Sept. 12, 1933. R. J. McFALL 1,926,878

TOTALIZING MECHANISM

Filed Oct. 3, 1931 2 Sheets-Sheet 1

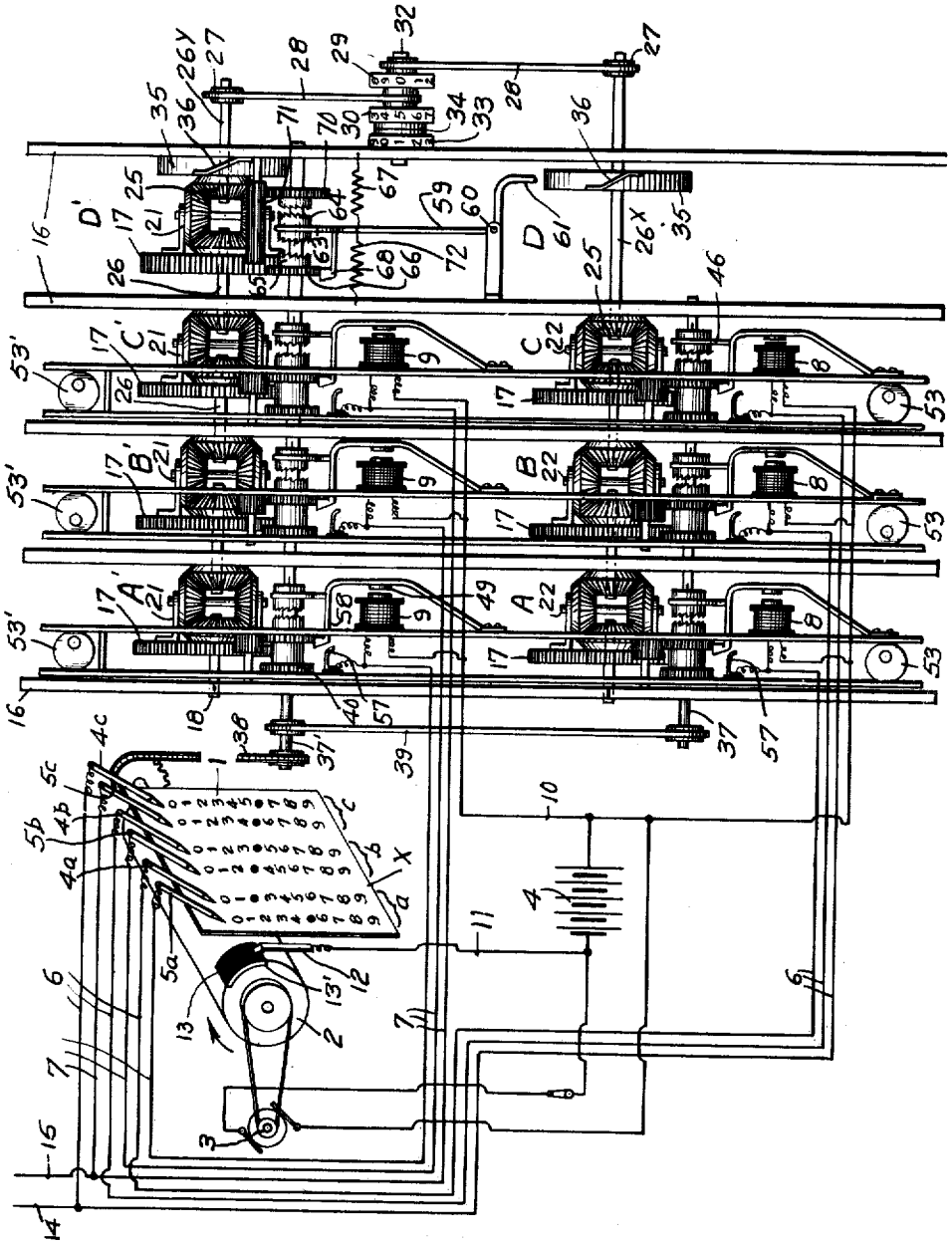


FIG. 1.

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FIG. 3.

