

GROUP, CHANNEL, AND PILOT SUPPLY

J2, K AND COMBINED J2 & K

<u>CONTENTS</u>	<u>PAGE</u>	<u>CONTENTS</u>	<u>PAGE</u>
1. GENERAL	1	(D) 3.9-Kc Pilot Channel Generator Output - K Carrier Supply Only	15
2. TESTS AND ADJUSTMENTS OF VACUUM TUBES	2	(E) Synchronization of the Carrier Supply with 4-Kc Reference Frequency	16
(A) Vacuum Tube Heater Circuit Operation	2	(F) Carrier Supply Output at Test Jacks	18
(B) Vacuum Tube Tests - General	3	(G) Carrier Supply Bus Bar Output	22
(C) Carrier Generator and Carrier Supply Amplifiers	8	(H) Ionization of Gas Tubes in Car- rier Generator Transfer Circuit	26
(D) Carrier Generator and 306-Kc Carrier Supply Amplifier - J2 and Combined J2 & K Supplies Only	9	(I) Operation of Carrier Generator Transfer Circuit	28
(E) J2 & K Pilot Supply and Pilot Alarm	10	(J) Voltage of Transfer and Alarm Circuit	30
(F) Carrier Generator Transfer Circuit	10	(K) Pilot Level Adjustments of the K 64, 92 and 108-Kc Stabilized Pilots - K and Combined J2 & K Supplies Only	30
3. TESTS AND ADJUSTMENTS OF CARRIER SUPPLIES	11	(L) Gain Adjustment of K Pilot Chan- nel Supply Alarm - K and Com- bined J2 & K Supplies Only	31
(A) Switching of Regular and Emer- gency Carrier Supplies	11	(M) Measurement and Adjustment of J2 Pilot Output Levels - J2 and Combined J2 & K Supplies Only	32
(B) 4-Kc Carrier Generator Output	12		
(C) 5-Kc Oscillator Output - J2 and Combined J2 & K Supplies Only	13		

1. GENERAL

1.01 This section describes the methods of making tests and adjustments on the J2, K, and combined J2 & K carrier supply and pilot supply equipment. Requirements are given for each test.

1.02 This issue replaces and brings up to date that part of Section E34.044, Issue 2 and E34.061, Issue 4 which deals with the carrier and pilot supply for J2 and K, respectively. It includes the combined J2 & K carrier supply which has not been covered previously. There has also been included the adjustment of the carrier supply when more than 10 Type K terminals are connected to the channel bus bar, or more than 11 Type K terminals are connected to the group bus bars as a temporary measure.

1.03 In common carrier supply equipment, certain tests are necessarily made

while many circuits dependent on the common equipment are in service. Special care should be exercised in the testing of equipment common to many circuits.

1.04 In making measurements using the attenuator and meter of the 30A Transmission Measuring Set it is not always possible to obtain a zero db reading on the meter. When this occurs, the measured value is the setting of the attenuator corrected for the reading of the meter. Unless otherwise specified, if the reading of the meter is above zero db it should be added to the attenuator setting, while, if it is below zero db it should be subtracted from the attenuator setting to give the measured value.

1.05 The electrolytic condenser in the 24 and 130 v battery supply associated with transfer circuit should be tested in accordance with information given for condenser

KS-7480 or KS-7763 in another BSP Section
A204.107.

2. TESTS AND ADJUSTMENTS OF VACUUM TUBES

(A) Vacuum Tube Heater Circuit Operation

2.01 For vacuum tube replacements it is necessary to open the heater circuit before removing the tube from or placing a tube in its socket. The heater circuit should not be opened except when the equipment is out of service.

2.02 Apparatus:

258C Plugs (open)

2.03 Procedure:

(1) To open the heater circuit of any of the tubes in the carrier or pilot supply equipment, insert a 258C plug in the appropriate jack indicated in the following tables:

J2 Carrier and Pilot Supply Equipment

	Jack Designation	Tubes
Carrier Generator (Reg. or Emer.)	Con. Fil. Amp. Fil.	(Con.)1, (Osc.)2 (Amp.T)1, (Amp.R)2
Carrier Generator Transfer Circuit	Fil. A Fil. B	A B
5-Kc Oscillator (Reg. or Emer.)	Fil.	1
306, 484, 541 and 543-Kc Amplifiers	Fil.	1,2
308, 340 and 364-Kc Amplifiers	Fil.	1 or 2
J2 Pilot Channel Supply Circuit	Fil.	1,2

K Carrier and Pilot Supply Equipment

	Jack Designation	Tubes
Carrier Generator (Reg. or Emer.)	Con. Fil. Amp. Fil.	(Con.)1, (Osc.)2 (Amp.T)1, (Amp.R)2
Carrier Generator Transfer Circuit	Fil. A Fil. B	A B
120-Kc Amplifier (Reg. or Emer.)	Fil.	1
Stabilized Pilot Supply ϕ	Fil.	1,2
3.9 Kc Pilot Supply	Fil.	Osc.

ϕ Caution: To prevent an office alarm operate the CO key before the plug is inserted and hold it operated after the plug is inserted until the CON relay operates. The CO key and CON relay are in the Pilot Channel Supply Alarm Relay Circuit.

Combined J2 & K Carrier and Pilot Supply Equipment

	Jack Desig- nation	Tubes
Carrier Generator (Reg. or Emer.)	Con. Fil. Amp. Fil.	(Con.)1, (Osc.)2 (Amp.T)1, (Amp.R)2
Carrier Generator Transfer Circuit	Fil. A Fil. B	A B
120-Kc Amplifier	Fil.	1
K Stabilized Pilot Supply ϕ	Fil.	1,2
5-Kc Oscillator (Reg. or Emer.)	Fil.	1
306, 484, 541 and 543-Kc Amplifiers	Fil.	1,2
308, 340 and 364-Kc Amplifiers	Fil.	1 or 2
J2 Pilot Channel Supply Circuit	Fil.	1,2

ϕ Caution: To prevent an office alarm operate the CO key before the plug is inserted and hold it operated after the plug is inserted until the CON relay operates. The CO key and CON relay are in the Pilot Channel Supply Alarm Relay Circuit.

(2) To close the heater circuit, remove the 258C plug from the jack as indicated in table above.

(3) After the heater circuit has been energized for at least three minutes, the equipment may be tested or returned to service.

(4) If only one tube of a series heater circuit is replaced, wait at least three minutes before closing the heater circuit in order to prevent damage to the tubes.

2.06 The space current limits in Tables I, II, III or IV should be met when the heater currents are normal - that is, before the heater current adjustments for the cathode activity tests are made.

Caution: When the heater current is changed in making tube tests, time should be allowed for the heater current and space current to become stabilized before making the final reading as discussed in the E40 Section of Bell System Practices covering the IR or LAC tube test set.

(B) Vacuum Tube Tests - General

2.04 The vacuum tubes are tested by means of the IR or LAC tube test set without being removed from their sockets and may be tested while the system is in service. This set provides for measuring heater currents, space currents and cathode activity and is described in the E40 Section. Limits applying to each measurement are given herein.

2.05 It is not practicable to make activity tests when the battery voltage is changing rapidly because the heater current is constantly changing. For this reason vacuum tube tests should not be made when battery voltage is changing rapidly or when it is outside its normal operating range. This situation will probably exist during and shortly after a power failure or during a routine battery overcharge.

2.07 When it is necessary to replace vacuum tubes because of failure to meet requirements, the procedure given in the E24 Section covering the operating routines should be followed with respect to switching equipment out of service and the supplementary tests which should be made on the equipment when returned to service.

2.08 Heater current adjustments should not be made using the IR or LAC tube test set but where adjustments are shown to be necessary, they should be made in accordance with the information in an A502 Section of Central Office Maintenance Practices and the adjust values shown on the SD drawings covering the equipment.

T A B L E I

J2 CARRIER SUPPLY

TUBE TEST REQUIREMENTS - REGULATED BATTERY SUPPLY

TEST	TUBE DES.	Carrier Generator				5-KC Oscil- lator	340-KC Amplifier	308-KC Amplifier
		(Con)	(Osc)	Amp.T	Amp.R			
		1	2	1	2			
	TYPE OF TUBE	310A	310A	311A	311A	310A	311A	311A
	FILAMENT JACK	Con Fil	-	Amp Fil	-	Fil	Fil	-
Heater Current in Amperes (See Paragraph 2.09)	Min.	.29	-	.58	-	.29	.58	-
	Max.	.35	-	.70	-	.35	.70	-
Normal Space Current Switch on 1R or 1AC Set Space-Millivolts, 130V. Battery,	Min.	P1 470	P2 490	P1 450	P2 450	P1 400	P1 350	P2 350
	Max.	720	800	700	700	600	650	650
	152V. Battery, Min.	*	*	*	*	450	400	400
	Max.					750	800	800
Cathode Activity Switch on 1R or 1AC Set Decrease Heater Current, Amp.		P1	P2	P1	P2	P1	P1	P2
		.02	-	.04	-	.02	.04	-
	Max. % Activity	8	15	25	25	15	25	25

TEST	TUBE DES.	364-KC Amplifier	306, 484, 541 & 543-KC Amplifiers		Pilot Channel Supply	Carrier Generator Transfer
		1	1	2	1,2	A,B
		TYPE OF TUBE	311A	310A	311A	310A
	FILAMENT JACK	Fil	-	Fil	Fil	Fil A, Fil B
Heater Current in Amperes (See Paragraph 2.09)	Min.	.58	-	.58	.29	.47
	Max.	.70	-	.70	.35	.53
Space Current Switch on 1R or 1AC Set Space-Millivolts, 130V. Battery,	Min.	P1 350	P1 400	P2 350	P1-P2 400	P1-P2 70
	Max.	650	700	650	600	∅ 320
	152V. Battery Min.	400	450	400	450	*
	Max.	800	850	800	750	
Cathode Activity Switch on 1R or 1AC Set Decrease Heater Current, Amp.		P1	P1	P2	P1-P2	-
		.04	-	.04	.02	-
	Max. % Activity	25	15	25	15	-

* These circuits operate only on 130 volt battery

∅ Where regulated A battery minimum voltage is less than 21 volts, use a maximum of 190 millivolts.

T A B L E II

J2 CARRIER SUPPLY

TUBE TEST REQUIREMENTS - NON-REGULATED BATTERY SUPPLY

TEST	TUBE DES.	Carrier Generator				5-KC Oscil- lator	340-KC Amplifier	308-KC Amplifier
		(Con)	(Osc)	Amp.T	Amp.R			
		1	2	1	2			
	TYPE OF TUBE	328A	328A	329A	329A	328A	329A	329A
	FILAMENT JACK	Con Fil	-	Amp Fil	-	Fil	Fil	-
Heater Current in Amperes	Min.	.385	-	.77	-	.385	.77	-
	Max.	.465	-	.93	-	.465	.93	-
Space Current Switch on 1R or 1AC Set Space-Millivolts	Min.	P1 470	P2 490	P1 450	P2 450	P1 400	P1 350	P2 350
	Max.	720	800	700	700	600	650	650
Cathode Activity Switch on 1R or 1AC Set Decrease Heater Current, Amp. Max. % Activity	Min.	P1 .025	P2 -	P1 .05	P2 -	P1 .025	P1 .05	P2 -
	Max.	8	15	25	25	15	25	25

TEST	TUBE DES.	364-KC Amplifier	306 484, 541 543-KC Amplifiers		Pilot Channel Supply	Carrier Generator Transfer
		1	1	2	1,2	A,B
		TYPE OF TUBE	329A	328A	329A	328A
	FILAMENT JACK	Fil	-	Fil	Fil	Fil A, Fil B
Heater Current in Amperes	Min.	.77	-	.77	.385	.77
	Max.	.93	-	.93	.465	.93
Space Current Switch on 1R or 1AC Set Space-Millivolts	Min.	P1 350	P1 400	P2 350	P1-P2 400	P1-P2 70
	Max.	650	700	650	600	200
Cathode Activity Switch on 1R or 1AC Set Decrease Heater Current, Amp. Max. % Activity	Min.	P1 .05	P1 -	P2 .05	P1-P2 .025	-
	Max.	25	15	25	15	-

T A B L E III

K CARRIER SUPPLY
TUBE TEST REQUIREMENTS

TEST	TUBE	Carrier Generator And 120 Kc Amplifier					3.9 Kc Pilot Supply	Carrier Gener- ator Transfer Circuit	Stabilized Pilot Supply Alarm		
		CON	OSC	Amp. T	Amp. R	120 kc Amp.			A or B	1	2
		310A	310A	311A	311A	311A			310A	338A	310A
Heater Current) Min. in Amperes) Max. (See Paragraph 2.09)			.29 .35		.58 .70	.58 .70	.29 .35	.47 .53		.29 .35	
Space Current Switch on 1R or 1AC Set Space Millivolts Min. Max.		P1 470 720	P2 490 800	P1 450 700	P2 450 700	P1 330 750	P1 270 430	P1 70 ø320	P1 400 640	P2 400 640	
Cathode Activity Switch on 1R or 1AC Set Decrease Heater Current Amp. Cathode Activity Max. %		P1 8	P2 .02 15	P1 25	P2 .04 25	P1 .04 25	P1 .02 15		P1 15	P2 .02 15	

ø Where regulated A battery minimum voltage is less than 21 volts use a maximum of 190 millivolts.

T A B L E I V

COMBINED J2 AND K CARRIER SUPPLY

TUBE TEST REQUIREMENTS

TEST	TUBE DES.	Carrier Generator				K 120 KC AMP.	J2 5-KC Oscil- lator	J2 340-KC Ampli- fier	J2 308-KC Ampli- fier
		(Con)	(Osc)	Amp.T	Amp.R				
		1	2	1	2	1	1	1	2
	TYPE OF TUBE	310A	310A	311A	311A	311A	310A	311A	311A
	FILAMENT JACK	Con Fil	-	Amp Fil	-	Fil	Fil	Fil	-
Heater Current in Amperes (See Paragraph 2.09)	Min.	.29	-	.58	-	.58	.29	.58	-
	Max.	.35	-	.70	-	.70	.35	.70	-
Normal Space Current Switch on 1R or 1AC Set Space-Millivolts, 130V.Battery, Min. Max. 152V.Battery, Min. Max.		P1	P2	P1	P2	P1	P1	P1	P2
		470	490	450	450	330	400	350	350
		720	800	700	700	750	600	650	650
		*	*	*	*	*	450	400	400
							750	800	800
Cathode Activity Switch on 1R or 1AC Set Decrease Heater Current, Amp. Max. % Activity		P1	P2	P1	P2	P1	P1	P1	P2
		.02	-	.04	-	.04	.02	.04	-
		8	15	25	25	25	15	25	25

TEST	TUBE DES.	J2 364-KC Amplifier	J2 306, 484 541 & 543-KC Amplifiers		J2 Pilot Channel Supply	K Stabilized Pilot Supply Alarm		Carrier Generator Transfer
		1	1	2	1,2	1	2	A,B
	TYPE OF TUBE	311A	310A	311A	310A	310A	310A	338A
	FILAMENT JACK	Fil	-	Fil	Fil	Fil		Fil A, Fil B
Heater Current in Amperes (See Paragraph 2.09)	Min.	.58	-	.58	.29	-	.29	.47
	Max.	.70	-	.70	.35	-	.35	.53
Space Current Switch on 1R or 1AC Set Space-Millivolts, 130V.Battery, Min. Max. 152V.Battery, Min. Max.		P1	P1	P2	P1-P2	P1	P2	P1-P2
		350	400	350	400	400	400	70
		650	700	650	600	600	640	∅ 320
		400	450	400	450	*	*	*
		800	850	800	750			
Cathode Activity Switch on 1R or 1AC Set Decrease Heater Current, Amp. Max. % Activity		P1	P1	P2	P1-P2	P1	P2	-
		.04	-	.04	.02	-	.02	-
		25	15	25	15	15	15	-

* These circuits operate only on 130 volt battery.

∅ Where regulated "A" battery minimum voltage is less than 21 volts, use a maximum of 190 millivolts.

2.09 310A and 311A tubes should normally fall within a heater current range of .300 to .335 ampere or .600 to .670 ampere, respectively, for normal battery voltage conditions. If a large group of tubes in an office falls outside this range, the adjustment of the heater current should be checked.

2.10 In non-regulated battery offices where ballast lamps are provided in the heater circuits of the J2 carrier supply no maintenance adjustments are required. The limits for the tests described below are based on filament battery voltages between 21 and 27 volts. If the voltage is outside this range, vacuum tubes may not meet the requirements. If heater currents are found to be out of limits in offices having non-regulated battery, the battery voltage should be checked and if the voltage is inside the 21-27 volt range, the ballast lamp in the circuit under test should be replaced. If the ballast lamp change does not bring the heater current within limits, replace the vacuum tubes one at a time.

