COMMON SYSTEMS
"O" & "ON" CARRIER TELEPHONE
APPLICATION SCHEMATIC
"O1", "ON1" & "ON2" CARRIER TERMINAL
ALSO FOR USE WITH
ON/K CARRIER TERMINAL

CHANGES

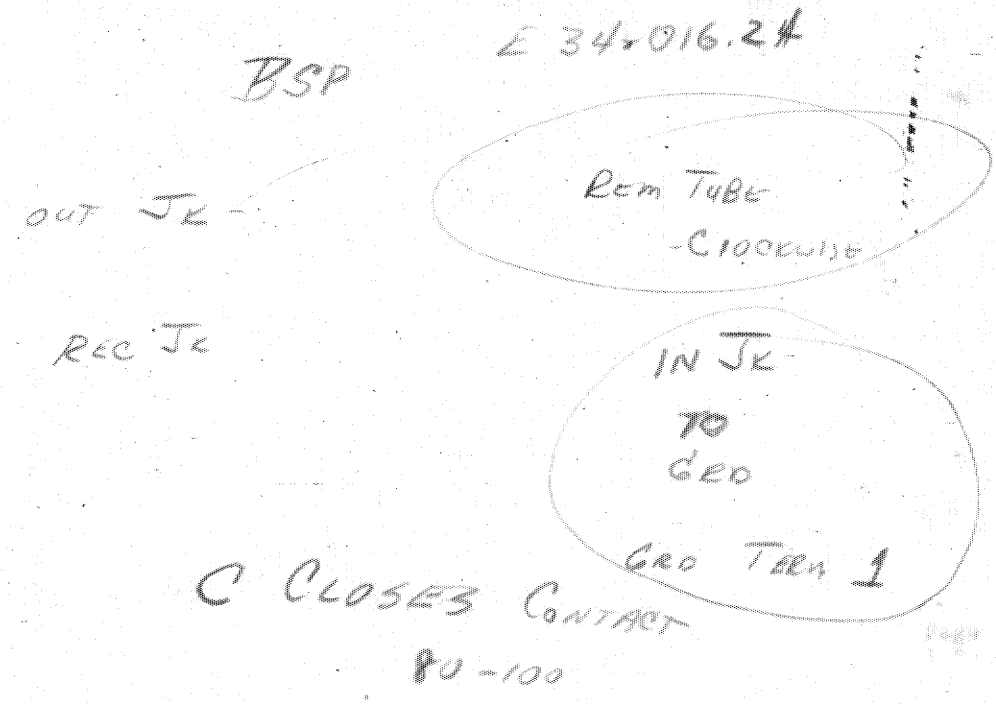
D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Information is added to the circuit requirements table which will enable testing of the S507 relay (C) on an ON2 terminal when Fig. 11 and option "AK" are provided.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2166-WCM-OLW



COMMON SYSTEMS
"O" & "ON" CARRIER TELEPHONE
APPLICATION SCHEMATIC
"O1", "ON1" & "ON2" CARRIER TERMINAL
ALSO FOR USE WITH
ON/K CARRIER TERMINAL

CHANGES

B. CHANGES IN APPARATUS

B.1 Removed

In Fig. 11

1 - Transistor (Q1) 7B

Replaced by

In Fig. 11

1 - Transistor (Q1) 12B

B.2 Added

In Fig. 11

1 - Inductor (L32) 1546B, 82 mh

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The code of (L32) added in Appendix 1B to Issue 11B of this CD was shown on the CD in error. No equipment change is involved in B.2 above.

D.2 Note 124 has been revised to clarify the application of option "AF" when Fig. B is provided.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2161-WCM-LP

COMMON SYSTEMS "O" & "ON" CARRIER TELEPHONE APPLICATION SCHEMATIC "O1", "ON1" & "ON2" CARRIER TERMINAL ALSO FOR USE WITH ON/K CARRIER TERMINAL

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.01 Option "AP" has been provided to cover remote alarm release circuit operation when channels are connected on a 4-wire basis. This was previously not shown, in error.

D.02 In Fig. 2, KS-14169, L2 has been changed to read KS-14169, L2 and L3.

D.03 Fig. 59 has been revised for ON2 applications.

D.04 Fig. 105 has been extended to include ON2 applications.

