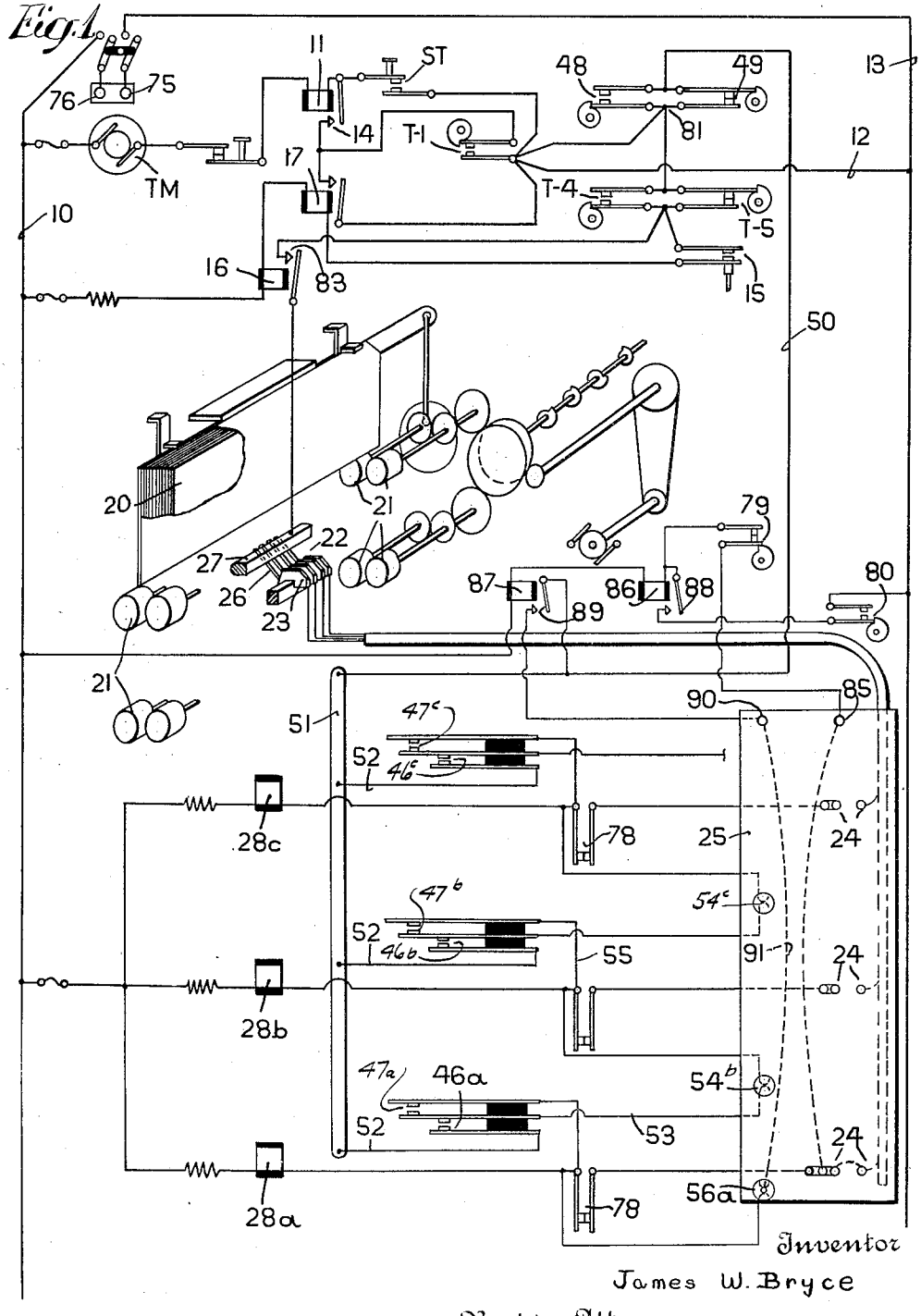
Oct. 18, 1932. J. W. BRYCE 1,882,764

ELECTRIC TRANSFER FOR TABULATING MACHINES

Filed Aug. 5, 1927 4 Sheets-Sheet 1

Fig. 1.



