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Vogelman et al.

[11] **3,727,190**

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[54] PATIENT SIGNAL DISPATCHER

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[52] **U.S. Cl.** **340/172.5**

[51] **Int. Cl.** **G06f 3/00**

[58] **Field of Search** 340/172.5; 178/24

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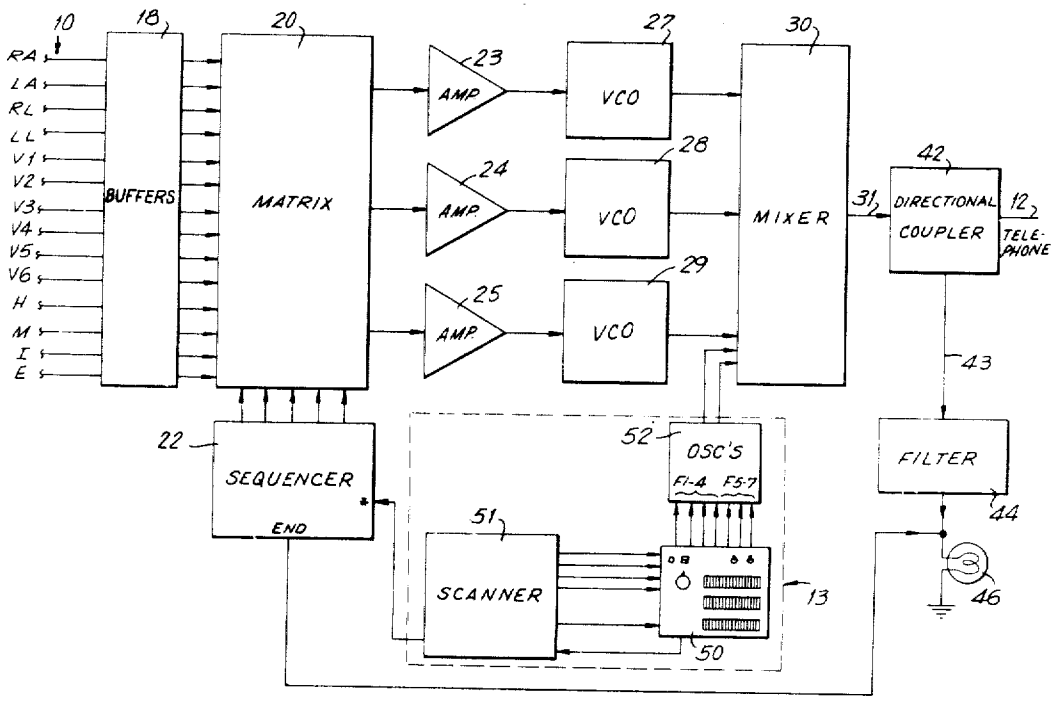
[57] **ABSTRACT**

In various medical electrical apparatus a patient's clinical information is entered, transmitted, and stored electrically. Accompanying this clinical data is information as to the patient's identity, e.g., name, age, when and where the clinical data was taken, etc. The invention is a novel and improved apparatus for, and a method of, entering patient identification information. The information is entered manually, stored in a memory, the stored information is displayed to an operator and then added to the clinical information.