2.11 The carrier and pilot supply equipment containing vacuum tubes upon which heater current, space current and cathode activity tests are to be made are as follows:

J2 Carrier and Pilot Supply Equipment

Reg. and Emer. Carrier Generator
 *Carrier Generator Transfer Panel
 Reg. and Emer. 5-Kc Oscillators
 Reg. and Emer. 306, 484, 541 and 543-Kc Amplifiers
 Reg. and Emer. 308, 340 and 364-Kc Amplifiers
 J2 Pilot Channel Supply Panels

K Carrier and Pilot Supply Equipment

Reg. and Emer. Carrier Generators
 *Carrier Generator Transfer Panel
 Reg. and Emer. 120-Kc Amplifiers
 Stabilized Pilot Supply Alarm Amplifier-Rectifier
 3.9-Kc Pilot Supply

Combined J2 & K Carrier and Pilot Supply Equipment

Reg. and Emer. Carrier Generators
 *Carrier Generator Transfer Panel
 J2 Reg. and Emer. 5-Kc Oscillators
 J2 Reg. and Emer. 306, 484, 541 and 543-Kc Amplifiers
 J2 Reg. and Emer. 308, 340 and 364-Kc Amplifiers
 J2 Pilot Channel Supply Panels
 K Reg. and Emer. 120-Kc Amplifiers
 K Stabilized Pilot Supply Alarm Amplifier-Rectifier

Note: The regular and emergency carrier generators and the carrier generator transfer panel are common equipment to the J2, K, and combined J2 & K carrier supplies.

*No cathode activity test.

2.12 Apparatus:

1R or 1AC Tube Test Set
 10 - 217D Plugs (600 ohms)

(C) Carrier Generator and Carrier Supply Amplifiers

2.13 Procedure - Regular Supply:

(1) If the regular generator and the regular carrier supply amplifiers are carrying the load, the tube tests may be made on them while in service. Lock-in the regular equipment by operating the white REG key on the carrier transfer panel in order to provide the proper grid conditions for meeting the test requirements.

(2) Make heater current, space current and cathode activity tests on the regular equipment as shown in Table I, II, III or IV.

Note: In the case of the K, or combined J2 & K carrier supply using stabilized pilots, whenever the REG, RLS or EMER keys are operated or an intentional automatic transfer is made, hold the RST key of the K Pilot Channel Supply Alarm Relay Circuit, operated for approximately 20 seconds in order to prevent an office alarm until the pilot stabilizers have functioned.

Requirements: See Table I, II, III or IV.

(3) At the completion of the test, operate the black RLS key on the transfer panel restoring the circuit to normal.

(4) If the emergency generator and emergency carrier supply amplifiers are carrying the load, lock-in the emergency equipment by operating the red EMER key on the carrier transfer panel. Terminate with 217D plugs the TST EVEN and TST ODD jacks on the regular generator panel whether J2, K, or combined J2 & K carrier supply and in addition in the case of the J2, the TST jacks on all the regular J2 carrier supply amplifiers. For the K supply, terminate the TST 120 kc jacks on the regular 120 kc amplifier. For the combined J2 & K supply, terminate the TST jacks on each of the regular J2 carrier supply amplifiers and the TST 120-Kc jacks on the regular 120-kc amplifier. The terminations are provided as a substitute for the working load, the condition on which the requirements are based.

(5) Make heater current, space current and cathode activity tests on the regular equipment as given in Table I, II, III or IV.

Requirements: See Table I, II, III or IV.

(6) At the completion of the tests, remove the 217D plugs.

2.14 Procedure - Emergency Supply:

(1) If the emergency generator and the emergency carrier supply amplifiers are carrying the load, the tube tests may be made on them while in service. Lock-in the emergency equipment by operating the red EMER key on the carrier transfer panel in order to provide the proper grid conditions for meeting the test requirements.

(2) Make heater current, space current and cathode activity tests on the emergency equipment as shown in Table I, II, III or IV.

Requirements: Refer to Table I, II, III or IV.

(3) After completion of the tests, except when it is necessary for the emergency generator and emergency carrier supply amplifiers to carry the load, operate the black RLS key on the carrier transfer panel, restoring the circuit to normal.

(4) If the regular generator and regular carrier supply amplifiers are carrying the load, operate the white REG key on the carrier transfer panel. This locks in the regular equipment so that automatic transfer cannot take place. Terminate with 217D plugs the TST EVEN and TST ODD jacks on the emergency generator panel whether J2, K or combined J2 & K carrier supply and in addition in the case of the J2 carrier supply, the TST jacks on each of the emergency J2 carrier supply amplifiers. For type K carrier supply, terminate the TST 120-kc jacks on the emergency 120-kc amplifier. For the combined J2 & K supply, terminate the TST jacks on each of the emergency J2 carrier supply amplifiers and the TST 120-kc jacks on the emergency 120-kc amplifier.

(5) Make heater current, space current and cathode activity tests on the emergency equipment as given in Table I, II, III or IV.

Requirements: See Table I, II, III or IV.

(6) After completion of the test, remove the 217D plugs and operate the black RLS key on the carrier transfer panel, restoring the circuit to normal.

(D) Carrier Generator and 306-Kc Carrier Supply Amplifier - J2 and Combined J2 & K Supplies Only

2.15 Procedure - Regular Supply:

(1) If the emergency generator and emergency carrier supply amplifiers are carrying the load, trouble location tests may be made in the case of the J2 carrier supply on the regular generator and the regular 306-kc amplifier as follows:

(2) Operate the red EMER key in order to provide the proper grid conditions for meeting the test requirements.

(3) With the emergency generator locked in, make space-millivolt readings on the regular equipment at the working value of heater current.

Requirements: The tubes listed in Table V should meet the limits given in the table.

TABLE V

J2, and Combined J2 & K Carrier Supply
Trouble Location Tests
Regular Generator with EMER Key Operated
or
Emergency Generator with REG Key Operated

Tube	Carrier Generator				306-Kc Amplifier
	Con.	Osc.	Amp.T	Amp.R	
Space Current	1	2	1	2	1
Switch on LR or LAC Set	P1	P2	P1	P2	P1
Space-Millivolts,					
Min.	210	490	330	330	-
Max.	260	800	600	600	20

2.16 Procedure - Emergency Supply:

(1) In the case of the J2 carrier supply if the regular generator and regular carrier supply amplifiers are carrying the load trouble location tests may be made on the emergency generator and the emergency 306-kc amplifier as follows:

(2) Operate the white REG key in order to provide the proper grid conditions for meeting the test requirements.

(3) With the regular generator locked in, make space-millivolt readings on the emergency equipment at the working value of heater current.

Requirements: The tubes listed in Table V should meet the limits given in the table.

(E) J2 & K Pilot Supply and Pilot Alarm

2.17 Procedure - J2 Pilot Channel Supply - J2 Carrier Supply:

(1) Make heater current, space current and cathode activity tests as shown in Table I for regulated battery and Table II for non-regulated battery supply.

Requirements: Refer to Table I for regulated battery and Table II for non-regulated battery supply.

2.18 Procedure - 3.9-Kc Pilot Supply Circuit and K Stabilized Pilot Supply Alarm - K Carrier Supply:

(1) Make heater current, space current and cathode activity tests as shown in Table III.

Requirements: Refer to Table III.

Note: In the case of stabilized pilot; when operating the key 2 of the 1R or LAC tube test set, in either direction hold the C0 key operated to prevent office alarms.

2.19 Procedure - J2 Pilot Channel Supply and K Stabilized Pilot Supply Alarm - Combined J2 & K Carrier Supply:

(1) Make heater current, space current and cathode activity tests as shown in Table IV.

Requirements: Refer to Table IV. See Note in Paragraph 2.18.

(F) Carrier Generator Transfer Circuit

2.20 Procedure:

(1) Operate the RLS and then the EMER key on the generator transfer panel, which switches the regular supply to the emergency. This operation lights the green lamp on the transfer panel, the regular carrier generator panel and the regular carrier supply amplifier panels for all group carrier supplies. In the case of the J2 and combined J2 & K carrier supplies, the green light on the regular 5-kc oscillator panel also lights. The operation also causes the ionization of one or both of the 338A

tubes on the transfer panel as indicated by the blue gaseous discharge in the tube. See Note, Paragraph 2.13 Item (2) for preventing office alarms associated with stabilized pilot supply.

(2) Remove the cover from the generator transfer panel, being certain that the green lamp is lighted on that panel.

(3) Insert 217D plugs (600 ohms) in the TST EVEN and TST ODD jacks on the regular generator panel whether J2, K or combined J2 & K carrier supply. In addition in the case of the J2, the TST jacks on each of the regular J2 carrier supply amplifiers should be terminated in 600 ohms. For the Type K supply, insert a 217D plug in the TST 120-Kc jacks on the regular 120-kc amplifier. For the combined J2 & K supply, insert 217D plugs in the TST jacks of each of the regular J2 carrier supply amplifiers and the TST 120-Kc jacks on the regular 120-kc amplifier. This prevents the regular carrier supply from feeding the load in multiple with the emergency carrier supply in case the transfer tubes fail to ionize.

(4) Remove tube B from its socket. This will cause tube A to ionize if it has not already done so. Proceed with measurements on tube A.

(5) Make the heater and space current tests as shown in Table I, II, III or IV.

Requirements: Refer to Table I, II, III or IV.

(6) Restore tube B to its socket and allow several seconds for it to heat up. Remove tube A, tube B should ionize. Repeat the tests under (5) for tube B. The same limits should be met.

(7) If tube A meets requirements, restore it to its socket. If it does not meet requirements, replace it by another tube and repeat the tests until the requirements are met.

(8) If tube B does not meet requirements, replace it by another tube and repeat the tests until the requirements are met.

(9) After both tubes meet requirements and are restored to their sockets, make sure that the 217D plugs are removed from the TST EVEN, TST ODD, and all amplifier TST jacks.

(10) If both tubes meet the required limits initially replace the can cover and operate the RLS key thus restoring the carrier supply to normal operation.

(11) If it were found necessary to replace one or both tubes, operate the RLS key and then the REG key, locking the regular carrier supply in service. Make the test, Ionization of Gas Tubes in Carrier Generator Transfer Circuit in Part 3(H).

(12) After the requirements of this test are met remove all the 217D plugs and then replace the can cover and operate the RLS key, thus restoring the carrier supply to normal operation.

3. TESTS AND ADJUSTMENTS OF CARRIER SUPPLIES

(A) Switching of Regular and Emergency Carrier Supplies

3.01 The following procedure which applies to J2, K and combined J2 & K carrier supplies, describes the method of manually switching from one carrier supply to the other for routine tests, and the procedure to be followed in restoring the regular supply circuit to service after there has been an automatic switch to the emergency supply. The preliminary steps to be followed in making any tests or adjustments on the carrier generator panels are also given. See Note, Paragraph 2.13 Item (2) for preventing office alarms associated with stabilized pilot supply.

3.02 Procedure - Locking-in Regular or Emergency Carrier Supply:

- (1) Assume the carrier supply circuits to be operating in their normal condition with all keys normal.
- (2) To lock-in the regular carrier supply, operate the white REG key, or to lock-in the emergency supply, operate the red EMER key.
- (3) To restore the transfer circuit to the condition whereby an automatic transfer from the regular to the emergency supply can take place, operate the black RLS key.

3.03 Procedure - Transferring from a Locked-in Regular Carrier Supply to a Locked-in Emergency Supply, or Vice Versa:

- (1) When transferring from one locked-in condition to another, it is desirable to go through the intermediate release condition in order to prevent momentary operation of the regular and emergency carrier supplies in parallel.
- (2) To transfer from the locked-in regular supply to the emergency supply, operate first the RLS key and then the EMER key.

(3) To transfer from the locked-in emergency supply to the regular supply, operate first the RLS key and then the REG key.

3.04 Procedure - Operations Preceding Adjustment of Equipment Under the Can Covers:

(1) Before testing or adjusting equipment on the carrier generator or transfer panel requiring removal of can covers, the carrier supply to be left in service must be locked in.

(2) Thus, when making any adjustments on the regular carrier generator, the emergency supply must be locked in by operating the EMER key. This operation also lights the green lamps on the transfer panel, the regular carrier generator panel, and the regular carrier supply amplifier panels for all carrier supplies. In the case of the J2 or combined J2 & K carrier supply the green light on the 5-kc oscillator panel also lights.

Caution: Do not remove a can cover from a carrier generator panel, a carrier supply amplifier panel or a 5-kc oscillator panel unless the green lamp associated with that panel is lighted.

(3) Before testing or adjusting the emergency carrier supply, the white REG key should be operated, causing the lamps on the panels of the emergency carrier supply to light.

(4) Before testing or adjusting the transfer circuit or removing the 24-volt filament battery fuses, the red EMER key should be operated causing the light on the transfer panel to light. Insert 217D plugs in the TST ODD and TST EVEN jacks of the regular generator so as not to feed the regular and emergency in parallel.

(5) When tests are completed, the RLS key should be operated to restore the transfer circuit to its normal condition.

3.05 Procedure - To Be Followed After an Automatic Switch to the Emergency Carrier Supply:

- (1) Operate the EMER key to silence the alarm.
- (2) An automatic transfer to the emergency carrier supply indicates interruption or failure of the regular carrier generator or a regular carrier supply amplifier, or trouble in the wiring between panels.

(3) Before attempting to transfer back to the regular supply, the regular carrier generator and carrier supply amplifiers should be checked as described in Part 3(G) omitting the test of the channel bus bar output. If this test does not disclose the trouble, the vacuum tubes should be tested as covered in Part 2(B).

(4) After the trouble in the regular carrier supply has been found and cleared, it should be restored to service by operating the RLS key.

(B) 4-Kc Carrier Generator Output

3.06 This test which applies to J2, K and combined J2 & K carrier supplies, provides a procedure for adjusting the 4-kc output to the harmonic producer and is also for use in checking the loss through the tuning fork so that it may be replaced if requirements are not met. The procedure also provides for the selection of vacuum tubes to secure the proper 4-kc generator output.

3.07 When making this test on either the regular or emergency carrier supply, the carrier supply must be locked in so that service will not be interrupted by an accidental operation of the transfer circuit. See Note, Paragraph 2.13 Item (2) for preventing office alarms associated with stabilized pilot.

3.08 Apparatus:

- 1 - 30A Transmission Measuring Set
- 1 - 2A or 2B Noise Measuring Set
- 1 - W2AY Cord equipped with 289A Plug (2W24A)
- 1 - P3P Cord equipped with 305A Plug (3P20B)
- 10 - 217D Plugs (600 ohms)
- 2 - No. 1 Test Clips
- 1 - 0.25 watt 1-megohm Resistance KS-8058 or equivalent

3.09 Procedure - Bridged Measurement at AMP T and AMP R Tubes - See Fig. 1:

- (1) Lock in the emergency carrier supply (See Part 3(A)) and test the regular carrier supply.
- (2) Make the vacuum tube test on the OSC and CON tubes as covered in Part 2(C) and replace the tubes if requirements are not met.
- (3) Insert 217D plugs (600 ohms) in the TST ODD and TST EVEN jacks whether J2, K or combined J2 & K carrier supply. In addition for J2, the TST jacks on the J2 carrier supply amplifiers of the carrier supply under test (regular or emergency) should be terminated in 600 ohms.

For the K supply, insert a 217D plug in the TST 120-kc jacks on the 120-kc amplifier. For the combined J2 & K supply, insert 217D plugs in the TST jacks of each of the J2 carrier supply amplifiers and the TST 120-kc jacks on the 120-kc amplifier of the carrier supply under test.

(4) Insert the plug of the 2W24A cord in the 600-ohm jacks of Coil-1 in the 30A set and patch from the 135-ohm jacks of Coil 1 to the 135-ohm TC jacks.

(5) Connect the test clips of the 2W24A cord across the grid terminals of the AMP T and AMP R tubes and read the 30A set meter. No correction should be made for the transformer loss.

Requirements: Between -3 and -5 dbm.

(6) If requirements are not met, adjust U, V, W and X resistances and repeat step 5.

(7) If the requirements are met after adjusting the U, V, W and X resistances remove all the 217D plugs from the TST ODD, TST EVEN, and TST jacks on the carrier supply amplifiers and then restore the carrier supply to normal operation by operating the black RLS key.

(8) If the requirements cannot be met by adjusting the U, V, W and X resistances, measure the loss through the tuning fork as covered in Paragraph 3.10.

(9) Lock-in the regular carrier supply (See Part 3(A)) and repeat the above test for the emergency carrier supply.

3.10 Procedure - Loss Measurements Through 4-Kc Tuning Fork - See Fig. 1:

(1) The 2A or 2B noise measuring set is used to measure the input and output of the tuning fork thus determining the loss through the fork. The input plug should be inserted in the PROG jack and the set should be calibrated as outlined in the E40 Section of Bell System Practices covering the noise measuring set.

(2) Two single test leads not over 2 feet long should be arranged with test clips at one end to connect to the tuning fork terminals. One of the leads should be equipped with a 1-megohm resistance at the end which is connected to the test clip.

(3) Connect the noise measuring set to terminals 1 and 2 of the tuning fork. The test lead equipped with the resistance at the test clip end should be connected to terminal 1.

Caution: Terminals 1 and 2 are above ground potential.

