

[54] **COMBINATION WRISTWATCH AND CALCULATOR**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 329,973, Feb. 6, 1973, Pat. No. 3,803,834.

[52] **U.S. Cl.**..... **58/152 R; 58/50 R; 58/153; 235/156**

[51] **Int. Cl.²** **G04B 37/12; G04B 19/30; G04C 21/32**

[58] **Field of Search** **G06F/7/38; 58/4 A, 50 R, 58/152 R, 153; 235/92 T, 152, 156**

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Primary Examiner—Edith Simmons Jackson
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[57] **ABSTRACT**

Disclosed is a combination wristwatch and calculator utilizing a common electro-optical digital display. A time and calendar circuit is combined with a calculator circuit, both formed by large scale integration, and used to actuate common display stations of a light emitting diode digital display. Time is constantly kept but the calculator circuit is only energized upon operation of a "calculate mode" switch to conserve battery energy. Also disclosed is a solar cell for recharging the battery and an inhibit timer for automatically extinguishing the display when the device is in the calculate mode but not in use.

20 Claims, 8 Drawing Figures

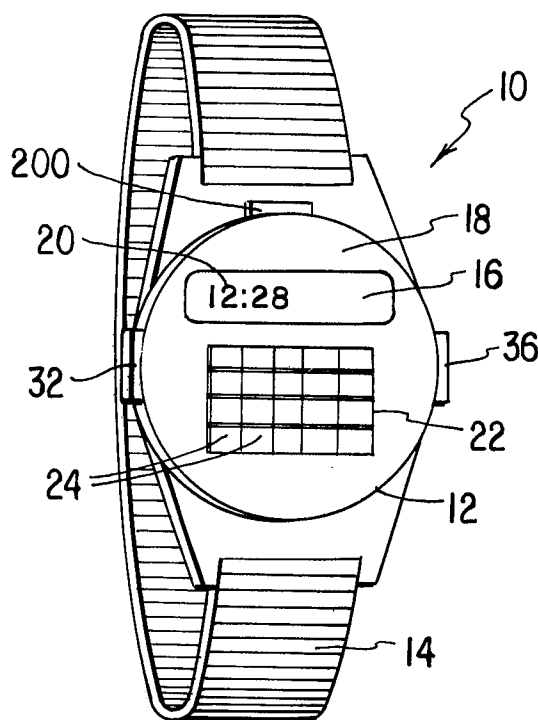


FIG. 1

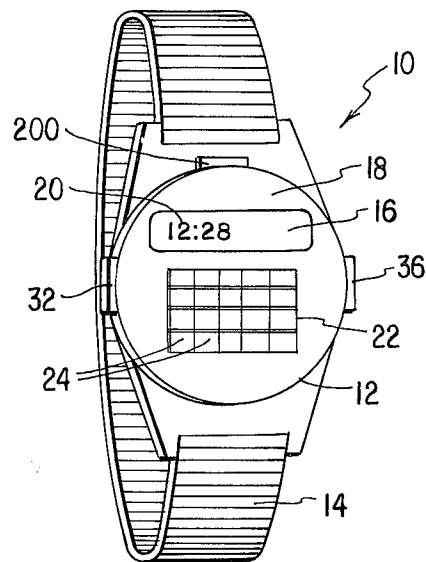


FIG. 2

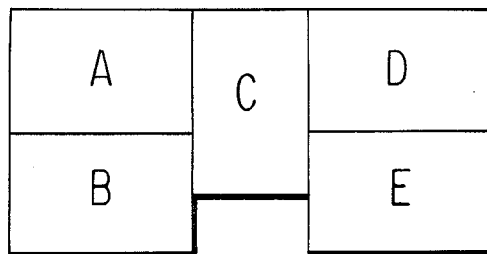


FIG. 3

7	8	9	X	+ M	K1
4	5	6	÷	- M	
1	2	3	-	RM	K2
0	.	CE	$\pm$	C	
K3					K12

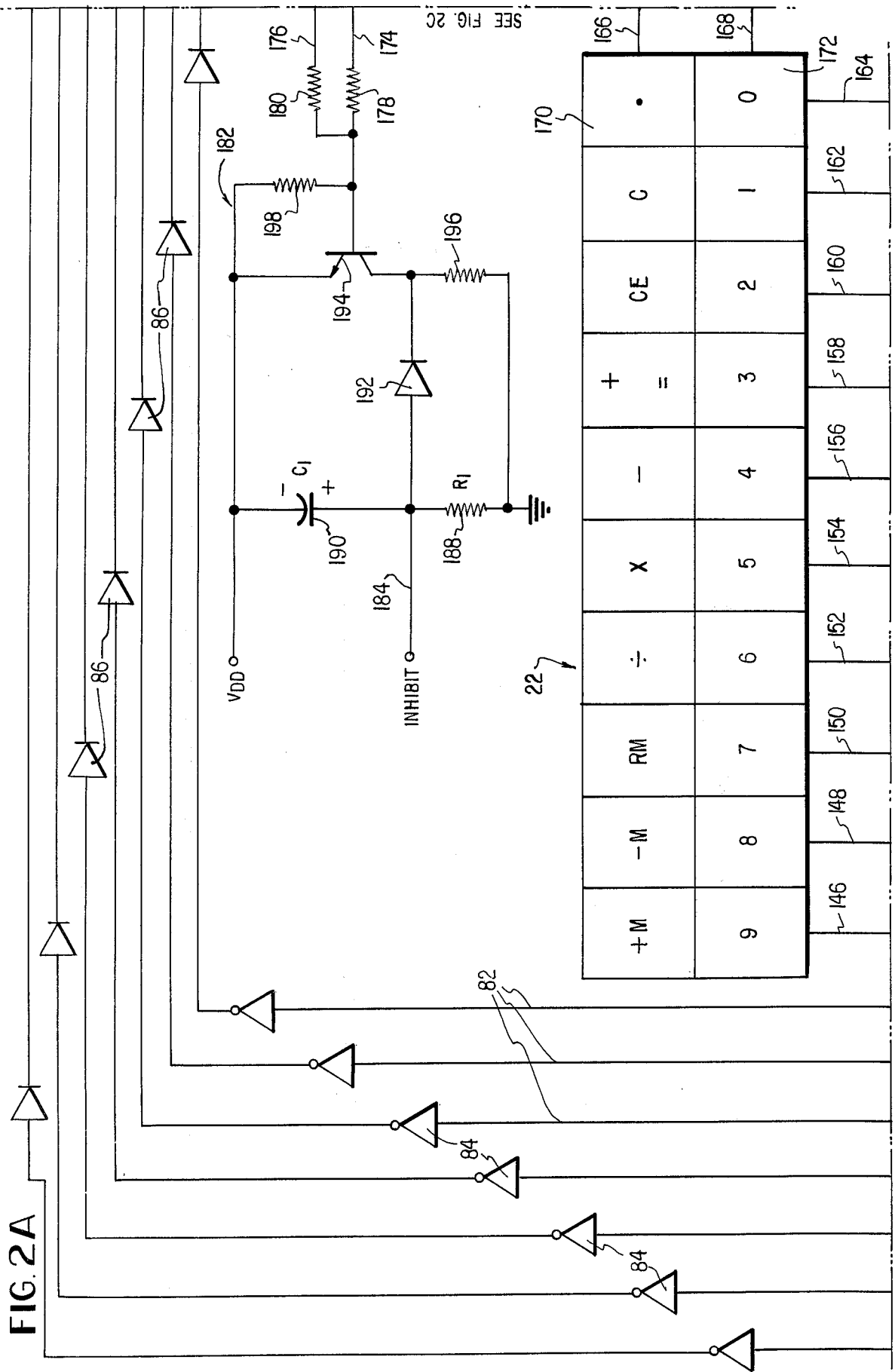


FIG. 2C

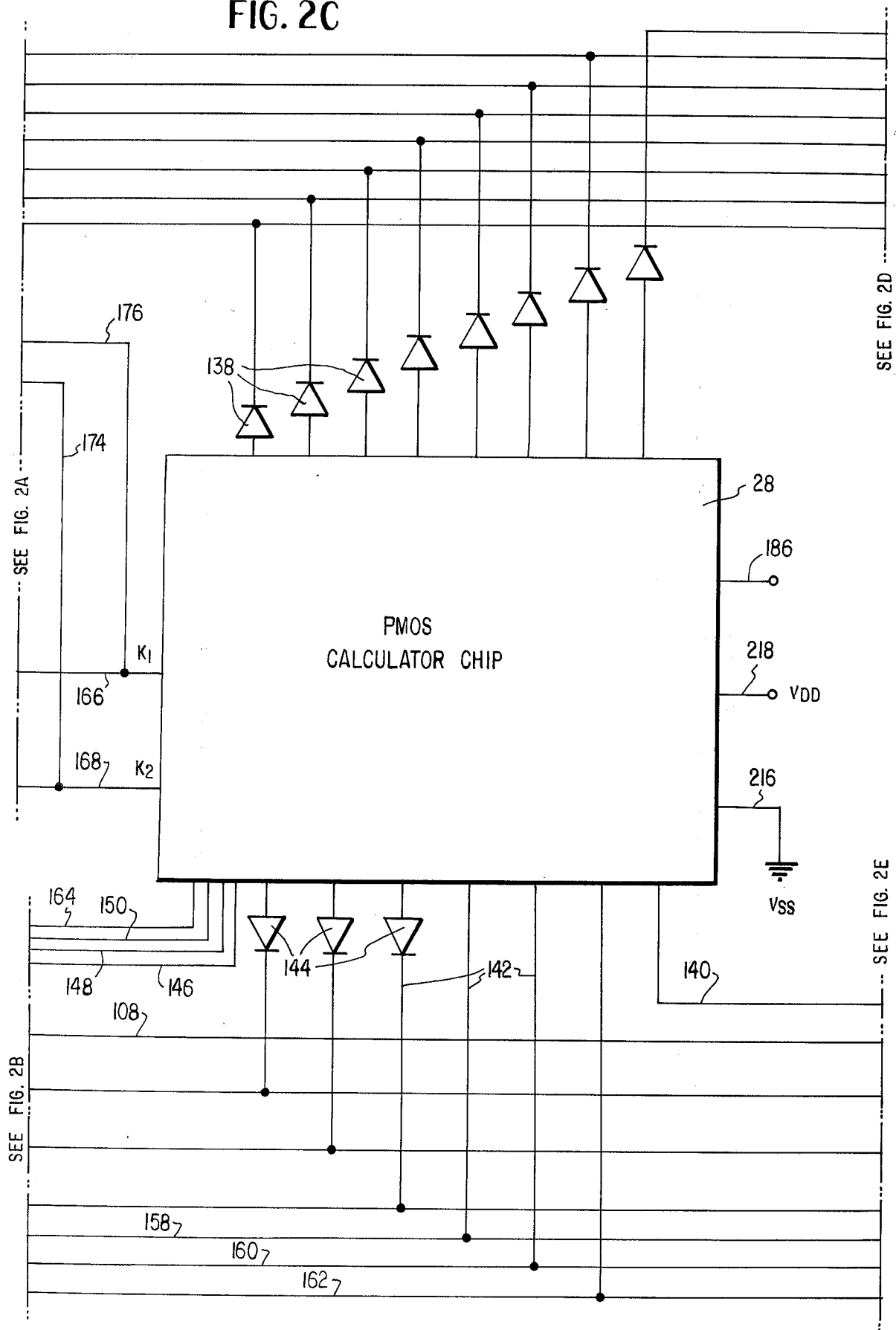
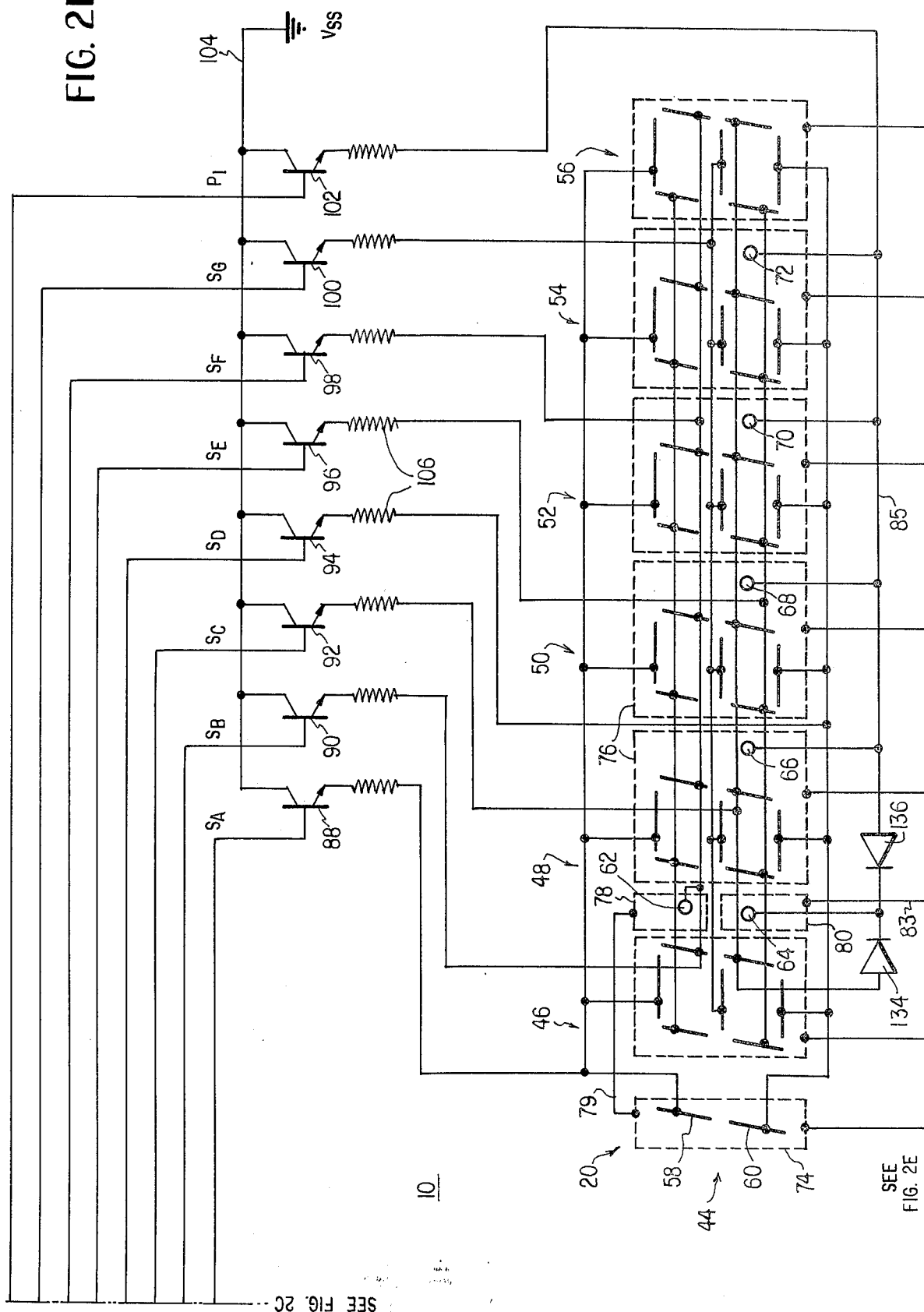
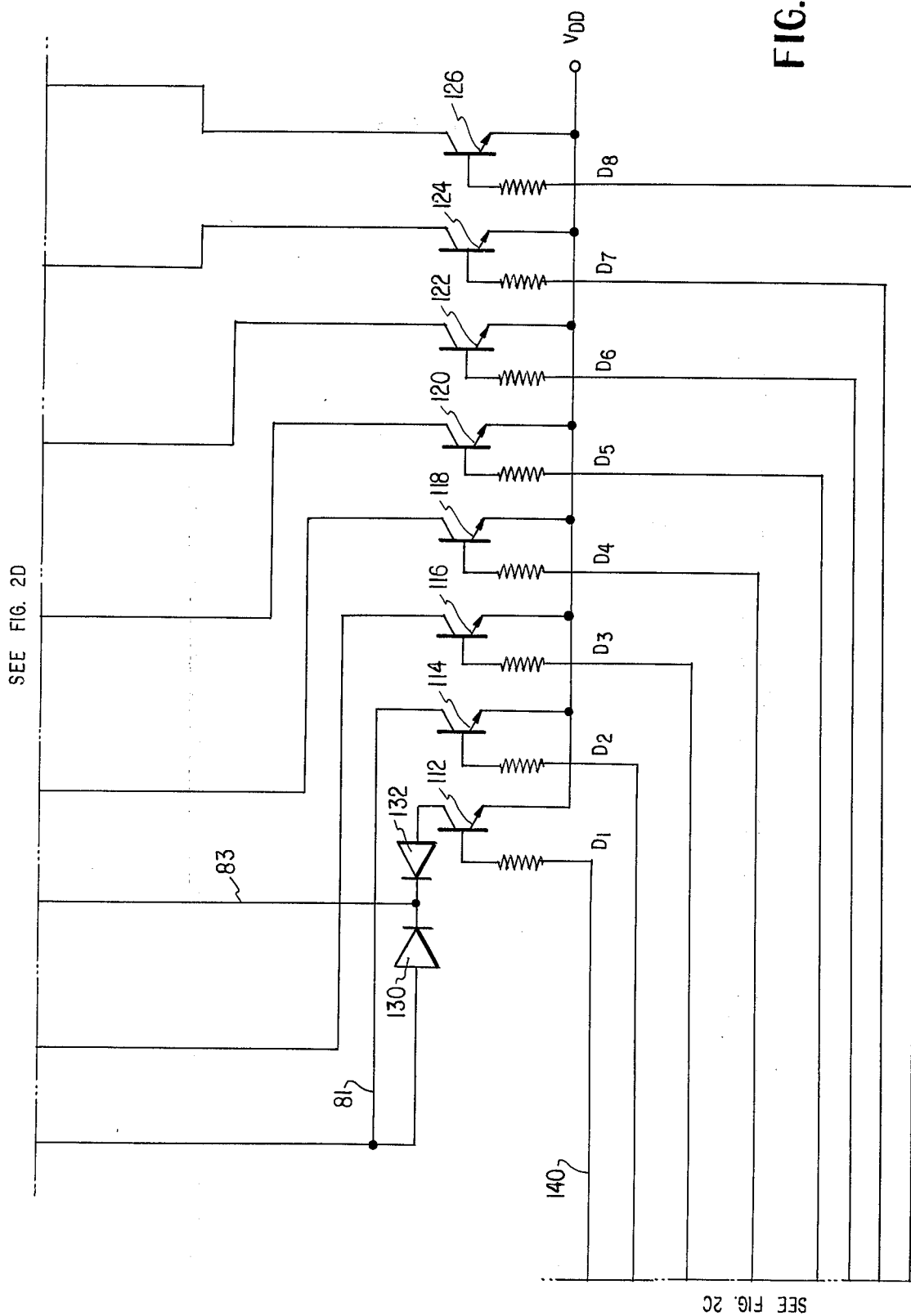


