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Nishimura et al.

[11] **3,855,782**

[45] **Dec. 24, 1974**

[54] **TIME-CORRECTING DEVICE FOR ELECTRONIC TIMEPIECES**

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[73] Assignee: **Kabushiki Kaisha Suwa Seikosha,** Tokyo, Japan

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[21] Appl. No.: **287,202**

[30] **Foreign Application Priority Data**

Sept. 9, 1971 Japan 46-69297

[52] **U.S. Cl.** ..... **58/23 R,** 58/85.5

[51] **Int. Cl.** **G04c 3/00,** G04b 27/00

[58] **Field of Search** ..... 58/23 R, 50 R, 85.5, 92 T; 235/92 EA

[56] **References Cited**

UNITED STATES PATENTS

3,576,099 4/1971 Walton ..... 58/23 R

3,699,763 10/1972 Zeph ..... 58/23 R

Primary Examiner—Edith Simmons Jackmon

Attorney, Agent, or Firm—Blum, Moscovitz, Friedman & Kaplan

[57] **ABSTRACT**

An electronic timepiece is provided with a plurality of display elements for the digital display of time, driven by time-keeping circuitry. A time-correcting device coupled to said time-keeping circuitry is provided for independently correcting each of said display elements, said time-correcting device including a mechanical selector switch for selecting the display element to be corrected and a correction switch for performing the correction function on said display element.

6 Claims, 7 Drawing Figures

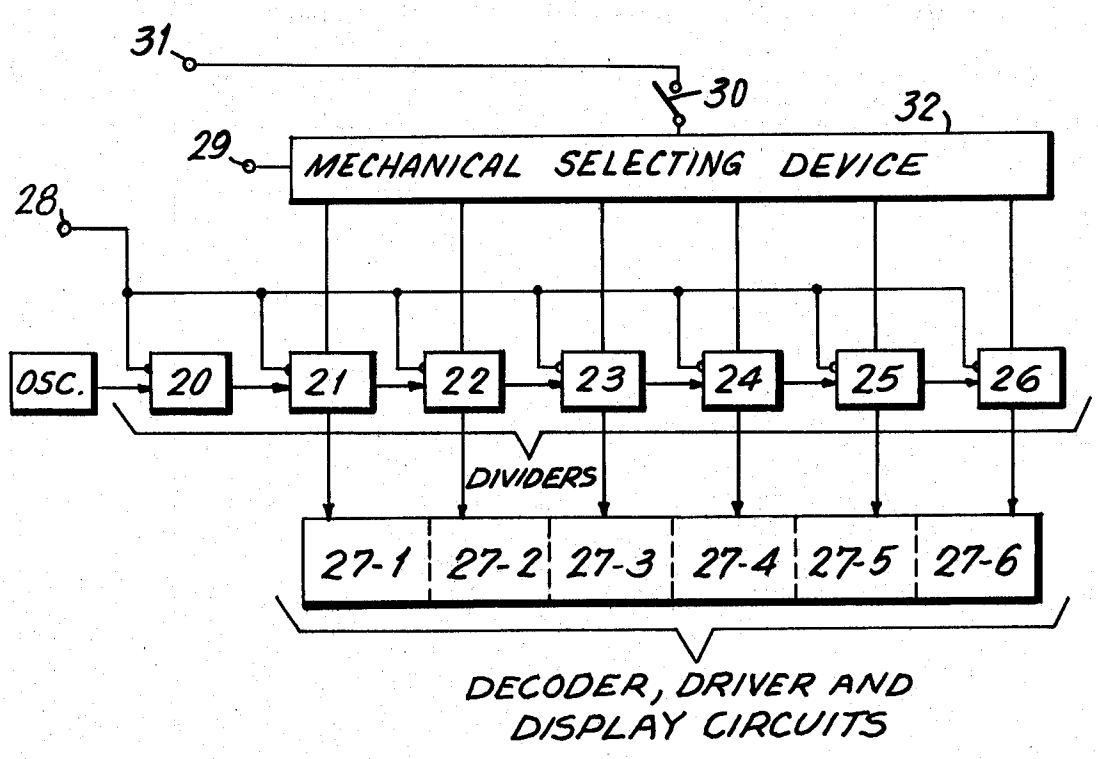
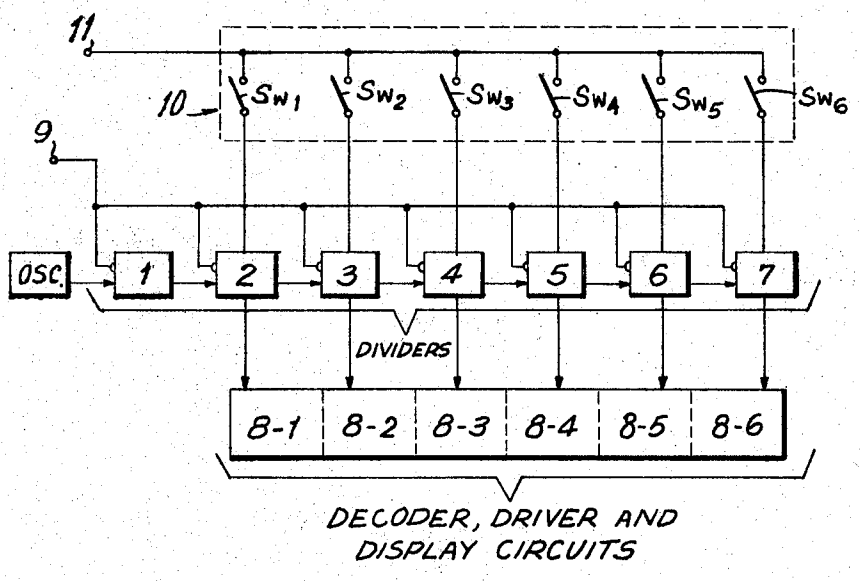


