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(54) INFANT CARDIAC AND APNEA HOME MONITORING SYSTEM

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(57) **ABSTRACT**

An infant cardiac and apnea home monitoring system, which provides audible, visual, and other auxiliary sensory alarms and also includes the ability to transmit an encrypted signal to an Emergency Message Retrieval Unit (EMRU), which in itself contains audible, visual, and touch sensory alarms.

The ability of the Personal Home Baby Monitor (PHBM) to identify when an infant's heart or respiratory rate is not within the pre-set parameters will result in the activation of an alarm state Once the PHBM has entered an alarm state, the base unit will trigger all available alerts, including the simultaneous transmission of a low frequency enable and a high frequency modulated signal, from the base unit to the EMRU. The EMRU upon successfully decoding and validation of the signal will trigger its sensory alarms.

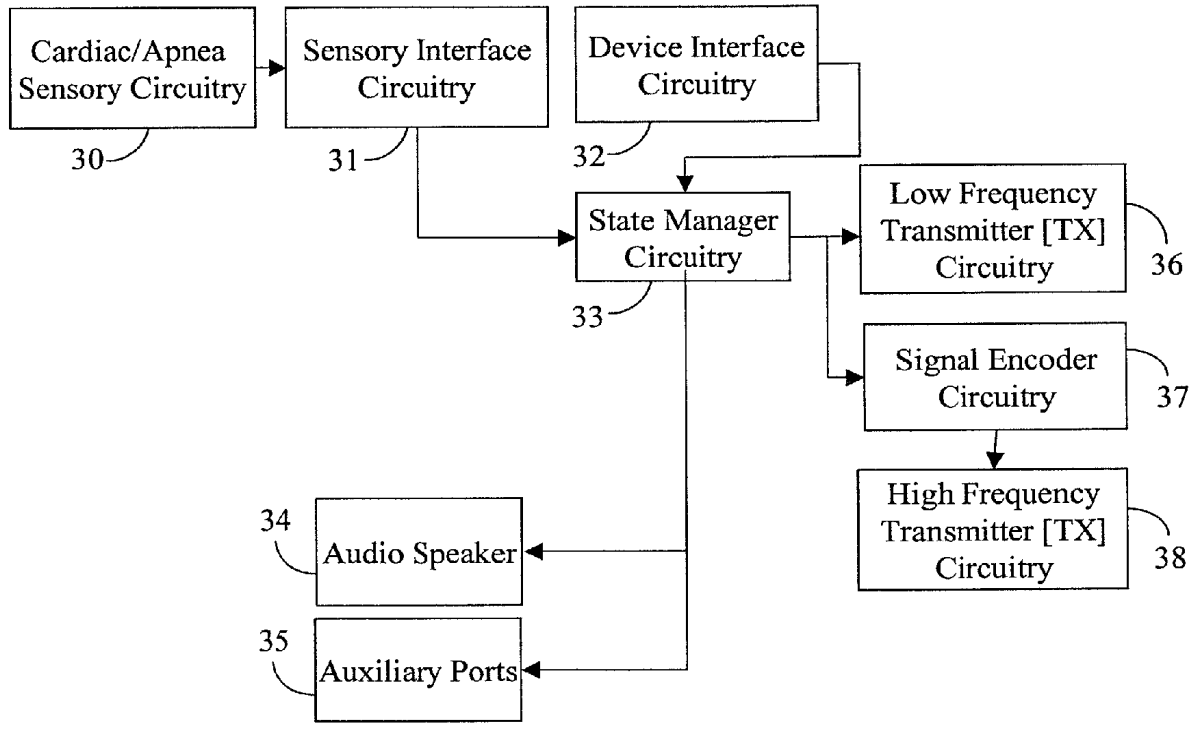


FIG. 1

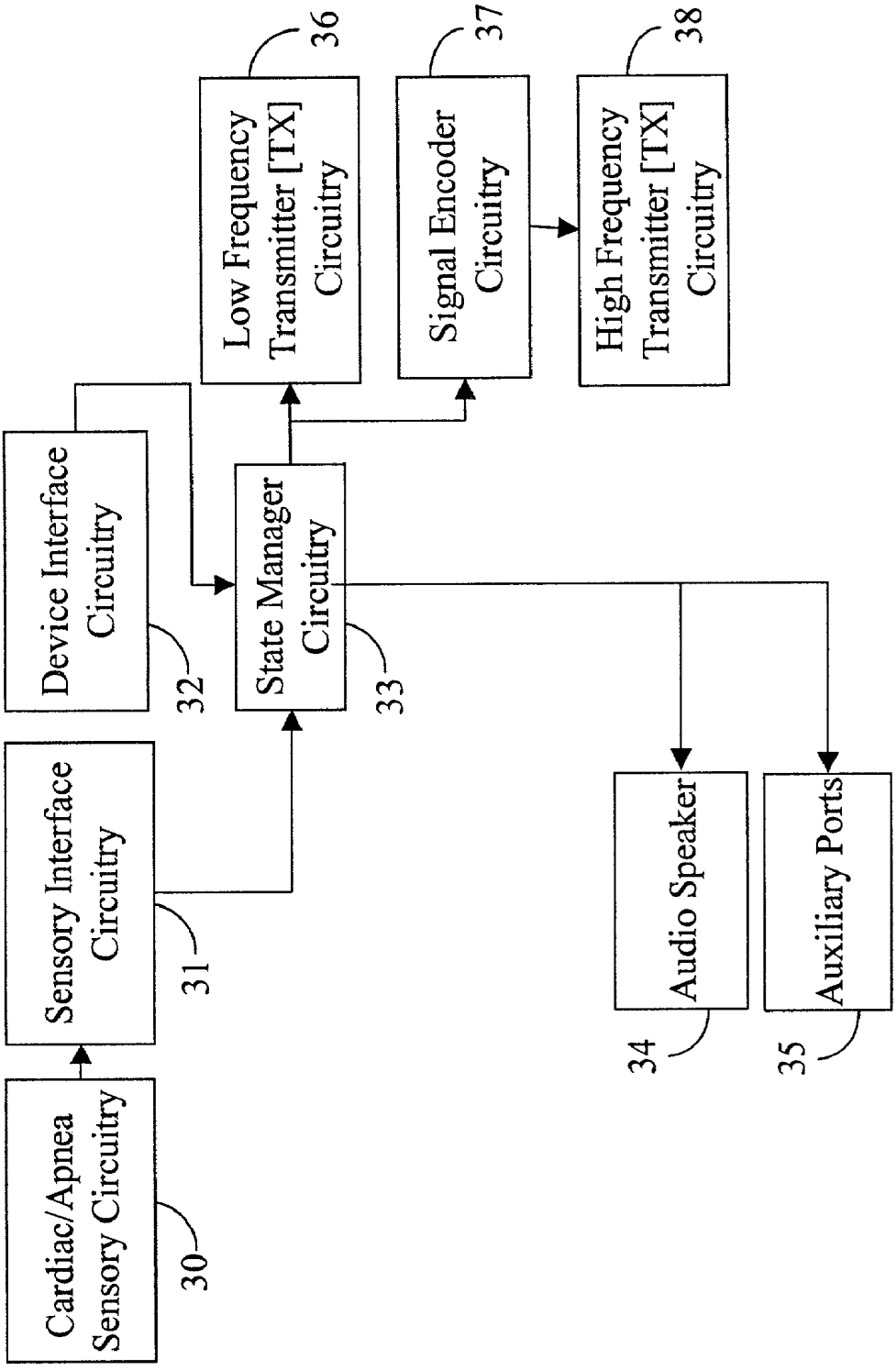

Cardiac/Apnea Sensory Circuitry
30
Sensory Interface Circuitry
31
Device Interface Circuitry
32
State Manager Circuitry
33
Audio Speaker
34
Auxiliary Ports
35
Low Frequency Transmitter [TX] Circuitry
36
Signal Encoder Circuitry
37
High Frequency Transmitter [TX] Circuitry
38