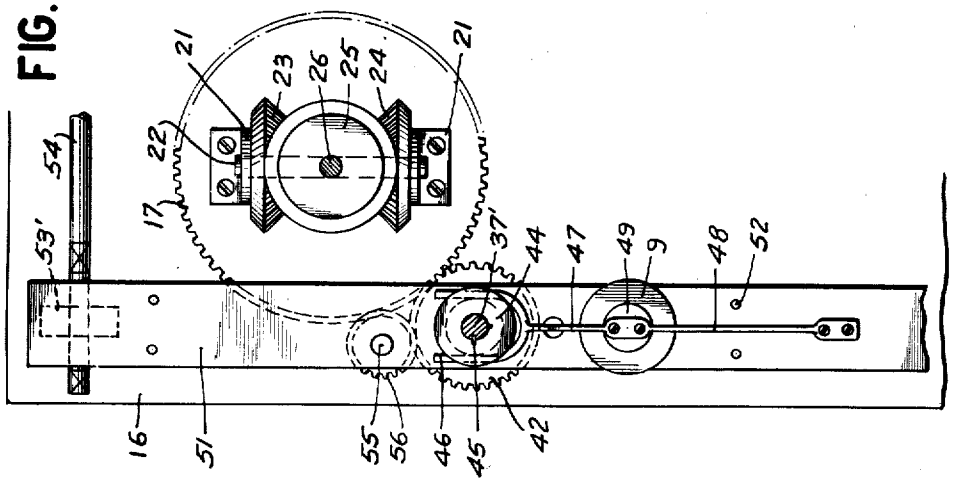
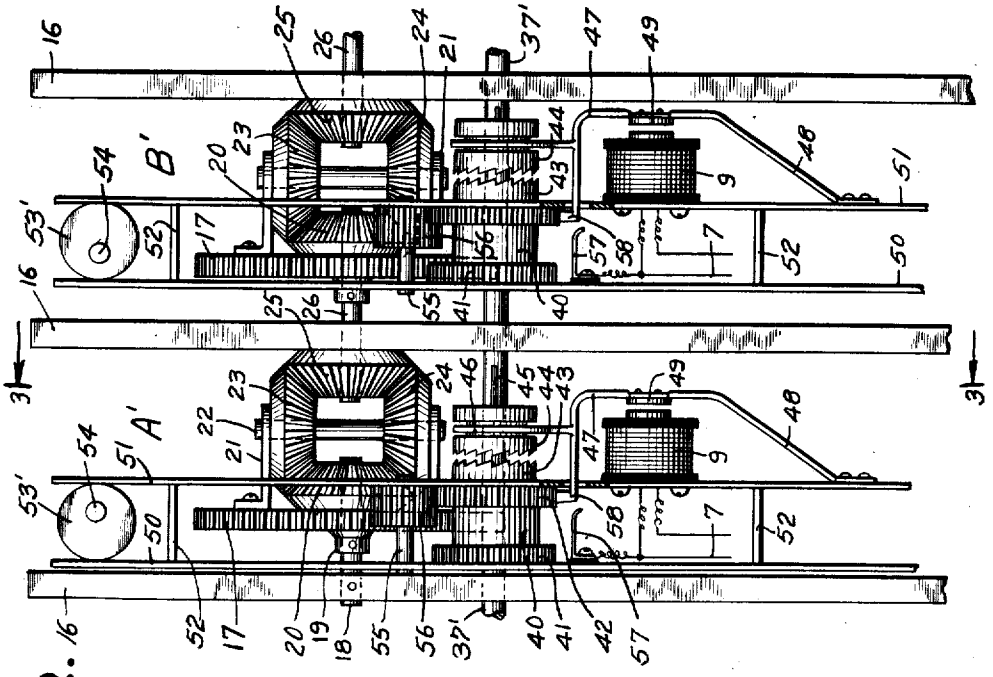


FIG. 2.



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Patented Sept. 12, 1933 1,926,878

UNITED STATES PATENT OFFICE

1,926,878

TOTALIZING MECHANISM

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Application October 3, 1931. Serial No. 566,709

10 Claims. (Cl. 235—92)

This case is a continuation in part of my application Serial No. 357,574, filed April 23, 1929.

This invention relates to integrating or totalizing apparatus, and more particularly to means for indicating the algebraic sum of two or more numbers, the records of which are presented concurrently to the apparatus.

For clearness of illustration, the invention will be described in connection with record cards having columns of figures printed thereon, and holes punched in said cards to indicate values or amounts, in a well known manner, but the invention is not limited to the use of such record cards.

Record cards of the type referred to are shown and described, for example, in Patents Nos. 777,209 and 945,236, to Herman Hollerith, and therefore, need not be explained in detail. In such cards, the index point positions in the field, indicating values or amounts, are determined by the location of the punched holes relative to one edge of the card. The figures or digits are arranged in columns, with zero at the top and 9 at the bottom, and the holes are punched at the location of these respective digits in accordance with the value or amount to be indicated.

