United States Patent

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[72] Inventor Hans-Dietrich Fischer
Wildpark, Germany
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[73] Assignee Walther-Buromaschinen B.m.b.H.
Gersttetten/Wurttemberg, Germany
[32] Priority Dec. 23, 1964
[33] Germany
[31] No. W38238

[54] **CONTROL DEVICE FOR MULTIPLE-DIGIT FIGURES**
16 Claims, 12 Drawing Figs.

[52] U.S. Cl. 235/153, 235/61.7, 235/61
[51] Int. Cl. G06f 11/10
[50] Field of Search 235/61.71, 60(T.K.), 61(A), 153; 340/146.1; 282(Inquired)

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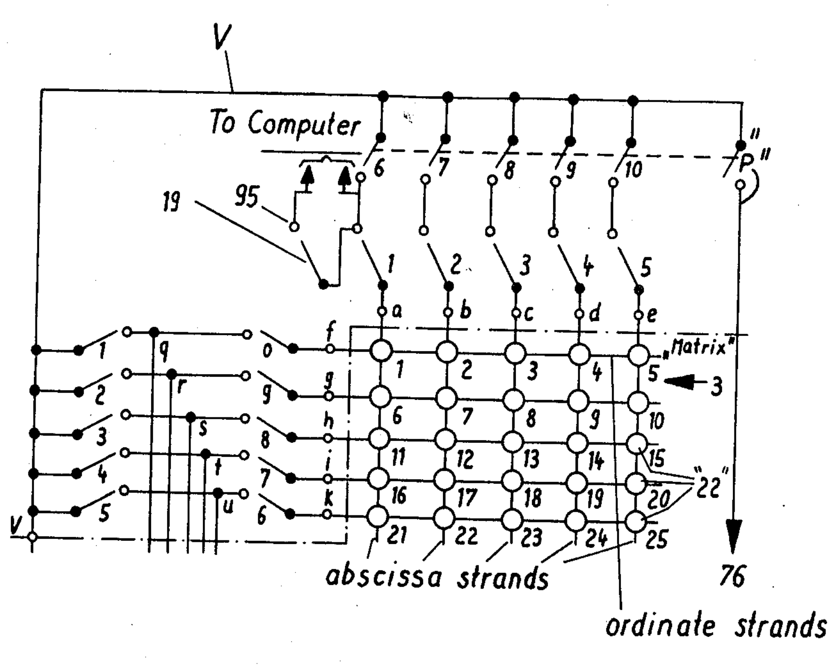
Primary Examiner—Eugene G. Botz
Assistant Examiner—Charles E. Atkinson
Attorney—Ostrolenk, Faber, Gerb & Soffen

ABSTRACT: A testing device for use in checking the entry of a multiple digit figure into a machine by means of a keyboard. Each of the digit positions is assigned a weight which is multiplied by the numeral of that position to form a product according to a predetermined modulus. The products so formed are stored in a matrix having one portion which is substantially a symmetrical mirror image of a second portion thereof. The design of the matrix enables the generation of products of four times the capacity of conventional matrices. Apparatus is provided for summing the individual products stored to generate a signal indicative of the accuracy of entry of the multiple digit figure. If the entry has been accurately made, the multiple digit figure is used to provide an output, for example, on a punch card or punch strip unit. If the entry has not been accurately made, no such output will be provided.



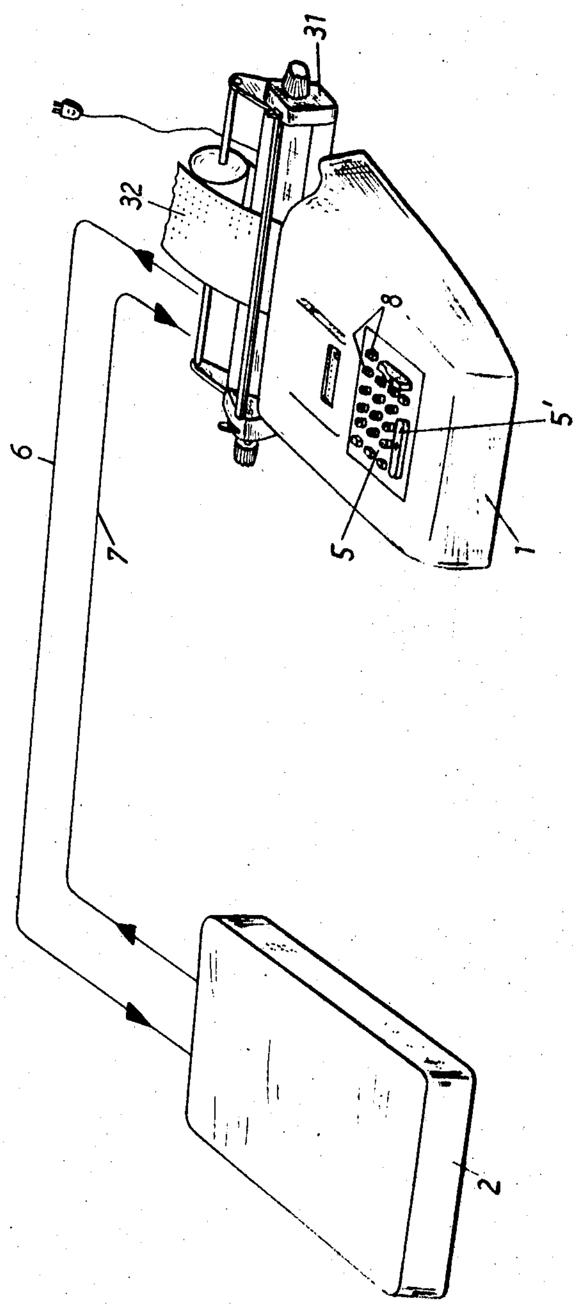


Fig.1

INVENTOR:

by Hans-Dietrich [illegible]
OSTROLENK, FABER, GERB & SOFFEN
ATTORNEYS

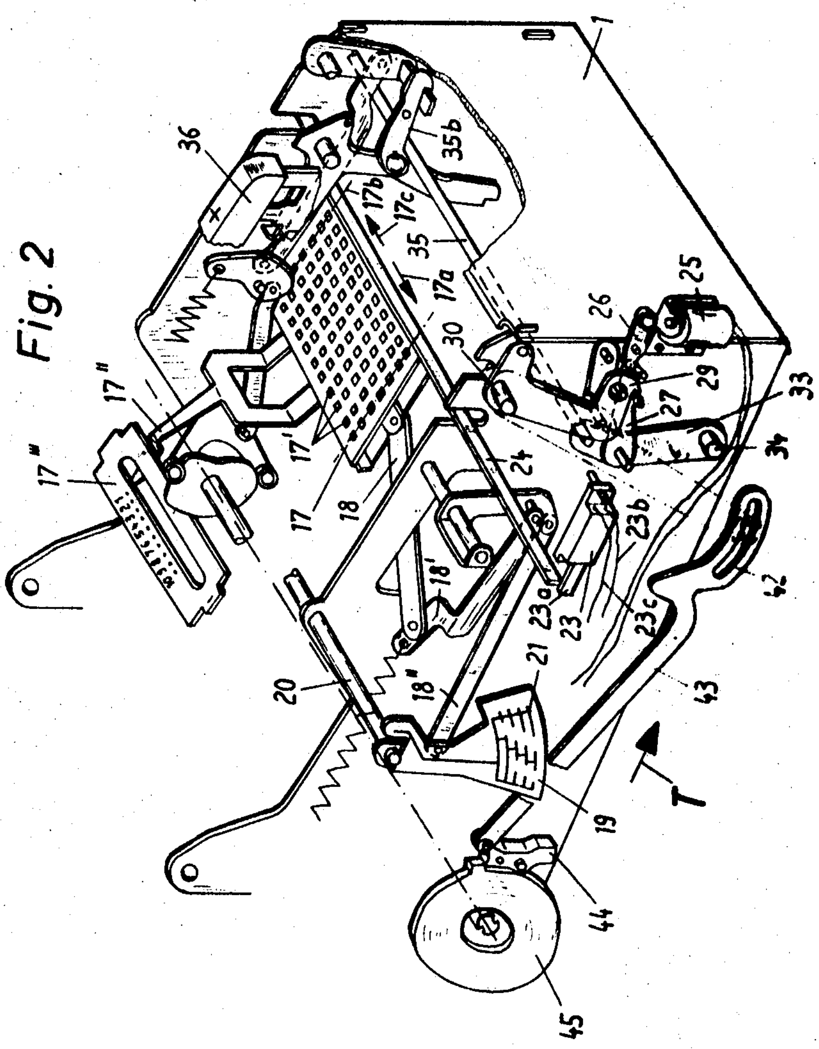


Fig. 2

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Fig. 4

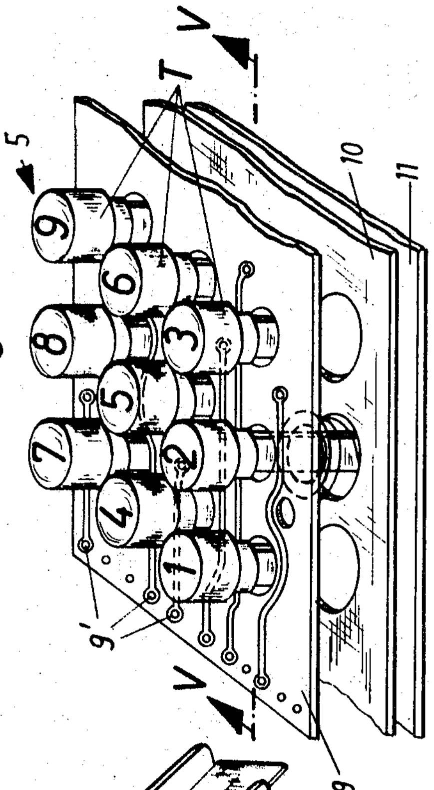


Fig. 3

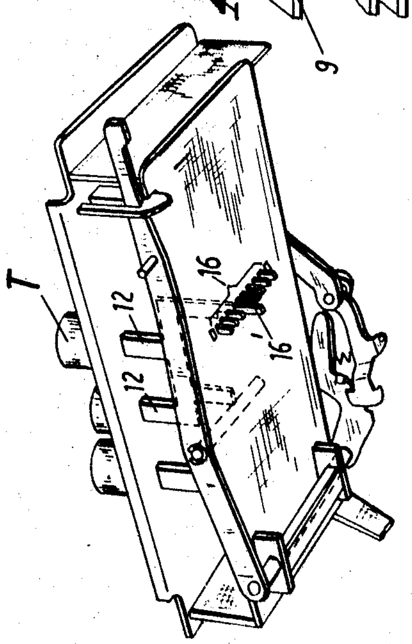
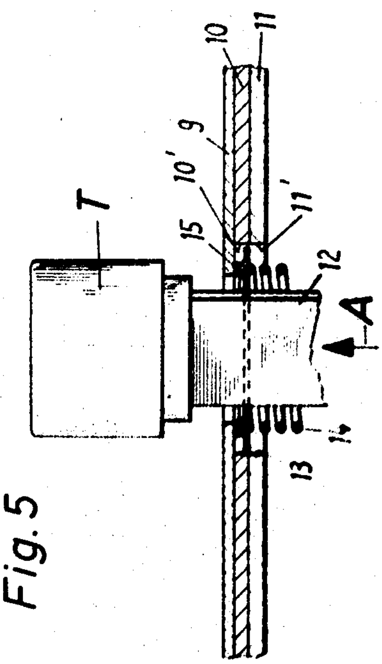


Fig. 5



INVENTOR:

By Ostrolenk, Faber, Gerb & Soffen
Attorneys

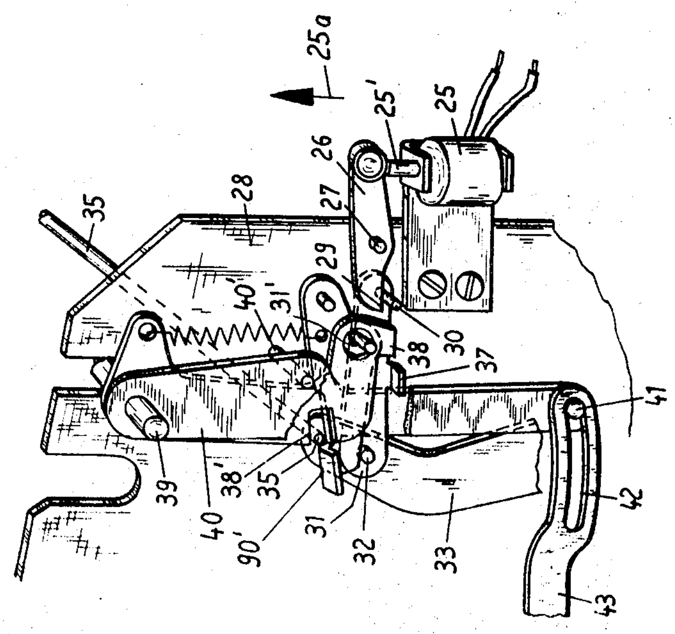


Fig. 7

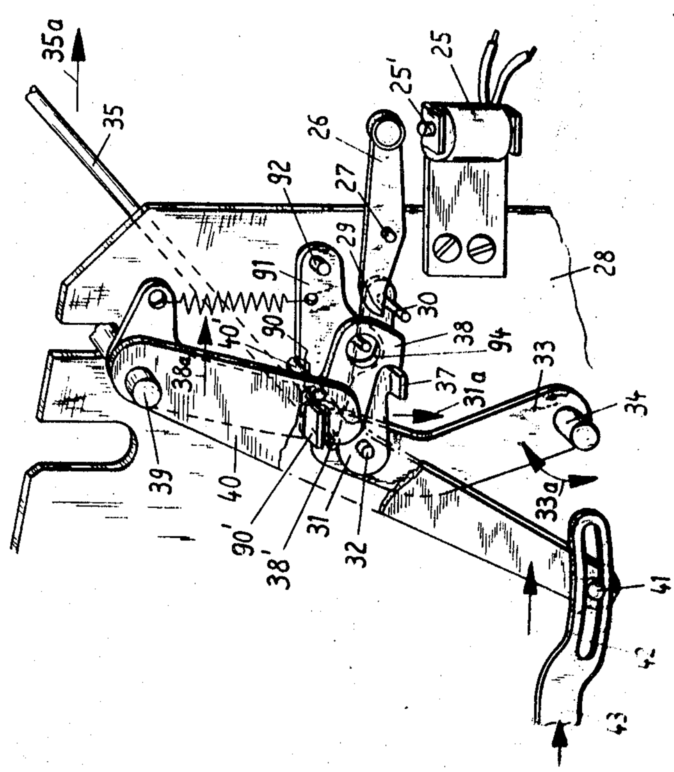


Fig. 6

INVENTOR:

By Ostrolenk, Faber, Gerb & Soffen
ATTORNEYS

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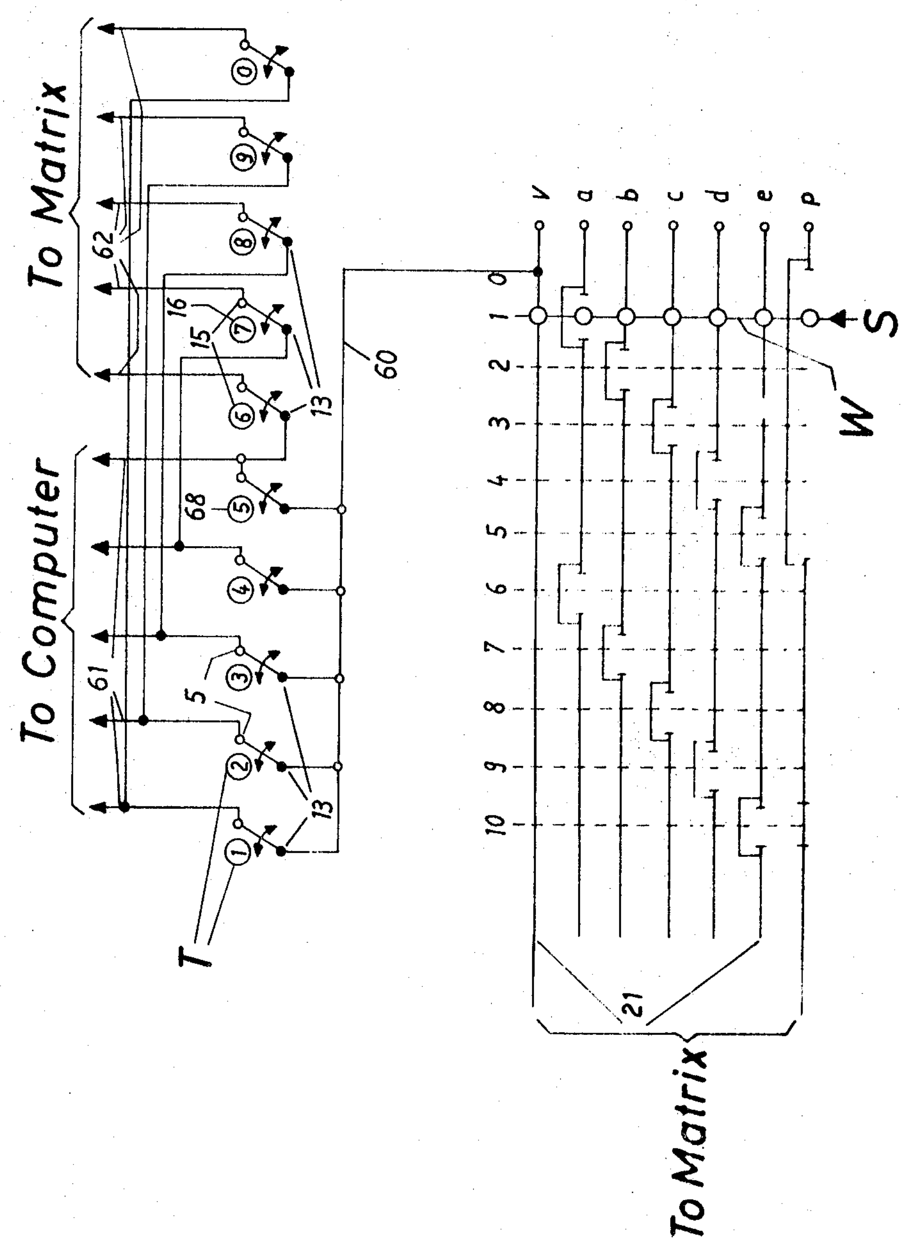
Fig. 8



INVENTOR:

By Ostrolenk, Faber, Gerb & Soffen
ATTORNEYS

Fig. 9

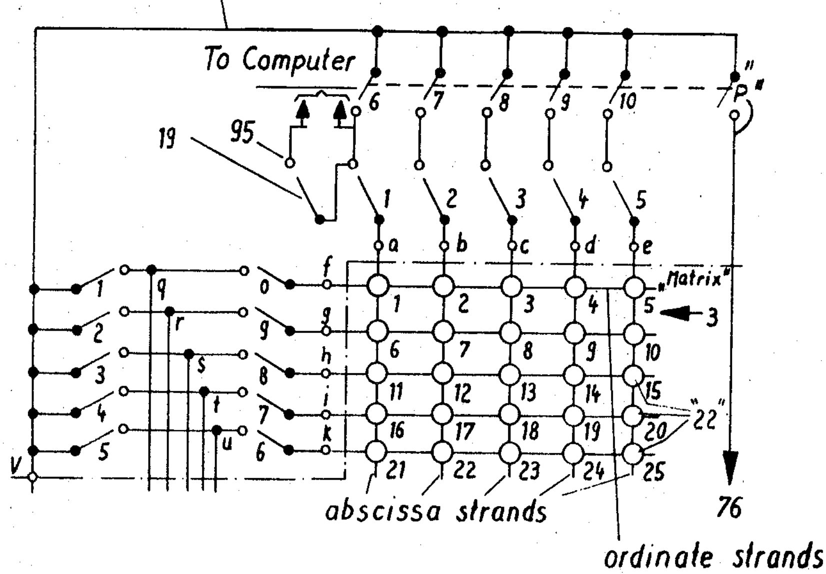


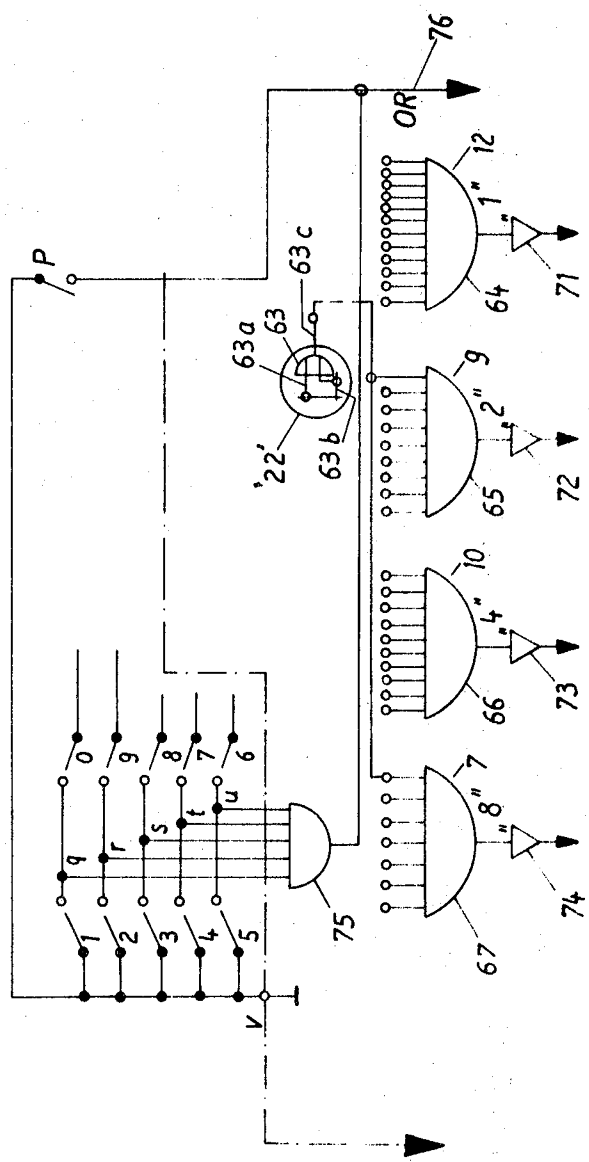
Fig. 10

C	B	1	2	3	4	5	10	9	8	7	6	B	C
1		10	9	8	7	6	1	2	3	4	5		1
2		9	7	5	3	1	2	4	6	8	10		2
3	a	8	5	2	10	7	3	6	9	1	4	c	3
4		7	3	10	6	2	4	8	1	5	9		4
5		6	1	7	2	8	5	10	4	9	3		5
6		5	10	4	9	3	6	1	7	2	8		6
7		4	8	1	5	9	7	3	10	6	2		7
8	b	3	6	9	1	4	8	5	2	10	7	d	8
9		2	4	6	8	10	9	7	5	3	1		9
10		1	2	3	4	5	10	9	8	7	6		10
C	A	1	2	3	4	5	6	7	8	9	10	A	C

INVENTOR:

By OSTROLENK, FABER, GERB & SOFFEN
ATTORNEYS

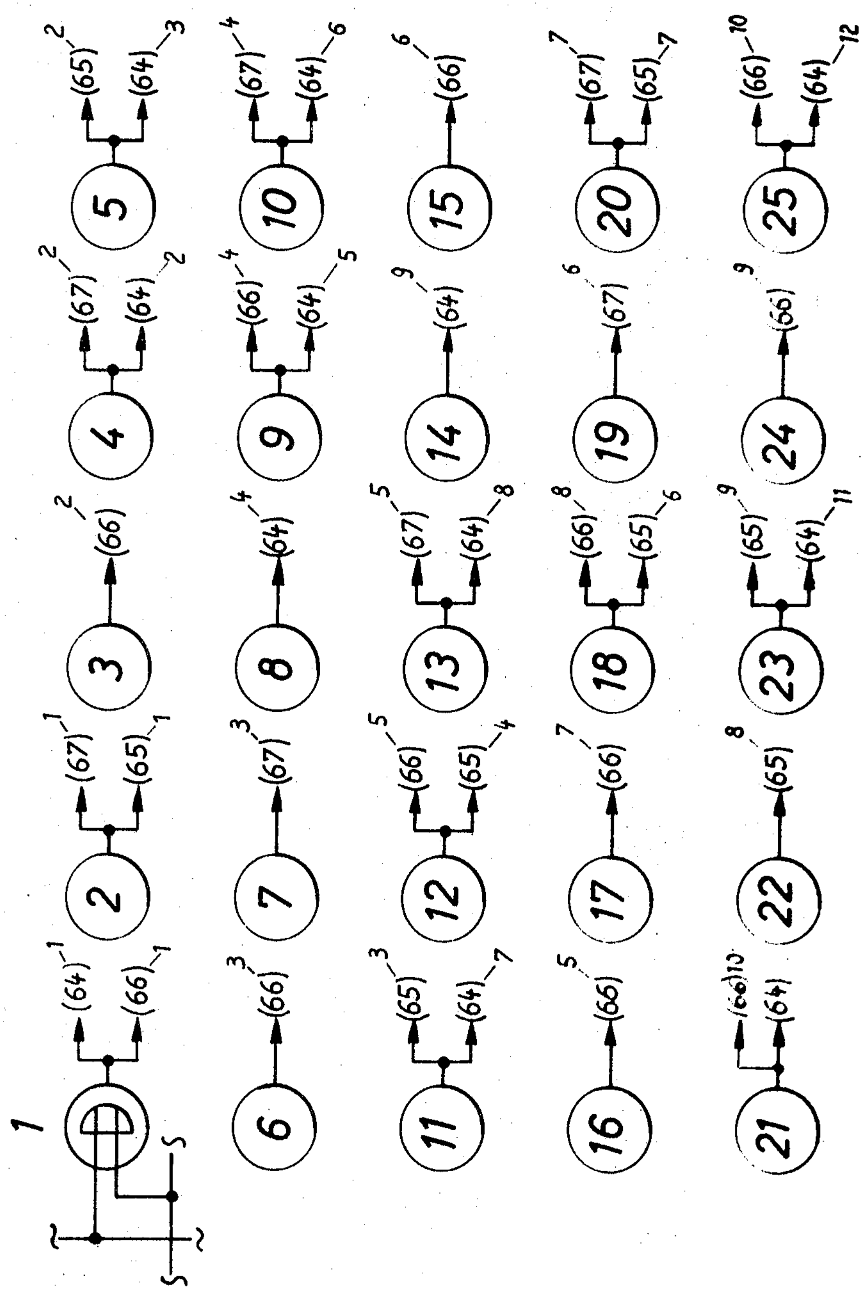
Fig. 11



INVENTOR:

By [signature]
OSTROLENK, FABER, GERB & SOFFEN
ATTORNEYS

Fig. 12



INVENTOR:

By

Ostrolenk, Faber, Gerb & Soffen
ATTORNEYS

CONTROL DEVICE FOR MULTIPLE-DIGIT FIGURES

The instant invention relates to computing devices and more particularly to a testing device for testing the accuracy of figures of multiple digits entered into a machine such as, for example, an accounting machine, wherein the accuracy of the figures is checked by means of adding an additional digit or group of digits with the latter being produced as a result of the multiplication of the individual digits of the numbers to be tested with characteristic "weights" for the different digit positions which are all added together to form a total of the digits or another addition of the intermediate results.

It is conventional to test the accuracy of multiple digit figures by the addition of one, or several, test figures in order to avoid errors of registration and in particular, to avoid incorrect or forged entries.

In the case of accounting machines which may be employed in banks or financial institutions even the most careful training of the machine operators will not serve to reduce the frequency of errors in keying and account numbers much below 1 percent. This error rate of wrong entries can be quite substantial even on a daily basis in institutions where the volume of business is quite substantial. Such incorrect entries can be economically detrimental especially in banking institutions and in particular if a credit is entered into the wrong account. Moreover, considerable work is necessary to discover and correct errors by cross-checking and trial balance methods.

The danger of such erroneous entries may be reduced considerably if an additional factor or figure is added to the account number, such additions resulting from the sequence of the account numbers in accordance with a particular computational system. If such a computational system is limited to a simple addition operation, for instance, the total of digits of a sum, then the only error being eliminated is that of a single numeral being typed erroneously, such as registering the decimal number 6 instead of the decimal number 5.

The very frequently occurring error of transposition of adjacent numbers, for example, the entry of the number 63654 instead of the correct account number 63645 will not be detected by the above suggested system since the digits of both the correct and the incorrectly entered account number have the same sum (i.e., 24=24). It will be readily understood that the transposition of adjacent numerals can be eliminated only if a multiplication system is employed. For example, if the first numerals are multiplied with different characteristic "weights" assigned to the digits before an addition operation, for instance, the summation of the digits, is performed. Using such an arrangement the wrong registration of a figure as well as the transposition of digits can be detected and eliminated and it can be shown that the frequency of errors is reduced by a factor of the order of 1 to 100, through the use of this arrangement. This means that, in practice, as an example, for 1000 registrations per day on the average, only one undetected per month will be found to occur.

It is conventional to provide in machines commonly referred to as complete key machines a rather complicated selector and indicator control means by means of which it is possible to test whether the registered numeral, including the test number, falls within the testing scheme. The expense for such testing devices, however, is so considerable that they have hitherto been used only for very special purposes.