FIG. 2D



SEE FIG. 2C

SEE
FIG. 2E



COMBINATION WRISTWATCH AND CALCULATOR

This application is a continuation-in-part of copending application Ser. No. 329,973, Filed Feb. 6, 1973, now U.S. Pat. No. 3,803,834.

This invention relates to a combination wristwatch and calculator and more particularly to a combination solid state wrist calculator and crystal controlled precision timepiece. It incorporates a miniature keyboard and an electro-optical digital display, preferably in the form of a plurality of light emitting diodes. The time display and the calculate operations are mutually exclusive and are selected by a mode switch.

In recent years, there have been developed a variety of new wristwatches generally referred to as "electronic" watches. In many instances, these device use as a timing source a crystal controlled electronic oscillator whose frequency is divided down to produce timing signals at a frequency of 1 Hz and less by a low power solid state divider often incorporating complementary MOS transistors. In some instances, the wristwatches have incorporated an electro-optical digital display in the form of liquid crystals or light emitting diodes. A wristwatch of this general type incorporating light emitting diodes is disclosed in assignee's U.S. Pat. 3,672,155, whereas a similar wristwatch construction utilizing a liquid crystal digital display is disclosed in assignee's U.S. Pat. 3,701,249. Through the use of large scale integrated circuits, it is possible to form most of the active components of the wristwatch from a single large scale integrated circuit chip, or at the most only a few chips.

Recent years have also seen the development of a new family of electronic calculators generally referred to as pocket calculators. These calculators have taken a wide range of forms, depending upon size and complexity, but in many cases have incorporated integrated circuitry in combination with a digital numerical display. While in some instances the pocket calculators have been sufficiently small to be readily held in the palm of one hand, they have in all instances been quite large and bulky in relation to a modern sized man's wristwatch. One of the limiting factors in further reduction in size of a pocket calculator has been the necessity for a readily accessible keyboard which can be easily and accurately operated without placing undue requirements on the manual dexterity of the operator to perform the desired mathematical calculation.

In order to overcome these and other problems, there is disclosed in my copending application Ser. No. 329,973, filed Feb. 6, 1973, now U.S. Pat. No. 3,803,834, a novel wristwatch device which combines the features of both a precision timepiece and a very small or miniature electronic calculator. This is made possible by combining in a novel manner certain features of the newer type wristwatches with certain features of the so-called pocket calculators and by providing an improved and unique miniature keyboard on the watch face.

In the device of that application, time, which as used herein includes calendar information such as the day and month of the year, is constantly kept. This time information is displayed when desired on the face of the watch in the form of a digital numerical display. The display took the form of an eight-digit electro-optical display using two digits to display minutes, two digits for hours, two digits for the day of the month and

the last two digits for the month of the year. By manually depressing a mode switch on the wristwatch, the calculator portion of the device is actuated and the eight digit display made responsive to the digital calculator circuitry. By depressing appropriate keys on the face of the wristwatch, the desired mathematical calculations are performed by the calculator circuits within the watch and the result displayed on the same digit display previously used to indicate time. Time is constantly being kept in the wristwatch even when operating in the calculate mode, so that accurate time may be displayed at any instant. In addition, when the device is used to display time, i.e., not in the calculate mode, the calculator circuits are de-energized so as to minimize the power drain on the small sized energy source or battery provided in the wristwatch case.

The present invention is directed to an improved device of the same general construction but one which is particularly adapted for use with a light emitting diode display. In the present device, the display takes the form of seven display stations four of which are used to display the same time (and calendar) information as in the previous construction. Three of these stations along with the remaining three stations of the display are connected to a calculator circuit to form a six-digit numerical calculator display.

The combination calculator and timepiece is constructed to take optimum advantage of present day, large-scale integrated circuit techniques and in the preferred embodiment, most of the active circuit elements are formed from only two large-scale integrated circuit chips, namely a combination clock and calendar chip and a calculator chip. Novel circuitry is disclosed which, in conjunction with a manually operated mode switch, selects the calculator or time circuit as desired to energize the light emitting diode display. During display, the diodes are scanned or strobed at a relatively high rate so as to conserve energy by reducing the maximum energy drain from the small battery power supply while at the same time giving the impression of continuous illumination. A further feature of the device of this invention is an improved keyboard construction and the incorporation of an inhibit timer circuit for extinguishing the display when the device is in the calculate mode, but not in use.

