TELEGRAPH

CIVIL AIR RAID WARNING SYSTEM FOR DISSEMINATING ALERTS FROM KEYPOINTS AND SUBKEYPOINTS TO WARNING STATIONS AND SIREN CONTROL STATIONS

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1. GENERAL

INTRODUCTION

1.01 This section provides a general description of the bell and lights system for Civil Air Raid Warning (CARW) and includes the modifications for 2-digit operation and improved testing facilities. It replaces Section A804.526. Since this section covers a general revision, the arrows normally used to indicate changes have been omitted.

A. Purpose of This CARW System

1.02 This CARW system provides a rapid means of disseminating alert signals from the keypoints and subkeypoints to the warning stations and/or siren control stations in their respective warning areas. These alerts are transmitted by dialing on private line signaling networks and are indicated by bells and lights at the warning stations or by the operation of the sirens. A typical arrangement of a network for this purpose is shown in Fig. 1.

B. Relation Between This and Other CARW Systems

1.03 CARW alerts originate in the Air Defense Control Centers (ADCCs) which are operated by the United States Air Force. The alerts are transmitted from these centers over private line telephone networks to the keypoint civil air raid warning stations sponsored by the Federal Civil Defense Agency (FCDA). From these keypoints, the alerts are relayed over signaling networks to subkeypoints, warning stations, siren control stations, and finally to the public. The transmitting of the alerts from the ADCCs to the public involves the following steps:

Step 1 - From each ADCC to its associated keypoints over a separate system.

Step 2 - From each keypoint to its associated subkeypoints.

Step 3 - From each subkeypoint to its associated warning and siren control stations.

Step 4 - From each siren control station by means of sirens or other attack warning devices to the public.

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LEGEND

DIAL

KEYPOINT OR SUB-KEYPOINT

INTER-CITY LINES (LOCAL OR LONG LINES TOLL PLANT)

INTRA-CITY LINES

A GROUP OF WARNING STATIONS AND/OR SIREN CONTROL STATIONS

Fig. 1 - Typical Arrangement of Civil Air Raid Warning Network for Dissemination to Keypoints, Subkeypoints, Warning Stations, and/or Siren Control Stations

1.04 Steps 2 and 3 may be combined so that the keypoint transmits the alerts directly to the warning stations and the siren control stations. The CARW system described herein is not concerned with the first step but may be used for any part, or all, of steps 2, 3, and 4.

C. System Planning

1.05 As illustrated in Fig. 1, a CARW system consists of a combination of station apparatus and central office equipments that are interconnected by outside wires. However, various combinations are possible. Therefore, planning work is required to design the particular combination needed in each area to suit the local needs of the subdivisions of the civilian organizations that are responsible for receiving and relaying the alerts. In connection with this planning, the following general principles may be helpful. From each keypoint, the alerts may be disseminated in any one, or all, of four ways:

(1) To groups of warning stations and/or siren control stations in the same city:

(a) served from the same central office, or

(b) served from different central offices.

(2) To a subkeypoint in the same city.

(3) To a subkeypoint in a neighboring locality.

(4) To a group of warning stations and/or siren control stations in a near-by city, town, or village.

1.06 A keypoint or subkeypoint from which alerts can be directly transmitted to warning stations or siren control stations is called a control point. Unless there is only one central office in the network, at least two control points should be provided. The one normally used is called the primary control point; the others, which are used only in emergencies, are called alternate control points. An emergency that requires the use of an alternate control point may arise from various causes such as damage to the primary control point which prevents its use, or damage to part of the wire network which prevents some of the stations from receiving alerts from the primary control point.

1.07 The area served from each control point depends on a variety of local conditions and follows the requirements established by those responsible for civil defense. This is influenced by the amount of centralization of control desired by those in the neighboring communities. Considerable centralization of control is technically possible by arranging a CARW network with a large number of branches covering a large area with all branches interconnected by automatic signaling facilities. With centralization, there is the advantage of fewer personnel responsible for alerts and more speedy dissemination. With decentralization, there are more people and less permanent wire connections and consequently greater flexibility for special procedures in emergencies.

1.08 Warning stations are usually located in police stations, fire stations, schools, factories, hospitals, etc. The siren control station equipment is located at the public warning device. These may be located on top of fire stations, power poles, in factories, etc. Control points are, for many areas, in police stations, fire stations, or civil defense control centers.

1.09 An early phase of this planning involves the preparation of a layout for the warning network. A typical layout indicating the various types of central office equipment used is shown in Fig. 2. The layout work includes the following:

(1) Procure a map of the area and spot on it the locations of the control points, warning stations, sirens, and central offices.

(2) Select the types of the various CARW central office equipment which will best satisfy the local needs.

(3) Select the outside conductors to interconnect the various central office and station equipments.

D. System Capacity

1.10 The number of warning stations or siren control stations that can be controlled by a single dial is virtually limitless. The capacity of any one network is determined by service needs of the civil defense authorities rather than by the technical possibilities. Three sizes of dial pulse receiving units are available. One has a capacity of 200 stations, another of eight stations, and the third of five stations. Any number of these units can be interconnected in a single network with any practical distances between the control points and warning stations. However, it is recommended that the number of interoffice links between any control point and any central office in the network be limited to ten. The public signal control circuit has a 30-line capacity and any number of these can be interconnected in a single network.