The columns of digits may be arranged singly or in groups of two, three or more, and when arranged in such groups, the first column on the right represents the units place, the next column tens, the third hundreds, etc. Each column or group of columns usually corresponds to a certain particular class of data being recorded, that is to say, to a certain kind, character, or type of article or material.

In well known systems heretofore employed, it has been the common practice to feed such perforated record cards seriatim to integrating mechanism, and to so design the integrating mechanism that it was capable of adding and indicating the total of the numbers represented by the positions of the holes in each column or group of columns of all of the cards passing successively through the machine. Thus, the mechanism showed the total separate amounts of each class or type of article or material recorded on a given series of cards.

As distinguished from this well known method of integrating successive items of the same class presented seriatim to the mechanism, the object of the present invention is to provide means for indicating the algebraic sum of a plurality of items presented concurrently, or during the same cycle of operation of the mechanism. Using the record cards as an illustration, while previous systems have provided means for adding and subtracting only items occurring in the same column positions on the successive cards, the present invention contemplates the algebraic cross-totalizing of items occurring in two or more different groups of column positions on the same card, and the integrating of these grand cross-totals as successive cards pass through.

To this end, I propose to employ a series of gear train or interconnected differential mechanisms, one for the units, one for the tens, etc., the number of mechanisms in each series corresponding with the number of column groups on the cards, and to impart to each mechanism of each series, during the passage of each card, an increment of rotation or angular displacement in either direction proportional to the position of the corresponding hole in the respective column, a suitable carry-over and borrowing device being provided at the end of each series of differential mechanisms or trains to transfer rotation from one series or train to the series or train next in rank.

Although by no means limited to such use, my invention has special utility when employed in conjunction with or as an attachment to the above referred to previously well known integrating mechanism, it thus being possible, with such a combination, to indicate at the same time both ordinary class totals and grand cross-totals.

Without attempting any further general discussion or explanation, it is thought that the invention may be best understood by reference to the accompanying drawings, conventionally illustrating one embodiment, and forming part of this specification, in which drawings:

Fig. 1 is a view partially in side elevation illustrating my improved algebraic totalizing mechanism in connection with record cards of the Hollerith type, the various parts being illustrated more or less conventionally;

Fig. 2 is a fragmentary side elevation on an enlarged scale, showing in more detail two of the differential mechanisms and associated parts illustrated in Fig. 1; and

Fig. 3 is a transverse section substantially on the line 3—3 of Fig. 2, looking in the direction of the arrows.

Referring to the drawings in detail, the record cards which I employ in connection with my invention are preferably of the type disclosed in the above mentioned Hollerith patents. One of these cards is illustrated at 1, and, as will be seen from the drawings, has printed thereon columns of digits running numerically from 0 to 9, the 9's being located adjacent the bottom or lower

edge x of the cards, and the 0's being located near the opposite edge of the card, and arranged in a row or line parallel with such edge. Thus, the numerical value of any digit is inversely proportional to its distance from the lower edge x of the card, that is to say, the further a digit is located from such edge, the smaller its value.

Any desired number of vertical columns of digits may be employed, the right hand column corresponding to the units place, the next column to the ten's place, the third column to the hundred's place, etc., but for the sake of simplicity of illustration, I have illustrated only two columns per number, namely, a unit's column and a ten's column.

My invention is particularly applicable to record cards which carry a plurality of such groups of columns, each group being employed to indicate the negative or positive value or amount of some particular class or type of article or material. Thus, in Fig. 1, I have illustrated a card having three groups of columns, each group comprising a unit's column and a ten's column. Thus, for example, if the cards are used in the lumber industry, the first group of columns a may designate the number of feet of siding, the second group b may designate the number of feet of hardwood flooring, and the third group c may designate the total number of feet of wood produced.

If the integrating devices of the present invention are to be used for bank accounting work, one amount on the record card may represent an old balance and the other amounts on the same card debits or withdrawals, or two amounts together may represent a balance and the other amount a debit. The devices disclosed are adapted to properly add and subtract such amounts. If used in connection with railroad accounting, the several numbers on a card may indicate the tonnage hauled over different lines during any given period, and such numbers may be subtracted one from the other to find the difference in tonnage carried on the several lines.

In order to adapt these record cards for the operation of automatic totalizing or integrating apparatus, it is the common practice to punch or perforate them at certain digit locations in the various columns. These holes or perforations thus constitute index points which, by their position, represent numbers indicating the several positive or negative amounts or values which it is desired to record. Thus, in Fig. 1, I have shown the group of columns a as having one perforation at the digit 5 in the ten's column and another perforation at the digit 2 in the unit's column; thus indicating the number 52; the group of columns b as having a perforation at the digit 3 in the ten's column, and the digit 4 in the unit's column, thus indicating the number 34; and the group of columns c as having a perforation at the digit 5 in the ten's column and at the digit 6 in the unit's column, thus indicating the number 56. As above pointed out, the numerical values corresponding to these perforations are inversely proportional to the distance of such perforations from the edge x of the card.

