No. 782,605. PATENTED FEB. 14, 1905.

H. E. GOLDBERG.

TOTALIZING MECHANISM.

APPLICATION FILED AUG. 16, 1904.

Fig. 1

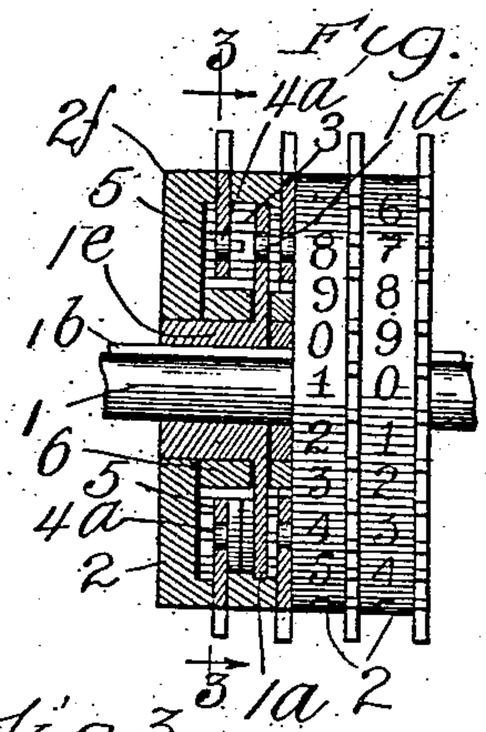


Fig. 2.

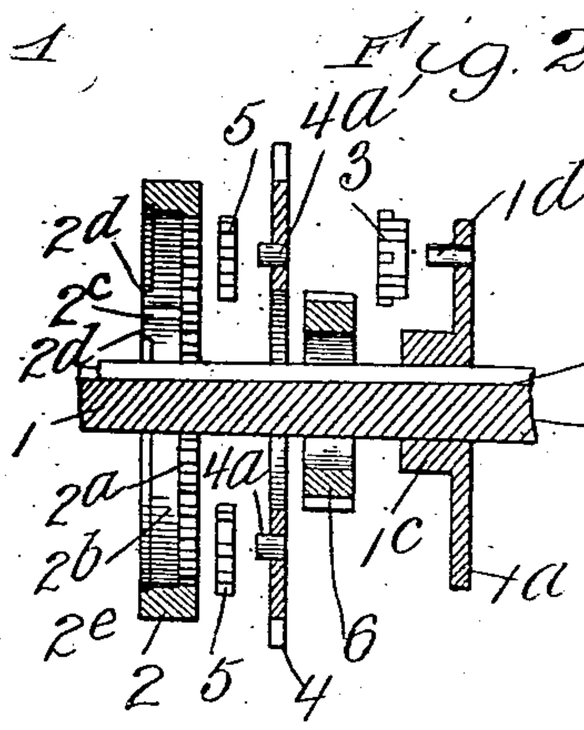


Fig. 8.

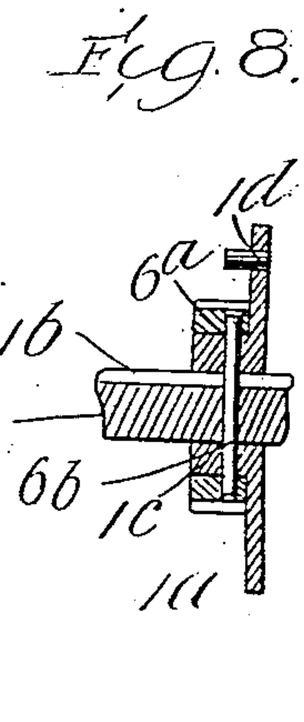
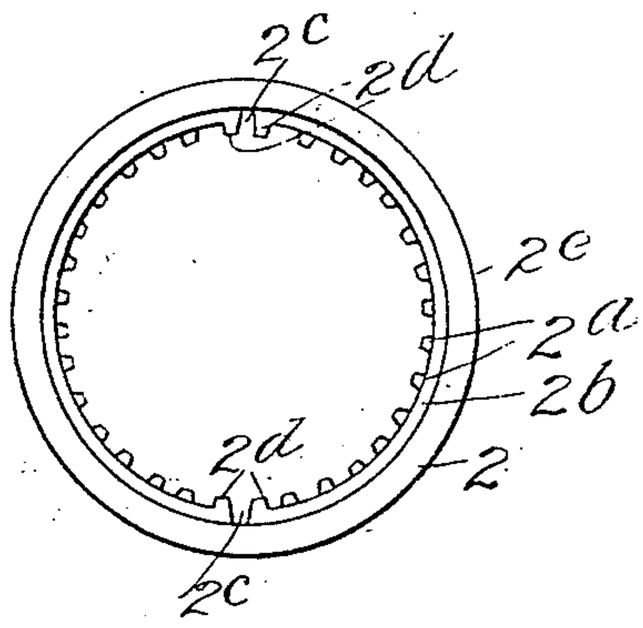


