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G. W. DUDLEY.

COMBINED ADDING AND PRINTING MACHINE.

No. 554,993. Patented Feb. 18, 1896.

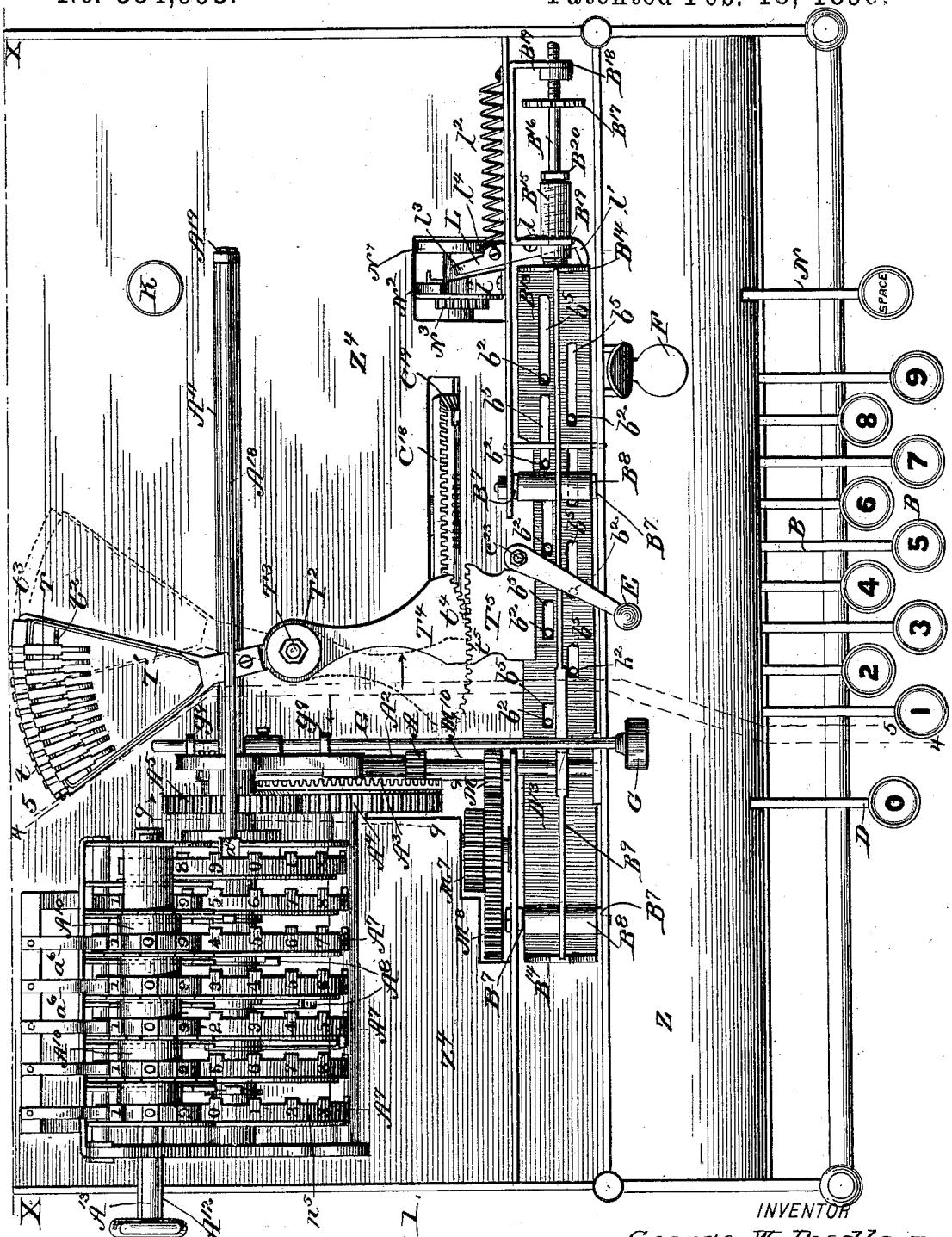

Fig. 1.

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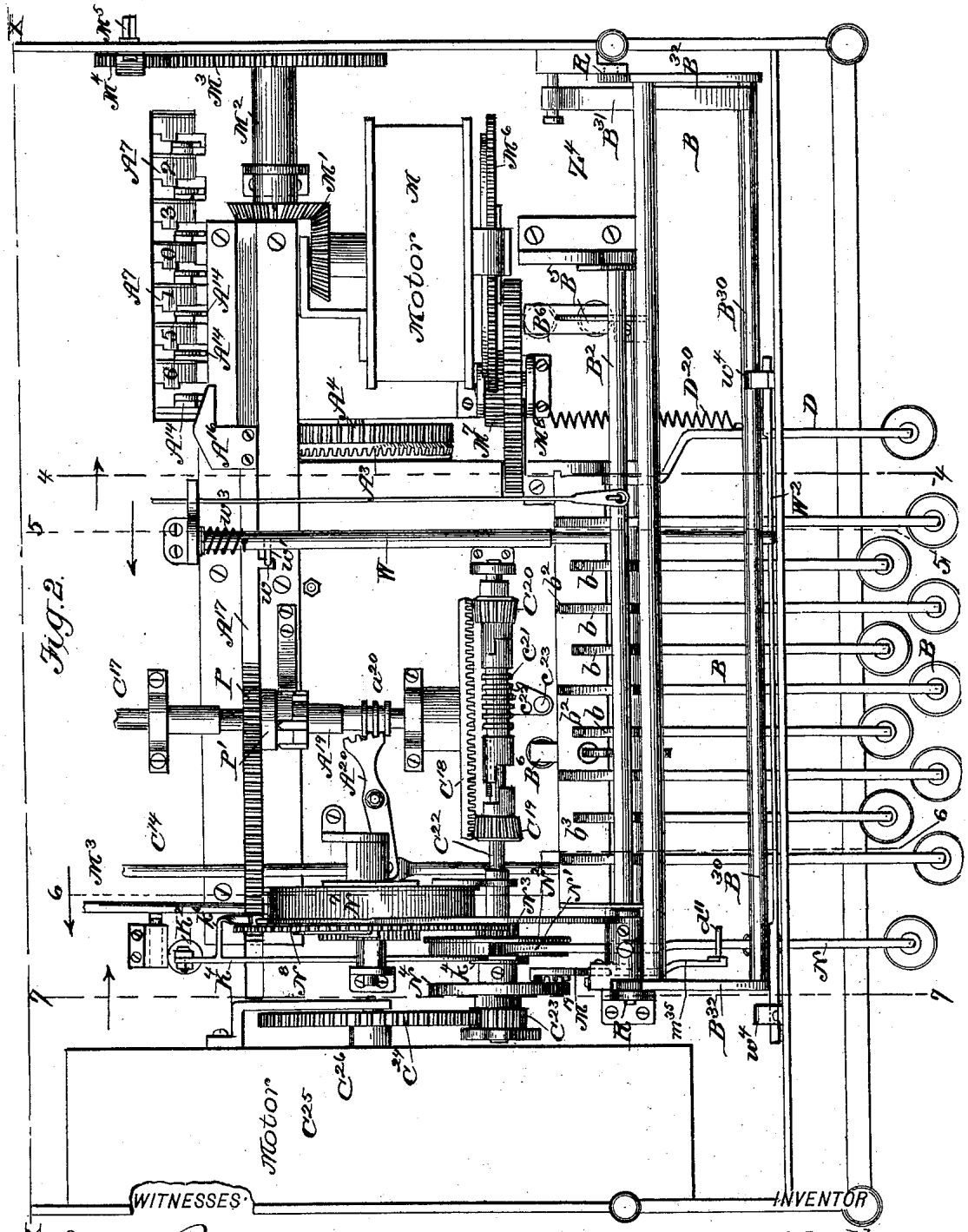

Fig. 2.

