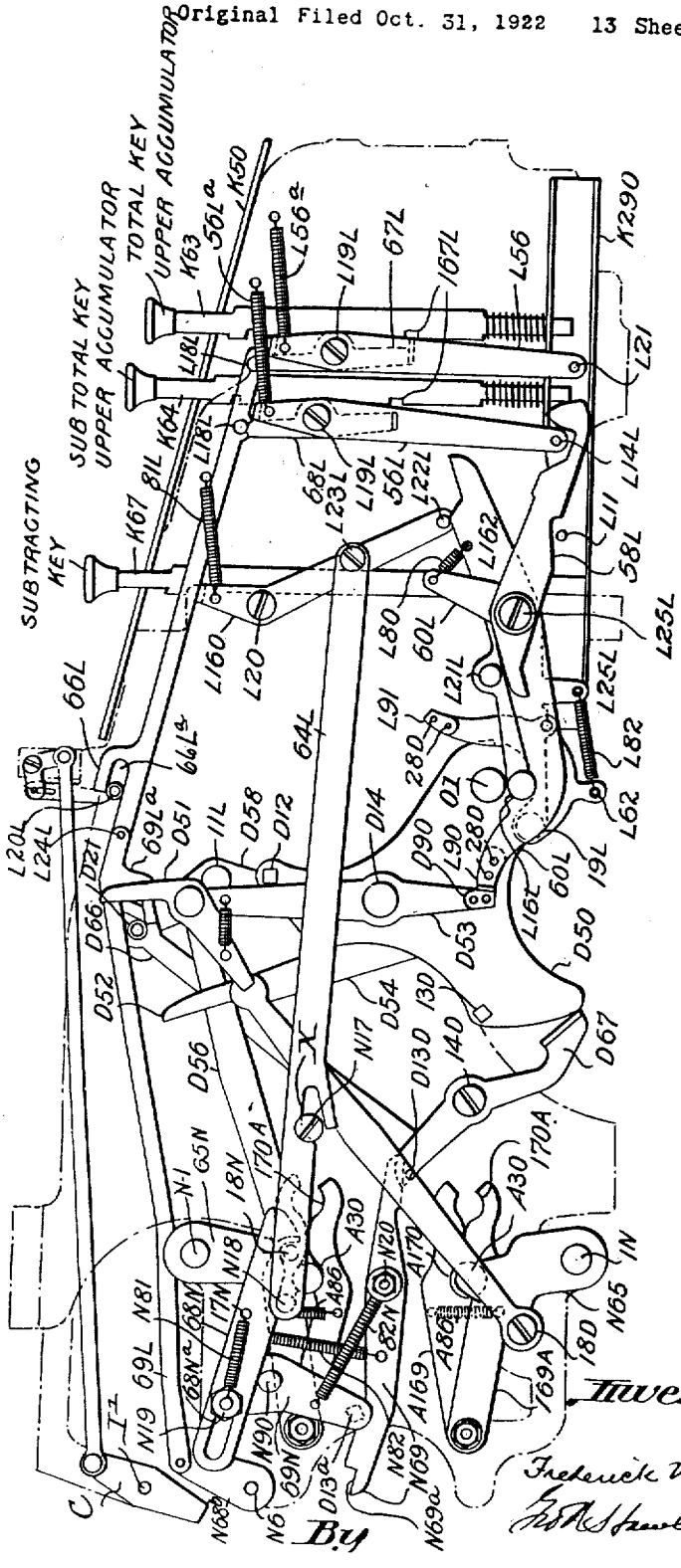
Sept. 9, 1924. 1,508,267

F. W. BERNAU

OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

Original Filed Oct. 31, 1922 13 Sheets-Sheet 1

Fig. 1.



Inventor;
Frederick W. Bernau
By
Attys.

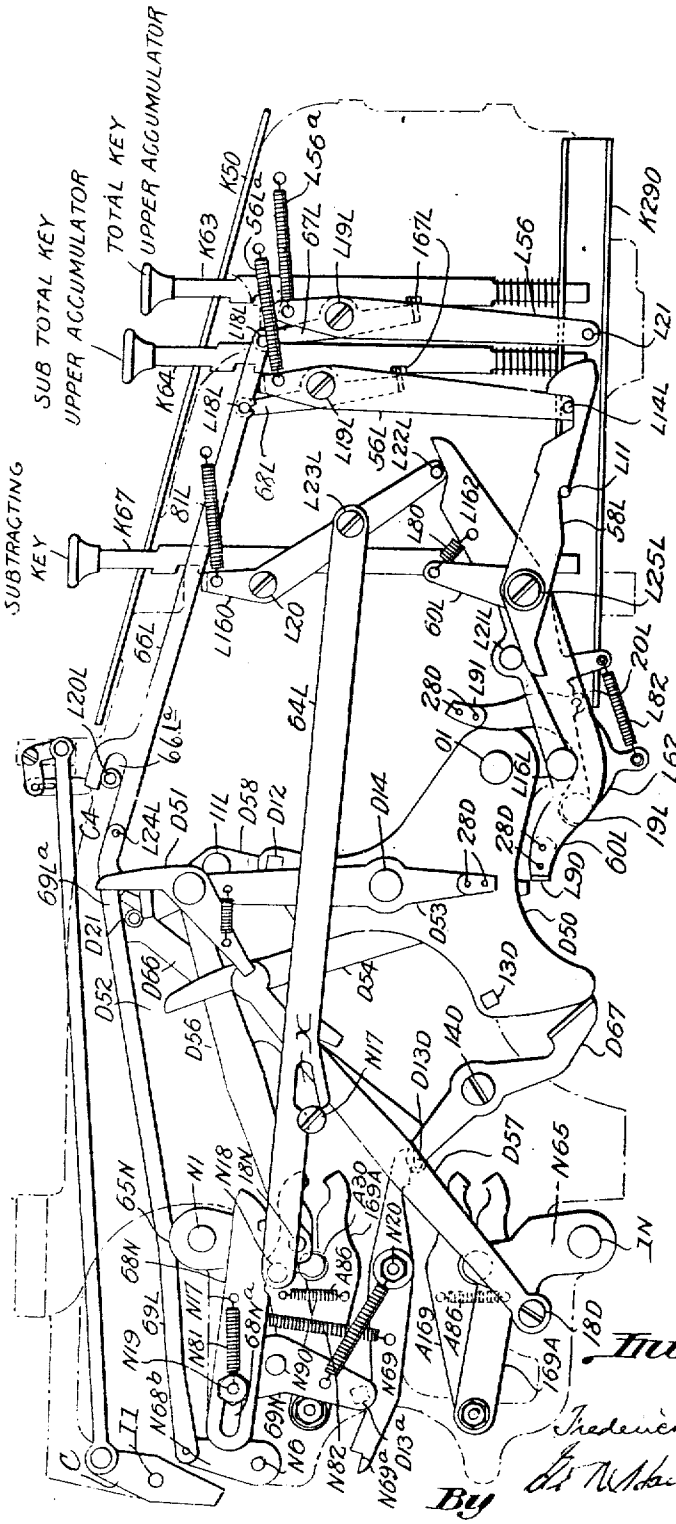
Sept. 9, 1924. 1,508,267

F. W. BERNAU

OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

Original Filed Oct. 31, 1922 13 Sheets-Sheet 2

Fig. 2.



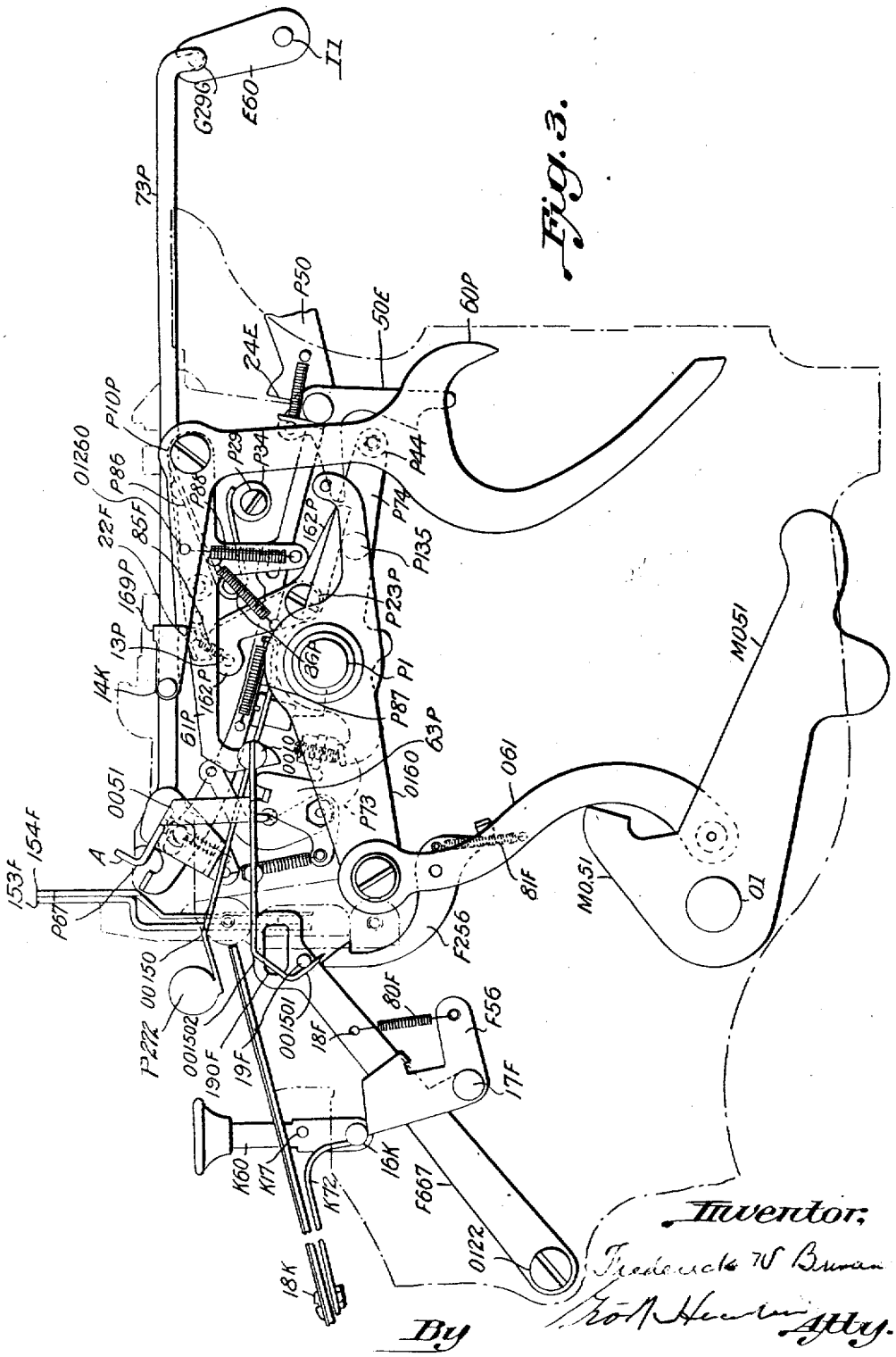
Inventor,
Frederick W. Bernau
By G. W. Wilkinson
Atty

Sept. 9, 1924. 1,508,267

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OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

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Sept. 9, 1924. 1,508,267

F. W. BERNAU

OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

Original Filed Oct. 31, 1922 13 Sheets-Sheet 4

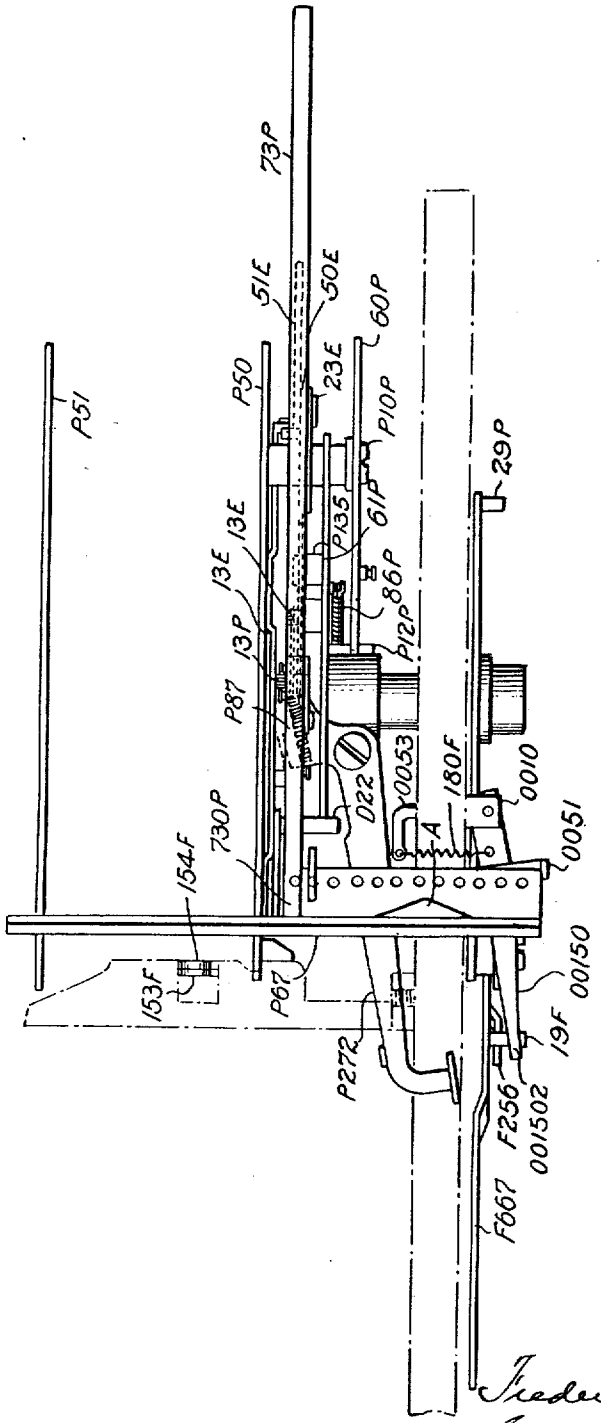


Fig. 4

Inventor;
Frederick W. Bernau
By Geo. N. Shurtleff Atty.

