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Schultz et al.

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[54] **HIGH CAPACITY PAGING SYSTEM EMPLOYING SUBAUDIBLE TONES**

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[52] **U.S. Cl.** **325/55**, 325/64, 325/155, 340/311

[51] **Int. Cl.** **H04b 5/04**

[58] **Field of Search** ..... 325/55, 64, 155, 187; 343/177; 179/100.1 Z, 15 BY, 41 A; 340/171 R, 171 PF, 311

[56] **References Cited**

UNITED STATES PATENTS

3,397,401	8/1968	Winterbottom	343/177
3,387,101	6/1968	Skiles	325/64 X
2,524,782	10/1950	Ferrar et al.	325/55
3,581,208	5/1971	Buehrle, Jr. et al.	325/64 X
3,467,790	9/1969	Bolick, Jr.	179/100.1 Z
2,671,166	3/1954	O'Brien	325/64 X
2,038,647	4/1936	Clausen	325/102 X
2,918,524	12/1959	Hume	178/6.6 A X

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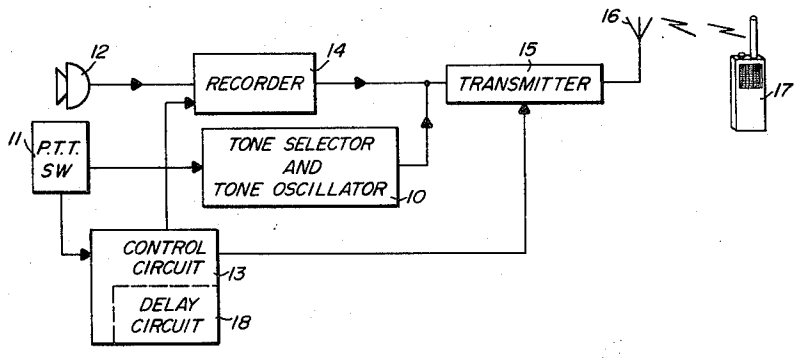
[57] **ABSTRACT**

A high capacity paging system includes a transmitter for transmitting a modulated signal in response to a message including address signals followed by audio signals. Each transmission is initiated by actuating the switch and terminated by deactuating the switch. Control circuitry is operative in response to the switch actuation to actuate the transmitter. The control circuitry includes time delay circuitry for holding the control circuitry operative for a first predetermined time period after deactuation of the switch. Address circuitry develops the address signals and is operative in response to actuation of the switch to couple the address signals to the transmitter for a second predetermined time period no greater than the first predetermined time period. Audio delay circuitry is operative in response to operation of the control circuitry to delay audio signals coupled from a microphone by the first predetermined time period and couple the delayed audio signals to the transmitter for transmission thereby. The address signals of the succeeding message are transmitted simultaneously with the terminal portion of the audio signals in the preceding message.

24 Claims, 3 Drawing Figures



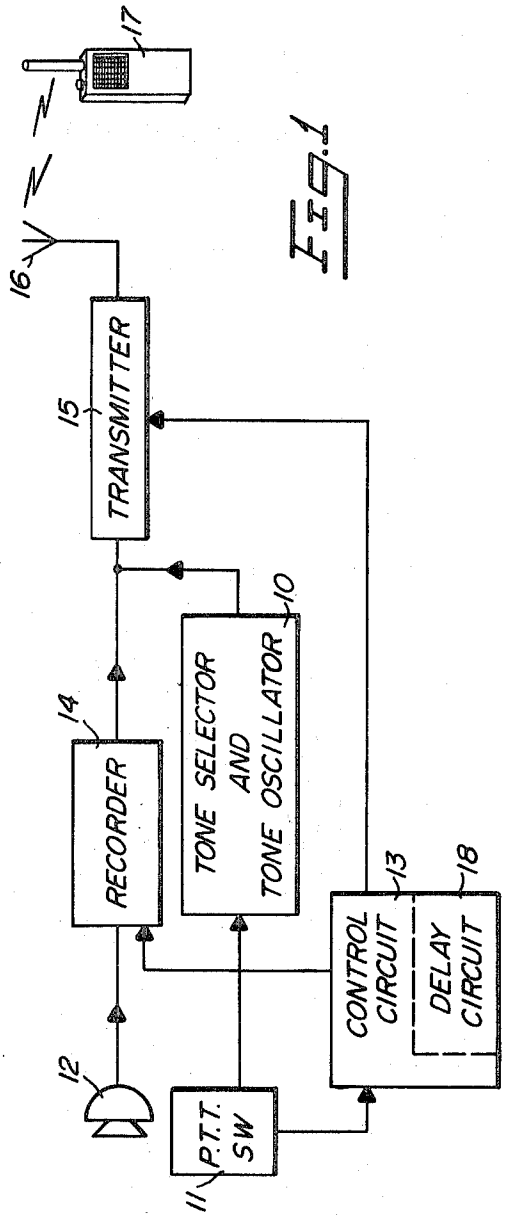
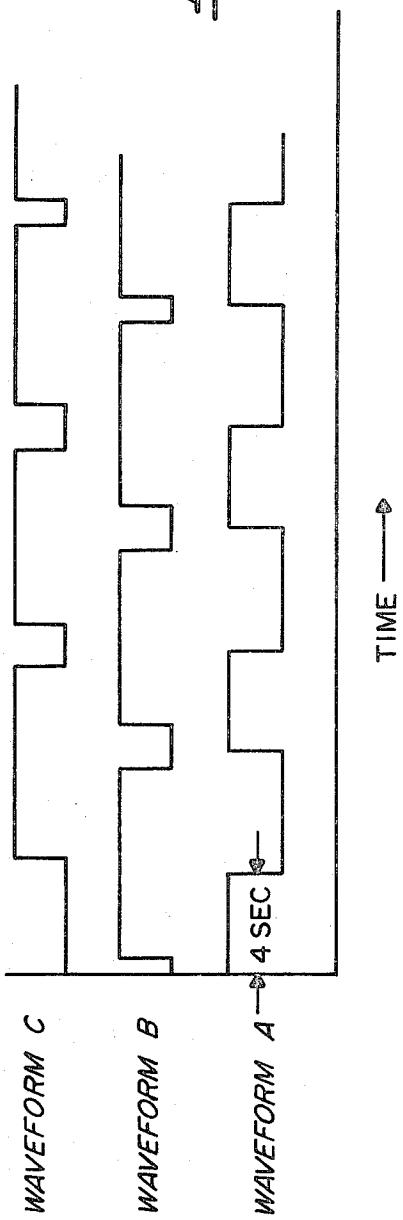