Fig. 3

Fig. 4



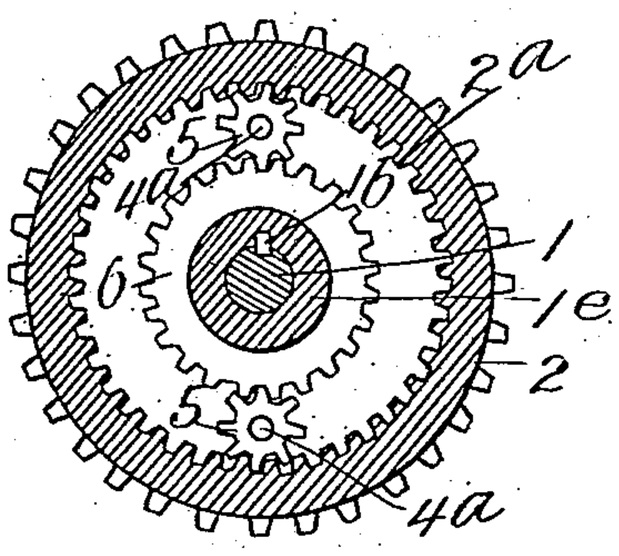
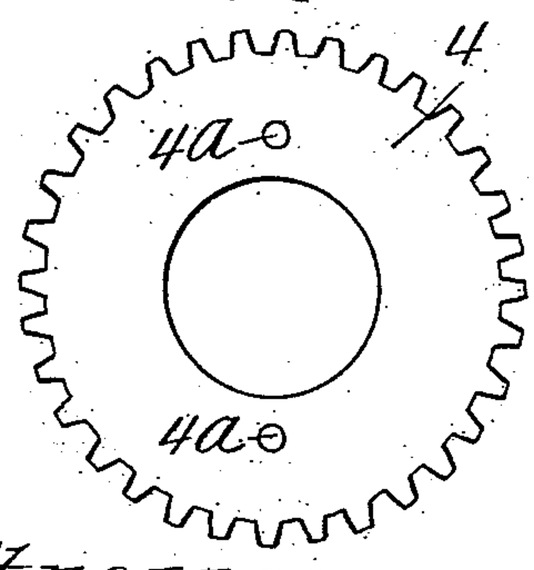
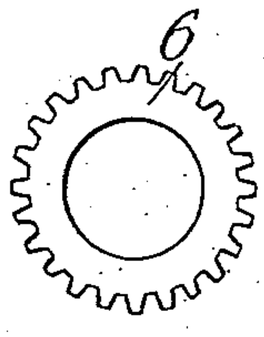


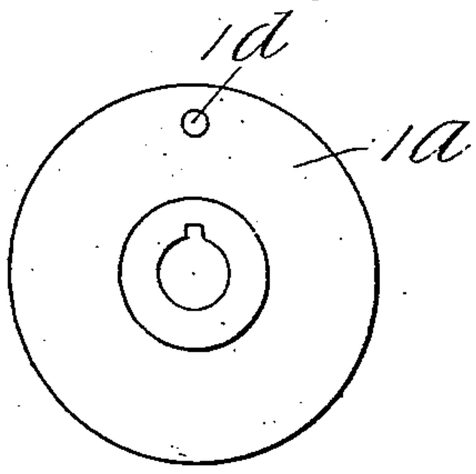
Fig. 5.

