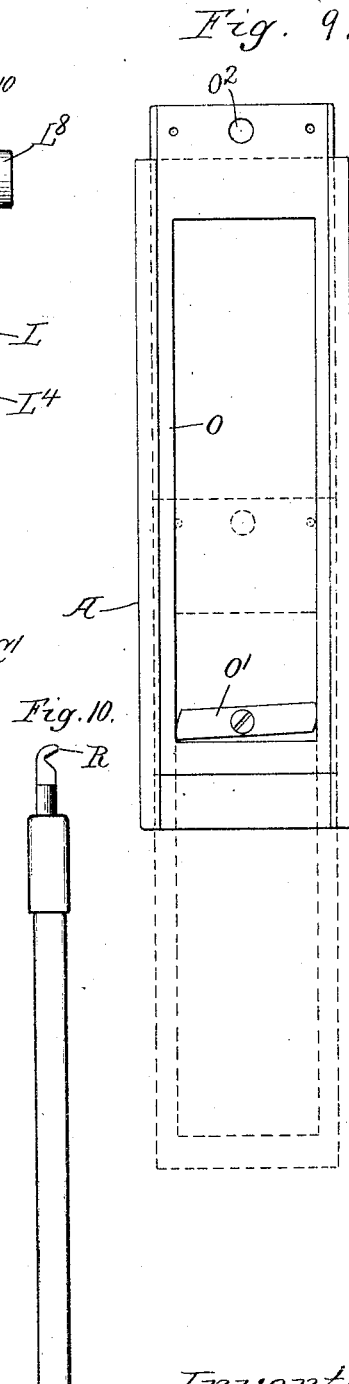
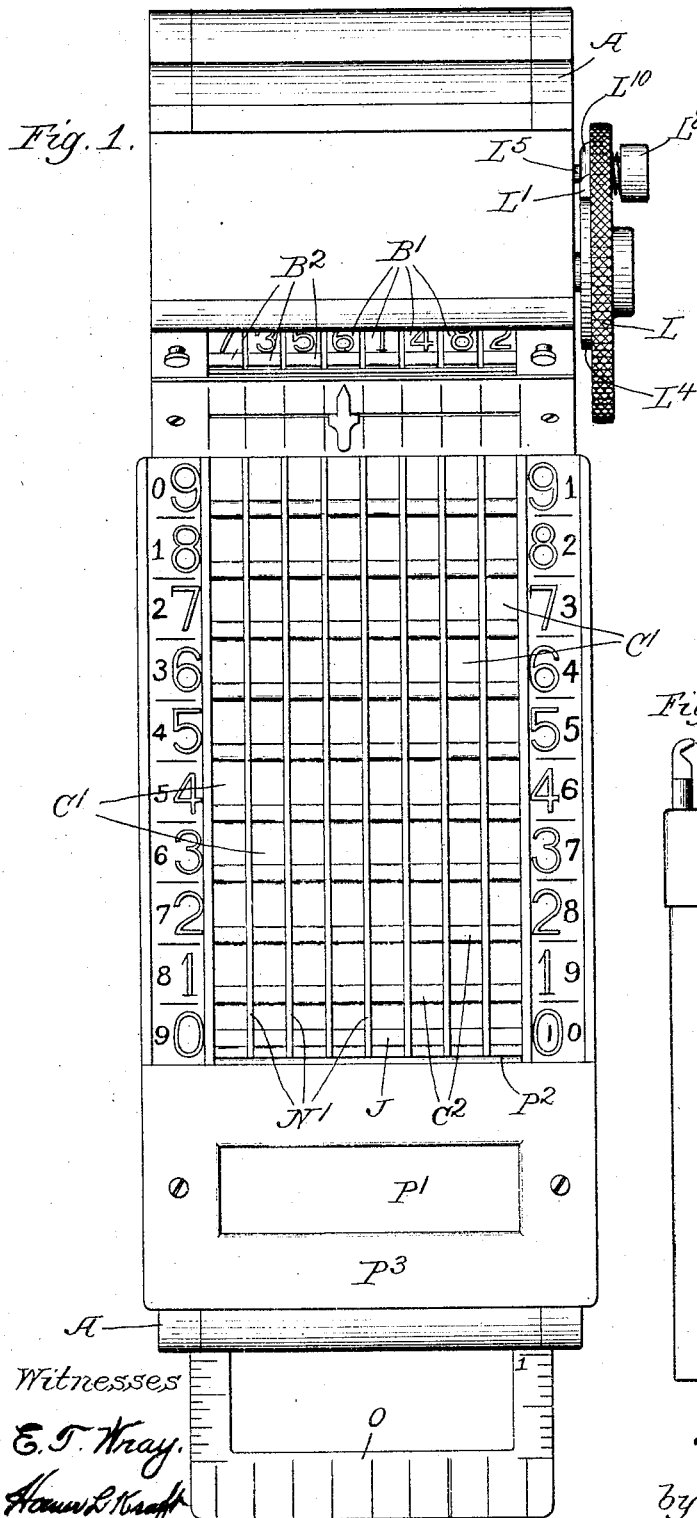


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CALCULATING MACHINE.  
APPLICATION FILED AUG. 1, 1900.