The instant invention yields a testing device which meets all of the following requirements:

a. The control device is suitable for machines having a 10-keyboard;
b. A control device which delivers an indication or an indication or release, or blocking of the machine before one of the operating keys (i.e., functional keys) of the machine is released, immediately after the keying in of each digit of a multiple digit figure has been completed;
c. A control device which is considerably smaller in overall dimensions as well as much less expensive than control devices so that as a result widespread use thereof may be reasonably anticipated.

A testing and control device fulfilling all of the above requirements as will be described herein in detail, differs from conventional devices by the fact that a 10-keyboard, into which the number to be checked is keyed in by individual positions, is additionally provided with key contacts and a circuit dependent upon the digit and that the key contacts and the circuits are scanned by impulse during, or immediately after, the keying in of a number to be registered, whereby an intermediate result is stored in an evaluation and storage means, said device delivering either directly with or after the keying in of the last figure of the number being checked, an indication regarding the result of the control, or which releases or blocks the machine which may be correlated with the testing device "key contact" which generally refers to any switching device which, by depression of a key, undergoes a change of condition.

Basically, the test of the account number to be registered takes place before connecting the mechanical part of the machine rotation to the registered number. An erroneous depression will therefore never be printed on the paper strip or appear on some connected punching means such as, for example, a punch card or punch strip unit. At the same time, in this manner, a tedious and frequently indistinct designation of a wrongly printed sequence of numbers, as well as the return of the transport connected thereto, is completely avoided.

Let it be assumed that an account number, including the control number which is represented by the last numeral is identified by the number 471,126-2 is to be keyed into a 10-position board. The number 471,126 represents the account number while the number 2 represents the test or control number. The weights associated with the positions of the account number are 7, 6, 5, 4, 3, 2 and 1. Thus, if the first key being depressed is the 4 key, then the control dependent on this digit position causes a multiplication by 7 to take place. During the impulse scanning at the end of the key depression, therefore, the plotting and storage device will store the product of this multiplication, namely the numeral 28. When the key is released and the value carrier such as the capstan spike carriage of an adding machine advances, the control dependent on the digit position attains the condition where a multiplication by the weight "6" takes place. When the "7" of the account number is keyed in, the control dependent on the digit position causes a multiplication by 6 to take place. Thus, in the plotting and storage device the product 42 is added to the intermediate result 28, yielding the sum 70, due to the impulse scanning at the end of the depression of a key. As the value carrier of the machine moves on, the control dependent upon the digit position reaches the condition in which a multiplication by 5 occurs. Thus, the intermediate product of 5 is added to the sum being stored in memory. Next the intermediate products 4, 6, 12 and 2 are added to the sum stored in memory in a like manner. The final sum being stored, therefore, is 99. For simplification, it will be suitable to have the plotting and control device operate in such a manner that, after reaching a specific modulus, it starts addition over again, and, if in this case, one bases the system on the modulus 11, then no result will remain in the plotting and control device. However, each time no result is present in the storage device, said device, upon the impulse passing therethrough, will immediately release the machine having the 10-keyboard to permit the functional operation to be performed. This is proper since the test procedure has shown the number entered in to compare favorably with the test and control number. Thus, the decision "right" or "wrong" is immediately and permanently recorded. It should be noted, however, that the system of the instant invention is not restricted to any particular number of positions in the figure or account number to be entered. Thus, 3-position and 10-position numbers may be checked successfully without any adjustment being made to the system. The "right" or "wrong" decision is made immediately upon keying in of the last figure of a multiple digit number. The test or control number "2" in the example given above was so selected that, when adding the intermediate results, the product obtained was a multiple of the modulus 11.

An object of the instant invention, therefore, is the use of a test and control device with a 10-keyboard as opposed to a complete keyboard such as, for example, a 10×10 keyboard of 100 keys, and furthermore the impulse scanning of the key depression being accompanied simultaneously with multiplication by the weight of the digit position whereby, under the impulse scanning, the cumulative result is immediately obtained after each figure is entered. The test and control operation is thus fully completed before any functional machine key has been operated. This is a very important advantage, since neither recording of a wrongly keyed in account number nor an erroneous calculating result can take place, which might have to be removed at a later time. If, on the other hand, in using the control device for an accounting machine, the multiplications and additions would have to be carried out by the accounting machine, the multiplications and additions would have to be carried out by the accounting machine proper thereby requiring an operation of the functional keys and an erroneous depression of a key could not be removed simply by operation of a clearing key.

In a preferred embodiment of the instant invention the multiplication of the figures by digit position "weights" takes place through a multiplication circuit in which the precomputed intermediary results or the values thereof which have been shortened by a specific modulus, are being controlled in the form of points of intersection of a matrix as a function of the key number being depressed and the position of the number to be entered into the machine. Such a multiplication circuit may be formed by a matrix consisting of a grid of perpendicularly oriented ordinate and abscissa strands with switching elements being provided at the intersecting points which are capable of at least two discrete switching conditions. The matrix is connected with the individual key contacts and with the circuit dependent upon the position of the key carriage.

In this manner it is possible, in accordance with the instant invention, to reduce system costs considerably. It is thus not necessary that the multiplications in the form of successive additions be carried out by complicated calculating devices. Rather, the precomputed results are stored in a matrix and are suitably controlled.

It is still further particularly preferred that the circuit which is dependent on the position of the key carriage be comprised of a movably mounted member being provided with a printed circuit, such that the movably mounted member is displaced or deviated in conjunction with the successive keying in of the digits of the number to be checked. In one preferred form the movable member may be a pendulum slider. The contacts scanning the pendulum slider are connected, on one hand, with the matrix, and on the other hand, with the key contacts. In this manner, several conductive strands of the printed circuit of the pendulum slider are always simultaneously scanned.

If a modulus 11-system is employed, the cross-point matrix, i.e., 10×10 matrix, possesses 100 points of intersection. It can be shown, however, that the intermediate results "stored" at the intersecting points have a double reflected imagelike arrangement. According to one preferred embodiment of the instant invention, it is possible to considerably reduce the points of intersection of the matrix, thereby considerably reducing the construction costs of the matrix. The preferred embodiment is achieved by first reducing the matrix by a reflected mirror process to one-half the number of intersecting points and preferably, however, by two reflected mirror processes so as to reduce the number of intersecting points to one-quarter of the total number, or for example, to 25 intersecting points, by adding one-half of the position weights and by subtracting the remaining half of position weights, and/or by adding to one-half of the figures, for example, the figures 1—5 and for subtracting the figures 6—0 in the electronic calculating device.

The intersecting positions of the matrix are coupled to suitable gating circuits which may, for example, be comprised of diodes and more particularly of solid state semiconductor devices.

It is further preferred that the control member carrying the printed circuit, namely the pendulum slider, have a lift-over position which it assumes for a brief interval during the reversal of the capstan spike carriage, whereby a disconnection of the electronic calculating device occurs, causing the calculating device to automatically be cleared in readiness for the next control and test operation.

It is furthermore particularly preferred that the matrix assembly and electronic calculating device be housed in a flat base having approximately the outline of the machine to which the testing device is coupled. The 10-keyboard may belong to any accounting-adding or data processing machine, for instance, a punch card machine. The invention thus also refers to any such machines which are provided with a checking device of the described type. The 10-keyboard need have no further function if, for example, only the control of the numbers, for instance, of stocks and bonds, is to take place. It is easily seen that the checking figures may be located at the beginning, middle, end or any other particular position of the figure being checked, since only the total of the test number generated is determinative of the correctness or incorrectness of the number to be registered.

The instant invention is comprised of a computing device having a 10-keyboard capable of entering any decimal digit from 0—9 into the machine. Functional keys may also be provided for the purpose of performing mathematical operations and/or a printing operation after correct entry of a number. A movable capstan carriage is provided for the purpose of entering each of the figures into writing figure wheels or other registers to effect addition or subtraction. The capstan carriage is designed to be moved by a discrete distance as each figure is entered. This movement is coupled to a movable member having a printed circuit configuration thereon which makes slidable engagement with a plurality of conductive sensing fingers. The keys of the 10-keyboard and the conductive sensing fingers are electrically coupled to a regular matrix so as to establish a predetermined input condition at only one of the intersecting points of the matrix so as to form the product between the "weighted" digit position and the decimal number being entered, which product is then transferred to suitable computer means for summing the products formed. By assigning half of the 10-position digits a positive value and the remaining half a negative value the 25-position matrix is capable of yielding 50 different combinations. In a like manner, by assigning half of the decimal digits to be entered a positive value and the remaining half a negative value the matrix is capable of providing an output of 100 different combinations. In the case where either a negative value digit position or a negative valued decimal number to be entered is present, either alone or in combination, a separate signal is generated to indicate that a subtraction should occur in the formation of the test and control number.

If the number such as, for example, account number and its test number is entered into the keyboard, the functional keys will be released to enable the entry of the number presented to the keyboard into the machine for printing, punching or arithmetic operations. In the case where the test signal indicates an error, the functional keys of the machine will be blocked so as to prevent any of the above operations from occurring and thereby requiring clearing of the keyboard and reentry of the number.

It is therefore one object of the instant invention to provide a novel system for testing figures to be entered into computing devices and the like.

Another object of the instant invention is to provide a novel device for testing the accuracy of numbers entered into keyboard machines for the purpose of detecting errors of incorrect entry and errors of transposition.

Still another object of the instant invention is to provide a novel device for testing the accuracy of numbers entered into keyboard machines and the like having means for generating a test number which is an integral multiple of a preselected modulus.

Still another object of the instant invention is to provide a novel device for testing the accuracy of numbers entered into keyboard machines and the like having means for generating a test number which is an integral multiple of a preselected modulus wherein a test number is added thereto so as to cause the resultant sum generated to be an integral multiple of the preset modulus.

Still another object of the instant invention is to provide a novel device for testing the accuracy of a number entered into a keyboard machine having means for forming a product comprised of the number being entered and a weighted value of the digit position in which the number is entered.

Still another object of the instant invention is to provide a novel device for testing the accuracy of numbers entered into a keyboard machine, said device being comprised of a novel matrix arrangement having a minimum number of intersecting points which is capable of generating four times as many possible combinations of product values as appear at the intersecting points of the matrix.