A set of such record cards, after having been perforated, as desired, to indicate various amounts or values, are preferably assembled in a bale or package in a feeding device, such as illustrated in Patents Nos. 685,608 and 945,236, to Hollerith, and from this feeding device, the cards are fed one at a time to the controlling mechanism which I shall hereinafter designate as a reading or analyzing device.

As shown in the second of the above mentioned Hollerith patents, this reading device, Fig. 1, comprises brushes and a metal roller or platen 2, driven at constant speed, as by means of an electric motor 3, supplied with current from a suitable source 4. Arranged to bear upon this roller are a plurality of contact fingers or brushes 4^a, 4^b and 4^c, 5^a, 5^b and 5^c, the ends of such brushes being arranged to bear upon the roller in a line parallel with the axis. One finger or brush is provided for each column on the cards.

The brushes 4^a, 4^b and 4^c are separately connected by conductors 6 to a set of control magnets 8 which operate the units totalizing mechanism, while the brushes 5^a, 5^b and 5^c are separately connected through conductors 7 with a set of magnets 9 which operate the 10's totalizing mechanism. The other terminal of the windings of all of the magnets 8 and 9 is connected to a common return 10, connected with one side of the battery 4, while the other side of this battery is connected by a conductor 11 with a brush 12 which also bears upon the roller 2, but at a point beyond the end of the card. Set into the surface of the roller 2, along the path of contact of the brush 12, is a strip of insulation 13, which strip extends through a suitable arc and has its forward end 13' terminating at a point on the roller in line wtih the position occupied by the row of 0's on the card, that is if the contact points of the brushes 4^a etc., 5^a etc. and 12 are in the same straight line; if the contact points of the reading brushes and brush 12 are not in alignment, the end 13' of the insulation strip is located so as to pass under the brush 12 at the same instant that the row of 0's pass under the other brushes.

In this connection, it will be understood that the card feeding mechanism is operated in synchronism with the roller 2, that is to say, a card is fed at each revolution of said roller.

Furthermore, the apparatus is so interconnected and timed that the lower edge of each card as it is fed comes into contact with exactly the same point on the roller, this point being so chosen relative to the width of the card and the diameter of the roller that the edge 13' of the strip of insulation 13 passes under the brush 12 at the same instant that the row of 0's passes under the brushes 4^a, etc., 5^a, etc., as above mentioned.

The purpose of this will be hereinafter further explained.

If it is desired to employ my improved totalizing apparatus, now to be described, in connection with the usual integrating mechanism such as that developed by Hollerith, there may be connected to each pair of conductors 6 and 7, branch circuits 14 and 15, these circuits being adapted to extend to integrating control mechanism such as the relays 25, 26 and magnets 35, 36 of Hollerith Patent 945,236, above mentioned. Thus, as the cards pass through the reading device, the usual integrating mechanism such as that shown in the Hollerith patent will be operated to add together or cumulate the totals of the numbers represented by the perforations in the same group of columns of said cards. Thus, the control circuit 14 and 15, illustrated in Fig. 1 as connected to the conductors extending from the brushes 4^c and 5^c, if connected with the Hollerith apparatus, would serve to integrate the amounts indicated by the perforations in the

column group *c*, as successive cards are fed through the reading device.

As distinguished from, or in addition to, this integrating of successive items in the same column positions as the cards are fed through, the object of my present invention is to provide means for algebraically cross-totalizing the items indicated by all of the column groups on each card. Thus, to refer again to the illustrations previously mentioned, if the record cards relate to the lumber industry, I propose to provide means whereby the footage of lumber recorded in column *a* and column *b* may be subtracted from total footage designated in column *c*, giving the net total footage produced other than siding and flooring.

In using the devices of the present invention to solve banking problems as set forth hereinbefore, the debit amount may be subtracted from the balance, in the first case, and the debit amount may be subtracted from the added positive amounts in the other case; the result in either case being a new balance or an overdraft. In the use for railroad accounting, the group figure of tonnage for any line or lines may be subtracted from the tonnage of the other line or lines, giving the advantage of one line system over another in tonnage hauled.

To this end, I employ a plurality of gear trains, one train for the unit's column, another train for the ten's column, etc., each train being made up of a series of units corresponding in number to the number of column groups on the record cards.

