E. C. WALTER.

COMPUTING AND RECORDING MACHINE.

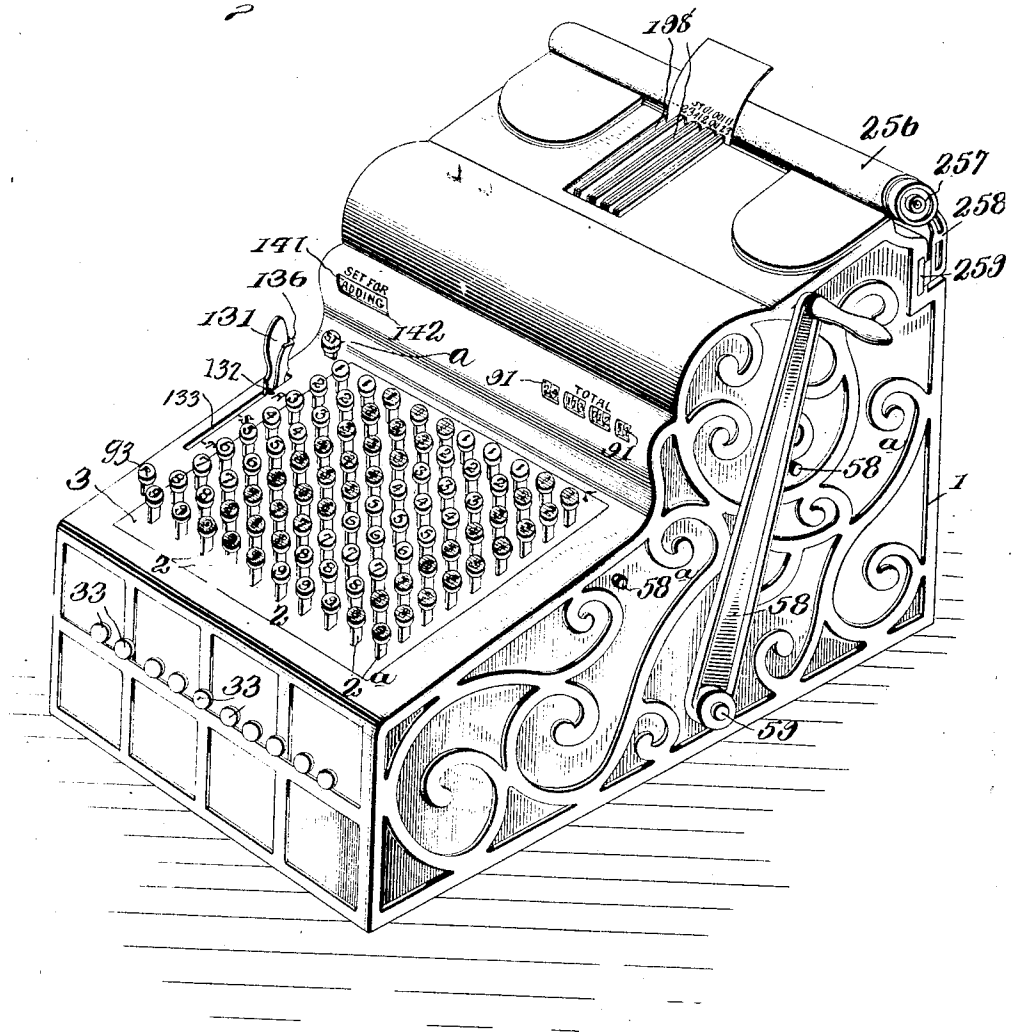
APPLICATION FILED AUG. 7, 1912.

1,224,873.

Patented May 1, 1917.

16 SHEETS—SHEET 1.

Fig. 1.



Witnesses

Helget, Murray,

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By Edmund H. Parry

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COMPUTING AND RECORDING MACHINE.

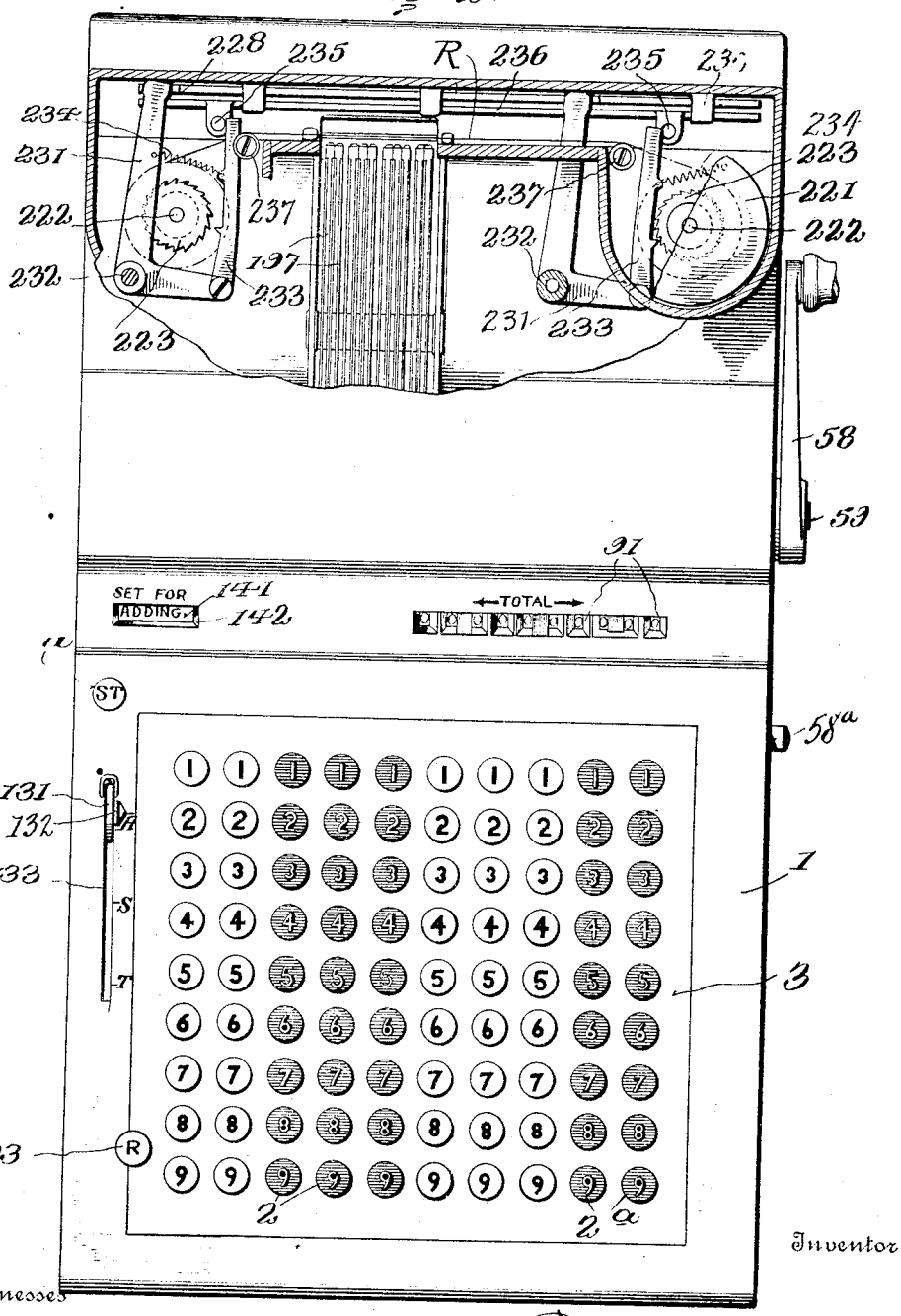
APPLICATION FILED AUG. 7, 1912.

1,224,873.

Patented May 1, 1917.

16 SHEETS—SHEET 2.

Fig. 2.



Witnesses

Helge A. Murray,

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COMPUTING AND RECORDING MACHINE.

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16 SHEETS—SHEET 3.

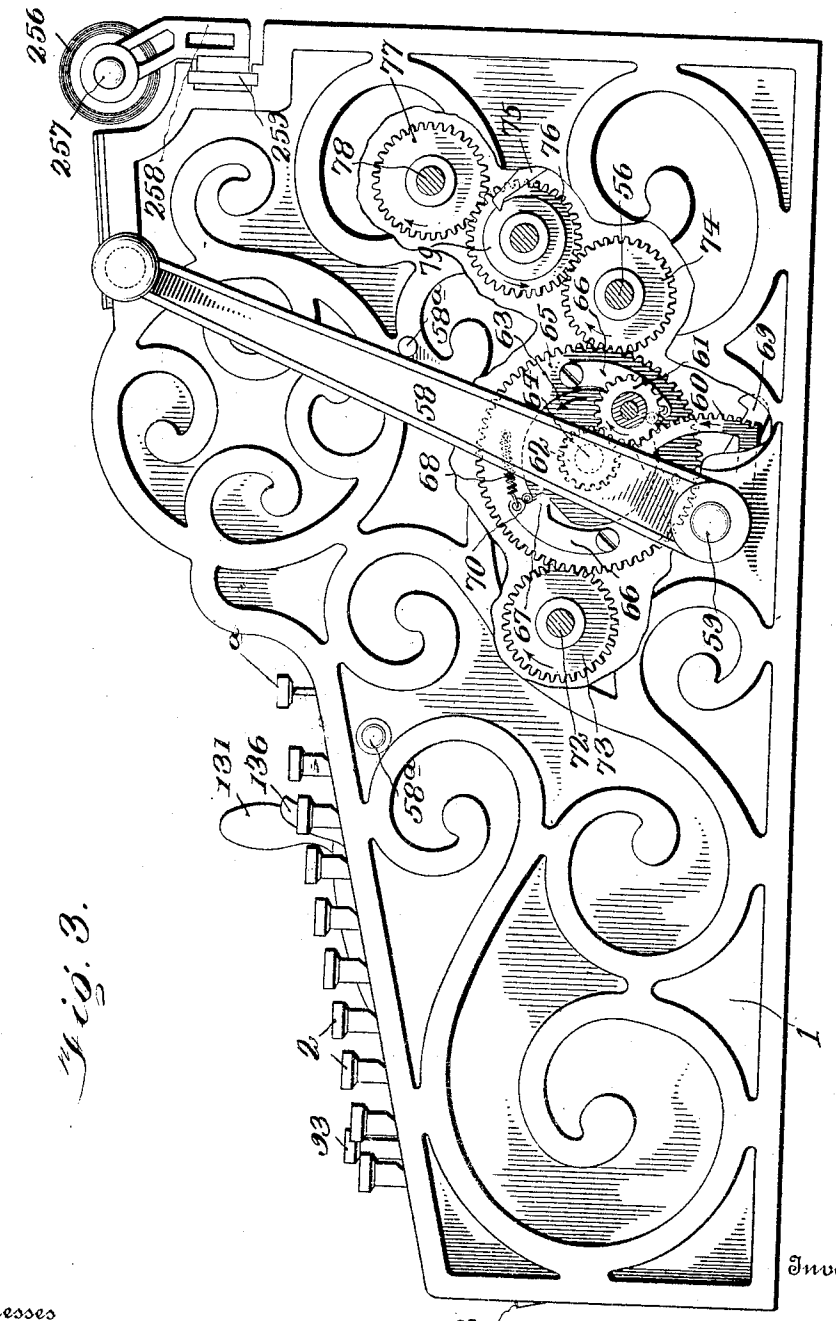


Fig. 3.

Witnesses

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COMPUTING AND RECORDING MACHINE.

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Patented May 1, 1917.

16 SHEETS—SHEET 4.

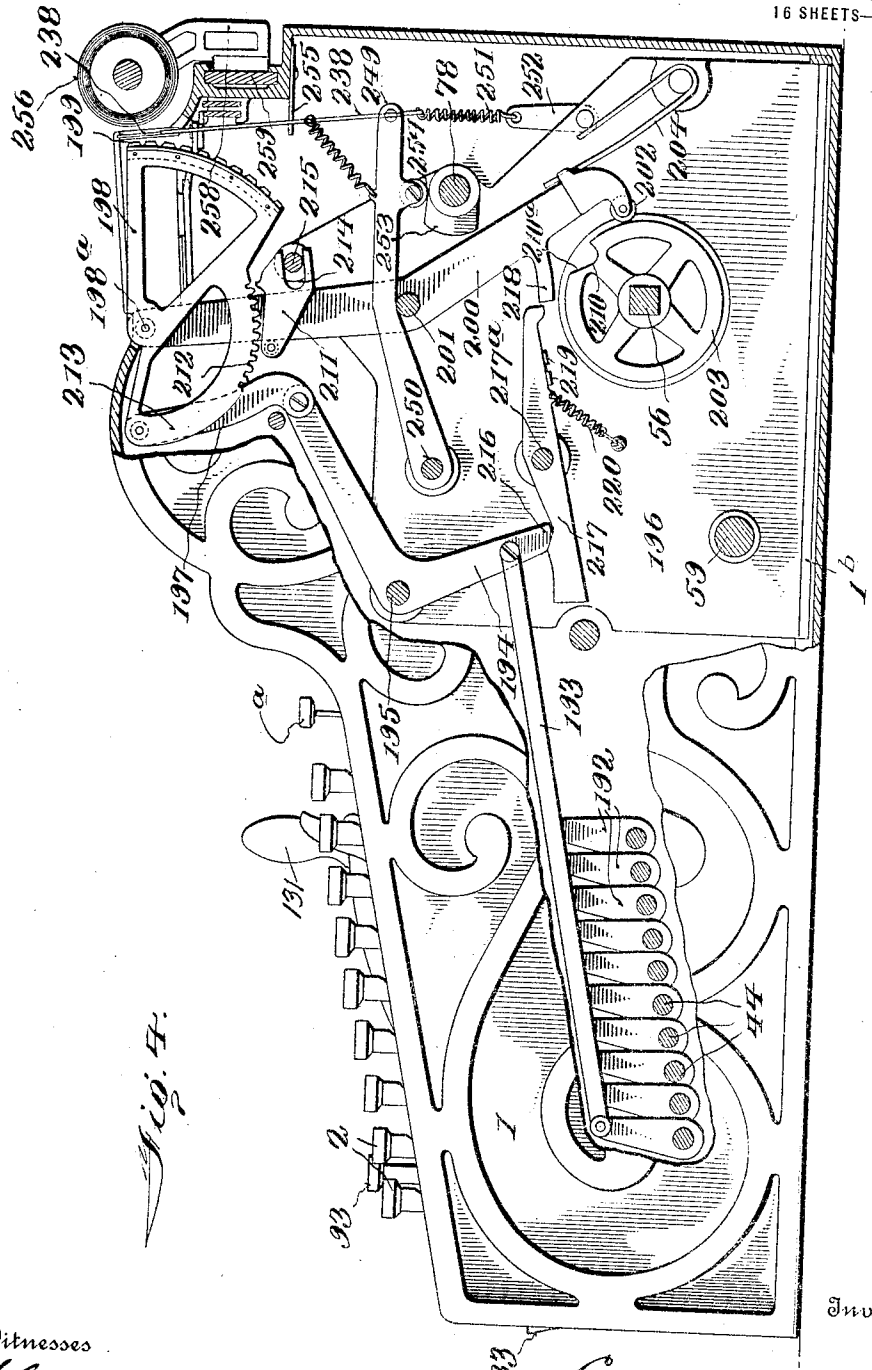


Fig. 4.

Witnesses

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COMPUTING AND RECORDING MACHINE.

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Patented May 1, 1917.

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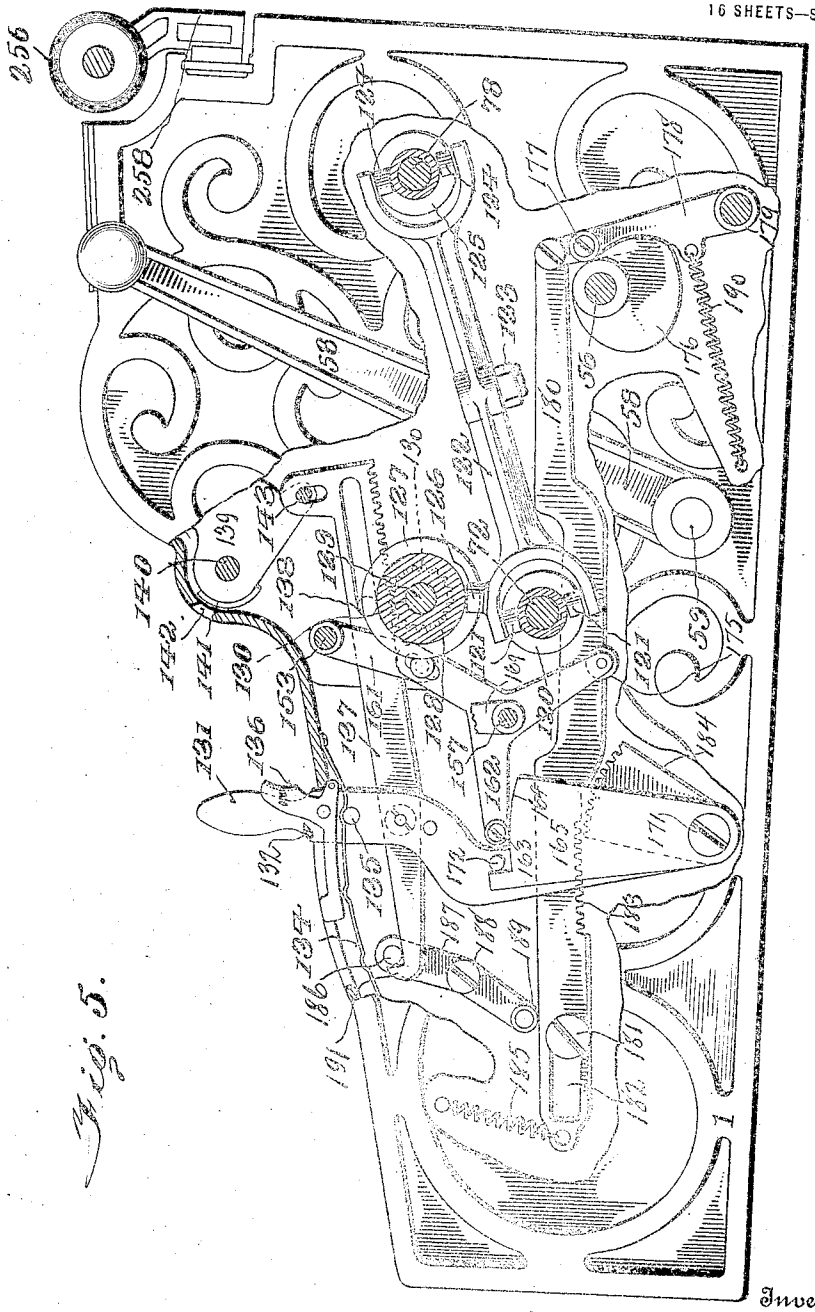


Fig. 5.

Witnesses

Nelze Ottaway,

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16 SHEETS—SHEET 6.

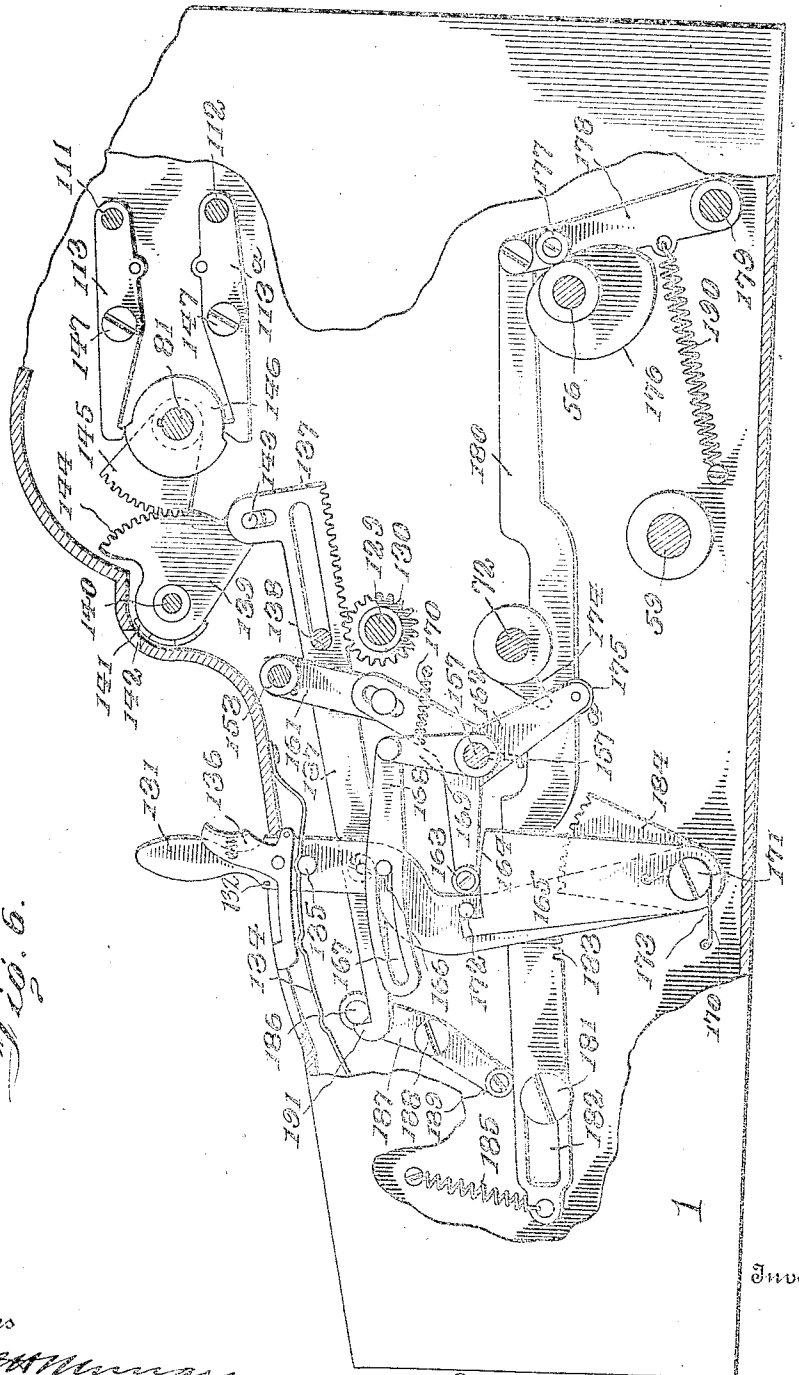


Fig. 6.