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ELECTRIC TRANSFER FOR TABULATING MACHINES

Filed Aug. 5, 1927 4 Sheets-Sheet 2

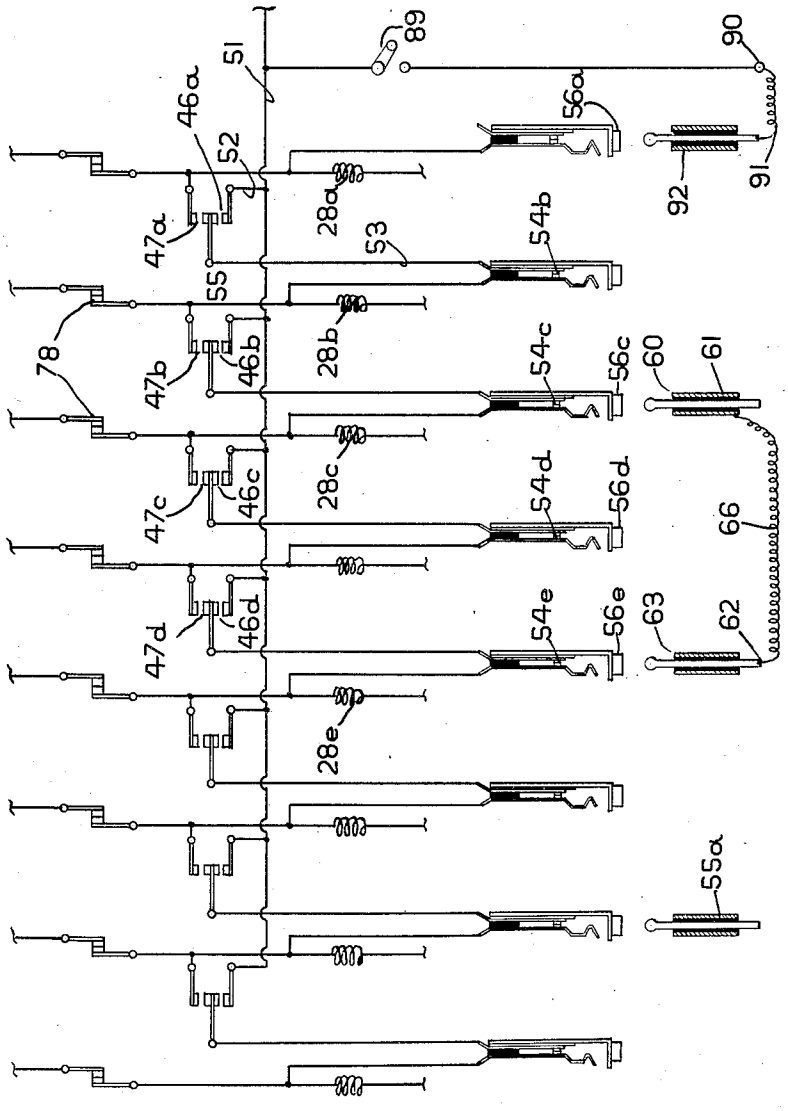


Fig. 2.

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ELECTRIC TRANSFER FOR TABULATING MACHINES

Filed Aug. 5, 1927 4 Sheets-Sheet 3

Fig. 4.