Fig. 6

Fig. 7.







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No. 782,605. Patented February 14, 1905

UNITED STATES PATENT OFFICE.

HYMAN ELI GOLDBERG, OF CHICAGO, ILLINOIS.

TOTALIZING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 782,605, dated February 14, 1905.

Application filed August 16, 1904. Serial No. 220,958.

To all whom it may concern:

Be it known that I, HYMAN ELI GOLDBERG, a citizen of the United States, residing at the city of Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Totalizing Mechanisms, of which the following is a specification.

My invention relates to totalizing mechanisms, frequently called also "registers" and "receiving mechanisms," by which is meant that part of a calculating-machine by means whereof are obtained in addition totals and in subtraction differences.

My present totalizing mechanism or, as it will be herein termed, "totalizer" is applicable to all kinds of calculating-machines and calculating attachments to type-writers and may well be substituted for the principal parts of the receiving mechanism shown in my prior patents, Nos. 710,772 and 741,961.

In order to facilitate an understanding of my present totalizer, it is thought best to briefly describe the theory of totalization, by which is included both addition and subtraction. An analysis shows that it consists of two processes, to wit:

Process 1—"Accumulation." Examples: 3+4=7 and 8+7=15, and

Process 2—"Carrying." Example: 8+7=10+5 or one ten and five units.

It will thus be seen that in order to distinguish between the two separate operations, which theoretically occur in addition and subtraction I employ the term "carrying" in its usual sense of carrying or transferring the tens from one totalizing-wheel onto the next higher one, which action is performed by the totalizer itself, whereas by "accumulating" I mean to designate that movement which any given figure-wheel derives from the action of "setting up," which action originates outside and independent of the totalizer. "Totalizing" therefore includes both carrying and accumulating. Now suppose two numbers each composed of more than one figure are to be added together, thus

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 467
+789
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The result may be accomplished by various methods. For example:

Method I: 7+9=16=10+6. Put down "6", one to carry. 1+6+8=15=10+5. Put down "5", one to carry. 1+4+7=12=10+2, put down "2," one to carry; put down "1". This is the mental process which most people employ in adding. Here the order is, first, accumulation of units; second, carrying into tens; third, accumulation of tens; fourth, carrying into hundreds, &c. Here all the accumulations and carryings are successive. A mechanism operating according to this method is found in the Chinese Abacus.

Method II:

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 4  6  7
+7  8  9
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11, 14, 16
11, 15,  6
12,  5,  6
 1,  2,  5,  6
 1  2  5  6
```

Here the accumulation in all the decimal places are simultaneous, and the carryings occur subsequently and *seriatim* from units to tens, tens to hundreds, &c. A mechanism operating in this manner is found in my Patent No. 765,774, issued July 26, 1904.

Method III:

$$\left.\begin{matrix}467\\+789\end{matrix}\right\} = \left.\begin{matrix}1167\\+\ 89\end{matrix}\right\} = \left.\begin{matrix}1247\\+\ \ 9\end{matrix}\right\} = 1256.$$

Here the accumulations are successive, while the carryings are simultaneous with the accumulations and also simultaneous with each other. Mechanisms operating according to this method are found in my Patents No. 710,772 and No. 712,518 and others.

The following is a complete graphic representation of the method according to which my present totalizer operates.

Method IV:

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 467
+789
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1256
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Here all the accumulations and all the carry-

ings occur at once, everything being simultaneous. My totalizer, which operates in this last-mentioned manner, possesses a great advantage of speed, and the attainment of speed is one of the objects of my invention.

Another object of my invention is to produce a reversible totalizer which may operate for both addition and subtraction, and it may be interesting from a theoretical standpoint to mention that my present mechanism may even be made to add in some decimal places and simultaneously subtract in other decimal places. Thus it may simultaneously add in the units-column, subtract in the tens-column add in the hundreds and thousands columns &c., although such use would probably have no commercial application.

Another of the objects of my invention is to make the mechanism of the totalizer self-contained, so that no auxiliary mechanism is required to reset its parts to "normal" or "initial" position after each accumulation or totalization. In consequence a long column of many numbers, each number composed of many figures, may be run into the totalizer without waiting for any pause or break between the various numbers, and it becomes immaterial whether the accumulations take place first in the units-place, then in the tens-place, &c., or in the reverse order or all together or in any other order.

I accomplish my object by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is an assembly view, partly in section, showing the preferred form of the invention. Fig. 2 is a sectional view of the parts shown in Fig. 1. In this view the parts are not assembled, but are arranged in a group for the purpose of illustrating the relationship of the parts. Fig. 3 is a sectional view taken on line 3 3, Fig. 1. Figs. 4, 5, 6, and 7 are side views of component parts of the mechanism. Fig. 8 is a sectional view of the intermediate wheel located farthest to the right. This wheel is non-rotatable and is shown to be pinned to the axle, whereas the intermediate wheels to the left thereof are rotatable.

Similar reference characters denote similar parts throughout the several views.

The device in the form here shown comprises the non-rotative shaft 1 and a plurality of sets or groups consisting of five principal parts—namely, the totalizing-wheels 2, the carrying-pinions 3, the accumulating-wheels 4, the epicyclic pinions 5, and the intermediate wheels 6. Wheels 2, 4, and 6 are all freely rotatable on shaft 1 independently thereof, with the exception of wheel 6^a, located at the extreme right to correspond with the units-column. This wheel is rigidly fastened to said shaft by means of a pin 6^b, (shown in Fig. 8,) although any other means may be substituted for holding it rigid and non-rotatable. The function of said wheel 6^a is to form the fixed basis of reference or foundation piece of the mechanism from which the rotatable parts move their definite amounts.

In each group of parts, 1^a represents a supporting-piece, which in the present instance is disk-like in form and is secured to shaft 1 by means of a spline 1^b, although said supporting-piece may be held rigid upon the shaft by any other suitable means. Said supporting-piece is provided at its left side with a hub 1^c, which is cylindrical and forms a bearing whereon the intermediate wheel 6 is freely rotatable. The pin 1^d extends toward the left from said supporting-piece 1^a and serves as an axle whereon the carrying-pinion 3 is freely rotatable. Said pinion has eight long and short teeth alternating with each other for alternately being locked and rotated by the totalizing-wheels 2 in the manner hereinafter described.