E. Types of Alerts

1.11 This CARW system is arranged to disseminate four types of alerts called yellow, blue, red, and white, respectively. The yellow alert denotes an impending attack. The blue alert has not yet been assigned any specific meaning by the FCDA but has been

Fig. 2 - Typical Arrangement of CARW Control Points and Central Offices Showing the Use of the Various Types of Central Office Equipments

made available in this system because of probable future use. Both the yellow and blue alerts may be treated as confidential signals which are restricted to certain selected warning stations. The red alert denotes an imminent attack. The white alert denotes the disappearance of all threats of attack. The red and white alerts are unrestricted and are transmitted to all warning stations. Only the red and white alerts are transmitted to the public via the sirens. The red alert is transmitted in every case and the white only if it is the initial signal, as during a test, or if it is preceded by a red alert.

2. SIGNALING PRINCIPLES

A. Dial Pulsing and Ringing Signals

2.01 The dials provided at the control points for sending alerts are connected to private line networks which extend to dial pulse receiving equipments in central offices. These equipments translate the dial pulse signals into ringing signals that are transmitted over lines to the near-by bell and lights stations. The dial pulse signals are transmitted over the relatively long portions of the networks. Signaling repeaters are provided to enable such transmission over long distances. These repeaters are essentially like telegraph repeaters, except that they operate on 48 volts instead of 130 volts and they include automatic alarm features. The ringing signals are transmitted over the relatively short end-links between the central offices and the warning stations. The use of ringing instead of dial pulse signals on these end-links enables the use of station equipment which operates without any local power. This contributes to high reliability and low cost.

2.02 Two types of ringing signals are provided. That from the large sized central office equipments, each of which has a capacity of 200 stations, is substantially the same as that provided for 4-party full-selective ringing on subscriber telephone lines. This type consists of a positive superimposed ringing voltage and a negative superimposed ringing voltage, either one of which may be connected to the tip side or ring side of the line.

2.03 The ringing signals from the smaller sized central office equipments, having a capacity of either five or eight stations, consist of a single superimposed ringing voltage in combination with two pairs to each station. These two pairs are arranged as three conductors by using both sides of one pair as one conductor. Four signals are obtained by connecting the ringing voltage across any one of four different combinations of the three conductors. For each signal, one of the lamps at the station will light and the associated bell will ring.

2.04 The equipment which accommodates five warning stations provides a continuous audible signal and an individual visual signal for each alert. Both the 200-station and the 8-station equipments provide a coded audible signal in addition to the individual visual signal for each alert.

B. Siren Control Signals

2.05 The operation of each siren is controlled by the application of 20-cycle ringing voltage to the associated siren control line. This voltage is applied steadily for the steady white signal and intermittently for the modulated red signal. However, the white alert causes the siren to operate only if it is an initial signal or if it is preceeded by a red alert. The confidential yellow and blue signals are never transmitted to the sirens.

C. Signaling Repeaters

2.06 Four different types of signaling repeater circuits are available for use in these CARW networks. Two of these are of the 2-way type. The other two are of the 1-way type. The 1-way receiving circuit is designed primarily for repeating the pulses from the control point dial into the network. It is arranged to give a visual indication whenever the dial is used. The 1-way sending circuit receives signals from one line or loop and sends them into another line or loop.

2.07 The two types of 2-way repeaters are the same on their "line" sides but are different on their "loop" sides. On the line side, each repeater operates on the principle of differential duplex on one wire of the line pair with ground potential compensating on the other wire of the line pair.

2.08 On noncomposited lines having conductor loop resistances less than 1500 ohms, a simple balancing network is provided and line compensating resistances are used to build the line out to approximately 1500 ohms. This network and the compensating resistances are also satisfactory for a signaling channel derived from a voice channel by means of a nonring-through type of repeating coil. The signaling associated with such a voice channel must be 135 cycles or of the voice frequency type such as 1000/20-cycle or "single-frequency" signaling.

2.09 The 2-way repeater circuits can also be connected to signaling channels derived from composite sets. On such connections, the line compensating resistances are omitted and the network is adjusted to balance the actual line resistance in accordance with information shown on the balancing network drawings.

2.10 The loop side of one of the 2-way repeaters operates on the principle of differential duplex without ground potential compensating. As differential duplex signal-

ing on a loop requires a signaling network to balance the impedance of the loop, this type of repeater is called the "balanced loop" type. This type is less expensive than the other 2-way repeater which is called the "open and closed loop" type.

2.11 The open and closed loop repeater contains two more relays than the balanced loop repeater in order to make it suitable for open and closed signals instead of alternate battery and ground signals.

D. Lines and Ranges

2.12 Each line over which alert signals are transmitted between central offices may be an individual pair of wires not used for any other purpose or it may be two 1-wire d-c signaling channels derived from composite sets or repeating coils. The maximum conductor loop resistance of each signaling pair is 1500 ohms over not more than 15 miles for the 1-way circuits or for 2-way repeaters equipped with the simplest networks. Greater conductor loop resistances are possible where the 2-way repeaters are equipped with more complicated balancing networks. Ranges up to 50 miles of 19 gauge cable can be obtained over channels derived from composite sets on side circuits. Ranges up to 100 miles can be obtained from composited phantom circuits.