Sept. 9, 1924. 1,508,267

F. W. BERNAU

OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

Original Filed Oct. 31, 1922 13 Sheets-Sheet 5

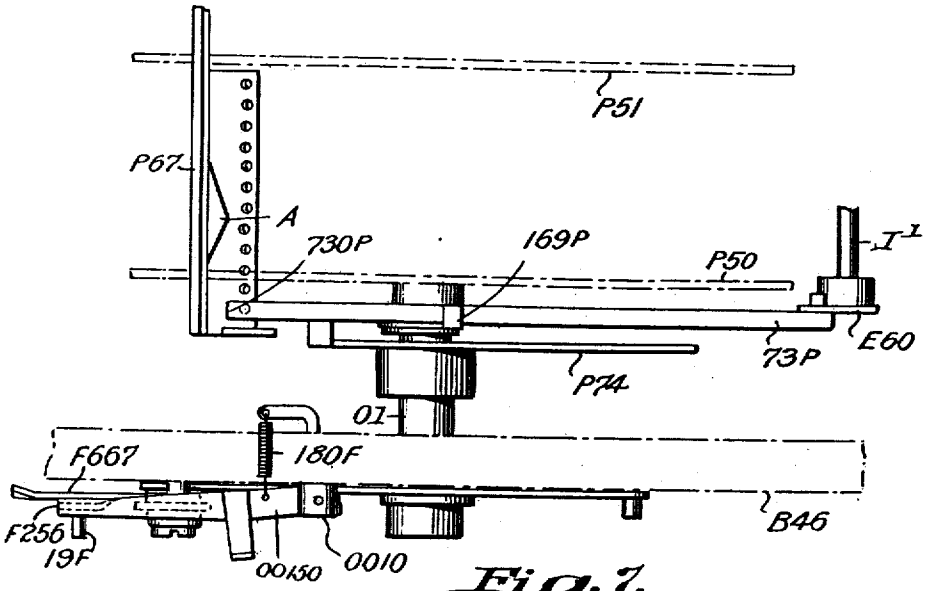


Fig. 7.

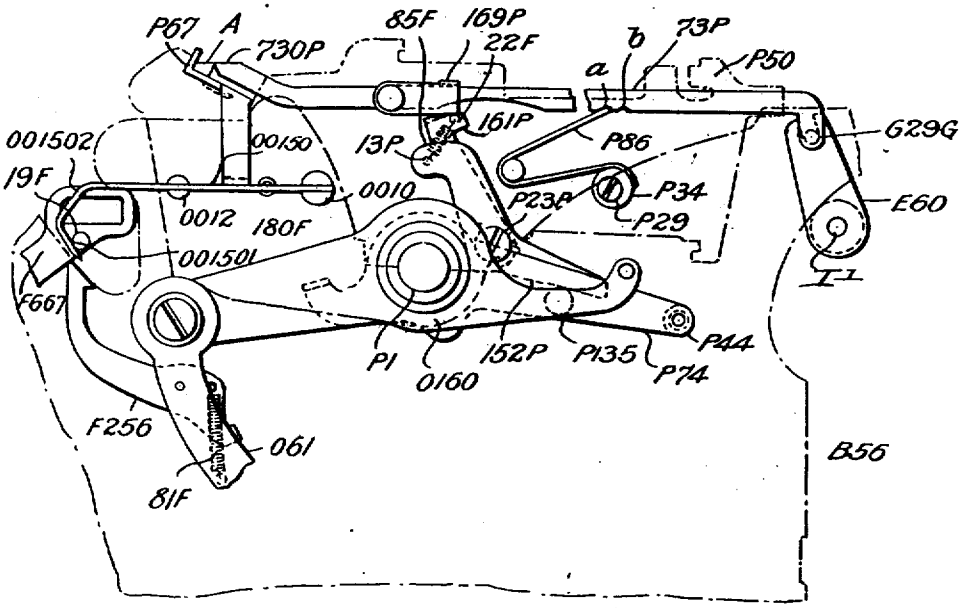


Fig. 5.

Inventor;
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By [illegible] Atty.

Sept. 9, 1924. 1,508,267

F. W. BERNAU

OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

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Fig. 6.

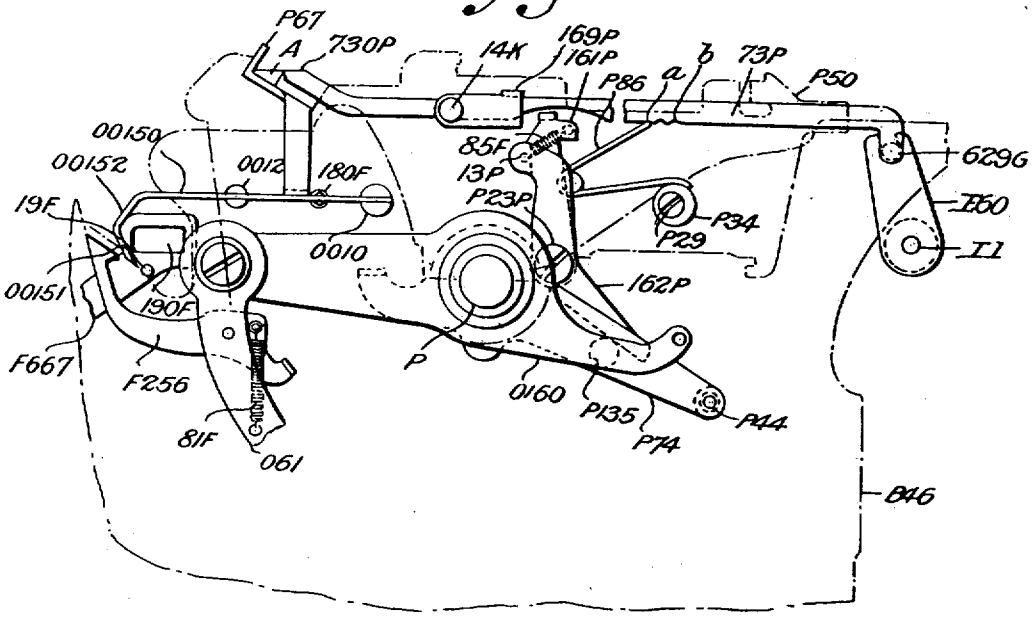


Fig. 14.

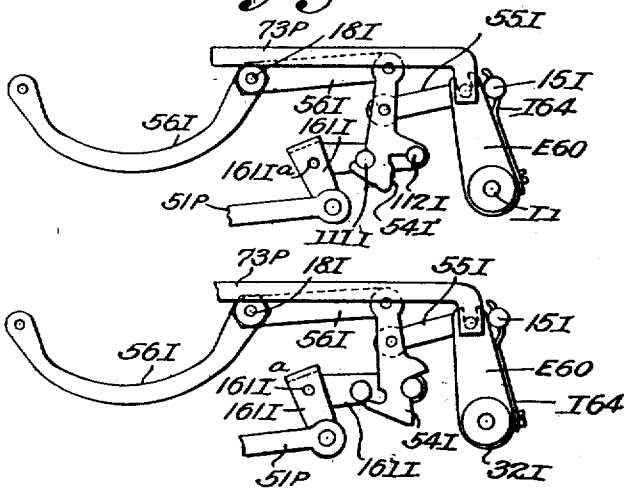


Fig. 15.

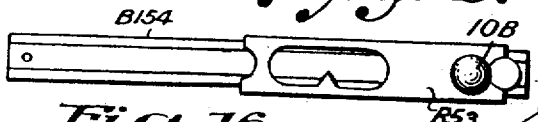


Fig. 16

Inventor;
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Sept. 9, 1924. 1,508,267

F. W. BERNAU

OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

Original Filed Oct. 31, 1922 13 Sheets-Sheet 7

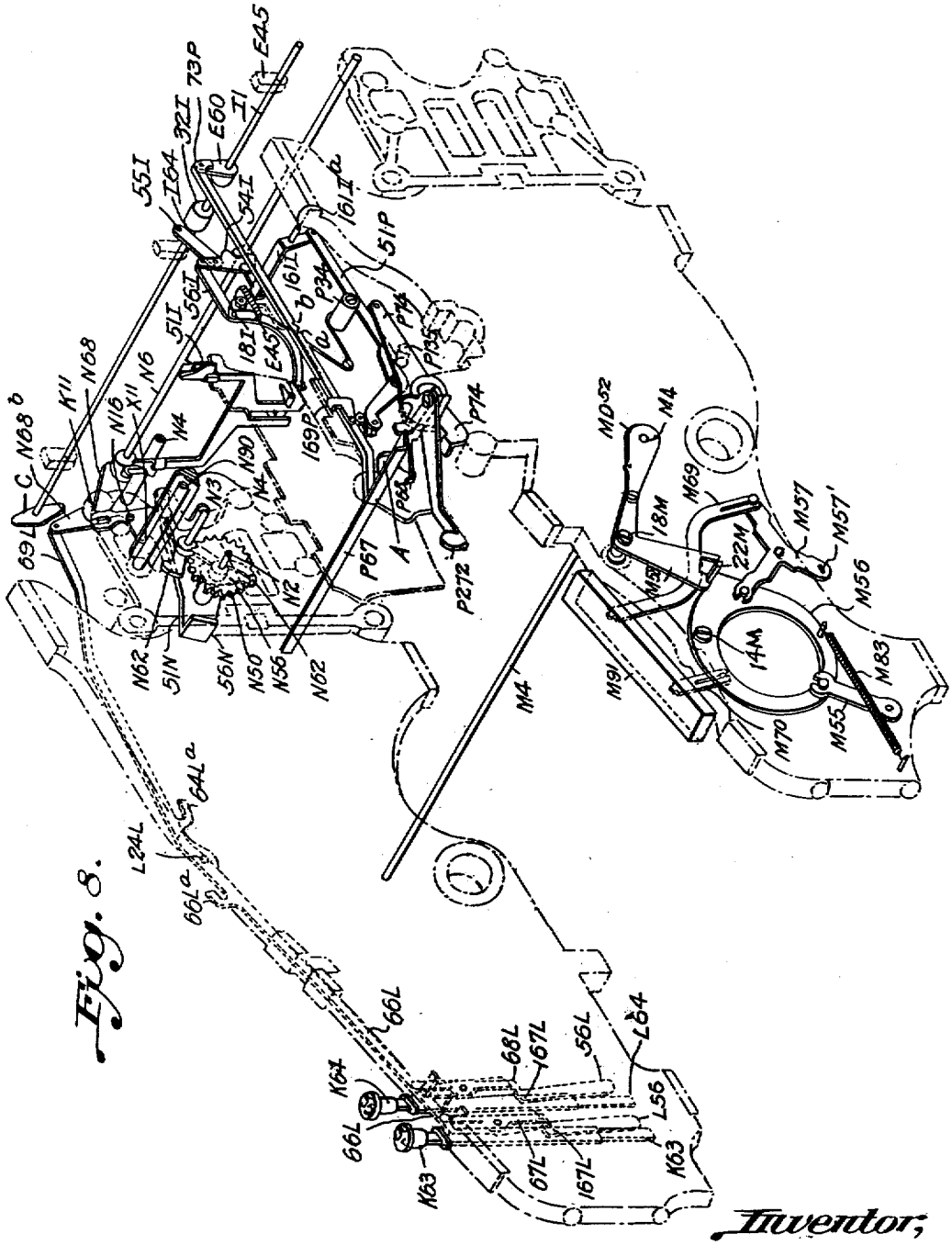


Fig. 8.

Inventor;
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By [illegible] Atty.

Sept. 9, 1924. 1,508,267

F. W. BERNAU

OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

Original Filed Oct. 31, 1922 13 Sheets-Sheet 8

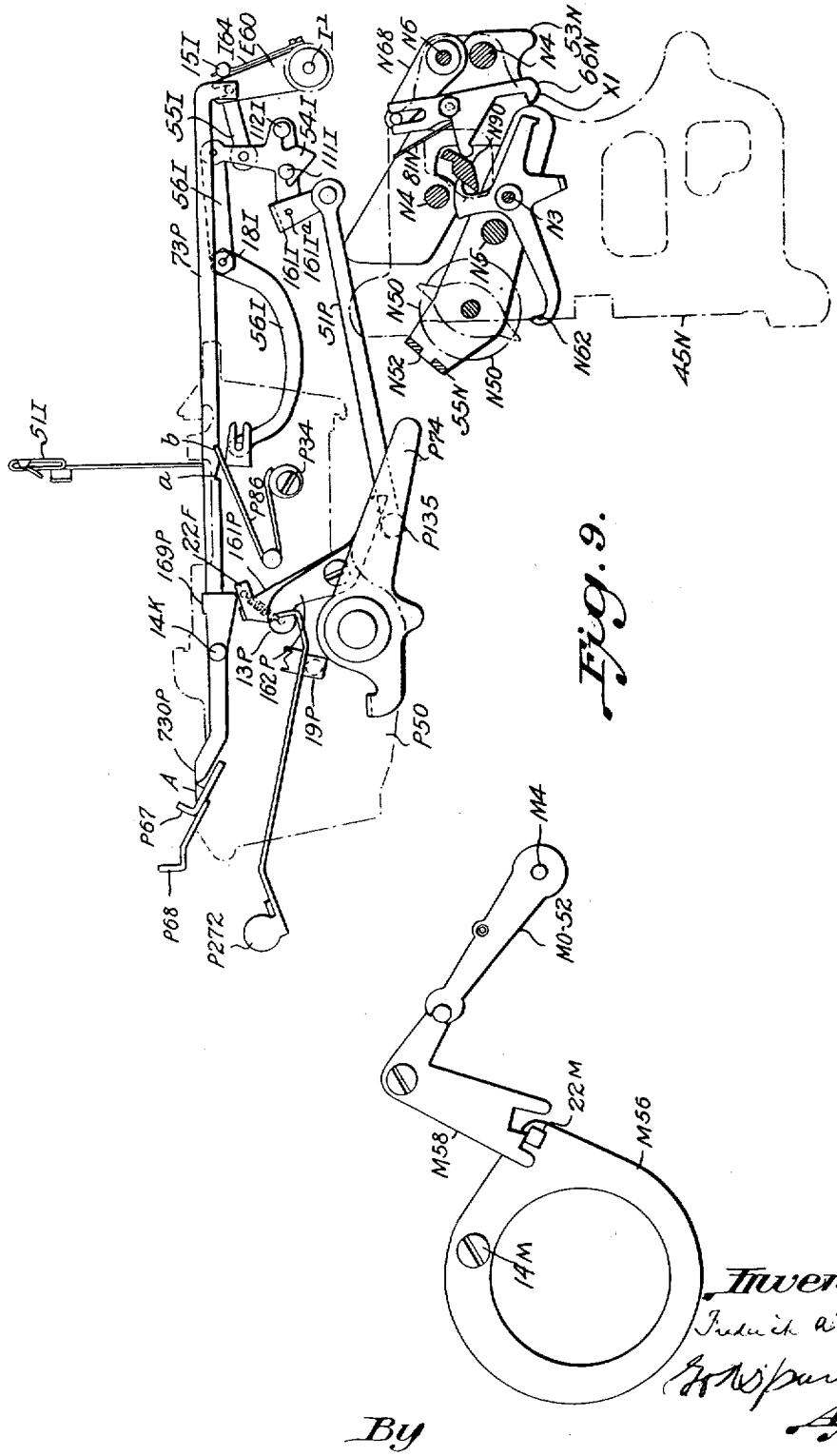


Fig. 9.