10 Claims, 6 Drawing Figures



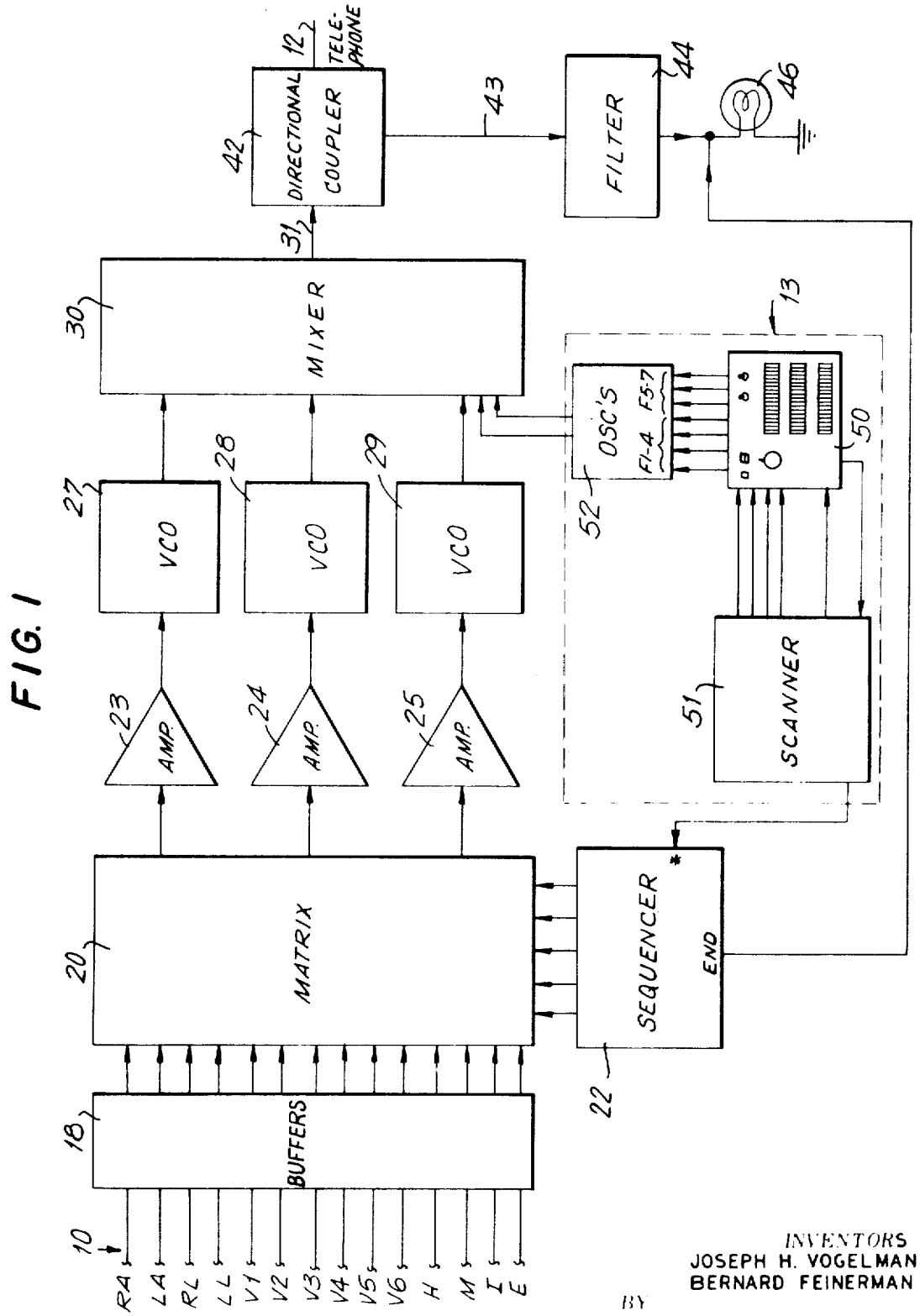


FIG. 1

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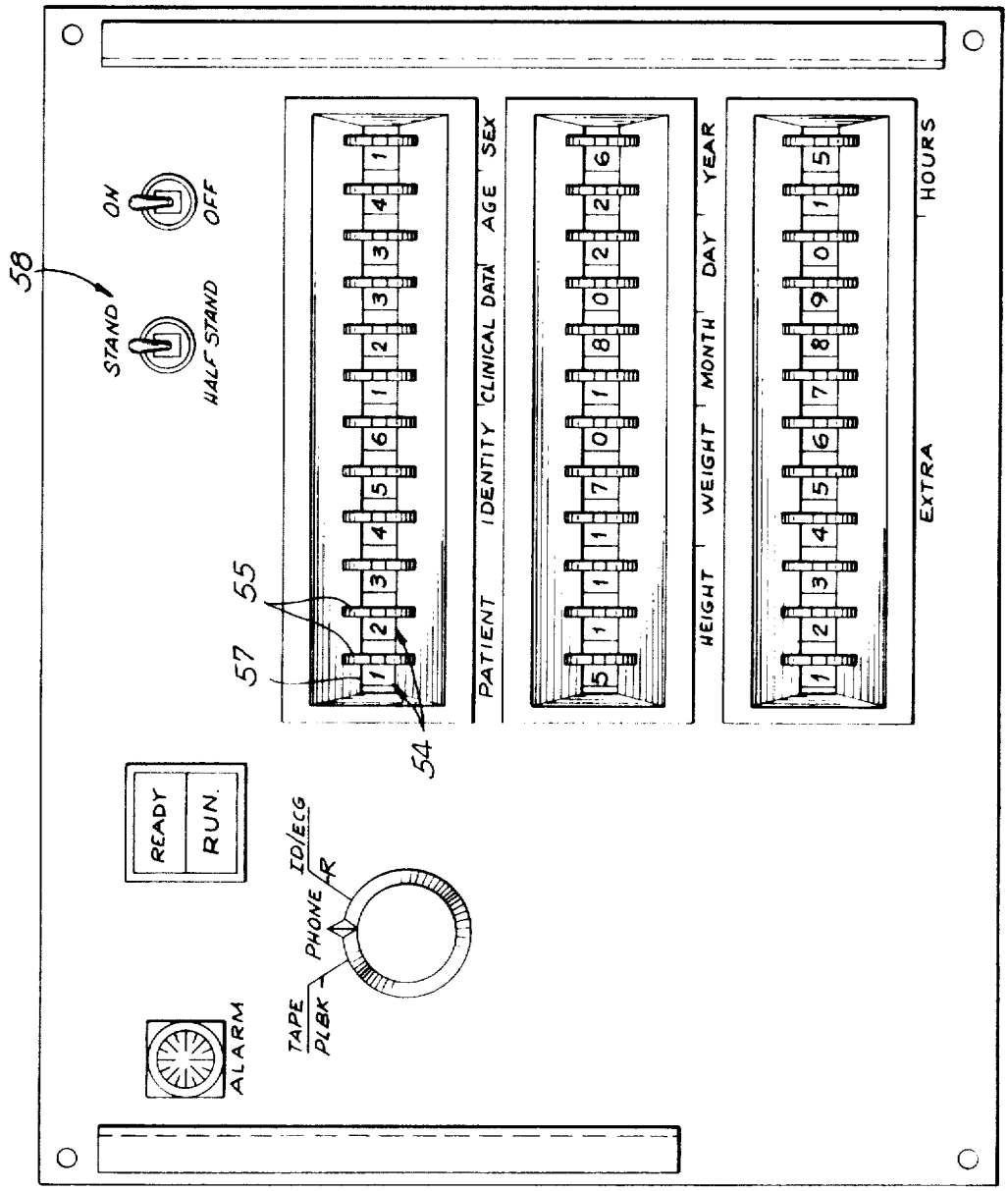