2.13 The lines used in the signaling network should be protected from the hazards of accidental contacts and sabotage by removing bridged cable taps, locking cable terminals, etc.

TABLE A

Minimum A-C Ringing Voltage with Minimum 45 Volts D-C	Maximum Earth Potential	Maximum Line Conductor Loop Resistance: One Signal Indicator per Line	Maximum Line Conductor Loop Resistance: Two Signal Indicators per Line
65 Volts	0 Volts	800	50
70 Volts	0 Volts	1300	400
70 Volts	±5 Volts	800	150
70 Volts	±10 Volts	300	0
75 Volts	0 Volts	1300	650
75 Volts	±5 Volts	1300	400
75 Volts	±10 Volts	900	200
80 Volts	0 Volts	1300	900
80 Volts	±5 Volts	1300	650
80 Volts	±10 Volts	1300	400

2.14 The resistance of each pair of wires from a "code distributing unit for 200 station lines" in a central office to a signal indicator at a station is limited by the ringing voltages and earth potentials as shown in Table A based on a minimum insulation resistance of 15,000 ohms. On lines with bells but without lights, the conventional ranges for bells are applicable and would normally exceed the ranges tabulated above.

2.15 The maximum resistance of each pair of wires from a control unit for five or eight station lines in a central office to a signal indicator at a station is 1000 ohms. This is based on a minimum of 70 volts a-c, 45 volts d-c, and 15,000 ohms insulation resistance.

2.16 On lines to the siren control stations from the public signal control circuit, the limiting resistances as shown in Table B are based on a ringing supply of 72 volts minimum.

TABLE B

No. of Siren Control Stations Per Line	Max. Conductor Loop Resistances (Ohms): Without D-C Test Feature	Max. Conductor Loop Resistances (Ohms): With D-C Test Feature
1	2700	1500
2	2000	1500
3	1400	1200
4	1000	850
5	700	600

The minimum insulation resistance is 10,000 ohms where the optional d-c test feature is not used and 30,000 ohms where it is.

3. STATION APPARATUS

A. Dials for Sending Alerts

3.01 The dial provided at each control point, which is shown in Fig. 3, is essentially a 7-type dial like that of the 500-type telephone set but it has a modified spring block

Fig. 3 - CARW Dial With Cover Closed

assembly, special cam, number plate, and finger wheel. The modified spring block assembly and special cam were designed so that the per cent break in the dial pulses is 50 ±2 per cent, instead of the 62 ±2 per cent that is produced by the more common 7-type dials. This smaller per cent break increases the over-all tolerance of the system for distortion. The finger wheel has only five finger holes corresponding to the digits 2, 4, 6, 8, and 0 on the more common wheel. They are designed STOP, Y (for yellow), B (for blue), R (for red), and W (for white), respectively. The areas in between the colored fields and under the finger wheel are black with 3/16-inch diameter white dots in the center of the holes.

3.02 The dial housing is a metal box 6 inches wide, 7-1/2 inches deep, and 4-1/2 inches high with a sloping front provided in a gray-green wrinkle finish. The dial is mounted in the face of a sloping front protected by a hinged cover with a plastic window. The cover is provided with a lock and key to protect the dial from unauthorized use. The key should be used to open the cover. However, the cover may be forced open without the key in case of an emergency, but cannot be reclosed without the key, thus furnishing evidence of use. The dial with the cover open is shown in Fig. 4.

3.03 This unit is normally equipped with feet and placed on a desk. However, it can, instead, be mounted on a wall by removing the feet, turning the dial 180 degrees in the housing so that the cover will open down and not obstruct use of the dial, and attaching the unit to a backboard which is fastened to the wall.

B. Bells and Lights for Receiving Alerts

3.04 Alerts are received at subkeypoints and warning stations by means of bells and lights or bells only. At each station equipped with lights, an indicator like that shown in Fig. 5 is provided. This station signal indicator with a ringer and four lights is a modified 531A-3, subscriber set. The modification consists of adding four 359A cold cathode tubes and several resistors. Where only a bell without lights is furnished, the standard 531A, or equivalent, subscriber set may be used. Where required, an extension bell may be provided at a point remote from the indicator.

Daily
2 Y for 15 sec
2 STOP
2 W for 15 sec
2 STOP
W Qd
2-B for 1 min
2 STOP

See GP 252 PAGE 13
GP 249 PAGE 12
OF A399.401

Fig. 4 - CARW Dial With Cover Open

Fig. 5 - CARW Station Signal Indicator

10:00 AM DAILY - DIAL 2 TEST DIGITS FOR 15 SEC - DIAL 1 STOP

12 NOON WED - DIAL 2 ALERT DIGITS

3.05 One of the four lamps in the indicator lights during each alert. The significance of the individual lamps is distinguished by the letter designations over the lamps, namely Y, B, R, and W, respectively. The actual color of the light is the same from each lamp. At stations where the confidential yellow and blue alerts are not received, only two of the four lamps, namely the R and W lamps, will ever light. A light appears only while the associated bell is ringing.

3.06 Coded ringing, consisting of a distinctive code for each alert, is supplied for the 200-station and 8-station units. However, with the 5-station unit, only noncoded ringing is available. In this case the bells sound steadily and continuously on every one of the four different alerts. To silence the audible signal, a nonlocking ringing cutoff key may be provided in series with the ringer. Such a key may be desired when the CARW signal indicator is located where people may be unduly annoyed by the continual ringing of the CARW bell throughout the complete warning cycle. Where a distinctive audible signal is desired from a subscriber set or indicator, one of the two 41-type brass gongs can be replaced with a 40-type aluminum gong.

