INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE TT-1 CARRIER ALARM RELAY

CAUTION Before putting relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment. Make sure that all moving parts operate freely. Inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

APPLICATION

The type TT-1 relay is an auxiliary used with the type HKB relaying system as a carrier alarm relay. It is connected in the relaying receiver plate supply circuit and operates upon the reception of carrier to complete an alarm bell circuit.

CONSTRUCTION

The type TT-1 relay consists of a telephone type relay element mounted in a small semi-flush or projection moulded case. The relay has a single normally open silver contact brought out to two terminals. The relay coil is shunted by a resistor and a capacitor in parallel to cancel the effect of the inductance in the operation of the HKB relaying system. The relay is not polarized, and can be connected without regard to direction of current flow.

CHARACTERISTICS

The pick-up current of the TT-1 relay is 10 milliamperes d.c. and the dropout is 4 to 6 milliamperes. The pick-up current is set higher than the safe minimum receiver current for correct operation of the HKB relay. This allows a check on the carrier channel, and whenever the TT-1 relay pick-up, there is sufficient carrier received for proper relay operation.

The coil circuit d.c. resistance is 285 ohms.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs. Either of these studs may be utilized for grounding the relay. The electrical connections may be made direct to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the relay for ebony-asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

All contacts should be cleaned periodically. A contact burnisher S#182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

The pick-up current of the relay is affected by two factors: the armature gap, and the contact spring tension. The dropout current of the relay is affected by the contact spring tension and the residual gap (armature set screw). The dropout of the relay can be increased by increasing the residual gap. When this is done, the contact gap and follow must be checked. The contact gap in the de-energized position should be at least 15 mils. After the contact closes, the stationary contact should deflect 5 to 10 mils.

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

SUPERSEDES I.L. 41-953
*Denotes Change From Superseded Issue

EFFECTIVE NOVEMBER 1962

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts canbe furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

Relay Styles

Semi-flush relay	1544594
Projection relay	1544595

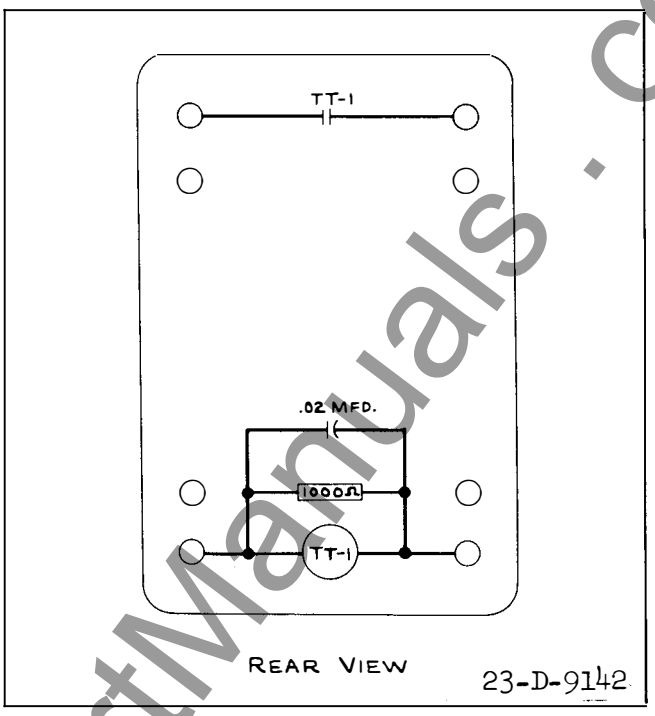


Fig. 1. Internal Schematic of the Type TT-1 Relay.

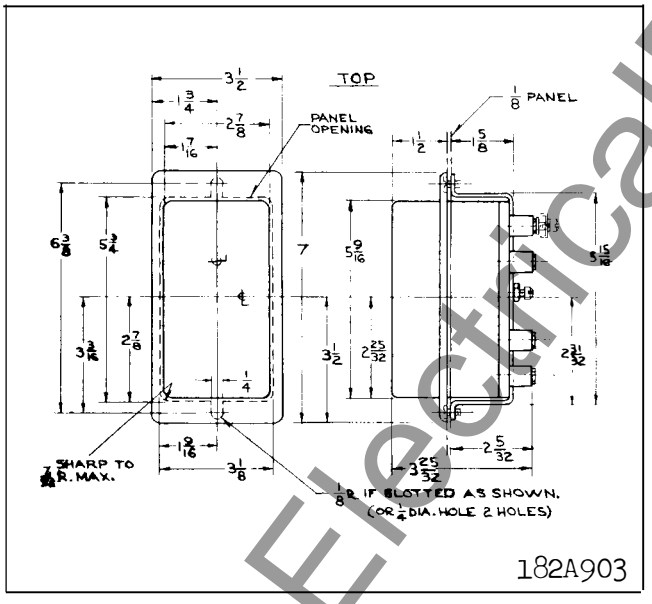


Fig. 2. Outline and Drilling Plan for Type TT-1 Relay in Semi-flush Case. For Reference Only.

