ELECTRONICALLY CONTROLLED STOP WATCH

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Field of Search 58/39.5, 74, 23 R, 23 A;

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ABSTRACT

An electronically controlled stop watch in which the output frequency of a standard frequency oscillator is divided by a frequency divider means, the divided frequency is counted by a counter means, the starting and stopping of this counting are controlled by a start-stop switch means, and by supplying power to a display means and a register means by the operation of a time display switch means, the content of said counting is displayed in a display device. Preferably a single indicating lamp indicates the off-on condition of a main power switch and also whether or not the counter is counting. The display means is preferably powered by an output of the frequency divider to conserve power. Moreover, reset means is preferably related to the counter control so that the register means cannot be accidentally reset during counting.

11 Claims, 1 Drawing Figure
ELECTRONICALLY CONTROLLED STOP WATCH

This invention relates to an electronically controlled stop watch and more particularly to an electronically controlled stop watch in which time signals are produced by dividing and counting a standard frequency and the starting and stopping of this counting is suitably controlled.

Most of the hitherto-used stop watches have been purely mechanical, but since stop watches are used more severely than wrist watches and other watches, not only is the accuracy lowered in long use due to friction, abrasion etc. of the mechanical parts, but also other faults are liable to occur. On the other hand, some electrically controlled stop watches have been introduced, but because of the complexity of their control circuits, several defects are apt to appear and moreover, the power consumption is rather large. In addition, since an indicator showing the on state of a power switch and an indicator showing whether the counter is counting or not, are individually provided, the power consumption becomes larger. In a small sized stop watch that houses a battery, this large power consumption is a disadvantage. Furthermore, the reset action of the counter is performed by use of an extremely complex control circuit having a large power consumption. Also even when the time display is not operated, power is supplied to the indicating part, resulting in consuming much electric power.

The present invention overcomes the above-mentioned difficulties and provides a newly improved electronically controlled stop watch. A characteristic of the present invention is to provide an electronically controlled stop watch comprising a standard frequency oscillator, a frequency divider means that divides the output frequency of said standard frequency oscillator, a counter means that produces time output signal by counting the divided frequency output signal, a register means that receives the time output signal of the counter means, a display means that provides a time display of the time output signal of the register means, a start-stop means that controls the starting and stopping of counting of the counter means, a reset means that resets the frequency divider means and counter means, and a display switch means that supplies power to said register means and display means only when the content of the counting is to be displayed by said display means. Since, by providing the above-mentioned construction and operation, power is supplied to the display means only when the time display is made, the power consumption is reduced. This is convenient especially in a small-sized stop watch.

It is an object of this invention to provide an electronically controlled and stabilized stop watch of low power consumption and high accuracy that is convenient for a small-sized stop watch, by supplying power to the register means and display means only when the time display is made.

It is another object of this invention to provide a capability of confirming the operational state of a stop watch by changing the indicating condition of an action indicating means according to the stop state and start state of the start-stop switch means.

It is a further object of this invention to assure a time measurement from the "O" state of counting, by confirming whether the reset operation has occurred or not from the indication of the display means given by supplying power to the display means when the reset operation is actuated.

It is also an object of this invention to assure a stable time measurement by preventing a misoperation during measurement in such a way that the reset can be actuated only when the start-stop means is in the stop state.

It is another object of this invention to provide an electronically controlled stop watch, in which a high-frequency output is taken out to open and close the power supplying gate of a display means, whereby the power consumption is reduced by supplying power to the display means intermittently.

The exact nature of the present invention as well as other objects and advantages thereof, will become more apparent from consideration of the following detailed description and the accompanying drawing in which:

The single FIGURE is an overall block diagram of an electronically controlled stop watch in accordance with this invention.

