METALLIC TELEGRAPH SYSTEM EQUALIZATION

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1. GENERAL

1.01 This section describes the equalizers used for metallic-telegraph facilities in cable.

1.02 In general, the term equalization as applied to telegraph refers to the process of adjusting the transmission characteristics of a telegraph circuit to reduce the characteristic distortion of telegraph signals transmitted over the circuit.

1.03 Telegraph transmission over a 4-wire metallic circuit is subject to distortion due to unequal attenuation and delay of the different frequencies involved. Since it is generally impossible to increase the amplitude of the frequencies which have been most affected by attenuation an equalizer is employed to attenuate the frequencies least affected by the line and composite sets, thereby reducing signal distortion. If these telegraph equalizers were applied at the sending end of the telegraph line facilities, the telegraph line currents might be reduced to such an extent that noise and other interference would adversely affect the telegraph signals. If the sending battery potentials were increased to overcome these effects, then the telegraph line currents might be high enough to cause excessive noise and other interference in telephone circuits. In order to reduce the effect of the distortion, it is necessary that the currents flowing through the receiving relay be properly equalized and therefore the telegraph equalizers are applied at or near the receiving end of the line.

Test Signals for Equalization

1.04 The method of adjusting the equalizers is to send test signals over the cable circuits, measuring distortion at the receiving end and adjusting the equalizer network until satisfactory low distortion is obtained. The signals used are the teletypewriter Blank, T, O, M, V and LTRS characters, each composed of two transitions (mark to space and space to mark).

2. EQUALIZER

2.01 It is found that the effects of characteristic distortion in 4-wire metallic-telegraph signals can be reduced by the use of simple equalizers. The function of the equalizer, as mentioned previously, is to alter the transmission characteristics of the telegraph facility so that the received currents in the receiving relay will produce a signal with reduced characteristic distortion. There are three types of equalizers which are found to be satisfactory, shown in Figs. 1, 2 and 3. The amount of equalization which may be applied is limited by the minimum value of steady-state line current which will give reliable operation. This minimum value will be 0.9 to 1.1 milliampere.

2.02 The equalizer of Fig. 1 consists of a resistance, R1, in series with the line and a condenser, C, bridged across this resistance. This equalizer is generally used to correct for positive characteristic distortion and it has been found that the condenser is rarely required. Increasing the value of R1 reduces the amount of positive characteristic distortion. The condenser may be required

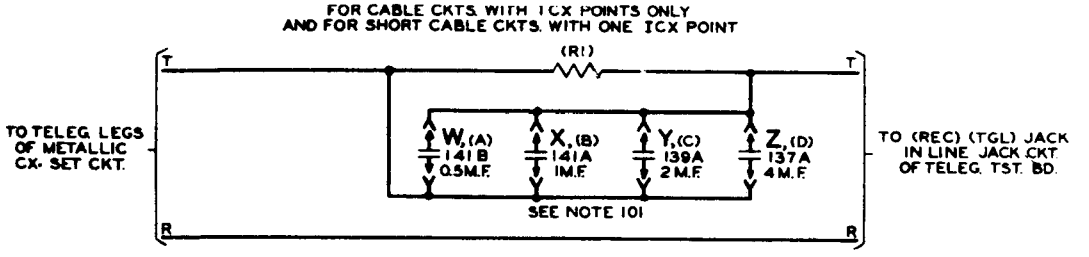


Fig. 1

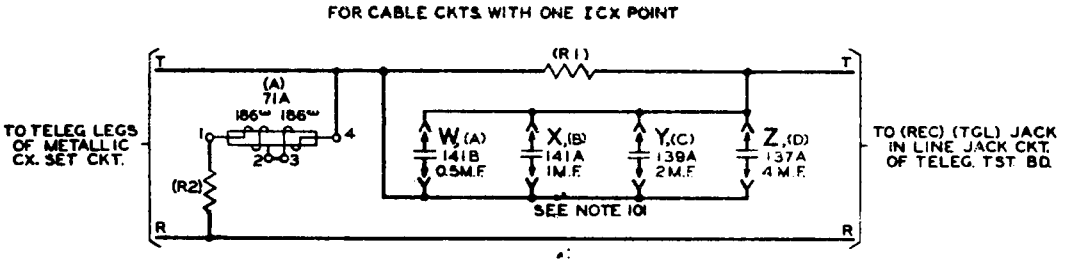


Fig. 2

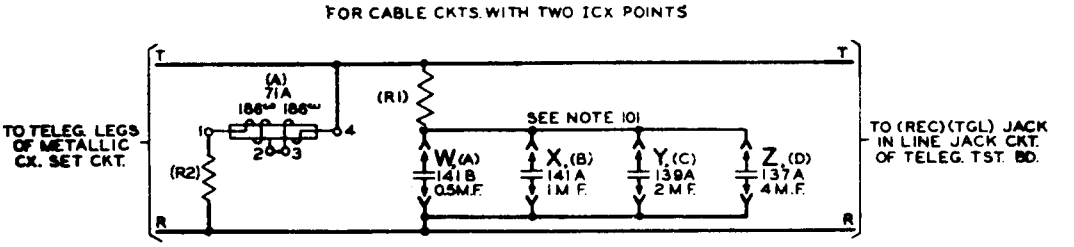


Fig. 3

when the value of R1 is such as to introduce negative characteristic distortion on LTRS and Blank. In such cases, increasing the value of C reduces the negative characteristic distortion.

