COMMON SYSTEMS "O" & "ON" CARRIER TELEPHONE OB1, OC1, OD1, ON1 & ON2 GROUP TRANSMITTING CKT.

CHANGES

B. CHANGES IN APPARATUS

B.1 Superseded	Superseded by
1 - Var (CR1) 45A	1 - Var (CR1) 45G

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The title of the drawing was changed. It formerly read:

COMMON SYSTEMS
"O" & "ON" CARRIER TELEPHONE
OB1, OC1, OD1, & ON1
GROUP TRANSMITTING CKT

D.2 Ckt note 101 was extended to include ON2 Terminal information.

D.3 Ckt note 106 was extended to omit the tube shield.

D.4 Ckt note 107 was added to ensure proper placement of apparatus and critical wiring.

D.5 Equipment note 204 was added to specify lead length of resistor (R5).

D.6 References limiting this circuit to "ON1" carrier terminal use were changed to include "ON2" carrier terminal use.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2161-JRP-LP

COMMON SYSTEMS
"O" & "ON" CARRIER TELEPHONE
OB1, OC1, OD1 & ON1
GROUP TRANSMITTING CKT

CHANGES

D. DESCRIPTION OF CHANGES

D.1 The impedance ratio of (T3), transformer was added.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 2123-AK-WAD-KO

COMMON SYSTEMS
"O" & "ON" CARRIER TELEPHONE
OB1, OC1, OD1 & ON1
GROUP TRANSMITTING CKT.

CHANGES

B. CHANGES IN APPARATUS

B.1 Added (Optional)

1 - Plug, 393A

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Fig. 2 was added to cover B.1 above.

D.2 Note 106 was added.

D.3 Voltages shown for terminals 12 and 8 were -20V and -40V only respectively.

D.4 Reference to "ON" equipment was added to connecting information.

D.5 Note 101 was revised to include reference to "ON".

D.6 List number of (OUT) jack is corrected to conform with ED drawing.

D.7 Connecting circuits have been brought up to date.

All other headings under Changes, No change.

1. PURPOSE OF CIRCUIT

1.1 This circuit provides frequency conversion of the transmitted channel frequencies (180-196 kc) to either the low group band or high group band of the OB, OC, or OD System. The group frequencies are then amplified to the proper level and applied through associated filters to the 2-wire transmitting medium. The transmitted group frequencies for the OB, OC, and OD Systems are listed below:

System	High Group Band	Low Group Band
OB	60 - 76 kc	40 - 56 kc
OC	100 - 116 kc	80 - 96 kc
OD	140 - 156 kc	120 - 136 kc

A controllable amount of noise is generated and injected, through the frame wiring, into the transmission path of the associated receiving group unit.

2. WORKING LIMITS

2.1 None.

3. FUNCTIONS

3.1 Converts the frequencies received from the channel units (180-196 kc) to either the low group band or the high group band of the OB, OC, or OD Systems by modulating with the proper carrier oscillator.

3.2 Generates noise which is introduced into the transmission path of the associated receiving group unit in order to mask intelligible crosstalk.

3.3 Provides either fixed or adjustable amplification for the modulated signals in the OB, OC, and OD frequency groups.

3.4 Provides means for measuring the space currents of the amplifier tubes.

3.5 Provides connection to a -20V source of voltage for operation of one of the vacuum tube heaters on the associated Receiving Group Unit.

4. CONNECTING CIRCUITS

4.1 O1 to N1 Group Receiving Ckt. - SD-95152-01.

4.2 O1 Terminal Group Oscillator & ON1 Grp. Osc. Ckt. - SD-95154-01.

4.3 N1 & O1 Channel Ckt. - SD-95118-01.

4.4 O1 & ON1 Twin Channel Carrier Ckt. - SD-95151-01.

4.5 Application Schematic for "O1" & "ON1" Carrier Terminal - SD-95150-01.

4.6 Application Schematic for "ON1" Junction - Grp. 1 - SD-95196-01.

4.7 Application Schematic - For "ON1" Junction - Grps. 2 & 3 or 4 & 5 - SD-95197-01.

DESCRIPTION OF OPERATION

5. GENERAL

5.1 The group Transmitting circuit consists of a modulator, low-pass filter, noise generator, and an amplifier. This circuit becomes either High Group transmitting or Low Group transmitting of the OB, OC, or OD System depending on application of the proper oscillator frequency of the Group Oscillator circuit. This unit when

associated with the Group Oscillator circuit, Twin channel carrier circuit, and the Group Receiving circuit constitutes the terminal group equipment.