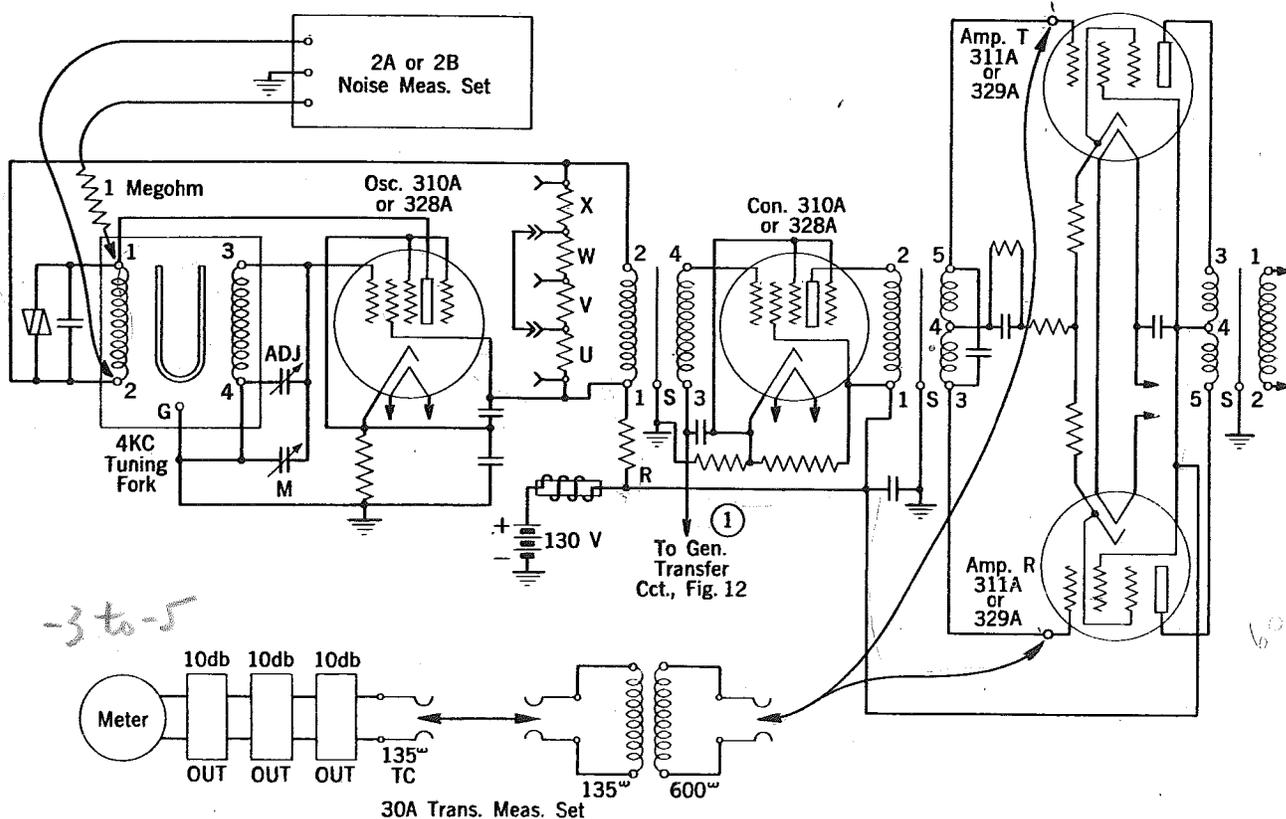


Fig. 1 - 4-Kc Carrier Generator Output

- (4) Adjust the db dial on the noise measuring set and note the reading in db.
- (5) Connect the noise measuring set to terminals 3 and 4 of the tuning fork. The test lead equipped with the resistance at the test clip end should be connected to terminal 3.
- (6) Adjust the db dial and note the reading on the noise measuring set.

Requirements: The difference between the readings noted in Items (4) and (6), that is, the loss through the tuning fork, should not exceed 25 db.

- (7) If the requirement is not met for a 52A tuning fork, the fork should be replaced. If the loss for a 52A tuning fork measures between 20 and 25 db the steps for locating tuning fork trouble discussed in the E24 Section covering Type J or K systems should be taken.
- (8) If the requirement is not met for a 54A tuning fork, the matter should be reported through the line of organization.

- (9) If the requirement is met but the output requirement of Paragraph 3.09 cannot be met, replace the OSC tube regardless of the results of the tube tests and repeat the procedure of Paragraph 3.09.
- (10) If the requirement of Paragraph 3.09 cannot be met after replacing the OSC tube, then replace the CON tube and repeat the procedure of Paragraph 3.09.

(C) 5-Kc Oscillator Output - J2 and Combined J2 & K Supplies Only

3.11 This test provides a procedure for checking the output of the 5-kc oscillator and also one for use in checking the loss through the tuning fork so that it may be replaced if requirements are not met. The procedure also provides for the selection of vacuum tubes to secure the proper 5-kc oscillator output.

3.12 When making this test on either the regular or emergency carrier supply, the other carrier supply must be locked-in so that service will not be interrupted by an accidental operation of the transfer circuit. See Note, Paragraph 2.13 Item (2) for preventing office alarms associated with stabilized pilot supply.

connect to the tuning fork terminal. The other end of the leads should be connected to a 289A plug. Each lead should be equipped with a 1-megohm resistance at the end which is connected to the test clip.

(3) Connect the test clips to terminals 1 and 2 of the tuning fork and insert the 289A plug in the 135-ohm jacks of Coil 1. Patch from the 600-ohm jacks of Coil 1 to the noise measuring set.

Caution: Terminals 1 and 2 are above ground potential.

(4) Adjust the db dial on the set and note the reading in db.

(5) Connect the clips to terminals 3 and 4 of the tuning fork.

(6) Adjust the db dial and note the reading.

Requirements: The difference between the readings noted in Items (4) and (6), that is, the loss through the tuning fork, should not exceed 25 db.

(7) If the requirement is not met, the matter should be reported through the line of organization.

(8) If the requirement is met but the output requirement of Paragraph 3.14 cannot be met, replace the vacuum tube in the 5-kc oscillator regardless of the results of the tube tests and repeat the procedure of Paragraph 3.14.

(9) After the requirements of Paragraph 3.14 are met, remove all patches and test connections and restore the carrier supply to normal operation by operating the black RLS key.

(D) 3.9-Kc Pilot Channel Generator Output - K Carrier Supply Only

3.16 No means of adjusting the 3.9-kc generator output are provided and this test is for use in checking the loss through the tuning fork so that it may be replaced if requirements are not met. It also provides for selecting vacuum tubes to secure the proper 3.9-kc generator output.

3.17 Apparatus:

- 1 - 30A Transmission Measuring Set
- 1 - 2A or 2B Measuring Set
- 1 - W2AY Cord equipped with 289A Plug (2W24A)
- 1 - P3P Cord equipped with 305A Plugs (3P20B)
- 2 - No. 1 Test Clips
- 1 - 0.25 watt 1-megohm Resistance KS-8058 or equivalent

3.18 Procedure - Output Measured at Filters - See Fig. 3:

(1) Make the vacuum tube test on the OSC tube as covered in Part 2(E) and replace the tube if requirements are not met.

(2) The leads supplying the carrier frequencies to the varistors should be disconnected from terminals B1, B2, B3, B4, B7 and B8.

(3) Insert the plug of the 2W24A cord in the 600-ohm jacks of one of the transformers of the 30A set and patch from the 135-ohm jacks of the same transformer to the ATTENUATOR IN jacks.

(4) Connect the clips of the 2W24A cord across terminals 1 and 2 of the M1, M2 and M3 filters in turn and, with test key of the 30A set operated to ADJUST position, measure the output. No correction should be made for the transformer.

Requirements: Between -1.5 dbm and +5 dbm.

(5) If requirements are not met, replace the OSC tube regardless of the results of the tube tests of the tube replaced and repeat the above procedure, Items (1) to (4).

(6) Reconnect leads to terminals B1, B2, B3, B4, B7 and B8.

(7) If requirements of Item (4) cannot be met after replacing the vacuum tube, measure the loss through the tuning fork as covered in Paragraph 3.19.

3.19 Procedure - Loss Measurement Through 3.9-Kc Tuning Fork - See Fig. 3:

(1) The 2A or 2B noise measuring set is used to measure across the input and output of the tuning fork, thus determining the loss through the fork. The input plug should be inserted in the PROG jack and the set should be calibrated as outlined in the information covering the noise measuring set.

(2) Two single test leads not over 2 feet long should be arranged with test clips at one end to connect to the tuning fork terminals. One of the leads should be equipped with a 1-megohm resistance at the end which is connected to the test clip.

(3) Connect the noise measuring set to terminals 1 and 2 of the tuning fork. The test lead equipped with the resistance at the test clip end should be connected to terminal 1.

Caution: Terminals 1 and 2 are above ground potential.

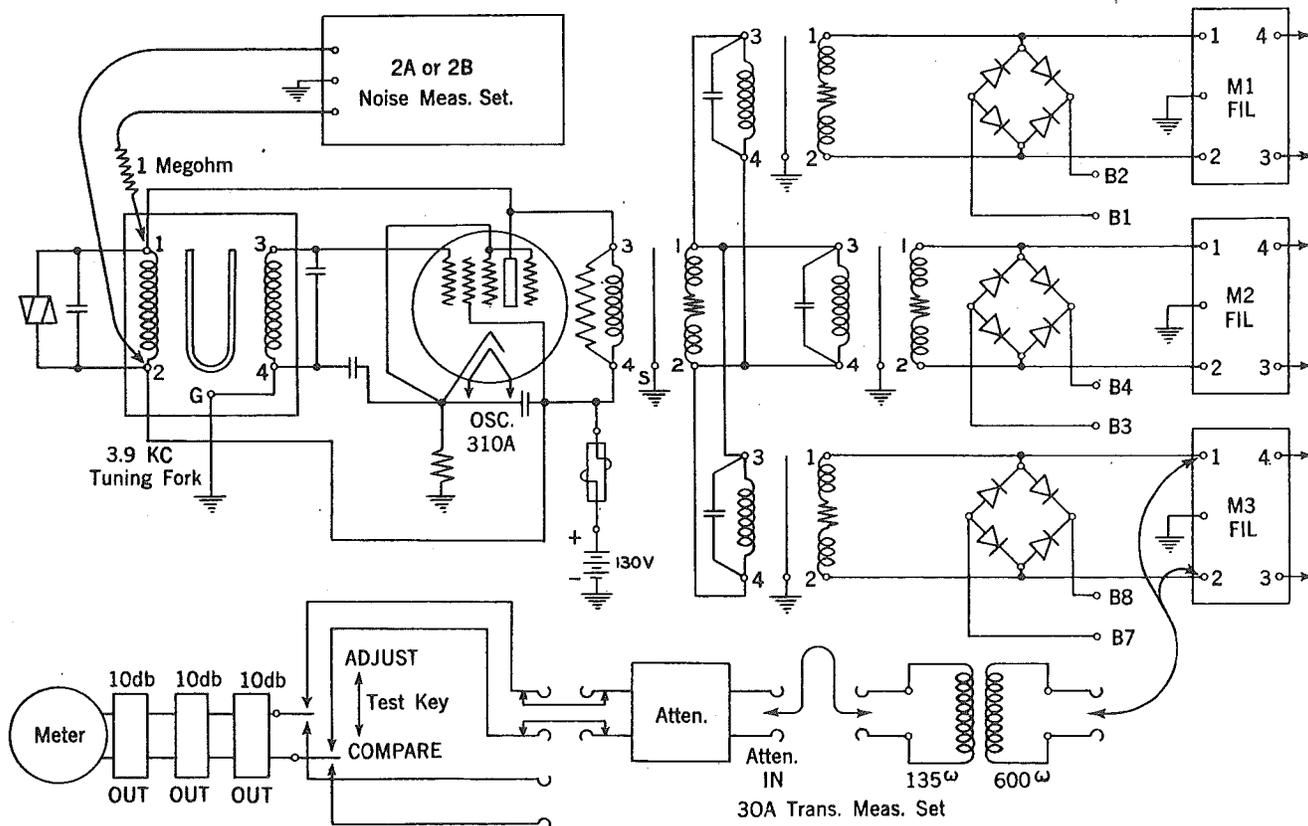


Fig. 3 - Type K 3.9-Kc Pilot Channel Generator Output

- (4) Adjust the db dial on the noise measuring set and note the reading in db.
- (5) Connect the noise measuring set to terminals 3 and 4 of the tuning fork. The test lead equipped with the resistance at the test clip should be connected to terminal 3.
- (6) Adjust the db dial and note the db reading on the noise measuring set.

Requirements: The difference between the noise measuring set readings noted in Items (4) and (6) that is, the loss through the tuning fork, should not exceed 25 db.

- (7) If the requirement is not met for a D-99305 tuning fork, the fork should be replaced. If the loss through a D-99305 fork measures between 20 and 25 db, the steps for locating tuning fork trouble, discussed in the E24 Section covering Type K Systems, should be taken.
- (8) If the requirement is not met for a 54B tuning fork, the matter should be reported through line of organization.

If the loss through a 54B tuning fork measures between 20 and 25 db, the steps for locating tuning fork trouble, discussed in the E24 Section covering Type K Systems should be taken.

(E) Synchronization of the Carrier Supply with 4-Kc Reference Frequency

3.20 A harmonic producer in the output of the 4-kc tuning fork oscillator and amplifier circuit is used in the J2, K and combined J2 & K supplies to provide the carrier frequencies required in the channel and group modulators and demodulators. Any error in the basic frequency will be multiplied in the harmonic producer in direct proportion to the number of the harmonic. Thus, a one-cycle error at 4 kc will be a 15-cycle error at 60 kc.

3.21 The frequency of the oscillator may be adjusted within narrow limits by means of variable condensers in the circuit. This test provides a procedure for checking the frequency of the carrier generator using the 4-kc reference frequency.

3.22 Apparatus:

- 1 - 30A Transmission Measuring Set
- 1 - W2AY Cord equipped with 289A Plug (2W24A)
- 5 - P3P Cords equipped with 305A Plugs (3P20B)
- 10 - 217D Plugs (600 ohms)

Not Required but May be Used if Available

- 1 - Cathode-Ray Oscillograph
- 2 - W2BP Cords 6 feet long equipped with 241A Plugs at one end (2W15B)

3.23 Procedure - See Fig. 4:

- (1) Lock-in the emergency carrier supply (See Part 3(A)) when testing the regular carrier supply. Lock-in the regular carrier supply (See Part 3(A)) when testing the emergency carrier supply. See Note, Paragraph 2.13 Item (2) for preventing office alarms associated with stabilized pilot supply.
- (2) Patch the 4-kc reference frequency to the 600-ohm jacks of Coil 1 in the 30A transmission measuring set and patch from the 135-ohm jacks of Coil 1 to the ATTENUATOR IN jacks.

- (3) Operate the test key to ADJUST position and adjust the attenuator of the 30A set to obtain a meter reading between -3 and -5 dbm.

- (4) Insert 217D plugs (600 ohms) in the TST ODD and TST EVEN jacks whether J2, K or combined J2 & K supply and in addition for the J2 supply, the TST jacks on the J2 carrier supply amplifiers of the carrier supply under test (regular or emergency). For the K supply, insert a 217D plug in the TST 120-kc jacks on the 120-kc amplifier. For the combined J2 & K supply, insert 217D plugs in the TST jacks on the J2 carrier supply amplifiers and the TST 120-kc jacks on the 120-kc amplifier of the carrier supply under test.

- (5) Patch from the ATTENUATOR OUT jacks to the MULTIPLE jacks of the 30A set.

- (6) Patch from the second set of MULTIPLE jacks to the 135-OHM TC jacks of the 30A set.

