# United States Patent

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[54] **BURGLAR AND FIRE ALARM**
**14 Claims, 2 Drawing Figs.**


[52] **U.S. Cl.** ..... **179/5,** 179/2
[51] **Int. Cl.** ..... **H04m 11/04**
[50] **Field of Search** ..... 179/5, 5 P, 2, 2 A, 2 B, 2 E



[56] **References Cited**

UNITED STATES PATENTS

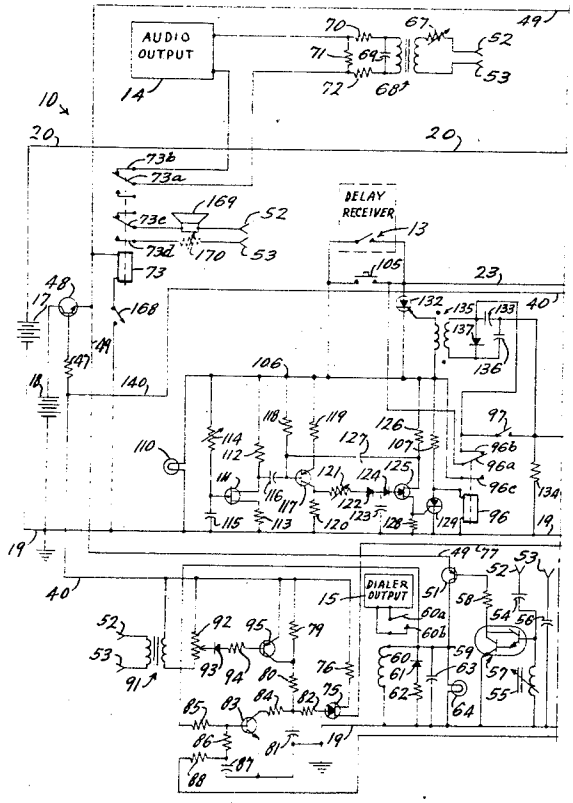
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|---|---|---|---|
| 2,827,515 | 3/1958 | Zuber | 179/5(P) |
| 3,072,746 | 1/1963 | Zimmermann | 179/5(P) |
| 3,267,379 | 8/1966 | Bloxsom | 179/2UX(B) |

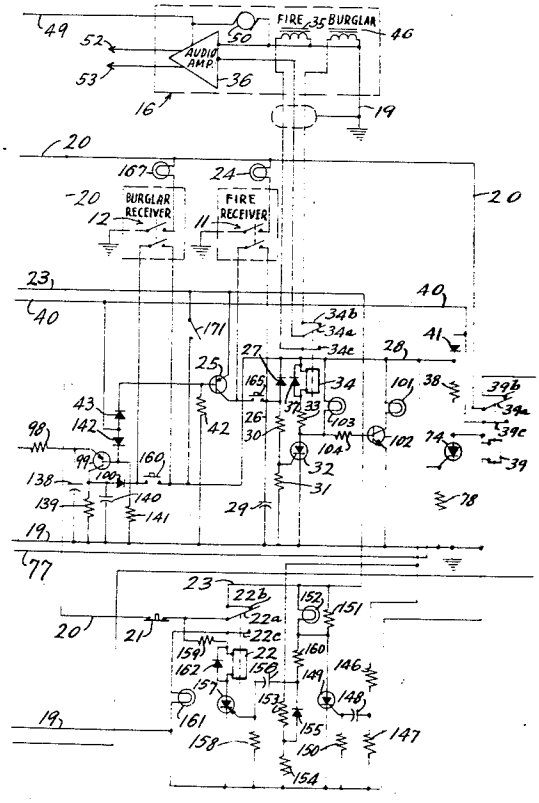


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**ABSTRACT:** An automatic alarm system responsive to the occurrence of a fire or a burglary in a monitored area. When a fire or a burglary is sensed, the system seizes a telephone line, successively dials one or more predetermined stations and successively transmits to each dialed station a prerecorded message relating to the sensed condition. If the sensed persists or reoccurs, the system will recycle for a predetermined number of times. A time delay circuit is automatically energized when the burglar channel of the alarm is initially armed to allow the system operator to leave the monitored area without triggering the alarm. The time delay circuit may be remotely energized to allow a system operator to enter the monitored area for disarming the burglar channel or to allow a system operator to pass through the monitored area without triggering the alarm. The alarm system is shut off in response to a prerecorded signal at the end of the tape or in response to the absence of a recorded signal for a predetermined period of time, should the recording medium fail.

