

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO ELECTRONIC TIMEPIECES

(71) We, KABUSHIKI KAISHA SUWA SRIKOSHA, a Japanese company of 3-4, 4-chome, Ginza, Chuo-ku, Tokyo, Japan, do hereby declare the invention for which we
5 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 time-
10 pieces and more specifically to electronic timepieces of the kind having electrically controlled numeric display means such as numeric display means of the liquid crystal or light emitting diode type.
15 The main object of the invention is to provide improved timepieces of this kind which shall be capable of displaying the time numerically and also of displaying, when required, chronograph time periods
20 (i.e. periods of elapsed time) with high accuracy (even down to 0.01 second) but which, nevertheless, are capable of being made of small size suitable for watches or even wrist watches. As will be seen later
25 this object is achieved by simplifying the display unit and making it much smaller than would be the case in a known timepiece of comparable performance and capability.
30 A known timepiece capable of displaying time numerically in month, date, hour and minute i.e. down to 1 minute, would require a certain number of digits (numerals) in the display unit. If it is also to display numerically (when required) an elapsed time period
35 (i.e. chronograph time — for example for timing a race) to a higher degree of accuracy, for example down to 0.01 second it would require an additional number of
40 digits (numerals) in the display unit. Thus, to quote a practical case, a timepiece of such capability would require a display unit of probably at least 8 display devices each capable of displaying any numeral. Such a
45 display unit would be much too large to be

[Price 25p]

practical for a watch. The present invention gets over this difficulty, as will be seen later, by providing a display unit with a considerably smaller number of numeric devices and utilising them for different pur-
50 poses successively. Thus a watch in accordance with the invention could be made with a display unit consisting only of four numeric display devices which could be used to display, first, the month and the date, then
55 the hours and the minutes and then the number of seconds, tenths of seconds and hundredths of seconds.

According to this invention an electronic chronograph timepiece comprises a numeric
60 display unit consisting of a plurality of electrically controlled numeric display devices and includes means enabling said unit to be switched over to display in one position of switching, time of day is
65 measured by time measuring apparatus in the timepiece and in another position of switching, elapsed time as measured by chronograph time measuring apparatus in
70 the timepiece.

Preferably the display unit consists of a plurality of liquid crystal or other solid state display devices.

Preferably the construction of the timepiece is such that in one position of switch-
75 ing, the numeric display devices are used to display elapsed time down to time units of one order of magnitude and in the other position of switching are used to display
80 elapsed time down to units of a smaller order of magnitude.

A preferred timepiece in accordance with the invention includes a memorising register connected and arranged to memorise time
85 and elapsed time counts.

In a preferred embodiment of the invention a timepiece includes two chains of counters fed from a time standard oscillator, one for time measurement and the other
90 for elapsed time measurement, a coder unit

Price 75p

arranged to take inputs from one of said chains or from the other, in dependence upon the setting of a switching control, memorising register means fed from the coder unit, means for supplying shift pulses to said register for required periods determined by the setting of the switching control selector gate, means fed from the memorising register means and also controlled in dependence on the setting of the switching control and decoder means fed from the selector gate means and providing output for operation of the display devices in the display unit.

The invention is illustrated in the accompanying drawing which is a block diagram showing one embodiment of the invention.

Referring to the drawing block 1 represents a counter adapted to produce a signal O_1 of 100 Hz. This signal is produced by suitably frequency dividing the output from a time standard crystal oscillator the crystal of which is represented at X.

The counter O_1 is followed by a cascade series of further counters 2, 3, 4 and 5 which provide suitable frequency divided signals for driving the watch. Counter 2 produces 0.01 sec, 0.1 sec and 1 sec signals (produced by decimal counting stages in block 2). The 0.01 sec and 0.1 sec signals are fed into input B_1 of a coder unit for binary coding (1, 2, 4, 8). For simplicity of representation in the drawings, only a single lead is shown between block 2 and terminal B_1 and similarly simplified representation is adopted as regards corresponding signal outputs from counters 3, 4 and 5. Block 3 is a counter in which one second, 10 second and one minute signals O_3 are produced by means of decimal and divide-by-6 counter stages and are fed for coding to input B_2 of the coder. Counter 4 similarly produces one minute, 10 minute and one hour signals by decimal and divide-by-6 counting stages and these signals are fed for coding to input B_3 of the coder. Counter 5 is a divide-by-24 counter for producing at input B_4 of the coder time period (24 hour day) signals. Counters 2, 3, 4 and 5 are used for operating the time indicating portion of the watch.