- (7) Patch from the 135-ohm jacks of Coil 2 in the 30A set to the MULTIPLE

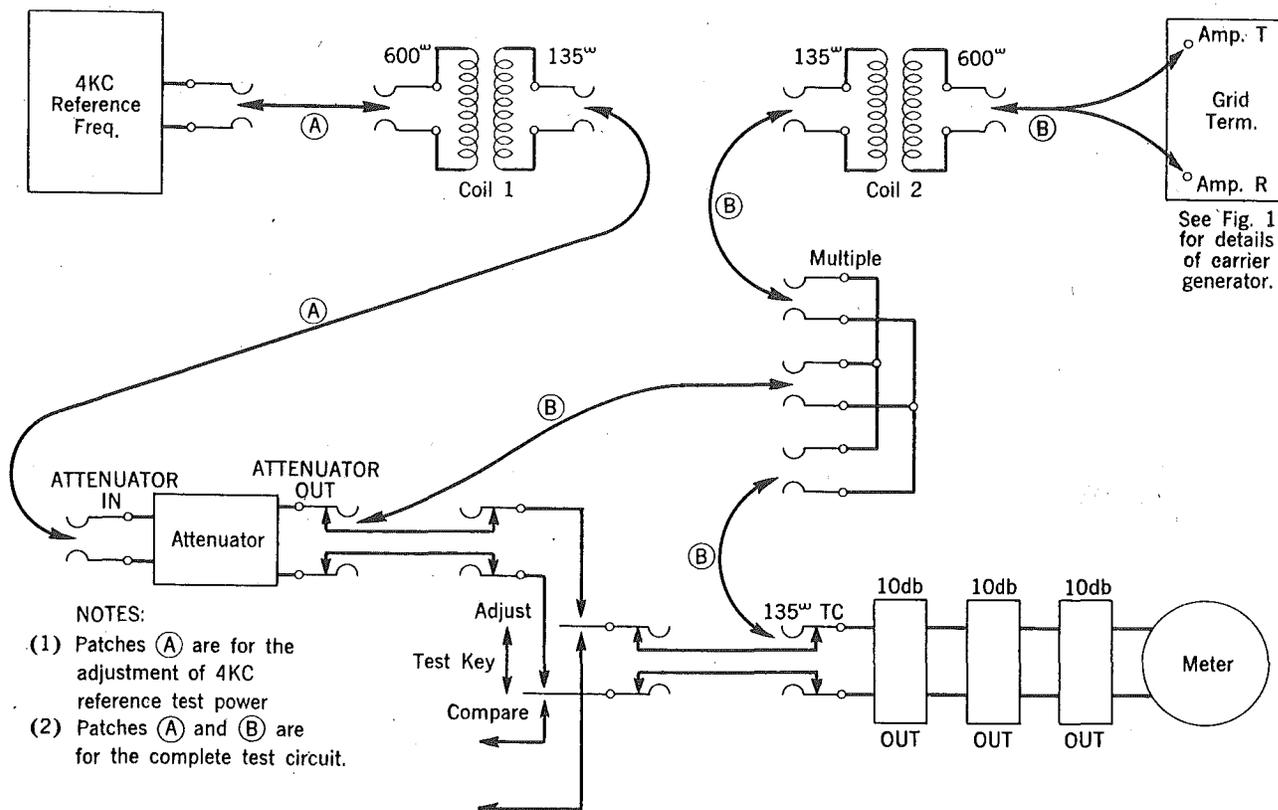


Fig. 4 - Synchronization of Carrier Supply with 4-Kc Reference Frequency

jacks. Using the 2W24A cord patched to the 600-ohm jacks of Coil 2, connect the test clips to the grid terminals of AMP T and AMP R tubes.

(8) Adjust the frequency of the carrier generator by means of the ADJ condenser and the M condenser and observe the beats on the meter of the 30A set adjusting the attenuator as necessary to give a convenient swing of the needle over the meter scale. A beat is a complete cycle of the swing of the meter needle and the reference point should be taken at some point other than the extreme ends of the needle swing.

Requirements: The beats should have a period longer than one beat in two minutes for the following conditions:

(a) Circuit order tests.

(b) Tests subsequent to the circuit order test if the beats are in excess of two beats in one minute.

(9) If a cathode-ray oscillograph is available, using the 2W15B cords connect from ATTEN OUT jacks to the X AXIS and GROUND terminals and from the 135-ohm jacks of Coil 2 to the Y AXIS and GROUND terminals. Adjust the amplitude for each axis by means of the corresponding GAIN dial until a satisfactory pattern is obtained. A beat is a complete cycle of the change observed in the pattern. The requirements of Item (8) should be met.

(10) A 52A tuning fork should be replaced under either of the following conditions. These conditions do not apply to a 54A fork for which no capacity limit has been established.

(a) When the M condenser is connected for 0 capacity and the setting of the ADJ condenser is less than 50.

(b) When the M condenser is connected for a capacity exceeding .001002 mf. When the M condenser is connected for a capacity of .001002 mf. the ADJ condenser setting should not exceed 50.

(11) After adjusting the frequency, make Test 3(B), 4-kc Carrier Generator Output.

(F) Carrier Supply Output at Test Jacks

3.24 The output of the 4-kc generator circuit is delivered to the harmonic producers which generate odd and even harmonics of 4 kc. These harmonics are measured at the TST ODD and TST EVEN jacks. In addition,

certain frequencies are selected and amplified to provide a carrier supply to the group modulators and demodulators. The output of each frequency is measured on the amplifier for that frequency at the TST jacks for the J2 supply, the TST 120-kc jacks for the K supply and both the TST and TST 120-kc jacks for the combined J2 & K supply.

3.25 This test is made on both the regular and emergency carrier supplies. When it is made on either the regular or emergency carrier supply the other carrier supply must be locked-in so that service will not be interrupted by an accidental operation of the transfer circuit. See Note, Paragraph 2.13 Item (2) for preventing office alarms associated with stabilized pilot supply.

3.26 Apparatus:

- 1 - 17B Oscillator
- 1 - 30A Transmission Measuring Set
- 1 - W2AY Cord equipped with 289A Plug (2W24A)
- 10 - 217D Plugs (600 ohms)
- 3 - P3P Cords equipped with 305A Plugs (3P20B)
- 1 - J2 Carrier Supply Test Termination - J64729A List 1 (See Fig. 5) - J2 and Combined J2 & K Supplies Only

3.27 Procedure - Output at TST ODD and TST EVEN jacks - See Fig. 6 for J2, Fig. 7 for K, and Fig. 8 for the Combined J2 & K Carrier Supply:

(1) Lock-in the emergency carrier supply (See Part 3(A)) and test the regular carrier supply.

(2) Terminate with a 217D plug the TST EVEN jacks of the carrier generator under test whether J2, K, or combined J2 & K supply. Also, terminate the TST jacks on the J2 carrier supply amplifiers for

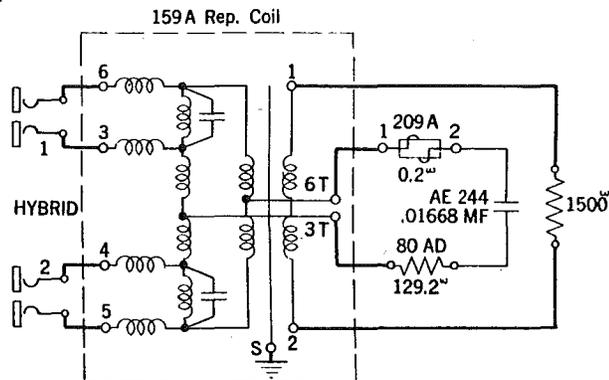


Fig. 5 - J2 Carrier Supply Test Termination

the J2 supply, the TST 120-kc jacks for the K supply, and both the TST and the TST 120-kc jacks in the case of the combined J2 & K supply.

- (3) Patch from ATTENUATOR IN jacks to 135-ohm jacks of Coil 1 in the 30A set.
- (4) Patch from the 600-ohm jacks of Coil 1 to the TST ODD jacks.
- (5) Set the attenuator to 27 db and operate the test key to the ADJUST position. Read the thermocouple meter with the three protection keys operated.
- (6) Interchange the patch cord and the 217D plug in the TST ODD and TST EVEN jacks and again read the thermocouple meter with the three protection keys operated.

Requirements: A reading of not less than -0.5 db should be obtained on the thermocouple meter of the 30A set for both (5) and (6).

- (7) If the requirement is not met, check the OSC, CON, AMP T and AMP R tubes as described in Part 2(C) and replace tubes if necessary. If the tubes are found to meet requirements, make test, 4-Kc Carrier Generator Output Part 3(B) and then repeat the above procedure. Do

not proceed with Paragraph 3.28 until the requirements are met.

3.28 Procedure - Output at Test Jacks of Regular and Emergency Carrier Supply Amplifiers - See Fig. 6 for J2, Fig. 7 for K, and Fig. 8 for the Combined J2 & K Carrier Supply:

- (1) Lock-in the emergency carrier supply (See Part 3(A)) and test the regular carrier supply.
- (2) Patch from the TST EVEN and TST ODD jacks of the carrier generator for the carrier supply under test to HYBRID 1 and 2 jacks of the J2 carrier supply test termination (Fig. 5) for J2 and combined J2 & K supplies. When measuring the output at the TST 120-kc jacks on the 120-kc amplifier whether for K or combined J2 & K supply, terminate the TST ODD and TST EVEN jacks with 217D plugs. Otherwise, patch to HYBRID 1 and 2 as above. Also, terminate with 217D plugs the TST jacks on the J2 carrier supply amplifiers for the J2 supply, the TST 120-kc jacks for the K supply, and both the TST and the TST 120-kc jacks in the case of the combined J2 & K supply, except the unit to be tested.
- (3) Patch from the TST jacks or TST 120-kc jacks of the carrier amplifier under test to the ATTEN IN jacks of the 30A set.

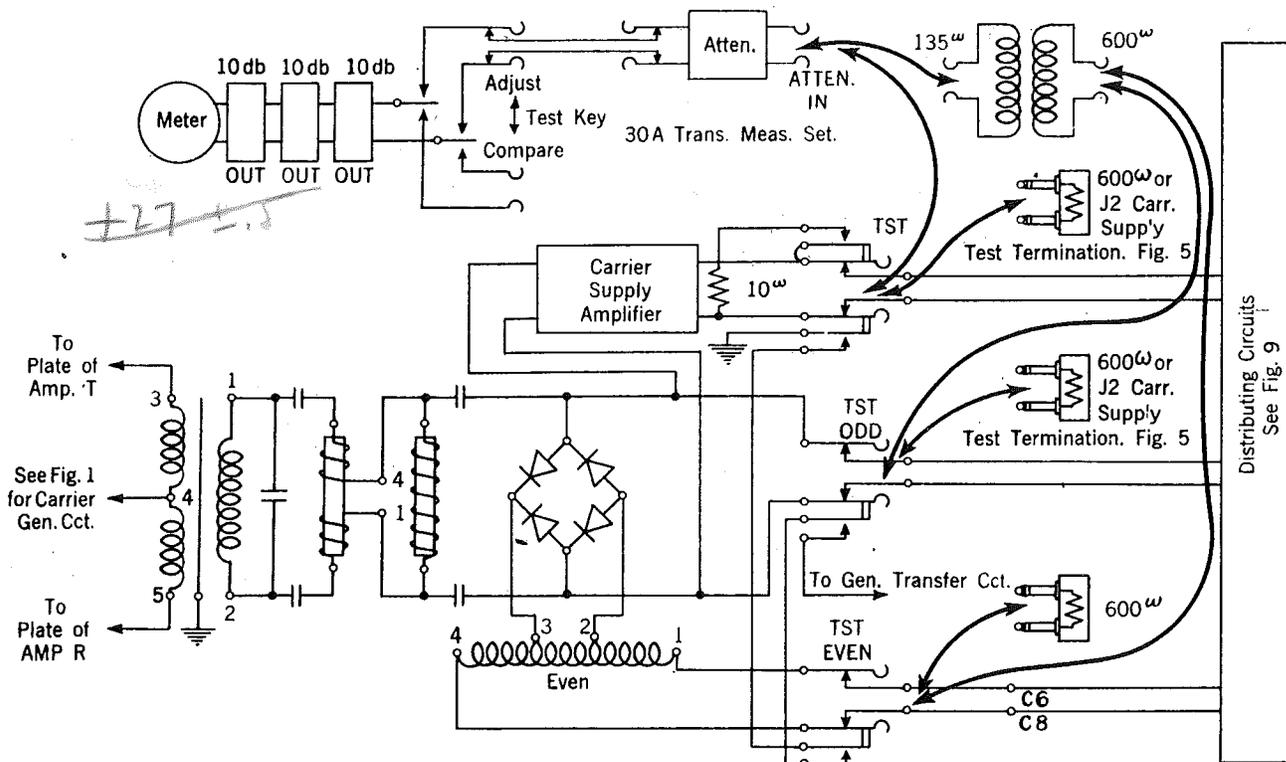


Fig. 6 - Carrier Supply Output at Test Jacks - J2 Carrier Supply

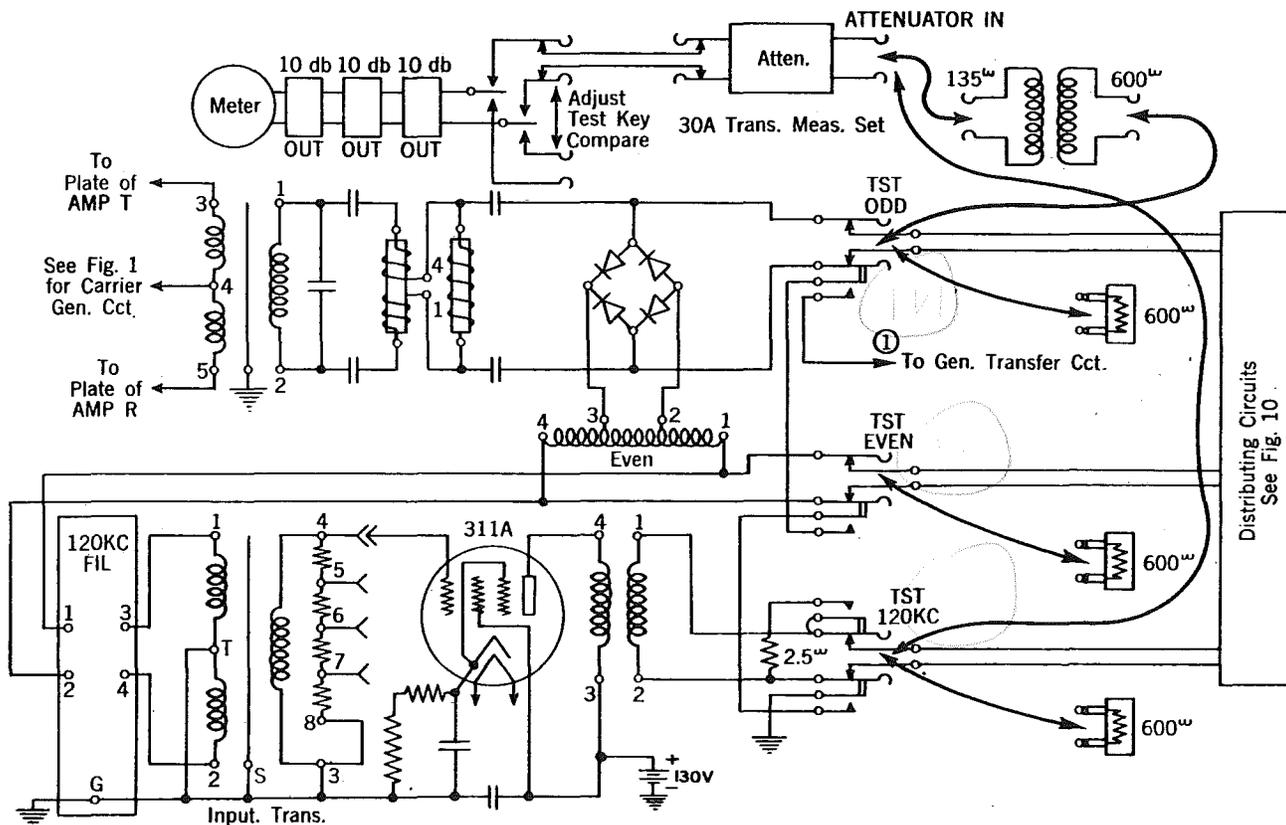


Fig. 7 - Carrier Supply Output at Test Jacks - K Carrier Supply

(4) Set the attenuator to 18 db for the J2 carrier supply amplifiers where 130 volt plate battery is used on the amplifier or to 20 db where 152 volt plate battery is used. For the 120-kc carrier supply amplifier, set the attenuator to 12 db. Operate the TEST KEY of the 30A set to the ADJUST position. Read the thermocouple meter with all three protection keys in the OUT position.

Requirements: For the J2 carrier supply amplifiers the meter should read 0 ± 1.5 db where 130 volt plate battery is used or between -2 and +1 db where 152 volt battery is used. The output of the regular and emergency carrier supply amplifiers should not differ by more than 1.0 db. For the 120-kc carrier supply amplifier the meter should read between -1.5 and +.5 db.

(5) If these requirements are not met, check the vacuum tubes of the unit under test, as described in Part 2(c).

(6) In the case of the 120-kc amplifier, if the requirement is not met, adjust the taps of the input transformer of the 120-kc amplifier.

(7) In the case of the J2 484 or 543-kc amplifiers, if the requirements are not met and the tubes are found to meet the requirements, make a bridging measurement at the output of the 484-kc or 548-kc group carrier supply filter as given in Paragraph 3.29.

(8) The requirements of Item (4) need not be met for the 120-kc amplifiers supplying a distributing bus bar to which more than 11 Type K systems are connected.

3.29 Procedure - Bridging Measurement at the Output of the 484 or 548-Kc Group Carrier Supply Filter.

(1) Insert 217D plugs in the TST jacks of the 5-kc oscillator and the J2 carrier supply amplifiers under test.

(2) Patch from the TST EVEN and TST ODD jacks to the HYBRID 1 and 2 jacks of the J2 carrier supply test termination (Fig. 5).

(3) Calibrate the 30A set as given in another E Section.