FIG. 1
PRIOR ART



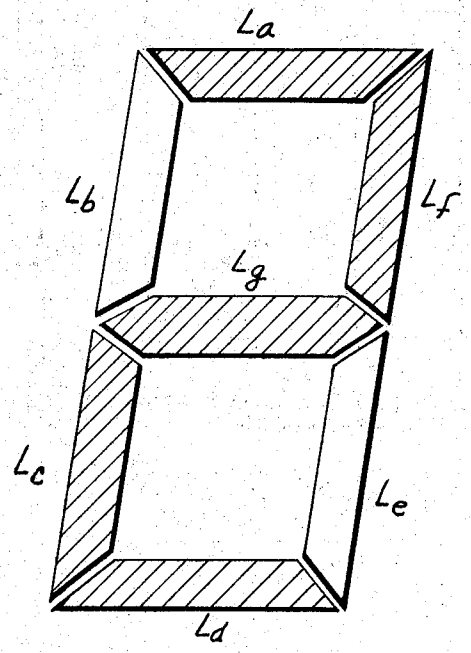


FIG. 2

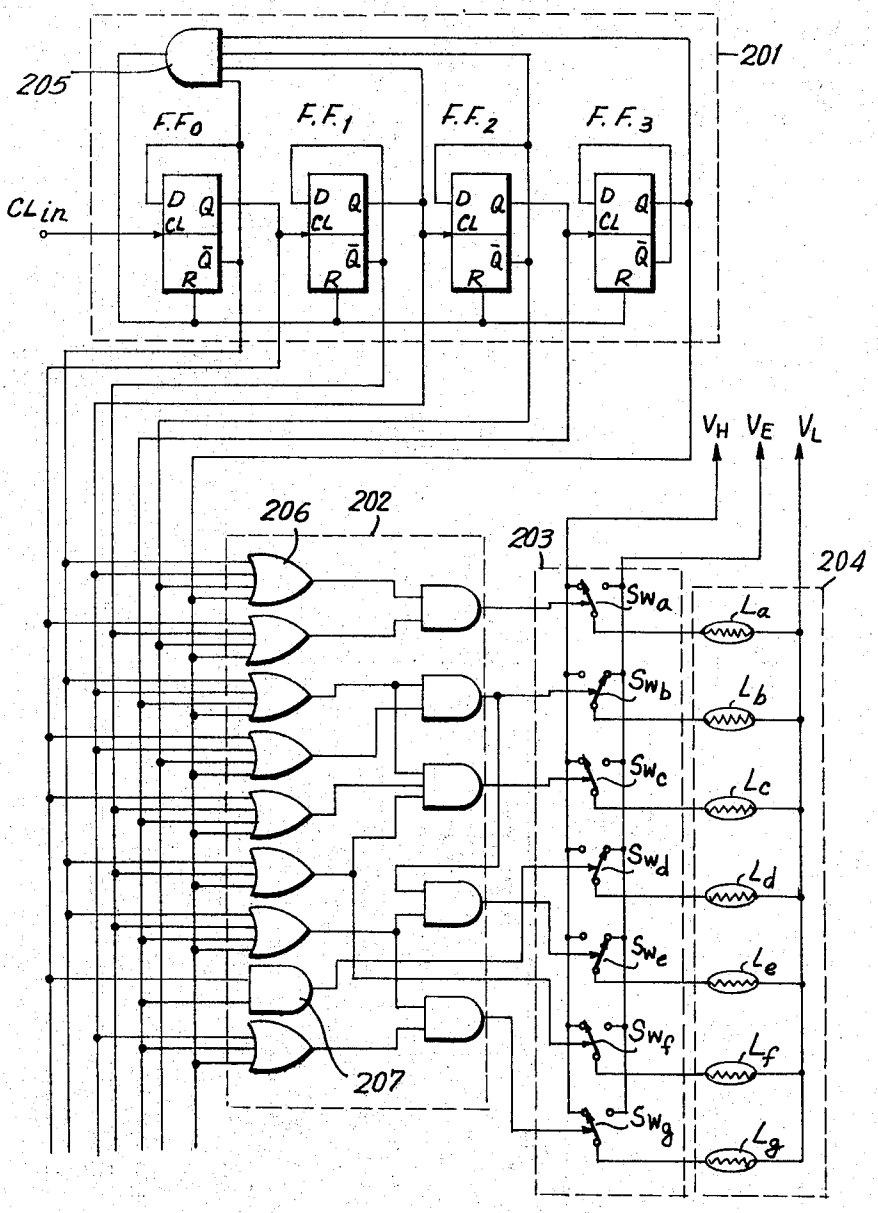

201
205
F.F0
F.F1
F.F2
F.F3
CLin
D
CL
Q
R
VH
VE
VL
206
202
203
204
Swa
Swb
Swc
Swd
Swe
Swf
Swg
La
Lb
Lc
Ld
Le
Lf
Lg
207

FIG. 3

FIG. 4