17
16
15
TRANSMITTER
14
RECORDER
10
TONE SELECTOR AND TONE OSCILLATOR
13
CONTROL CIRCUIT
18
DELAY CIRCUIT
12
11
P.T.T. SW

Fig. 1

Fig. 2


WAVEFORM C
WAVEFORM B
WAVEFORM A
4 SEC
TIME

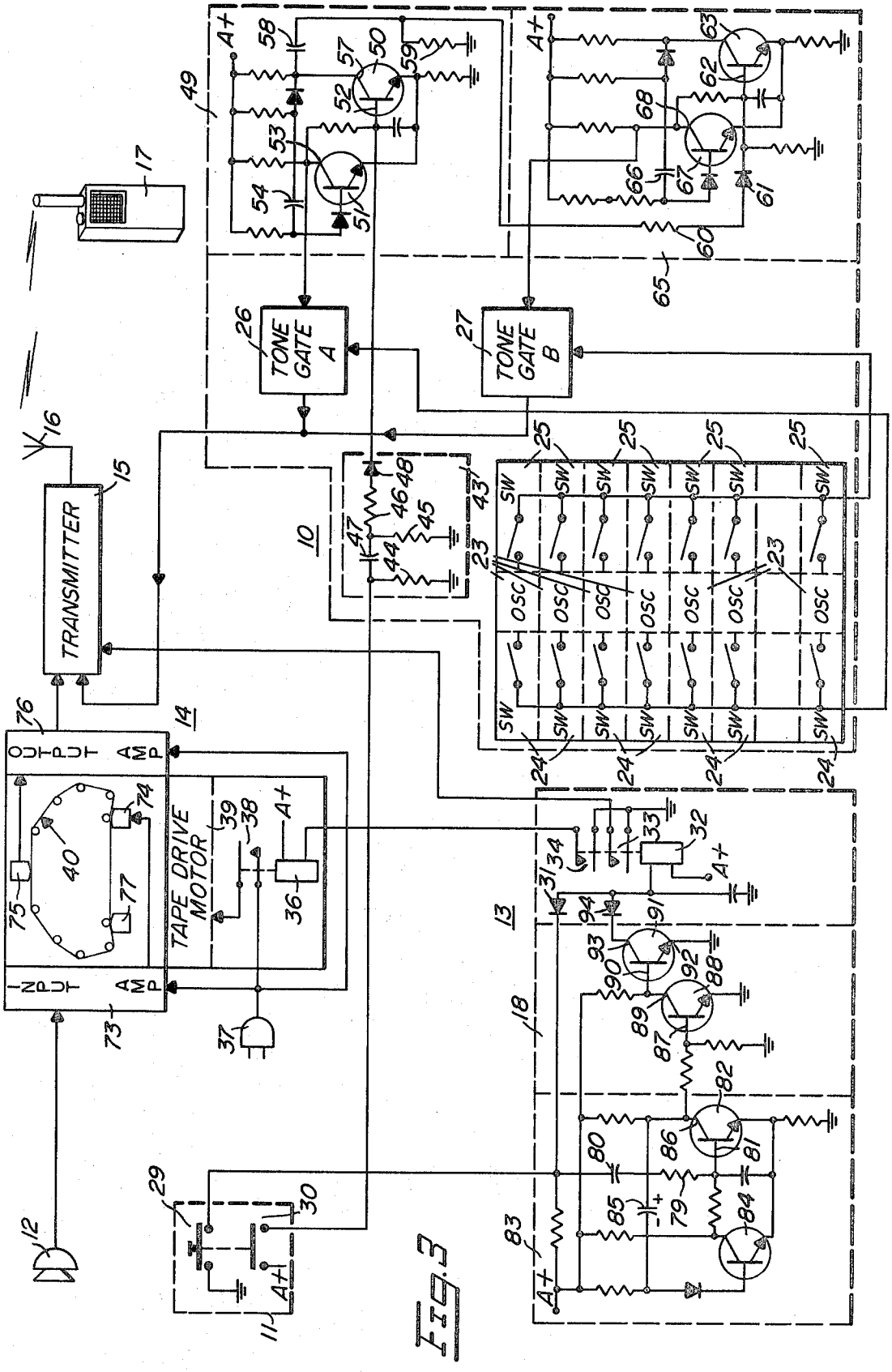

TONE GATE A
TONE GATE B
TRANSMITTER
TAPE DRIVE MOTOR
OUTPUT AMP
INPUT AMP
OSC
SW
A+

FIG. 3

HIGH CAPACITY PAGING SYSTEM EMPLOYING SUBAUDIBLE TONES

BACKGROUND

Paging systems currently employed which transmit audio messages to the desired paging receiver, contact the desired paging receiver by first transmitting an address signal for selecting the desired paging receiver. The audio message is transmitted immediately following the address signal. The address signals generally consist of one or more audio frequency tone signals, which may be simultaneously or sequentially transmitted for a predetermined period of time. The address signals in most systems are transmitted for one to four seconds, whereas the audio signals generally extend from four to eight seconds. At the desired receiver, the audio frequency tones are received and detected, causing actuation of the pager receiver audio amplifier. With the audio amplifier actuated, the following demodulated audio signals can be heard by the user.

In systems such as that described above, the address portion of the message accounts for one-third to one-half of the total time necessary to transmit a message. As the number of users in a paging system increases, a point will be reached when the system reaches full capacity. A maximum number of messages can then be transmitted during a one hour period, with messages being transmitted continuously. During the one hour period, one-third to one-half of the time is spent transmitting the address portion. Transmitting an address portion of a message prior to the audio portion therefore, seriously limits the number of message transmissions per hour time period, and the system message capacity.

SUMMARY

It is, therefore, an object of this invention to provide a high capacity paging system.

Another object of this invention is to provide a high capacity paging system which requires substantially less time for address portion transmission, and allows substantially more time for audio portion transmissions.

Yet another object of this invention is to provide a high capacity paging system employing subaudible tone signals for the address portion.

Still another object of this invention is to provide a high capacity paging system wherein the address portion is transmitted during the audio portion of a preceding message.

In practicing this invention, a high capacity paging system is provided which includes a transmitter for transmitting a modulated signal in response to a message, including address signals and audio signals. The address signals are two sequentially transmitted subaudible tone signals. Each transmission is initiated by actuating a push-to-talk switch, and the message terminated by deactuating the push-to-talk switch. Control circuitry is coupled to the push-to-talk switch and the transmitter and is operative in response to actuation of the push-to-talk switch to actuate the transmitter. A monostable multivibrator in the control circuitry maintains the control circuitry in an operative condition for a predetermined time period after deactuation of the push-to-talk switch.

