

118C3 AND 118C4 TELEGRAPH TRANSMISSION MEASURING SETS

OPERATION

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1. GENERAL

1.01 This section gives the methods for calibrating, operating, and maintaining the 118C3 and 118C4 telegraph transmission measuring sets (TMS).

1.02 This section is reissued to provide coverage of the 118C4 TMS, and to update information on the modified 118C3 TMS. Since this section covers a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 The 118C3 and 118C4 sets are designed for use in central offices to indicate the bias and peak distortion of teletypewriter signals directly on meters at the set and at extensions located at telegraph testboards or serviceboards. The modified 118C3 TMS and the 118C4 TMS differ only in the arrangement of panel controls, and are arranged to measure at 60, 75, and 100 speeds. Any one of these speeds may be selected by operating a key at the extension or at the set.

1.04 The set is arranged for use in 0.0625- and 0.020-ampere neutral circuits, in polar circuits and in the type 1 hub circuits of the No. 1 serviceboard. For use with the type 2 hub circuits of the 2 and 9B serviceboards, a coupling unit is associated with the set.

1.05 Either 5- or 6-unit code signals may be measured at the set or at extension units where provided.

1.06 Figure 1 is a full-length view of the set, showing the operating panel with its controls and meters.

1.07 Figure 2 shows the face of the extension unit, and Fig. 3 shows the miscellaneous jack strip with its designations.

2. ADJUSTMENT OF SET

2.01 At certain times, for instance when a set is first put into service and whenever tubes or relays are changed, a complete adjustment is required. At more frequent intervals the set is checked following a simplified adjustment procedure. Reference should be made to Fig. 3 and Table A in the following procedures.

A. Complete Adjustment

2.02 *60-Speed Adjustment:* The following procedures are for 60-speed operation.

(1) Patch from the TMS IN jack to the 60-speed POL CAL jack. Operate the SIGS key to M. Operate the POL key. If the set is already in use at an extension, wait until the BSY lamp goes out.

(2) Operate the 60- 75- 100-speed key to 60.

(3) With the power switch off, check the zero current indications of the BIAS and TOTAL DIST meters. The BIAS meter should indicate 0 and the TOTAL DIST meter should indicate -5.0.

