

Feb. 3, 1970

NOBUO KOJIMA
PORTABLE CALCULATOR

3,493,171

Filed March 25, 1968

2 Sheets-Sheet 1

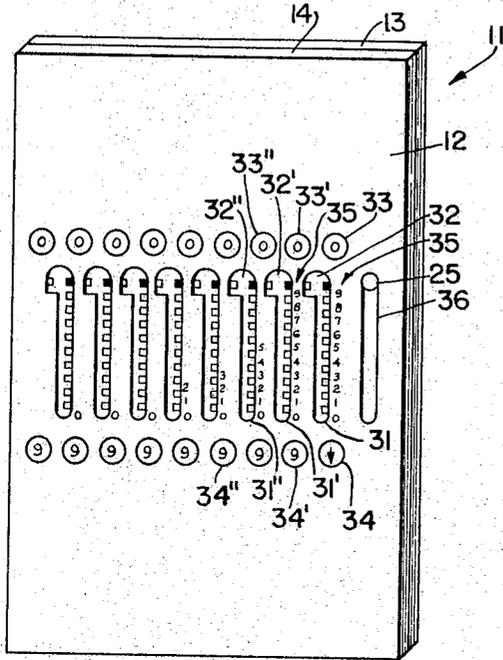


FIG. 1



FIG. 3

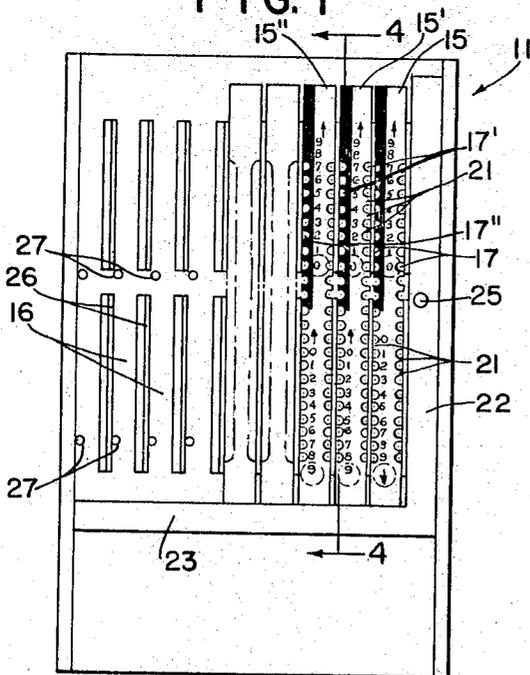


FIG. 2



FIG. 4

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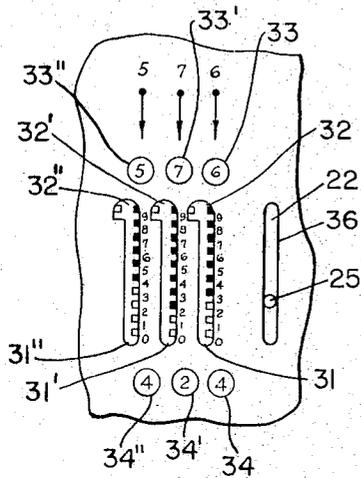


FIG. 5(a)

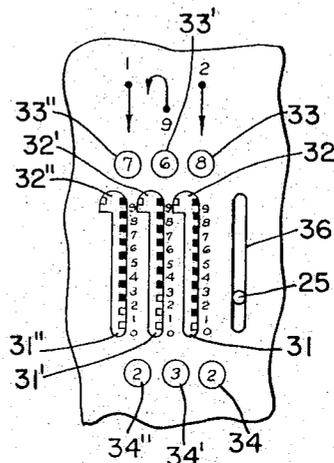


FIG. 5(b)

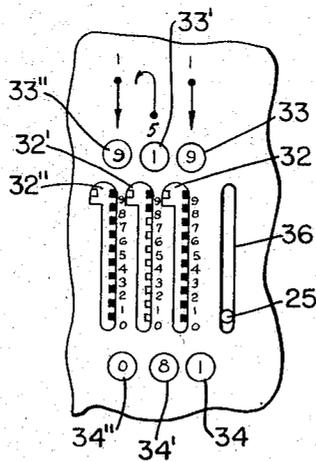


FIG. 5(c)

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PORTABLE CALCULATOR

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9 Claims

ABSTRACT OF THE DISCLOSURE

A portable hand operated calculator having a plurality of elongated strips slidably mounted in a body for longitudinal movement, each of the strips being formed with a series of notches in both sides thereof to receive a stylus tip for calculating operations. Projections are provided on the back of the body of the calculator for engaging the notches by spring means to thereby prevent accidental slippage of the strips when the calculator is handled.