Inventor:
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Sept. 9, 1924. 1,508,267

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OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

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Fig. 10.

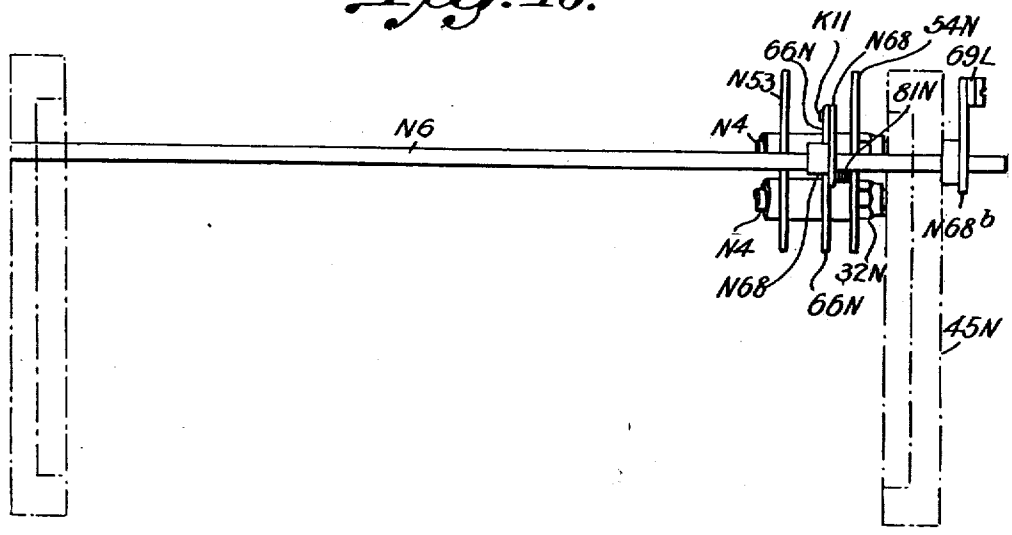


Fig. 13.

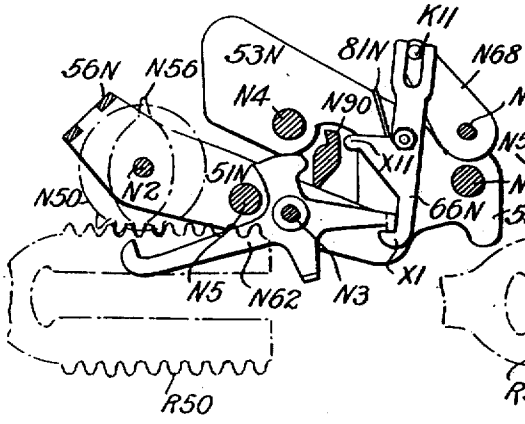
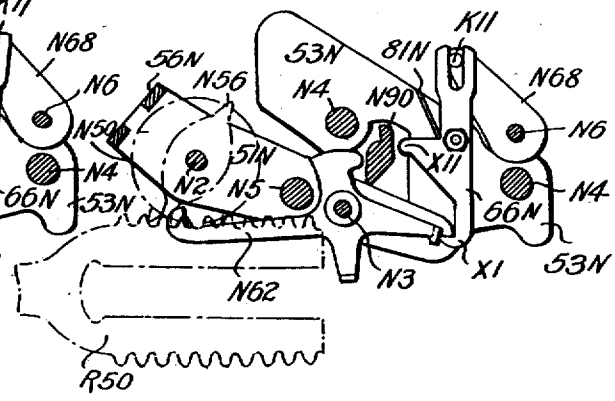


Fig. 12.



Inventor,
Frederick W. Bernau
By [illegible] Atty.

Sept. 9, 1924. 1,508,267

F. W. BERNAU

OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

Original Filed Oct. 31, 1922 13 Sheets-Sheet 10

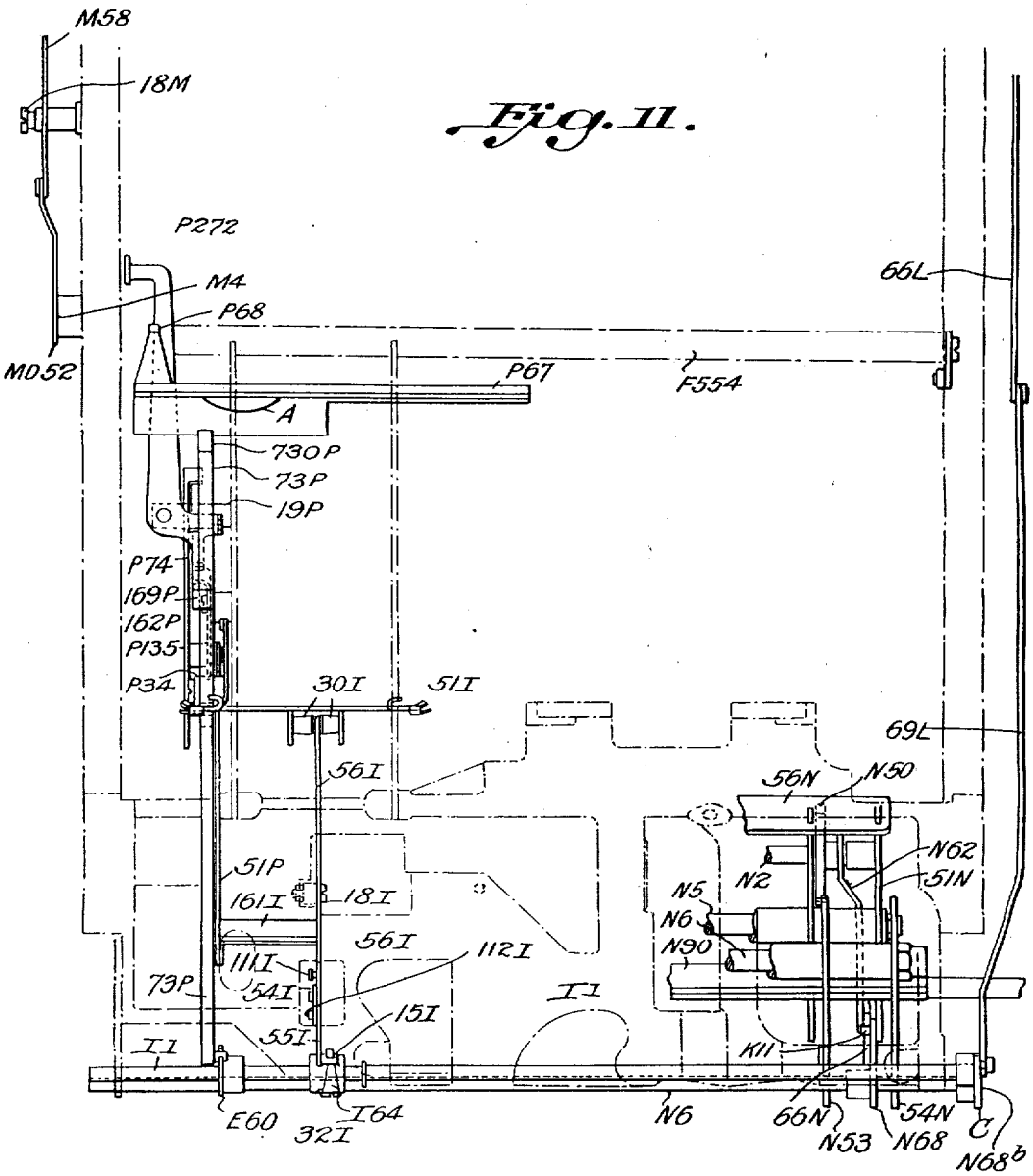


Fig. 11.

Inventor;
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Sept. 9, 1924. 1,508,267

F. W. BERNAU

OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

Original Filed Oct. 31, 1922 13 Sheets-Sheet 11

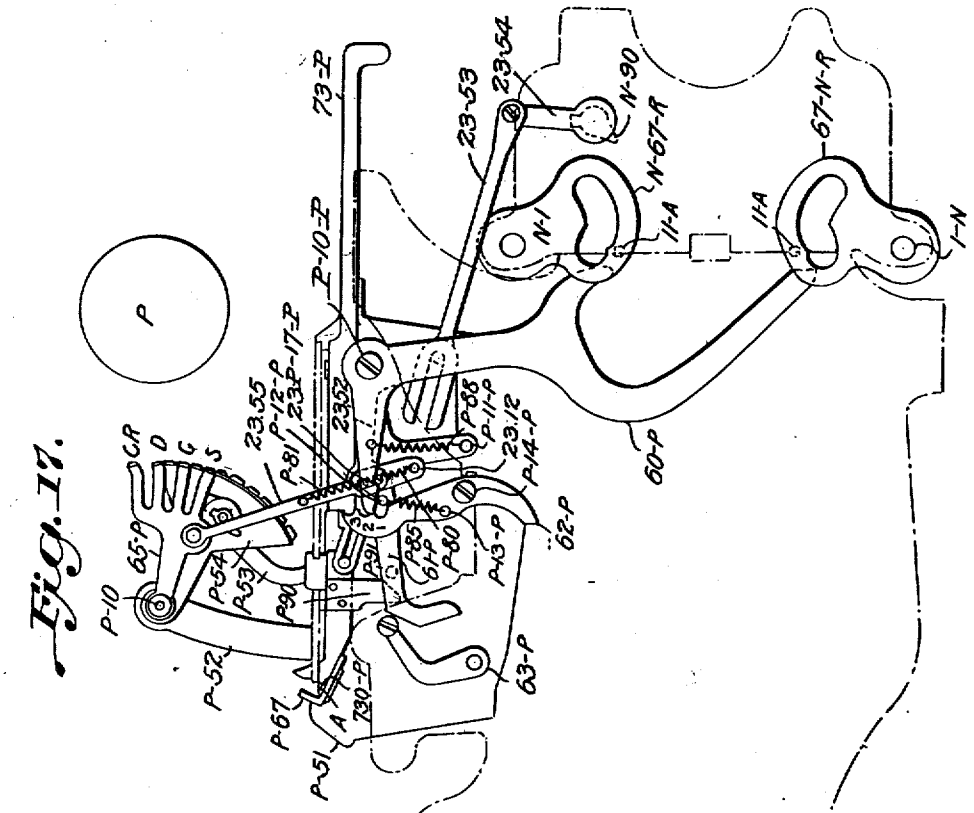


Fig. 17.

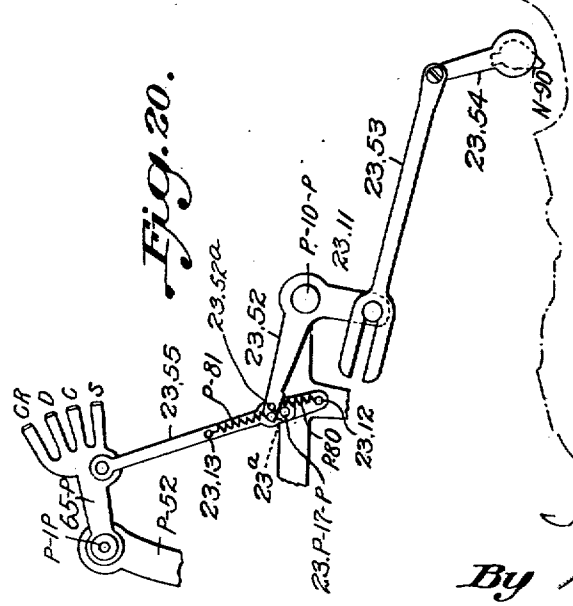


Fig. 20.

Inventor;
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By Atty.