Still another object of the instant invention is to provide a novel device for testing the accuracy of numbers entered into a keyboard machine, said device being comprised of a movable member positionable under the control of the machine carriage and having a printed circuit configuration thereon and sensing finger means for sensing the position of the movable member at any given instant to condition the matrix of the testing device as to the weighted digit position which is being entered into the keyboard machine.

Still another object of the instant invention is to provide a novel device for testing the accuracy of numbers entered into the keyboard machine employing a matrix means for forming the products of the digit position being entered and the decimal number being entered at the digit position and further comprising means for blocking operation of the machine functional keys in the case where an incorrect number has been detected by the test means.

These and other objects of the instant invention will become apparent when reading the accompanying description and drawings in which:

FIG. 1 is a perspective view showing a conventional accounting or adding machine with a 10-keyboard and a housing containing the matrix and electronic calculating device of the control means of the instant invention which may be used as the base for the keyboard machine.

FIG. 2 is a perspective view of the keyboard machine of FIG. 1 with certain of the portions thereof removed to permit observation of the internal mechanism of the device which is shown in the rest position.

FIG. 3 is a perspective view showing the underside of the 10-keyboard and the keyshift arrangement.

FIG. 4 is an enlarged perspective view showing the 10-keyboard and key contacts in greater detail.

FIG. 5 is a sectional view of the keyboard of FIG. 4 taken along the line V–V of FIG. 4, showing the key contact arrangement.

FIGS. 6 and 7 are perspective views of the blocking mechanism of the instant invention shown in the blocking and released positions, respectively.

FIG. 8 is a schematic diagram showing the electrical circuit for the key contacts and the pendulum slider printed circuit configuration of FIGS. 4 and 2, respectively.

FIG. 9 is a schematic diagram showing the matrix arrangement of the instant invention and the manner in which the key contact and pendulum slider circuitry are associated therewith.

FIG. 10 is a chart showing graphically the manner in which the intersecting points of the matrix may be drastically reduced.

FIG. 11 is a logical diagram showing the manner in which the matrix key contacts and pendulum slider circuits are coupled to the electronic computer.

FIG. 12 shows the matrix of FIG. 9 in greater detail with the connections between the gate circuits and the computer being given in parenthesis.

Referring now to the drawings, FIG. 1 shows an accounting or adding machine 1 with a 10-keyboard 5 for entering the decimal numbers 0 through 9 into the machine and further being provided with functional keys 8 to cause the number entered to either be printed or punched or to cause a mathematical operation such as addition, subtraction, multiplication, et cetera, to occur. The arrangement of FIG. 1 is further provided with a base 2 on which the machine 1 may be positioned. The dimensions of base 2 are preferably similar to the length and width of the machine 1 so as to permit it to be readily positioned upon the base. As one example, the width of base 2 may be of the order of 20—25 cm., the depth on the order 35—40 cm. and the height of the order of 5—10 cm. The base 2 is designed to house the matrix and electronic calculating mechanism of the instant invention to be more fully described and from the dimensions given above it can be seen that the electronics of the control device of the instant invention occupies very little space.

After depression of a key of the keyboard group 5, or near the end of such a depression, an electronic signal is coupled from machine 1 through a circuit 6 to the matrix provided in base 2 (and to be more fully described), as well as to the electronic calculating machine for the purpose of testing whether the sequence of figures thus far keyed in is in agreement with the testing and control scheme. If the sequence of figures has been found to be correct, machine 1 receives a signal from the computing device housed in base 2 through a circuit 7 for the purpose of releasing the keys of the functional key group 8 for the purpose of either enabling the printing of the figures entered in or permitting the performance of a mathematical operation.

FIGS. 3, 4 and 5 show the keys of the 10-keyboard in greater detail. The decimal "zero" key 5′ has been omitted from the FIGS. 3—5 only for purposes of simplicity and it should be understood that the contact arrangement of this key is substantially identical to the contact arrangements of the remaining decimal keys 1—9, to be more fully described. As shown best in FIGS. 1, 3 and 4, the decimal keys 1—9 generally designated by the letter T, are arranged in three rows, as shown. In addition to a "zero" key, the keyboard may also be provided with a double-zero or triple-zero key as is customary in many conventional adding or computing machines.

Each of the keys T are secured to an associated shaft 12 which is arranged to pass through suitable holes provided in a conductive plate 9, a guide plate 10 and an insulating plate 11, all of which openings are substantially in alinement. The openings 10′ and 11′ in guide plate 10 and insulating plate 11, respectively, are of suitable dimensions as to receive a substantially circular metallic contact ring 13 which is biased in the direction shown by arrow A by means of a helical spring member 14. Each helical spring 14 normally biases the conductive contact ring 13 into electrical engagement with a contact 15 provided on the under side of conductor plate 9. The electrical condition, i.e. open or closed, of the contacts are conveyed to the matrix (not shown in FIGS. 3—5) through the printed circuits 9′, in a manner to be more fully described.

Each of the shafts 12 of the keys T are offset in the conventional manner, as shown best in FIG. 3, so that all of the extreme ends 16 of the shafts 12 are in a substantially linear array and are all substantially parallel to one another. When one of the keys T is depressed, the end such as, for example, the end 16′ of the depressed key is displaced downwardly, as shown in FIG. 3. The other keys T which have not been depressed are blocked against a depression operation either deliberate or accidental as is conventional in machines of this type.

The ends 16 of the key shafts 12 operate in the conventional manner on the capstan spikes 17′ of the capstan carriage 17 as shown in FIG. 2. It should be clearly understood that the keyboard of FIG. 3 is positioned immediately above capstan carriage 17 so that the key ends 16 are substantially in alinement with the imaginary straight line 17*b*, shown in FIG. 2. The capstan carriage 17 serves as the value carrier retaining the value of the key being depressed in one of its rows while each of its columns represents the digit position into which the number is entered. The capstan carriage 17 is displaced toward the left as shown by arrow 17*a* either by steps or half steps when the key T is depressed or released. In any case, stepping of the capstan carriage 17 causes a displacement sufficient for the key shaft ends 16 to line up with the next capstan spike column. Each steplike displacement is visibly indicated by means of the place or digit position indicator 17″ which is rigidly secured to carriage 17 and which has a tapered end cooperating with a graduated scale 17‴ so that the position of the pointer relative to the numbers provided thereon immediately indicates the digit position of the number being entered. The keyed-in figure is then finally fixed by suitable setting of the capstan spikes 17′. The capstan spikes are thereupon scanned by conventional means (not shown in the drawing) for the purpose of rotation of the writing figure wheels or of the registers effecting an addition or subtraction. The capstan spikes writing figure wheels and registers are conventional and lend no novelty to the device of the instant invention and have therefore been omitted for purposes of simplicity. As one specific example of the form which these devices may take, reference can be made to copending U.S. Pat. application Ser. No. 478,050, filed Aug. 9, 1965 and assigned to the assignee of the instant invention. Specific detailed descriptions of the capstan spikes, writing figure wheels and registers is incorporated herein by reference thereto.

In the instant application the importance of the capstan carriage 17 is that its movement in the direction shown by arrow 17*a*, is coupled through the connecting levers 18, 18′ and 18″ to a pendulum slider 19 which is pivoted about a shaft 20. Thus, displacement in the linear direction 17*a* by capstan carriage 17 is converted to rotational displacement of the pendulum slider 19. The levers 18, 18′ and 18″ and the shaft 20 also serve other functions within the machine in the manner well known in the art.

The novelty of the instant invention is the arrangement of the pendulum slider 19, which is provided with a printed circuit configuration 21, which is scanned by conductive sensing fingers (i.e., contact springs) in such a way that two circuits of the test device simultaneously receive current, in a manner to be more fully described.

The pendulum slider 19 further provides the function such that, upon further movement occurring at the time when the figure to be checked is keyed in, intersecting points of the matrix (not shown) are selectively coupled to the current signal so as to carry out the multiplication of the keyed-in figure with the associated digit position "weight".

The chart of FIG. 10 serves to describe the matrix employed in the instant invention. The lower row A–A of figures shown in the chart indicates the location of the capstan pin carriage 17 which is also the digit position indicated by the pointer 17′ and the graduated scale 17‴, shown in FIG. 2. The positions of the capstan pin carriage are coordinated with the weights for the positions shown in the upper line B–B. Thus, it can be seen that the digit positions 1, 2, 3, 4 and 5 carry the weights 1, 2, 3, 4 and 5, respectively; while the digit positions 6, 7, 8, 9 and 10 carry the weights 10, 9, 8, 7 and 6, respectively. It should be noted that the weight 10 has been employed as opposed to the weight zero, since multiplication of any number by zero will not provide a suitable product for use in testing the accuracy of a figure which has been keyed in. The vertical columns C–C, on opposite sides of the chart, correspond to the decimal numbers which may be keyed in by the 10-keyboard. Again, it should be noted that the decimal zero has been replaced by decimal 10 for otherwise decimal zero could not be distinguished positionwise. This is because the multiplication by any of the weighting values times zero results in a product zero.

The matrix registers the multiplication of the weights times the decimal number keyed in according to the modulus 11. For example, if the decimal figure 2 is depressed in the first digit position, the result 11−2×1=9 is obtained; if the decimal figure 2 is depressed in the third digit position the result is 11−2×3bx5 is obtained; if the decimal 2 is depressed in the sixth position, the result is 22−2×10=2. Since the sixth digit position is associated with the weight 10, the modulus 11 is doubled or multiplied by a further integral multiple in order to accommodate those cases where the product of the figure times the position number is larger than 11 or larger than a multiple of 11. For example, if the decimal number is entered into the sixth digit position, this product would be equal to 90, requiring the modulus to be 99, causing the result to be 99−9×10=9.