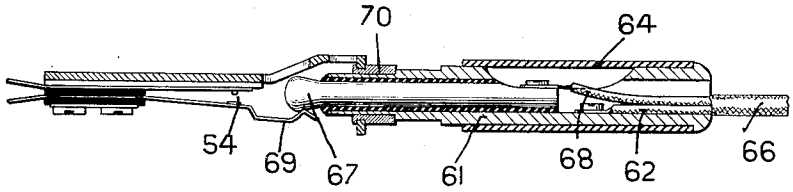
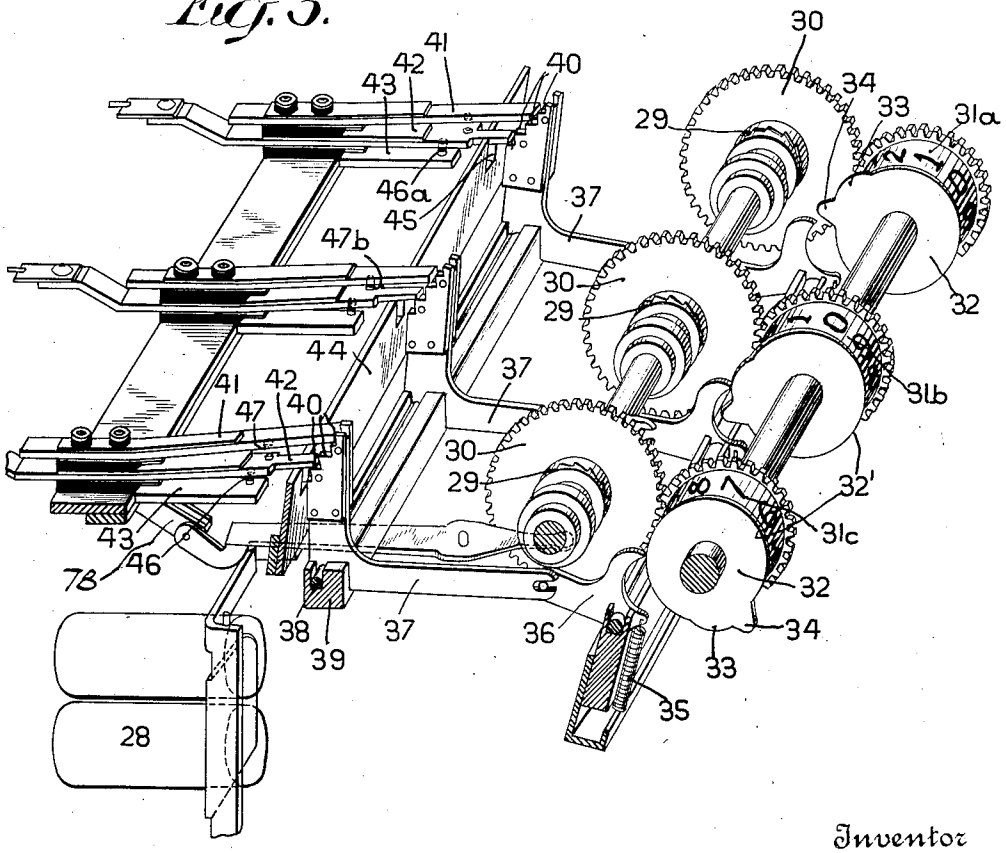


Fig. 3.



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ELECTRIC TRANSFER FOR TABULATING MACHINES

Filed Aug. 5, 1927 4 Sheets-Sheet 4

FIG.6.

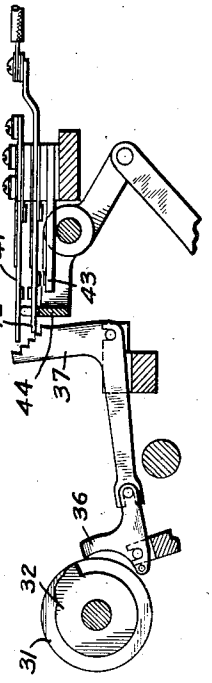


FIG.8.

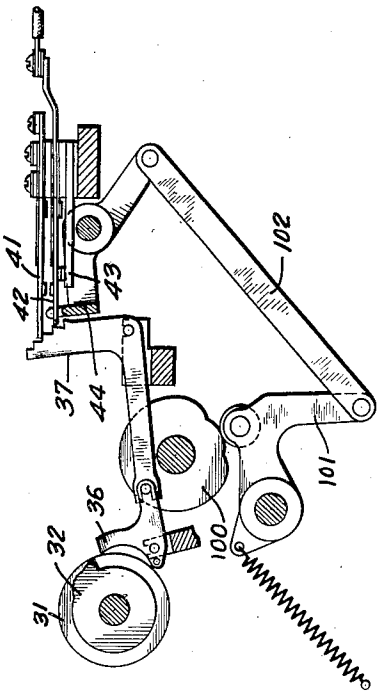


FIG.5.