These gear trains are supported in a plurality of fixed parallel frame members 16, and the various units of the two gear trains illustrated are designated A, B, C, D, and A', B', C', D' respectively. As these units are substantially similar in construction, except as hereinafter explained, a detailed description of one will suffice for all. Reference is therefore had to Figs. 2 and 3, which clearly illustrate the details. Each of the units A or A' comprises a relatively large gear 17 serving as a planetary gear carrier, loosely mounted for rotation upon a fixed stub shaft 18 set into the frame 16. A collar 19, fixed to this shaft, serves to prevent lateral displacement of the large gear 17. Rigidly fixed to the inner end of the stub shaft 18 is a sun gear 20 constituting one member of a differential mechanism. Secured to the face of the large gear 17 are a pair of bracket arms 21 extending in axial spaced relation and serving to support between them a shaft 22. Journalled at the ends of the shaft 22 are planetary gears 23 and 24, meshing with the sun gear 20. The planetary gears 23 and 24 also mesh with a gear 25 similar to the gear 20, which gear 25 is fixed to a shaft 26, journalled in a frame member 16.

Thus, the gears 17, 20, 23, 24 and 25 constitute a differential mechanism, and while I have shown such mechanism as employing bevel gears, it will be understood that other types of gears can be utilized, if desired. Each unit of each of the gear trains, above referred to, consists of one of these differential mechanisms substantially as above described.

The large gear or planetary gear carrier 17 of the next unit B or B' is mounted for free rotation on the shaft 26, while the sun gear 20 of such units is rigidly secured to said shaft. The same is true for the succeeding units C, C' and D', no differential mechanism being employed at the unit D for reasons which will hereinafter appear.

Referring now to Fig. 1, it will be seen that the gear 25 of the differential mechanism C is secured to a shaft 26*x* which extends through a pair of frame members 16 and carries at its extreme end a sprocket wheel 27, geared by means of a chain 28 to a number wheel 29, mounted for free rotation on a stub shaft 32. Similarly, the gear 25 of the differential mechanism D' is mounted on a shaft 26*y*, which carries at its extreme end a sprocket wheel 27, geared by means of a chain 28, to a number wheel 30, freely mounted on the shaft 32.

From the foregoing, it will be understood that the number wheel 29, driven by the unit's gear train A, B, C, is the unit's wheel, while the number wheel 30, driven by the ten's gear train A', B', C', D' is the ten's wheel. 33 designates a hundred's wheel, which is mounted on the shaft 32 adjacent the wheel 30, and is driven from the wheel 30 through the usual transfer mechanism designated by the numeral 34. Thus, when the totals exceed two places, they are transferred to and accumulate on the wheel 33, in the usual manner. Similarly, additional wheels for thousands, etc., may be added, each being driven through transfer mechanism from the adjacent wheel of the next lower order.

Secured to the final shaft 26*x* or 26*y* of each series or train is a transfer wheel 35, having on its periphery a cam flange 36 for the purpose of carrying over or borrowing from one gear train to the next higher order, as will be hereinafter more fully explained.

Extending through and journalled in the frame members 16 are a pair of shafts 37 and 37', the first adjacent the units train and the second adjacent the tens train of differential gearing. These shafts are continuously driven in synchronism with the drum 2, as for example, by having the shaft 37' driven from the drum 2 by means of a chain 38, and by having the two shafts geared together by means of a chain 39. Mounted on each of these shafts adjacent each of the differential mechanisms of each train of gears are certain gears and clutches, the construction of which can best be understood by reference to Figs. 2 and 3. Mounted to turn freely on each of these shafts, as for example, the shaft 37', is a sleeve 40, having formed integral therewith two similar spaced gears 41 and 42. Also carried by the sleeve 40 beyond the gear 42 is a clutch member 43. A similar and cooperating clutch member 44 is slidably mounted on the shaft, but is splined thereto by means of a key or feather 45. This clutch member 44 has a peripheral groove in which works a yoke 46, carried by an arm 47, the lower portion of which, 48, is somewhat flexible and is secured to a fixed support. Carried by the arm 47 adjacent the corresponding magnet such as 8 or 9 is an armature 49, adapted to be attracted by such magnet.

In the embodiment shown in the drawings, the arm structure 47, 48 and associated parts are secured to and carried by a movable frame member comprising a pair of parallel bars 50 and 51, united at intervals by cross bars 52. As shown in Fig. 3, this movable frame structure does not lie in the plane of the shafts 26, but is disposed to one side thereof. The bar 51, however, has an opening through which the clutch member 43 projects, and the bars 50 and 51 are spaced apart a sufficient distance to re-

ceive snugly between them the gear structure 40, 41, 42.