D.05 Notes in Fig. 106A have been changed to show preferred method of adding ON2 groups.

D.06 Fig. 109 has been extended to include ON2/K applications.

D.07 In note 107, "SD-95246-01, SD-95252-01, or SD-95118-03" was added.

D.08 Note 114 was revised to include use of the remote alarm release circuit.

D.09 Note 119 was revised to include application where thru-channel unit, J98705AF, is provided.

D.10 Note 121 previously read: "Transmission Channel Unit."

D.11 Note 201 has been changed to make Figs. 7 and 8 installer wiring.

D.12 In Fig. 4, a short length of shielded cable has been replaced with an unshielded pair.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 This circuit shows the components and wiring which are required for type O, ON1, and ON2 carrier terminals. Jacks for connecting channel units, transmitting and receiving group units, oscillator unit and twin-channel carrier units into the terminal, are shown. Alarm and power supply circuits as well as carrier line terminating circuits are also given.

2. WORKING LIMITS

2.1 The maximum allowable resistance in the "M" lead for earth potentials of 5 volts or less shall be 200 ohms.

3. FUNCTIONS

3.1 Provides information regarding the interconnection of the units that make up an O or ON terminal.

3.11 Provides connecting message and signal circuit information.

3.12 Provides information regarding the connections between the terminal and office line equipment.

3.13 Provides information regarding interconnection of different type terminals on the same line pair.

3.14 Provides information regarding the interconnection of a terminal with repeaters and bypass circuits of other type O systems on the same line pair.

3.15 Provides alarm circuits which operate when there is failure of (1) the 3700-cycle oscillator used for signaling, (2) the carrier frequencies received over the line, and (3) the 48-volt supply due to a fuse blowing.

3.16 Provides automatic disconnect and make busy in case of a 3700-cycle or carrier failure.

3.17 Provides identification of the system in trouble at both terminals, excepting failure of the 48-volt supply to the alarm circuit.

3.18 Provides means for testing the carrier equipment prior to returning the system to normal after a trouble condition.

3.19 Provides means for restoring the system to normal at an unattended office after a trouble has been cleared.

3.20 Provides means for tandem connection of type O channels on a 4-wire basis without the use of compandor.

3.21 Provides information for interconnection of ON1 terminals and ON1 junctions.

3.22 Provides for the interconnection of ON1 terminals and ON/K combining network.

3.23 Provides for the interconnection of ON1 terminals and O carrier channel dropping circuit.

3.24 Optional wiring was indicated in Figs. 1 and 3 to provide resetting of alarms over the system.

3.25 Provides optional wiring "AF" to eliminate a 10-second ring on a private-line channel having ringdown signaling.

3.26 Provides optional wiring "AN" which was not provided previously. This wiring will be supplied in all terminals. It is necessary for converting existing O1 or ON1 terminals to ON2 terminals.

3.27 Provides alarm lead multiple points connecting to office alarm circuits.

4. CONNECTING CIRCUITS

4.1 Plug-in Units

4.11 Channel Ckts. - SD-95118-01, SD-95191-01, SD-95246-01, or SD-95252-01

4.12 O1 and ON1 Twin Channel Carrier Ckt. - SD-95151-01

4.13 Group Transmitting Ckts. for OB1, OC1, and OD1 - SD-95153-01

4.14 Group Receiving Ckt. for OB1, OC1, OD1, and ON1 - SD-95152-01

4.15 O1 Terminal Group Osc. and ON1 Grp. Osc. Ckts. - SD-95154-01

4.16 OA Group Transmitting Ckt. - SD-95172-01

4.17 OA Group Receiving Ckt. - SD-95174-01

4.2 When this circuit is listed on a key sheet the connecting information therein should be followed. The following are typical connecting circuits.