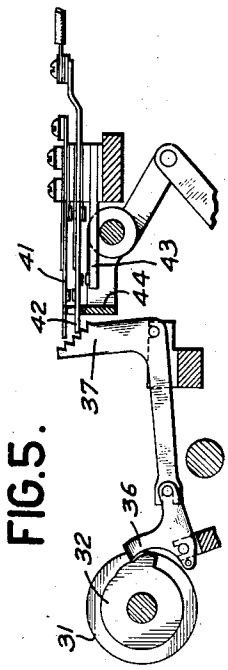
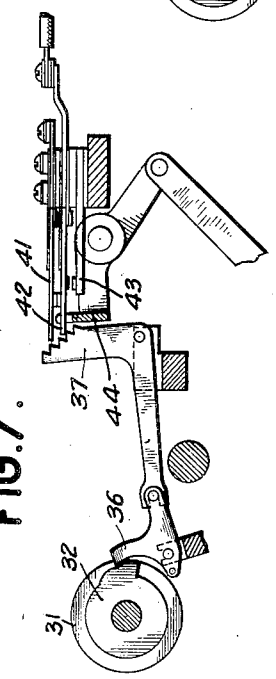


FIG.7.



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UNITED STATES PATENT OFFICE

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ELECTRIC TRANSFER FOR TABULATING MACHINES

Application filed August 5, 1927. Serial No. 210,769.

The invention relates to improvements in accounting machines and is particularly concerned with an improvement in the method of associating denominational order elements together to form accumulating banks which may consist of any desired elements regardless of their physical and structural arrangement in the machine. The invention further concerns mechanism for adapting such banks after they have been formed to either adding or subtracting operation.

The several denominational order elements of an accumulating bank in accounting machines are ordinarily provided with a fixed transfer system which provides for transferring in order from each unit to a physically adjacent one. That is, the tens and hundreds elements etc. for the bank are fixed at the time the machine is built and the order cannot be varied without redesigning the machine. In Patent No. 1,723,499, granted August 6, 1929, there is disclosed a method of associating any different elements together to form banks by forming each element as a unit including transfer transmitting mechanism and transfer receiving mechanism which is electrically controlled and which transmitting and receiving mechanism can be plugged from each unit to any other unit thereby providing for universal flexibility of operation of the machine. This differs from the prior practice in that each element is separate and requires plugging to form a bank.

The principal object of the present invention is to devise a system which shall partake of the advantages of both systems. That is, the several elements are associated together for transfer in a definite order and in effect form an accumulating bank always ready for operation as was the case in the prior form of practice. In the present case, however, the transfer transmitting mechanism and the transfer receiving mechanism of each element while normally connected, is arranged so that a simple operation will simultaneously not only interrupt the normal transfer operation but also associate any desired units together.

The preferred method of accomplishing this is to use an electric transfer system in which the transmitting mechanism of each unit is connected to the receiving mechanism of an adjacent unit by spring contacts normally in contact but adapted to be readily separated by inserting a plug between them. By the use of a suitable jack, a single operation will not only interrupt the normal transfer sequence of the units but will connect any unit to any other desired unit for transfer.

Provision is further made to adapt any bank so formed for subtracting as well as adding. The most feasible method of subtracting on accounting machines consists of entering the nine complement of a number which is to be subtracted into the accumulator and then adding one to the units order accumulator to obtain the true complement. The method of adding the nine complement does not enter into the present invention and this may be done in the case of card controlled machines by punching the cards with the nine complement or by entering true numbers on the cards and translating them by means of suitable translating mechanism. The additional one which is to be entered in the units accumulator is effected by means of a timed impulse each machine cycle and so timed that it enters one into any accumulator unit with which it is associated. Preferably this is a timed electric impulse which is applied to a plug or jack which may be inserted between the spring contacts connecting the transfer mechanism heretofore mentioned, and simultaneously interrupt the transfer system between the units and arrange for applying the timed impulse to one of them thereby fixing the latter as the units element of the bank.

The general objects then reside in new and improved means for reforming a normally operative accumulator bank into other banks, each of which may consist of any desired elements and to provide for adapting these reformed banks either to adding or subtracting operations.

Other objects and advantages will be hereinafter pointed out in the following descriptions which should be read in connection with

the accompanying drawings which show by way of example a preferred embodiment of the invention.

In the drawings:—

Fig. 1 is a circuit diagram of a tabulating machine embodying the invention;

Fig. 2 is a circuit diagram showing the machine adapted for various transferring operations and for adding the fugitive one;

Fig. 3 shows in perspective the main elements of the accumulator with the associated transfer controlling devices;

Fig. 4 shows a cross section of jack and plug.

