

## 1A TELETYPEWRITER TEST SET DESCRIPTION

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### 1. GENERAL

1.01 This section describes and gives operating information on the 1A Teletypewriter Test Set. This set provides a single source of accurate teletypewriter testing signals primarily for determining distortion tolerances of teletypewriters or regenerative repeater receiving mechanisms. This set may also be used as a source of test signals when testing between central offices and subscriber stations or in testing between central offices.

1.02 The single source of test signals is obtained directly from the distributor face on an open-and-close basis. Repeated test sentences or repeated selected test characters may be obtained. The test sentence is "The quick brown fox jumps over the lazy dog's back 1234567890" followed by station identifying characters and is identical with that provided by multiple senders. Any

one of the test characters BLANK, T, O, M, V, LETTERS, R and Y may be sent repeatedly.

1.03 The signals produced may be biased or may have end distortion in any desired amount up to approximately 100 per cent. marking or spacing. (With bias all space-to-mark transitions are shifted with respect to the start pulse and with end distortion all mark-to-space transitions are shifted with respect to the start pulse.) Gears are provided to permit obtaining 60 or 75 speed signals.

1.04 Polar signals or inverse neutral signals may be obtained by transmitting the signals from the 1A set through standard one-way repeaters.

1.05 The test set may be permanently mounted on any convenient horizontal surface, including a battery shelf on a relay rack where this type of mounting is desired. In some cases it may be desired to mount the set on a standard large table type wagon so that the 1A set may be wheeled to a telegraph or testboard.

1.06 115-volt 60-cycle a-c, or 115-volt d-c power supply is required for driving the motor and 110 to 130-volt d-c for lighting the small neon lamp used for viewing the signals.

### 2. DESCRIPTION

2.01 Fig. 1 shows a front view of the 1A teletypewriter test set with the viewing hood and the distributor faceplate removed in order to show the face and brush assembly. The unit measures 19-1/4" wide by 13-1/4" high by 19-1/4" deep, overall. These dimensions include the viewing hood which extends 6" beyond the base casting. The exterior surfaces are finished in a black wrinkled finish.

2.02 The distributor face is equipped with six concentric rings. The two outer rings are segmented and the outer segmented ring may be oriented with respect to the inner segmented ring. The angular displacement of the corresponding segments of these rings with respect to each other determines the amount of distortion transmitted. The next pair of solid rings are the common rings associated with the two segmented rings; the two inner solid rings are collector rings for a neon lamp which is used as a distortion indicator.