FIG. 2

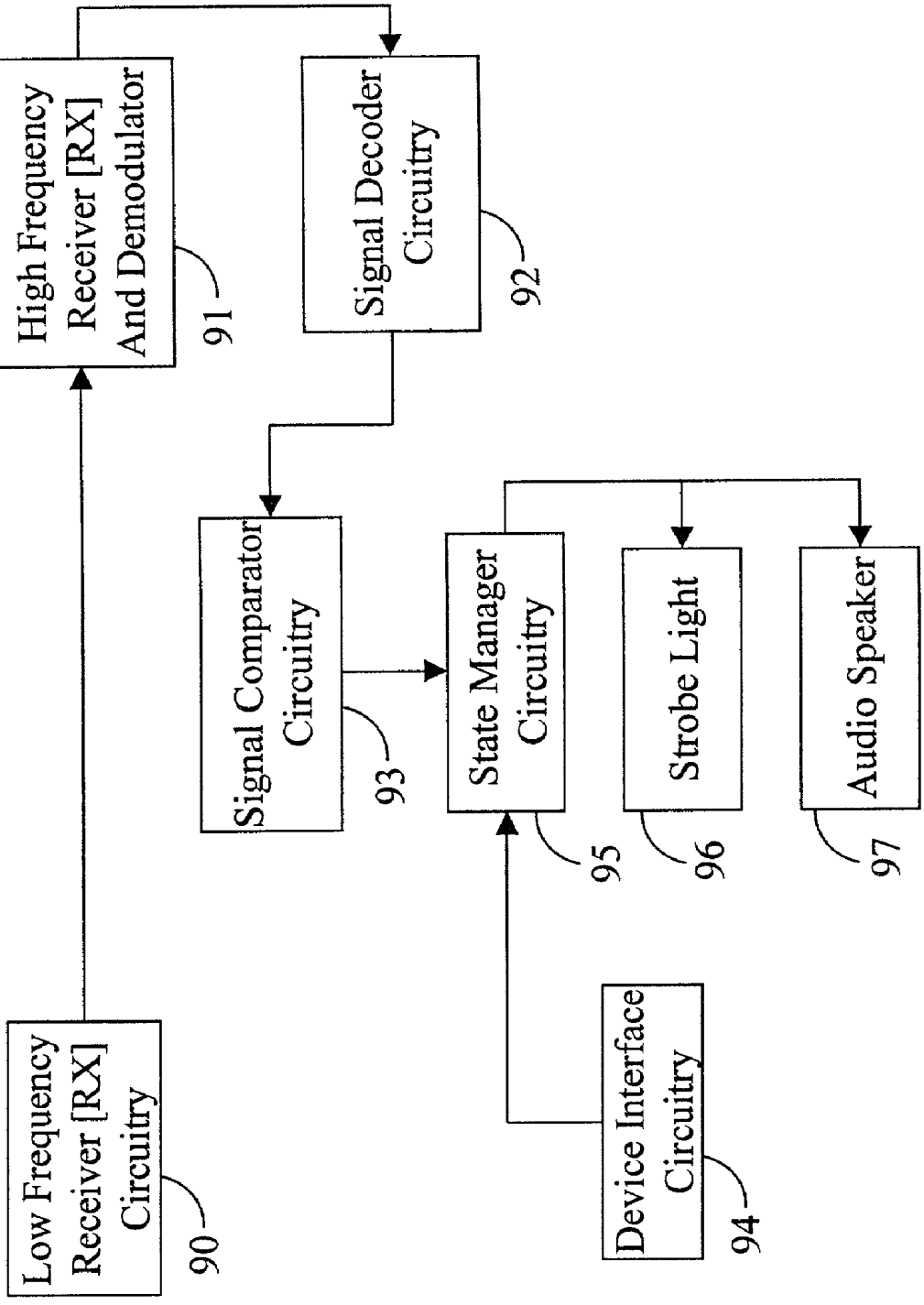

High Frequency Receiver [RX] And Demodulator
91
Signal Decoder Circuitry
92
Signal Comparator Circuitry
93
State Manager Circuitry
95
Strobe Light
96
Audio Speaker
97
Low Frequency Receiver [RX] Circuitry
90
Device Interface Circuitry
94

