Title 2nd Floor

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Central Office Maintenance
Educational Information

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BELL SYSTEM PRACTICES
Toll Test Room Operation
Description and Operating Principles
of Systems and Equipment

~~SECTION E42.013~~
Issue 1, January, 1952
AT&TCo Standard

TYPE N1 CARRIER TELEPHONE SYSTEM

ORDER WIRE AND ALARM FACILITIES

CONTENTS

1. GENERAL

1.01 This section describes local order wire and alarm circuits for the operation of Type N Carrier Systems. These circuit arrangements together with the two loaded voice frequency pairs of a quad provide:

(1) A 2-wire talking path between stations.

(2) An alarm circuit along which voice frequency alarms may be applied at unattended power supply points and received and identified at the receiving office.

(3) A power supply from a power supply station to a non-power repeater station for operating the 2M repeater switching set.

1.02 Supplementary information is given in sections as follows:

E42.133 - 1000-Cycle Signaling Arrangements per SD-55392-01 and SD-55393-01
E42.212 - 4-Wire Telephone Order Wire - Hybrid Coil Bridging
E43.120 - V1 Telephone Repeater and Associated Equipment
E43.121.1 - V3 Repeater

1.03 The order wire and alarm system requires a quad or two pairs of cable, one pair for the order wire facility and the other for the transmission of the alarm indications from remote stations to an attended station. Over the simplexes of these two pairs d-c power is transmitted, +130 volts over the order wire simplex and -130 volts over the alarm pair simplex.

1.04 Line and balancing circuits which are used for 2-wire circuits together with bridging circuits are utilized in equipment unit arrangements for the order wire. Signaling may be either the 1900-cycle described here or the regular 1000-cycle signaling systems. Either an oscillator or a lineman's whistle may be employed to signal the control terminal. The use of 52A operator's head sets is used at all offices. An 84A lineman's test set with either 52A head set or 63A test set is employed at pole mounted cabinets. The 63A test set is 10-15 db poorer in transmission than the 52A head set.

1.05 The principal parts of the alarm system are:

(1) Voice frequency oscillator for the sending of alarm tones.

(2) Receiving circuits for reception of individual alarm tones.

(3) A delay circuit which is common to a group of receiving circuits.

(4) Repeating coils for coupling alarm oscillators or receiving circuits to the alarm line. Associated with this equipment may be a 4-wire equalizer and V3 voice amplifier for raising the level of received alarm tones and an adjustable loss resistance hybrid for coupling a local alarm circuit to the main alarm line or lines.

1.06 The alarm features are based upon continuous transmission and reception of station alarm tones. One alarm tone is sent from each remote station from which it is desired to provide an alarm. The tones are received at a common station where a particular alarm tone is identified. Interruption of an outgoing tone at any remote station institutes an alarm at the receiving station.

1.07 The individual receiving circuits for receiving an alarm tone are alike except for the band pass filters in the input circuits. Rectified a-c tone of the receiving circuit supplies the output relay operating current to control the alarm indication.

1.08 These alarm indications provided by the individual receiving circuit output relays are connected to a common cold cathode tube delay circuit which provides about five seconds delay to guard against false operation from lightning disturbances or other momentary shorts or opens of the line. An output relay in the delay circuit activates the audible and visual office alarm circuits. The delay panel also provides an auxiliary visual alarm indication.

1.09 Besides the alarms for failure of carrier equipment, failure of the order wire and the alarm circuit fuses may be included. All alarms are treated as minor alarms and as such have only station identification. For this reason a single station alarm oscillator is employed.

1.10 The equipment units of the alarm system oscillator, receiving and delay circuits are also employed for the 1900-cycle signaling on the order wire. In this system discrimination between speech and signaling tone is obtained partly by the band pass filter in the receiving circuit and partly by the associated delay circuit. A steady application of 1900-cycle ringing tone for one second or longer duration is required to actuate the office calling-in signal. Speech energy in the 1900-cycle band would have to be sustained for a one-second interval before falsely operating the calling-in signal.

1.11 No power is provided at pole cabinet points other than that obtained from the simplex for operation of the 2M repeater switching set.

1.12 The order wire and alarm circuits include suitable jacks for ease in circuit line-up and for maintenance purposes. The 19" light steel equipment panel units are shop wired and tested. Upon installation the required connections to the line pairs and between units are made at unit terminal blocks. External power leads are, however, wired directly into the fuse posts on the panels. The various equipment arrangements to meet job requirements are fully covered in J98704 (Section AA308.076).

1.13 Drawings: Due to the extreme flexibility required of alarm and order wire circuits which employ most of the features now extensively covered on the V3 Line and Balancing Application Schematic SD-95144-01, this drawing is employed together with the other drawings listed in Table I.

TABLE I

Drawing	For J98704 Codes											For J68651-Z
	A	B	C	D	E	F	G	H	J	K	L	
SD-95144-01					X	X		X	X			X
SD-95142-01) includes cross-) connections for) all situations)					X	X	X	X	X	X	X	
SD-95143-01	X	X	X	X								
SD-90517-01								X	X			
SD-95113-01					X	X	X	X	X			
SD-56073-01						X		X	X			
SD-59046-01									X			
SD-55574-01						X		X	X	X		
SD-55385-01						X		X	X			
SD-55039-01										X		

Note: Subsequent issues of SD-95144-01 will include needed features of SD-90517-01, SD-59046-01 and SD-55385-01 so as to eliminate their use for N order wire circuits.

2. GENERAL DESCRIPTION OF ORDER WIRE AND ALARM

2.01 A typical order wire and alarm circuit for operating the Type N system is shown in Fig. 1. The order wire follows standard message practice as to locations of repeaters. At order wire repeater stations the through tones of the alarm circuit will in general also require amplification. Telephone drops are furnished at all power supply points. Those at intermediate non-repeatered stations are obtained via a high impedance repeating coil bridge. At pole station non-power points the 84A lineman's test set bridged across the order wire line terminals provides means for talking.

2.02 Tones are fed to the one-way alarm line under the control of a relay in the output circuit of the oscillators. To institute an alarm, the operating circuit of the relay is disabled. Tones at intermediate alarm sending stations requiring a line amplifier are applied to the alarm line through an adjustable loss resistance hybrid which can be set to equalize the levels of through and local alarms. High impedance bridging repeating coil arrangements are employed at other intermediate points. At the receiving terminal each tone passes into its proper filter and receiving circuit, the d-c output of which holds a relay in the circuit operated. Interruption of any incoming alarm tone causes the relay associated with that receiving tone to release. The release of the relay for five seconds or longer activates the common delay circuit to set up the control office alarms. Neon pilot lamps serve to indicate the office in which the trouble originates. A key is provided in the control terminals for silencing the audible alarm and its operation restores the alarm circuit when trouble is cleared.

2.03 The oscillator, receiving and delay circuits of the alarm system are adapted for use as parts of an order wire signaling system using spurts of 1900-cycle over the order wire side of the quad. Standard 1000-cycle interrupted signaling equipment may be used for the order wire but the 1900-cycle signaling system shown in Fig. 1 provides simpler equipment arrangements. At pole mounted repeater stations calling-in signals are generated with the 1A whistle blowing into the mouthpiece of a connected 52A operator's set when the 1000-cycle system is used. The P-499093 whistle is available for 1900-cycle signaling.

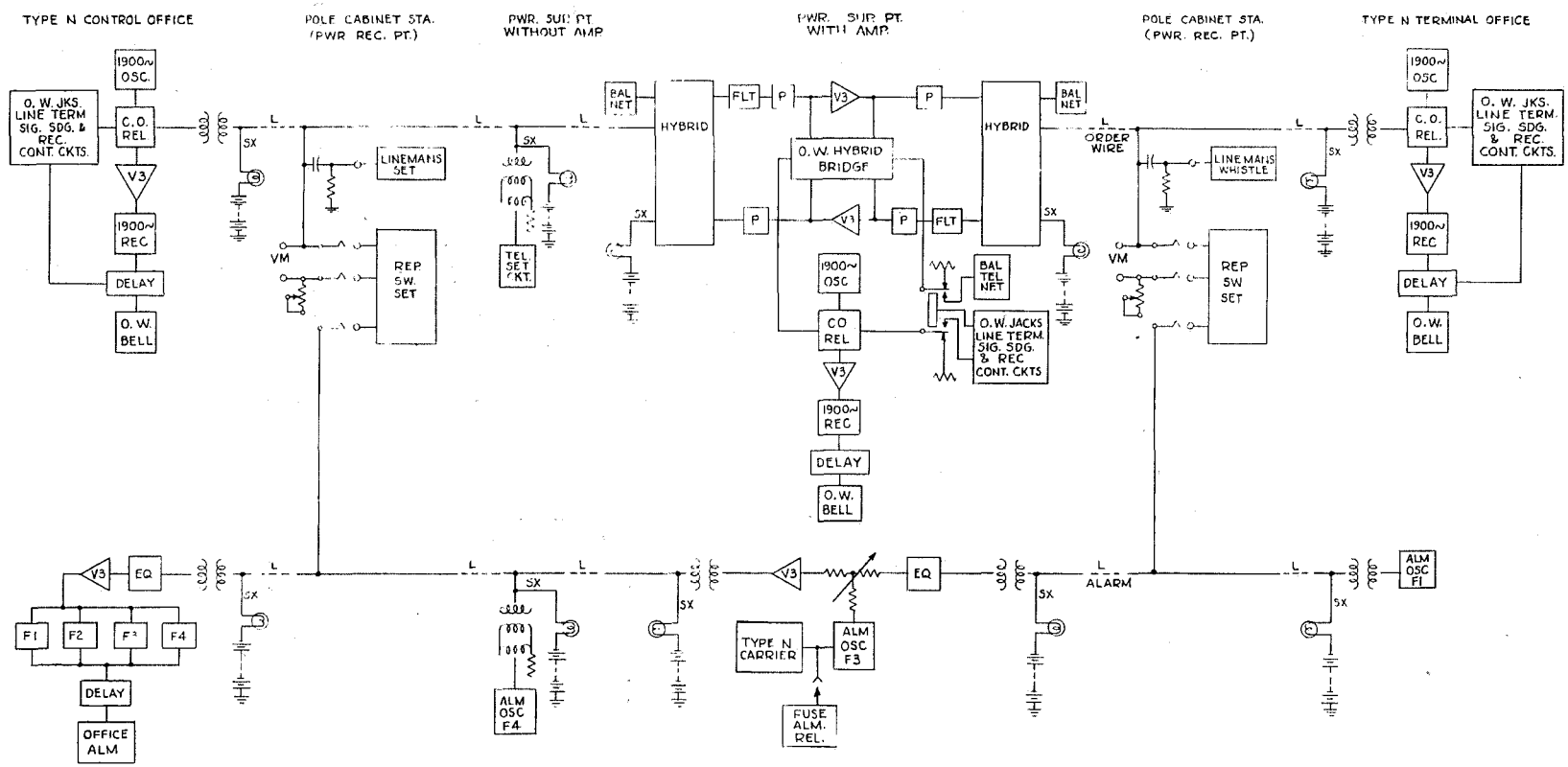


Fig. 1 - Schematic Circuit of Order Wire and Alarm

3. DESCRIPTION OF CIRCUIT

(A) Alarm and Signaling Oscillator

3.01 The oscillator Fig. 2 is designed around a 407A twin triode vacuum tube whose heaters may be operated at either 20 or 40 volts. The triode section, connected to the tube pins 6, 7 and 8, is used for resistor coupled oscillator circuit whose frequency is determined by a selection of values of R11 and R12 such that frequencies of 700, 900, 1100, 1300, 1500, 1700, 1900 and 2100 cycles per second can be realized. However, only the 700, 1100, 1500 and 1900 cycles per second frequencies are available for general use without special arrangements. Capacitors C3, C4 and C5 provide the capacitance portion of the circuit with C5 used as a variable trimmer for making vernier frequency adjustment to allow for manufacturing variations.

Notes applying to Fig. 2.

101 "AA" Option for alarm circuits
"BB" Option for order wire signaling

102 The heater connections shown are correct for +130V operation. These three leads are employed when heaters are operated on -24 or -48 volts

103 This relay is furnished as part of the K unit; see Fig. 20

3.02 Positive voltage feedback is supplied to the oscillator grid through capacitor C3 and the oscillator frequency determining resistor to sustain oscillations. Negative feedback is supplied to the oscillator cathode through thermistor TH1 and LEVEL potentiometer R13. The control of the negative feedback by thermistor TH1 stabilizes the oscillator against voltage variations in the power supply. Potentiometer LEVEL provides an adjustment of oscillator output power to compensate for apparatus component variations in addition to about 4 db excess range to provide for very high output for unusual applications such as non-repeater lines. Blocking capacitor C2 is by-passed by a high value resistor R8 to provide a d-c voltage across thermistor TH1 to insure the immediate start of oscillations when power is applied to the circuit. The oscillating path in this circuit is around both tubes. The output of the oscillator section of V1 is fed to the triode amplifier section through coupling capacitor C1. The output of the amplifier section of V1 is coupled by means of the output transformer T1 to the OUT 600-ohm pad control, consisting of the 600-ohm potentiometer R14 and resistors R4 and R5, whose range is about 24 db.