In this embodiment, a crystal oscillator that produces a standard frequency is used as a standard frequency oscillator 1. A frequency divider means 2 consists of a plurality of flip flop circuits which divide the output frequency of the standard frequency oscillator 1 to provide a desired frequency. As the stop watch of this embodiment is to measure 1/100 sec. as a limit, a divided frequency output of 100 Hz is produced. A counter means 3 consists of counters 4, 5, ..., 10. Counters 4, 5, 6 and 8 count in units of 1/100 sec., 1/10 sec., second and 1 minute respectively, producing a binary-coded decimal output. Counters 7 and 9 count in units of 10 seconds and 10 minutes respectively, producing a binary-coded hexa decimal output, and the counter 10 counts in units of 1 hour and 10 hours, producing a binary-coded duo-decimal output. A register means 11 consists of registers 12, 13, ..., 18, which receive the outputs of the counters 4, 5, ..., 10 respectively. When input gates of the registers are open, the stored contents of said registers are changed each time when the counting is changed. When the input gates of the registers 12, 13, ..., 18, are closed, they store the contents of counting supplied before closing.

A display actuating means 19 consists of display actuating devices 20, 21, ..., 26 which supply respective output signals from the registers 12, 13, ..., 18 to respective display elements of a display device 27 after code conversion and amplification. The display element for each unit of time of the display device 27 comprises a display pattern composed, for example, of a light emission diode, a display tube or a liquid crystal. Thus, the above-mentioned display actuating means 19 and display device 27 compose a display means 28.

A start-stop switch means 29 consists of a start-stop switch 30 and an action indicating switch 31 which are mutually interlinked. The start-stop switch 30 consists of a start-stop contact piece 32, a stop contact point 33 and a start contact point 34. The action indicating switch 31 consists of a contact piece 35 and contact points 36, 37. The stop contact point 33 is connected to an input of a gate in the frequency divider means 2. The start-stop switch 30 is connected in such a way that the gate is closed when the contact piece 32 is connected with the stop contact point 33, and the gate of the
frequency divider means 2 is opened when the start-stop contact piece 32 is connected with the start contact point 34. In other words, the start-stop switch 30 controls the opening and closing action of the input gate of the frequency divider means 2 by supplying two different signal levels. The start contact point 34 is connected to the reset terminals of the frequency divider means 2 and the counter means 3. The reset level is set in such a way that the reset is released when said reset terminals are brought to ground potential. The action indicating switch 31 controls means for indicating the operational state of the start-stop switch 30. This action indicating means 38 consists, for example, of a lamp. The contact point 36 of the action indicating switch 31 is at ground potential, and the contact point 37 is connected to the output terminals of the counter 6 which produces a signal of 1 second period. One terminal of the action indicating means 38 is connected to a power source 40 through a power switch 39, and the other terminal thereof is connected to the contact piece 35 of the action indicating switch 31.

A time display switch means 41 is composed of a time duration indicating switch 42 and a lamp time switch means 43. The lamp time switch means 43 controls the display device 27 to display a particular time during the elapsed time, and consists of a lamp power switch 44 to supply power to the register means 11 and the display means 28, and a lamp display switch 45 that opens and closes the input gates of the registers 12, 13, 14, 15, 16, 17, 18. The lamp power supply switch 44 is composed of a contact piece 46 and contact points 47, 48, and the lamp display switch 45 is composed of a contact piece 49, a lamp display contact point 50 and a lamp display stop contact point 51. The contact pieces 46, 49 are interconnected with each other so as to operate together. The contact piece 46 is connected to the power source 40, through the power switch 39, and the contact point 47 is connected to the power input terminals of the register means 11 and the display means 28. The contact point 50 is connected to the input gates of the registers 12, 13, 14, 15, 16, 17, 18. The time duration indicating switch 42 is connected between the power switch 39 and the contact point 47 and, when switched on, gives an indication of the content of counting, i.e., the duration of time, of the counter means 3.

A reset switch means 52 is composed of a reset switch 53 and a reset power switch 54. The reset switch 53 is composed of a reset contact piece 55, a reset release contact point 56 and a reset contact point 57. The reset contact piece 55 is connected to the ground. The reset indicating power switch 54 is composed of a reset power contact piece 58 that is interconnected with the reset contact piece 55, a reset power contact point 59, and a reset release power contact point 60. The reset contact point 57 is connected to the reset terminals of the frequency divider means 2 and the counter means 3. The frequency divider means 2 and the counter means 3 are reset when the reset contact piece 55 is connected with the reset contact point 57, and released when the reset contact piece 55 is connected with the reset release contact point 56. A high-frequency output of the frequency divider means 2 is supplied to the power supply gates of the display actuating means 19 and the gates are opened and closed at this frequency.

