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THE CBS NetALERT
A SYSTEM FOR NETWORK SIGNALING

BY

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CBS LABORATORIES

STAMFORD, CONN.

and

D. VORHES

CBS RADIO

NEW YORK, N. Y.

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Volume 37 Spring, 1961 No. 2

THE CBS NetALERT - A SYSTEM FOR NETWORK SIGNALING

by

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Introduction

Network radio broadcasting has changed considerably compared to the pre-television era. Fifteen years ago, the public looked toward radio for a complete repertoire of music, drama, comedy, and news. The affiliate stations were on the network most of the time and bulletins or special programs were automatically received. Any communications from network headquarters to the stations could be handled during station breaks. Now, however, the stations are off the network most of the time, and there is no simple way to alert these stations to receive urgent news bulletins or national emergency announcements.

Under certain conditions, hundreds of telephone calls must be placed to alert all 210 CBS Radio affiliated stations. Alerting is particularly difficult at night when the maximum number of calls would have to be made to the homes of station managers.

The CBS NetALERT System, developed and produced by CBS Laboratories, enables all CBS Radio affiliates to be automatically alerted. The CBS NetALERT System provides nine different alert signals, transmitted over the network's regular telephone lines at a fraction of the normal program level. Signals identifying extremely important or emergency news alerts are simultaneously transmitted to the station executive's home.

The nine different alert signals are each composed of from one to nine virtually inaudible pulses; each less than 1/30th of a second. These signals are received by a logic filter which recognizes and accepts only the particular alert code being transmitted.

NetALERT transmitters are now being installed in the outgoing program lines at major network points. When installation of the system is completed, NetALERT signals will be capable of being sent to the entire network, to those stations in any single time zone, or to those in any combination of time zones, as the situation may require.

Statement of the Problem

Telephone Lines

Two types of telephone lines are used on the network; class B lines and class C lines. Ninety-five percent of the stations are served by B lines which have a guaranteed frequency response of 100 to 4900 cps. The balance of the stations are served by C lines with a frequency response of 200 to 3500 cps. Experience has shown that the upper response of the C line is not dependable above 3500 cps. NetALERT must operate on both class B and C lines.

Unobtrusiveness

Any signals superimposed on the normal program must be unobtrusive. The signal need not be completely inaudible, although this would represent the ultimate in unobtrusiveness.

Subjective tests were conducted to determine the audibility of 1000 to 3500 cps signals of varying duration. A jury agreed that burst durations of 20 milliseconds or less sounded like a click, whereas longer durations conveyed the actual tone. Burst durations greater than 50 milliseconds were considered objectionable. These tests were carried out against a silent background and at full level.

When the tests were made in the presence of music and speech, the jury agreed that a 30-millisecond burst at a level of -20 db with respect to program, was unobtrusive. In fact, the signal could be completely masked by rhythmic music.

During all of these tests, the program was muted during the duration of the burst. When the burst amplitude was reduced to zero, all that remained was a short duration "hole" in the program.

Depending on the program content, this "hole" was inaudible or sounded like a click. Shaping of the rise-time and decay-time minimized this click.

Reliability

Two types of system reliability are desired: (1) The transmitted signal should always be received; (2) No signal should ever be received in the absence of a transmitted signal (false alarm). Both types of reliability are important. In the case of the first, if a program cue alert should not be received, the network would suffer embarrassment. If a national defense alert should not be received, the results could be very serious. Similarly, in the case of the second, false alerts could cause important inconveniences.

Unobtrusiveness and reliability are conflicting requirements. As the signal pulse width and level are reduced, audibility decreases but the signal becomes increasingly difficult to separate from the program. It was decided that the signal width should not exceed 30 milliseconds and the signal level should not exceed -20 db with respect to the program. Since the signal frequency must be less than 3500 cps, a circuit had to be developed that would discriminate against program, despite the higher level, and act only when a signal was received.