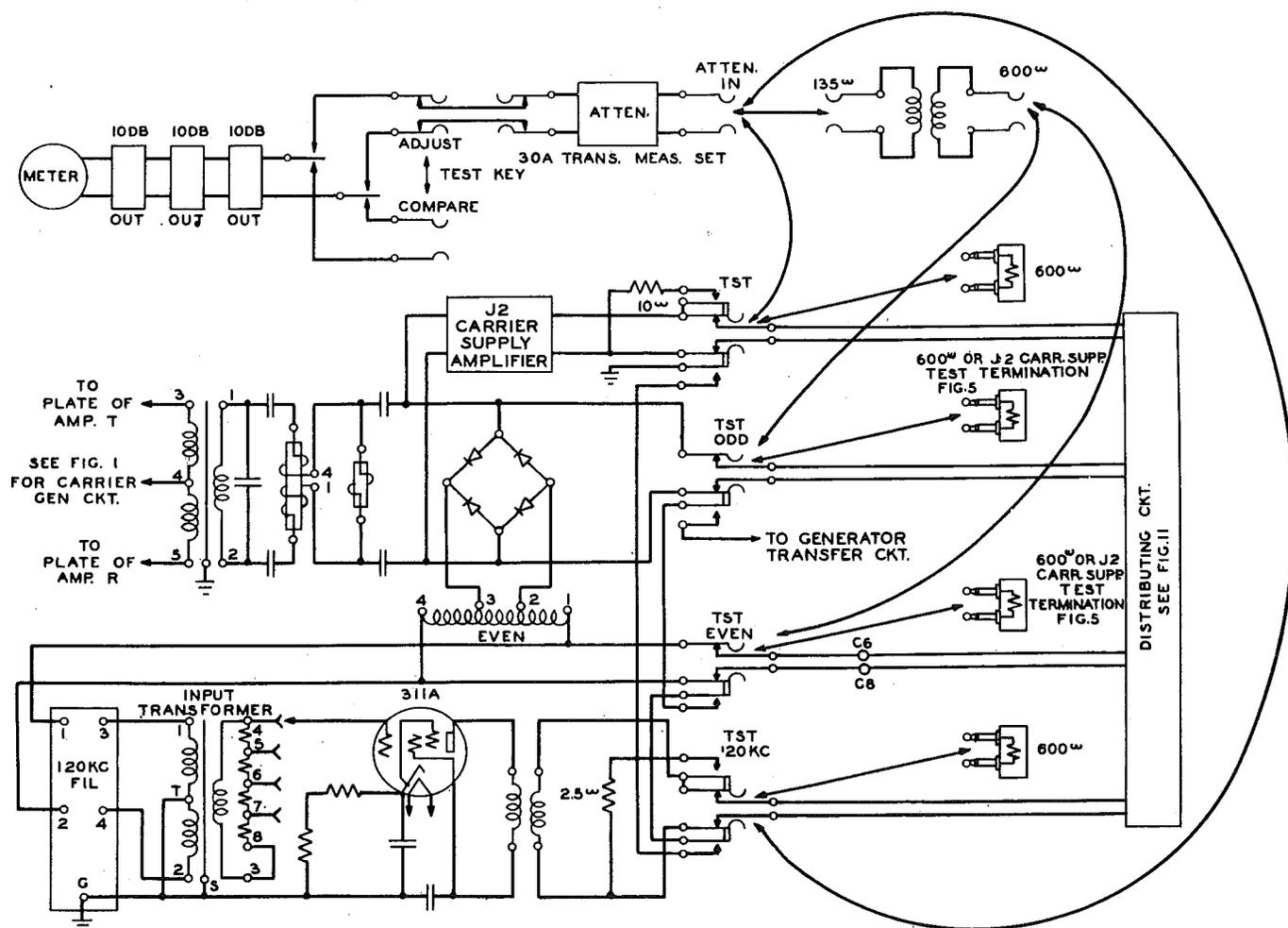


Fig. 8 - Carrier Supply Output at Test Jacks -
Combined J2 & K Carrier Supply

(4) Patch from the OUT or TST OSC OUT jacks of the 17B oscillator to the POT IN jacks of the 30A set and set the attenuator to 11db.

(5) Set the frequency at 60 kc.

(6) Operate the TEST KEY of the 30A set to the COMPARE position and adjust the oscillator output control and the TEST CURRENT POTENTIOMETER to obtain a reading of 0 db on the thermocouple meter with all three protection keys in the OUT position.

(7) Bridge the test clips of the 2W24A cord across terminals 3 and 4 of the 484-kc CSF1 filter (484-kc amplifier) or the 548-kc CSF2 filter (543-kc amplifier).

Note: If in Paragraph 3.33 Item (7) the HP condenser is used to meet the channel bus requirements thereby necessitating this bridging test, where both the 484 and 543-kc amplifiers are furnished, connect to the 548-kc CSF2 filter.

(8) Insert the plug of the 2W24A cord in the LOSS OUT jacks.

(9) Operate the TEST KEY to the ADJUST position and observe the thermocouple meter of the 30A set. This reading is a calibrated -11 dbm.

(10) Operate the TEST KEY to the COMPARE position and observe the thermocouple meter.

Requirements: The thermocouple meter reading in Item (10) should not be lower than the reading in Item (9); that is, should not be lower than the calibrated -11 dbm.

(11) If this requirement is not met remove if furnished the "A" strappings of the HP varistors in the carrier generator panel to bring the output within limits. If this is done, the channel and group bus bar voltage should be checked, Part 3(G).

(12) Remove all cords and plugs from the regular carrier generator and regular carrier supply amplifiers.

(13) Lock in the regular carrier supply (See Part 3(A)) and test the emergency carrier supply using the procedure of Paragraph 3.28 Items (2) through (7).

(14) Remove all cords and plugs from the emergency carrier generator and emergency carrier supply amplifiers. Operate the RLS key to restore the carrier supply to normal operation.

(G) Carrier Supply Bus Bar Output

3.30 The output of the harmonic producer and the carrier supply amplifiers for the carrier supplies as measured at the TST-ODD, TST EVEN, TST jacks and TST 120-ko jacks is delivered through suitable filters to the distributing bus bars. This test provides a procedure for measuring the bus bar output and for adjusting the load on the bus bars.

3.31 This test is made first with the regular carrier supply locked-in and then with the emergency carrier supply locked-in. When making tests or adjustments on the bus bars, extreme caution should be observed to avoid interruption of the carrier supply to working equipment. The bus bar itself is covered by a fibre protector which should not be removed for test. The adjusting resistances A, B, C, D and E on the channel bus bar are not to be used for measuring carrier output. See Note, Paragraph 2.13 Item (2) for preventing office alarms associated with stabilized pilot supply.

3.32 Apparatus:

- 1 - 30A Measuring Set
- 1 - W2AY Cord equipped with 289A Plug (2W24A)

3.33 Procedure - Channel Bus Bar Output - Regular Carrier Supply - See Fig. 9 for J2, Fig. 10 for K, and Fig. 11 for the Combined J2 & K Carrier Supply:

- (1) Lock-in the regular carrier supply (See Part 3(A)) and test the regular carrier supply.
- (2) Insert the plug of the 2W24A cord in the 135-OHM TC jacks of the 30A set.
- (3) Connect the test clips of the 2W24A cord to the terminals of an unused resistance for channel 1 other than the ADJ resistances. If no unused resistance

tap is available, turn down channel 1 of one of the systems and then remove its leads from the bus bar in order to make the measurement.

- (4) Read the 30A set meter, which gives a measure of the bus bar output.

Requirements:

- (a) The bus bar output as measured should be 1 milliwatt ± 0.5 db. When the channel bus is fully loaded, if the -0.5 db cannot be obtained for all 12 channels in the case of J2 and combined J2 & K carrier supplies two of the 12 channels may drop to -1.0 db.
- (b) When more than 10 Type K terminals are connected to a channel distributing bus bar, the output should be between -1.0 dbm and $+0.5$ dbm. However the output should be adjusted to between -0.5 dbm and $+0.5$ dbm when possible.
- (5) If requirements are not met, adjust the voltage on the bus bar by strapping various combinations of the ADJ resistances designated A, B, C, D, E.
- (6) Repeat the above procedure for each channel bus bar.
- (7) If the requirements are not met on any of the channels, connect and adjust the HP condenser in the carrier generator panel to meet the above requirements. The addition of more of the HP condenser will increase the lowest readings of the even channel busses, but at the same time the reading obtained in Paragraph 3.29 Item (10) which concerns itself with J2 and combined J2 & K supplies will be lowered. Care must be taken that no more capacity be added than that necessary to meet the requirement for the channel busses, in order that the requirement in Paragraph 3.29 Item (10) be met. Turning over the "ET" and "ER" leads to the even HYB repeating coil at terminals C6 and C8 of the EM carrier generator may be a further aid in meeting the channel bus requirements in the case of the J2 and combined J2 & K supplies. If any change is made in the adjustment of the HP condenser repeat test Part 3(F), Carrier Supply Output at Test Jacks.
- (8) After all channel bus bars have been adjusted, remeasure the output of each bus bar and readjust, if necessary. This procedure should be repeated until all the channels meet requirements without the adjustment of other channels.

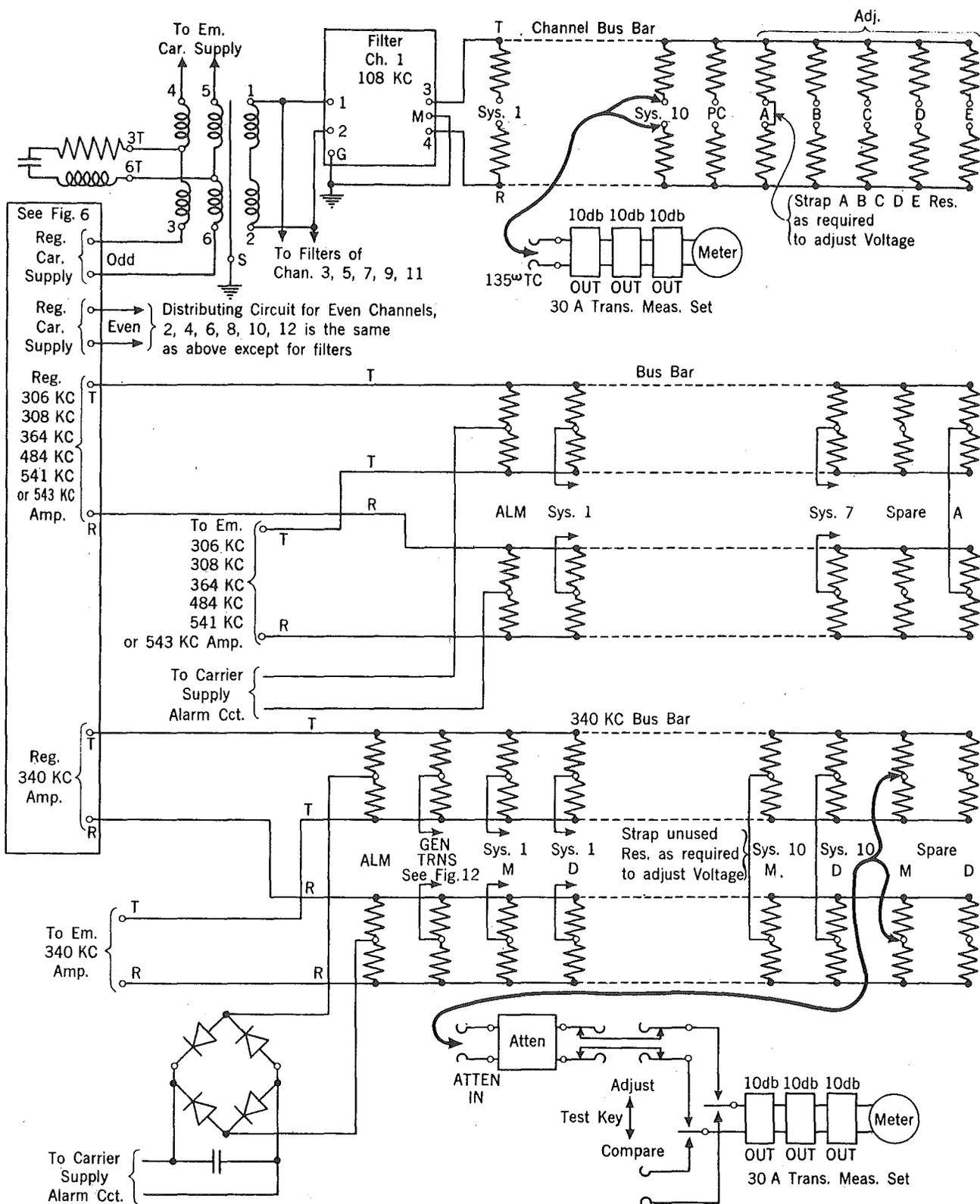


Fig. 9 - Carrier Bus Bar Output - J2 Carrier Supply

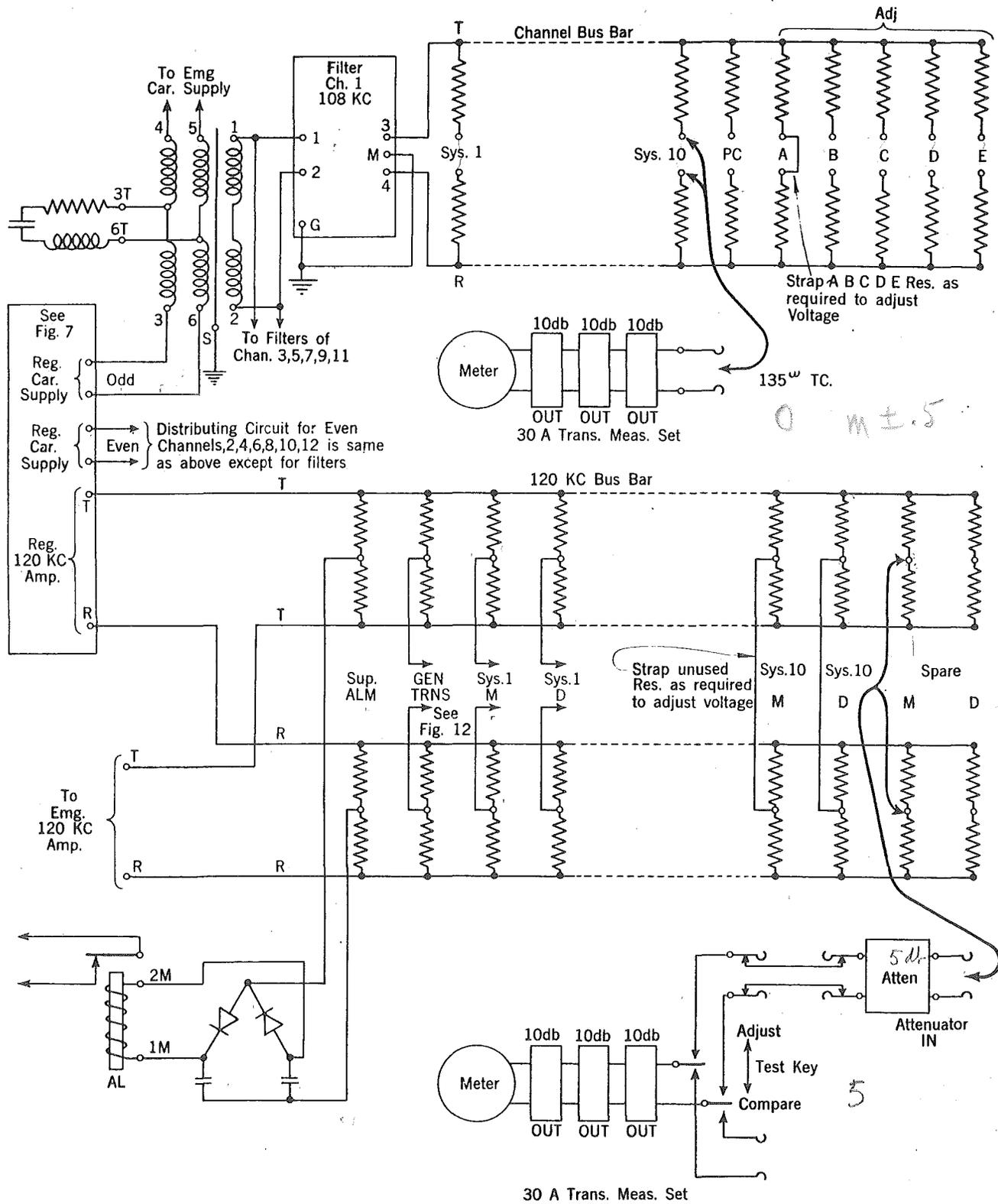
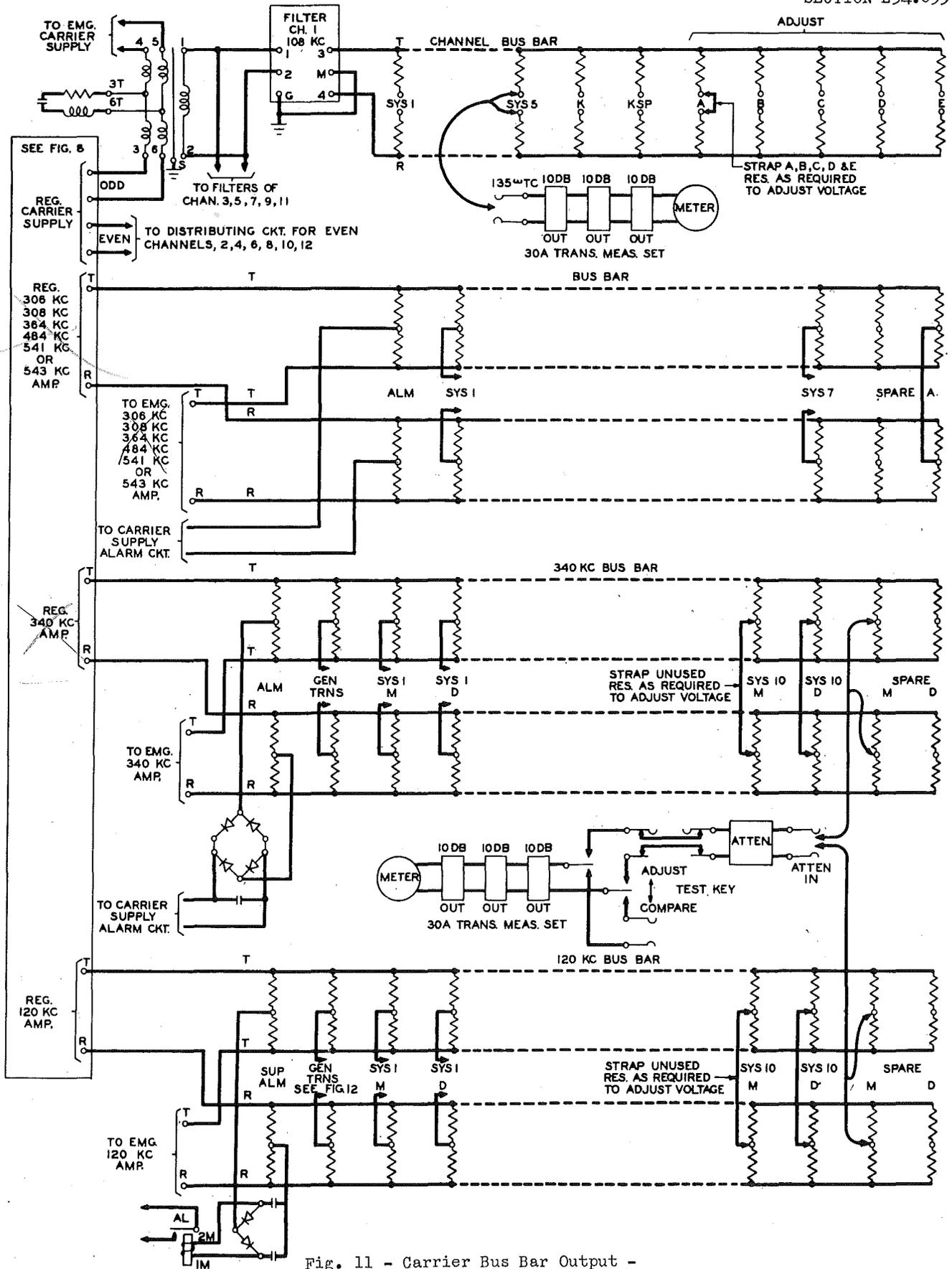