The totalizing-wheels 2 carry on their cylindrical peripheries two series of figures for visibly indicating the numbers set up, as usual in mechanisms of this class. Each series of figures runs from "0" to "9," thus making twenty figures, which are consequently one-twentieth of a circumference apart. Said wheels have formed upon their left portion an internal forty-toothed gear 2^a, as best shown in Figs. 2 and 4, and to the left of said gear portion 2^a is an internal cylindrical surface 2^b for locking the carrying-pinion 3, which constitutes a locking-ring. Each totalizing-wheel has two slots or spaces 2^c located diametrically opposite to each other, each slot having a projecting carrying-tooth 2^d on each side thereof for engaging the teeth on said carrying-pinion. At the left side of the totalizing-wheel is an internal cylindrical surface or ring 2^e, which is of greater diameter than ring 2^b and is cut in the wheel for the purpose of clearing the short teeth on said carrying-pinion.

The construction is such that the carrying-teeth 2^d of the wheel 2 will engage the short teeth of pinion 3 and rotate the same two steps or tooth-spaces, after which the locking-ring 2^b will enter between two adjacent long teeth on the pinion 3 and lock the same. During the rotation of the locking-pinion the space 2^c will permit the rotation of the carrying-pinion by receiving one of the long teeth thereof. Thus when the totalizing-wheel 2 is rotated it will twice during each complete rotation impart a partial rotary movement to its carrying-pinion to carry the tens. Although in the present construction the totalizing-wheel 2 carries at two points and has two sets of figures, the fact that it is double is merely a matter of design and convenience in construction and operation. Each totalizing-wheel 2 is supported by the contact of its internal cylindrical surface or locking-ring 2^b upon the cylindrical edge of the supporting-piece 1^a. Said wheel is thus freely

rotatable independently of piece 1^a and remains at all times concentric with shaft 1. Said supporting-piece is not necessarily a complete disk, but when thus formed affords the maximum bearing-surface.

The accumulating-wheels 4 are analogous to the receiving-wheels described in my former patents, Nos. 710,722 and 741,961, in that they are adapted to be rotated different amounts for accumulating the digits. They are plain thirty-two-toothed spur-gears having a comparatively large central aperture, so that they may fit over and be freely rotatable upon the points of the teeth of the intermediate wheels 6. By preference said accumulating-wheels are narrow, and their teeth project beyond the circumference of the totalizing-wheels 2, so that they may be engaged by suitable driving-wheels.

The totalizing-wheel 2^f and supporting-piece 1^e (shown at the extreme left of Fig. 1) are slightly modified to illustrate the form which these parts will take to impart a workmanlike appearance to the highest or extreme left termination of the totalizer.

Extending toward the left from each totalizing-wheel 4 are the pins 4^a 4^a, which constitute axles for the epicyclic pinions 5 5. Said pinions are freely rotatable upon said pins 4^a and are epicyclic in the sense of being rotatable upon an axis which is itself movable about another center. They are designed to remain at all times in mesh with both the intermediate wheel 6 and the internal gear 2^a for transmitting rotation from the former to the latter. They are plain spur-pinions and in the present instance have eight teeth, which is the proper number to coöperate with the forty-toothed internal gear 2^a and the twenty-four toothed intermediate spur-wheel 6. Although two epicyclic pinions 5 are here shown, one is theoretically sufficient for transmitting motion to the carrying-wheels. Two pinions cause the mechanism to operate more smoothly.

Each intermediate wheel 6 is a wide-faced twenty-four-toothed spur-gear having a full complement of teeth and when in position on the hub 1^c on the piece 1^a remains permanently in mesh with the carrying pinion 3, so that any rotation of said pinion will impart rotation to said intermediate wheel. Said intermediate wheel also remains permanently in mesh with the epicyclic pinions 5 5 aforesaid, and the relationship of the parts is such that the pinion 5 engages the left portion of wheel 6, while the pinion 3 engages the right portion thereof and the accumulating-wheels 4 occupy an intermediate position. The purpose of said intermediate wheels is to transmit rotation from the carrying-pinions 3 to the epicyclic pinions 5 and through said epicyclic pinions to the totalizing-wheels 4.