Fig. 3

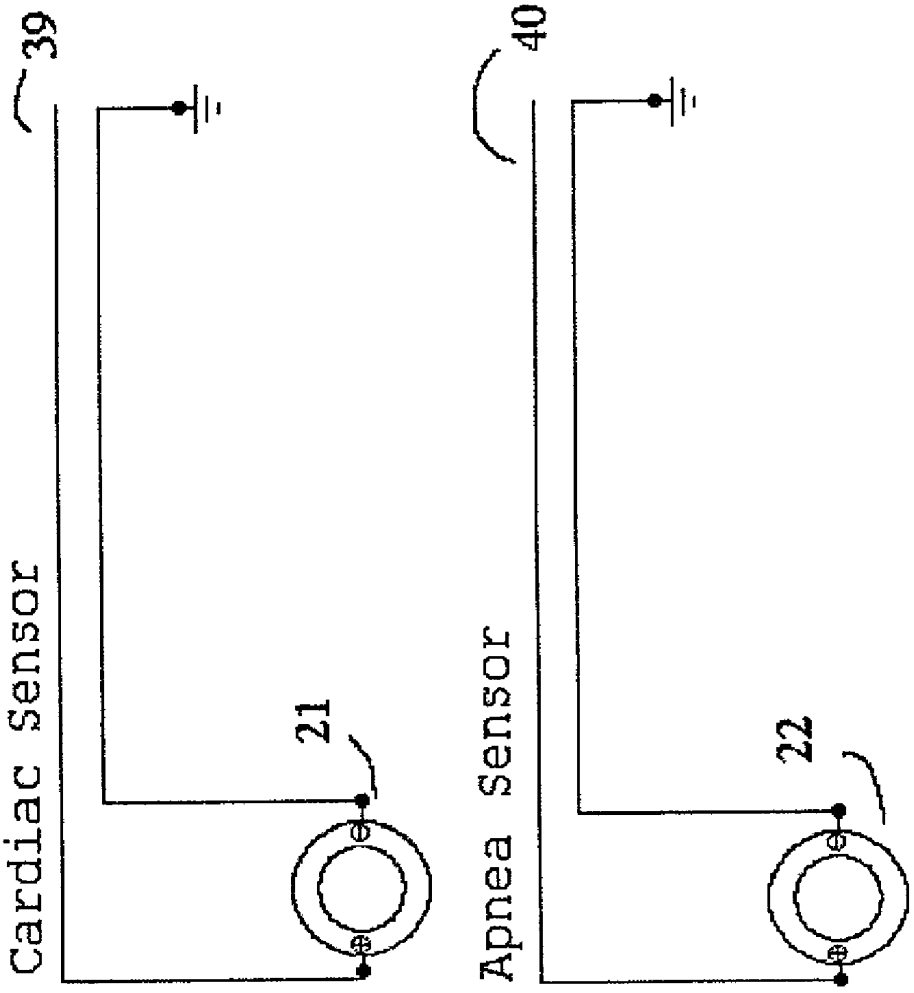


Fig 4

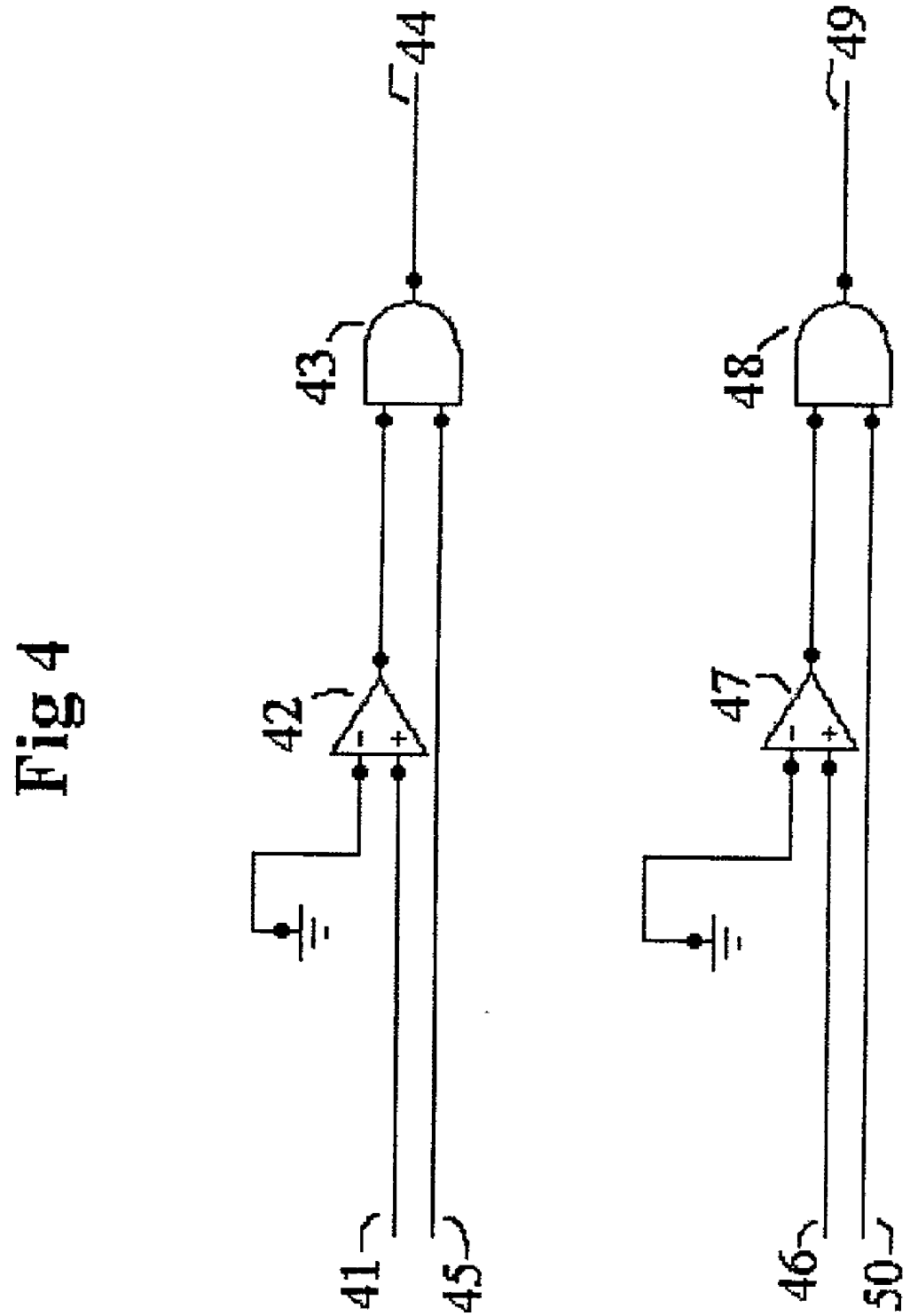


Fig. 5

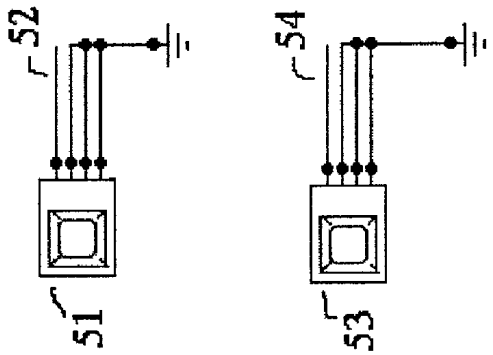


Fig. 6

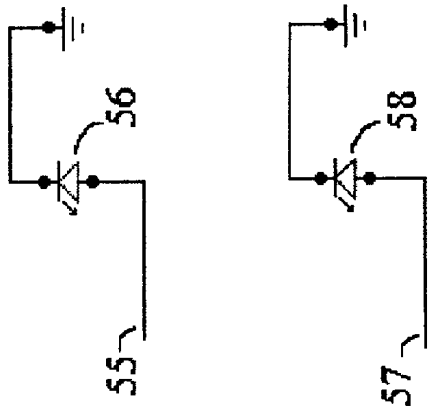
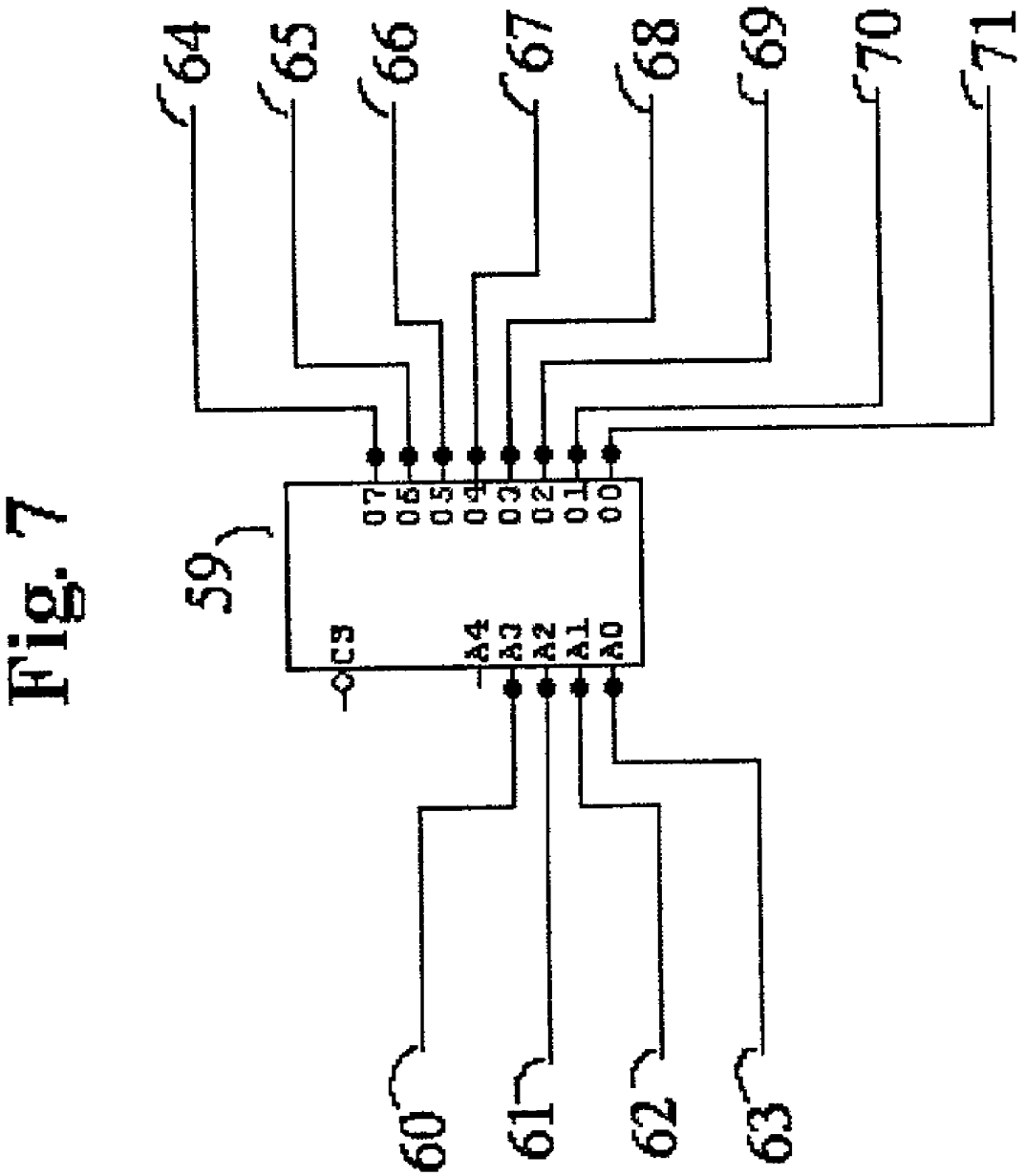


Fig. 7


64
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68
69
70
71
59
O7
O6
O5
O4
O3
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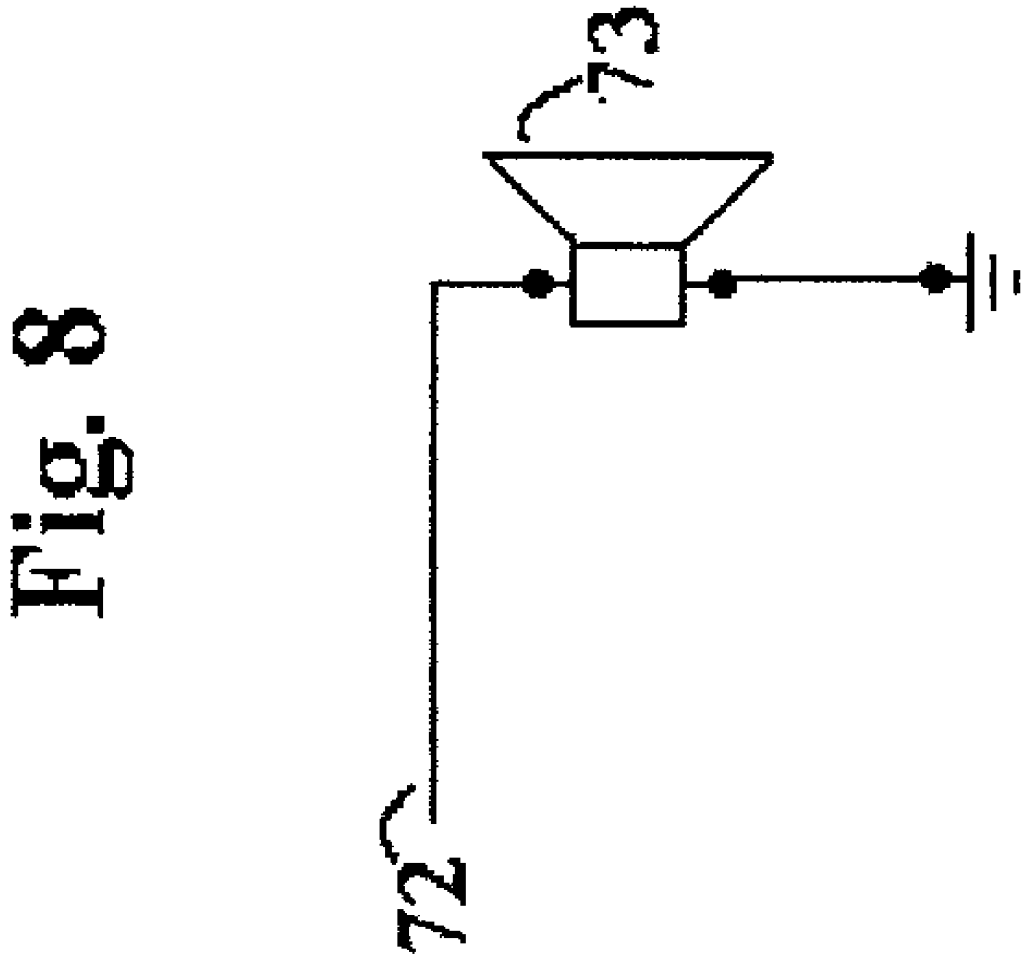
CS
A4
A3
A2
A1
A0
60
61
62
63

