

**CIVIL AIR DEFENSE WARNING SYSTEM
FOR DISSEMINATING WARNINGS FROM
KEYPOINTS AND SUBKEYPOINTS
TO
WARNING STATIONS
AND SIREN CONTROL STATIONS
GENERAL DESCRIPTIVE INFORMATION**

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3. STATION APPARATUS	8	1.01 This section gives a general description of the Civil Air Defense Warning System (CADWS), often referred to as the Bell and Lights System.	
A. Dials for Sending Warnings	8	1.02 This section is reissued to: (1) show the substitution of words and digits for colors at the station equipment, (2) change references to Civil Air Raid Warning (CARW) to read Civil	
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Air Defense Warning (CADW), (3) expand the range table showing maximum conductor loop resistance, (4) add information for recording pulses sent from a keypoint dial, (5) add information pertaining to signaling over telegraph facilities, (6) add information about an optional automatic signal stopping device. Since this re-issue covers a general revision, arrows ordinarily used to indicate changes have been omitted.

A. Purpose of This CADW System

1.03 This CADW system provides a rapid means of disseminating warning signals from the keypoints and subkeypoints to the warning stations and/or siren control stations in their respective warning areas. These warnings 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 CADW Systems

1.04 CADW warnings originate in the Air Defense Control Centers (ADCCs) which are operated by the United States Air Force. The warnings are transmitted from these centers over private line telephone networks to the keypoint civil air defense warning stations sponsored by the Office of Civil Defense and Mobilization (OCDM). From these keypoints, the warnings are relayed over signaling networks to subkeypoints, warning stations, siren control stations, and finally to the public. The transmitting of the warnings 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.

1.05 Steps 2 and 3 may be combined so that the keypoint transmits the warnings directly to the warning stations and the siren control

stations. The CADW 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.