Witnesses

Helgel[illegible] Murray,

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COMPUTING AND RECORDING MACHINE.

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16 SHEETS—SHEET 7.

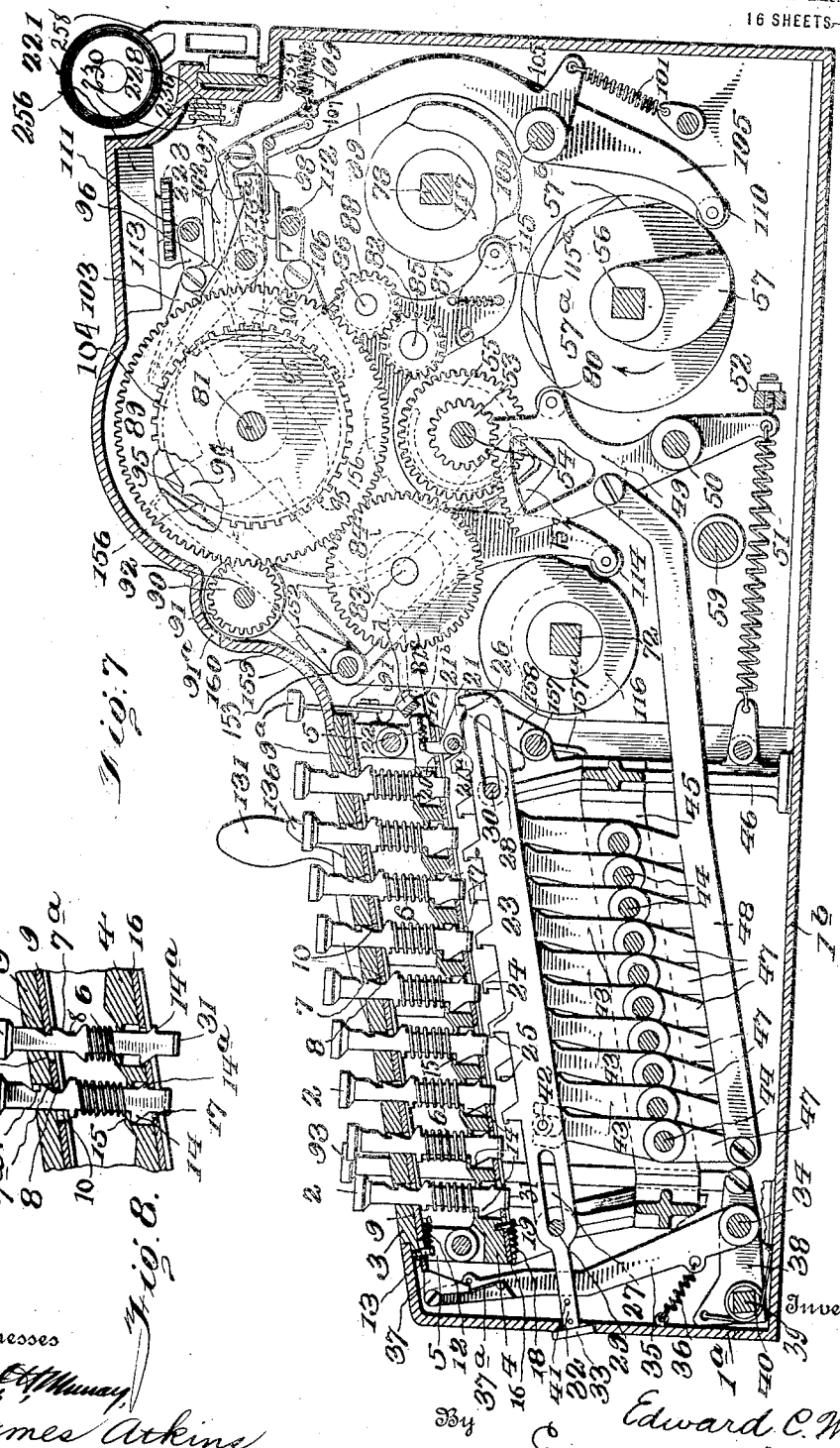


Fig. 7

Fig. 8.

Witnesses

Helge A. Murray.

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Inventor

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Attorney

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16 SHEETS—SHEET 8.

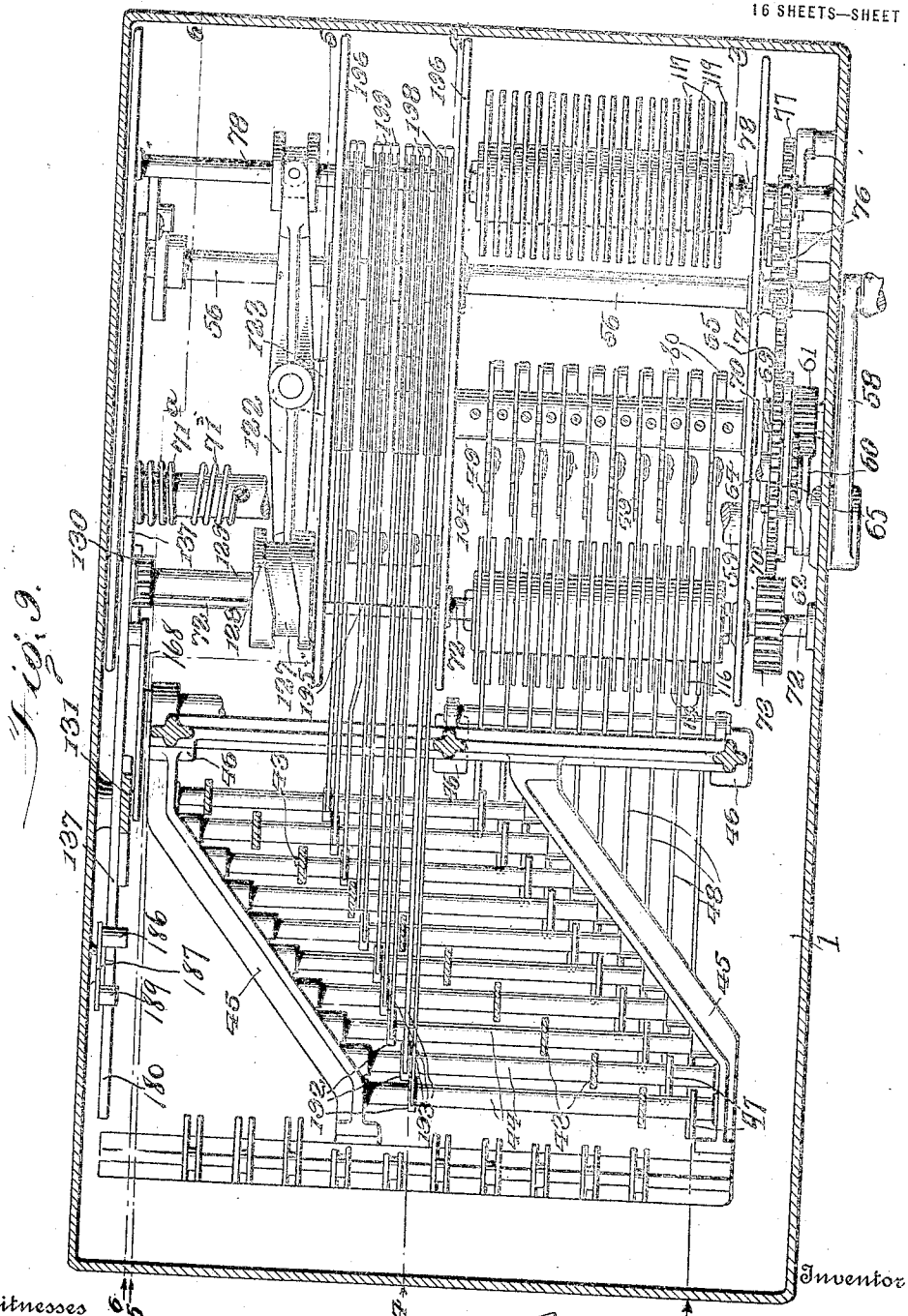


Fig. 9.

Witnesses

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COMPUTING AND RECORDING MACHINE.

APPLICATION FILED AUG. 7, 1912.

1,224,873.

Patented May 1, 1917.

16 SHEETS—SHEET 9.

Fig. 11.

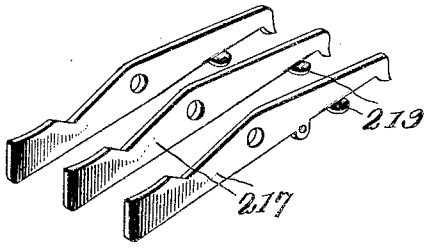


Fig. 10.

Witnesses

Helgel H. Murray.

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COMPUTING AND RECORDING MACHINE.

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Fig. 12.

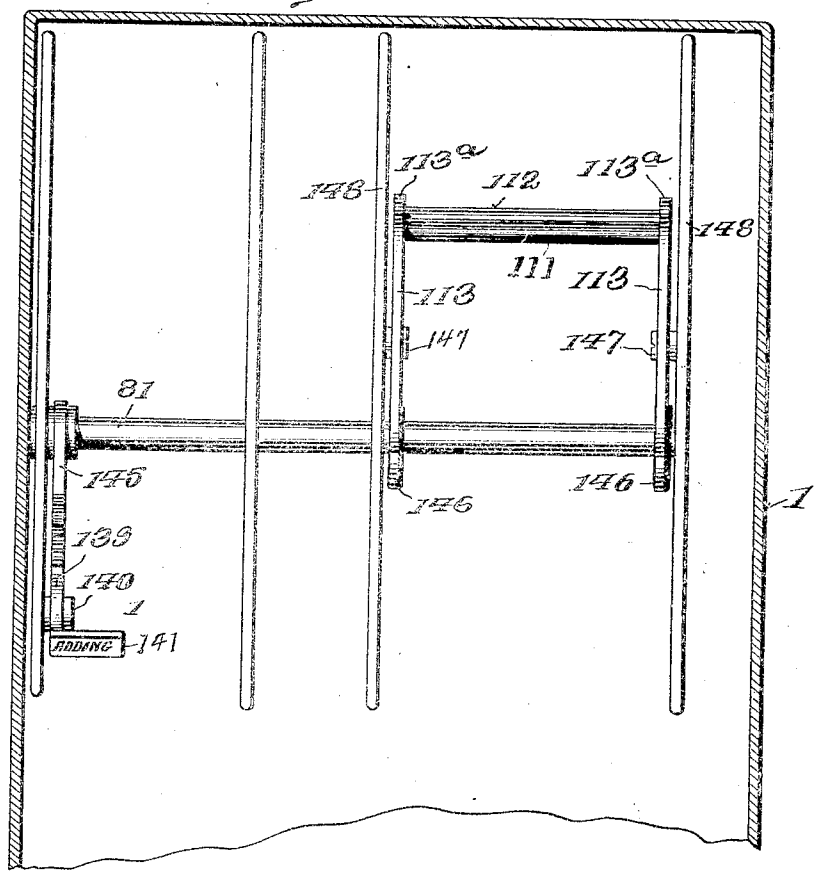


Fig. 27.

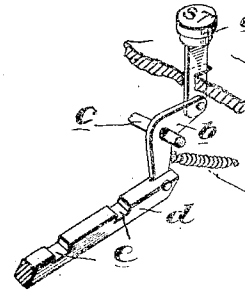
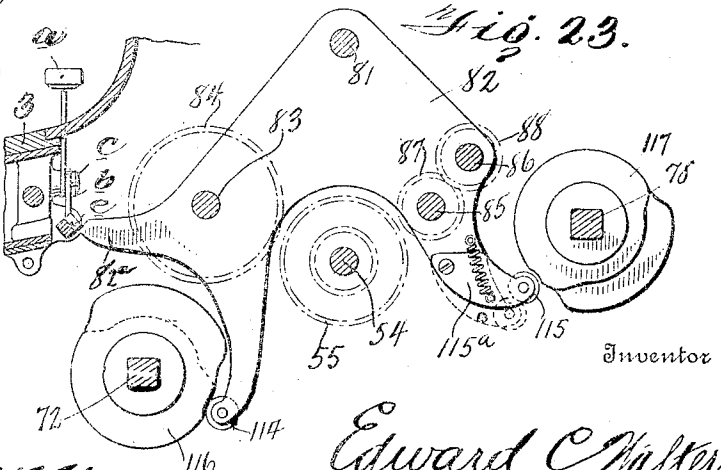


Fig. 23.



Witnesses

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16 SHEETS—SHEET 11.

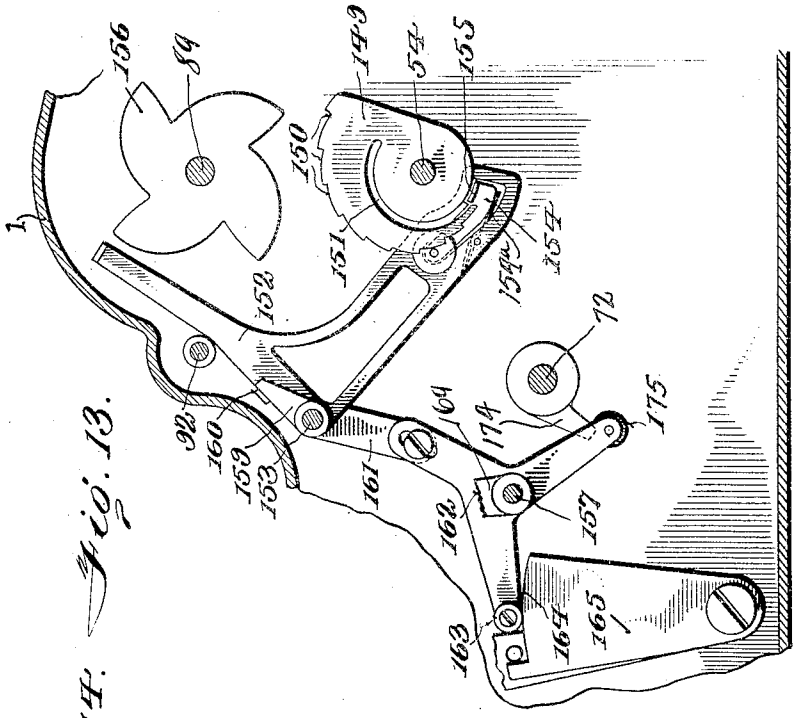


Fig. 13.

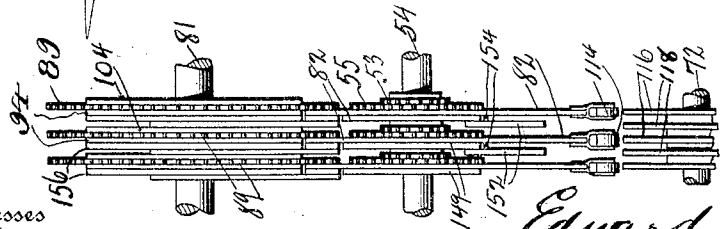


Fig. 14.

Witnesses

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COMPUTING AND RECORDING MACHINE.

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16 SHEETS—SHEET 12.

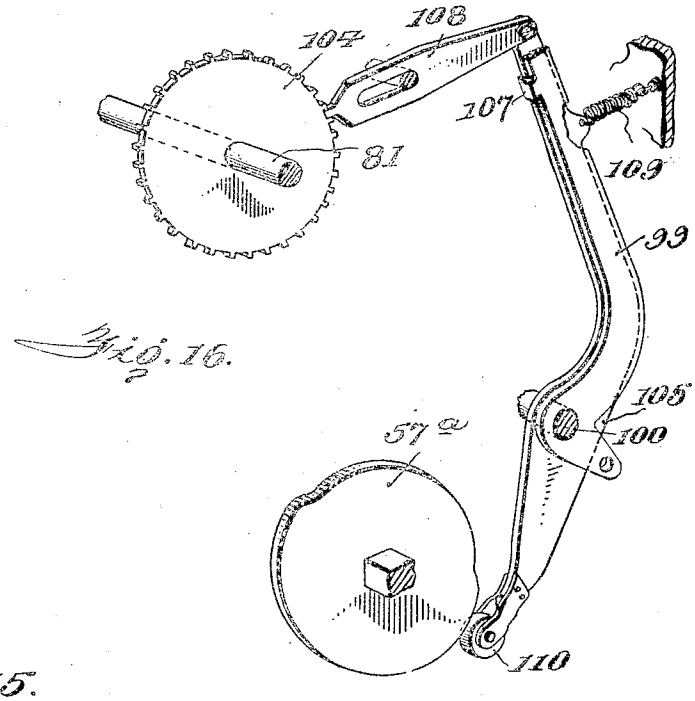
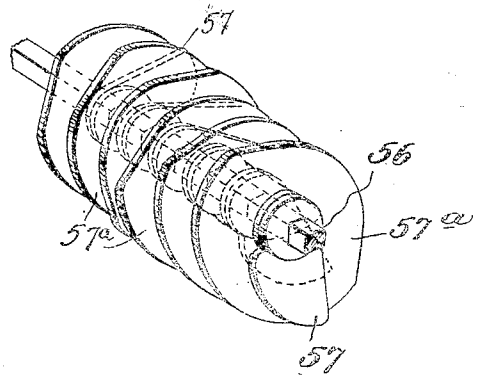


Fig. 16.

Fig. 15.



Inventor

Witnesses

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COMPUTING AND RECORDING MACHINE.

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Patented May 1, 1917.

16 SHEETS—SHEET 13.

Fig. 18.

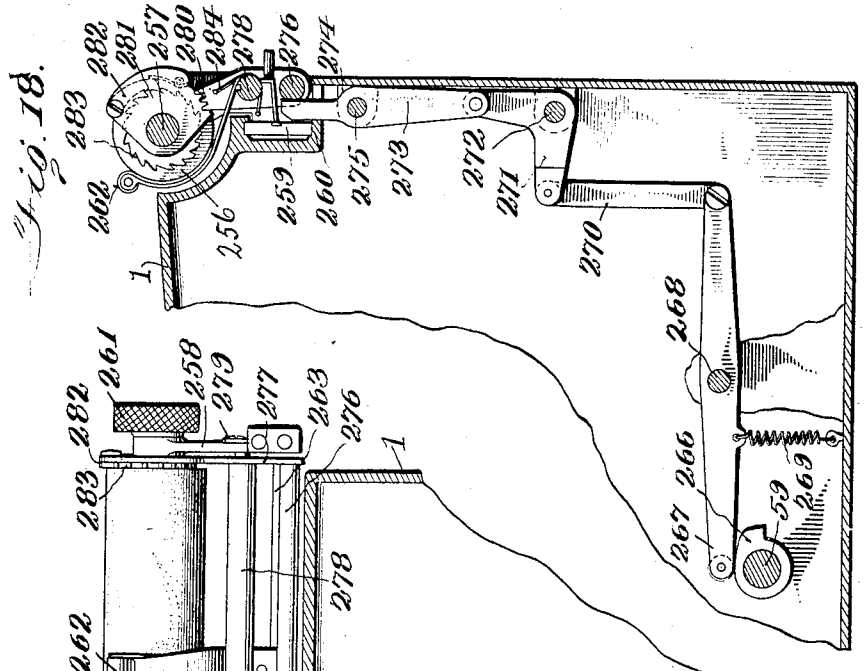


Fig. 17.