Accessories

Optional accessories include:

1. Remote indicator
2. Executive alarm
3. Notch filter

The Remote Indicator, which is connected via a multiconductor cable to the receiver, provides means for the alert to be indicated on the desk of the station executive. It must be compact and pleasingly styled.

During "very special programs" or "national emergency" alerts, means must be provided to sound an alarm in the home of the station executive. This is done via telephone company service. A small accessory box, known as an Executive Alarm, feeds the telephone company lines.

Whenever one section of the network tapes a program originating from another part of the network, it may be desirable to eliminate the NetALERT signals during playback. Here a notch filter tuned to the NetALERT signal frequency would be inserted in the program line from the tape player.

Types of Alert Signals

Six different alerts and three spares are desired and are assigned the following functions:

Alert No. 1 - Station cue
Alert No. 2 - Network cue
Alert No. 3 - Voice closed-circuit
Alert No. 4 - Exclusive bulletin
Alert No. 5 - Spare
Alert No. 6 - Spare
Alert No. 7 - Spare
Alert No. 8 - Very special program
Alert No. 9 - National emergency

For Alerts Nos. 1 and 2, the receiver will automatically reset to zero after four seconds. For Alerts 3 to 9, the receiver will maintain the alert until reset by the network. Alerts Nos. 8 and 9 actuate the executive alarm.

Two different modes of operation were considered: (1) Alerts could be sent by employing a unique signal for each alert and having the correct number indicated immediately; or (2) Alerts could be sent by transmitting an appropriate number of similar signals sequentially. The second approach, requiring less expensive apparatus, would achieve a system of excellent performance and reliability and was selected for the NetALERT system.

NetALERT System

Basic Theory of Operation

While actual frequencies and burst durations may not be divulged, it can be stated that the frequencies are contained in the spectrum between 1000 and 3500 cps, and that the total burst duration does not exceed 30 milliseconds.

Referring to Figure 1, the program line at the CBS Radio Central Control passes through the NetALERT transmitter. When an alert is dialed, each closure of the dial contacts causes switch S1 to go through one cycle. The cycle consists of the outgoing line departing the incoming program line, dewlling first on the F1 signal for duration D1, next on the F2 signal for duration D2, and finally returning to the incoming program line. For example, if Alert No. 4 is dialed, the cycle is repeated four times. At the radio station, the NetALERT receiver is bridged across the network program line. An audio amplifier with a bandpass of 200 to 6000 cps amplifies the signal which then divides into two paths; namely, an F1 analysis channel and an F2 analysis channel.

In the F1 channel, a clipper circuit is set to clip not the sinusoidal alert signals but only the program which is at a 20 db greater level. The clipped program is then analyzed for a pure F1 signal in the absence of any other signal. It accomplishes this in the following manner: The outputs of an F1 bandpass detector and an F2 band-reject detector are summed. When the desired signal conditions exist, the combined detector output is a negative pulse that is used to trigger a one-shot multivibrator. The