By observing the obtained remainder values and dividing the matrix into four quadratic fields *a*, *b*, *c* and *d*, it can be seen that the field *a* is a symmetrical mirror image of field *d* and that field *b* is a mirror image of field *c*. For example, each vertical column in field *a* read from top to bottom reappears in field *d* in the same arrangement when read from bottom to top. For example, the left-handmost column of field *a* read from top to bottom is 10, 9, 8, 7, 6 and the left-handmost column in field *d* read from bottom to top is 10, 9, 8, 7, 6. In a similar manner, the left-handmost column of field *c* read from top to bottom is 1, 2, 3, 4, 5 and the left-handmost column of field *b*, reading from bottom to top is 1, 2, 3, 4, 5.

Furthermore, the remaining columns of the first five rows, read from top to bottom, are equal to the corresponding columns in the second five rows, read from bottom to top. For example, the right-handmost column 5 of rows 1—5, read from top to bottom reads 61728 and the right-handmost column 10 of the bottom five rows read from bottom to top reads 61728. This factor may also be expressed as follows, namely, that each balance of the first row, added to the associated balance of the last row equals the modulus 11. Consider, for example, the topmost row which is 10, 9, 8, 7, 6, 1, 2, 3, 4, 5. Adding this to the last row which is 1, 2, 3, 4, 5, 10, 9, 8, 7, 6, each addition equals the modulus 11. The same applies for the sums of the balance of the second row added to the balance of the ninth row; the balance of the third row with the eighth row; the balance of the fourth row with the seventh row and finally, the balance of the fifth row with the sixth row. Since the system modulus has been chosen as the decimal number 11, the same result can be obtained when the fifth column is added to the sixth; the fourth to the seventh; the third to the eighth; the second to the ninth and the first to the tenth It is therefore possible, so to speak, to superimpose the fields *c* and *d* over the fields *a* and *b* and connect position 1 with position 6, position 2 with position 7, position 3 with position 8, position 4 with position 9, and position 5 with position 10, provided that each time the remaining balance of the positions 6—10 occur they are subtracted instead of added. Likewise the field *d* may be slid over the field *b* for the indicated reasons of symmetry, the figures of 1—5 associated with the field *a* being counted negatively and the figures 6—10 being counted positively. It is of course also possible to proceed in the reverse order and slide field *b* across field *a*. This, however, would be less favorable since the field *a* contains the figure decimal 7 several times. It is more advantageous to count the figure decimal 7 as negative decimal 4. Since the field *b* contains no decimal figure 7, this method is of great advantage for a binary electronic computing device since only the figure 7 would require three impulses in a basic binary coded decimal system where four binary digits represent the positions 1, 2, 4 and 8. Thus, by avoiding use of decimal 7, all remaining figures will only require two binary "one" states to represent any of the decimal figures 0—9 with the exclusion of decimal 7.

This surprisingly simple numerical system makes it possible to reduce the matrix to 25 points of intersection as compared with 100 points of intersection of the matrix arrangement shown in FIG. 10. Each of the 25 intersecting points are coupled through an electronic gate to selectively generate the appropriate signals, as will be more fully described with reference to FIGS. 8, 9 and 11. The logical OR gates employed may be formed of semiconductor diodes, which gating circuits are well known in the art. For example, see the text "Arithmetic Operations in Digital Computers" by R. K. Richards, and particularly to page 32, showing semiconductor diode AND and OR circuits.

The logical gates employed are so connected with any conventional electronic computer device through the key contacts **15** and the pendulum slider assembly **19** in such a manner that the computer will add or subtract the value associated with the corresponding gates, in a manner to be more fully described.

The pendulum slider **19**, shown in FIG. **2**, is provided with five printed circuit configurations *a—e*, as shown best in FIG. **8**, with each of the printed circuits *a—e* having a break along the contacting surface in at least two positions along the circuit. For example, the printed circuit *e* has a break in the digit positions **1** and **6**; the printed circuit *b* has a break in digit positions **2** and **7**, and so forth. FIG. **8** shows the printed circuits arranged in linear fashion, but it should be understood that these circuits may be presented in arcuate fashion upon the surface of the pendulum slider **19**. The conductive sensing fingers S are arranged so as to be stationary with the printed circuits *a—e* as well as the printed circuits *v* and *p* being movable relative to the sensing fingers. There is a sensing finger associated with each of the seven printed circuits and all of the sensing fingers are electrically connected to one another through a conductive wire W. At one of the "breaks" in each of the printed circuits *a—e* the positive or add direction is associated therewith while the remaining break is associated with the negative or subtract direction. For example, for the digit positions **1—5**, it can be seen that the lowermost sensing finger does not make electrical engagement with the printed circuit *p* indicating the positive or add direction. For the digit positions **6—10**, the lowermost sensing finger makes electrical engagement with the printed circuit *p* to indicate the negative or subtract direction. The function of the presence of this pulse will become evident upon description of the operation of the testing scheme. All of the printed circuits, *v*, *p*, and *a—e* are electrically connected into the matrix arrangement as shown in FIG. **9**, wherein the printed circuits *a—e* are connected to the vertical conductors or abscissa strands of the matrix **3**. For example, in the first digit position, it can be seen that the conductor *v* is coupled to the printed circuits *b*, *c*, *d*, and *e* and is disengaged from the printed circuit *a* so as to decouple the conductor *v* from the left-handmost abscissa strand of matrix **3**. Thus, all of the vertical wires of matrix **3** except for the left-handmost vertical wire will receive a pulse. In FIG. **9**, the **10** possible connections are shown as two-position switches numbered **1** through **10**, it being understood that this is only a shorthand schematic notation with the actual circuitry being shown in FIG. **8**.

From a consideration of FIG. **8**, it can be seen that conductor means **60** are provided to connect the printed circuit *v* with the keys T of the 10-key keyboard. Conductor **60** is connected in common to all of the contact rings **13**, as shown in FIG. **5**, which are normally engaged with the conductive rings **15**. FIG. **8** shows the cooperative contact arrangement, schematically, as a two-position switch being in the normally closed position and being operative to be opened when the keys T are depressed, in the same manner as previously described. The conductors **61**, shown in FIG. **8**, are the schematic equivalents of the conductors **9'**, shown in FIG. **4**, and are coupled to an AND gate circuit of the computer facility, in a manner to be more fully described. It should further be noted that the conductors **61** are connected to the contact rings **13** of the keys representing decimals **6** through decimal zero. The contact rings **15** of the keys representing decimal **6** through decimal zero are coupled through conductors **62** to the row windings of the matrix **3**, shown in FIG. **9**.

It can be seen from a consideration of FIG. **9** that the intersection of row and column windings or strands is provided with a semiconductor gate "**22**" at each of the 25 intersections. One typical gate "**22**" is shown in detail in FIG. **11**. Only one of such gates has been shown in detail, it being understood that the remaining gates are all substantially identical in both function and configuration and details of the remaining gate circuits have been omitted for purposes of simplicity. Each gate circuit is comprised of an OR gate **63** having a first input **63***a* coupled to a vertical winding and a second input **63***b* coupled to a horizontal winding of matrix **3**. The nature of the OR gate **63** is such that when a signal is present at either one of its inputs **63***a* or **63***b*, or at both of its inputs simultaneously, an output will be generated. This is standard for OR gate circuits. Thus, no output will be generated at the output terminal **63***c* if there is no signal present at either of its input terminals **63***a* and **63***b*.

Each of the gating circuits "**22**" of FIGS. **9** and **11** located at an intersecting point of the matrix represents one of the values shown in the field *b* of FIG. **10**. Since each of these gates must generate a decimal output representing an associated decimal number of the field *b*, gating means are provided for the purpose of indicating this decimal value in binary coded decimal fashion. For example, let it be assumed that the gating circuit "**22**" of FIG. **11** represents the intersection numbered **25** in FIG. **9**. From a consideration of the field *b* of FIG. **10**, it can be seen that this must yield a binary coded decimal output of 0101. This is provided for in the instant invention by the logical AND gates **64—67** shown in FIG. **11**. The operation of the logical AND gates **64—67** is such that they will yield an output signal only when input signal is present at all of its input terminals. For example, AND gate **64** is provided with 12 input terminals. Thus, for AND gate **74** to yield an output signal, the signals must be simultaneously present at each of its 12 input terminals. Since the matrix **3** of the instant invention operates in such a way as to provide an absence of signals at one of the 25 intersecting points (in a manner to be more fully described) the output of the gating circuit "**22**", shown in FIG. **11**, must be simultaneously coupled to one input terminal of AND gates **67** and **65**, as is shown in FIG. **11**. The operation of the AND gates **64—67** is such that the gating circuits **22** at the remaining intersecting points will cause AND gates **66** and **64** to yield output signals while the state of the gating circuit "**22**" of FIG. **11** will inhibit AND gates **65** and **67** from yielding output signals so as to generate the binary decimal code 0101 indicative of a binary decimal coded **5**.

The operation of the test and control scheme matrix is as follows:

Let it be assumed that the key T representing the decimal number **5** is to be entered in the first digit position. Referring to the chart of FIG. **10**, it can be seen that the product of decimal **5** (see column C–c), times the "weight" of the first digit position (see row A–A) is 5×1=5. Subtracting this from the modulus 11 yields the result 11−5×1=6. This is the result given in the lower left-hand corner of the field *a*. Referring now to a consideration of the electronics for performing this product, with the pendulum in the angular position indicative of the first digit position, the sensing contacts S will be in the position as shown in FIG. **8** so that the voltage circuit *v* will be electrically coupled to the printed circuits *b* through *e* and will be electrically isolated from the printed circuits *a* and *p*. From a consideration of FIG. **9**, the vertical conductors *b* through *e* of matrix **3** will receive a voltage and the vertical conductor *a* will receive no voltage.

Since the decimal **5** pushbutton, designated by the numeral **68** of FIG. **8** is depressed, this opens the contact at this position, coupling only the decimal **1** through decimal **4** conductors **61** to the horizontal or row conductors *f* through *i* of FIG. **9**. Thus, the voltage printed circuit *v* as shown in both FIGS. **8** and 9 will connect voltage to row windings *f* through *i* while row winding *k* will be electrically isolated from the voltage printed circuit *v*. Since the printed circuit *p* of FIG. **8** is not electrically connected to the printed circuit *v*, this switch position *p*, shown in FIG. **9**, will be open.