Fig. 10 - Carrier Bus Bar Output -
K Carrier Supply



3.34 Procedure - Group Carrier Supply Bus Bar Output - Regular Carrier Supply - See Fig. 9 for J2, Fig. 10 for K, and Fig. 11 for the Combined J2 & K Carrier Supply:

- (1) Remove the plug of the 2W24A cord from the 135-OHM TC jacks and insert it in the ATTEN IN jacks of the 30A set.
- (2) Connect the test clips of the 2W24A cord to the terminals T and R of unused resistances of the group carrier bus bar under test as shown in Fig. 9 for J2, Fig. 10 for K, and Fig. 11 for the combined J2 & K carrier supply.
- (3) Set the attenuator to 14 db for the J2 carrier supply bus where 130 volt plate battery is used on the J2 carrier supply amplifiers or to 16 db where 152 volt plate battery is used on these amplifiers. For the 120-kc carrier supply bus, set the attenuator to 5 db. Operate the TEST KEY of the 30A set to the ADJUST position.
- (4) Read the 30A set meter which gives a measure of the bus bar output and record the readings for use in the procedure of Paragraph 3.35.

Requirements: For the J2 carrier supply bus the meter should read 0 ± 1.5 db where 130 volt plate battery is used or between -2 and $+1$ db where 152 volt plate battery is used. For the 120-kc carrier supply bus the meter should read 0 ± 1 db.

- (5) If the requirements are not met, add or remove strapping of the unused T and R resistances as required. When requirements are met, restore the carrier supply to normal operation by operating the black RLS key and proceed with Paragraph 3.35.
 - (6) When more than 11 Type K terminals are connected to the group distributing bus bar, add or remove the straps from the T and R resistances as necessary to meet the requirements. If the requirements cannot be met when all of the T and R resistance straps are removed, change the tap on the REG 120-kc amplifier input transformer until the requirements can be met. Moving the grid lead to a lower tap number increases the output.
- 3.35 Procedure - Channel and Group Carrier Supply Bus Bar Output - Emergency Carrier Supply - See Fig. 9 for J2, Fig. 10 for K and Fig. 11 for the Combined J2 & K Supply:
- (1) Lock-in the emergency carrier supply and read the output for the emergency carrier supply following the

procedures outlined in Paragraphs 3.33 and 3.34.

Requirements: For Emergency Carrier Supply.

- (a) When the channel bus bar is measured, the meter should read 0 ± 1.5 db.
- (b) Except for the 120-kc bus bar, when any of the group carrier supply bus bar outputs is measured, the meter reading should meet the requirement obtained in Item (4) of Paragraph 3.34 and also be within 1 db of the value for the J2 carrier supply bus. For the 120-kc bus bar the reading should be within 2.0 db of the reading obtained in Item (4), Paragraph 3.34.
- (2) If requirements are not met, repeat test, Carrier Supply Output at Test Jacks, Part 3(F) and if necessary adjust the bus bar output to provide a compromise for the two carrier supplies.

Note: A slow beat will probably be observed when measuring the 543-kc and 541-kc busses.

Requirements: The beat should not exceed a swing of ± 0.5 db from the mean and the measured output on the 543 and 541-kc busses in Paragraphs 3.34 and 3.35 should be recorded as the average between maximum and minimum readings on the thermocouple set.

- (3) If the requirements are not met when more than 11 Type K terminals are connected to the group distributing bus bar, change the tap on the EMG 120-kc amplifier input transformer until the requirements can be met. Repeat the procedure as covered in Paragraph 3.34 and if necessary readjust the REG 120-kc amplifier input transformer tap to meet the requirements. If the tap is re-adjusted, repeat the above procedure for the EMG carrier supply and if necessary re-adjust the EMG input transformer tap. Repeat this procedure until the requirements have been met for both carrier supplies.

(H) Ionization of Gas Tubes in Carrier Generator Transfer Circuit

3.36 The carrier generator transfer circuit is operated by failure of any group carrier supply output which causes a gas tube to break down, that is, to ionize and increase the bias on the control tube of the regular carrier generator and decrease the bias on the control tube of the emergency carrier generator. This blocks the regular

generator output and releases the output of the emergency generator which is normally blocked. This test provides a procedure for adjusting the ionization point of the two gas tubes which operate in parallel, and to make the necessary adjustment so that the two tubes will fire at approximately the same voltage. The tubes used in this test should meet the requirements of Part 2(F). See Note, Paragraph 2.13 Item (2) for preventing office alarms associated with stabilized pilot supply.

3.37 Apparatus:

- 1 - 20 Ω + 1-Ohm Resistance for J2 supply and one 18GW Resistance (5.4 ohms + 1%) for K or the combined J2 & K supply, connected to test leads three inches long terminated with test clips. To be assembled locally.

3.38 Procedure - (See Fig. 12):

- (1) Lock-in the regular carrier supply. See Part 3(A).
- (2) Remove one of the gas tubes from its socket or remove both tubes and insert a new tube in one of the sockets.
- (3) For the J2 carrier supply connect the 20 ohms across the GEN TRNS terminals of the J2 340-kc bus bar. For the K or combined J2 & K supplies connect the 5.4

across the GEN TRNS terminals of the 120-kc bus bar. The connecting lead should not exceed three inches in length. This is equivalent to placing the resistance across the input transformer of the carrier transfer circuit as shown in Fig. 12.

(4) Operate the RLS key.

(5) If the tube ionizes, that is, shows a bluish glow, operate the REG key and move the resistance tap lead one step towards the AB resistance. Continue this procedure until a point is reached where the tube fails to ionize. When this point is reached, move the resistance tap lead back one step towards the X resistance. If the tube ionizes with the tap connected to the cathode end of the AB resistance, consider this to be the operating step for this tube unless the procedure of Item (6) results in a change in the location of the resistance tap lead. It may take several seconds for the tube to heat up enough to ionize.

(6) If after operating the RLS key, Item (4), the tube does not ionize, operate the REG key and move the resistance tap lead one step toward the X resistance. Operate the RLS key again and if the tube still fails to ionize, operate the REG key and move the resistance tap lead one more step toward the X resistance. Continue this process until a point is

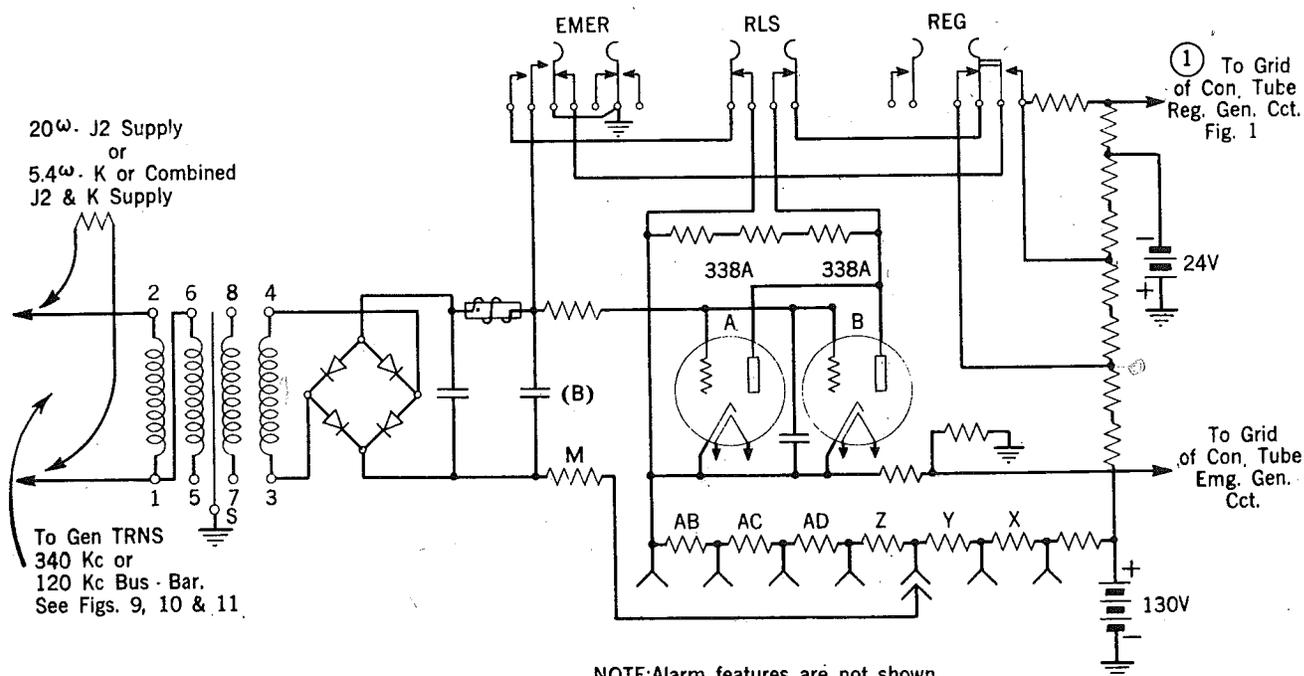


Fig. 12 - Ionization Test of Tubes in Transfer Circuit

reached where the tube ionizes and consider this to be the operating step for this tube.

(7) After determining the proper operating step for the tube being tested, operate the REG key and insert another tube in the other socket, removing the tube which has just been tested. Note the resistance tap.

(8) Repeat Items (4) to (7), inclusive, to find the proper operating point for the second tube.

Requirements: The adjustment point for the two tubes which are connected in parallel should not differ by more than one resistance step.

(9) If this requirement is not met, repeat the above procedure with other tubes. The resistance tap lead should be connected between the AB and X resistances at one of the critical adjustment points determined above. Connect to the one which is farthest from the cathode, (AB resistance).

(10) After the requirements are met, insert the other tube in its socket. Remove the 20-ohm or 5.4-ohm resistance. Restore the carrier supply to normal operating condition and check the operation of the transfer circuit, Part 3(I).

(I) Operation of Carrier Generator Transfer Circuit

3.39 The transfer circuit is operated automatically by failure of any one of the group carrier supply outputs. The circuit can also be made to function manually by operating keys provided for that purpose and this test provides a procedure for checking both automatic and manual operation. See Note, Paragraph 2.13 Item (2) for preventing office alarms associated with stabilized pilot supply.

3.40 Apparatus - J2 Carrier Supply Only:

1 - 217D Plug (600 ohms)

Apparatus - K and Combined J2 & K Supplies Only:

1 - 30A Transmission Measuring Set
1 - W2AY Cord equipped with 289A Plug (2W24A)
1 - P3P Cord equipped with 305A Plug (3P20B)
1 - 217D Plug (600 ohms)

3.41 Procedure - Automatic Operation - K and Combined J2 & K Supplies - See Fig. 13:

(1) Operate the RLS key on the transfer panel to insure that the load is on the regular generator.

(2) Insert the plug of the 2W24A cord into the ATTENUATOR IN jacks.

(3) Connect the test clips of the 2W24A cord to the SUP AIM terminals of the 120-kc distributing bus bar.

(4) Operate the TEST KEY to ADJUST and observe the reading on the 30A set meter.

(5) Insert a 217D plug in the TST 120-kc jacks of the regular carrier supply. A green lamp TRNS should light on the generator transfer panel, indicating that the transfer circuit has operated and an alarm bell should ring until the EMER key is operated. The operation of the EMER key should cause the green lamps to light on the REG carrier supply amplifiers and on the REG carrier generator panel. Again read the 30A set meter.

Requirements: The difference between the meter readings obtained in Items (4) and (5) should not be greater than 2 db.

(6) Remove the 217D plug from the TST 120-kc jacks of the regular carrier supply.

(7) If the requirements are not met, make test, Carrier Supply Output at TEST jacks, Part 3(F).

(8) Operate the RLS key on the transfer panel to restore the regular carrier supply, and again read the 30A set meter. The green lamp TRNS on the transfer panel should be extinguished.

Requirements: The meter reading should be the same as that obtained in Item (4).

3.42 Procedure - Automatic Operation - J2 Carrier Supply:

(1) Operate the RLS key on the transfer panel to insure that the load is on the regular generator.

(2) While watching a CON sensitrol relay on one of the receiving terminals, insert a 217D plug in the TST jacks of

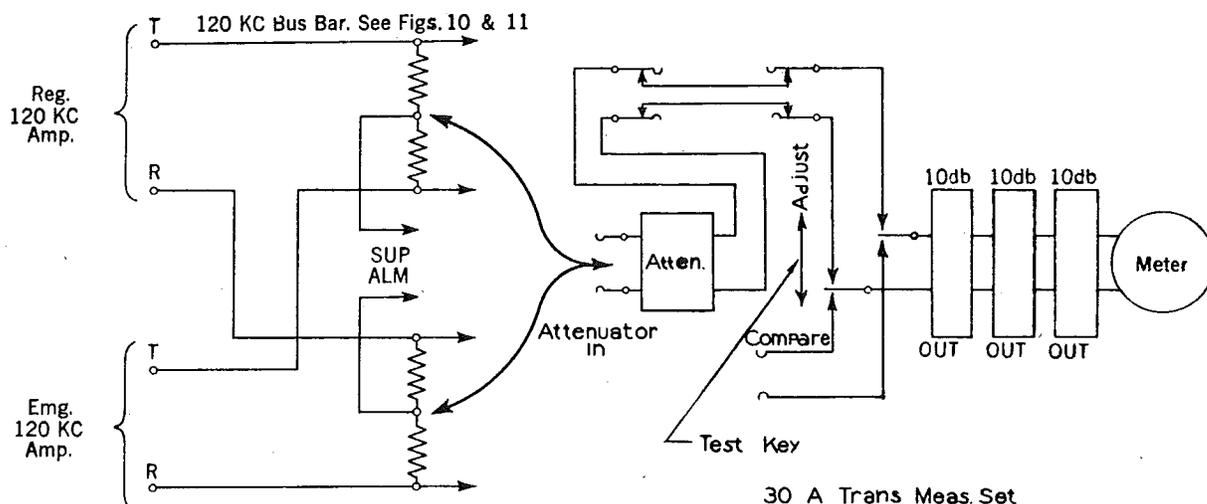


Fig. 13 - Check of Carrier Supply Transfer Circuit

any one of the regular carrier supply amplifiers.

Requirements:

- (a) The reading of the sensitrol relay should not change by more than 0.2 db.
- (b) When the transfer is made by inserting the 217D plug in the TST jacks, the green TRNS lamp on the carrier transfer panel should light and an alarm bell should ring until the EMER key is operated. The operation of the EMER key should cause the green lamps to light on the REG carrier supply amplifiers and on the REG carrier generator panel.
- (3) If Requirement (a) is not met, check the regular and emergency supply circuits first as described in Part 3(G), Carrier Supply Bus Bar Output omitting the test of the channel bus bar output, and then if necessary as described in Part 3(F), Carrier Supply Output at Test Jacks.