Address circuitry is provided for developing the subaudible tone signals in the address portion. Selectors

are provided for manually selecting the tones necessary to form a desired address. The address circuitry is coupled to the push-to-talk switch and the transmitter, and is operative in response to the push-to-talk switch actuation to couple the subaudible tone signals to the transmitter for a second predetermined time period, no greater than the first predetermined time period. monostable multivibrators in the address circuitry provide the necessary timing for the second predetermined time period.

An endless loop tape recorder is also provided and is coupled to the microphone, transmitter and control circuitry. The tape recorder is operative in response to operation of the control circuitry to record the audio signals coupled from the microphone. The recorded audio signals are reproduced at the end of the first predetermined time period and these delayed audio signals are coupled to the transmitter for transmission thereby.

THE DRAWINGS

FIG. **1** is a simplified block diagram of a high capacity paging system in accordance with this invention;

FIG. **2** is a timing diagram which shows the timing for the various portions of the message;

FIG. **3** is a combined schematic and block diagram of a high capacity paging system in accordance with this invention.

DETAILED DESCRIPTION

Referring to FIG. **1**, a simplified block diagram for a high capacity paging system is shown, which transmits messages including subaudible tone signals followed by audio signals. Tone selector and tone oscillator **10** contains a plurality of tone oscillators for developing the desired subaudible tone signals. These subaudible tone signals extend in a range from 65 Hz to 250 Hz. A plurality of tone selectors are also provided in tone selector and tone oscillator **10**, which allow manual selection of the desired tone oscillators and tones for the address portion of the message. Actuation of particular tone selectors will allow the desired tones to be transmitted when a message is initiated.

Push-to-talk switch **11** is connected to control circuit **13**. Upon action of push-to-talk switch **11**, control circuit **13** operates, and causes the actuation of recorder **14** and transmitter **15**. Transmitter **15**, when actuated, develops a radio frequency (RF) signal, which may be modulated by subaudible tone signals and audio signals. The RF signal is transmitted via antenna **16** to a portable paging receiver such as that shown at **17**.

Push-to-talk switch **11** is also coupled to tone selector and tone oscillator **10**. Upon each actuation of push-to-talk switch **11**, the selected subaudible tone signals for the address portion of a message are coupled from tone selector and tone oscillator **10** to transmitter **15**. The subaudible tone signals modulate the transmitter RF carrier, and are radiated via antenna **16** to the desired portable paging receiver **17**. FIG. **2** waveform A shows the timing for the subaudible tone signals. In the embodiment shown, two tones are sequentially transmitted. The two tones have a total time period of approximately 4 seconds.