Fig. 8



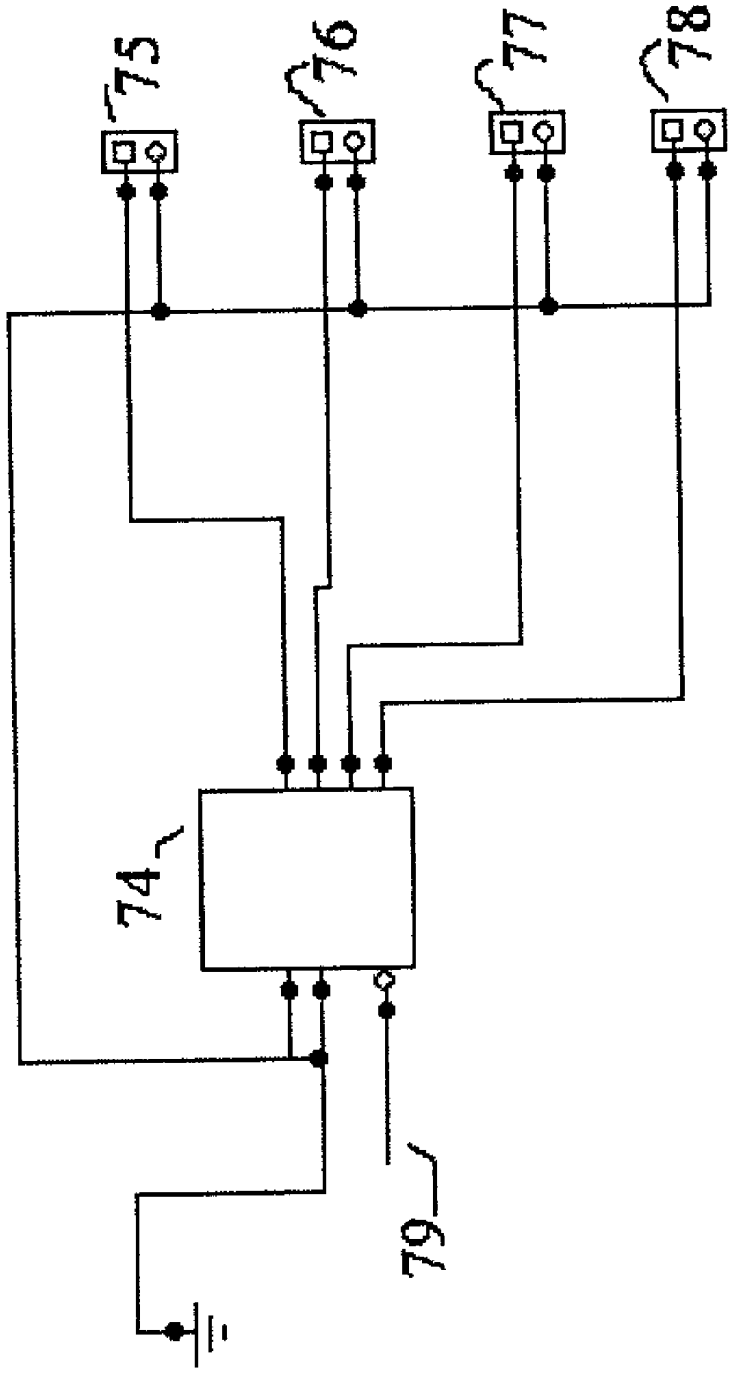


Fig. 9

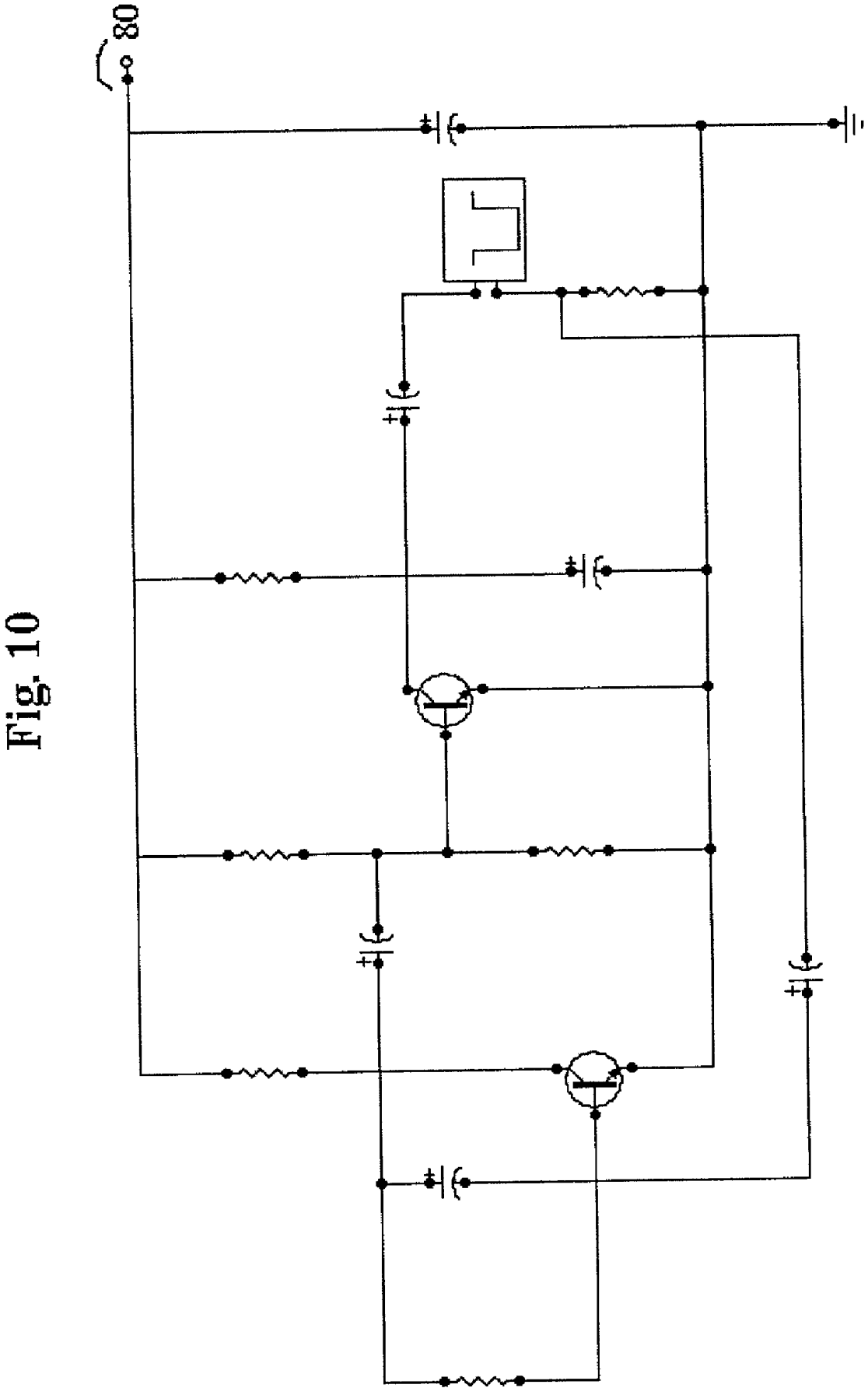
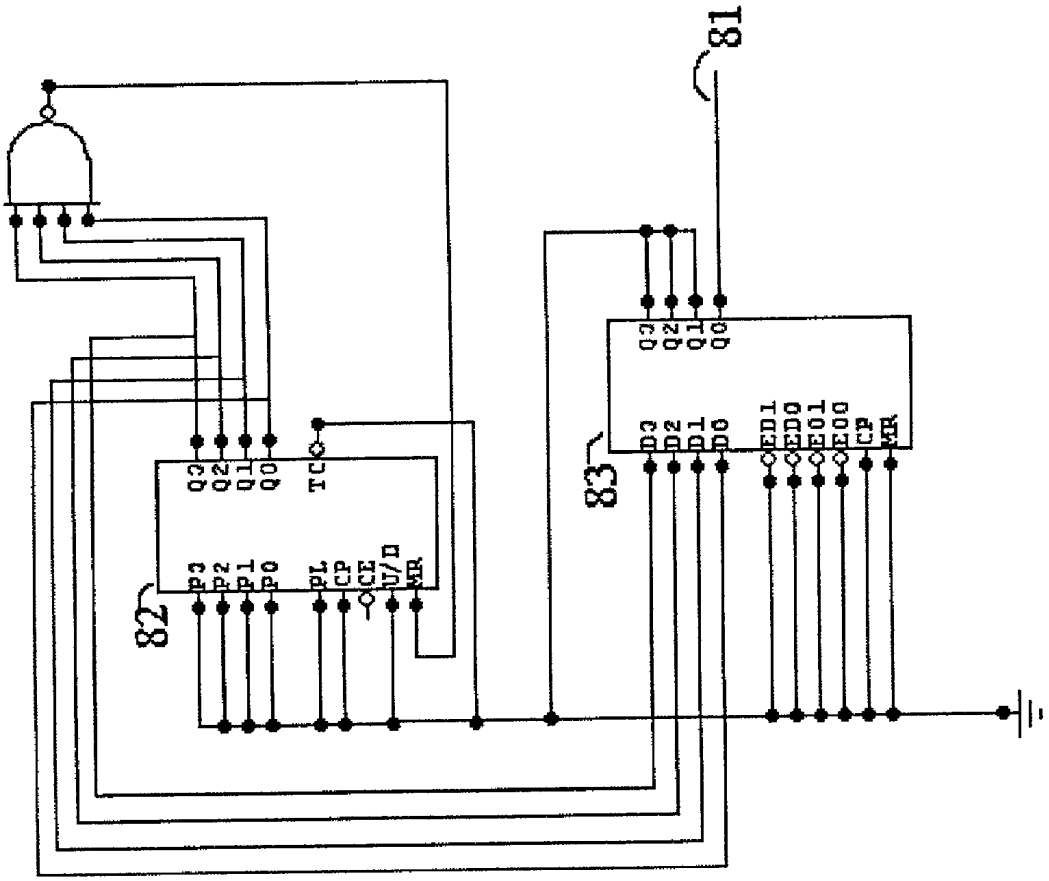


Fig. 10

Fig. 11


81
82
83
Q3
Q2
Q1
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TC
P3
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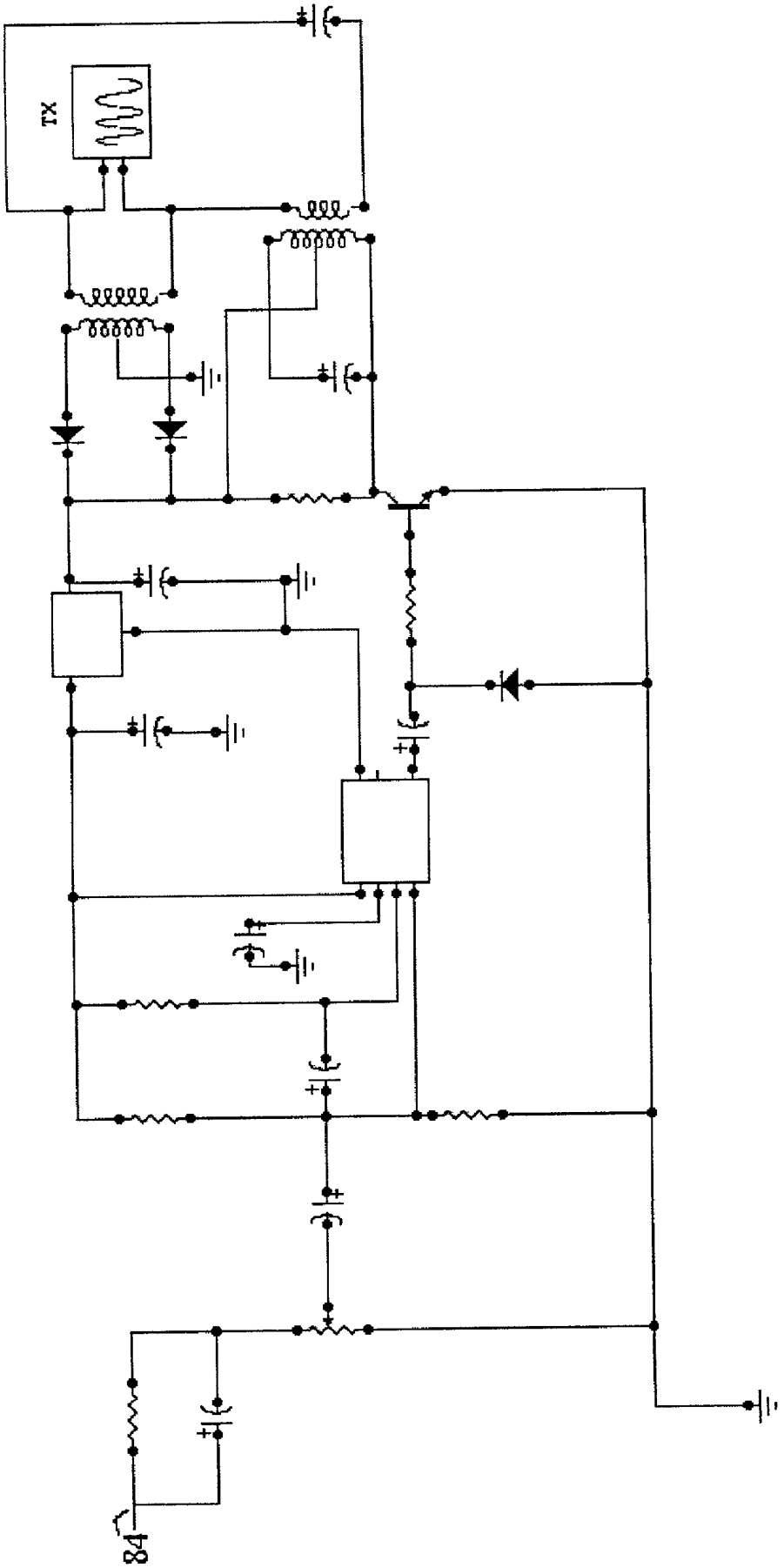
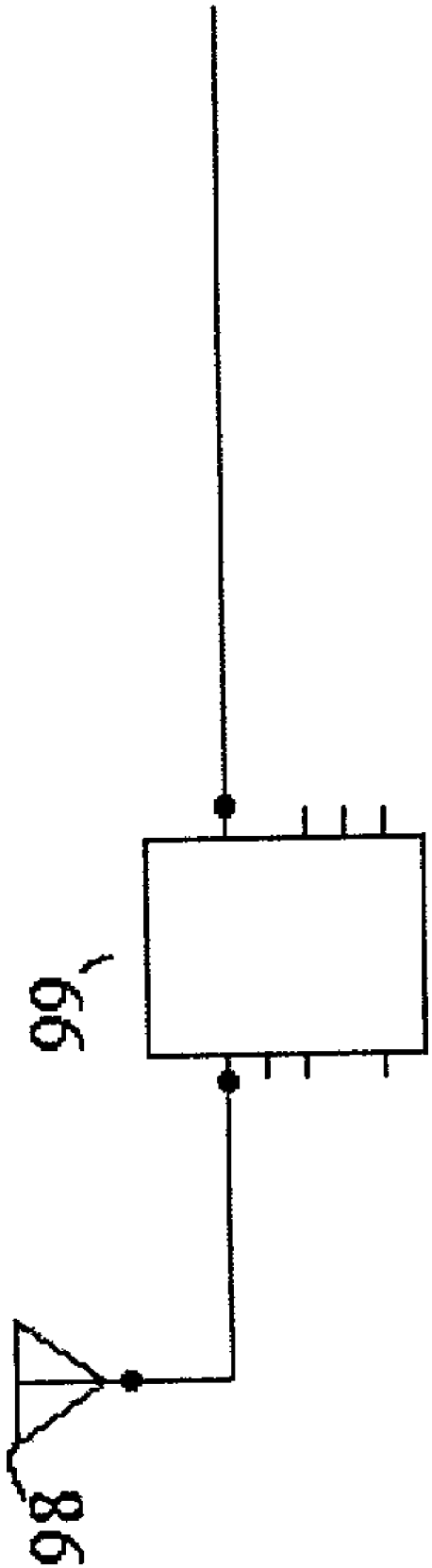