FIG. 2

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FIG. 3

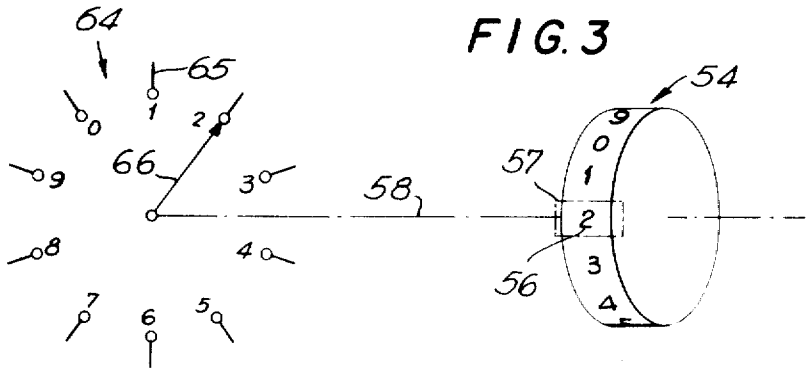

FIG. 5

		1209	1336	1477
		F-5	F-6	F-7
697	F-1	1	2	3
770	F-2	4	5	6
852	F-3	7	8	9
941	F-4	*	0	#

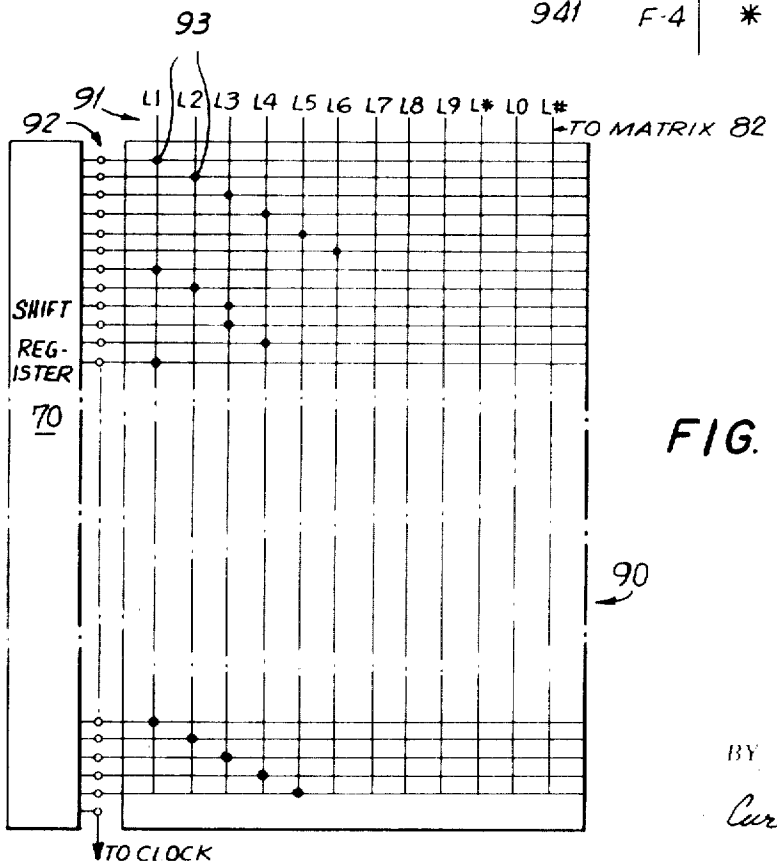

FIG. 6

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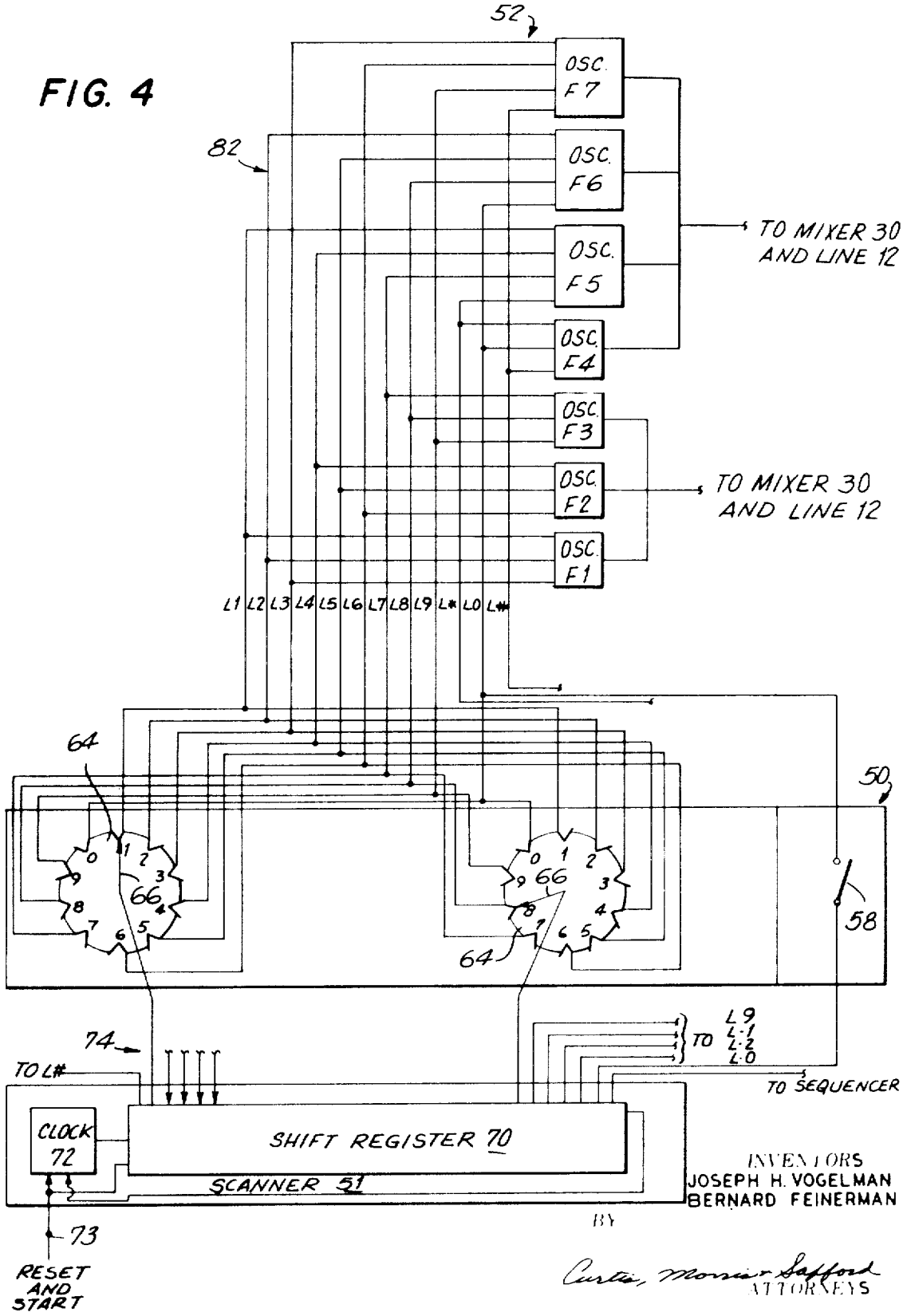
FIG. 4



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PATIENT SIGNAL DISPATCHER

The invention relates generally to medical electronics and more particularly to methods and means for entering information about the identity of a patient which accompanies clinical information about the patient.

In the field of medical electronics, clinical information about a patient, and identification information about the same patient although stored together, originate from separate sources. For example, in the taking of an electrocardiogram, the electrocardiogram machine may be connected to a transmission line, for transmission of the electrocardiogram information to a remote recorder or diagnostic computer. The clinical information is taken directly from the leads attached to the patient. The patient identification information, i.e. which patient the leads are attached to, is entered by a technician. It is essential that the technician enter the proper patient identification information, for if the wrong patient identification information is entered, the record or diagnosis may then be applied to another patient. The consequences of patient mis-identification are grave. In extreme cases, failure to connect the clinical information with the proper patient may produce lack of proper medication or treatment; or might produce a medication or treatment for a patient who does not require it; and in extreme cases this may prove fatal. It is, therefore, of grave importance that the patient identification information that accompanies clinical information always identify the correct patient.

The clinical information is most often automatically produced from sensing electrodes connected to the patient. The identification information is almost always entered manually by a technician such as by punching a keyboard. It is important to minimize any error in the entry of patient identification information by the technician. The present invention is a method of and means for reducing the human error in entering patient identification information.

A separate but additional problem in medical electronics has to do with the efficient use of the electronic equipment. Electrical recording and electrical transmission of medical information is relatively fast. A great deal of information can be transmitted or recorded in a very short period of time. The manual entry of information, such as by a typewriter, or pushing buttons on a telephone is relatively slow. It is therefore not efficient to operate most medical electrical devices in a recording or transmitting mode with a manual input. The present invention has the further advantage of overcoming the inefficiencies associated with manual inputs by provided means for entering the patient identification information into a temporary memory, and when the recording or transmitting device is ready to receive the information, it is automatically entered into the recording or transmitting device at a rapid pace, which is comparable with the speed of the device.