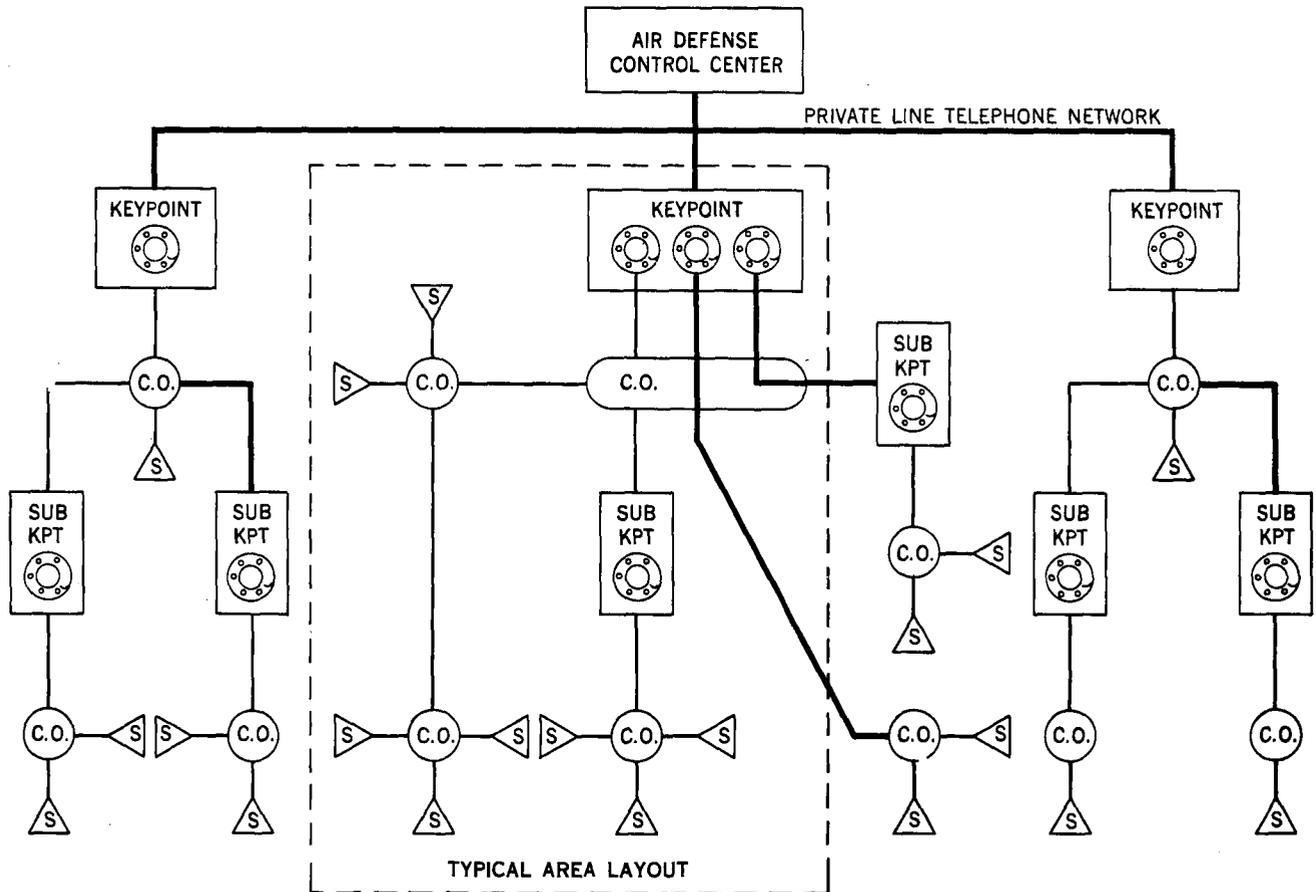
C. System Planning

1.06 As illustrated in Fig. 1, a CADW 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 warnings. In connection with this planning, the following general principles may be helpful. From each keypoint, the warnings 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 nearby city, town or village.

1.07 A keypoint or subkeypoint from which warnings 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 warnings from the primary control point.

1.08 The area served from each control point depends on a variety of local conditions and follows the requirements established by



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 Defense Warning Network for Dissemination to Keypoints, Subkeypoints, Warning Stations, and/or Siren Control Stations

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 CADW 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 warnings and more speedy dissemination. With decentralization, there are more people and fewer permanent wire connections and consequently greater flexibility for special procedures in emergencies.

1.09 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.

1.10 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 CADW central office equipment which will best satisfy the local needs.
- (3) Select the outside conductors to interconnect the various central office and station equipment.

D. System Capacity

1.11 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 8 stations, and the third of 5 stations. Any number of these units can be interconnected in a single network within 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 10. 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 Warnings

1.12 This CADW system is arranged to disseminate four types of warnings. These warnings are, generally, used as follows: position 1 for TEST purposes, position 2 indicates ALERT, position 3 indicates TAKE COVER, and position 4 is optional. Position 2 and position 3 signals are transmitted to both the bell and lights stations and to the public signal system (siren control line). Position 1 and position 4 signals are passed to the bell and lights stations only. Interpretation of position 1 and position 4 signals are the responsibilities of the local authorities.

2. SIGNALING PRINCIPLES

A. Dial Pulsing and Ringing Signals

2.01 The dials provided at the control points for sending warnings are connected to private line networks which terminate in dial pulse receiving equipment in central offices. These equipments translate the dial pulse signals into ringing signals which are transmitted over lines to bell and lights stations. The dial pulse signals may be transmitted over relatively long portions of the networks by means of signaling repeaters which enable such transmission. These pulse repeaters are essentially like telegraph repeaters, except that they operate on 48 volts instead of 130 volts and include automatic alarm features. The ringing signals are transmitted over the relatively short end-links between the central offices and warning stations and permit the use of visual and audible station equipment which does not require local power.