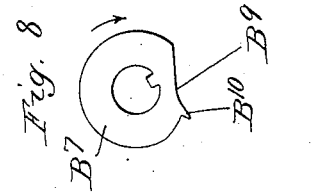
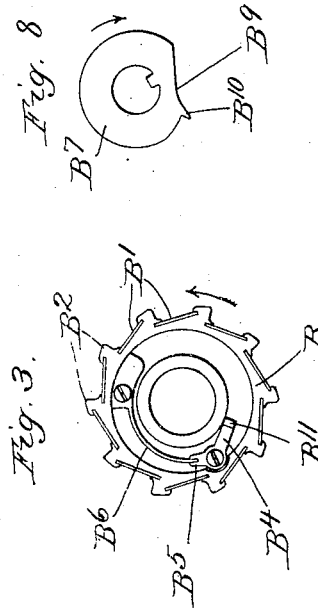
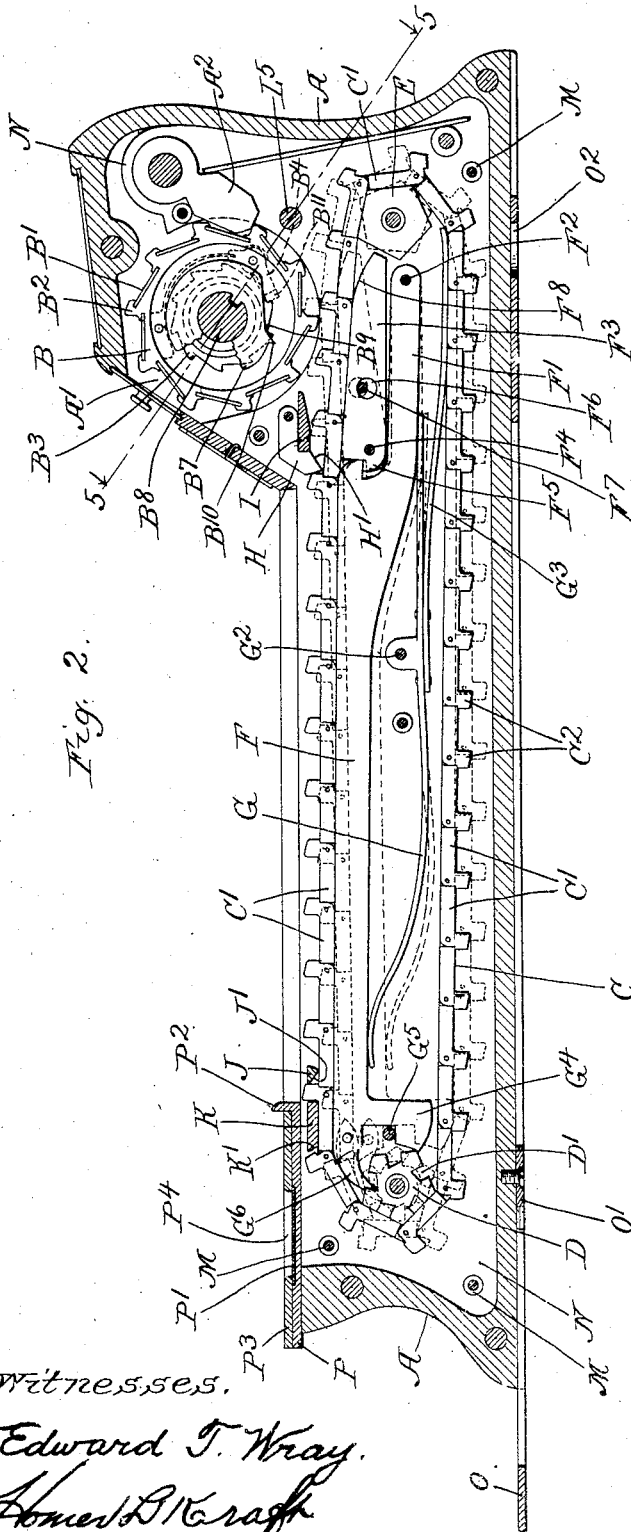
3 SHEETS—SHEET 1.



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3 SHEETS—SHEET 2.