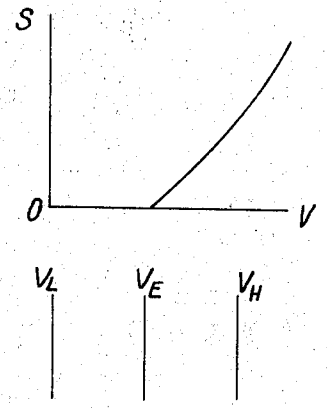

S
0
V
V_L
V_E
V_H

FIG. 5

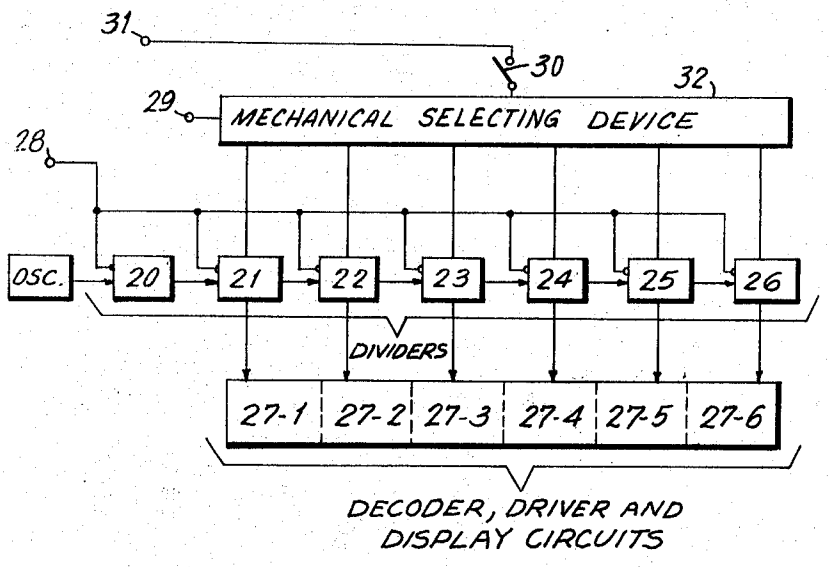

31
30
32
29
MECHANICAL SELECTING DEVICE
28
OSC.
20
21
22
23
24
25
26
DIVIDERS
27-1
27-2
27-3
27-4
27-5
27-6
DECODER, DRIVER AND
DISPLAY CIRCUITS