Speech information to be transmitted is coupled to microphone **12** where it is converted into audio signals. These audio signals are coupled from microphone **12**

to recorder **14.** FIG. **2,** waveform B, shows the timing for the audio signals coupled to recorder **14.**

Recorder **14** is an endless loop type tape recorder which is capable of recording the audio signals coupled from microphone **12** and reproducing the same audio signals a predetermined time period after they are recorded. The delay must be as long as, or longer than, the time period necessary to transmit the tones from tone selector and tone oscillator **10.**

Control circuit **13** includes a time delay circuit **18.** Upon termination of the message, push-to-talk switch **11** is deactuated. Each deactuation of push-to-talk switch **11** causes delay circuit **18** to maintain control circuit **13** in an operative condition for a predetermined time period. The predetermined time period for which control circuit **13** is maintained operative is the same as the predetermined time period for which the audio signals reproduced by recorder **14** are delayed. Maintaining control circuit **13** operative for this predetermined time period after deactuation of push-to-talk switch **11** allows recorder **14,** and transmitter **15,** to remain actuated during this time period, and thereby allows the delayed audio signals to be coupled from recorder **14** to transmitter **15** where they modulate the RF carrier signal and are transmitted to portable paging receiver **17.** FIG. **2** waveform C shows the timing for the delayed audio signals coupled to transmitter **15.**

In operation, a calling sequence is initiated by an operator actuating push-to-talk switch **11** after selection of the desired subaudible tone signals in the address. This causes the subaudible tones to be coupled from tone selector and tone oscillator **10** to transmitter **15.** Two subaudible tones are sequentially transmitted during the four second time interval immediately following actuation of push-to-talk switch **11** as shown in FIG. **2,** waveform A. Shortly after actuation of push-to-talk switch **11,** the operator begins speaking into microphone **12.** Microphone **12** develops audio signals in response to the operator's speech, and couples the audio signals to recorder **14** where they are recorded, then reproduced a predetermined period of time after recordation. These delayed audio signals are shown in FIG. **2** waveform C. The audio signals are delayed by a period of time greater than that necessary to transmit the subaudible tone signals as shown in FIG. **2,** waveforms A and C. These delayed audio signals are coupled from recorder **14** to transmitter **15** where they modulate the RF carrier signal. While the operator is speaking itno microphone **12** she selects the desired address for the next portable paging receiver to be contacted by actuating the proper tone selectors. Upon termination of the first message, push-to-talk switch **11** is deactuated, then again actuated to start a second message. When push-to-talk switch **11** is again actuated the delayed audio signals in the first message are still being coupled to transmitter **15** for modulation of the RF carrier signal, due to the operation of delay circuit **18.** Upon reactuation of push-to-talk switch **11** the subaudible tone signals for the second message are coupled to transmitter **15** where they modulate the transmitter RF carrier signal simultaneously with the delayed audio signals from recorder **14.** FIG. **2,** waveforms A and C shows the simultaneous presence of the address portion of the second message, and the delayed audio portion of the first message at transmitter **15.** Simultaneously with the transmission of the tones for the second message, the operator again begins speaking into microphone **12,** reciting the information in the audio signal portion of the second message. Microphone **12** converts the speech to audio signals and couples them to recorder **14.**

The subaudible tone signals for the second message terminate shortly after the delayed audio signals from the preceding message as shown in FIG. **2.** Shortly after termination of the subaudible tone signals from the second message, the delayed audio signals for this second message modulate the RF carrier signal developed by transmitter **15** and are radiated by antenna **16** to the desired portable paging receiver **17.** The subaudible tone signals for each succeeding message are, therefore, transmitted simultaneously with a terminal portion of the audio signal portion of a preceding message. By transmitting the subaudible tone signals simultaneously with the audio signals in a preceding message, the time period necessary for transmitting an entire message is substantially reduced, thereby allowing a greater system call capacity.

Portable paging receivers such as shown by paging receiver **17** are designed to have an audio response characteristic between 300 and 3000 cycles. That is, audio signals in the 300 to 3000 cycle range will be reproduced by the speaker and heard by the portable paging receiver user. Signals below 300 cycles and above 3000 cycles are greatly attenuated by the paging receiver and will not, therefore, be reproduced by the speaker nor heard by the user. This audio response characteristic is common to all portable paging receivers presently in use and is required by Federal Communications Regulations. All frequencies below 300 cycles are therefore considered in radio pager applications to be subaudible signals. The subaudible tone signals developed by tone selector and tone oscillator **10** extend in a range from 65 to 250 cycles, as previously mentioned. If the subaudible tone signals in the address portion of a succeeding message are transmitted simultaneously with the terminal portion of the audio signals of a preceding message, the user of the portable paging receiver hearing the preceding audio message will not hear the subaudible tones. He will not, therefore, be disturbed by the addressing of the succeeding pager to be contacted while he is receiving his audio message.