3.03 The contacts of relay K1 used for ON and OFF control for alarms are wired through the panel terminal block in order that wiring to the relay may be disconnected for order

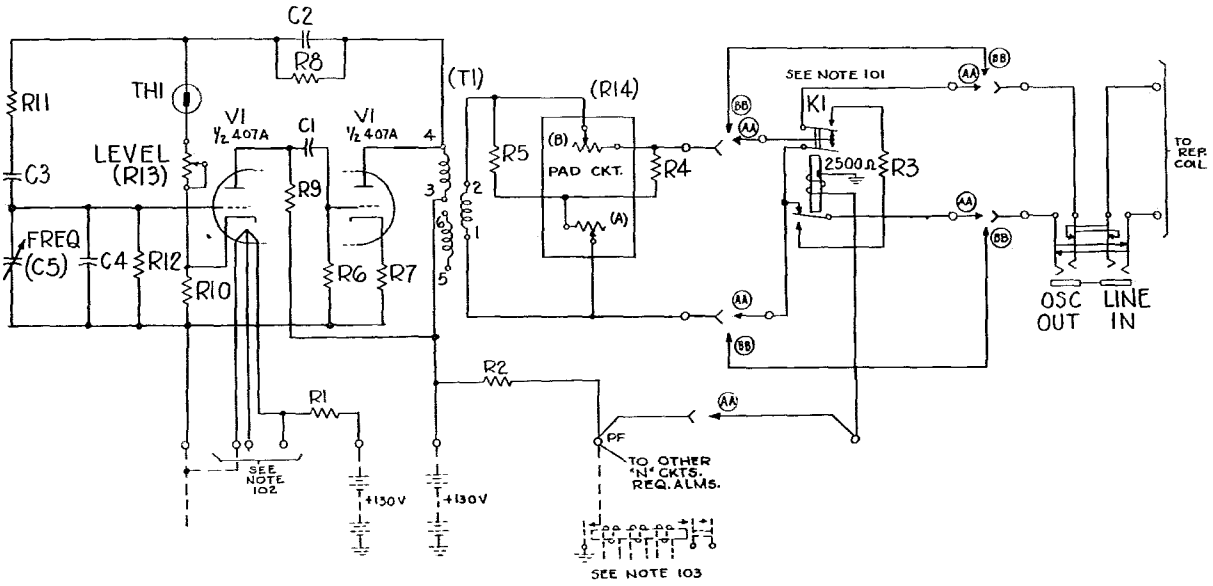


Fig. 2 - Oscillator Circuit for Order Wire and Alarm Signaling

wire signaling applications. The relay operated PF lead provides for connection to a power failure alarm circuit. When a power failure occurs, ground is placed on the PF lead releasing relay K1 which then removes tone from the alarm line, shorts the oscillator and terminates the line in 600 ohms provided by resistor R3. Failure of the alarm oscillator itself gives an alarm. Jacks are provided so that output of the oscillator may be measured at OSC OUT or the line may be tested at LINE IN.

3.04 The equipment arrangement is shown in Fig. I attached. The oscillator panel occupies 1-3/4" of relay rack space.

(B) Receiving Circuit for Alarm and Order Wire Signals

3.05 The receiving circuit Fig. 3 provides means for selective receiving, amplifying and detecting the signaling tones which are used for alarm indications and order wire signals. A separate receiving circuit with an appropriate input filter is used for each tone received over the alarm line. For normal use, filters centered on 700, 1100, 1500 and 1900 cycles per second are used. Four additional filters centered on 900, 1300, 1700 and 2100 cycles per second are available but require special consideration to assure adequate margin against false operation if used together with the first four filters. For order wire signaling applications only the 1900-cycle allocation is ordinarily used.

Notes:

101 Heater circuits may be operated on either -24 or -48V battery

102 The following filters are available

Freq. Cycles	Filter Code
700	200E
900	200F
1100	200G
1300	200H
1500	200J
1700	200K
1900	200L

3.06 Filter 200F has an unbalanced configuration and matches, by a transformer, the nominal 600-ohm line to the high impedance grid of the receiving circuit. Potentiometer R7 at the output of the filter provides a means of applying any part of the voltage across resistor R1 to the grid of tube V1 to adjust the circuit sensitivity. Screen voltage is supplied from +130-volt battery through resistor R2. The output of tube V1 is nominally stabilized by about 12 db of negative feedback provided by cathode resistors R3 and R4 operating in series. When 4.5 db more sensitivity is required than can be provided by potentiometer R7, R4 may be strapped out at the expense of a reduction in feedback voltage by the same amount. The output voltage of tube V1 is stepped down by output transformer T3 for application to varistor VR1. The d-c output of varistor VR1 operates the K2 relay when tone in the normal input frequency range is supplied to the 200F filter input. Jack RC provides for measuring relay operating and release currents when required. Relay K2 is a polar relay with biasing voltage applied to it from +130-volt supply through the R5 resistor. This relay has a

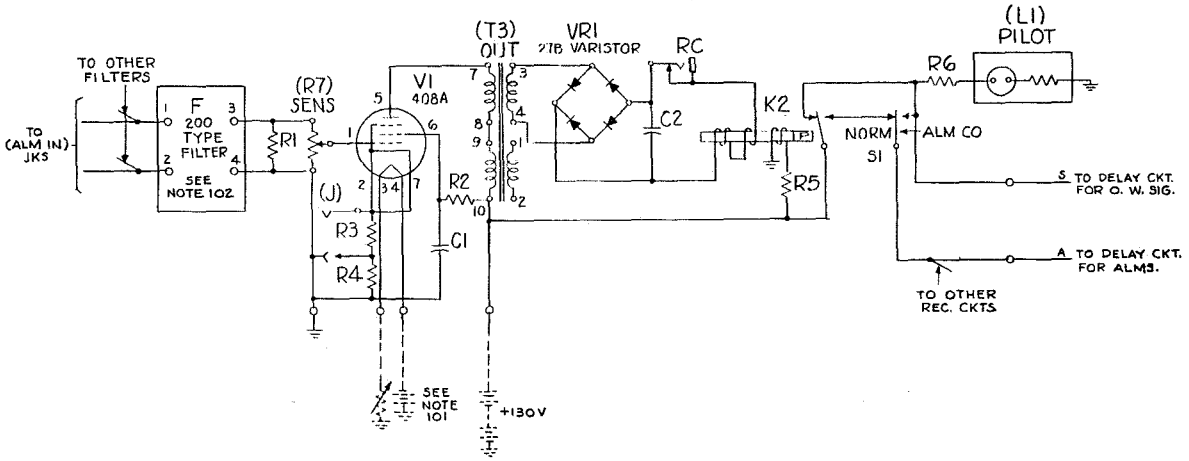


Fig. 3 - Receiving Circuit for Order Wire and Alarm Signaling

high ratio of release to operate current and hence insures maximum margin against being held operated by any interference voltages when the normal tone is removed to set off an alarm. The K2 relay is normally operated when the receiving circuit is used for alarm purposes and normally released when used for order wire signaling purposes.

3.07 For the alarm application, the relay K2 upon releasing when the tone is interrupted supplies +130 volts through its armature and release contact to the normal contacts of key S1 to the delay circuit and thence to the alarm bell. Key S1 provides a means of silencing the alarm bell by breaking the connection between the receiving circuit and the delay circuit. With key S1 operated the alarm again sounds when the trouble is cleared and relay K2 is again operated. The bell can be silenced again by restoring Key S1 to its normal position where it is ready to indicate another alarm. A clear capped neon indicator lamp PILOT glows dimly as long as relay K2 is operated (normal condition) and provides a means of determining which receiving circuit of a group connected in parallel to the alarm pair is in an alarm PILOT lamp out condition. A high series resistor external to the lamp reduces the current drain and provides for many years continuous service of the lamp. The receiving panel occupies 1-3/4" of relay rack space. The equipment arrangement is shown in Fig. II attached.

(C) Delay Circuit for Alarm and Order Wire Signals

3.08 The delay circuit, Fig. 4, provides a guard against false alarms when used in connection with either alarm receiving circuits or an order wire signaling circuit. In the alarm application, about five seconds delay is used to reduce the chance of false alarms resulting from interference on the alarm line or from certain inadvertent maintenance operations. When the circuit is used in connection with 1900-cycle order wire signaling, a delay of about one second is provided to assist the receiving circuit band pass filter in effecting satisfactory discrimination against voice operation of the calling-in signal circuit. The change of time delay is the only option needed to make the circuit function for either use.

3.09 When +130 volts are applied on either the A or S leads, relay K3 operates and simultaneously the voltage is applied to the timing elements of the circuit consisting of R3 and C4 for one second delay or R3, R4 and C4 for five seconds delay. Operation of relay K3 removes the R2 shunt from C4, thus permitting it to start charging, and applies +130 volts to terminal 2 of cold cathode tube V1. After the interval required to build up a voltage at terminal 1 on tube V1 sufficient to break down the control gap between terminals 1 and 4, the main gap fires between terminals 2 and 4 and provides a path for operating relay K4. Relay K4 when operated, energizes the office alarm or order wire calling-in signal. A visual signal is provided, by the ALARM LAMP L2 which lights red as soon as voltage is applied to the circuit and before the delay circuit has had time to break down the gaps in tube V1. This feature provides a means of observing the effects of interference along the alarm line, such as severe lightning storms with resultant protective flashovers and which manifests itself as flashing of the L2 lamp.

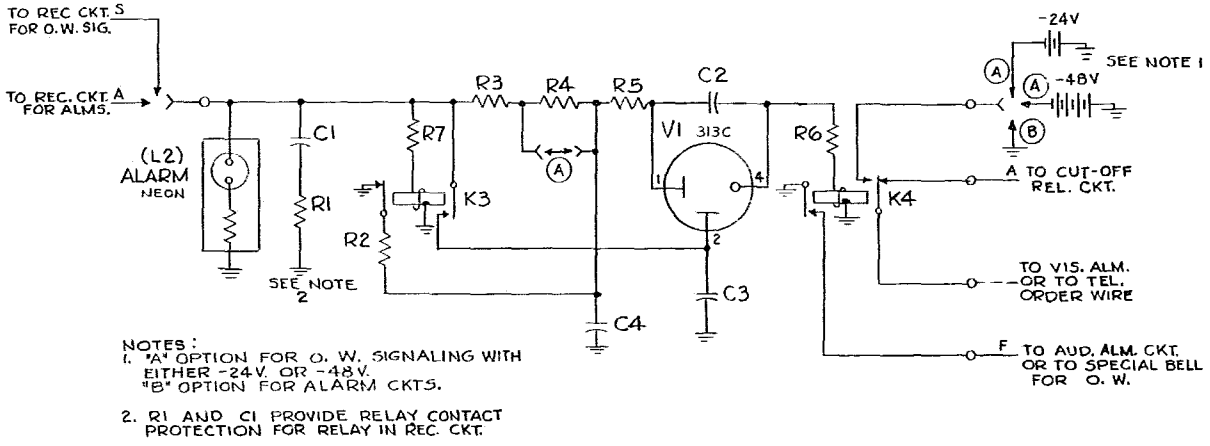


Fig. 4 - Delay Circuit for Order Wire and Alarm Signaling

Since the response of the receiving circuit, including its output relay, is fast, the ALARM lamp will flash intermittently in response to such line conditions but the office alarm will be actuated only if the condition lasts for five seconds. Since the ALARM lamp operates only occasionally, no external series resistor is used and hence maximum brightness is obtained without sacrificing long life. For order wire signaling applications the ALARM lamp serves just as an aid to trouble location.

3.10 Capacitor C1 and resistor R1 provide contact protection to the receiving unit output relay as it breaks the battery supply to the relay K3. Resistor R5 prevents the possibility of excessive current surges flowing from the main anode to the starter anode under conditions which result in a large potential difference between them. The small capacitors C2 and C3 by-pass any office interference which, even though a very high frequency, might cause false breakdown of the gaps. Resistor R2 discharges capacitor C4 in a very short interval when relay K3 releases so that after either a full time or partial timing interval, the circuit resets so that a full time interval is always required to actuate an alarm or calling-in signal.