FIELD OF THE INVENTION

This invention relates in general to portable calculators and more particularly concerns a hand operated calculator having a plurality of notched strips and means for engaging the notches by spring action to prevent slippage of the strips during handling of the calculator.

DISCUSSION OF THE PRIOR ART

Portable hand operated calculators having elongated notched strips adapted to be operated by a stylus are well known and have been used commercially for a considerable length of time. However, these calculators have been subject to certain deficiencies, one of which is that the setting on the calculator during a computation may be accidentally disturbed if the calculator should be jarred or dropped. If this occurred in the middle of a series of computations, it would necessitate starting the entire computation over again. This undesirable situation has not been adequately rectified by the prior art calculators. Some attempts have been made to correct the problem, but these have either been prohibitively expensive for such a simple machine or have been ineffectual after prolonged use of the calculators.

SUMMARY OF THE INVENTION

Broadly speaking, this invention resides in a calculator body having a substantially rigid back and a flexible indicating front face. A plurality of flexible notched calculating strips are slidably mounted within channels in the body and are operable by means of a stylus, the point of which extends through slots in the front face to engage the notches. Numerical indicia are provided on the front face and on the calculating strips in such a way as to be viewable through windows in the front face. The body is provided with projections extending from the back into each channel in which the calculating strips slide, these projections being so positioned as to engage the notches in the strips. As a calculating strip slides in its channel, the tabs between the notches, by which the notches are defined, are allowed, because of the flexibility of both the strip and the front, to pass over the projections. The back of the body, which is substantially rigid, provides a sur-

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face against which the front face acts as a spring to force the projections into engagement with the notches whenever they are in mutual registration. An L-shaped member is also slidably mounted in the body and is adapted to abut one end of all of the strips for clearing the calculator. In this context, "clearing" means to place all the calculating strips in a zero position so that the calculator is in condition to commence a new computation.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a calculator constructed in accordance with the principles of this invention;

FIG. 2 is a plan view of the calculator of FIG. 1 with the front face and some of the calculating strips removed;

FIG. 3 is a side view of the stylus used for operating the calculator of FIG. 1;

FIG. 4 is an enlarged partial cross-sectional view of the calculator taken along cutting plane 4—4 of FIG. 2;

FIGS. 5(a), 5(b) and 5(c) are partial plan views of the calculator of FIG. 1 illustrating a series of calculating steps.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing and more particularly to FIGS. 1 and 2 thereof, there is shown a calculator 11 constructed in accordance with the principles of this invention having a body 12 comprising a substantially rigid back 13 and a flexible indicating front face 14. A plurality of calculating strips 15, 15', 15'', etc. are mounted in channels 16 formed in body 12 so that they may slide longitudinally. For purposes of illustration, only a few of calculating strips 15 are shown in FIG. 2. The calculator may include any desired number of calculating strips depending upon the number of digits which the calculator is intended to handle. A column of notches 17, 17', 17'', etc. is provided on each vertical edge of each calculating strip. These notches are regularly spaced, sharply defined indentations in the edges of the calculating strips.

For addition purposes, the digits 0 through 9 are imprinted on the front side of each strip 15 from near the center toward the top, as shown in FIG. 2. The digits 0 through 9 are imprinted from near the center toward the bottom of each strip for subtraction purposes. These digits are positioned in juxtaposition with notches on each of the calculating strips. It will be observed that the subtraction digits on calculation strip 15, which strip corresponds to the least significant digit of the calculator, are stepped upward one position above the digits of the other strips. It is further evident from the shading shown in FIG. 2 that the upper ten notches on the left edge of each strip are surrounded by colored tabs 21. These tabs are between and serve to define notches 17. The function of these notches which are thus distinguishable from the other notches on the strips will be discussed in detail below.

