

Sept. 1, 1936.

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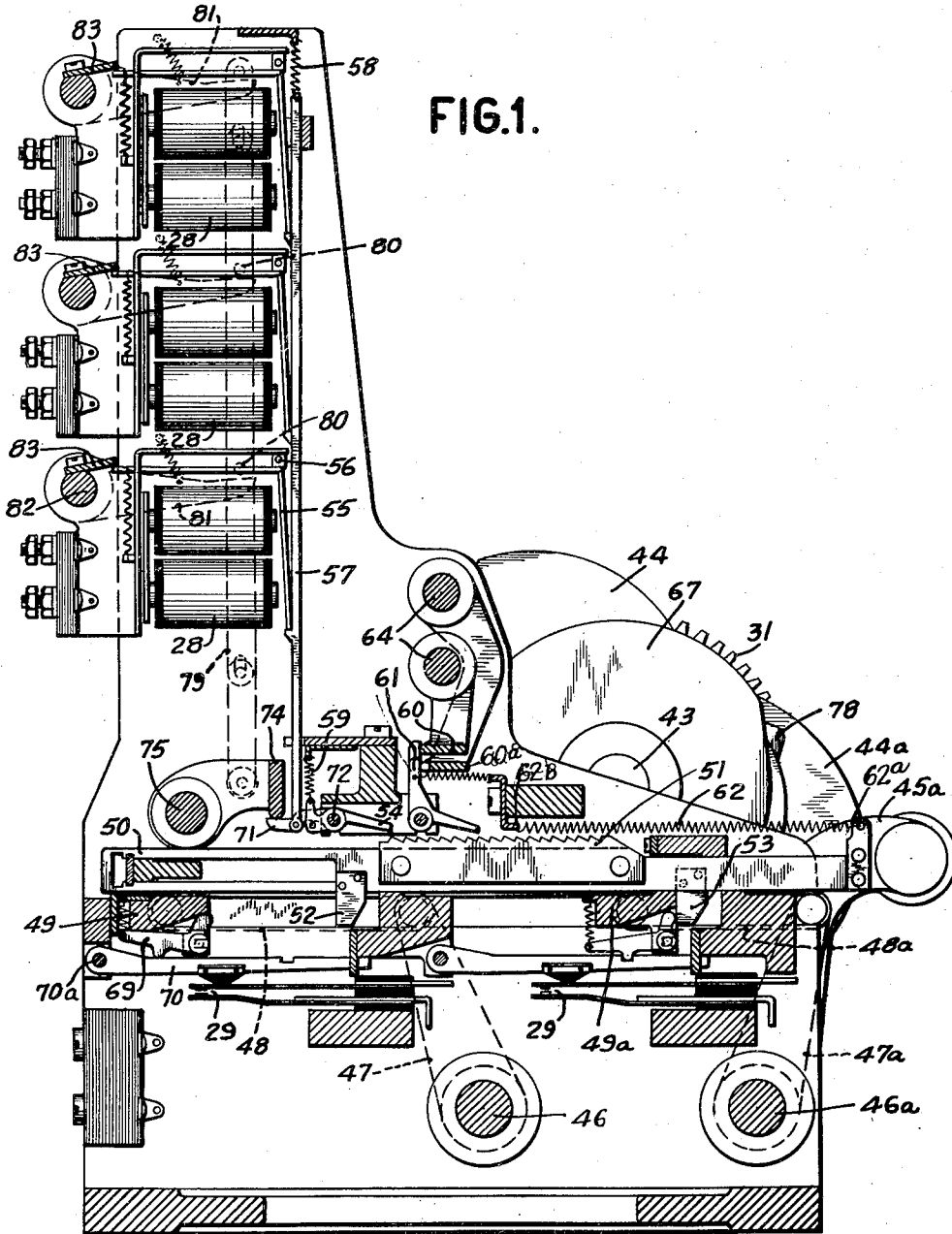
2,053,105

TRANSLATING DEVICE FOR ACCOUNTING MACHINES

Filed Feb. 3, 1931

5 Sheets-Sheet 1

FIG. 1.