3.11 The delay panel occupies 1-3/4" of relay rack space. The equipment arrangement is shown in Fig. III attached.

(D) Line and Order Wire Equipment

3.12 The line equipment is made up, in general, of parts which are standard for voice frequency cable circuits. However, by special arrangement of parts in units, considerable flexibility is obtained to take care of different office layout requirements. The line equipment consists essentially of V3 amplifiers, hybrids, repeating coils and equalizer arrangements for providing a 2-way circuit on the order wire pair of the quad, a 1-way voice frequency circuit on the alarm pair of the quad, and simplex legs on both pairs of the quad for d-c power transmission. The associated telephone set and auxiliary signal circuit equipment is adapted from present circuits for this application. A cutoff relay circuit is provided for 1900-cycle ringing.

3.13 The several panel arrangements provided in order to adapt economically the equipment to the various functional requirements at any given station are given in Table II.

TABLE II

J98704 Letter	See Fig. Attached	Functional Equipment Included	Size of Panel - in.	Weight of Panel - lb.
D (pole unit)	-	Line bridging for order wire and PWR jack (for repeater switching set)	1-1/2" by 10" bracket	1-1/2
E (Note 1)	IV	Miscellaneous alarm connecting equipment	1-3/4	5
F	V	Non-repeated order wire panel for terminals or intermediate stations requiring signaling or order wire multiple	3-1/2	10 approx.
G	VI	Non-repeatered intermediate station order wire panel	3-1/2	8-1/2
H	VII	Order wire terminal repeater panel	7	21-1/2
J	VIII	Order wire intermediate repeater panel	10-1/2	36
K (Note 1)	IX	Fuse alarm and signaling relay panel	1	5
L (office unit)	-	Line bridging for order wire and PWR jack (for repeater Sw. Set)	3-1/2	7

Note: One E and one K unit are required per office installation.

4. DESCRIPTION OF ALARM LINE EQUIPMENT

(A) Common Alarm and Order Wire Line Equipment

4.01 The J98704D pole cabinet and the J98704L office units are common to both the alarm and order wire pairs at power receiving stations. Signal line schematic circuit diagrams for these units are shown respectively in Figs. 5a and 5b. The D unit consists of miscellaneous equipment on two brackets. One

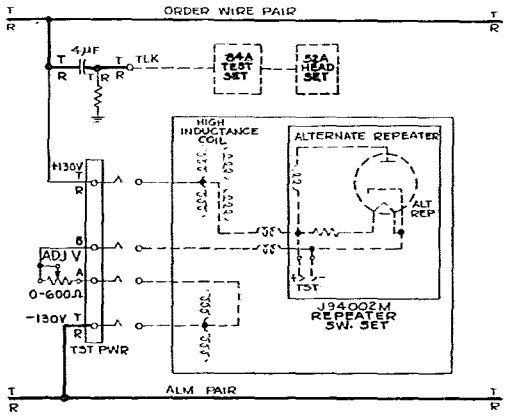


Fig. 5a - J98704D Pole Cabinet Unit

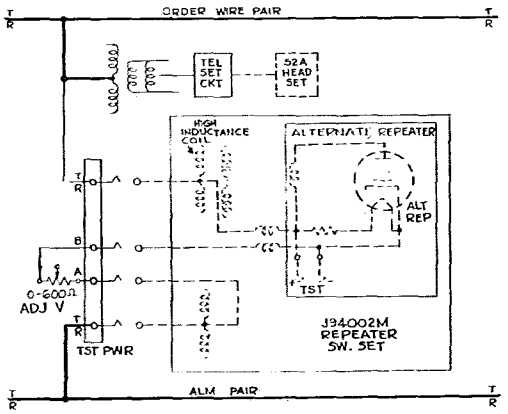


Fig. 5b - J98704L Office Unit for Power Receiving Points

bracket mounts at the left side of a pole mounted Type N repeater cabinet without interfering with any panel mounted equipment therein. On this bracket are a pair of binding posts TLK for connecting the lineman's 84A test set to the order wire pair and a multiple pin jack for connecting power to a 2M repeater switching set. The second bracket is located at the top of the cabinet. It provides a potentiometer for adjusting the voltage presented to the switching set, a pair of 4 mf series capacitors and a pair of shunt .51 megohm resistors with their midpoint grounded. The capacitors and resistors serve to isolate the TLK terminals from +130 volts.

4.02 The J98704L office unit similarly supplies the multiple pin jack for connecting power to a 2M repeater switching set and a potentiometer for adjusting the voltage presented to the set. The "L" unit, however, differs from the "D" unit in that a permanently mounted line bridging repeating coil and telephone set circuit replace the blocking capacitors and shunt resistors and TLK terminals. The 84A lineman's test set is then required.

4.03 Connections from the pin jack of either the J98704D or L units to the 2M repeater switching set are made with a cord and plug attached to the switching set. The simplex coils for receiving power from the order wire and alarm pairs are mounted in the 2M repeater switching set which obviates the need for individual simplex coils at each pole mounted repeater station. Within the 2M set a repeating coil of high inductance is used for bridging the order wire side of the quad and a retard coil is used for bridging the alarm pair where bridging loss requirements are less rigid.

4.04 The ADJ V potentiometer provides sufficient range to reduce the voltage obtained from the two simplex taps to 130 volts for operation of the repeater switching set.

(B) Alarm Line Equipment

4.05 The J98704E unit has universal wiring for a number of equipment arrangements which are covered by separate list numbers under the code to apply at any station through which the alarm pair passes or at which it is terminated. Fig. IV attached gives the equipment arrangement of the miscellaneous alarm panel. It supplies -130 volts through a slow acting 1/4 amp. 70J fuse so as to prevent blowing on short transient disturbances, a 13J protective resistance lamp and a simplex coil to the line. The unit supplies connections for the sending or receiving of alarm tones. An associated -130-volt fuse alarm resistor and lamp circuit are part of this panel. Provision is included for accommodating a V3 amplifier for raising the necessary alarm levels at through or terminal points. At through alarm sending or intermediate alarm receiving points an adjustable loss resistance hybrid is furnished for coupling the local alarm circuit to the through line. When the V3 amplifier is supplied, an additional panel J68651Z is used in connection with the J98704E panel to supply

the input simplex repeating coil and equalizer. At an alarm station receiving tones from both directions a second J68651Z panel is required. In this case the voice frequency amplifier is common to both lines and the simplex output repeating coil is omitted from the panel. A breakdown of all of the various circuit features which may be obtained with the J98704E is illustrated in Fig. 6a to e.

4.06 The repeating coil for terminating the alarm line pair is shown in Fig. 6a. Its ratio is such as to terminate the line impedance smoothly considering its drop side terminated in 600 ohms. For most of the alarm line facilities this is a 173E repeating coil connected for a ratio of 2:1 (line windings 10-9, 4-3, 8-7, 11-12 and drop windings 2-1, 6-5). The capacitor within the drop windings serves to prevent low frequency noise from overloading the receiving circuits. The repeating coil loss at alarm frequencies will, in general, be about 0.5 db. At points from which power is fed over the simplexes, but not requiring either alarm sending or receiving, the drop side of the repeating coil is terminated in a 600-ohm resistor.

4.07 At line bridging points requiring the sending of -130 volts over the alarm simplex and/or the sending of an alarm tone, the repeating coil of Fig. 6b is required. This is a 175A repeating coil connected to give a 1 to 4 step up to the line. A resistor in series with the parallel connected drop windings serves to present a better impedance to the oscillator and to reduce the loss to through transmission of the bridged oscillator circuit. The loss between the oscillator output and the through 19H88 line is about 10 db and the bridging loss of this equipment to through transmission is about 1 db.

4.08 The adjustable loss resistance hybrid circuit of Fig. 6d allows tones from two inputs to the hybrid to be equalized at the output of the hybrid. This type of hybrid is employed only at alarm circuit gain points (1) having one or more through alarm tones which

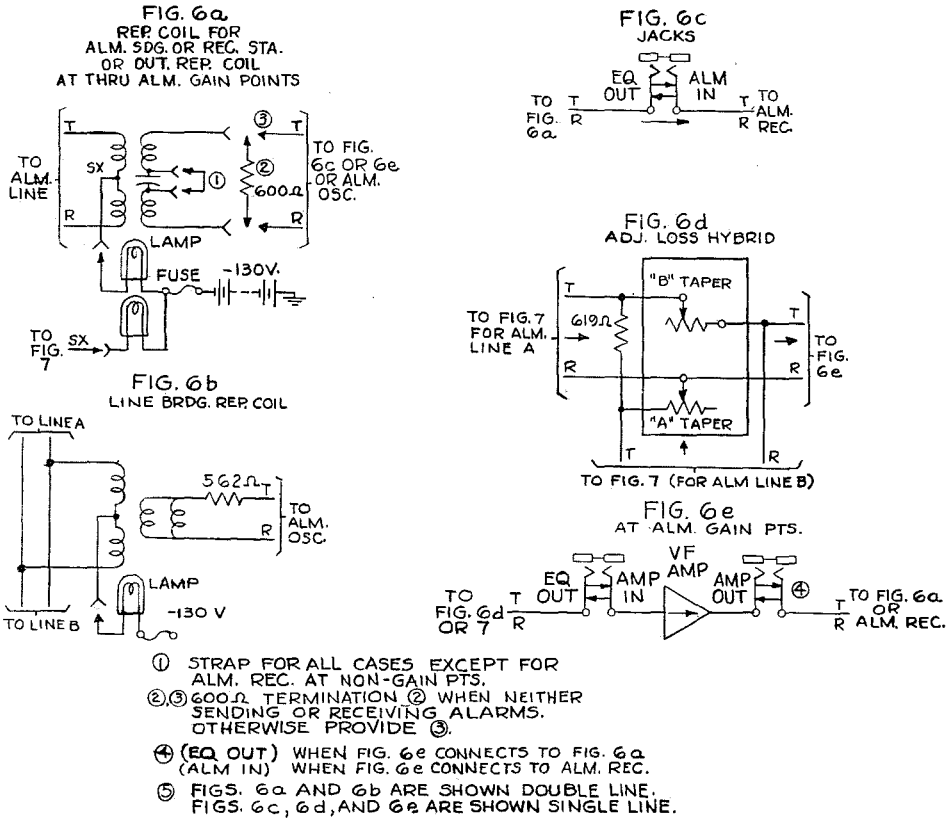


Fig. 6a to e - Alarm Line Equipment Which May Be Obtained with the J98704E Panel

are required to be equalized with a local outgoing alarm and (2) having alarm tones entering from two separate lines which are to be equalized in a common receiving path. The arrows in Fig. 6d show the normal direction of transmission through the circuits. The geared A and B potentiometers have inverse modified logarithmic tapers. For any setting the product of the resistance introduced into the circuit by the potentiometers is approximately equal to 600 x 600. If the two input arms, lines A and B and the output arm C of Fig. 6d are each terminated in 600 ohms, the circuit becomes a simple 600-ohm unbalanced to ground resistance bridge or hybrid. The 619-ohm resistor (a comprised value) is the 6th arm of the bridge circuit. For resistance terminations the approximate losses are given below. Other corresponding losses are given in curve form in Fig. 6f.

	Losses	
	A to C	B to C
Potentiometer Assembly in Midposition	6 db	6 db*
Extreme clockwise position	0 db	high**
Extreme counterclockwise position	24.5 db	0.5 db

* Each potentiometer introduces 600 ohms.

** The "A"-potentiometer goes open in this position. When the potentiometer assembly is moved about 35° off extreme clockwise position the loss A to C is 0.5 db and B to C is 24.5 db. For either direction the loss going from 0 to 24.5 db increases slowly at first and then at an increasing rate with rotation.