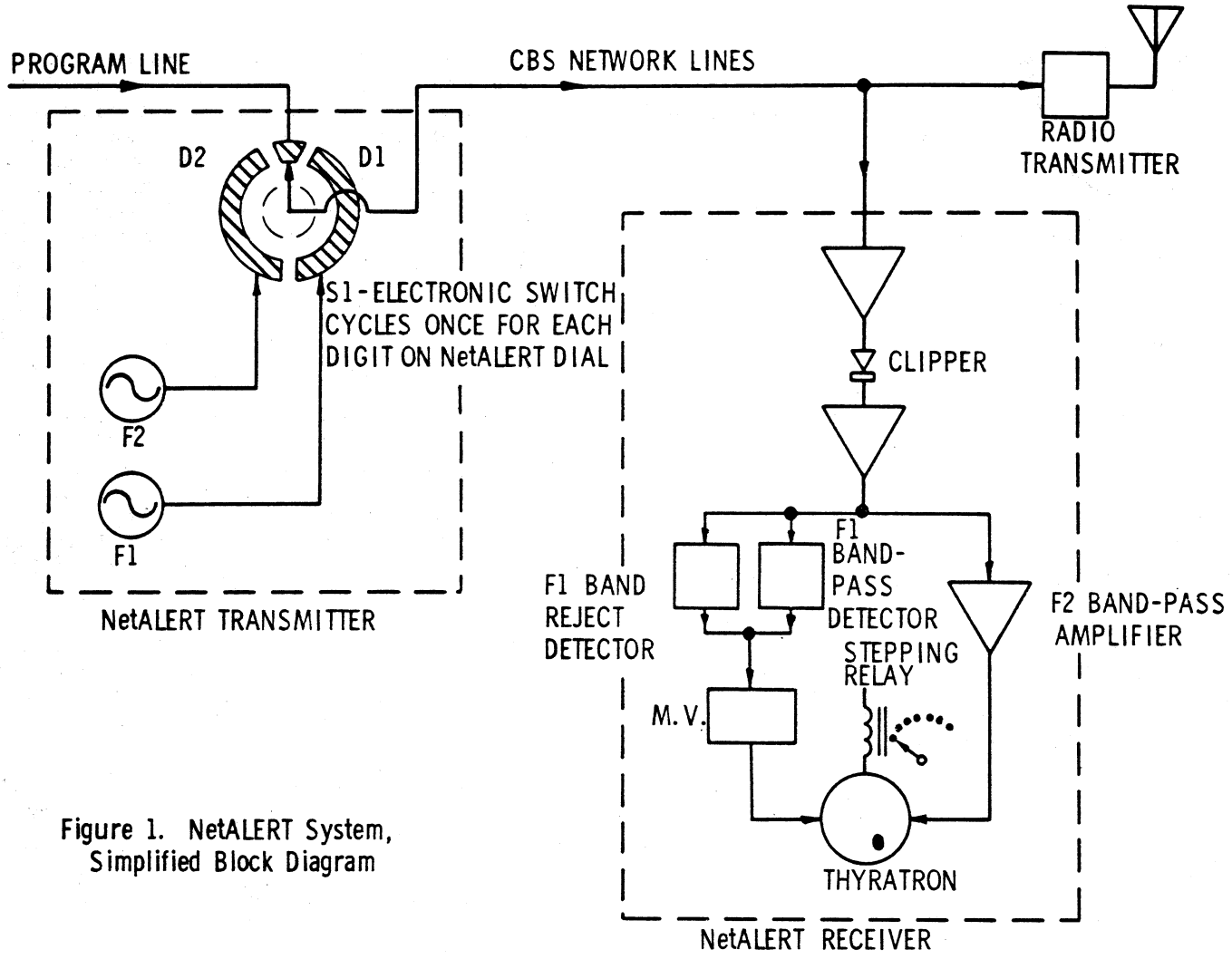


Figure 1. NetALERT System, Simplified Block Diagram

multivibrator output is a square positive pulse of approximately D1 + D2 duration which allows a thyratron to fire upon receipt of a coincident signal from the F2 channel.

The F2 channel contains a tuned amplifier peaked at F2. When the F2 alert signal is received, it is amplified and fires the thyratron when the coincident gating pulse is simultaneously present.

The thyratron fires once for each received alert signal. Current passes through a stepping relay containing a multiplicity of contacts as well as a disk which presents a numeral to the viewer. Means are available for the NetALERT transmitter to reset the receiver to zero.

NetALERT Transmitter

Figure 2 is a simplified diagram of the NetALERT transmitter. Four program lines are shown entering the transmitter and four lines leaving at respective indicated impedance and signal levels. These lines are designated "Line 3", "Line 4", etc., to correspond with numbers used at Central Control of the CBS Radio Network. In addition, two internal lines are provided, one being driven by an F1 oscillator, the other by an F2 oscillator.

During a program period, switches W in Figure 2, which are transistor single-pole switches, are maintained in a "closed" condition by the application of positive control voltages applied to the bases of these transistors. Thus, program enters and leaves the transmitter. Switches X and Y are identical line switches maintained in an "open" condition during program periods by applying negative voltages to the respective transistor bases. Therefore, no NetALERT signals will appear across the outgoing program lines.