The present invention provides a means and method of efficient utilization of electronic recording and transmission facilities used in medical electronics.

Heretofore, in a specific example, it has been common when taking an electrocardiogram for transmission over a commercial telephone line to a remote recorder or diagnostic center, to add to the electrocardiogram clinical information (which is recorded directly from the patient) as to the patient's hospital identification number, his date of birth, the date and hour on which the recording is being made, patient height, weight and sex, etc. Heretofore, this identification information was taken from the patient, or from his chart and noted by the technician. After connecting the leads and setting up the transmitting portion of the ECG machine, the technician would dial on a telephone into the remote recording station, which for example, might be in a hospital. After the recording station answers, he would then dial in (or if a touch tone telephone, punch the buttons on the touch tone telephone) to enter the patient identification number, his date of birth, sex, height, weight, any clinical data code, and date and time at which the cardiogram was being taken. All in all, the technician might have to punch the button some 24 times to enter the 24 items of information. The drawbacks of doing this manually are several. First, the chance of error in making more than 24 dials is considerable. Moreover, the technician has no way of knowing if he has made a mistake in the dialing, due to pushing the wrong button, or dialing the wrong number. Furthermore, the time required to do the dialing or pushing the buttoms, is relatively slow. The present invention avoids these shortcomings of the prior art by providing a means and methods of reducing human error entering patient identification information, and which also makes more efficient use of the transmission and recording facilities used in medical electronics.

According to an embodiment of the present invention, a unit is provided in which a technician enters the patient identification information from the patient or from his chart. The unit includes means for displaying the entered information. After reviewing the entered information, the technician may actuate the transfer of the information to a remote station. This transfer is made at a speed consistent with the electrical capabilities of the transmitting line, and the recording medium. The transmittal of the patient identification information would be immediately followed by the automatic sensing and transmittal of the clinical information. In one embodiment the identification information is continuously displayed to the technician. Should it be discovered, that an error has been made in the identification information, he can then easily correct the identification information and retransmit it along with the clinical information.

It is an object oof the present invention to provide a novel method and means of minimizing error in the entry of patient identification information which accompanies clinical information.

It is a further object of the present invention to provide a novel method and means for the efficient use of recording facilities and/or the transmission facilities used in medical electronics.

According to the invention, there is provided an apparatus for transmitting clinical information concerning a patient's medical condition having means for entering patient identification information into a memory; means for displaying the patient identification information stored in the memory, and means for transmitting the patient identification information with the clinical information.

According to the invention, there is also provided a method of reducing error in entering electrically represented patient identification information which accompanies separately originated electrically represented clinic patient information comprising the steps of entering the patient identification information into a memory, displaying the entered information, and transmitting the information in the memory.

The construction of an illustrative embodiment as well as further objects and advantages thereof, will become apparent when read in conjunction with the accompanying drawings wherein:

FIG. **1** is a block diagram of an automatic medical data acquisition unit showing an embodiment of the invention.

FIG. **2** is a plane view of a typical control panel of the patient identification information apparatus.

FIG. **3** is a partial isometric and schematic view of a dial shown in FIG. **2**.

FIG. **4** is a schematic view of the patient identification information apparatus.

FIG. **5** is a table of the relation between tones and numbers represented by two tone signals.

FIG. **6** is a schematic drawing of a manually operated switch in which patient identification information may be entered.

FIG. **1** shows in block diagram form, an automatic electrocardiograph data acquisition unit having an apparatus of this invention. The operation of the unit as a whole may be very briefly reviewed as follows. At the left hand side there is schematically shown 14 leads or electrodes **10** which are connectable to a patient. The electrodes are connected through a buffer **18** to a matrix **20** which generates the twelve standard ECG leads or waveforms as well as three waveforms of the Frank Orthogonal System. These outputs are provided three at a time to an output **12** shown here (right hand side of the drawing) as a telephone line, for transmission to a remote diagnostic center or a remote recording unit (not shown). At the same time, the outputs of the amplifiers **23**, **24** and **25** are fed to a three-channel chart-writer (not shown) to provide a visual record of the patient's cardiogram. The unit also includes a patient identification apparatus shown generally by the legend **13**. At the time of attaching the electrodes **10** to the patient, the medical technician would also enter into the patient identification apparatus **13**, information as to the patient's name or identification number, the date, clinical data, if appropriate, patient's age, his sex, height, weight, and the time that the cardiogram is being taken. Apparatus **13** would then provide an optical display of the information so entered and when the data acquisition unit commences operation, the entered data in the patient identification apparatus is transferred to the output **12**.