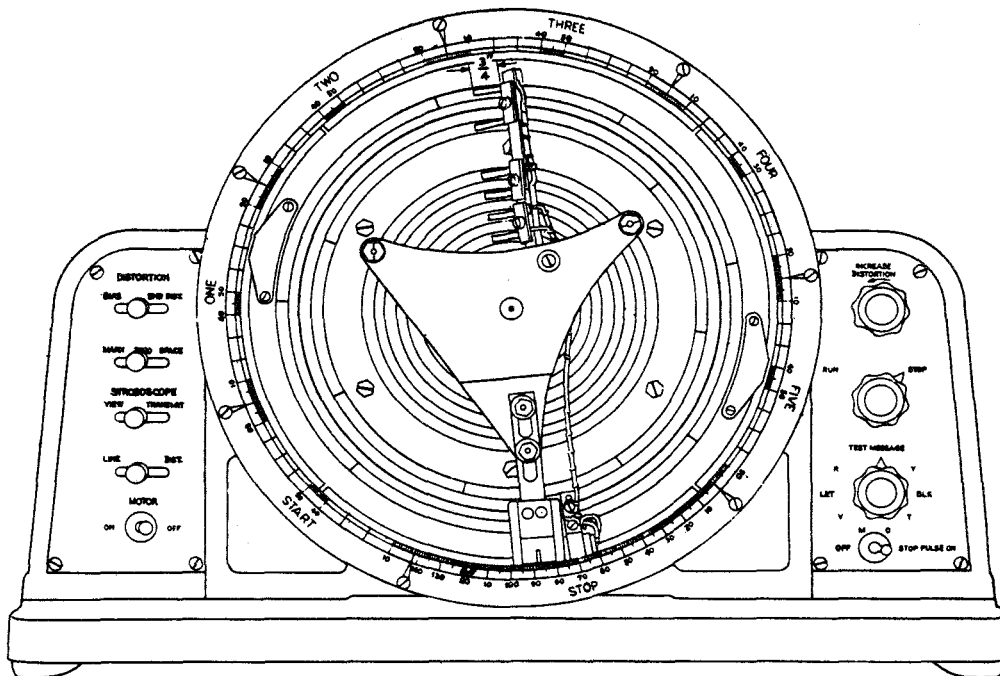


Fig. 1 - Front View of 1A Test Set

2.03 The brush arm assembly is equipped with six woven wire brushes and is balanced by an arm equipped with a neon lamp, the light of which may be viewed through a narrow slot in the lamp holder arm. A cutout in the faceplate which normally covers the distributor face permits viewing the slotted portion of the lamp holder arm.

2.04 A scale graduated in per cent. of a unit signal impulse is used as a means of indicating the amount of distortion being transmitted. As the lamp revolves with the distributor brush arm, it is lighted during marking impulses so that the positions of the beginnings and ends of marking pulses may be noted with respect to the scale.

2.05 A cylindrical viewing hood is mounted over the movable scale to exclude extraneous light and facilitate more accurate observation of the points where the neon lamp is lighted and extinguished.

2.06 To the left of the face are four three-position lever-type keys and a switch, as follows:

- (1) The first key (top) is for selecting "BIAS" or end distortion "END DIST."
- (2) The second key is for setting the bias or end distortion to "MARK," "ZERO" or "SPACE."

(3) The third key "STROBOSCOPE" is for connecting the transmitting rings to the neon lamp in the "VIEW" position or to the outgoing line circuit in the "TRANSMIT" position.

(4) The fourth key is for connecting the neon lamp to an external line for testing incoming signals in the "LINE" position or to the distributor for calibration in the "DIST" position.

(5) The MOTOR switch is for starting or stopping the motor.

2.07 To the right of the face are three knobs and a switch for the following purposes:

(1) The first knob (top) is for adjusting the amount of distortion to be transmitted.

(2) The second knob in the "STOP" position short-circuits the outgoing line, to prevent opening the line circuit when calibrating the set. In the "RUN" position the short-circuit is removed.

(3) The third knob is for selecting the characters to be transmitted. In addition to the test message, any of the repeated character combinations R, Y, BLANK, T, O, M, V and LETTERS may be selected.