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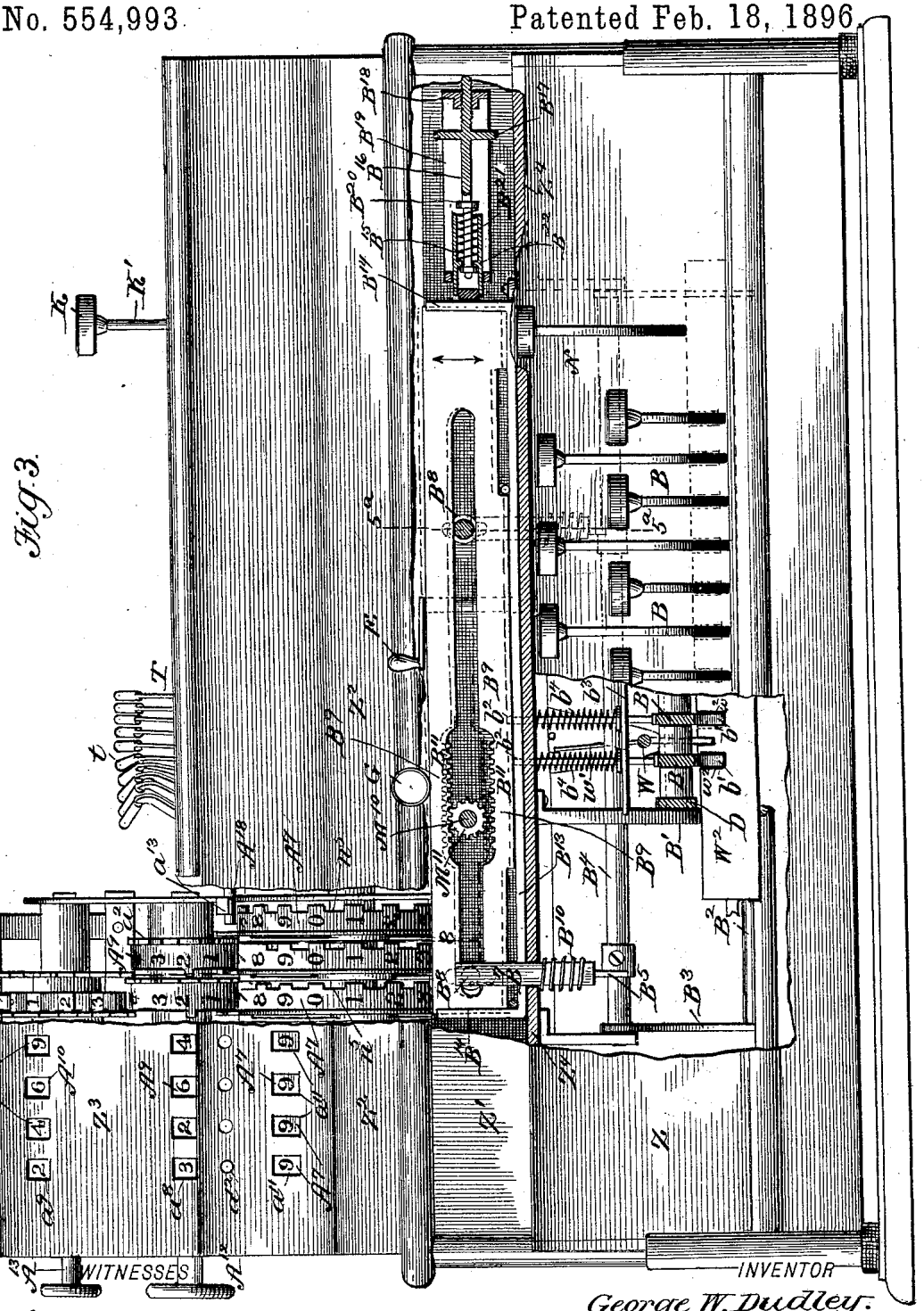

Fig. 3.

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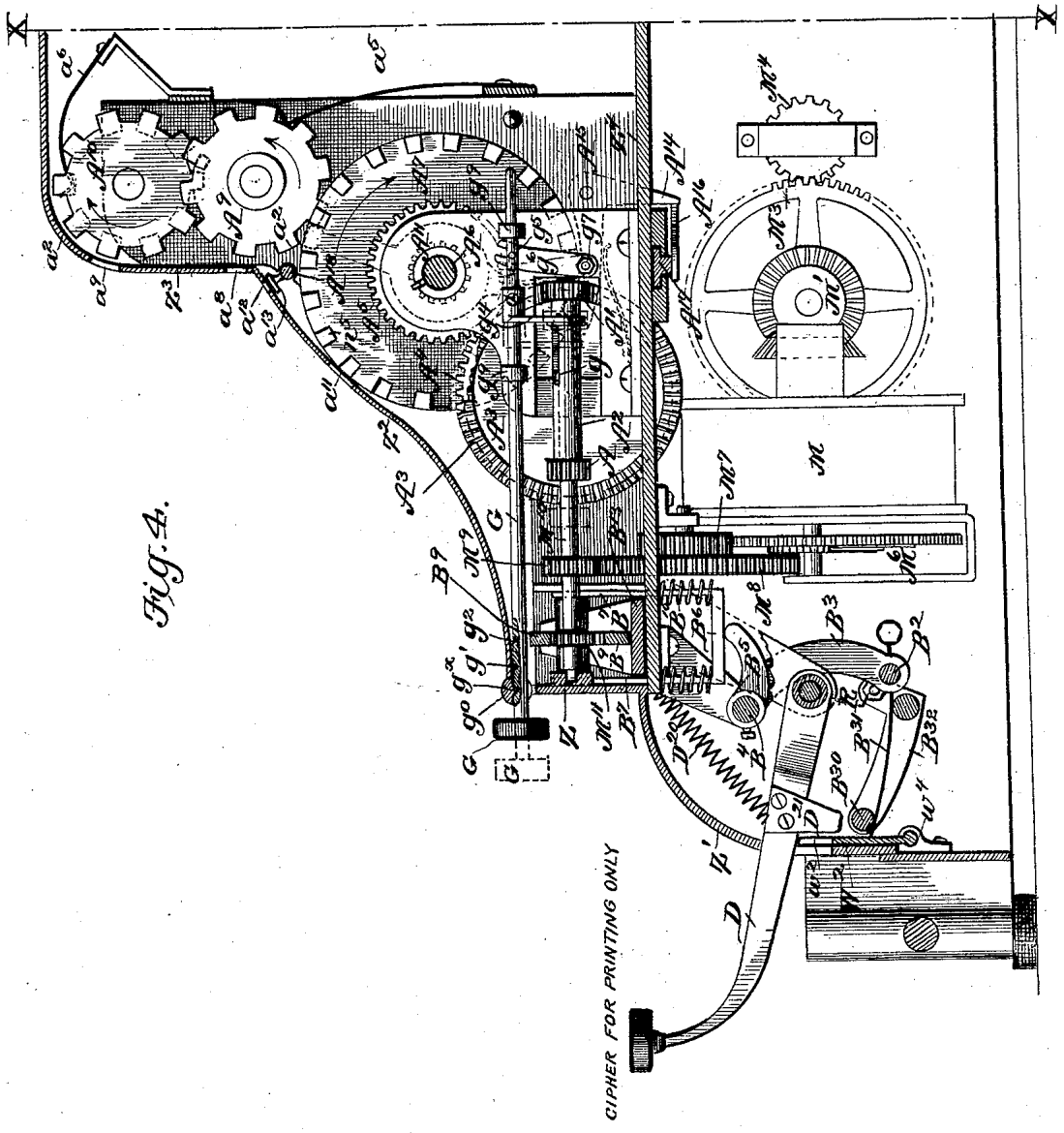

Fig. 4.

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Fig. 5a

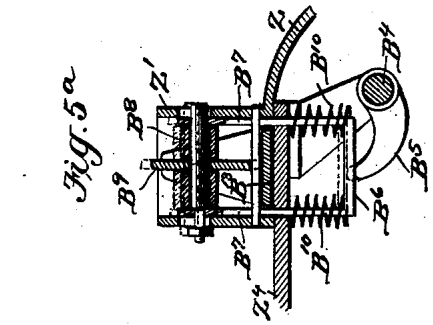

Fig. 5

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Fig. 6b

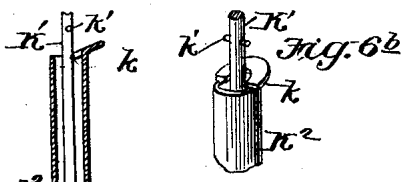


Fig. 6a

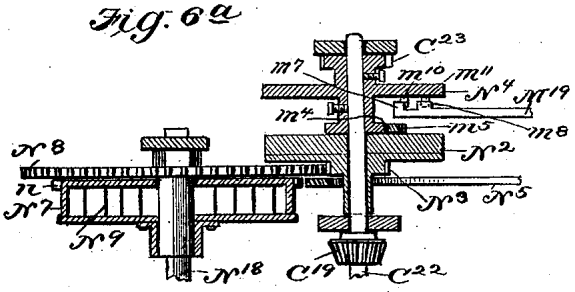


Fig. 6.