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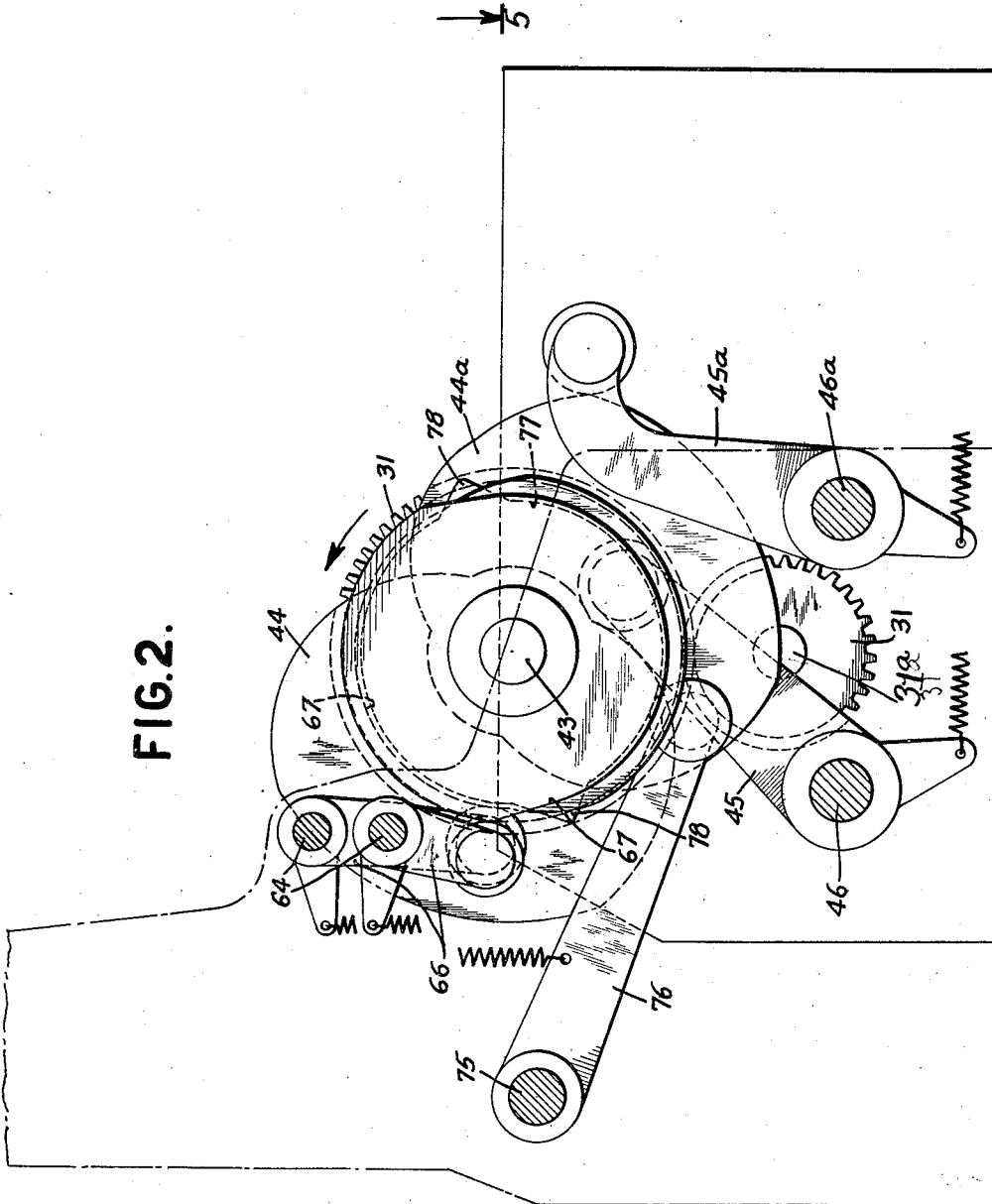
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TRANSLATING DEVICE FOR ACCOUNTING MACHINES

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5 Sheets-Sheet 2

FIG. 2.