4.201 Annunciator Ckt. - SD-90202-01

4.202 Audible Alarm & Pilot Lamp Ckt. - SD-90614-01

4.203 Audible & Visual Alarm Ckt. - SD-96188-01, SD-95063-01

4.204 In No. 1 Step-by-Step Offices

4.2041 Audible & Visual Alarm Ckt. - SD-96188-01

4.2042 Audible Alarm Ckt. - SD-31551-02

4.205 In No. 350A Step-by-Step Offices

4.2051 Audible Alarm Ckt. - SD-31551-02

4.2052 Pilot Lamp and Power Alm. Lamp Ckt. - SD-31573-01

4.206 In No. 355A Step-by-Step Offices

4.2061 Misc. Alm. Ckt. - Alarm Control - SD-31980-01

4.2062 Misc. Alm. Ckt. - Pilot Lamp - SD-31970-01

4.207 Conn. Bank Mult., Ckt. - SD-32188-01

4.208 OG Trk., Man. - Toll - SD-15362-01

4.209 OG Trk. Sdr. TDM to Step-by-Step - SD-21866-01

4.210 CBR. TDM. OFF INC. TRK - Dial Puls. - SD-25905-01

4.211 TDM. INC. TRK - M.F. PULSING - SD-25909-01

4.212 OG Trk. - Step-by-Step to SEL. M - SD-31795-01

4.213 TDM. PTCH. BAY. JK & CORD CKT. - SD-55248-01

4.214 1000 cycle SIG. CO RELAY - SD-55393-01

4.215 I.T.O.G. TRK., DIAL-SEL MULT - SD-55109-01

4.216 No. 4 or 5 T.TST BD - PTCH JK CKT. - SD-55337-01

4.217 2 WAY OPR OFF - T. SWBD - SD-55256-01

4.218 SIG. CONV. INC. AUT - SD-56131-01

4.219 INTERTOLL TRK. - MF to DIAL PLSG. - SD-56109-01

4.220 SIG. CONVR - DC - SD-56159-01

4.221 SIG. CONVR - CS to 20 - SD-56163-01

4.222 SIG. CONVR - CS to 20 T.D. - SD-56199-01

4.223 1A Echo Spr. App. Sch. - SD-59035-01

4.224 I.T. Swbd. - O.G.T. - Dial - SD-64472-01

4.225 I.T. Swbd. - O.G.T. - Dial (CX or SX) - SD-64474-01

4.226 No. 17 or 18 T.T.Bd., PTCH. JK. CKT. - SD-64724-01

4.227 I.T., INC TRK, DIAL TO SEL OR OPR - SD-64590-01

4.228 VF PTCH. JACK CKT - SD-64303-01

4.229 LINE & BAL. - APPL. SCH. - CABLE - SD-64903-01

4.230 LINE & BAL. - APPL. SCH. - OPEN WIRE - SD-64903-03

4.231 No. 4 SW I TRK. INC OR 2 WAY - SD-68006-01

4.232 No. 4 SW I TRK INC - M.F. PLSG. - SD-68154-01

4.233 No. 4 SW I TRK, 2 WAY DIAL - CS SIG. - SD-68102-01

4.234 No. 4 or 4A SW. I.T. INC. DIAL - SD-68135-01

4.235 No. 4 or 4A PTCH. JK CKT. - SD-68327-01

4.236 SW. NO. 4, PAD SW - SD-68285-01

4.237 No. 4 SW I.T. O.G.T.

4.238 2 WAY TRK, LOOP CX - SD-95060-01

4.239 AUX PULSE LINK - SD-95095-01

4.240 SIG. LEAD EXT. - SD-95488-01

4.241 AUX. TRK. CX - LOOP - SD-96398-01

4.242 AUX. ALM & PILOT LAMP - SD-90614-01

4.243 Annunciator - SD-90202-01

4.244 Aud. & Visual Alm. - SD-95075-01

4.245 V. F. ALARM SYSTEM - SD-95143-01

4.246 Thru entrance cable, when required, to carrier line facilities.

4.247 C Carrier Telephone - Line & Bal - Transfer Ckts. - SD-59010-01

4.248 Subscriber Line Ckt. for Terminating Service - SD-31224

4.249 V.F. CH PTCH - SD-59329-01

4.250 "O" Carrier Telephone - Line & Bal Ckts. - SD-95181-01

4.251 Mis. Alm. Ckt. in a 360A Step-by-Step Office - SD-31209-01

4.252 ON1 Comb. Net. and Osc. Ckt. - SD-95198-01

4.253 Application Schematic for N1 and ON1 Repeater - SD-95124-01

4.254 Line Filter & Auto Transformer Ckt. for use with "O" Carrier - SD-95181-01

4.255 O1 Repeater Ckts. - SD-95155-01

4.256 OB1, OC1 & OD1 Carrier By-Pass & Branching Ckt. - SD-95171-01

4.257 Application Schematic for ON1 Junction GRP 1 - SD-95196-01

4.258 Application Schematic for ON1 Junction GRP 2 & 3 or 4 & 5 - SD-95197-01

4.259 Line and Balancing Application Schematic for Carrier Line Filters - SD-95213-01

4.260 "O" Carrier Telephone - Line and Balancing, Channel Dropping Circuit - SD-95227-01