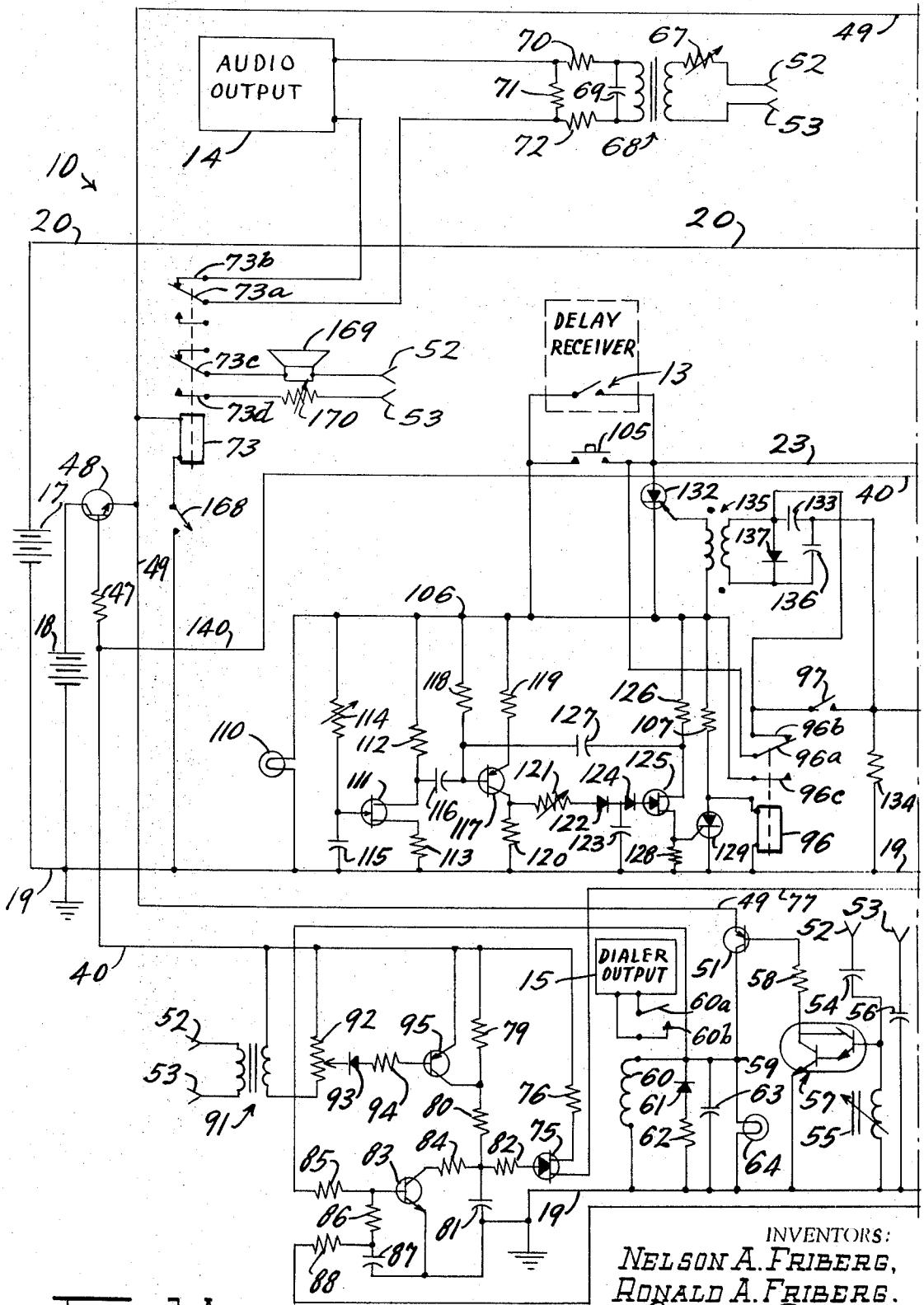



FIG-1A-

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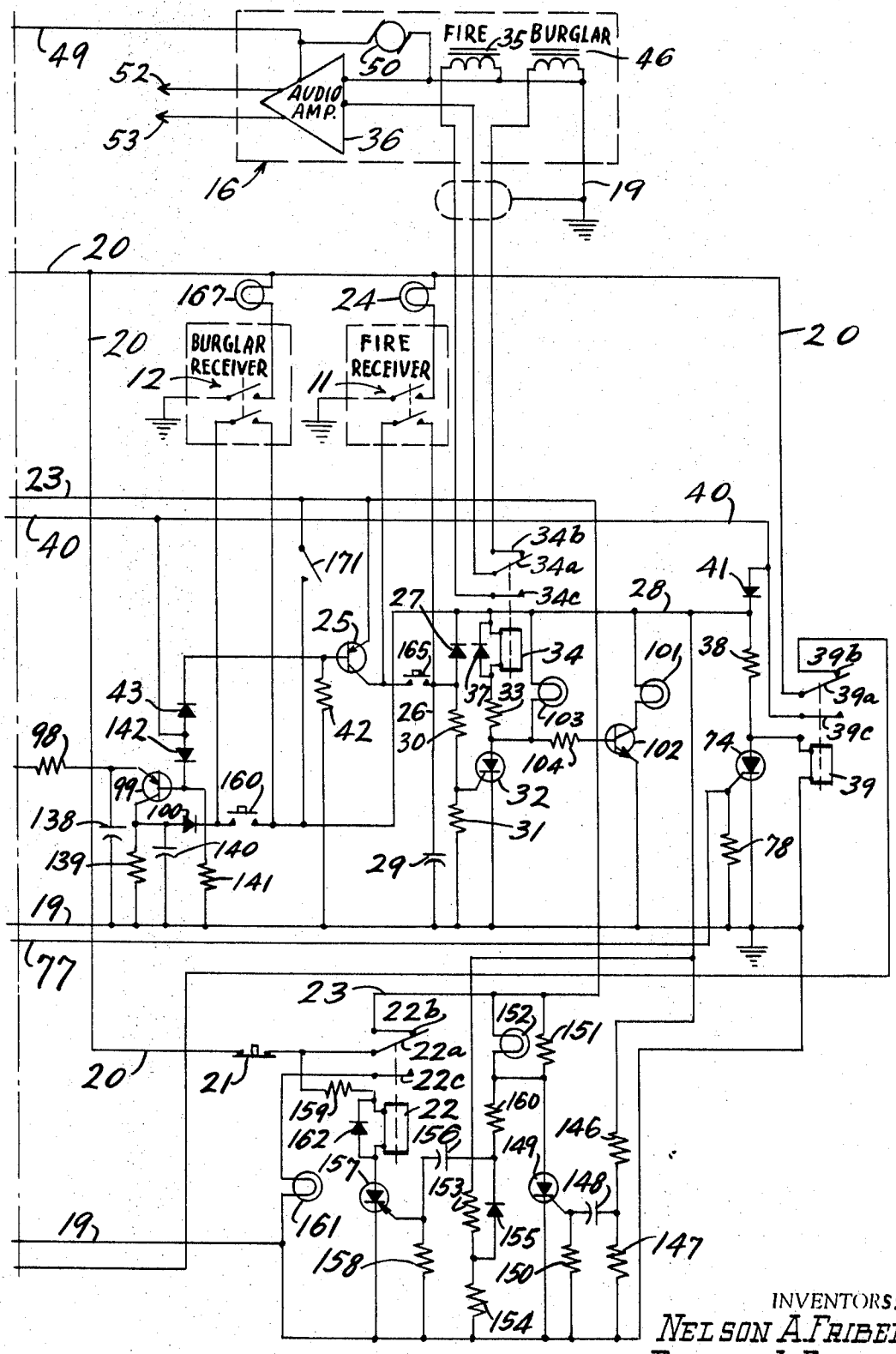



FIG-1B-

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# BURGLAR AND FIRE ALARM

## BACKGROUND OF THE INVENTION

This invention relates generally to automatic alarm signaling systems, and more particularly to an automatic alarm system which utilizes the telephone system for contacting predetermined telephone stations and relaying information concerning any one or more of several predetermined conditions or disturbances.

It is desirable in many alarm systems, such as fire and burglary systems, to eliminate the need for continuous human surveillance of an area to be protected. Yet it is also desirable to have continuous human surveillance of the area since essentially instantaneous warnings are then available upon the occurrence of a fire, a burglary, or other monitored condition. In one commonly used protection system, the high expense of continuous surveillance is reduced by having a single attendant at a central station monitor a large number of areas. Detectors such as bimetallic fire detectors, door switches, ultrasonic disturbance detectors, and photoelectric detectors are connected from each protected area through leased telephone lines to indicator lamps at the central station. When a fire or burglary is detected, an associated lamp or other signal is energized and the attendant contacts the local police or fire station.