FIG. 6a

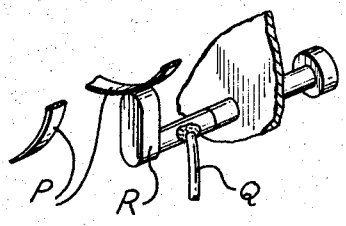
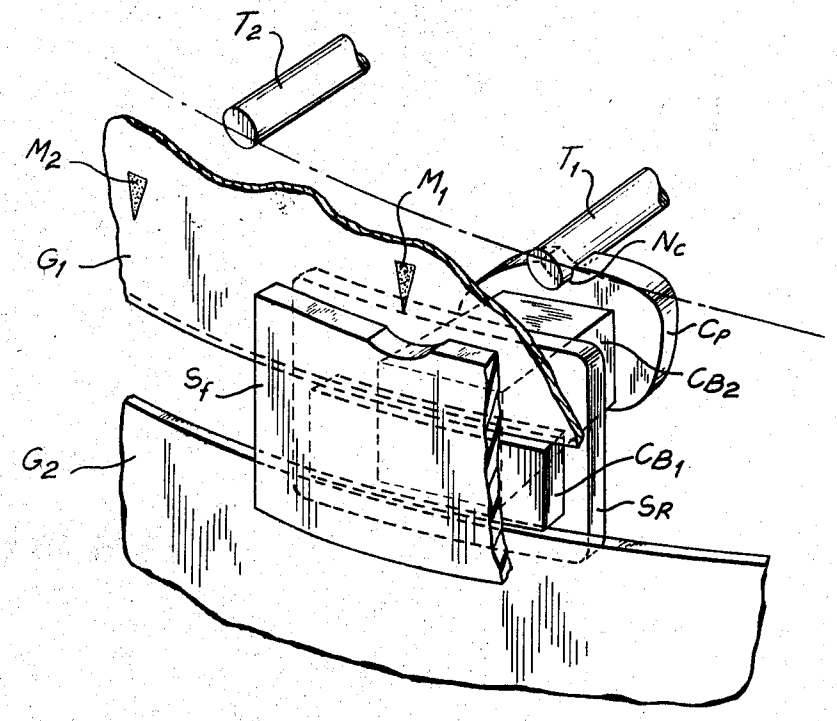


FIG. 6b



TIME-CORRECTING DEVICE FOR ELECTRONIC TIMEPIECES

BACKGROUND OF THE INVENTION

This invention relates to devices for correcting the digital display of electronic timepieces. Such digital displays generally consist of a plurality of digits representative of the hours, minutes, and seconds time indication. In the art, a pushbutton correction switch has been provided for each of said time display digits, occupying a great deal of space in the watch case, and causing confusion and difficulties in operation. By providing a mechanical selector switch for selecting the digit to be corrected these difficulties have been avoided.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the invention, an electronic timepiece is provided including timekeeping circuit means and display means. Said display means is provided with a plurality of digits for the display of time. Said timekeeping circuit means includes a frequency divider stage operatively coupled to each digit of said display means for providing timing signals for the driving of said display means digit. A time-correction means is operatively coupled to at least two of said divider stages, said time-correction means including a selector switch for selecting one or more of said two or more divider stages to be corrected and an enabling switch for applying a time-correcting signal to the selected detector stage. Said selector switch may take the form of a rotary switch or a slide switch.

Accordingly, it is an object of the invention to provide an accurate and quick means for performing the time-correction function in an electronic watch.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:

FIG. **1** is a block diagram of an electronic timepiece including a conventional time-correcting device;

FIG. **2** is a top plan view of a display segment for displaying a single digit in the digital display of FIG. **1**;

FIG. **3** is a circuit diagram of a decimal counter circuit, a decoder circuit and a driver circuit for the electronic watch of FIG. **1**;

FIG. **4** is a graphical representation of the relation between voltage applied to a liquid crystal material and the light-scattering effects produced therein;

FIG. **5** is a block diagram of an electronic timepiece incorporating the time-correcting device in accordance with the invention; and

FIGS. **6***a* and **6***b* are perspective views of two embodiments of the mechanical selector switch in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. **1**, the electronic timepiece depicted includes an electronic frequency standard oscillator OSC of high precision which produces a high-frequency time standard signal which is applied to a frequency divider circuit **1**. Said frequency divider circuit consists of a series of flip-flop stages and reduces the high-frequency time standard signal to a signal having a pulse once every second. This one-second signal is applied to a decimal divider circuit **2** which produces a pulse signal every ten seconds. Said ten-second signal is applied to a one-sixth divider circuit **3** which produces a pulse signal every minute. This one-minute signal is applied to a decimal divider circuit **4** which produces a pulse signal every ten minutes. This ten-minute signal is applied to a one-sixth divider circuit **5** which produces a pulse signal every hour. Said one-hour signal is applied to a decimal divider circuit **6** which produces a pulse signal every ten hours. The ten-hour signal is applied to a divider circuit **7** which serves to recycle the divider chain at the end of each 24-hour period.