Fig. 5 is a detail view showing an accumulator element standing at "9" with the transfer bail holding the transfer contacts apart.

Fig. 6 is a detail view showing an accumulator element standing at "0" after passing the nine position, with the transfer bail holding the transfer contacts apart.

Fig. 7 is a detail view showing an accumulator element standing at "9" with the transfer bail lowered in position to allow the upper contacts to close.

Fig. 8 is a detail view showing an accumulator element standing at "0" with the transfer bail lowered in position to allow the lower contacts to close.

The circuit diagram shown in Fig. 1 is a conventional one which has been selected to illustrate the invention in connection with a tabulator. The operation of substantially the same circuit is fully described in the patent to C. D. Lake, No. 1,307,740, and will be very briefly summarized. The motor TM which drives the card and tabulating mechanisms may be started by depressing the start key ST whereupon a circuit is established from the left line 10 through relay 11, the start key contacts, and line 12 to right line 13. Energization of relay 11 closes contacts 14 to establish a shunt circuit around the start key through cam contacts T—1, timed to open once each cycle. When cards are feeding, they close the usual card lever contacts 15 and thereby establish a circuit extending through relay 16, motor control relay 17, the card lever contacts, and cam contacts T—4 and T—5 which are timed to close the circuit during the passage of the data bearing portion of the card and open it at other times. The cam contacts T—4 and T—5 are both closed during the portions of the machine cycle when cam contacts T—1 are opened. The motor control relay when energized closes a shunt circuit around the cam contacts T—1 so that as long as cards are feeding, the motor remains in operation regardless of the periodic openings of cam contacts T—1. After the last card is fed, the card lever contacts open, deenergizing relay 17 and opening the shunt circuit around contacts T—1 which are opened near the end of the cycle, opening the TM motor operating circuit, and causing the motor to stop.

When the TM motor is in operation, and cards are in the magazine, a card 20 is fed by feed rolls 21 through well-known analyzing devices 22, the lower contacts 23 of which are individually connected to plug sockets 24 on the plug board 25. The analyzing brushes 26 have a common contact bar 27 which is ultimately connected to the right supply line. When the brushes encounter a perforation in the card, a circuit is completed through the counter magnet at a time depending on the position of the perforation in the card column, so that the counter controlled by the magnet will be actuated an amount corresponding to the position of the perforation on the card in a manner well-known in the tabulating art as for example shown and described, in the patents to C. D. Lake, No. 1,307,740 and No. 1,372,965. In brief, the contact of the analyzing brushes results in energizing the counter magnet 28 (one of which is shown in perspective in Fig. 3) corresponding to the column in which the perforation occurs. The energized magnet attracts its armature and permits engagement of the constantly rotating clutch 29 with the gear 30 which drives the counter wheel 31. Similarly the occurrence of a perforation in any column causes the actuation of the counter wheel 31 corresponding to said column.

Each counter wheel is provided with a cam 32 having two raised parts 33 and 34 of different heights. Held in engagement with cams 32 by springs 35 are pawls 36, pivoted to the horizontal arms of right angled plates 37 which are pivoted at 38 on a frame member 39. The forward top edge of each plate 37 carries a series of steps 40. When pawl 36 is on the 1–8 portion 32′ of the cam 32, which occurs when the counter wheel reads 1 to 8, a contact blade 41 rests on the uppermost step, a second contact blade 42 rests on the third step, and a third fixed contact blade 43 is beneath the second blade and out of engagement therewith. A bail 44 during the adding portion of the cycle is in an elevated position and while the accumulating wheel is in the 1–8 positions with its corresponding contact blades retained on the first and third steps 40, the upper edge of the bail is located above the second plate, the end of which is then positioned within a slot 45 of the bail, the slot being too narrow however to permit entrance of the first contact blade. Bail 44 is actuated by a cam 100 (Fig. 8) operating on a roller which is mounted on an arm 101 connected by a link 102 to the bail. When the counting wheel during the adding cycle has a 9 at the reading position, the lower cam portion 33 engages the end of pawl 36, depressing its other end and rocking plate 37 clockwise with the result that the vertical arm of plate 37 is moved a step to the right so

that the upper contact blade leaves the upper step and drops onto the upper edge of the bail (Fig. 5) which keeps it out of contact with the second contact blade resting on the third step in normal position. When the counting wheel moves from the 9 to the 0 position, the pawl 36 is depressed still farther by passage of cam part 34, moving the plate 37 and steps 40 another step to the right as a result of which the second contact blade moves off the third step 40 and drops to the bottom of the bail slot 45 where it is held out of contact with the fixed contact blade 43 by the bail 44 which is in its upper position at the time (see Fig. 6).