To illustrate the operation of the mechanism, suppose that some one intermediate wheel 6 is temporarily held fast and that its accumulating-wheel 4 is rotated one step, which in the present construction is one-fortieth of a circumference. By means of its epicyclic pinion 5 it will move the totalizing-wheel at the left twice as far or one-twentieth of a circumference or from one figure to another on the totalizing-wheel. If the accumulating-wheel 4 had been rotated several steps, then the totalizing-wheel 2 would have been rotated just as many figure-distances. The figures are thus accumulated upon the totalizing-wheel. Again, suppose the accumulating-wheel 4 to be temporarily held fast and the totalizing-wheel 2 at its right to be rotated. As long as some part of the locking-ring 2^b on said totalizing-wheel is lying between two of the longer teeth of the carrying-pinion 3 no rotation is imparted by said totalizing-wheel to said pinion; but as soon as the space or cut 2^c and carrying-teeth 2^d pass said pinion they rotate it two steps or spaces and immediately lock it again. This occurs when the figures "0" and "9" are interchanged at the reading-line. The carrying-pinions 3 rotate the intermediate wheel 6 an equal amount, and wheel 6 rotates the epicyclic pinion 5, which rotates wheel 2 next to the left an equal amount in the same direction as wheel 2 to the right is rotated. Thus the tens are carried. It is evident, therefore, that mechanism is able to carry the tens when an accumulating-wheel remains motionless. It is true, therefore, that the numbers may be accumulated on the totalizing-wheels independently of the carrying-wheels and the tens may be carried independently of the accumulating-wheels. Each action is independent of the other, and the actions may take place either separately or simultaneously. In either case the final result will be the same—that is, the algebraic sum of the accumulating and carrying actions. Therefore if the totalizing wheels 2 show "467," for example, and it is desired to add "789," the hundreds, tens, and units accumulating-wheels may be rotated seven, eight, and nine steps, respectively, at one and the same time, and the total, "1256," will instantly appear, and the mechanism will be ready for the next number without any further resetting or adjustment. In other words, the mechanism is so universal in its operation that the accumulating-wheels 4 will each have their proper influence upon the mechanism no matter whether they are rotated all at once or singly in their proper digital order or in any other order.

Although the carrying-pinions have been described as "eight-toothed pinions," the number of teeth in the carrying-pinion is not essential; but eight teeth are preferable, for the reason that this number affords security in the locking action. With this construction only four long teeth occur, and consequently there is a wide angle between their adjacent

faces,—to wit, almost ninety degrees—thereby affording a large space for the reception of the locking portion of the totalizing-wheel.

It will be noted that the totalizing-wheels perform three distinct functions: First, they constitute figure-wheels; second, they act as carrying-wheels for alternately rotating and locking the carrying-pinions, and, third, they act as totalizing-wheels—that is, they receive rotation both from the accumulating-wheels and the tens-carrying means, and they algebraically combine or totalize the two effects; but the reason said totalizing-wheels are made to perform three functions is not because it is theoretically or practically necessary, but only for the sake of simplicity and compactness.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a totalizer, an accumulating-wheel, an intermediate wheel rotatable about the same axis; an epicyclic spur-pinion mounted on one of said wheels so as to be freely rotatable thereon at a point outside of the axis thereof; an internally-toothed totalizing-wheel freely rotatable about the axis of the accumulating-wheel and means for rotating said intermediate wheel to carry the tens thereto from the decimally lower parts of the mechanism, said epicyclic pinion being adapted to mesh continuously both with said intermediate wheel and the internal gear of said totalizing-wheel.

2. In a totalizer, an accumulating-wheel, an intermediate spur-toothed wheel rotatable about the same axis; an epicyclic spur-pinion mounted on said accumulating-wheel so as to be freely rotatable thereon at a point outside of the axis thereof; an internally-toothed totalizing-wheel freely rotatable about the axis of the accumulating-wheel and means for rotating said intermediate wheel to carry the tens thereto from the decimally lower parts of the mechanism, said epicyclic pinion being adapted to mesh continuously both with said intermediate wheel and the internal gear of said totalizing-wheel.

3. In a totalizer, an accumulating-wheel; an intermediate wheel; an epicyclic pinion mounted upon one of said wheels so as to be freely rotatable thereon at a point outside of the axis thereof; two totalizing-wheels, one decimally next higher than the other, the lower of said totalizing-wheels having a locking-ring and carrying-teeth thereon; and a carrying-pinion operated by the locking-ring and carrying-teeth of said lower totalizing-wheel for carrying the tens, said intermediate wheel being operated by said carrying-pinion, and said epicyclic pinion being adapted to mesh continuously with both the said intermediate wheel and the higher of said totalizing-wheels.