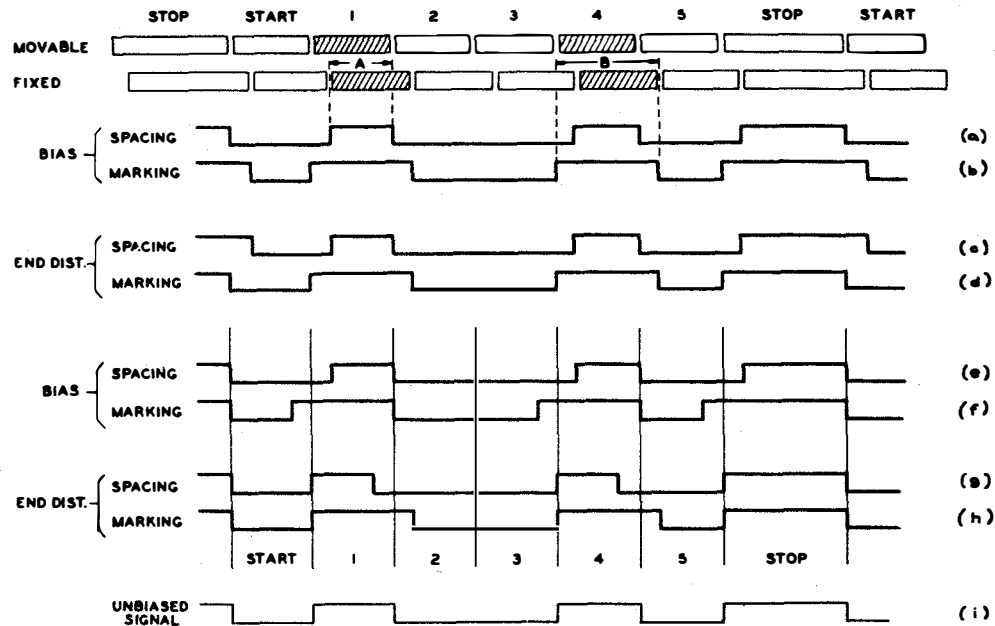


Fig. 2 - Examples of Distorted Signals

(4) The toggle switch at the bottom is for disconnecting the stop pulse where transmission of unit-length impulses is desired.

2.08 The motor unit is mounted to the rear of the face at the left side, and is one of the standard 15-type motor units.

2.09 The motor pinion and main shaft gears are of tapered sleeve construction to permit accurate alignment. As the gear is tightened on the tapered tube, the sleeve is compressed about the shaft, clamping the gear securely to the shaft.

2.10 The main shaft is equipped with a pulley and wedge arrangement which prevents rotation of the brush arm in the reverse direction and resultant damage to the brushes.

2.11 To the rear of the face near the right side of the unit are the character sending cams driven from the main shaft by a train of gears. To the right of these cams are the associated selecting contacts and combination selecting cam which is rotated by means of the lowermost knob at the right.

2.12 The weight of the test set with aluminum castings is about 65 pounds. In some sets, however, the weight may be about 125 pounds due to the use of cast iron in place of aluminum.

3. PRODUCTION OF BIAS AND END DISTORTION

3.01 Means by which various amounts of bias or end distortion are obtained and examples of signals with 25 per cent. bias and end distortion will be explained by reference to Figs. 2 to 6.

3.02 At the top of Fig. 2 are shown diagrammatically the fixed and movable segments with the movable segments shifted 25 per cent. of a sending segment to the left to produce 25 per cent. distortion.

3.03 When spacing bias is desired, the segments are connected as shown in Fig. 3 by means of the two upper keys at the left of the face. Since the segments are connected in series, current will flow through the selected segments of the two rings only during

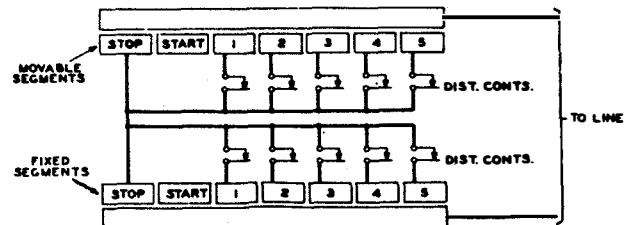


Fig. 3 - Connections for Spacing Bias

the time the selected segments overlap as shown by "A" of Fig. 2. The resulting signal trace for the combination illustrated - letter "D" - is shown at trace "a" of Fig. 2.

3.04 When marking bias is desired, the segments are connected as shown in Fig. 4 by means of the two upper keys at the left of the face. Since the segments are connected in parallel, current will flow during the time "B" of Fig. 2. The resulting current is shown by trace "b."

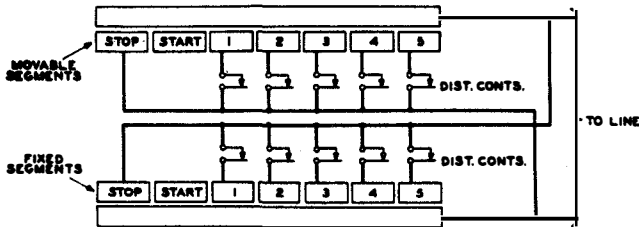


Fig. 4 - Connections for Marking Bias

3.05 When spacing end distortion is desired, the segments are connected as shown in Fig. 5 by means of the two upper keys at the left of the face and since the segments are again connected in series, current will flow when the selected segments overlap, resulting in signal trace "c" of Fig. 2. It will be noted that the "Start" and "Stop" segments of the movable segment ring are connected together resulting in a start pulse always equal to a unit-length pulse.