Divider stages **2, 3, 4, 5, 6** and **7**, respectively, drive display elements **8-1, 8-2, 8-3, 8-4, 8-5** and **8-6** of the digital display device. The one-second digit is displayed on display element **8-1**, the ten-second digit is displayed on display element **8-2**, the one-minute digit is displayed on display element **8-3**, the ten-minute digit is displayed on display element **8-4**, the one-hour digit is displayed on display element **8-5**, and the ten-hour digit is displayed on display element **8-6**.

Each display element is formed from a seven-segment array in the nature of a seven-bar display, as depicted in FIG. **2**. By selective actuation of the seven bars L_a, L_b, L_c, L_d, L_e, L_f and L_g of the display, any numeral from 0 to 9 may be displayed digitally. In FIG. **2**, the cross-hatching represents the segments or bars actuated to display the numeral **2**. Each display segment may be formed from luminous diodes, liquid crystal material or the like.

The output of each divider stage **2–7** would be applied to decoder and driver circuits as more particularly depicted in the circuit diagram of FIG. **3**. In said circuit diagram, a decimal divider circuit **201**, corresponding by way of example to divider circuit **2**, is depicted. Said divider circuit consists of four flip-flop circuits FF_0, FF_1, FF_2, FF_3. Each of the flip-flop circuits is of the data type and operates at $Q_i = D_{i-1} = \bar{Q}_{i-1}$ where D and $\bar{Q}$ are connected together and i−1 represents the condition one digit before the condition at *i*. An AND circuit **205** receives signals from selected terminals of each of the flip-flops such that said flip-flops are reset when flip-flops FF_0, FF_1, FF_2 and FF_3 are disposed respectively in the 1,0,1,0 state (representative of a decimal 10), thereby producing a decimal counter. The other divider stages are constructed in accordance with the same principles.

The decoder circuit **202** is adapted to select the segments of the associated display elements representative of the state of the flip-flops of divider **201**. Driver circuit **203** applies decoded driving signals to the selected segments **204**. Counter circuit **202** consists of eight OR gates **206** and six AND gates **207**. The drive circuit consists of seven drivers SW_a, SW_b, SW_c, SW_d, SW_e, SW_f and SW_g, each of which are formed of complementary MOS transistors and are respectively coupled to corresponding display segments L_a, L_b, L_c, L_d, L_e, L_f, L_g. The complementary MOS transistor drivers operate as double-throw switches, conducting a voltage V_E

when an element is not to be displayed and a voltage V_H when a segment is to be displayed. Since the segments of the display **204** are formed from a liquid crystal material in the embodiment depicted in FIG. **3**, this switching arrangement may be utilized. Thus, liquid crystal materials will not cause the light-scattering effects which render them visible when subjected to a voltage below a fixed level. This characteristic is illustrated in the graph of light-scattering vs. voltage of FIG. **4**. The continuous application of a minimum voltage below the threshold of light-scattering hastens the response speed of the liquid crystal display cells. Each display segment is connected between a voltage V_L and one of the MOS transistor switches.

Referring again to FIG. **1**, the conventional time-correcting device **10** depicted consists of a plurality of switches SW_1, SW_2, SW_3, SW_4, SW_5 and SW_6, each of which is connected on one side to a common terminal **11** and on the other side to one of divider stages **2, 3, 4, 5, 6** and **7**. The correcting signal is applied to terminal **11** for application to the selected one of the divider stages for correcting same. Where six digits were to be corrected, six separate switches, usually of the push-button type, were provided, increasing the size of the wristwatch, and making time correction both difficult and subject to error.