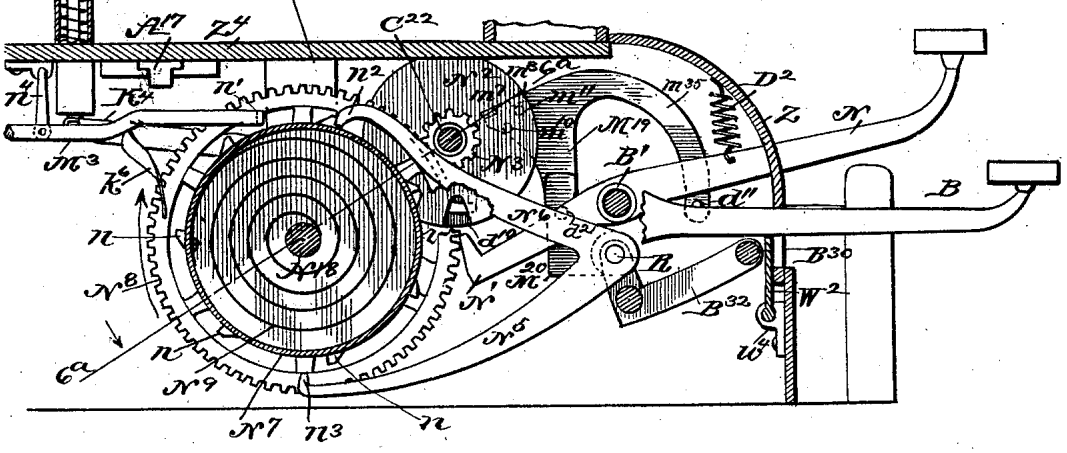
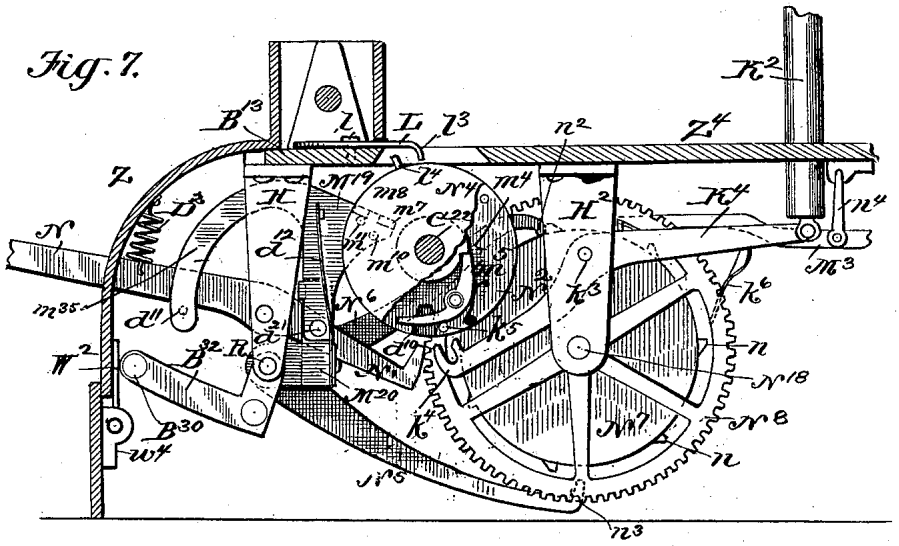


Fig. 7.



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COMBINED ADDING AND PRINTING MACHINE.

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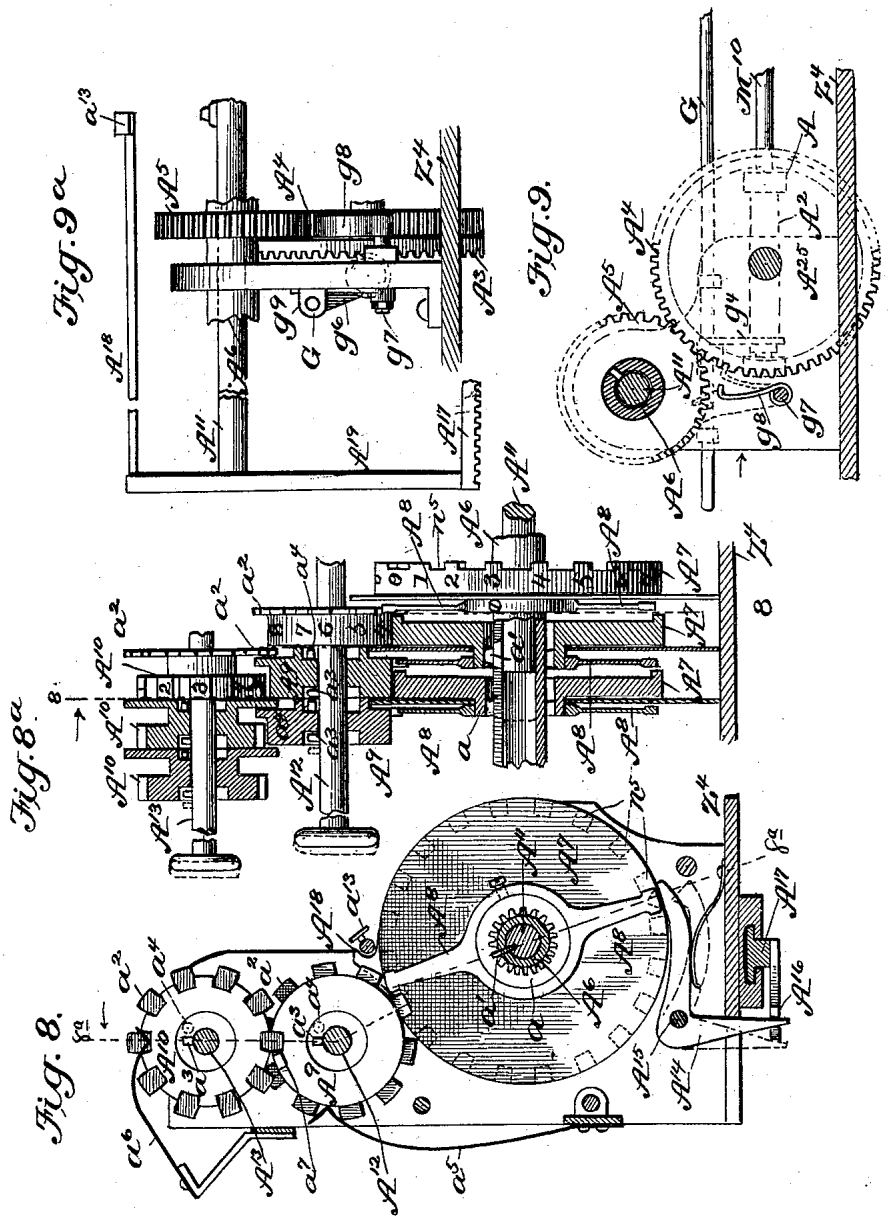

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UNITED STATES PATENT OFFICE.

GEORGE W. DUDLEY, OF CHARLESTON, WEST VIRGINIA, ASSIGNOR TO THE NUMEROGRAPH MANUFACTURING COMPANY, OF SAME PLACE.

COMBINED ADDING AND PRINTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 554,993, dated February 18, 1896.

Application filed September 9, 1895. Serial No. 561,949. (No model.)

To all whom it may concern:

Be it known that I, GEORGE W. DUDLEY, of Charleston, in the county of Kanawha and State of West Virginia, have invented a new and useful Improvement in a Combined Adding and Printing Machine, of which the following is a specification.

In an application for a patent filed by me January 7, 1895, Serial No. 534,106, for a combined adding and printing machine, I have shown and described an organization of devices whose object is to quickly and accurately add a column or columns of figures, and at the same time and by the same manipulation of the keys to print upon a sheet of paper these figures in the order in which they are added, so as to form a proof-sheet which shall verify the correctness of the addition, and which machine by special adjustments may be made to print at the bottom of the column the sum total of the column, and to do this work in a vertically-descending progression or vertically-ascending progression or in a horizontal progression.

My present invention, while combined with the principal features of that machine, comprises certain new features which I designate generally as follows: First, an improved mechanism for causing the keys representing the different digits to impart a variable throw to the adding-wheels and type-carrier; second, a means for dispensing with the strain on the machine of turning at one time a number of the adding-wheels, which becomes necessary in carrying from one denomination to the next, for which purpose I provide a set of supplementary receiving-wheels to which the numbers to be carried are delivered in a cumulative way until the addition is completed on the main wheels, after which these accumulated numbers on the supplementary receiving-wheels are added into the total by a subsequent adding operation; third, a novel organization of devices for spacing, adding and printing, or spacing without printing and printing without adding.

In connection with these general features of improvement other improvements of a minor character are also provided, which may be best understood hereinafter by reference to the drawings.

In the drawings hereto annexed, I have for the sake of avoiding complication and prolixity omitted such portions of the previous machine as remain unchanged and are preserved intact, only showing the new features and such portions of the old as are correlated to the said new features.