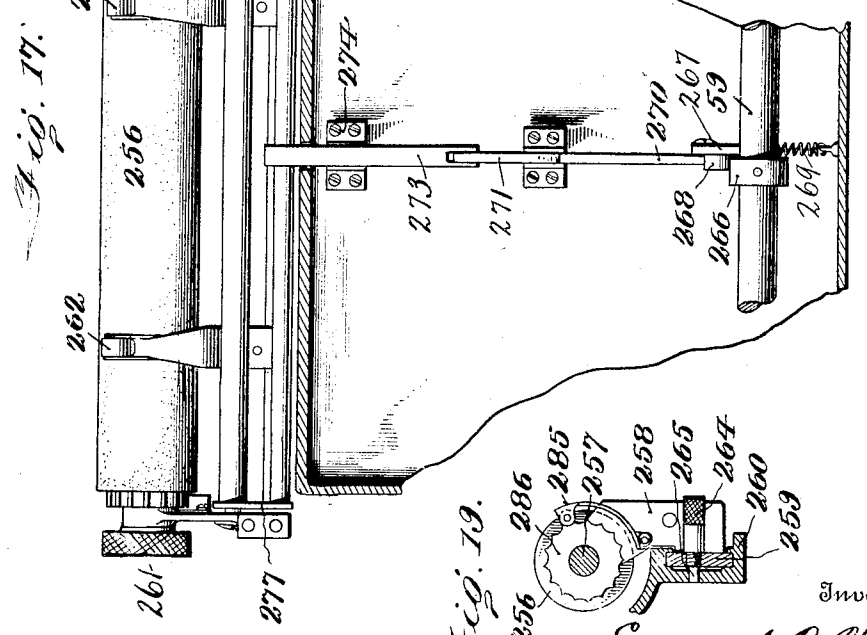


Fig. 19.

Witnesses

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Patented May 1, 1917.

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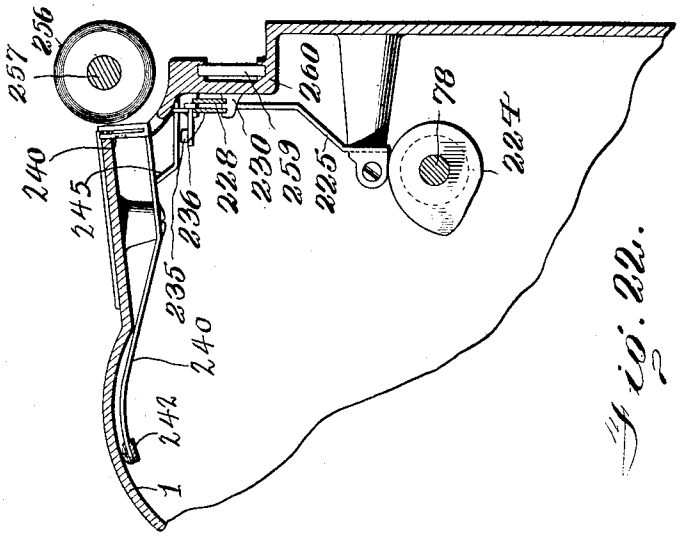


Fig. 22.

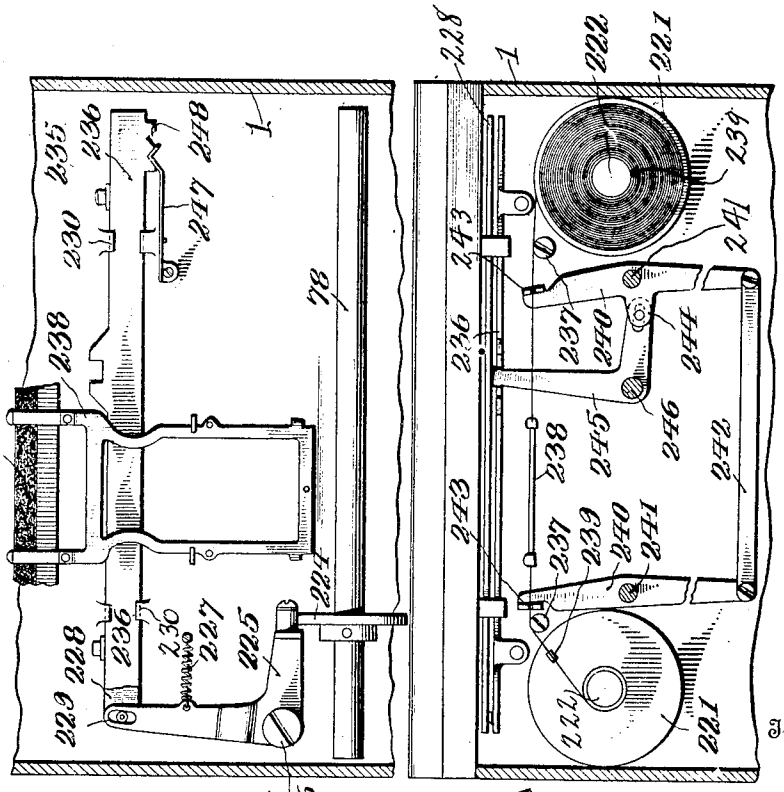


Fig. 20.

Fig. 21.

Witnesses

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COMPUTING AND RECORDING MACHINE.

APPLICATION FILED AUG. 7, 1912.

1,224,873.

Patented May 1, 1917.

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Fig. 25.

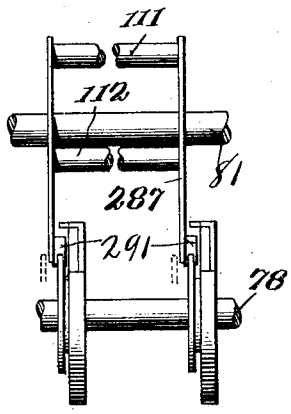


Fig. 26.

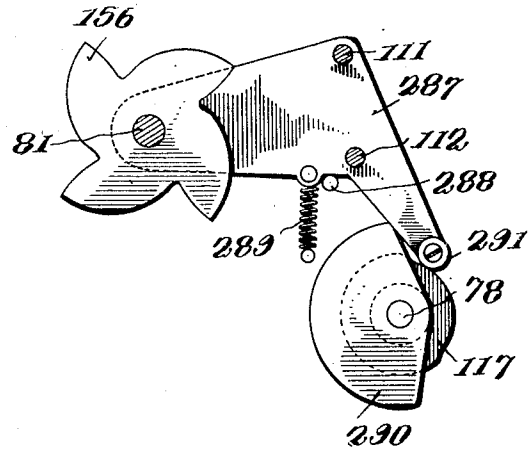
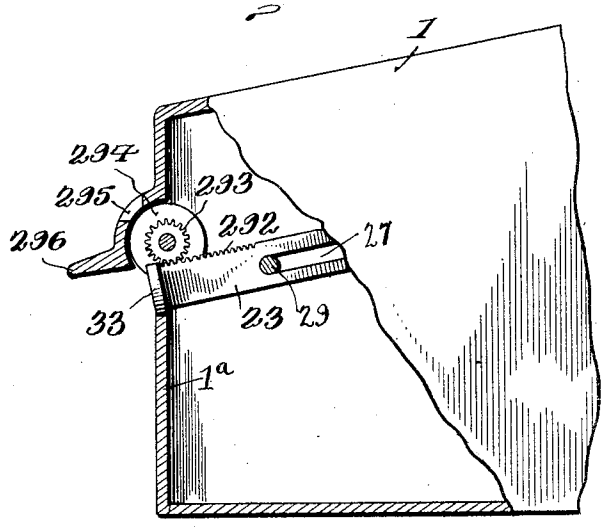


Fig. 27.



Inventor

Witnesses

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COMPUTING AND RECORDING MACHINE.

APPLICATION FILED AUG. 7, 1912.

1,224,873.

Patented May 1, 1917.

16 SHEETS—SHEET 16.

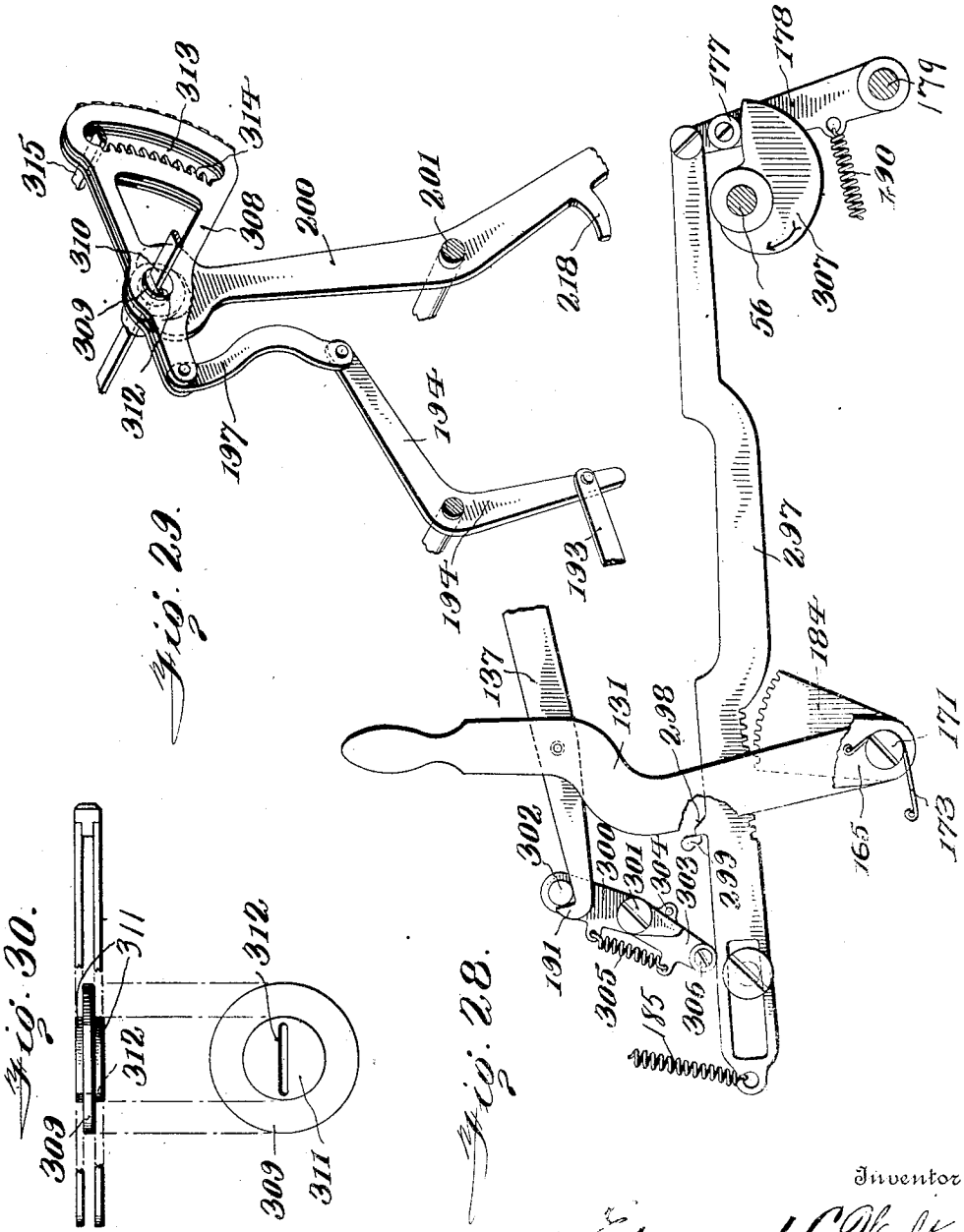


Fig. 29.

Fig. 28.

Fig. 30.

Witnesses

Helge Ostlund

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Inventor

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By Edmund S. Parry

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UNITED STATES PATENT OFFICE.

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COMPUTING AND RECORDING MACHINE

1,224,873. Specification of Letters Patent. Patented May 1, 1917.

Application filed August 7, 1912. Serial No. 713,921.

To all whom it may concern:

Be it known that I, EDWARD C. WALTER, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Computing and Recording Machines, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to adding, subtracting and recording machines, and particularly machines adapted for making lists of checks or other items, adding and subtracting items, and printing the amounts and totals thereof.

One object of the invention is to provide a machine having positively actuated adding and subtracting mechanism of simple, durable and efficient construction, and designed to print each item on a work-sheet or strip of paper, and, then, the totals thereof.

Another object of the invention is to provide a machine of the character specified in which the manual operations may be easily and quickly effected, first, through the instrumentality of keys and, then, by a suitable motor, such as an operating handle.

A further object of my invention is to provide a novel aggroupment of mechanisms adapted to effect additive and subtractive computations, with provision of means for shifting certain instrumentalities in the machine whereby it may be adapted either to effect one or the other of the specified character of computation.

A still further object of my invention is the arrangement of connections between numeral-keys and computing-mechanism and by which connections only an actuation of the selecting-mechanism (which forms a part of the structure) is effected when one or another of the numeral-keys is depressed by the operator, there being mechanism provided for independently actuating said selecting-mechanism to effect a computation; so that, to the end that each numeral-key shall be required to do a minimum amount of work, the connections between the numeral-keys and computing-mechanism are peculiarly arranged, first, in order that no part of said computing-mechanism shall be operated by the numeral-keys when it is desired to add or subtract and, secondly, before said computing-mechanism is operated, only that part of said mechanism shall be actuated which includes the selecting-mechanism, wherefore, upon the depression of a numeral-key, only slight work is imposed thereon in actuating the selected instrumentality or instrumentalities of the machine, the remaining instrumentality or instrumentalities of said machine depending for operation upon the actuation of other mechanism to effect the necessary computation and, also, to effect simultaneously a printing of the item upon the work-sheet.

The invention also has for its object the provision of instrumentalities by which the actuation of number-wheels or dials is accomplished through means which are controlled by but which are actuated independently of the numeral-keys, provision being made, as stated, in independent mechanism to effect successive actuations of the parts of the computing-mechanism and, thus, of the successive number-wheels or dials in the operation of adding or subtracting.

A still further object of the invention is the provision of suitable means formed for actuating the parts of the computing-mechanism whereby it is readily converted from an adding machine into a subtracting machine, the actuation of the necessary parts, devices and mechanisms for effecting this change being under the control, preferably, of a suitable device conveniently arranged on the machine and operating, with certainty and ease, to shift the parts that may be required to make the desired conversion.

Still another object of the invention is to provide a connection between the instrumentalities which control the total-computation and the ribbon-mechanism of the machine whereby, by the operation of said instrumentalities, said ribbon-mechanism is actuated to cause a printing of the total amount in a distinguishing color.

Still another object of the invention is to provide instrumentalities whereby a selection in the machine, once made, may be eliminated or destroyed without the necessity of operating the machine to effect a computation, whereby proper correction of any errors in the selection may be effected preliminary to the final operation of effecting the computation.

Still another object of the invention is to provide, in conjunction with the numeral-

keys, means for controlling their operation and position whereby the danger of errors, due to the possibility of inaction or improper action of the parts, is eliminated.

Still another object of the invention is to provide instrumentalities whereby the printing upon the work-sheet is not effected until after a selection has been made, and this printing shall be effected as a distinct operation to the selection-operation.

Still another object of the invention is to provide instrumentalities for automatically returning the mechanisms of the machine to adding condition whenever a total has been taken.

Still another object of the invention is to provide novel instrumentalities for automatically "clearing" the machine after a total has been taken.

Still another object of the invention is to provide an indicator or indicator-instrumentalities to display the condition in which the machine is set; that is to say, for adding, or for subtracting, or for totaling, or otherwise.

Still another object of the invention is to operate all mechanisms of the machine, acting under the control of the pull-handle, during the forward movement of said handle, thereby leaving the same free to return to normal position without imposing any work thereon.

Still another object of the invention is to provide means for controlling the return of the motor or pull-handle.

Still another object of the invention is to provide means for producing a sub-total in connection with additive and subtractive computations.

Still another object of the invention is to provide means whereby the printing of an item may be effected without producing a computation in the machine.

With the aforementioned general objects in view, and other specific objects which will be hereinafter set forth, my invention resides in the novel combination and arrangement of mechanisms, devices, and instrumentalities, all as hereinafter more fully described and claimed.

In the accompanying drawings, I have illustrated an embodiment of the invention, by way of example, and at this point desire to state that it is to be understood, that in exemplifying such an embodiment, I am by no means claiming or restricting myself to such particular form, since other embodiments, adapted to perform the functions and to secure the results for which the illustrated embodiment is designed, are within the spirit of my invention.

In these drawings:—

Figure 1 is a view in perspective of the machine, showing particularly the arrangement of the keys, the relative position of the operating-handle, and the relative position of the setting lever—the machine being shown, here, as set for adding;

Fig. 2 is a view, in plan, illustrating the keyboard, a part of the casing being broken away to illustrate portions of the ribbon-mechanism, and, also, the printing sectors;

Fig. 3 is a view in side elevation of the machine, a part of the casing, at the side, being broken away to illustrate the gearing actuated by the operating-handle, and constituting the active instrumentalities of the actuating mechanism when a computation is to be effected;

Fig. 4 is a view in side elevation, partly in section, of the machine, showing the printing-mechanism and the instrumentalities connecting therewith and operating, in part, to actuate the same; showing, also, certain parts of the ribbon-shifting device and the zero-printing preventive arms;

Fig. 5 is an elevational view, with a part of the casing broken away and portions of the interior mechanism omitted to illustrate the setting-lever and certain of the parts operated thereby;

Fig. 6 is a similar view showing other of the parts of the machine actuated by said setting-lever;

Fig. 7 is a view in vertical section illustrating particularly the numeral-keys, the selecting-mechanism, and certain of the parts controlled by said selecting-mechanism;

Fig. 8 is a fragmentary view of two of the keys, one being shown in normal position, and the other in its actuated position;

Fig. 9 is a top plan view of the machine, the top-plate of the casing being removed, and certain of the parts being shown in section;

Fig. 10 is a fragmentary view showing particularly certain parts of the printing structure and the actuating-instrumentalities which control the same;

Fig. 11 is a fragmentary view showing, in detail, stop-devices employed in connection with the printing-mechanism;

Fig. 12 is a fragmentary view, in plan, of the carry-pawl shifting-mechanism;

Fig. 13 is a fragmentary view, in elevation, of the total-producing mechanism;

Fig. 14 is a fragmentary view, in front elevation, of some of the main gears, the shifting pinion-plates, the shifting cams, and companion set of cams, respectively, forming a part of the computation-mechanism;

Fig. 15 is a perspective view of the cam-carrying drive-shaft;

Fig. 16 is a fragmentary view, in perspective, of mechanism adapted to be actuated into locking engagement with a part of computation-mechanism, whereby overthrow of any of the parts is prevented:

Fig. 17 is a fragmentary view, in plan, of the sheet-carrying platen, and showing, also, a part of the automatic line-spacing mechanism;

Fig. 18 is a fragmentary view, in vertical section, showing particularly the sheet-carrying platen and means for automatically actuating the platen for line spacing;

Fig. 19 is a fragmentary view, in sectional elevation, of the platen and the means for holding it in operative position;

Fig. 20 is a fragmentary view, in front elevation, illustrating a portion of the ribbon-mechanism;

Fig. 21 is a fragmentary view, in top plan, thereof;

Fig. 22 is a fragmentary view, in side elevation thereof;

Fig. 23 is a fragmentary view, in side elevation, of a sub-total mechanism;

Fig. 24 is a fragmentary view, in perspective, of the key, etc., forming part of the same;

Fig. 25 is a fragmentary view, in top plan, of a modified form of carry-pawl shifting device;

Fig. 26 is a fragmentary view, in side elevation, of said modified form of mechanism for controlling the parts when changing from adding to subtracting, or vice versa;

Fig. 27 is a fragmentary view of the machine-casing, a portion being broken away to show a modified form of construction whereby the extent of operation of the selecting-mechanism of the machine may be visually determined by the operator;

Fig. 28 is a fragmentary view, in side elevation, of a modified form of setting-lever returning-mechanism; and

Figs. 29 and 30 are detached views, in perspective and plan, respectively, of a modified form of one of the printing-sectors and its mounting.

In the following description, I shall, with a view to abbreviating the same as much as possible, use descriptive expressions to comprehend mechanisms, operations, or series of operations, and results: For instance, I shall employ the expression "set up" or "setting up" to refer to the operation of the predetermined movement of certain devices which will hereinafter be referred to as the "selecting mechanism." The results of the operation of said selecting-mechanism I shall hereinafter refer to as a "condition," wherever the same is accomplished in the usual manner of depressing any one or more of the numeral-keys. Moreover, I shall use such expressions as "transit," "transmitting," or the like, to designate the operation of the movable or actuating parts which are thrown into operative engagement with the selecting mechanism, and whose movements are or may be controlled by said selecting mechanism.