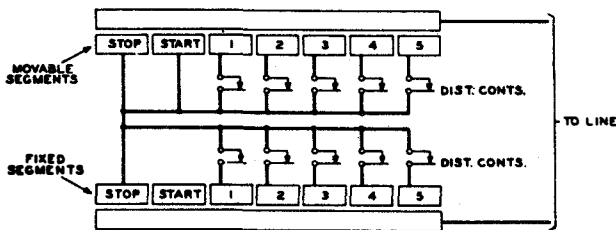


Fig. 5 - Connections for Spacing End Distortion

3.06 When marking end distortion is desired, the segments are connected as shown in Fig. 6. It will be noted in this case that only one stop segment is used and that the several selecting segments are connected in parallel. The resulting current is shown at trace "d" of Fig. 2.

3.07 Signal traces e, f, g and h in Fig. 2 are identical with traces a, b, c and d

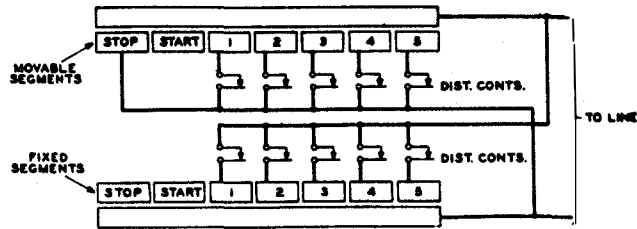


Fig. 6 - Connections for Marking End Distortion

except the beginnings of the start pulses are brought into line with each other to illustrate the manner in which the signals appear to a start-stop receiving selector mechanism.

3.08 Unbiased signals are obtained from the fixed segmented ring and trace "i" in Fig. 2 shows the unbiased signals for comparison with the signals illustrating distortion. In this trace, again, the signal is shown shifted so that the beginning of the start pulse is lined up with those of traces e, f, g and h.

#### 4. OPERATION

##### (A) Connections

4.01 At the rear of the base on the underside are two terminal blocks. As received from the factory, a power cord is connected to the terminals labeled "Motor Power," S2L cords equipped with 347-type plugs are connected to the "Signal Line" and "Stroboscope" terminals and S1C cords equipped with 347-type plugs are connected to the "+ and - 110 V d-c" terminals. Any d-c voltage between 110 volts and 130 volts may be used for the 110-volt supply. (If at the location at which the test set is used 130-volt d-c battery does not terminate in switchboard type jacks, it will be necessary to remove the two S1C cords and to install a sufficient length of No. 18 Tyrex cord equipped with a plug corresponding to the type of d-c receptacle provided.) The d-c power supply must be polarized as shown on the wiring diagram (Fig. 8) to provide for illumination of the front electrode of the neon lamp.

4.02 The signals from the 1A set are open-and-close. In case it is desired to send polar signals, or to send inverse neutral signals, it is necessary to repeat the signals from the 1A set through a relay arranged to retransmit them in the desired manner. Standard one-way repeaters are suitable for the purpose.

4.03 To send polar signals into a 60-milliampere circuit using  $\pm 130$  volts, the "Signal Line" cord of the 1A set may be connected into a 60-milliampere dummy containing the input side of a 13C1 repeater or a 13F1 repeater arranged for neutral operation. The output sides of these repeaters transmit polar signals. The noise-killer in the output side of the repeaters should be removed for this condition. For 20-milliampere circuits it will be necessary to add resistance in the output side to reduce the current to 20 milliamperes, since the resistances normally provided are for 60 or 30-milliampere circuits.

4.04 To send signals into an inverse neutral or hub circuit, a 90A1 repeater may be used.

#### (B) Calibration

4.05 In the following the four keys to the left of the face will be referred to as keys 1 to 4, key 1 being the key at the top; the three knobs to the right of the face will be referred to as knobs 1, 2 and 3, knob 1 being at the top.

4.06 Procedure:

- (1) Connect the motor power plug to a source of power corresponding to the type of motor unit used.
- (2) Connect the 110-volt d-c cord to a source of 110 volt or 130 volt d-c.
- (3) Operate key 1 to "BIAS."
- (4) Operate key 2 to "MARK."
- (5) Operate key 3 to "VIEW."
- (6) Operate key 4 to "DIST."
- (7) Turn knob 2 to "STOP."
- (8) Turn knob 3 to "R."
- (9) Turn motor switch "ON."