Figure 1 is a plan view of the front part of the machine with the inclosing case removed, the ribbon paper carrying and feeding devices, all of which lie back of the line X X, (see Figs. 1, 2, and 4,) being omitted, it being understood that the paper and printing-ribbon occupy the plane of the line X X. Fig. 2 is an inverted plan view showing all the parts of the machine lying in front of the same line X X. Fig. 3 is a front elevation of the machine with parts broken away and parts shown in section. Fig. 4 is a vertical section taken on line 4 4 of Figs. 1 and 2, looking in the direction of the arrow on said line. Fig. 5 is a vertical section taken on line 5 5 of Figs. 1 and 2, looking in the direction of the arrow on said line. Fig. 5^a is a sectional detail taken through line 5^a 5^a of Fig. 3. Fig. 6 is a vertical section of the escapement mechanism, taken on line 6 6 of Fig. 2 and looking in the direction of the arrow on this line. Fig. 6^a is a section through the escapement mechanism, taken on line 6^a 6^a of Fig. 6 and looking in the direction of the arrow on this line. Fig. 6^b is a detail in perspective of the top of the barrel K^2. Fig. 7 is a vertical section of the escapement mechanism, taken on the line 7 7 of Fig. 2 and looking in the direction of the arrow on this line. Fig. 8 is a vertical section through the adding-wheels, taken on line 8 8 of Figs. 3 and 8^a, looking in the direction of the arrow on said line. Fig. 8^a is a sctional edge view of the adding-wheels seen in Fig. 8 and shown partly in section on line 8^a 8^a of Fig. 8 and partly in side elevation. Fig. 9 is a sectional detail view of the means for locking the adding-wheels, taken on line 9 9, Fig. 1; and Fig. 9^a is a rear view of the same, looking in the direction of the arrow on Fig. 9.

I will first describe generally the external construction of the machine, and designate the location and functions of the several parts visible on the outside of the machine.

Z Z′ Z^2 Z^3, Figs. 1 and 3, are the four parts of the external case, which for convenience may be made in separate pieces.

B, D and N are the operating-keys. Of these keys the first one, D, on the left bears a cipher and is not connected with the adding mechanism, but only with the printing mechanism. The middle keys, B, are nine in number and bear on their faces the numerals 1 to 9, and all have the same action and connections, and all operate both upon the adding and printing devices when depressed. The key N on the extreme right is the spacing-key and has no connection with the adding-wheels, but only co-operates with the paper-feeding mechanism and has its own peculiar connections.

F is a tilting thumb-piece whose manipulation changes the direction of the feed of the paper-feeding devices from vertical to horizontal or vice versa.

E is a reversing-lever for reversing the feed of the printing devices and shifting backward or forward from one denomination of the adding-wheels to another.

G is a pull-rod which when in one position causes the adding-wheels to move forward to add, and when in another position causes the adding-wheels to move backward so as to subtract, and when in still another position throws out the adding devices altogether and allows the printing alone to be effected.

I will first describe the action of the keys in determining the extent of movement of the adding and printing mechanism.

Referring to Fig. 5 it will be seen that the number-keys B have horizontal shanks or levers, which are loosely hung upon an axial shaft B′ and extend through slots in the section Z of the outer casing. On the inner ends of each of these levers are formed two tappet-arms b and b'. Each tappet-arm b of each lever rests beneath and is arranged to lift a vertical stop-pin b^2. Each stop-pin slides through and is guided by a stationary horizontal plate b^3 and a deck-plate Z^4, the pins being forced downward normally by helical springs b^4 surrounding the pins and bearing at their upper ends against the deck-plate and at their lower ends against a collar or flange on the pin.

B^{13} (see Figs. 1, 3, 4, and 5) is a reciprocating gage-slide arranged horizontally on the deck Z^4, just behind the part Z′ of the casing. This gage-slide is provided with a series of nine longitudinal slots b^5, (see Fig. 1,) through which the stop-pins b^2 may be made to protrude by the lifting action of the tappet-arms b. This gage-slide serves by these slots to give a different throw for each key to the adding devices and printing devices, which throw is exactly commensurate with the value of the number represented on the key—that is to say, referring to Fig. 1, the length of the slot b^5 on the left is taken as the unit of throw and co-operates with key 1. The second slot b^5 is twice as long and co-operates with key 2. The third slot b^5 is three times as long as the first and co-operates with key 3, and so on throughout the nine slots b^5 and the nine keys. When any one key, therefore, is depressed, as that numbered 2, for instance, its stop-pin b^2 rises in the second slot b^5 of the reciprocating gage-bar B^{13}, and the latter has a longitudinal movement that is exactly commensurate with the number-value of that key, the pin b^2 stopping the sliding gage-bar B^{13} when the opposite end of slot b^5 reaches it.

The differential movement of the gage-bar is made the means of imparting a differential movement to both the adding and printing devices, as will be hereinafter described.

To explain how the gage-bar B^{13} moves I would state that it is under the direct influence of a spring-motor. This motor is shown at M in Fig. 2, and is wound up through a bevel-gear M′, shaft M^2, gear-wheel M^3, and pinion M^4 bearing a squared shaft M^5 projecting through the case to receive a winding-key. On the main shaft of the motor is a rigid gear-wheel M^6, which meshes with and transmits motion to a pinion M^7 which is fixed to the side of a gear-wheel M^8, (see Fig. 4,) which latter gear-wheel extends up through the deck Z^4 of the machine and (see Fig. 1) engages with a pinion M^9 rigidly fixed on a shaft M^{10}. This shaft M^{10} is the medium for transmitting the power of the motor to the adding devices, and the extent of this transmitted motion is determined through the gage-bar B^{13} with variable slots b^5, as follows:

On the front end of the shaft M^{10} is a rigid pinion M^{11} (see Figs. 3 and 4) which lies in the plane of a double rack-bar B^9. This rack-bar is slotted throughout its length, and its ends slide vertically in the upturned ends B^{11} B^{11} of the gage-slide B^{13}, but when moved longitudinally in a horizontal direction said rack-bar causes the gage-slide B^{13} to move with it, because the said rack-bar is held between the upturned ends B^{11} B^{11} of the gage-slide. When said rack-bar is adjusted to its lowest position, as shown in full lines in Fig. 3, the top section of the double rack-bar engages with the top of the pinion M^{11}, and when said rack-bar is adjusted to its upper position the bottom section of said rack-bar engages with the bottom side of said pinion. The pinion being strained in a given direction by the power of the motor to which it is geared it will be seen that when the rack-bar is down it, with the gage-slide B^{13}, is driven by the pinion in one direction, and when said rack-bar is up it is driven by the same pinion in the opposite direction, carrying the gage-slide B^{13} with it. To adjust this rack-bar up and down at each operation of a key, two short cross-bars B^8 B^8 (see Figs. 1, 3, 4, 5, and 5^a) pass through the slot at opposite ends of the rack-bar, and are connected at their opposite ends to the vertical bars B^7 B^7, which pass through the deck Z^4, and are connected at their lower ends by a cross-bar B^6. (See Figs. 3, 5, and 5^a). Helical springs B^{10} encircle the arms B^7, and by

pressing upwardly against the deck Z^4 force them downwardly and bring down the cross-bars B^8 B^8 and rack-bar B^9 and cause its upper teeth B^{11} to engage the top side of pinion M^{11}. To cause the lower rack-teeth B^{11} to engage the bottom side of the said pinion M^{11} the arms B^7 are lifted by tappet-arms B^5 rigidly fixed on a rock-shaft B^4, which has curved arms B^3 extending downwardly and connected at their lower ends by a horizontal shaft B^2, against which bear the tappet-arms b' of each of the key-levers B, as seen in Fig. 5. The operation of these devices is as follows: Whenever a key B is depressed, its downward movement causes its tappet-arm b to lift its particular stop-pin b^2 up through its particular slot b^5 in the gage-slide B^{13}. At the same time the tappet-arm b' of the said lever strikes against shaft B^2 and through curved arms B^3, rock-shaft B^4, and lift-arms B^5, vertical bars B^7, and cross-bars B^8 causes the rack-bar B^9 to be lifted, engaging its lower teeth B^{11} with the pinion M^{11}. The power of the motor is now free to turn the shaft M^{10} with the pinion M^{11} and propel the rack-bar and gage-bar to the left (in Fig. 1) a distance equal to the length of the slot through which the stop-pin of the particular key protruded. When the key is released and rises the springs B^{10} force down the vertical bars B^7 and by bringing the rack-bar down again re-engage its upper teeth with the pinion, and the latter being still under a rotary strain in the same direction, but being engaged by the rack-bar upon the opposite side, gives to the rack-bar and gage-slide B^{13} its return movement. Thus it will be seen that the stop-pins b^2 and slots b^5 of different lengths in the gage-slide furnish means for causing each key-lever to differentially limit the extent of rotation of the shaft M^{10}, which transmits the motive power to the adding mechanism. It must be understood, however, that one half of this extent of movement in shaft M^{10} is permitted by the forward movement of the gage-slide B^{13} and the other half by the backward movement of the gage-slide, and this enables me to make the slots b^5 only half as long as they would otherwise require to be.