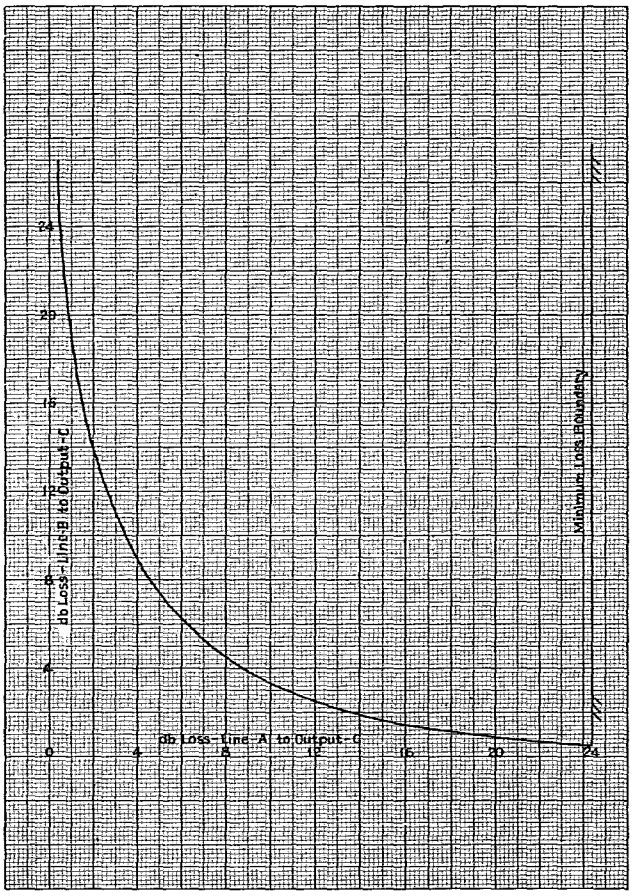


Fig. 6f - Loss Characteristics of Adjustable Loss Hybrid

4.09 The V3 voice amplifier together with jacks, Fig. 6e, serves to raise the tone levels at alarm gain points while the input repeating coil and 4-wire equalizer circuit of Fig. 7 allows the various frequency tones incoming from a line to be equalized for the

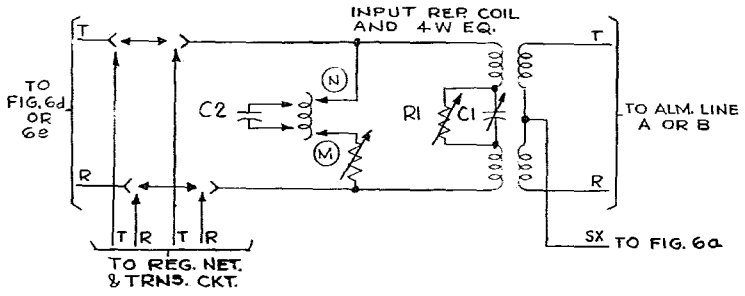


Fig. 7 - Alarm Line Equipment per J68651Z Unit for Alarm Line

loss frequency characteristic of the line. The input repeating coil of Fig. 7 is identical to that of Fig. 6a. The information for Figs. 6a, 6e and 7 are more fully covered in Section E43.120.

4.10 The specific office alarm circuit arrangements which are obtainable with different E units used in conjunction with the alarm oscillator or with the alarm receiving and delay circuits are shown in Figs. 8 to 14, inclusive. Table III gives a summary of functions, equipment and circuit figures involved for each application. 482A jacks are provided for testing and maintenance per J98704A (Fig. 2) or E (Fig. 6) panels. These jacks require patch cords equipped with 310-type plugs.

TABLE III

See Fig.	Type of Station	J98704 Panels	J68651 Panel Equip. (see Fig. 7)
8	Term. Alm. Send.	1-E and A	-
9	Thru Line Bridging Alarm Send.	1-E and A	-
10	Alarm Circuit Terminated. No Alarm Send. or Rec.	1-E panel	-
11	Term. Alm. Rec. Station without Amplifier	1-E and C, (Note) B panels	-
12	Term. Alm. Rec. Station with Amplifier	1-E and C, (Note) B panels	1-Z
13	Bridge thru Alm. Station with Rec. Amplifier and with or without Alm. Send.	1-E and 1-A panel when specified	1-Z
14	Term. Alm. Rec. from both directions with common voice	1-E, C (Note) B panels	2-Z

Note: 1-B unit per alarm tone being received.

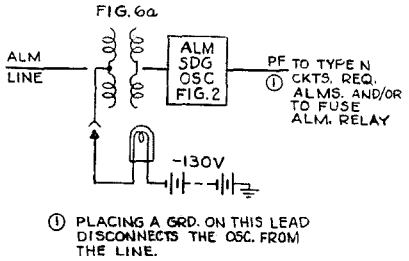


Fig. 8 - Terminal Alarm Sending J98704A and E Units

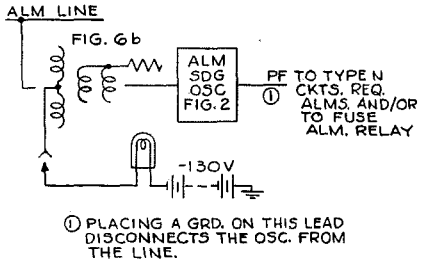


Fig. 9 - Through Line Bridging with Alarm Sending - J98704A and E Units

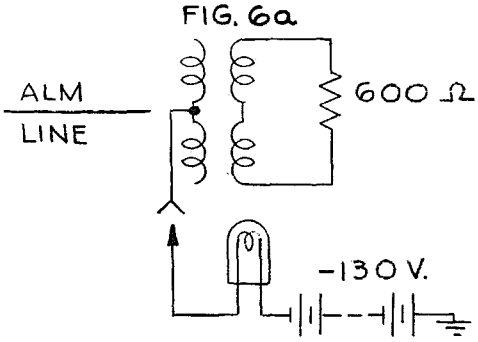


Fig. 10 - Alarm Line Terminated No Sending or Receiving Alarms - J98704E Unit

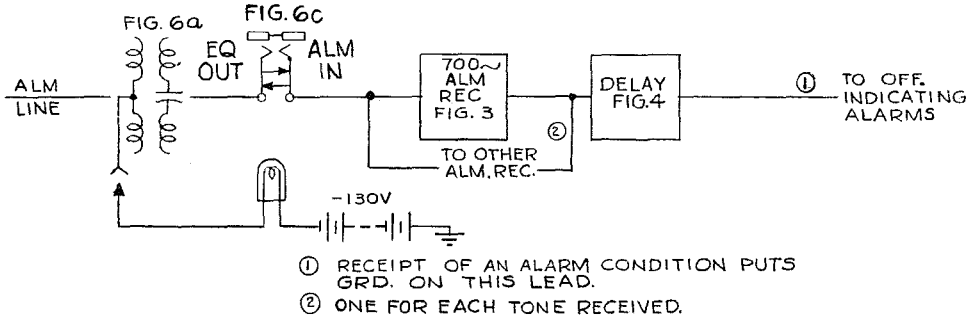


Fig. 11 - Alarm Terminal Non-Gain Point Receiving J98704B, C and E Units

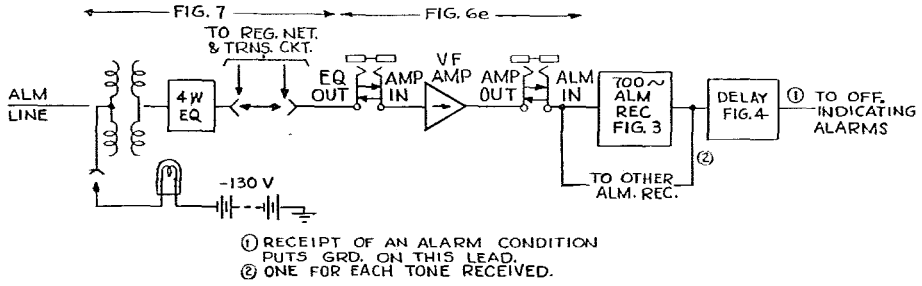


Fig. 12 - Alarm Terminal Gain Point Receiving J68651Z, J98704B, C and E Units

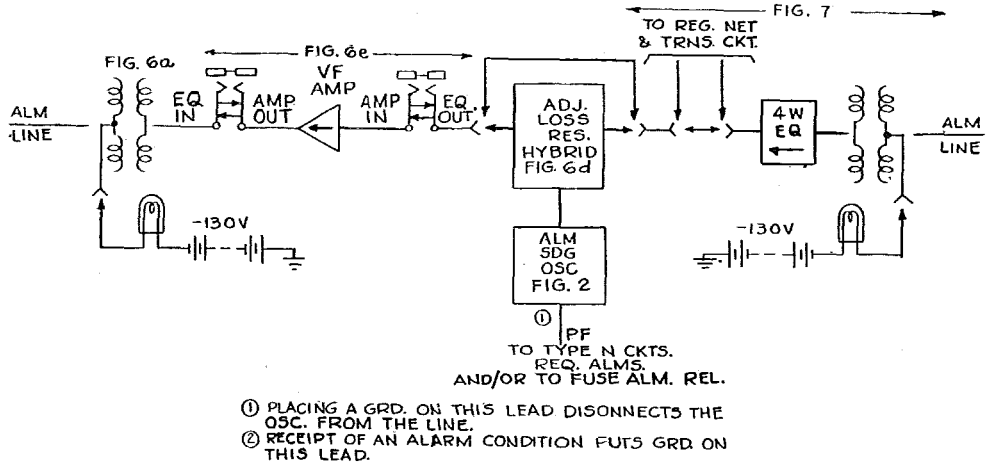


Fig. 13 - Intermediate Alarm Gain Point with or without Alarm Sending - J68651Z, J98704A and E Units

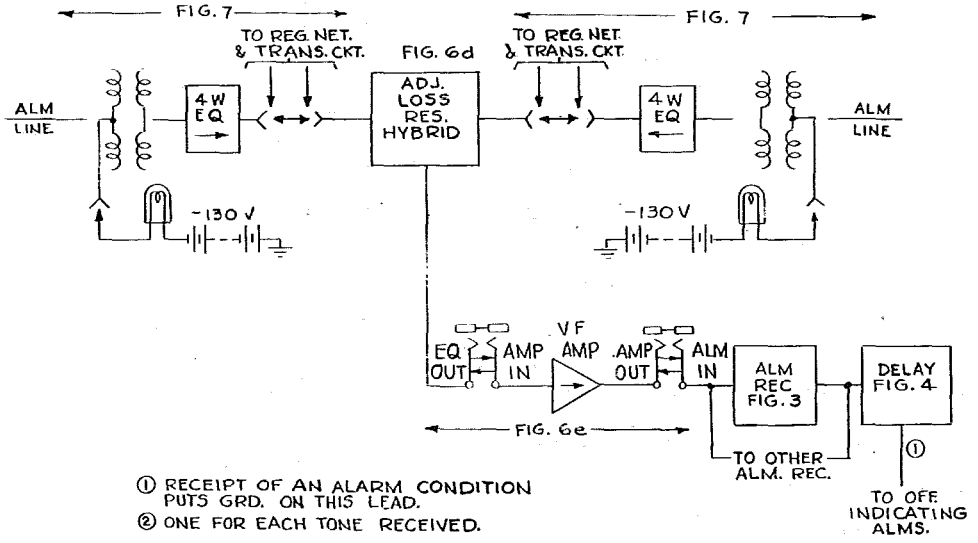


Fig. 14 - Alarm Receiving from Two Lines 2-J68651Z, 1-J98704B, C and E Units

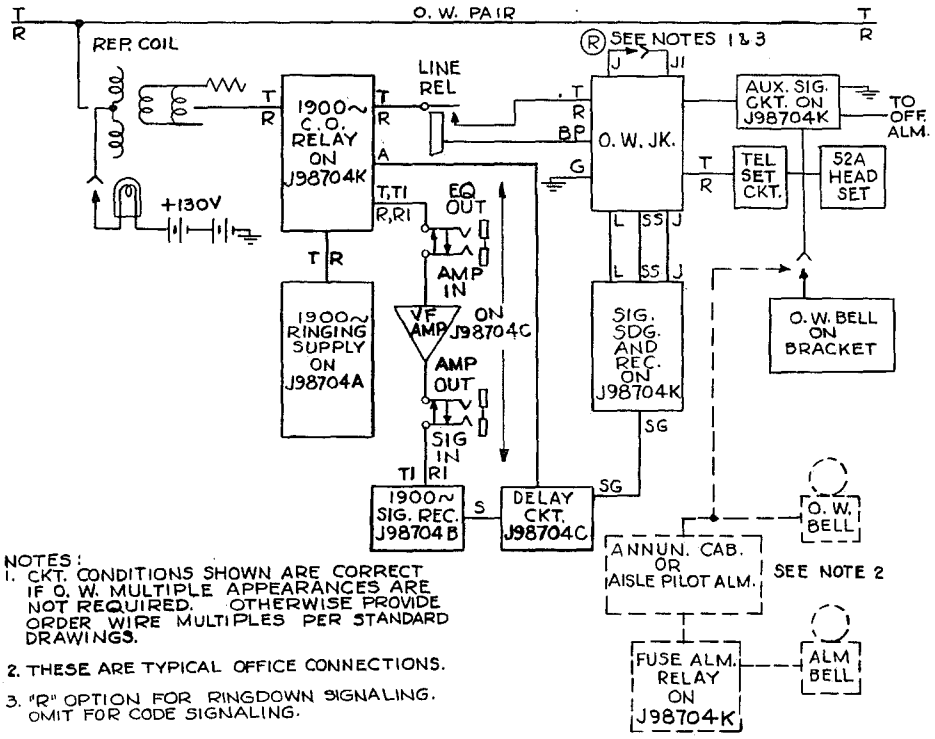


Fig. 15 - Intermediate Order Wire without V3 Repeater - 1900-Cycle Signaling Provided