An electronic water incorporating a time-correcting device in accordance with the invention is depicted in FIG. **5**. The watch is provided with an oscillator OSC and a frequency divider chain **20, 21, 22, 23, 24, 25, 26** which corresponds in function and structure to the oscillator OSC and divider chain **1, 2, 3, 4, 5, 6** and **7** of FIG. **1**. Similarly, the watch is provided with decoding, driving and display circuits **27-1, 27-2, 27-3, 27-4, 27-5** and **27-6**, which correspond in structure and function to the decoder, driving and display circuits **8-1, 8-2, 8-3, 8-4, 8-5** and **8-6** of FIG. **1**. The correcting signal at terminal **31** is selectively applied through a common switch **30** and a selecting switch **32** to each of divider stages **21, 22, 23, 24, 25** and **26**. Selecting switch **32** is manually operable as indicated schematically by terminal **29** to select which one of the divider stages is to be corrected. Both switches **30** and **32** project outside the watch case and are manually manipulatable.

A reset signal is applied from terminal **28** to each of the divider stages **20, 21, 22, 23, 24, 25** and **26** for return-to-zero of each of said divider stages in the same manner that a reset signal may be applied to terminal **9** of FIG. **1**.

Referring now to FIG. **6***a*, one embodiment of a mechanical selecting switch in accordance with the invention is depicted. This mechanical selecting switch is provided with a plurality of fixed contacts P, two of which are depicted in FIG. **6***a*, such fixed contacts being circumferentially spaced in the path of a movable contact R mounted on a rotor operable from outside of the watch case. The correcting signal would be applied by second manually operated switch **30** of FIG. **5**, to the fixed contact R along lead Q. Each fixed contact P would be connected to one of divider stages **21–26** of FIG. **5**.

The second embodiment of the selecting switch is depicted in FIG. **6**b, said second embodiment being based on a slide switch having a holdfast feature. Said switch consists of slider plates S_f and S_R, which are joined as a single body by connecting them with CB_1. This body slides from side to side along guide plates G_1, G_2, which also serve as the watch case. A contact plate C_p is mounted on rear slider plate S_R through a connecting member CB_2. Contact plate C_p is provided with a notch N_c in the upper surface thereof for engagement with spring contact elements T_1, T_2. The number of these spring contacts will depend on the number of digits of the display device to be corrected, one of said contacts being provided for each digit. The resilient property of the spring contacts T_1, T_2 permits engagement in the notch N_c for retaining the slide at each operative position. The outer surface of guide plate G_1 is provided with marks M_1, M_2, etc. corresponding in position to each of said spring contacts providing a marker for the user in positioning the slide. The correcting signal would be applied to the movable contact C_p. The embodiment of FIG. **6***b* defines a click-stop selecting switch which may readily be incorporated in a wristwatch. By the provision of an additional manually operated switch corresponding to switch **30** of FIG. **5**, either the arrangement of FIG. **6***a* or the arrangement of FIG. **6***b* defines a manually operable time-correcting device which is readily usable through the manipulation of a minimum number of switches.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained, and since certain changes may be made in the above constructions without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. An electronic timepiece comprising oscillator circuit means for producing a high-frequency time standard signal; multi-stage frequency divider circuit means for sequentially dividing said high-frequency time standard signal and producing low-frequency timekeeping signals at a selected group of said stages; display means including a plurality of display elements for the digital display of time; means for driving each of said display elements in response to one of said timekeeping signals; and time-correcting means including a manually operable selector switch means connected to at least two of the divider stages producing said timekeeping signals for selecting one of said divider stages, and a secondary switch means manually operable independent of said selector switch means for selectively applying a time-correction signal through said selector switch means to the selected divider stage for correcting the display element associated with said selected divider stage.

2. An electronic timepiece as recited in claim **1**, wherein said selector switch is a rotary switch.

3. An electronic timepiece as recited in claim **1**, wherein said selector switch is a slide switch.

4. An electronic timepiece as recited in claim **3**, including a watch case, said watch case being formed with a longitudinally extending slot; said selector switch means including a slide member mounted on said watch case for longitudinal displacement along said slot in response to manual manipulation by the user; said movable contact being mounted on said slide member,

said fixed contacts being positioned in the path of said movable contact.

5. An electronic timepiece as recited in claim **4,** wherein said movable contact is formed with a notch in the path of said fixed contacts, said fixed contacts being resiliently mounted for engagement in said notch when said movable contact is in registration therewith.

6. An electronic timepiece as recited in claim **1,** wherein said selector switch means is coupled to each of the divider stages producing said timekeeping signals.

* * * * *