

PATENT SPECIFICATION (11)

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(54) IMPROVEMENTS IN OR RELATING TO ELECTRONIC TIMEPIECES AND ELECTRONIC CALCULATORS

(71) We, KABUSHIKI KAISHA SUWA SEIKOSHA, a Japanese company of 3-4, 4-chome, Ginza, Chuo-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electronic timepieces and calculators.

The popularity of electric and electronic wrist-watches employing batteries as their driving energy sources (the term "electronic wrist-watches" is herein used as a general term to cover all battery driven watches) is steadily increasing. Also electronic wrist-watches of the digital electronic type wherein time is displayed by numeric characters i.e. in figures, are coming increasingly into use. Light emitting diode displays and liquid crystal displays are the most popular type of display for a numeric indicating digital electronic watch. With the development of such forms of display of low power consumption, numeric displays become increasingly attractive because of the direct and effective way in which they display the time. In normal practice a digital electronic wrist-watch displaying time numerically does so by means of six figures (all changed, of course, as time progresses) of which two are used to display the hour, two to display the minute and the remaining two to display the second of the time. In the most popular arrangement the six figures are displayed on the dial surface of the timepiece.

Much development has taken place in recent years in miniaturisation of the circuitry of electronic wrist-watches. At the present time a crystal oscillator of, for example, 16384 Hz, employed as the time standard of an electronic watch, together with a fifteen stage frequency divider dividing down the oscillator frequency to a frequency of 0.5 Hz can be accommodated on one "chip" of about 0.5 mm diameter. With miniaturisation to this degree, there is already space in a wrist-watch of acceptably small size

ot accommodate additional miniaturised circuitry, and, as the techniques of miniaturisation improve, still more "spare" space will become available.

Development in miniaturisation of electronic calculators has also taken place and, at the present time, the circuitry for an electronic calculator suitable for use on an office table and giving a display in twelve figures can be accommodated on only two chips—or even, in many cases, on one.

The present invention seeks to take practical advantage of the foregoing facts and the present stage of miniaturisation development to provide improved combined electronic timepieces and calculators.

According to this invention, a combined electronic timepiece and electronic calculator comprises, in a single instrument, time-measuring circuit means, calculation-effecting circuit means, numeric indicating display means, and switch means, operable at will, for switching over the display means from the output of the time-measuring circuitry to the output of calculation-effecting circuitry and vice versa.

In those cases in which a calculator presenting the results of calculations in only six figures is used, one and the same six figure display means may be used either to display time or to display calculation results by switching it over from the time-measuring circuitry to the calculation-effecting circuitry or vice versa. In order, however to accommodate calculators requiring for their display a multiple figure number (for example up to a twelve figure number) larger than the number of figures (usually six) required to display time, the display means may provide for the larger number of figures (e.g. twelve) in two lines (e.g. six figures in each line), one of these lines being utilised, at will, for displaying time or the results of calculations which can be expressed by the figures in one line (e.g. in six figures) and there being provided further switching means which, when operated, cause the lower value figures (e.g. the lower value six figures) in a calculation to be displayed in

the lower line and the remaining higher value figures to be displayed in the upper line. In an arrangement of this nature, although the circuit means themselves present no problems, there are problems with regard to the method of supplying input data for calculation. The way in which these problems are solved will be explained later when describing the drawings.

In the drawings, Figure 1 is a schematic face view of a conventional digital electronic wristwatch giving a six figure numeric display as indicated at 11 in the drawing. 12 is the knob of a three position switch which is operated by pulling on said knob. The switch is so arranged and has contacts so connected that, when the knob is pulled out into one position, the switch sets the time display at zero and when the knob is pulled further out to another position, the switch causes the time circuitry in the watch to advance the time display rapidly. (This is for use when it is desired to adjust the watch to correct time). When the knob is in its normal, inward position, the display advances normally with time. Such a switch arrangement is known per se and, since it forms per se no part of this invention, it will not be further described herein.

Figure 2 is a view similar to that of Figure 1 but showing one form of electronic wristwatch in accordance with this invention. As before there is a six figure display, here referenced 21. There are four switch operating knobs of which the knob 22 performs the same function as the knob 12 in Figure 1. A second knob 27 operates a switch whereby the instrument illustrated can be changed over from measuring and displaying time to effecting and displaying the results of calculations and vice versa. 23 is a rotatable ring whereby input data for calculation can be supplied. By rotating this ring to bring a desired number or function indication thereon opposite a mark 24 and then operating the knob 25 of an input data switch, the calculation determined by the setting of the ring 23 is made and the result is displayed at 21. In order to enable a calculated result requiring a multiple figure number with more than six figures—a twelve figure number will be here assumed—to be displayed if required, the display may be arranged to accommodate that twelve figure number in two lines of six figures each. One line only is used to display time but, for displaying calculation results requiring more than six figures, there is provided a further switch, operated by a knob 26 which, when operated, causes the lower value six figures of the calculation result number to be displayed in the lower line and the remaining higher value figures thereof to be displayed in the upper line. If, as will probably occur in the majority of cases, a six figure display is sufficient for the calculated