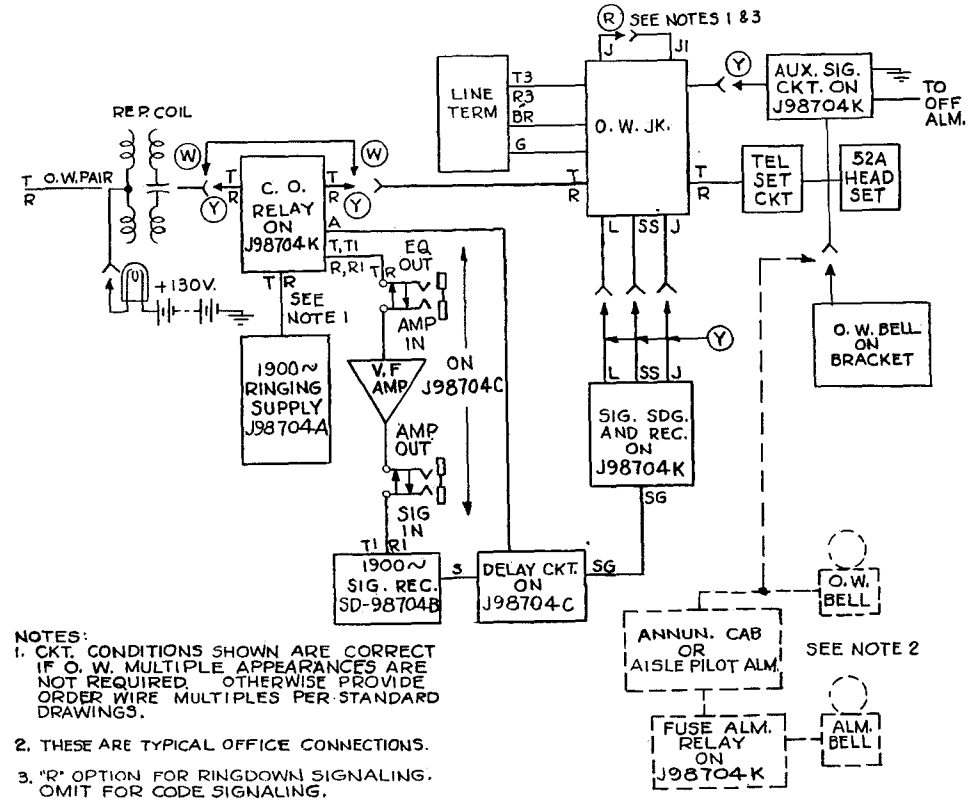


Fig. 16 - Terminal Order Wire without V3 Repeater

5. DESCRIPTION OF ORDER WIRE LINE EQUIPMENT

5.01 All of the order wire panels provide +130 volts through a 0.25-ampere slow blow 70J fuse, 13J resistance lamp (see Fig. 20) and simplex repeating coil to the order wire line pair at power sending points. Jacks for testing and lining up the order wire are of the 482A type which require patching cords equipped with 310 plugs. Each order wire panel provides a multiple pin jack TST PWR for connection to a 2M repeater switching set for use when the order wire and carrier equipment are mounted in close proximity. An OW jack appearance with the associated OW RING OUT key and calling-in signal OW lamp is furnished as part of the J98704F, H and J panels. These panels are arranged to connect to either 1000 or 1900-cycle signaling equipment. The J98704D, G and L units require no signaling equipment, a lineman's whistle being employed with these units for signaling into the transmitter of a 52A head set. In the case of repeater H and J panels, provision has been made at gain regulating points to connect in the regulating network pads when required. Figs. 15 to 19 cover the circuits of the order wire panels and include connections to 1900-cycle signaling equipment which equipment is furnished separately as indicated.

(A) J98704F Panel - Non-Repeatered Order Wire Equipment for Terminals or Intermediate Stations

5.02 The F non-repeatered unit (see Fig. 15) is wired for either line bridging at intermediate points or terminating at circuit terminals as specified. The equipment arrangement is shown on Fig. V attached. When arranged for intermediate line bridging, a high inductance repeating coil is employed to give low shunting loss. The windings on the drop side of the coil are connected for a 4:1 step down from the line. A resistor in series with one drop winding terminal serves to help build out a connecting telephone set impedance to maintain a high line bridging impedance. With nominal H88 line impedances the impedance facing the telephone set circuit is approximately 750 ohms. The loss to the H88 line from a 600-ohm sending source is about 10.5 db. In the idle circuit condition the OW jack and all multiple appearances of the OW jack are disconnected by the line relay. Upon inserting a cord plug into the order wire jack or a multiple thereof, the line relay operates to close the transmission path toward the order wire line pair.

5.03 The second version of the F unit for a non-repeatered terminal is illustrated in Fig. 16. It shows a line terminating repeating coil, replacing the bridging repeating coil of Fig. 15. A line termination relay circuit provides an idle circuit termination which is removed upon inserting a cord plug into an associated order wire jack.

(B) J98704G Unit - Intermediate Order Wire Equipment for Non-Repeatered Circuits

5.04 The G order wire unit (see Fig. 17) arranged for intermediate line bridging points provides an order wire TEL set jack and the same high impedance line bridging repeating coil circuit of Fig. 15. The equipment arrangement is shown on Fig. VI attached. In the idle circuit condition the telephone set

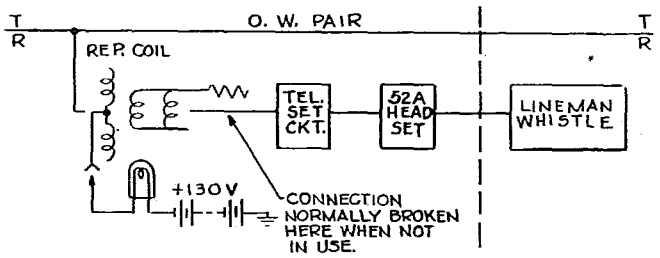


Fig. 17 - Intermediate Order Wire without V3 Repeater - No Signaling Equipment Provided

circuit is disconnected thus leaving the drop side of the bridging repeating coil open. Upon plugging a 52A head set into the TEL set jack, the transmission circuit is closed through the make contacts of the jack. A lineman's whistle may be used for signaling into a 52A head set.

(C) J98704H Unit - Terminal Order Wire Repeater Equipment

5.05 The H unit (see Fig. 18) provides arrangements for a repeatered terminal order wire. The equipment arrangement is shown in Fig. VII attached. The SW relay in series with the transmitting side of the resistance hybrid and the input to the EVEN amplifier serves via its make contacts to break the path of circulating currents involving the end repeater and terminates the leads thus broken in 600 ohms. Upon inserting a plug into the OW jack the SW relay is operated to close the path from the OW jack to the input of the EVEN amplifier. The other end of the cord is plugged into the TEL line jack and a 52A head set plugged into the TEL set jack. In this case the impedance terminating the OW jack on the 2-wire line of the resistance hybrid is balanced in the resistance hybrid network circuit by an equivalent balancing network. The resulting balances of telephone set and balancing network will be about 15 db over the voice-frequency range. In lining up procedure terminal repeater gains are adjusted to +3 db output level at the line and to -14 db receiving at the OW jack.

(D) J98704J Unit - Intermediate Order Wire Repeater Equipment

5.06 This unit (see Fig. 19) provides an intermediate V3 order wire repeater arranged for a telephone order wire drop. The equipment arrangement is shown on Fig. VIII attached. The order wire drop is obtained via the three hybrid coil bridging circuit. Information concerning the three hybrid coil bridge is covered in the Section E42.212. The SW relay serves to reduce echo effects and to maintain a high repeater singing point. Normally when the OW jack is not connected to the TEL set circuit, the SW relay contacts break the path to the OW jack and the BAL NET and terminate both pairs of open leads toward the three hybrid bridge in 600 ohms. In this condition the internal loss of the three hybrid bridge is high. The 5560-ohm resistance across the balancing network balances the 1900-cycle signal receiving circuit. During the time

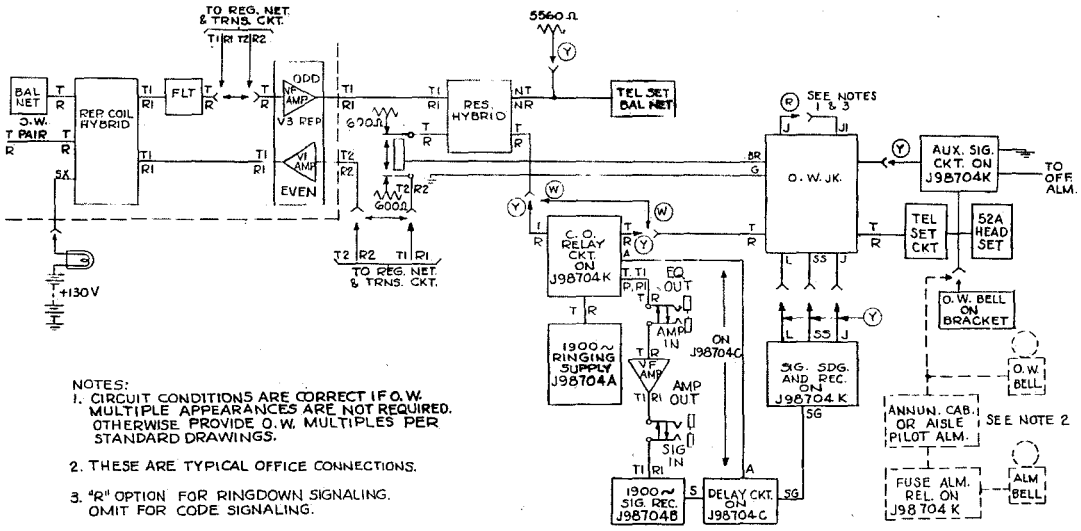


Fig. 18 - Terminal Order Wire with V3 Repeater

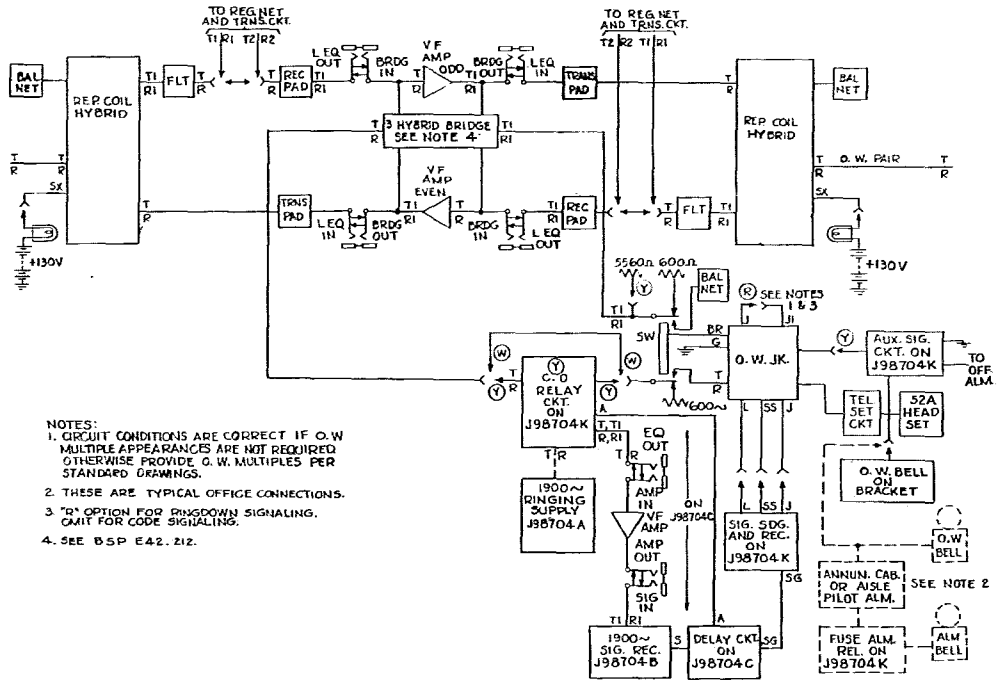


Fig. 19 - Intermediate Order Wire with V3 Repeater

that the OW jack is connected to the TEL set circuit the SW relay is operated closing the paths from the three hybrid bridge circuit to the BAL NET and to the OW jack. The resulting balance between the telephone set and its balancing network is 15 db or better. Since the amplifiers of the V3 repeater are plug-in units input and output jacks are not provided.