Such a central station alarm system, however, is subject to a number of inherent problems. Heavy wind, rain and hailstorms sometimes affect the leased telephone lines, causing a large number of simultaneous false alarms. In such cases, the central station attendant must have a guard check each area from which an alarm was received prior to notifying the police or fire station. This may cause considerable lost time in reporting the alarm, which may result in either an increased loss or a total loss, where only a partial loss would have occurred if the alarm had been promptly reported. Furthermore, the central station system is expensive because a central station attendant must be paid a salary and there is a monthly lease charge for the telephone lines between each monitored area and the central station. In rural areas, the monthly line lease charge is prohibitively high due to the long lines required between each area and the central station.

Automatic alarm systems have been suggested to totally eliminate the need for continuous human surveillance. Such systems typically dial either the telephone operator or a single telephone station in response to the detection of a fire or burglary and deliver a prerecorded message. Many automatic systems are designed for use with a standard telephone, leaving the telephone operable during the daytime. To use the alarm, the telephone headset is placed in a cradle on the alarm with the microphone positioned adjacent to a speaker which is connected to a magnetic tape player. A solenoid pulser is placed over the hookswitch on the telephone base to release the hookswitch when an alarm is sensed, thus seizing a telephone line, and to pulse the hookswitch for dialing a predetermined telephone number. The solenoid pulser is typically operated by either a coded disc, a coded tape, or a pulsed signal recorded on a separate channel on the magnetic tape containing the prerecorded message.

One problem occurring in prior art automatic alarm systems is that the telephone line may be tied up for some time after an alarm condition is detected. Typically, the system will continuously recycle as long as a condition continues to be sensed by the detector. If many of these systems were simultaneously triggered by a disaster such as an earthquake or even by a bad storm, critical switchboards at police and fire stations could be paralyzed for hours.

Another problem occurs when it is necessary to temporarily disarm the system. A large warehouse or factory may have only a few selected areas which are monitored or protected by detectors connected to an automatic system. Armed guards may also be used to periodically check the entire warehouse, including the protected areas. As a guard makes his rounds, the alarm must be temporarily disarmed whenever he crosses through a protected area. Also, when the alarm is actually positioned in a protected area, the alarm must be temporarily disarmed to allow personnel to leave the area when the alarm system is initially armed and to enter the area when the alarm system is to be disarmed. This is usually accomplished by a key-operated switch mounted outside the protected area. To date, there has been no satisfactory method other than a manual switch for temporarily disarming an alarm system.



## SUMMARY OF THE INVENTION

According to the instant invention, remotely positioned fire and burglary detectors are connected to trigger an automatic alarm system by means of radio control linkages. Conventional fire and burglary detectors are connected to radio transmitters, with separate channels used for fire and burglary alarms. When an alarm is received, a tape transport is energized to drive an endless magnetic sound reproducing tape. The endless tape preferably has two prerecorded tracks, one for fire and one for burglary. Each tape track is divided into a predetermined number of groups for making a corresponding number of telephone calls while each group is divided into three portions. A continuous high frequency audio tone is recorded on the first portion of each group to cause a relay to close, thereby seizing a telephone line. The audio tone is pulsed in the second portion of each group to pulse the line seizing relay for dialing a selected telephone number over the seized line. The tone then remains continuous throughout the third portion of each group to hold the line seizing relay closed while a message is transmitted to the dialed station. The message and the continuous tone are superimposed on each third portion on the tape.

After a message is completed, the recorded tone stops and the seized line is released. If there are remaining groups on the tape, the tape transport will continue to operate until all numbers have been dialed and all messages have been transmitted. At the end of the tape, the tone is finally stopped to release the telephone line and a prerecorded audio signal causes a control circuit to shut off the tape transport. The control circuit will also shut off the alarm system after a predetermined period of time during which there is no tone or audio signal due to either a defective tape or a defective audiocircuit component.

If the detected condition reoccurs or persists after the alarm system has completed a cycle, the alarm system will be recycled. A cycle counter is included to limit the number of times the system will recycle without first being manually reset. Therefore, the number of telephone calls made by the alarm system is limited and telephone lines and critical switchboards will not be tied up for unreasonable periods of time.

A variable time delay circuit is connected to the burglar channel of the alarm system to permit personnel to pass through a protected area without triggering the alarm. The delay circuit is automatically energized whenever the burglar channel of the alarm system is initially armed, allowing personnel to leave the protected area. The delay circuit may also be energized by a small hand-held radio transmitter. Thus, when a guard or other personnel must pass through a protected area, he temporarily disarms the burglar channel of the alarm system by energizing the delay circuit with a small portable transmitter and then walks through the area. The alarm system automatically rearms itself after a preset time delay. The radio actuated time delay circuit is also used to temporarily disarm the alarm system for entering the protected area to shut off the burglar channel of the alarm. The fire channel will remain operative even though the burglar channel has been disarmed.

Test switches and indicator lamps are connected to the alarm system to permit a quick, positive check of circuit operation. The connection to the phone line is broken and a speaker is connected to the audio output from the tape when the system is in the test position.

Accordingly, it is a primary object of the invention to provide an improved automatic alarm system responsive to the

detection of an alarm condition for successively dialing a series of telephone numbers and successively transmitting messages to each dialed telephone.

Another object of the invention is to provide a radio controlled time delay circuit in an automatic alarm system for temporarily disarming the alarm to permit passage through a monitored area without triggering the alarm.

Still another object of the invention is to provide an improved circuit for shutting off an automatic alarm system at the end of an alarm cycle and in the event of failure of the audio portion of the alarm circuit.