It is therefore one object of the present invention to provide an improved combination wristwatch and calculator.

Another object of the present invention is to provide an improved wristwatch and digital calculator.

Another object of the present invention is to provide an improved digital wristwatch and calculator utilizing a light-emitting diode display.

Another object of the present invention is to provide an improved wrist calculator having a novel miniaturized calculator keyboard.

Another object of the present invention is to provide a combination wristwatch and calculator in which both share a common light-emitting diode digital display.

Another object of the present invention is to provide a combination wristwatch and calculator including a calendar time display.

Another object of the present invention is to provide a combination wristwatch and electronic calculator incorporating a common light emitting diode display which minimizes power drain on the watch batteries.

Another object of the present invention is to provide a combination wristwatch and electronic calculator

particularly adapted for construction using primarily large-scale integrated circuit chips.

Another object of the present invention is to provide a combination wristwatch and calculator which can be made using only one or at the most only two large-scale integrated circuit chips.

These and further objects and advantages of the present invention will be more apparent upon reference to the following specification, claims and appended drawings, wherein:

FIG. 1 is a perspective view of a combination wristwatch and electronic calculator constructed in accordance with this invention;

FIGS. 2A through 2E, when assembled in the manner illustrated in FIG. 2, show a detailed circuit diagram of the device of this invention; and

FIG. 3 is an enlarged view of the keyboard of the device of FIG. 1.

Referring to the drawings, the novel combination wristwatch and electronic calculator of the present invention is generally indicated at 10 in FIG. 1 as comprising a watch case 12 to which is attached a wristwatch band or bracelet 14. Visible through a window 16 in the watch face 18 is a numerical digital time and calculator display 20. Also mounted on the face 18 of the watch is a calculator keyboard 22. The display includes a four digit or four station time portion which is shown with the numerals 12:28, indicating that the time is 28 minutes after 12 o'clock. These same four display stations are used to indicate the day of the month and month of the year, as well as the AM or PM of time as more fully described below. The three rightmost of the time stations are common to a calculator display which includes three more stations (not illuminated in FIG. 1) to form a six-digit or six-station calculator display.

Keyboard 22 is of the same type as disclosed in my copending application Ser. No. 329,974 filed Feb. 6, 1973, now U.S. Pat. No. 3,803,834, the disclosure of which is incorporated by reference. Briefly, it comprises a plurality of keys 24 which, when depressed, complete an electrical circuit to a calculator inside watch case 12. The keys are formed of an electrically conductive plastic of the snap-acting type, having sufficient resiliency to snap back into position when the pressure is removed. By way of example only, the conductive plastic for the keys may be formed of a composite of micron-sized copper particles dispersed in a cross-linked polymer classified as a conductive polymer. Volume resistivity and thermo-elasticity are a function of the metal loading by weight. When a key is depressed by the end of a standard ball point pen or similar device, the central portion of the key engages the head of an electrically conductive pin beneath the key. Depression of the key into engagement with the head of the pin establishes an electrical connection to the calculator circuit. When the key is released, the inherent resiliency of the plastic material from which it is formed causes it to snap back, thus breaking the circuit to the calculator.

By way of example only, the keys may comprise a composite consisting of a copper base filler in a silicone rubber binder. Conductive polymers of this type are generally as flexible as rubber and nearly as conductive as copper. Usually, the copper particles must be segregated to an optimum size and particle shape and subsequently plated to prevent surface oxidation. Metal filled elastomers are typically orders of magnitude

more conductive than conventional carbon elastomers and give greater electrical stability. They typically contain about 80% by weight of metal and are capable of 300 percent elongation and tensile strengths of 200 psi.

FIGS. 2A through 2E, when arranged as illustrated in FIG. 2, show a detailed circuit diagram of the combination wristwatch and calculator 10 of FIG. 1. Principal components of the device are formed by a CMOS clock and calendar chip 26 and a second MOS calculator chip 28. If desired, both the chips 26 and 28 may be formed using complementary-symmetry MOS transistors and in fact, they may both be formed as a single chip. However, at the present time, more desirable calculator features are available in P-MOS so that in the preferred construction, chips 26 and 28 are separate chips and the LIS chip 26 is a CMOS chip while the calculator chip 28 is made using P-MOS.

In the preferred embodiment, the clock and calendar chip 26 is the same circuit as that set forth in assignee's copending application Ser. No. 328,639, filed Feb. 1, 1973, now U.S. Pat. No. 3,803,827, the disclosure of which is incorporated herein by reference.

In order to understand the remainder of the circuitry of the device of the present invention, a brief description of the timekeeping portion of the circuit and the operation of chip 26 is believed necessary. The time keeper comprises a crystal oscillator formed by a CMOS inverter in chip 26 in combination with a quartz crystal 30, which acts as a frequency standard for the time keeper operating at a frequency of, for example, 32,768 Hz. Other components of the oscillator external to chip 26 have been omitted for the sake of clarity. This relatively high frequency from the oscillator is supplied to a frequency converter in chip 26 formed of a CMOS binary divider, so that the output from the converter is at a frequency of 1 Hz. This signal is supplied to a display actuator also in chip 26 to produce segment drive signals at output pins labeled *a* through *g*, and digit drive signals at pins labeled *S*₁ through *S*₄ for actuating the time portion of the display 20. When in the time keeping mode, the diodes are normally not illuminated but time is constantly being kept. When it is desired that time be displayed, the wearer depresses the time demand button 32 in FIG. 1, closing time switch 34 labeled *S*₁. With the operation of this switch, the hours and minutes are first displayed for a predetermined time and if the pushbutton 32 remains depressed, the hours and minutes are extinguished and the seconds become visible. The same display diodes are used for both minutes and seconds since these are not displayed simultaneously, thus minimizing the power drain from the watch battery.