5.07 As described in Section E42.212 incoming test tone level from the line is adjusted at the L EQ OUT jacks by means of the REC pad to -24 db and the repeater gains adjusted to 32.2 db. The repeater gain includes the 0.9 db input and 0.9 db output bridging losses of the three hybrid bridge circuit. The TRANS pad is adjusted as required in case the repeater is the last repeater in the line (no terminal repeater) to give -14 db at the associated circuit terminal. In other cases the TRANS pad will be adjusted to give +3 db level on the line. With intermediate repeaters adjusted as above, the over-all loss terminal to terminal, terminal to any repeater point order wire drop or between order wire drops at repeater points will be in each case 14 db. The loss between a way-station and point A, either a terminal or an intermediate order wire point, will be approximately as follows:

(1) Way-Station Receiving from Point A

Loss in db = 10-LA
Where LA is the receiving level from point A on the line at the point under consideration

(2) Way-Station Transmitting to Point A

Loss in db = 14+10+LB
Where LB is the receiving level on the line from the other direction at the point under consideration L will, in general, be different in the two directions and its sign will usually be minus although if monitoring near a repeater it may be plus

(E) J98704K Panel - Fuse Alarm and Signal Relay Equipment

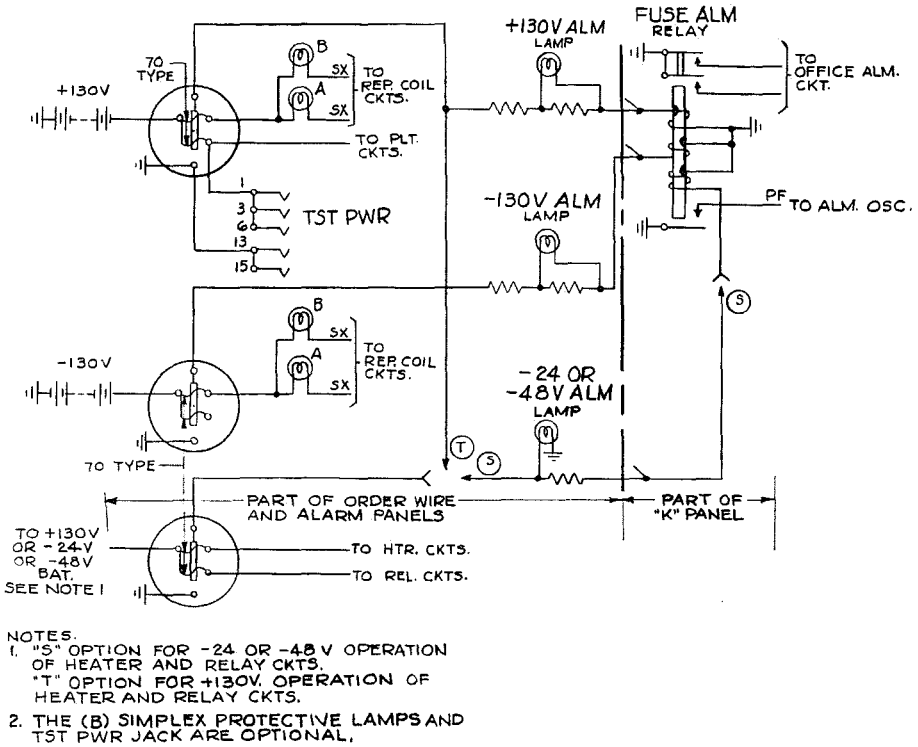
5.08 This panel comprises miscellaneous equipment. One is required at each power supply point to furnish a fuse alarm relay (see Fig. 20), a SIG SDG and REC relay, and an AUX SIG relay (see Fig. 21). At points equipped for 1900-cycle signaling it also furnishes a 1900-cycle CO relay. The 1000-cycle CO relay is furnished. Equipped K panel is shown in Fig. IX attached.

6. ORDER WIRE SIGNALING

6.01 Signaling equipment for either 1000 or 1900-cycles is optional for the J98704F, H and J equipment units. For either, the drawings provide for both ringdown or code signaling. With ringdown signaling a received signal is locked in until answered. When code ringing is employed lockup is eliminated and the ringing spurts are heard at all stations so equipped. Figs. 16, 18 and 19 with "W" option and Fig. 17 are utilized for offices normally not attended. At such points, signaling receiving or oscillator sending equipment is not desired and a lineman's whistle can be used for signaling out. 1900-cycle signaling is provided with "Y" option. With "X" option, standard equipment for 1000-cycle signaling is furnished. For purposes of simplification 1000-cycle signaling is not illustrated in Figs. 16, 18 and 19.

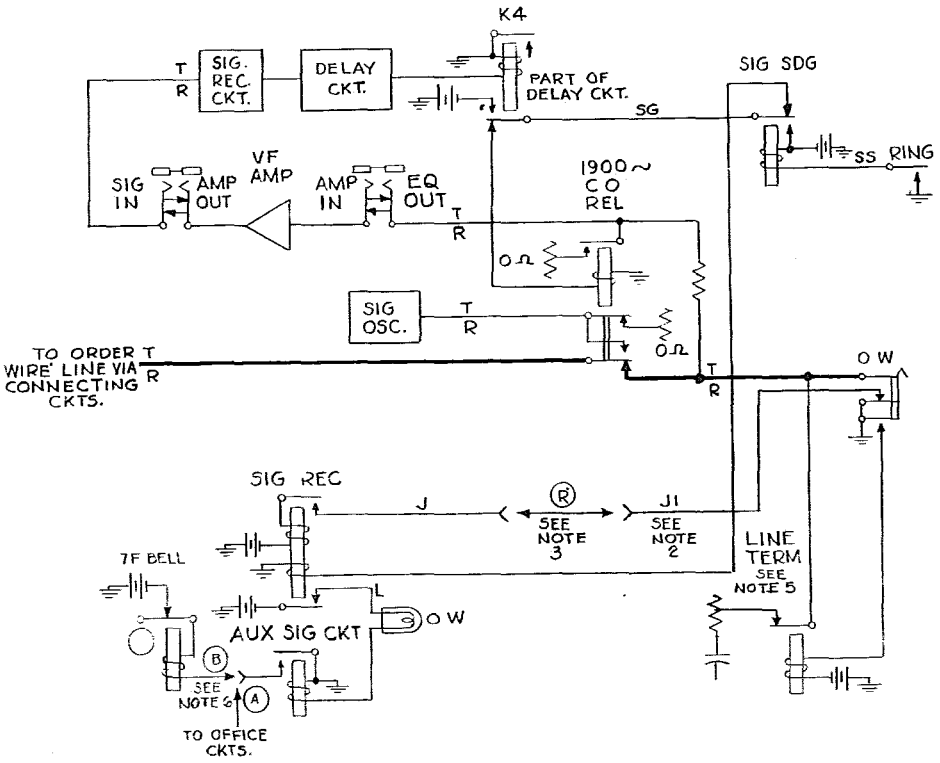
6.02 The lineman's whistles are of metal and should be carried in a warm pocket by the user in freezing weather. If the signaling is 1000 cycles the 1000-20 cycle whistle should be used. The 1900-cycle whistle is of rectangular shape and has a resonant chamber with a closed end. Upon blowing, a narrow thin stream of air is directed across the resonating chamber. There is relatively little change in frequency, no matter how hard the whistle is blown until it is blown hard enough to produce harmonics. The whistle when blown near the lineman's transmitter (52A head set and 84A test set) will easily give a +4 vu output from the transmitter. This output is sufficient to bring in with ample margin any terminal lined up for a 14 db over-all net loss.

6.03 The 1900-cycle signaling system shown in Fig. 21 employs the 1900-cycle alarm oscillator and receiving circuit and alarm delay circuit described previously. A cutoff relay



NOTES.
1. "S" OPTION FOR -24 OR -48 V OPERATION OF HEATER AND RELAY CKTS.
"T" OPTION FOR +130V. OPERATION OF HEATER AND RELAY CKTS.
2. THE (B) SIMPLEX PROTECTIVE LAMPS AND TST PWR JACK ARE OPTIONAL.

Fig. 20 - Fusing, SX Fuse Protective Lamp and Fuse Alarm and Lamp Circuits



NOTES:
1. ALL RELAY OPERATING CKTS. ARE ARRANGED FOR -24 V. OR -48 V. BATTERY.
2. THE LINE TERMINATION SHOWN IS FOR THE CASE OF A NON-REPEATERED O. W. TERMINAL.
3. "R" OPTION FOR R D SIG. AND OMIT "R" OPTION FOR CODE SIG.
4. EQPT. IS FURNISHED AS FOLLOWS:

EQPT.	PANEL
RING KEY	F, H AND J
O.W. LAMP	
O.W. JACK	
LINE TERM. REL.	
SIG. OSC. CKT.	A
SIG. REC. CKT.	B
V. F. AMP. & JACKS	C
DELAY CKT.	D
SIG. SDG. REL.	K
SIG. REC. REL.	
AUX. SIG. REL.	
CUT OFF REL.	

5. THE LINE TERMINATION RELAY IS FURNISHED ONLY AT NON-REPEATERED TERMINAL. SEE FIG. 17. IT IS REPLACED FOR OTHER SITUATIONS AS FOLLOWS:

FOR	BY
FIG. 16	LINE RELAY
FIG. 18	SW. RELAY
FIG. 19	SW. RELAY

6. "B" OPTIONS FOR OFFICES WITHOUT AUDIBLE SIG. OTHERWISE "A" OPTION.

Fig. 21 - Order Wire and 1900-Cycle Signaling Schematic Circuit

circuit is used and the V3 amplifier is employed to increase signal receiving level. To ring out from an OW appearance, depressing the Ring Key, operates the SIG SDG relay which in turn operates the CO relay. The CO relay via its pairs of operated contacts does three things:

(1) Connects 1900-cycle tone to the outgoing T and R leads.

(2) Places a short across the input to the receiving amplifier.

(3) Breaks the T and R leads going to the OW jack so that the high level outgoing 1900-cycle is not heard in the attendant's telephone set receiver.

6.04 An incoming ring entering the T and R leads passes through the normally made contacts of the CO relay to a pair of 2520-ohm resistors which together with the input impedance of the V3 amplifier form a high impedance shunt across the T and R leads of the OW jack. The shunt causes a 0.5 db loss to through voice transmission. With the OW jack terminated in 600 ohms and the impedance looking toward the line assumed to be 600 ohms, the loss to the V3 amplifier input caused by the pair of 2520-ohm resistors is about 19.5 db. Tone which reaches the amplifier input is amplified, then passes through the 1900-cycle receiving circuit where it is filtered, amplified and rectified. The rectified current operates the K2 relay in the receiving circuit. The operation of the K2 relay places +130 volts on the S lead to the delay circuit and activates this circuit. If the incoming tone is sustained for one second or longer the delay circuit responds to operate its K4 relay which upon operating disables the CO relay, places a voltage on the SG lead which in turn operates the SIG REC relay through the normal contacts of the SIG SDG relay. The operation of the SIG REC relay lights the lamp and operates the AUX SIG relay which is in series with the lamp. Operation of the AUX SIG relay actuates, (A) option, the office order wire indicating signals which may be the aisle pilot alarm, and annunciator or similar circuit. Offices not so equipped may employ option (B) which provides a special order wire bell. If a lock-up is desired as for ringdown signaling the J-J1 leads are connected together. For code ringing the J-J1 strap is omitted.

6.05 Normally the 1900-cycle oscillator tone is adjusted to 0 dbm at the OSC OUT jacks. This tone is then applied at the 0 level point to the order wire. Since the order wire operates at 14 db net loss at terminals and other intermediate repeater points the incoming receiving ring is -14 dbm and then it suffers a further loss of 19.5 db before reaching the V3 amplifier input. If the amplifier is adjusted for a gain of 23.5 db, the input to the 1900-cycle signaling receiving circuit is a power of -14 -19.5 +23.5 or -10 dbm. Since the signaling receiving circuit is normally adjusted with an input of -15 dbm to give 13 mils d-c at the RC jack there is with the normal -10 dbm signaling input a margin of about 9 db over the just operate condition to allow for circuit and line variations. The time delay of one second after 1900-cycle tone reaches the receiving circuit provides a safeguard against false operation by normal speech currents. Shorter spurts of current of 1900 cycles will operate the receiving circuit and cause the K3 relay in the delay circuit to operate for the length of the spurt. However, each release of the K3 relay causes whatever charges that have accumulated on the capacitor associated with the cold cathode tube in the delay circuit to be quickly dissipated. Thus, a spurt at least one second long is required to bring in the order wire signal.