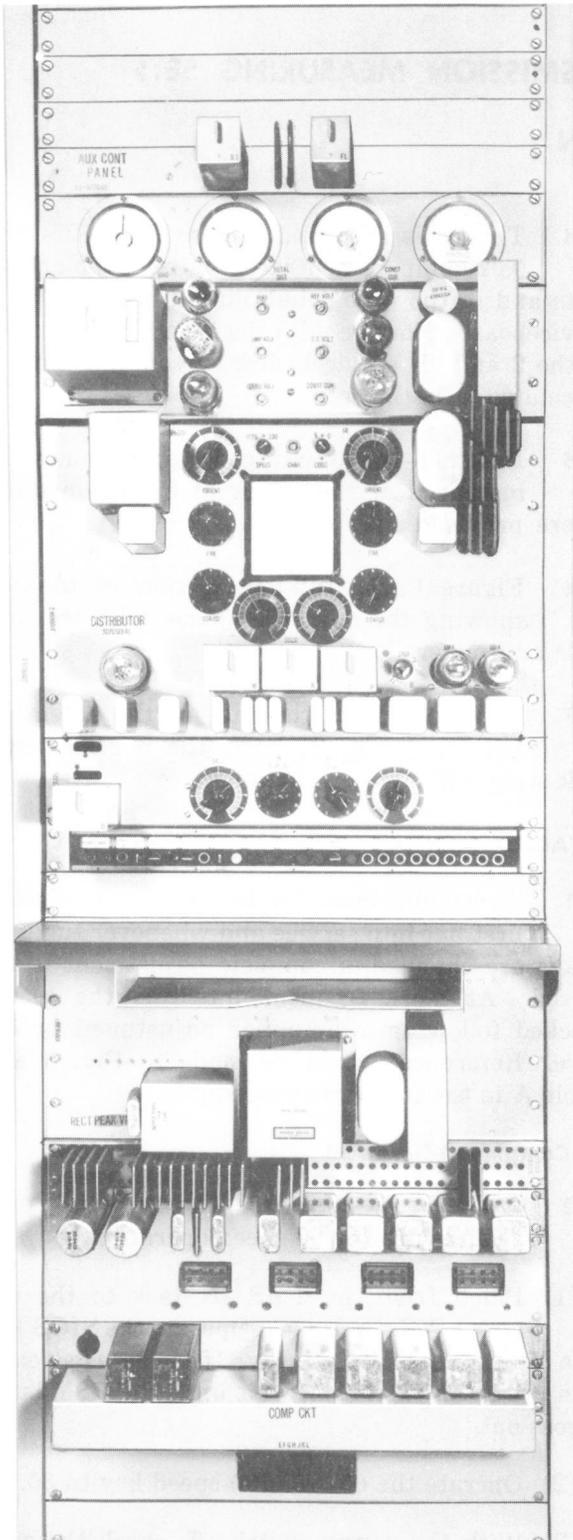


Fig. 1 — 118-Type Set — Front View

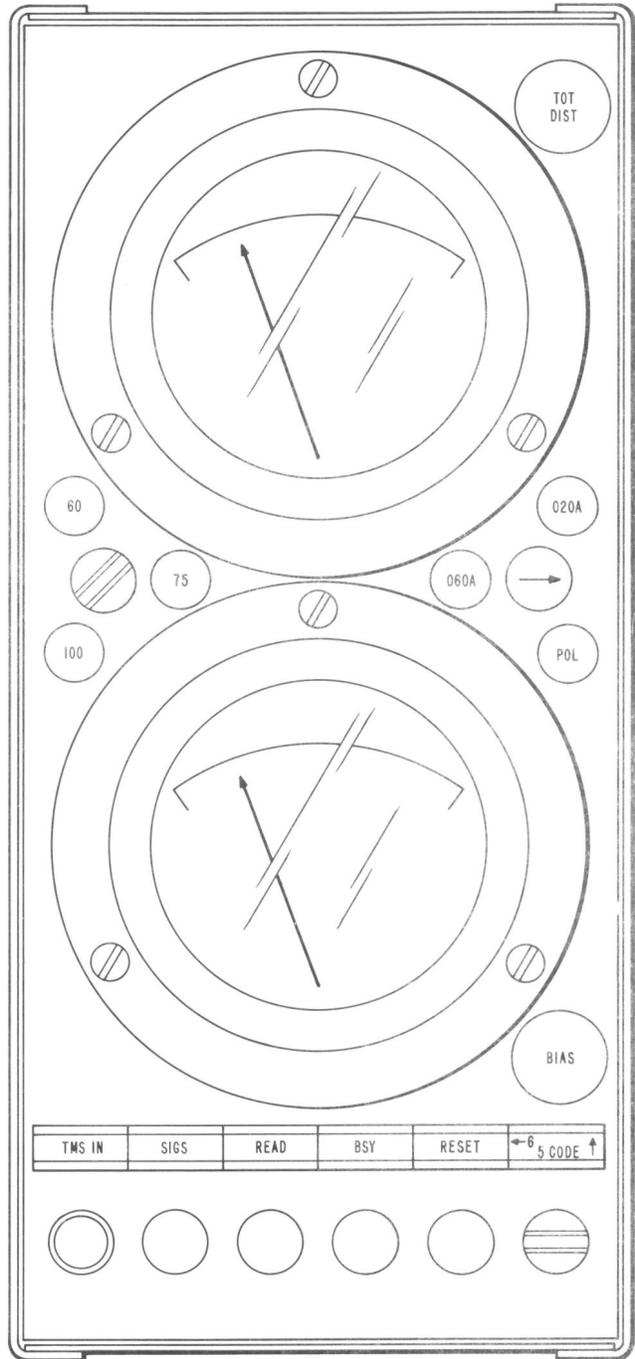


Fig.2 — Testboard Extension — Jack and Meter Circuit

TABLE A
SIMPLIFIED LOCAL CHECK PROCEDURE

1. Patch TMS to POL CAL. Operate SIGS key to M, all other keys normal. Check that CONST CUR meter reads 30 ma, and SC-REF VOLT meter reads 55V, depress RESET and adjust TOTAL DIST meter to 0 using ZERO ADJ potentiometer.			
2. Operate speed controls to 60, 75, or 100 as desired.			
3. Decrement — Operate SIGS key to S. Operate ADJ DECR key. Adjust DECR control until TOTAL DIST meter indicates predetermined value (about 30). Restore ADJ DECR and SIGS keys.	<u>SETTINGS</u> <i>Decrement</i>	Dial	Meter
	60	_____	_____
	75	_____	_____
	100	_____	_____
4. Speed — Operate ADJ SPD key and POL key. Adjust COARSE and FINE controls for minimum BIAS meter indication (about 2%).	<i>Speed</i>	Coarse	Fine
	60	_____	_____
	75	_____	_____
	100	_____	_____
5. Orientation — Depress M-S ONLY key. Adjust ORIENT control until BIAS meter indicates at zero.			
6. Depress CAL key. Adjust bias to S15. Adjust TOTAL DIST meter to 15 using AMP ADJ potentiometer.			
7. Depress RESET key — Depress M-S ONLY key — Adjust TOTAL DIST meter to 0 using ZERO ADJ potentiometer.			
8. Depress RESET key — Check BIAS meter ($0 \pm 1\%$). TOTAL DIST meter (0 to 1%, 60 and 75 speeds; 0 to 2%, 100 speed).			
9. Remove patch between TMS IN jack and POL CAL jack.	<i>Orientation</i>		
<i>Restore all keys to normal.</i>	60	_____	_____
	75	_____	_____
	100	_____	_____