Other objects and advantages of the invention will become apparent from the following detailed description, reference being made to the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**, composed of FIGS. **1***a* and **1***b*, is a detailed schematic circuit diagram of an automatic alarm system constructed in accordance with the instant invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. **1**, a detailed schematic circuit diagram is shown for an improved burglar and fire alarm system **10**, according to the instant invention. The alarm is designed for use with conventional detectors (not shown), such as bimetallic switches, smoke sensors and thermal rise detectors for fires and window and door switches, ultrasonic disturbance detectors and photoelectric switches for burglaries. The detectors may be positioned remotely from the alarm system **10** and linked to the alarm system by means of small, battery operated radio transmitters. The transmitters, which are commercially available units, preferably operate on a single carrier frequency. The carrier is modulated with two predetermined audio tones in response to the detection of a fire and with two different audio tones in response to the detection of a burglary. A conventional receiver is mounted in the alarm system **10** and is tuned to the carrier frequency of the fire and burglary transmitters. The receiver is connected to close a fire relay **11** (upper center—FIG. **1***b*) in response to reception of the carrier and the two audio signals associated with the fire transmitters and to close a burglary relay **12** in response to reception of the carrier and the two audiofrequencies associated with the burglary transmitters. The receiver has a third channel which is connected to close a delay relay **13** (FIG. **1***a*) in response to the reception of the carrier and two distinct audio signals transmitted by a small, hand-held transmitter. When the delay relay **13** is momentarily closed, the alarm system **10** will be temporarily disarmed for a predetermined period of time, allowing personnel to enter and pass through a monitored area without triggering the burglary alarm portion of the system **10**. Although three separate carrier frequencies may be used and each carrier may be modulated by a single audio signal for each of the fire, burglary and delay channels, it is preferable to use a single carrier frequency since only a single receiver will than be required for the alarm system and it is preferable to modulate the carrier with two audio signals for reducing the chance of the alarm system being triggered by a stray signal.

The alarm system **10** has an audio output **14** (top or FIG. **1***a*) and a dialer output **15** (lower right—FIG. **1***a*) which are designed for connection to a conventional telephone line. The audio output **14** and the dialer output **15** may be connected to the appropriate inputs of a conventional telephone coupler (not shown) which is available from the telephone company or, where permitted by the telephone company, connected in series and directly to the telephone line. When the alarm system **10** is armed, and either a burglary or a fire is detected, a tape transport **16** (top of FIG. **1***b*) is energized for driving a two-track prerecorded endless magnetic sound reproducing tape. Prerecorded signals on the tape cause the dialer output **15** to successively seize a telephone line, dial a predetermined telephone number and apply a prerecorded message to the audio output **14** for transmission to the dialed telephone station.

The alarm system **10** is designed for operation from suitable direct current power sources **17** and **18**. The source **17** is of a relatively high voltage, for example, 18 volts, for operating the solid state control circuit portion of the alarm system **10**, while the source **18** may be of a relatively lower voltage, for example, 6 volts, for operating the tape transport **16** and the phone dialer **15**. Although the sources **17** and **18** may be batteries, it is preferable to have a power supply connected for operation from conventional power lines with batteries connected in reserve in case of power failure.

The direct current source **17** is connected between a ground terminal **19** and a positive line **20**. The positive line **20** is connected through a normally closed reset switch **21** (bottom left—FIG. **1***b*) and through normally closed contacts **22***a* and **22***b* of a relay **22** to a positive buss **23**. The buss **23** will remain positive until the alarm system **10** has cycled a predetermined number of times (the circuitry shown is designed to cycle twice), at which time the relay **22** is energized to open the contacts **22***a* and **22***b* and thereby remove voltage from the buss **23**. The relay **22** will remain energized until the reset switch **21** is momentarily opened, as will be discussed in greater detail below.

To facilitate describing the circuitry, assume that the fire relay **11** is closed in response to the detection of a fire in a monitored area. A fire signal received indicator lamp **24** will be illuminated when the fire relay **11** is closed and a positive voltage will be applied from the buss **23**, through a normally conducting transistor switch **25** and the energized fire relay **11** to a junction **26**. The junction **26** is connected through an isolation diode **27** to apply the positive voltage to a buss **28**, through a capacitor **29** to the ground terminal **19** and through a voltage divider including series resistors **30** and **31** to the ground terminal **19**.

The voltage applied to the junction **26** will rapidly build up, as the capacitor **29** charges, to a point sufficient to trigger a silicon controlled rectifier **32** which has a control electrode connected to the common junction between the series resistors **30** and **31**. The controlled rectifier **32** has input and output terminals connected in series with a resistor **33** and a relay **34** between the buss **28** and the ground **19**. When the relay **34** is energized by the triggering of the controlled rectifier **32**, normally open relay contacts **34***a* and **34***c* are shorted to connect a fire channel tape head **35** in the tape transport **16** to the input of an audio amplifier **36**. A reverse biased diode **37** is placed in parallel with the relay **34** to discharge energy stored in the relay when voltage is removed from the buss **28**.

The buss **28** is also connected through a resistor **38** and a relay **39** to the ground terminal **19**. When voltage is applied to the buss **28** due to the detection of a fire, the relay **39** is energized, thereby closing associated contacts **39***a* and **39***c* to apply a voltage from the positive line **20** to a buss **40**. The buss **40** is connected through a diode **41** to maintain a positive voltage on the buss **28**, even though the fire relay **11** may have become deenergized. Once the relay **39** is energized to close the contacts **39***a* and **39***c*, current will flow serially from the positive line **20**, through the closed contacts **39***a* and **39***c*, the diode **41**, the resistor **38** and the relay **39** to keep the relay **39** energized. The base of the normally conducting transistor switch **25** is connected through a resistor **42** to the ground terminal **19** and through a diode **43** to the buss **40**. When the relay **39** is energized in response to the detection of an alarm, the transistor switch **25** is biased into a nonconducting state by the positive voltage on the buss **40**. When the transistor switch **25** is nonconducting, voltage is removed from the fire relay **11** to disable the relay **11**. This circuit arrangement prevents the fire relay **11** from triggering the controlled rectifier **32** while a burglary alarm is being transmitted, as will be discussed below.

The buss **40** is also connected through a resistor **47** to the base of a normally nonconducting transistor switch **48** (left center—FIG. **1***a*). The transistor switch **48** is connected in series between the direct current source **18** and a line **49**. The

line 49 is connected to the tape transport 16 for supplying operating current to the audio amplifier 36 and to a tape drive motor 50. The line 49 is also connected to a transistor switch 51 (lower right—FIG. 1*a*) for operating the telephone dialer circuit. When the relay 39 has been energized in response to the detection of a fire to apply a voltage from the line 20 to the buss 40, the transistor switch 48 is biased on to apply power from the direct current source 18 to the line 49. The tape motor 50 is then powered to drive a prerecorded endless magnetic sound reproducing tape past the fire channel tape head 35 and past a burglar channel tape head 46. Since a fire has been detected, the fire tape head 35 is connected to the input of the audio amplifier 36 which is also energized from the line 49.