When the gage-slide B^{13} returns to its normal position of rest its jar is cushioned (see Figs. 1 and 3) by a buffer consisting of a cylinder B^{15} sliding in a support B^{19} and having a cushion at one end. This cylinder has an internal flange B^{22}, which bears against a helical spring B^{21} wound about a stem B^{16} having a collar B^{20}. This stem has a rigid milled disk B^{17} by which it is rotated, and its end is screw-threaded and works through a stationary nut B^{18} in the support B^{19}. By turning the milled disk B^{17} with the fingers the stem B^{16} is advanced into the cylinder and the cylinder, through the spring, is adjusted to stop the gage-slide B^{13} sooner or later to properly adjust the stop-pins b^2 in the slots b^5 and the pinion M^{11} to the rack-teeth B^{11}.

I will now proceed to describe how the adding devices are constructed and rotated with a different throw from the motor through the shaft M^{10} as controlled by the keys B, as before described.

The motor M, Fig. 2, it will be remembered, transmits power through gear-wheels M^6 M^7 M^8 to the pinion M^9 on shaft M^{10}, which latter is allowed a different extent of rotation when each key is operated, corresponding in extent to the number represented by that key. This shaft M^{10} (see Figs. 1 and 4) transmits motion to the crown-wheel A^3 of the adding devices, either in a forward direction to add or in a backward direction to subtract, or may be disconnected wholly from the adding devices, as when it is desired only to print. These adjustments are effected through the pull-rod G, which has three notches $g^\times$ g' g^2 adapted to engage a tooth g^0 on the main frame to determine the positions of its adjustments. The pull-rod G slides in guides g^9 and carries an arm g^4 acting upon a sleeve A^2 to slide it back and forth on the shaft M^{10}. This sleeve slides longitudinally on said shaft, but rotates with it through a pin g (see Fig. 4) on the shaft, playing in a slot in the sleeve, and said sleeve bears at one end a rigid pinion A and at the other a rigid pinion A', one or the other of which may be engaged with the teeth of the crown-wheel A^3, or both be disconnected, according to the adjustment of the sleeve as effected through the pull-rod G. Thus when the pull-rod is forced all the way in, so that its outer notch, $g^\times$, engages the tooth g^0, the pinion A' engages the crown-wheel A^3 and turns the adding-wheels in one direction, and when the pull-rod is drawn out, so that its middle notch g' engages the tooth g^0, the pinion A engages the crown-wheel A^3 and turns the adding-wheels in the opposite direction, and when the pull-rod is drawn all the way out, as indicated in dotted lines in Fig. 4, both the pinions A and A' are out of engagement with the crown-wheel A^3, and the operation of the keys has no influence on the adding devices, but only works the printing mechanism, as hereinafter described. When the adding devices are thus disconnected from the operating devices said adding devices are locked against accidental displacement as follows: The crown-wheel A^3 is rigidly connected to a spur-wheel A^4 placed against its side on the same shaft A^{25} (see Figs. 1, 4, 9 and 9^a) and the spur-wheel A^4 transmits the adding or subtracting motion to a pinion A^5 on the shaft A^6 of the adding-wheels hereinafter described.

On the pull-rod G (see Fig. 4) is a pin g^5 which engages a slot in an arm g^6 rigid on a short rock-shaft g^7. (See Figs. 9 and 9^a.) This rock-shaft has upon its opposite end a hook-shaped detent g^8, which, when the pull-rod is drawn out and the adding devices disconnected, passes into engagement with the teeth of the spur-wheel A^4, as shown in dotted lines in Fig. 9, and locks the adding devices against displacement.

I will now proceed to describe the adding devices, referring more particularly to Figs. 1, 3, 4, 8, and 8^a. The entire operation of these devices is effected through the rotation of the shaft A^6, one portion of which is shown in Fig. 9^a with the gears connecting it to the motor and another portion of which is shown in Fig. 8^a in its relation to the adding-wheels A^7. This latter relation is substantially the same as that heretofore shown and described in my previous application referred to, and it consists of a hollow longitudinally-slotted shaft A^6 in which slides a rod A^{11} bearing a bit or tooth a' which engages the teeth of an internal gear a rigidly connected to each one of the adding-wheels A^7. These wheels are arranged in the order of units, tens, hundreds, &c., and have two series of numbers on their faces, each series running from 0 to 9, and each wheel "carries" at each half a rotation. These adding-wheels A^7 are all loose on the shaft A^6, except when individually coupled thereto for rigid rotation therewith, which is effected through the slide-rod A^{11}. Thus when slide-rod A^{11} is adjusted to cause its bit a' to lie in the plane of and lock into the internal gear-teeth a of any adding-wheel, that adding-wheel is rigidly locked to the shaft A^6 for rigid rotation thereby, because the bit a' passes through the slot in shaft A^6 and locks it to the said internal gear of that adding-wheel. This is the same mode of operation and substantially the same construction described in my previous case and forms no part of my present invention. I have found, however, that when one adding-wheel acts upon the next adding-wheel in carrying "tens" in accordance with the decimal system there are times when the motor has to move a number of these large adding-wheels at once, which involves a tax on the motive power that is liable to lead to imperfect and inaccurate work. I provide a means for overcoming this by dispensing with the carrying from one adding-wheel to the next, but carry from each adding-wheel to a corresponding supplementary receiving-wheel, which receiving-wheels store up the carried numbers, and when the addition is completed these stored-up carried numbers are added into the adding-wheels as a separate and subsequent operation. By this arrangement each adding-wheel is only required, in carrying, to turn its own receiving-wheels.

Referring to Figs. 8 and 8^a, A^{12} and A^{13} are two shafts arranged above and parallel to the shaft A^6 of the adding-wheels. These shafts bear each a series of wheels A^9 and A^{10} arranged side by side. They bear on their faces numbers 0 to 9, and have a flange a^2 with a corresponding number of notches, which notched flange lies in the plane of a diametrical bar A^8, which has a middle ring rigidly attached to the hub of each adding-wheel A^7. At each half-rotation of an adding-wheel A^7 this diametrical bar A^8 strikes a notch of the flange a^2 of the receiving-wheel A^9 and carries one to this receiving-wheel, causing it to move one notch. At each complete rotation of a wheel A^9 a lug a^7 on its side (see Fig. 8) strikes the notched flange of a companion wheel A^{10} above and turns it one notch, so that when the carried numbers exceed ten they will be accumulated and stored up on the wheels A^{10} of higher denomination above. The numbers of these two series of wheels A^9 and A^{10} appear through openings a^8 and a^9 in the case, as in Fig. 3, while the numbers of the main adding-wheels A^7 appear through lower openings a^{11}. To hold these receiving-wheels to the positions to which they are turned they have notched peripheries and spring-detents a^5 a^6 drop into the notches to determine and fix the limit of their movements.

After an addition has been performed and the numbers carried by the supplementary receiving-wheels A^9 and A^{10} have been added in, these wheels require to be set back to zero, and for this purpose their shafts A^{12} and A^{13} carry pins a^3, (see Fig. 8^a,) which ordinarily lie within recesses on the left side of the wheels A^9 and A^{10}. These wheels have also on their opposite sides pins a^4, and when the shafts A^{12} and A^{13} are pulled longitudinally to the left, as shown by dotted lines, their pins a^3 pass into range of engagement with the pins a^4 of the wheels, and by then rotating the shafts A^{12} and A^{13} the wheels A^9 and A^{10} may be restored to zero. These features, however, are not new and I make no claim to the same.

Referring now to Figs. 1, 8, and 8^a, whenever the bar A^{11} is adjusted to bring its bit a' into locking engagement with an adding-wheel A^7, an index-plate a^{13}, Figs. 1 and 3, is made to simultaneously appear through a hole a^{12}, Fig. 4, in the case to show in what order the adding is being done. This index-plate is on a rod A^{18}, (see Fig. 9^a,) just above the bar A^{11}, and connected to and operated simultaneously with it by a post A^{19}, Figs. 1 and 9^a, exactly in the manner described in my previous application. This post is attached to and moved by a rack-bar A^{17}, beneath the deck of the machine, as shown in Figs. 8, 9^a, 4, and 2. This rack-bar is also provided on its end with a double-inclined cam A^{16}, which acts upon an elbow-lever A^{14}, Figs. 2 and 8, fulcrumed on a horizontal shaft A^{15} and deflects it, as shown in dotted lines, to cause its other end to become disengaged from the notches n^5 in the side of the adding-wheels, so that the adding-wheel upon which the addition is being performed is free to be turned, while all the other adding-wheels are locked by their elbow-lever detents A^{14}. This mechanism is also substantially as shown and described in my previous application and need not be further described, except to say that this rack-bar A^{17} simultaneously moves rod A^{18} carrying the index-plate a^{13}, wheel-locking bar A^{11}, and detent-releasing cam A^{16}, while the rack-bar

itself (see Fig. 2) meshes with and is moved by a pinion P, clutch P′, shaft C^{17}, and reversible gear C^{18} C^{19} C^{20} on shaft C^{22} from a motor C^{25}, all as shown in my previous application.