Note: Check that the switch at the right of the face is turned to "ON."

- (10) Rotate the movable scale - this may be done by grasping and rotating the hood - to bring the end of the stop pulse, as indicated by the neon lamp trace, opposite the end of the stop arc (beginning of the start arc) of the graduated scale.

(11) Rotate knob 1 to give the desired amount of bias as indicated by the neon lamp trace on the scale. Check the bias for each marking segment - 2, 4 and stop. Dirt on the segments or brush bounce is indicated by a broken light trace. Any such condition should be corrected before proceeding further.

(12) Turn knob 3 to "Y" and check the light traces for the marking pulses as just described for the "R" combination.

(13) Operate key 2 to "SPACE" and check the amount of bias being transmitted. The amount of spacing bias should be the same as the amount of marking bias just observed within 1 per cent.

Note: If the brushes are flat, the amount of spacing bias will be less than the amount of marking bias. When this condition occurs, the brushes should be replaced by freshly cut brushes.

4.07 The calibration procedure for end distortion is as outlined above except key 1 is operated to "END DIST."

4.08 The calibration procedure given above specifies that the amount of distortion for which the set is to be calibrated is determined by observing the neon lamp indicator when the indicator is connected directly to the signal output of the 1A set. This procedure is recommended for all cases, regardless of whether the signals are retransmitted through a 13C1, 90A1 or 13F1 repeater as it avoids the necessity of making special arrangements for using the neon lamp on the output sides of these repeaters and standardizes the operating conditions for the neon lamp. To avoid any undesirably large bias being added by the repeating arrangements, it is well to check the condition of the repeaters by sending undistorted reversals through them and measuring these reversals on the output of the repeaters using a meter-type measuring set, such as the 161A1 set before they are used in connection with the 1A set.

#### (C) Sending Distorted Test Signals

4.09 When the amount of bias and end distortion to be transmitted has been determined as outlined above, distorted signals may be sent by proceeding as follows:

4.10 Procedure:

- (1) Turn knob 3 to the type of signals required.

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- (2) Insert the 347A plug (red) of the S2L cord (connected to the "Signal Line" terminals) into the jack connecting to the apparatus under test.
- (3) Operate key 3 to "TRANSMIT."
- (4) Operate key 4 to "LINE."
- (5) Turn knob 3 to "RUN."

4.11 For transmitting marking or spacing bias, unbiased signals or marking or spacing end distortion keys 1 and 2 are positioned as follows:

<u>Transmitting</u>	<u>Pos. of Key 1</u>	<u>Pos. of Key 2</u>
Marking Bias	Bias	Mark
Zero Bias	"	Zero
Spacing Bias	"	Space
Marking End Dist.	End Dist.	Mark
Spacing End Dist.	"	Space

(D) Local Tests of Teletypewriters and Regenerative Repeaters

4.12 In making local tests of teletypewriter apparatus the bias and end-distorted signals obtained from the 1A set may be used in measuring the bias tolerance, the fortuitous distortion tolerance, the internal bias and the skew of the teletypewriter. Information on these tests is given in another section of the Practices. Certain parts of this information are repeated below, for convenience.

4.13 The bias tolerance is the amount of bias both marking and spacing that a teletypewriter will receive without typing errors when the range finder is at the optimum position for bias.

4.14 The fortuitous distortion tolerance is the amount of fortuitous distortion that a teletypewriter will receive without errors when the range finder is set at the optimum position for the reception of biased signals. This corresponds to the switched-bias tolerance obtained when using the 119-type signal-biasing set.

4.15 Internal bias is the amount of bias within the machine terminals and may be electrical or mechanical.

4.16 The presence of skew is indicated by a teletypewriter responding differently on space-to-mark transitions than on mark-to-space transitions.

4.17 The above quantities may be calculated from the results of four orientation limit values obtained from the four different types of distortion available with the 1A set when using a distortion value which is known to be less than the maximum capability of the teletypewriter. Formulae are given below for these calculations.