The operation of the circuit will now be explained. First, a case of displaying an arbitrary time duration after the start of a counting is considered. Before starting the counting, the contact pieces 32, 35 of the start-stop means 29 are connected with the contact points 33, 36, and the contact pieces 46, 49 of the lamp time switch means 43 are connected with the contact points 48, 51 respectively. The contact pieces 55, 58 of the reset switch means 53 are connected with the contact points 56, 60. Then, if the power switch 39 is closed, a current flows from the power source 40 to ground through the action indicating means 38, contact point 35, contact point 36 so as to light the lamp of the action indicating means 38, thus clearly showing that power from the power source 40 has been supplied. Power from the power source 40 is further supplied to the standard frequency oscillator 1, frequency divider means 2, and counter means 3, but the input gate of the frequency divider means 2 is kept closed because the stop contact 33 is held at ground level, so that the output of the frequency divider means 2 does not produce an output. In starting the counting, in order to confirm that the contents of counting of the counters 4, 5, . . . 10 are at “0”, the contact piece 55 of the reset switch 53 is connected with the reset contact point 57 to reset the counters 4, 5, . . . 10 to “0”.

Thus, the preparation for starting the counting is completed. At the outset of counting, when the contact piece 32 of the start-stop switch 30 is switched to the start contact 34, the contact piece 35 of the action indicating switch 31 is also connected to the contact point 37. Accordingly, the action indicating means 38 is connected to the output terminal of 1 sec. signal of the counter 6 through the contact piece 35 and the contact point 37. Therefore, the action indicating means 38 receives signals of 1 sec. frequency to produce alternate lighting and extinguishing as an indication of being in the state of counting. On the other hand, when the start-stop switch 30 is switched to the start contact 34, the potential of contact point 33 is brought to the opening level of the gate of the frequency divider means 2, and the gate of the frequency divider means 2 is opened. Therefore, the frequency divider means 2 divides the standard frequency and produces an output signal of 100 Hz. The output signal is supplied to the counter 4. This is counted in the counter 4 and, when a counting of 0.1 sec. is reached, a carry signal is produced from the counter 4 and supplied to the counter 5. When a counting of 1 sec. is reached in the counter 5, a carry signal is produced from the counter 5 and supplied to the counter 6. The counter 7 counts 10 sec. units, and when the counting reaches 60 sec., a carry signal is produced and supplied to the counter 8. Thus, the counting of respective time units is performed successively with the lapse of time and the respective contents of counting are produced at the output terminals of the respective counters 4, 5, 6, . . . 10 and supplied to the registers 12, 13, 14, . . . 18. However, the register means 11, display actuating means 19 and the display device 27 are not supplied with power from the power source 40, so that all of them are at a standstill.

In case of indicating the time elapsed, when the time duration indicating switch 42 is switched on, power from the power source 40 is supplied to the register
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5 means 11, display actuating means 19, and display device 27. Therefore, the counting output of the counter means 3 is converted into a signal for display by the display actuating means 19 through the register means 11 and, on being amplified further, indicates the time elapsed by means of the display device 27. For example, if the elapsed time when the time duration indicating switch 42 is closed is 15 min. 15 sec., the time is indicated in the display device 27.

Next, the display action of lap time will be explained. When the lap time switch means 43 is operated, the contact piece 46 of the lap power switch 44 is switched to the contact point 47, whereby power from the power source 40 is supplied to the register means 11, display actuating means 19 and display device 27. On the other hand, the contact point 49 of the lap indicating switch 45 is switched to the contact point 50 to close the gate of the register means 11, and the counting output from the counter means 3 to the register means 11 is stopped. Therefore, the time at the time the lap indicating switch 45 is switched on is stored in the register means 11, the output thereof is converted into a signal through the display actuating means 19, and the lap time is displayed in the display device 27. In the meanwhile, counting is being carried out in the counter means 3, which is confirmed by the on-off of the action indicating means 38. When the display of the lap time is completed, the contact pieces 46, 49 are brought into contact with the contact points 48, 51 by the action of the lap time switch means 43 again to interrupt the power supply to the register means 11 and the display means 28, whereupon the time display disappears. As it has been devised to supply power only when the display time is made, the power consumption is extremely low.