Witnesses.

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3 SHEETS—SHEET 3.

Fig. 5.

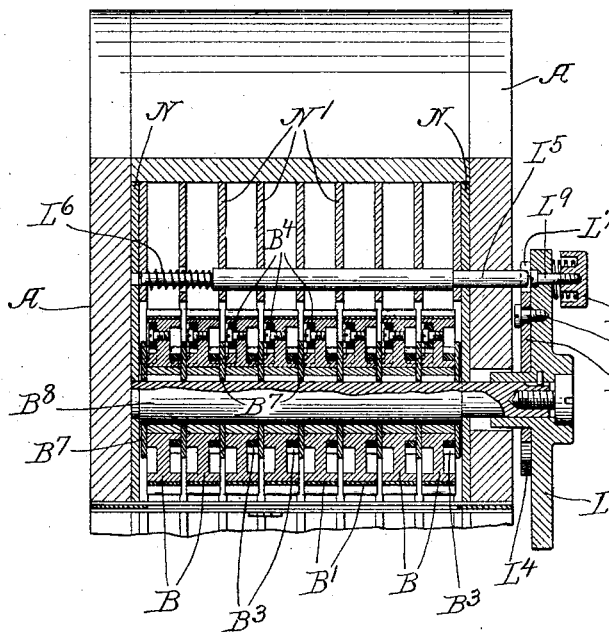


Fig. 6.

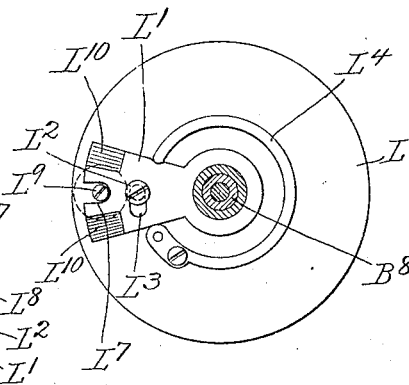


Fig. 7.

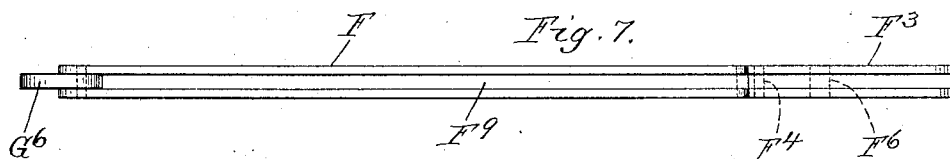
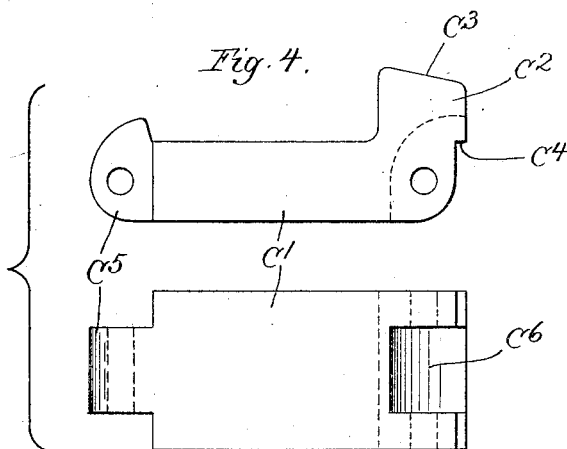


Fig. 4.



Witnesses.

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# UNITED STATES PATENT OFFICE.

HENRY GOLDMAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO INTERNATIONAL ARITHMOGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

## CALCULATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 786,282, dated April 4, 1905.

Application filed August 1, 1900. Serial No. 25,483.

*To all whom it may concern:*

Be it known that I, HENRY GOLDMAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Calculating-Machines, of which the following is a specification.

My invention relates to calculating-machines, and has for its object to provide a new and improved machine of this description.

My invention is illustrated in the accompanying drawings, wherein—

Figure 1 is a view of a machine embodying my invention. Fig. 2 is a longitudinal section through the same. Fig. 3 is a view of one of the numeral-wheels. Fig. 4 is an enlarged view showing the construction of the chain-links. Fig. 5 is a section with parts omitted along the shaft carrying the numeral-wheels. Fig. 6 is a view of the inner face of the resetting-wheel. Fig. 7 is a view of the upper face of one of the platform-levers. Fig. 8 is a view of one of the carrying and resetting disks. Fig. 9 is a bottom view on a reduced scale. Fig. 10 is a view of the stylus used in operating the machine.

Like letters refer to like parts throughout the several figures.

