H. MARSHALL.

COMPUTING MACHINE.

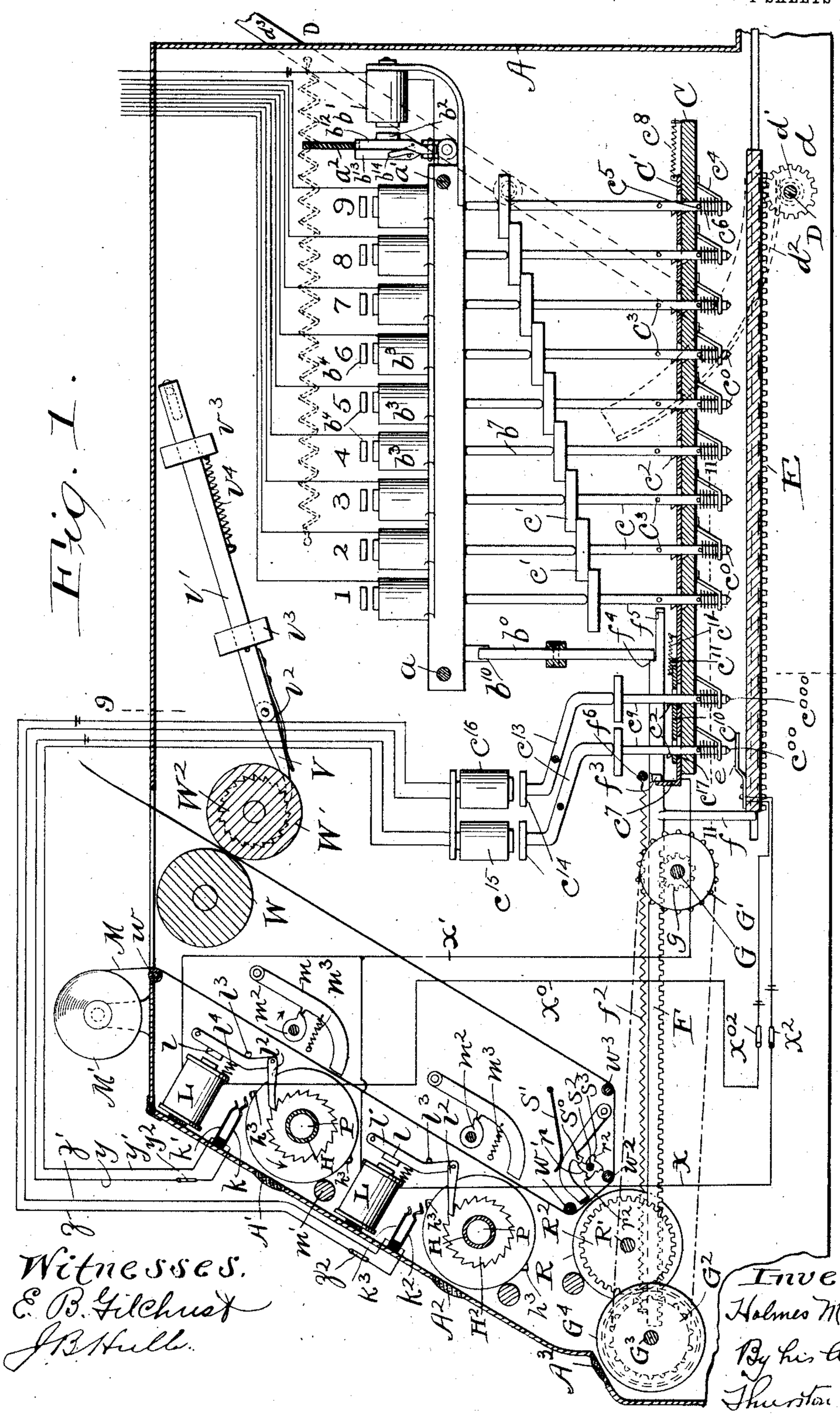
APPLICATION FILED JUNE 8, 1903.

987,150.

Patented Mar. 21, 1911.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
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J. B. Hull.

Inventor:
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By his Attorneys,
Thurston & Bates.

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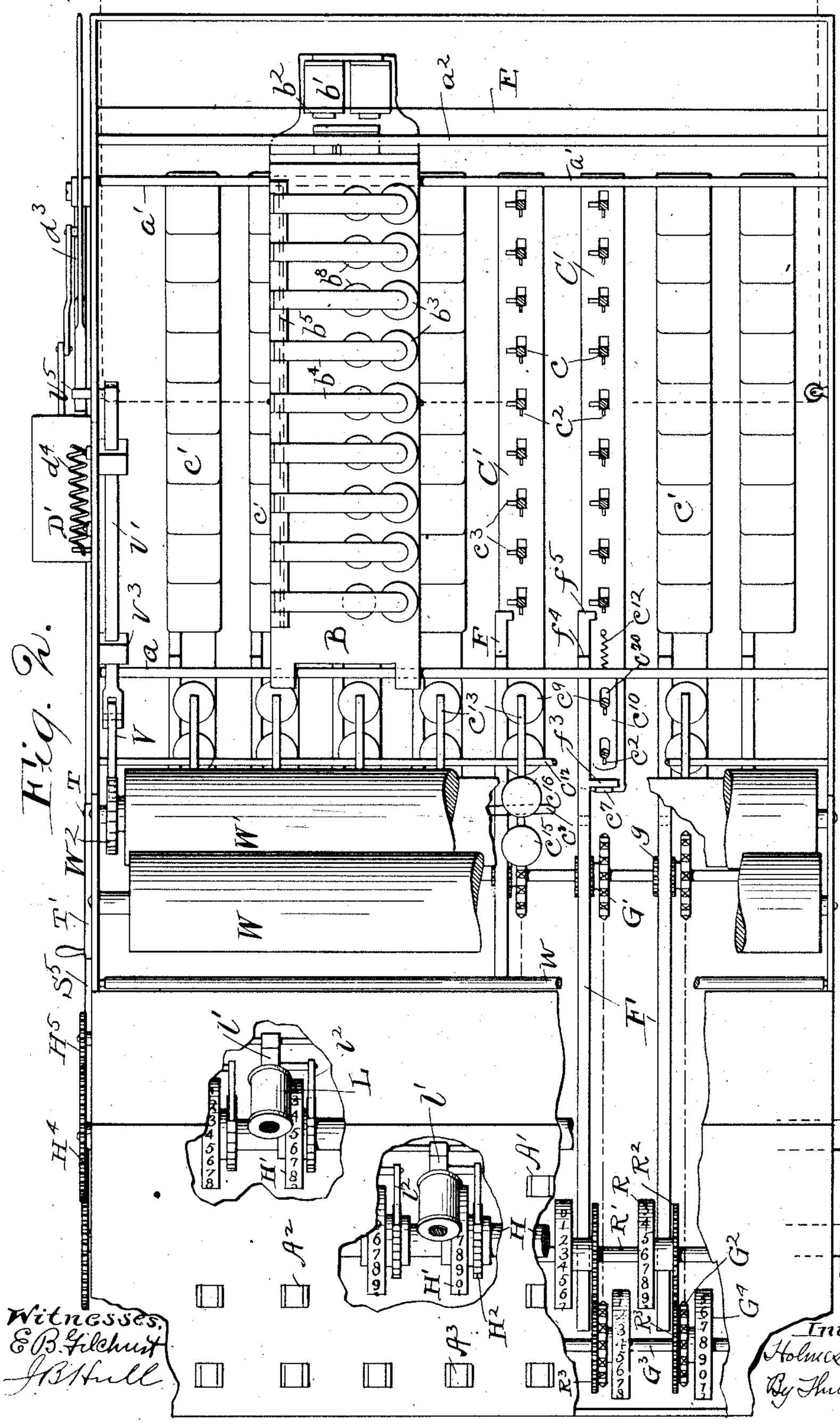
4 SHEETS—SHEET 2.

Fig. 2.



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4 SHEETS—SHEET 3.

Fig. 3.