An L-shaped element 22, which is herein termed a clearing bar, is also slidably mounted in body 12 and provides means for clearing the calculator. Clearing bar 22 also moves toward the top and bottom of the calculator parallel to the motion of the calculating strips. Clearing bar 22 is shown in its upper or clearing position in FIG. 2. When it is desired to clear the calculator, the point of stylus 24 (shown in FIG. 3) is inserted in hole 25 in clearing bar 22, and the clearing bar is moved vertically toward the top of calculator 11, as shown in FIG. 1.

The horizontal portion 23 of clearing bar 22 contacts the lower ends of calculating strips 15 and moves them all in the same direction so that they are all equally positioned, thereby clearing the calculator.

Body 12 is formed with a plurality of walls 26 which project from back 13 of body 12 a sufficient distance to substantially meet the underside of front face 14. These walls 26 form channels 16 therebetween for retaining calculating strips 15 for sliding motion in body 12. Back 13 is provided with small projections 27 which extend toward front face 14. These projections have generally rounded surfaces which permit tabs 21 to smoothly ride over them, and are shown in the drawing as generally hemispherical. Projections 27 are substantially shorter than the distance between back 13 and front face 14. Projections 27 are positioned in channels 16 so as to engage notches 17. Front face 14 of body 12 is sufficiently flexible so that projections 27 engage notches 17 by spring action.

As shown in FIG. 1, front face 14 is provided with slots 31, 31', 31'', etc. which, when face 14 is properly positioned on back 13, are aligned over the column of notches on the left side of each of calculating strips 15 as viewed in FIGS. 1 and 2. At the top of respective slots 31 are loops 32, 32', 32'', etc. through which appear the notches on the right side of the calculating strips. The function of loops 32 will be described below.

Front face 14 is also provided with windows 33, 33', 33'', etc. above respective slots 31, which display answers to addition calculations, and with windows 34, 34', 34'', etc. below respective slots 31, which display answers to subtraction calculations. Beside each slot 31, front face 14 is imprinted with a column 35 of the digits 0 through 9 starting with 0 near the bottom of each slot. These digits 35 correspond in size and spacing to the digits imprinted on calculating strips 15 and provide indices for notches 17. The digits which are imprinted on the strips themselves only appear in respective windows 33 and 34.

A slot 36 through one side of front face 14 provides access to clearing bar 22 for purposes of clearing the calculator. Hole 25 in clearing bar 22 is visible through slot 36. When it is desired to clear the calculator, the point of stylus 24 is inserted through slot 36 into hole 25 and clearing bar 22 is moved vertically toward the top of the calculator to the position of FIGS. 1 and 2. As shown in these figures, the calculator is in the cleared or zero position with 0's appearing in all of the addition windows 33, and 9's appearing in all of the subtraction windows 34, except that an arrow pointing toward the bottom of the calculator appears in the right-hand window 34 corresponding to the least significant digit. In this position the upper colored notches on strips 15 do not correspond to any of the digits 0 through 9 imprinted on front face 14.

When calculator 11 is properly assembled, walls 26, calculating strips 15 and clearing bar 22 are each of substantially the same thickness as the space between front face 14 and back 13. Thus, calculating strips 15 are confined by back 13, front face 14 and walls 26 for longitudinal motion within channels 16. With projections 27 in position in channels 16 to register with at least one notch in each of strips 15, the calculator remains firmly set with whatever setting has been intentionally entered. However, since front face 14 and strips 15 are flexible, strips 15 are readily movable longitudinally by inserting the point of stylus 24 through slots 31 into notches 17 and exerting force either toward the top or toward the bottom of the calculator. As each tab 21 between the notches 17 contacts a projection 27, flexible front face 14 and strip 15 deform sufficiently to allow that tab to ride over the projection. While one calculating strip 15 is being moved, the projections 27 in the unaffected channels maintain engagement with notches in the remaining strips so that the positions of these strips are undisturbed.

Some previous calculators have attempted to solve the

setting stability problem, to which this invention is directed, by cutting tabs in the back portion of the body and bending them toward the calculating strips to provide a leaf-spring effect. The useful life of these springs is extremely short when the back is made of thin sheet material. To make such a device practical, a substantially heavier back plate was necessary with commensurate increases in material, tooling and fabricating costs. Even then there was a substantial amount of mutual wear on the individual leaf springs and the calculating strips and the spring action tended to decrease over a period of time due to the continued bending pressures exerted on the leaves with movement of the calculating strips.