2.03 The equalizer of Fig. 2 consists of a Fig. 1 equalizer with a retard coil and resistance, R2, bridged across the line on the line side of the Fig. 1 equalizer. Decreasing the value of R2 reduces negative characteristic distortion. The corrections due to R1 and C are as outlined in Paragraph 2.02.

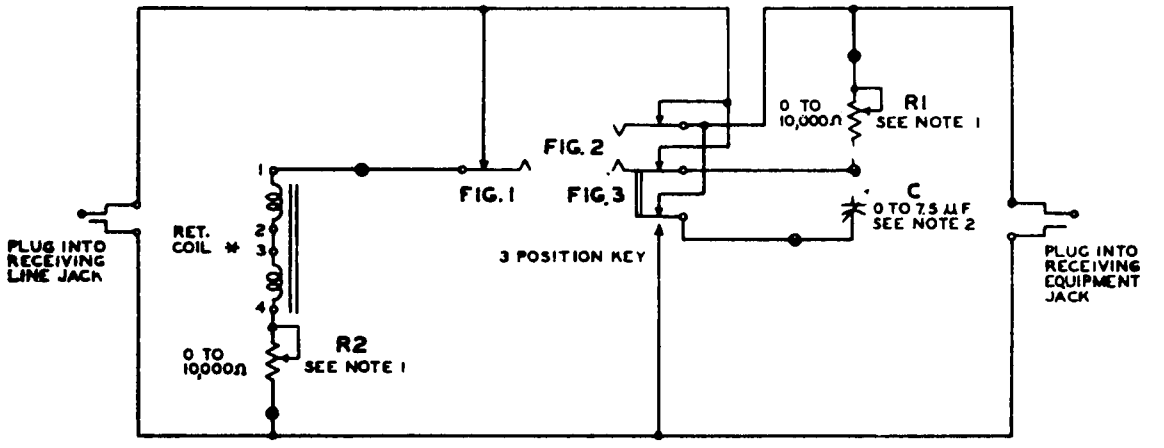
2.04 The equalizer of Fig. 3 consists of two parallel branches bridged across the line. One consists of a resistance R1 and condenser C and the other a resistance R2 and a retard coil. Resistance R2 functions as described in Paragraph 2.03, i.e., decreasing R2 decreases negative characteristic distortion. Increasing the value of condenser C reduces positive characteristic distortion on LTRS and Blank signals.

2.05 For convenience in determining the equalizer constants, a test equalizer, as shown in Fig. 4 should be made up locally. This equipment may be mounted on a board and terminated in cords so that the test equalizer may be patched into the circuit at the receiving terminal. With this arrangement, the adjustment of the equalizer may be accomplished easily and quickly.

3. TESTING EQUIPMENT

(A) Signal Source

3.01 The 100A teletypewriter test distributor is the most suitable source of test characters and should be used in preference to



* USE PARTICULAR COIL TO BE INSTALLED ON CIRCUIT TESTED.

● BINDING POST.

NOTES:
1. USE DECADE RESISTANCE BOX.
2. USE 7A CONDENSER BOX AND BUILD OUT WITH FIXED CONDENSERS.

Fig. 4

any other source for the measurement of characteristic distortion and the determination of equalizer constants. When a 100A distributor can not be made available, the following equipment, listed in order of preference, may be used as a source of test signals:

(a) 1A Teletypewriter Test Set

(b) 14-Type Transmitter-Distributor (Station Type) with 119-type Telegraph Signaling Biasing or Distorting Set

3.02 In order that the accuracy of measurement and correction for bias may be adequate, it is desirable that the distortion of the test signals at their source be as intended. To insure this, measurements of each transmitted character should be made at the sending end, either at the facility position of service boards, or at the transmitting TLT if there is a testboard. For the test signals without prebias, the measured distortion should not exceed 1%; for the 20% prebiased signals, it should be within the range 19-21%. If in the beginning of a series of tests the transmitted signals do not seem to vary, it may not be necessary to recheck each test signal, whether obtained directly from a 1A or 100A set or a 14-type transmitter-distributor, or indirectly through a 119-type set.

(B) Measuring Equipment

3.03 The 161A1 telegraph station test set should be used in determining and checking equalizer constants because of its accuracy and simplicity of operation. When this can not be done, a 118-type transmission measuring set may be used. In these cases, it will be necessary to multiply the 118-set bias-meter indications by 2 in order to obtain correct bias readings for the 2-transition test characters.