At the instant a NetALERT pulse is dialed in the Control Unit (described below), all W switches are opened and the X switches are closed. This causes a 1.6-volt rms, F1 signal to appear across the 560Ω termination and 0.11-volt rms across each program line when properly terminated by 150Ω. This signal attenuation is the result of using two

1 K bridging resistors in series with the signal lines to prevent line loading and crosstalk. The X switches are held closed for a period of D1 whereupon they are opened, and simultaneously the Y switches are closed for a period D2. During this period, a 0.11-volt rms, F2 signal is placed on the program lines. When the Y switches are opened, a total duration D1+D2 after the start of the NetALERT pulse period, the W switches are closed and the program resumes. This full sequence of events occurs once for each NetALERT pulse transmitted.

Push-pull power amplifiers are required to raise the outputs of the NetALERT signal oscillators from 1 milliwatt to approximately the required 10 milliwatts.

Switches Z are transistors wired in shunt with the NetALERT signal lines. During program periods, these are kept closed to provide a short circuit across the 560Ω resistor. In this way, the common impedance "seen" by the four program lines via the 1 K bridging resistors is zero and program crosstalk is held to less than -60 db. The Z switches are open for the full D1+D2 period necessary to send a NetALERT pulse.

Figure 3 is a symbolic diagram of the transmitter logic and control circuits. Three one-shot transistor multivibrators are shown, designated I, II, and III. Upon the momentary closing of the telephone dial switch, an 18-volt positive pulse is applied to multivibrators I and II to initiate their respective quasi-stable cycles. The natural quasi-stable period of multivibrator I is in excess of duration D1+D2, that of multivibrator II is exactly duration D1. The output of I opens the W and Z switches, that of II closes the X switches. When II returns to its stable state after duration D1, it furnishes a positive pulse to III, thereby initiating its quasi-stable period of D2 during which the Y switches are closed. On the return of III to a stable state, a negative trigger is supplied to I for the purpose of returning it to its stable state, approximately 5 ms before the end of its natural quasi-stable period. Thus, a full cycle of NetALERT pulse is timed, and all switches have been returned to their normal program condition.

The 2 K and 100 K resistors and the .05 mf capacitor in the dial-triggering circuit are incorporated to prevent spurious triggering of the system as a result of telephone dial contact bounce.