Sept. 9, 1924. 1,508,267

F. W. BERNAU

OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

Original Filed Oct. 31, 1922 13 Sheets-Sheet 12

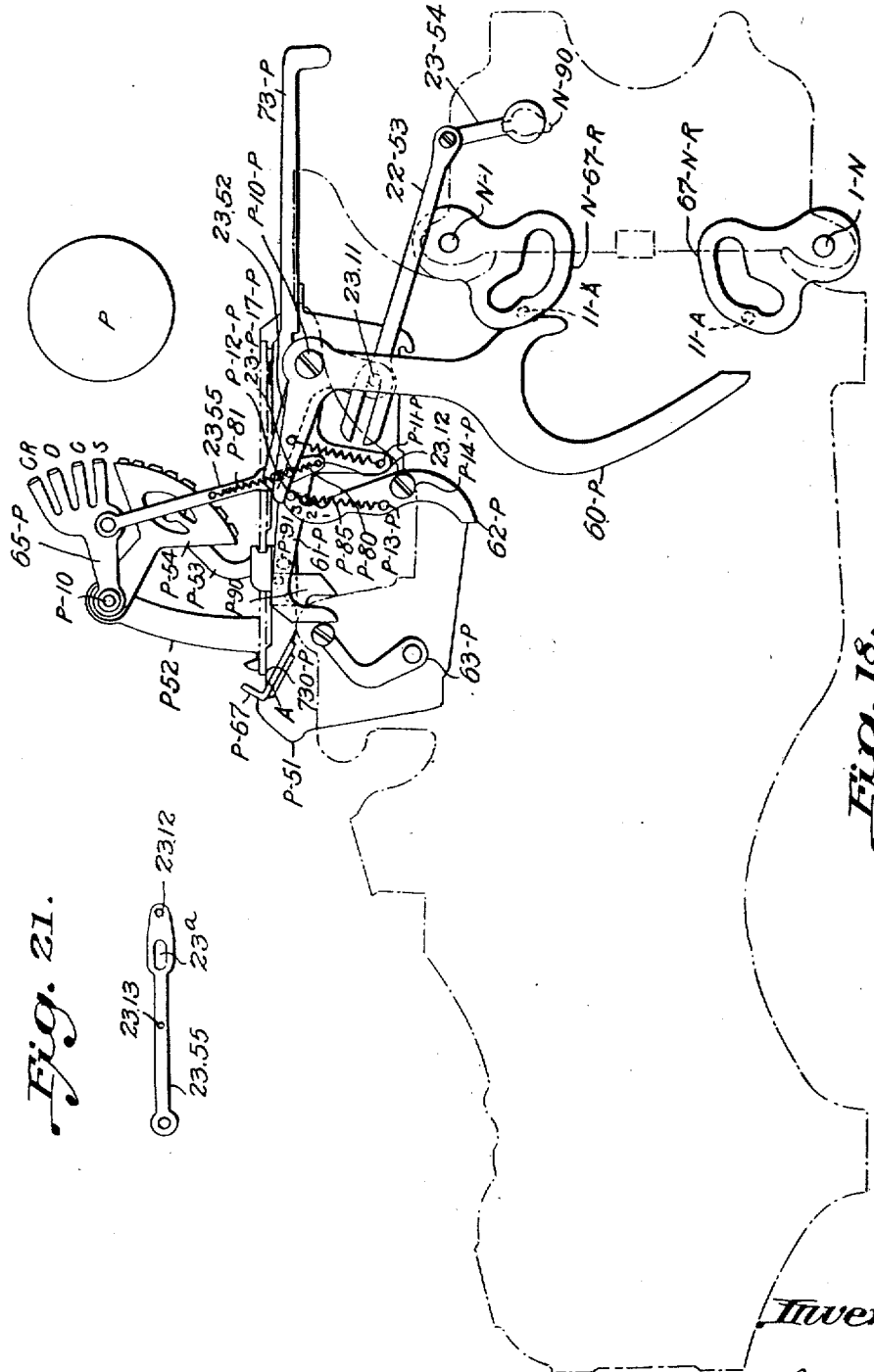


Fig. 18.

Fig. 21.

Inventor,
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By Geo. H. Hamilton Atty.

Sept. 9, 1924. 1,508,267

F. W. BERNAU

OVERDRAFT KEY LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES

Original Filed Oct. 31, 1922 13 Sheets-Sheet 13

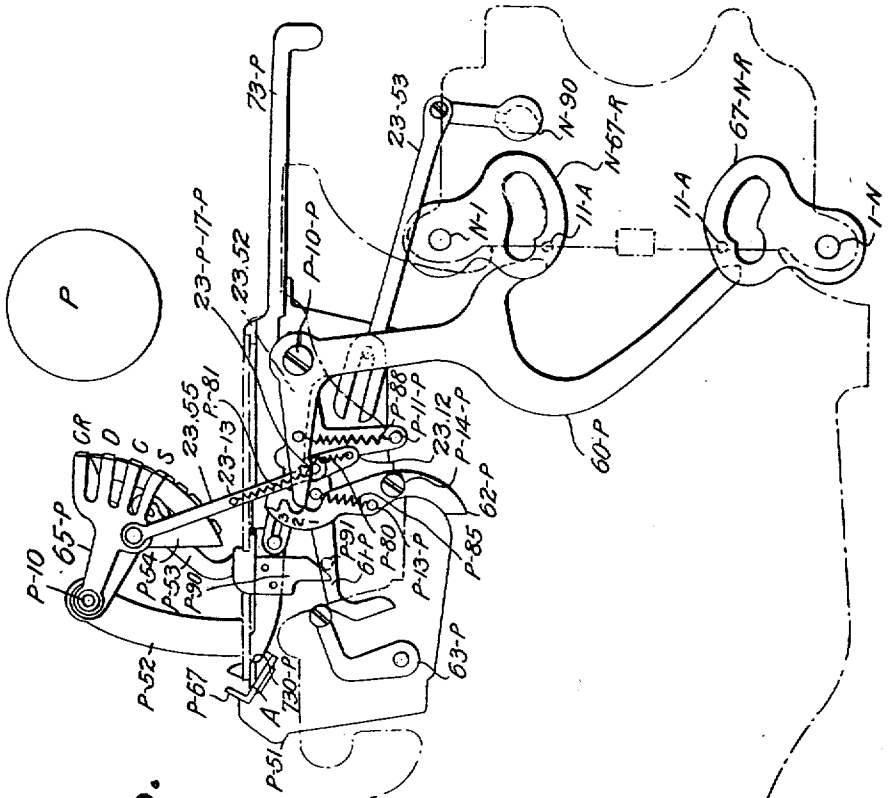


Fig. 19.

Inventor;
Frederick W Bernau
By F. W. Bernau Atty.

Patented Sept. 9, 1924. 1,508,267

UNITED STATES PATENT OFFICE.

FREDERICK W. BERNAU, OF HILLSIDE, NEW JERSEY, ASSIGNOR TO ELLIS ADDING TYPEWRITER COMPANY, OF NEWARK, NEW JERSEY, A CORPORATION OF NEW JERSEY.

OVERDRAFT KEY-LOCKING AND INDICATING MECHANISM FOR CALCULATING MACHINES.

Original application filed October 31, 1922, Serial No. 598,155. Divided and this application filed June 4, 1924. Serial No. 717,782.

To all whom it may concern:

Be it known that I, FREDERICK W. BERNAU, a citizen of the United States, residing at Hillside, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Overdraft Key-Locking and Indicating Mechanism for Calculating Machines, of which the following is a specification.

The present application is a division of Serial No. 598,155, filed October 31, 1922.

This invention relates to calculating machines which are adapted for performing addition and subtraction, and, if desired, for listing numbers and for printing the results of addition and subtraction carried on by the machine.

My present improvements are particularly intended for use in connection with the mechanisms of the well known "Ellis" printing calculating machine, especially the mechanism set forth in patents to Halcolm Ellis No. 1,065,792, June 24, 1913, Total signal device; No. 1,197,276, September 5, 1916, Combined adding machine and typewriter; and No. 1,203,863, November 7, 1916, Mechanical calculator.

It is to be understood, however, that the present improvements and the principles involved therein are not, necessarily, restricted to embodiment in mechanism similar to the "Ellis" machine as these improvements may be used in other calculating machines and the claims are to be understood as covering any improvements involving the principles of the invention in whatever calculating machine they may be employed.

However, to afford a clear understanding of the different mechanisms involved in the present invention, they are hereinafter described, and are shown in the accompanying drawings, in connection with so much of the mechanism of the "Ellis" machine, particularly as disclosed in Patents Nos. 1,065,792, 1,197,276 and 1,203,863, as will afford a clear understanding of the constructions, operations, functions and principles involved in the invention.

There are certain classes of work which a calculating machine is required to handle, demanding notice to the operator that the debit items accumulated exceed the credit items; depositors' accounts in a bank constitute a class of work wherein such notification is important because an account in that condition is "overdrawn." Furthermore, it is important that a calculating machine not only signal the fact that an account is overdrawn but also enable the operator to determine the amount of the overdraft and to print on the ledger sheet being handled by the machine the amount the account is overdrawn or the complement of that amount and to so print the figures or identify them that they will be prominently displayed on the sheet and on carbon copies thereof.

The "signal" provided by the present invention for the purpose of informing the operator that an "overdraft" is present in the accumulator and that the account being handled by the machine is "overdrawn," comprises means adapted to automatically lock the "balance" or total key or keys when this condition is present. When the operator attempts to depress the "balance" or total key or keys, the locked condition thereof is notification that the accumulator contains an overdraft.

Therefore, when attempt is made to take the balance, and it is found that an overdraft exists, it becomes necessary for the operator to manually restore the key-locking mechanism to normal, released, condition in order that the machine may be operated.

To enable this to be done, the locking mechanism is coordinated with the "decimal slide" of the Ellis machine, such slide being disclosed in Patent No. 1,197,276, in such manner that on operating the slide the locking mechanism will be released so that the machine can be operated.

An overdraft is an important and abnormal condition, and it is desirable that it be printed in a distinguishing manner so that it will be easily picked out by the eye. To that end, novel means is provided for printing the item representing an overdraft in a distinguishing fashion, as in a different color, for instance red, and, also, identified by a sign so that the item will be marked

in a distinguishing manner on any carbon copies, such distinguishing printing occurring on the next operation of the machine after the lock has been released as that operation causes printing of the overdraft item. The operation of printing an overdraft item in a distinguishing color may be carried out by employing a bichrome inked ribbon, and ribbon vibrator therefor, and combining therewith novel means which is automatically set so that when the machine operates after the release of the lock or locks, the ribbon vibrator or shift will be moved for that one operation a sufficient distance to bring the differently colored, say red, section of the ribbon in line with the printing type so that a red impression will be made when the item is printed, the mechanism immediately thereafter being restored to its normal condition so that succeeding items will be printed in the usual color.

Identification of an overdraft item is accomplished by employing means for automatically printing the overdraft item with a distinguishing mark or sign. When this means is employed the same item is identified not only on the original ledger sheet but also on all carbon copies being made.

Identification of an overdraft item by printing it with a distinguishing characteristic may, according to my invention, be had by printing the item in a different color, or, accompanied by a sign or "signal", or both methods may be used simultaneously.

The Ellis Patent No. 1,203,863, dated November 7, 1916, provides a subtraction key in addition to the usual controlling keys of the Ellis machine; furthermore, both of the accumulators of the duplex calculator shown in that patent are adapted for the performance of either addition or subtraction.

In the present invention I prefer to have one of the accumulators adapted for both addition and subtraction, as with the accumulators of the machine of the Ellis Patent No. 1,203,863, and to have the other accumulator a straight adding accumulator. The straight adding accumulator may be of the construction set forth in my application filed October 24, 1921, Serial No. 510,029.

It is to be understood, however, that both of the accumulators employed in connection with the present improvements may be adapted for both addition and subtraction as, for instance, in Ellis Patent No. 1,203,863.

While the subtraction key may be otherwise arranged, I prefer to substitute it for one of the controlling keys, for instance, the "Dr." sub-total key. Of the other controlling keys of the Ellis machine, the sub-total and total keys may be suitably labeled to represent the "total deposits" and the "balance", respectively, and another of the keys may be labeled to represent the "total checks", to particularly adapt the machine for use in bank work.

As described and shown, the subtraction key of the present machine is adapted to become automatically restored after the machine has gone through its cycle of operation, making it necessary for the operator to hold down the subtraction key by the finger if a series of subtracting operations are to be carried on consecutively but as it is a simple matter to provide latching means for holding down the subtraction key, when it is desired to carry on a series of subtracting operations, it is to be understood that such latch may be used. In ordinary bank accounting, it is generally inadvisable to provide means for latching the subtracting key as this opens the way for forgetfulness on the part of the operator which would result in improper operation in that class of work.

Combined with the substracting key is special mechanism, substituted for certain of the pieces, cams, and levers of the machine of Ellis Patent No. 1,203,863 and, additional thereto, a link and a special hook or pawl by which the parts are conditioned so that the accumulator is brought into a condition by which it will perform subtraction on the next operation of the machine. It is to be understod that the foregoing mechanism does not interfere with the carrying on of addition in the straight adding accumulator as if both adding and subtracting accumulator and straight adding accumulator are employed, subtraction can be carried on in one accumulator while addition is being performed in the other accumulator. Furthermore, a total can be taken from one accumulator, the amount of which may be subtracted from the accumulation of the remaining accumulator.

The overdraft mechanism by which the lock or locks or signal or signals heretofore referred to are operated and other mechanisms are set, is under the control of the subtracting pawl or hook of the highest "order" of the adding and subtracting accumulator. The subtracting pawl or hook itself is of the same construction as the corresponding device of the Ellis Patent No. 1,203,863. Combined with this subtracting pawl or hook and with the "shift bar" of the adding and subtracting accumulator, is an overdraft lock latch by means of which an overdraft condition results in such a setting of the overdraft lock latch that the overdraft mechanism hereinbefore referred to is operated to lock the balance or total keys.

The present improvements being additional to the mechanism of the Ellis machine, reference is to be had to the afore-

mentioned Ellis patents for a full disclosure of all mechanisms and their operations which are directly or indirectly related to the said improvements and in the following description and accompanying drawings reference is made to only so much of the patented Ellis machine as will afford a clear understanding of the relationship of the present improvements thereto.

I am aware that modifications may be resorted to in carrying out the essential principles of the various improvements hereinbefore outlined and which are hereinafter specifically described and are shown in the accompanying drawings. It is to be understood, therefore, that the constructions specifically described and shown, while the preferred embodiments of the invention as at present devised by me, are susceptible of modification in many respects without departing from the essential principles thereof.

In the accompanying drawings:

Figure 1 is an elevation of the left hand side of the machine showing only so much of the mechanisms of the patented Ellis machine as will afford a clear understanding of such of the present improvements as directly relate to the subtracting key, which is in depressed position, mechanism for controlling the upper adding and subtracting accumulator, and the overdraft locks for the balance and total deposits keys or total and sub-total keys, the keys illustrated being in normal position.

Fig. 2 is a view similar to Fig. 1, the total or balance key and the sub-total or total deposits keys being locked by the overdraft mechanism, an overdraft having previously occurred.

Fig. 3 is an elevation at the right hand side of the machine, the parts being shown in normal position; certain parts being omitted.

Fig. 4 is a plan view thereof, certain parts being omitted.

Fig. 5 is a view similar to Fig. 3, the set link having been moved to the right by the manipulation of the decimal slide, the tabulating hook being in normal position, and the tabulating control lever being in position to prevent automatic tabulation.

Fig. 6 is a similar view, the tabulating hook having risen and being prevented from operating the tabulating mechanism by the control lever, the parts being as they appear at the end of the forward stroke of the operating shaft.

Fig. 7 is a plan view of the parts when in the position shown in Fig. 5.