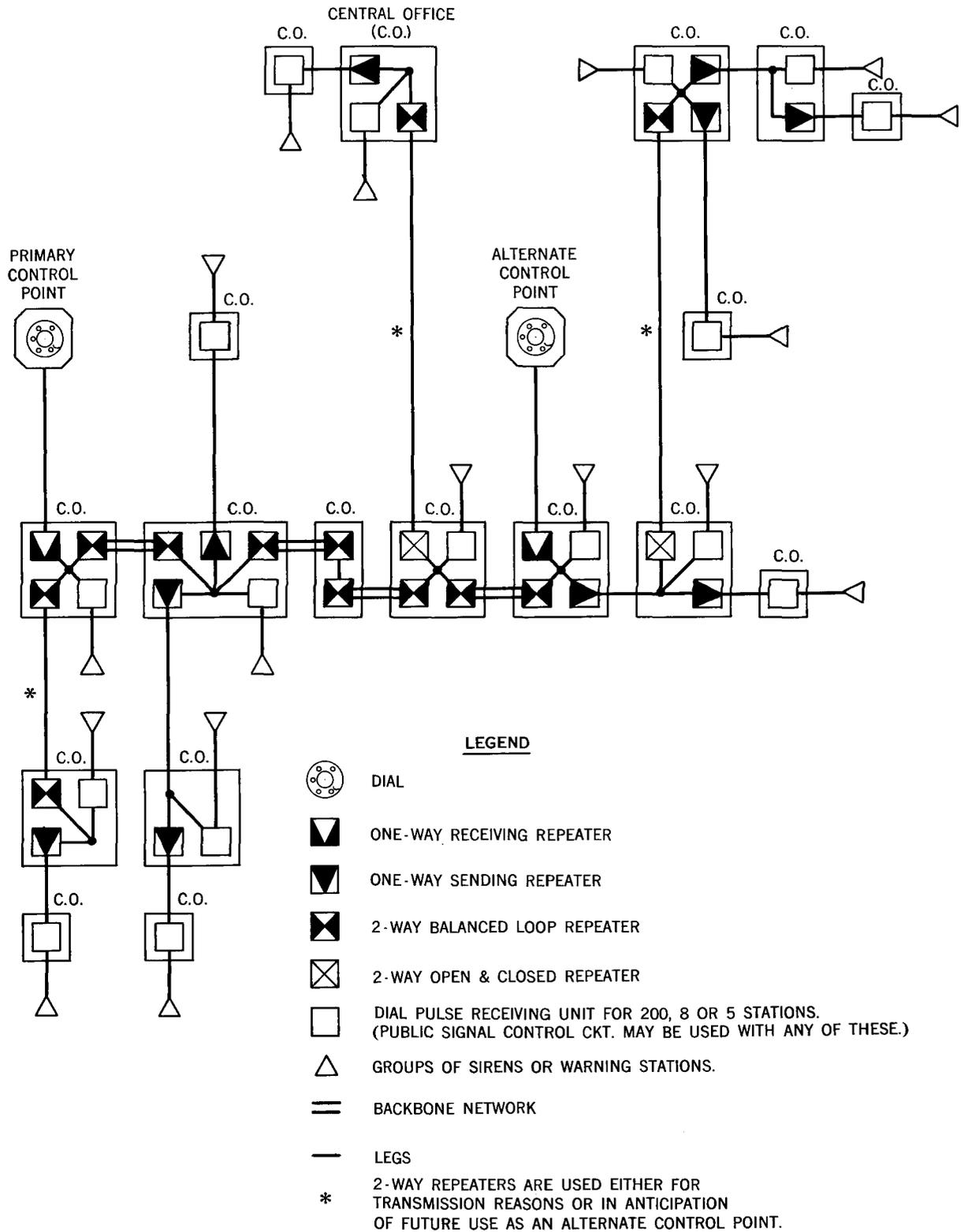


Fig. 2 - Typical Arrangement of CADW Control Points and Central Offices Showing the Use of the Various Types of Central Office Equipment

2.02 Two types of ringing signals are provided.

That provided by the 200-station capacity central office equipment is substantially the same type as that provided for 4-party full selective ringing on subscriber telephone lines and consists of superimposed negative and positive ringing voltages connected to the ring side of the line for position 1 and position 2 station warning signals, respectively, and to the tip side of the line for position 3 and position 4 station warning signals, respectively.

2.03 The ringing signals from the 5- or 8-station capacity central office equipment 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.

2.04 The 5-station capacity equipment provides a continuous audible signal and an individual visual signal for each warning. Both the 200-station and the 8-station equipment, however, provide a coded audible signal in addition to the individual visual signal for each warning.

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 position 2 (ALERT) and intermittently for the modulated position 3 (TAKE COVER) signal. The position 1 (TEST) and position 4 (optional) signals are not passed to the siren stations.

C. Signaling Repeaters

2.06 Four different types of signaling repeater circuits are available for use in these CADW 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 the tip side of the line pair with ground potential compensating on the ring side 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 signaling on a loop requires a signaling network to balance the impedance of the loop, this type of repeater is called the "balanced loop" type.