Due to the voltage conditions which have now been set up, it can clearly be seen that there will be a vertical input signal to all of the gates "**22**", shown in FIG. **9**, except for the gates numbered **1**, **6**, **11**, **16** and **21**, i.e., except for those gates connected to the vertical winding *a*. In a like manner, all of the gates "**22**" receive a horizontal input except for those gates in the bottommost row connected to winding *k*. It can therefore be seen that 16 of the total number of 25 gates receive input signals at both of its input terminals, namely, the gates at positions **2, 3, 4, 5, 7, 8, 9, 10, 12, 13, 14, 15, 17, 18, 19** and **20**. Eight of the remaining gates receive at least one input signal at one of its input terminals, namely, the gates at positions **1, 6, 11, 16, 22, 23, 24,** and **25**. Thus, only the remaining gate at position **21** in the lower left-hand corner of matrix **3** fails to receive any input signal at its gate input terminals.

FIG. **12** shows a reproduction of the matrix **3** of FIG. **9**, showing the output connections of the 25 gate circuits. For example, the gate "**22**" in the "**1**" position, that is, the upper left-hand corner position, has one output coupled to one input of AND gate **64**. In a like manner, the remaining output connections are shown in FIG. **12**, which connections are appropriate for generating a binary coded decimal representation. As can clearly be seen from a consideration of FIGS. **11** and **12**, AND gate **67** (the weighted decimal **8** gate) has seven input leads; AND gate **66** (the weighted decimal **4** gate) has 10 input terminals; AND gate **65** (the weighted decimal **2** gate) has nine input terminals; and AND gate **64** (the weighted decimal **1** gate) has 12 input terminals. The gate circuits "**22**" to which the AND gates **64—67** are connected are shown in FIG. **12**. Since the gate circuit "**22**" in position **21**, i.e., that gate in the lower left-handmost corner of the matrix **3** provides no signal at its output terminal, then one of the input terminals of AND gates **64** and **66**, to which the outputs of gate "**22**" in position **21** are connected, receive no input signals. From a careful consideration of FIG. **12**, it can clearly be seen that the AND gates **65** and **67** will receive signals at all of their input terminals so that the gates **67—64** will generate binary output signals thereby generating the code 1010.

The outputs of AND gates **67—64** are coupled to inverter circuits **74—71**, respectively, which invert the signals appearing at the outputs of the AND gates **67—64**, respectively. Thus, the binary decimal code appearing at the outputs of inverters **74—71** will be 0101, thereby representing the decimal number **5**. Comparing this result against the chart of FIG. **10**, it can be seen that a decimal **5** entered into the first digit position and subtracted from the modulus 11 should yield the result 11−5×1=6. It can be seen that if the computer recognizes the output of AND gates **67—64** as being subtracted from the modulus 11 that the necessary result, i.e., decimal number **6** will be obtained. The appropriate signal is derived by means of AND gate **75**, shown in FIG. **11**, having five input terminals connected at the points *q—u* which are equivalent to the outputs leads **61** shown in FIG. **8**. Since the five contacts **68**, shown in FIg. **8**, were previously described as having been depressed and this contact position will be opened so that one of the inputs to AND gate **75** will have no signal present causing the AND gate **75** to yield no output. This is coupled through a conductor **76** into the computer facility and the appearance of no signal at the output conductor **76** indicates to the computer that the decimal number **5** presented to the computer must be subtracted from the modulus 11 **to yield the result of decimal number** 6.

As one other example of the operation, let it be assumed that the decimal number 7 key is depressed for digit position "**1**". The resultant, for this operation, should be 11−7×1=4, which can clearly be readout of the chart of FIG. **10**. In order to obtain this result, it is clear that the depression of the 7-contact button designated by the numeral **76** in FIG. **8**, isolates the row winding *i* from the voltage signal, as can be seen from FIG. **9**. Thus, the row windings *f, g, h* and *k* are coupled to the voltage signal. Since the pendulum slider is in the "**1**" position, all of the column windings *b* through *e* receive the voltage signal and column winding *a* is isolated from the voltage signal. Thus, all the gate circuits, with the exception of the gate circuit in position **16** of matrix **3** receive at least one input signal. From a consideration of FIG. **12**, the gate in position **16** has one output terminal coupled to one input terminal of AND gate **66**. This will inhibit AND gate **66** from generating an output signal while AND gates **67, 65** and **64** will yield output signals to generate the binary code 1011. The inverter circuits **74—71** convert this code to 0100 which is the binary coded representation for the decimal number **4**. Since this should be the resultant answer it is necessary to supply the computer with a signal indicative of the fact that the output from the AND gates **67—64** and inverters **74—71** is not to be subtracted from the modulus 11. This is carried out by the AND gate **75**. It will be noted that all of the pushbutton keys for the decimal numbers **1—5** are closed coupling voltage *v* through pushbutton switches and the conductor **61** to all of the input terminals of AND gate **75**. Thus AND gate **75** will yield an output signal appearing at the output conductor **76** which binary "**1**" state indicates to the computer that the output of inverter **74—71** is the final result and that this result need not be subtracted from the modulus **11**.

As still one further example, let it be assumed that the decimal number **5** is to be inserted into the sixth digit position. The result should therefore be 55−10×5=5. This value lies in the lower left-hand corner of the *c* field, as shown in FIG. **10**. Under this condition, depression of the contact key **68**, shown in FIG. **8**, isolates the row winding *k* from voltage, as well as inhibiting AND gate **75** from generating an output. Since the sixth digit position is a position in which the decimal number **5** is being entered, a consideration of FIG. **8** shows that the sensing contacts S isolate voltage from the printed circuit *a* while coupling voltage to the printed circuits *p—e* as well as the printed circuit *p*. Thus, all of the column windings *b—e* receive voltage while column winding *a* receives no voltage. This again causes the gate "**22**" in the gate position **21** of matrix **3** to be the only gate which receives no voltage signals at either of its input terminals while all of the gates in the remaining gate positions receive at least one input signal. This again causes the gate in gate position **21** to inhibit AND gates **66** and **64** from generating outputs yielding the output code 1010. Inverters **74—71** convert this to the binary coded decimal representation 0101. Since this output (decimal 5) should not be subtracted from modulus 11, it is necessary that a binary "**1**" level signal appear at the output winding **76**. This is accomplished by virtue of the printed circuit *p*, shown in FIG. **8**, which makes conductive engagement with its associated sliding contact, thereby establishing a conductive path from the voltage printed circuit *v* through the *p* switch shown in FIG. **9** to the output **76** thus indicating to the computer facility that the coded decimal character appearing at the output of inverters **74—71** is the final result and need not be subtracted from modulus 11.

It can therefore be seen from the foregoing description that a 25-position matrix, coupled with the capabilities of the AND gate **75** and the printed circuit *p* of FIG. **8** will provide the necessary outputs equivalent to a 100-position matrix simply by providing the additional signal which indicates to the computer whether the output from the inverter circuit **74—71** should be added to or subtracted from the running total being developed in the computer.

Whereas the matrix 3 has been described as being comprised of OR gate logic present at each gate position of the matrix, it should also be understood that the logical arrangement may be reversed, if desired, whereby AND gate logic can be used for the matrix gates, thus allowing the use of OR gate logic in place of the gates **67—64**. Such modifications are obvious to those with ordinary skill in the art.

In order that the outputs of inverter circuits 74—71 appear only after a key has been depressed, a switching bar 24, shown in FIG. 2, is provided which is caused to reciprocate under control of the moving capstan spike carriage 17 causing momentary closure of a microswitch 23 due to the left-hand end of switching bar 24 impinging upon the microswitch arm 23a. One input terminal or conductor 23b of microswitch 23 is thereby coupled to a voltage source, while the other winding 23c is electrically coupled to the printed circuit V, shown in FIG. 8.

The testing scheme operates in such a manner that the machine functional keys will be in a blocked condition if any remainder is present in the computer facility. The blocking operation is performed by a blocking magnet 25, shown in FIG. 2, which operates in a manner which can best be seen from a consideration of FIGS. 6 and 7. In FIG. 6, the machine is shown in the position wherein the control lever is not urged in the counterclockwise direction about its pivot pin 27 to permit a machine rotation when a keyed-in sequence of figures has been tested and been shown to be correct.

FIG. 7, on the other hand, shows the machine in the blocking position whereby the keyed-in sequence of figures has been shown to be incorrect.

If a correction indication has been developed in the computer, the computer will feed a signal through circuit 7 of FIG. 1 to operate the blocking magnet 25 to the position shown in FIG. 6.

The tripping lever 33 is pivoted to wall 28 of the computer and is arranged to rotate in the manner shown by double-headed arrow 33a. The upper end of tripping lever 33 is secured to engaging shaft 35, which is actuated by means of the functional operating keys 36 or 8, as shown in FIGS. 1 and 2. The movement of the engaging shaft 35 in the direction shown by arrow 35a causes tripping lever 33 to rotate clockwise about its pivot pin 34. Engaging plunger 31, which is coupled to tripping lever 33 by pin 32, is thereby urged substantially in the direction shown by arrow 35a. The engagement of the bent ear 37 on engaging plunger 31 urges catch lever 38 substantially in the direction 38a about its pivot pin 39. Counterclockwise rotation of the catch lever 38, by a predetermined amount, releases the bent ear 90′ of lever 91 from the slot 38′ provided in catch lever 38. This permits pin 40′which is carried by connecting lever 40, to urge lever 91 counterclockwise about its pivot pin 92 thereby completely releasing the blocking of connecting lever 40 and enabling it to rotate counterclockwise about pin 39 in order to move pull rod 43 from the left to the right so as to release the machine gear 45 for rotation and thereby allow the machine functional operations to be performed.