As stated above, the endless magnetic tape is preferably divided into two channels, one containing messages relating to fires and one containing messages relating to burglaries. Each channel is divided into a number of groups of three consecutive portions, with each group relating to a different telephone call to be made in response to the associated detected condition. The first portion of each group contains a constant high frequency audio tone, for example, an 8 kHz. tone. The second portion of each group contains the same frequency audio tone which is pulsed to correspond to the telephone number of a predetermined station. The third portion of each group contains the same frequency constant audio tone as the first portion as well as a superimposed message relating to the associated detected condition.

The audio amplifier 36 has a pair of output lines 52 and 53. The schematic has been simplified by the omission of the several connections to the output lines 52 and 53 of the audio amplifier 36. However, all lines designated 52 are interconnected and all lines designated 53 are interconnected. The output line 52 of the amplifier 36 is connected (lower right—FIG. 1*a*) through a capacitor 54 and a series connected variable inductor 55 to the ground terminal 19 while the output line 53 is connected through a capacitor 56 to the ground line 19. The variable inductor 55 is adjusted to resonate with the capacitors 54 and 56 at the frequency of the audio tone recorded in each group on the endless magnetic tape, for example, at 8 kHz. The junction between the series capacitor 54 and the inductor 55 is connected to the high impedance input of a current amplifier 57. The amplifier 57 is preferably a pair of Darlington connected transistors, which may have a current gain as high as 900 or more. The output of the amplifier 57 is connected through a resistor 58 to the base of the transistor switch 51. The transistor switch 51 is normally in a nonconducting state, but is biased into a conducting state whenever the constant audio tone is applied to output lines 52 and 53 of the amplifier 36. When the transistor 51 is in a conducting state, current flows from the line 49 through the transistor 51 to a junction 59 for energizing a dialing relay 60. A reverse biased diode 61 and a series connected resistor 62, a capacitor 63 and a line seized indicator lamp 64 are each connected in parallel with the dialing relay 60. Thus, whenever the audio amplifier 36 applies the audio tone from the tape to the output lines 52 and 53, the transistor switch 51 will conduct to energize the dialing relay 60 and the line seized lamp 64. When the relay 60 is energized, associated contacts 60*a* and 60*b* are closed to apply a signal at the dialer output 15 for seizing, dialing or holding a telephone line. The pulsed tone recorded on the second portion of each group on the tape causes the relay 60 to be pulsed for dialing a predetermined telephone number. After the number has been dialed, the constant tone from the third portion of each recorded group causes the relay contacts 60*a* and 60*b* to be held closed for holding the telephone line seized.

While the constant tone recorded in each third portion on the tape causes the relay contacts 60*a* and 60*b* to be held closed for holding the telephone line, the prerecorded audio message is simultaneously applied to the output lines 52 and 53 of the audio amplifier 36. The message is applied through a variable resistor volume control 67 to the primary winding of an isolation and impedance matching transformer 68. The secondary winding of the transformer 68 is connected through a network including a capacitor 69 and three resistors 70, 71 and 72 and through normally closed contacts 73*a* and 73*b* of a test relay 73 to the audio output 14. The relay contacts 73*a* and 73*b* are maintained closed except when the alarm system 10 is being tested, as will be discussed in greater detail below. Although the message and the constant audio tone are superimposed on each third portion, the frequency of the tone is sufficiently high as to be attenuated (particularly by the transformer 68, the capacitor 69, and the resistors 70, 71 and 72) to a point where it does not interfere with the transmission of the message.

When the last message has been played in an alarm cycle, a stop circuit applies a triggering signal on the control electrode of a silicon controlled rectifier 74. The controlled rectifier 74 is connected in parallel with the relay 39 for momentarily shorting out the relay 39 when triggered. When the relay 39 is momentarily shorted, the contacts 39*a* and 39*c* are opened, removing voltage from the buss 40 and, if the fire relay 11 and the burglar relay 12 are both open, removing voltage from the buss 28. A unijunction transistor 75 (lower center—FIG. 1*a*) is connected to trigger the controlled rectifier 74. One base of the unijunction transistor 75 is connected through a resistor 76 to the buss 40 (which is positive whenever an alarm is being given) and the other base is connected through a line 77 to the control electrode of the controlled rectifier 74 and through a resistor 78 to the ground terminal 19. The controlled rectifier 74 will be triggered when the unijunction transistor 75 is conducting. A series connection is made from the buss 40 through a resistor 79, a resistor 80 and a capacitor 81 to the ground terminal 19. The common junction between the resistor 80 and the capacitor 81 is connected through a resistor 82 to the emitter of the unijunction transistor 75. Whenever the capacitor 81 is charged to a predetermined level, the unijunction transistor 75 will conduct to trigger the controlled rectifier 74. A transistor switch 83 and a series resistor 84 are connected in parallel with the capacitor 81. The base of the transistor 83 is connected through a resistor 85 to the junction 59, which is positive whenever the dialing relay 60 is energized. The base of the transistor 83 is also connected through a resistor 86 and a series capacitor 87 to the ground terminal 19. A resistor 88 is connected from the junction between the resistor 86 and the capacitor 87 to a contact 39*b* of the relay 39. When an alarm is being received by the alarm system 10 and a tone causes the dialing relay 60 to be energized, a voltage is applied from the junction 59 through the resistor 85 to the base of the transistor 83 to bias the transistor 83 on. As long as the transistor 83 is biased on, the capacitor 81 will be discharged and the unijunction transistor 75 will be in a nonconducting state. Should the tape break, or should the prerecorded constant tone stop, the transistor 83 will be biased off and the capacitor 81 will start charging through the series resistors 79 and 80.

A relatively strong, low frequency audio signal is recorded at the end of the tape cycle without the high frequency audio tone which controls the dialing relay 60. Since there is no audio tone, the transistor 83 will be biased off and the capacitor 81 will start charging. The audio signal is applied from the amplifier 36 outputs 52 and 53 to the primary winding of a transformer 91 (lower left—FIG. 1*a*). A portion of the output of the transformer 91 is connected from a variable calibration resistor 92 through a diode 93 and a series resistor 94 to the base of a normally nonconducting transistor switch 95. The transistor switch 95 is connected in parallel with the resistor 79 to short out the resistor 79 in response to the audio signal at the amplifier 36 outputs 52 and 53. When the resistor 79 is shorted out, the capacitor 81 will rapidly charge through the resistor 80 to bias the unijunction transistor 75 into a conducting state. Thus, if the transistor 83 is nonconducting to permit the capacitor 81 to charge and the transistor 95 is biased into a conducting state to bypass the resistor 79, the unijunction transistor 75 may, for example, be switched into a conducting state in a matter of a second or two. If, on the other hand, the

transistor **95** is nonconducting because of the absence of an audio signal on the outputs **52** and **53**, the capacitor **81** may take a minute or two to charge to a level sufficient to switch the unijunction transistor **75** into a conducting state. Such an arrangement allows a pause on the tape between each recorded group for successive telephone calls without shutting off the alarm system **10**, but assures that the alarm system **10** will be quickly shut off at the end of an alarm cycle and will be shut off after a predetermined time if there should be no audio signal due to a broken tape or a defective component in the audio circuitry.