When calendar information is to be displayed, the demand button 36 in FIG. 1 is depressed. This closes switch 38 labeled *S*₂ so that the same diodes which previously displayed hours and minutes now display, in numerical form, the day of the month and month of the year, as long as the date button 36 remains depressed. When hours and minutes are displayed, these are separated by a pair of colon dots (:), each formed by a light-emitting diode. During the calendar display, the upper colon dot is illuminated to indicate AM of time and the lower colon dot is illuminated to indicate PM of time. Minutes are reset by momentarily closing switch 40 labeled *S*₃ on the back of the watch and hours are independently reset by closing switch 42 also from the back of the watch, all as more fully described below.

Display 20 is also of the type more fully shown and described in assignee's copending application Ser. No. 328,639, filed Feb. 1, 1973, now U.S. Pat. No. 3,803,827, and comprises a plurality of light-emitting diodes mounted on a ceramic substrate (not shown) to form a single unitary display package. In the device of the present invention, the display comprises seven digits or stations 44, 46, 48, 50, 52, 54 and 56. The first station 44 is formed by a pair of light-emitting diode segments 58 and 60 whereas each of the other stations are formed as seven-segment LED arrays. Individual diodes 62 and 64 form colon dots between the hours and minutes display and the lower colon dot 64 also acts as a decimal point for the calculator display. Individual LEDs 66, 68, 70 and 72 also are used for decimal points in the calculator mode. During date display, illumination of the upper colon dot 62 indicates AM of time and illumination of the lower colon dot LED 64 indicates PM of time.

The first four LED stations or digits, namely digits 44, 46, 48 and 50, are used to display time and calendar information. At station 44, both segments 58 and 60 are simultaneously ON or OFF to display either a one or nothing at all. The seven-bar segment arrays at the other six stations display the numbers zero through 9. These other six stations all form part of the calculator display. Separate connections are made to the anodes of the diode segments at each station as illustrated. The diode cathodes at each station are connected in common, as indicated by the rectangular dashed box 74 at station 44, and the larger rectangular dashed boxes 76 at each of the other stations. The only exception to this is the individual cathode connections for the colon dots 62 and 64 as indicated by the small dashed boxes 78 and 80.

Timing information from CMOS chip 26 appears only on demand at the seven pins labeled a through g and passes by way of leads 82 through inverters 84 and rectifier diode 86, to the seven segment drivers 88, 90, 92, 94, 96, 98, and 100. The eighth driver 102 is a decimal point driver connected to the calculator chip. These are NPN junction transistors in which the timing information is supplied through the diodes 86 to the transistor bases. The collectors of each of the segment driver transistors are connected in common to the power supply or battery voltage V_{ss} as indicated at 104, and the emitters are all connected to the display 20 through current limiting resistors 106. The inverters 84, diodes 86, and transistors 88 etc. are preferably each formed as arrays, that is, formed on a common substrate so as to have more nearly matching characteristics.

In the preferred embodiment, the stations are strobed or scanned to reduce excessive current drain on the watch battery. This is done for the time and calendar displays by turning the first four stations 44, 46, 48, and 50 on in sequence, so that no two stations are energized from the battery at the same time. However, this is done at a sufficiently high rate so as to create the appearance of constant illumination of all four stations. These strobing or scanning signals are derived from CMOS chip 26 and appear at the pins labeled S_1 , S_2 , S_3 , and S_4 . They pass by way of leads 108 and the three rectifier diodes 110 to four of a set of eight digit drivers 112, 114, 116, 118, 120, 122, 124 and 126. These digit drivers are NPN junction transistors and they have their emitters connected in common to the power supply or battery voltage V_{dd} . The connections are to the

bases of these transistors through current limiting resistors 128 and the transistor collectors are connected to the cathodes of the respective display stations forming the display 20. The digit driver transistors, as with the segment drivers previously described, are preferably formed as an array, that is, on a single common substrate, so as to better match their characteristics. The four digit drivers 114, 116, 118 and 120, connected to CMOS chip 26, control the sequence of display of the first four display stations 44, 46, 48 and 50. The last three digit drivers 122, 124 and 126 control the display of the last three stations 52, 54, and 56. The digit driver 112 is connected through the first of a pair of rectifier diodes 130 and 132 to the cathode 80 of the lower colon dot LED 64. The driver 114 for the first station is connected to the cathode 78 of the upper colon dot LED 62 by way of cathode 74 of station 44 and lead 79. A second pair of rectifier diodes 134 and 136 cooperate with the diodes 130 and 132 to control the operation of the colon dot diodes 62 and 64. In the time display mode the upper colon dot is energized at the same time as station 44 by way of lead 79 from the cathode 74 of the station to the colon dot cathode 78. The lower colon dot is also energized at this time from driver 114 by way of lead 81, rectifier diode 130, and lead 83 to cathode 80. However, colon dot 64 is also used in the calculator mode (as a decimal point) and in this mode cathode 80 is energized from driver 112 by way of rectifier diode 132. Rectifier diode 136 connects the anode of dot 64 to the decimal point lead 85 and rectifier diode 134 supplies the colon and PM logic signals from segment driver 92 to the anode of dot 64 in the time display mode. The colon dots are energized along with station 44 since that station consists of only two segments 58 and 60.

As previously indicated, the calculator chip 28 is preferably a P-MOS chip and by way of example only, in the preferred embodiment, is a Cal-Tex P-MOS chip identified as CT-5007. It supplies signals to the seven segment driver transistors 88, 90, 92, 94, 96, 98 and 100, and to the decimal driver 102, by way of a plurality of rectifier diodes 138. Again, these diodes are preferably formed as an array and are eight in number, one for each of the display stations and a last one supplying a signal to the decimal point driver transistor 102. The digit or station drivers are connected to the calculator chip by way of a decimal point on lead 140 to the driver 112 and by way of six leads 142, for the six station drivers 116, 118, 120, 122, 124 and 126. No signal is supplied to station driver 114 from the calculator chip since the first station 44 is not used in the calculator mode and only six digits can be energized. Three of these six connections are through rectifier diodes 144.