Also supported between the bars 50 and 51 is a shaft 55, on which is mounted a back gear 56, which is preferably of a width substantially double that of the gears 41 and 42, and which continuously meshes with the gear 42. Thus, when one of the magnets such as 8 or 9 is energized, the clutch members 43 and 44 are brought into engagement and the gears 41, 42 and 56 rotated.

Means are provided for causing either the gear 41 or the back gear 56 to mesh with the large gear 17, as desired. To this end, the movable frame 50, 51, 52 is so supported as to be capable of being shifted laterally, and in order to effect such lateral shifting, I mount between the bars 50 and 51 of each movable frame a pair of eccentrics 53, 53', each of such eccentrics being secured to a shaft 54 and the two shafts for any one unit being geared together so as to move in synchronism. Thus, by rotating these shafts 54, the movable frame may be shifted laterally from the position shown at A' in Fig. 2 to that illustrated at B'. When in the first position, it will be seen that the large gear 17 is in mesh with the back gear 56, and consequently will be driven in one direction by the shaft 37', while in the second position, it will be seen that the large gear 17 is in mesh with the gear 41, and hence will be driven in the opposite direction by shaft 37'.

Each of the arms or members 47 carries an extension 58 in the nature of a pawl, which is adapted to engage and lock the associated gear 42, as clearly shown in Fig. 2. When, however, the armature 49 is attracted and the clutch members 43 and 44 brought into engagement, the locking pawl 58 is shifted to the left out of engagement with the gear 42, thus permitting this gear and associated parts to turn freely.

Means are provided for maintaining the energization of the magnets 8 and 9, after the circuit has been momentarily closed by the passage of a perforation in the card under one of the brushes of the reading device. Such means may comprise, as shown in the drawings, a contact member 57, secured to but insulated from the movable frame member 50, and having its end so disposed as to be engaged by the locking pawl 58 when it is moved to the left, as the armature 49 is attracted.

Referring to Fig. 1, it will be seen that when the pawl 58 engages the contact 57, current will flow from one side of the battery through the conductor 11 and brush 12 to the roller 2, thence to the frame of the machine, thence through the arm 47, pawl 58, and contact 57, through the magnet and thence through common return conductor 10 to the other side of the battery, it being assumed, of course, that the roller 2 is grounded to the frame of the machine.

It will be further apparent that the circuit thus closed will be maintained until the forward edge 13' of the insulation strip 13 comes under the brush 12, at which instant the circuit will be interrupted, the clutch members disengaged, and the gears locked by the pawl 58.

With the above general explanation of the construction and arrangement of my improved addition and subtraction totalizing apparatus, a fuller understanding can best be arrived at by a brief discussion of the operation. Let us consider first the gear train A, B, C. As above pointed out, the magnets 8 of this gear train are connected by conductors 6 with the brushes 4^a, 4^b and 4^c corresponding to the position of the unit's column in the several column groups on the card. Thus, as the first perforation in the unit's column of the group c passes under the brush 4^c, the magnet 8 of the differential mechanism C will be momentarily energized. The corresponding clutch members will thus be brought into engagement, and an increment of rotation in either direction imparted to the large gear 17 of this mechanism. This particular magnet will be maintained energized and the clutch members maintained in position during the time that the card is travelling from the position of digit 6 to the zero position, and an angular displacement of the large gear 17 will be produced which is determined by the location of the position of the digit 6 in the column. In other words, the angular displacement corresponds with the numerical value of that particular digit.

Similarly, when the perforation at the position of digit 4 in the unit's column of group b passes under the brush 4^b, the magnet 8 of the differential mechanism B is energized, and is maintained energized and the clutch members maintained in engagement during the passage of the card from the position of digit 4 to the zero position, and an increment of rotation in either direction is imparted to the large gear 17 of differential mechanism B, this increment of rotation or angular displacement being proportional to the location of the position of the digit 4 in the column. Similarly, when the perforation at the position of digit 2 in the units column of a group passes under the brush 4^a the magnet 8 of differential mechanism A is energized, the clutch members brought into engagement, and an increment of rotation in either direction imparted to the large gear 17. The clutch members are maintained in engagement and an angular displacement of the large gear 17 is produced to an extent proportional to the location of the position of digit 2 in the column.

It will, of course, be understood that the gear trains made up of the several differential mechanisms are continuous trains, that is to say, the gears are all so interconnected that motion imparted to the first unit is transmitted to the next succeeding unit throughout the train and finally, to the last member thereof.