3.07 Most of these indicators are provided at the subkeypoints and warning stations. However, they should also be provided adjacent to dials at control points and in central offices having dial pulse receiving units. At the control point, the indicator should be located where it can readily be seen by the attendant who operates the dial. This will enable the attendant to check that the alert is actually being sent.

3.08 In each central office, at least one indicator should be permanently installed to inform the personnel that the system is in use so that its performance can be checked. Where coded ringing is employed and only half of the stations receive an alert at one time, this indicator should be on an odd line to receive the alert without delay. An indicator attached to a cord and plug is also required as a portable test unit in connection with local tests on the code distributing units.

C. Siren Station Equipment

3.09 The siren station equipment consists of a relay set that will operate when 20-cycle current is connected to the siren line at the central office end. The contacts of this relay (KS-7340, KS-7341, or equivalent) have a 5-ampere current capacity at 110 volts and 60 cycles. (An additional relay will be provided by the subscriber if the inrush current exceeds 5 amperes.) Through this relay the circuit is completed to the control circuit of the siren. Where the optional continuous line testing is provided, a resistance such as KS-8512, L6A will also be connected at the relay set terminal block to provide a continuous d-c circuit across the line.

4. CENTRAL OFFICE EQUIPMENTS

A. Dial Pulse Receiving Units

4.01 A dial pulse receiving unit receives the dial pulses transmitted from a dial at a control point and converts these pulses into ringing signals that are transmitted to the bell and lights stations. However, it will not transmit an alert unless the same digit is received twice in succession within 16 seconds. Three types of these units are available. They have capacities of 200, 8, and 5 stations respectively. The 200-station unit, which may be supplied in steps of fifty, transmits coded visual and audible signals. The 5-station unit is provided with a steady audible bell for all signals and a distinctive lamp for each of the four signals. The unit having a capacity of eight stations is a modified form of the 5-station unit. After the conversion from a 5-station unit, this equipment will provide coded ringing and will have a capacity of four stations. An option to increase this number to eight stations is available. The public signal (siren) control circuit is arranged to receive and translate the alert signals from each of these units.

4.02 Each of the dial pulse receiving units includes three lamps to indicate what type of pulses was received; these are designated PD (for prime digit), WD (for wrong digit), and TST (for test). The (PD) lamp lights when the first digit of a regular alert code (4, 6, 8, or 0) is received to "prime" the system. The (WD) lamp lights if an improper or "wrong" digit (1, 3, 5, 7, or more than 10) is received. The (TST) lamp lights when the "test" digit 9 is received.

B. Code Distributing Unit for 200 Stations

4.03 The basic dial pulse receiving and code distributing unit having a capacity for 200 stations is shown in Fig. 6. At least one line connector relay unit is required with each of these code distributing units. The line connector unit for the first group of fifty or less station lines is shown in Fig. 7. The similar unit for each of the second, third, and fourth groups of fifty or less station lines is shown in Fig. 8.

4.04 The code distributing unit includes a pulse receiving circuit, a pulse checking unit, a code generating circuit, and a multicontact line connector relay circuit. This unit is arranged to receive and record the dial pulses sent from the control point, and to control the operations of the code generator and multicontact line connector relays so that the code ringing signals are distributed to the associated warning stations. An option is available so that the signal may

Fig. 6 - Dial Pulse Receiving and Code Distributing Unit for 200 Stations

Fig. 7 - Line Connector Relay Unit for First Group of Fifty Stations

Fig. 8 - Line Connector Relay Unit for Second, Third, or Fourth Group of Fifty Stations

also be transmitted to the public signal control circuit. The lines and associated loops between the dials and this unit are checked continuously for trouble conditions such as false ground or opens. Any pulse on the system produces visual and audible alarms in the central office.

4.05 When the control point attendant dials, the loop to this circuit is opened a number of times corresponding to the digit dialed. These pulses are counted by a counting relay chain like that provided in the dial pulse register circuits in crossbar central offices. When a train of pulses ends, one of the register relays will operate and lock up. The first digit is then stored while the train of pulses for the second digit is transmitted. An alert will not be sent unless the same alert digit is received twice in succession within 16 to 48 seconds. When the second of two successive identical digits is received, the line connector relays operate. These line connector relays follow the coded signals from the code generator circuit and thus transmit the proper signals to the associated stations. When the STOP digit is dialed once at the control point, the circuit is restored to normal.

4.06 The coded ringing signals are divided into two phases, 180 degrees apart. One half of all the stations are served from one phase and the other half are served from the other phase. In this way, twice as many warning stations can be signaled from the available supply of ringing power.

4.07 An option is available to provide continuous ringing on the white alert. Where this is employed, there must be a sufficient source of power to ring all lines simultaneously.

4.08 Optional wiring is provided so that either one or both of the confidential yellow and blue alerts can be restricted from each of the first group of 50 station lines served by a 200-line unit. The remaining 150 lines of a 200-line unit can be arranged to receive only all four alerts or only the red and white alerts. The wiring for this restriction is all in the central office to obviate unauthorized tampering.