2.11 The other 2-way repeater is of the "open and closed loop" type and operates on its loop side by opening and closing a metallic circuit rather than alternating battery and ground signals as in the "balanced loop" type.

2.12 The 1-way receiving circuit is used at a central office to receive the dial pulses originated by the dial at the control center, and to repeat these pulses into the loop circuits of the repeaters and other associated circuits of the system in the office. A visual alarm feature indicates whenever a dial pulse is received from the control point.

2.13 The 1-way sending circuit, consisting of a single polarized type pulse repeating relay with a test jack and resistances for protection and line resistance compensating, may be connected to a pen register for recording pulses from a control point dial. This optional arrangement may be desirable as a means of verifying any accidental or unauthorized operation of a control point dial.

2.14 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.

2.15 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.

2.16 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 in

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.

D. Lines and Ranges

2.17 Each line over which warning signals are transmitted between central offices may be an individual pair of wires not used for any other purpose or may be two 1-wire dc 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.

2.18 For ranges beyond the limits of the signaling repeaters used in this system a signal converter unit is available to permit the use of toll telegraph facilities on interoffice connections. This signal converter unit uses two 1-way loops (4 wires) to connect to the telegraph circuit and relies upon the associated balanced or open and closed 2-way repeater for alarm and sectionalizing features.

2.19 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.

2.20 Table A shows the maximum loop resistance permissible for reliable operation of the CADW station signal indicators with and without extension indicator(s) and extension ringer(s).

2.21 The range values as shown have been determined for ac voltages of 65 to 90 volts (with 45 to 52 volts dc), with earth potentials of 0 ± 10 volts, and with loop leakage values of 15,000 and 50,000 ohms.

TABLE A

LINE TO CONNECTING CIRCUIT	AC VOLTAGE WITH 45V - 52V DC	MAXIMUM EARTH POTENTIAL (VOLTS)	MINIMUM INSULATION RESISTANCE (KILOHMS)	MAXIMUM CONDUCTOR LOOP - OHMS			
				MAIN INDICATOR ONLY	MAIN INDICATOR PLUS ONE EXTENSION INDICATOR*	MAIN INDICATOR PLUS ONE EXTENSION RINGER	MAIN INDICATOR PLUS TWO EXTENSION RINGERS*
2 Wire	65 - 90	0	15	600	50	300	200
"	70 - 90	0	"	1300	400	700	600
"	70 - 90	± 5	"	800	150	400	200
"	70 - 90	± 10	"	300	—	—	—
"	75 - 90	0	"	1800	800	1200	1000
"	75 - 90	± 5	"	1300	400	800	600
"	75 - 90	± 10	"	900	200	400	300
"	80 - 90	± 10	"	1300	400	900	700
4 Wire	65 - 90	—	15	500	—	200	100
"	70 - 90	—	"	1000	200	500	400
"	75 - 90	—	"	1500	600	1000	900
2 Wire	65 - 90	0	50	1000	200	600	200
"	70 - 90	0	"	1800	700	1200	700
"	70 - 90	± 5	"	1300	300	800	400
"	70 - 90	± 10	"	600	—	300	—
"	75 - 90	0	"	2600	1000	1700	1200
"	75 - 90	± 5	"	2000	700	1300	800
"	75 - 90	± 10	"	1600	400	800	500
"	80 - 90	± 10	"	2400	800	1500	900
4 Wire	65 - 90	—	50	800	100	500	300
"	70 - 90	—	"	1500	400	800	700
"	75 - 90	—	"	2000	700	1500	1100

*Note 1: The addition of an extension indicator or two extension ringers will reduce by one the number of lines which can be served by a given central office ringing source.

Note 2: The extension ringers are the B1AL type, connected across the line in series with a 0.5 MF capacitor and a 3600-ohm resistor.

2.22 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 DC TEST FEATURE	WITH DC 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 dc test feature is not used and 30,000 ohms where it is.

3. STATION APPARATUS

A. Dials for Sending Warnings

3.01 The dial provided at each control point is a special 7-type dial with a modified spring block assembly, special cam, number plate, and finger wheel. The modified spring block assembly and special cam are designed so that the per cent break in the dial pulses is 50 ± 2 per cent. The finger wheel has only five finger holes corresponding to the digits 2, 4, 6, 8, and 0. They are designated STOP, TEST, ALERT, and TAKE COVER to correspond to the 2, 4, 6, and 8. The last finger hole corresponding to the "0", the use of which is optional, may be designated locally for purposes such as "Natural Disaster."