Next, the reset action will be explained in detail. The contact pieces 55, 58 of the reset means 52 are switched to the contact points 57, 59 and by reversing the potential level of the contact point 56 to a value different from ground potential, the frequency divider means 2 and the counter means 3 are held at the reset level and are reset to "0". Since power from the power source 40 is supplied to the register means 11, display actuating means 19 and display device 27 by the connection between the contact point 58 and the contact point 59, the "0" output of the counter means 3 is fed to the register means 11 and a "0" indication is made by the display device 27 through the display actuating means 19. In this way it is confirmed that the resetting of the counter means 3 has been performed.

It is noted that the resetting mentioned above cannot occur during the action of counting. During this action, the contact piece 32 of the start-stop switch 30 is connected with the start contact 34, and the start contact 34 is at ground potential. Therefore, the reset inputs of the frequency divider means 2 and the counter means 3 are at ground potential, so that even though the contact piece 55 of the reset switch 53 is switched on to the reset contact point 57, the reset inputs of the frequency divider means 2 and the counter means 3 are kept at ground potential and no resetting is effected.

To stop the counting, the contact pieces 32, 35 of the start-stop switch means 29 are switched to the contact points 33, 36 on the stop side by the action of the start-stop switch means 29, and the output of the frequency divider means 2 is stopped by closing the gate of the frequency divider means. Accordingly, the counter means 3 is in a state of storing the content of counting and, when the start-stop switch 30 is switched again to the start contact 34, the subsequent time will be integrated with the former content of counting. Therefore, it is convenient to use for the purpose of integrating additional time with the former time. On the other hand, by being connected to ground through the contact piece 35, the action indicating means 38 is in a lighting state.

As described in detail above, the power source supply and the counting action state are shown by a single indicating means and, by making the reset switch means relate to the start-stop switch means, the reset action is activated only when the counting is stopped. By supplying power to the register means and the display means, the "0" indication is made to appear on the display device, and further in the case of indicating the elapsed time and the lap time, power is supplied to the register means and the display means by the action of the time display switch means. As a result, it is possible to confirm the conditions of supply of power and action of counting by one action indicating means. Moreover, since the reset action is performed in relation to the start-stop switch and the reset switch, it is possible to make the construction simple and the operation reliable. Even if the reset switch is operated by mistake during the action of counting, no effect at all will be caused. Further, since power is supplied to the register means and the display means only in the case of time indication, the power consumption is very low. This is particularly convenient for a small-sized stop watch in which a battery is housed. Furthermore, since the required action is directly realized by means of switches, there is provided a stop watch of simple construction and reliable performance.

In the above-mentioned embodiment, the number of counters 4, 5 . . . 10, and the dividing ratio of frequency divider means 2 are determined according to the time to be measured. For example, in the case of a stop watch that counts only up to 60 min., the counter 10, register 18 and display actuating device 26 are not needed. Accordingly, the numbers of counters and registers are increased or decreased as required. In the case of the present embodiment, the action indicating means 38 is supplied with intermittent current from the output of an appropriate stage of the frequency divider means 2 or the counter means 3. In case the action indicating means 38 is not needed, the start-stop means 29 may consist of only the start-stop switch 30. Also, since the function as a stop watch may be accomplished by providing a display of an elapsed time, the lap time switch means 43 is not needed. In this embodiment, the contact piece 46 and the contact piece 49 of the lap time switch means 43 are interlinked, but the contact piece 46 and the contact piece 49 may be separated from each other to constitute independent switches individually. In this case the display of lap time may be made in such a way that, by actuating the switch for supplying power, the power is supplied to the register means 11 and the display means 28, then by actuating the switch for lap time, the lap time is obtained. However, the construction of interlinking the power supply switch with the lap time switch affords low power consumption.
If the reset switch means 52 is merely required to carry out the reset action of the frequency divider means 2 and the counter means 3 only, but not to make a display confirming that the reset has been done, the reset switch means 52 will comprise the reset switch means 53 only.

Further, in the present embodiment the power supply gate of the display means 28 is opened and closed by the high frequency output from the frequency divider means 2 to reduce the power consumption. But if there is no particular necessity of reducing power consumption, the display device 27 may be supplied with continuous current instead of intermittent current from the output from the frequency divider means 2.