In performing an addition of columns of figures, if a series of figures in a column aggregate less than one hundred the numbers to be carried will only turn the lower series of receiving-wheels A^9, but if the figures in a column to be added aggregate one hundred or more then the adding-wheel A^7 will turn its receiving-wheel A^9 to store up the carried tens and will also turn the receiving-wheel A^{10} (through lug a^7, Fig. 8) to store up the carried hundred or hundreds, so that in no case will any adding-wheel be required to move more than two other wheels, and generally where the column footed up is less than one hundred it will need to turn only one of the wheels A^9. After the addition of the columns is completed, then the figures showing through openings a^8, Fig. 3, are added into the adding-wheels A^7 by a manipulation of the keys, and so also with the numbers showing through the openings a^9, provided there be any showing. The numbers showing through these openings represent the carried numbers and are added each into its corresponding denomination-wheel below to indicate the grand total at the openings a^{11}. Thus for illustration, referring to Fig. 3, after the addition of the columns to be added has shown a total at openings a^{11}, as 9 9 9 9 9 9 9, and stored up carried numbers in tens show at a^8, as 3 2 6 4 2 2, the 2 is added to the 9 of the tens-adding wheel A^7 immediately below it, (by depressing key marked 2,) making 11, of which 1 is made to show on the tens-wheel A^7 through its opening a^{11} and 1 is carried to the next wheel A^9, making its figure 2 to be 3, and 3 is then added to the 9 of the "hundreds-wheel" A^7 immediately below it, (by depressing key marked 3,) making 12, of which 2 is made to show on the hundreds-wheel A^7 and 1 is carried to the next wheel A^9, making its figure 4 to be 5. This figure 5 is then added to the 9 of the "thousands-wheel" A^7 immediately below it, (by depressing key marked 5,) making 14, of which the 4 is made to show on this thousands-wheel A^7 and the 1 is carried to the next wheel A^9, making its figure 6 to be 7, which in turn is added to the "tens-of-thousands-wheel" A^7 below, and so on. In this operation it is to be understood that the locking-lug a' is always adjusted into the plane of the adding-wheels A^7, to which the carried number is to be added. In the same way the numbers showing at a^9 on the "carried-hundreds wheels" A^{10} (if any exist) are added to the adding-wheels A^7 immediately below them of the proper order, until the carried numbers are all added in to complete the total.

I have already described how the movement of each key controls the throw of the adding-wheels through the gage-bar B^{13}, the stop-pins b^2 and slots b^5 of varying length, as shown in Figs. 1 and 5. These same devices control the throw of the printing-type levers and their carrier, which I will now proceed to describe, referring more especially to Figs. 1 and 5.

T, Figs. 1, 3 and 5, are the type-levers, which are shaped like the letter **Z** with a printing-type t at the upper end and an impact-arm t' at its lower end. These levers are fulcrumed upon a curved bar t^3 on the outer end of a segmental type-carrier T′. This carrier has a rest-bar t^2 against which all the type-levers are supported, and against which they fall back after having delivered a printing-blow. The segmental type-carrier T′ is formed on the upper end of a hollow sleeve T^2 turning upon a vertical post T^3 mounted upon the deck Z^4. The lower end of this sleeve is provided with a rigid arm T^4 having a toothed segment t^4 that is engaged by a corresponding toothed segment t^5 on an offsetting-plate T^5 rigidly fixed to the reciprocating gage-bar B^{13}, so that when this gage-bar, under the influence of the motor M and controlled by the keys, reciprocates its segmental plate T^5 acting through the segmental gear t^4 t^5 on the arm T^4 and the plate T^5 gives to the type-lever carrier T′ a throw that is exactly commensurate with the movement of the gage-bar as controlled by the slots b^5, and this throw of the type-carrier T′ in a horizontal plane brings the proper one of the type-levers to the printing position. For instance, if key No. 5 be depressed it not only moves the adding-wheels five notches, but it also swings the type-carrier T′ to a position that brings the type-lever T, bearing figure 5, to the printing position. When so brought to a position an impact-bar M (see Fig. 5) suddenly rises and striking the arm t' of that type-lever throws it forward against the type-ribbon R to print, as shown in dotted lines. The means for operating this impact-bar are the same as those shown in my previous patent and need not be here described, as they have nothing to do with my present improvements.

I will now proceed to describe how the keys operate upon the printing mechanism to do the printing and effect the feeding or spacing. This is accomplished through the agency of the spring-motor C^{25}, (see Fig. 2,) whose power is controlled and expended intermittently through an escapement mechanism and is transmitted through a reciprocating rod M^3 to the impact-bar M, Fig. 5, through the crank M^2, rock-shaft M′ and crank o^4, just as in my former case, and through the rotary shaft C^{17} to the paper-feeding devices, just as shown in my former case. The escapement mechanism itself is, however, entirely different and I will now proceed to describe this, referring more especially to Figs. 2, 6^a and 7.

Refering to Fig. 2, the shaft C^{26} of motor C^{25} is provided with a rigid gear-wheel C^{24}, which turns pinion C^{23} rigid on the shaft C^{22}. This pinion is rigidly formed with a disk N^4, Fig. 6^a, which has a sleeve on its side (oppo-

site the pinion) bearing a single ratchet-tooth m^4. (See Figs. 6ª and 7.) This ratchet-tooth engages a pawl m^5 fulcrumed on a loose disk N^2, (see Fig. 7,) the end of said pawl lying across a notch d^{10} in the periphery of a disk N^2, which turns loosely on shaft C^{22} except when pawl m^5 engages ratchet-tooth m^4, at which time the disk N^2 is geared rigidly to shaft C^{22} through the rigid disk N^4 and pinion C^{23}.

On the side of the disk N^2 there is formed a pinion N^3, Figs. 6 and 6ª, which engages with a gear-wheel N^8 rigid on a countershaft N^{18}. Beside this gear-wheel is a hollow casing N^7, (see Fig. 6ª,) containing a coil-spring N^9, the inner end of which is connected to the shaft N^{18} and the other end of which is connected to the hollow casing N^7. This hollow casing has on its outer periphery a series of separated or spaced teeth n which catch against a lug n' on the end of the horizontal reciprocating rod M^3 and move it to the right. This is the same rod which operates the impact-bar M, Fig. 5, as described in my previous case, and when this bar M^3 is drawn toward the right in Fig. 6 by a tooth n a link n^4, pivoted to the bottom of the deck Z^4 and also to rod M^3, lifts the lug n' at the end of the movement off of the tooth n, and a spring (not shown in this case but shown in my previous case) draws the rod M^3 to the left again.

The hollow casing N^7 moves intermittently a space equal to the distance between the teeth n, and its actuating power is that of the motor C^{25}, Fig. 2, whose energy is stored up in the coil-spring N^9 and intermittently allowed to assert itself on the rod M^3 by an escapement set into action by the keys, as follows:

B, Fig. 6, is one of the key-levers which, when depressed, strikes a depressible yoke-frame composed of horizontal bar B^{30} and arms B^{32}, rigidly fixed to the rock-shaft R, which also has attached to it two pallet-arms N^5 N^6 (see Figs. 5, 6, and 7) also rigidly attached to said rock-shaft R and depressible frame B^{32} B^{30}. These pallet-arms N^5 N^6 have engaging-spurs n^2 n^3, and when the pallet-arms move downwardly the upper one, n^2, engages a tooth n, and the lower one, n^3, passes out of engagement of said teeth, and vice versa, to constitute an intermittent escapement for the hollow casing N^7. There is also rigidly attached to the rock-shaft R another escapement consisting of a rigid arm M^{19}, which has two lugs m^7 m^8 adapted to stop alternately against two pins m^{10} m^{11} on the side of the disk N^4—that is to say, normally pin m^{11} rests against lug m^8, but when arm M^{19} moves outwardly in obedience to the depression of a key B lug m^8 is taken away from pin m^{11} and the latter passes between the lugs, while lug m^7 is brought into range of pin m^{10} and still holds the disk; but when arm M^{19} moves inwardly again pin m^{10} passes also between the lugs, and the disk N^2 being then unrestrained turns a complete rotation, rotating (through its pinion N^3) the gear-wheel N^8 and winding up the rigidly-attached shaft N^{18} and coil-spring N^9. It will therefore be seen that the effect of the depression of a key B is (see Figs. 6 and 6ª) to release disk N^4 and allow the power of the motor C^{25} through pinion C^{23} to turn disk N^4 and shaft C^{22} one rotation, and also to wind up through pinion N^3 and gear N^8 the spring N^9, and also further through the double-armed pallet N^5 N^6 to allow the stored-up energy in spring N^9 to be expended to give an impulse on the rod M^3 that operates the impact-bar M and causes it to lift and operate a printing-type, as heretofore described.