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 discourage unauthorized use. The key should be used to open the cover. However, the cover may be forced open in case of an emergency, but cannot be reclosed without the key. The dialing assembly with the cover open is shown in Fig. 3.

3.03 This unit is normally equipped with feet and placed on a desk. It can be attached to a wall after removing the feet and mounting the housing so that the cover opens downward to prevent obstructing the use of the dial. The dial should be turned through 180° for this type of mounting.

B. Bell and Lights Indicators for Receiving Warnings

3.04 Warnings 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. 4 is provided. This station signal indicator with a ringer and four lights is a modified 531A-3 subscriber set. Where only a bell is to be furnished, a 531A, or equivalent, subscriber set may be used. An extension bell may be provided as is necessary.

3.05 One of the four lamps in the indicator lights during each warning. The significance of the individual lamps is distinguished by the number designations over the lamps, namely 1, 2, 3 and 4, respectively. A light appears only while the associated bell is ringing. To silence the audible signal a nonlocking ringing cutoff key may be provided. Where a distinctive audible signal is desired one of the 41-type brass gongs of the ringer assembly can be replaced with a 40-type aluminum gong.

3.06 Most subkeypoints and warning stations are provided with indicator sets and should be located where they can readily be seen to enable the attendant to check that the warning is actually being sent.

3.07 In each central office, at least one indicator should be permanently installed to inform the personnel when the system is in use so that circuit performance can be checked. Where coded ringing is employed and only half of the stations receive a warning at one time, this indicator should be on an "odd" line termination to indicate the warning 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

3.08 The siren station equipment consists of a relay set that will operate when 20-cycle current is connected to the siren line. 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 feature is provided, a resistor such as KS-8512, L6A will be connected at the relay set terminal block to provide a continuous dc circuit across the line.

4. CENTRAL OFFICE EQUIPMENT

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 a warning unless the same digit is received twice in succession within 16 seconds. Three types of units are available having capacities of 200, 8, and 5 stations respectively. The 200-station unit, which may be supplied in steps of 50, transmits coded visual and audible signals. The 8-station unit having a capacity of eight stations is a modified form of the 5-station unit. The public signal (siren) control circuit is arranged to receive and translate the warning signals from each of these units. Optional signal stopping equipment, for automatically stopping signals in approximately three minutes, is available for all three units.