Referring now to the elements in FIG. **1** in detail, the fourteen electrodes **10** have the legends RA, LA, RL, LL, V_1, V_2, V_3, V_4, V_5, V_6, H, M, I, and E. These legends identify the location on the patient's body where the electrode is attached. Namely, RA for right arm, LA for left arm, RL for right leg, LL for left leg. The next six electrodes V_1 to V_6 are connected to the six precordial or chest points from which the chest measurements are derived. The electrodes identified H, M, I and E are connected respectively to the right or left side of the neck posteriorly; to the center of the spine opposite to the chest leads; to the right mid-axillary line at fifth intercostal space; and to the mid sternum at the level of the fifth intercostal space of the patient to provide the Frank Orthogonal measurements. The outputs from the electrodes **10** are applied to a buffer **18** which for example, presents a high impedance to the electrodes and a low impedance to the next stage matrix **20**. The buffer **18** typically consists of fourteen unity gain amplifiers with an input impedance of ten megohms shunted by 470 pf capacitance. The outputs from the buffer are applied to matrix **20** which generates the twelve output electrocardiogram leads or waveforms and the three Frank Vector waveforms. The leads or waveforms generated in the electrocardiogram group are the three standard limbleads I, II, III; the three aV leads; and the six V leads from **1–6** inclusive. The three Frank Vector waveforms, X,Y,Z, are also generated. A sequencer **22** is connected to tthe matrix **20** and successively gates three of the leads or waveforms to output amplifiers **23**, **24**, and **25**. For example, in a first time interval t_1, which typically might be six seconds in duration, the three standard limbleads, I, II, III are applied respectively to amplifiers **23**, **24** and **25**. The sequencer **22** would then cause a marker signal of approximately 1/10 second duration to be applied to the three amplifiers, after which the sequencer would cause the three generated aV leads or waveforms to be applied respectively to the amplifiers **23**, **24** and **25** for a time duration of approximately 6 seconds, after which a spacer signal of one-tenth second would again be applied to the three amplifiers, after which the first three of the six V leads or waveforms is applied, from the matrix **20** to the amplifiers etc. After the 15 generated leads or waveforms, three at a time, have been passed to the amplifiers, a marker signal is applied afterwhich a calibration signal of known time duration and voltage amplitude is added. The amplified leads or waveforms from amplifiers **23**, **24** and **25** are shaped as required for the particular transmission system and are applied to three voltage controlled oscillators **27**, **28** and **29**. Each oscillator has a carrier frequency compatible with voice transmission on a telephone line; and typically oscillator **27** has a carrier frequency of 1,075 Hertz, oscillator **28** has a carrier frequency of 1,935 Hertz, and oscillator **29** has a carrier frequency of 2,365 Hertz. The incoming signals or leads from the amplifiers **23**, **24** and **25** frequency modulate the carriers of the oscillators. The frequency modulated output signals from the oscillators are then applied to a mixer **30** which combines the signals on a single lead **31**. The signal is sent to a directional coupler **42**; which for example, is a hybrid transformer of a kind adapted to pass signals in one direction of a given frequency range, and to pass signals in the other direction of a selected frequency range. The combined frequency modulated signals from the mixer **30** pass through directional coupler **42** and go out over telephone line **12** to a remote recording station or remote diagnostic station. Alternatively, the directional coupler **42** may be replaced by a tape recorder for making a tape recording of the frequency modulated and mixed signals. The entire patient clinical information is sensed, generated, and transmitted in less than 1 minute.

The directional coupler **42** passes incoming signals from the telephone line **12** to a filter **44** and a lamp **46**, provided the signals are in a predetermined frequency range (e.g. typical frequencies; 385 and 445 Hertz). The incoming signals from the telephone line are warnings indicating that the remote receiving unit is not in a condition for receiving information or the information source is not operating properly.

Patient identification is provided from an apparatus shown generally by legend **13**. It includes a manually operable control **50** connected between a scanner **51** and a group of oscillators **52**. The front panel of the control **50** is shown in detail in FIG. **2**. On the face of the panel there is a plurality of thumb-wheel operator-operable dials **54**. In FIG. **2** there is shown 36 dials **54**, arranged in three rows. Each one of the dials **54** is arranged to take any one of 10 possible positions and each dial **54** has a knob **55** adapted to be turned by an operator. A group of legends numbered **0** through **9** are mounted on the dial next to the knob and any one legend may be displayed in a window **57**. The different positions of the dial, the positions of the window and the location of the legends on the dial are so arranged that one of the legends will appear on the window for each different position on the dial.

In the drawing, the first knob is at position **1** with the number **1** displayed in the window **57**. The technician operating the ECG data accumulation unit will turn the knob **55** of the dials **54** on the front panel to enter information to identify the patient. A total of 41 items of information make up the patient identification. Thirty-six items are entered by the manipulation of the knobs of the dials. A remaining four are pre-wired and identify the machine being used. The last item is a scale signal and is controlled by the "half-stand" switch **58** on the control panel. When the switch **58** is in the "-standard" position all of the transmitted ECG signals are full amplitude. However, for certain patients, this magnitude is too large, and an antenuator (not shown) is connected in the output line by operation of the standard - half stand switch to reduce the effective magnitude of the transmitted signal by 50 percent. When the switch **58** is in the half stand position, a signal is transmitted (as the 41st item of information) to indicate that the ECG has been attenuated and that the receiving equipment should amplify the received signal by a factor of two to bring them up to their correct size.