7. PERFORMANCE

(A) Oscillator

7.01 The output power of the oscillator is normally adjusted to +6 dbm by means of the LEVEL potentiometer R13 with the OUT potentiometer R14 set for minimum loss, and then the output may be varied by the OUT potentiometer as required. In special cases in order to save a repeater the output may be adjusted to a minimum of 9.5 dbm by means of the LEVEL potentiometer. However, the second harmonic increases at the higher output power and the stability is slightly impaired as a result of reduced feedback voltage. The change in output power resulting from ±4% change in battery voltage for both plate and heater in the same direction simultaneously is in the order of 0.04 db. The frequency of oscillation may be reduced as much as 30 cycles per second in a 1900-cycle per second oscillator if it is operated at a +10 dbm output as compared with the frequency obtained at +6 dbm. At +10 dbm output the frequency of oscillation can be reset to the nominal value by an adjustment of the trimmer capacitor C5. The trimmer capacitor C5 provides a range of frequency adjustment to compensate for circuit element variations on any given panel. This range varies from about 17 cycles in case of a 700-cycle oscillator to about 47 cycles in case of the 1900-cycle oscillator, and adjustment can be made to within less than 1 cycle per second from the desired nominal. There is a frequency deviation of about 1 cycle per second for a change in load impedance between 500 ohms and 700 ohms and about 4 cycles for a load change between 700 and 1000 ohms. The following table gives typical values of frequency deviation for changes in each circuit parameter affecting the frequency.

Variable	Per Cent Deviation
Temperature 30° to 120°F.	+0.1
Plate voltage ±5%	±0.04
Heater voltage ±6%	±0.04
Load impedance 600 ohms to infinity	-0.014

7.02 For an output of +6 dbm the second harmonic output is about 39 db below the fundamental frequency. For an output of +8 dbm the second harmonic output is about 35 db below the fundamental frequency. Third harmonic output is considerably lower than the second harmonic output and is negligible.

(B) Receiving and Delay Circuits

7.03 The loss frequency curves of the various optional input filters are shown in Fig. 22. The frequency at the minimum loss point in a given filter may deviate from nominal by a maximum of one-half per cent. Because the received frequency may also shift in either direction by a maximum of one-fourth per cent, the most adverse combination of the two deviations would result in a minimum filter loss of 29 db to an alarm tone 200 cycles away from the nominal center in one direction and 32 db minimum filter loss in the other direction from the nominal center. Hence, an adjacent tone 200 cycles removed will cause considerably more interference into any receiving circuit than any second or third order modulation products generated in one of the V3 line amplifiers. For frequencies 400 cycles removed, the minimum filter loss to an adjacent alarm tone on one side might be about 40.5 db and about 45 db on the other side.

7.04 The following operating characteristics of the receiving circuit refer to the normal 600-ohm cathode condition. The 300-ohm strapping of the cathode circuit would increase the sensitivity about 4.5 db. The circuit provides more than 13 mils relay current with an input power of -15 dbm applied to the line side of the band filter. With an input potentiometer adjustment to give 13 mils relay current at -15 dbm input and with the circuit lined up for operation to provide -10 dbm tone to the receiving circuit input, a 9 db operating margin is provided for line and circuit deviations without the hazard of the relay operating current dropping below the usual 9 mil operating value. Any increase in margin against relay release also increases the likelihood of false holdup from adjacent tones when an actual trouble denoted by the omission of the tone in question is attempting to initiate an alarm. Hence, the 9 db allowance against relay release is a fair compromise between false release and false holdup.

7.05 To assist in obtaining an adequate margin against both false release and false holdup from adjacent frequency tones, repeater modulation products, noise and crosstalk, a high ratio of release to operate current of the output relay is desirable. The polar relay K2 provides this high ratio and, when properly adjusted, the difference in operate and release current in general will not exceed 1.6

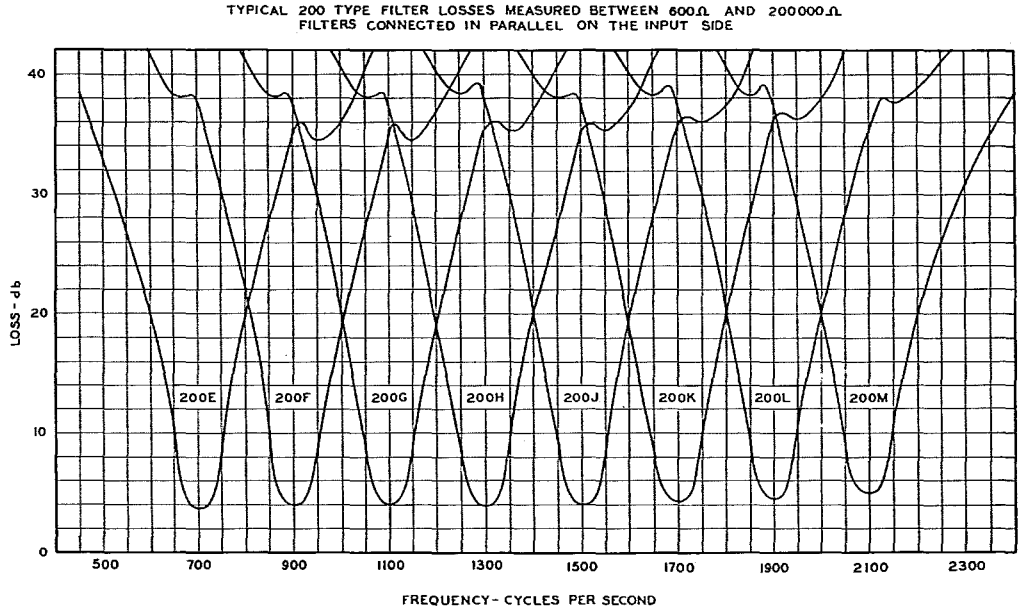


Fig. 22 - Typical 200-Type Filter Loss Curves for Order Wire and Alarm Circuits

mils and in many cases may be as low as 0.1 mil. A 1.0 mil change in relay current at the just operate point of the relay is roughly equivalent to 1 db change in input power.

7.06 With 400-cycle separation of tones no special consideration for a given application is required because about 21 db margin is available against false holdup from unwanted tones under normal conditions of circuit and line. If operation of tones 200 cycles apart were attempted then assuming the worst case of interference from two tones 200 cycles removed on each side of 1900 cycles per second and taking into account a small contribution from one additional tone 400 cycles removed (1500 cycles per second), the possible unwanted power infiltrating the receiving circuit may be as high as 19 db below the normal alarm frequency level or 10 db below the false holdup. Allowing 1 db for the difference between the relay operate and relay release power, there remains 9 db release margin over the total unwanted power all of which is required to provide for line and circuit deviations as previously stated. Hence, 400 cycles separation of signal tones is essential unless close control of line and circuit variations is maintained. If more than four alarm tones are required, the tones with 200-cycle separation are employed at points nearest the alarm receiving station in order to reduce the effect of variations in line net loss on these closer spaced tones.

7.07 The delay circuit provides approximately five seconds between the operation of the K2 relay and the K4 relay to insure sufficient margin against any false operation of the alarm system.

7.08 The application of tone to the receiving circuit on the order wire operates the signal. Because only 1900 cycles per second signaling tone is transmitted over the order wire pair, there can be no interference from other tones on the pair; but false operation from speech and noise as well as crosstalk from tones on other pairs in the cable must be minimized. In this application, components of speech in the 1900 cycles per second band operate the K2 relay intermittently. However, the insertion of the 1-second delay between the operation of the K2 relay and the K4 relay provides sufficient protection against these voice currents in the band passed by the input filter because they are not sustained for a sufficiently long interval to operate the delay relay K4. The 1-second delay is a compromise value intended to provide as much discrimination as possible against talkup without introducing excessive hazard of missing one or more short spurts of code ringing. In signaling from pole cabinets by means of a 1900-cycle whistle, a tone duration of longer than two or three seconds can not be maintained without considerable effort.

(C) Line Equipment

7.09 The transmission characteristics of the order wire line equipment are, except as indicated, the same as that of message voice circuits from the standpoint of level, balance, noise, singing margin, etc. The characteristics given in Sections E43.120 and E43.121 are modified in instances by the loss of associated transmitting and receiving pads and the shunt losses of the 3-way bridge. At intermediate repeater points with the telephone drop not in use, the internal balance of the 3-way bridge circuit is sufficiently high to have negligible effect on repeater performance and 22-type singing point tests. When the telephone drop is in use the internal balance is still sufficiently high.

7.10 The alarm pair is similar in transmission requirements to any 4-wire voice circuit although it is only equipped for transmission in one direction. Because the alarm tones cause interference into other pairs in the cable and because the alarm pair is subject to interference from other pairs it is treated like any other 2-wire circuit and is lined up to +3 db output line level at voice repeater stations. The maximum energy limit for alarm tones must be such as to limit interference into other circuits to not more than 26 db RN at the -9 db level point where the over-all noise from all sources is 29 db RN. Fig. 23 shows the maximum permissible power for various combinations of alarm tone

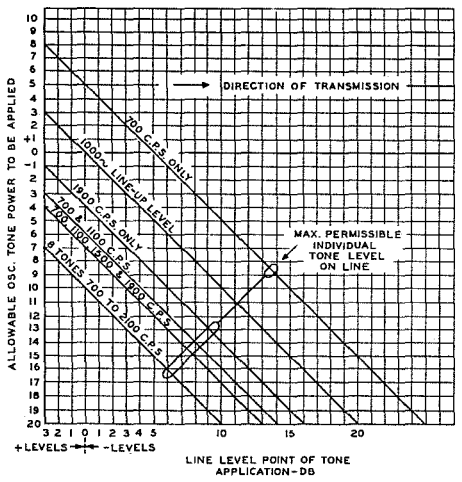


Fig. 23 - Tone Transmission Level Chart for Alarm Tones Applied to the Alarm Line

frequencies applied to the voice alarm section of line. As noted in Fig. 23, to meet the interference objective the maximum power for each of the four tones of 700, 1100, 1500 and 1900 cps employed together is limited to -7 dbm referred to the 0 level point. For application of only a 1900-cycle tone to an alarm section the oscillator output may be 3 db higher than for the four tones. At the same oscillator power, the 700-cycle frequency alone results in 9 db improvement in interference compared to the 1900-cycle frequency alone.

7.11 At terminal alarm sending stations the oscillator terminates the line and the loss between the oscillator and line is only about 0.5 db. At bridging points the loss of the coupling equipment between the oscillator and various loaded lines and also the bridging loss of this equipment to through transmission is given in the following table:

Facility	Loss - db Oscillator To Line	Loss - db To Through Transmission
H-44	11.5	0.7
H-88	10.5	1.0
H-172	9.2	1.3
600 ohm	12.6	0.5

7.12 At the point on a bridging station where an alarm tone is to be applied, the line level is likely not to be more than +1 db and will generally be less than 0 db. At this bridging point on H-88 cable the oscillator output power is applied to the line through a 10.5 db loss. Thus considering four alarm tones on the line the highest permissible output power at the oscillator jacks would be about +4.5 dbm for application at a +1 db line level point in order to meet the -7 dbm limit referred to the 0 level point (equivalent to a -6 dbm at the +1 db level point). For application of only a 1900-cps tone to an alarm section at a bridging point the oscillator output can be increased 3 db to +7 db at the oscillator jacks without exceeding the interference value.

7.13 At a voice frequency intermediate gain point the applied alarm tone is introduced at the input to the amplifier and hence the 24 db range of the oscillator output attenuator may not be enough to reduce the tone power sufficiently to equal the power of the one or more through alarm tones. The additional attenuation required is provided by an adjustment of the resistance hybrid potentiometer. This potentiometer is arranged to supply a nominal loss of 6 db to both the through line and to the oscillator tone when the two mechanically coupled units are adjusted for midposition. For adjustments in one direction from midposition the loss in the through branch can be increased to 24 db at the same time the loss in the bridging branch is being decreased to 0.5 db. For adjustments in the other direction from midposition the losses in the two branches are in the reverse direction. This loss characteristic is shown in Fig. 6f. This arrangement thus provides the means for adjusting the through tones on a multi-tone alarm line to the same level as the tone being applied at the through station.