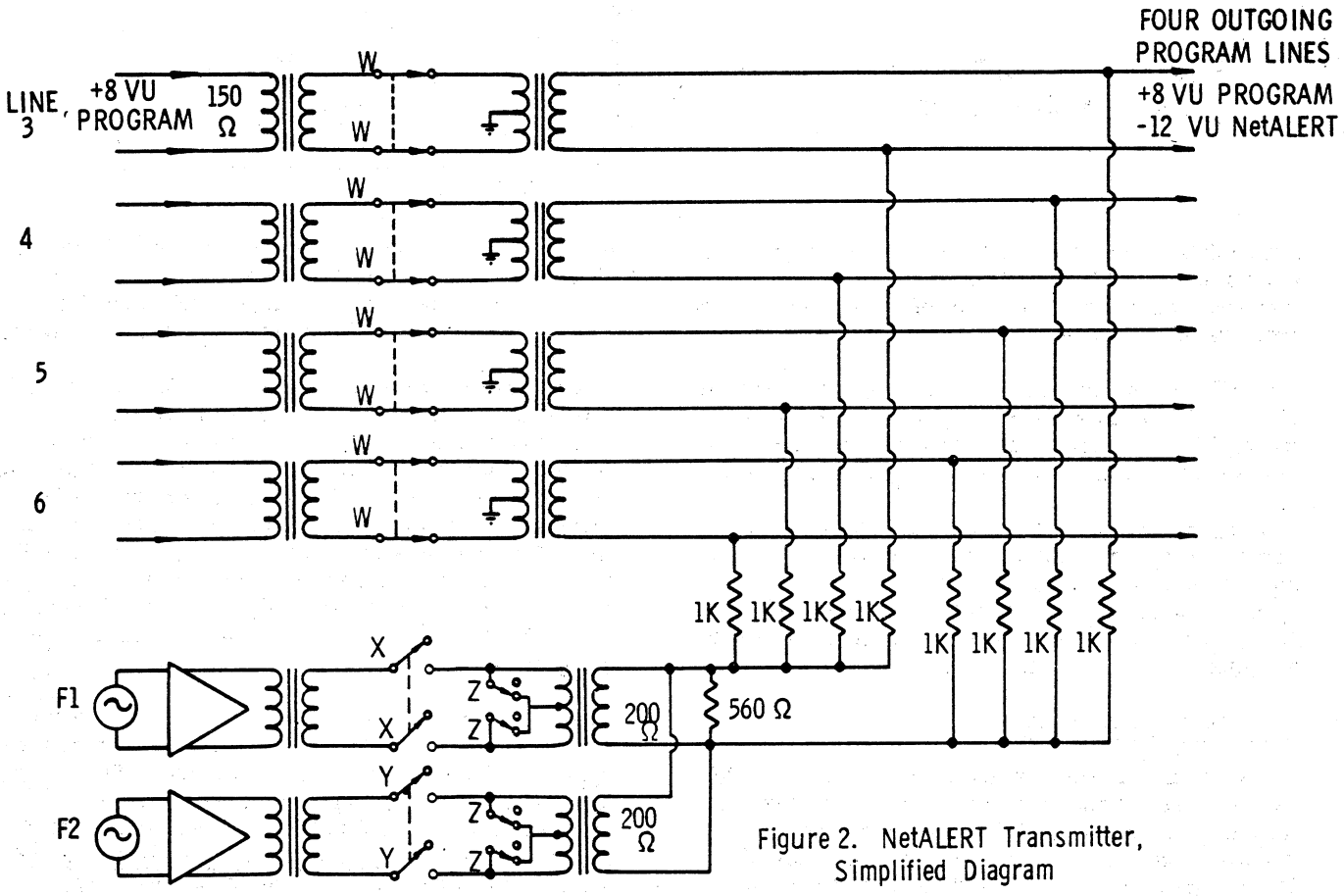


Figure 2. NetALERT Transmitter, Simplified Diagram

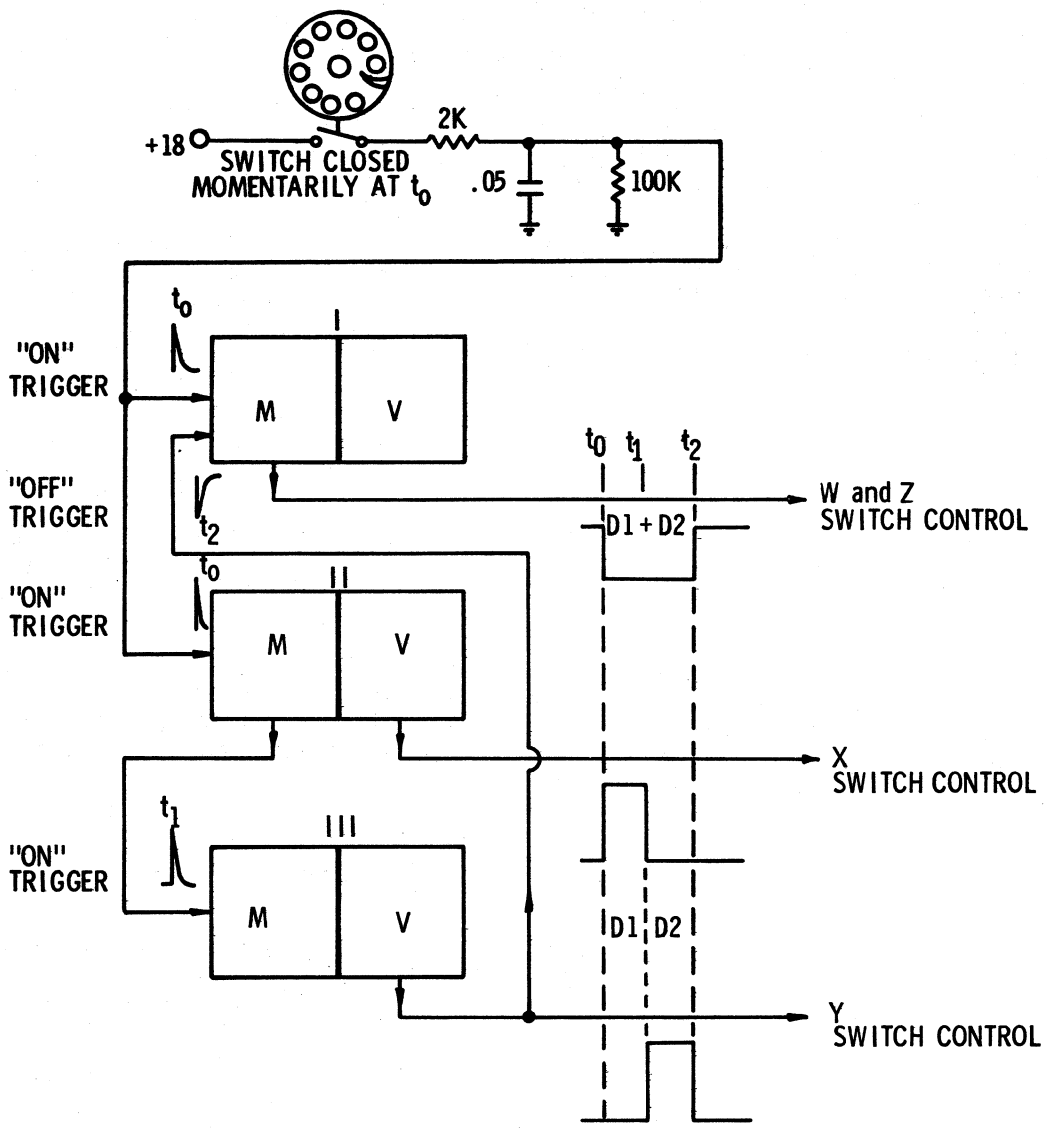


Figure 3. Transmitter Logic Diagram

The transmitter has been packaged in two parts: The control unit and the transmitter proper.

Control Unit. This unit may be rack mounted and contains the telephone dial assembly, manual switches, indicator lights, and power for the low-voltage ac control relays located in the transmitter. It also contains thermally operated switches and an electromagnetic relay.

Transmitter. This unit may be installed up to 50 feet away from the Control Unit. Plug-in modules contain the transistor line switches and the F1, F2 power amplifiers. Semi-conductor circuitry is used throughout. The F1 and F2 generators are stable tuning fork oscillators that are on continuously.

NetALERT Receiver

Each affiliate of the CBS Radio Network will have a NetALERT receiver bridged across the incoming program line. Line impedances can be either 150 or 600 ohms; balanced or unbalanced. Line level is not critical and can be between -20 and 0 VU. The receiver is energized continuously from the 117 volt, 60 cycle line. A total of 7 tubes (including power supply rectifier) plus three germanium diodes are used.

Only key CBS Radio Network Central Controls can send alerts. As mentioned previously, alerts Nos. 1 and 2 reset to zero automatically after four seconds. This is coded into the circuitry of the receiver. Alert No. 3 and higher can be reset only

NetALERT Receiver
7-1/4"H x 19"W x 12"D

by Central Control. This is accomplished by their sending one NetALERT pulse after a minimum wait of 15 seconds. Each receiver is programmed to return to zero upon receipt of this delayed pulse.