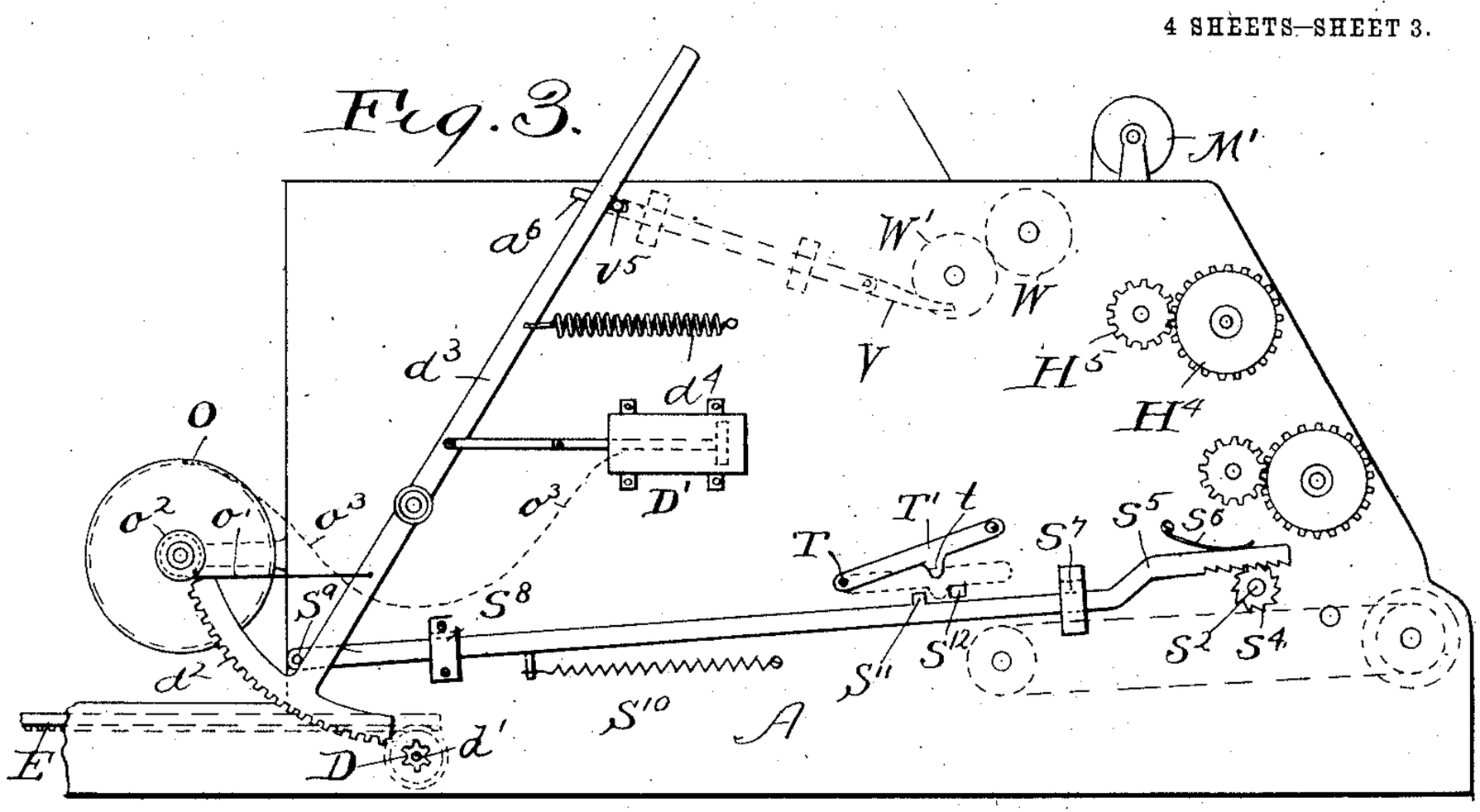


Fig. 4.

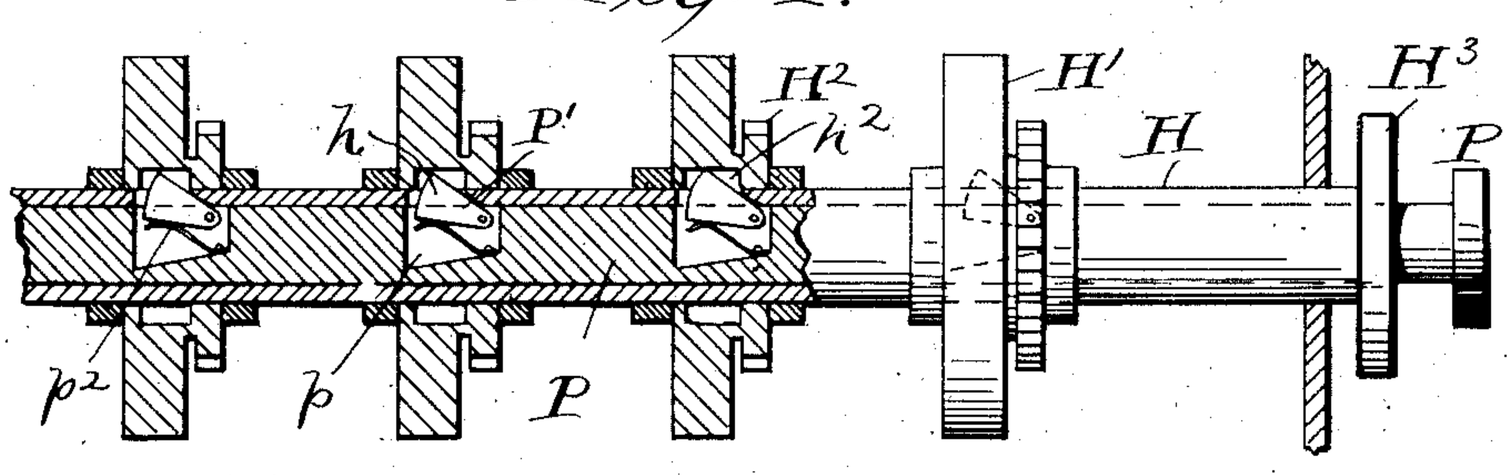


Fig. 5.

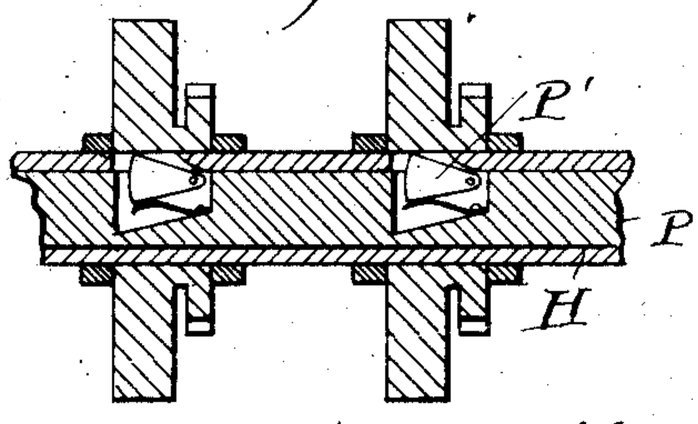


Fig. 6.

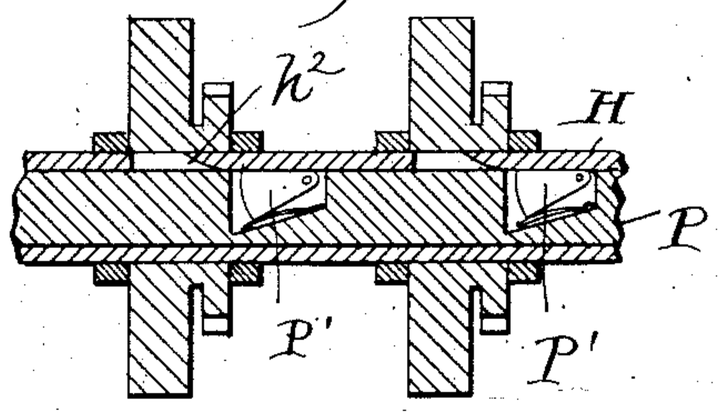


Fig. 7.

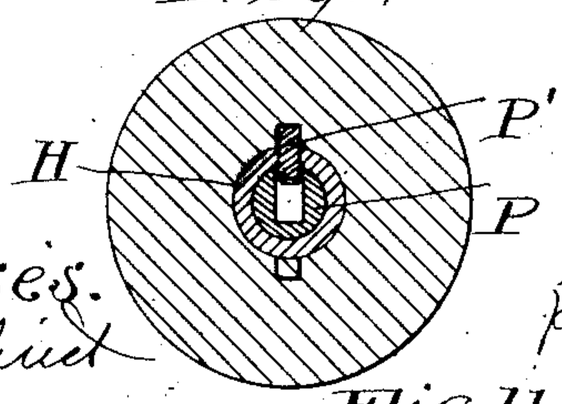
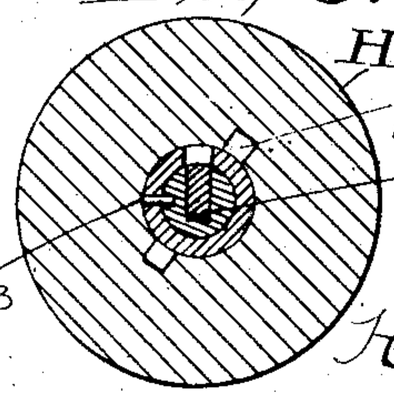


Fig. 8.