4.09 Red or white signals are produced at a station signal indicator by superimposed ringing voltage that is negative or positive, respectively, on the tip side of the line. Yellow and blue signals are produced at a station signal indicator by superimposed ringing voltage that is negative or positive, respectively, on the ring side of the line.

C. Control Unit for Five Stations

4.10 The dial pulse receiving and control unit for five warning stations is shown in Fig. 9 (here equipped for one line). This circuit differs from the similar circuit for 200 lines, not only in its smaller capacity, but also in its methods of transmitting signals to the stations and in the omission of positive superimposed ringing power. This circuit transmits negative superimposed ringing

Fig. 9 - Dial Pulse Receiving and Control Unit for Five Stations

during all types of alerts. The ringing from this 5-station unit to the station signal indicators is continuous for all codes and all stations.

4.11 Two pairs of wires are required from this 5-line unit to each of the station indicators. These two pairs are arranged as three conductors by using both sides of one pair as one conductor. This double conductor is connected to the station indicator at the terminal which, if used with the 200-station unit, would be connected to local ground. The extra cost of the second pair of wires to each station from a 5-line unit will generally be offset by the lower cost of the central office equipment resulting from the smaller basic size of this 5-line unit in comparison with the 200-line unit, and the omission of the positive superimposing battery and code generating circuit.

4.12 This unit is also equipped with the testing arrangements and lamps described in 4.02.

D. Control Unit for Eight Stations

4.13 The dial pulse receiving and control unit for eight stations which is shown in Fig. 10 is substantially the same unit as that for five stations. However, to provide coded audible signals for each alert, this unit has been equipped with a code ringing generator. This unit normally accommodates four stations but an option is available which increases this number to eight. The option to provide a continuous white alert is also available for this unit.

E. Signaling Repeaters

4.14 Two types of 2-way signaling repeater circuits are available for use in these CARW networks as explained in Part 2. The 2-way repeater unit of the balanced loop type is shown in Fig. 11. This repeater is designed for ground potential compensating on the line side. The tip side of the line pair of wires is used for signaling, and the ring side is used for ground potential compensating.

4.15 The loop circuit of this repeater operates over one wire which is extended locally through the dial pulse receiving circuits and/or other repeaters. This loop is balanced by a network in this repeater, and signals are sent by changing from battery to ground or vice versa on the circuit to the loop.

4.16 The 2-way repeater unit of the open and closed loop type is shown in Fig. 12. The line side of this repeater is the same as that of the balanced loop repeater described above. The loop side of this repeater operates by opening and closing a metallic circuit.

Fig. 10 - Dial Pulse Receiving and Control Unit for Eight Stations

(3) West other spare

95681

Fig. 11 - Two-way Signaling Repeater Balanced Loop Type

95682

Fig. 12 - Two-way Signaling Repeater Open and Closed Loop Type

4.17 The 1-way receiving repeater unit is shown in Fig. 13. This includes facilities that light the ALM lamp on this unit whenever a dial pulse is received from the associated dial at the near-by control point.

4.18 The 1-way sending repeater unit is shown in Fig. 14. It contains three simple 1-way repeater circuits, each consisting of a single polarized type of pulse repeating relay with a test jack and resistances for protection and line resistance compensating.

4.19 The 2-way repeaters have two principal advantages: (1) they permit 2-way transmission of signals and (2) they include automatic alarm features which isolate faulty lines from the rest of a network and produce audible and visible signals to attract attention to the trouble. However, the 1-way repeaters are less expensive. In general, the 2-way repeaters are required in the "backbone" portions of each network; that is, between the primary and alternate control points. One-way repeaters are usually adequate for the branch lines from the "backbone" which extend to the central offices near the stations. However, when the conductor loop between central offices is more than 1500 ohms, 2-way repeaters are required. In this case a strapping is provided on the 2-way repeater to limit it to 1-way operation. A "special" key may be mounted for this purpose, if desired.

4.20 Where not more than two lines of the 2-way signaling type are connected together in a central office with one or more dial pulse receiving units, each line is terminated in a balanced loop repeater. Then the loop circuit of one of these repeaters is connected in series with the winding of the receiving relays of the dial pulse receiving units or the sending relays of the 1-way repeaters to the loop circuit of the other repeater. An open and closed loop repeater is provided on each 2-way line in addition to the first two where three or more 2-way signaling lines are connected together in a central office. The loop side of each of these repeaters is connected in series with the loop circuits of the two balanced loop repeaters.

4.21 The methods by which the various types of repeaters can be interconnected with lines, loops, dial pulse receiving units, and public signal control circuits are indicated briefly on Fig. 2 and in more detail on the application schematic drawing. This drawing includes information on the arrangement of the testing and patching jacks and the connections to the central office alarms.

F. Public Signal Control Circuit

4.22 The public signal (siren) control circuit is an optional addition to the CARW system to permit the control of the

Fig. 13 - One-way Receiving Repeater

95683

Fig. 14 - One-way Sending Repeater Three Circuits Per Unit

sirens simultaneously with transmittal of the alert signals to the bell and lights stations. The circuits are arranged to receive the alert signal information from any of the dial pulse receiving units and to transmit the red and white alerts to the siren control stations.