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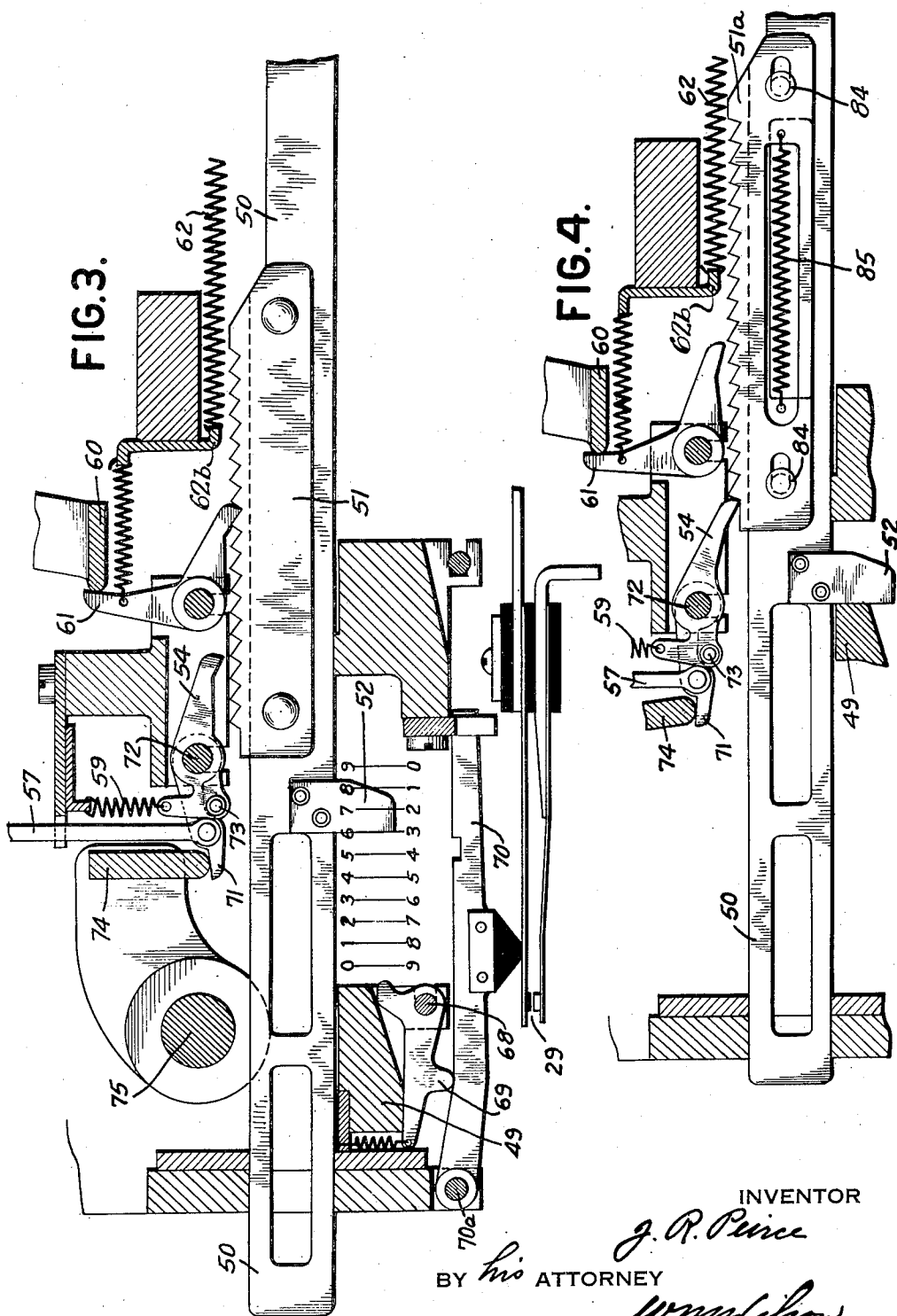
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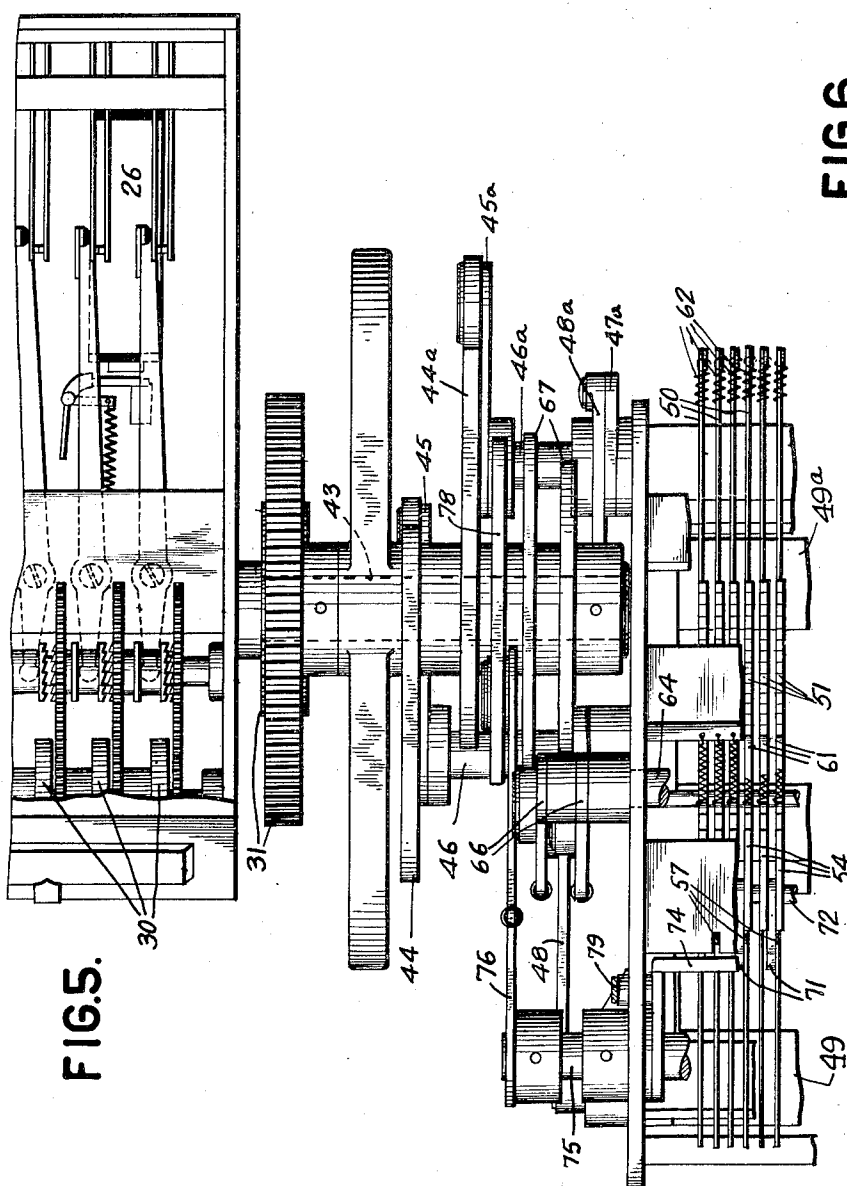


FIG. 5.

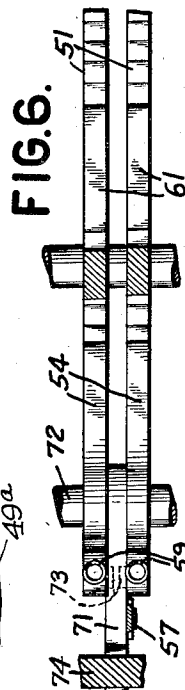


FIG. 6.