The keyboard 22 is shown diagrammatically in FIG. 2A to illustrate its electrical connection in the circuit. It comprises ten lower keys numbered 0 through 9. The upper row also contains ten keys and these are labeled beginning at the upper left, +M, Add To Memory, -M, Subtract From Memory, RM, Read Memory, Division, Multiplication, Subtraction, a common Equals and Add Key, a Clear Entry Key, a Clear Key for clearing both entry and memory, and a decimal point key for inserting the decimal point. The two vertically aligned keys from each row are connected in series with the ten respective output leads 146, 148, 150, 152, 154, 156, 158, 160, 162 and 164. Each row is connected to the calculator chip 28 by the respective leads 166 and 168 labeled K_1 , K_2 , respectively. For example, when the

decimal point key 170 is depressed, the K_1 signal on lead 166 is connected to lead 164. Similarly, when the 0 key 172 is depressed, the K_2 signal on lead 168 is connected to lead 164. Similar connections of either the K_1 signal or the K_2 signal are made to the respective output leads when either a corresponding upper or lower key is depressed. The decimal point is inserted by depressing key 170 and the appropriate number for energizing from the K_2 line the cathode of the station at which it is to appear.

An important feature of the present invention resides in the fact that the K_1 and K_2 pins of the calculator chip are also connected by way of leads 174 and 176 and resistors 178 and 180 to an inhibit timer circuit generally indicated at 182.

The purpose of the inhibit timer 182 is to extinguish the LED display when in the calculate mode, if one of the keys on the keyboard is not depressed within a predetermined length of time. This acts to conserve battery energy by avoiding the possibility of inadvertently leaving the display on in the calculate mode when no calculations are actually being performed. Inhibit timer 182 applies a signal on inhibit lead 184 to the inhibit input 186 of the calculator chip 28. Lead 184 is connected to the junction of a resistor 188 and a capacitor 190 in turn connected through a rectifier diode 192 to an NPN junction transistor 194 having bias resistors 196 and 198. During normal operation, the capacitor 190 is charged with the polarity indicated and junction transistor 194 is turned off or in the non-conducting state. At this time, the display is inhibited by the inhibit voltage on lead 186 of the calculator chip.

When one of the keys of the keyboard 22 is depressed, current flow from one of the K_1 or K_2 pins of the calculator chip through one of the resistors 178 or 180 turns on transistor 194, causing its emitter-collector circuit to conduct. This results in a discharge of capacitor 190 causing the inhibit voltage to approach V_{dd} , which permits the display to come on. Subsequent keyboard entries keep capacitor 190 at least partially discharged so that the calculator display remains on. However, if a key is not depressed within a predetermined length of time, determined primarily by the RC time constant capacitor 190 (C_1) and resistor 188 (R_1), then the capacitor recharges, the inhibit voltage on lead 184 approaches ground potential, and the calculator display is automatically extinguished.

The combination calculator and wristwatch 10 of FIG. 1 is provided with a third demand or pushbutton 200. This pushbutton operates a mode switch 202 which, as illustrated, is a double pole, double throw switch. It comprises a pair of ganged movable contacts 204 and 206, with the first movable between the stationary contacts 208 and 210, and the second movable between the stationary contacts 212 and 214. The switch is shown in the "time" position where movable contact 204 engages stationary contact 210 and movable contact 206 engages stationary contact 214. When pushbutton 20 is momentarily depressed, the switch moves to the "calculate" position with movable contact 204 engaging stationary contact 208 and movable contact 206 engaging stationary contact 212. Successive depressions of pushbutton 20 cause the mode switch to move back and forth between the mode and time positions. As with the time and date buttons 32 and 36, mode button 200 preferably carries a permanent magnet which actuates a magnetic field responsive

reed switch within the watch case. Stationary switch contact 208 is connected to the calculator by way of a lead 216 and stationary contact 212 is connected to the calculator chip by way of a lead 218. Movable contact 204 is connected to ground or the positive side of a battery (V_{ss}) whereas movable contact 206 is connected to the negative side of the rechargeable battery 220. The battery is a conventional rechargeable dry cell type energy source, preferably formed by three dry cells connected in series to produce an output voltage of approximately 4 1/2 volts. It is preferably connected in series with a solar cell 222, mounted on the face of the watch to receive ambient light, such as through the window 16 of FIG. 1. By placing the device near a suitable light source, such as a conventional 100-watt lightbulb, where the light from the lightbulb impinges upon solar cell 222, it is possible to completely recharge battery 220 in a matter of only a few hours and this may be done, for example, overnight, when the device is not being worn.

The keyboard 22 is diagrammatically illustrated in FIG. 2 as a two-line keyboard in order to illustrate the electrical connections to the calculator chip by way of the K_1 and K_2 leads 166 and 168. The actual physical layout of the keyboard is shown in FIG. 3 where, in the preferred embodiment, the keyboard comprises 20 keys arranged in four rows of five columns. Various keyboard arrangements may be provided as desired but the one illustrated in FIG. 3 is preferred in that it provides ready access to the keys most used and is fully consistent with accepted calculator keyboard layouts. As previously indicated, the individual keys may be depressed to actuate the circuits by the tip of a ball-point pen, a small stylus, or any small relatively narrow tipped instrument which may be readily grasped in the fingers and applied to the keyboard.

