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(54) CHRONOGRAPH

(71) We, KABUSHIKI KAISHA SUWA SEIKOSHA, a Japanese body corporate, 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 chronographs, and is an improvement in or modification of the invention disclosed in our co-pending Application No. 44145/73 (Serial No. 1,412,165).

Mechanical chronographs are already known and used but have several defects. Firstly, when a mechanical chronograph functions as a stop watch, the hour and minute hands used to display a time of day indication are almost indistinguishable from the hands used to display elapsed time. Secondly, the seconds indication of the time of day indication is lost when the chronograph is used as a stop watch and, moreover, it is difficult to measure a timing period to an accuracy greater than one second. In addition, it is difficult to provide a mechanical chronograph with a lap function. A lap function enables the chronograph, when it is used as a stop watch, to continue to count the elapsed time even though the display of the total elapsed time is stopped and, when the display is started, to display the elapsed time starting from the beginning of measuring. A lap function differs from a start-stop function in that, in the case of the latter, counting of the elapsed time ceases when the display of the elapsed time is stopped, and when counting of the elapsed time is started an integrated elapsed time starting from the beginning of measuring, excluding the time for which the display of the elapsed time was stopped, is displayed.

The present invention seeks to avoid these defects found in conventional mechanical chronographs.

According to the present invention there is provided a chronograph comprising a quartz crystal oscillator for producing a standard time signal, a display device composed of liquid crystal or solid state elements, an electronic circuit arranged to cause the same display device to display a time of day indication when the chronograph functions as a timepiece and to display elapsed time when the chronograph functions as a stop watch, and means, when the chronograph functions as a stop watch, for differentiating between a lap time reading state and a stopped state.

Said means may comprise a display element disposed between a part of the display device for indicating hours and a part of the display device for indicating minutes. Thus said display element may be in the form of a colon.

Preferably said electronic circuit includes switch means for causing the display device selectively to display the time of day indication when the cronograph functions as a timepiece and for causing the display device to display the elapsed time when the chronograph functions as a stop watch.

The chronograph may include a plurality of switches arranged to correct the time of day indication when the chronograph functions as a timepiece and to control the operation of the chronograph when it functions as a stop watch.

In the preferred embodiment the electronic circuit comprises a decoder and driving circuit for driving the display device, a first electronic divider circuit for producing first timing signals from the standard time signal and operable when the chronograph functions as a timepiece, a second electronic divider circuit for producing second timing signals from the standard time signal and operable when the chronograph functions as a stop watch, and a selector circuit for selectively transmitting either the first timing signals or the second timing signals to the decoder and driving circuit.

The invention is illustrated, merely by way of example, in the accompanying drawings in which:—

Figure 1 is a block diagram of a chronograph according to the present invention; and

Figures 2 and 3 are plan views of the chronograph of Figure 1 illustrating its operation.

Referring first to Figure 1, there is shown in block diagram form, a chronograph according to the present invention. The chronograph comprises: a digital display device 1 employing liquid crystal or solid state elements for displaying a time of day indication, when the chronograph is used as a timepiece, in tens of hours, units of hours, tens of minutes, units of minutes, tens of seconds and units of seconds and for displaying elapsed time, when the chronograph is used as a stop watch, in tens of hours, units of hours, tens of minutes, units of minutes, tenths of seconds, units of seconds and one-tenths of a second; an oscillator circuit 4 incorporating a quartz crystal oscillator (not shown) for producing a standard time signal; an electronic decoder and driving circuit 2 for providing driving signals to the display device; a change-over switch 7 for providing change-over signals to cause the chronograph to function either as a timepiece or as a stop watch; correcting switches 8, 9, 10 for correcting the time of day indication when the chronograph functions as a timepiece and for controlling the operation of the chronograph when it functions as a stop watch; a first electronic divider circuit 5 for producing from the standard time signal first timing signals to enable a time of day indication to be displayed when the chronograph functions as a timepiece, a second electronic divider circuit 6 for producing from the standard time signal second timing signals to enable measurement of elapsed time to be effected when the chronograph functions as a stop watch; and an electronic selector circuit 3 controlled by the change-over switch 7 for selectively transmitting either the first timing signals from the first divider circuit 5 or the second timing signals from the second divider circuit 6 to the decoder and driver circuit 2. As will be seen from Figure 1, the first and second divider circuits 5, 6 are connected in parallel between the oscillator circuit 4 and the selector circuit 3. Further, a colon 11 is disposed between the units of hours and tens of minutes of the time of day indication and the elapsed time indication to distinguish the hours and minutes from one another.