Fig. 8 is a perspective view, the side frames of the machine being in dotted lines, showing the overdraft mechanism and operative connections to the locks for the balance or total, and total deposits or sub-total key, the ribbon shifting mechanism and decimal slide, various mechanisms of the machine being omitted for the sake of clearness and the overdraft mechanism and locks being in normal position.

Fig. 9 is a part side elevation and part sectional view showing certain of the mechanisms at the right hand side of the machine, and, also, the overdraft mechanism at the left hand side of the machine, the shift bar of the accumulator being set for addition and the overdraft mechanism and ribbon mechanism being in normal condition.

Fig. 10 is a rear elevation of the machine showing the overdraft shaft and certain of the devices related thereto.

Fig. 11 is a plan view of the overdraft mechanism, ribbon mechanism and links or bars that control the locks, the decimal slide being shown as having been moved toward the left, the front part of the machine and various mechanisms being omitted.

Fig. 12 is a partly sectional, partly elevational, detail view of the overdraft mechanism as set for carrying on a subtracting operation, before an overdraft has taken place.

Fig. 13 is a similar view showing the position of the parts after an overdraft has occurred.

Fig. 14 is a detail side elevation of the ribbon shift mechanism when in normal position for causing ordinary printing, say in black, to occur.

Fig. 15 is a similar view showing the mechanism arranged so that the ribbon vibrator will be shifted to cause printing in a distinctive color, say red, as when an overdraft has taken place.

Fig. 16 is a front view of the decimal slide shown in its extreme right hand position.

Fig. 17 is a side elevation of mechanism for automatically printing identifying signs or "signals", the parts being in normal position.

Fig. 18 is a similar view, the parts being in position to print a subtracting sign.

Fig. 19 is a similar view, the parts being in position to print a credit balance sign, or an overdraft.

Fig. 20 is a detail side elevation of certain of the parts of the mechanism of Figs. 17, 18, 19; and

Fig. 21 is a detail of a link shown in Figs. 17, 18, 19.

As set forth in Ellis Patents No. 1,197,276 and No. 1,203,863, the machine is driven or operated, either by a handle, or by an electric drive, neither of which is shown, from a shaft 01. In the accompanying drawings only so much of the patented Ellis machine is shown as will afford a clear understanding of the relation of the present improvements thereto. Modern calculating machines, particularly those intended for loose

leaf ledger work, are electrically driven and controlled by a starting bar. I have, therefore, illustrated starting bar mechanism for the control of the electric drive such mechanism appearing in Figs. 8, 9 and 11.

The shaft 01 carries a piece M051 (Fig. 3) which is operated by the electric drive.

Secured to shaft P1 which is mounted in the frame and in the side plate P50 of the printing section is a crank 0160 which is operated from the piece M051 by the printing pitman 061. Carried by the shaft P1 is the paper feed lever P74.

Referring to Figs. 3, 17, 18, 19, the signal setting arm which is moved by the cams N67R and 67NR that swing the frames of the wheels of the accumulators, as shown in Ellis Patent No. 1,065,792, appears at 60P. One of the printing type sectors is shown at P54, pivoted to arm P52 at P10 and adapted to be set by link P53; the signal 65P which is pivoted to arm P52 at P10, is operated by link 23.55 by improved means hereinafter described, of which the signal lever 61P pivoted at P10P constitutes a part.

The decimal slide P67 is operated by a slide B53 connected to the hook P68 of the slide P67. The piece B53 has a button 10B and is movable over the scale B154. The decimal slide P67 appears in Figs. 3 to 9, and 11.

The lever P272 (Figs. 3, 4, 8, 9) controls the automatic turning of the platen.

A plate D50 which is secured to the left hand end of the operating shaft 01 (Figs. 1, 2) affords the means by which the motion of said shaft is utilized for the operation of the accumulators, according to the controls effected by the various controlling keys.

Such of the present improvements as relate to the controlling keys, including the subtracting key K67, the balance or total key K63 for the upper accumulator, and the sub-total key or total deposits key K64 are shown more particularly in Figs. 1, 2, and 8.

The lower accumulator is not shown in detail. This accumulator as combined with the mechanisms of Figs. 1 and 2, is controlled only for purposes of addition and may be constructed as set forth in my application Serial No. 510,029, filed October 24, 1921. It is to be understood, however, that the lower accumulator may be a combined adding and subtracting accumulator as disclosed in Ellis Patent No. 1,203,863 as additional mechanism could be employed so that subtraction as well as addition could be carried on in the lower accumulator in connection with the "overdraft" features of the present invention.

Only so much of the upper combined adding and subtracting accumulator is shown in Figs. 8, 9, 10, 11, as will afford a clear understanding of the operation of the mechanisms when an overdraft takes place, and the relationship of this accumulator to the improved mechanisms shown in Figs. 1 and 2 by which the upper accumulator is controlled. Reference is to be had to Ellis Patent No. 1,203,863 for a detailed disclosure of the general construction and principle of the upper adding and subtracting accumulator.

The subtraction key and subtracting mechanism.—The key used for setting the machine so that subtraction may be performed in the upper accumulator is shown at K67 in Figs. 1 and 2, this key being, in the present instance, substituted for the Dr. sub-total key K67 of the lower accumulator of the Ellis Patent No. 1,197,276. It is not essential, however, that the Dr. sub-total key of the lower accumulator be dispensed with. A latch L160 which is actuated by spring 81L and is pivoted at L20, is adapted to latch the subtraction key K67 when the latter is in depressed position. Pivotally connected to the latch L160 at L23L is a long set link 64L which is provided at N18 with a pin and is provided at X with a cam slot so fashioned and located that the set link is normally sustained by a screw pin N17 projecting from the frame B47 and on which said set link rests. When the subtraction key K67 is depressed, however, the movement of the set link 64L to the left, causes the screw pin N17 to enter the cam slot X which thereupon allows the set link to drop to the position shown in Fig. 1. The shafts N1 and 1N carry the cams N67R and 67NR (Figs. 17, 18, 19) which swing the wheels of the upper and lower accumulators into and out of engagement with the adding racks or actuators, as explained in Ellis Patent No. 1,203,863, and carry on their ends the cranks 65N and N65, respectively. These cranks have rollers A30 adapted to be held in the rearwardly or forwardly arranged notches A170 and 170A of scissors like latching devices comprising pieces A169 and 169A which are drawn together by springs A86 connecting them as explained in my application Serial No. 510,029 by which the accumulator is suitably held in its engaged and disengaged relation to the adding racks.

As shown in Figs. 8, 9, 11, 12, 13, the irregular shaped shift bar N90 of Patent No. 1,203,863 is employed and on the left hand end of this bar there is secured a crank lever 69N which has a square stud D13[a] at its lower end and a stud N19 at its upper end. Spring 82N normally pulls the crank lever 69N in a counter-clockwise direction.

A subtracting operating hook 68N has a slot 68N[a] by which it is slidably mounted on the pin N19. This hook is normally drawn rearwardly on the pin N19 by two contractile coil springs N81 located on op-

posite sides thereof and connected to the pin N19 and to a pin 17N on the hook. One of the springs N81 is obscured by the hook 68N in Figs. 1 and 2. A coil spring N82 which is connected to one of the pins 17N and to the subtracting detent N69, serves the double purpose of tending to draw the subtracting operating hook 68N downwardly and the subtracting detent N69 upwardly.

Referring again to Figs. 1 and 2, there is pivoted on a screw L25L a subtracting cam L162 which has a cam at its right hand end with which the pin L22L on the latch L160 normally engages, the said pin riding on the cam end of L162 and depressing said cam L162 when the subtraction key is depressed as shown in Fig. 1. A subtracting cam lever 60L is also pivoted on the screw L25L and is connected to the subtracting cam L162 by a contractile spring L80 which normally holds the left hand end of the subtracting cam lever 60L raised and in contact with a headed stud L16L on the subtracting cam L162.

A total cam lever 58L is pivoted on screw L25L and has its left hand end abutting a pin L21L projecting from the subtracting cam L162. The normal position of the total cam lever 58L is maintained by the engagement of the right hand cam notch thereof with pin L14L carried by the latch 56L for the sub-total or total deposits key K64, such latch and key being of the same general construction set forth in Ellis Patent No. 1,197,276. A spring 56L normally draws the upper end of the latch 56L against the stem of key K64 so that when the key is depressed the latch will engage the notch thereof.

A hardened shoe L90 is secured by rivets 28D to the left hand end of the subtracting cam lever 60L for cooperation, when set by the keys K63, K64 and K67, with the hardened shoe D90 on the lower end of flying lever D53 which is pivotally mounted on the plate D50 at D14 and adapted to cooperate with the square studs D12, and 13D on said plate.

A total pawl L62 is pivoted on a stud 19L carried on the inner face of the subtracting cam L162, said total pawl having a pin 20L which extends underneath the subtracting cam L162. The total pawl L62 is normally held in the position shown in Figs. 1 and 2, with the pin 20L abutting the lower edge of subtracting cam L162 by the action of a spring L82 connecting said total pawl to a projecting part of the subtracting cam L162. The total pawl L62 carries on its upper end a hardened shoe L91 secured by rivets 28D.

The total or balance key K63, is held, when depressed, by a latch L56 which is pivoted at L19L and is provided with a pin L21 adapted to be drawn against the end of the total cam 58L by the action of spring L56a when the key K63 is depressed.

Setting the accumulator by subtraction key.—When the subtraction key K67 is depressed, it is immediately latched in its depressed position by the latch L160 whose operation results in parts assuming the positions shown in Fig. 1. The riding of the pin L22L on the subtracting cam L162 causes the whole system of mechanism associated with L162 to turn in a general clockwise direction, resulting in the total cam lever 58L becoming released from the pin L21L, the subtracting cam lever 60L to rise so that its shoe L90 is against the shoe D90 of the flying lever D53, and the total pawl L62 to become elevated so that it will be engaged by the shoe D90 at the end of the forward stroke of the shaft 01 and plate D50.

The movement of the latch L160 causes the set link 64L to shift toward the left, thereby allowing the screw guide pin N17 to enter the cam slot X. This results in the set link 64L dropping from its normal position to that shown in Fig. 1. Normally the lower edge of the subtracting operating hook 68N rests on the pin N18 so that said subtracting operating hook is held in elevated position. When, however, the set link 64L descends, as described, the subtracting operating hook 68N is allowed to drop so that it is positioned for engagement by a pin 18N on the crank 65N which turns the cams (not shown) that lower the wheels N50 (Figs. 8, 9, 12, 13) into engagement with the adding racks of the machine at the proper time. The subtracting operating hook 68N is, by the movement of the set link 64L, thus conditioned so that it may be pulled toward the right when the crank 65N swings to the right.

Subtracting operation.—The parts having thus been set, when the machine is operated, either by a handle or electric drive used for the purpose of turning shaft 01, the plate D50 which is normally in the position shown in Fig. 1 is turned to the right and then reverses its motion and resumes the position shown in Fig. 1. Before the return of the plate D50 to the normal position of Fig. 1, the subtraction key K67 becomes restored and the subtracting cam L162 and subtracting cam lever 60L and total cam lever 58L all resume their normal position.

In the Ellis machine set forth in Patents No. 1,197,276 and No. 1,203,863 when an operation of addition is to be performed, the adding racks or actuators R50 (Figs. 12, 13) advance, during the operation of the machine, as far as allowed by the setting of the numeral keys before the shafts N1, 1N, are turned (according to which accumulator is being used) for the purpose of engaging the wheels N50 (Figs. 8, 9, 12, 13) with said

racks. This action occurs, in an adding operation, when the plate D50 has moved through an angle of about 45°. The wheels N50 remain in engagement with the racks R50 until the racks have returned to normal position, such return of the racks turning the adding wheels N50 according to the extent of travel of said racks.

When an operation of subtraction is to be performed, however, as the number is to be immediately deducted from any number set up on the wheels N50 during a previous operation of the machine, it becomes necessary to cause the wheels N50 to engage the racks R50 before said racks move and to disengage the wheels N50 from the racks before the racks start to return to their normal position. In a subtracting operation, therefore, it is necessary to move the upper crank 65N to the right from the position shown in Fig. 1 to its other position before the racks R50 have started to move.

The subtraction key having been set and the parts being in the position shown in Fig. 1, when the machine is operated, the swinging of the plate D50 in a clockwise direction results in a temporary arrest of the flying lever D53 because its lower end is temporarily blocked by the shoe L90 on the subtracting cam lever 60L. This results in lever D53 pulling upon link D56 which connects it to the crank 65N of the adding and subtracting accumulator, causing the shaft N1 to be turned and the frame 51N, 56N, which carries the shaft N2 to be moved and wheels N50 then mesh with the racks R50 before the racks start to move. The roller A30 on crank 65N is drawn into the notches 170A so that the wheels N50 are retained in engagement with the racks R50. The movement of the connecting link D56 to the right from the position shown in Fig. 1 also results in the pin 18N pulling upon the subtraction operating hook 68N which, through the spring connections N81, pulls upon the pin N19 and thus turns the crank 69N and the shift bar N90, bringing the shift bar N90 to the position shown in Fig. 12, which is the subtracting position.

The first part of the movement of the plate D50 releases the restoring lever D67, allowing the spring N82 to snap the subtracting detent N69 upwardly so that the notch N69ª thereof engages the square stud D13ª on crank 69N.

During its clockwise movement, the plate D50 drags the lever end of flying lever D53 past the shoe L90 on the substracting cam lever 60L so that after the accumulator has been set for substraction and the wheels N50 engaged with the racks R50, the said flying lever D53 simply turns idly on its pivot D14 and exerts no further action on the crank 65N and hook 68N. The lower end of the lever D53 is finally drawn across the shoe L91 of the total pawl L62 and as this pawl is actuated by spring L82, it is slightly depressed, allowing the flying lever D53 to finally abut the shoe L91.

On the return stroke of the shaft 01, the plate D50 is turned in a counter-clockwise direction. The return movement of the plate D50 causes the lower end of lever D53 to press against the shoe L91 of the total pawl L62. The pressure being almost in a direct line with the pivot 19L of the total pawl L62, i. e., almost directly on a dead center, there is no tendency for the lever D53 to depress the total pawl L62 but, on the contrary, the total pawl L62 constitutes a solid abutment to temporarily resist the return of the lever D53 so that pressure is applied through lever D53 and connecting link D56 to the crank 65N, causing said crank to be returned to its normal position at the beginning of the return stroke of the plate D50, thereby resulting in the turning of shaft N1 and the raising of the frame 51N, 56N, (Figs. 8, 12 and 13) and disengagement of the wheels N50 from the racks R50 before the racks start to return to normal position. When the plate D50 returns to its normal position it again engages the restoring lever D67 and causes the pin D13D to elevate the right hand end of the substracting detent N69 and to withdraw the notch N69ª from engagement with the stud D13ª.