Assuming the counter wheels are connected for column to column transfer, after the adding portion of the cycle, the transfer is effected from wheel to wheel by the lowering of the bail 44 by means described in Patent No. 1,372,965, above referred to. Prior to the transfer operation those accumulators which read 9 will have their corresponding upper contact blades resting on the upper edge of the bail and free of the steps 40 on which they normally rest as described above. As the bail is lowered during the transfer, the upper contact blade moving with it contacts the second contact blade (Fig. 7) closing upper contacts 47 and coming to rest on the second step 40. Those wheels which passed from the 9 to the 0 position before the transfer operation will have their corresponding second contact blade resting on the bottom of the bail slot and free of the third step on which it normally rests as hitherto explained. When the bail lowers, the second contact also lowers and contacts with the fixed contact blade 43, closing lower contacts 46 (Fig. 8). The first contact blade which had previously been released from the first step as the wheel reached the 9 position will also lower but being prevented from lowering still farther by the second step, it will not engage the second contact blade which is now below its normal position and in contact with the fixed blade. Those counting wheels which are at the 1-8 positions have their corresponding contact blades resting in the 1st and 3rd step and lowering of the bail has no effect thereon.

To illustrate the transfer operation, assume the wheels to read 699 during the early part of the adding cycle and that later in the adding cycle one is added to the units wheel, the counter then reading 690 before the transfer operation is completed, as shown in Fig. 3, where 31*a* is the units wheel, 31*b* the tens wheel, and 31*c*, the hundreds wheel The appended letters *a*, *b*, *c*. etc. will hereinafter respectively indicate units, tens, hundreds elements, etc. The lower contacts 46*a* (Fig. 2) of the units wheel are in position to make and the upper contacts 47*b* of the tens wheel are likewise in readiness to make while the hundreds wheel contacts are open. After the adding cycle, as the transfer operation occurs, the bail 44 lowers, permitting closing of contacts 46*a* and 47*b*. At this point, the transfer contacts 48, 49 (Fig. 1) close, permitting an impulse to be sent through line 50 to bus bar 51, through line 52, contacts 46*a*, now closed, line 53, normally closed jack contacts 54*b* of the tens accumulator unit, and the tens counter magnet 28*b*, resulting in the addition of one to the tens wheel which now reads 0. At the same time, the transfer impulse from jack contacts 54*b* goes through line 55, tens contacts 47*b*, now closed, jack contacts 54*c* and magnet 28*c* of the hundreds wheel resulting in the addition of one to the latter wheel which now reads 7. Contacts 46*c* and 47*c* being open, the transfer impulse will be transmitted no further, the wheels now reading 700 and the transfer being completed.

It is sometimes desired to tabulate a plurality of different classifications, the number of which is in excess of the number of counter banks in the machine. Assuming that each of two of these classifications require only four denominational orders to complete an entire tabulation. In such a case, an eight column counter bank by being split in two will provide two four column counters, each sufficient for a classification. In order to split the counter, the plug 55*a* (Fig. 2) having no external connections is inserted into the jack 56*e* corresponding to the fifth column thereby opening the jack contacts 54*e*, and breaking the transfer connection from the fourth column to the fifth column, which otherwise would be made from contacts 46*d* or 47*d* to the fifth column counter magnet 28*e* through the jack contacts 54*e*.