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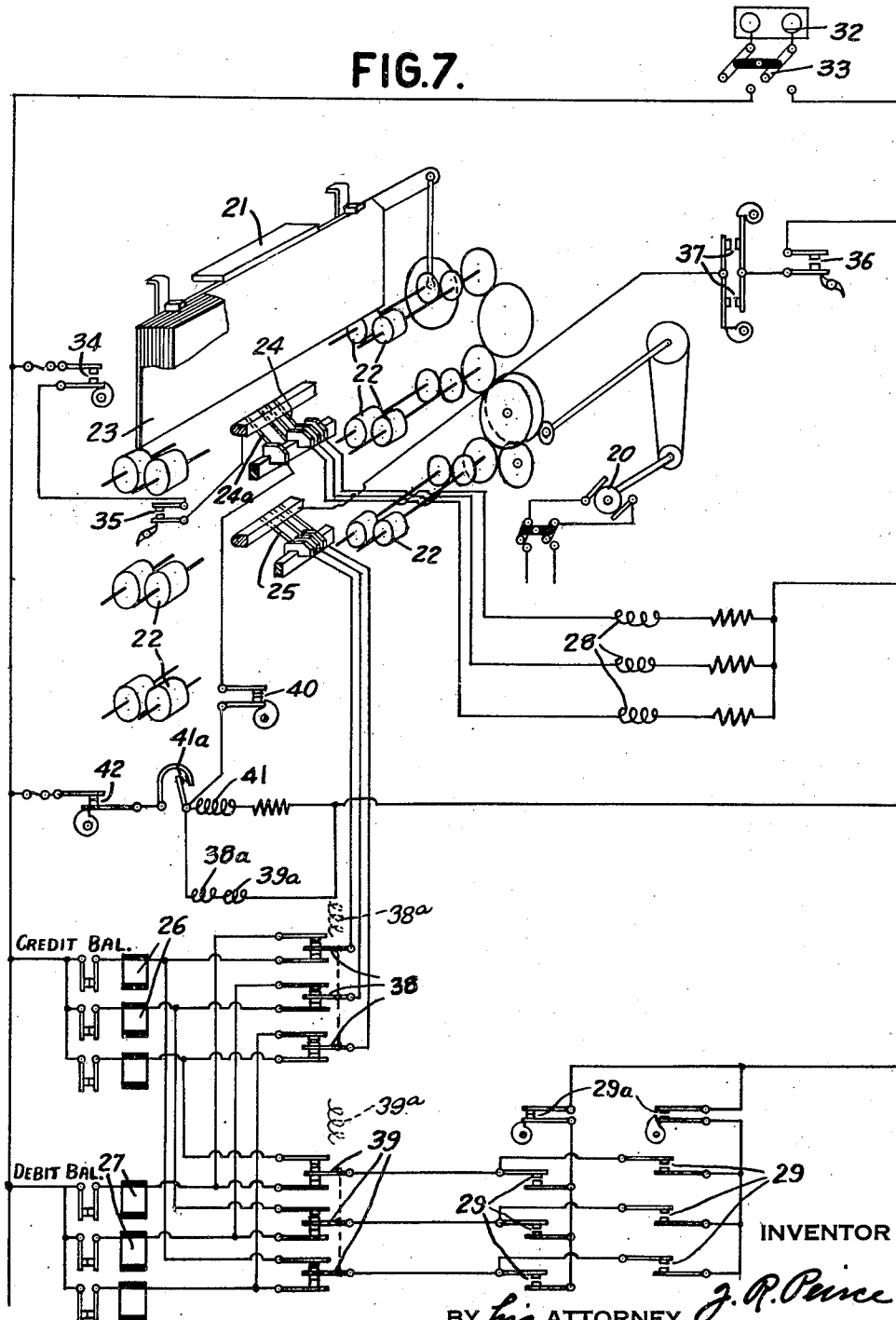
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TRANSLATING DEVICE FOR ACCOUNTING MACHINES

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5 Sheets-Sheet 5

FIG. 7.



UNITED STATES PATENT OFFICE

2,053,105

TRANSLATING DEVICE FOR ACCOUNTING MACHINES

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Application February 3, 1931, Serial No. 513,121

5 Claims. (Cl. 235—92)

The invention relates to mechanical accounting machines and more particularly to mechanism for receiving a reading from the entry control or analyzing mechanism of such machines and translating it into a reading of different meaning for entry into the accumulating and printing mechanisms of the machine.

The present invention is concerned particularly with an improved translator mechanism for use in connection with a tabulator controlled by record cards on which characters may be represented by perforations which control machine operation by initiating a single current impulse, timed in accordance with the positions of the perforations on the card to differentially control adding or printing mechanism. The characters usually represented on these cards consist of numerical data and the differential operation of the adding mechanism results in adding or subtracting the data represented on successive cards.

It is frequently desirable to control machine operation in such a way that the character manifested by the adding or printing mechanism is not identical with that represented on the controlling record but bears a logical or arbitrary relationship to it. The present invention contemplates an improved mechanism for effecting such a translation. One of the most frequent translations desired in machines of this type is from an actual number to a complement of it. Thus in mechanical subtraction actual numbers which represent minus quantities or debits are often entered on the controlling records or on a controlling key board in their true value and mechanically translated into their complements for entry into the adding mechanism. The result on the accumulators in actual figures then represents a difference between numbers although the specific operation is an adding one. This form of mechanical subtraction in the decimal system requires a figure in the units column to be translated to its ten or true complement and all figures in columns to the left of the units column to be translated into their nine complements.

The present invention further contemplates an improved method of direct translation of the figure in the units column into its ten complement thereby obviating the necessity of complementing it to nine and thereafter adding one to obtain the true complement as has generally been done formerly.