Referring to FIG. **3,** there is shown a more detailed combined schematic and block diagram for the high capacity paging system. Oscillators **23** are the oscillators in tone selector and tone oscillator **10** which develop the subaudible tone signals. In the preferred embodiment 10 oscillators are provided, however, the system may be increased to 30 oscillators, or as many as are desired.

Two columns of switches are also shown, the switches in one column being labelled **24** and those in the other column being labelled **25.** Switches **24** and **25** are the selectors in tone selector and tone oscillator **10,** for selecting the two subaudible tone signals which form the address portion of the message to be transmitted. In the preferred embodiment, ten switches labelled as **24** are provided, and ten switches labelled as **25** are provided. One of the switches labelled **24** is manually actuated to select any one of the 10 subaudible tone signals for the first transmitted tone; and one of the switches **25,** is manually actuated to select any one of the remaining nine subaudible tone signals for the second tone. If the system capacity is increased to thirty tones, additional switches are provided. Actuation of one switch **24** and one switch **25,** will couple the subau-

dible tone signals from oscillators 23 through switches 24 and 25 to tone gates 26 and 27, respectively. The operation of tone gates 26 and 27 will be further explained in a subsequent portion of this application.

Push-to-talk switch 11 is shown including two form A contacts, labelled 29 and 30. Upon actuation of push-to-talk switch 11, a ground potential is coupled through form A contact 29 to control circuit 13.

In control circuit 13 the ground potential is coupled through diode 31 to one terminal of control relay 32, causing the relay to energize and close form A contacts 33 and 34. The closure of contact 33 provides a ground potential through contact 33 to transmitter 15, causing the transmitter to actuate and develop a radio frequency carrier signal which is coupled to antenna 16. The radio frequency carrier signal is radiated by antenna 16 to the portable paging reciever 17. The closure of contact 34 provides a ground potential through contact 34 to relay 36 in recorder 14, causing relay 36 to energize and close form A contact 38. The closure of form A contact 38 couples an AC signal from AC plug 37 through contact 38 to tape drive motor 39, causing the motor to rotate. Actuation of tape drive motor 39 causes the endless loop magnetic tape 40 in recorder 14 to begin to rotate and record, playback and erase any information coupled thereto.

Actuation of push-to-talk switch 11 also couples an A+ signal through contact 30 to differentiator circuit 43 in tone selector and tone oscillator 10. This differentiator circuit, consisting of resistors 44, 45 and 46, capacitor 47 and diode 48, produces a positive going pulse in response to the A+ signal coupled thereto. The positive going pulse is coupled from diode 48 in differentiator circuit 43 to monostable multivibrator 49 in tone selector and tone oscillator 10. Multivibrator 49 is a standard type multivibrator, commonly used in the art, consisting of a first transistor 50 and a second transistor 51. Transistor 50 is normally nonconductive or "off," and transistor 51 is normally conductive or "on." The positive going pulse from differentiator circuit 43 is coupled to base 52 of transistor 50 causing transistor 50 to switch to a conductive or "on" state. Transistor 51, in response to the change of state of transistor 50, switches to a non-conductive or "off" state, causing collector electrode 53 of transistor 51 to increase positively in potential towards supply voltage. Monostable multivibrator 49 will remain in this unstable, switched state for a predetermined period of time, determined by the period of time required to charge capacitor 54. In the embodiment shown, monostable multivibrator 49 will remain in this switched state for approximately 1.3 seconds. While in this switched state the positive voltage developed at collector 53 of transistor 51 in monostable multivibrator 49 is coupled to tone gate 26.

Tone gate 26 is a gate for coupling the first subaudible tone from oscillators 23 and switches 24 to transmitter 15. Tone gate 26 may consist of a single transistor, having base, emitter and collector electrodes which is biased to operate as a switch. A typical switch configuration which has the emitter electrode connected to switches 24, the collector electrode to transmitter 15, and the base electrode to collector electrode 53 of transistor 51.

Upon application of the positive voltage from collector 53 of transistor 51 to tone gate 26, the tone gate would be rendered conductive, allowing the first subaudible tone signal to be coupled to transmitter 15. Tone gate 26 will remain conductive for the same period of time as monostable multivibrator 49 remains in its switched or unstable state, allowing the subaudible tone signal to modulate the RF carrier signal at transmitter 15 for that period of time.

When monostable multivibrator 49 reverts to its stable state, transistor 51 will revert to a conductive condition, and transistor 50 will revert to a nonconductive condition, causing the voltage at collector 57 of transistor 50 to increase towards supply potential. Capacitor 58, resistors 59 and 60, and diode 61 form a differentiation circuit which develops a positive going pulse in response to the increased positive voltage developed at collector 57 of transistor 50. This positive going pulse is coupled to base electrode 62 of transistor 63 in a second monostable multivibrator 65, in tone selector and tone oscillator 10.