4.261 ON/K Carrier Telephone - Combining Network Circuit - SD-95243-01

DESCRIPTION OF OPERATION

5. TRANSMISSION - (FIG. 1)

5.1 Type O

5.11 Each type O system provides four channels for transmission over the open-wire line. This basic channel group may also be used on other systems. The units for these channels are either of two types. They may be the normal compandored channel unit which would also include the channel unit without signaling, or they may be the non-compandored thru channel unit or the special services channel unit. The thru-channel unit is employed for tandem operation of O, N, or ON channel. The special services channel unit is used at each O or ON terminal where data or other special services are to be transmitted over the system. In the case of the compandored channel unit, the VF circuits are connected either 2-wire or 4-wire along with the "E" and "M" leads when these are required. The thru-channel unit, which, as stated above, is used only at intermediate points for tandem channel operation, always functions on a 4-wire basis and does not involve "E" and "M" lead functions.

5.12 When 2-wire is used, the connection is made to the "T" and "R" leads, and when 4-wire is used, the connections are made to the "T1" and "R1" as well as the "T" and "R" leads. The input to the channel will enter the channel unit, where the input voice-frequency band is translated to a band of equal width in the 180- to 184-, 184- to 188-, 188- to 192-, or 192- to 196-kc range, corresponding to the four channels which are used. These are called "baseband frequencies." The outputs of the four channel units plugged into jacks (CH1), (CH2), (CH3), and (CH4) are combined through resistors (R2) to (R9) which, with (R10) and (R11), form a combining network. (R10) and (R11) combine the transmitted carriers from the twin-channel units with the four channel sidebands. In the group transmitting unit, this combined output is amplified and translated in frequency to the frequencies applied to the open-wire line.

5.13 Fig. 101 shows the allocation of O channel sidebands in the carrier-frequency spectrum at baseband frequency (180 to 196 kc)

and line frequency (2 to 156 kc) for type O systems not associated with type ON1 junctions. Fig. 104 shows the channel allocations when the type O systems are associated with type ON1. For these cases, two arrangements of channel sidebands in the carrier spectrum are provided, called channel order A and channel order B. Channel order A is identical with that shown in Fig. 101. In channel order B, however, the arrangement of channels in the carrier-frequency spectrum is reversed, as would be required, for example, where a type O LGT terminal connects via two ON1 junctions to another type O LGT terminal, without type O repeaters. One of these type O terminals would then use channel order A and the other, channel order B. If one type O terminal were LGT and the other were HGT, both terminals would use channel order A.

5.14 When a type O terminal transmits low group, it receives high group, and vice versa. In either case, the group receiving unit raises the level of the signal received from the line and translates it back to the baseband frequencies accepted by the four channel units, in the range of 180 to 196 kc.

5.15 In the transmitting direction, the twin-channel carrier units supply 184- and 192-kc carrier current to the modulators in the four channel units. Also, they add 184 and 192 kc to the outgoing channels by means of the combining network. In the receiving direction, the output of the group receiving unit is connected to the twin-channel unit where changes in amplitude of the received carrier (184 kc in one twin-channel unit and 192 kc in the other) are regulated to a nearly constant value. The range of regulation in the twin-channel unit is relatively small, a wide range regulator being incorporated in the group receiving unit to make up for the large transmission loss changes in the open-wire line. A portion of the received carrier is furnished by the twin-channel unit to the two demodulators. One twin-channel unit is associated with channels 1 and 2 and the other is associated with channels 3 and 4.