Depending upon the position of the change-over switch 7, the chronograph can be used either as a timepiece or as a stop watch. Since there is only a single display device 1 which displays either the time of day indication or the elapsed time, the size of the chronograph can be minimised and this is especially important when the chronograph is a wrist watch. Furthermore, misreading of the display device is reduced because the time of day indication and the elapsed time are displayed separately and distinguishably. In the conventional mechanical chronograph the time of day indication and elapsed time are displayed simultaneously and so tend to be misread. In addition, the time of day indication is displayed accurately and is not disturbed when the chronograph is changed from functioning as a stop watch to functioning as a timepiece because the time indication is retained in the electronic circuitry regardless of whether it is being displayed or not. Accordingly, a chronograph according to the present invention can be provided with a lap function which, as mentioned previously, is difficult to provide in a mechanical chronograph.

If the time of day indication and the elapsed time were displayed in exactly the same manner it would be difficult to determine merely from glancing at the display device 1 whether the chronograph was functioning as a timepiece or as a stop watch. Furthermore, when the chronograph is functioning as a stop watch and when the display of the elapsed time is stopped, it is difficult to differentiate between a stopped state of the display and a lap time reading state.

However, the embodiment of the present invention shown in Figures 2 and 3 avoids these difficulties. Figure 2 is a schematic external view of the chronograph of Figure 1 functioning as a timepiece and Figure 3 is a schematic external view of the chronograph of Figure 1 functioning as a stop watch. As clearly shown, when the chronograph functions as a timepiece fractions of a second, e.g. one-tenth of a second are not displayed by the display device 1. When the chronograph functions as a stop watch the display device does display fractions of a second. Thus, the user of the chronograph can see immediately from the display device whether the chronograph is functioning as a timepiece or whether the chronograph is functioning as a stop watch merely by seeing whther or not fractions of a second are being displayed by the dispsay device. By virtue of the fact that the display device 1 is digital in form, fractions of a second, e.g. tenths of a second, can be displayed more easily than with conventional mechanical chronographs.

Differentiation, when the chronograph functions as a stop watch, between the stopped state and a lap time reading state will now be explained. Cleraly a further display element could be provided to indicate when counting of the elapsed time is being effected thus indicating when a lap function is performed. When the chronograph is a wrist watch, it may be difficult to provide such a further display element having regard to the space available. Thus in the present embodiment, the colon 11 is uti-

lised to differentiate between the lap time reading state and the stopped state. The colon 11 is continuously lit when the chronograph functions as a timepiece i.e. when a time indication is displayed. When the chronograph functions as a stop watch, i.e. when an elapsed time is displayed and furthermore when in the stopped state, the colon 11 is also continuously lit but when in the lap time reading state the colon 11 winks or flashes. This arrangement is clearly advantageous having regard to the limited space available in a wrist watch. Thus a user of the chronograph can see immediately whether it is functioning as a timepiece or as a stop watch merely by the absence or presence respectively of fractions of a second and when the chronograph functions as a stop watch can determine whether it is in the lap time reading state or stopped state merely by seeing whether the colon 11 is continuously or intermittently lit. It will be appreciated that the arrangement may be such that the colon 11 is intermittently lit when in the stopped state and is continuously lit when in the lap time reading state.

From the above discussion it will be understood that the described chronograph is of practical commercial value.

WHAT WE CLAIM IS:—

1. A chronograph comprising a quartz crystal oscillator for producing a standard time signal, a display device composed of liquid crystal or solid state elements, an electronic circuit arranged to cause the same display device to display a time of day indication when the chronograph functions as a timepiece and to display elapsed time when the chronograph functions as a stop watch, and means, when the chronograph functions as a stop watch, for differentiating between a lap time reading state and a stopped state.

2. A chronograph as claimed in claim 1 in which the display device is capable of displaying fractions of a second, the electronic circuit being so arranged that, when the chronograph functions as a timepiece, fractions of a second are not displayed and when the chronograph functions as a stop watch, fractions of a second are displayed.

3. A chronograph as claimed in claim 1 or 2 in which said means comprises a display element disposed between a part of the display device for indicating hours and a part of the display device for indicating minutes.

4. A chronograph as claimed in claim 3 in which said display element is in the form of a colon.

5. A chronograph as claimed in any preceding claim in which said electronic circuit includes switch means for causing the display device selectively to display the time of day indication when the chronograph functions as a timepiece and for causing the display device to display the elapsed time when the chronograph functions as a stop watch.

6. A chrongraph as claimed in any preceding claim including a plurality of switches arranged to correct the time of day indication when the chronograph functions as a timepiece and to control the operation of the chronograph when it functions as a stop watch.

7. A chronograph as claimed in any preceding claim in which the electronic circuit comprises a decoder and driving circuit for driving the display device, a first electronic divider circuit for producing first timing signals from the standard time signal and operable when the chronograph functions as a timepiece, a second electronic divider circuit for producing second timing signals from the standard time signal and operable when the chronograph functions as a stop watch and a selector circuit for selectively transmitting either the first timing signals or the second timing signals to the decoder and driving circuit.

8. A chronograph substantially as herein described with reference to and as shown in the accompanying drawings.

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