The operation of monostable multivibrator 65 is identical to monostable multivibrator 49. It will change to an unstable state in response to the positive going pulse at base 62 of transistor 63, and will remain in this unstable state for a predetermined period of time determined by the value of capacitor 66. In the preferred embodiment, monostable multivibrator 65 will remain in an unstable state for approximately 2.5 seconds. When in an unstable state transistor 63 is rendered conductive and transistor 67 is rendered nonconductive, causing the voltage at collector 68 of transistor 67 to approach supply potential. This voltage is coupled to tone gate 27, which is identical to tone gate 26, allowing the second subaudible tone signal in the address portion of the message to be coupled from oscillators 23 and switches 25 to transmitter 15 where it modulates the RF carrier signal. Tone gate 27 just as tone gate 26 will allow the subaudible tone signal to be coupled to transmitter 15 for the period of time that monostable multivibrator 65 remains in its unstable state. Monostable multivibrators 49 and 65 and tone gates 26 and 27 in tone selector and tone oscillator 10 therefore allow the selected two subaudible tone signals in the address portion of the message to be coupled to transmitter 15 for a period of time of approximately four seconds, upon actuation of push-to-talk switch 11.

After actuation of push-to-talk switch 11, and during the interval that the subaudible tone signals in the address portion are being transmitted by transmitter 15 the operator will speak the information into microphone 12 where it is converted into audio signals. Again, the timing of the audio signal portion of the message is shown by waveform B, FIG. 2. The audio signals are coupled to input amplifier 73 in recorder 14, where they are amplified and coupled to a recording head 74. Recording head 74 causes the audio signals to be recorded on magnetic tape 40. A reproduction or playback head 75, is physically positioned in recorder 14 so that a point passing record head 74 will pass playback head 75 four seconds later. This time period is selected to be the same as the time period for which transmitter 15 and recorder 14 remain operative after push-to-talk switch 11 has been released, and is as long as, or longer than the time period necessary to transmit the subaudible tone signals in the address portion of the message. The audio signals recorded on magnetic tape 40 by recording head 74 are therefore reproduced by playback head 75 4 seconds after they are recorded, producing a delayed audio signal. The delayed audio

signals are amplified in output amplifier **76**, and coupled to transmitter **15** where they modulate the RF carrier signal which is radiated at antenna **16**. The delayed audio signals reproduced by playback head **75** are erased by erasing head **77**, positioned after playback head **75**, so that audio signals in a later portion of the message, or the audio signals for a subsequent message may be recorded on magnetic tape **40** by recording head **74**.

The delay provided by recorder **14** allows the address portion of the first message in a sequence of messages to be transmitted prior to the audio signal portion. The audio signal portion of the message is, however, coupled to tape recorder **14** at the same time that the address portion is being transmitted, eliminating the time period required in previous systems during which no audio signals were developed. During the time that the audio signals are developed, and after completion of the address signal, the operator may select the address for subsequent message and operate the corresponding switches **23** and **24**.

Upon termination of a message the operator will deactuate push-to-talk switch **11**. When push-to-talk switch **11** is deactuated, the ground potential supplied through form A, contact **29** for operation of control circuit **13** is removed. Removal of this ground potential causes a positive pulse to be developed by capacitor **80** in the delay circuit **18** of control circuit **13**, which is coupled through resistor **79** to base electrode **81** of transistor **82** in monostable multivibrator **83**, also in delay circuit **18**. Monostable multivibrator **83** includes transistors **82** and **84**, and will switch to an unstable state for a predetermined amount of time in response to a positive pulse applied to base electrode **81** of transistor **82**. In the stable state transistor **82** is nonconductive and transistor **84** is conductive. In the unstable state transistor **82** is rendered conductive and transistor **84** is rendered nonconductive. The time period for which the monostable multivibrator **83** remains in this unstable state is determined by the value of capacitor **85**. In the preferred embodiment, this time period is equal to the time period for which the audio signals are delayed by recorder **14**, and must be greater than the time period necessary to transmit the subaudible tone signals in the address portion of the message. As the recorder **14** delays the audio signals coupled thereto by 4 seconds, monostable multivibrator **83** must remain in its unstable state for four seconds.

When monostable multivibrator **83** is in its unstable state the voltage at collector **86** of transistor **82** will approach ground potential. This ground potential is coupled to base **87** of transistor **88**, rendering transistor **88** nonconductive. With transistor **88** nonconductive, the voltage at collector **89** of transistor **88** increases and is coupled to base **90** of transistor **91**, rendering transistor **91** conductive. With transistor **91** conductive, the ground potential at emitter **92** of transistor **91** is coupled to collector **93** of transistor **91** and through diode **94** to control relay **32**, causing relay **32** to remain in an actuated condition during the time period that monostable multivibrator **83** remains in its unstab'e state. With relay **32** held in an actuated condition, recorder **14** and transmitter **15** will also be held in an actuated condition for the time period that monostable multivibrator **83** remains in its unstable state. This allows the last four seconds of the audio signals coupled to recorder **14** to be reproduced and coupled to transmitter **15** for modulating the RF carrier signal. When monostable multivibrator **83** reverts to its stable state, the ground potential for actuating control relay **32** will be removed allowing recorder **14** and transmitter **15** to deactuate.

During the interval, after deactuation of push-to-talk switch **11**, and while transmitter **15** and recorder **14** remain actuated, the operator can again actuate push-to-talk switch **11**. As each actuation of push-to-talk switch **11** will cause the subaudible tone signals in the address portion of a message to be transmitted, the address portion of a subsequent message will be coupled to transmitter **15** and transmitted simultaneously with a portion of the delayed audio signals. The reactuation of push-to-talk switch **11** will cause monostable multivibrator **83** to revert to its stable state; however, it will also provide a ground potential which will maintain control relay **32** in an operative condition, thereby maintaining transmitter **15** and recorder **14** in an operative condition so as to allow the audio signals in the subsequent message to be immediately coupled to the recorder.