5.16 For OB, OC, and OD systems, the equipment which is mounted separate from the terminal frame (Fig. 4) includes the line transformer and jack and a simulating network. The (L) transformer of Fig. 4 is a 135:135 transformer which provides means for connecting the terminal, which is unbalanced with respect to ground, to the balanced entrance cable or line filter. Capacitor (L) is bridged across the (L) transformer to improve the impedance characteristic of the transformer. A simulating network (SIM NET) is provided across the input to the terminal to improve the transmission and the input impedance of the terminal over the carrier-frequency band. Jacks (EQ) and (LINE) provide access to the terminal and the line for patching and test purposes. Test jacks (EQ BRDG) permit bridging measurements to be made by means of a vacuum tube voltmeter or selective analyzer.

5.17 For type OA systems, no separate line transformers or networks are required, and Fig. 6 is supplied in place of Fig. 4 or 7. Fig. 6 consists of the (EQ) and (LINE) jacks and associated bridging jacks (EQ BRDG).

5.2 Type ON

5.21 For ON systems, four channels are provided in each ON group for transmission over the cable. The associated VF circuits are connected to these four channels, either 2-wire or 4-wire, along with the "E" and "M" leads, when these latter are required. For 2-wire operation, connection is made to the "T" and "R" leads, and for 4-wire operation, connections are made to "T1" and "R1" as well as the "T" and "R" leads. The input to the channel will enter the channel unit where the input voice-frequency band is translated to a band of equal width in the 180- to 184-, 184- to 188-, 188- to 192-, or the 192- to 196-kc range, corresponding to the four channels which are used. These are called "baseband frequencies." The outputs of the four channel units plugged into jacks (CH1), (CH2), (CH3), and (CH4) are combined through resistors (R2) to (R9) which, with (R10) and (R11), form a combining network. The resistors (R10) and (R11) combine the transmitted carriers from the twin channels with the output of the four channels. The combined output enters the group transmitting unit where it is amplified and translated in frequency to the ON low-group line frequencies which are eventually supplied to the ON repeater. The outputs of up to six ON group transmitting units are combined in the combining network and oscillator circuit with the output of the level control oscillator. This combined output is applied to the ON repeater.

5.22 Fig. 102 shows the allocation of ON1 channel sidebands in the carrier-frequency spectrum at baseband (180 to 196 kc) and line frequencies (40 to 136 kc, low group; or 168 to 264 kc, high group). In the low-group line-frequency spectrum, ON1 groups occupy the same frequency bands as certain type O systems, as follows:

Line Freq, kc	ON1 Grp	O System
120-136	1	OD Low Grp.
100-116	2	OC High Grp.
80-96	3	OC Low Grp.
60-76	4	OB High Grp.
40-56	5	OB Low Grp.

Two arrangements of channel sidebands are used, called channel order A and channel order B. The positions of channel sidebands for channel orders A and B at baseband and low-group line frequencies are the same for ON1 as for the corresponding type O systems, as can be seen by comparing Fig. 102 with Fig. 104.

Fig. 110 shows the allocation of ON2 channel sidebands in the carrier-frequency spectrum at baseband (180 to 196 kc) and line frequencies (36 to 132 kc, low group; or 172 to 268 kc, high group). The only ON2 group that occupies the same frequency band as a type C group is group 2 which occupies the same line frequency (100 to 116 kc) as the OC high group.

When an ON terminal transmits channel order A, it must receive channel order B; hence, when two ON terminals are connected via a type N carrier line, one transmits channel order A and the other transmits channel order B.

5.23 For an ON terminal, the group receiving unit raises the level of the signal received from the ON1 repeater unit and translates it back to the 180- to 196-kc baseband frequencies accepted by the four channel units.

5.24 Operation of the twin-channel carrier units for a type ON terminal is the same as described in 5.12 for type O terminals.

5.3 For type ON terminals, Fig. 7 is supplied in place of Fig. 4 or 6. Fig. 7 consists of a multiple pad for combining the outputs of the group transmitting units, a level control oscillator, and an impedance matching transformer.

5.4 For ON1 terminals at ON1 junction locations, Fig. 9 is supplied. This is a connecting circuit which permits interconnection of ON1 terminals to ON1 junctions where it is desired to terminate an ON1 group.

Fig. 107 shows in single-line block diagram form, typical examples of cross connections for multipling the transmission circuits of ON terminals toward the repeater, and Fig. 108 shows the cross connections involving ON1 junctions and terminals.