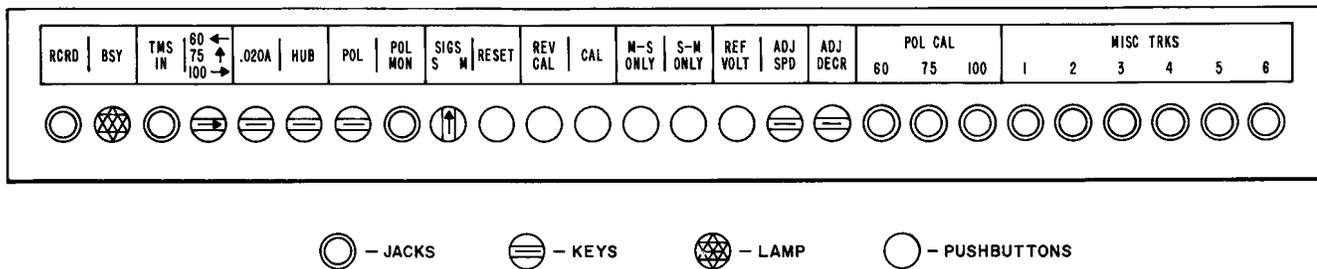


Fig. 3 — Miscellaneous Jacks and Keys

- (4) Operate the power switch to ON. Allow the tubes of the set to heat up for at least 5 minutes before attempting to make adjustments.
- (5) Adjust the CONST CUR potentiometer so that the CONST CUR meter indicates 30 milliamperes.
- (6) Adjust the SC VOLT potentiometer so that the SC-REF VOLT meter indicates 55 volts.
- (7) Check the reading of the CONST CUR meter and readjust the CONST CUR potentiometer to obtain a reading of 30 milliamperes, if necessary.
- (8) If a readjustment has been made under (7), repeat (6) and (7).
- (9) Hold the REF VOLT key depressed and adjust the REF VOLT potentiometer so that the SC-REF VOLT meter indicates 55 volts. Release REF VOLT key.
- (10) With the CODE key set to 5, turn the AMP ADJ potentiometer clockwise to the limit of its motion and set the CHAR potentiometer at a point approximately one-half way between its limits of motion.
- (11) Momentarily depress the RESET key. Adjust the ZERO ADJ potentiometer so that the TOTAL DIST meter indicates zero. Restore the SIGS key to normal.
- (12) Hold the CAL key operated. Adjust the BIAS potentiometer so that the indication of the BIAS meter averages at S15. Still holding the CAL key operated, adjust the AMP ADJ potentiometer while repeatedly operating the RESET key until the indication of the TOTAL DIST meter rises to 15 between operations of the RESET key. Release the CAL key.
- (13) Hold the CAL and REV CAL keys operated. The BIAS meter indication should average at S15. The TOTAL DIST meter indication should rise to 15 after momentary operations of the RESET key. If the latter is less than 14 or more than 16, varistors VR11 and VR12 of the rectifying peak voltmeter circuit should be checked. Release the CAL and REV CAL keys.
- (14) If the set has been calibrated previously, set the DECR control at the value indicated on the card on the panel. If the set has not been calibrated previously, obtain a preliminary setting of the DECR control by operating the SIGS key to S, operating the ADJ DECR key and adjusting the 60-speed DECR control until the TOTAL DIST meter reads 35. Return the ADJ DECR and SIGS keys to normal.
- (15) Operate the ADJ SPD key. Adjust the 60-speed dials COARSE and FINE until the indication of the BIAS meter is at a minimum, waiting a few seconds for the slow responding bias meter to reach its final reading between adjustments. Restore the ADJ SPD key to its normal position.
- (16) Determine the final TOTAL DIST meter indication to be used in setting the DECR control as follows:
 - (a) Operate the ADJ DECR key, and turn the DECR control fully counterclockwise.

- (b) While receiving polar calibrating test signals (SIGS key normal) momentarily depress the RESET key and then note the TOTAL DIST meter indication.
- (c) Operate the SIGS key to S. Adjust DECR control until the TOTAL DIST meter indicates the value noted in (b).
- (d) Repeat (b) and (c) twice to obtain the final settings. If the set is known to be in good condition, write the TOTAL DIST meter indication on the simplified calibration instructions. If the set is not known to be in good adjustment, proceed with the remainder of the adjustment procedure, then repeat steps (a), (b), and (c) above.
- (17) Hold the M-S ONLY key operated. Adjust the 60-speed ORIENT control so that the BIAS meter indicates at zero, again waiting for the slow responding meter to reach its final reading between adjustments. Release the M-S ONLY key.
- (18) Refine the adjustments by repeating (15) and (17).
- (19) The BIAS meter reading should not be greater than 1 percent. If this requirement is not met, one of the 255A relays (A, C, or D) is probably biased. These relays should be checked. A small amount of bias in the C and D relays is not objectionable if the two relays are biased alike. This may be checked by interchanging the relays.
- (20) Momentarily depress the RESET key. The TOTAL DIST meter reading should not exceed 2 percent. If it does, there is excessive distortion in the source of signals or in the set relays.
- (21) While depressing the M-S ONLY key, adjust the ZERO ADJ potentiometer so that the reading of the TOTAL DIST meter is zero. Release the M-S ONLY key.
- (22) Momentarily depress the RESET key. The TOTAL DIST meter reading should be 0 to 1 percent.
- (23) Operate the CODE key to 6 and adjust the CHAR potentiometer to the highest setting (clockwise) at which the TOTAL DIST meter indicates as high as possible but still on scale, between momentary operations of the RESET key. Restore the CODE key to 5.
Note: This operation of the CODE key to 6 is to adjust the set for 5-unit code operation and is not a part of the operations (described below) to adjust the set for 6-unit code operation.
- (24) At the time of installation and occasionally thereafter, checks should be made with biased test signals obtained from a 1A teletypewriter test set, a 119-type signal biasing or distorting set, or a 911-type test set by gradually increasing marking bias and then gradually increasing spacing bias to determine whether the TOTAL DIST meter indication follows directly and smoothly as the bias is increased. A suitably adjusted 118C3 or 118C4 set should follow the distortion of the test signals within ± 2 percent distortion. (A single exception occurs in the case of 100-speed signals supplied by the 119A set. Here, the output of the 119A set contains some characteristic distortion in addition to the desired bias, and the TOTAL DIST meter will read distortions of 3 to 5 percent more than the bias indicated by the reversals calibration of the 119A set.)
- (25) If a set does not follow the input distortion smoothly, the cause may be internal distortion, in the polar relays, or it may be inequality in response between the two rectifier tubes A and B in the peak voltmeter circuit. Relays which meet the test table requirements may still have some small bias when inserted in the measuring set, because of change in the surrounding magnetic fields or because of the waveshape of the operating current.
- (26) At the time of installation and occasionally thereafter, check the rate at which the TOTAL DIST meter indication decays after a large distortion is indicated. With signals from a POL CAL jack operating the set, momentarily disconnect the signals so as to cause a large distortion indication. Do not depress the RESET key. The distortion indication should decay very slowly, taking at least 30 seconds to drop from about 30 percent to about 10 percent.