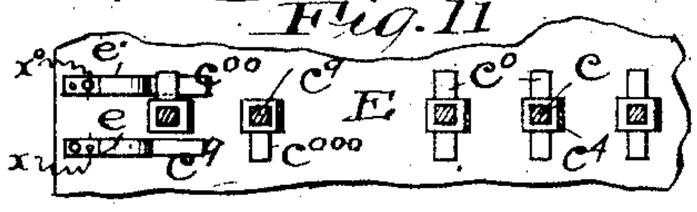


Witnesses.

E. B. Gilchrist

J. B. Hull.

Fig. 11



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4 SHEETS—SHEET 4.

Fig. 9.

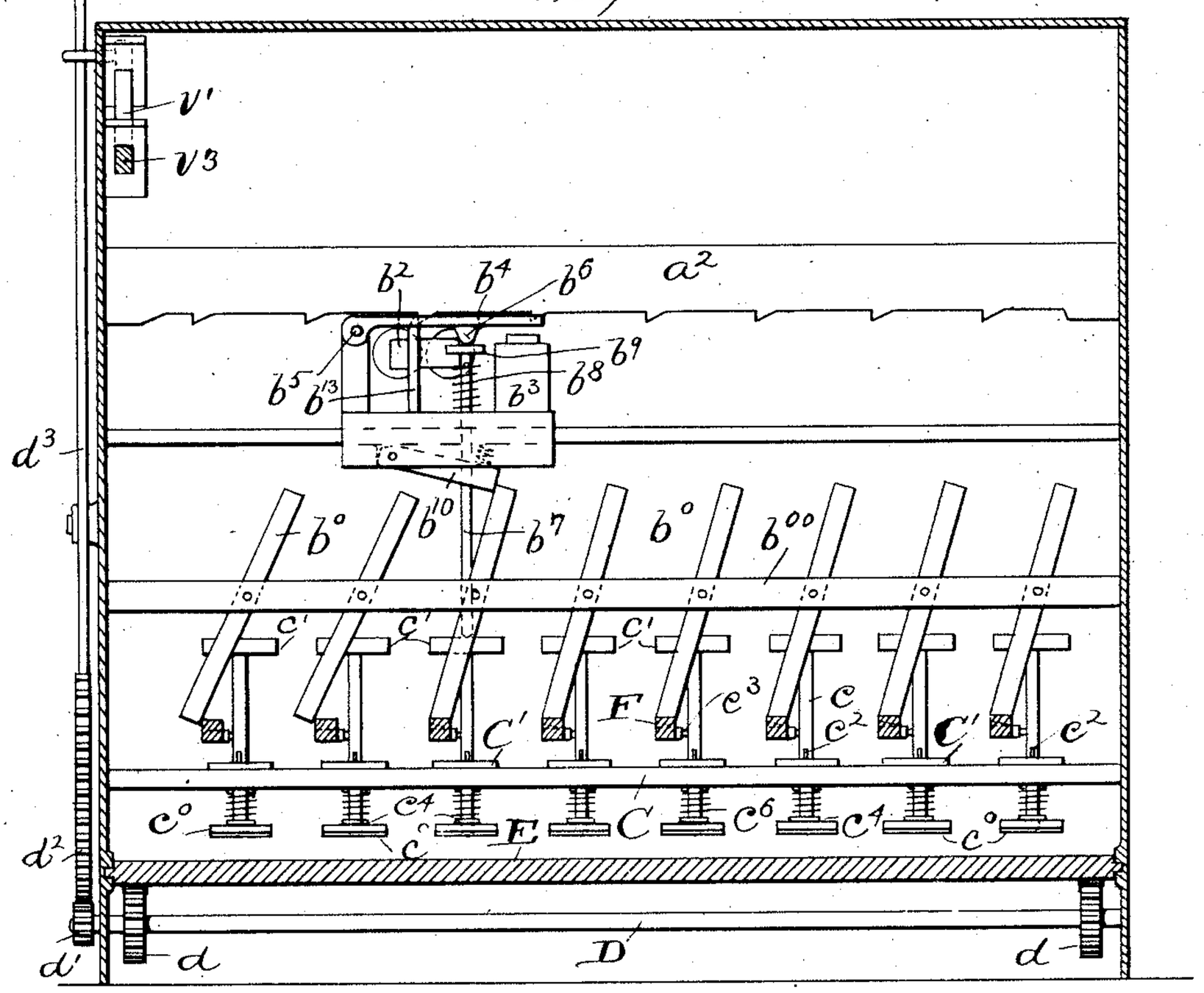
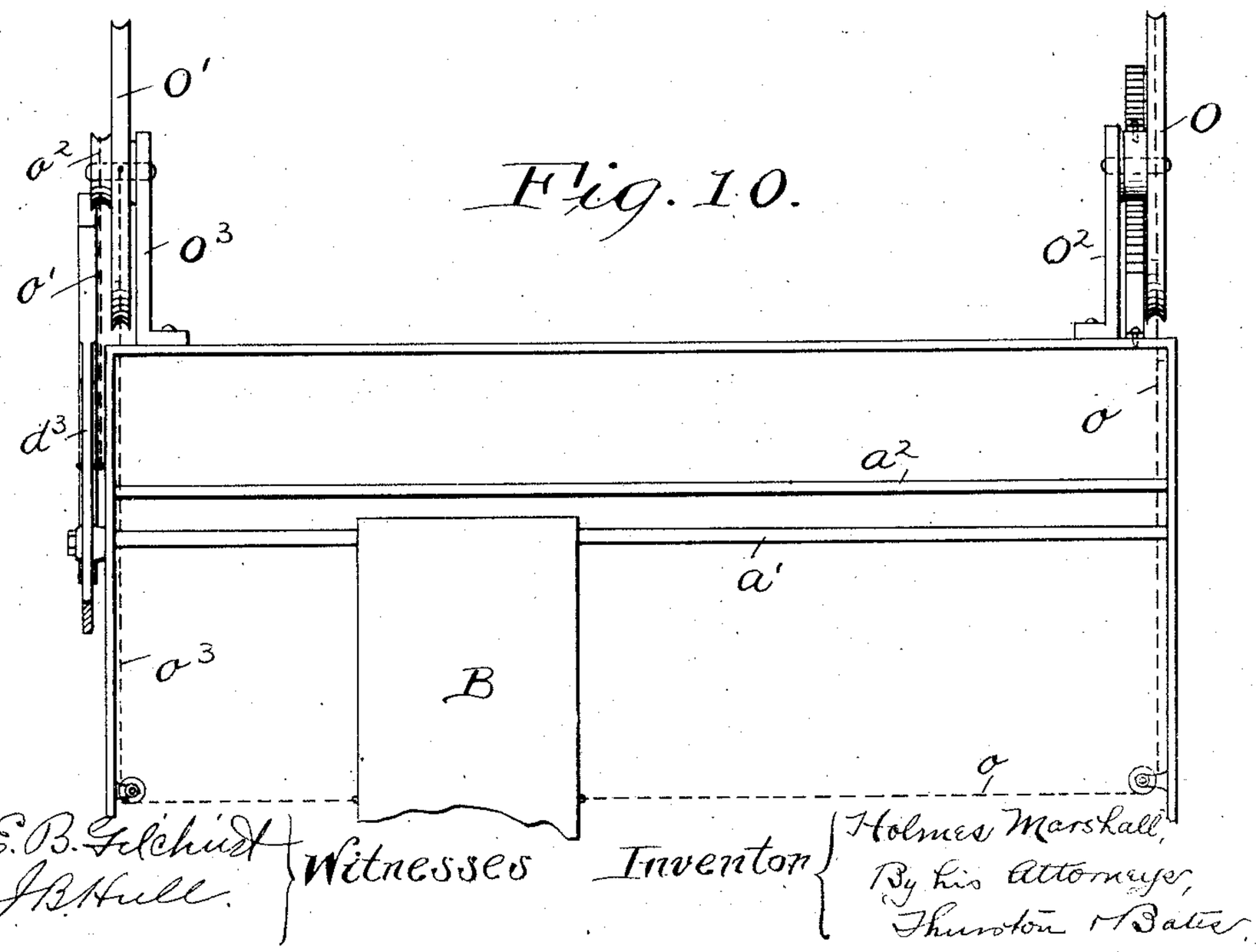


Fig. 10.



E. B. Fulchiud
J. B. Hull.
Witnesses

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UNITED STATES PATENT OFFICE.

HOLMES MARSHALL, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO ADDOGRAPH MANUFACTURING COMPANY, A CORPORATION OF NEW YORK.

COMPUTING-MACHINE.

987,150. Specification of Letters Patent. Patented Mar. 21, 1911.

Application filed June 8, 1903. Serial No. 160,460.