result, the knob 26 is not operated and the calculation is displayed in the lower line of six figures. When, however, the calculated result requires more than six figures for display—up to twelve figures—knob 26 is operated and the upper line of figures is also utilised for the display. The rotatable ring 23 with the figure and function indicators marked on it carries electric contacts (which do not appear in Figure 2), or is otherwise arranged to actuate electric contacts so that, when the ring is moved to any particular position, input data corresponding with the figure or function indicator then opposite the mark 24 is applied to the calculator circuitry when the switch knob 25 is operated.

Figure 3 is a broken-away partly "exploded" perspective view showing, sufficiently for an understanding thereof, an arrangement in which electric contacts are carried by the ring 23. Although in practice the ring 23 is in contact with the circuitry unit or main body 35 inside the watch case, it is, for clarity of showing, drawn spaced therefrom in Figure 3. The ring is mounted in a suitable circular guide so that it can be rotated relatively to the watch case. Under each of the figures and functions indicators on the rotatable ring 23, are contacts appropriate thereto. When the ring is in a position in which any particular figure or function indicator is opposite the mark 24, contacts 32 beneath said indicator make contact with cooperating contacts 33 suitably connected by leads as indicated with suitable points in the calculator circuitry in the unit 35 so that if the input data switch knob 25 is pushed, the required item of input data is supplied to the calculator circuitry. With the ring 23 positioned as shown in Figure 3, the numeral 3 will be read into the calculator circuitry. In one data input signal circuit arrangement, predetermined potential is applied to the contacts 33 and the input data switch (not separately shown) actuated by the knob 25 is arranged, when actuated, to apply ground connection via contacts 32 to complete the input signal circuits selected by the ring 23.

Figure 4 shows, in manner similar to Figure 3, a modified arrangement in which a switch contact carried by the ring moves over a series of fixed contacts beneath it. When the ring 23 in Figure 4 is rotated, a contact arm 42 carried thereby moves over cooperating contacts 43 so that, in each position of the ring 23, input data circuits appropriate to the input data indicator then opposite the mark 24 will be established, whereby, upon actuating the input data switch by knob 25, the required input data is fed into the calculator circuitry.

In Figures 3 and 4 the electric contacts 32 and 42 are ground-connected and the cooperating contacts 33 and 43 are separated and provided with predetermined suitable

potentials in accordance with well known electric calculator practice. Obviously other input data selecting arrangements known per se, can be employed.

- 5 As will now be appreciated, the invention, in its preferred illustrated embodiments, provides very advantageous combined numeric display digital electronic watches and calculators which are compact and very attractive and have most conveniently and easily
10 operated means for supplying input data to the calculator portion of the instrument.

WHAT WE CLAIM IS:—

- 15 1. A combined electronic timepiece and electronic calculator comprising, in a single instrument, time-measuring circuit means, calculation-effecting circuit means, numeric indicating display means, and switch means,
20 operable at will, for switching over the display means from the output of the time-measuring circuitry to the output of calculation-effecting circuitry and vice versa.

- 25 2. An instrument as claimed in claim 1 wherein, in order to accommodate an output of the calculation-effecting circuitry expressible by a larger multiple figure number containing more figures than are required in the display means for displaying time, the display
30 means is arranged in two lines of figures, half of the said figures in one line and the other half in the other, the figures of one line being used to display time or calculation results expressible by the number of figures in that
35 line and there being provided further switch means which, when the instrument is in use as a calculator and said further switch means

is operated, cause the lower value figures in said larger multiple figure number to be displayed in the lower one of said lines and the
40 remaining higher value figures in said larger multiple figure number to be displayed in the upper one of said lines.

3. An instrument as claimed in any preceding claims and having, for the selection
45 of input data to the calculation-effecting circuitry, an externally accessible and visible rotatable ring marked with numerals and/or calculation function indicating indicia.

4. An instrument as claimed in claim 3
50 wherein the ring is arranged selectively to operate switches having contacts at least one of which is carried by said ring, whereby input data signals corresponding with the indicia marked on the ring are selectable in
55 accordance with the rotational position of said ring.

5. An instrument as claimed in claim 3 or 4 and comprising a switch the operation of which causes data input signals selected by
60 said ring in dependence on its rotational position to be supplied to the calculation-effecting circuitry.

6. Combined watches and calculators substantially as herein described with reference
65 to Figures 2 to 4 inclusive of the accompanying drawings.

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