It will thus be seen that regardless of which of the mechanisms A, B or C is actuated first, and regardless of whether they are actuated seriatim or simultaneously, the rotation imparted to one mechanism is added to or subtracted from that imparted to the others, in accordance with the relative direction, with the result that the final member of the train, namely, the shaft $26x$ is rotated a distance corresponding to the algebraic sum of the increments of rotation or angular displacements imparted to the several gears 17 of the train, or in other words, an amount proportional to the numerical value of the algebraic sum of the numbers indicated by the location of the digit positions in the unit's column of the several groups on the card. Thus, the unit's wheel 29 is rotated to a corresponding extent.

Similarly, the large gears 17 of the train comprising the differential mechanisms A', B' and C' are independently actuated by the passage of the perforations in the ten's columns of the card under the corresponding brushes of the reading device, the angular displacement in either direction imparted to each being proportional to the numerical value of the corresponding digit, and the train serving to rotate the final shaft to an ex-

tent proportional to the algebraic sum of such digits.

The carry-over mechanism at the ends of the trains will now be briefly described. Referring to the unit's train, the wheel 35 and cam flange 36 have already been referred to. Arranged to engage the cam flange 36 is a finger 61 carried at the end of a bell crank lever 59, pivoted at 60 to a fixed support. The lever 59 is normally held in the position shown in Fig. 1, by springs 67 and 72. The bell crank lever carries at its upper end a yoke 63, working loosely in a groove in a clutch member 64, splined to the shaft 37' and adapted to engage a cooperating clutch member 65 integral with a gear 66 loose on said shaft in engagement with the large gear 17 of differential mechanism D'. The cam flange 36 is so located relative to the number wheel 29 that at the moment when this number wheel moves from the nine position to the ten position, the flange 36 engages the finger 61, thus swinging the bell crank lever 59 to the left, and bringing the clutch members 64 and 65 into engagement, thereby imparting an increment of rotation to the large gear wheel 17 of differential mechanism D'. The length of the flange 36 is designed so as to hold the clutch members 64 and 65 in engagement for a length of time sufficient to produce in the gear 17 an angular displacement corresponding to one unit. This displacement is thus added to that already imparted to the final shaft 26 of the ten's train, thus causing the shaft 26y to move the ten's number wheel 30 one step further than it would have been moved under the influence of shaft 26 only. In this way, the units accumulated on the train A, B, C, are transferred to the ten's train, when the total of such units exceeds nine.

Similarly, carry over mechanism is provided to transfer increments of rotation from the ten's train to the hundred's train, etc., where more than two trains are utilized.

When one of the accumulator mechanisms is set for subtraction, it will be necessary on occasion, to effect negative transfer or borrowing. The clutch member 64 is therefore provided with clutch teeth opposite those which cooperate with the clutch teeth on member 65. These clutch teeth on member 64 cooperate with clutch teeth on a gear 70 freely rotatable on shaft 37'. The gear 70 is connected to large gear 17 through an idler gear 71 so that when gear 70 rotates it will rotate gear 17 backward. If the shaft 26x is turned backward from the nine to the zero position the cam flange 36 on encountering finger 61 rocks the bell crank lever 59 to the right thereby causing rotation of the gear 70 and effecting reverse rotation of gear 17 resulting in a negative transfer or a borrowing operation.

From the foregoing, it will be obvious that as each card passes through the reading device, the algebraic sum of all numbers indicated by the position of the perforations in all of the columns is registered on the wheels 29 and 30. Thus, to again use the illustration in the lumber industry, my improved mechanism serves to indicate the total number of feet of wood, minus the number of feet of siding and flooring. Furthermore, as successive cards pass through the reading device, these cross totals are themselves accumulated on the wheels 29, 30 and 33, so that the grand total represented by all of the numbers punched in all of the columns of any given set of cards can be read off these wheels.

It will, of course, be understood that suitable means are provided for interrupting the circuit to prevent operation of the gear trains during the period between the passage of successive cards. I may employ the mechanism of Hollerith Patent No. 945,236, but I prefer to so proportion the length of the insulation strip 13 that it holds the circuit open at the brush 12 until the forward edge x of each succeeding card has passed under the brushes 4^a, 5^a etc.