4.23 This equipment consists of two main units as shown in Fig. 15, the common control unit and the line connector unit. The common equipment consists of the control relays and the red alert signal generator. It is arranged to handle a maximum of thirty siren lines. The line connector units are provided with a capacity of five or ten lines each. Three of these units may be provided, thus varying the capacity from five to thirty siren lines in steps of five or ten.

4.24 These circuits receive signals for all four of the alerts, yellow, blue, red, and white, from the dial pulse receiving circuits of the bell and lights system. The public signal control circuit identifies the yellow and blue alerts as confidential signals and not to be transmitted to the sirens. It also identifies the red alert signal and causes all of the sirens associated with the particular unit to be operated.

4.25 Since the red signal from the sirens is a warble or modulated signal, this circuit is arranged to provide an intermittent opened and closed condition on the siren lines. In this way the sirens are repeatedly started and stopped, thus generating the modulated signal. This successive starting and stopping of the sirens will continue until the STOP is dialed by the control point operator.

4.26 This circuit will recognize the initial receipt of a white signal or the receipt of a white signal following a red signal and will cause the sirens to be operated. Since the all clear or white signal is a steady blast, the circuits are arranged to bring the sirens into unmodulated operation. The signal will continue until the STOP signal is dialed by the control point operator. A lockout feature is provided to prevent transmitting to the sirens a white signal following a yellow or blue signal. If a yellow or blue signal is received before a red signal, the circuit operates to lock out the next white signal from going to the sirens. However, once a white or red is received, the lockout is removed and subsequent white signals are transmitted to the sirens.

4.27 Since sirens of various manufacture and size are employed, these circuits have been arranged so that by varying the number of relays and the associated strapping, a suitable frequency of modulation can be obtained. Facilities are provided to give the cyclical variations shown in Table C.

TABLE C

Seconds per Cycle	Seconds Open	Seconds Closed	In Steps of
20	4 to 16	16 to 4	2 seconds
18	4 to 14	14 to 4	2 seconds
16	4 to 12	12 to 4	2 seconds
14	4 to 10	10 to 4	2 seconds
12	4 to 8	8 to 4	2 seconds
10	2 to 8	8 to 2	1 second
9	2 to 7	7 to 2	1 second
8	2 to 6	6 to 2	1 second
7	2 to 5	5 to 2	1 second
6	2 to 4	4 to 2	1 second
5	2 to 3	3 to 2	1 second
4	2	2	1 second

Since these relays and strappings are a part of the common equipment, the same frequency of variation in the opened and closed periods will apply to all sirens connected to any one particular unit. Other units in the same system may, of course, utilize different frequencies of variation.

Also Black R & RW Relays in Normal (Deenergized)

Fig. 15 - Public Signal Control Circuit

4.28 This circuit provides continuous line test features on an optional basis where it is felt necessary to guard against opens, shorts, or grounds on any or all of the associated siren lines. This testing is accomplished by producing a continuous flow of direct current through marginal and sensitive relays and a high-resistance bridge placed across the line at the siren station. The alarm circuit itself is designed to work with from one to ten continuous line test circuits, each of which in turn are arranged for three siren lines. Thus in steps of three lines, continuous test capacity may be provided for from three to thirty siren lines.

G. Power for Code Ringing

4.29 The ringing codes are generated by relays which are actuated from a source of 60 ipm pulses. These pulses are counted and added by these relays so as to produce the following code signals for transmission to bell and lights stations.

Type of Alert	Nominal Ringing Code	Details of Each Ringing Cycle
Yellow	2 rings	0.5 second on 0.5 second off 0.5 second on 2.5 seconds off
Blue	3 rings	0.5 second on 0.5 second off 0.5 second on 0.5 second off 0.5 second on 1.5 seconds off
Red	continuous warble	0.5 second on 0.5 second off
White	steady	16.0 seconds on 16.0 seconds off

These relays are mounted on the code distributing unit shown in Fig. 6. A relay interrupter circuit is available to supply 60 ipm pulses in central offices where these pulses are not otherwise available.

Fig. 16 - Ringing Machine Unit for Auxiliary Ringing Supply to Fifty Stations

4.30 The power for lighting lamps in station signal indicators in combination with code ringing consists of 20 cycles superimposed on positive and negative d-c voltages similar to that which has been used for 4-party full-selective ringing. To assure proper visual signals from the station signal indicators, the voltage of both the positive and negative superimposing batteries should not be less than 45 volts. A separate 48-volt positive superimposing battery is required in each central office having a 200-station code distributing unit even if a standard positive battery for 4-party telephone service is already available in the office.

4.31 The 20-cycle voltage of the ringing supply to these indicators should be minimum 65 volts. If the minimum voltage is higher, greater signaling ranges can be obtained as indicated in 2.14.

4.32 Approximately 0.010 ampere of superimposed ringing current will flow on a line to one station indicator during each ringing period. On each line having two of these indicators, the current will be approximately 0.020 ampere. Where the ringing interruptions are divided into two phases, 180 degrees apart, each 10 milliamperes of capacity in the ringing power plant will be adequate for two station indicators. Because of the large number of station indicators which may be rung simultaneously during the transmission of an alert signal, the capacity of many of the regular central office ringing plants will not be adequate. Where additional ringing supplies are needed, they may be provided by means of extra ringing generators as shown in Fig. 16.