- (4) If the requirements are met, remove the 217D plug from the TST jacks and operate the RLS key on the transfer panel.

3.43 Procedure - Manual Operation - K or Combined J2 & K Supply - See Fig. 13:

- (1) Follow the procedure of Paragraph 3.41, Items (1) to (4), inclusive.
- (2) Operate the EMER key on the transfer panel and read the 30A set meter. The green lamp on all the regular carrier

supply panels and the transfer panel should light.

Requirements: The difference between the meter readings obtained in Items (1) and (2) should not be greater than 2 db.

- (3) Operate the RLS key to restore the regular carrier supply and read the 30A set meter. All lights should be extinguished.

Requirements: The reading should be the same as obtained under Item (1).

3.44 Procedure - Manual Operation - J2 Carrier Supply:

- (1) Operate the RLS key on the transfer panel to insure that the load is on the regular generator.
- (2) While watching a CON sensitrol relay on one of the receiving terminals, operate the red EMER key on the carrier transfer panel.

Requirements:

- (a) The reading of the sensitrol relay should not change by more than 0.2 db.
- (b) When the transfer is made the green TRNS lamp on the transfer panel and the green lamps on the REG carrier generator and all REG carrier supply amplifier panels including the 5-kc oscillator panel should light.

(3) Operate the RLS key, extinguishing the lamps.

(4) Operate the REG key.

Requirements: The green lamps on the EMER carrier generator panel and on all the EMER carrier supply amplifier panels should light.

(5) Operate the RLS key.

Requirements: All lamps should be extinguished.

(J) Voltage of Transfer and Alarm Circuit

3.45 The measurement of the rectified voltage across the B condenser in the transfer circuit (Fig. 12) serves to indicate trouble in the varistor circuit. Also, for K or combined J2 & K supply, the measurement of the rectified voltage across the AL relay in the alarm circuit (Figs. 10 & 11) serves to indicate trouble in the varistor circuit. The requirements of Part 3(G), Carrier Supply Bus Bar Output, should be met before making this test and the measured value of the 120-kc bus bar output noted.

3.46 Apparatus:

1 - KS-8295 Volt-ohmmeter

Note: If another type of meter is used it must have at least 30,000-ohms resistance when measuring the voltage across the B condenser and at least 10,000-ohms resistance when measuring the voltage across the AL relay.

3.47 Procedure - Transfer Circuit - See Fig. 12:

(1) Using the 0-30 volt scale of the KS-8295 volt-ohmmeter, measure the voltage across the B condenser at the output of the varistor.

Requirements: The voltage should be between 8.0 and 14.0 volts.

(2) If the requirements are not met, check the output of the 340 or 120-kc busbar depending on whether the carrier supply is J2 or K (also combined J2 & K) as described in Part 3(G), Carrier Supply Bus Bar Output.

3.48 Procedure - Alarm Circuit - K or Combined J2 & K Supply Only - See Figs. 10 & 11:

(1) Using the 0-15 volt scale of the KS-8295 volt-ohmmeter measure the voltage across the winding of the AL relay at the output of the varistor.

Requirements: The minimum voltage should be between .6 and .7 volt when the 120-kc bus bar output as measured in Paragraphs 3.34 and 3.35 is between 0 and -1 dbm.

The minimum voltage should be between .7 and .8 volt when the 120-kc bus bar output as measured in Paragraphs 3.34 and 3.35 is between 0 and +1 dbm.

(K) Pilot Level Adjustments of the K 64, 92 and 108-Kc Stabilized Pilots - K and Combined J2 & K Supplies Only

3.49 For pilot level adjustment the level of each K pilot channel frequency is measured with the 42A or 31A transmission measuring system at the PC LEV M or the 108-KC FILT OUT jacks. The Regular Supply is stabilized and has one individual adjustment of the output of each pilot frequency, which is common for all carrier systems connected to the same Pilot Supply. The Alternate Supply is not stabilized and has no level adjustments.

3.50 Apparatus:

1 - 42A or 31A Transmission Measuring System

3.51 Procedure - Regular Stabilized Pilot Level Adjustment - See Fig. 14:

(1) Measure the level of each pilot channel frequency at the PC LEV M or 108-KC FILT OUT jacks as required.

(2) With the 42A transmission measuring system calibrated and ready for test and the TRNS switch on the Pilot Supply Panel set at ALT, measure each pilot level in accordance with the information covering the 42A or 31A system.

(3) The pilot frequencies are 64, 92 and 108 kc and the 17-type oscillator settings when using the 42A system are 66, 38 and 22 kc, respectively.

(4) The 64 and 92-kc outputs are measured at the PC LEV M jacks and the 108-kc output is measured at the 108-KC FILTER OUT jacks.

(5) If there is more than one Pilot Supply circuit in the office, in order to measure the 108-kc outputs, it is necessary to patch from the PC LEV M jacks to the 108-KC FILT IN jacks for all but the first circuit.

(6) If the pilot levels do not meet the requirements specified below, readjust the output of the Regular by connecting resistances A3 to A8, inclusive, B3 to B8, inclusive and C3 to C8, inclusive as required to form new "X" and "Y" resistance combinations. Resistances A3 to A8 will control the 64-kc output, B3 to B8 will control the 92-kc output and C3 to C8 will control the 108-kc output. Increasing the X resistances and decreasing the Y resistances will decrease the pilot level and conversely decreasing the X and increasing the Y resistances will increase the pilot level. Changing 2.5 ohms from the X to

the Y resistance or vice versa changes the pilot level approximately .15 db.

Supply Panel in Item (2) should be set at REG instead of ALT for this measurement.

Requirements: The pilot level reading should be:

- 64 kc, - 56.7 + .2 dbm.
- 92 kc, - 57.4 ± .2 dbm.
- 108 kc, - 57.9 ± .2 dbm.

Requirements: The pilot level reading should be:

- 64 kc, - 56.7 + 2.3 dbm.
- 92 kc, - 57.4 ± 1.6 dbm.
- 108 kc, - 57.9 ± 1.8 dbm.

(7) After the desired levels are obtained, set the TRNS switch on the pilot supply panel at REG.

(L) Gain Adjustment of K Pilot Channel Supply Alarm - K and Combined J2 & K Supplies Only

3.52 Procedure - Alternate Pilot Level Measurement - See Fig. 14:

Except for Item (2), follow the procedure of Paragraph 3.51 Items (1) to (5). The position of the TRNS switch on the Pilot

3.53 Amplifier Rectifier Circuit: A voltage is picked off from the Pilot Supply Bus and is amplified and rectified. Any variation of this voltage from normal will be indicated on the Sensitrol relay CON. Variations of ± 0.5 db will cause the alarm to function.

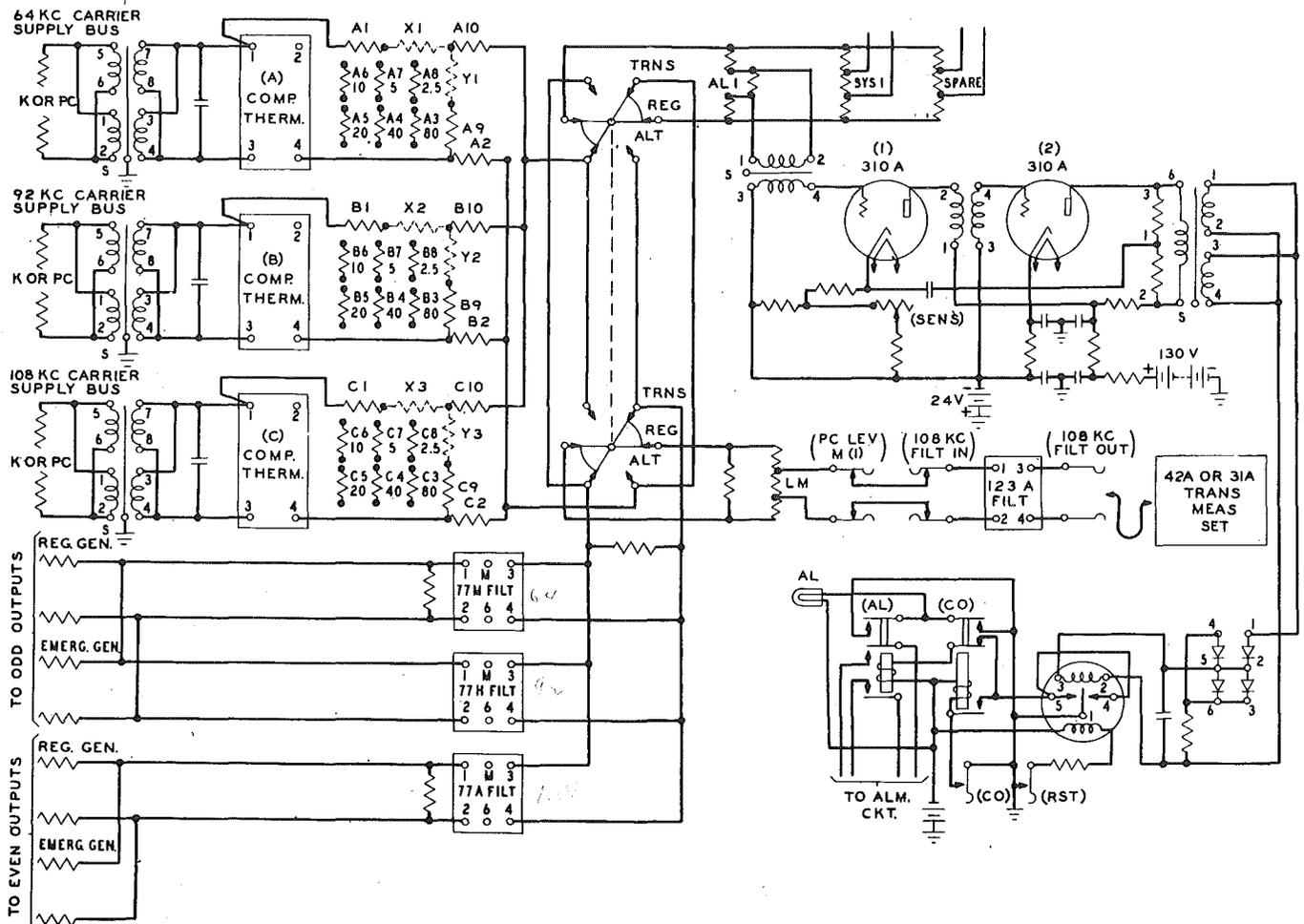


Fig. 14 - 108, 92 and 64-Kc Pilot Level Measurement

The requirements of Paragraph 3.51 should be met before making this test.

Note: Since the Alternate Pilot Supply is not held to the +.5 db limits when it is used the Pilot Supply Alarm may operate; if so the audible alarm may be silenced by operating the CO key of the Pilot Supply Alarm.

3.54 Procedure - See Fig. 14:

- (1) Adjust the SENS potentiometer so that the rectified current will read zero on the CON sensitrol relay.

Note: The operation of the CO key silences the Audible Alarm. The operation of the RST key restores the Sensitrol relay CON to normal after an alarm condition has been cleared.

(M) Measurement and Adjustment of J2 Pilot Output Levels - J2 and Combined J2 & K Supplies Only

3.55 This test gives a procedure for measuring and adjusting the pilot output level and for adjusting the IND 1 and IND 2 relays which give an alarm in case the pilot level departs from the required value by more than .5 db.

3.56 The pilot supplies for controlling the automatic regulation system are introduced in the transmitting terminal equipment just ahead of the first group modulator. The frequencies introduced at that point are shown in the following table:

Frequency Allocation	Pilot Supply Frequency - Kc			
	EAST Terminal		WEST Terminal	
	Slope	Flat	Slope	Flat
NA	111	60	104	64
NB	58	109	104	64
SA	60	111	64	104
SB	109	58	64	104

3.57 Apparatus:

- 1 - 17B Oscillator
- 1 - 30A Transmission Measuring Set
- 1 - D-158550 Plug (125 ohms)
- 2 - P3P Cords equipped with 305A Plugs at each end (3P20B)
- 3 - P3P Cords 6 feet long equipped with 305A Plug at one end and Test Clips at the other. Assemble locally.
- 1 - Cathode Ray Oscillograph (Optional)
- 1 - Telephone Receiver with leads having Test Clips at one end

3.58 Procedure - Pilot Output:

- (1) Remove the J2 system from service unless a spare group terminal is

available, in which case this test can be made on the spare equipment.

- (2) Measure and if necessary adjust the transmitting group gain as described in another section in the E34 series covering J2 carrier telephone terminal.

- (3) Insert the D-158550 plug in the GR MOD IN jacks.

- (4) Patch from the EQPT jacks of the J2 terminal to the 135-ohm TC jacks in the 30A set and measure the power delivered to the thermocouple.

Requirements: The total output should be within 0.5 db of 17 db below the specified level at the EQPT jacks.

- (5) If this requirement is not met, check the SLOPE pilot separately as described in the following items:

- (6) In order that only one pilot at a time will be measured, the grid on the oscillator tube of the pilot supply circuit not being measured should be grounded.

Caution: This procedure will remove pilot from all systems in the office that are supplied from the panel under test.

- (7) Measure the output at the EQPT jacks by noting the reading of the meter.

Requirements: The output should be within 0.2 db of 20 db below the specified level at the EQPT jacks.

- (8) If this requirement is not met, adjust the OUTPUT condenser of the SLOPE pilot being measured until the pilot level is as close as possible to 20 db below the specified level at the EQPT jacks.

- (9) Repeat Items (6) through (8) for the FLAT pilot. Replace any grid clip that has been removed.

Note: It should be borne in mind that adjustment of the OUTPUT condensers raises or lowers the amount of pilot current being supplied to all carrier systems using this pilot supply.

3.59 Procedure - Adjustment of IND 1 and IND 2 Relays:

- (1) With the SLOPE and FLAT pilots each set as closely as possible to 20 db below the specified level at the EQPT jacks, observe the reading of the IND 1

and IND 2 sensitrol relays on the pilot supply panel.

Requirements: Each relay should have a reading of approximately 0.

(2) If the relay reads within 0.1 db of 0, adjust it to read 0 as closely as possible by means of the pointer adjusting screw on the sensitrol relay.

(3) If the IND 1 or IND 2 sensitrol relay reads more than 0.1 db from 0 or if there is any indication that the 64-kc or 104-kc pilot supply has changed in frequency, the corresponding pilot channel supply output should be checked and adjusted as described in Paragraphs 3.60, 3.61 or 3.62.

3.60 Procedure - 58-109-Kc and 60-111-Kc Pilots:

(1) These pilot supply circuits are equipped with a crystal in the feedback circuit so that the output frequency is normally held constant. The output level may, however, be subject to change in case the tuning adjustment has been altered or a change has occurred in the balance of the bridge circuit.

(2) Retune the TUNE IN and TUNE OUT condensers for the particular frequency to obtain maximum deflection on the sensitrol relay. After one condenser has been adjusted, the setting of the other condenser should be rechecked and so on until maximum deflection has been obtained.

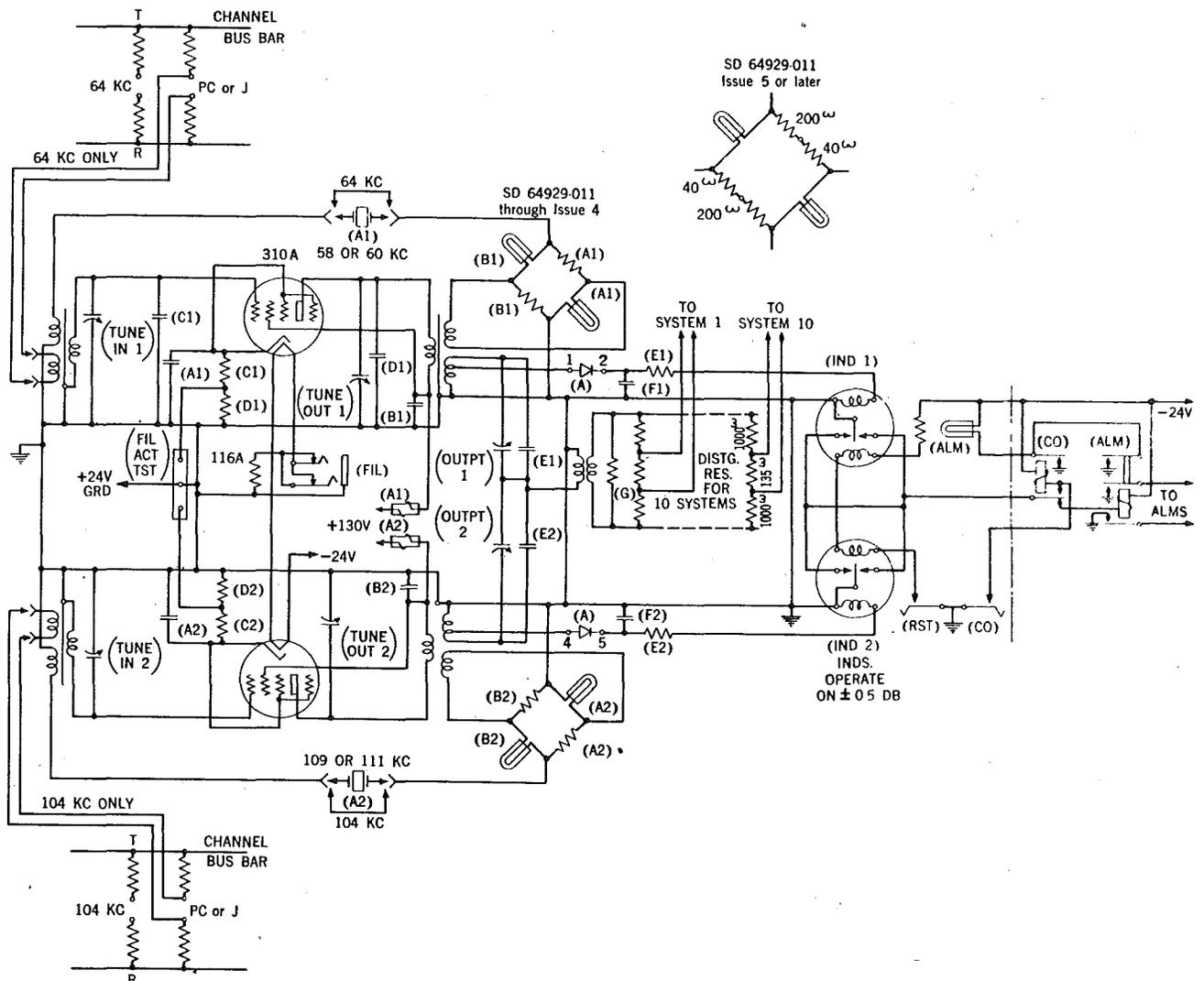


Fig. 15 - J2 Pilot Channel Supply

(3) The sensitrol relay should then be adjusted to read zero as closely as possible by means of its pointer adjusting screw.