To all whom it may concern:

Be it known that I, HOLMES MARSHALL, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented a certain new and useful Improvement in Computing-Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

My invention relates to a computing machine wherein the mechanism may receive its actuation from a key-board, a card punched out to indicate the different numbers, or any other suitable mechanism.

The object of the invention is to provide an efficient computing machine of great adaptability, not only as to its method of primary actuation, but in its results in keeping separate records, sub-footings, totals, individual items, etc.

The embodiment of my invention herein shown may be defined, more specifically, as consisting of indicator wheels set forward by electromagnets which are arranged to be operated by a series of contacts set by suitable electromagnets.

A prominent feature of this invention is also the arrangement of the series of contacts mentioned above so that when one is set, it sets all the contacts of lower denomination thus furnishing, in every instance, a number of impulses to the computing wheel-operating magnets equal to the number to be added. It also provides for carrying from one computing wheel to another.

My invention further comprises a printing mechanism which is provided in connection with all the computing wheels and the arrangement of this printing mechanism is such that first, an itemized record may be obtained of all of the separate items before they are tabulated, second, that subfootings may be obtained from time to time and lastly that total amounts may be printed. Thus it will be seen that a complete record statement will be given of all the several steps in an account.

The invention may be summarized as consisting in the construction and combination of parts hereinafter described reference being had to the accompanying drawings, description and claims.

For convenience in illustration and description, I have shown this form of my invention in a more or less diagrammatical way leaving out such frame-parts, guides, etc., as do not directly enter into my invention. I have also omitted, in places, insulation for the electrical connections as this is not necessary for the proper understanding of my invention.

Referring to the drawings, Figure 1 is a longitudinal section through substantially the center of the device. Fig. 2 is a plan with the top plate of the casing removed in order to more clearly show the internal mechanisms. Fig. 3 is a side elevation showing the operating lever and some of the gearing connected with the different parts. Fig. 4 is a detailed view of the computing wheels and their mounting, showing the sleeves and shaft for setting the wheels back to zero. Figs. 5, 6, 7, and 8 are detail views of the same mechanism. Fig. 9 is a section taken upon the line 9—9 of Fig. 1; Fig. 10 is a partial top plan of the rear portion of the machine, showing the carriage and its actuating mechanism; and Fig. 11 is a view taken upon the line 11—11 of Fig. 1, looking down upon the top of a portion of the contact rods and of the contact plate E.

In constructing a device substantially embodying the features set out above, I employ a casing A of such a size and arrangement that it may be capable of carrying all the necessary mechanisms. This casing A is provided with sight openings A′, A^2 and A^3 shown in Fig. 1 for exposing the numerals on the several computing wheels. The computing mechanism hereinafter described is arranged so that for each decimal column there is a complete computer and each one of these computers is connected in an individual circuit x—x' to itself with its operating contacts to be described.

Within the casing and preferably in the back part thereof are two transverse guide rods a, and a' (Figs. 1, 2, 9 and 19) secured to the sides thereof and serving as a supporting means for a transversely sliding carriage B. To the rear of these rods and also rigidly secured to the casing is a rack bar a^2 similar to the rack bars used in an ordinary type-writer but having spaces between the teeth. Upon the rear end of the transverse carriage B and at a suitable point for en-

gagement with the rack, is an escapement dog, of ordinary construction, with the two pawls b^{12}, b^{13} for engaging in the teeth of the rack bar, but instead of being shifted by mechanical means, they are shifted upon their pivot by an electromagnet b', rigidly carried by said carriage and arranged to attract an armature b^2 secured to said dog. It will be seen that as an impulse is given to the electromagnet b', the dog will be operated and the carriage will move from one tooth to another. The operating mechanism for actuating this magnet b' is so arranged that as the numbers are set, the carriage will be permitted to travel from one decimal column to another, toward the right in Figs. 2, 9 and 10, under the influence of a spring drawing on the cord o. The carriage B is further provided with a series of electromagnets b^3 (Figs. 1, 2 and 9), nine in number, which are adapted to attract corresponding armatures b^4 pivoted upon a suitable rod b^5 and located in a manner such, that a lug b^6 on each armature may engage a vertically slidable pin b^7 mounted below each one. These pins are provided with springs b^8 which engage under a suitable shoulder b^9 for normally holding the same elevated and also moving the armatures b^4 from their magnets.

Any suitable form of operating device such as a key-board, or a device which is operated by a card or slip, may be used in connection with this mechanism, but there must be certain means which is adapted to close an individual circuit for each separate numeral. A common return wire is used between this device, the magnet b', and each of the magnets b^3. From each of these magnets b^3 is a separate wire leading back to the key-board, or other operating device. It will be seen therefore that when a connection is made upon the key-board, the magnet b' will be energized, thus pulling the locking pawl of the escapement into the rack and holding the carriage. The current will also pass through the electromagnet upon the carriage corresponding to the number struck on the key-board. This will force downward its corresponding pin, which is arranged to operate mechanism hereinafter described for actuating the computing wheels. When the circuit is broken the movable pawl of the escapement comes into the rack, and the carriage is shifted one step to the right.

The carriage B is still further provided upon its forward end with a depending spring-actuated pawl b^{10} (Figs. 1 and 9) which is pivoted to said carriage and is arranged to travel, in its depressed position, in a path into which project a series of pivoted arms b^0 mounted in a cross bar b^{00}, for a purpose hereinafter described.

Below the carriage B and in proximity to the lower ends of the pins b^7 are a number of rows of contact rods c (Fig. 1), and each row of these contact rods is slidably mounted in a stationary base plate C. Each row contains nine contact rods, and each one of these rods is provided with a head c' which is adapted to be engaged by one of the pins b^7 same figure. The rods are arranged with respect to each other so that one head will take over the head of the next contact rod below it, with reference to its denomination, and will take under the head of the next contact rod above it as clearly shown in Fig. 1. From this it will be seen that if one pin, say the fifth in the series or row shown in Fig. 1, were to be depressed it would press down its corresponding contact rod, and the pressing down of this rod would, through the medium of the heads of the contact rods lower in denomination, force all five downward. Slidably mounted upon the base plate C is a series of plates C′ provided with slots through which the contact rods operate, and the contact rods c are provided with projections c^2 adapted to take on the under side of plate C′ when said contact rods are depressed. The contaet rods c are further provided with stop pins c^3 in Fig. 2, projecting out upon the same side of each rod for a purpose hereinafter described, and at their extreme lower ends are provided with long narrow contact feet c^0 arranged to extend in a transverse direction to the line of contact rods for a purpose which will later appear. Each of the plates C′ is capable of being thrown into electrical connection with its respective computer through individual circuits represented by the lines x—x^0—x' in Fig. 1.

Below the plate C (see Fig. 1) the contact rods project downward where they are slidably mounted in suitable brackets c^4 and between these brackets and cross pin c^5, carried by each contact rod, coil springs c^6 are adapted to operate. These springs tend to hold the contact rods in an elevated position as shown in Fig. 1. Each of the plates C′ referred to is provided at its forward end with a stop c^7, for a purpose which will later appear, and at its rear end with a spring c^8 secured to the base plate C. This spring normally tends to hold the plate C′ in a rearward position and allow it to give forward as the projections c^2 are forced down through the slots therein.

In the forward portion of the base plate C are additional pairs of contact rods c^9. These contact rods (two for each row) are for the purpose of carrying from one adding wheel to another in the two sets thereof, as will be hereinafter described. These rods c^9 are similar to the other contact rods c having projections c^2, and springs c^6 for forcing them upwardly, but instead of being provided with long narrow contact feet,

as are the rods c, they are provided with shorter contact feet c^{00} and c^{000} projecting from but one side thereof and in a transverse direction to the line of the row. The foot c^{00} projects from one side of one carrying contact rod, while the foot c^{000} extends out from the opposite side of the other carrying contact rod, as is clearly shown in Fig. 11. The projections c^2 of the carrying contact rods c^9 do not engage underneath the plate C′ but are adapted to engage underneath auxiliary plates c^{10} which are provided with slots c^{20} (Fig. 2) for receiving the said rods and permitting the passage of the projection c^{20} thereon. Each of these plates is limited in its backward movement by a pin c^{11} and is held against said pin by a spring c^{12}. Suitable slots are provided in the plate C′ for permitting the passage of the contact rods c^9 and allowing the projection c^2 to engage underneath the plate c^{10}. Above the heads of the contact rod c^9 are suitable levers c^{13} carrying armatures c^{14} adapted to be attracted by magnets c^{15} and c^{16} (see Fig. 1) which are connected up with individual local circuits to be described.

