle.

28. In a calculating machine, the combination of a totalizer, means to insert a number therein *seriatim*, means to compute the nine
45 functions of said numbers, means to compute the eleven functions of said numbers, a characteristic mark, means for printing the same, and means to prevent the printing of said characteristic mark unless the nine function computing mechanism has moved
50 through a complete cycle.

29. In a calculating machine, the combination of a totalizer, means to insert a number therein *seriatim*, means to compute the nine
55 functions of said numbers, means to compute the eleven functions of said numbers, a characteristic mark, means for printing the same, and means to prevent the printing of said characteristic mark unless both the nine and eleven function computing mechanisms have
60 moved through a complete cycle.

30. In a calculating machine, the combination of a decimal carriage, number inserting
65 mechanism, means to compute a function of the number which is inserted by said number inserting mechanism, and means to reverse the direction of computation of said function computing mechanism at alternate steps

70 of said decimal carriage.

31. In a calculating machine, the combination of a decimal carriage, number inserting mechanism, means to compute a function of the number which is inserted by said number
75 inserting mechanism, and automatic means to reverse the direction of computation of said function computing mechanism at alternate steps of said decimal carriage.

32. In a calculating machine, the combination of a decimal carriage, number inserting
80 mechanism, means to compute a function of the number which is inserted by said number inserting mechanism, and a cam on said decimal carriage to reverse the direction of
85 computation of said function computing mechanism at alternate steps of said decimal carriage.

33. In a calculating machine, the combination of a decimal carriage, number inserting
90 mechanism, means to compute a function of the number which is inserted by said number inserting mechanism, and a slotted cam to reverse the direction of computation of said function computing mechanism at alternate
95 steps of said decimal carriage.

34. In a calculating machine, the combination of a decimal carriage, number inserting
100 mechanism, means to compute a function of the number which is inserted by said number inserting mechanism, and a slotted cam to positively reverse the direction of computation of said function computing mechanism at alternate steps of said decimal carriage.

35. In a calculating machine, the combination of a totalizer, means to enter a number therein *seriatim*, a disk connected with said
105 number inserting means, said disk operated in a cycle of nine steps, another disk operated by said number inserting means, said disk operating in a cycle of eleven steps, means for printing a characteristic mark,
110 and means for preventing the operation of said printing means unless both of said disks shall stand at a predetermined point.

36. In a calculating machine, the combination of number inserting mechanism, a disk
115 working in a cycle of nine steps and adapted to compute the nine functions of the numbers entered in said totalizer, means for printing a characteristic mark, and means for preventing the printing of said characteristic mark unless said totalizer stands at zero or a multiple of nine.

37. In a calculating machine, the combination of a totalizer, number inserting mechanism adapted to insert numbers in said totalizers *seriatim*, a device for computing the
125 eleven function of said numbers including a member moving in a cycle of eleven steps,

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means for printing a characteristic mark, and means for preventing the printing of said characteristic mark unless said device for computing the eleven function stands at zero or a multiple of 11.

38. In a calculating machine, the combination of a totalizer, actuating means for inserting a number therein *seriatim*, a nine function computing device operated by said actuating mechanism, an eleven function computing device also operated by said actuating mechanism, means for printing a characteristic mark, and a control for said printing means, said control being determined jointly by said nine and eleven function computing mechanism.

39. In a calculating machine, the combination of a totalizer, actuating means for inserting a number therein *seriatim*, a nine function computing device, an eleven function computing device, means for printing a characteristic mark, and a control for said printing means operated jointly by said nine and eleven function computing mechanism.

40. In a calculating machine, the combination of number inserting mechanism, means to compute a function of the number inserted by said number inserting mechanism, and means to render said function computing mechanism inoperative at will.

41. In a calculating machine, the combination of number inserting mechanism, means to compute the nine function of the number inserted by said number inserting mechanism, and means to render said nine function computing mechanism inoperative at will.

42. In a calculating machine, the combination of number inserting mechanism, means to compute the eleven function of the number inserted by said number computing mechanism, and means to render said eleven function computing mechanism inoperative at will.

43. In a calculating machine, the combination of number inserting mechanism, means to compute the nine and eleven function of the number inserted by said number computing mechanism, and a common means to render both said nine and eleven function computing mechanisms inoperative at will.

44. In a calculating machine, the combination of a traveling member, number inserting mechanism, a device to compute a function of the digits of the number inserted by said number inserting mechanism, and means under control of said traveling member to render said function computing mechanism inoperative at certain points in the travel of said traveling member.

45. In a calculating machine, the combination of a decimal carriage, number inserting mechanism, a device to compute a function of the digits of the number inserted by said number inserting mechanism, and means under control of said decimal carriage to ren-

der said function computing mechanism inoperative at certain points in the travel of said decimal carriage.

46. In a calculating machine, the combination of a decimal carriage, number inserting mechanism, a device to compute a function of the digits of the number inserted by said number inserting mechanism, and a cam under control of said decimal carriage to render said function computing mechanism inoperative at certain points in the travel of said decimal carriage.