5. METHODS OF OPERATION

A. Normal Operation

5.01 During normal operation, the attendant at the primary control point is the only person required to operate any particular CARW network. The procedure followed by the attendant upon receipt of an alert from the next higher echelon is merely to select the appropriate alert color on the face of the control point dial and then dial this color twice.

5.02 The resulting dial pulses are transmitted over the signaling network to the associated dial pulse receiving units. Each of these units converts the dial pulses into the particular alert code, and automatically sends the signal to its group of warning stations. Thereafter, this alert signal will continue until STOP is dialed.

5.03 In order to insure proper operation of the system, the attendant should always dial STOP once when changing from one class of alert to another. The system will not transmit a second alert within 16 to 48 seconds (depending upon the type of central office) after the previous one unless the network has been cleared by dialing STOP. After this time has passed, a failure to dial STOP between alerts will not prevent the transmission of the new alert, but it may provide an incomplete audible code at the warning stations on the first ring. Since a second ring with a complete code would be repeated immediately, such an incomplete code would not be serious. However, it will be avoided if the prescribed order of operations is followed.

5.04 The "prime digit" lamp (PD) will light when the pulses for 4, 6, 8, or 0 (corresponding respectively to yellow, blue, red, or white) are received. If the same digit is subsequently received, that particular alert will be disseminated. However, this second digit must be received within 16 to 48 seconds or the equipment will time out and restore to normal. The receipt of the pulses for digit 2 corresponding to STOP will also restore the unit to normal.

5.05 The "wrong digit" lamp (WD) will light if an initial digit 1, 3, 5, or 7 is received or if more than 10 pulses are received. This will lock the equipment out of service for 16 to 48 seconds or until the digit 2 corresponding to STOP has been received. The same reaction will be obtained if the second digit is not the same as the first. To transmit an alert the digits must be received as 4-4, 6-6, 8-8, or 0-0. Any other combination will not transmit an alert but will bring in the central office major alarm and will remove the equipment from operation under control of the digit 2 or the 16- to 48-second timing interval. The (WD) lamp will remain locked in until manually restored by the operation of the associated (WD) button.

5.06 The test digit lamp (TST) will light whenever the test digit 9 is received. Like the (WD) lamp, once lighted, it will remain locked in until it is manually restored by the operation of the associated (TST) button.

5.07 Where sirens are involved, the "public signal control unit" receives the signals from the dial pulse receiving units and automatically determines whether the sirens are to be operated, and if so, sends the appropriate signals to the siren control stations. The sirens will not operate on a yellow or blue alert at any time due to their confidential nature. A red alert will, however, cause the sirens to operate under all conditions. A white alert is transmitted by the sirens only under two conditions: (1) when it is the initial signal, or (2) when it is preceded by a red alert. Certain conditions might arise where a confidential yellow or blue alert would be transmitted to the warning stations but would not be followed by a red alert. In this case, the white alert, to indicate the yellow or blue condition no longer exists, would be confidential and would not activate the sirens. To accomplish this, a feature is provided in the public signal control circuit to prevent the white signal from activating the sirens

after a yellow or a blue signal until a red alert has been transmitted or until a white signal has been sent to the bell and lights stations. The requirement that the sirens operate on an initial white signal is for testing purposes.

5.08 The red alert signal from the sirens is a warble or modulated signal produced by automatically starting and stopping the sirens as explained in 4.25. However, the exact duration of this interval will be determined by the control point operator and is usually about 3 minutes.

5.09 The white alert signal from the sirens consists of three separate steady alert signals, each lasting about one minute with 2 minutes of silence between. The duration of the signals and the silent intervals will be under control of the control point operator. However, when it is required to send a confidential white alert, following only a yellow or blue, the white signal should be sent only once to prevent activating the sirens.

5.10 In order to check the system for operation and to be sure that the proper alert digit has been dialed, the attendant at the control point should observe the station signal indicator which normally is provided adjacent to the dial at every control point. Where the system controls only sirens, a 531-type subscriber set or equivalent will be provided. In this case the bell will sound coincidently with current being sent to the sirens, and thus provide a check on the operation of the system and aid in the timing of the alerts. Where the system controls sirens in addition to bells and lights, both the station signal indicator and the subscriber set may be provided. This will then provide a check on the operation of both of the control units.

5.11 During any operational period, whether under normal or emergency conditions, care should be taken by the local civil defense authorities that two control point attendants do not dial on the same network at the same time. No lockout feature is provided in this system so that this simultaneous dialing could result in a mutilated signal.

B. Emergency Operation

5.12 During emergency conditions, the method of operation remains identical, except that if part of the backbone signaling network is destroyed, it may no longer be possible for the primary control point attendant to alert all or part of the area normally served by the control point. Under these conditions, the remaining section or sections of the network may be served by an alternate control point, or by a number of alternates, depending on the system layout and other facilities available. The methods of operation employed, at these times, may be different in each instance and will be influenced by the possibilities of using the commercial telephone or other means to bring the alternate control points into operation. Because of the need for maximum efficiency under emergency conditions, it will be important that arrangements be made for promptly reporting all troubles affecting the signaling networks to the telephone company maintenance people and the local civil defense people.