It will be seen from the description of the contact rods that when they are depressed the projections c^2 will force the plates C′ and c^{10} forward until these projections pass through the plates, when the latter will return and will hold such of the rods as have been pressed in that position until they are released. These depressed rods form electrical contact points for governing impulses to the computing wheels, as will now be described.

Rotatably mounted in the lower part of the casing is a transverse shaft D (Figs. 1 and 3) having rigid therewith two gears d and a suitable pinion d', which is keyed to the end of the shaft D extending outside of the casing. This pinion d' is adapted to engage with a gear segment d^2 secured to the end of an operating lever d^3, pivoted to the side of the casing. This lever is normally held in the position shown in Fig. 3 by a coil spring d^4. Above the gear wheels d within the casing, and slidable in suitable guideways therein, is a contact frame E which is provided with a pair of racks on its under side for engagement with the gears d. Thus it will be seen that this contact frame may be slid longitudinally within the casing by shifting the lever d^3 upon its pivot, through the instrumentality of the gearing just described. At the forward end of this frame are a plurality of pairs of contacts e, e', one pair being shown in Fig. 11, so located upon said frame that when shifted they travel in a path which may be interrupted by the projecting feet of any of the contact rods c and c^9. One pair of these contacts e and e' is provided for each row of contact rods and is connected with the other lines x and x^0 of the main circuits opposed to the common return x', to which the corresponding plate C′ is connected. The contacts e e' are made as long as possible without being sufficient to span two contact rods.

Each one of the contacts is in the form of a spring of such width and arrangement that two of them may be placed side by side with sufficient distance between them so that the contact e' will only engage the contact foot c^{00} and the other e will only engage the foot c^{000}. It will, therefore, be seen, that when one carrying contact rod is depressed it will only give an impulse to the computer which is in circuit with that particular contact rod. This obviates the difficulty which might arise when one computing device of a row is set to give sub-footings and the other total, for if one of the computers is ready to carry from 9 to the next higher column and the other is not ready to carry at all then an additional impulse will only be given to the computer in the next column corresponding to the one which is ready to carry. Thus it results that as the frame E is reciprocated longitudinally by the lever d^3, from the position shown in Fig. 3, to that shown in Fig. 1, the contacts e, e' will engage each one of the contact feet which are at that time projecting into the path of said contacts, and give for each contact made an impulse to the adding wheel operating mechanism corresponding to that row of contacts. For instance, if the fifth key from the front of the series shown in Fig. 1 (corresponding to the digit 5), were depressed there would be five contacts made and these five contacts would give five separate impulses to the adding wheel operating mechanism.

I will now describe the mechanism for setting free all of the contact rods which have been previously depressed and locked in such position, and since this mechanism is connected with a test indicator mechanism for showing the numbers set up by the machine before being added, I will also describe the same. These parts are best shown in Figs. 1, 2 and 3 and the description will be substantially confined to these figures.

Slidably mounted in the casing and in connection with each plate C′, and its corresponding row of contact rods, is a rack bar F. This bar is provided on its under side with rack teeth and with a depending arm f arranged to take against the forward end of the contact frame E. This arm is held against the frame E by a coiled spring f^2 secured at one end to the bar F and at the other end to a stationary pin f^6. The bar F is further provided with a stop f^3 rigid with said bar and located in such a manner that when the contact frame is in its extreme forward position, said stop f^3 will engage the stop c^7, carried by the plate C′. From this it will be seen that, when the contact

frame upon its forward movement has completed the several contacts, it will engage the arm f, shift the bar F forward, and also, through the stop f^3, just described, shift the plate C′ forward, thus releasing all of the contact rods c to the action of their springs which return them to their normal position. The forward movement of the plate C′ carries the plate c^{10} forward also, through the medium of the step c^{11}, therefore the carrying contact rods c^9, if previously depressed, will be set free also. Before the releasing just described takes place, however, in fact before the operating lever d^3 is moved at all, the test wheels are set, by mechanism which I will now describe.

Rotatably mounted in the casing is a transverse shaft G having loosely mounted thereon a series of sprocket wheels G′, one for each row of contact rods. Each one of these sprocket wheels G′ is rigid with a pinion g meshing with the rack on the under side of its bar F. Thus it will be seen that any movement of the bar will convey a rotary motion to the sprocket wheel G′. This sprocket wheel is, however, geared with a sprocket wheel G^2 loose upon the transverse shaft G^3, and the size of both of these sprockets being the same, they will rotate in unison. This sprocket wheel G^2 is fast with an indicator wheel G^4 arranged to expose the characters on its periphery through the sight opening A^3.

Upon the extended end of the bar F is a shoulder f^4 arranged to take against one of the depending pivoted pawls b^0 hereinbefore mentioned. This engagement is retained by the spring f^2 tending to force said bar rearward. On a projected end of the bar is a detent f^5, extending from said bar in a position such that it will engage with the stop pins c^3 when the contact rods c are in their normal position, but when they are in their depressed position, these pins will be out of the path of said detent.

It is evident from the foregoing that as the transversely movable carriage B moves from one decimal row toward another, the pawl b^{10} will trip the pivoted arm b^0, which is in engagement with the shoulder f^4 of the bar corresponding to the row of contact rods, which was previously operated upon by the pins b^7 of the carriage. The releasing of this bar permits it to travel rearward through its spring f^2 until the detent f^5 engages with the first one of the stop pins c^3 in its path. This stopping of the bar stops the indicating wheel C^4 at a point to indicate the number which is being set up in that particular row of contact devices and upon the key-board. As an example, after the above operation, if the numeral 6 was intended to be set up the sixth contact rod would be depressed, thus depressing all the contact rods lower in denomination. Consequently when the bar F was released it would travel backward until it engaged the stop pin carried by the seventh contact rod, but the arrangement of the parts is such that when the detent stops upon the pin of a contact rod, there will be indicated upon the periphery of the indicator wheel G^4, a number which is one less than the number corresponding to said rod. This, shows to the operator the number which has been set up by the machine, before it is recorded by the adding mechanism, since the lever d^3 has not been operated and the contacts between the contact rods c and the contact e have not been made, and no impulses have been given to the tabulating operating mechanism. When the carriage is returned to its initial position as hereinafter set forth the pawl b^{10} will drag over the pivoted arm b^0 without shifting them,

The parts now to be described are those which relate to the computing mechanism which is arranged in groups, one group for each decimal column. These parts are shown in Figs. 1 and 2.

Rotatably mounted in the frame are sleeves H corresponding in number to the number of computing devices used on the machine. In this instance, I have shown two, one above and the other below, each connected in an individual circuit, but having the same common return x'. These circuits are represented by the lines x, x^0, and the common return x',—the said lines x and x^0 being connected to the spring contacts e and e' respectively hereinbefore mentioned. Loosely mounted upon these sleeves H are a plurality of registering wheels H′ having the digits on their peripheries,—each wheel having two complete sets. It will also be seen that these register wheels are provided with ratchet wheels H^2 for the purpose of rotating the same, there being one ratchet tooth for each digit. Secured to the casing and in proximity to each of the register wheels is its actuating magnet L arranged to attract its armature l rigidly carried by a pivoted lever l' having upon its free end a pawl l^2 which takes into the ratchet wheel H^2. Pins l^3 limit the outward movement of these levers and springs l^4 retain said levers against said pins with the armatures away from the magnets. It is obvious that when an impulse is given to one of these magnets L it will attract its armature l and through its lever l', and pawl l^2, will rotate its computing wheel one step for each impulse.

As previously stated, the computing mechanism is composed of a number of groups, each one of which represents a decimal column. Each group is composed of two registering wheels arranged in vertical alinement, their operating mechanisms, magnets, circuits represented by the lines x, x^0 and x', a plate C′ and contacts e and e', and

each row of contact rods is adapted to control that group corresponding to the decimal column represented by said row of contact rods.

When any contact rod is depressed and the contact frame E operated, a number of contacts corresponding to the number represented by such contact rod will be made, thus giving the necessary number of impulses to its corresponding magnets L to rotate the associated computer wheels the number of spaces to compute the number.

Mechanism is provided for carrying from one decimal column of computers or from one row of computing wheels to the next higher, and this mechanism consists of contacts for connecting up the carrying magnets c^{15} and c^{16}. Upon the periphery of each one of the registering wheels are a pair of teats h^3 each so located upon the same that when the numeral 9 is about to move from the sight opening, such teat will engage a spring finger k rigidly secured to the casing and will press it against another spring finger k' which is insulated from said other finger and from the casing. These two fingers are terminals of a local circuit through the wires y and y' to the carrying magnet c^{15} which is associated with the computer of the next higher column, so that when the sliding carriage sets up a number which sums up, with the number already registered, to a greater amount than nine, then another contact will be made to give one additional impulse to the computer next to the left.