4.18 The four values of orientation limits are: (a) the upper limit using marking bias, (b) the lower limit using spacing bias, (c) the upper limit using spacing end distortion, (d) the lower limit using marking end distortion.

Note: The limit (b) should be lower than the limit (a). If the machine does not have a bias tolerance as high as the bias in the signals then a lower value of bias in the signals must be used for the test.

4.19 Calculation of the bias and fortuitous distortion tolerances, the internal bias and the skew are made from the following formulae. They do not apply to monitoring teletypewriters having end-zero scales. It is assumed that the range finder is set at the point resulting in equal marking and spacing bias tolerance.

(1) Bias tolerance = bias in test signals + 1/2 (a-b)

(2) End-distortion = bias in test signals tolerance + the difference between the value 1/2 (a+b) and c or d whichever gives the smaller quantity.

Fortuitous distortion tolerance = result obtained in (1) or (2) whichever is the smaller.

Internal bias = 1/2 (c+d) - 1/2 (a+b)

Skew = 1/2 (c-d) - 1/2 (a-b)

(E) Tests from Central Offices to Stations

4.20 When the 1A set is used for testing from a nearby central office to a subscriber station, the test signals and the distortion requirements as given in the Section entitled, "Teletypewriter Stations - Orientation and Distortion Tests," should be used.

4.21 When tests of teletypewriters are to be made over loops the same type of signal should be used during the test as is used

operate the loop in service. This is particularly important in the case of pulling magnet and holding magnet teletypewriters without line relays.

4.22 If open-and-close signals are required, they may be obtained directly from the 1-A set. If polar signals are required they may be obtained as described above under subheading "Connections."

#### (F) Tests over Line Sections

4.23 When testing over lines it will generally be sufficient to send substantially undistorted signals from the 1A set and measure these on a 118-type measuring set at the receiving end. In some cases it may be desirable to test the bias tolerance, that is, the margin against bias variations, by sending steady marking and steady spacing bias up to the amount where the 118-type set at the receiving end indicates excessive distortion or failure.

4.24 To send signals having a known distortion over a line section, the output of the 1A set may be connected directly in the TLT terminating the section, providing all loops are removed and the current readjusted. In the case of a service-board office it is necessary to send the signals through a 90AL loop repeater to the hub circuit and thence to the line section. If the loops are not removed, they may modify the signals and change the amount of distortion in them, as determined in the calibration, before they reach the line circuit.

#### (G) Measurement of Received Signals

4.25 The neon lamp indicator of the 1A teletypewriter test set may be used to check signals received from an external transmitter distributor or other teletypewriter transmitting equipment if (1) the signals are being sent continuously as from automatic tape, and (2) the sending speed of the signals is identical with that of the 1A teletypewriter test set. Signals sent to a distant station and returned on a loop-back basis may be measured readily by means of the neon lamp indicator. Repeated signals from a distant brush-type transmitter may also be measured but in this case any speed irregularity or speed difference will cause an error in the results.

4.26 The measurement of signals on a synchronous basis, since it eliminates the start-stop effect, will generally indicate less distortion than is obtained when measuring on a start-stop basis as with 118-type

sets. For this reason the measurement on a start-stop basis as by means of a 118-type set is generally preferable.

#### 4.27 Procedure:

- (1) Insert the 347B plug (black) of the S2L cord connected to the stroboscope terminals into the output of the signal source under test.

Note: The d-c voltage for lighting the neon lamp must be supplied from the incoming signals. The voltage should be 75 volts or more to light the lamp and the poling should be such as to light the front electrode. It may be obtained by connection across a resistance in the receiving local circuit; a 2000-ohm resistance in the case of a 60-milliampere circuit and 6000-ohm resistance in the case of a 20-milliampere circuit. Any considerable amount of wiring between the source of signals and the test set will affect the operation of the lamp.

- (2) Operate the motor switch to the "ON" position and key 4 to the "LINE" position.
- (3) Operate the transmitting equipment under test to send a single character repeatedly and continuously.
- (4) Rotate the movable scale to line up the end of the stop arc of the scale with the end of the stop trace of the neon lamp.
- (5) Observe the relation of the neon lamp trace with the graduated scale from which the distortion present in the signals from the external source may be determined. (Any constant difference in speeds between the two rotating units will result in a creeping of the lamp trace around the scale.)