(4) If the relay is off scale, the output of the oscillator should be checked by bridging from the ATTEN IN jacks to the panel ground and Terminal 1 of the A varistor when using the TUNE IN 1 and TUNE OUT 1 condensers or panel ground and Terminal 4 of the A varistor when using the TUNE IN 2 and TUNE OUT 2 condensers. Operate the TEST key to the ADJUST position. Tune the condensers as above to obtain maximum output. The output is equal to the attenuator setting corrected for the meter reading.

Requirements: The output should be $\pm 5.0 \pm 1.5$ dbm.

(5) If the requirement is met, remove the bridged connection and adjust the relay to read zero. If the requirement is not met, proceed as outlined below.

(6) During the adjustment the pointer of the relay may be restored when desired by pressing the RST key which also silences the audible alarm, if the pilot supply has become normal. If the pilot supply is not normal, the audible alarm may be silenced by pressing the CO key.

(7) If the bridge balance has been affected in any way, the output requirements of Item (4) above may not be met.

(8) For a pilot channel supply arranged as shown in SD-64929-011, Issue 5 or later, readjust the output. If the output is too low, change the oscillator bridge arms to use XX wiring and remove ZZ wiring. If the output is too high, change the oscillator output bridge arms to use YY wiring and remove ZZ wiring. If the output is brought within limits by changing the oscillator output bridge arm wiring, retune the TUNE IN and TUNE OUT condensers to obtain maximum output. After this has been done, the output should meet the requirements stated in Item (4) above.

(9) For a pilot channel supply circuit arranged as shown in SD-64929-011 of issues up to and including Issue 4, if the bridge balance cannot be readjusted to meet the output requirements of Item (4) above by substituting new switchboard lamps, the sensitrol relay should be readjusted to read zero by means of its pointer adjusting screw after disconnecting the measuring circuit.

(10) If the relay reads low and cannot be readjusted with the range of adjustment available, the sensitrol relay alarm circuit should be disabled. The pilot output at the EQPT jacks should be adjusted following the procedure of Paragraph 3.58. The failure to meet the requirements of Item (4) above and the fact that the alarm circuit has been disabled should be reported through the line of organization.

(11) If the relay reads high and cannot be readjusted with the range of adjustment available, a shunt should be placed across Terminals 2 and 3 of the sensitrol relay to bring it within the range of adjustment. The use of a decade resistance box may be found convenient in determining the value of resistance to be used in the shunt. The relay should then be adjusted to read zero by means of its pointer adjusting screw. The pilot output at the EQPT jacks should be adjusted following the procedure in Paragraph 3.58. The failure to meet the requirements of Item (4) should be reported through the line of organization.

3.61 Procedure - 64-104-Kc Pilots - Using Cathode Ray Oscillograph:

(1) The 64-kc and 104-kc pilot supply circuits are connected to the 64-kc and 104-kc channel supply circuits, respectively, and are arranged with a feedback connection so that they are forced to oscillate at the channel supply frequency. However, if the pilot supply circuit is not tuned correctly, it may also oscillate at some other frequency, thus causing noise in one or more channels of the system. The pilot supply circuit cannot be tuned correctly by adjusting the TUNE IN and TUNE OUT condensers to give maximum output. It is necessary to make sure that it is tuned accurately to the corresponding channel supply frequency by following the procedure given below.

(2) To adjust the 64-kc or 104-kc pilot supply circuit, disconnect the leads connected to the PC or J resistance depending on whether the carrier supply is J2 or combined J2 & K, at the corresponding channel distributing bus.

(3) Set the TUNE IN and TUNE OUT condensers of the pilot supply circuit under test for maximum capacity, (plates fully meshed). The TUNE IN and TUNE OUT condensers of the other pilot supply circuit should be left in the position in which they were found.

(4) Bridge from the ATTEN IN jacks to panel ground and Terminal 1 of the A

varistor when testing a 64-kc pilot or to panel ground and terminal 4 of the A varistor when testing the 104-kc pilot.

(5) Make sure that the GROUND terminal of the oscillograph is connected to panel ground. Then bridge X AXIS and GROUND terminals of the cathode ray oscillograph between terminal 1 of the A varistor and panel ground for the 64-kc pilot supply or between terminal 4 of the A varistor and panel ground for the 104-kc pilot supply.

(6) Bridge from the 135-ohm jacks of the Coil 1 across the PC or J resistance of the 64-kc bus or 104-kc bus from which the leads were removed in Item (2) above and connect from 600-ohm jacks of Coil 1 to Y AXIS and GROUND terminals of the oscillograph.

(7) With the TEST KEY in the ADJUST position, note the output of the pilot channel supply, first with the TUNE IN and TUNE OUT condensers both fully meshed and then both fully unmeshed.

Requirements: In each case the output should be $+5 \pm 1.5$ dbm.

(8) If the bridge balance has been affected in any way, these requirements may not be met and the procedure below should be followed.

(9) For a pilot channel supply arranged as shown in SD-64929-011, Issue 5 or later, readjust the output. If the output is too low, change the oscillator bridge arms to use XX wiring and remove ZZ wiring. If the output is too high, change the oscillator output bridge arms to use YY wiring and remove ZZ wiring.

(10) For a pilot channel supply circuit arranged as shown in SD-64929-011 of issues up to and including Issue 4, if the bridge balance cannot be readjusted to meet the output requirements of Item (7) above by substituting new switchboard lamps, the sensitrol relay should be readjusted to read zero by means of its pointer adjusting screw after disconnecting the measuring circuit.

(11) If the relay reads low and cannot be readjusted with the range of adjustment available, the sensitrol relay alarm circuit should be disabled. The pilot output at the EQPT jacks should be adjusted following the procedure of Paragraph 3.58. The failure to meet the requirements of Item (7) above and the fact that the alarm circuit has been disabled should be reported through line of organization.

(12) If the relay reads high and cannot be readjusted with the range of adjustment available, a shunt should be placed across terminals 2 and 3 of the sensitrol relay to bring it within the range of adjustment. The use of a decade resistance box may be found convenient in determining the value of resistance to be used in the shunt. The relay should then be adjusted to read zero by means of its pointer adjusting screw. The pilot output at the EQPT jacks should be adjusted following the procedure in Paragraph 3.58. The failure to meet the requirements of Item (7) should be reported through line of organization.

(13) Increase the capacity of the TUNE IN and TUNE OUT condensers for the pilot supply circuit under test, first one and then the other by small amounts, observing the oscillograph until a straight line pattern or an ellipse results. If the phase relation between the applied potentials is 0° or 180° , an inclined straight line will be obtained. At other phase relations, an ellipse will result, the slope of the axis of this ellipse depending on the phase relation. The pattern need not remain absolutely stationary. In the final position both condensers should be meshed by approximately the same extent.

(14) Reconnect the bridged connection to the ATTEN IN jacks and note the output.

Requirements: The output should be $+5.0 \pm 1.5$ dbm and unless the bridge balance has been readjusted since making the measurement called for in Item (7), the output should be within 0.1 db of the value measured in Item (7).

(15) Reconnect the leads to the PC or J resistance which were removed in Item (2). With the Y AXIS and GROUND terminals of the oscillograph bridged across this resistance through Coil 1 as in Item (6) and the X AXIS and GROUND terminals connected as in Item (5), observe that the pattern on the oscillograph screen is a stationary single line figure and that the output as measured by the 30A set is increased slightly (about 0.1 db) from the final output measured in Item (14).

(16) Remove all test connections.

(17) Operate the RST key and adjust the sensitrol relay for the pilot channel supply under test to read zero by means of the pointer adjusting screw. If the range of adjustment is not sufficient to permit this, the alarm circuit should be disabled or the sensitrol relay shunted as outlined in Items (11) and (12).

3.62 Procedure 64 - 104-Kc Pilots - Cathode Ray Oscillograph Not Available:

- (1) The conditions of Item (1) under Paragraph 3.61 above also apply here.
- (2) In tuning the 64-kc or 104-kc pilot supply circuits by means of a telephone receiver and the thermocouple meter in the 30A set, the pilot supply circuit is first tuned to the frequency of the corresponding channel frequency supply while operating almost entirely free from the control of the channel frequency supply. This tuning adjustment is first made approximately using a telephone receiver and then more accurately using the meter of the 30A set and the test oscillator which is adjusted accurately to the channel supply frequency. After tuning to within ± 50 cycles of the channel frequency supply, the pilot supply circuit is reconnected to operate under the control of the channel frequency supply. Since tuning which is correct within this amount is satisfactory, carrying the procedure further to obtain greater refinement of the tuning adjustment is not believed to be warranted.
- (3) To adjust the 64-kc or 104-kc pilot supply circuit, disconnect the leads connected to the PC or J resistance depending on whether the carrier supply is J2 or combined J2 & K, at the corresponding channel distributing bus.
- (4) Set the TUNE IN and TUNE OUT condensers of the pilot supply circuit under test for maximum capacity (plates fully meshed). The TUNE IN and TUNE OUT condensers of the other pilot supply circuit should be left in the position in which they were found.
- (5) Bridge from the 135-ohm TC jacks to panel ground and terminal 1 of the A varistor when testing a 64-kc pilot supply circuit or to panel ground and terminal 4 of the A varistor when testing a 104-kc pilot supply circuit.
- (6) Note the output of the pilot channel supply, first with the TUNE IN and TUNE OUT condensers fully meshed and then with both condensers fully unmeshed. The measurement should be made with two of the protection keys in the OUT position.

Requirements: The output in each case should be $\pm 5 \pm 1.5$ dbm.

- (7) If the bridge balance has been affected in any way, these requirements may not be met and the procedure below should be followed.

(8) For a pilot channel supply arranged as shown in SD-64929-011, Issue 5 or later, readjust the output. If the output is too low, change the oscillator bridge arms to use XX wiring and remove ZZ wiring. If the output is too high, change the oscillator bridge arms to use YY wiring and remove ZZ wiring.

(9) For a pilot channel supply circuit arranged as shown in SD-64929-011 of issues up to and including Issue 4, if the bridge balance cannot be readjusted to meet the output requirements of Item (6) above by substituting new switchboard lamps, the IND relay of the pilot channel supply circuit under test should be readjusted to read zero by means of its pointer adjusting screw after disconnecting the measuring circuit.

(10) If the relay reads low and cannot be readjusted with the range of adjustment available, the sensitrol relay alarm circuit should be disabled. The pilot output at the EQPT jacks should be adjusted following the procedure of Paragraph 3.58. The failure to meet the requirements of Item (6) above and the fact that the alarm circuit has been disabled should be reported through line of organization.

(11) If the relay reads high and cannot be readjusted with the range of adjustment available, a shunt should be placed across terminals 2 and 3 of the sensitrol relay to bring it within the range of adjustment. The use of a decade resistance box may be found convenient in determining the value of resistance to be used in the shunt. The relay should then be adjusted to read zero by means of its pointer adjusting screw and the pilot output at the EQPT jacks should be adjusted following the procedure under Paragraph 3.58. The failure to meet the requirements of Item (6) should be reported through the line of organization.

(12) Remove the patch from 135-ohm TC jacks to panel ground and terminal 1 of the A varistor for the 64-kc pilot supply circuit or panel ground and terminal 4 of the A varistor for the 104-kc pilot supply circuit. Connect a telephone receiver to terminal 2 of the A varistor and panel ground for the 64-kc pilot supply or to terminal 5 of the A varistor and panel ground for the 104-kc pilot supply.

(13) Set the attenuator for a loss of 50 db and connect ATTEN IN jacks across the PC or J resistance. Connect ATTEN OUT jacks to the leads removed from the PC or J resistance. With these connections the frequency of the 64-kc or 104-kc

bus is beating against the frequency from the pilot channel supply circuit which is oscillating at its independent frequency.

(14) Starting with the TUNE IN 1 and TUNE OUT 1 condensers fully unmeshed and listening to the beat tone in the receiver, increase the capacity of first one condenser and then the other by small equal amounts to find the null region (no sound in the receiver). Mark on the panel with a pencil the limits of the condenser settings at each side of the null region using the screwdriver slot as a reference. Then set each condenser mid-way between the two pencil marks on the panel. Remove the connections to ATTEN IN and ATTEN OUT jacks but do not reconnect the leads to the PC or J resistances which were removed in (3). Disconnect the receiver.

(15) Check the frequency calibration of the 17B oscillator and set the frequency at the nominal frequency of the pilot channel supply under test (64 kc or 104 kc). Patch from OUT or TST OSC OUT jacks to GAIN OUT jacks of the 30A set and with all three protection keys in the OUT position and the TEST KEY in the ADJUST position, adjust the oscillator output until a reading of zero is obtained on the meter.

(16) Change the patch from GAIN OUT jacks to one set of the MULTIPLE jacks. Patch from OUT or TST OSC OUT jacks to a second set of MULTIPLE jacks. Connect from the third set of MULTIPLE jacks to the PC or J resistance from which the leads were removed.

(17) Adjust the frequency of the 17B oscillator to obtain zero beat on the meter with the CYCLES dial set approximately at zero. The oscillator is now tuned to the frequency of the channel frequency supply.

(18) Remove all patches from the MULTIPLE jacks but do not reconnect the leads to the PC or J resistance which were removed in Item (3).

(19) When testing the 64-kc pilot supply circuit connect the grid of Tube 2 to panel ground. When testing the 104-kc pilot supply circuit connect the grid of Tube 1 to panel ground. Patch from OUT or TST OSC OUT jacks to ATTEN IN jacks. Set the attenuator for a loss of 60 db. Connect ATTEN OUT jacks across the system resistance of the pilot channel supply

bus of the J2 system. Place a D-158550 plug in the GR MOD IN jacks.

(20) Patch from 135-ohm TC jacks to EQPT jacks. A beat should be observed on the meter. If the beat is not observed, change the CYCLES dial of the oscillator slowly over its entire range to obtain a slow beat on the meter. If this does not produce a beat, set the CYCLES dial at approximately zero and return the TUNE IN 1 and TUNE OUT 1 condensers slowly and by equal amounts in the same direction within the two pencil reference marks on the panel to obtain a slow beat on the meter, changing the CYCLES dial within its range. Remove the connection to the 17B oscillator and from the EQPT jacks. Remove the connection to the ATTEN OUT jacks.

(21) After tuning, connect the 135-ohm TC jacks to panel ground and Terminal 1 of the A varistor when testing the 64-kc pilot channel supply or to panel ground and Terminal 4 of the A varistor when testing the 104-kc pilot channel supply. With two of the protection keys in the OUT position note the output.

Requirements: The output should be ± 1.5 dbm and unless the bridge balance has been readjusted since making the measurement called for in Item (6), the output should be within 0.1 db of the output measured in Item (6).

(22) Reconnect to the PC or J resistance the leads which were disconnected from it in Item (3).

(23) Remeasure the output.

Requirements: It should be slightly (about 0.1 db) greater than the output measured in Item (21).

(24) Remove all test connections. Remove the connection between the grid of the pilot oscillator tube and panel ground which was made in Item (19).

(25) Operating the RST key as necessary to obtain a reading, adjust the IND relay for the pilot supply circuit under test to read zero by means of its pointer adjusting screw. If the range of adjustment is not sufficient to permit this, the alarm circuit should be disabled or the relay shunted as outlined in Items (10) and (11).