As stated above, there is a recorded audio signal on the tape after the last group for shutting off the tape transport **16**. This recorded signal may continue on the tape for several seconds of playing time after the alarm system **10** is stopped. The capacitor **87** is connected to prevent the stop circuit from immediately shutting off the alarm at the beginning of a cycle due to the recorded audio signal. When the alarm system **10** is shut off, a positive voltage is applied from the line **20** through the normally closed relay contacts **39***a* and **39***b* and the resistor **88** to charge the capacitor **87**. When the alarm is initially energized, the charge on the capacitor **87** will bias the transistor **83** into a conducting state to keep the capacitor **81** discharged for a sufficient time to prevent the remaining few seconds of recorded audio signal from immediately shutting off the alarm system.

The burglary channel is, in many respects, similar to the fire channel, with the major exception that a time delay circuit has been added. In the fire channel, a positive voltage is normally applied from the buss **23** through a normally conducting transistor **25** to the fire relay **11**. In the burglary channel, however, a positive voltage is normally applied from the buss **23** through normally closed contacts **96***a* and **96***b* of a relay **96** (right center of FIG. **1***a*), through a safe-arm switch **97**, a resistor **98** (left center of FIG. **1***b*), a normally conducting transistor **99**, and a diode **100** to the burglary relay **12**. When a burglary signal is received from an associated detector and transmitter and the relay **12** is closed, this positive voltage is applied directly to the buss **28**. The alarm system **10** will then cycle in a manner similar to that described above for the fire channel with the exception that the controlled rectifier **32** will remain in a nonconducting state and, therefore, the relay **34** will be unenergized. Since the relay **34** is unenergized, the associated normally closed relay contacts **34***a* and **34***b* will be shorted to connect the burglary tape head **46** to the input of the audio amplifier **36**.

A burglary report indicator lamp **101** (right center—FIG. **1***b*) is connected in series with a transistor **102** between the buss **28** and the ground terminal **19** while a fire indicator lamp **103** is connected between the buss **28** and the silicon controlled rectifier **32**, in parallel with the relay **34** and the series resistor **33**. A bias resistor **104** is connected from the base of the transistor **102** to the common junction between the resistor **33**, the fire indicator lamp **103** and the controlled rectifier **32**. When a burglary is received, the transistor **102** is biased into a conducting state to energize the burglary indicator lamp **101**. When, on the other hand, a fire is detected and the controlled rectifier **32** is fired, the fire indicator lamp **103** is energized and the transistor **102** is biased into a nonconducting state to prevent the burglary indicator lamp **101** from being energized.

As stated above, a time delay circuit (center of FIG. **1***a*) is connected in the power supply for the burglary channel. The time delay circuit is energized to open the normally closed relay contacts **96***a* and **96***b* and thereby disarm the burglary channel for a predetermined period of time whenever (a) the safe-arm switch **97** is closed, (b) a delay test switch **105** is momentarily closed, or (c) the receiver closes the delay relay **13**. When the delay circuit is triggered, voltage is applied from the buss **23** to a buss **106**. When voltage is momentarily applied to the buss **106**, current will flow through a resistor **107** to energize the relay **96** causing normally closed contacts **96***a* and **96***b* to open, removing the voltage from the burglary receiver relay **12**, and causing normally open contacts **96***a* and **96***b* to short, thereby applying a voltage from the positive buss **23** to the buss **106**. Once energized, the voltage applied through the shorted contacts **96***a* and **96***c* to the buss **106** will hold the relay **96** in an energized state. The voltage applied to the buss **106** will also energize a "delay on" indicator lamp **110** and will operate a pulse generator including a unijunction transistor **111**. One base of the unijunction transistor **111** is connected through a resistor **112** to the positive buss **106** while the other base is connected through a resistor **113** to the ground terminal **19**. The emitter of the unijunction transistor **111** is connected through a variable resistor **114** to the buss **106** and through a capacitor **115** to the ground terminal **19**. The voltage on the buss **106** will charge the capacitor **115** through the resistor **114** to a point where the unijunction transistor **111** is biased on. At this point, the capacitor **115** will be rapidly discharged through the emitter of the unijunction transistor **111** and the unijunction transistor **111** will again become nonconducting. Each time the unijunction transistor **111** is switched on, a pulse is applied through a capacitor **116** to the base of a pulse amplifying transistor **117**. The repetition rate or frequency of the pulse as applied through the capacitor **116** is adjusted by varying the resistor **114**. The base of the transistor **117** is connected through a bias resistor **118** to the buss **106** while the emitter is connected through a bias resistor **119** to the buss **106** and the collector is connected through a resistor **120** to the ground terminal **19**. The output of the transistor **117** is connected through a variable calibration resistor **121** and a diode **122** to charge a capacitor **123**. The capacitor **123** is also connected through a diode **124** to the emitter of a unijunction transistor **125**. The unijunction transistor **125** will be biased into a conducting state when the capacitor **123** is charged to a predetermined level. The time required to charge the capacitor **123** to the predetermined level is dependent upon the pulse rate of the output of the unijunction transistor **111** and the peak pulse voltage, as set by the calibration resistor **121**. The number of pulses required to charge the capacitor **123** to the voltage required to trigger the unijunction transistor **125** is nearly a constant number and is nearly independent of the pulse rate.

One base of the unijunction transistor **125** is connected through a resistor **126** to the buss **106** and through a capacitor **127** to the base of the transistor **117** while the other base is connected through a resistor **128** to the ground terminal **19**. The base of the unijunction transistor **125** which is connected to the resistor **128** is also connected to the control electrode of a silicon controlled rectifier **129**. When the capacitor **123** is charged to a level where the unijunction transistor **125** just begins to conduct, a signal is applied through the capacitor **127** to the base of the transistor **117** to switch the transistor **117** on. Sufficient voltage is then applied through the transistor **117**, the resistor **121** and the diodes **122** and **124** to the emitter of the unijunction transistor **125** to bias it into a fully conducting state, thereby triggering the controlled rectifier **129**. The controlled rectifier **129** is connected to short out the relay coil **96** when triggered. When the relay **96** is shorted, the associated contacts **96***a* and **96***c* are opened to remove voltage from the buss **106** and the contacts **96***a* and **96***b* are again closed to arm the burglary channel.