#### (H) Accuracy

4.28 Signals obtained directly from the distributor face on an open-and-close basis should have no more than  $\pm 1$  per cent. distortion. This amount of distortion is normally expected and is due to the inaccuracies of the brush contacts, cutting of the segments and gears. The neon lamp indicator affords a direct indication of the output of the set and when carefully used it permits adjusting the set to within  $\pm 1$  per cent. distortion of the desired distortion.

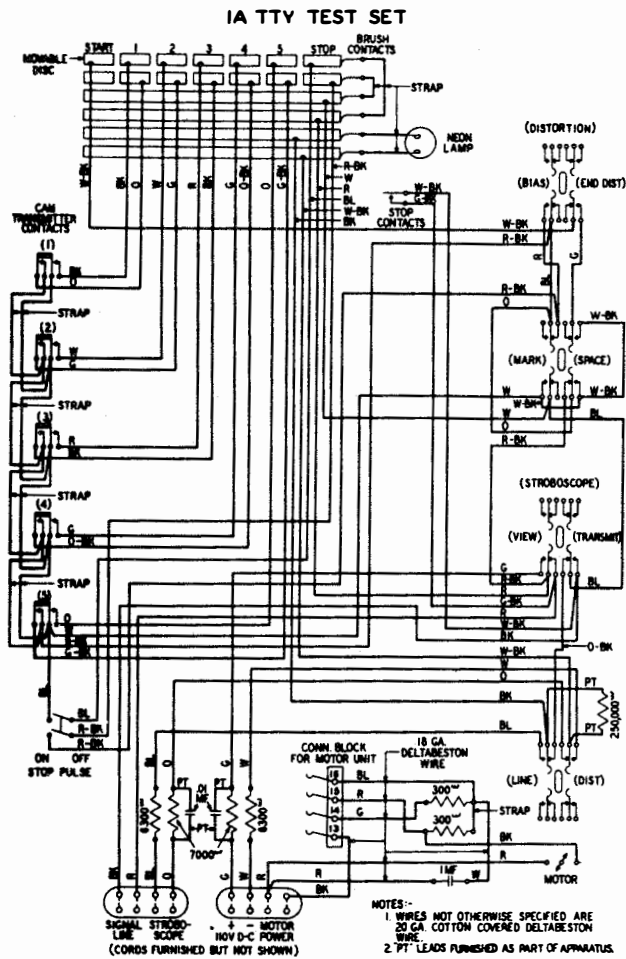


Fig. 7 - Wiring Diagram of 1A Set

4.29 When signals are transmitted through a repeating relay, a small amount of additional distortion will be introduced by the relay but this in general will not exceed about  $\pm 1/2$  per cent. if the relay is in good condition.

**5. WIRING DIAGRAM**

5.01 The diagram of connections internal to the 1A teletypewriter test set and the connections of the cords furnished as a part of the 1A teletypewriter test set are shown in Fig. 7 and Fig. 8, respectively.

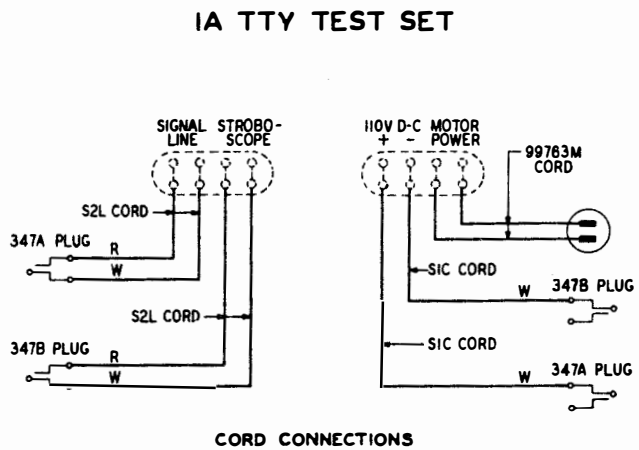


Fig. 8 - Cord Connections