Fig. 12

Fig. 13



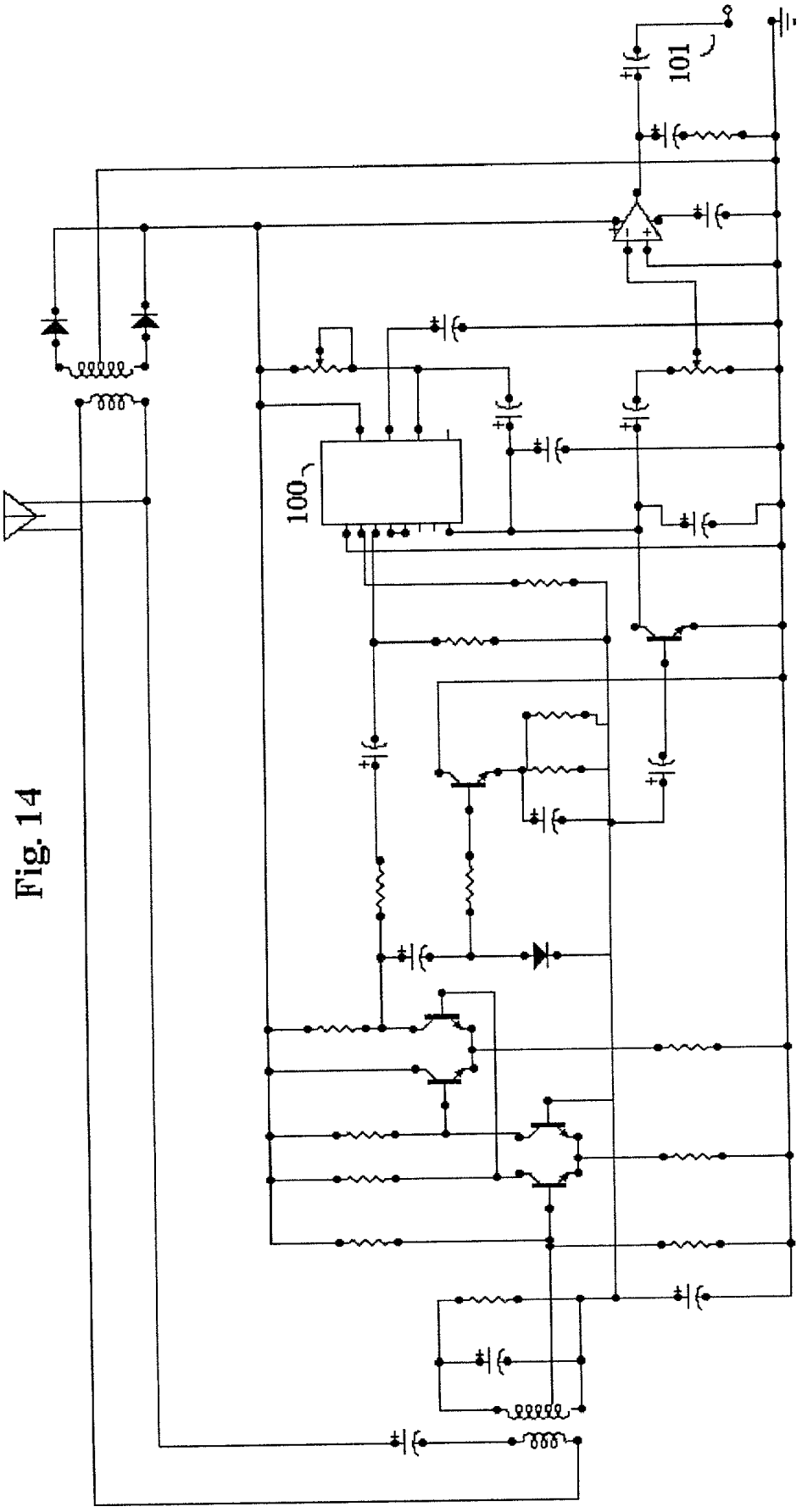
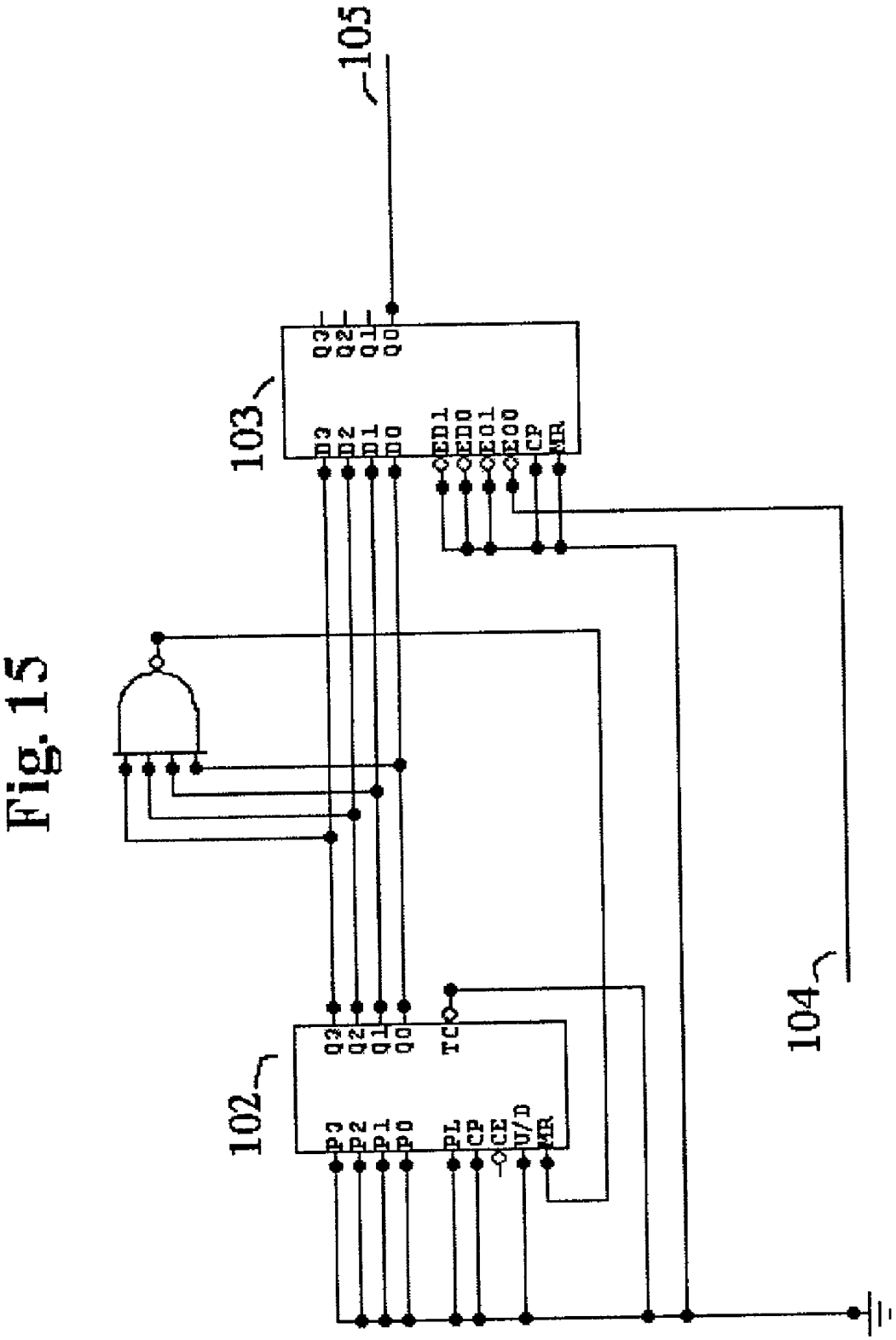