Referring to the drawings:—

The casing.—The numeral 1 designates the casing of the machine, which may be of any preferred form or construction. Preferably and as shown, the same comprises a metallic case having a broad, flat base adapted to rest upon a table or the like. The inside walls of the opposite sides of the casing provide journals or bearings for the various shafts and supports of the mechanisms inclosed within the casing.

The keyboard and keys.—The keyboard comprises, in this instance, a plurality of rows of keys 2, there being preferably and as shown nine of these keys in each row (which represent the nine cardinal figures without the cipher) for each order or place, that is, for each position of units, tens, hundreds, etc. In the machine illustrated there are ten rows of the keys, there being two rows of decimal keys 2^a. It will thus be seen that the machine illustrated, having a capacity of 99,999,999.99 contains ten orders or places, making a total of ninety keys. From this, it will be obvious that a machine which has a capacity of only 999.99 will contain but forty-five keys.

At this point, it is proper to state that the machine, as illustrated in the several figures, is set to effect an additive computation. As will presently be explained, the structure is adapted to have its parts positioned, by a single instrumentality, whereby it will effect a subtractive computation, all as will presently be explained.

Referring, now, particularly, to Figs. 7, 8 and 9, it will be seen that the keys have a vertical movement in apertures formed in the top-plate 3 of the keyboard section of the machine. Underlying this top-plate is an abutment-piece 4 supported on end-brackets 5 depending from the top-plate, and which abutment-piece serves the dual function of limiting the upward movement of the key, and, also, as a support for a spring 6 which is adapted to return the key to normal position after it has been depressed and released for such return movement.

Each key-stem is formed on one side with two notches 7 and 8, respectively: Slidably mounted on the top-plate 3 is a locking-plate 9 provided with a plurality of apertures 10 through which the keys 2 extend. This plate 9 is adapted to engage the key in the notch 7. The notch 8 is, for practical purposes, merely a clearance notch for the plate 9, as shown in Fig. 8. The notch 7 is so formed that, when the locking-plate 9 is in an engaging position therein, it will hold the key depressed and against the action of the spring 6, as shown. The locking-plate 9 is normally held out of engagement with the stems of the keys by a spring 12 attached to the plate and to a pin 13

projecting from the inside of the casing, as shown in Fig. 7. It will be understood that the locking-plate 9 is actuated out of its normal position whenever a key is depressed, whereupon said plate engages in the locking-notch 7 in the key, in which it remains until the plate is forced out of engagement with said holding-notch. To limit the upward movement of the key on being returned to its normal position by the spring 6, the key, on the side opposite to the notches 7 and 8, and below the lower end of the spring 6, is provided with an angled and cam-faced projection 14 adapted to engage a projection 15 on the abutment-piece 4, as clearly shown in Figs. 7 and 8.

Slidably mounted upon the lower face of the abutment-piece 4 is a pawl-release-plate 16 provided with apertures 17 through which the lower portion of the stem of each key 2 projects. Attached to this plate is a spring 18 which is also secured to a pin 19 projecting from the bottom of the abutment-piece 4. This spring operates to maintain the release-plate against the key-stem. At the opposite end of this plate, there is a slot 20 through which one member of a two-armed pawl 21 extends and which has secured to it a retractile spring 22 adapted to hold the pawl against the rear end of the slot.

The aforementioned angular and cam-faced projection 14, when the key is depressed, engages with and actuates the release-plate 16 toward the front of the machine to cause the holding-pawl 21 to be rocked on its fulcrum 21^a mounted in a bracket 21^b. The spring 18 will permit the release-plate 16 to be moved by said projection and thereafter reshift the plate to permit the pawl 21 to assume its normal position, namely, that shown in Fig. 7.

Key-lock mechanism.—When one key in an order or place-row of keys is depressed, the other keys in that row will be locked in their raised or normal position until the depressed key is returned to its normal position. Thus, only one key at a time can be in the depressed position. Each key has formed on its lower end a projection 14^a which will pass through the opening 17 in the release-plate 16, when a key is being depressed. The release-plate will go under all of the other projections 14^a, thus preventing the other keys from being depressed until the depressed key is in its raised position.

Selecting-mechanism.—Underlying each row of key-stems is a slide-member 23 comprising two spaced bars (Figs. 7 and 10) connected for simultaneous movement and both provided with a plurality of upstanding projections 24, each having a hooked end 25. It will be observed that the right-hand bar of the sliding-member has five of these projections, whereas the left-hand bar has but four of them. At one end, said slide-member is provided with an incut or notch 26 into which the lower member of the aforementioned two-armed pawl 21 is normally seated to lock said member against movement. Whenever a key is depressed and its projection 14 actuates the release-plate 16 forward, the pawl 21 is rocked out of engagement with the slide-member 23. Said member is then free to move forwardly and thereby influence mechanism presently to be described. When all of the keys in any particular row are in their raised or normal position, the release-plate 16 will be in its normal position, namely, that shown in Fig. 7. If it had been actuated, its spring 18 will restore it to normal position. In consequence, the pawl 21 will, under the action of its spring 22, be held in the incut 26 in the bar 23 and thereby lock it, as already stated.

The slide-member is provided, near its ends, with elongated slots 27 and 28 through which extend, respectively, shafts 29 and 30, and by which the several slide members are supported.

Each key-stem, at its lower end, is bent at right angles to provide an angulated extension 31. On each alternate key-stem of the row, the extension is on the side opposite from that of the proximate key in order to be in the plane of the bar of the slide-member directly beneath it. As the right-hand bar of the slide-member 23 has five projections, they will respectively engage the stems of the keys bearing the denominational numerals "1", "3", "5", "7" and "9"; whereas, the left-hand bar, having four of such projections, will respectively engage the "2", "4", "6" and "8" keys.

It will now be understood that, when a key is depressed, and its angular projection 14 has cammed or forced the release-plate 16 forward to release the pawl from the slide-member 23, the latter will be free to move forwardly so that one or another of the projections 24 may engage the lower extremity of that key-stem which is depressed and which (according to its denominational value) will predetermine the extent of movement of said slide-member. As will be understood, there are in all nine of the upstanding projections on each of the slide-members, and each bears a definite relation to the key which it is designed to engage whenever that key is depressed. The hooked form of said upstanding projection permits it temporarily to interlock with the key when the latter is depressed into engaging position.

The forward end of each of the slide-members 23 is provided with an extension 32 which extends through the front wall 1^a of

the casing and is provided with a button 33. By means of this extension, the operator may, whenever necessary, push said slide-member back into its normal position.

After the keys have been depressed, and locked in such position by the locking-plate 9, as already described, they will return to their normal position after being released by the following mechanism:

Pivoted on a shaft 34 is a series of arms 35—one for each row of keys—each normally controlled by a retractile spring 36. At its upper end, said arm is provided with a spring-actuated pawl 37 which is adapted to engage the forward end of the sliding lock-plate 9, as shown in Fig. 7. The shaft 34 is supported, at opposite sides of the machine-casing, on two arms 38 mounted on a shaft 39, said arms being held in an elevated position by a spring 40. The arm 35 occupies a position between the bars forming the slide-member, which latter is provided with a stud 41 adapted to engage the edge of the arm 35 when the slide-member is moved rearward, either by means of the push-extension 32, or when returned to normal position by mechanism to be hereafter described. The movement of the arm 35 causes the pawl 37 to force the locking-plate 9 rearward and, thus, out of the locking notches 7, in the key-stems, whereupon the depressed keys, being thus released, are, by their respective springs, raised to normal position.

Having now described the operation of the numeral-keys and the manner in which they operate to control the extent of movement of the slide-member 23, it is now in order to describe the parts and mechanisms affected by the particular position which any of said slide-members may assume:

As already described, each of the sliding-members 23 comprises two spaced bars. These are held apart by a stud 42. Projecting between the pair of bars forming the slide-member 23 and adapted to engage said stud (Fig. 10), is the bifurcated end of a vertical arm 43 mounted at its lower end upon a transverse shaft 44 journaled in side-bars 45 supported on standards 46 secured to the base-plate 1^b of the machine-casing. Also mounted on said shaft 44 is a depending arm 47 to which is pivoted a long selector-arm 48, this arm connecting at its opposite end with a segmental-gear member or selector 49 loosely mounted on a shaft 50 and having a spring 51 connected to its lower end, said spring being also attached to the aforementioned standard 46. Arranged to the rear of said member 49 is an adjustable stop 52 for predetermining the extent of movement of said member in one direction. The selector-arm 48, as controlled by the slide-member 23 (and this in turn controlled by one or another of the keys 2) predetermines the extent of movement of said member 49 in the opposite direction.

As seen in Figs. 7 and 10, the member 49 is provided on its upper segmental portion with rack-teeth which are adapted to mesh with a pinion 53 supported on a shaft 54 and fast to a drive-gear 55.

The parts which have now been described—comprising the slide 23, arms 43 and 47, the selector-arm 48, the segmental rack-member 49, the pinion 53 and drive-gear 55—constitute the selecting-mechanisms aforementioned and upon which a "condition" is "set up" whenever a key or a series of keys have been depressed by the operator, said parts operating in the following manner: The slide-member 23 having been released after the holding-pawl has been disengaged therefrom, permits the selector-actuating spring 51 to rock the selector 49 on its axis and, thereby, the arm 48 is thrust backward to actuate the slide-member 23 forward so that one or another of its projections 24 will engage the depressed key-stem which will, as already explained, predetermine not only the degree of movement of said slide but, thereby also, that of the selector 49. This in turn will, by its movement, rotate the pinion 53, and drive-gear 55 to the same extent as its said adjunctive actuating parts have been moved. A "condition" or "selection" will, thus, have been "set up" or established on said drive-gear 55 for a purpose presently to be described. If it be desired to restore the parts to normal position, to change or correct the "condition" or "selection," the operator pushes the slide-members inwardly, whereupon the selector (through the intermediate connecting parts) is restored to normal position and the keys being released from the holding-plate, will rise to their normal position. It will be understood, of course, that there is a separate selecting mechanism for each row or order of keys. In other words, there are as many selecting mechanisms as there are rows of keys.

Actuating mechanism.—As already mentioned, my machine, being of the so-called "key-set" style, includes mechanism that is operative independently of the keys to effect an actuation of those parts which operate to effect the desired computation. I shall now proceed to describe such mechanism.

Fast on a square shaft 56 is a series of cam-members 57 and cam-disks 57^a, their cam-faces being successively arranged spirally, whereby each cam 57 operates successively upon its respective selector 49 (in a manner presently to be explained), and whereby the various mechanisms affected by the movement of each selector are succes-

sively operated. These cams 57 are, therefore, the active instrumentalities for operating upon the selectors. The shaft—and thereby, the cams—is set into operation by mechanism (see Figs. 1–3, 7 and 9) which includes a pull-lever 58, which must be operated by the operator for every item to be computed; but other mechanism (other than manually operated mechanism) and not shown, may be used, such as an electric motor (not shown). In the latter case, the pressing of a motor-key (not shown) will cause the motor (not shown) to operate the computing-mechanism in the same way that the manually-operated pull-lever 58 does. The pull-lever is arranged on the right-hand side of the machine, outside of the casing thereof, and is fastened on the end of the actuating shaft 59, which extends through the machine to the left side. Fastened on the shaft 59 and within the casing 1 is a segment gear 60 which meshes with a pinion 61, this pinion being for reversing the movement. The pinion 61 is mounted on any suitable part of the casing of the machine, and meshes with a pinion-gear 62 which is fastened to a ratchet 63 and loosely mounted on a stub-shaft 64. Also loosely mounted on the shaft 64 is a gear 65 which carries on one face two pawls 66 having projections 67 which engage with the ratchet 63 when the handle 58 is pulled, and which will ride over the ratchet when the handle is returning to its normal position. Springs 68 will cause the pawls 66 to engage the ratchet whenever free to do so. Therefore, the gear 65 will always turn in one direction and will have movement only from the forward action of the handle 58 and will remain idle while the handle is returning to its normal position. An arm 69, fastened to the shaft 59, will engage with pins 70, on the gear 65, when the handle is pulled, to prevent any overthrow of the gear 65 and its adjunctive parts. A coil-spring 71 around the shaft 59, (one end of which spring is fastened to the shaft and the other end to any suitable part of the frame of the machine) will return the handle and its connecting parts to normal position. Another spring 71^a, wound in a direction opposite to spring 71, and secured to the shaft 59 and to the machine-casing, will assist the operator in moving the handle 58 forward and also control the return-movement of the handle. Fastened to a shiftable shaft 72, is a pinion 73 which meshes with the gear 65, and is of sufficient width to allow the shaft to be shifted endwise without becoming unmeshed therefrom. The gear 65 will cause the pinion 73 and shaft 72 to make one revolution every time the handle is pulled. Meshing with the gear 65 on its opposite side is a pinion 74 which is fast on the shaft 56, which is also rotated one revolution every time the handle is pulled. Meshing with the pinion 74 is an intermediate pinion 76 of sufficient width to permit a pinion 77 which is fastened to the shifting-shaft 78 to be shifted without becoming unmeshed therewith. This pinion 77 and shaft 78 will also make one revolution every time the handle is pulled. All these pinions and shafts rotate in one direction only, but not necessarily in the same direction. The actuating-cam 57 and the carry and lock-plate cam 57^a being fastened on the shaft 56 will make one complete revolution every time the handle 58 is pulled. Therefore, the segment gear 49 is permitted to be engaged by the cam 57 and be actuated or forced back to its normal position thereby. The extent of movement of the handle is governed by the studs 58^a in the side plate or casing of the machine. A second pawl 75 and ratchet 79 will prevent the gear 65 from being rotated in a reverse direction, by friction or otherwise, when the handle is returning to its normal position.

It is to be understood that the pinions 73, 76 and 77, while rotated when the pull-handle 58 is moved forward, do not effect any action of the driving-cams 57, but the pinion 74 does because it is fast on the shaft 56 which carries said cam-disks. Therefore, it will now be obvious that when the handle 58 is operated, the pinion 74 and its shaft 56 are rotated, and, thereby, the cam-disks are actuated and with the following result:

The segmental-rack 49 carries a small roller 80 adapted to traverse the periphery of the cams 57, being held in engagement therewith by the spring 51. Thus, it will be recognized that whenever one or another of the keys 2 or 2^a is depressed to set up a "condition" on the selecting-mechanism, and the actuating means just described—and which includes the aforementioned actuating cams 57—is then operated to rotate in the direction indicated by the arrow (Fig. 7), the roller 80 will, when engaged by the cam 57, travel upon its periphery (the spring 51 holding said roller hard against said periphery), whereupon the selector 49 which will be actuated in the opposite direction and, by its action on other parts (soon to be described) be instrumental in effecting a computation; such movement of the selector causing a rotation of said drive-gear 55 through a number of unit-places or spaces equal to the character-numeral on the key depressed. The "condition" or "selection" of the amount to be computed and recorded is first effected by the depression of a key. Then the actuating mechanism co-acts with said selecting-mechanism, as a second and distinct operation, to effect a movement of other mechanisms to produce a computation and record, in a manner that will be made clear farther on. In computing amounts which contain ciphers, such as

"1002," no notice need be taken of a cipher except to skip an order or place-position on the keyboard for every such cipher that may be contained in the amount to be recorded. As none of the keys has to be depressed in the order or place representing the cipher in the number being computed, no co-action takes place between the pawl-release-plate 16 and the holding pawl 21. Thus, the slide-members of those orders or places representing the ciphers in the number being computed, as well as those orders or places representing the capacity of the machine in excess of the amount being computed, will be prevented from moving under the action of the spring 51, since the pawls 21 will not have been disengaged from the slide-member and the latter will have had no movement. It will now be seen that no "selection" will have been effected on and, thus, no rotative movement given to, the drive-gear 55 on those orders or places corresponding to the cipher-positions in the computed number, nor those orders or places corresponding to the capacity of the machine in excess of the amount being computed, that is, the orders or places to the left of the last figure in the number being computed.

Computing mechanism.—Having now described the several mechanisms brought into operation to set up a "condition" or "selection," I now shall proceed to describe the mechanisms and instrumentalities which are thrown into coöperative relation to be affected thereby when the aforementioned actuating-mechanism is operated by the movement of the motor-handle 58:

Suspended from a shaft 81 is a shiftable pinion-carrying plate 82 having two depending arms on one of which is mounted (on a stub-shaft 83) an adding-pinion 84. On the other arm of said shiftable plate are mounted (respectively, on stub-shafts 85 and 86) two subtracting-pinions 87 and 88, there being companion subtracting-pinions in order to effect a reversal of movement on the second of the two. Normally (and as shown in Fig. 7) the pinion 84 and the companions 87 and 88 are not in mesh with the drive-gear 55. As will presently be set forth, means are provided (under the control of the operator) for shifting the pinion-carrying plate 82 whereby either the pinion 84 or the lower of the companion pinions 87 and 88 are meshed with drive-gear 55.

Meshing with the pinions 84 and 88 and loose on the shaft 81 is a main gear 89, with which meshes a pinion 90 fast on one side of a number or character-bearing sight-wheel 91 which is loose on a shaft 92.

It will now be clear that the shifting of the plate 82 toward the right (in Fig. 7) will mesh the adding-pinion 84 with the selecting or drive-gear 55, whereby it will, when rotated in a direction opposite to that which occurred when it was actuated in making a selection, effect a rotative movement of said pinion and through it, rotate the main gear 89 of the sight-wheel 91, the extent of the rotation corresponding to the "condition" previously set up on the selector 49 and gear 55; whereas, a corresponding shift of said plate in the opposite direction will mesh the pinion 87 with the drive-gear 55 and, receiving motion therefrom, will transmit the same to its companion pinion 88 which, in turn, will set in motion the main gear 89 (in a direction opposite to that in which it had previously rotated when acting under the control of the pinion 84) and this will rotate the number-wheel 91. It will therefore be seen that the direction in which the main gear 89 will turn is determined by the shifting of the plate 82 in one direction to mesh the adding-pinion 84 with the selecting-gear 55, and in the other direction to cause the subtracting pinion 87 to mesh with the selecting-gear. A selection having been made, as already described, the actuating mechanism (which includes the cam 57) when operated, will return the selecting-mechanism to its normal position, thus destroying any selection which may have been made. If the mechanism has been set for adding, the shifting-plate 82 will cause the adding-pinion 84 to mesh with the selecting-gear 55 just before the selecting-mechanism starts to return to its normal position. It will be seen that as the selecting-gear 55 is being returned to its normal position, and as the adding-pinion 84 is in mesh with this selecting-gear, it will be caused to turn (as will also the main gear 89, and the number-wheel 91 in mesh therewith), the amount equal to the selection made. Should the mechanism be set for subtracting, the shifting-plate 82 (moved in the opposite direction) will cause the subtracting pinion 87 to mesh with the selecting-gear 55, and this will rotate pinion 88 and turn the main gear 89 and number-wheel in the reverse direction to that for adding when the selection made on the selecting-gear is being destroyed and the selecting-mechanism is returned to its normal position. Just after the selecting-mechanism has been returned to its normal position, the shiftable plate 82 will be caused to assume a neutral position, wherein neither the adding pinion nor the subtracting pinion will be in mesh with the selecting gear, thus leaving the selecting-gear free to turn when another selection is made thereon, and also leaving the main gear free to turn when actuated by the tens-carrying mechanism to be described later on.

From the foregoing, it will be understood that, in the cycle of operation incident to

effecting a computation, a selection having been made and when the operator first moves the handle 58, the adding-pinion or the subtracting-pinion (as the case may be) will mesh with the selecting-gear 55, and a further movement of the actuating-mechanism will simultaneously destroy the selections and, by the operation of the main gear and number-wheel, produce a computation on the latter: These results follow from the fact that the cam-disk 57 will abut against the roller 80 to force the same back to its normal position and thereby restore the selecting-mechanism—including the slide-member 23—to normal position. Incidentally, this destroys the selection, as aforementioned. Moreover, as any of the depressed keys will have been unlocked from its lowermost position and caused to resume its normal position by the action of the spring 6, the pawl 21 will enter the notch in the slide-member and hold the same in a locked position until it is again released by the depression of another key. The return movement of the slide-member 23 will have actuated the arm 35 and caused the pawl 37 to move the locking-plate 9 so that the keys may be released to permit their return. The spring 36 will, of course, when a selection is being made, cause the pawl 37 to be removed from the locking-plate 9, thus leaving it free to enter the locking notch in the key-stem to hold the key in its depressed position. The interlocking of the stem with the slide-member, when the hooked projection thereon engages the projection 31 on the key-stem, will prevent the key from rising in the event that a key should be depressed far enough to release the slide-member from its holding pawl 21 but not sufficiently far to permit the locking-plate to enter the holding-notch until said member is returned to normal position.