4. In a totalizer, an accumulating-wheel; an intermediate wheel; an epicyclic pinion mounted upon one of said wheels so as to be freely rotatable thereon at a point outside of the axis thereof; two totalizing-wheels, one decimally next higher than the other, the lower of said totalizing-wheels having an internal locking-ring and carrying-teeth thereon; and a spur-carrying pinion operated by the locking-ring and carrying-teeth of said lower totalizing-wheel for carrying the tens, said intermediate wheel being operated by said carrying-pinion, and said epicyclic pinion being adapted to mesh continuously with both the said intermediate wheel and the higher of said totalizing-wheels.

5. In a totalizer, an accumulating-wheel; an intermediate wheel; an epicyclic pinion mounted upon one of said wheels so as to be freely rotatable thereon at a point outside of the axis thereof; two totalizing-wheels, one decimally next higher than the other, the lower of said totalizing-wheels having a locking-ring and carrying-teeth thereon; and a carrying-pinion operated by the locking-ring and carrying-teeth of said lower totalizing-wheel for carrying the tens, said intermediate wheel being operated by said carrying-pinion, and said epicyclic pinion being adapted to mesh continuously with both the said intermediate wheel and the higher of said totalizing-wheels, and said higher totalizing-wheel and said intermediate wheel being freely rotatable about a common axis, but said carrying-pinion being rotatable about a fixed axis non-coincident with the axis of rotation of said higher totalizing-wheel.

6. In a totalizer, a totalizing-wheel having an internal gear, an intermediate spur-wheel and an annular accumulating-wheel, all of said wheels being freely rotatable about a common axis; an epicyclic pinion mounted so as to be freely rotatable upon said accumulating-wheel at a point outside of the axis thereof, said epicyclic pinion being adapted to mesh continuously with said totalizing-wheel and said intermediate wheel, and said accumulating-wheel being adapted to circumferentially inclose said intermediate wheel; other parts having a lower decimal-place value; and means operated by the said decimally lower parts of the mechanism for carrying the tens therefrom to said intermediate wheel.

7. In a totalizer, a non-rotatable shaft; a totalizing-wheel; an accumulating-wheel; and an intermediate wheel, all of said wheels being freely rotatable about the center of said shaft as an axis; an epicyclic pinion mounted on one of said wheels so as to be freely rotatable thereon at a point outside of the axis thereof, and said epicyclic pinion being continuously in mesh with said intermediate wheel and the remaining one of said wheels not carrying said epicyclic pinion; a carrying-pinion for rotating said intermediate wheel to carry the tens to the totalizing-wheel; a piece rigidly secured to said shaft for supporting said carrying-pinion; and means operated by the decimally

lower parts of the mechanism for operating said carrying-pinion to thereby carry the tens.

8. In a totalizer, a totalizing-wheel, an intermediate wheel and an accumulating-wheel all freely rotatable about the same axis; an epicyclic pinion mounted on the left side of said accumulating-wheel so as to be freely rotatable thereon at a point outside of the axis thereof, said epicyclic pinion being adapted to be continuously in mesh both with said totalizing-wheel and intermediate wheel; a carrying-pinion at the right of said accumulating-wheel adapted to be continuously in mesh with said intermediate wheel; other totalizer parts having lower decimal-place value; and means operated by the decimally lower parts of the mechanism for operating said carrying-pinion.

9. In a totalizer, a non-rotatable main shaft; a pair of totalizing-wheels freely rotatable about said shaft, each totalizing-wheel having carrying-teeth at the left portion and an internal gear at the right portion; an accumulating-wheel also freely rotatable about said shaft and interposed between said totalizing-wheels; an intermediate wheel also freely rotatable about said shaft; an epicyclic pinion journaled upon said accumulating-wheel and adapted to mesh continuously with both said intermediate wheel and the internal gear of the totalizing-wheel having the higher place value; carrying-pinions adapted to mesh continuously with said intermediate wheel and be operated by the carrying-teeth of the lower of said totalizing-wheels; and a piece rigidly fixed to said shaft for supporting said carrying-pinion.

10. In a totalizer, a totalizing-wheel having carrying-teeth, a carrying-pinion operated by said totalizing-wheel, an intermediate gear operated by said carrying-pinion; an epicylic pinion rotated about its center by said intermediate wheel and continuously in mesh with said intermediate wheel; a second and higher-valued totalizing-wheel operated by said epicyclic pinion and always in mesh therewith; and a member adapted to be rotated various amounts about the axis of said higher totalizing-wheel, said last-mentioned member carrying said epicyclic pinion eccentrically.

In witness whereof I have hereunto subscribed my name in the presence of two witnesses.

HYMAN ELI GOLDBERG

Witnesses:

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