As before stated, the spring contacts e, e' are made of a length such that when three or more columns, or orders, are ready to transfer upon the next addition, or upon the next computation, the carriage will not move too far but what the carrying devices all along the line will have a chance to operate and carry from one order to the other before the contact springs have passed out of range of the carrying contacts. For example, let us suppose that 9,999 has been set up upon the register and a rod was depressed in the units columns, then the indicator wheel corresponding thereto would complete the local carrying circuit in the tens order, and upon the contacts of the frame E reaching the carrying contact rod position, would complete the carrying operation in the tens column. This carrying operation throws down, by reason of the tit upon the ten indicator wheel, an additional contact in the hundreds column, but since contact e, e' are made sufficiently long, there will be ample opportunity for all of these devices to carry and complete the computation throughout the entire machine.

Fingers k^2, k^3 are, also, provided in connection with the lower tabulating wheel associated with the one previously described, and these two fingers are connected with a local circuit and with the carrying magnet c^{16} by wires z and z'. The operation of this mechanism is similar to that above described and therefore needs no further explanation. Switches y^2 and z^2 in the carrying circuits allow the same to be opened at any point, thereby separating the computing mechanism into two or more distinct computers. In the illustration shown with eight columns, there could thus frequently be used to advantage two independent computers of four columns, each. Of course the system could be extended and sub-divided as much as desired. For example, let us suppose that upon the upper set of the registering devices, totals are to be kept, and on the lower set, sub-footings are to be registered, and, further, let us suppose that the sub-footings, in no instance, will contain more than two digits in units and two digits in decimal fractions thereof. Then, after several items are put down, the total of these items will always appear on the lower set of registering wheels, while the total of all of these particular items, together with any others that may have been previously registered upon the machine, will be registered upon the upper set of indicator wheels. After each set of items relating to a particular account, or, after a sub-footing has been obtained, then it is necessary that the registering wheels used in obtaining these sub-footings, or, in this instance, the lower set of registering wheels, should be turned back to zero, in order to start a new set of items upon them, the printing operation taking place in each instance upon the setting to zero operation. If the sub-footings should run up to numbers which exceed two digits, or, let us suppose, a number containing three digits, then it would be necessary to either do away with the decimal fractions or add more indicating devices. The carrying circuit in the fourth row is broken by throwing the switch, z^2 in that row so that there is no carrying at that point. This is not necessary, however, unless the next series of indicating devices, or in this instance the remaining four devices, are used for recording sub-footings also, then these will operate in a manner similar to the ones just described.

The registering wheels H' are provided with internal diametrically opposed notches h. Each sleeve H has a knurled head H^3 and a longitudinal row of slots h^2 which are so arranged in said sleeve that they may register with the notches in said wheels. Within each one of the sleeves H there is a shaft P having a plurality of recesses p in which are pivoted a series of pawls p' arranged to be forced out by leaf springs p^2 secured in said recess. Each shaft P has a longitudinal movement within its associated

sleeve H such that when said shaft is in its outermost position the pawls will be drawn into and held in their recesses as shown in Fig. 6, such being the normal position of the parts. When the shaft P is pressed inward the pawls P′ pass into the slots h^2 in the sleeves H and then, upon rotation of the sleeve and shaft, by the knurled head H^3, each pawl picks up a wheel H′ as it comes into one of the notches h therein. The shafts P and the sleeves H are permitted to move with respect to each other in a longitudinal direction, but are kept from any relative rotative movement by pins p^3 secured in said shafts and passing through slots in said sleeves. Whenever it is desired to set any series of the tabulating wheels back to zero, the shaft P is pushed inward and the knurled head H^2 is rotated half a rotation. As every wheel H′ has a notch h in each half thereof, located according to the zero on the periphery, it follows that this half rotation will collect all the wheels and return them to zero.

Printing mechanism is provided in connection with this machine, and this mechanism consists of a series of hammers located back of a web of paper M which is stretched adjacent to the periphery of said computer wheels. The numerals used for the printing operation are those upon the periphery of the computing wheels. These numerals are inked by an inking roller m' which operates against the same. The hammers m are in the form of pivoted members adapted to be drawn toward said wheels by means of coiled springs m^3. Suitable cams m^2 are provided for setting free these hammers to operate against the back of the paper and force it against the inked characters upon the periphery of said wheels. The cams m^2 are mounted upon a transverse shaft on the outer end of which is a gear H^5 meshing with a gear H^4 on the end of the sleeve H. These gears H^4, H^5 are so proportioned that a half rotation of the sleeve H gives a complete rotation to the cams. Thus it results that whenever any set of computing wheels is set back, a print is taken of the amounts computed. This printing operation is caused by the very first movement of the sleeve H before any of the wheels have been moved. It will be seen that one of the sets of wheels H′ may thus show and print sub-footings, while the other set shows and prints totals.

Printing mechanism is also provided in connection with each of the test wheel indicators G^4 for the purpose of keeping a record of the individual items as they are set up by the machine. This is brought about by a printing wheel R loosely mounted on the shaft R′ secured in the casing. This printing wheel receives its rotation through a gear R^2 secured to it meshing with a gear R^3 rigid with the sprocket wheel G^2. The gearing and the arrangement thereof is such that the number, appearing through the sight opening A^3, will be presented upon the printing wheel R at a point where it may be engaged by a pivoted hammer S. The hammer S is provided with a projection S^0 and is pressed toward the printing wheel and paper by a leaf spring S′ but is held away from the same by a cam wheel S^3, secured to a transverse shaft S^2. A test indicating wheel G^4, a printing wheel R, and a hammer, together with its operating cam wheel, are provided in connection with each group of computing wheels and computing wheel operating devices. The operating cam wheel is arranged as shown with four cam faces r, which are provided at their highest points with notches r^2 for the purpose of forming a rest for the projection S^0 of the hammer which normally seats in the notch r^2.

Suitable mechanism is provided for rotating the cam wheel shaft a quarter of a turn for each item which is tabulated by the machine. Thus there is secured on the end of the shaft S^2 a ratchet wheel S^4, and above this ratchet wheel is a ratchet-bar S^5, meshing therewith and pressed into such engagement by a leaf spring S^6. This bar is slidably mounted in suitable guides S^7 and S^8, the guides S^7 being arranged to permit said ratchet bar to give upward from said ratchet wheel S^4 against the tension of said spring. The opposite end of the bar S^5 is provided with a stop S^9 which lies in the path of the operating lever d^3. This stop is arranged behind the lever and follows the same as it is pushed backward. This following operation is brought about by a spring S^{10} secured to said bar at one end and to the casing at the other in such a manner that it tends to pull said stop up against the back of said lever. A shoulder S^{11} is provided upon said bar for engagement with a fixed stop S^{12}. These two stops limit the movement of said bar, which movement is sufficient to give the cam shaft S^2 a quarter of a turn. The printing wheels R for the test print on the paper intermediately of the columns printed by the wheels H′. The characters on the wheels R are of different type or the inking roller therefore is of a different color to prevent confusion.

The double set of digits on the wheels H′ allows the same number to show through the opening A′ or A^2 and be beneath the hammer which is diametrically opposite. The numbers will be printed in each instance, upon the paper upside down and in a reverse position, but the paper is sufficiently thin to permit the record to be read through from the back side.

The paper web is guided in its course through the machine over rollers w, w', w^2,

w^3 and from there to the feed rollers W, W^. These feed rollers receive their rotation from a ratchet wheel W^2 shown in dotted lines in Fig. 1. This ratchet wheel is operated by a pawl V pivotally carried by a sliding rod V′ and pressed into engagement with said ratchet wheel by a spring V^2. This sliding rod is mounted in suitable blocks V^3 and is held in a rearward position by a spring V^4. Motion is conveyed to this sliding rod by a pin v^5 rigid with the same and extending through the slot a^6 in the side of the casing and out into the path of the operating lever d^3, so that whenever the lever returns to its normal position, as shown in Fig. 3, it will engage said pin v^5 and set the feeding rollers forward one notch.

The mechanism for shifting the transversely movable carriage B across the machine consists of a spring actuated drum O, and a return operating drum O′. Suitable supporting brackets O^2 and O^3 are provided for these drums. A cord o passes from the drum O to one side of the carriage B and the spring of said drum tends to draw said carriage from left to right. The other drum O′ is connected by a cord o^3 to the other side of said carriage, and a cord o' wound about a smaller drum o^2, connected with said lever d^3 operates to rotate the drum O′ and draw said carriage into its initial position. Thus it will be seen that when the lever d^3 is shifted upon its pivot to make the contacts through the contact frame, the cord o' will be drawn, thus rotating the drum O′ and winding up the cord o^3 which is secured to the left of the carriage. This necessarily draws the carriage back to its initial position, the pawl b^{10} clicking idly over the detents b^0 and the movable pawls of the escapement giving way sufficiently to allow the return.