Repeat mechanism.—To repeat the amount selected, the operator has only to press and hold down a repeat-key 93 and pull the handle 58 the number of times the amount is to be repeated. Pressing down the repeat-key will depress the arms 38 and lower the pawls 37 away from the locking-plates 9, so that when the selections, on the different order or place-rows of keys, are being destroyed, the depressed keys 2 will not be released and the same selections will again be made. Thus an amount may be repeated as many times as desired. When the operator releases the repeat-key, the pawls 37 will be raised and will then abut against the locking-plates 9 to release the depressed keys when the handle is pulled for the last repeat-operation. It may be the case that no key in some of the place or order-rows of keys is depressed when the repeat-key is depressed: If so, the slide-bar 23 in those rows will have no movement, but the pawls 37 in those rows will be lowered and allow the locking-plates to assume a position in the clearance notches 8 in the key-stems of that row, which movement of the locking-plate will position it over the pawl 37. Therefore, the pawl 37 is under spring tension when being raised to allow it to swing on its fulcrum. When the repeat-key is released by the operator, the pawl 37 will rise and again be positioned in front of the locking-plate by its spring 37^a, when a key in those rows is depressed. There is one of these arms 35 and pawls 37 for every order or place-row of keys. The locking-plate will, of course, be out of engagement with the keys 2 at all times, except when a selection is being made, and also during and after a repeat-operation on the rows in which no selection had been made before the repeat-key was depressed. Thus, when the keys are depressed, they are relieved of the strain necessary to move the locking-plate, except in the above-mentioned cases. When the pawl 37 is positioned under the locking-plate, (as in the above case) and a key is depressed, the cam 7^a between the two notches in the key-stem will force the locking-plate out of the clearance notch and, when the locking-notch arrives in the same plane as the locking-plate, this plate will enter the locking-notch and hold the key in the depressed position. The arm 35 will move back when the slide-member 23 shifts to make a selection, thus allowing the pawl 37 again to rise and be positioned so as to abut against the locking-plate to effect a release of the depressed key when the selecting-mechanism is returned to normal position. The spring 40 is strong enough to raise all the arms 35 when all the pawls 37 are under the locking-plates 16, and, thus, acting to depress all the pawls 37 when the repeat-key is released, after being depressed when no selection has been made on the keyboard or, say, after one cent has been added or subtracted.

Carrying mechanism.—As is well known in the art, every time the character-bearing or sight-wheel 91 moves from nine to zero, in adding, or from zero to nine, when subtracting, certain mechanism must be brought into play to cause one unit to be added or subtracted from the sight-wheel of the next higher denomination.

As shown in Figs. 7 and 14, this carrying takes place immediately after the selecting-mechanism has been returned to its normal position, or after the bulk of the computation has been made and the main gear becomes idle. Fast on the side of the main gear 89 is a carry-disk 94 (shown in Fig. 7 partly in dotted lines) which has on its periphery four projections 95 equally spaced apart. The distance from the center of one projection to the center of the

next is equal to ten unit-spaces. Thus, every time the sight-wheel 91 moves through ten unit-spaces, one of these projections will pass a predetermined point. Arranged to lie in the path of and to be actuated by one or another of these projections, is a short lever 96, which is loosely mounted on shaft 97 and held in contact with the carry-disk 94 by a spring 98. Therefore, every time one of the projections 95 passes the contact-point, the forward end of the lever 96 will be caused to raise while its rear end will be lowered sufficiently to release a carry-arm 99 which is loosely mounted on shaft 100 and is provided with and controlled by a spring 101. Attached to the upper end of the carrying-arm 99 is a pawl-carrying plate 102 which has movement back and forth with the carrying-arm 99. Fulcrumed on the upper part of the plate 102 is a pawl 103 arranged to lie in the path of and to actuate a ratchet 104 (fastened to the right side of the main gear 89 of the next higher denomination) one unit-space whenever the carrying-arm 99 is forced forward or returned to its normal position by a lever 105 fulcrumed on the shaft 100, when the mechanism is set for subtracting. Fulcrumed on the lower side of the pawl-carrying plate 102 is another pawl 106 arranged to actuate the ratchet 104 in the reverse direction, when the machine is set for adding, and the arm 99 is forced forward in the same manner as for subtracting. Fastened on the shaft 56 is a second set of cam-disks 57ª arranged to actuate the lever 105 (every time the actuating-mechanism, already described, is actuated), immediately after the selecting-mechanism has been returned to its normal position and as soon as either the adding-pinion 84, or the subtracting-pinion 87, has been unmeshed from the selecting-gear 55. The lever 105 will have no action on the carry-arm 99 unless said carry-arm has been released from the lever 96 and the spring 101 has moved the arm 99 and its connecting parts to a position where a projection 107 on the carrying-arm 99 will abut against the lever 105. Thus, when said lever is forced forward by the cam-disk 57ª, it will abut against the projection 107 on the carry-arm 99 and cause said arm and its connecting parts to assume their normal positions. The adding-pawl 106 or the subtracting-pawl 103 (according to which is in mesh with the ratchet 104) will skip over one tooth of the ratchet when the carry-arm 99 is unlatched from the arm 96 and is actuated by the spring 101; but, when the carry-arm 99 is being returned to its normal position, the pawl 103, or the pawl 106, will abut against the tooth over which it skipped and will turn the ratchet 104 one unit-space.

Connected to the upper end of the lever 105 is a locking-plate 108 (Fig. 16) whose forward end is shaped to fit in the space between two teeth of the ratchet 104 to prevent overthrow thereof.

The lever 105, as shown in Fig. 7, is held forward by the cam 57ª until the adding-pinion 84 or subtracting-pinions 87 and 88 become meshed with the selecting-gear 55, thus holding the lock-plate 108 between the teeth of the ratchet 104 until the meshing of these gears take place, at which time the lever 105 by the action of its spring 101 will follow the edge of the cam 57ª and this will allow the lock-plate 108 to move out of mesh with the ratchet, thus leaving the main gear free to turn until the selection has been destroyed and the carry-operation completed, at which time the cam 57ª will force the lever 105 and the lock-plate 108 forward to again mesh with the ratchet to prevent all overthrow, and to prevent the main gear and its connecting parts from being disturbed (either by friction or otherwise) and perfectly to aline the figure-rolls 91 and the main gears 89, etc. The cams 57ª are arranged on the shaft 56 to act on the lever 105 in successive order, the same as the cams 57 act on the segment-gears 49. Therefore, the carry-operation will take place in successive order and just after the selecting-mechanisms are returned to their normal position.

A spring 109 will cause a roller 110, on the lower end of the arm 105, to follow the periphery of the cam 57ª when the actuating-mechanism is being operated. It will be noticed that the arm 105 will have a back-and-forth movement every time the actuating-mechanism is operated but will not actuate the carry-arm 99 unless it has been released from the arm 96. The carry-pawls 103 and 106 are held against the ratchet by springs (not shown), unless they are held out of engagement therewith by the action of depressing bars 111 and 112 bearing against the rear end of the pawls, which action will cause the forward end of each pawl to be thrown out of engagement with the ratchet 104. The bars 111 and 112 are supported at their ends by two vertically oscillating arms 113 and 113ª which are caused to shift (by means which will be explained later) whenever the mechanism is changed from adding to subtracting, or vice versa. Therefore, only one pawl is in engagement with the ratchet at any time.

The locking-plate 108 will maintain the main gear 89 and its connecting parts in proper alinement after the computation of any number, thus insuring the mechanism from disturbance either from friction or otherwise. The locking-plate remains in mesh with the ratchet until the adding or subtracting-pinions are meshed with the selecting-gear 55, and is unmeshed therefrom during the time that the adding or subtracting-pinions are in mesh with the selecting-

gear, and remeshed with the ratchet when the arm 105 is being moved by the cam 57ª, which takes place immediately after certain portions of the computation are made and while the carrying-operation is taking place.

The carrying-operation will take place in successive order, as the mechanism must pass the tenth unit-place to actuate the carrying-mechanism to carry that unit forward; and the operation of carrying this unit forward to the next device of higher denomination may cause the carrying-mechanism of that order to be actuated, etc., as in adding 1 to 99,999.99. In this instance, the first number-wheel on the right is the only one actuated by the selecting-mechanism, while all of the others are actuated, one after the other, by the carrying-mechanism. It is for this reason that the cams 57ª are arranged on the shaft 56 in a spiral order. This arrangement relieves the actuating-mechanism of any sudden jar or strain and causes the actuating-mechanism to have a smooth and easy action.

Moreover, any selections or "conditions" existing on the different selectors will be successively destroyed by the cams 57 which, being also arranged in a spiral order on shaft 56, act on the selecting-mechanisms just in advance of the carrying-operation.

Reference has heretofore been made to the fact that mechanism is provided for shifting the pinion-carrying plate. This will now be described:

Mechanism for shifting adding and subtracting pinions.—As previously mentioned, the direction in which the pinion-carrying plate 82 is shifted to effect a meshing with the selecting-gear 55 of either the adding-pinion 84 or the subtracting companion-pinions 87 and 88 determines the character of the computation. The following instrumentalities are adapted to control the position of said pinion-carrying plate: Mounted on the extremities of the pendant portions of the shiftable-plate 82 are rollers 114 and 115. Fast on the shafts 72 and 78 are cam-elements 116 and 117, respectively. These cam-members are disposed in alinement with the rollers 114 and 115 on the shiftable-plate 82 and are adapted to engage the same, respectively, whenever the handle 58 is pulled, the shafts 72 and 78 being set into operation by the rotation of the pinions 73 and 77, heretofore described. The peripheries of the elements 116 and 117 are so formed and relatively arranged as to shift the plate 82, to the left to mesh the subtracting-pinion 87 with the selecting-gear 55 at the proper time and, also, to cause the disengagement of said pinion from said gear immediately after the bulk of the computation is completed.

Also arranged on the shafts 72 and 78, and alongside of the cams 116 and 117 thereon, are companion-cams 118 and 119 which will operate the shifting-plate 82 in the opposite direction at the proper time for adding, when said shafts 72 and 78 are shifted endwise (by mechanism presently to be described) to position the companion-cams 118 and 119 in alinement with the rollers 114 and 115, respectively, on the shifting-plate 82. Simultaneously, the cams 116 and 117 are positioned out of alinement and contacting position with the rollers 114 and 115.

Thus, it will be seen that, in the event that the machine is set for subtracting, the cams 116 and 117 will be disposed in alinement with the rollers on the shifting-plate and will cause that plate to be actuated at the proper time to effect a meshing of said subtracting-pinion 87 with the selecting-gear 55 and, successively, the unmeshing of the same. In the event, however, that the machine is set for adding, said cams 116 and 117 will be shifted transversely to a position at one side and out of alinement with the rollers 114 and 115, such positioning of the cams being produced by the endwise shifting of the shafts 72 and 78. Synchronously with the shifting of the cams 116 and 117 out of contacting position with the rollers of the shifting-plate, the companion-cams 118 and 119 will have been shifted into alinement and contacting position with said rollers, whereby the pinion-carrying plate 82 will be shifted to mesh and unmesh the adding-pinion 84 with the selecting-gear 55 at the proper time. It will be clear that the endwise shifting of the shafts 72 and 78 will determine which set of cams 116—117, and 118—119, will be in operative alinement with the rollers on the pinion-carrying plate, and the position of which plate determines the character of the computation to be effected.

The mechanism for shifting the shafts 72 and 78 may be seen in Figs. 5 and 9, and from which it will be perceived how the machine is changed from adding to subtracting: To begin with, it is to be understood that the shafts are shiftable in opposite directions; that is to say, when the shaft 72 is shifted toward the right, the shaft 78 is shifted in the opposite direction. This arrangement permits the utilization of a walking-beam connection between the two: The plate-shifting cams 116—117, and 118—119, are arranged, preferably, toward the right-hand ends of these shiftable shafts 72 and 78, as shown in Fig. 9, and will be so disposed thereon, relatively, as to alternately aline with the rollers on the shiftable-plate, according to the direction in which their respective shafts are shifted. The shifting-shaft 72 is provided with a grooved collar 120, in the groove of which rollers 121, on the bifurcated end of a lever 122, travel. This lever is fulcrumed intermediate of its ends on a projection 123 of the casing of the machine, and at its end opposite to that

carrying the rollers 121, is similarly bifurcated and provided with rollers 124 adapted to travel in the groove of a grooved collar 125 fast on the shaft 78. The lever 122, on the end carrying the rollers 120, is also provided, on its upper face, with a roller 126 adapted to travel in a cam-groove 127 of an actuating cam-collar 128 fast on a shaft 129 directly over the roller 126 mounted on the walking-beam lever 122. The shaft 129 is suitably journaled in the frame of the machine, and has mounted on it, near its left-hand end, a pinion 130. It follows that the rotation of this pinion 130 will rotate the shaft 129 and this will turn the actuating-cam 128. The cam-groove in this collar 128 is so formed that the traveling therein of the roller 126 on the lever 122 will cause the latter to rock on its fulcrum, and this action will shift the shafts simultaneously in opposite directions. Of course, when the pinion 130 and the cam-collar 128 are turned in the opposite direction, the shifting of the shafts will be reversed.

The turning of the shaft 129, pinion 130, and cam-collar 128—and, through these, the shifting of the shafts 72 and 78—will be controlled by a setting-lever 131 which projects upwardly through the casing of the machine and forms one of the operating elements in the keyboard thereof. This setting-lever is fulcrumed at its lower end on a stud extending inwardly from the inside face of the left side of the casing. The lever, near its upper end, is provided with a pointer 132 (Fig. 2) which will conveniently index the various operative positions of the setting-lever, when operated: The lever has three operative positions; one, for instance, in a position to set the parts to operate to add, in a second position, to set the parts of the machine to subtract, and, in a third position, to set the parts to effect a total-computation. As shown in Fig. 2, the casing may be marked with appropriate indices, such as the letter "A" to indicate adding position; with the letter "S" to indicate subtracting position; and with the letter "T" to indicate total position. In other words, when the lever is set at the rear end of the slot 133 in the machine-casing, the mechanism of the machine would be set for adding; similarly, when the lever is set midway of the slot, said mechanism will be set for subtracting; and, when the lever is at the front end of the slot, the mechanism will be set for effecting a total operation. Attached to the inner side of the top of the machine-casing is a flat spring 134 crimped at three places corresponding with the letters "A," "S" and "T," aforementioned. In the depressions formed by these crimps, a stud 135 is adapted to be seated, whereby the operator will be assisted in properly positioning the setting-lever, and whereby, also, said setting-lever will be yieldingly retained in position when set.

As a means for arresting the setting-lever at the subtracting-position, it is provided with a stop 136 suitably pivoted on the lever and preferably spring-actuated, and adapted to be actuated out of arresting position, whenever it is desired to move the setting-lever beyond said subtracting-position.

Pivoted toward the upper end of the setting lever, but within the casing of the machine, is a rack-bar 137 slotted at one end to receive a stud 138 that serves to slidably support the same. This rack-bar is arranged in alinement with the pinion 130 on the shaft 129, and whereby it is actuated. In other words, when the setting-lever is shifted, the rack-bar 137 will be actuated longitudinally to effect a rotation of the pinion 130. This in turn will, as already explained, effect a rotary movement of the shaft 129 whereby the cam-collar 128 is actuated to rock the lever 122 on its fulcrum and, in this manner, effect a shifting of the shafts 72 and 78 for the purpose of alining one or the other of the sets of cams 116—117, and 118—119 with the shiftable plate 82.

When the setting-lever is moved from the subtracting position—that is, when the pointer 132 moves from the letter "S" to the letter "T" (Fig. 2)—the roller 126 on the lever 122 will travel in the subtracting-portion (not shown) of the groove in the cam-collar 128; wherefore, as this subtracting-portion is relatively straight, no movement of the lever 122 is effected and, hence, no shifting of the shafts 72 and 78 will occur. These shafts will be shifted only when said roller travels in the angulated portion of the groove 127 in the collar 128, and this will be only when the setting-lever is moving from adding position to subtracting position, or from subtracting position back to adding position. As the setting-lever cannot arrive at the total-position without passing the subtracting-position, it will be seen that the operative parts of the machine which act under the influence of the setting-lever 131, will remain at subtracting-position when the said lever is set at total-position.

The machine is further provided with another indicating device to show the position in which the setting-lever is set, this indicating device being in addition to the pointer 132 and the three characters "A", "S" and "T", already referred to: This indicating device includes the following parts: An index-member 139 is pivoted on a shaft 140 near the left side of the machine and has provided on its exposed face 141 the words "Adding," "Subtracting" and "Total". Successively, these words will appear in the sight-opening 142 in the upper casing of the

machine. The position of said index-member is controlled by the setting-lever, in that, by a pin-and-slot connection 143, it is connected to the rack-bar 137. Imprinted on the casing, just above the numeral 142, are the words "Set for". In consequence, according to the relative position of the index-member 139, the machine will read thus:

"Set for adding",

or

"Set for subtracting",

or

"Set for total".

Carry-pawl shifting-mechanism.—As the carry-pawl shifting mechanism is under the control of the setting-lever 131, it is now in order to describe the manner in which the positioning of the carry-pawls of the carrying-mechanism, already mentioned, is effected: To begin with, it is to be understood that the shifting of the carry-pawls 103 and 106 will be effected simultaneously with any movement of the setting-lever 131 when changing the character of computation, and this is accomplished in the following way: The index-member 139, aforementioned, is preferably in the form of a segment and is provided with teeth 144 on its periphery adapted to mesh with a corresponding segmental member 145 carried by the main gear-shaft 81. Keyed on this shaft 81 are two cams 146 (Figs. 6 and 12) which will be rotated by said shaft 81 whenever the setting-lever is actuated, the rack-plate 137 and segment-members 139 and 145 operating to set said shaft in motion. Adapted to ride upon each cam 146, at opposite sides of the shaft 81, are the two vertical oscillating arms 113 and 113ª, previously referred to, each of which is fulcrumed on a stud 147 mounted in support-pieces 148 suitably attached to the casing of the machine, and between which said arms 113 and 113ª have a vertical movement. Secured, respectively, in the opposite ends of the arms 113 and 113ª are the bars 111 and 112. As seen in Fig. 6, each of the cams 146 is so formed that, when the arm 113 is on a high portion of the cam-periphery, the arm 113ª will ride upon the low portion thereof. In consequence, these arms will be rocked as they travel from the high to the low portion of the periphery and, hence, the cross-arms 111 and 112 will be elevated or depressed, according to which of the arms is riding upon the high portion, or the low portion. As a result of the movement of these cross-pieces 111 and 112, the adding and subtracting-pawls 102 and 106 will be correspondingly positioned in relation to the ratchet 104, and their positions will depend upon the position to which the setting-lever has been set. The arms 113—113ª, will ride upon the cams and be thereby positively positioned, as just explained. The extremities of the adding and subtracting pawls, by abutting against the bars 111 and 112, will cause the forward ends of the arms 113 and 113ª to ride on the cams 146. When the setting-lever is shifted, say, from subtracting-position to total-position, the subtracting-pawl 103 will be in engagement with the ratchet 104 and the hooked ends of the arms 113 and 113ª will ride on the respective portions of the cam 146. The shifting of the pawls 103 and 106, will occur during the first part of the movement of the setting-lever 131 from the adding-position to the subtracting-position, and during the last part of the movement of said setting-lever when it is being returned to adding-position. The endwise shifting of the shafts 72 and 78 will take place in the same manner, because the subtracting-computation must be completed when taking a total before the mechanism of the machine is reshifted to add; wherefore, the setting-lever can be nearly returned to adding-position before the mechanism itself is shifted for adding.

Automatic totaling-mechanism.—When the setting-lever is moved, as already explained, to the total-position, means will be automatically brought into operation to make a selection on the selecting-gear of corresponding amount showing on the figure-rolls or wheels 91; and, as the machine is set for subtracting when a total is being taken, the amount appearing on said figure-wheels will be subtracted therefrom when the pull-lever 58 is drawn forward by the operator, whereby the figure-rolls are "cleared," that is, returned to a position to exhibit only zeros, and this, as hereafter explained, leaves the machine set for adding:

The selection which takes place on the selecting-gear 55 is independent of the operation of any of the place-rows of keys. All that it is necessary for the operator to do to effect a totaling, "clear" the machine, and re-set it for adding, is to shift the setting-lever to the total-position and operate the pull-lever 58. However, as a selection takes place before the actuating-mechanism is operated, certain other mechanism must be actuated, and this will now be described:

Mounted on the shaft 54 and attached to the side of each selecting-gear 55, is a stop-plate 149 provided on one edge with nine step-formations or stops 150, as shown in full lines in Figs. 13 and 14, and in dotted lines in Fig. 7. This stop-plate is provided with an arcuate slot 151, the function of which will presently be explained. Arranged to coöperate with the stop-plate is a two-arm stop-carrying lever 152 loosely mounted on a shaft 153 to which is attached

a coil-spring (not shown) which, when released, causes said stop-carrying lever to rotate on the shaft. The lever 152 carries, on its lower arm, a pivoted spring-controlled stop 154 having an angulated projection 155 which is adapted to engage one or another of the stops 150, as presently will be explained. The end of the upper arm of the stop-carrying lever 152 is bent at right angles, as shown in Fig. 13, and, under the action of said spring, is adapted to engage a star-wheel 156, fast on the side of the main gear 89, to be positioned by said wheel so that its stop 154 will be shifted into operative relation with certain portions of said stop-plate 149.