To supplement the indication of the alert number on the front panel of the receiver, it was decided to attract additional attention to the higher alerts by means of an alarm system. A flashing red panel light plus a repeating chime calls the attention of the radio station personnel that an Alert No. 3 or higher has been received. An alarm reset push-button is provided on the receiver to shut off the alarm.

Three receptacles on the rear of the receiver can be used by the radio station to operate supplementary devices such as remote indicators and executive alarms.

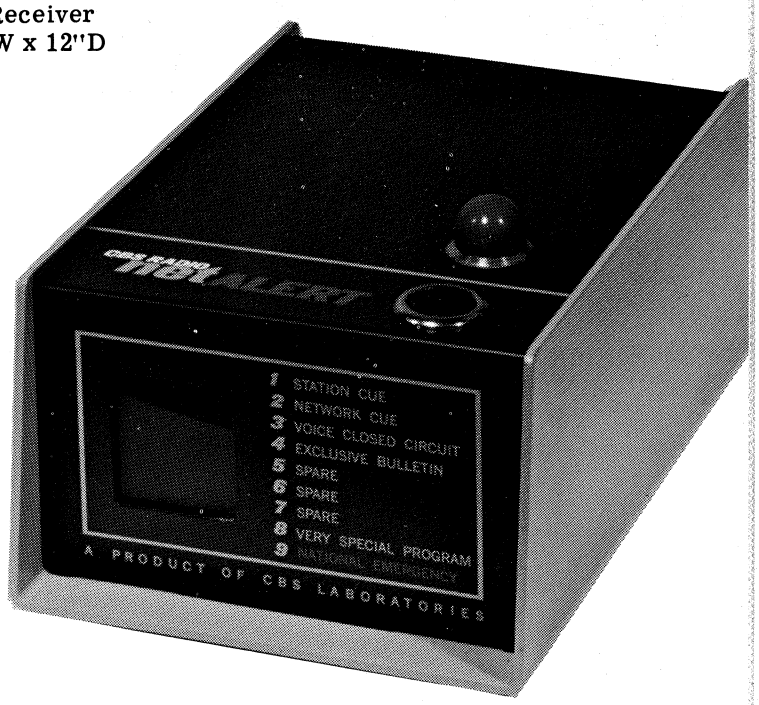
Remote Indicator

The remote indicator provides a means for numerical indication of the alert at a remote point, especially on the desk in an executive's office within the radio station.

Referring to Figure 4, a cable (up to 250 feet long) plugs into one of the three receptacles in the rear of the NetALERT receiver. The face of the indicator displays an illuminated numeral that will duplicate the numeral displayed on the front panel of the receiver.

Executive Alarm

The purpose of the executive alarm is to indicate at an executive's home if an Alert No. 8 or 9 has been received at the radio station. The alarm will continue even after the alert on the station's NetALERT receiver has been reset to zero. It can be turned off only after: (1) The receiver has been reset to zero, and (2) The executive alarm reset button has been operated at the station.