Fig. 3 - CADW Dial with Cover Open

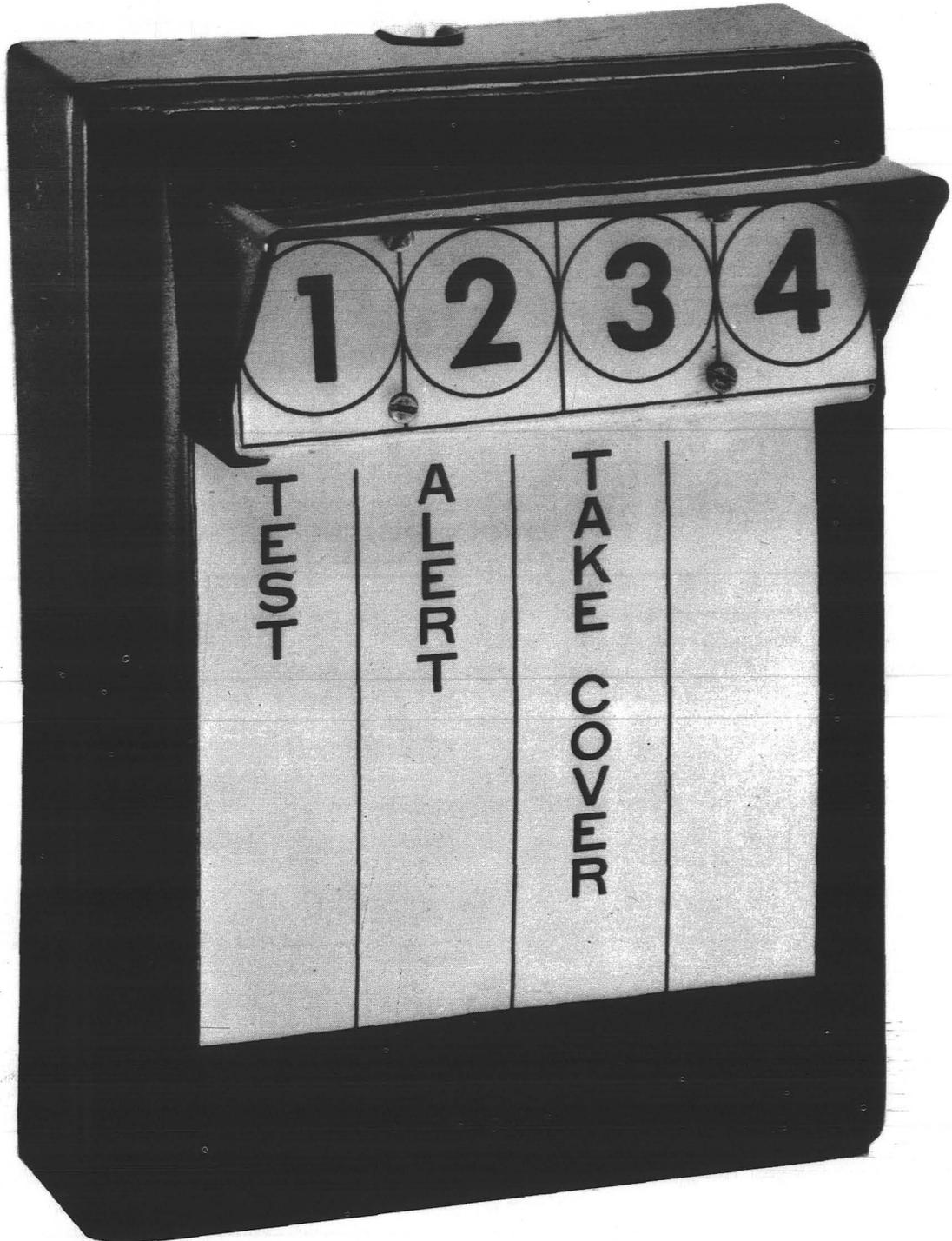


Fig. 4 - CADW Station Signal Indicator

4.02 Each of the dial pulse receiving units includes three lamps to indicate what type of pulses was received; these are designated PD (prime digit), WD (wrong digit), and TST (test). The PD lamp lights when the first pulse train of a regular warning code (4, 6, 8, or 0) is received to "prime" the system. The WD lamp lights if an improper or "wrong" series of pulses (corresponding to 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 has a capacity of 200 stations with at least one line connector relay unit required for each code distributing unit.

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 also be transmitted to the public signal control circuit. The 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. A warning will not be sent unless the same digit is dialed twice in succession within 16 to 48 seconds. When the second of series of identical pulses 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 at the control point, or when the automatic signal stopping equipment functions, 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. The purpose of this ringing arrangement is to keep within the fusing capacity of the system.

4.07 An arrangement is available to provide continuous ringing on the position 4 signal. 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 it is possible to restrict either one or both the TEST and ALERT signals from each of the first 50 station lines served by a 200-line unit. The remaining 150 lines of a 200-line unit can be arranged to receive either all four signals or only the TAKE COVER and position 4 signals. The wiring necessary to provide these restrictions is done in the central office.

C. Control Unit for Five Stations

4.09 The dial pulse receiving and control unit for five warning stations 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 for all types of warnings. The ringing from this 5-station unit to the station signal indicators is continuous for all codes and all stations.

4.10 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 com-

parison with the 200-line unit, and the omission of the positive superimposing battery and code generating circuit.

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

D. Control Unit for Eight Stations

4.12 The dial pulse receiving and control unit for eight stations is substantially the same unit as that for five stations. However, to provide coded audible signals for each warning, 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 position 4 warning signal is also available for this unit.

E. Public Signal Control Circuit

4.13 The optional public signal (siren) control circuit to the CADW system permits the control of the sirens coincident with transmittal of the warning signals to the bell and lights stations. The circuits are arranged to receive the warning signal information from any of the dial pulse receiving units and to transmit the ALERT and TAKE COVER signals to the siren control stations.