2.03 75- and 100-Speed Adjustment: The procedure below assumes that the set has been adjusted for 60 speed.

- (1) Repeat 2.02, (1) using the 75-speed POL CAL jack.
- (2) Operate the 60-, 75-, and 100-speed key to 75.
- (3) Repeat (14) to (18) inclusive, of 2.02, using the 75-speed controls instead of the 60-speed controls.
- (4) Momentarily depress the RESET key.
- (5) The BIAS meter reading should not exceed 1 percent and the TOTAL DIST meter reading should not exceed 2 percent.
- (6) Repeat 2.02, (1), using the 100-speed POL CAL jack.
- (7) Operate the 60-, 75-, and 100-speed key to 100.
- (8) Repeat 2.02, (14) to (18), using the 100-speed controls.
- (9) Restore all keys to normal and remove the patch between the TMS IN and POL CAL jacks.

2.04 6-Unit Code Adjustment: The set is calibrated in the normal manner for 5-unit code operation and then used for measuring 6-unit code signals by setting the controls as indicated in the table in 3.09. To measure 6-unit signals at 53 speed, the 5-unit calibration should be at 60 speed, and for 6-unit signals at 66 speed, the 5-unit calibration should be at 75 speed.

2.05 Check in 20-Milliampere Circuits: If the set is arranged for measuring in 20-milliampere loop circuits, the .020A key should be operated, and the indications of the BIAS and TOTAL DIST meters checked using a source of undistorted miscellaneous signals in a 0.020-ampere local circuit. The readings obtained should be within ± 1 percent of those obtained with the same source operating the set in a 0.0625-ampere local circuit.

2.06 Check in Type 1 Hub Circuits: When the set is arranged for measuring the -48 volt type 1 hub signals of the No. 1 serviceboard, the HUB key should be operated and the readings of the BIAS and TOTAL DIST meters checked by patching a source of -48 volt, type 1 hub test signals to the TMS IN jack. These readings should not differ by more than ± 1 percent from those obtained when the set was calibrated with signals obtained from the POL CAL jack.

2.07 Adjust in 2 and 9B Serviceboard Offices: Calibrate the set with polar calibrating signals as outlined in the preceding paragraphs. Then check with type 2 hub test sentence signals sent from the serviceboard through the associated coupling unit. The BIAS and TOTAL DIST meter readings should not change by more than about 1/2 percent distortion.

B. Simplified Local Check Procedure

2.08 This procedure is for a local check of the set and assumes it to have been in operating condition and warmed up. A set of these instructions suitable for cutting out and mounting in the 3-1/2 by 4-inch card holder on the distributor panel of the set are shown in Table A.

3. MEASUREMENT

A. General Method

3.01 The testing method employed with this set is to observe, on the meters at the extension or at the set, the bias and the peak distortion of the teletypewriter signals in the telegraph local circuits. The input relay of the set is patched into the local circuit by way of the input TMS IN jack, or connected into test cords by operation of keys at serviceboard positions.