6. NOISE GENERATOR

6.1 OB1, OC1, OD1 & ON1 Terminals

The noise generator consists of a neon lamp (RT) used to generate thermal noise and a variable gain noise amplifier (V1) to obtain the proper noise voltages. The noise output is connected to terminals on the unit plug, and is injected by frame wiring into the transmission path of the associated receiving group unit. The thermal noise generated in neon lamp (RT) is coupled to the grid of (V1) through coupling condenser (C11) and grid return resistor (R9). D.C. voltage necessary for operating the neon lamp (RT) is applied through resistor (R17). The noise voltages are amplified by vacuum tube (V1) and applied to terminals 6-4 of transformer (T5). Resistance (R21) provides the required level and output impedance for bridging the noise output (terminals 1-3) of (T5) across the transmission path of the associated receiving group unit. Resistance (R10) by-passed by condenser (C6) provide cathode bias for the tube while resistance (R12) and condenser (C8) provide plate filtering. The plate is fed through terminals 4 and 6 of transformer (T5) and the screen through the (NOISE) potentiometer. The screen is placed at a-c ground potential by condenser (C7). The gain of vacuum tube (V1) is varied by the (NOISE) potentiometer which controls the amount of screen potential.

6.2 ON1 Junction

In the ON1 junction the noise generator is not used. The vacuum tube is replaced by the shorting plug which completes the heater circuit.

7. MODULATOR AND LOW-PASS FILTER

7.1 The signal frequencies (180-196 kc) received from the output of the channel units are fed into a double balanced modulator consisting of repeating coils (T1) and (T2) and varistor (CR1), condenser (C14) provides impedance and transmission correction for repeating coil (T1). The carrier supply for the modulator is obtained from the group oscillator circuit and is introduced at the center taps of the (T1) and (T2) repeating coils. The resulting carrier current flow from this source is longitudinally through the two halves of the associated windings on (T1) and (T2) via the appropriate sections of the varistors. These sections are respectively 1, 2 and 4, 5 or 2, 3 and 5, 6 on alternate halves of the carrier supply frequency cycle. The impedance of the pairs of varistor disks is thus made alternately low and high at the carrier rate by virtue of a property of the varistor. The impedance switching action results in the control of the direction of signal current through the disks. Upper and lower sidebands as well as other modulation products are generated by virtue of the non-linearity of the impedance versus voltage characteristics of the varistor. Since this is double balanced modulator considerable reduction is obtained in the flow of:

(1) Input signal currents in the output circuit.

(2) Carrier frequency currents in both input and output circuits.

(3) Certain orders of modulation products from the input circuit.

(4) Certain other orders of modulation products from the output circuit.

Of the modulation products produced by the varistor the lower sideband is selected by the filter (FL1). Filter (FL1) is a low pass filter designed to attenuate frequencies above 156 kc and will pass the lower side band product of the channel frequencies (180-196 kc) modulated by the carrier oscillator for the OB, OC, and OD Systems. The following table gives the required carrier frequencies and the high and low group bands selected by Filter (FL1) for the OB, OC and OD Systems.

System	Carrier Freq.	Lower side band selected by (FL1)
OB		
Low Group	236 kc	40 - 56 kc
High Group	256 kc	60 - 76 kc
OC		
Low Group	276 kc	80 - 96 kc
High Group	296 kc	100 -116 kc
OD		
Low Group	316 kc	120 -136 kc
High Group	336 kc	140 -156 kc

The output of filter (FL1) is applied to the input transformer (T3) through a low loss pad composed of Resistors (R16) and (R11). The pad in conjunction with resistor (R1), connected across the high side of (T3), provide a suitable termination for low pass filter (FL1).