Fig. 14


105
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MR

Fig. 15

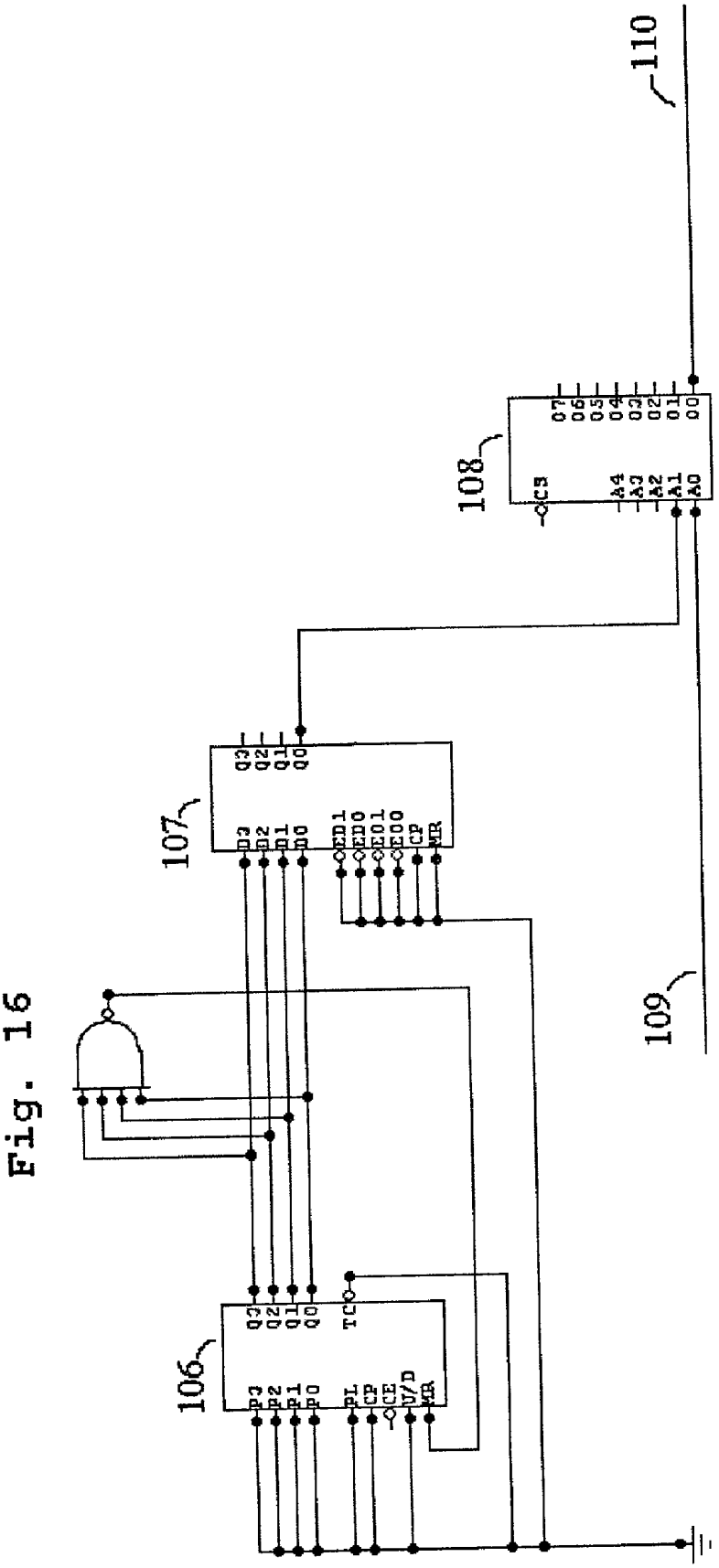
110
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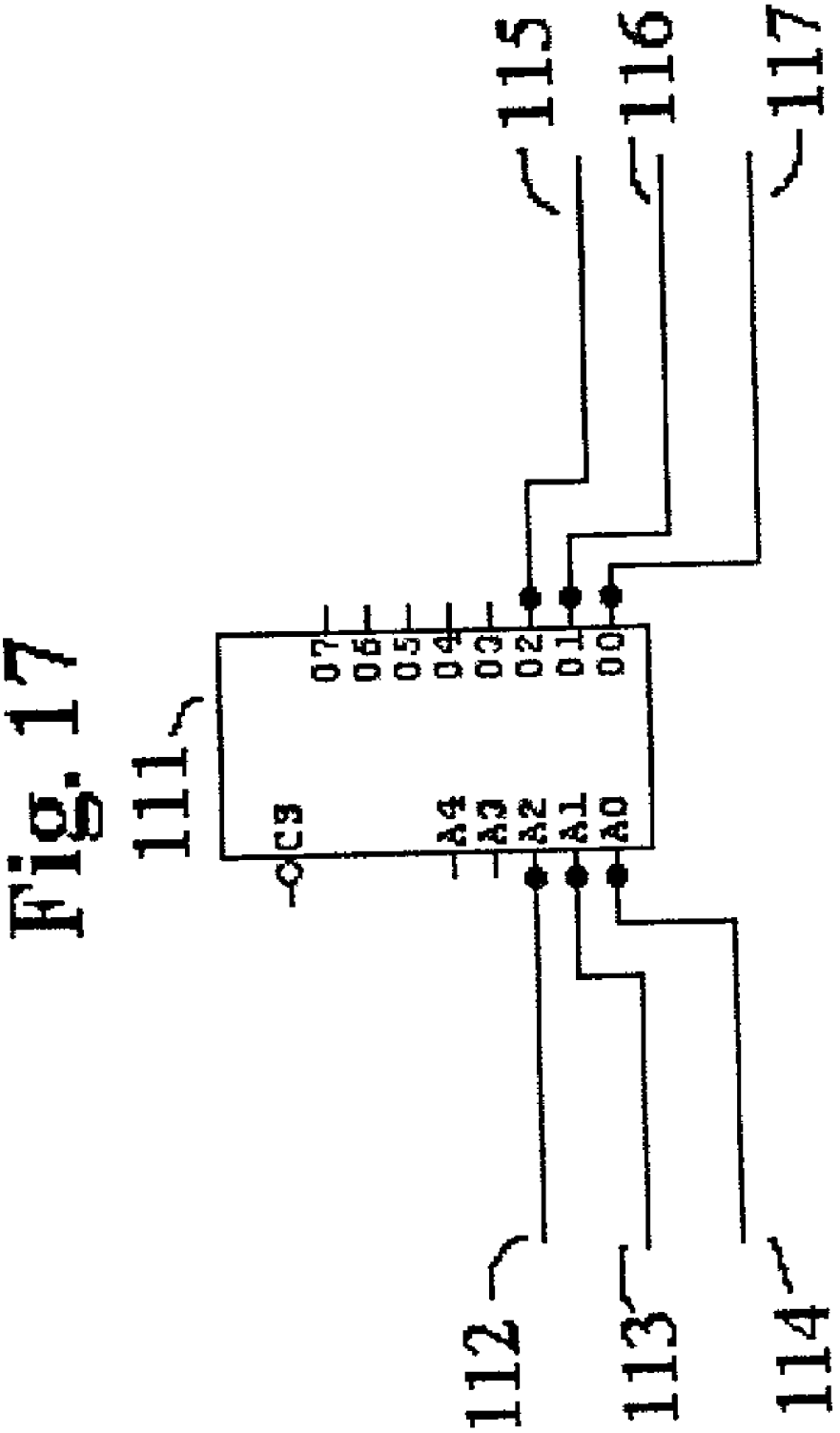
Fig. 16