The extent of movement that the lever 152 will have is dependent upon what numeral is showing in the sight-opening 91ª: Thus, if the "0" is showing, the lever 152 will move one space before it comes into contact with the star-wheel 156. If "1" is showing in the sight-opening, the lever 152 will drop two spaces; and so on, up to ten spaces. Therefore, the movement of the lever 152 is controlled by the position which the selecting gear 55 and the figure-roll 91 occupy. The movement of the lever 152 will position its lower end, thereby carrying the stop 154 into line with the proper stop on the stop-plate 149, which (as aforementioned) is fastened to the selecting-gear 55. The normal position of the lever 152 is one space above or away from the star-wheel. When in this position, the stop 154 carried by the lower end of the arm 152 will be positioned in the arcuate slot 151 in the stop-plate 149, which (as aforementioned) is fastened to the selecting-gear 55, thus leaving the selecting-gear free to move to its full extent when actuated for adding or for subtracting. The one space that the lever moves when released for totals is just sufficient to cause the stop 154 to move out of line with the slot 151 and be positioned in front of the first step of said stop-plate, which step forms a stop to prevent the selecting-gear 55 from turning, and which would correspond to the position of the selecting-gear when none of the keys in the keyboard is in the depressed position. Should the lever 152 move two spaces, or the amount which it would move if the numeral "1" is showing through the sight-opening, the stop 154 would be caused to assume a position in front of the second step, or stop, on the stop-plate 149, which position will allow the selecting-gear 55 to turn and a selection of one to be made thereon. The several levers 152 will, therefore, have a variable movement and according to what numeral is showing on its respective figure-roll. From the above, it is seen that should the figure-rolls be standing to show "721.51" through the sight-opening, the first lever 152 on the right would move two spaces; the second, six spaces; the third, two spaces; the fourth, three spaces; and the fifth, eight spaces. This will cause their respective selecting-gears 55 to turn and make a selection of an amount equal to the amount showing on the figure-rolls.

When the setting-lever 131 is shifted to the total-position, it automatically unlocks the slide-member 23 so that it may move to make the selection, as above explained. The slide-member 23 is unlocked, from the holding-pawl 21, by the setting-lever in the following manner: Positioned between each pair of bars forming the slide-member, and fast on a shaft 157, is an arm 158 (Fig. 7) which, when caused to rise (by the rotation of shaft 157) will abut against the locking pawl 21 and disengage it from the slide-member 23, thus leaving the latter free to move when the setting-lever is operated and a selection is being made. The shaft 157 extends across the machine directly under the pawls 21 and carries an arm 158 for each locking-pawl 21.

The shaft 153 has fast on it an arm 159 for every total-lever 152, and this arm will abut against a projection 160 on the total-lever 152 and hold the same one space away from the star-wheel 156. Therefore, it will be seen that by causing the upper shaft 153 to turn, leaving each total-lever 152 free to make a selection on its respective selecting-gear 55, equal to the amount standing on the figure-rolls 91, and turning the shaft 157 to cause the locking-pawls 21 to be positioned out of engagement with the slide-member 23, to allow the selecting-gear 55 to turn; and, as the machine is set for subtracting, the machine will be "cleared" of the amount standing thereon when the actuating-mechanism is operated, which operation will record the total and reset the machine for adding. The upper shaft 153 has fastened to its left end an arm 161 which connects with a three-arm member 162, which is fastened to the left end of shaft 157. One of the arms of the member 162 carries a roller 163 which rests on a ledge 164 of an arm-sustaining element 165 connected to the setting-lever.

When the setting-lever 131 is moved from the central or subtracting-position to the total-position, the roller 163 will drop from the ledge 164, upon the start of this movement, and this will permit the total-levers 152 to be free to move and position the stops 154 in front of the stop-plates 149. When the setting-lever has been moved nearly to the total-position, a pin 166 on the setting-lever will abut against the end of a slot 167 in a link 168 and move it a slight distance, which in turn will rock an arm 169 fastened to the end of the shaft 157, and thereby cause this shaft to rotate. As the

arms 158 are fast on the shaft 157, they will be raised and will then abut against and lift the holding-pawls 21 out of engagement with the slide-members 23, allowing these members and the remainder of the selecting-mechanism to be free to move until arrested by the stop-plates 149 abutting against the stops 154. It will be seen that when the setting-lever 131 is shifted from the subtracting-position to the total-position, the total-levers 152 are free to permit them to position the stops 154 in front of the proper stops on the stop-plates 149 before the stop-plates are free to move, thereby insuring the proper selection, or that selection which corresponds with the amount standing on the sight or figure-rolls 91.

The pulling of the handle 58 by the operator, then, will cause the selecting-gears 55 to turn to operate the computing-mechanism, as heretofore described. At the same time, the selection is destroyed or eliminated, and the total-levers 152 will be returned to their normal position by the star-wheels 156 forcing the total-levers 152 away from the center of the star-wheels and toward their edges.

When the actuating-mechanism is set into motion by the operator pulling handle 58, the selections will be destroyed or eliminated in successive order, thereby returning the total-levers and selecting-mechanism, one at a time, to normal position, and, as the setting-lever is being returned to its normal, or adding-position, as already described, the arms 158 will be lowered away from the holding-pawls 21 by a spring 170, acting on the link 169 and thus, on the shaft 157, allowing the holding-pawls 21 to reëngage the slide-members and retain the same in normal position until again released. During the return of the setting-lever to its normal or adding-position when a total is being taken, (before all of the total-levers are returned to normal position on account of the selections being destroyed in successive order), it will abut against the roller 163, which will actuate the piece 165, because the ledge 164 is formed on the separate piece 165 and this latter is fulcrumed on a stud 171 and is positively moved with the lever in one direction by a pin 172 on the setting-lever 131 when it is being moved from the adding-position to the total-position, but yields and tensions a spring 173 when the setting-lever 131 is being returned to its normal position. Therefore, the setting-lever may be nearly returned to its normal or adding-position before all of the total-levers 152 are returned to their normal positions, because the piece 165 will abut against the roller 163 and stand still until the roller is lifted by a cam-arm 174, fast on shaft 72, abutting against a roller 175 on the lower arm of the lever 162, when the movement of the actuating-mechanism is nearly at an end and after all of the total-levers 152 have been returned to normal position. When the roller 163 is lifted, the plate 165 will be free to move by the action of the spring 173 and assume a position under the roller 163 and rest against the pin 172. When in this position, the total-levers 152 are held away from the star-wheels, and the entire total-mechanism is out of operative condition. When cam-arm 174 on shaft 72 operates upon the roller 175 on the end of the arm of the three-arm member 162, it causes the shaft 153 to be turned in the opposite direction to cause the arms 159 to return said levers 152 to their normal position. The arms 159 will lift and hold the total-levers 152 one space away from the star-wheels until the setting-lever 131 is again set to the total-position. The arm 174, having caused the three-arm plate 162 to return to its normal position, the roller 163 will again ride on the ledge 164, thus holding all parts of the total-mechanism out of operative relation. The stop 154 is held against the side of the lever 152 by a spring 154ª, which will prevent any jamming that might otherwise occur between the stop plate 149 and the stop 154 when the total-lever 152 and the selecting-gear 55 are being returned to normal position, because the stop will trip over the steps on the stop-plate.

The three-arm plate 162 is loosely mounted on the shaft 157 and connects with the total-levers 152, as already described. A pin 157ª on shaft 157 and abutting against the frame of the machine, will prevent the spring 170 from moving the arm 169 and its connecting parts too far.

Automatic return of setting-lever after taking a total.—When a total is to be taken, the various mechanisms in the machine will be in position for subtracting: Thus, the amount of the total will be subtracted, and the setting-lever shifted to adding position, that is, will be eliminated, to "clear" the number-wheels and leave them all exhibiting zero and the machine set for adding. In consequence, no form of computation, other than adding, would ordinarily be desired until the adding-mechanism has first been operated to show figures on the number-wheels other than zeros. With a view to saving the operator occasion to turn or reset the setting-lever to adding-position, after a total has been taken, means are provided for automatically effecting such return. These automatic means comprise the following elements. The shaft 56 is provided with a cam 176 which is adapted to engage a roller 177 near the upper end of an arm 178 pivoted on a shaft 179 at its lower end, and pivotally connected at its upper end to a long arm 180 that is supported at its opposite end on a stud 181 inserted in an elongated slot 182, and which construction permits said long arm 180 to

be reciprocated under the action of the cam 176 each time that the pull-lever 58 is operated, it being understood, as already explained, that the shaft 56 is the main drive-shaft acting under the influence of the pull-lever. A portion of the lower edge of the long arm 180 is provided with rack-teeth 183. Arranged in juxtaposition thereto and fastened on the side of the setting-lever 131 is a toothed segment 184. Normally, the arm 180 is held out of engagement with said segment 184 by a retractile spring 185 when the setting-lever is standing either at the adding or at the subtracting-positions, but would be caused to be positioned in engagement with said toothed segment whenever the setting-lever is moved to the total-position, because it will abut against a stud 186 on the upper end of a lever 187 pivoted at 188, and provided at its lower end with a roller 189 adapted to bear against the upper edge of said long arm 180 and depress the same, against the action of the spring 185, to engage the teeth 183 with the toothed segment 184. It will, therefore, be understood that when the pull-handle 58 is operated, the cam 176 will, at the proper moment, move the arm 178 (against the action of a retractile spring 190) backwardly to impart a reciprocatory movement to the rack-arm 180. If said rack-arm is then in engagement with the toothed segment 184, movement will be imparted to it and, being secured to the lower end of the setting-lever 131, will operate to move said setting-lever back to adding-position. At the same time, the hooked end 191 of the rack-bar 137 will engage the stud 186 on the lever 187 and rock said lever 187 on its fulcrum, which action will permit the spring 185 to perform its designed function of raising the long arm 180 back to normal position, and this will disengage said long arm from the toothed segment 184. The spring 190 will operate, at the same time, to cause the arm 178 to follow the lines of the cam 176 and restore said arm 178 to normal position. It will be obvious that, through the arm 178 and its connecting parts, as the long arm 180 will be reciprocated each time that the pull-handle 58 is operated, it will operate to return the setting-lever to setting-position only when a total is being taken.

Sub-total mechanism.—At times, it may be desirable to produce a sub-total; that is, a total struck from a total of additive and subtractive computations: This may be accomplished by means of structure shown in Figs. 7, 23 and 24, and which includes the following: Disposed adjacent the keyboard is a key *a*—which I shall herein refer to as a "sub-total" key—which, at its lower end, is pivotally connected to a spring-controlled bell-crank-lever *b*, fulcrumed on a stud *c* and which, in turn, is pivotally connected to a transversely-slidable square bar *d* provided with a plurality of incuts or notches *e* that normally occupy a position in alinement with projections 82^a on the pinion-carrying plates 82. The pendant portion of each of said plates, at the opposite side of the drive-gear 55, carries a spring-controlled plate 115^a on which the roller 115, heretofore described, is mounted. Under normal conditions, the pinion-carrying plates are free to shift to the left whenever the pinions 87 are to be meshed with the drive-gears 55. This movement is permitted by reason of the fact that the projections 82^a enter the notches *e* in the bar *d*. If, however, said bar has been shifted laterally by the operator depressing the key *a*, said notches will be shifted out of alinement with the projections 82^a, whereupon the bar *d* forms an abutment for said projections 82^a and prevents shifting movement of said pinion-carrying plates. These means permit the pinion-carrying plates to be maintained in a neutral position while the actuating-mechanism, already described, is operated, with the result that, during the return of the selecting-mechanisms to normal position, the driving gears 55 are not meshed with either the adding or subtracting-pinions. In consequence, these pinions and the main gears 89 receive no motion from said gears 55; hence, the position of the number-wheels 91 is not changed but the wheels will show the total that may theretofore have been produced thereon. When the key *a* is released, the bar *d* will be returned to normal position by the spring-controlled bell-crank-lever and, thus, it will reposition the notches *e* in alinement with the projections 82^a. To permit the plate 82 to be held in the neutral position when the actuating-mechanism is operated, the plates 115^a will yield when actuated by the cams 117. Therefore, this mechanism being utilized in connection with the total-mechanism, which as heretofore explained, makes a selection on the selecting mechanism of the amount showing on the figure wheels, a record of the total may be recorded and the total retained. When this mechanism is used in connection with the subtracting-instrumentalities of the machine and its keys for the purpose of making any selection, an item or an amount may be recorded without a computation being produced.

The structure thus far described constitutes a machine, complete in itself, for producing additive and subtractive computations: and may be used for this purpose. However, for listing checks and performing similar work, it is desirable to provide recording mechanism with other necessary constructions, and it is now in order to describe the same:

Recording-mechanism.—As will be clear from an inspection of Figs. 9 and 10, the several transverse shafts 44 which operate under the control of the selecting-mechanism, as already described, are elongated in order to permit a connection therewith of certain elements of the printing-mechanism now being described. As a particular selecting-mechanism connects with one of the shafts 44, so will a corresponding printing-mechanism connect therewith, it being understood that there are as many printing-units as there are selecting-units, and each printing-unit bears a definite relation to, and operates in a definite manner with respect to, its corresponding selecting-mechanism. A description of one set of these units will, therefore, suffice when it is remembered that each of these units is the same as another, and that each is independently operable.

Referring, now, particularly to Figs. 4, 9 and 10, it will be seen that there is fast on the shaft 44 an upstanding arm 192 to which is pivoted an actuating-arm 193 corresponding, in some respects, to the selector-actuating arm 48, and adapted, when the shaft 44 is rotated, to be operated synchronously therewith. The actuating-arm 193 is pivotally connected at its opposite end to a bell-crank-lever 194 fulcrumed on a shaft 195 journaled in upstanding supporting-plates 196 secured to the base-plate 1^b of the machine-casing. Pivotally connected to the upper member of said bell-crank-lever is a link 197, and to this link is operatively connected a printing-segment 198 bearing printing characters 199 on its outer curved edge. It may be here stated that the shaft 44 nearest the front of the machine will be operated by the first order or place-row of keys 2—that is, the one nearest the right edge of the machine, in Figs. 1 and 2; also, that it will operate in conjunction with the selecting-mechanism-unit farthest to the right of the machine; and, also, that it will operate that printing-unit, just described, which is the farthest to the right. The second shaft 44 will be operated by the second order or place-row of keys and connect with the second printing-sector and, also, with the second selecting-mechanism-unit. The several other shafts will be operated by their respective order or place-row of keys and connect with their respective selecting-mechanism-units and with their respective printing-units. It will, therefore, be perceived that when the key in the first order or place of the keyboard is depressed, the first slide-bar 23 will be permitted to move, and this will result in a selection on the first selecting gear 55. Moreover, the first printing-sector being connected to the first shaft will be caused to make a similar selection and will present the proper type in front of the printing-point. This action will occur throughout the different orders or place-positions, according to which of the order or place-keys is depressed. Referring, now, to Fig. 9, it will be observed that the arms 193 are of different lengths so that the arm which connects with the rearmost shaft 44 and with the bell-crank-lever farthest to the left is only about half the length of the arm 193 which connects the first shaft with the first bell-crank-lever; but the movement of each and all of these arms and the parts connecting therewith is the same, except in so far as it is predetermined by the rotative movement of the shafts 44 which, as already explained, are controlled by the keys.

Referring, now, to Figs. 4 and 10, it will be seen that each printing-segment or sector is pivoted (at 198^a) on and supported at the upper end of an arm 200 fulcrumed on a shaft 201 which, by mechanism presently to be described, will, at the proper time, produce an accelerated movement upon the arm 200 and, thus, cause the printing-sectors to be thrust rearward to print. Such accelerating mechanism includes the following:

The lower end of the arm 200 is provided with a roller 202 adapted to traverse the periphery of a notched-wheel 203 fast on the shaft 56 and held in contact with said wheel by a spring 204. In the periphery of the wheel 203 is formed a notch 210 into which the roller 202 will move and permit the arm 200, under the action of its spring 204, to be rocked with an impulse sufficient to carry the printing-sector rearwardly with considerable rapidity.

It will now be understood that whenever a particular shaft 44 is moved under the action of the spring 51 which controls the movement of the selecting-mechanism-unit in one direction to cause a selection on the selecting-gear 55, the printing-sector will simultaneously be caused to make a selection, so to speak, corresponding to the selection made on the gear 55. For instance, if the printing-key bearing the numeral "1" is depressed, the selecting-gear 55 will, in the manner already described, be actuated by the selector 49, so that, when the computing-mechanism is brought into operative relation with said selecting-gear 55, the number-wheel 91 will be rotated to exhibit the numeral "1" through the sight-opening 91^a. If, however, it had been the number "6" key which had been depressed, the selecting-gear 55 will have been correspondingly actuated so that the number-wheel 91 would exhibit the numeral "6". In the first instance, where the number "1" key was depressed, the respective printing-sector 198 will have been positioned to print the number "1" on the work-sheet, it being understood that the printing-characters 199 on the printing-sectors 198 are so arranged that the uppermost

character will be the cipher, the next lower character will bear the numeral "1", and so on. If, in the second instance, where the number "6" key had been depressed, the printing-sector 198 will have been elevated to present the printing-character "6" on said selector in alinement with the printing-point.

After the arm 200 has moved rearwardly, at the moment that the roller 202 thereon is seated in the notch 210 in the wheel 203, any rebound thereof will be taken up by the cam-face 210^a of said notch, and, then, the roller riding upon the periphery of the wheel 203 will restore the arm 200 and the printing-segment to normal position. The return to normal position of the printing-sectors will be simultaneous with the return of the selecting-mechanism to its normal position at the time that the computation is made.

Printing-sector alining-mechanism.—To aline the several sectors perfectly, a member 211, pivoted on a boss 200^a formed on the arm 200, is adapted to engage teeth 212 provided on an arc-shaped portion 213 of each of the printing-segments 198. The engaging-member is provided with an open-ended slot 214 and embraces a shaft 215 so that, as the arm 200 moves rearwardly, the member 211 is caused to rock on its pivot and enter one or the other of the teeth 212. Normally, the engaging-member is out of engaging position with said teeth; but when it rises and enters the teeth, it will make a rigid connection between the printing-sector 198 and the arm 200 and prevent any relative movement of the sector, so that proper positioning of the printing-character on the sector is insured. Each of the printing-sectors is thus positively controlled so that perfect alinement of the printing line, which is essential in high-class work, is produced.

Means for preventing printing of zeros to the left of the amount.—Some means must, of course, be provided to prevent the ciphers to the left of the amount being recorded from printing. This is accomplished in the following manner: The end of the lower arm of the bell-crank-lever 194 is provided with a projection 216 which will abut against an arm 217 whenever said arm is in its normal position, (as shown in Figs. 4 and 10) and will prevent the arm 200 from jumping forward under the action of the spring 209 when the notch 210 in the wheel 203 passes the roller 202 on the arm 200. Should the arm 217 be in its raised position, however, the arm 200 will be allowed to jump forward to print. The extension 216, (when the bell-crank-lever 194 is operated to make a selection on the printing-sector) will act on the arm 217 to depress the same and this will rock the arm on its fulcrum 217^a, and cause the other end to be raised out of the path of a projection 218 on the arm 200, leaving it free to act. Each bell-crank-lever 194 is provided with one of these arms 217. Each arm has a projection 219 arranged to underlie the next arm to the right. Thus, should the farthermost bell-crank to the left be actuated, as in printing "10,000,000.00", each of the arms 217 will be caused to rise on account of the projection which underlies it, and will move the next arm to the right. Therefore, all of the arms 217 to the right of the highest number in the amount being computed will be caused to rise and permit the respective printing-sectors to print, whereas, those printing-sectors which represent the capacity of the machine in excess of the amount being computed will be prevented from jumping forward. When no selection is made, all the arms 200 are prevented from jumping forward. A light spring 220 will cause the arms 217 to engage the extensions 216 on the bell-crank-levers. Thus, the arms 217 which correspond to the order or place-positions of the numbers in the amount being computed, to the right of the highest number thereof (whether a cipher or a number) will be coupled together, and act as one piece and allow the arms 200, which correspond to the ciphers in the number, to jump forward, as would be the case in printing "1,000.00"; while all of those arms to the left of the highest number (according to place-position) will be prevented from printing, as the projections 218 on those arms 200 which correspond to those places will abut against the arms 217 and be prevented from jumping forward, thereby preventing the printing of the ciphers to the left of the amount being computed, and causing only "1,000.00" to be recorded instead of "00,001,000.00". The cipher-type on the printing-sector is normally in printing-position when the printing-sector is in its normal position.