What I claim and desire to secure by Letters Patent is:

1. An electronically controlled stop watch comprising: a power source, a standard frequency oscillator, frequency divider means for dividing said standard frequency to provide a selected time signal, counter means for counting said time signal to produce a counting output thereof, register means for receiving and registering said counting output, display means actuated by the output signal of said register means, start-stop switch means for starting and stopping the counting of said counter means by controlling said frequency divider means, reset means for resetting said frequency divider means and counter means, and time display switch means for supplying power to said register and display means only when a time is to be displayed in said display means by the counting output of said counter means.

2. An electronically controlled stop watch according to claim 1, in which said frequency divider means include gate means, and said start-stop switch means includes a start-stop switch controlling the opening and closing of said gate means to control the starting and stopping of counting of said counter means.

3. An electronically controlled stop watch according to claim 2, in which said start-stop means further includes an action indicating switch interlinked with said start-stop switch and action indicating means controlled by said action indicating switch to indicate the on or off state of said start-stop switch.

4. An electronically controlled stop watch according to claim 3, in which said action indicating switch has two portions in one of which it supplies continuous current from said power source to said action indicating means and in the other of which it supplies intermittent current from said counter means to said indicating means.

5. An electronically controlled stop watch comprising: a power source, a standard frequency oscillator for producing a standard frequency, frequency divider means for dividing said standard frequency to provide a selected time signal, counter means for counting said time signal to provide a time counting output thereof, register means for receiving and registering said time counting output, display means actuated by the output signal of said register means, start-stop switch means for starting and stopping the counting of said counter means by controlling said frequency divider means, reset switch means for resetting said frequency divider means, and counter means, and time display switch means including a time duration indication switch for supplying power to said register means and to said display means only when a time is displayed in said display means by the time counting output of said counter means.

6. An electronically controlled stop watch according to claim 5, in which said register means includes gate means, and said time display switch means further includes a lap power switch for supplying power to said register means and display means, and a lap display switch controlling the opening and closing of the gate means of said register means.

7. An electronically controlled stop watch according to claim 6 in which said lap power switch and said lap display switch are interlinked with each other.

8. An electronically controlled stop watch comprising: a power source, a standard frequency oscillator for producing a standard frequency, frequency divider means for dividing said standard frequency to provide a selected time signal, counter means for counting said time signal to provide a counting output thereof, register means for receiving and registering said time counting output, display means actuated by the output signal of said register means, start-stop switch means for starting and stopping the counting of said counter means by controlling said frequency divider means, reset switch means including a reset switch to change over said frequency divider means and said counter means, reset switch means, and display means only when a time is displayed in said display means by the time counting output of said counter means.

9. An electronically controlled stop watch according to claim 8, in which said reset switch and said reset power switch are interlinked with each other.

10. An electronically controlled stop watch according to claim 8, in which said frequency divider means and said counter means have reset terminals connected by a reset line to said reset switch means and in which said reset line is interconnected with said start-stop switch means to prevent resetting during said counting.

11. An electronically controlled stop watch comprising: a power source, a standard frequency oscillator for producing a standard frequency, frequency divider means for dividing said standard frequency to provide a selected time signal, counter means for counting said time signal to produce a time counting output thereof, register means for receiving and registering said time counting output, display means actuated by the output signal of said register means, start-stop switch means controlling said frequency divider means to control the starting and stopping of counting by said counter means, reset means for resetting said frequency divider means and counter means, and time display means for supplying high frequency power from said frequency divider to said register means and display means only when a time is displayed in said display means by the time counting output of said counter means.

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UNIVERS STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,686,880 Dated August 29, 1972

Inventor(s) Toshihide SAMEJIMA

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the title page in column 1, after the Inventor is listed and before Filed, please insert:
Assignee: KABUSHIKI KAISHA HATTORI TOKEITEN, Tokyo, Japan.

On the title page in column 1, change Appl. No. 17,806 to 178,060.

Signed and sealed this 13th day of March 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents
UNited States Patent Office
Certificate of Correction

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(SEAL)
Attest:

EDWARD M. FLETCHER, JR. ROBERT GOTTSCHALK
Attesting Officer Commissioner of Patents