As can be seen, a high capacity paging system has been provided which requires substantially less time for the address portion transmissions and allows substantially more time for audio portion transmission so as to allow an increased system message transmission capability. This is accomplished by transmitting subaudible tone signals for the address portion simultaneously with the transmission of the audio portion of a preceding message, and by providing a delay in the audio message so as to facilitate transmission of the subaudible tone signals for a succeeding message during the terminal portions of the audio signal portion of a preceding message.

We claim:

1. In a high capacity paging system including a transmitter for transmitting a modulated signal in response to a plurality of messages sent in sequence with each message including address signals and audio signals, and wherein each transmission is initiated by a switch being actuated, and the message terminated by deactuating the switch, the combination including; control means coupled to said switch and transmitter and operative in response to a first actuation of said switch to actuate said transmitter, said control means further including time delay means for holding said control means operative for a first predetermined time period after a first deactuation of said switch, address means for developing address signals coupled to said switch and transmitter and operative in response to said first actuation of said switch to develop said address signals in a first of said plurality of messages and couple said address signals to said transmitter for a second predetermined time period no greater than said first predetermined time period, audio delay means coupled to said control means and said transmitter, said audio delay means operative in response to said control means operation to receive said audio signals in said first message and delay said audio signals by a third predetermined time period greater than said second predetermined time period and no greater than said first predetermined time period and couple said delayed audio signals to said transmitter, said control means being further operative in response to a second actuation of said switch during said first predetermined time period after said first deactuation of said switch to maintain

said transmitter and audio delay means operative and to reset said first delay means for holding said control means operative for another first predetermined time period after a second deactuation of said switch, said address means being operative in response to said second actuation of said switch to develop said address signals in a second of said plurality of messages and couple same to said transmitter during said first predetermined time period after said first deactuation of said switch, said audio delay means being operative in response to said second actuation of said switch and said maintained operation of said control means to receive said audio signals in said second of said plurality of messages and delay said audio signals of said second message by said third predetermined time period after said second actuation of said switch and couple said second message delayed audio signals to said transmitter.

2. The high capacity paging system of claim 1 wherein said address means includes, means for developing a plurality of address signals, and selection means for selecting a particular one of said plurality of address signals to be coupled to said transmitter.

3. The high capacity paging system of claim 2 wherein said address means includes, circuit means operative in response to said switch actuation to couple said selected address signals to said transmitter for said second predetermined time period.

4. The high capacity paging systey of claim 3 wherein said control means includes, first switching means operative in response to said switch actuation to develop a first switching signal for actuating said transmitter and audio delay means, and time delay circuit means coupled to said first switching means and said switch and operative in response to deactuation of said switch to hold said first switching means operative for said first predetermined time period.

5. The high capacity paging system of claim 4 wherein said audio delay means is a tape recorder operative in response to said first switching signal to record said audio signals coupled thereto, said tape recorder including reproducing means for reproducing said audio signals and coupling same to said transmitter said third predetermined time period after said audio signals are recorded.

6. The high capacity paging system of claim 5 wherein said circuit means includes monostable multivibrator means operative in response to said switch actuation to change state for said second predetermined time period, and gate means coupled to said monostable multivibrator means and to said transmitter, said gate means operative in response to said change of state of said monostable multivibrator means to couple said selected address signals to said transmitter.

7. The high capacity paging system of claim 6 wherein said first switching means is a relay, and said time delay circuit means is a monostable multivibrator.

8. The high capacity paging system of claim 7 wherein said tape recorder includes an endless magnetic recording tape for recording said audio signals, means for rotating said magnetic tape, recording means for receiving said audio signals, said recording means operative in response to receipt of said audio signals to record same on said rotating magnetic recording tape, playback means for reproducing said audio signals from said rotating magnetic tape said third predetermined time period after said audio signals are recorded thereon, and erase means for erasing said recorded audio signals from said rotating magnetic tape after reproduction by said playback means.

9. The high capacity paging system of claim 8 wherein said tape recorder further includes motor means coupled to said endless magnetic recording tape and operative to rotate said magnetic tape, and second relay means coupled to said motor means and said first switching means and operative in response to said first switching signal to actuate said motor means.

10. The high capacity paging system of claim 9 further including microphone means for converting speech to said audio signals, said microphone means being coupled to said audio delay means for coupling said audio signals thereto.

11. The high capacity paging system of claim 10 wherein said address signals are subaudible tone signals.

12. The high capacity paging system of claim 11 wherein said means for developing a plurality of address signals includes, oscillator means for developing said subaudible tone signals, said selector means being operative to select particular ones of said subaudible tone signals.

13. The high capacity paging system of claim 11 wherein said address signals include, a plurality of subaudible tone signals, said selector means being operative to select said plurality of said subaudible tone signals to form said address signals.