8. POWER SUPPLY AND FUSE ALARMS

8.01 Both ±130 volts supply is required for application to the simplexes of the line pairs to operate the 2M repeater switching set. Alarm sending or receiving, signaling and repeater equipment require +130 volts supply. Heaters of electron tubes, talking circuits and relays require either -24 or -48 volts. In the absence of -24 or -48 volts provision has been made for +130 volts operation of equipment.

8.02 All fusing is provided as part of the order wire panels except in the case of -130 volts which is located on the "E" alarm panel. Power and ground leads are run direct into the 70-type fuse blocks on the panels. Each fuse block accommodates two 70-type fuses. The 70-type fuse is a small cartridge fuse equipped with a colored tongue indicating the current rating which protrudes out, upon fuse failure, through the center of the fuse cap to indicate that the fuse is blown.

8.03 A fuse upon blowing connects a voltage to the alarm terminal of the fuse block. All fuse alarm circuits required by an order wire and alarm installation are tied (see Fig. 20) through separate resistance lamp circuits into a single 3-winding relay, one winding for each voltage employed. Any fuse blowing causes the relay to operate and the associated lamp to light. If the office is continuously attended, ground furnished by the relay contacts causes the local visual and audible alarms to function. When the office is to be unattended, ground is furnished by another relay contact to a PF lead which connects to the PF lead of an alarm oscillator circuit. The operation of the fuse alarm relay places ground on this lead causing the relay in the alarm oscillator to fall back, thus, disconnecting the alarm tone from the alarm pair. Absence of this tone brings in the alarm at the control office.

9. REFERENCE DRAWINGS (Not Attached)

(A) Circuit Drawings

SD-55039-01 - Auxiliary Signal Circuit
SD-55385-01 - Signaling Application Schematic - Order Wire
SD-55574-01 - Telephone Order Wire Circuit
SD-56073-01 - Telephone Circuit
SD-59046-01 - Hybrid Coil Bridge Circuit
SD-90517-01 - Balancing Networks
SD-95113-01 - V3 Amplifiers and Telephone Repeaters - Battery Supply
SD-95142-01 - N Carrier - Telephone Order Wire
SD-95143-01 - N Carrier - Alarm Circuit
SD-95144-01 - V3 Telephone Repeater - Line and Balancing - Application Schematic

(B) Equipment Drawings

ED-92347-01 - Order Wire and Simplex Equipment for Pole Mounted Cabinet
ED-92432-01 - Oscillator Panel
ED-92433-01 - Receiving Detector Panel
ED-92434-01 - Delay Panel
ED-92444-01 - Non-repeatered Order Wire Panel
ED-92445-01 - Non-repeatered Intermediate Order Wire Panel
ED-92446-01 - Order Wire Intermediate Repeater Panel
ED-92447-01 - Miscellaneous Alarm Connecting Equipment Panel
ED-92448-01 - Terminal Order Wire Repeater Panel
ED-92474-01 - Fuse Alarm and Signaling Relay Panel

Attached:
Figs. I to IX, incl.

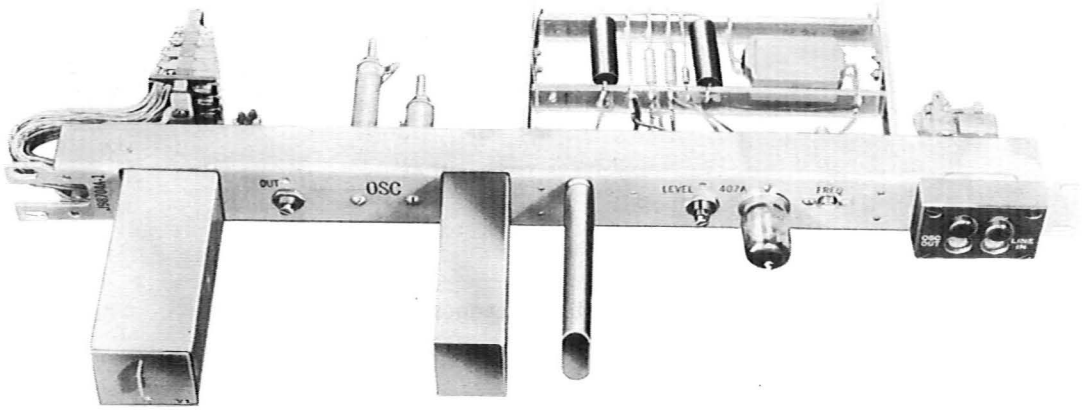


Fig. I - J98704A - Oscillator Panel for Alarm and Order Wire Signaling

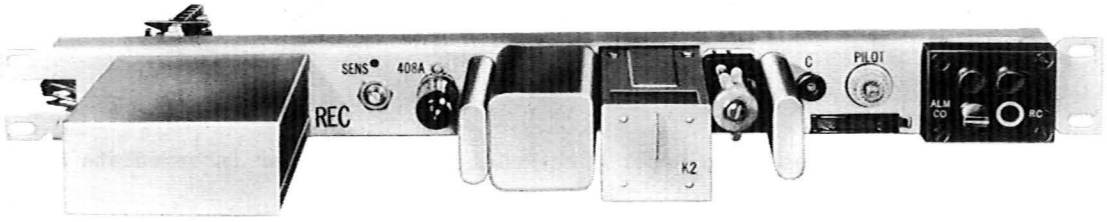


Fig. II - J98704B - Receiving Panel for Alarm and Order Wire Signaling

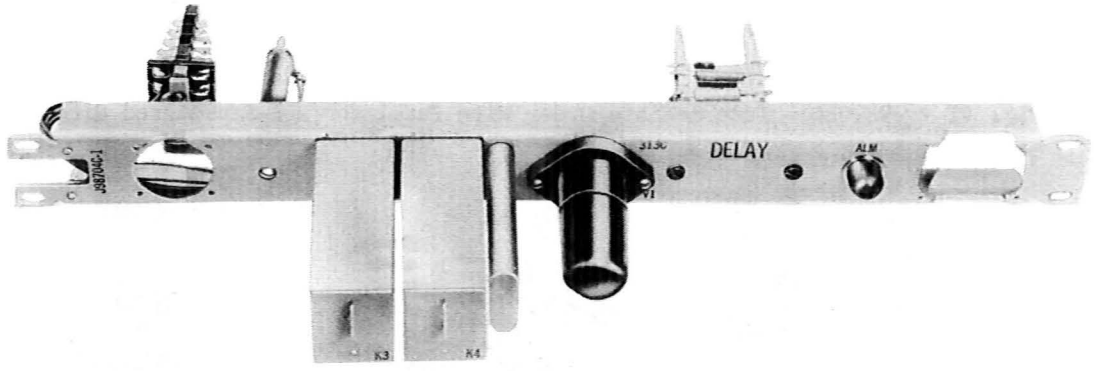


Fig. III - J98704C - Delay Panel for Alarm and Order Wire Signaling

Fig. IV - J98704E - Miscellaneous Alarm Panel

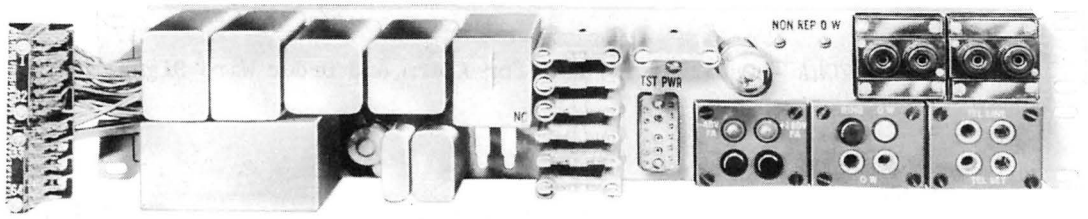


Fig. V - J98704F - Non-Repeatered Order Wire Panel for Terminal or Intermediate Stations

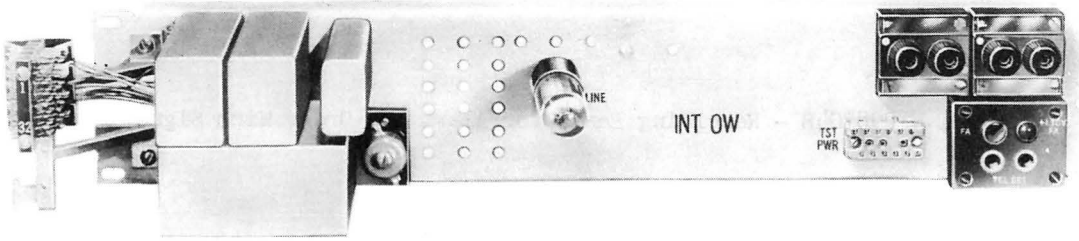


Fig. VI - J98704G - Intermediate Order Wire Panel for Non-Repeatered Circuits

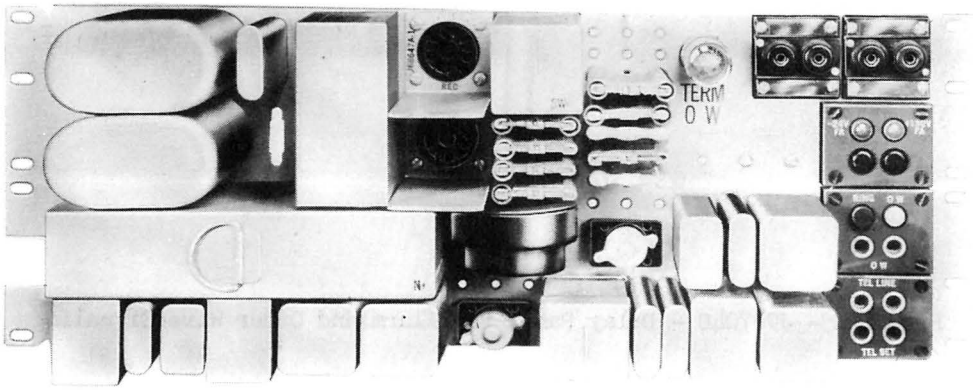


Fig. VII - J98704H - Terminal Order Wire Repeater Panel

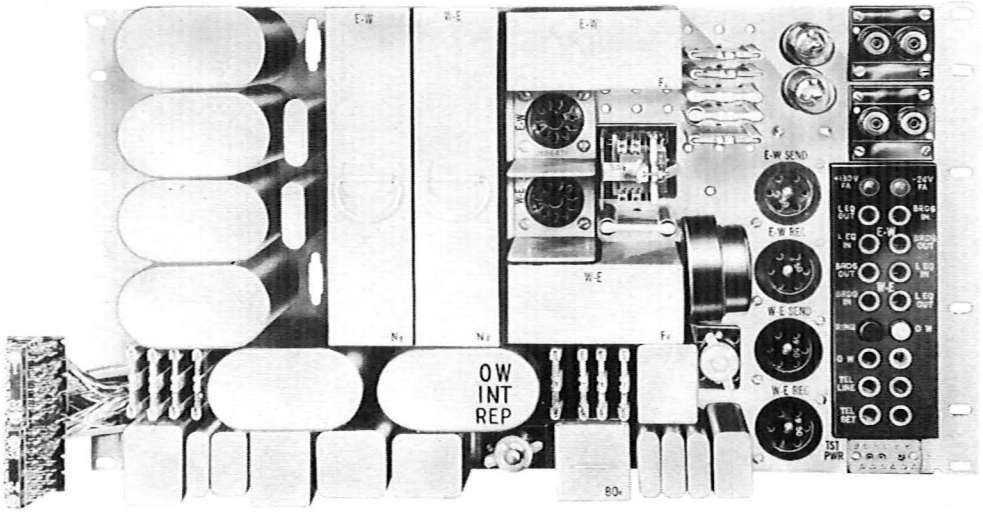


Fig. VIII - J98704J - Intermediate Order Wire Repeater Panel

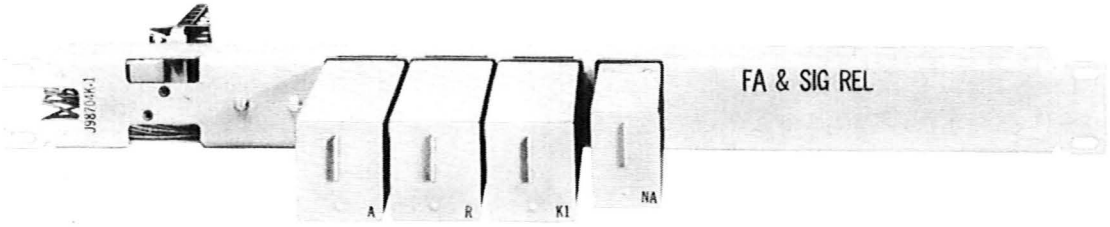


Fig. IX - J98704K - Fuse Alarm and Signal Relay Panel