It has previously been suggested to translate data for operating record controlled machines by entering the data from record cards into the

translating mechanism during one portion of a card cycle and reading it out in its translated form during a subsequent portion of the same cycle. This results in machine cycles of unusual length and it is necessary to modify the card feed or card structure in some manner so that the active entering field of each card cooperates with the analyzing mechanism only after the data picked from the previous card has been completely translated and entered into the accumulating and printing mechanisms. According to the present invention it is proposed to translate the data with improved mechanism and without lengthening the machine cycles. This is accomplished by providing for an overlapping relationship between the reading-in and reading-out operations. Preferably the data is picked from a card and entered into the translating mechanism during one card cycle and the translated data read out of the translating mechanism and entered into the accumulating and printing mechanisms during the subsequent cycle, while data is being picked from the following card and entered into the translating mechanism for translation. The machine cycles may thus remain exactly as they were before the translating mechanism was applied.

The invention will be described for the purpose of illustration in connection with a subtracting tabulator controlled by Hollerith cards although it is to be understood that the inherent features of the translator itself and its particular cooperation with a tabulating machine make it adaptable to many and varied uses. The preferred form, however, comprises a tabulator through which controlling cards of the Hollerith type are passed successively, one each machine cycle, and from which the numerical data thereon are sensed by the analyzing mechanism and entered into the accumulating mechanism for addition.

In order to fully explain the operation of the device a subtracting tabulator of the general type disclosed in the copending application of J. W. Bryce, Serial No. 119,803, filed July 1, 1926 now Patent No. 1,950,475 and also shown in the corresponding British Patent No. 273,731, accepted October 1, 1928 has been selected for illustration. This machine is provided with upper and lower brushes spaced from each other so that the upper brushes analyze a card during one machine cycle and the lower brushes analyze the same card exactly one machine cycle later. Both debit and credit amounts are entered on the cards in their true value and cards of one class, for example debit cards, are provided with a distin-

guishing perforation which, through the analyzing mechanism, serves to modify machine operation to conform to this type of card. The machine is provided with two banks of adding units.

5 The number on each card is entered from the upper brushes into the translating mechanism and during the following machine cycle read out of the translating mechanism as a complement into one accumulator bank. During this latter
10 cycle the number is read from the card by the lower brushes and entered into the other accumulating bank in its true value. The selection between the banks into which complements and true numbers are to be entered is effected
15 by the presence or absence of the distinguishing perforation. That is, a credit card will enter a true number into one accumulator and its complement into the other while a debit card will enter its complement into the one accumulator
20 and its true value into the other. This addition of true numbers and complements in the two banks of accumulators results in the manifestation of the positive difference between the two types of items as a true number on one bank
25 and the negative difference between the same items as a complement on the other. The particular bank on which the true positive difference occurs depends on which type of items predominate, that is, if debit items predominate in
30 aggregate value the true debit balance is found on one bank and if credit items predominate in aggregate value the true credit balance is found on the other bank.

The true positive balance can be recognized by the presence of zeros on the counter elements to the left of the first significant figure, the complement of the negative balance being indicated by the presence of nines on the counter elements to the left of the first significant figure. The
40 machine thus indicates the true difference between two sets of figures and indicates whether the difference represents a debit or a credit balance.

Such a machine operating with uninterrupted
45 card feed requires a translation of data from each card and the data is entered into the translator during one machine cycle and read out of it in its transposed meaning during the following machine cycle. During this following
50 cycle the data from the following card is being read into the translator. The preferred form of the invention contemplates a single reading in or entry receiving device for each card column which receives items from every card and a pair
55 of reading out devices for each card column which are operative on alternate cards.

The principal object of the invention is the provision of an improved and simplified translator for use in connection with accounting machines.
60

Another object of the invention is to provide an improved translating mechanism which may translate data received from controlling mechanism without disturbing the normal cyclical
65 operation of the machine with which it is associated.

Another object of the invention is the provision of an improved translating mechanism in which readings are entered into the translator
70 during one machine cycle and read out during a subsequent machine cycle.

Another object of the invention is the provision of an improved translating mechanism in which readings are entered into the translator during
75 one machine cycle and read out during a subse-

quent machine cycle coincidental with the entering of a second reading into the translator and in which the number of parts is substantially reduced.

Another object of the invention is the provision
5 of an improved translating mechanism in which numerical data entered in their true value may be read out in their true complementary value.

Another object of the invention is to provide a translating mechanism in which an improved
10 type of single magnet controlled reading-in mechanism operative during every machine cycle is provided and a plurality of reading-out mechanisms are provided each operative only during
15 selected machine cycles.

Various other objects and advantages of my invention will be obvious from the following particular description of one form of mechanism embodying the invention or from an inspection of the accompanying drawings; and the invention
20 also constitutes certain new and novel features of construction and combination of parts herein-after set forth and claimed.

In the drawings:

Fig. 1 is a central section taken through the
25 translator mechanism.

Fig. 2 is a detail of the operating cam mechanism.

Fig. 3 is a detail of an entry receiving bar.

Fig. 4 is a detail of an entry receiving bar for
30 translating tens complements.

Fig. 5 is a fragmentary view illustrating the driving connections between the accumulating mechanism and the translating mechanism of a
35 tabulating machine.

Fig. 6 is a detail of a pair of selecting devices, and

Fig. 7 is a circuit diagram of a complete subtracting tabulator equipped with translators according to the invention.
40

The general operation of the machine will first be explained in connection with the circuit diagram shown in Fig. 7 and the details of translator construction by which the several objects are realized will then be described in connection with
45 the remaining figures of the drawings.