The 36 items of information entered manually on the dials can be seen in FIG. **2**. The items of information are as follows: beginning with the top row and progressing from left to right — six positions for the patient identification number; the next three are for clinical data; the next two are for age; and one for sex. On the next line, the first three positions are for height; then three positions for weight; and then six positions for the date — month, day and year. On the third line, 10 positions are reserved for extra information and then the last two positions for the hour at which the measurement is being made. Some of the information which is entered here may also be used to provide a check or error detection to insure that the operator has the correct patient. For example, if the patient identity number does not agree with his sex, or his approximate height and weight, then there would be an indication that the data being accumulated is not that of the patient whose identity is being entered into the machine. Furthermore, a technician who enters the wrong day and wrong hour is apt to make other mistakes on entering the data, and is an indication to check further.

Referring now to FIG. **3** there is shown a partial isometric view of the dial **54** with legends **56** appearing in the window **57**, connected by a shaft shown schematically as **58** to a ten positon rotary switch **64**. The switch **64** has 10 fixed contacts **65** and a movable contact **66**. The movable contact **66** is mechanically linked by the shaft **58** to the rotary dial **54**. When the dial **54** is moved from one of its positions to the next, tthe movable contact **66** makes electrical connection with different fixed contacts corresponding to the different numbers being displayed in the window **57**. The legends **0–9** next to the fixed contacts **65** indicate which contact is connected to movable contact **66** when the corresponding number **0–9** is being displayed in the window **57**.

FIG. **4** schematically shows the control **50**, scanner **51** and oscillators **52** in detail. In the previously given example, the patient identification information includes forty-one items of information. The scanner **51** has 41 information output leads and sequentially provides on each output lead a pulse typically of 100 milliseconds duration. The scanner is a 48 stage shift register **70** driven by a clock source **72**. The output from each stage is provided on a different lead and the output from the last stage is fed back to the clock **72** to block further pulses. The scanner **51** is set in operation by a signal applied to a rest and start lead **73**. Thirty-six of the outputs from the shift register **70** are connected to the 36 switches **64**; four outputs are connected through fixed wiring and one output is connected to the half stand switch **58**. The outputs from the switches **64**, fixed wiring and switch **58** are applied to matrix **82** and then to a group of tone oscillators **52** for transmission. It might be helpful here to next examine the tone oscillators. The recording or receiving equipment (not shown) which receives the information from the unit, is of the kind adapted to receive identification and supervisory information as a simultaneous two-tone signal. This kind of signal is commonly used in touch tone telephone dialing. For those unfamiliar with this method of signaling, the following brief description may be helpful. Each item of information, which here is a number from **0** through **9** (and two command signals identified as a star * and a diamond #) is made up of two simultaneous tones. For example, the number **1** is represented by a tone of 697 Hertz simultaneous with a tone of 1,209 Hertz. The number **2** is represented by the two tones of 697 Hertz and 1,336 Hertz. Tone sensitive decoders receive these two tone signals to provide information as to the number it represents. The sources of the tones are typically two oscillators taped at four and three frequencies respectively, and activated in pairs to indicate the number. The oscillators are shown in FIG. **4** (for simplicity) as seven separate oscillators F1 through F7. It will be appreciated that seven tones may be combined two at a time to produce 12 different combinations of pairs of tones.

FIG. **5** is a table showing the number representations **1, 2, 3, 4, 5, 6, 7, 8, 9, 0, *, #**, arranged in rows and columns. Above each column and to the left of each row, is listed the frequency of the tones that are com-

bined to represent the number appearing at the intersection of a particular row and column. For example, the number **1**, first row and first column, is made up of the two tone signals of 697 Hertz and 1,209 Hertz. Two is represented by 697 Hertz and 1,336 Hertz, etc.

In the table, there is also shown the legends F1 through F7 associated with various rows and columns. These numbers designate the oscillators which provide the signals at the associated tone. For example, the F1 oscillator will provide a signal of 697 Hertz. The * (F4 and F5; 942 Hertz and 1,209 Hertz) and the # (F4 and F7; 942 Hertz and 1,477 Hertz) are used as command signals to initiate, terminate and space operation of the remote recording or of diagnostic equipment (not shown).

Referring again to FIG. **4**, the oscillator **52** includes seven oscillators, F1 – F7 which provide, when activated, the tones required for two tone signaling. The oscillators are connected to a coding matrix **82** having 12 input leads corresponding to the numbers **0–9**, * and # . The coding matrix **82** is interconnected such that when an input signal is applied for example, on the "1" lead, L-1, the oscillators F1 and F5 are energized. This will be appreciated by tracing the connection from the one lead L-1 to the oscillators F1 and F5. Likewise, an input on any other of the leads L-1 through L-0 and L* and L # will cause actuation of the appropriate pair of tone oscillators F-1 through F-7 that represent that number with which the lead is associated. Ten of the twelve outputs L-1 through L-0 are connected to the corresponding fixed contacts **65** on each of tthe rotary switches **64**, i.e. the L-1 input is connected to the "1" fixed contact of each of the 36 rotary switches **64**, and the L-2 input is connected to the "2" fixed contact of each of the 36 rotary switches **64**, etc. The connections are shown schematically being made to only two of the switches **64** but it is understood that the connections are made to all oof the switches. Thirty-six of the 41 output leads **74** of the scanner **51** are connected respectively to the movable contact **66** of the switches **64**. Thus, the output pulses from the scanner **51** are sequentially applied through the movable contact **66** to the fixed contact **65** with which it is in contact and then to the matrix **82** which applies the pulse to activate the two tone oscillators associated with the fixed lead through which the signal passes. The output two tone signal is determined by the position of the rotary switch, which in turn is determined by the position of the thumb knob **54**.