47. In a calculating machine, the combination of printing mechanism, mechanism to enter a number in said machine, means to compute the nine function of the entered number, and a set of keys simultaneously operative on said printing mechanism, number entering mechanism and nine function computing mechanism.

48. In a calculating machine, the combination of a totalizer, mechanism to enter a number in said totalizer, and means to compute the nine function of the number entered into said totalizer.

49. In a calculating machine, the combination of a printing mechanism, means to enter a plurality of numbers in said machine, means to compute the nine functions of said numbers, means to obtain the sum of said nine functions, and a set of numeral keys simultaneously operative on all of said previously recited mechanisms.

50. In a calculating machine, the combination of a totalizer, means to enter a plurality of numbers in said totalizer, means to compute the nine functions of said numbers, and means to obtain the sum of said nine functions.

51. In a calculating machine, the combination of printing mechanism, mechanism adapted to enter a series of numbers in said machine both positively and negatively, said printing mechanism being adapted to print the numbers so entered, and means to compute the algebraic sum of the nine functions of said entered numbers, and a common set of numeral keys operative on said printing mechanism, number entering mechanism and nine function computing mechanism.

52. In a calculating machine, the combination of mechanism adapted to enter a series of numbers in said machine both positively and negatively, a set of numeral keys adapted to actuate said number entering mechanism, printing mechanism operated by said keys, and means to obtain the sum of the nine functions of the numbers printed by said printing mechanism.

53. In a calculating machine, the combination of a totalizer, mechanism adapted to enter a series of numbers in said totalizer both positively and negatively, a set of numeral keys operative on said number enter-

ing mechanism, and means to obtain the sum of the nine function of said entered numbers, said means being also operable by said numeral keys.

5 54. In a calculating machine, the combination of printing mechanism, mechanism to enter a number in said machine, means to compute the eleven function of the entered number, and a set of keys simultaneously
10 operative on said printing mechanism, number entering mechanism and eleven function computing mechanism.

55. In a calculating machine, the combination of a totalizer, mechanism to enter a
15 number in said totalizer, and means to compute the eleven function of the number entered into said totalizer.

56. In a calculating machine, the combination of a printing mechanism, means to
20 enter a plurality of numbers in said machine, means to compute the eleven functions of said numbers, means to obtain the sum of said eleven functions, and a set of numeral keys simultaneously operative on
25 all of said previously recited mechanisms.

57. In a calculating machine, the combination of a totalizer, means to enter a plurality of numbers in said totalizer, means to compute the eleven functions of said
30 numbers, and means to obtain the sum of said eleven functions.

58. In a calculating machine, the combination of printing mechanism, mechanism adapted to enter a series of numbers in said
35 machine both positively and negatively, said printing mechanism being adapted to print the numbers so entered, means to compute the algebraic sum of the eleven functions of said entered numbers, and a common set of
40 numeral keys operative on said printing mechanism, number entering mechanism and eleven function computing mechanism.

59. In a calculating machine, the combination of mechanism adapted to enter a
45 series of numbers in said machine both positively and negatively, a set of numeral keys adapted to actuate said number entering mechanism, printing mechanism operated by said keys, and means to obtain the sum
50 of the eleven functions of the numbers printed by said printing mechanism.

60. In a calculating machine, the combination of a totalizer, mechanism adapted to enter a series of numbers in said totalizer
55 both positively and negatively, a set of numeral keys operative on said number entering mechanism, and means to obtain the sum of the eleven function of said entered numbers, said means being also operable by
60 said numeral keys.

61. In a calculating machine, the combination of a totalizer, mechanism to enter a number in said totalizer, and mechanism to accumulate the sum of the digits of the
65 numbers entered into said totalizer.

62. In a calculating machine, the combination of a totalizer, mechanism to enter a number in said totalizer, and mechanism operating in a cycle of nine steps to accumulate the sum of the digits of the numbers entered
70 into said totalizer.

63. In a calculating machine, the combination of a totalizer, mechanism to enter a number in said totalizer, and mechanism operating in a cycle of eleven steps to compute
75 the difference between the sums of the alternate digits of the numbers entered into said totalizer.

64. In a calculating machine, the combination of a totalizer, means to enter a
80 number therein, and means to accumulate the difference between the sum of the alternate digits of the numbers entered into said totalizer.

65. In a calculating machine, the combination of a totalizer, a set of numeral keys
85 adapted to enter numbers therein, printing mechanism actuated by said keys and adapted to print the numbers entered into said totalizer, and mechanism operated by
90 said numeral keys to accumulate the difference between the sums of the alternate digits of the numbers printed by said printing mechanism.

66. In a calculating machine, the combination of a totalizer, means to enter a
95 number therein, means to compute the nine function of said entered numbers, and means to compute the eleven function of said entered numbers, and a set of numeral keys
100 operative on both said function computing means and said totalizer, whereby the sums of numbers entered into the machine and the sums of the nine and eleven functions of said numbers may be simultaneously computed.
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67. In a calculating machine, the combination of a totalizer, mechanism adapted to enter a number therein either positively or negatively, a set of numeral keys operative on said number entering mechanism,
110 mechanism also operated by said keys to compute the nine function of the number entered in said totalizer, and a common reverse operative on both said number mechanism and said mechanism for computing
115 the nine function, said reverse being adapted to act on both of said mechanisms simultaneously.