I have illustrated in the drawings a particular construction of my invention wherein the mechanism is contained within a suitable casing A. A series of numeral-wheels B are suitably mounted in position, and associated with each is an endless chain C, by means of which it is actuated. A spring-pressed stop-pawl A<sup>2</sup> is associated with each numeral-wheel. These pawls prevent the backward movement of the numeral-wheels and also insure their proper alinement. Said pawls are also preferably formed so as not to injure the plates or faces B'. The numeral-wheels B are provided on their peripheries with a series of detachably-attached plates or faces B', separated by the teeth or projections B<sup>2</sup>. These faces are preferably made of material different from the wheels and may be attached in position in any desired manner. As herein shown, the wheels are provided with profiled recesses, into which are slipped the plates or faces B', the projections or teeth B<sup>2</sup> being pro-

vided with engaging parts which engage the plates to hold them firmly in position. These plates may be made of any desired material—such, for example, as celluloid or the like—and the figures or characters on the numeral-wheels may be painted, enameled, or otherwise affixed thereon. The casing A is provided with an opening A', through which the figures on the numeral-wheels are read. The plates B' may be completed before being attached to the wheels and it will thus be seen can be readily slipped into place without injury to any of the parts. By this means the figures and the background upon which they are carried may be made of such different colors as to cause the figures to stand out clearly, so that they can be easily read. The plates on the different wheels may also be made of different colors, so as to form different-colored backgrounds for the purpose of distinguishing columns and denominations.

The chains C are made up of a series of links C', each being provided with a projecting tooth C<sup>2</sup>, adapted to engage the projections or teeth on the numeral-wheels. These projecting teeth C<sup>2</sup> are provided with the inclined faces C<sup>3</sup> and also with the projecting shoulders C<sup>4</sup>. Each link is provided with a lug C<sup>5</sup>, which enters a recess C<sup>6</sup> in the adjacent link, the two links being pivoted together. The shoulder C<sup>4</sup> of one link engages the end of the adjacent link, as shown in Fig. 2, to cover the joint, thus giving the chain the appearance of a solid bar and preventing dust and other material from entering the joints and interfering with the action of the parts. These chains pass over pentagonal rollers D E at each end of the device. The chains are separated by intervening partitions, so as to be independent of each other, and are each provided with a platform-lever F, provided at one end with the part F' out of alinement therewith. This platform-lever is pivoted at one end, as shown at F<sup>2</sup>. A chain-lever F<sup>3</sup>, pivoted at F<sup>4</sup>, is located above the part F' and has an engaging end F<sup>5</sup>, which engages a projection on the platform-lever F. This chain-lever is provided with an enlarged opening F<sup>6</sup>, through which passes a limiting device or stop F<sup>7</sup>, which limits its upward movement

and prevents the chain from being thrown up so as to engage the faces or plates B' and thus injure them or prevent the free movement of the wheels. The inclination of the faces of the teeth C<sup>2</sup> on the chain permits a complete engagement with the teeth of the numeral-wheels and yet prevents an engagement with the plates or faces B', so as to injure said plates or faces. The end of the chain-lever is rounded or beveled at F<sup>8</sup>, so as to conform with the chain-movement when in contact with said chain. Each chain is supported by the platform-lever F, and I prefer to form said platform-levers with a groove or cut-away part F<sup>9</sup>, as shown in Fig. 7, so as to reduce the friction due to the contact of the chain with said lever. Each platform-lever is provided with a controlling-spring G, (see Fig. 2,) which is pivoted at G<sup>2</sup> and which engages the platform-lever on both sides of the pivot. The platform-lever, being pivoted, permits the chain to be moved downwardly by pressure applied thereto, carrying with it the platform-lever, and the spring G then returns the parts to their initial position when the pressure is released. Attached to or associated with the spring G is a tension-spring G<sup>3</sup>, which engages the chain near the pentagonal roller E, so as to stretch the chain on the platform-lever and take up any slack of the chain produced by the depression of said platform-lever. The platform-lever is provided with a foot G<sup>4</sup>, which engages the chain near the pentagonal rollers D and aids in taking up the slack of the chain when the lever is depressed. A suitable stop G<sup>5</sup> is provided for the platform-lever, which limits its downward movement. The pentagonal rollers D are preferably provided on each face with an indentation or recess D', and the platform-lever F is provided with a spring-actuated pawl G<sup>6</sup>, which engages said recesses, as shown in Fig. 2. This prevents the pentagonal rollers from moving backward and also tends to move them when the lever is depressed, so as to tighten the chain.