The first or left most output from the scanner **51** is connected to the L # lead. This is a control signal to indicate that the "patient identification information is coming". The 38th through 41st outputs from the scanner **51** (right hand side of the scanner) are connected by fixed wiring to leads L-9, L-1, L-3, L-0 of the matrix **82**. This information or code (**9130**) represents the number of the machine. Each machine has a different number. Should a machine become faulty in operation, all clinical information obtained from that machine may be identified and reviewed for accuracy. The 42nd output is connected to the half stand switch **58**, whose function is defined above.

The remaining output leads (43rd through 48th) from the scanner **51** may be connected (not shown) to the sequencer **22** to begin generation and transmission of the patient clinical information immediately after complete sending of the patient identification information. Finally, the last output pulse (or the pulse after the last used pulse) is applied to the clock **72** to turn off the clock and stop further pulses from the shift register.

The output from the two groups of oscillators F-1 through F-4 and oscillators F5, F6 and F7 are combined and applied (via the mixer **30**) to the directional coupler **42** for transmission on output line **12**.

An alternative embodiment to the dial **54** rotary switch **64** combination is to use a matrix switch **90** as shown schematically in FIG. **6**. The matrix switch **90** has 12 output conductors **91** which are joined to the 12 leads L1 through L # of the matrix **82**. Switch **90** has 36 input conductors **92** which are connected to the second through 37th outputs of shift register **70**. The conductors **91** and **92** are located adjacent to each other in a con-conducting electrical relation. Thirty-six manually operated contacts **93**, such as sliders, are activated by the technician entering the patient identification information. There is one contact **93** for each input conductor **92**. The contacts **93** join each of the conductors **92** to any one of the output conductors **91**. There is shown schematically in the figure a contact being made between the first of the conductors **92** and the first of the output leads **91** which makes contact to the L1 lead on the matrix **82**. Alternatively (not shown) diodes can be used to provide isolation between positions in the matrix. This corresponds to the entry of the numeral 1 in the first position of the first item of patient identification information (i.e. a 1 in the first number of the patient identity). Contact is made by a manually operative contact knob located on the control panel of the patient signal dispatcher. A suitable matrix switch of the kind described is manufactured by the Cherry Electrical Products Corp., Highland Park, Ill. Alternatively, any convenient or conventional matrix switch may be used.

Thus, there has been shown a data acquisition unit in which the patient identification information is entered manually by a technician, and the information entered is displayed to the technician for him to check. When the ECG lead or other source of clinical information is ready, the technician causes the patient identification information displayed to him, along with the clinical information, to be transmitted to a recording medium and transmitting line.

The above description of the invention is intended to be illustrative only, and various changes and modifications in the embodiment described may occur to those skilled in the art. These changes may be made without departing from the scope of the invention, and thus it should be apparent that the invention is not limited to the specific embodiment described or illustrated in the drawings.

What is claimed is:

1. Apparatus comprising: means for receiving clinical information concerning a patient's medical condition; means for entering patient identification information into a memory; optical display means for displaying the patient identification information entered; and means for transmitting the displayed patient identification information with the clinical information.

2. Apparatus according to claim **1**, wherein the display means are operator viewable and the transmitting

means includes operator-operable means for initiating the transmission of the patient identification information.

3. Apparatus according to claim 2, wherein the means for initiating the transmission of the identification information also includes means for initiating transmission of the clinical information immediately adjacent to the identification information.

4. Apparatus according to claim 1, in which the means for entering patient identification information into the memory is a plurality of multi-position arrays with each position thereof corresponding to a different information character.

5. Apparatus according to claim 4 wherein the multi-position arrays are dials.

6. Apparatus according to claim 4 wherein the multi-position arrays are matrix switches.

7. Apparatus according to claim 4 further including a plurality of different tone sources; and means for selectively combining two tone sources into a two tone signal in accordance with the selected position of the array.

8. Apparatus according to claim 5 wherein the means for transmitting the patient identification information includes sequencing means for sequentially enabling the two tone signal which corresponds to the dial portion to an output.

9. Apparatus according to claim 4 wherein the means for displaying the information in the memory includes a plurality of information characters, each character being associated with a particular position on the array; and means for identifying the information characters in accordance with the position of the array.

10. A method of reducing error in entering electrically represented patient identification information which accompanies separately originated electrically represented patient clinical information comprising the steps of entering the patient identification information into a memory, displaying the entered information, and transmitting the information in the memory together with the clinical information.

* * * * *