The above-described action takes place whenever a key B is depressed to operate both the printing and adding mechanism.

It is sometimes necessary, however, to space without adding or printing. To do this I provide a special spacing-key N. This does not act on the depression-frame B^{32} B^{30} at all, but is held up by a spring D^2, and when depressed acts upon a pin d^{11} on a curved extension m^{35} of the arm M^{19}. This arm M^{19} is articulated at d^{21} to the arm M^{20}, which is rigid on shaft R, and a spring d^{12}, Fig. 7, holds the two arms M^{19} M^{20} together as one except when the space-key N is depressed. When this occurs, the toothed inner end N′ of this space-key enters the notch d^{10} in disk N^2, and striking against pawl-lever m^5 removes its end from the ratchet-tooth m^4. At the same time the space-key N strikes the pin d^{11}, and pulling back arm M^{19} about its center d^{21} allows the following action to take place: First, it unlocks disk N^4 from disk N^2 by deflecting pawl m^5, thereby leaving the train of mechanism N^2 N^3 N^8 N^7 stationary, while the power of the motor acting on shaft C^{22} is intermittently expended through escapement M^{19} m^7 m^8 m^{10} m^{11} to turn shaft C^{22} alone, and through the gears C^{18} C^{19} C^{20}, Fig. 2, to turn shaft C^{17} and space or feed the paper of the printing mechanism, as described in my previous case.

It is necessary at times to operate the adding mechanism without operating the printing mechanism—as, for instance, when the carried numbers which are temporarily stored up on the supplementary receiving-wheels are to be added into the sum total—and I will now describe how this is effected.

K, Figs. 1 and 3, is a vertically-adjustable key which when pulled up is negative in effect, but when forced down locks the printing mechanism and allows the adding alone to proceed from the operation of the keys B. This adjustable sliding key K (see Figs. 3, 6, and 7) has a stem K′ that descends through an upright barrel K^2, which barrel is mounted in the deck Z^4, and said key-stem at its lower end is jointed to a lever K^4, fulcrumed at k^3 in a hanger H^2, and having a forked end k^4 projecting laterally. Ordinarily the stem K′ is held up by a helical spring K^3 within the barrel K^2, which spring bears against a collar k^2 on the stem, but when the stem is forced

down against the tension of said spring pins k' on the stem K' are caught beneath a stationary catch k (see Fig. 6) on top of the barrel, and said stem is so held depressed as long as may be desired. When so depressed, (see Fig. 7,) it forces down lever K^4, and its forked end k^4 grasps and holds a pin k^5 on the disk N^2, and at the same time throws lever-pawl m^5 out of engagement with tooth m^4. This action makes disk N^2 loose on shaft C^{22}, and while locking it against turning permits shaft C^{22} under the influence of the motor to be turned to operate the adding devices, the escapement M^{19} m^{10} m^{11} being operated to space in the adding-wheels by the working of the depression-frame B^{32} B^{30}, which latter through its shaft R is rigidly connected with escapement-arm M^{20}, carrying escapement M^{19} m^{10} m^{11}. When this action takes place, the depression of lever K^4 is made to hold the hollow disk N^7, so that the pallet-detents n^2 n^3 do not lose their position against the teeth n, and for this purpose a temporary restraining-detent k^6 is attached to lever K^4, (see Figs. 2, 6, and 7,) and when the lever K^4 descends this detent k^6 engages one of the teeth n, and forcing back slightly the disk N^7 allows the pallet-detents n^2 n^3 when rocked away from their hold on teeth n (by the rocking of shaft R) to regain their hold on the same tooth.

It will be remembered that the adding-wheels are rotated one half the way by the advance of the gage-slide B^{13} and the other half of the way by the return of the gage-slide, and in spacing horizontally in adding it is obvious that the spacing must not take place at any time during the advance or return movement of the gage-slide. I make the spacing through the devices hereinbefore described to take place just at the end of the return stroke of the gage-slide and provide means for holding the spacing devices until said gage-slide has completed its return stroke as follows:

Referring to Figs. 1 and 7, L is a lever arranged horizontally on the deck Z^4 and fulcrumed at l. This lever has on one end a toe l', that is adapted to be struck by the return movement of the gage-slide arm B^{14} and deflected as shown in Fig. 1. A helical spring l^2 serves to pull the lever in the other direction. When this lever is occupying a position at right angles to the gage-slide, as it does when the gage-slide is performing its stroke, a hook l^3 (see Fig. 7) on the end of this lever will lie in the plane of the escapement-disk N^4, and will catch against a pin l^4 on the periphery of this disk and hold it against rotating; but when the gage-slide B^{13} has about completed its stroke, just before it stops it strikes against the toe l' of lever L and deflecting the latter removes its hook l^3 (see Figs. 1 and 7) from the plane of escapement-disk N^4 and allows the spacing then to take place without interfering with the other devices. Beside the lever L is arranged a spring-detent l^5, which engages with a notch on the disk N^2 and prevents it from moving backward.

D, Figs. 1, 2, 3, and 4, is the cipher-key. This is held up by a spring D^{20} and has a projection D^{21}, which when the key is depressed strikes the bar B^{30} of the depression-frame and deflects the latter against the tension of its spring B^{31}. This key does not affect the adding devices at all, but only operates the impact-bar M of the printing devices against the first type-lever T, which is a cipher, and for which the carrier T' does not need to be moved, as this first (or cipher) type stands normally in the printing position.

In performing additions it is desirable to have some means for locking the keys at the end of an operation, so that in case the operator is momentarily called away, there can be no possibility of any meddling person operating a key and thereby falsifying the addition. To provide against this disastrous contingency, I arrange a locking device which locks all the keys whenever the index-plate a^{13} is carried back to the zero-point or place of beginning. This index-plate it will be remembered is connected through its rod A^{18} and post A^{19}, Fig. 1, with the rack-bar A^{17}, carrying the cam A^{16}, which acts upon the adding-wheels A^7. This rack-bar A^{17}, I provide with a lug w, (see Figs. 2 and 5,) which is adapted to strike an arm w' on a rock-shaft W, journaled in bearings underneath the deck Z^4, parallel with the key-levers. This shaft is turned in one direction by a spring w^3 at its back end and at its front end has a radial arm W', (see Fig. 5,) that enters a notch in a sliding locking-bar W^2, which moves on guides w^4 parallel with and immediately behind the front part of the machine. This locking-bar has in its upper edge (see Fig. 3) slots w^2, which normally lie immediately beneath the key-levers, so that when the latter are depressed they can enter said slots and make their complete stroke, but when the locking-bar W^2 is slid lengthwise these slots pass out of coincidence with the key-levers and lock the latter so that they cannot be depressed. This sliding locking-bar is actuated by the arm W' of the rock-shaft W which is held in the normal position of use by the spring w^3, but when the rack-bar A^{17} is moved back to the point of beginning, where its cam A^{16} does not act upon any of the detents of the adding-wheels, then lug w, (see Figs. 2 and 5,) acting upon arm w' of rock-shaft W, turns the latter against the tension of its spring and through its arm W' at the front slides the locking-bar W^2 to its locking position where it remains until the cam A^{16} on the rack-bar is advanced to its co-operation with the units-wheel of the series of adding-wheels A^7 preparatory to adding again.

In defining my invention with greater clearness I would state that I am aware that a slotted gage-bar having slots of different lengths corresponding to the different values of the different keys has heretofore been em-

ployed in connection with stops protruding through these slots and acting as cams to positively and directly actuate the gage-bar with a definite throw, and I make no claim to this. In my invention relatively heavy adding-wheels and printing devices are to be actuated, and it is necessary to employ a motor in contradistinction to utilizing the direct action of the key-levers, and my slotted gage-bar in this combination only acts as an escapement to regulate the intermittent expenditure of power from the motor to the adding-wheels.

I am also aware that a locking-bar for locking the key-levers against accidental movement is not new; and I only claim in this connection the special construction and arrangement of parts whereby the key-levers are automatically locked when the adding devices are brought back to the starting-point.

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

1. In a key-operated adding-machine, the combination of the adding-wheels and a motor for actuating them; a set of key-levers, a set of stop-pins operated upon by the key-levers, a reciprocating gage-slide having slots of different lengths corresponding to the size of the digits and adapted to be penetrated by the stop-pins and a gearing connecting this reciprocating gage-slide to the train of gears between the motor and adding-wheels to differentially limit the extent of rotation of the motor-gears in their action upon the adding-wheels substantially as and for the purpose described.

2. In a key-operated adding-machine, the combination with the adding-wheels, a motor for actuating them, and a set of key-levers; of a throw-regulating device consisting of a reciprocating gage-bar having a range of movement equal to one-half of each complete advance movement of the adding-wheels and geared to permit movement of the adding devices both on the advance and return stroke of the gage-slide substantially as and for the purpose described.