I prefer to provide a locking-pawl H for each chain, located near the numeral-wheel, as shown in Fig. 2. This locking-pawl is pivoted at one end, as shown, and has a projecting part which projects downwardly beneath the teeth on the chain. This part has a beveled face H', which is engaged by the teeth on the chain in their forward movement, so as to lift the pawl and permit the free movement of the chain. This pawl, however, engages the teeth, so as to prevent a backward movement of the chain, thus preventing the plates or faces B' from being injured by the teeth on the chain. Associated with each chain is a limiting device I, which in this case consists of a cross-bar provided with a beveled or inclined face and which keeps the chain-links properly depressed, thus insuring complete contact with the teeth of the numeral-

wheels. This limiting device is also used as a support for the locking-pawl H. The beveled or inclined face on the limiting device engages the teeth on the chain, so as to insure their movement thereunder. Each chain is provided with a suitable locking device which normally locks it in position and which, as herein shown, consists of the two parts J and K, spaced so as to permit the teeth of the chain to fit between them. These parts are connected with the casing or the partitions in any desired manner and are so positioned that the teeth of the chain fit between them when the chain is in its normal initial position. The part J is provided with the beveled face J', which is engaged by the teeth of the chain. When a tooth of the chain is moved beneath the part J and the chain is released, the pressure of the spring G causes the teeth to move along this inclined or beveled face and insures its being moved in proper alinement, so as to pass between the two parts of the locking device. It is of course evident that this locking device may be made in a single piece, if desired, with a suitable opening for the teeth on the chain-links. The part K is also provided with the beveled face K', which assists in the proper alinement of the chain.

Each numeral-wheel B is recessed on both sides. In one of these recesses is the ratchet-wheel B<sup>3</sup>, which is connected to the wheel B, so as to rotate therewith, and in the other recess is located a spring-pressed pawl B<sup>4</sup>, provided with a recessed tailpiece B<sup>5</sup> for receiving the end of the spring B<sup>6</sup>, said spring being also connected with the numeral-wheel. Between the wheels B are located the carrying and resetting disks B<sup>7</sup>, connected with the shaft B<sup>8</sup>, so as to rotate therewith. These disks are provided with a depression B<sup>9</sup> and a projection B<sup>10</sup>. Each pawl B<sup>4</sup> is provided with a laterally-projecting part B<sup>11</sup>, which extends into the recess of the opposed wheel B and which normally rides upon the edge of the disk B<sup>7</sup>. This disk is of such diameter that it holds the projecting part B<sup>11</sup> out of contact with the teeth of the ratchet-wheel B<sup>3</sup> on the adjacent numeral-wheel, but permits it to engage one tooth when it reaches the depression B<sup>9</sup>. It will thus be seen that when one of the numeral-wheels is given one complete rotation it will carry the adjacent wheel forward one tooth. Each numeral-wheel and each ratchet-wheel is provided with ten teeth, and hence this arrangement causes the numeral-wheels to be properly rotated. When the shaft B<sup>8</sup> is rotated, the projections B<sup>10</sup> of the carrying and resetting disks engage the pawls B<sup>4</sup>, so as to move all of the numeral-wheels back to the zero-point. The shaft B<sup>8</sup> passes through the casing and is provided with some suitable controlling means. As herein shown, said shaft is provided with a resetting-wheel L, rigidly connected therewith. This resetting-wheel is provided with some suitable holding mechanism-

ism for holding it against rotation while the machine is being used. As herein shown, this resetting-wheel is provided with a movable piece  $L'$ , preferably mounted upon the hub of the wheel  $L$ . This movable piece is connected to the wheel by means of a screw or the like  $L^2$ , which passes through an enlarged opening  $L^3$  in the movable piece, so as to allow it a limited movement with relation to the wheel. A spring or the like  $L^4$  is connected with the wheel  $L$  and bears against the movable piece  $L'$ , so as to normally hold it against the screw  $L^2$ . Some suitable engaging device is connected with the casing  $A$  or some stationary part and is adapted to engage the movable piece  $L'$ , so as to hold it against rotation. Any desired construction for this purpose may be used. As herein shown, a movable lock-pin  $L^5$  is located in the casing and is provided with a spring  $L^6$ , which normally moves it outwardly. The movable piece  $L'$  is provided with a suitable opening  $L^7$  to receive the end of this lock-pin, as shown in Fig. 6. Some suitable means is provided for disengaging the lock-pin from the movable piece  $L'$ . Any suitable construction for this purpose may be used, and, as herein shown, I provide the resetting-wheel with a spring-actuated push-button  $L^8$ , which has a projecting part  $L^9$  adapted when the the push-button is pressed to move the lock-pin out of engagement, as shown in Fig. 5. The movable piece  $L'$  is provided on each edge with beveled faces  $L^{10}$ , which permits it to easily ride upon the end of the lock-pin  $L^5$  when rotated in either direction, so that said lock-pin may pass into the opening  $L^7$ . This lock-pin is provided with a suitable stop which limits its outward movement, the parts being arranged so that it will be stopped before it projects far enough to engage the face of the resetting-wheel. By having a spring-actuated or elastic intermediate part between the resetting-wheel and the holding mechanism therefor the shaft carrying the numeral-wheels is free to move a short distance when a predetermined pressure is applied thereto, the spring moving it back again when the pressure is released. This feature is of great importance in reducing the pressure necessary to operate the numeral-wheels. If, for example, the numeral-wheels are moved to a position where several of them show the figure "9" through the opening in the casing, a further manipulation of the machine necessitates the simultaneous movement of all of these wheels. Under these conditions the pressure applied to the chain must be sufficient to overcome the frictional resistance of all of the wheels. This often requires quite a good deal of force. If, however, the construction shown in Fig. 6 is used, the parts can be so adjusted that the shaft  $B^8$  will itself move slightly when the pressure applied to the chain is somewhat greater than is necessary to rotate any one wheel, and thus all the wheels