Referring to Fig. 7, a complete tabulator is indicated which for the sake of simplicity of explanation is illustrated for last card operation. That is, when a group of cards is placed in the
50 usual card magazine the entire group will be tabulated in one run without regard to the relationship of the cards to one another; and current to the brushes ceases after the last card has passed. It is obvious, however, that the invention is
55 equally well adapted to any of the automatically controlled tabulators which operate separately on different groups of cards. The tabulator is provided with an electric motor 20 which through suitable gearing and shafting operates the card
60 picker mechanism shown at 21 and the card feed rolls 22. Once each machine cycle the picker mechanism delivers one card 23 from the magazine in the usual manner to the feed rolls which pass it in succession beneath the upper analyzing
65 brushes 24 and the lower analyzing brushes 25. Each card passes the lower brushes 25 exactly one machine cycle later than it passes the upper brushes 24 and the cards are so spaced that when one card is under the lower brushes
70 the succeeding card is correspondingly located under the upper brushes, the card feed being continuous so that the brushes analyze the cards while they are in motion.

It will be assumed that debit and credit items
75

may be represented indiscriminately on the cards and that a card bearing a debit item will be identified by a perforation located outside of the amount bearing field. Cards of the Hollerith type are provided with ten index points representing the ten digits and the card is fed to the analyzing brushes so that the index point positions will be analyzed in the order 9, 8, 7, etc. Beyond the zero index point several extra spaces are provided which are used for special purposes and it is contemplated that the debit designating perforation will be placed in one of these extra spaces. A credit balance accumulator bank consisting in the present case of three accumulator units is indicated by counter magnets at 26 and a similar debit balance accumulator is indicated at 27. The translator mechanism which converts the true readings on the cards to their complements consists of reading-in magnets 28 and associated differentially positionable reading-in bars 50 and reading-out contacts 29.

The translating mechanism which controls these magnets and contacts is geared to the counter elements of the accumulators as indicated in Fig. 5. A plurality of counter elements 30 of the type illustrated in the U. S. patent to Lake, No. 1,307,740, dated June 24, 1919 are shown diagrammatically with their operating shaft 31a geared through gear wheels 31 to the translator units, a 2 to 1 driving ratio being provided so that the operating shaft 31a of the counter elements makes two revolutions while the operating shaft 43 of the translator elements makes one revolution. One accumulator unit and one translator unit is provided for each denominational order which the machine is to handle.

Referring again to Fig. 7, the machine circuits are energized from a source of energy indicated at 32 connected to the circuits through a double pole switch 33. Upper brushes 24 are energized through cam contacts 34, which close during each card cycle and open between the feeding of successive cards, and card lever contacts 35 which are closed by the cards when they are feeding under the upper brushes. The lower brushes 25 are energized through card lever contacts 36, which close when the cards are feeding under the lower brushes, and cam contacts 37, which are closed only when the index point positions of the card are passing the lower brushes and open at other times. As each card feeds past the upper brushes each of its item designating perforations instantaneously closes a circuit from one of the upper brushes 24 to one of the reading-in magnets 28. These circuits may be traced from left side of line, through contacts 34, 35, brushes 24, magnets 28 to right side of line.

The energization of magnet 28 sets up the value of the perforation sensed, and during the subsequent cycle this set up is converted into a timed impulse emanating from either of a pair of contacts 29 to enter the complement of a number on either the credit balance counter 26 or the debit balance counter 27 depending upon the position of the switches 38 and 39.

When the complement of a reading obtained from the upper brushes is being read out of the translator through contacts 29, the card which set up the reading is passing the lower brushes 25 and during this cycle will close the circuits through the lower brushes at the proper time to enter its true value into one or the other of the accumulators depending on the position of switches 38, 39. It will be recalled from the Bryce

Subtracting Tabulator patent above referred to, that when the item represented on a card is a credit item, it will be entered in its true value on the credit balance counter and as a true complement on the debit balance counter. The selection of counters is effected through the switches 38, 39 which are magnetically controlled by relay coils 38a and 39a respectively.

When these coils are deenergized the switches are in the position shown in the drawings and when the coils are energized the switches are shifted to an alternative position in which the middle contact engages the upper instead of the lower contact. The energization of these coils is controlled by the designating perforation representing a debit card. As a debit card passes the upper brushes its item will first be entered into the translator through magnets 28 to prepare for reading-out the complement during the following cycle. After this the debit perforation passes a selected one of the brushes 24 as at 24a closing a circuit through cam contacts 40 which make instantaneously as the distinguishing perforation reaches the brush and through relay 41 in parallel with the coils 38a, 39a, the energization of which shifts the switches 38, 39 to their alternative positions. When relay 41 is once energized a stick circuit is prepared for it through its relay contacts 41a and cam contacts 42 which close just before the debit denoting perforation reaches the controlling brush and remain closed until the zero index point of the following card has passed the brushes. The switches 38, 39 therefore remain shifted during the entire reading cycle in which a debit card is under the lower brushes.

A debit card then, as it passes the upper brushes will first arrange for reading out the complement of the item during the following cycle, then shift the switches 38, 39, to select the proper accumulator bank and during the following cycle, the true value of the item will be entered from the lower brushes 25 through switches 38 to the debit balance counter elements 27, while its true complement will be entered from the reading-out contacts 29 through switches 39, into the credit balance counters 26.