Fig. 17



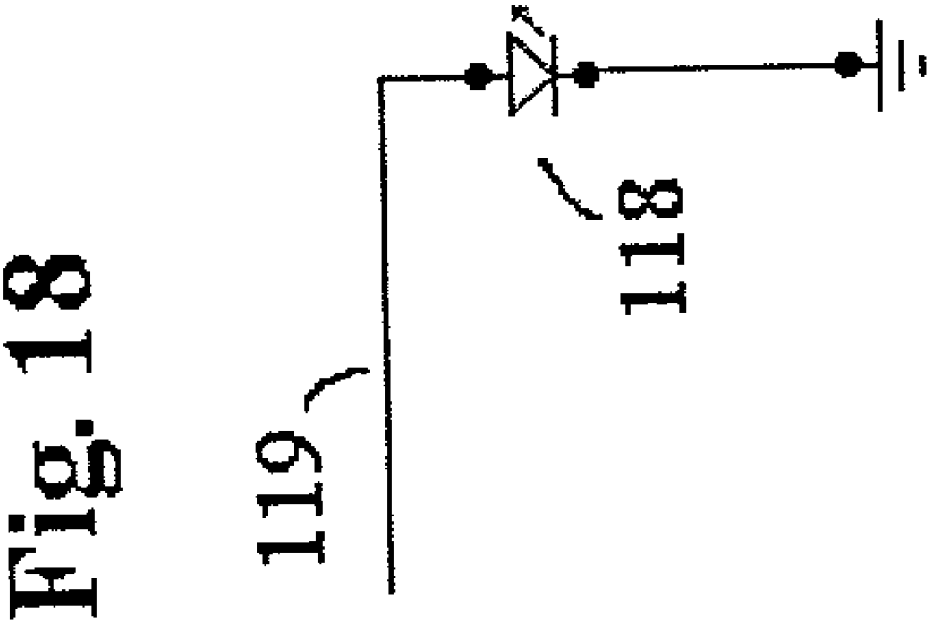


Fig. 18

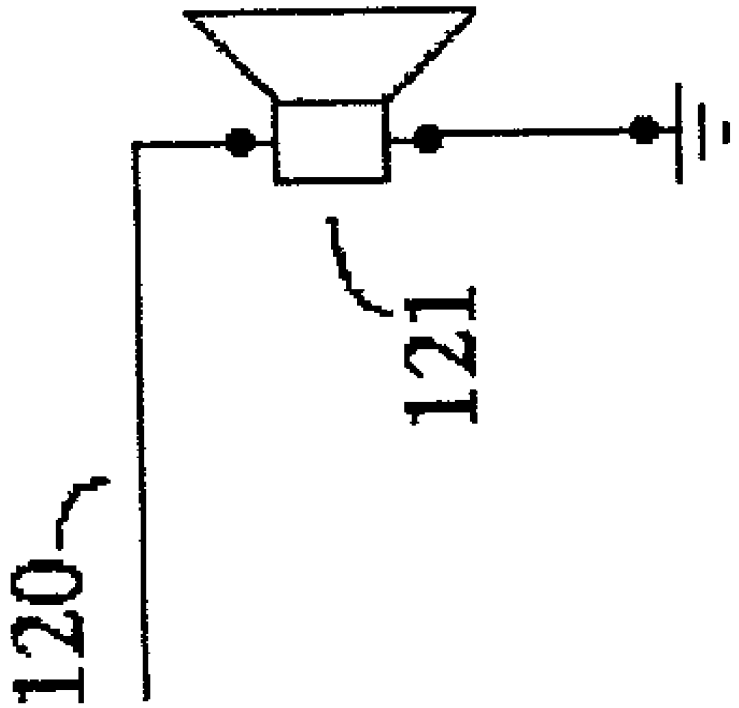
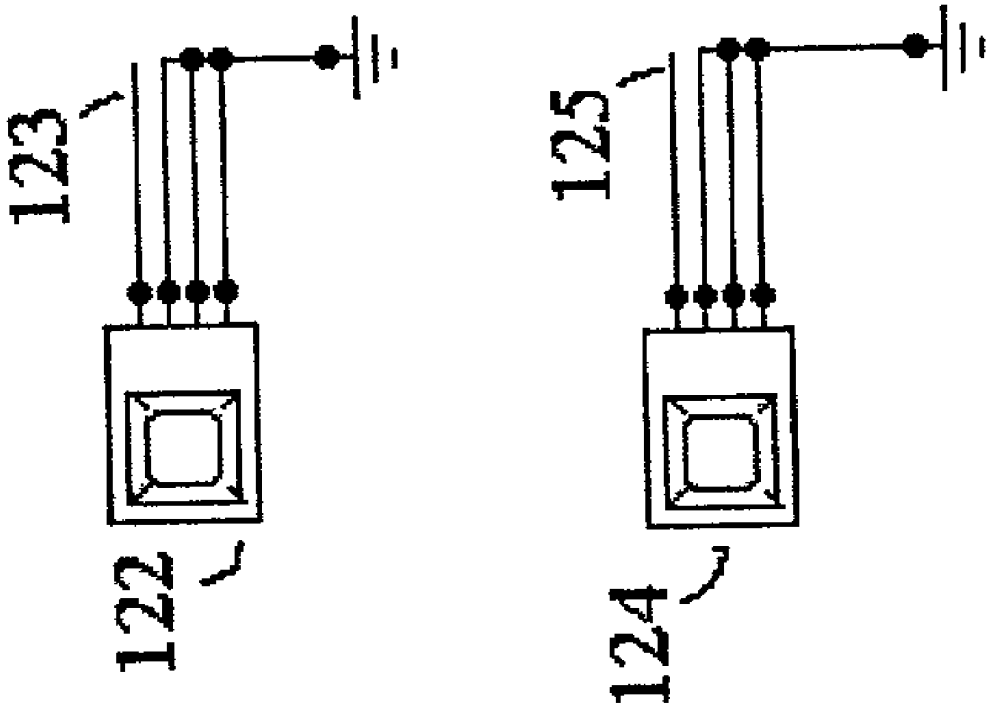


Fig 19

Fig. 20



INFANT CARDIAC AND APNEA HOME MONITORING SYSTEM

I. BACKGROUND

[0001] The conceptual idea for the design was initially brought about by the acknowledgement that: parents affected by physical ailments were more challenged to care for newborn children, due to the lack of sufficient monitoring systems. Existing monitoring technologies fail to satisfy the needs of wanting parents.

[0002] The focus of the design became based on providing a solution for the dilemma at hand. The overall purpose of the invention is to assure parents who are sensory challenged to be notified of a life-threatening event that requires an emergency response.

II. SUMMARY

[0003] A robust and dynamic system for monitoring young children that allows parents to be notified of a life threatening event that requires an emergency response. The invention encapsulates special considerations for parents who have sensory disabilities. The invention is comprised of three sub systems: A sensory system that utilizes open end electrodes that are physically attached to a young child; A portable base that is connected to the sensory system and monitors the electrical impulses transmitted by the electrodes, manages alarm states, encapsulates and triggers alarms, and also transmits simultaneous high and low frequency signals during alarm states; and an EMRU that receives signals, decodes signals, and triggers alarm states.

III. FIELD AND USEFULNESS OF THE INVENTION, BRIEFLY

[0004] The present invention relates to the home monitoring of infants who are at risk for life-threatening events triggered by alterations of the cardiac or pulmonary systems of the body.

[0005] More particularly, the concepts add to the state of home monitoring of cardiac and/or pulmonary art, a valuable system utilizing communication between system parts, and enacting a personal EMRU, which is unique to this system. This invention further establishes a new communication home monitoring cardiac and pulmonary system schema.

[0006] The usefulness of this invention provides for increased safety in monitoring of infants, greater mobility, and increased quality of life for those utilizing home cardiac-pulmonary monitoring systems. This system furthermore encapsulates special considerations particularly for those parents experiencing sensory limitations, therefore enabling them to respond to emergency needs as well as those parents who do not experience sensory limitations.

IV. PROBLEMS AND OTHER FACTORS INHERENT IN INFANT CARDIAC PULMONARY ROME MONITORING SYSTEMS

[0007] A long-standing known problem of current patient cardiac pulmonary monitoring systems in inpatient acute care facilities is that current systems utilizing pagers and telemetry systems can and do frequently receive interference from other transmitting objects, such as cell phones or other patient monitors. Thus, precluding current art utilizes permanently installed antennas as part of the systems, rendering the systems non-portable. Accordingly, the present invention deals with problems of inaccurate, interrupted signaling and portability of the monitoring system in relation to patient proximity. Current art of home monitoring systems, to these inventors' knowledge, do not utilize a personal EMRU to verify notification of alert life-threatening events. Current art is burdened by the requirement of constant visualization of a flashing strobe or bed-shaker for those parents who are hearing impaired. The present invention encapsulates special considerations for physically impaired parents, as well as those that are not physically challenged.

V. PRIOR ART AS PARTICULAR INSTANCES OF FAILURE TO PROVIDE THIS NOVEL SYSTEM

[0008] In view of the vital life saving and high economic advantages achieved generally by the present invention, it may be difficult to realize that the prior art has not conceived of the combination purpose and achievement of the present invention. Even though cardiac and pulmonary infant monitoring systems are widespread, there continues to be a need in the development of more effective systems. Improvements are needed to provide increased safety and an increased quality of life for those utilizing such systems.

[0009] The consideration of the nature of the present invention concepts may be helped by a summarized consideration of the prior art as known to the inventors, however, as infant cardiac and apnea monitoring systems are widespread. Various types of infant cardiac and apnea monitoring systems are here conceded, but the nature of the prior art existing for such systems does not provide the overall combinations of the present invention.

VI. SUMMARY OF THE PRIOR ART'S LACK OF SUGGESTIONS OF THE CONCEPTS OF THE INVENTION'S COMBINATION

[0010] In spite of all such factors of the prior art knowledge and use, the problem here solved awaited these inventors' consideration, ideas, and creativity. More particularly, as to the novelty here of the invention as considered as a whole, a consideration of the prior art uses and needs helps show its contrast to the concepts, and emphasizes the advantages, novelty, and the inventive significance of the present concepts as are here shown, particularly as to emergency response ability and enhanced quality of life.

[0011] Moreover, prior art systems, such as cardiac and pulmonary monitoring systems for home use, as known to these inventors, which could possibly be adapted for this duty, fail to show or suggest the details of the present concepts as a combination; and a realistic consideration of the prior art's differences from the present concepts of the overall combination may more aptly be described as a parallel ideology with a common goal as existing inventions, but existing inventions do not suggest the novel concepts of this invention.

[0012] The existence of such prior art knowledge and related ideas which embody such various features is not only conceded, it is emphasized; for as to the novelty here of the combination, of the invention as considered as a whole, a contrast to the prior art helps also to remind of needed

improvement, and the advantages and the inventive significance of the present concepts. Thus, as shown herein as a contrast to all the prior art, the inventive significance of the present concepts as a combination is emphasized, and the nature of the concepts and their results can perhaps easier be seen as an invention.

[0013] Although varieties of prior art are conceded, and ample motivation is shown, and full capability in the prior art is conceded, no prior art shows or suggests details of the overall combination of the present invention, as is the proper and accepted way of considering the inventiveness nature of the concepts.

[0014] That is, although the prior art may show an approach that is parallel to the overall invention, it is determinatively significant that none of the prior art show the novel and advantageous concepts in combination, which provide the merits of this invention.

[0015] And the prior art's lack of an invention achieving the inclusion of parents with sensory challenges in response to their child's unexpected life-threatening event, as well as parents who are not physically challenged, merits the improvements and solutions offered by the system of this invention.

VII. BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The above description of the novel and advantageous invention is of somewhat introductory and generalized form. More particular details, concepts and features are set forth in the following and more detailed description of the preferred embodiment, taken in conjunction with the accompanying drawings which are of somewhat schematic and diagrammatic nature for showing the inventive concepts; and more particularly;

[0017] **FIG. 1** is a so-called block diagram of the overall circuitry and components of the monitoring base apparatus;

[0018] **FIG. 2** is a block diagram of the circuitry and components of the EMRU apparatus;

[0019] **FIG. 3** shows Cardiac/Apnea Sensory circuitry for each of cardiac and apnea circuitry;

[0020] **FIG. 4** shows Sensory Interface circuitry for amplifying the signals from each the cardiac and apnea circuits;

[0021] **FIG. 5** shows the power and reset buttons of the circuitry of both the cardiac and apnea circuits;

[0022] **FIG. 6** shows indicator Light Emitting Diodes (LED(s)) of each of the cardiac and apnea circuits;

[0023] **FIG. 7** shows a programmable logic chip that receives input from the power button, reset button, cardiac and apnea circuitry; and also signals to indicator lights, signal transmitters, audio speaker, auxiliary ports, and enable circuitry;

[0024] **FIG. 8** shows an audio speaker,

[0025] **FIG. 9** shows a multiplexer chip for switching auxiliary ports for powering external peripherals;

[0026] **FIG. 10** shows a low frequency transmitter,

[0027] **FIG. 11** shows a signal encoder circuitry having a counter chip, a register chip, and a NAN) gate;

[0028] **FIG. 12** shows a signal modulator and high frequency transmitter circuitry;

[0029] **FIG. 13** shows a low frequency signal receiver;

[0030] **FIG. 14** shows high frequency signal receiving circuitry and signal demodulator, **FIG. 15** shows a signal decoding circuitry having a counter chip, a register chip, and a NAND gate;

[0031] **FIG. 16** shows signal comparison circuitry having a counter chip, a register chip, a NAND gate, and a Programmable Logic chip;

[0032] **FIG. 17** shows a programmable logic chip that receives input from the power button, reset button, and signal receiver circuitry; and also signals to indicator lights, audio speaker,

[0033] **FIG. 18** shows a light emitting diode (LED);

[0034] **FIG. 19** shows an audio speaker,

[0035] **FIG. 20** shows the power and reset buttons of the circuitry

VIII. DESCRIPTION OF THE PREFERRED EMBODIMENT

[0036] As shown in the drawings, the details of the circuitry and components are shown for a preferred embodiment, providing and achieving the advantageous monitoring apparatus useful particular for the safety monitoring of cardiac and apnea dangers.