4.14 This equipment consists of two main units called 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.

4.15 These circuits receive signals for all four of the warnings, positions 1, 2, 3 and 4, from the dial pulse receiving circuits of the bell and lights system. The public signal control circuit identifies the position 1 and position 4 signals as restricted and not to be transmitted to the sirens. It also identifies the position 2 and position 3 signals and causes all of the sirens associated with the particular unit to be operated.

4.16 Since the TAKE COVER signal from the sirens is a warble or modulated signal, this circuit is arranged to provide an intermittent open 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 STOP is dialed by the control point operator, or the signal stops automatically in approximately three minutes if automatic timing control is provided.

4.17 The receipt of the ALERT signal will start the sirens sounding continuously. The ALERT signal is stopped manually by dialing STOP after three to five minutes, or the signal stops automatically in approximately three minutes if automatic timing control is provided.

4.18 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. Cyclical variations obtainable are 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

The same frequency of variation in the open 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.

4.19 This circuit provides a continuous line test feature on an optional basis. This testing is accomplished by producing a continuous flow

of direct current to the station through marginal and sensitive relays at the central office 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 is arranged for three siren lines. Thus in steps of three lines, continuous test capacity may be provided for from three to thirty siren lines.

F. Power for Code Ringing

4.20 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 code signals for transmission to bell and lights stations as shown in Table D.

TABLE D

TYPE OF WARNING	NOMINAL RINGING CODE	DETAILS OF EACH RINGING CYCLE
Position 1	2 rings	0.5 second on 0.5 second off 0.5 second on 2.5 seconds off
Position 2	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
Position 3	continuous warble	0.5 second on 0.5 second off
Position 4	steady	16.0 seconds on 16.0 seconds off

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

4.21 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 stand-

ard positive battery for 4-party telephone service is already available in the office.

4.22 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 2.20.

4.23 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 milli-amperes 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 a warning 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.

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 CADW network. The procedure followed by the attendant upon receipt of a warning signal from the next higher echelon is merely to select the appropriate number on the face of the control point dial and then dial this number 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 warning code, and automatically sends the signal to its group of warning stations. Thereafter, this warning signal will continue until STOP is dialed, or the signal stops automatically in approximately three minutes if automatic timing control is provided.

5.03 In order to insure proper operation of the system, the attendant should always dial STOP once when changing from one signal to

another. The system will not transmit a second signal 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 warning signals will not prevent the transmission of the new warning 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 positions 1, 2, 3, and 4) are received. If the same digit is subsequently received, that particular warning 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 a warning the digits must be received as 4-4, 6-6, 8-8, or 0-0. Any other combination will not transmit a warning 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 TEST signal (dialed twice) or the optional signal (dialed twice) will *not* sound the sirens under any conditions. The ALERT signal (dialed twice) starts the sirens sounding continuously. The TAKE COVER signal (dialed twice) will start the sirens sounding intermittently (warbling sound). Any of these four signals are stopped by dialing STOP (dialed once), or by the automatic timing control if provided.

5.08 The TAKE COVER signal from the sirens is a warble or modulated signal produced by automatically starting and stopping the sirens as explained in 4.16. However, the duration of this interval will be determined either by the control point operator or by the automatic timing control if provided.

5.09 In order to check the system for operation and to be sure that the proper warning 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 coincidentally 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 warning signals. 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.

B. Emergency Operation

5.10 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 warn 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.

5.11 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, warnings 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 warning, namely 4, 6, 8, or 0 for position 1, 2, 3, or 4 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 CADW 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 nearby central office.
- (3) The major central office alarm which indicates that any pulse (warning 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 signals over any part of the CADW network.

6.02 While a warning 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 signal 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 1-way receiving repeater. The CTL PT ALM (formerly ALM) lamp in the 1-way receiving 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 CADW 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 DP ALM lamp lights on the dial pulse receiving and control unit. This alarm may be released by the operation of the cutoff key adjacent to the DP ALM lamp. 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 visual 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 CADW 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 em-

ployed 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 CADW equipment on the relay racks. A test circuit to produce each of the four ringing conditions for the four warning signals is available for this purpose.

7.02 The methods of testing the repeaters, dial pulse receiving and code distributing units, and public signal control units in the central office are described in test sections of the Plant Series covering the particular equipment involved.