A credit card operates in a similar manner except that as it has no debit distinguishing perforation, the relay 41 remains deenergized, and the switches 38, 39 remain in the position shown in the drawings. In this case the true value of the credit item will be entered from the lower brushes through the switches 38 into the credit balance counter 26 and the true complement will be entered from the contacts 29 through switches 39 to the debit balance counter elements 27. As previously explained, after a plurality of promiscuously arranged debit and credit cards have passed the brushes a true credit balance will be on the credit counter if the credit items predominate in aggregate value and a true debit balance will be on the debit counter if the debit items predominate in aggregate value.

There are two contacts 29 located as shown in Fig. 1, for each denominational order and a pair of cam contacts 29a (Fig. 7) is provided to alternately connect one of each pair for controlling operation during successive cycles. The controlling cams of contacts 29a may be mounted on or driven from shaft 43.

The construction and operation of the translator mechanism will now be explained in connection with Figs. 1 to 6 of the drawings. The various operating cams are mounted upon a stub shaft 43 geared as already explained to the count-

er drive shaft so as to make one revolution for each two revolutions of the counter mechanism. A cam 44 mounted upon the shaft 43 (Fig. 2) is adapted to rock a cam follower arm 45 secured upon a rod 46. In Fig. 1 this rod 46 carries an arm 47 connected by a link 48 to one end of a cross head 49 mounted for horizontal reciprocation in the side frames of the translator unit.

A second cam 44a cooperates with a follower 45a secured to a rod 46a which also in Fig. 1 carries an arm 47a connected by a link 48a to a second cross head 49a. The timing of the cams 44 and 44a is such that the cross heads 49, 49a alternate in their movement, that is, the operating strokes of each cross head take place in alternate cycles. Slidably mounted above the cross heads 49 and 49a are a plurality of translating bars 50 mounted for horizontal reciprocation and having toothed plates 51 secured thereto. There are two of these translator bars for each denominational order of the mechanism, one of each pair of bars having a depending tab 52 attached thereto cooperating with the cross head 49 and the remaining bar of each pair having a depending projection 53 cooperating with the cross head 49a so that during one cycle as the cross head 49 moves toward the left from its right hand position only one of each pair of bars 50 will follow under the influence of its spring 62 which is connected to bar 50 at 62a and to a fixed terminal at 62b. During the succeeding cycle those bars having projections 53 will follow cross head 49a to the left and during this same cycle the cross head 49 will be restoring its associated bars 50 to their right hand position. The timing of the cross head movement is such that as the record cards being sensed pass beneath the analyzing brushes the teeth on the plates 51 pass beneath a pawl 54, one tooth passing the nose of the pawl for each index point position of the record card. The occurrence of a perforation in any index point position will, as has already been traced in connection with Fig. 7, complete a circuit to energize the corresponding magnet 28 whose energization will rock an associated armature 55 about its pivot 56 to release a link 57 so that its spring 58 may move it upwardly. This will permit clockwise rotation of the pawl 54 under the influence of its spring 59 thereby engaging the plate 51 in the tooth corresponding to the controlling index point perforation. After all the index point positions in the record card have been analyzed and the several bars 50 have been positioned in accordance with the reading of the card a bail 60 is permitted to rock in, a counterclockwise direction permitting spring pressed bell crank pawls 61 to rock into engagement with the plates 51 of translator bars 50.

There are two pawls 61 for each denominational order corresponding to the two bars 50 in each order. One of each pair of pawls 61 is controlled in its operation by a bail 60 and the other set is controlled by a similar bail 60a. These two bails are mounted on rods 64 having at their extremities (see Figs. 2 and 5) spring pressed cam follower arms 66 each cooperating with one of a pair of cams 67. The timing of the cams 67 is such that the sets of bell crank pawls 61 are permitted to rock clockwise into cooperation with their translator bars 50 during alternate cycles. As has been already pointed out, the translator bars 50 move synchronously with the passage of the record card past the analyzing brushes and a circuit completed through a perforation in the card will cause the interruption of the movement

of the associated bar at a position corresponding to the location of the perforation on the card. After the entire card has been sensed by the brushes, bell crank pawls 61 corresponding to the bars 50 which are now set are rocked into engagement with the toothed plates 51 of the translator bars to hold the same in their displaced positions. The relationship of the various parts is shown in Fig. 3 wherein a translator bar 50 is positioned to represent the entry thereon of a 6. Bell crank pawl 61 has been rocked into cooperation with the bar and the stopping pawl 54 has been rocked out of engagement with the bar. During the next succeeding cycle the cross head 49 due to the configuration of its controlling cam 44 will move toward the right in synchronism with the passage of the card past the lower analyzing brushes. The relative positions of the parts are indicated on the scale superimposed on the drawings in Fig. 3 in which the leading face of the cross head is shown at a distance from the tab 52 equal to the complementary value of the number set up on the translator bar. The leading face of the cross head will pass successively through the positions indicated below the scale, that is, 9, 8, 7, 6, 5, and so on, as the same index point positions of the card are passing the lower analyzing brushes.

Pivotaly mounted on the cross head 49 at 68 are a plurality of spring pressed members 69 arranged in the plane of the tabs 52 and adapted when rocked in a counterclockwise direction to depress arms 70 pivoted at 70a to close contacts 29. In Fig. 3, coincident with the engagement of the cross head with tab 52 member 69 will by virtue of its engagement with the tab be rocked to cause closure of contact 29. The function of this contact as has been explained in connection with the circuit diagram will complete a circuit to the proper accumulator magnet 26 or 27. In this manner the contact 29 associated with cross-head 49 is closed at a time corresponding to the complementary value of the number set up during the previous card reading cycle of the machine. Further movement of the cross head will restore the translator bar to its normal or home position preparatory to receiving a new reading from another card. Since the reading-in and reading-out of a number and its complement require two cycles, the aforescribed duplicate mechanism in each denominational order is utilized to permit the sensing of a card each cycle without loss of time.