While no disclosure is given of means for latching down the substraction key K67 for a series of repeated substractions without requiring the operator to hold his finger on said key, such latching means may be provided, if desired. In the construction disclosed, the substraction key K67 will instantly rise when the latch L160 is moved in a counter-clockwise direction. This action automatically occurs on the return stroke of the shaft 01 and plate D50.

Means, such as set forth in my application Serial No. 598155, may be provided for automatically releasing the latches 67L, 68L, L160 for the keys K63, K64, K67 on the return stroke of the plate D50; and means for releasing them by depressing the error key, may be used, as disclosed in that application.

The releasing movement of the latch L160 in a counter-clockwise direction by means such as previously explained, causes the set link 64L to be drawn toward the right, out of the position shown in Fig. 1, whereupon the cam edges of the slot X cause the set link to ride on the pin N17 and resume its normal position. The rising of the set link 64L causes its pin N18 to elevate the subtracting hook 68N from the subtracting position to the adding position where it will remain as long as the subtraction key K67 remains in elevated position so that addition may be performed in the upper accumulator

by depressing the proper controlling key provided in the Ellis machine.

When the plate D50 assumes its normal position, its engagement with the restoring lever D67 results in disengagement of the detent N69 from the lever 69N and the shift bar then returns to the adding position shown in Fig. 9.

When it is desired to subtract a series of items, the subtraction key is held in depressed position by the finger of the operator, the subtracting cam L162 and the subtracting cam lever 60L then remaining in the position shown in Fig. 1 by reason of the cooperation of pin L22L of latch L160 with subtracting cam L162. When the subtracting key is thus held down, at a time just prior to the plate D50 assuming its normal position on the return stroke, the lower end of the flying lever D53 strikes the upper side of the shoe L90 on the subtracting cam lever 60L but as the left hand end of said lever is held in raised position by spring L80, the return of the flying lever D53 to normal position merely slightly depresses the left hand end of cam lever 60L and then passes beyond it, finally assuming the position shown in Fig. 1.

Release of numeral keys.—The numeral keys (not shown) which are fully disclosed as to construction and operation in Ellis Patent No. 1,197,276 are released, so that they may spring up to normal position, by means substantially similar to those shown in Ellis Patent No. 1,203,863. When addition or subtraction is being performed, the numeral keys are released on the return stroke of the shaft 01 and plate D50.

When a total or balance, or sub-total or total of deposits, is to be taken, the numeral keys are released during the first 15° of the forward stroke of the shaft 01 and plate D50. This is accomplished from the latches L56, 56L when the key or keys K63, K64 are set, the total cam 58L then being shifted and, in turn, setting the parts L162, 60L and bringing about operations as explained in Serial No. 598,155.

The adding or debit accumulator.—In the drawings I have shown the operating mechanism for the lower or "Dr" accumulator in Figs. 1 and 2. This accumulator may be of the construction shown in my application Serial No. 510,029, filed October 24, 1921. As previously explained the lower accumulator may be a combined adding and subtracting accumulator such as set forth in the Ellis Patent No. 1,203,863. In the present description and drawings I have not shown the controlling keys for the lower accumulator nor will specific description be given of the means by which the adding crank N65 of the lower accumulator is rocked to turn the shaft 1N which carries the cams 67NR that swing the lower accumulator wheels into mesh with the lower sides of the racks R50 but the manner of operating said accumulator will be clear from the disclosures of the Ellis Patent No. 1,197,276 and the mechanism shown in Fig. 46 of that patent and also Fig. 3 of Ellis Patent No. 1,197,278. It is only necessary, for the purposes of the present invention to state that the rocking plate D50 operates the flying lever D54, connection D57 to the pin 18D of the crank N65 and that there is a piece D52 similar to the piece D51, said parts being located back of the plate D50 and serving, when the proper keys, not shown, are set, to enable the lower accumulator to be used for purposes of addition.

Assuming, therefore, that the lower accumulator is used as explained, it is possible with the present invention to subtract the total accumulation of the lower accumulator from the amount added in the upper or "Cr." accumulator.

Subtracting the amount in the debit accumulator from the amount in the credit accumulator.—For carrying on a subtracting operation, it is immaterial as to what means is used to limit the travel of the racks R50. If the lower or "Dr." accumulator is engaged with the racks R50 for the purpose of taking a total while the "Cr." accumulator is engaged with said racks for the purpose of carrying on a subtracting operation, it is evident that the wheels of the "Dr." accumulator will limit the travel of the racks R50 and that the precise extent of travel of the racks will be represented by a corresponding subtracting operation which will deduct the amount from what is contained in the "Cr." accumulator.

Furthermore, if both of the accumulators are constructed for both addition and subtraction, it will be immaterial as to which accumulator is set for the taking of a total and which is set for subtraction.

The piece D58 which is shown in Figs. 46 and 47 of Ellis Patent No. 1,197,276, and Fig. 3 of Ellis Patent No. 1,197,278 has a pin D21 which is received in the forked end of the piece D66 which is connected to the end of the restoring lever D67, said pin D21 cooperating with the angled piece D51. The pin D21 performs an additional function having to do with the "overdraft" features of the invention hereinafter described, its purpose being to prevent further addition when an overdraft has occurred. The manner in which this is accomplished will be explained hereinafter.

Overdraft mechanism and its operation.—When the total of the items subtracted from the upper accumulator exceeds the total of the items added on said accumulator, a condition occurs causing the mechanism that coordinates with the total or balance keys to become inoperative, thus indicating to the

operator, when he attempts to depress the total or balance keys, that an overdraft condition prevails.

In Figs. 8, 9, 12 and 13, disclosure is given of only so much of the upper accumulator as will afford a clear understanding of how the overdraft mechanism operates in connection with the shift bar N90 and the subtracting pawl or hook N62 and adding wheel N50 and two point carrying cam N56 of the highest order of the set of accumulator wheels; the accumulator wheel N50 of the highest order appears most clearly in respect to position, in Fig. 8, all of which elements appear in Ellis Patent No. 1,203,863. It will be understood, however, that the adding hook or pawl, the controlling cam plates and other mechanism of the combined adding and subtracting accumulator are omitted as they will be clearly understood from Patent No. 1,203,863.

Pivoted to the order plate 53N of the highest order by a stud N16, is an overdraft lock latch 66N. A spring 81N which cooperates with the overdraft lock latch 66N and the order plate 53N, tends to swing the overdraft lock latch so that its point X' will move in a clockwise direction. This movement is prevented when the shift bar N90 is set for addition as shown in Fig. 9, there being a rounded projection X'' on the overdraft lock latch which is pressed downwardly by the shift bar N90 when the latter is set for addition. Consequently when the accumulator is set for addition as shown in Fig. 9, the pointed end X' performs no function.

However, when the shift bar N90 is set for subtraction, as will be the case when the subtracting key K67 is depressed and the machine operated, the turning of the shift bar N90 from the position shown in Fig. 9 to the position shown in Fig. 12, relieves the pressure against the projection X'' and thereupon the spring 81N turns the overdraft lock latch 66N so that the point X' comes against the rear end of the subtracting pawl or hook N62 which arrests it as shown in Fig. 12. The turning of the wheel N50 of the highest order either directly by rack R50 or by carrying, resulting in an accumulation of subtracted items, causes the cam N56 to engage the tip of the subtracting pawl or hook N62 by moving from the position shown in Fig. 12 to that shown in Fig. 13, thus depressing the left hand end of the subtracting pawl and elevating the right hand end thereof. This action results in the release of point X' so that the spring 81N immediately swings the overdraft lock latch to the position shown in Fig. 13 whereupon it engages the rear end of the subtracting pawl or hook N62 and holds it in that position until released as hereinafter described.

The movement and position of the overdraft lock latch 66N controls signals or locks and distinctive printing of the overdraft item as will presently appear. To utilize this movement there is provided an overdraft shaft N6 suitably journaled in the side frames of the machine and carrying a crank N68 which has a pin K11 received in the slotted upper end of the overdraft lock latch 66N.

Starting bar mechanism.—The starting mechanism for the electric drive may be of the general construction shown in the patent to Perkins No. 1,136,165 although not precisely similar thereto. A substantially circular operating lever M56 is pivoted to the frame at 14M and is provided with a retracting spring M83 (Figs. 8, 9). The link M55 operates means not necessary to describe. The three-armed pivoted lever M57 is the controlling device for the electric motor drive. The starting bar M91 is carried by pieces M69 and M70, the former being connected to the lever M57 and the latter to the circular lever M56. When the starting bar M91 is depressed, the circular lever M56 is turned against the tension of the spring M83 and the pin M57' releases the operative connection to the electric drive. On moving the hand from the starting bar M91, the parts are returned to normal position by spring M83. The starting bar is normally locked but is released when the controlling keys are operated, as set forth in the Ellis patents. Only so much of this normal locking mechanism is disclosed as will illustrate this feature. A shaft M4 extends across the machine to the mechanism on the left side which is under the control of the controlling keys. An arm M052 is secured to shaft M4 and is pivotally connected to a bell crank locking device M58 which is adapted to engage a square stud 22M carried by the ring-shaped lever M56.

Lock or signal for total or balance keys.—To prevent the "balance" or total key K63 for the upper accumulator and the sub-total or total deposits key K64 from being operated when the upper accumulator represents an overdrafted condition, means are provided for automatically locking these keys when this condition prevails, said means being operated from the overdraft shaft N6.

Referring to Figs. 1, 2, 8, 11, there is provided on the left hand end of the shaft N6 a crank N68^b. Pivoted on the screws L19L of the latches 56L and L56 for the keys K64 and K63, are locks 67L and 68L whose lower ends are positioned so that they can be engaged with notches 167L in the stems of keys K63, K64, when said keys are in elevated or normal position. For the purpose of causing the locks 67L, 68L, to engage the notches 167L or to be released therefrom by the turning of overdraft shaft N6, there is provided an operative connection comprising

a link 69L pivoted to the crank N68[b] and a link or slide bar 66L pivotally connected to link 69L at L24L. The link 66L is pivoted to studs L18L on the upper ends of the locks 67L, 68L. Near the rear end of the slide bar 66L there is a slotted part 66L[a] which slides on a pin or stud L20L on the side frame of the machine, thereby guiding and suspending the bar 66L. Normally the crank N68[b] is in the position shown in Figs. 1 and 8 even when the subtracting key K67 is depressed.

When an overdraft condition exists in the upper accumulator which causes the overdraft latch 66N to move to the position shown in Fig. 13, the rocking of the shaft N6 turns the crank N68[b] backwardly and thereupon the locks 67L, 68L, are swung so that their lower ends engage the notches 167L as shown in Fig. 2. This results in locking the keys K63 and K64 so that the operator cannot take a total or sub-total and a signal is thus given, indicating to the operator that the account is ovedrawn and necessitating the manual operation of the decimal slide P67 or such other means as may be employed to unlock the keys K63, K64.

When an overdraft has taken place, no further addition should be permitted in the accumulator. Referring to Figs. 1, 2 and 8, there is provided a hook 69L[a] on the link 69L which is normally free of the pin or stud D21 carried by the piece D58 which is pivoted to the frame at 11L but when an overdraft occurs and the link 69L moves rearwardly, the hook 69L[a] embraces the pin or stud D21 which renders the piece D58 inoperative, thereby preventing any addition from taking place in the credit accumulator. Reference is to be had to Ellis Patent No. 1,197,276 for a more detailed disclosure of the piece D58 and its functions.

My invention also contemplates the provision of a visual signal, suitably displayed to attract the operator's attention when an overdraft occurs, said signal being operated by the overdraft mechanism.

Two embodiments of the visual signal are hereinafter described, both of which are adapted to print an overdraft item with a distinguishing characteristic. One mechanism prints the overdraft item in a distinguishing color, say red; the other mechanism prints an identifying signal or sign in connection with an overdraft item and is also, by preference, adapted to print signals to show that an item is a total, or, a subtracted item, or that the machine is clear.

Means for releasing the overdraft lock or locks.—As previously stated, the total and sub-total key locks remain in locked arrangement until the operator deliberately releases them which is done by manipulating the decimal slide P67 or other suitable means provided for that purpose. A shaft I1 which is suitably mounted in bearings on the machine frame carries a crank E60 which is provided with one or more set screws so that it can be adjusted for proper operation. A horizontally slidable set link 73P which is pivoted to the crank E60, has its beveled forward end 730P arranged back of the decimal slide P67 in position to be engaged by a double cam A carried by said decimal slide. Normally the decimal slide is in its right hand position as shown, for instance, in Fig. 4, so that there is no interference with the forward movement of the set link 73P when the overdraft shaft N6 turns to swing the crank N68[b], rearwardly to lock the total and sub-total keys K63, K64. The set link 73P is moved to the rear to turn the shaft I1 and, through the cranks E60, N68[b], to unlock the keys K63, K64, by moving the decimal slide P67 so that the cam A thereof will engage the tip 73P of the set link 73P. By this means, the keys K63, K64, are unlocked so that the machine may be operated to print the number representing the overdraft or the complement thereof.

The movement of the decimal slide P67 to unlock the total and sub-total keys also sets ribbon mechanism for printing the overdraft in a dintinguishing color, say red, as will now be described and it serves to prevent automatic tabulating movement of the carriage of the machine if the machine has the automatic tabulating mechanism; it also sets the signal printer so that it will print an overdraft sign or signal on the next operation of the machine. The set link 73P is provided with notches *a*, *b*, adapted to receive the end of a bowed spring P86 which is connected to the side plate of the printing section and has an end engaged with a stud P34 thereof. This detent mechanism holds the set link 73P in either its forward or rearward position, as set, and prevents accidental movement thereof. Pivoted to the set link 73P by stud 14K is a triangular shaped return latch 169P with which certain mechanism hereafter described cooperates to shift the set link 73P forwardly.