In contrast, the material of the back of body 12 of the calculator herein described may be made of a relatively thin material such as sheet aluminum. The sheet material is stamped in such a way that smoothly rounded projections 27 result. This configuration allows tabs 21 between notches 17 to ride smoothly over projections 27 while the entire front face 14 provides the necessary spring action. Thus the spring action of the calculator cannot deteriorate and wear on the projections and the calculating strips is negligible over reasonable operating periods. The back may also be made of a plastic material with projections 27 molded thereon. Other materials and methods of making projections 27 could also be used.

It is important to note that the specific configuration of front face 14 including the size and position of slots 31 therein, together with the placement of projections 27 in relation to the slots, as shown in the drawing, comprises a combination of elements and features particularly adapted for the intended mechanical action of the calculator. With reference to FIGS. 1 and 2, it may be observed that two projections 27 are positioned in each channel just beyond the end of each elongated opening (slot 31 and loop 32) in the front face. The projections are separated by an integral multiple of notch spaces so that both of them simultaneously register with a notch 17 or a tab 21. When the tabs 21 of a calculating strip pass over projections 27, the entire central portion of the strip tends to bow upward, forcing the adjacent portion of front face 14 to flex outward against the normal biasing action of the front face. The decrease in stiffness of the central portion of the front face which results from the removal of the material defining the slots allows strips 15 to flex easily as they pass over projections 27. However, since the portion of each strip extending between the respective projections 27 is biased toward back 13 by the front face material (unnumbered) between slots 31, the front face portion adjacent a moving strip is allowed to flex relatively independently of the rest of the front face. The remainder of the front face thus preserves its biasing pressure on the remaining strips so that they maintain their positions within the calculator.

FIGS. 5(a), 5(b) and 5(c) show the steps involved in making computations by means of this calculator. The direction of movement of the stylus after insertion into the proper notches is shown by means of arrows associated with each of the digits of the numbers used in the computations illustrated in the figures. For example, the steps involved in the addition of the number 576 and 192 will be described with reference to FIGS. 5(a) and 5(b). Stylus 24 is first inserted through slot 31' into the notch adjacent to the digit 5 on front face 14 and moves calculating strip 15' toward the bottom of the calculator to the lower limit of that slot. At this point the digit 5 will appear in window 33'. Similarly, calculating strips 15' and 15 are moved in the same direction so that the figures 7 and 6 appear in windows 33' and 33, respectively. At this time the calculator will have the appearance shown in FIG. 5(a) with colored notches appearing as indicated by the shading.

Whenever a digit to be entered in the calculator is in juxtaposition with a colored notch, the stylus point engages that notch on the corresponding strip and moves

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vertically toward the top of slot 31 with the strip until the stylus is disengaged by following the curvature of loop 32 which is smoothly connected to slot 31. As the stylus follows the curvature of loop 32, the disengaged strip ceases moving and the stylus then engages a notch on the right side of the next strip to the left. The shape of the loop 32 permits the stylus to move that strip vertically toward the bottom of the calculator the distance of one notch, in effect carrying the 1 to the next higher significant figure. The stylus is then removed and used to start the next calculation step.

FIG. 5(b) indicates the steps involved in adding the number 192 to the number 576 already registered in the calculator. Since the notch corresponding to the digit 1 is not colored, it is moved downward in a manner similar to that previously described. However, the notch corresponding to the digit 9 in slot 31' is colored and the arrow corresponding to the digit 9 above window 33' shows the movement of the stylus. Stylus 24 is inserted through slot 31' into the notch adjacent digit 9 and strip 15' is moved as shown by the arrow until the stylus disengages by following the curvature of loop 32'. At this point strip 15' has moved vertically toward the top of the calculator a distance corresponding to the space between two digits on front face 14, or one notch width. Strip 15' is subsequently engaged by stylus 24 as it continues around loop 32' and is moved vertically toward the bottom of the calculator one notch width, thus raising the value of the digit appearing in window 33" by one. The final digit 2 is entered in a manner similar to the first digit 1 since it is uncolored as shown in FIG. 5(a), and the answer 768 appears in respective addition windows 33. Another set of numbers which may be termed "complementary" to those in the addition answer windows appear in the respective subtraction windows 34. The term "complementary" in this sense means that the numbers in the subtraction and addition windows, if added, will be a multiple of 10. In this instance, since three windows are involved, the sum of the figures in these two sets of windows should be 1000. The respective numbers are 768 and 232, which do indeed add up to 1000.