While the cross head 49 is moving toward the right to read out the number set in one of the bars of each order the cross head 49a is moving towards the left (see Fig. 1) to permit the other bar 50 of each pair to receive a reading from the card under the upper brushes, both the cross heads moving in opposite directions and in synchronism with the passage of the card past the analyzing brushes, and subsequently when the cross head 49a is moved toward the right to cause reading out of the complements set up by its set of bars 50 through the tabs 53 the cross head 49 will be moving toward the left in synchronism therewith to set up a new number on the bars having tabs 52.

A single magnet 28 is employed to set both of the translator bars 50 in each denominational order. The structure permitting this is shown in Fig. 6 wherein the operating link 57 is pivotaly connected to an arm 71, pivoted on the rod 72 and overlying pins 73 extending from pawls 54. A bail 74 (Fig. 1) is mounted upon a rod 75 which in Fig. 2 carries a spring pressed follower arm

76 cooperating with a cam 77 having a pair of camming edges 78 disposed at diametrically opposite sections of its periphery. Through the medium of the cam 77 the bail 74 is thus actuated twice for each operation of the translator mechanism or once each card sensing cycle. As has been already pointed out, immediately following the sensing of the card by the upper brushes the bell crank pawls 61 associated with the bars 50 being positioned will lower into engagement with the bars to hold the reading set up. Immediately following this the bail 74 is rocked in a clockwise direction as seen in Fig. 1 rocking the arms 71 counterclockwise and through the pins 73 rocking the pawls 54 in a similar direction to release them from engagement with the toothed portion of the translator bars. In the next cycle the bail 74 having meanwhile been raised, magnet 28 may again be tripped to permit the clockwise rotation of pawls 54 to set up the new number. It will be recalled that at this time one of the bars of each pair is moving toward the left while the other is moving in the opposite direction. For this reason the pawls 54 are individually mounted and separately controlled by individual springs 59 so that as one of the pawls is rocking into position to intercept the bar about to be seated the bar being restored may pass under the second pawl 54 without interfering with the setting of a new number.

The bail 74 has connection with a vertical link 79 which in turn carries pins 80 cooperating with spring pressed arms 81 mounted on rods 82. The bail 83 secured to each rod 82 serves when rocked in a clockwise direction as viewed in Fig. 1 to cause rocking of armature latches 55 about their pivots 56 to positively restore them.

As has been pointed out, it is desirable to have the values in the units column converted into complements of ten. To this end the bars in the units column are provided with a relatively slidable toothed plate 51a slidable on studs 84 and urged toward the left as viewed in Fig. 4 by a spring 85. The value of the digit is entered into the toothed plate 51a in the same manner as in the other denominational orders. However, as the cross head 49 continues its movement toward the left the bar 50 will continue one step further by virtue of the spring and slot connection to the toothed member 51a thereby placing the tab 52 in a position where it will be engaged on the return movement of cross head 49 one point sooner than a corresponding setting in the other orders. This may be more apparent from a specific reference to Fig. 3 where the tab 52 is positioned to represent an entry of 6. This as has been explained will be read out as 3. In the units column this tab will be permitted to advance to the 5 position as indicated above the scale. During its reading-out movement, the cross head will engage the tab and close the contact 29 at the 4 position as indicated below the scale, this being the tens complement of the number 6.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification, it will be understood that various omissions and

substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention therefore to be limited only as indicated by the scope of the following claims.

I claim:

1. An accounting machine including data entering means and entry receiving means in combination with translating mechanism controlled by said data entering means and consisting of a pair of slidably positionable bars, means for causing said bars to alternately receive successive data entries, a pair of restoring members for alternately restoring said bars and a contact controlled by each member upon engagement of said member and said bars to cause translation of the data entries and entry of the same into the entry receiving means.

2. An accounting machine including data entering means and entry receiving means in combination with translating mechanism comprising a slidable bar controlled by the data entering means, a restoring member, said bar being adapted to be positioned relatively to said restoring member in accordance with the data entered therein, and means controlled by the relative movement of said bar and member to translate the data and enter them into the entry receiving means.

3. An accounting machine including data entering means and entry receiving means in combination with translating mechanism comprising a reciprocable bar differentially positionable during its movement in one direction under control of said data entering means, a restoring member for moving said bar in the other direction and means operative upon the engagement of said bar and member to control translation of the data entry and entry of such translated data to its complementary value into the entry receiving means.

4. An accounting machine including data entering means and entry receiving means in combination with translating mechanism, comprising a pair of differentially slidable bars, a single magnet controlled by said data entering means for controlling the differential sliding of said bars, means for causing said magnet to control said bars alternately in accordance with the controlling value, means controlled by said bars for translating the successively received data and entering them into the entry receiving means.

5. An accounting machine including data entering means and entry receiving means in combination with translating mechanism comprising a magnet and pawl mechanism controlled by said entering means, two differentially positionable bars, means for causing said bars to alternately coact with said magnet and pawl mechanism for positioning thereby in accordance with data entries, two sets of electrical contacts each controlled by a different one of said bars and means for causing said bars to alternately close their related contacts to control the entry of items into said entry receiving means.

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