3.02 If the set is being used at another extension, the BSY lamp (or the TMB lamp at serviceboards) will be lighted steadily. The circuit is arranged so that there will be no interference between working telegraph circuits, if connections are made at the same time to the input of the set at different locations. When the lamp at the extension goes out, the user at that extension automatically has possession of the set or may obtain possession by pushing his READ key, if one is

provided. Subsequent flashing of the busy lamp at 60 ipm indicates that another user desires the set. If the lamp flashes continuously at 120 ipm, this indicates that either the CODE key at the set is operated to 6 rather than to 5, or that the SPEED key at the set is operated so that the speed setting is not one of the two normal settings used at the extensions. When the lamp flashes at the 120 ipm, there is no 60-ipm indication to advise the user that use of the set is desired at another location. If a SIGS lamp is provided (optional), it will flash in response to the signals in the loop circuit to advise the attendant that signals are present.

3.03 The BIAS and TOTAL DIST meters indicate bias and total distortion, respectively, in percent of a unit element.

3.04 The character and magnitude of the BIAS meter indications depend on the number of transitions in the received signals. The set is calibrated with test sentence signals, which have, on the average, 4 transitions per character. To convert readings made with other kinds of signals, a correction factor should be applied in accordance with Table B.

TABLE B
BIAS READING CORRECTION FACTORS
TO CORRECT FOR DIFFERENCES IN THE AVERAGE NUMBER OF
TRANSITIONS PER CHARACTER

SIGNALS	AVG NUMBER OF TRANSITIONS PER CHARACTER	MULTIPLY BIAS METER READINGS BY
Reversals	8**	1/2
<i>5-Unit Code</i> (60, 75, or 100 speed)		
Test Sentence*	4	1*
Blank, T, O, M, V, and LTRS	2	2
<i>6-Unit Code</i> (53 or 66 speed)		
Any 6-unit signals***	5	0.9

* The standard 5-unit code test sentence is used for the calibration of the set.

** Eight transitions of 23-cycle reversals occur in one 60-speed character length.

*** Special test signals are not ordinarily available in the 6-unit code.

Note: Signals from keyboard sending do not give reliable BIAS meter readings, because the indicated amount of bias varies with the speed at which the characters are sent. Keyboard sending may be useful for total distortion measurements.

3.05 The TOTAL DIST meter indicates the largest values of the total distortion during the period of observation. No correction is required for difference in speed of sending or in the number of transitions per character. Since the fortuitous distortion in a circuit is usually variable, the period of observation for reading total distortion should be long enough to obtain a representative value. This may require only 5 to 10 seconds on a steady circuit. On an unsteady circuit, from a minute to several minutes may be required, and longer if occasional hits are being experienced.

3.06 For a single outstanding peak of fortuitous distortion rising substantially above the average level, the TOTAL DIST meter reading will be only about 70 percent of the peak value. This is because the duration of the peak is not sufficient to fully charge the condenser in the peak indicating circuit. Usually, however, a succession of distortion peaks of about the same size occur frequently enough so that no correction of meter readings is required.

B. Procedure

3.07 The general procedure in testing at *telegraph test boards* is as follows:

- (1) Insert a patch cord in the TMS IN jack and patch to the local circuit containing the signals to be observed.
- (2) Observe that the set is not busy (BSY lamp dark) and that the .020A and POL keys and speed controls are properly operated.

(3) Note the BIAS meter reading. Momentarily depress the RESET key and then note the TOTAL DIST meter reading. If a READ key is provided, this key must be held depressed while making the observations.

(4) Remove the patch, first removing the plug from the jack of the local circuit under test to avoid causing an interruption to service.

3.08 At serviceboards, access to the transmission measuring set is obtained through keyshelf cords, as shown in Table C.

After connection is made to the set through a suitable cord, proceed with the steps of 3.07.