8. AMPLIFIER

8.1 The amplifier circuit is a two-stage feedback amplifier employing hybrid feedback on the output and series feedback on the input. The feedback circuit is arranged to provide the amplifier with either fixed or adjustable amplification over the OB, OC, and OD range. The signals

received from the modulator low-pass filter (FL1) are stepped up by input transformer (T3) and applied to the grid of vacuum tube (V2). Resistance (R1) provides the termination for the high side of transformer (T3). Bias for vacuum tube (V2) is provided by resistance (R2), while resistance (R3) and condenser (C2) provide plate filtering. The output of the plate filter is fed directly to the screen, and condenser (C2) places the screen of (V2) at a-c ground potential. Plate voltage is fed to the tube through retardation coil (L1). The output of (V2) is impedance coupled to the grid of the 2nd stage (V3) by means of retardation coil (L1), condenser (C1), and grid return resistance (R5). The plate of the 2nd stage (V3) delivers the signals to the output through output transformer (T4) whose high side winding is arranged to provide hybrid feedback. The signal voltage appearing across terminal 5 and ground is fed back to the cathode of (V2) through resistance (R7) and condenser (C5). Condenser (C5) blocks the d-c voltage, present at terminal 5 of (T4), from the low resistance path to ground. The feedback or "Beta" circuit controls the gain of the amplifier and includes:

(a) The hybrid winding of transformer (T4) and resistor (R8) which is the terminating network for the hybrid transformer. Resistor (R8) in conjunction with the ratio of the turns on the high side of transformer (T4), and the step-down ratio of transformer (T4) determine the output impedance of the amplifier.

(b) Resistances (R7) and (R2) (and any resistances shunted across (R2)) form a voltage divider which controls the amount of voltage fed back to the 1st stage, in series and out of phase with the signal voltage applied to the grid of (V2). For a fixed amount of amplification "X" wiring is used and resistance (R2) is shunted by resistance (R4), (R13), and (R14). Proper strapping of these resistances is used for manufacturing adjustment of the amplifier gain. For adjustable amplification, "Y" wiring is used and resistance (R2) is shunted by resistance (R18) in series with the (OUT) potentiometer. The (OUT) potentiometer changes the amount of voltage fed back and therefore the gain of the amplifier. Condenser (C3) blocks any of the d-c space current of vacuum tube (V2) from flowing through any resistances shunting (R2) and thus prevents a change of bias when the strapping is changed ("X" wiring) or when the (OUT) potentiometer is varied("Y" wiring).

8.2 Resistance (R6) provides bias for vacuum tube (V3). D-c voltage is fed to the screen of (V3) through retardation coil (L2) and resistance (R8). Condenser (C4) provides a-c ground for both the screen of (V3) and one side of resistance (R8). Retardation coil (L2) prevents an a-c short across the feedback path. D-c voltage is fed through retardation coil (L2), and the high side winding of transformer (T4) to the plate of (V3). Resistance (R15) in series with condenser (C10) provides for correction of the high frequency µ8 phase. Condensers (C9) and (C13) provide for correction of the output impedance. Condenser (C13) will also be bridged across the low winding of transformer (T4) by connection provided on the OB1 Terminal Frame as indicated on the application schematic for OB1 Carrier Terminal. This connection is not provided for on OC1 and OD1 Terminal Frames.

8.3 The space currents for each stage can be determined by voltage measurements between test jack (K2) and ground for the 1st stage and between test jack (K3) and ground for the 2nd stage. Another test jack (OUT) is connected to terminal 1 of output transformer (T4) and is used to measure the output signal level that is applied to the directional band-pass filter (transmitting section) located on the Group Receiving circuit unit.

9. FILAMENT CIRCUIT

9.1 The filament supply is obtained from a -48V office battery. A resistance, external to this circuit drops the voltage to approximately -40V.

9.2 For "01" and "ON1" Term. - Grp Trsg Units the filaments of vacuum tubes (V2) and (V1) are operated in series from the -40V supply, while the filament of vacuum tube (V3) is operated in series with vacuum tube (V3) of the associated Group Receiving circuit, the connection between the two units being made over the -20V lead. (C12) connected across the heater of vacuum tube (V1) reduces the filament battery crosstalk.

9.3 For ON1 Junction Grp. Trsg, the filaments of (V2) and (V3) are operating in series from the -40V supply while pins 3 and 4 of (V1) are shorted by the shorting plug.