5.13 In the event that a code distributing or control unit is isolated from the signaling network as the result of an emergency, but the station loop facilities are unaffected, an alert can be disseminated directly from the code sending unit, the test circuit associated with the 1-way sending repeater, or the digit 9 jack associated with the 1-way receiving repeater at the central office. The procedure for such operation is to connect a regular dial hand test set to a jack on one of these units and dial twice the digit corresponding with the alert, namely 4, 6, 8, or 0 for yellow, blue, red, or white, respectively, or dial the digit 2 once for STOP. This procedure, however, should be undertaken only by telephone company personnel, and then only upon specific direction from certain identifiable responsible sources in accordance with previously established practices.

6. ALARMS

6.01 Four types of central office alarms are provided with these CARW systems:

(1) The usual fuse alarms associated with the power and ringing supply circuits.

(2) The control point dial alarm lamp which indicates that a pulse has been transmitted from a dial at the control point to the 1-way receiving repeater in a near-by central office.

(3) The major central office alarm which indicates that any pulse (alert digit, prime digit, wrong digit, test, or trouble condition) is transmitted over the network.

(4) Line trouble alarms that indicate trouble conditions which would prevent the transmission of alerts over any part of the CARW network.

6.02 While an alert is being transmitted, the resistance lamps, through which ringing voltage is supplied to the loops for operating the station signal indicators, should be observed to check that none are lighted. If one is lighted, it indicates a short circuit or ground on the associated line which should be promptly corrected. It also indicates a need for special notice of the alert to the warning station on this line because the station signal indicator may not be operating.

6.03 The control point dial alarm is actuated from the one-way receiving repeater shown in Fig. 13. The ALM lamp in the 1-way re-

ceiving repeater is lighted and locked in each time that a pulse is received from the associated dial. This signal remains until released by the manual operation of the adjacent CA key. This signal enables the telephone maintenance personnel to keep a record of each use of the CARW network, it helps to detect quickly any false operations that might result from sabotage or other troubles, and assists in assuring prompt attention to the performance of the system at the times when perfect performance is most urgently needed.

6.04 Whenever any pulse at all, whether caused by the operation of the dial or by a trouble condition, is transmitted over the network, the central office major alarm sounds and the ALM lamp shown in Figs. 6, 9, and 10 lights. This alarm may be released by the operation of the adjacent cutoff key. In the case of unattended offices, it may be released by either dialing a particular number at a remote master office or by the operation of a key on the local switchboard. The cause of the pulse may be determined by examining the control point dial alarm lamp, the prime digit lamp, the wrong digit lamp, and the test lamp.

6.05 The line trouble alarms are of three general types:

(1) A section isolating alarm which indicates that trouble producing a "break" signal for more than about 0.5 second has occurred on a line served by a 2-way repeater, and that this repeater has automatically isolated the line in trouble from the rest of the network. Such a trouble lights a lamp on each repeater involved and operates the office audible and visible alarms.

(2) On siren lines which are arranged to be continually tested, an open, short, or ground condition will bring in the central office audible and visual alarms. In addition an alarm lamp on the relay rack is provided as a visual indication of siren line trouble.

(3) The alarm associated with the dial pulse receiving units will indicate line troubles on the 1-way section serving them.

7. MAINTENANCE FEATURES

7.01 The following arrangements are provided to test the CARW equipment:

(1) Observation and tests of over-all system performance in connection with the regularly scheduled over-all system tests by civil defense personnel. This includes observing the signal indicators, alarm lamps, and ringing lamps associated with the dial pulse receiving and code distributing units in the central offices. The operation of the sirens should also be checked.

(2) A test circuit, consisting essentially of a key and two jacks, is associated with the 1-way receiving repeater in the central office which serves a control or alternate control point. Provision is made for a fixed jack-ended dial to be patched to this test circuit to enable the telephone company people to dial the digit 9 for an over-all signaling network operational test. Standard portable test sets may be employed with the test circuit for over-all pulsing tests.

(3) A regular dial hand test set may be plugged into any dial pulse receiving unit to test that individual unit without disturbing any equipment in any other central office or causing signals at any warning or siren stations.

(4) A test circuit may be provided in association with each of the 2-way repeaters. Standard portable test sets may be connected to this circuit to make 2-way pulsing tests of individual sections of the backbone network.

(5) A test jack circuit may be provided in association with 1-way sending and 2-way open and closed repeaters. A regular dial hand test set may be used with this circuit so that the digit 9 may be dialed to test the operation of a single leg.

(6) Tests of station indicators:

(a) Tests of station signal indicators from local test desks using the +STA and −STA keys that are available as standard options in these desks.

(b) Tests of station signal indicators from the CARW equipment on the relay racks. A test circuit to produce each of the four ringing conditions for the four alerts is available for this purpose.

7.02 The FCDA has suggested over-all system operational tests which consist of operating five alert signals, starting with the white signal, and followed by yellow, blue, red, and white successively in that order. However, the blue signal may not be used until such use has been officially designated. In order to avoid any possible confusion in the minds of the civil defense employees and the public concerning the distinction between the test signals and an actual CARW alert signal, the interval of each test signal will be considerably shorter than that of any prescribed alert interval, and the entire series of test signals will be completed in a relatively short time. The over-all time of all five signals will be not more than about that which would normally be consumed by any one of the real alert signals.

7.03 The methods of testing the repeaters, dial pulse receiving and code distributing units, and public signal control units in the central office are covered in Bell System Practices in Division A200.

TELEGRAPH
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