In conjunction with the printing-mechanism, just described, there is employed a novel form of

Ribbon-mechanism.—To the end that the amounts added may be recorded in one color, while those which are subtracted may be recorded in a different color, I prefer to utilize a bichrome ribbon: This ribbon is preferably supported on spools 221 (Figs. 2, 7, 20 and 21) which are placed at the top of the machine, near the rear thereof, and are preferably covered by a plate which is either hinged to the machine-casing or removably attached thereto in order that a new ribbon may be substituted whenever necessary.

The ribbon-spools 221 are removably keyed to stub-shafts 222, which shafts are intermittently driven by means of a ratchet 223 fast on the lower end of said shaft. Any suitable means may be employed to maintain the ribbon taut while the ribbon is being unwound from one of the spools and wound

on the other spool. As seen in Figs. 20 and 22, the shaft 78 carries a cam 224 which, at the proper time, will cam or move a bell-crank-lever 225 pivoted at 226 and held in contact with said cam by a spring 227. The movement thus effected upon the bell-crank-lever 225 by the cam 224 will reciprocate a cross-bar 228, there being a pin-and-slot connection 229 between said bell-crank-lever and the cross-bar 228. Said cross-bar is held in guide-ways 230 formed in the machine-casing. It will be understood that the spring 227 will, after said cross-bar 228 has been actuated, rock the bell-crank-lever 225 in the opposite direction and return said cross-bar to its normal position. As the shaft 78 is geared to the pull-lever 58, it will be seen that the cross-bar 228 will be given an endwise movement each time said pull-lever is operated. As seen in Fig. 2, bell-crank-levers 231 are arranged in juxtaposition to the ribbon-spools, being fulcrumed at 232 on the underside of the top portion of the casing, and connect with the cross-bar 228, which (as shown) is slotted to receive the arms of the bell-cranks 231. The other members of the bell-crank-levers each carry an elongated pawl 233, there being one for each spool, and adapted to alternately engage the teeth of the ratchet 223 and thereby actuate the same each time that the cross-bar 228 moves in one direction, and will ride over the teeth of the ratchet when said cross-bar 228 is returned to normal position by the spring 227. Connecting with the pawl 233 is a spring 234, the function of which is to maintain the pawl in proper relation to the ratchet when in engagement therewith, but which will permit the pawl to trip over the teeth of the ratchet when being returned to starting position. It will be understood that when the pawl on one side of the machine is in engagement with its ratchet, the pawl on the opposite side is disengaged from its ratchet, leaving the ribbon free to be unwound from the spool connected to that ratchet. The end of each pawl is held in contact with studs 235 projecting from a slide-bar 236 which is arranged in parallelism with the bar 228 and similarly supported in the guides 230. Each stud is adapted to engage its respective pawl to position one of them in engagement with its respective ratchet and to disengage the other pawl from its ratchet when the slide-bar 236 is shifted to the right or left, as the case may be. The ribbon R, itself, passes over guide-rolls 237 arranged in juxtaposition to the spools, and passes through a ribbon-guide 238, the movement of which will presently be described. By these means, the ribbon will be held in proper position to be impinged upon by the printing-sectors whenever the same are actuated.

Automatic ribbon reverse.—The position of the slide-bar 236 will determine the direction in which the ribbon will be moved. Therefore, if, when the ribbon is nearly unwound from one of the spools, said slide-bar is caused to shift, the ribbon will begin to wind upon the empty spool. When the opposite spool is empty, the bar 236 will be shifted in the opposite direction and thereby cause the ribbon again to be wound upon that spool. From this, it will be seen that after the ribbon has been placed in the machine, it is unnecessary to give it attention until it is worn out, when it may conveniently be replaced. Suitably secured to the ribbon, near its ends, are eyelets or buttons 239 which are adapted to alternately engage levers 240 fulcrumed at 241 and connected by a link 242. As seen in Fig. 21, the arms 240 are provided with a slot 243 through which the ribbon passes, but which slot is of less width than the thickness of the buttons 239. The lever 240 at the right-hand side (Fig. 21) is connected, by a pin-and-slot connection 244, to one arm of a bell-crank-lever 245 fulcrumed at 246 on the underside of the top casing. The other arm of said bell-crank-lever connects with the slide-bar 236 and is adapted to shift said slide-bar whenever one or the other of the buttons 239 engages one of the levers 240 resulting in the rocking of the bell-crank-lever 245 upon its fulcrum. The arm 240, on the left side of the machine, will, when engaged by the button 239, shift the slide-bar 236 to the left, and cause the ribbon-feed-pawl 233 on that side of the machine, to disengage from its ratchet, while the pawl on the opposite side of the machine will be thrown into engagement with its ratchet. When the other end of the ribbon is reached, the lever 240 on the right side of the machine will cause the slide-bar 236 to move to the right and position the pawl on that side of the machine in engagement with its ratchet, the pawl on the left side of the machine being then disengaged from its ratchet. In this manner, the feed of ribbon is automatically reversed. In order to prevent the drag of the ribbon, in passing through the slotted levers 240, from moving the cross-bar 236 except when said levers 240 are engaged by one or the other of the buttons, a detent-spring 247 is provided to engage serrations 248 formed in one edge of said cross-bars 236. This detent will, moreover, properly position the cross-bar 236 to insure the proper meshing and unmeshing of the pawls with their ratchets.

Mechanism for shifting bichrome ribbon.—It has already been stated that the ribbon is supported between the two ribbon-pools by the ribbon-guide 238. This guide is fulcrumed at its lower end in two arms 249 (Fig. 4) which, in turn, are fulcrumed on a shaft 250 and normally rest upon the cross-rod or shaft 201. The ribbon-guide

and these arms are held against said shaft by a spring 251 attached to the ribbon-guide 238 and to an attaching-piece 252 secured to the machine-frame. When the parts are in the position shown in Fig. 4, the black portion, say, of the ribbon will occupy a position adjacent the printing point. When, however, the machine is set for subtracting, cams 253 fast on the shaft 78 will be shifted, with the shaft, under rollers 254 carried by the arms 249 and, by the rotation of said shaft 78, will raise said arms 249 and, thus, the ribbon-guide 238, thereby positioning the red portion, say, adjacent the printing-point. The spring 251 is so tensioned that it will permit a slight movement of the ribbon-guide when the printing-sectors jump forward to print, as already explained, and will return said guide to its normal position against a stop 255, secured to the machine-frame, when the printing-sectors are returned to normal position. This stop and the spring 251 will serve to hold the ribbon-guide midway between the normal position of the printing-sectors and the work-sheet, the support for which will now be described:

Platen and its mounting.—The support for the work-sheet, in this instance, includes a platen 256, which is fast on a shaft 257. This shaft is mounted in brackets 258 that are secured to a slide-bar 259 shiftably supported in a guideway 260. The shaft 257 is provided at its ends with knurled knobs 261 (Fig. 17) by which the operator may turn the platen, when desired. Frictionally engaging the platen are work-holders 262 adapted to be shifted upon their support 263 whenever necessary. The structure thus described, by reason of being supported upon the shiftable-bar 259, constitutes a platen-carriage that may be shifted transversely of the machine for columnar work whenever this style of work is being performed, and be held in position by means which are shown, by way of example, in Fig. 19, and which include a plunger 264 adapted to be seated in a hole 265 in the machine-casing.

Automatic line-spacing mechanism for platen.—Each time that the operating-handle 58 is actuated, it is desirable to rotate the platen the distance of a line-space, and this is desirably effected immediately after the printing-operation takes place in order that the work-sheet may be in position for the next item to be printed thereon, and so that the last item printed will be made visible: By means which I shall now describe, the operation of the platen is entirely automatic: Mounted on the shaft 59 upon which the actuating-handle 58 is secured, and disposed centrally of the machine, is a cam 266 designed to lift the forward end of a roller-carrying lever 267 fulcrumed at 268 to any suitable part of the machine-casing and held in contact with the cam 266 by a spring 269. The opposite end of said lever is pivotally connected to a link 270 that, in turn, is pivotally connected to a bell-crank-lever 271 fulcrumed on a bracket 272 secured to the back of the machine. To the vertical member of said bell-crank-lever 271 is pivotally connected an actuating link 273 fulcrumed on a bracket 274, also secured to the back of the machine. It will be understood that when the operating-handle 58 is moved by the operator, and the shaft 59 is thereby thrown into motion, the cam 266 will, through the lever 267, link 270, and bell-crank-lever 271, actuate the link 273 and swing it on its fulcrum 275 on the bracket 274. As soon as the operating-lever 58 is released by the operator and as it is returned to its normal position, the spring 269 will cause the lever 267 to ride on the cam 266 which will return all of the above-mentioned mechanism to normal position. When the actuating-link 273 swings on its fulcrum, as aforementioned, it will abut against and move a rod 276, which has fast on its ends arms 277. These arms are also secured to a second rod 278 which is fulcrumed on pilot-screws 279 secured in the platen-supporting brackets 258. It will be understood that when the rod 276 is moved by the rocking of the link 273 on its fulcrum, it actuates the arms 277. The upper end of the right-hand side arm 277 is provided with teeth 280 adapted to engage in a segment-plate 281 which is fulcrumed on the platen-shaft 257. This plate carries a pawl 282 so disposed as to engage and actuate a ratchet 283 secured to the end of the platen, and which actuation will occur whenever the operating-handle is moved by the operator. When the handle is returning to its normal position, the pawl 282 will ride over the teeth. As seen in Fig. 18, there is a spring 284 which has one of its ends fastened to the arm 277 and has its other end secured to the platen-supporting bracket. The function of this spring is to return the pawl 282 and the rods 276 and 278 to normal position. To prevent the platen from turning in a reverse direction while the pawl is being returned to its normal position after line-spacing the platen, a detent 285 (Fig. 19) is provided to engage a ratchet 286 secured to the end of the platen opposite to the line-space-mechanism.

From this description, it will be seen that whenever the operating-handle is moved by the operator, the platen will be turned one line-space or ratchet tooth, which turning will insure the items being recorded one under another and the proper line-space distance apart.

Modifications.

Carry-pawl shifting-mechanism.—In Figs.

25 and 26, I have illustrated a modified form of construction for positioning the carry-pawls in relation to the ratchet secured to the main gear-wheel 89: In this instance, in lieu of mounting the cross-bars 111 and 112 (Fig. 12) in arms 113—113ª, I dispose the same in end-plates 287 and these will normally rest on a stop-stud 288 under the action of a spring 289 which is of greater tension than would be the springs which control the carry-pawls. When in the position shown in Fig. 26, the upper depressing-bar 111 will cause the subtracting-pawl 103 to be positioned out of mesh with the ratchet 104, while the lower bar 112 will release the adding-pawl 106 and permit it to engage the ratchet. Should the machine be set for subtracting, the cams 290 fast on the shiftable shaft 78 will be positioned in line with rollers 291 carried by the lower end of each plate 287, and will thereby raise said plates when the actuating-mechanism, already described, and which rotates the shaft 78, is thrown into operation. This will cause the adding-pawl to be disengaged from the ratchet while the subtracting-pawl is moved into engagement therewith. By the action of the depressing-bars 111 and 112, releasing one pawl and depressing the other, the cams 290 will force said plates to their lower position in the event that the spring 289 fails to work, because said cams 290 are attached to the cams 117 on said shaft 78 and will operate to rock the plates on their fulcrum 81 and thereby permit the rollers 291 thereon to be positioned, when adding; but will be positioned out of line therewith when the machine is set for subtracting. Thus, if the machine be set for adding, said plates will be in their lower position and against the stud 288; but, if the machine is set for subtracting by the action of the cams, said plates will rise and fall at the proper time whenever the actuating-mechanism is operated.

Slide-member indicator.—In Fig. 27, there is illustrated an initial indicator which may be utilized to disclose to the operator exactly what selection or "condition" may have been set up and as controlled by the slide-members 23: In this instance, the upper edges of the slide-members 23 are formed as a rack 292 and adapted to actuate a pinion 293 fast on the side of an index-wheel 294 disposed in alinement with a sight-opening 295 in the front of the machine-casing. It will be understood that when the slide-bar 23 is actuated under the influence of the spring 51 (Fig. 7) and is thereby thrust outwardly, when a selection is made, the extent of movement will be indicated on the index-wheel 294, and this movement will correspond exactly with the selection made on the selecting-gear 55. It will be understood that there will be as many of the index-wheels 294 as there are slide-members 23. To protect the slide-members 23 when in their outer position and also to enable a convenient disposition of the index-wheels 294 in the front of the casing, the latter is provided with an overhanging portion 296.

Setting-lever returning-mechanism.—In Fig. 28, there is illustrated a modified form of the setting-lever returning mechanism, already described. In this instance, the long arm 297—corresponding to the arm 180 in the embodiment illustrated in Fig. 6—is provided with an upstanding lug or abutment 298 which is adapted to engage a projection 299 on the machine-casing and which is designed to hold the arm in its forward or normal position, and from which lug it is disengaged by the following devices: A lever 300—corresponding in part with the lever 187—is fulcrumed at 301 and carries a stud 302 at its upper end adapted to be engaged by the hooked end 191 on the rack-bar 137. Also fulcrumed at 301 is another lever 303 carrying a stud 304 against which a pendant portion of the lever 303 is normally held by a spring 305. The lever 303 carries a roller 306 adapted to engage and depress the long arm 297 when the setting-lever 131 is being moved to the total-position, and thereby disengages the lug 298 from the projection 299 and also positions said arm in engagement with the toothed segment 184. As the lug 298 disengages from the projection 299, the teeth on the arm 297 will have become slightly meshed with the segment 184, so that the continued movement of the setting-lever 131 to total-position will cause the teeth in the arm 297 to be completely seated in the teeth in the segment 184, whereupon the arm will be further thrust forward to the limit of its movement. Then, when the actuating-mechanism is operated, a cam 307—corresponding in part to the cam 176 in the embodiment of Fig. 6—and which moves in the direction indicated by the arrow, will act upon the roller 177 on the arm 178. This, in turn, forces the arm 297 to the rear, and the latter being still connected to the setting-lever 131, through the segment 184, returns said setting-lever to adding-position. The arm 137, being attached to the setting-lever 131, and engaging the stud 302, rocks the lever 300 on its fulcrum to tension the spring 305 which, in turn, will rock the lever 303 on its fulcrum when the arm 297 has reached the limit of its rearward movement, at which moment the roller 177 will drop from the high portion of the cam 307, permitting the arm 297 (acting under the influence of the spring-actuated arm 178) to move forward to abut the lug 298 against the projection 299. The spring 185 will have raised the arm 297 out of engagement with the segment 184 when the spring 305 rocked the lever 303 on its fulcrum, as aforementioned, to permit said disengagement.

Printing-sector and its mounting.—In Figs. 29 and 30, I have illustrated a modified form of printing-sector and its actuating and controlling devices: In this instance, the sector 308 is not supported on the actuating-arm 200—as in the embodiment illustrated in Fig. 4—but is rotatably mounted on a bearing-member 309 slidably sustained on a flat bar 310 supported at its ends in the machine-casing. The bearing-member 309 includes side bosses 311 upon which the printing-sector rotates, and is provided with an elongated slot 312 through which the supporting-bar 310 extends. The upper end of the actuating-lever 200, in this instance, is yoked to embrace the bearing-member, as shown. It will be understood that when the actuating-arm 200 is operated, in the manner heretofore described, its yoked upper end thrusts the bearing-member and the sector toward and away from the platen. It will be understood that the supporting-bar 310 is common to all of the selectors and thus constitutes a common support for these. The vertical oscillation of each of the selectors is effected by the means already described and which includes the link 197, bell-crank-lever 194, etc.

This particular embodiment also includes a modified form of sector-alining mechanism, in that the sector is provided with an elongated slot 313, one wall of which is provided with teeth or serrations 314 into one or another of which a transverse bar 315—common to all of the sectors and supported at its ends in the machine-casing—is adapted to enter when the sector is thrust forward to print and be disengaged therefrom when said sectors are returned to normal position.

Cycles of operation.

The following are, generally expressed, the cycles of operation of the various instrumentalities and mechanisms of my computing and recording machine when set into operation, manually or otherwise, while set for additive computations:

1. Operation of key.—This permits the positioning of the selecting-mechanisms—thereby effecting a "condition" in the machine—and simultaneously actuates the printing-sectors of the printing-mechanism to a corresponding selecting-position.

2. Wrong selection.—In the event of an error in the selection, the slide-members (forming parts of the selecting-mechanisms) are manually restored to normal position; this operation, in turn, restores the selecting and printing-mechanisms to normal position, releases the numeral-keys, and relocks the slides, thus reëstablishing all parts in normal position.

3. Actuation of operating-handle.—Assuming that keys have been depressed, and that the selecting and printing-mechanisms have thereby become positioned, a forward movement of the operating-handle will set into operation the following mechanisms, to-wit:

(*a*). After a slight movement, the printing-selectors are thrust forward and print upon the work-sheet.

(*b*). Immediately following the printing-action, the computing-mechanisms are actuated to produce a computation, and a return of the selecting and printing-mechanisms to normal position is effected.

(*c*). During actuation of the computing-mechanisms, the depressed keys are released and each selecting-mechanism is relocked in its normal position.

(*d*). Immediately following, the tens-carrying mechanisms are brought into play and returned to normal position successively to the restoration of the selecting-mechanisms.

(*e*). The handle being about half way down, line-spacing of the platen occurs and this is simultaneously with the elimination of the selections and operation of the tens-carrying mechanisms. The first tens-carrying mechanism may, however, be in operation with the elimination of the second, third or fourth selections or "conditions."

(*f*). Practically simultaneous with the line-spacing movement of the platen, the ribbon feed operation will occur: The vibratory movement of the printing-segments to the printing-surface carries the ribbon with it to that surface.

(*g*). Immediately after the printing takes place and before the selections are eliminated, the computing-mechanisms mesh with their respective selecting-mechanisms and remain in operative engagement therewith until the selecting-mechanisms are returned to normal position and become disconnected therefrom just prior to the actuation of the tens-carrying mechanisms.

The following are the cycles for subtractive computations:

1. Operation of setting-lever.—This may be effected either before or after a "condition" has been "set up", and sets in motion the following:

(*a*). Upon the initial movement of the lever from adding to subtracting positions, the tens-carrying pawls are positioned; that is, the adding-pawls are disengaged and the subtracting-pawls engaged with the ratchets.

(*b*). Simultaneously therewith, the shiftable shafts are moved endwise to bring into play the companion-cams for shifting the pinion-carrying plate to mesh the subtracting-pinion with the driving-gear, and also to position the bichrome ribbon shifting-cams.

(*c*). The computation-indicator is actu-

ated by further movement of the setting-lever whereby the character of the computation about to take place is displayed.

2. The machine being now set for a subtractive computation, the depression of a key will actuate the selecting-mechanism to produce a "condition", similarly as described for the additive computation, followed by the production of a computation, elimination of selections, etc.

Repeat key operation.—A selected amount may be repeated by preventing the release of the depressed keys when the selecting-mechanisms are being returned to normal position, which permits the selecting-mechanisms again to be set into operation to set up the "condition" again, immediately after being destroyed. The operations which then take place are as before explained.

Total operation.—This is controlled by the setting-lever and results as follows:

1. The initial movement of the setting-lever from the subtracting-position to total-position releases the total-arms so as to form stops for the selecting-mechanisms.

2. A further movement of the setting-lever releases the selecting-mechanisms.

3. Simultaneously with this action, the lever-automatic-return-mechanism is meshed with the setting-lever, and the display of the character of computation is changed and "Total" indicated.

4. The pulling of the handle first raises the ribbon.

5. Printing is then effected.

6. The selecting-mechanisms are meshed with their respective computing-mechanisms.

7. The selections or "conditions" are eliminated.

8. Simultaneously with the elimination of the selections, the total-arms are returned nearly to normal position, the ribbon feeds, and line-spacing of the platen takes place.

9. During the final part of the movement of the pull-handle, the total-mechanisms are restored to normal position.

10. During nearly all of the movement of the pull-handle, the setting-lever will be returning to normal position, thereby changing the display of the character of computation, which will also reset the mechanism from "Total" to "Adding".

11. The operation of taking the total will also "clear" the machine and reset to zero.

While I have herein described my invention in detail, it is nevertheless to be understood that the specific disclosure herein is, in a large measure, an exemplification. Obviously, the same is susceptible of a wide range of modification and rearrangement without departing from the spirit of the underlying features of my invention.

What I claim is:

1. An adding and subtracting machine including, in combination, a row of depressible keys, a slide-bar adapted to abut against a key when depressed, a pawl for holding said slide-bar against movement until a key is depressed, a lever loosely connected to said slide-bar and caused to rotate when said slide-bar is moved, an arm connected to said lever, a segment-gear attached to said arm, a spring juxtaposed thereto, a manually-operated cam disposed adjacent thereto, and a pinion-gear in mesh with said segment and rotatable in one direction by said segment acting under the influence of the spring when a key is depressed and operated in the opposite direction by the manually-operated cam.