will be rotated simultaneously. This may therefore be accomplished with much less force than would be necessary to rotate all of said wheels independent of the shaft, and the strain upon the parts is thus greatly reduced. It will further be seen that by this means the chains can always be operated by a substantially uniform pressure regardless of the number of "9's" to be carried over. The reason for this yielding or dipping of the shaft or arbor when a series of "9's" are being carried over will be made clear by referring to Fig. 2. It will be remembered that there is associated with each wheel one of the disks  $B^7$  and that all of these disks are connected with the shaft or arbor, so as to rotate therewith. When the numeral-wheel is in a position to expose a "9" through the opening in the casing, the pawl  $B^1$  and its projecting part  $B^{11}$  are in the position shown in this figure, the projecting part  $B^{11}$  engaging one of the teeth on the ratchet-wheel  $B^3$ , connected with the associated numeral-wheel. It will be seen that the next move of the numeral-wheel carrying the pawl  $B^1$  will cause the projecting part  $B^{11}$  to ride along the depression  $B^9$  and up the incline over the projection  $B^{10}$ . This engagement produces considerable resistance to the movement of the parts, and this resistance is reduced by the yielding of the shaft or arbor. When two or more "9's" are to be carried over, the parts are so arranged that the friction at this point causes the arbor to dip or yield, thus moving the disks and the projections  $B^{10}$  slightly and changing the incline, as it were, so as to permit the projecting parts  $B^{11}$  to readily pass the projections  $B^{10}$ . The pressure is then relieved, and the arbor automatically returns to its normal condition. It will thus be seen that this construction produces a simultaneous yielding or dipping of all the disks and greatly reduces the internal friction and yet permits the arrangement of the parts in a small space, so as to produce a compact machine. This feature of my invention is claimed in a divisional application composed of matter divided from this case and filed on the 7th day of January, 1901, Serial No. 42,313.

In forming the casing  $A$ , I prefer to connect the various partitions and the outer plates together by means of suitable rods passing entirely therethrough, the parts being spaced in any desired manner—as, for example, by the space-rollers  $M$ . In order to hold all these parts in position, I prefer to provide double outside plates, the outer plates  $N$  not being provided with holes, but being held in position by suitable holding devices. It will thus be seen that the outside plates hold all of the pins, bars, and the like in position and avoid a separate holding arrangement for each one. This greatly facilitates the construction of the machine.

At the bottom of the casing  $A$ , I provide a

sliding guide-frame O, which may be extended beyond the edge of the machine, so as to take in a specified length of a column of figures when the figures to be added, for example, are in long columns. The machine can then be moved up and the guide-frame again moved out, thus aiding the operator in the manipulation of the machine. This guide-frame may be locked in any desired position by the locking-piece O' and may be ruled so as to aid in keeping the machine in graduation alinement with a column of figures of an account-book or similar device. The guide-frame O is provided at one end with a hole or opening O<sup>2</sup>, by means of which it may be suspended upon a nail or other holding device when desired, the frame being locked in position by the locking-piece O'. The partitions between the several chains may be made of various colors, so as to aid in distinguishing the columns. At the end of the frame I provide a plate P, which is preferably slightly recessed to receive the name-plate P', of celluloid or other material. This plate P is provided at its inner edge with an upturned preferably-beveled projection P<sup>2</sup>, which acts as a guard-plate. Above the plate P is a holding-plate P<sup>3</sup>, provided with a recess or opening P<sup>4</sup>, through which the name-plate is exposed. The operator in the rapid use of the stylus during the operation of the machine is apt to engage the plate P<sup>3</sup> with the sharp end of the stylus, so as to injure said plate. The projection P<sup>2</sup> acts as a deflector, which deflects the stylus so that it misses the plate P<sup>3</sup>, and thus the injury to said plate and associated parts is entirely obviated.