5.5 Fig. 103 shows channel allocations at various points in a typical O - ON1 system connection. To illustrate the use of this diagram and Figs. 101, 102, and 104, consider a group 3 ON1 terminal, transmitting channel order B, at the left, connected to an OB HGT terminal, transmitting channel order A, at the right, via a type N line with one repeater, an ON1 junction and type O line with one repeater. Follow channel 1 through from left to right. At the left terminal at baseband frequency, channel 1 is the upper sideband of the 192-kc carrier, between 192 and 196 kc. After modulation against the 276-kc group 3 oscillator frequency (Fig. 102) in the group transmitter, channel 1 becomes the lower sideband of the 84-kc carrier, between 80 and 84 kc. In the ON1 LH repeater, this channel is translated to 220 to 224 kc, and in the N1 HL repeater, on the line, back to 80 to 84 kc.

No frequency translation occurs in the LL ON repeater nearest the ON1 junction so that channel 1 remains between 80 and 84 kc at the input to the group receiver CA. In this unit, translation to baseband occurs and channel 1 again becomes the upper sideband of 192 kc, lying between 192 and 196 kc.

Now since there is a frequency frogging repeater between this junction and the HGT OB terminal, the open-wire side of the junction receives low-group OB frequencies and must therefore transmit OB high-group frequencies. With channel 1 at 192- to 196-kc baseband frequency, HGT OB, we transmit channel order A (See Fig. 104). At OB high-group line frequency, at the group transmitter OW output, this channel sideband is between 60 and 64 kc. In the type OB repeater, channel 1 sideband is translated to 52 to 56 kc. Finally channel 1 is translated to a baseband frequency of 180 to 184 kc by the OB group receiver and is transmitted through the twin-channel unit and channel 1 band filter to the channel demodulator where the sideband is converted to voice frequency.

With regard to ON2, the channel allocations at various points in a typical system are shown by Fig. 111. Fig. 111 for ON2 is comparable to Fig. 103 for O and ON1, and the illustration in 5.5 may be adapted to ON2 with the realization that the only group oscillator frequency that is common is that of group 2; no ON1 junction is used, and the line frequencies differ slightly from ON1 frequencies.

5.6 Fig. 105 shows (1) how to choose correctly among the four list numbers of the J98705E twin-channel units and (2) correct orientation for the 529A and 529B channel filters for type O and type ON terminals. If any O baseband unit is to be associated with a system using cable in any part (ON system), it is necessary to use list 3 or 4 on the twin channel carrier circuit. If it is entirely CW, use lists 1 and 2. Lists 3 and 4 indicate wider band carrier supply filters than lists 1 and 2. The 529A filter is used in channels 1 and 4, while the 529B is used in channels 2 and 3. Each of these filters can be oriented in one or the other of two positions, the correct orientation being determined by (1) the channel order, (2) type of terminals (HGT, LGT, Grp 1, 3, 5, or Grp 2, 4, 6) and (3) channel number.

5.7 Fig. 106 shows a few of the many possible arrangements of type O and type ON equipment to illustrate flexibility of interconnection of the basic equipment blocks shown in Fig. 106A. For example, Fig. 106B shows a junction of five ON1 groups on cable with five type O systems, four on one open-wire pair, and one on another open-wire pair which is shared with a type O terminal at the same location.

6. POWER SUPPLY - (FIG. 2)

6.1 The heater supply voltage is obtained from the -48-volt office battery. All heater circuits are fused by a single fuse which is connected to these circuits through a 12-ohm rheostat which permits the heater voltage to be adjusted. The adjustment will depend upon the nominal office battery voltage and the number of channel units in use. A voltmeter may be connected between jacks (GRD) and (-40V) to measure this voltage. In most cases, the (R23) resistor will be strapped out; but where maximum battery conditions and a minimum number of channel units are found, it will be necessary to remove the strap. A second -48-volt supply feeds the alarm circuit and the signaling circuit disabling lead "B."

6.2 Plate Battery

Plate battery for the entire circuit is obtained from a single fuse. Inductor (L31) and the two 100-mf capacitors, (C34) and (C35), provide plate circuit filtering. Jack (+130V) permits the plate voltage to be tested by means of a voltmeter.