If, at any time in the setting up of the machine before the number is computed, there should be a wrong number appearing through the sight openings A^3, this error may be rectified by the release of the contacts which have been depressed and arranged in the machine so that it will start in anew. This is brought about by breaking all of the local circuits through the computers through the medium of a gang of switches x^2 and x^{02} and then operating the frame E to set free the contact rods. The plates of these switches are mounted upon a shaft T running clear through the machine. Knives of said switches are arranged to complete the circuits when they are in their upward position. At the top of this shaft T and outside of the casing is an operating lever T′, which is provided with a nose t which is arranged to lie in the path of the projection S^{14}, carried by the bar S^5. This switch and its operating lever, together with the nose upon said lever, break all the local circuits and also prevent the movement of the bar S^5 and the printing of the incorrect number set up. The segment of the operating lever is so arranged that it is out of engagement with the pinion d' and thus allowing sufficient movement of said lever to accomplish the printing of the items before the contact frame E is operated. A dash pot D′ is provided in connection with the operating lever for preventing too rapid movement thereof.

The great adaptability of my computing machine to various business requirements will be apparent from the foregoing description thereof. Thus; first, it may be actuated by any suitable means for making electric contacts such as the keys of a special key board, or the numeral keys of a typewriter, or a perforated card operating with contact plungers, or in fact any means for making electrical contacts. Second, an indicator shows, after the number is set by the actuating device, but before it is computed, whether the number is correct, whereby it may be altered without computing, if incorrect. Third, the machine may be divided into sections operated independently, so that a plurality of columns may be computed at the same time, while for work involving high denominations the full number of computing members may be availed of for one column. Fourth, portions of a column may be added whenever desired, thus keeping an independent record of sub-footings. Fifth, printed records are made, as desired, of the individual numbers added, of the sub-footings, and of the totals.

Having described my invention, I claim

1. In a computing machine, a series of plungers corresponding to the different digits and each connected to operate all the plungers below it in denomination, but independent of those above it, latching means for holding the actuated plungers in active position, computing mechanism, and means for operating it corresponding to the number of latched plungers.

2. In a computer, the combination with an operating device, of electrically operated computing mechanism, a plurality of movable members, means for operating a sufficient number of said members to correspond to the number set up by the operating device, and means for making an extra contact in the next higher column for carrying from one decimal column to the other.

3. In a computer, the combination of electrically operated computing mechanism, a series of electromagnets and a set of contacts controlled thereby for operating said computing mechanism, the number of contacts set corresponding with the number to be added.

4. In a computer, the combination with electrically operated computing mechanism.

of a series of electromagnets, a set of contacts controlled thereby for operating said computing mechanism, the number of contacts set corresponding with the number to be added, and means operated by the computing device for making an additional contact in the next higher decimal column and thereby carrying from one column to the other.

5. In a computer, the combination with electrically operated computing mechanism having decimal columns, of a series of electromagnets, a set of contacts controlled thereby for operating said computing mechanism, the number of contacts set corresponding with the number set up by the operating device, and an electromagnet for making an additional contact in the next higher line for carrying from one decimal column to another.

6. In a computer, the combination of electrically operated computing mechanism, a plurality of contact devices electrically connected with the same, independent means for setting a number of said devices to make a number of electrical contacts corresponding to that to be added, and means for carrying from one decimal column to the next higher.

7. In a computer, the combination with electrically operated computing mechanism, a plurality of contact rods controlling said mechanism and arranged in decimal rows and means whereby the setting up of a number to be added will cause a depression of its corresponding contact rod, the depressing of said rod causing the depression of all of the other contact rods of lower denomination.

8. In a computer, the combination with electrically operated computing mechanism, of a plurality of contact rods for controlling the same and arranged in decimal columns, a series of electromagnets for depressing said contact rods, and means whereby the operation of one magnet corresponding to the numeral to be added will operate its contact rod and all of the others below it in denomination.

9. In a computer, the combination with electrically operated computing mechanism, of a plurality of contact rods arranged in decimal columns for operating said mechanism, each rod corresponding to a digit, means whereby the operation of one rod corresponding to the numeral to be added will operate its contact rod and all of the others below it in denomination, means for temporarily locking said contact rods in such actuated position, and means for then making contacts therewith.

10. In a computer, the combination with electrically operated computing mechanism, of a plurality of contact rods for the same arranged in rows representing decimal columns, a series of electromagnets for depressing said rods, means for completing the circuit through said magnets, means whereby the operation of one magnet may operate its contact rod and thereby operate all of the others below it in denomination, and means for making an additional contact when it is necessary to carry from one column to the next.

11. In a computer, the combination with electrically operated computing mechanism for each decimal column, of a plurality of rows of contact devices corresponding to each column for operating said mechanism, means whereby a number of contacts may be actuated in each row corresponding to the digit for that decimal column of the number to be added, and a traveling contact for each decimal row adapted to engage with all of the actuated contacts, and means for shifting said traveling contacts.

12. In a computer, the combination with electrically operated computing mechanism for each decimal column, a row of contact devices corresponding to each decimal column, each of said contact devices being adapted to make a number of contacts corresponding in number to its relative position in said row, a traveling carriage, means for giving the carriage step by step movement, and means mounted on the carriage for governing the contact devices to give a number of contacts equal to the number to be added.

13. In a computer, the combination with computing mechanism corresponding to each decimal column, a row of contact devices corresponding to each column, means provided in connection with each of said contact devices whereby the actuation of one will actuate all below it in denomination, a transversely movable carriage, a plurality of plungers, mounted in said carriage, for operating said contact devices.

14. In a computer, the combination with computing mechanism corresponding with each decimal column, a row of contact rods for each decimal column adapted to operate said mechanism, means for holding said rods in an elevated position and means whereby the depression of one of said rods will depress the other rods below it in denomination, and a latch plate in connection with each row for holding such of the rods as are depressed in that position.

15. In a computer, the combination with electrically operated computing mechanism corresponding with each decimal column, of a traveling contact for each column, a plurality of contact rods normally out of the path of said contact and means whereby the actuation of one rod will actuate a sufficient number of contact rods to convey impulses to the computing mechanism to compute the number to be added.

16. In a computing machine, the combina-

tion of computing mechanism, a plurality of rows of rods adapted to govern the same, a traveling carriage having a row of plungers adapted to operate various of said rods in the different rows successively, and a set of magnets carried by said carriage for operating said plungers.

17. In a computer, the combination with computing wheels, of mechanisms for actuating the same, rows of independent devices for controlling said mechanism, a carriage arranged to travel over said rows, pins carried by said carriage, electromagnets carried by said carriage and arranged to operate said pins and means for controlling the escapement of said carriage from one row to the other.

18. In a computing machine, the combination of a traveling carriage, an electrically governed escapement therefor, electrically operated actuating members carried by the carriage, a plurality of rows of depressible rods adapted to be governed by said actuating members, and a computing mechanism controlled by said rods.

19. In a computer, the combination with computing wheels of mechanisms for actuating the same, rows of devices for controlling said mechanism, a carriage arranged to travel over said rows, pins carried by said carriage, electromagnets carried by said carriage and arranged to operate said pins, and an electromagnet for operating the escapement of said carriage permitting it to travel from one of said rows to the other.

20. In a computer, the combination with electrically operated computing mechanism, of rows of contacts, a carriage traveling over said contacts and provided with means for setting said contacts, escapement mechanism for said carriage, and electrical mechanism for operating said escapement.

21. In a computer, the combination with electrically operated computing mcehanism, a plurality of contact rods arranged in rows corresponding to each decimal column, other sets of contact rods arranged in each row, and connected with the computing mechanism of the column below, a frame carrying a contact for each row of contact rods, means whereby the depression of one rod will depress a number thereof into the path of said contacts sufficient to give a number of impulses to the computing mechanism to indicate the number, means for shifting said contact frame, and means for holding said contact rods in a depressed position until after the several contacts are made.

22. In a computer, the combination with electrically operated computing mechanism, a plurality of contact rods, means for holding said rods in an elevated position, a contact frame slidably mounted in the casing, contacts carried by said frame and arranged to travel in a path in proximity to said contact rods, electric connections between said contact rods said frame and the computer-operating mechanism, means for depressing said contact rods, and means for shifting said contact frame.

23. In a computer, the combination with electrically operated computing mechanism, a plurality of contact rods arranged in rows corresponding to each decimal column, a plate for each row, said contact rods being slidably mounted in said plate, means for holding said rods in an elevated position, a contact frame slidably mounted in the casing, contacts carried by said frame and arranged to travel in a path in proximity to said contact rods, electrical connections between said rods, said frame and the computer operating mechanism, electromagnets for depressing said contact rods into the path of said traveling contacts, means for temporarily holding said rods in a depressed position, means for shifting said contact frame, additional contact rods provided in connection with each row and arranged to be operated by the computing mechanism corresponding to the next lower decimal column, said rod making an additional contact.