Ribbon shift mechanism and its operation.—Referring to Figs. 8, 9, 11, 14 and 15, the ribbon vibrator 51I is of the same general construction set forth in the Ellis Patent No. 1,197,276 but improved means are provided to cause the vibrator 51I to be automatically shifted to cause distinctive printing, say red, on the next succeeding operation of the machine after an overdraft and after the shifting of the set link 73P by movng the decimal slide P67.

As in the Ellis patent aforesaid, a rocker 56I pivoted at 18I to the top frame E45 of the machine is used to vertically vibrate the ribbon shift or vibrator 51I. Pivotally carried by a shaft 161I[a] which is mounted

in the top frame is a double rocker arm 161I whose rearwardly extending arm is provided with two studs 111I and 112I, (Figs. 14, 15). Pivotally suspended from the rear of the ribbon forked vibrator arm 56I is a ribbon shift arm 54I which has hook shaped slots on its forward and rearward edges respectively adapted to engage the studs 111I and 112I, at different times. The studs 111I and 112I are so spaced and the width of the ribbon shift arm 54I is such that said arm can be shifted forwardly or rearwardly for the purpose of engagement with one of the studs at a time. A shifting link 55I is pivoted to the ribbon shift arm 54I. A leaf spring I64 which is carried by a settable hub 32I on the shaft I1, has a hooked or bent part at its upper end which is received in a slot in a laterally extending stud or pin 15I carried by the shifting link 55I. There is thus provided a flexible operating connection from the shaft I1 to the ribbon shift arm 54I and the rocker 56I which operates the ribbon vibrator 51I.

Normally the set link 73P is in its forward position as shown in Figs. 3 and 4, for instance, the shift arm 54I then being in the position shown in Figs. 9 and 14, that is, engaged with the stud 111I. When thus set, the paper feed lever P74 through the link 51P which is pivoted thereto at P135 and is also pivoted to the downwardly extending arm of the double rocker 161I, causes normal operation of the ribbon fork or vibrator 51I.

When the decimal slide P67 is moved to bring its cam A against the end 730P of set link 73P, the rearward shifting of the set link 73P from the position shown in Fig. 3 to that shown in Fig. 6, for instance, results in backward swinging of the crank E60 and turning of shaft I1 which not only unlocks the total and sub-total keys but also turns the hub 32I and the spring I64 rearwardly and shifts the arm 54I from the position shown in Fig. 14 to that shown in Fig. 15 so that the notch on the rear side of the arm 54I is engaged with the stud 112I. As the stud 112I is located farther back from the shaft 161I[a] than the stud 111I, when the machine is subsequently operated, the fork or vibrator 51I is elevated sufficiently to bring the other section of the bichrome ribbon, the red section for instance, in position to receive the impression of the printing type so that a distinctive printing takes place.

Referring to Figs. 3, 5, 6, 8 and 9, pivoted to the right hand side plate P50 of the printing group by the screw P23P is a return latch 161P and a return lever 162P which are independently movable and are flexibly connected together by a spring 85F attached to studs 13P and 22F. The spring 85F tends to hold the front side of the return latch 161P against the pin 13P on the return lever 162P. The purpose of relative flexibility of the pieces 161P and 162P is to compensate for any unusual strain which would result if the decimal slide P67 is not in proper position when the machine is operated as, for instance, if it is left with the cam A engaged with the tip 730P of the seat link 73P.

A spring 86P connects the operating return lever 162P and the clear signal lever 61P at a suitable position to apply the requisite tension to the lever 162P to hold the lower end of the lever against the pin P135 which is carried by the paper feed lever P74.

As previously described, the set link or bar 73P is normally in the position shown in Figs. 3 and 17 but when an overdraft has occurred and the machine is locked, the operator shifts the decimal slide P67 to cause the cam A to engage the end 730P of the set link 73P to shift the set link 73P rearwardly to set the ribbon mechanism so that on the next operation of the machine the overdraft item will appear in a distinctive color, say, red. For the purpose of returning the set link 73P to its normal position, the latch 161P and the return lever 162P are provided. When the machine is operated, the turning of the 01 shaft causes the printing pitman 061 to turn the crank 0160 and as this is fixed on the same shaft with the paper feed lever P74, said lever is turned from the position shown in Fig. 5 to that of Fig. 6. The lowering of the stud P135 causes the tail of the return lever 162P to follow it by reason of the tension of spring 86P and the return latch 161P finally passes beyond the right hand end of the pivoted latch 169P carried by the set link 73P. Therefore, on the return of the parts to the normal position shown in Fig. 3, the latch 161P engages the latch 169P and first shifts the set link 73P back to the normal position of Fig. 3 and then slips past said latch 169P.

The forward stroke of the parts results in the paper feed lever P74 pulling upon the link 51P and rocking the double rocker 161I for the purpose of pulling downwardly the depending arm 54I and thus elevating the ribbon vibrator 51I. On the return stroke of the parts the paper feed lever P74 pushed on the link 51P and restores the ribbon vibrator 51I to normal position but without effect on the shaft I1 because of the use of the yielding spring I64 which prevents transmission of motion to said shaft I1.

The foregoing movements occur when numbers are being added, subtracted, or listed without being printed in a distinctive color, as under ordinary conditions of op-

eration. The adaptability of the arm 54I to shift so that the leverage applied thereto in pulling said arm 54I downwarlly will determine the extent of downward movement of said arm 54I, results in the ordinary, or in an unsual, extent of movement of the ribbon fork 51I according to the nature of the operation.

Without restricting this part of the invention to dimensions, in practice, if the arm or link 54I is engaged with the stud 111I, which is the normal condition, this stud being located nearest the shaft 161I^a, the upward travel of the ribbon, when the machine is operated, is about 5 mm., whereas if the arm or link 54I is engaged with the stud 112I, the greater distance of stud 112I from shaft 161I^a, results in about double the upward shift of the ribbon, say 10 mm. Consequently by the use of a bichrome ribbon arranged so that the more distinctive color is lowermost, distinctive printing, as when an overdraft occurs, will only take place when the shaft I1 is turned backward. This occurs by shifting the slide bar or set link 73P by moving the decimal slide P67 so that the cam A engages the end 730P.

Automatic tabulation and control thereof.—In the Ellis machine, the tabulating hook F256, Figs. 3, 4, 5, 6, 7, is carried the printing pitman 061.

The tabulating lever F667 has a stud 19F which is adapted to be engaged by the tabulating hook F256 on each operation of the machine and this will ordinarily result in the tabulating lever F667 being pulled down and the lever 50F turned to elevate the plungers 153F, 154F, just as would occur were the tabulating key K60 depressed. Consequently on the return stroke of the shaft 01, the tabulating hook F256 ordinarily will cause tabulation to take place automatically.

To prevent automatic tabulation from occurring on the next operation of the machine after an overdraft has occurred or at any other time when automatic tabulation is not desired, as when the decimal slide P67 has been moved from its normal position for the purpose of shifting the set link 73P and releasing the locks, there is provided a control lever 00—150 (Figs. 3 to 7) which is pivoted to a stud 00—10 on the side frame of the machine and is provided with an upright extension or arm 00—51 which is so arranged that it is normally engaged by the decimal slide P67 when the latter is in its right hand position. The control lever or cut out 00—150 is connected by spring 180F to the frame at 00—53. The spring 180F tends to draw the control lever or cut out 00—150 from the position shown in Fig. 4 to the position shown in Fig. 7 but the decimal slide P67 by its engagement with the extension 00—51 normally prevents the spring 180F from thus moving the control lever 00—150. Consequently, the pin 19F on the tabulating lever F667 is exposed to the tabulating action of the hook F256 on each operation of the machine unless the decimal slide P67 is moved sufficiently from the position shown in Fig. 4 to permit said control lever 00—150 to prevent this action.

The control lever 00—150 is provided with a hooked end composed of the parts 00—1501 and 00—1502. When the decimal slide P67 is moved from its right hand position, the pressure on the extension 00—51 is released and the spring 180F then draws the hooked end of the control lever over the stud 19F on the tabulating lever F667 as shown in Fig. 7, which results in guarding the pin 19F from engagement by the tabulating hook F256 and automatic tabulation is thus prevented.

Inasmuch as the decimal slide P67 is moved by hand for the purpose of releasing the machine after an overdraft has occurred, the cut out lever 00—150 is immediately positioned to prevent automatic tabulation when said decimal slide is moved to the extent of only one point to the left.

Regardless of whether an overdraft condition of the machine has occurred, automatic tabulation can be prevented by merely moving the decimal slide P67 sufficiently to enable spring 180F to cause the hook 00—1501; 00—1502 to move over the stud 19F to block the engagement of the tabulating hook F256 with said stud 19F.

Signal printing mechanism.—In Figs. 17 to 21, signal printing mechanism is shown embodying improvements on the signal mechanism of the Ellis Patent No. 1,065,792, June 24, 1913, and, also, novel means for printing a sign opposite an item which represents that a corresponding amount has been subtracted from the amount or amounts stored in the accumulator or accumulators. Figs. 17 to 21 also disclose novel mechanism for printing a sign opposite an item representing a credit balance or what is known as an "overdraft" item, or the complement of such item. The mechanism last specified affords a printing signal or distinguishing characteristic which identifies a credit balance or "overdraft" item not only on the outermost sheet carried by the platen but, also, on all carbon copies being taken. This signal printing mechanism for a credit balance or "overdraft" item therefore marks the given item on all the sheets so as to identify that item aside from its identification by being printed in a distinctive color as previously explained.

The mechanism disclosed in Figs. 17 to 21 for identifying a credit balance or "overdraft" item by printing a special sign or signal adjacent said item may be used separately from the special distinctive color or

ribbon shift mechanism hereinbefore set forth, or employed in the same machine with said distinctive color or ribbon shift mechanism.

The printing of identifying signs or signals opposite items representing the totals or sub-totals taken from the debit and credit accumulators is effected in substantially the same manner as set forth in the Ellis Patent No. 1,065,792, June 24, 1913. Novel mechanism additional to the mechanism of Patent No. 1,065,792 is herein provided for operating the signal printer to identify an item representing a subtracting operation. Other novel mechanism is provided, operated by the "overdraft" mechanism, for operating or setting the signal printer to identify a credit balance or "overdraft" item.

Referring to Figs. 17 to 21, the platen of the machine is shown at P. The cams which swing the frames 51N—56N carrying the accumulator wheels N50 to cause said wheels to engage or disengage the racks R50 are secured to the shafts N1 and 1N of the upper and lower accumulator. The upper cam N67R has a pin 11A and the lower cam 67NR has a similar pin 11A. A forked arm 60P which is pivoted at P10P is normally free from engagement by the pins 11A of both cams N67R and 67NR as shown in Fig. 17. The cooperation of the pins 11A of the upper and lower cams with the forked arm 60P is the same as explained in the Ellis Patent No. 1,065,792, the pin 11A of the upper cam N67R being adapted, when said cam is moved, to swing the forked arm 60P a shorter distance to the left than will occur when the lower cam 67NR moves.

These movements are transmitted to the signal or sign printing arm 65P so that either a "D" sign will be brought into line to print, or a "C" sign, as the case may be.

Sign printing arm 65P is pivoted on the same center P10 as that of the right hand printing type segment P54 of the printing group, the sign printer and the right hand segment P54 being carried by pivoted arm P52. Each printing segment P54 is operated by its own link P53 as will be understood from the Ellis patents, for instance, No. 1,065,792.

Pivoted on the screw pin P10P is a lever 61P to which reference has heretofore been made, said lever being connected to arm 60P by a contractile coil spring P88 attached at P11P, the tendency of the spring being to draw the lever 61P upwardly. As distinguished from the operative connection between lever 61P and the signal printing arm as set forth in Ellis Patent No. 1,065,792, there is provided a link 23.55, said link being provided with a slot 23^a and having pins 23.12 and 23.13. A stud 23P17P is carried by the lever 61P and projects into the slot 23^a. A contractile coil spring P81 has one end connected to the pin 23.13, its other end being attached to the stud or pin 23P17P. This spring tends to normally pull the link 23.55 downwardly so that the upper end of the slot 23^a abuts the pin 23P17P.

Pivoted on the screw pin P10P back of the forked arm 60P is a bell crank lever 23.52 whose horizontal arm bears on the stud 23P17P. The bell crank lever 23.52 has a pin 23.52^a. A contractile coil spring P80 which is connected to the pin 23.52^a is of sufficient strength, when stretched by the movement of the bell crank lever 23.52 to the position shown in Figs. 18 and 20, to overbalance the spring P81 and to thereby overcome the tendency of said spring to draw down the link 23.55 and consequently, when the bell crank lever 23.52 is thus shifted, the signal printing arm 65P is shifted so that the signal used to identify a subtracted item will be brought to the printing line.

The shift bar N90 carries on its right hand end an arm 23.54 to which is pivoted a link 23.53 having a fork which straddles a stud 23.11 carried by the downwardly extending arm of the bell crank lever 23.52. Except when a subtracting operation is being carried on, the shift bar N90 lies in the position shown in Figs. 17 and 19 and the spring P80 actuates the bell crank lever 23.52 to hold the stud 23.11 in the rear end of the fork of the link 23.53. When an operation of subtraction is carried on, as hereinbefore described, the shift bar N90 moves to the position shown in Figs. 18 and 20, this action putting the spring P80 under such tension that it overbalances the spring P81 and elevates the link 23.55 and moves the signal printer 65P a greater distance than it would travel if the shift bar N90 was not operated although a printing operation was taking place. Consequently the signal printing arm 65P travels a greater distance when a subtracting operation is performed than it does when other operations take place.

A detent 62P, which is pivoted at P14P has its lower end adapted to cooperate with the paper feed lever P74 in the manner set forth in Patent No. 1,065,792. A contractile coil spring P85 which is attached to a stud P12P on the lever 61P and to a stud P13P on the detent 62P tends to turn the detent 62P in a clockwise direction. The detent 62P is provided with notches 1, 2, 3, which are adapted to engage the stud P12P to lock the lever 61P, according to the position of the latter, when the paper feed lever P74 has moved.

If the machine is set for the performance of addition, at the time the paper feed lever P74 moves, the detent 62P is swung by its spring P85 so that the notch 1 en-

gages the pin P12P and thus holds the signal printing arm 65P in inoperative position so that no sign or signal of the series carried thereby will be brought to the printing line.