7. ALARM CIRCUIT - (FIG. 3)

7.1 General

7.11 Three types of alarms are given by this circuit as follows:

(1) Fuse alarm (-48V) which lights the lamp (-48V) and operates relay (ALM) to give the desired office alarms.

(2) When O1 or ON1 terminal is in use, the received carrier output of the group receiving unit controls the operation of the (C) relay. For ON2 terminals, the received carrier output of the twin-channel carrier unit 1-2 is connected by (C64) to the base of the transistor-detector circuit, Fig. 11. Inductor (L32) provides a high impedance to the input signal while providing a low-resistance dc return for the base. The potentiometer (R40) provides a means of varying the bias on the base for different transistors and under various supply voltage conditions. The 420A diode across the potentiometer regulates the voltage at 6 volts. The 420N diode regulates the collector supply voltage at 16 volts. Resistors (R39) and (R41) provide the necessary voltage drops from the +130-volt and -40-volt supplies.

With the base biased to cutoff or beyond without signal, the collector current is zero. When a carrier is received over the line there will be signal input, and collector current will flow during the negative half cycle of the input signal. These pulses of current flow through the winding of the (C) relay. The 20-uf capacitor (C65) tends to eliminate any tendency for the relay to chatter at levels slightly higher than the alarm condition. Thus, when carriers are being received, the (C) relay will be held operative.

(3) In both cases of (2) above, loss of received carrier over the line will cause the (C) relay to release. After a short period, depending upon the time constant of the circuit made up of resistor (R35) and capacitor (C31), the gas tube will fire to operate relay (CA). When relay (CA) has operated, it locks up and gives the desired office alarms by operating the (ALM) relay, and lights the (CARR 3700) lamp.

(4) Failure of the 3700-cycle oscillator in the group oscillator unit will cause the release of the (3700) relay. This operates relay (CA) and lights the (CARR 3700) lamp.

7.2 In addition to the usual type of alarms, the alarm and busy test circuit provides the following features:

(1) Identifies the system which is in trouble because of 3700-cycle or carrier failure at both terminals.

(2) Removes the ground (Fig. A) or battery (Fig. B) which may be connected to each "E" lead by the signaling relay in all channels when there is a carrier or 3700-cycle failure to provide "automatic disconnect."

(3) After a 10-second interval, all channels are made busy by the application of a permanent ground (Fig. A) or battery (Fig. B) on the "E" leads.

(4) Provides means whereby a system may be "transmission" tested from either terminal prior to returning the system to service. This is useful where the interruption is of short duration and the maintenance man wishes to establish that the trouble is still present before he travels several miles in an effort to locate the trouble. Obviously, if trouble still persists, it is necessary for it to be cleared wherever it may be.

(5) Provides means for returning the system to service, whether at an attended or unattended station.

7.3 A detailed description of the alarm circuit follows: Let us assume the loss of carrier due, for example, to a short circuit on the line. Relay (C) will release and capacitor (C31) will begin to charge through the resistor (R35) from the 130-volt battery. After a period of about 2 seconds, this capacitor will have sufficient charge to cause the control gap of the gas tube to break down.

Once this has happened, the main gap will break down and cause current to flow through the primary winding of the (CA) relay. As soon as relay (CA) has operated, it will lock up on the battery supplied through its contacts and the resistors (R32) and (R33). In addition to extinguishing the main gap of the gas tube by removing the battery supplied to it, six things happen when this relay is operated:

(1) Ground (Fig. A) which is normally supplied on the "G" lead to channels 2, 3, and 4, is removed. This is the "automatic disconnect" arrangement required by the connecting circuits.

(2) Ground which is normally supplied on the "G" lead to channel 1 (Fig. A), is replaced by the −48-volt battery.

(3) The "E" and "M" lead connections in channel 1 to the connecting circuits are opened and connected together. This loops the signaling circuit so that tests through the signaling circuit can be made from the distant terminal.

(4) The office alarm is brought in through key (ALM RLS) to the operation of the (ALM) relay. The office alarm can be released by operating the (ALM RLS) key; but when the trouble is cleared, the office alarm appears again and it will be necessary to release the (ALM RLS) key to silence the alarm.