While the mode switch 202 has been described as a pushbutton actuated magnetic reed switch, it may, if desired, be a conventional electrical circuit switch actuated by the keyboard. For example, successive depression of two keys in an unusual sequence (such as the divide key followed by the multiply key) can be used to set an RS flip-flop to place the device in the "calculator" mode. In order to return the device to the "time" mode, the flip-flop is reset by depression of the time read demand button 32 and the accompanying momentary closure of switch 34.

It is apparent from the above, that the present invention provides an improved combination wristwatch and watch calculator. The device is particularly adapted for use with a light-emitting diode display and because of this incorporates an inhibit timer circuit for automatically turning off the display when not in use. Also provided is a rechargeable battery which is connected to a solar cell so that the battery may be recharged from a conventional light source, such as a conventional 100-watt incandescent lightbulb. Novel circuitry is disclosed for strobing or scanning the display to minimize maximum current drain from the battery and a novel diode arrangement for isolating the time and calculator portions of the circuit so that the device may be converted from time to calculator display by the operation of a single manual switch. Time setting is effected by bringing a permanent magnet near one of two indentations in the back of the watch case so as to actuate either a minute set reed switch or hour reed switch inside the case. Actuating the hour set switches advances the hours at a rate of 2 Hz and actuation of the

minute set switch advances the minutes at the same rate while automatically resetting the seconds to zero, all as more fully shown and described in assignee's pending application Ser. No. 328,639, filed Feb. 1, 1973, now U.S. Pat. No. 3,803,827.

In the preferred embodiment, the light-emitting diode display is a seven-digit or seven-station display with the first digit used only to display the tens digit of the hours of time and the tens digit of the month of the year. Time information, including the date, is displayed on the first four digits whereas only the last six digits are used for the calculator display. The circuit is particularly adapted for large-scale integration and requires for the principal components of the device, at the most, only two chips, namely, a time chip 26 and a calculator chip 28.

While the device of the present invention is particularly adapted for use with a light-emitting diode display, other digital displays such as field effect liquid crystals and the like may be used if desired. For displays of this type, which draw less current, the inhibit timer circuit 182 is not required and the calculator chip may take the form of a CMOS chip. By way of example only, one type of LSI chip usable in such a construction is a Toshiba type T3171B. In constructions where the time and calculator chips are both all CMOS, these may, if desired, be combined in a single CMOS chip.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. A combination wristwatch and wrist calculator comprising an electro-optical digital display, a time circuit having a plurality of time information outputs, a demand switch coupled to said time circuit for energizing said time information outputs only on demand, a calculator circuit having a plurality of calculator information outputs, a miniature keyboard coupled to said time and calculator information outputs to said display, and a second demand switch coupled to said calculator circuit for energizing said calculator information output, said common coupling means comprising a plurality of driver transistors.

2. A combination wristwatch and wrist calculator comprising an electro-optical digital display, a time circuit having a plurality of time information outputs, a demand switch coupled to said time circuit for energizing said time information outputs only on demand, a calculator circuit having a plurality of calculator information outputs, a miniature keyboard coupled to said time and calculator information outputs to said display, a second demand switch coupled to said calculator circuit for energizing said calculator information output, a battery, and means coupling said battery to said time circuit, said battery being coupled to said calculator circuit through said second demand switch.

3. A combination wristwatch and wrist calculator comprising an electro-optical digital display, a time circuit having a plurality of time information outputs, a

demand switch coupled to said time circuit for energizing said time information outputs only on demand, a calculator circuit having a plurality of calculator information outputs, a miniature keyboard coupled to said calculator circuit, common means coupling both said time and calculator information outputs to said display, a second demand switch coupled to said calculator circuit for energizing said calculator information output, and an inhibit timer coupled to said calculator circuit for inhibiting said calculator information output after a predetermined period of time.

4. A device according to claim 1 wherein said driver transistors are bipolar.

5. A device according to claim 1 wherein said driver transistors form a transistor array.

6. A device according to claim 2 wherein said battery is rechargeable.

7. A device according to claim 6 including a solar cell coupled to said battery for recharging it.

8. A device according to claim 3 including means coupling said inhibit timer to said keyboard whereby said inhibit timer is reset whenever a key on said keyboard is depressed.

9. A combination wristwatch and wrist calculator comprising a plurality of electro-optical digital display stations, a time circuit having a plurality of time information outputs, a first demand switch for coupling said time information outputs to said display stations, a calculator circuit having a plurality of calculator information outputs, a miniature keyboard having a plurality of keys electrically coupled to said calculator circuit, a second demand switch for coupling said calculator information outputs to said display stations, and common driver transistors coupled between said display stations and both said time information outputs and said calculator information outputs.

10. A device according to claim 9 wherein said driver transistors comprise a transistor array.

11. A device according to claim 9 wherein said driver transistors are bipolar.

12. A device according to claim 9 wherein said driver transistors comprise both segment drivers and digit drivers.

13. A device according to claim 9 including rectifier diodes coupling said time information outputs and said calculator information outputs to said common driver transistors whereby said time and calculator information outputs are electrically isolated from each other.

14. A device according to claim 9 wherein said display comprises four time stations, and a plurality of additional stations, at least some of said time stations and all of said additional stations being coupled to said calculator information outputs.

15. A device according to claim 14 wherein said time stations include a pair of colon dots, the lowermost of said colon dots also being coupled to said calculator information outputs to serve as a decimal point.

16. A device according to claim 14 wherein three of said time stations are coupled to said calculator information outputs.

17. A device according to claim 9 including a power supply, said second demand switch coupling said power supply to said calculator circuit whereby said calculator circuit is energized only when said second demand switch is operated.

18. A device according to claim 17 including means continuously coupling said time circuit to said power supply whereby time is continuously kept by said time

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circuit.

19. A device according to claim 9 including an automatic display turnoff circuit coupling said keyboard to said calculator circuit whereby the display is automatically turned off if a calculator key is not actuated 5

within a predetermined time.

20. A device according to claim 19 wherein said automatic turnoff circuit comprises a capacitor, the actuation of a key acting to discharge said capacitor.
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