[0037] More particularly the overall apparatus is shown in **FIGS. 1 and 2**, they being functional representations utilizing circuitry and components shown illustratively in the FIGS. **3-20**.

[0038] The system **30** as shown in **FIG. 1** is the cardiac/apnea sensory circuitry, and as shown is comprised in part by the elements detailed in **FIG. 3** and constitutes two electrodes **21** and **22**, connecting wires, and cable utilized for measuring heart and respiratory rates. The make up and utilization of the electrodes, connecting wires, and cable are conceded as prior art. Electronic impulses generated by the human body are propagated through the wires **39** and **40** for cardiac and apnea respectively.

[0039] The system **31** as shown in **FIG. 1** is the sensory interface circuitry, shown as being comprised by the elements detailed in **FIG. 4**. The signals propagated on wires **39** and **40** respectively are connected to wires **41** and **46** respectively which lead to operational amplifiers **42** and **47** respectively that will amplify signal polarities and strengths as may be determined by physical design requirements, such as deviations in component operation, impedance matching, and electrode sensitivity, etc. After the cardiac and apnea signals have been amplified, they are further propagated to AND gates **43** and **48** respectively. When the signals propagated via wires **45** and **50** (connected to wires **70** and **71** respectively, described below) are in an active state the amplified signals are propagated via **44** and **49** respectively.

[0040] The system **32** as shown in **FIG. 1** constitutes the device interface circuitry, being comprised in part by the elements detailed in **FIG. 5** and **FIG. 6**. **FIG. 5** consists of two electronic switches **51** and **53** being 'POWER' and 'SYSTEM RESET' respectively. When either switch is

depressed wires **52** and **54** connected to wires **62** and **63** (wires **62** and **63** are described below) are brought down to ground state. **FIG. 6** consists of two light emitting diodes **56** and **58** as cardiac and apnea signal indicator lights respectively. These lights indicate emergency situations in regards to cardiac and apnea aberrant episodes respectively. Wires **55** and **57** are connected to wires **64** and **65** (wires **64** and **65** are describe below). Wires **64** and **65** propagate the cardiac alert and apnea alert signals respectively.

[**0041**] The system **33** as shown in **FIG. 1** constitutes the state manager circuitry, being comprised by the elements detailed in **FIG. 7**. **FIG. 7** shows a programmable logic chip **59**. The system **33** receives input signals: cardiac signal via wire **60** connected to wire **44**; apnea signal via wire **61** connected to wire **49**; system reset signal via wire **62** connected to wire **54**; and power 'on' and 'off' signal via wire **63** connected to wire **52**. The system **33** sends signals: cardiac alert via wire **64**; apnea alert via wire **65**; alarm state via wire **66**; low frequency enable via wire **67**; auxiliary enable via wire **68**; audio enable via wire **69**; apnea sensor enable via wire **70**; and cardiac sensor enable via wire **71**. Connections for wires **64** through **71** are detailed below.

[**0042**] The system **34** as shown in **FIG. 1** is comprised by the elements detailed in **FIG. 8**, which constitutes an audio speaker **73**. Wire **72** is connected to wire **69** (Wire **69** propagates the audio enable signal). The audio enable signal is active when the system has determined that either a cardiac or apnea aberrant episode has occurred.

[**0043**] The system **35** as shown in **FIG. 1** constitutes the auxiliary port circuitry as being comprised by the elements detailed in **FIG. 9**. **FIG. 9** shows a multiplexer **74** and auxiliary ports **75-78**. The wire **79** is connected to wire **68**.

[**0044**] The system **36** as shown in **FIG. 1** being comprised in part by the elements detailed in **FIG. 10** constitute the low frequency transmitter. The wire **80** is connected to wire **67**.

[**0045**] The system **37** as shown in **FIG. 1** being comprised in part by the elements detailed in **FIG. 11** constitutes the high frequency encoder. **FIG. 11** is comprised of a counter chip **83**, a register chip **82**, and a NAND gate. The counter chip iterates through a repeating numerical sequence. The output of the counter chip is the input to the register. The register outputs the value of the memory address of its corresponding input value input to wire **81**.

[**0046**] The system **38** as shown in **FIG. 1** being comprised in part by the elements detailed in **FIG. 12** constitutes the high frequency transmitter. The wire **84** is connected to wire **81**. The circuit modulates the signal carried via the wire and further transmits the carrier signal.

[**0047**] The system **90** as shown in **FIG. 2** being comprised in part by the elements detailed in **FIG. 13** constitutes the low frequency receiver. The low frequency receiver is comprised of an antenna **98** and a phased lock loop **99**.

[**0048**] The system **91** as shown in **FIG. 2** being comprised in part by the elements detailed in **FIG. 14** constitutes the high frequency receiver. The high frequency receiver detects the carrier signal, demodulates the signal. The demodulated signal is propagated via wire **101**.

[**0049**] The system **92** as show in **FIG. 2** being comprised in part by the elements detailed in **FIG. 15** constitutes the high frequency decoder. The high frequency decoder is comprised of a register chip **103**, counter chip **102**, and a NAND gate. Wire **104** is connected to wire **101**. The signal propagated on wire **104** is the input to the register. For each value the counter chip outputs the register has a corresponding memory location. As the counter chip iterates the values propagated on wire **104** are stored in corresponding memory locations.

[**0050**] The system **93** as shown in **FIG. 2** being comprised in part by the elements detailed in **FIG. 16** constitutes the registry comparator. The registry comparator is comprised of a counter chip **106**, a register chip **107**, a comparator chip **108** and a NAND gate. Wire **109** is connected to wire **105**. The comparator evaluates the signals that are propagated via wire **109** and the output of the register chip. The resultant value is propagated via wire **110**.

[**0051**] The system **94** as shown in **FIG. 2** being comprised in part by the elements detailed in **FIG. 17** constitutes the state management of the Emergency Message Retrieval Unit (EMRU). Being comprised of a programmable logic chip **111**. The EMRU receives input signal comparator output **110** connected to wire **112**, power on and off propagated on wire **123** connected to wire **113**, reset propagated on wire **125** connected to wire **114**. The system sends output data: audio enable via wire **115**, light enable via wire **116**, and alarm state via wire **117**.

[**0052**] The system **96** as shown in **FIG. 2** being comprised in part by the elements detailed in **FIG. 18** constitutes the indicator light. The indicator light is comprised of a light emitting diode (LED) **118**.

[**0053**] The system **97** as shown in **FIG. 2** being comprised in part by the elements detailed in **FIG. 19** constitutes the audio speaker **121**. Wire **120** is connected to wire **115**.

[**0054**] The system **94** as show in **FIG. 2** being comprised in part by the elements detailed in **FIG. 20** constitutes the EMRU device interface. **FIG. 20** consists of two electronic switches **122** and **124** begin 'Power' and 'Reset' respectively. When either switch is depressed a signal is propagated via wires **123** and **125** respectively.

[**0055**] Modifications and variations may effected without departing from the scope of the novel concepts of the invention; accordingly, the invention is not limited to the specific form or arrangement of parts herein described or shown.

What is claimed is:

1. An alarm state manager system of the human body's pulmonary and cardiac systems having cardiac and apnea detection means for carrying electrical impulses from a pair of monitoring sensors operatively connected to the human body, and having a base receiving means operatively connected to the monitoring sensors; and having base receiving timing means which detects interrupted electrical impulse signals from the respective monitoring sensors outside of specific parameters and having alarm devices for activating an alarm signal in response to the signals received by the base receiving means and the timer means;

The improvement comprising the provision of signal transmitting means for sending an enable signal, and further modulating a high frequency carrier with a binary code personalized to the base receiving means,

Alarm State Manager means for signal transmitting switching; sending a signal to the alarm devices and also to the EMRU specified below;

Alarm State Timer means for returning said alarm state manager to "idle state" from "alarm state";

Signal Receiving means for receiving an enable signal, and further demodulating a carrier corresponding to the binary code mentioned above;

Signal Demodulator means for demodulating the carrier signal;

Signal Comparator means for performing Boolean comparisons of demodulated data against unique binary code within the EMRU;

Signal Register means for holding data in memory for future data access;

Emergency Message Retrieval Unit (ERU) means for enabling strobe light switching, audio speaker switching, motion switching, and audio speaker switching.

2. The invention as set forth in claim 1 in a combination in which said cardiac and apnea detection means actuates the said base receiving means by receiving electrical impulses via conducting wires connected to the body.

3. The invention as set forth in claim 1 in a combination in which said base receiving means receives electrical impulses from the said cardiac and apnea detection means and indicates that the received signal is not within system parameters of the said alarm state manager means.

4. The invention as set forth in claim 1 in a combination in which said alarm state manager means has received an impulse exceeding preset parameters, this impulse actuated the enabling function of the EMRU.

5. The invention as set forth in claim 4 in a combination including switch means, which controls actuation of the EMRU and the signal transmitting switching.

6. The invention as set forth in claim 5 in a combination in which, when said alarm state manager means actuates the modulation of a unique binary code into a carrier signal and transmits signal to the EMRU and actuates the invention as set forth in claim 1.

7. An alarm state manager system of the human body's cardiac and pulmonary systems, including cardiac and apnea detection means for carrying electrical impulses, operatively connected to the human body, and having sensors connected to the human body; having a plurality of alarm actions and circuitry operatively connecting the detection means to the alarm action means; said circuitry including control means which activates the alarm action means in response to any electrical impulse from the detection means, which exceeds pre-set parameter limits in a combination; which includes control means which utilizes a unique, individualized alarm state managing system (EMRU) to detect alterations in the monitoring system of the cardiac and pulmonary systems of the body.

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专利名称(译)	婴儿心脏和呼吸暂停家庭监测系统		
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摘要(译)

婴儿心脏和呼吸暂停家庭监控系统，提供听觉，视觉和其他辅助感官警报，还包括将加密信号传输到紧急消息检索单元（EMRU）的能力，紧急消息检索单元本身包含听觉，视觉和触摸感官警报。个人家庭婴儿监视器（PHBM）识别婴儿的心脏或呼吸率何时不在预设参数范围内的能力将导致警报状态的激活一旦PHBM进入警报状态，基本单元将触发所有可用的警报，包括从基本单元到EMRU的低频启用和高频调制信号的同时传输。成功解码和验证信号后的EMRU将触发其感官警报。