14. In a high capacity paging system including a transmitter for transmitting a modulated signal in response to a plurality of messages sent in sequence with each message including subaudible tone signals and audio signals, coupled thereto, and wherein each transmission is initiated by a switch being actuated, and the message terminated by deactuating the switch, the combination including, control means coupled to said switch and transmitter and operative in response to a first actuation of said switch to actuate said transmitter, said control means further including time delay means for holding said control means operative for a first predetermined time period after a first deactuation of said switch, address means for developing said subaudible tone signals coupled to said switch and transmitter and operative in response to said first actuation of said switch to develop said subaudible tone signals in a first of said plurality of messages and couple said subaudible tone signals to said transmitter for a second predetermined time period no greater than said first predetermined time period, audio delay means coupled to said control means and said transmitter, said audio delay means operative in response to said control means operation to receive said audio signals in said first message and delay said audio signals by a third predetermined time period greater than said second predetermined time period and no greater than said first predetermined time period and couple said delayed audio signals to said transmitter, said control means being further operative in response to a second actuation of said switch during said first predetermined time period after said first deactuation of said switch to maintain said transmitter and audio delay means operative and to reset said first delay means for holding said control means operative for another first predetermined time period after a second deactuation of said switch, said address means being operative in response to said sec-

ond actuation of said switch to develop said subaudible tone signals in a second of said plurality of messages and couple same to said transmitter during said first predetermined time period after said first deactuation of said switch, said audio delay means being operative in response to said second actuation of said switch and said maintained operation of said control means to receive said audio signals in said second of said plurality of messages and delay said audio signals of said second message by said third predetermined time period after said second actuation of said switch and couple said second message delayed audio signals to said transmitter.

15. The high capacity paging system of claim **14** wherein said address means includes means for developing a plurality of subaudible tone signals, and selection means for selecting particular ones of said plurality of subaudible tone signals to be developed.

16. The high capacity paging system of claim **15** wherein said means for developing a plurality of subaudible tone signals includes a plurality of oscillator means, said selector means being operative to select particular ones of said subaudible tone signals.

17. The high capacity paging system of claim **16** wherein said address means includes circuit means operative in response to said switch actuation to sequentially couple said selected subaudible tone signals therefrom for said second predetermined time period.

18. The high capacity paging system of claim **17** wherein said control means includes, first switching means operative in response to said switch actuation to develop a first switching signal for actuating said transmitter and said audio delay means, and time delay circuit means coupled to said first switching means and said switch and operative in response to deactuation of said switch to hold said switching means operative for said first predetermined time period.

19. The high capacity paging system of claim **18** wherein said audio delay means is a tape recorder operative in response to said first switching signal to record said audio signals coupled thereto, and including reproducing means for reproducing said audio signals and coupling same to said transmitter said third predetermined time period after said audio signals are recorded.

20. In a high capacity paging system including a transmitter for transmitting a modulated signal in response to a message coupled thereto including address signals having a second predetermined time period followed by audio signals, and wherein said transmission is actuated by operation of a switch and said message terminated by deactuation of said switch, the method of transmitting said message comprising the steps of; actuating said switch to initiate a first transmission, initiating said transmission of a first message address signals for said second predetermined time period upon actuation of said switch, developing said audio signals of said first message simultaneously with transmission of said first message address signals, delaying said transmission of said audio signals by a third predetermined time period not less than said second predetermined time period and no greater than said first predetermined time period, terminating said first message by deactuating said switch, maintaining transmission for said first predetermined time period after termination of said first message, actuating said switch to initiate a second transmission and initiating said transmission of a second message address signals for said second predetermined time period during said first predetermined time period after termination of said first message, developing said audio signals of said second message simultaneously with transmission of said second message address signals, delaying said audio signals of said second message by said third predetermined time period after said second actuation of said switch.

21. The method as set forth in claim **20** wherein said address signals are selectable from a plurality of address signals and including the step of selecting the desired address signals for transmission.

22. The method as set forth in claim **21** wherein said address signals are subaudible tone signals and including the step of selecting the desired subaudible tone signals for transmission.

23. A method for rapidly transmitting a plurality of messages in sequence in a paging system wherein each message includes address signals having a first predetermined time period and audio signals, and wherein a transmitter transmits said signals said transmitter being initiated by actuating a switch, and the message terminated by deactuating the switch, including the steps of:

a. transmitting a first message including said address signals followed by said audio signals;
b. transmitting the address signals of a second message simultaneously with a terminal portion of the audio signals of said first message;
c. transmitting the audio signals of said second message after the audio signals of said first message and the address signals of said second message.

24. A method for rapidly transmitting a plurality of messages in sequence in a paging system wherein each message includes address signals having a first predetermined time period and audio signals, and wherein a transmitter transmits said signals, said transmitter being initiated by actuating a switch, and the message terminated by deactuating the switch, including the steps of:

a. actuating said switch for actuating said transmitter and coupling said address signals and audio signals to said transmitter;
b. delaying transmission of said audio signals by a second predetermined time period at least as long as said first predetermined time period;
c. deactuating said switch;
d. maintaining said transmitter actuated for third predetermined time period at least as long as said second predetermined time period;
e. actuating said switch a second time during said third predetermined time period;
f. coupling address signals and audio signals of a second message to said transmitter during said third predetermined time period;
g. delaying transmission of said audio signals of said second message by a second predetermined time period.

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