A silicon controlled rectifier **132** is connected between the buss **23** and the delay buss **106** to trigger the time delay circuit whenever the safe-arm switch **97** is initially closed or moved from the "safe" to the "arm" position. This will automatically cycle the time delay circuit, giving the operator sufficient time to leave the area before the burglary channel will be armed. A capacitor **133** and a series resistor **134** are connected between the relay contact **96***b* and the ground terminal **19**. The capacitor **133** will normally be charged from voltage applied from the buss **23** through the normally closed contacts **96***a* and **96***b* when the safe-arm switch **97** is in the safe or open position. The primary winding of a transformer **135** and a capacitor **136** are connected in series with each other and in parallel with the capacitor **133** such that the capacitor **136** will also be charged

when the switch **97** is in the safe position. The secondary winding of the transformer **135** is connected between the control electrode and the cathode of the controlled rectifier **132**. When the safe-arm switch **97** is initially closed, energy stored in the capacitor **136** is discharged through the primary winding of the transformer **135** to trigger the controlled rectifier **132**. A diode **137** is connected in parallel with the primary winding of the transformer **135** to decrease the charging time of the capacitor **136** and to prevent the primary winding, the capacitor **133** and the capacitor **136** from oscillating. When the controlled rectifier **132** is fired, voltage is applied from the buss **23** to the time delay buss **106** to energize the time delay circuit. As stated above, this voltage will energize the relay **96**, closing the relay contacts **96***a* and **96***b*. The contacts **96***a* and **96***c* are in parallel with the controlled rectifier **132** and therefore shut off the rectifier **132** when they close. A time delay circuit, comprising the resistor **98** and a capacitor **138**, prevents the burglary channel from being momentarily armed after the switch **97** is closed and before the relay **96** is energized.

When a positive voltage is applied to the emitter of the transistor **99** (left center—FIG. **1***b*) current normally flows through the transistor **99** to the collector, which is connected through a resistor **139** and a parallel capacitor **140** to the ground terminal **19**. The base of the transistor **99** is connected through a bias resistor **141** to the ground terminal **19**. A diode **142**, similar to the diode **43**, is connected from the buss **40** to the base of the transistor **99** to bias the transistor **99** into a nonconducting state whenever a voltage appears on the buss **40** because an alarm is in progress.

As stated above, a counter (lower center—FIG. **1***b*) is provided to energize a relay **22**, and thereby remove voltage from the buss **23**, after the alarm system **10** has cycled a predetermined number of times. A counter is shown to open the relay **22** after the second alarm cycle is initiated, although additional cycles may be provided for. The counter is operated at the beginning of each cycle by the voltage applied to the buss **28**. The buss **28** is connected through a voltage divider including a resistor **146** and a series resistor **147** which is connected to the ground terminal **19**. The junction between the resistors **146** and **147** is connected through a capacitor **148** to the control electrode of a silicon controlled rectifier **149**. The control electrode of the controlled rectifier **149** is also connected through a resistor **150** to the ground terminal **19**, while the cathode is connected directly to the ground terminal **19** and the anode is connected through a resistor **151** to the buss **23**. A "first alarm" indicator lamp **152** is connected in parallel with the resistor **151**. The first time voltage is applied to the buss **28**, the controlled rectifier **149** is triggered, thereby illuminating the lamp **152**. The resistor **151** assures that the rectifier **149** will be triggered, even though the lamp **152** may have failed. The buss **28** is also connected through a second voltage divider including resistors **153** and **154** to the ground terminal **19**. The common junction between the resistors **153** and **154** is connected through a diode **155** and a capacitor **156** to the control electrode of a second silicon controlled rectifier **157**. The control electrode of the controlled rectifier **157** is also connected through a resistor **158** to the ground terminal **19**, while the cathode is connected directly to the ground terminal and the anode is connected through the relay **22** and a current limiting resistor **159** to the contact **22***a* of the relay **22**. As previously stated, the contact **22***a* of the relay **22** is connected through the normally closed reset switch **21** to the positive line **20**. A blocking resistor **160** is connected from the anode of the controlled rectifier **149** to the junction between the diode **155** and the capacitor **156** to apply a positive blocking voltage on the capacitor **156** as long as the rectifier **149** is nonconducting. This voltage is removed during the first alarm cycle when the controlled rectifier **149** is triggered. When the alarm is cycled for a second time, the voltage applied to the buss **28** applies a pulse through the resistor **153**, the diode **155** and the capacitor **156** to the control electrode of the controlled rectifier **157**, thereby triggering the rectifier. When the controlled rectifier **157** is triggered, the relay **22** is energized to remove voltage from the buss **23**. Normally open contacts **22***a* and **22***c* of the relay **22** are at this time shorted to illuminate a "second alarm" indicator lamp **161**. Once energized, the relay **22** will hold itself in an energized state until the reset switch **21** is momentarily pushed. When the system is reset, energy stored in the coil of the relay **22** will discharge through a parallel diode **162** and the contacts **22***a* and **22***b* will return to their normally closed position.

The alarm system **10** is provided with numerous test switches and indicator lamps to facilitate in checking out the operation of the system. As previously stated, a "delay on" indicator lamp **110** is connected to the delay circuit to indicate correct circuit operation. A test switch **105** permits an operator to trigger the delay circuit. The fire channel is provided with a "fire signal received" lamp **24** which is illuminated whenever the fire relay **11** is energized and with a "fire report" indicator lamp **103** to indicate that a fire is currently being reported. A fire test switch **165** is provided in parallel with the fire relay **11** to test the fire channel. A burglar test switch **166** is provided in parallel with the burglar relay **12** to test for proper operation of the burglar alarm channel. The "burglar report" indicator lamp **101** will indicate proper operation of the burglar channel while a "burglar signal received" light **167** indicates that the burglary relay **12** has been energized.