The machine may be operated by any device which will engage the projecting teeth C<sup>2</sup> of the chain. I prefer, however, to provide a stylus, as shown in Fig. 10, which is provided with an inclined or curved stylus-point R, which insures bringing said projections beneath the stop bar or part J.

The use and operation of my invention are as follows: When it is desired to make a calculation of any description upon the machine, the numeral-wheels are first brought back to the zero-point by means of the resetting-wheel. The operating stylus-point is then placed between the projections on the links of the chain to be operated opposite the desired figure on the scale at the side of the machine and is then pressed downwardly. The pressure applied to the stylus moves the platform-lever F downwardly, rotating it about its pivotal point F<sup>2</sup>, and disengages the chain from the locking device consisting of the parts J and K. The downward movement of the platform-lever simultaneously lifts the end of the chain-lever F<sup>3</sup>, as shown in dotted lines in Fig. 2, and lifts the projections on the chain into contact with the projections on the associated numeral-wheel. The movement of the chain-lever is limited by the pin F<sup>7</sup>, so that the chain will be stopped be-

fore the projections thereon engage the plates or faces B', thus preventing injury to said plates. The chain is kept tight by the tension-spring G<sup>2</sup> and the foot G<sup>4</sup> on the platform-lever. This downward movement of the platform-lever also tends to slightly rotate the pentagonal roller D, so as to keep the chain taut. The instrument is then moved forward, carrying the chain with it, the numeral-wheel being at the same time rotated by engagement of the projections on the chain. The stylus is stopped by engagement with the part J and is then removed from contact with the chain. The spring G then moves the platform-lever upwardly, and one of the beveled faces of the projections on the chain engages the beveled face J' on the part J. The pressure of the spring G then moves the parts so that the projection passes between the part J and the part K, so as to lock the chain against movement. The chain-lever F<sup>3</sup> is lowered by the upward movement of the platform-lever and becomes disengaged from the numeral-wheel. This operation is repeated with the various chains until the desired calculation is completed. The distinguishing-partitions between the various chains aid the operator in manipulating the chains. The projections on the chains being beveled, as shown, engage the teeth on the numeral-wheels substantially the full length of the engaging face, but do not strike the plates or faces B', and hence do not injure them. When the chain is moving forward, the projections strike the beveled face of the limiting device I and are confined or limited by it, so that full contact with the teeth of the numeral-wheels is insured. During the forward movement the pawl H is lifted each time a link of the chain passes thereunder, but engages the projecting parts on the links in case there should be an attempt to move the chain backward, thus preventing such backward movement, and hence insures the proper operation of the parts, at the same time preventing injury to the plates B' by contact with the projections on the chain. When a series of "9's" are shown through the opening A', a further movement of the chain causes all of the wheels showing these "9's" to be simultaneously moved over. This would ordinarily require considerable extra pressure; but when the construction shown herein is used the shaft B<sup>8</sup> moves slightly after the pressure is increased somewhat beyond that necessary to turn one of the wheels, the friction between the carrying-pawl and the carrying-disk being diminished, and all of said wheels are thus simultaneously started and easily carried over. After the calculation has been made it is necessary to reset the device to zero. To accomplish this result, the push-button L<sup>8</sup> on the resetting-wheel is pressed inwardly, so as to disengage the pin L<sup>5</sup>. This releases the resetting-wheel L, and it is then rotated. The projections B<sup>10</sup> on the disks B' engage the projec-

tions on the pawls B<sup>4</sup> and carry them around, the parts being so arranged that all of the wheels are brought back to zero, whatever position they may be in, by one rotation of the resetting-wheel. After this resetting-wheel has completed its rotation the beveled face L<sup>10</sup> on the movable piece L' engages the lock-pin L<sup>5</sup> and presses it inwardly, so that it can ride up on the part L'. The pin when opposite the opening L<sup>7</sup> is forced into said opening, and thus locks the resetting-wheel in position.

I claim—

1. A calculating-machine, comprising a series of numeral-wheels, a series of operating devices therefor consisting of endless chains making tangential contact with said wheels, means for independently moving each chain in and out of contact with its associated wheel and a limiting device for limiting the movement of the chain toward the wheel.

2. A calculating-machine, comprising a series of numeral-wheels, a series of operating devices therefor consisting of endless chains making tangential contact with said wheels, means for independently moving each chain in and out of contact with its associated wheel, a limiting device for limiting the movement of the chain toward the wheel and a locking-pawl to prevent backward motion of the chain.