C. Six-Unit Code Signals

3.09 For the measurement of 6-unit code signals, the set should be calibrated in the normal manner with 5-unit code signals. Then, for measuring, the controls should be set as indicated in Table D.

The resulting BIAS meter readings should be multiplied by 0.9 to correct for the effect of the different number of transitions per character in the measured signals. No correction is required for the TOTAL DIST readings.

D. Reversals

3.10 The 118C3 or 118C4 set may be used for the measurement of the distortion of telegraph reversals, if the set is adjusted for the

TABLE C

NO. 1 SERVICEBOARD	NO. 2 AND 9B SERVICEBOARDS	
	FACILITIES POSITION	SERVICE POSITION
TTY Cord	TTY Cord	TTY Cord
Telegraph Cord	Telegraph Cord	Telegraph Cord
Test Signal Cord	Neutral Cord	Test Signal Cord
		TWX Legs Mon Cord

TABLE D
SETTINGS FOR MEASURING 6-UNIT CODE SIGNALS

6-UNIT WORD SPEED	CODE KEY SETTING	60- 75- 100-SPEED CONTROL	SIGNAL ELEMENT LENGTH (MILLISEC)	BAUD RATE
53	6	60	22	45.5
66	6	75	17.6	56.9

speed corresponding to the reversal rate, for example, 60 speed for 22.7-cycle (nominal 23-cycle) reversals. The BIAS and TOTAL DIST meters should be read in the usual way. The BIAS meter indication should be divided by two to obtain the percent bias. The TOTAL DIST meter indicates correctly. If the readings are small, it may be assumed that the reversals are of good quality.

E. Use of Recording Meter

3.11 For special engineering tests involving observations over long periods, a record may be made of the total distortion by connecting a recording meter, such as an Esterline-Angus 5-0-5 milliamper meter of the type used with the 117-type stability test set, by way of the RCRD jack in the miscellaneous jack strip, if this jack is provided. This connection inserts the meter into the tube C cathode circuit of the rectifying peak voltmeter. Current of approximately 5 milliamperes corresponds to zero distortion. Set the recording meter and the TOTAL DIST meter to zero at the same time. The indication of the recording meter should be divided by two (approximately) to obtain the actual distortion.

4. MAINTENANCE

4.01 With the exception of difficulties which cause complete failure of the set, the best criterion for the condition of the parts, relays and tubes, is their performance in the set. Dirty contacts and bias in relays, and aging of tubes are likely to be the main sources of trouble.

4.02 The relays of the set should be maintained in accordance with standard instructions outlined in Bell System Practice Sections on Central Office Maintenance. The contacts of relay P of the distributor panel should be burnished and the adjustment checked at 6-month intervals.

4.03 A need for maintenance work on other parts of the set, especially the tubes, is indicated if there is difficulty in obtaining a satisfactory calibration after checking the relays. The tubes, with the exception of the 338A tube, may be checked with the available models of the Hickok tube tester. The 338A tube should be replaced if it is suspected of being faulty.

4.04 Low electron emission in tube E (349A) of the constant current supply is a possible cause of undesirable drifting of the constant current by 1 or 2 ma. When this condition is encountered, substitution of the 349A tubes should be made to obtain satisfactory performance.

4.05 Undesirable variation in the constant current may also be caused if the primary taps on the power transformers are not connected for for the *lowest* ac supply line voltage usually obtained. Taps are provided for 107.5 volts, 115 volts, and 122.5 volts, respectively. If the voltage regular (VR) tubes do not glow, it is probably an indication that the ac line voltage is lower than the value for the tap in use.

4.06 Periodic checks of the set are suggested, as follows:

- (1) Daily overall check with good signals. This consists of merely applying the polar calibrating signals to the set and noting the meter indications to see that they are within limits.
- (2) Three-month check of relays. Make a complete adjustment per Part 2(A) at this time.
- (3) Tubes should be checked only when trouble is suspected.

4.07 Low TOTAL DIST readings, of the order of half the BIAS readings or less, may be an indication of an open electrolytic capacitor in the reference voltage circuit.