3. In a key-operated adding-machine the combination with the adding-wheels a motor for actuating them, and a set of key-levers of a throw-regulating device for the motor consisting of a reciprocating gage-bar having slots of varying length corresponding to the size of the digits, a set of stop-pins adapted to be protruded through said slots by the key-levers, said gage-slide being geared to the actuating-motor and arranged to allow it to positively expend its power in the same direction upon the adding-wheels both on the forward and backward movement of the gage-slide substantially as and for the purpose described.

4. The combination with the reciprocating gage-slide, having slots of different length, stop-pins penetrating said slots and key-levers operating the pin; of means for reciprocating the gage-slide consisting of a horizontal double rack-bar having means for giving an up-and-down adjustment a pinion arranged in said rack-bar to engage alternately with opposite sides thereof and a shaft carrying said pinion and geared to the motor substantially as and for the purpose described.

5. The combination of the reciprocating gage-slide having slots of different lengths, stop-pins penetrating said slots, a horizontal double rack-bar having an up-and-down movement in the gage-bar a pinion arranged on the rack-bar and geared to the motor, a rocking frame with lift-arms and means for connecting with the rack-bar for giving its up-and-down movement, and key-levers having each two tappet-arms one engaging with the stop-pins and the other with the rocking frame and rack-adjusting mechanism substantially as and for the purpose described.

6. The rack-bar-adjusting mechanism consisting of the combination with the key-levers having tappet-arm b'; of the rocking frame B^2 B^3 B^4 having lift-arms B^5, the yoke-frame B^6 B^7 B^8 with springs B^{10} connected to the rack-bar substantially as and for the purpose described.

7. In an adding or printing machine having a reciprocating gage-slide of variable throw, the combination with the reciprocating gage-slide of an adjustable bumper adapted to limit the return stroke of the slide and adjust it in relation to its co-operating parts substantially as shown and described.

8. In an adding or printing machine having a reciprocating gage-slide, of variable throw, the combination with said slide of a bumper consisting of a cylinder having an internal flange B^{22} and a cushion at its end, a screw-stem B^{16} with collar B^{20} and milled disk B^{17}, a helical spring arranged in the cylinder between the flange B^{22} and the collar B^{20} of the stem and a supporting-frame embracing the cylinder at one end and having a screw-threaded nut B^{18} at the other end engaging with the threaded stem substantially as and for the purpose described.

9. The combination with the oscillating type-carrier and the adding devices; of a motor for actuating both, a gage-slide having slots of different lengths in the same, gearing for connecting the motor to the gage-slide, gearing for connecting the type-carrier to the gage-slide, stop-pins adapted to penetrate the slots in the gage-slide, and key-levers for operating said stop-pins substantially as and for the purpose described.

10. The combination of the Z-shaped type-levers T, the type-carrier T' with curved axial shaft t^3 and rest t^2, the sleeve T^2 secured at its upper end to the type-carrier and having an arm T^4 with segment-teeth t^1 at its lower end, an axial post T^3, and the gage-slide B^{13} having attached to it an arm T^5 with segment-teeth t^5 arranged to mesh with and oscillate the arm of the type-carrier substantially as and for the purpose described.

11. In an adding-machine, the combination of the adding devices comprising a series of wheels of different denominations, the adding-key levers, a locking-bar for the same, a shifting device moving from one adding-wheel to another automatic mechanism connected to the shifting devices and also to the locking-bar and arranged to adjust the latter to its locking position when the adding devices are moved back to the starting-point substantially as and for the purpose described.

12. The combination with the adding-key levers B; of the sliding and slotted locking-bar W^2 arranged beneath the levers, the rock-shaft W having arm W′ at its front end engaging the locking-bar and arm w' at its back end, a spring for rocking said shaft in one direction, and the rack-bar A^{17} with lug w for acting upon the arm w' of the rock-shaft and moving it in the other direction, said rack-bar being connected to the adding devices substantially as shown and described.

13. In an adding-machine, the combination of the adding-wheels representing units, tens, hundreds, &c., disconnected from each other by any carrying mechanism; a motor with connecting mechanism extending to and operating the adding-wheels; a throw-limiting mechanism connected with the motor, keys, and adding-wheels; numbered keys controlling the throw-regulating mechanism to regulate the throw as effected by the motor; a separate set of supplementary receiving-wheels for storing up the carried numbers from each adding-wheel, and carrying devices for connecting the adding-wheels to their respective carrying-wheels, whereby the carried numbers are separately registered on the said receiving-wheels, and the motor is relieved from the excessive and variable strain of causing one adding-wheel to turn a portion or all of the other adding-wheels, substantially as described.

14. The combination of the adding-wheels A^7 having two series of figures on their peripheries, the wheels being disconnected from each other by any carrying mechanism and having each a projecting hub; a rigid diametrical bar A^8 having a middle ring embracing the wheel-hub and rigidly attached to it; the separate set of receiving-wheels A^9 arranged on a separate axis beside the adding-wheels and having notched flanges a^2 operated upon by the bar A^8; and means for setting the wheels A^9 back to zero substantially as and for the purpose described.

15. The combination of the adding-wheels A^7 having rigid diametrical bar A^8, the separate set of receiving-wheels A^9 having notched flanges a^2 operated upon by the bar A^8 and also a lug a^7 on its side and a second series of receiving-wheels A^{10} of higher denomination, and means for setting these receiving-wheels to zero substantially as and for the purpose described.

16. The adjusting mechanism for adding, subtracting, or throwing out of gear these devices consisting of the pull-rod G with arm g^4, slotted sleeve A^2 with pinions A and A′, actuating-shaft M^{10} having a slot-and-key connection with the sleeve, the crown-wheel A^3 and spur-wheel A^4 connected with the adding-wheels, and the motor for rotating shaft M^{10} substantially as and for the purpose described.

17. The means for locking the adding-wheels consisting of the combination with pull-rod G having pin g'; of a slotted arm g^6, rock-shaft g^7 rigidly attached to said arm and bearing a pawl g^8 adapted to engage one of the gear-wheels in the adding-train substantially as and for the purpose described.

18. The escapement mechanism for delivering the power of the motor intermittently to the printing and paper-feeding devices, consisting of the rocking depressible frame B^{30} B^{32} R acted on by the keys and carrying rigid pallet-arms N^5 N^6, the counter-shaft N^{18} with loose hollow disk N^7 having teeth n and a coil-spring N^9 connecting the disks to the shaft, gear-wheel N^8 rigidly fixed on the counter-shaft, the motor-shaft C^{22} with rigid disk N^4 having pins m^{10} m^{11}, loose disk N^2 detachably locked to disk N^4 and the escapement-arm M^{19} carried by the rocking frame B^{30} B^{32} R, substantially as and for the purpose described.

19. The combination with the escapement mechanism described having rigid disk N^4 with pins m^{10} m^{11} and ratchet-tooth m^4, the loose disk N^2 having notch d^{10} and detent-lever m^5, the articulated escapement-arm M^{19} with lugs m^7 m^8 and arm m^{35} having pin d^{11}, and the spacing-lever N with toothed end N′ adapted to act on pin d^{11} and also enter the notch d^{10} and disengage the lever-pawl m^5 substantially as and for the purpose described.

20. The combination of the hollow disk N^7 with teeth n spring N^9 and gear N^8 the rocking frame B^{30} B^{32} R with rigid pallet-arms N^5 N^6, the disk N^2 with notch d^{10}, lever-pawl m^5 and pin k^5, the lever K^4 with forked end k^4, the spring-actuated stem K′ jointed thereto and the pawl k^6 mounted on the lever K^4 and adapted to engage and temporarily hold the teeth n substantially as and for the purpose described.

21. The combination with the impact-bar of the printing devices; of the actuating-bar M^3 having lug n', and a suspending hanger-link n^4 and the escapement-disk N^7 with teeth n adapted to catch against lug n' and pull back bar M^3 and then allow the latter to automatically disengage itself substantially as shown and described.

22. The combination with the reciprocating gage-slide B^{13} operating to move the adding devices by both its forward and backward movements; of a spacing mechanism, a lever-detent for holding it against spacing, said detent being arranged at the end of the return stroke of the gage-slide to be operated thereby and release the spacing devices after the

throw of the adding devices substantially as and for the purpose described.

23. The combination with the reciprocating gage-slide B^{13}, operating to move the adding devices by both its forward and backward movements, a spacing mechanism as described consisting of an intermittently-acting escapement with pin l^4, a detent-lever L for holding said pin, said lever being arranged at the end of the return stroke of the gage-slide and operated by it in one direction, and having a spring l^2 for operating it in the other direction substantially as and for the purpose described.

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