This machine is also adapted to separate a number into groups of digits when listing it to facilitate its inspection in relation to monetary denominations or the like. For example 3794 may be separated to read 37 94, to print $37.94. In order to do this, a column is skipped between the second and third digits, the fourth and fifth columns and their corresponding accumulating mechanisms now being used respectively in conjunction with the third and fourth denominational orders of digits on the tabulating card. To disable the printing of the zero in the third column, devices may be used such as those illustrated in the Patent No. 1,702,628 to J. W. Bryce. To skip the third column counting mechanism, 28*c* etc., a pair of plugs 60 and 63, connected by a wire 66, are inserted respectively into the third and fourth counter wheel jacks 56*c* and 56*d*. As shown in detail in Fig. 4 each plug comprises an outer sleeve 64 of insulating material, an inner sleeve 61 of conducting material to which is attached aforementioned wire 66 for connection at 68 to the conducting post 67 seated within the

sleeve 61 of the coupled jack plug. When the plug is inserted in a jack, the normally closed contacts 54 are opened and jack contact blade 69 engages post 67 while jack contact sleeve 70 engages the sleeve 61. Thus in Fig. 2 when the plugs are inserted as described, contact 54*c* will be opened cutting out magnet 28*c* so that a transfer impulse coming through either contacts 46*b* or 47*b* of the second counter wheel will pass from jack sleeve 70*c* of the third counter wheel, plug sleeve 61, wire 66, plug post 63 of the coupled jack plug to jack spring contact blade 69 of the opened jack contacts 54*d*, from which it passes to counter magnet 28*d*, thus transferring directly from column *b* to column *d* and skipping column *c*. In a similar manner, any selected column or columns may be skipped.

When subtractions of amounts are desired on a tabulating machine it is customary in a machine of the type referred to, to add the complement of the number to be subtracted. This necessitates punching a card with the complement of said number. In arriving at the complement of a given number, it is necessary to supplement the first right hand significant figure to 10 and all other figures of higher denomination to 9. As the first right hand significant figure is not always in the units position but is sometimes in the tens, hundreds, or thousands position, this is confusing to the operator of the card perforating machine who must not only remember to make the first subtraction from 10 and then change to 9 for all others but must also observe carefully what position the first significant figure is in. To obviate this source of confusion it is proposed to have the operator supplement every figure to 9 thus punching a 9 complement on the card which will be one less than the true complement. To compensate for this it is proposed to have the present transfer mechanism automatically add the additional one to the right significant figure, which additional one will hereinafter be termed the "fugitive unit". Thus of a number 760 is to be subtracted, the nine complement is 999239 and the fugitive unit must be added to the latter number to obtain the true complement 999240. In order to add the fugitive after the ordinary adding cycle only when a complement is added it is necessary to make provision for the machine to sense when a complement is being added and not a true number. To do this in the ordinary Hollerith card, a column is selected to act as a complement designating column and each card to be added that has a complement punched therein has an additional hole punched in the eleven or X position of said column. This column is usually the units column although any column may be selected. This means that more than one hole may appear in the units column, i. e., one hole for a figure to be added and one hole in the X position designating a complement. Referring to Figs. 1 and 3, contacts 78 are the usual circuit breaking contacts opened by the movement of the clutch levers when the latter are released by the armatures of magnets 28 to thereby prevent sparking of the analyzing contacts. Contact 79 is timed to make between 10 and 11 and break right after eleven. Contact 80 is timed to make between 10 and eleven and break right after 12. Transfer impulse contacts 48–49 make at the beginning of the 12 position and break at the end of the 12 position sending out a quick impulse which is the transfer impulse. When the brush 26 senses a hole in the 11 position showing a complement card a circuit is completed from terminal 75 through line 12 binding post 81, contacts T—4 and T—5 now closed, relay contacts 83 now closed, the brush contacts to the plug board sockets 24, binding post 85, cam contact 79 now closed, relay magnets 86 and 87 to the left hand supply line 10 and terminal post 76. Relay magnet 86 being energized attracts its armature closing contact 88 thereby establishing a holding circuit from left supply line 10 through relay magnets 87 and 86, cam contact 80 now closed to the right supply line 13. This holding circuit through relay magnet 87 closes its contacts 89. Thus when the transfer impulse contacts 48, 49 close, a transfer impulse is sent through line 50, relay contacts 89, binding post 90, plug connections 91, plug 92, (Fig. 2) jack 56*a*, unit counter magnet 28*a*, to the left supply line 10. Thus the fugitive unit impulse is added to unit counter magnet 28*a* at the same time the transfer impulse takes place through bus bar 51 and contacts 46, 47 as previously described. Immediately after this impulse, cam contact 80 breaks, thus releasing the holding circuit and preventing further fugitive unit impulses being sent to the counter until another complement card is sensed. The plug 92 may be inserted in any of the counter jacks, and the proper plugboard connections made, depending on which accumulating wheel is to be used for accumulating the right hand significant figures.