The test relay **73** (upper left—FIG. **1***a*) is connected through a normally open, key operated test switch **168** between the line **49** and the ground terminal **19**. As previously stated, a positive voltage will be applied through the transistor **48** to the line **49** whenever the relay **39** is energized by an alarm in progress. When a voltage is applied to the line **49** and the test switch **168** is closed, the relay **73** will become energized to open the relay contacts **73***a* and **73***b*, removing the audio signal from the audio output **14**, and to close normally open relay contacts **73***c* and **73***d*. The audio output lines **52** and **53** from the audio amplifier **36** are connected in series through a speaker **169**, the normally open relay contacts **73***c* and **73***d* and a variable resistor volume control **170**. Thus, whenever the test switch **168** is in the test position, the relay **73** is energized to remove the audio signal from the audio output **14** and to apply the audio signal from the output lines **52** and **53** to the speaker **169**, allowing the operator to listen to the prerecorded messages on the tape.

An optional burglary switch **171** (center of FIG. **1***b*) is shown connected between the buss **23** and the buss **28**. The switch **171** may be located at a convenient location, such as adjacent a cash register or a teller's counter. If an armed robbery should occur during the day while the burglary channel is disarmed and personnel such as a store clerk or a bank teller are nearby, the momentary closure of the switch **171** will trigger the burglary channel of the alarm to silently notify the police of the occurrence of a robbery.

What we claim is:

1. In an automatic burglar alarm system for use with a telephone system and including at least one burglary detector and means responsive to the detection of a burglary for successively seizing a telephone line, dialing a predetermined telephone station and transmitting a recorded alarm message to the dialed station, an improved control circuit comprising, in combination, switch means for arming said alarm system, an electronic time delay circuit having a predetermined time delay, means for energizing said time delay circuit when said alarm system is initially armed, means for preventing said alarm system from operating for the predetermined time after said time delay circuit is energized, and radio control means for remotely energizing said time delay circuit.

2. An improved control circuit for an automatic burglar alarm system, as defined in claim **1**, and including means for changing the predetermined time delay of said time delay circuit.

3. An improved control circuit for an automatic burglar alarm system, as defined in claim **1**, wherein said electronic

time delay circuit comprises a constant frequency pulse generator, a storage capacitor, means for charging said capacitor with pulses from said pulse generator, said capacitor charging to a predetermined voltage in the predetermined time, and switching means for preventing said alarm system from being responsive to the detection of a burglary after said time delay circuit is energized until said capacitor is charged to the predetermined voltage.

4. An improved control circuit for an automatic burglar alarm system, as defined in claim 3, and including means for changing the constant frequency of said pulse generator to change the rate at which said capacitor is charged and thereby change the predetermined time delay.

5. An automatic alarm system for transmitting a message over a telephone line to at least one predetermined station in response to the detection of a monitored condition, said alarm system comprising, in combination, an endless magnetic sound reproducing tape, said tape having a prerecorded channel divided into at least one group of three consecutive portions, the first of such portions having a continuous audio tone recorded thereon, the second of such portions having a pulsed audio tone corresponding to the dialing signal for a predetermined station recorded thereon, the third of such portions having the message and a superimposed continuous audio tone recorded thereon, said tape having recorded thereon after the last of said at least one group an audio signal other than said audio tones recorded in said three portions, transport means responsive to the detection of the monitored condition for driving said endless tape, means operable when said tape is driven for generating signals corresponding to the prerecorded signals on said tape, means responsive to said continuous audio tones in said first and third portions for seizing and holding the telephone line, means responsive to said pulsed audio tone in said second portion for dialing the corresponding predetermined telephone station, means for transmitting the message in said third portion to the dialed predetermined station, and means responsive to said audio signal recorded after the last of said at least one group for stopping said transport means.

6. An automatic alarm system, as defined in claim 5, and including means for stopping said transport means in the absence of said audio tones for a predetermined period of time.

7. An automatic alarm system, as defined in claim 5, wherein said means responsive to the audio signal recorded after the last of said at least one group for stopping said transport means comprises a capacitor, means responsive to said audio signal for applying a first charging current to said capacitor for charging said capacitor to a predetermined voltage, means responsive to the predetermined voltage on said capacitor for stopping said transport means.

8. An automatic alarm system, as defined in claim 7, and including means for applying a second charging current to said capacitor in the absence of said audio tones and said audio signal, said second charging current charging said capacitor to the predetermined voltage at a slower rate than said first charging current.

9. An automatic alarm system, as defined in claim 8, wherein said first charging current charges said capacitor to the predetermined voltage in a time less than 15 seconds and said second charging current charges said capacitor to the predetermined voltage in a time greater than 1 minute.

10. An automatic alarm system, as defined in claim 5, and including counting means for limiting the number of times said transport means is responsive to the detection of the monitored condition for driving said endless tape.

11. An automatic fire and burglar alarm system for transmitting messages over a telephone line to predetermined telephone stations in response to the detection of a fire or a burglary, said system comprising, in combination, an endless magnetic sound reproducing tape, said tape having two prerecorded channels, each of said channels being divided into at least one group of three consecutive portions, the first of such portions in each group having a continuous audio tone recorded thereon, the second of such portions in each group having a pulsed audio tone corresponding to the dialing signal for a predetermined telephone station recorded thereon, the third of such portions in each group having a message and a superimposed continuous audio tone recorded thereon, said tape having recorded on each channel after the last of said at least one group an audio signal other than said audio tones recorded in each of said three portions, transport means responsive to the detection of a fire or a burglary for driving said endless tape, means operable when said tape is driven in response to the detection of a fire for generating signals corresponding to the prerecorded signals on one of said channels on said tape, means operable when said tape is driven in response to the detection of a burglary for generating signals corresponding to the prerecorded signals on the other of said channels on said tape, means responsive to said continuous audio tones in said first and third portions of each group for seizing and holding the telephone line, means responsive to said pulsed audio tone in each of said second portions for dialing the corresponding predetermined telephone station, means for transmitting the message in each third portion to a dialed predetermined telephone station, and means responsive to said audio signal for stopping said transport means.

12. An automatic fire and burglar alarm system, as defined in claim 11, and including means for stopping said transport means in the absence of said audio tone for a predetermined period of time.

13. An automatic fire and burglar alarm system, as defined in claim 11, and including counting means for limiting the number of times said transport means is responsive to the detection of a fire or a burglary for driving said endless tape, and means for resetting said counting means.

14. An automatic fire and burglar alarm system, as defined in claim 11, and including an electronic time delay circuit having a predetermined time delay, radio control means for remotely energizing said time delay circuit, and means for preventing said transport means from being responsive to the detection of a burglary for the predetermined time after said time delay circuit is energized.