A subtraction example is illustrated in conjunction with FIGS. 5(b) and 5(c) wherein the number 151 will be subtracted from the number 232. The calculation starts with the number 232 already appearing in subtraction windows 34 in FIG. 5(b) resulting from the previous example. The initial condition of calculator 11 is shown in FIG. 5(b), while the answer and the movements of the stylus are shown in FIG. 5(c). Stylus 24 is placed in the uncolored notch as shown in FIG. 5(b) corresponding to the digit 1 in slot 31" and calculating strip 15" is moved vertically toward the bottom of the calculator to the limit of slot 31". The notch corresponding to the digit 5 in slot 31' is colored and therefore must be moved up and around loop 32' as previously described so that stylus 24 engages one notch on the right side of calculating strip 15" and moves that strip vertically toward the bottom of the calculator one position. The final digit 1 is then entered in the manner just described for the first digit 1. The answer 81 appears in subtraction windows 34, and the complementary figure 919 appears in the addition windows 33. Thus it can be seen that the manipulations required for subtraction are identical with those required for addition with the exception that the digits significant to the subtraction operation appear in the lower windows 34.

From the above description it is readily apparent that the calculating strips move in incremental distances during computations. The incremental length is the distance between two digits on front face 14 which is the same as the distance between two digits on the strips themselves. Furthermore, this incremental distance is also equal to the space between two notches. Whenever the stylus moves a strip toward the top of the calculator one or more increments because it is inserted into a colored notch, it

continues on to move the next higher strip toward the bottom of the calculator one increment only. Each time a computation is completed, stylus 24 is inserted through slot 36 into hole 25 and clearing bar 22 is moved toward the top of the calculator until 0's appear in all of the addition answer windows 33.

Having described one embodiment of this invention, it is now apparent that numerous and varied other embodiments may be devised in accordance with the principles disclosed herein by those skilled in the art without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited by what has been particularly shown and described, except as indicated in the appended claims.

What is claimed is:

1. A portable calculator comprising:

a body having a back and a flexible indicating front face, said back having a plurality of projections extending toward said front face, said front face having a plurality of openings therethrough;

a plurality of parallel walls extending from said back toward said front face, said walls defining therebetween a plurality of channels within said body; and a plurality of flexible calculating strips each slidably mounted within a respective channel, said strips having a multiplicity of regularly spaced notches along both edges thereof and also having printed indicia regularly space on one side thereof, said notches being accessible via certain of said openings in said front face by which said strips can be moved distances which are integral multiples of said spaces, thereby to perform computations;

each of said channels having at least one of said projections located therein, said projections being adapted and positioned to engage said notches by means of spring action of said flexible front face thereby to bias each of said calculating strips in corresponding channels such that intentional movement of a selected calculating strip during computations does not cause spurious movement of other calculating strips in their respective channels.

2. The portable calculator recited in claim 1, wherein: said back is made of relatively thin sheet material; and wherein

said sheet material is stamped to form said projections, each having a smoothly rounded configuration.

3. The portable calculator recited in claim 1, wherein: said back is made of plastic with said projections molded thereon, said projections having a smoothly rounded configuration.

4. The portable calculator recited in claim 1, and further comprising:

a clearing bar slidably mounted within said body and accessible through one of said openings in said front face, said clearing bar being shaped and configured to clear said calculator by aligning all of said calculating strips in a zero position by movement in a single direction.

5. The portable calculator recited in claim 4, wherein: said calculating strips are biased against said back by said flexible front face.

6. The portable calculator recited in claim 5, wherein: said openings through which said notches are accessible are so shaped and configured to govern the movement of said calculating strips during computations.

7. The portable calculator recited in claim 6, wherein: said projections extend from said back substantially less than the distance between said front face and said back, said projections being generally of a smoothly rounded configuration.

8. The portable calculator recited in claim 7, wherein: said printed indicia on said calculating strips comprise numerical digits, individual ones of which are visible through openings in said front face, one group of

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digits being visible through one set of openings for addition answers and a second group of digits being visible through a second set of openings for subtraction answers.

9. The portable calculator recited in claim 8, wherein: 5
said front face has printed indicia regularly spaced adjacent said openings through which access is made to said notches, said indicia denoting the numerical positions of said notches.

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