3. A calculating-machine, comprising a series of numeral-wheels, a series of independently-operating chains associated with said wheels and normally out of contact therewith, said chains provided with projecting parts adapted to engage the wheels, movable levers upon which said chains are supported so that the chains may be raised or depressed, an elastic device associated with each chain for raising it, a locking device for holding each chain from motion when in its normal position, said locking device comprising an opening in which the projections on the chains are received, and an inclined face leading thereto, so that the pressure of the spring insures the movement of said projections into said opening.

4. A calculating-machine, comprising a series of numeral-wheels, each provided with projecting teeth, a series of plates carrying the characters and attached to the periphery of the wheel between said teeth, an endless chain associated with each wheel and provided with projections which engage the teeth on the wheel, means for moving said chain so as to bring the projections in contact with the teeth on the wheel and a limiting device for limiting said movement so as to prevent the projections from engaging the plates carrying the characters.

5. A calculating-machine, comprising a series of numeral-wheels, each provided with projecting teeth, a series of plates carrying the characters and attached to the periphery of the wheel between said teeth, an endless

chain associated with each wheel and provided with projections which engage the teeth on the wheel, said projections being beveled on their upper faces, so as to secure full engagement with the teeth of the numeral-wheels without striking the plates carrying the characters.

6. A calculating-machine, comprising a series of numeral-wheels, each provided with projecting teeth, a series of plates carrying the characters and attached to the periphery of the wheel between said teeth, an endless chain associated with each wheel and provided with projections which engage the teeth on the wheel, said projections being beveled on their upper faces, so as to secure full engagement with the teeth of the numeral-wheels without striking the plates carrying the characters, and means associated with said chain to prevent its backward movement.

7. A calculating-machine, comprising a series of numeral-wheels, an endless chain associated with each wheel and provided with projections which engage the wheel so as to rotate it when the chain is moved, pentagonal rollers over which the chain passes, one of said rollers having a notch or indentation in each face, a movable lever upon which the upper part of the chain is supported, said lever provided with a spring-actuated pawl which engages the notches in the pentagonal roller so as to keep the upper part of the chain taut when the lever is depressed.

8. A calculating-machine, comprising a series of numeral-wheels, an endless chain associated with each wheel and provided with projections which engage the wheel so as to rotate it when the chain is moved, two rollers about which the chain passes, a pivoted lever upon which the upper part of the chain is supported, a retracting-spring for said lever and a projecting foot on said lever which engages the lower part of the chain near one roller, so as to depress it when the lever is depressed.

9. A calculating-machine, comprising a series of numeral-wheels, an endless chain associated with each wheel and provided with projections which engage the wheel so as to rotate it when the chain is moved, two rollers about which the chain passes, a pivoted lever upon which the upper part of the chain is supported, a retracting-spring for said lever, a projecting foot on said lever which engages the lower part of the chain near one roller, so as to depress it when the lever is depressed, and a tension-spring engaging the lower part of the chain near the other roller, the foot and tension-spring taking up the slack produced by the depression of the lever.

10. A case for calculating-machines, having an opening for the admission of the operating-stylus, a guard-plate or deflector at one edge of said opening, which engages the stylus and deflects it outwardly so as to prevent injury to the parts back of the deflector.

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11. A calculating-machine comprising a series of numeral-wheels, an endless chain associated with each wheel and provided with projections which, when the chain is moved, engage the wheel so as to rotate it, pentagonal rollers over which the chain passes, a lever upon which the upper part of the chain is supported, said lever having two separated engaging faces which engage the chain, one at each side thereof.

12. The combination with a calculating-machine of a sliding guide-frame which may be extended beyond the edge of the machine so as to take in a specified length of a column of figures, and means for locking said guide-frame in any desired position.

13. A case for calculating-machines having an opening for the admission of the operating part, a guard-plate or limiting device near the end which limits the movement of the operating part, a name-plate back of said guard and a deflector associated with said guard which deflects the operating part as it is moved toward the end of the machine so as to prevent injury to the name-plate and associated parts.

14. A case for calculating-machines having

an opening for the admission of the operating-stylus, a limiting device which limits the movement of the stylus, said limiting device acting as a deflector to move the stylus outwardly during the remainder of its backward movement.

15. A calculating-machine comprising a series of endless chains, movable parts upon which said chains are supported so that they may be raised or depressed, and a locking device which engages said chains when in their normal position and prevents them from being moved when in said normal position.

16. A calculating-machine comprising a series of endless chains, movable parts upon which said chains are supported so that they may be raised, or depressed, a series of projecting parts on each chain, a locking device for preventing each chain from being moved when in its normal position and comprising an opening in which the said projections are received.

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Witnesses:

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HOMER L. KRAFT.