(5) The plate battery supply lead to the twin-channel carrier units, which furnishes the dc power for operation of the resupplied carrier circuit, is broken. This removes the carrier, which causes the (C) relay to release at the distant terminal to identify the system in trouble.

(6) Relay (DB) operates after an interval of 10 seconds. After thermal relay (DB) operates, the (RC) relay is operated and locks up. This restores the transmitted carrier by resupplying the plate battery to the twin-channel carrier unit and grounds all of the "E" leads (Fig. A) to make the channels appear busy. Relay (RC) locks up to permit the (DB) relay to release between alarms.

If Fig. B were used, the "E" leads may operate with ground or battery on them. This will permit system-to-system signaling connections without the use of pulse link interconnecting circuits. When a plug is inserted in any of the (CH) jacks, the "E" leads in a particular channel associated with the (CH) jack can be connected directly to the "M" leads of a connecting type O carrier system. The (R38) resistor serves to prevent the gas tube from breaking down, when the plate voltage is reapplied as in (6), until after the system has been restored.

Options are provided for remote control reset alarm features. Two methods are provided: (1) use of a subscriber set assigned to the terminal and (2) use of the remote alarm release circuit. The latter provides remote alarm reset over a channel of the system.

When channel 2, 3, or 4, or any combination of these three channels, is connected for private-line service with ringdown signaling, there will be a 10-second ring on that channel during an alarm condition. To eliminate this customer annoyance, the options in Fig. 10 have been provided. Option "AE" is provided for trunk applications, while "AF" will be provided by the installer for the channels equipped for private-line service with ringdown signaling. Option "AF" provides a direct ground to "G" lead of the channel on the alarm circuit side of the (RC) relay transfer contacts. Operation of the (RC) relay, 10 seconds after the beginning of an alarm, transfers ground from the "G" lead of the channel directly to the "E" lead. This "E" lead ground is independent of the channel unit signaling relay and thus is not disturbed by removal of a channel unit for maintenance.

7.4 System Loop Tests

With relays (RC) and (CA) operated, loop tests through the signaling circuit in channel 1 can be made from either terminal. To do this, the operator at the terminal will hold the (TST A) key operated while intermittently operating the (TST B) key. If the (TST) light follows the operations of the (TST B) key, the carrier circuits are operating satisfactorily. If not, the circuit is still in trouble and nothing further can be done until the trouble is cleared. If, however, transmission is satisfactory, the subscriber's set assigned to the carrier terminal may be called. Ringing current over the subscriber's line circuit will operate a relay in the subscriber's set, which will release the (CA) and (RC) relays. If the remote alarm release circuit is provided, a 1000-cycle tone is transmitted over the channel provided with this feature to reset the remote alarm. The 1000-cycle tone will operate a relay in the remote alarm release circuit, which will release the (CA) and (RC) relays, thus restoring the distant terminal to normal. The restore system key (REST SYS) should be operated at the attended terminal to restore it to normal. If the distant terminal is in an attended office, the attendant at that terminal will have to restore the system by operating the (REST SYS) key unless Fig. 5 or the remote alarm release circuit has been provided at that terminal.

7.5 In the description given in 7.3 it was assumed that there was a temporary failure in transmission over the open-wire line. This failure brought in an alarm and performed several functions. This failure

could have been caused by a number of troubles such as loss of plate or heater power to the group or repeater units, burned-out tubes in repeater or group units, or high loss in the line. The same alarm and busy-test features are provided in connection with failure of the 3700-cycle supply, either because of loss of plate and heater supply or because of failure of the circuit to oscillate. Indication of a blown plate battery fuse is given only through the carrier or 3700-cycle alarm circuits which require only -48-volt battery for their operation. The -48-volt battery has a fuse alarm circuit which operates when the alarm circuit is without power.

7.6 The capacitors (C32) and (C33) associated with the gas tube serve to prevent breakdown of the control or main gaps of the gas tube by high-frequency voltages which may be coupled into the circuit. Resistor (R34) limits the current in the control gap of the gas tube (V31), and resistor (R36) allows the (C31) capacitor to discharge after a short interruption of the carrier.

7.7 Where the thru-channel unit, special services channel unit, or a channel unit without signaling is used in the channel 1 position, the loop-test function mentioned in 7.2 (4) and described in 7.4 is inoperative.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2161-WCM-LP