I have referred to the algebraic sum of the numbers represented by the perforations in the various column groups of the card, and this will be now further explained. In order to actually add the increments of rotation of all of the wheels 17 to each other so as to rotate the final shaft 26 an amount proportional to the actual arithmetical sum of the several numbers, a consideration of the mechanism illustrated in Fig. 1 will show that it is necessary to drive alternate units or differential mechanisms through the back gear 56. Thus, the mechanisms A' and C' are shown as driven through the back gear, while the mechanism B' is shown as driven directly through the gear 41. It may often happen, however, that the perforations in one or more columns of a card indicate amounts on hand or additions to stock, while the perforations in another column indicate subtractions from the stock. In such a case, by shifting the corresponding movable frame 50, 51 to the proper position, the increments of rotation imparted by the perforations in one particular column group may be caused to take place in a direction the reverse of those corresponding to the other column groups, thereby subtracting the numbers indicated in one column from the sum of those indicated in the remaining columns. Hence, I refer to the totalizing of the algebraic sums of the numbers represented by the perforations in the several column groups of the cards, and in this way, a continuous inventory may be obtained from the number wheels 29, 30 and 33.

While I have shown and described, for the purpose of illustration, my invention as applied to perforated record cards, it will, of course, be understood that I contemplate the operation of my improved mechanism also by setting up index point positions in a field by any other means.

Further, while I have illustrated my improved apparatus as operated by electrical means, it will, of course, be understood that I contemplate the employment of mechanical means also, as within the scope of my invention.

I claim:

1. The combination with a record card having index point positions in column, and provided with a plurality of independent columns, of a reading device, totalizing means controlled by the passage of said card through said reading device for indicating the sum of the numbers corresponding to the index point positions in all of said columns and selective means including shiftable gearing for adjusting said totalizing means so that it shall indicate the arithmetical or algebraic sum of the numbers.

2. In apparatus of the character described, a train of differential gearing, a registering device driven by the final member thereof, and shiftable gearing in said train for imparting independent increments of rotation in either of two directions to each of a plurality of intermediate members of said train.

3. In apparatus of the character described, a train of differential gearing each unit of which comprises a planetary gear carrier, a registering device driven by the final member of said train,

and means including gears cooperating with each unit of said gearing for imparting independent increments of rotation in either one of two directions to each of a plurality of said planetary gear carriers.

4. In apparatus of the class described, a train of differential gearing each unit of which comprises a planetary gear carrier, a registering device operatively connected with the final member of said train, gearing for independently driving each of said planetary gear carriers, and manipulative means cooperating with said driving gearing for reversing the direction of drive of any desired ones of said carriers.

5. In apparatus of the class described, a train of differential gearing each unit of which comprises a planetary gear carrier, a registering device operatively connected with the final member of said train, a constantly rotating shaft, means for independently driving each of said planetary gear carriers from said shaft, said means comprising reversing mechanism including gears slidable on said shaft, and means for shifting said slidable gears at will, whereby the direction of rotation of the corresponding planetary gear carrier may be reversed.

6. The combination with a record card having a plurality of index points arranged so that their positions correspond to definite values or amounts, of a reading device, a continuous gear train, a registering device driven by the final member of said gear train, means controlled by the passage of the record card through said reading device for independently imparting to a plurality of intermediate members of said train angular displacements proportional to the numbers representing the values or amounts corresponding to the respective positions of said index points, and means for adjusting the members associated with certain groups of index points to cause the displacement of said members to take place in a direction opposite to that of others, whereby said registering device will show the algebraic sum of said numbers.

7. A record controlled machine including in combination record analyzing means for analyzing a plurality of record fields, an algebraic accumulator, means controlled by the analyzing means for operating the accumulator to effect entry of items therein from the several fields and selective means cooperating with said operating means for causing entry of the items positively and negatively to effect algebraic summation of the same in said accumulator.

8. A record controlled machine including in combination, record analyzing means for analyzing a plurality of record fields, an algebraic accumulator, means controlled by the analyzing means for operating the accumulator to effect entry of items from the several fields therein and selective devices individual to the several fields for causing entry of items from the separate fields positively or negatively to effect algebraic summation of the same.

9. An accounting machine including an algebraic totalizer having a plurality of denominational order elements for totalizing multi-denominational amounts, entering means divided into sections each including multi-denominational amount entering devices, means controlled by the entering means for operating the several denominational order elements of the totalizer concurrently to receive amount entries from the several sections concurrently and selective means individual to each section for determining whether the amount entry therefrom shall be made positively or negatively.

10. A record controlled accounting machine including record analyzing means for concurrently analyzing a plurality of multi-denominational order record fields concurrently, an algebraic totalizer having a plurality of denominational order elements, means controlled by the analyzing means for concurrently operating the denominational order elements of the totalizer to concurrently enter multi-denominational amounts therein from the several record fields and selective devices individual to the several record fields for determining when the entries shall be made positively or negatively.

ROBERT J. McFALL.