While I have 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. I intend to be limited therefore only as indicated by the scope of the following claims:

I claim:

1. In an accumulator mechanism, a series of denominational order accumulating elements, means for making differential entries

in a plurality of denominational orders concurrently means for thereafter transferring data from one element to another, and means for entering an arbitrary number in the lowest denominational order element of the series simultaneously with the transferring operation.

2. In an accumulating mechanism, a series of denominational order elements, means for entering the false complement of a number therein and means for thereafter correcting the false complement entry by automatically making an additional entry in any one of said elements.

3. In an accumulating mechanism controlled by records having numerical value designations in the form of index points in different positions, an analyzing device for reading said numerical designations, accumulating elements controlled by said device in accordance with said designations, and means controlled by said device after the reading of said numerical designations and effective during the same cycle of operation for operating said accumulating elements in a predetermined manner.

4. In an apparatus for operating on record cards bearing numerical value designations, some of said cards being complement cards bearing values which are the false complements of a number, an analyzing device for sensing said designations, accumulating elements controlled by said device in accordance with said designations, and means controlled by said analyzing device upon the sensing of a complement card for effecting an additional entry into any one of said accumulating elements.

5. An apparatus for operating on record cards bearing numerical value index point designations, comprising analyzing means to sense said designations while the cards are in motion, accounting elements controlled by said means for operation in accordance with said designations, and means controlled by said analyzing means for making an entry in said elements in addition to the number represented by said index point designations after said designations have passed the analyzing means.

6. In a machine for operating on record sheets bearing data in the form of index point designations, some of said sheets bearing the data corresponding to the false complement of a number, an analyzing device for sensing said designations, accumulating means controlled by said device for operation in accordance with said designations, and means operative after the entry of a false complement number into said accumulating means for effecting an additional entry into said accumulating means to obtain the true complement number.

7. In a machine for operating on record sheets bearing numerical data in the form of index point designations, some of said sheets bearing the false complement data of a number, an analyzing device for reading said designations, accumulating elements controlled by said device for making entries in accordance with said designations, a control circuit set up upon the sensing by the analyzing brushes of a complement card, and a second operating circuit controlled by said first circuit for effecting an additional entry into said accumulating elements.

8. In a machine for accumulating record card data, a series of denominational order accumulating elements, means for making entries therein in accordance with the data on the record card, transfer mechanism to effect a transfer entry from one element to another of a higher order, and means for making an additional arbitrary entry in one of said elements, said last named means being selectively associable with any of said accumulator elements.

9. In a machine for accumulating record card data, a series of denominational order accumulating elements, means for making entries therein in accordance with the data on said record card, transfer means to effect a transfer entry from one of said elements to another of a higher order, and electrically controlled means for making an arbitrary entry in the lowest denominational order accumulating element. said electrically controlled means including a member adapted for selective association with any of said accumulator elements to thereby make said selected element the lowest denominational order element of a series of accumulating elements.

10. In an accumulating mechanism, a series of denominational order adding elements. item entering means for concurrently entering a false complement of a number in a plurality of orders, transfer means for transferring a unit from a lower to a higher denominational order and means selectively associated with the adding elements for entering an arbitrary number of any one of said adding elements to correct a false complement, operable concurrently with said transfer means and in seriatim with respect to said item entering means.

11. In a machine of the class described comprising in combination, a plurality of different denominational order adding elements, item entering means for entering data therein, means for effecting a transfer entry from one element to a higher order element, and means selectively associated with any of said adding elements for making an additional arbitrary entry in the selected one of said elements.

12. In a machine of the class described comprising in combination, a group of different denominational order adding elements, item entering means for entering data there-

in, transfer means to effect a transfer from one element to a higher order element, a member selectively associated with said elements whereby said group may be sub-divided into groups to convert one of the higher denominational order elements to an element of the lowest order and means for making an arbitrary unit entry in the last mentioned adding element.

In testimony whereof I hereto affix my signature.

JAMES W. BRYCE.