In the case where a keyed-in sequence of figures has been tested and shown to be incorrect, the blocking magnet 25 operates to move its armature 25′ from the position shown in FIG. 6, in the direction shown by arrow 25a, to the position of FIG. 7. The armature 25′ rotates control lever 26 counterclockwise about its pivot pin 27 causing its surface 29 to engage pin 30 moving it substantially vertically downward. This movement of pin 30 positions the bent ear 37 beneath the downward projection of catch lever 38 preventing the clockwise rotation of tripping lever 33 from releasing bent ear 90 from the slot 38′ in catch lever 38, thereby preventing release of machine gear 45. Pin 31′ is secured to engaging plunger 31 to control its repositioning in readiness for subsequent operations.

The pendulum slider 19 may be provided with an additional sliding circuit serving to disconnect the electronic computing device (not shown). For this purpose a so-called "upper lid position" may be provided. While the capstan spike carriage 17 moves in the return direction 17c, as shown in FIG. 2, which will occur, for example, when one of the functional keys 8 is depressed, the pendulum slider is briefly in the upper lid position thereby causing a sliding circuit to become closed momentarily disengaging the electronic computer from the matrix arrangement. The pendulum slider then rebounds into its zero position, as shown in FIG. 8. At the next depression of the key the capstan spike carriage 17 initially moves through a first half step thereby causing reconnection of the electronic computer to the matrix circuitry. This sliding printed circuit is represented by the switch symbol 95, shown in FIG. 9.

As a further facility, a lamp means (not shown) may be provided which is energized simultaneously with the blocking magnet means to indicate that the electronic test operation is being performed. The lamp may be deenergized when the figures are being keyed in.

It will be obvious to those with ordinary skill in the art that the control device of the instant invention may likewise be used for testing purposes in data processing machines of various types including those machines in which alphabetic figures may be entered in. Thus, the decimal system may then be replaced by a system of higher order provided that it is not intended to associate several letters together with the same computation in the electronic computing device.

A particular advantage of the instant invention may further be seen in the fact that, despite the application of an electronic computer based on binary operation and having only four basic storage positions, namely those for the weighted decimal characters 8, 4, 2 and 1, it is nevertheless possible to have a capacity for 10 digit positions. This, of course, does not exclude the possibility of performing a checking operation upon account numbers having more than 10 digit positions provided that the input machine 1 has a similar capacity. In such a case, it is possible to repeat in the 11th position the first position, in the 12th, the second position, and so forth, in particular, since erroneous transpositions of figures beyond 10 positions are quite rare.

If desired, a modulus of greater than the modulus 11 may be used. For this purpose primary figures are especially suited, since, as is well known, corresponding computations can then be carried out which deliver testable results.

If it is desired to provide for deblocking of the blocking magnet 25, an additional switch means may be provided which may be secured by a suitable lock.

In another machine of the type shown in FIG. 1, which has a broad carriage 31 and which is capable of tabulation, care should be taken, by means of an additional switch (not shown) that the checking of the account number and the blocking by the blocking magnet 25 occurs only when printing takes place in one particular column of a booking tape 32. In this way the checking of an account number occurs only when the account number is written down, such as the account number of a customer, wholesaler, or inventory item, whereas the checking operation is omitted when nonaccount number figures are entered into the machine.

It is also possible and quite straightforward to provide the electronic computer with means for continuously indicating the balance remaining therein. This may be significant for computing machines in which the computational operations are to be tested by formations of the sum of the digits, or if the supplementary figures are first to be generated to render the account numbers testable.

In oscillating or start and stop machines having automatic control, the checking device may be activated exclusively with the tabulating key just as is the case in ordinary machines which may be operated by the previously mentioned auxiliary switch. All functional keys, for example the functional keys of an adding machine, despite the auxiliary operation of the number control means, retain their normal operational power and operational direction, so that unfavorable typing conditions do not occur.

It can therefore be seen from the foregoing that the instant invention provides a novel electronic testing scheme employing a matrix arrangement vastly reduced in size from that which would normally be expected to be used in order to permit a test to be made upon the accuracy of an account number entered into a machine, which together with its additional test figure controls the entry of the number into the machine so as to prevent the entry of the number in the case where an error of entry or an error of transposition has occurred and conversely, to permit entry of the number into the machine in the case where the verification operation has shown that a correct number has been entered into the machine. Failure of the verification operation blocks the machine from performing a printing or other functional operation while valid verification enables functional operations to be performed by the machine.

Although there has been described a preferred embodiment of this novel invention, many variations and modifications will now be apparent to those skilled in the art. Therefore, this invention is to be limited, not by the specific disclosure herein, but only by the appending claims.

I claim:

1. A testing device for use in checking the entry of a multiple digit figure into a computer device by means of a 10-key keyboard input, with at least one of the digits of said figure serving to check the accuracy of said entry, comprising:

first means dependent upon the position of each digit of a figure being entered for selecting a weighting value for each of said digit positions;

second means controlled by depression of a selected key of the keyboard and by said first means for generating a product output signal corresponding to each of said digit positions and for storing said product output signals according to a predetermined modulus prior to the summing thereof, with said means including a matrix having a first portion which is substantially a symmetrical mirror image of a second portion thereof; and

electronic computer means for summing the stored product output signals to generate a signal indicative of the accuracy of entry of said multiple digit figure into said computer device.

2. The device of claim 1 further comprising means coupled to said electronic computer means for blocking operation of said computer device responsive to an error signal.

3. The device of claim 1 wherein said first means is comprised of:

a movable member having a printed circuit;

sliding contact means associated with said printed circuit; and

said movable member being movable under control of the digit position being entered into the computer device to establish selected circuits between said printed circuit and said sliding contacts.

4. The device of claim 1 wherein said second means is comprised of:

a regular matrix of intersecting row and column conductors;

said row conductors being coupled to said first means;

said column conductors being coupled to said input keys; and

a first plurality of gate circuits each being positioned at an intersection and being coupled to an associated row and column winding.

5. The device of claim 4 further comprising a second plurality of logical gate circuits selectively coupled to said first gate circuits for generating a binary code decimal output.

6. The device of claim 3 wherein said second means is comprised of:

a regular matrix of intersecting row and column conductors;

said row conductors being coupled to said first means;

said column conductors being coupled to said input keys; and

a first plurality of gate circuits each being positioned at an intersection and being coupled to an associated row and column winding.

7. The device of claim 6 further comprising a second plurality of logical gate circuits selectively coupled to said first gate circuit for generating a binary code decimal output.

8. The device of claim 7 wherein said printed circuit includes means for controlling the development of a functional signal for each of said digit positions of said multiple digit figure, with the presence of said functional signal controlling the electronic computer means to add in a positive manner the output of said second gate circuits into the electronic computer means; and with the absence of said functional signal controlling the electronic computer means to add in a negative manner the output of said second gate circuits into said electronic computer means.

9. The device of claim 3 wherein said movable member is a pivotally mounted pendulum means movable in discrete angular steps as each digit position of a figure is entered into the computer device.

10. The device of claim 4 wherein said first gate circuits are logical OR gates.

11. The device of claim 5 wherein said second gate circuits are logical AND gates.

12. A device for testing the accuracy of multiple digit figures to be entered into computer devices and the like having a 10-key input keyboard and a movable value carriage for storing each decimal number entered into the computer device, the improvement comprising:

a pivotally mounted pendulum member rotatable under control of said movable value carriage;

said pendulum member having a printed circuit configuration;

a set of sliding contacts wipingly engaging said printed circuit;

a matrix comprised of a plurality of row and column conductors;

a first plurality of logical gating circuits coupled to said row and column conductors at each intersection formed by said row and column conductors;

a signal source coupled to all of said row and column conductors;

an electronic circuit coupled between said column conductors and said 10-key keyboard for isolating a selected one of said column conductors from said signal source upon depression of one of said keys;

a second electronic circuit coupled between said sliding contacts and said row conductors for selectively isolating one of said row conductors from said signal source determined by the position of said pendulum member; and

second logical gating means coupled to said first plurality of logical gating circuits for generating a binary coded representation of a decimal number determined by the isolated row and column conductors.

13. The device of claim 12 further comprising third logical gate means coupled to said second electronic circuit for determining the polarity of the decimal character generated by said second logical gating means.

14. The device of claim 13 wherein said printed circuit is further comprised of means for controlling the generation of a signal indicative of the polarity of the decimal character generated by said second logical gating means for a predetermined group of angular positions assumed by said pendulum member.

15. For use with a number system of a predetermined radix, a method for checking the accuracy of a multidigit figure which is entered into a computer together with an associated check digit, which check digit is equal to the difference between an integral multiple of a predetermined modulus or zero and the sum of products formed between each digit of the multiple digit figure and a weighting factor assigned to each digit position comprising the steps of:

a. entering the numeral of each digit position of the multidigit figure;

b. generating a numeral signal representative of the particular numeral entered at each digit position;

c. assigning the numerals within the number system to either a first or second group;

d. determining whether the numeral of the digit position being entered falls into the first group of numerals;

e. generating a first functional signal which remains associated with the numeral being entered when the numeral of the digit being entered falls into said first group of numerals;

f. counting the digit positions entered;

g. generating a second functional signal which remains associated with each numeral of the digit positions being entered after the count reaches a predetermined value;

h. forming a product signal representing the product of the numeral signal and the weighting factor assigned to its digit position which weighting factor is in the form of a weighting factor signal;

i. summing each product signal generated with the product signals previously generated or negatively adding those product signals generated to the product signals previously generated when the numeral signal of any product has either a first or second functional signal or both first and second functional signals assigned to it to form a grand sum signal;

j. dividing the grand sum signal by a signal representing said predetermined modulus to form a quotient signal; and

k. generating a signal representing the validity of the multiple digit figure and its check digit when the quotient signal is equal to N times the predetermined modulus, where N=0, 1, 2, 3, ...n.

16. The method of claim 15 wherein the step (1) further comprises the steps of:

generating a remainder signal representing the invalidity of the multiple digit figure when the quotient is accompanied by a remainder greater than zero; and

blocking entry of another multiple digit figure into the computer until the invalid number is cleared from the computer.