If the machine is set for taking either a "DR" total or sub-total, the movement of the forked arm 60P shifts the lever 61P and the notch 2 then engages the pin P12P and locks the lever 61P and the link 23.55 so that the printing arm 65P is held in the proper position to print the sign or signal, for instance "D". If the machine is set to take a "CR" total or sub-total, the forked arm 60P is moved as explained in the Ellis Patent No. 1,065,792 and the lever 61P is correspondingly moved and notch 3 then engages pin P12P so that the proper sign, say "C" of the printing arm 65P is locked in position to be brought to the printing line when the machine is operated.

The slidable set link 73P is provided with a depending cam plate P90. The lever 61P has a roller P91 which is so disposed when the set link 73P is in its normal position it does not interfere with the roller P91 and there is no interference with the usual movements of the lever 61P. When, however, an "overdraft" has occurred, the operator is apprised of that fact by the locking actions hereinbefore set forth and it becomes necessary for the decimal slide P67 to be moved to its extreme left hand position for the purpose of causing the cam A to engage the point 730P of the set link 73P. This results in shifting the set link 73P rearwardly to the position shown in Fig. 19 which brings the cam end of the plate P90 over the roller P91 and into engagement therewith, thus depressing the lever 61P As the normal tendency of the spring P81 is to pull the link 23.55 upwardly so that the upper end of the slot 23^a is against the stud 23P17P, this action of cam P90 on roller P91 results in swinging the signal printer 65P to such position that when the machine is operated a suitable identifying or distinguishing sign, such as "CR", which has been brought to the printing line, prints opposite the overdraft item. Assuming that the ribbon shift mechanism heretofore described is used, the identifying sign "CR" will be printed in a distinguishing color, say red, on the "original" or outer sheet on the platen P and it will also appear on all carbon copies being taken so that overdraft items are identified on all copies, just as total, sub-total, and subtracted items are identified by their respective signs as previously described.

The precise signs used to identify totals, sub-totals, subtracted items, and overdraft items may vary as any desired signs or signals may be employed. I have shown and described printing type such as "CR" for a credit balance or overdraft item identifying mark; "D" as a mark or signal representing the contents of the debit accumulator; "C" as a signal to represent the contents of the credit accumulator: and "S" to represent a subtracted item.

General operation.—An "overdraft" is manifested in the machine by the locking of the balance and total keys K63 and K64. If it is assumed, for instance, that the operator has set up an amount, or a series of items totaling, say 525.00, the credit add key (not shown but which appears at K65 in the Ellis patents) is depressed, and the starting bar M91 struck to cause the machine to operate. The amount, 525.00 which has been added in the credit accumulator, is now printed on the paper carried by the platen of the machine. Let it be assumed that it is desired to subtract the item 675.00 from the total accumulation carried by the credit accumulator which, as has been specified, is 525.00. Having set up the number 675.00 on the numeral keys and the credit subtraction key K67 having been depressed and the starting bar M91 struck, the amount 675.00 is printed and is subtracted from the accumulation in the credit accumulator

The operator now desires to find the balance of the account. Normally, on depressing the balance or total key K63 and operating the machine by striking the starting bar M91, the operation of the machine will show the balance represented by the difference between the previous total or accumulation, and the item subtracted therefrom. In the present example, however, the item to be subtracted, 675.00, exceeds the amount, 525.00, previously contained in the accumulator. In brief, in the example set forth, the subtrahend (675.00) is greater than the minuend (525.00) which constitutes an "overdraft". The machine, as previously explained, has therefore caused the locks 67L, 68L, to operate and when the operator touches the balance key K63 he finds that he cannot depress it and a signal is thus given to him that an overdraft has occurred.

It then becomes necessary to restore to normal position the locks 67L, 68L. Assuming that the decimal slide P67 which is operated by the slide B53, Fig. 16, is in its extreme right hand position as shown, for instance in Fig. 4, the operator shifts the decimal slide to its extreme left hand position, thus releasing the locks 67L, 68L, which permits the balance key K63 to be depressed. In the Ellis machine, however, the decimal slide when in its extreme left hand position also cuts off the operation of the printing mechanism so that the items may be added or subtracted without their being printed, as explained in Patent No. 1,197,276. Consequently, in order to print

the result of the subtraction of 675.00 from 525.00, it becomes necessary to return the decimal slide to the extreme right hand position. The total key K63 is then depressed and the starting bar M91 struck, whereupon the machine prints in red or other distinctive color, the contents of the credit accumulator which is then represented by the number 9,999,850.00 which represents the complement of the net amount of the overdraft.

Having the complement of the net amount of the overdraft, it is a simple matter to immediately learn what is the net amount of the overdraft. The net amount of the complement number is figured by beginning at the extreme left hand figure and adding to each figure in succession enough additional to make 9, except that in the last figure enough should be added to make 10. When the last right hand figure or figures are ciphers, they are disregarded and enough is added to make 10 to the last figure which is not a cipher. Taking for example the specific amounts hereinbefore given, the complement of the net amount of the overdraft being 9,999,850.00, we begin at the left hand numeral and add enough to each numeral in succession to make 9. In the complement above noted the first four numerals at the left are already 9, so that they can be disregarded and to the next numeral 8 it is found it is necessary to add 1 which is then set down. The next numeral is 5 but as this is the last significant figure it is necessary to add enough to make 10 and consequently 5 is set down. The remaining columns are filled out by annexing ciphers.

The net amount of the overdraft is therefore easily found to be 150.00.

If it is desired to figure the net amount of an overdraft by operating the machine, this can be done in the following manner, taking the foregoing items of 525.00 for the minuend and 675.00 for the subtrahend. The complement of the overdraft which is 9,999,850.00 is transferred from the upper or credit accumulator into the lower or debit accumulator, assuming that the debit accumulator has first been "cleared". The transfer from the upper accumulator to the lower accumulator sets back to "cipher position" the wheels of the upper or credit accumulator. The next operation is to depress the debit total key, which is the key for taking totals from the lower or debit accumulator, said key not being shown but appearing at K66 in the Ellis patent. The subtraction key K67 is also depressed. The machine is then operated. This operation causes the contents of the debit or lower accumulator, into which has been put the complement (9,999,850.00) to be subtracted from the upper or credit accumulator. As previously explained, the gears of the upper or credit accumulator have been turned back to "cipher position" and, therefore, the operation which is now taking place is the subtraction of the complement (9,999,850.00) which is in the lower or debit accumulator from zero or nothing in the credit or upper accumulator. Therefore, this action automatically creates another overdraft in the credit or upper accumulator and the following operation shows the net difference which is 150.00.

It now becomes necessary to print the balance or contents of the upper or credit accumulator to show the amount of the overdraft. The decimal slide having been in the previous operations moved to the extreme left, must now be moved to the right which serves to unlock the key, as hereinbefore described, and also causes the ribbon mechanism to be set in a manner which will cause the net amount of the aforesaid overdraft, which is 150.00, to appear in a distinctive color, say red, when the starting bar M91 is operated. The item is also identified by the mark "CR" on the original ledger sheet and on all carbon copies being made.

I claim:

1. In a calculator, the combination with an accumulator, of a key for controlling the printing of the condition of the accumulator, and means adapted to automatically, and invariably, lock said key each time an "overdraft" occurs in the accumulator.

2. In a calculator, the combination with an accumulator, of total and sub-total keys, and means adapted to automatically, and invariably, lock either or both of said keys each time an "overdraft" occurs in the accumulator.

3. In a calculator, the combination with an accumulator, of a key for controlling the printing of the condition of the accumulator, means adapted to automatically, and invariably, lock said key each time an "overdraft" occurs in the accumulator, printing means, and means adapted to cause the printing means to print an "overdraft" item with a distinguishing characteristic.

4. In a calculator, the combination with an accumulator, of total and sub-total keys, means adapted to automatically, and invariably, lock either or both of said keys each time an "overdraft" occurs in the accumulator, printing means, and means for causing said printing means to print an "overdraft" item with a distinguishing characteristic.

5. In a calculator, the combination with an accumulator, of a key for controlling the printing of the condition of the accumulator, means adapted to automatically, and invariably, lock said key, each time an "overdraft" occurs in the accumulator, printing means, and means for causing the print-

ing means to print an "overdraft" item in a distinguishing color.

6. In a calculator, the combination with an accumulator, of total and sub-total keys, means adapted to automatically, and invariably, lock either or both of said keys each time an "overdraft" occurs in the accumulator, printing means, and means for causing the printing means to print an "overdraft" item in a distinguishing color.

7. In a calculator, the combination with an accumulator, of a key for controlling the printing of the condition of the accumulator, means adapted to automatically, and invariably, lock said key each time an "overdraft" occurs in the accumulator, printing means, multi-color inking means for said printing means, said inking means and printing means being adapted for relative shifting, and means for causing said printing means and inking means to relatively shift to cause printing of an "overdraft" item in a distinguishing color.

8. In a calculator, the combination with an accumulator, of total and sub-total keys, means adapted to automatically, and invariably, lock either or both of said keys each time an "overdraft" occurs in the accumulator, printing means, multi-color inking means for said printing means, said inking means and printing means being adapted for relative shifting, and means for causing said printing means and inking means to relatively shift to cause printing of an "overdraft" item in a distinguishing color.

9. In a calculator, the combination with an accumulator, of a key for controlling the printing of the condition of the accumulator, means adapted to automatically, and invariably, lock said key each time an "overdraft" occurs in the accumulator, printing means, shiftable multi-color inking means, and means for shifting said inking means to enable an "overdraft" item to be printed in a distinguishing color.

10. In a calculator, the combination with an accumulator, of total and sub-total keys, means adapted to automatically, and invariably, lock either or both of said keys each time an "overdraft" occurs in the accumulator, printing means, shiftable multi-color inking means, and means for shifting said inking means to enable an "overdraft" item to be printed in a distinguishing color.

11. In a calculator, the combination with an accumulator, of a key for controlling the printing of the condition of the accumulator, means adapted to automatically, and invariably, lock said key each time an "overdraft" occurs in the accumulator, printing means, shiftable bichrome ribbon means, and means for shifting said bichrome ribbon means so that an "overdraft" item will be printed in a distinctive color.

12. In a calculator, the combination with an accumulator, of total and sub-total keys, means adapted to automatically, and invariably, lock either or both of said keys each time an "overdraft" occurs in the accumulator, printing means, shiftable bichrome ribbon means, and means for shifting said bichrome ribbon means so that an "overdraft" item will be printed in a distinctive color.

13. In a calculator, the combination with an accumulator, of a key for controlling the printing of the condition of the accumulator, means adapted to automatically, and invariably, lock said key each time an "overdraft" occurs in the accumulator, and manually operable means for releasing the locking means to permit the controlling key to be operated.

14. In a calculator, the combination with an accumulator, of total and sub-total keys, means adapted to automatically, and invariably, lock either or both of said keys each time an "overdraft" occurs in the accumulator, and manually operable means for releasing the locking means to permit the locked key or keys to be operated.

15. In a calculator, the combination with an accumulator, of a key for controlling the printing of the condition of the accumulator, means adapted to automatically lock said key when an "overdraft" occurs in the accumulator, printing means, means adapted to cause the printing means to print an "overdraft" item with a distinguishing characteristic, and manually operable means adapted to release the controlling key so that it may be operated and for setting the printing means so that said printing means will print the "overdraft" item with a distinguishing characteristic on the next operation of the machine.

16. In a calculator, the combination with an accumulator, of total and sub-total keys, means adapted to automatically lock either or both of said keys when an "overdraft" occurs in the accumulator, printing means, means for causing said printing means to print an "overdraft" item with a distinguishing characteristic, and manually operable means adapted to release the said key or keys so that they may be operated and for setting the printing means for printing the "overdraft" item with a distinguishing characteristic on the next operation of the machine.

17. In a calculator, the combination with a single set of registering wheels comprising an accumulator adapted for either addition or subtraction, of a key controlling the printing of the condition of the accumulator, and means cooperating with the accumulator adapted to invariably lock said key each time the total of the items subtracted exceeds the total of the items added therein.

18. In a calculator, the combination with a single set of registering wheels comprising an accumulator adapted for either addition or subtraction, of total and subtotal keys, and means cooperating with the accumulator adapted to invariably lock either or both of said keys each time the total of the items substracted exceeds the total of the items added therein.

19. In a calculator, the combination with an accumulator adapted for either addition or substraction, of a key controlling the printing of the condition of the accumulator, means cooperating with the accumulator adapted for locking said key when the total of the items subtracted exceeds the total of the items added therein, means adapted for printing the "overdraft" item with a distinguishing characteristic, and manually operable means for restoring the key-locking means to normal position and also for setting the printing means for printing the "overdraft" item as aforesaid on the next operation of the machine.

20. In a calculator, the combination with an accumulator adapted for either addition or subtraction, of total and sub-total keys, means cooperating with the accumulator adapted for locking either or both of said keys when the total of the items subtracted exceeds the total of the items added therein, means adapted for printing the "overdraft" item with a distinguishing characteristic, and manually operable means for restoring the key-locking means to normal position and for setting the printing means for printing the "overdraft" item as aforesaid on the next operation of the machine.

21. In a calculating machine, the combination with an adding and subtracting accumulator having wheels and "carrying" means therefor, of total and subtotal keys, and a lock for either or both of said keys which is operated by the "carrying" means of the highest "order" of the accumulator to invariably prevent operation of either or both of said keys each time an "overdraft" occurs.

22. In a calculator, the combination with an accumulator, of printing means, operating means for the machine, a key for controlling the printing of the condition of the accumulator, means adapted to automatically lock said controlling key when an "overdraft" occurs in the accumulator, manually operable means for releasing the locking means to permit the controlling key to be operated, a signal printer, and means adapted for arranging the signal printer when the manually operable means is operated, whereby the signal printer will print an identifying sign or signal for an "overdraft" item printed by the printing means aforesaid on the next operation of the machine.

23. In a calculator, the combination with an accumulator, of printing means, operating means for the machine, total and subtotal keys, means adapted to automatically lock either or both of said keys when an "overdraft" occurs in the accumulator, manually operable means for releasing the locking means to permit the locked key or keys to be operated, a signal printer, and means adapted for arranging the signal printer when the manually operable means is operated, whereby the signal printer will print an identifying sign or signal for an "overdraft" item printed by the printing means aforesaid on the next operation of the machine.

In testimony whereof I affix my signature.

FREDERICK W. BERNAU.