2. An adding machine including in combination, a row of depressible keys, a releasing member operated by a key when depressed, a pawl operated by said member, a slide-bar held in normal position by said pawl and when released from said pawl by the depression of the key, movable to abut against the depressed key, a locking member for holding the keys in a depressed position, a lever for moving said locking member to release said keys from such depressed position, manually-operated means juxtaposed to said lever, said lever being also actuatable to release keys from the depressed position by the slide-bar abutting thereagainst in being returned to normal position by said manually operated means.

3. The combination, in an adding machine of a row of keys, a slidable member operated by a key when depressed, a pawl operated by said member, a slide-bar held in normal position by said pawl and movable when released from said pawl by the depression of a key to abut against a depressed key, a sliding locking member for holding the keys in a depressed position, a lever for moving said locking member to release said keys from their depressed position, manually-operated means juxtaposed to the lever; the latter also being actuatable to release the keys from the depressed position by action of said slide-bar in abutting thereagainst while being returned to normal position by said manually operated means, and means for displacing the lever from its member-operating position.

4. The combination, in an adding machine, of a row of keys, a slidable member for holding any of said keys in a depressed position when depressed, a slide-bar adapted to abut against said key when depressed, and repeat-mechanism including a lever adapted to abut against said member and move the same to release the key from its depressed position, and displaceable to prevent actuation of said member to prevent releasing of the depressed key, means for holding the lever in its displaced position, and means for effecting return thereof to normal position.

5. The combination, in an adding machine, of a swinging arm, repeat mechanism including a lever fulcrumed to the swinging arm, a spring for holding the lever and arm in a raised position, a manually-depressible button connected to said arm and adapted to lower the same when depressed, key-operated selecting-means having movement when a key is depressed, and manually-operated means for restoring said key-operated selecting-means and keys to normal position and adapted to restore only the key-operated selecting-means to normal position when the repeat-button is in its depressed position.

6. The combination, in a computing machine, of a shaft, a main-gear loosely mounted on said shaft, a gear-supporting member adjacent said main-gear, an adding-gear and two subtracting-gears mounted on said member and in mesh with the main-gear, a drive gear positioned between and normally out of mesh with said adding-gear and subtracting-gears, manually-operated cams for moving said member in one direction to mesh said adding-gear with said selecting-gear, and separate cams for moving said member in the opposite direction to mesh said subtracting-gear with said selecting-gear.

7. The combination, in a computing machine, of a denominational-wheel, a main-gear for turning the same alternately in opposite directions, a shaft upon which said gear is loosely mounted, a gear-supporting member loosely mounted on said shaft adjacent said gear, an adding-gear and two subtracting-gears mounted on said member and meshing with said main-gear, cams for moving said plate in opposite directions, and parallel shafts on which said cams are mounted.

8. The combination in a computing machine, of a shaft, a main-gear mounted on said shaft and movable in one direction to produce additive computation and in an opposite direction to produce subtractive computation, a plate loosely mounted on said shaft, a single gear and a pair of gears mounted on said plate and meshing with said main-gear, an operating-gear interposed between and normally out of mesh with said single gear and pair of gears, two parallel shafts, cams mounted on each shaft for moving said plate in one direction to cause the single gear to mesh with said interposed gear to turn said main-gear to produce additive computation and in the opposite direction to cause the pair of gears to mesh with the interposed gear and turn said main-gear to produce subtractive computation, said parallel shafts having endwise movement to position said cams in operative relation to the plate to move the same.

9. The combination in a computing machine, of a main-gear, a shaft upon which said main-gear is mounted, a plate mounted on said shaft adjacent said gear, a single gear mounted on said plate, a pair of gears mounted on said plate and meshing with said main-gear, a gear interposed between and normally disengaged from said single gear and pair of gears, two parallel shafts, a connection between said shafts for moving them endwise and in relatively opposite directions, cams mounted on said shafts and in approximate alinement with said plate for moving it in one direction to mesh the single gear with the interposed gear, and cams also mounted on the said shafts out of normal alinement with said plate and positionable into alinement therewith by said shafts to move said plate in an opposite direction to mesh the pair of gears with said interposed gear.

10. The combination, in a computing machine, of a setting-lever positionable to determine the character of computation to be effected, a rack-bar connected to said lever, a pinion in mesh with said rack-bar, a shaft upon which said pinion is mounted, a cam attached to said shaft, a walking-beam juxtaposed thereto, a roller on the beam and adapted to be actuated by said cam to swing said walking-beam, two parallel shafts having grooved ends and movable endwise by said lever, and rollers on the ends of the walking-beam and fitting in said grooves and permitting rotation of said shafts.

11. The combination, in an adding, subtracting and recording machine, of a lever positionable in any of three positions, mechanism operable in one direction to produce additive computation when said lever is in one position, and operable in an opposite direction to produce subtractive computation when said lever is in another position, and recording mechanism positionable to record the total of said computations when said lever is moved to its third position.

12. The combination, in a combined adding, subtracting and recording machine, of a lever positionable in three positions, rotatable mechanism operable in one direction to produce additive computation when said lever is in one position, and operable in the reverse direction to produce subtractive computation when said lever is in another position, selecting and recording mechanism adapted to be set to record the total of said computations when said lever is moved to its third position, and means for setting said selecting and recording mechanism.

13. The combination, in a combined adding, subtracting and recording machine, of a lever positionable in any of three positions, rotatable mechanism operable in one direction to produce additive computation when said lever is in one position, and operable in a reverse direction to produce subtractive computation when said lever is in another position, selecting and recording mechanism

settable to represent the product of said computations when said lever is in its third position, means for setting said last-mentioned mechanism, and means under the control of the operator for causing actuation of said rotatable mechanism to produce the aforementioned computations; said operator-controlled means being movable to act on said lever when in its third position to return it to its first-mentioned position.

14. The combination in a combined adding, subtracting and recording machine, of a lever positionable in any of three positions to control the character of computation to be effected, product-producing means releasable thereby, and operator-controlled means for actuating the product-producing means to record a product when said lever is in one of its three positions and, itself, actuatable to move the lever out of that position.

15. The combination, in an adding, subtracting and recording machine, of a lever positionable in any of three positions, rotatable mechanism operable in one direction to accumulate additive computations when said lever is in one of its positions and operable in a reverse direction to deduct subtractive computations from said accumulated computations when said lever is in another of its positions, selecting and recording mechanisms settable to record the product of such computations when said lever is in still another of its positions, means for setting said mechanisms, operator-controlled means for actuating said rotatable mechanism to operate said mechanisms and thereby produce computations and a record thereof when said lever is in its third position, said controlled means being also actuatable to move said lever to the first-mentioned position.

16. The combination, in an adding and subtracting machine, of settable selecting and recording means, a setting-lever adapted to be positioned in either of two positions to determine the character of computation to be performed and movable to a third position to release the selecting and recording means, mechanism for setting said means preliminary to recording a product, and a hand-operated lever for operating said recording mechanism to record the product and actuatable to move said setting-lever to one of the two first-mentioned positions.

17. The combination, in an adding and recording machine, of an actuating handle, a shaft rotatable in one direction only by said handle, a grooved drum on said shaft, recording mechanism including a swinging arm, a type sector supported on one end of the swinging arm, a roller on the other end of the arm and adapted to rest against said drum, and a spring for holding said roller against the drum and prevent movement of said arm and operating to cause said arm to move when the groove passes the roller.

18. A combined computing and recording machine including in combination, settable recording mechanism, means juxtaposed thereto for actuating it to produce a record, selecting means connected to the recording mechanism for setting it for operation by said actuating means, a computation-producing mechanism operable in conjunction with said recording mechanism for producing additive and subtractive computations, operating means therefor, selecting mechanism for said computation-producing mechanism, an operating shaft common to the selecting means for the recording mechanism and to the selecting mechanism for the computation-producing mechanism, and key-controlled means for actuating said operating-shaft.

19. A combined computing and recording machine including in combination, settable recording mechanism, means juxtaposed thereto for actuating it to produce a record, selecting means connected to the recording mechanism for setting it for operation by said actuating means, a computation-producing mechanism operable in conjunction with said recording mechanism for producing additive and subtractive computations, operating means therefor including a main gear, an adding gear and a plurality of subtracting gears meshing with said main gear, a gear-supporting member for sustaining said adding and subtracting gears, and positioning means for said member, selecting mechanism for said computation-producing mechanism, an operating shaft common to the selecting means for the recording mechanism and to the selecting mechanism for the computation-producing mechanism, and key-controlled means for actuating said operating-shaft.

20. A combined computing and recording machine including in combination, settable recording mechanism, means juxtaposed thereto for actuating it to produce a record, selecting means connected to the recording mechanism for setting it for operation by said actuating means, a computation-producing mechanism operable in conjunction with said recording mechanism for producing additive and subtractive computations, operating means therefor, selecting mechanism for said computation-producing mechanism including a drive-gear and a selector-gear meshing therewith, an operating shaft common to the selecting means for the recording mechanism and to the selecting mechanism for the computation-producing mechanism, and key-controlled means for actuating said operating-shaft.

21. A combined computing and recording machine including in combination, set-

table recording mechanism, means juxtaposed thereto for actuating it to produce a record, selecting means connected to the recording mechanism for setting it for operation by said actuating means, a computation-producing mechanism operable in conjunction with said recording mechanism for producing additive and subtractive computations, operating means therefor, selecting mechanism for said computation-producing mechanism including a drive-gear and a selector-gear meshing therewith, an operating shaft common to the selecting means for the recording mechanism and to the selecting-mechanism for the computation-producing mechanism, means interposed between said selector-gear and the shaft for transmitting motion from the shaft to the gear, and key-controlled means for actuating said operating-shaft.

22. A combined computing and recording machine including in combination, settable recording mechanism, means juxtaposed thereto for actuating it to produce a record, a selecting means connected to the recording mechanism for setting it for operation by said actuating means, a computation-producing mechanism operable in conjunction with said recording-mechanism for producing additive and subtractive computations, operating means therefor, selecting mechanism for said computation-producing mechanism including a drive-gear and a selector-gear meshing therewith, an operating shaft common to the selecting means for the recording mechanism and to the selecting mechanism for the computation-producing mechanism, means interposed between said selector-gear and the shaft for transmitting motion from the shaft to the gear, said operating means including a main gear, adding and subtracting gears meshing therewith and normally disengaged from said drive-gear, a gear-supporting member juxtaposed to said drive-gear for sustaining said adding and subtracting gears, and means for shifting said member for meshing the adding or subtracting gears with the drive-gear, and key-controlled means for actuating said operating-shaft.

23. A combined computing and recording machine including in combination, settable recording mechanism, means juxtaposed thereto for actuating it to produce a record; selecting means connected to the recording mechanism for setting it for operation by said actuating means, a computation-producing mechanism operable in conjunction with said recording mechanism for producing additive and subtractive computations, operating means therefor, selecting mechanism for said computation-producing mechanism including a drive-gear and a selector-gear meshing therewith, an operating shaft common to the selecting means for the recording mechanism and to the selecting mechanism for the computation-producing mechanism, means interposed between said selector-gear and the shaft for transmitting motion from the shaft to the gear, said operating means including a main gear, adding and subtracting gears meshing therewith and normally disengaged from said drive-gear, a gear-supporting member juxtaposed to said drive-gear for sustaining said adding and subtracting gears, and means for shifting said member for meshing the adding or subtracting gears with the drive-gear including a setting-lever and operating connections between the lever and the gear-supporting member, and key-controlled means for actuating said operating-shaft.

24. A combined computing and recording machine including in combination, settable recording mechanism, means juxtaposed thereto for actuating it to produce a record, selecting means connected to the recording mechanism for setting it for operation by said actuating means, a computation-producing mechanism operable in conjunction with said recording mechanism for producing additive and subtractive computations, operating means therefor, selecting mechanism for said computation-producing mechanism including a drive-gear and a selector-gear meshing therewith, an operating shaft common to the selecting means for the recording mechanism and to the selecting mechanism for the computation-producing mechanism, means interposed between said selector-gear and the shaft for transmitting motion from the shaft to the gear, said operating means including a main gear, adding and subtracting gears meshing therewith and normally disengaged from said drive-gear, a gear-supporting member juxtaposed to said drive-gear for sustaining said adding and subtracting gears, and means for shifting said member for meshing the adding or subtracting gears with the drive-gear including a setting-lever and operating connections between the lever and the gear-supporting member, said lever being movable into any of three positions, and key-controlled means for actuating said operating-shaft.

25. An adding and subtracting machine including, in combination, a series of keys, a slide-member adapted to abut against one of said keys when depressed, a holding instrumentality for retaining said slide-member against movement until a key is depressed, a lever connected to said slide-member and actuatable when it is moved, a gear-member, a connection between said lever and the gear-member, gear-returning mechanism operating on said gear-member to actuate it in one direction, means engageable with the gear-member to actuate the same in

a different direction, and means in engagement with said gear-member and actuated in one direction by the same when acting under the influence of said gear-returning mechanism and in the opposite direction when acting under the influence of said gear-engageable means.

26. An adding and subtracting machine including, in combination, a series of keys, a slide-member adapted to abut against one of said keys when depressed, a holding instrumentality for retaining said slide-member against movement until a key is depressed, a lever connected to said slide-member and actuatable when it is moved, a selector-gear, a connection between said gear and the lever, a gear-returning device operating on the gear to actuate it in one direction, means engageable with the gear to actuate the same in a different direction, and means in engagement with said gear and actuated in one direction by the same when acting under the influence of said gear-returning mechanism, and in the opposite direction when acting under the influence of said gear-engageable means, said lever also being actuatable to release keys from their depressed position by the slide-member abutting thereagainst in being returned to its normal position by said gear-engageable means.

27. An adding machine including, in combination, a series of depressible keys, a slidable member operated by a key when depressed, a holding-member operated by said slidable member, a slide-element normally held in position by said holding-member and movable when released therefrom by the depression of a key, a sliding locking-member for holding the keys in a depressed position, a releasing means for moving said locking-member to release the keys, manually-operated means juxtaposed to the releasing-means and actuatable to release the keys from their depressed position by the action of said slide-element in abutting thereagainst while being returned to normal position by the manually-operated means, and means for displacing the releasing means from its member-operating position.

28. A computing machine including a main gear rotatable in one direction to produce additive computation and in the opposite direction to produce subtractive computation, a gear-supporting member juxtaposed to the main gear, a single gear and a pair of gears mounted on said supporting-member and alternately operative on said main gear, a drive-gear interposed between and normally out of mesh with said single gear and pair of gears, a plurality of juxtaposed shafts, member-moving means carried by each shaft for moving said supporting-member, first in one direction for engaging the single gear with the drive-gear to turn the main gear in one direction for producing additive computation, and, then, in the opposite direction for engaging the pair of gears with the drive-gear to turn the main gear in the opposite direction for producing subtractive computation; said shafts being shiftable for positioning said member-moving means into operating relation with respect to said supporting-member to move the same.

29. A computing machine including a main gear rotatable in one direction to produce additive computation and in the opposite direction to produce subtractive computation, a gear-supporting member juxtaposed to the main gear, a single gear and a pair of gears mounted on said supporting-member and alternately operative on said main gear, a drive-gear interposed between and normally out of mesh with said single gear and pair of gears, a plurality of juxtaposed shafts, member-moving means carried by each shaft for moving said supporting-member, first in one direction for engaging the single gear with the drive-gear to turn the main gear in one direction for producing additive computation, and, then, in the opposite direction for engaging the pair of gears with the drive-gear to turn the main gear in the opposite direction for producing subtractive computation; said shafts being shiftable for positioning said member-moving means into operating relation with respect to said supporting-member to move the same, and means for shifting said shaft.

30. In an adding and subtracting machine, instrumentalities for producing additive and subtractive computation, settable means for determining the style of computation to be produced thereon, including a plurality of juxtaposed shafts, and a walking-beam connecting the shafts for shifting the same in opposite directions.

31. In an adding and subtracting machine, instrumentalities for producing additive and subtractive computation, settable means for determining the style of computation to be produced thereon, including a plurality of juxtaposed shafts, a plurality of sets of cams carried by each shaft, a set of cams on one shaft being in operative alinement with a set of cams on another of the shafts, means interposed between the same and shiftable in one direction, and means connected to the shafts for effecting an endwise movement of the same to position a set of cams on one shaft into operative alinement with the interposed mechanism and to shift the same in a direction opposite to that when shifted by the first-mentioned set of cams.

32. In an adding and subtracting machine, instrumentalities for producing addi-

tive and subtractive computation, settable means for determining the style of computation to be produced thereon, including a pair of shafts, two sets of cams on each shaft, one set on one shaft being in operative relation with a corresponding set on the other shaft, and means connecting the shafts for changing the relation of the alined sets of cams and to position a second set thereof into operative alinement.

33. In an adding and subtracting machine, instrumentalities for producing additive and subtractive computation, a shiftable member, gears carried thereby and shiftable therewith in one direction to position certain of the gears for producing additive computation and shiftable in the opposite direction to position other of the gears for producing subtractive computation, and means including a plurality of sets of rotatable cams for shifting said member.

34. In an adding and subtracting machine, instrumentalities for producing additive and subtractive computation, a shiftable member provided with a yieldable portion, gears carried by the shiftable member and shiftable therewith in one direction to position certain of the gears for producing additive computation and shiftable in the opposite direction to position other of the gears for producing subtractive computation, means including a plurality of sets of rotatable cams acting on said yieldable portion to shift said shiftable member, and means for restricting movement of said shiftable member when said yieldable portion is moved by said cams.

35. In an adding and subtracting machine, instrumentalities for producing additive and subtractive computation, including number-carrying elements, a toothed-member coöperating therewith and rotatable a predetermined distance to effect a selection, means including a plurality of sets of gears shiftable into operative relation with said member and adapted when shifted in one direction to receive movement therefrom to produce additive computation and when shifted in the opposite direction to produce subtractive computation, and controlling mechanism coöperating therewith whereby the member will be rotated a distance equal in unit-value to the number showing on the number-carrying elements.

36. In an adding and subtracting machine, instrumentalities for producing an additive and subtractive computation, a hinged plate juxtaposed thereto, a plurality of sets of rotatable cams for moving the plate in one direction when said cams are rotated, means for shifting the cams out of active relation with respect to said plate and for positioning a second set of cams into active relation therewith for shifting the plate in the opposite direction, and means for holding the plate against shifting and for operating the hinge on the plate when said cams are rotated.

37. In an addition and subtracting machine, the combination of a shiftable member, shiftable to one position for subtraction and to another position for addition, a plurality of sets of rotatable cams for shifting said member to either position, a pull-handle operatively connected to the cams for rotating them and comprising a segment, a pinion meshing therewith and receiving movement therefrom, a second pinion meshing with the first-mentioned pinion, a toothed disk connected to the second-mentioned pinion and rotatable therewith, a gear, pawls carried thereby and rotatable in one direction by the disk abutting against the pawls, a plurality of gears meshing with said first-mentioned gear, and shafts rotatable by said plurality of gears and connected to certain of said cams; said disk being rotatable in the opposite direction independent of rotation of the plurality of gears, and said cams being fastened to the shafts and rotated therewith and acting on the shiftable member to shift the same in either direction.

38. In an adding and subtracting machine, instrumentalities for producing additive and subtractive computations, a plate coöperating therewith and provided on one side with a large gear and on the opposite side with a pair of relatively small gears, an interposed gear between the large and small gears and disengaged therefrom, a segment-gear for effecting rotative movement of said interposed gear independent of said large and small gears, means for positioning said large and small gears alternately in mesh with said interposed gear whereby the large gear or the small gears may receive rotative movement from said interposed gear when the segment effects its rotation, and means including rotatable cams for actuating the segment-gear.

39. In an adding and subtracting machine, instrumentalities for producing additive and subtractive computations, a lever settable to predetermine the style of computation to be produced thereon, a pull-handle for effecting actuation of said additive and subtractive instrumentalities, and means interposed between the setting lever and the pull-handle including a shiftable rack-member, a segment engageable therewith, and means for effecting engagement of the rack-member with the segment whereby the pull-handle will effect movement of the settable lever.

40. In an adding and subtracting machine, instrumentalities for producing additive and subtractive computation, a setting

lever coöperating therewith, a segment connected to the lever, a rack-bar disengaged from said segment when the setting lever is in one position, means for positioning the rack-bar into mesh with the segment when the lever is actuated into another position, and means active on said bar for actuating the same and, thereby, effecting return of the segment and setting lever to starting position and for disengaging the bar from the segment.

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

EDWARD C. WALTER.

Witnesses:
H. W. AMBROSE,
F. H. BLAKE.