Counters 6, 7, 8 and 9 are for producing signals for the chronograph portion of the watch and corresponding with counters 2, 3, 4 and 5 respectively. The signals from counters 6, 7, 8 and 9 are fed in at inputs A_1 , A_2 , A_3 and A_4 respectively of the coder unit 10 which incorporates selective switching (not separately shown) whereby either the time signals at B_1 , B_2 , B_3 , B_4 or the chronograph (time period) at A_1 , A_2 , A_3 , A_4 may be taken in dependence upon whether a selector switch S_1 is closed or open. This switch S_1 when closed connects a voltage V_{DO} from a source (not shown) to

produce across resistance R_0 a voltage for actuating suitable circuit means in unit 10 to effect the required selective switching. The outputs from unit 10 are applied to inputs C_1 , C_2 , C_3 , C_4 of a memorising register 11 composed of flip-flop circuits and to which shift or clock pulses are applied through a NOR gate G from output O_0 of the counter 1. When a switch S_2 is closed voltage V_{DO} is set up across resistance R_2 to cause the gate G to cut off the shift pulses so that the register 11 memorises the contents already in it when the said pulses cease. Block 12 is a selecting gate unit which can select for passing on to the terminals D_1 , D_2 of the unit 13 either the signals at the C_4 , C_3 (time period signals down to minute signals) of unit 12 or those at the inputs C_2 and C_1 (second 0.1 seconds and 0.01 second signals) thereof. Selection is effected by opening or closing a switch S_3 which, when closed, applies voltage V_{DO} across a resistance R_3 to effect the required circuit switching changes within unit 12. The unit 13 is a decoder for decoding the selected coded signal (1, 4, 2, 8) from unit 12 to produce decoded signals, suitable for driving a numeric display unit 14. This unit has four display devices each of which has seven display electrodes so arranged and connected in known manner that by energising different combinations of the seven electrodes under control of the input signals from 13 the appropriate numeral between 0 and 9 can be displayed. The numeric display devices are, as stated, as known per se. They may be of the liquid crystal type or of the light emitting diode type.

Thus, despite that there are only four numeric display devices in the display unit the said unit is utilisable (in dependence on the positions of the switches S_1 , S_2 and S_3) either as a chronograph display unit displaying the length of a time period down to 0.1 second, by means of four figures or as a time indicating display unit displaying time down to 1 minute by means of four figures. Because of the action of the memory unit 11 the required high accuracy is obtained in both cases. Despite the performance of which it is capable, the illustrated embodiment can be made small enough to be of watch size — even wristwatch size — by utilising integrated circuit technique for the circuitry, (especially if complementary field effect transistors — so-called CMOS devices — are used as the active elements in the circuitry) while adoption of these techniques enables the electric power consumption to be kept very low so that the watch can be driven by a small size watch-type dry battery as commonly used for electronic watches.

In the claims which follow a chronograph timepiece means a timepiece capable

of measuring and displaying elapsed time to a degree of accuracy — for example to one tenth or one hundredth of a second — appropriate to a chronograph time measurement e.g. measuring elapsed time in a race.

WHAT WE CLAIM IS:—

1. An electronic timepiece having a numeric display unit consisting of a plurality of electronically controlled numeric display devices and including means enabling said unit to be switched over to display, in one position of switching, time of day as measured by time measuring apparatus in the timepiece and in another position of switching, elapsed time as measured by chronograph time measuring apparatus in the timepiece.

2. A timepiece as claimed in claim 1 wherein the display unit consists of a plurality of liquid crystal or solid state display devices.

3. A timepiece as claimed in claim 1 or 2 wherein, in one position of switching, the numeric display devices are used to display elapsed time down to time units of one order magnitude and in the other position of switching are used to display elapsed time down to units of a smaller order of magnitude.

4. A timepiece as claimed in any of the preceding claims and comprising a memor-

ising register connected and arranged to memorise time and elapsed time counts.

5. A timepiece as claimed in any of the preceding claims and comprising two chains of counters fed from a time standard oscillator, one for time measurement and the other for elapsed time measurement, a coder unit arranged to take inputs from one of said chains or from the other, in dependence upon the setting of a switching control, memorising register means fed from the coder unit, means for supplying shift pulses to said register for required periods determined by the setting of the switching control, selector gate means fed from the memorising register means and also controlled in dependence on the setting of the switching control, and decoder means fed from the selector gate means and providing output for operation of the display devices in the display unit.

6. A timepiece substantially as herein described with reference to the accompanying drawing.

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2. A timepiece as claimed in claim 1 wherein the display unit consists of a plurality of liquid crystal or solid state display devices.

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