68. In a calculating machine, the combination of a totalizer, means to enter a
120 plurality of numbers in said totalizer whereby the sum of said numbers may be obtained, a set of numeral keys to operate said number inserting mechanism, and means also operative by said numeral keys to compute the eleven functions of said entered
125 numbers and to sum said eleven functions.

69. In a calculating machine, the combination of a set of numeral keys, printing mechanism adapted to print numbers set up
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on said keys, a totalizer adapted to obtain the sum of the numbers printed by said printing mechanism, said totalizer being adapted to be actuated by said numeral keys, and means to compute the nine functions of the numbers set up on said keys and printed by said printing mechanism.

70. In a calculating machine, the combination of a totalizer, a set of numeral keys, actuating mechanism adapted to insert a number in said totalizer *seriatim*, said actuating mechanism being operated by said numeral keys, printing mechanism to print the number entered in said totalizer, and said printing being under the control of said numeral keys, and mechanism to compute the nine function of a number printed by said printing mechanism, said function computing mechanism being also under the control of said numeral keys.

71. In a calculating machine, the combination with mechanism to enter a number in said machine, of means to compute the 9 function of the number entered by said mechanism, a traveling carriage and means under control of said traveling carriage to render said 9 function computing mechanism operative at a plurality of points in the travel of said carriage.

72. In a calculating machine, the combination with mechanism to enter a number in said machine, of means to compute the 9 function of a number entered by said mechanism, a traveling carriage and means mounted on said carriage to render said 9 function computing mechanism operative at a plurality of points in the travel of said carriage.

73. In a calculating machine, the combination with mechanism adapted to enter a series of numbers in said machine both positively and negatively, of a traveling carriage, means to compute the 9 functions of said entered numbers and means under control of said carriage to determine when said 9 function computing mechanism will come into operation and also to determine whether the numbers entered in the machine shall be computed by said 9 function computing mechanism positively or negatively.

74. In a calculating machine, the combination with mechanism adapted to enter a series of numbers in said machine both positively and negatively, of a traveling carriage, means to compute the 9 functions of said entered numbers and means mounted on the carriage to determine when said 9 function computing mechanism will come into operation and also to determine whether the numbers entered in the machine shall be computed by said 9 function computing mechanism positively or negatively.

75. In a calculating machine, the combination with mechanism adapted to enter a series of numbers in said machine both posi-

tively and negatively, of a traveling carriage, means to compute the 9 functions of said entered numbers and means adjustably mounted on the carriage to determine when said 9 function computing mechanism will come into operation and also to determine whether the numbers entered in the machine shall be computed by said 9 function computing mechanism positively or negatively.

76. In a calculating machine, the combination with mechanism to enter a number in said machine, of means to compute the 11 function of a number entered by said mechanism, a traveling carriage and means under control of said traveling carriage to render said 11 function computing mechanism operative at a plurality of points in the travel of said carriage.

77. In a calculating machine, the combination with mechanism to enter a number in said machine, of means to compute the 11 function of a number entered by said mechanism, a traveling carriage and means mounted on said carriage to render said 11 function computing mechanism operative at a plurality of points in the travel of said carriage.

78. In a calculating machine, the combination with mechanism adapted to enter a series of numbers in said machine both positively and negatively, of a traveling carriage, means to compute the 11 functions of said entered numbers and means under control of said carriage to determine when said 11 function computing mechanism will come into operation and also to determine whether the numbers entered in the machine shall be computed by said 11 function computing mechanism positively or negatively.

79. In a calculating machine, the combination of a traveling carriage, a set of keys, differential mechanism controlled by said keys whereby numbers are entered into the machine, a function computing device and a cam whose position is controlled by said traveling carriage to determine at what points during the travel of said carriage said function computing mechanism shall compute certain functions of the numbers entered into the machine by said keys.

80. In a calculating machine, the combination of a set of keys, differential mechanism controlled by said keys whereby numbers are entered into the machine, a traveling carriage also controlled by said keys and a function computing mechanism, and a plurality of cams on said carriage to determine at what points in the travel of said carriage said function computing mechanism shall compute the numbers entered into the machine by said keys.

81. In a calculating machine, the combination of a set of numeral keys, differential mechanism controlled by said numeral keys, and a function computing mechanism whose

operation is determined by said differential mechanism, said function computing mechanism being adapted to compute functions of the form $p - F_n(p) = K_n$ where K and p are both integer.

82. In a calculating machine, the combination of a set of numeral keys, differential mechanism controlled by said numeral keys and a function computing mechanism whose operation is determined by said differential mechanism, and means for reversing the action of said keys on said function computing mechanism.

83. In a calculating machine, the combination of a set of numeral keys, differential mechanism controlled by said numeral keys and a function computing mechanism whose operation is determined by said differential mechanism, with a traveling carriage and means governed by said traveling carriage for reversing the action of said differential mechanism on said function computing mechanism.

In witness whereof, I have hereunto signed my name this 31 day of August, 1916.

ARTHUR F. POOLE.