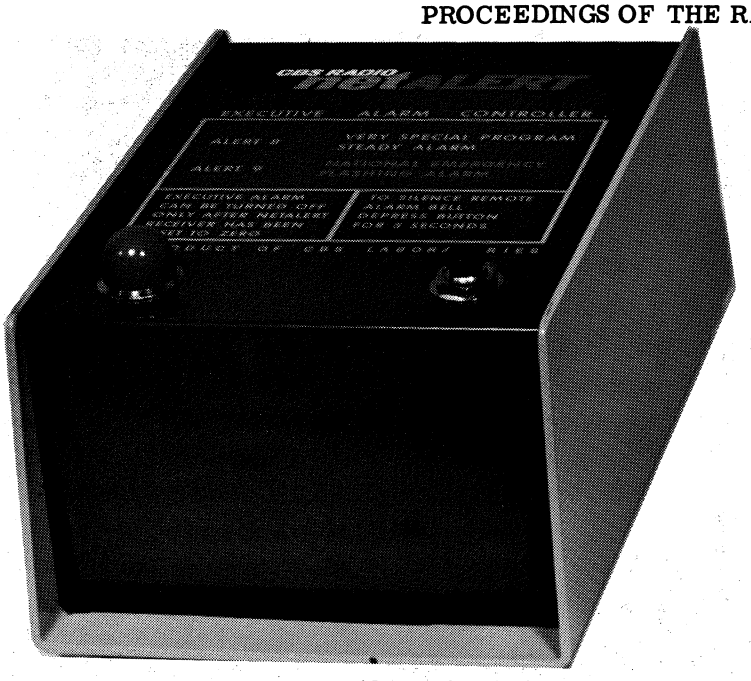


Remote Indicator Desktop Unit
3"H x 4-1/2"W x 6"D

Figure 4

The executive alarm is housed in a small cabinet and is plugged into the NetALERT receiver. A leased telephone company line is attached to the executive alarm, and the alarm bell furnished by the telephone company in the executive's home will ring continuously for Alart No. 8 and intermittently for Alert No. 9.

A red light on the top of the indicator glows brightly when an Alert No. 3 or higher is indicated.



Executive Alarm Controller
3"H x 4-1/2"W x 6"D

An optional push-button is provided for turning off the NetALERT receiver and indicator alarms.

Notch Filter

A notch filter tuned to F1 has been provided for use in a tape recorder playback line to prevent the NetALERT receivers from being triggered during a delayed broadcast. The input and output impedances of the notch filter are 600 ohms. The insertion loss is less than 0.5 db. Listening tests have proven that the filter causes no noticeable deterioration of program quality.

Conclusions

The CBS Radio NetALERT system is in the process of being field tested. Receivers installed in Los Angeles and Boise, Idaho, indicate good system reliability. It is expected that by August of 1961, NetALERT will be in operation throughout the entire CBS Radio Network. The American public can look forward to better radio service and prompt dissemination of the important news that shapes our lives.

Acknowledgements

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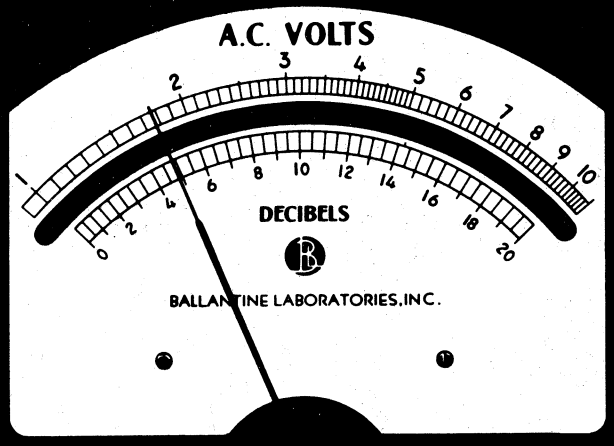

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310A	10 cps-2 Mc; 5 cps-4 Mc as a null detector	100 μV-100 V (Down to 40 μV as null detector)	2 MΩ shunted by 9 to 19 pF	3% 15 cps-1 Mc; 5% elsewhere	$250
314 Wide Band	15 cps-6 Mc	1 mV-1000 V (100 μV-1 mV without probe)	11 MΩ shunted by 8 pF with probe, or 1 MΩ shunted by 25 pF without probe	3% 15 cps-3 Mc; 5% elsewhere	$300
316 Infrasonic	0.05 cps-30 kc; 0.01 cps with corrections supplied	0.02 V-200 V Peak-to-Peak	10 MΩ shunted by 17 to 40 pF	3%	$330
317 Wide Band	10 cps-11 Mc	300 μV-300 V	10 MΩ shunted by 7 pF with probe; 2 MΩ shunted by 11 to 24 pF without probe	2% 20 cps-2 Mc 4% 10 cps-6 Mc 6% 10 cps-11 Mc	$495 with probe
320 True RMS	5 cps-500 kc	100 μV-320 V	10 MΩ shunted by 8 to 18 pF	3% 15 cps-150 kc; 5% elsewhere	$445
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