24. In a computer, the combination with electrically operated computing mechanism, a plurality of contact rods, means for retaining said rods in an elevated position, means for depressing a sufficient number of said rods to give contacts corresponding in number to the number to be added, a locking plate for temporarily holding said contact rods depressed, means for operating said plate to set said contact rods free, traveling contacts arranged to operate in a path into which said depressed rods project, and means operated by said traveling contacts to set free said contact rods after completing all of the connections between said rods and said contacts.

25. In a computer, the combination with computing mechanism, a plurality of electrical contact rods arranged in rows corresponding to each decimal column, means for depressing said rods, a traveling contact frame, means carried by said frame and adapted to make connections with the depressed electrical contact rods and to thereby permit the actuation of said computing mechanism, and means for shifting said contact frame.

26. In a computer, the combination with computing mechanism, a plurality of contact rods arranged in rows corresponding to each decimal column, means for depressing said rods, a traveling contact frame, means carried by said frame and adapted to make connections with the depressed contact rods and thereby permit the actuation of said computing mechanism, a rack provided upon said frame, a pinion operating in connection with said rack, an operating lever, and

a connection between said operating lever and said pinion whereby the rocking of said lever will rotate said pinion and shift said contact frames.

27. In a computer, the combination with computing mechanism, of a plurality of contact rods, adapted to be set according to the number which is to modify the computation; electrical conductors adapted to connect the rods with the computing mechanism, means for completing circuits with said contact rods and conductors, and means for indicating the number set up before the computing operation takes place.

28. In a computer, the combination with a plurality of devices for actuating the computing operating mechanism, each one of said devices carrying a shoulder, and means traveling in the path of said shoulders, and a test indicator operated thereby for indicating a number equal to the number of shoulders absent from the path of said indicator operating device.

29. In a computer, the combination with computing mechanism of a plurality of rods for governing the same, means for actuating said rods, a test indicator, an operating bar for said indicator, means tending normally to shift said bar and a series of projections carried by said rods for determining the amount of movement of said bar.

30. In a computer, the combination with electrically operated computing mechanism, of test indicator mechanism, a plurality of contact rods arranged in rows, each of the rods of a row carrying a separate projection, an operating bar for said test indicator mechanism, means for automatically shifting said bar in a line with said projections, means whereby the depression of one of said contact rods will depress all of those below it in sequence, the depressed of said contact rods removing the projections from the path of said operating bar thereby permitting it to travel to the next contact rod not depressed and indicating upon its indicator the number set up.

31. In a computer, the combination with computing mechanism of an additional test device consisting of a plurality of indicator wheels, a printing wheel geared with each of said indicator wheels, means for inking the same, hammers for making the several impressions and mechanism for operating said hammers.

32. In a computer, the combination with computing wheels of electromagnets for operating the same, a plurality of independently mounted contact devices for operating each of said magnets, and means whereby the operation of one contact device will convey a number of impulses to its corresponding computer-operating magnet to register the denomination of such contact device.

33. In a computer, the combination with computing wheels of electromagnets for operating the same step by step, a plurality of independently mounted contact devices controlling the operations of said magnets, and means for actuating said contact devices whereby the operation of one of said contact devices will give a sufficient number of contacts to convey impulses to the computer operating magnets for registering the number to be computed.

34. In a computer, the combination with computing wheels, electromagnets for rotating said wheels step by step, rows of contact devices for controlling said magnets and means whereby the actuation of one of said contact devices in a row will actuate all of those below it in denomination, and means for completing the circuit through such actuated contacts.

35. In a computer, the combination with computing wheels, of electromagnets for operating said wheels step by step, contact rods controlling said magnets, means whereby the operation of one of said contact rods may operate all below it in denomination, and a traveling contact adapted to complete the circuit between said several contacts and the computer-operating magnet.

36. In a computer, the combination with computing wheels, pawl and ratchet construction for rotating said wheels step by step, electromagnets for operating said pawl and ratchet mechanism, contact rods adapted to convey a number of impulses to said operating magnets corresponding to the relative value of said rod, and means for operating said rods.

37. In a computer, the combination with computing wheels, ratchet wheels for operating the same, electromagnets, armatures for the same, pawls carried by said armatures operating in connection with said ratchet wheels, a plurality of contact rods for controlling said electromagnets, a traveling contact adapted to make contact with any depressed contact rod, means for depressing said rods, and means whereby the depression of one rod will cause the depression of all those below it in denomination.

38. In a computer, the combination with electrically operated computing wheels, of a plurality of independently mounted, but co-acting contacts for controlling said computing wheels, means for setting said contacts, and means carried by one computer wheel for making an additional independent contact for actuating the next higher computer wheel.

39. In a computer, the combination with computing wheels of electrically operating mechanism, a set of contacts for operating each computer wheel, means for setting said

contacts, an additional contact in connection with each set of contacts, an electromagnet for controlling said additional contact, and means actuated by each of said computer wheels for operating said additional contact for the next higher column.

40. In a computing machine, the combination of two concurrently operating adders, and means for automatically printing their totals.

41. A computing machine having two series of concurrently operating adders, one adapted to add an entire sum, and the other to add individual portions of such sum, and automatic means for printing the individual totals of such portions.

42. A computing machine having two series of adding devices, mechanism for concurrently operating the two series, means for setting one of said series back to zero without interfering with the other set, and means for printing the totals indicated by the two sets.

43. In a computing machine, the combination with two concurrently operating adders, means for independently setting each of said adders back to zero, and mechanism for printing the amount of each adder whenever it is set back to zero.

44. A computing machine having actuating keys and two series of adders, means for concurrently operating the two adders by the same actuation of the keys, and means for setting one of said adders back to zero without interfering with the other.

45. In a computing machine, the combination of two series of concurrently operating adders, one adapted to register grand totals, and the other partial totals, and means for setting back to zero the adders for the partial totals without interfering with the computation on the other adder.

46. In a computing machine, the combination of computing mechanism, means for setting it back to zero, and means for printing operated by such setting.

47. In a computing machine, the combination of computing wheels, impression hammers adapted to print the number indicated by the wheels, and conjoint mechanism for setting the wheels back to zero and operating said hammers.

48. In a computing machine, the combination with digit keys and differential mechanism actuated thereby of two concurrently operating adders, means for setting one of said adders back to zero independently of the other, and means for independently printing the totals on the two adders.

49. In a computing machine, the combination with digit keys and differential mechanism actuated thereby of two concurrently operating adders, means for setting one of said adders back to zero independently of the other; and means for independently printing the totals on the two adders, said means being actuated by the zero setting mechanism.

50. In a computing machine, the combination with two concurrently operating sets of adding wheels, means for setting one set of said wheels to zero independently of the other, and means for printing from said wheels on the same piece of paper.

51. In a computing machine, the combination of two registers, one above the other, observation windows on the front side of said registers, and means for guiding a strip of paper along the backside of said registers.

52. In a computing machine, the combination of two registers, one above the other, observation windows on the front side of said registers, means for guiding a strip of paper from the backside of said registers, and means for independently printing from either register.

53. A computing machine having computing devices, a test indicator to indicate the number set up before it is computed, and a recorder positioned by the test operating mechanism for recording the individual amounts added.

54. In a computer, the combination with computing mechanism, test mechanism, recording members operated by the test mechanism, and means for printing on the same piece of paper from both the computing mechanism and recording mechanism.

55. In a computing machine, the combination of means for simultaneously adding two columns, means for recording the individual amount added, and means for setting back to zero one of the column adders independently of the other.

56. In a computing machine, the combination with digit keys and differential mechanism actuated thereby, of two adders, means for setting one of said adders back to zero independently of the other, and means for independently printing the totals on the two adders.

57. In a computing machine, the combination of means for adding two columns, means for recording the individual amount added and means for setting back to zero one of the column adders independently of the other.

58. In a machine of the character described, the combination of a set of actuators and two sets of accumulator wheels, means whereby the operation of said actuators and the accumulator wheels may result in the same amount being added on both sets of accumulator wheels, and means for setting one set of accumulator wheels back to zero without disturbing the other set.

59. In a machine of the character described, the combination of a set of actua-

tors and two sets of accumulator wheels, motion being transmitted between the actuators and said accumulator wheels, and means for turning one set of accumulator wheels back to zero without disturbing the other set.

60. In a machine of the character described, the combination of two sets of adders, one adapted to add an entire sum, and the other to add individual portions of such sum, and means for printing the individual totals of such portions.

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

HOLMES MARSHALL.

Witnesses:
WM. H. ROMER,
JOHN D. HAYES.