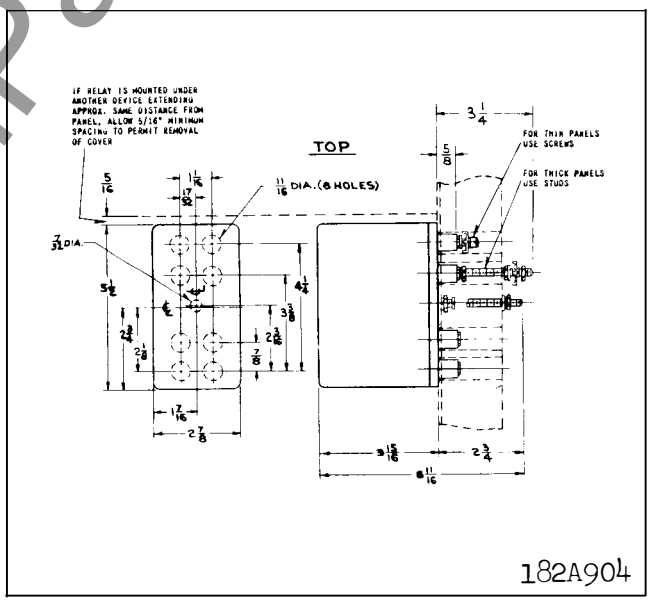


Fig. 3. Outline and Drilling Plan for the Projection Type TT-1 Relay. For Reference Only.

WESTINGHOUSE ELECTRIC CORPORATION
RELAY - INSTRUMENT DEPARTMENT **NEWARK, N. J.**
Printed in U. S. A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE JZ 72.36 LINE COUPLING TUNERS

Two-Frequency Phase-to-Ground Line Coupling Tuner
—with a two-winding matching transformer
—for single coaxial cable input

Type	*Style*	*Description*
JZ 72.36	293B336A17	—(see title above)
JZ 72.36D	290B883A34	—with drain coil
JZ 72.364	290B883A35	—with .006 MFD series capacitor
JZ 72.364D	290B883A36	—with .006 MFD. series capacitor and drain coil

SUPPLEMENTARY DATA

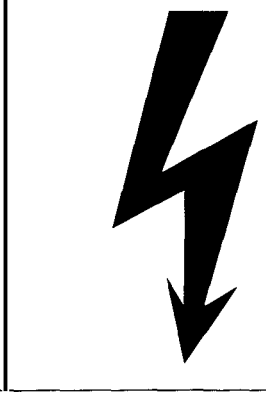
Drawings	*References*
FIGURE 1—Schematic	899C325
FIGURE 2—Outline	50-B-7683
FIGURE 3—Line Coupling Tuner Adjustment	205C475
FIGURE 4—Inductance of Line Tuning Coil	358433
FIGURE 5—Frequency Calibration of Trap Circuit	358434
FIGURE 6—Capacitance of Trap Circuit at Line Tuner Frequency	358436
FIGURE 7—Carrier Frequency L-C Product	358437
FIGURE 8—Lead-In Bushing Assembly	3492A22

CAUTION

FOR YOUR SAFETY

DO NOT ATTEMPT TO HANDLE, INSTALL, USE OR SERVICE THIS PRODUCT BEFORE READING INSTRUCTION BOOK

To Do So Will Lead to Bodily Injury or Property Damage or Both



All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

Supersedes IL. 41-949.21
✪ Denotes change from superseded issue

EFFECTIVE AUGUST 1977

SAFETY WARNING

Protect your life while making adjustments! Before handling any part of the electrical circuits:

1. Be sure the grounding switch in this assembly is in the "grounded" or closed position.
2. Be sure that all power switches in this assembly are turned "off."

Protect the equipment against damage by not applying power until thoroughly familiar with the adjustments described in this book.

APPLICATION

JZ 72.36 Line Coupling Tuners are designed to provide efficient phase-to-ground coupling for two carrier frequencies from a single coaxial cable through a single coupling capacitor to a power line.

DESCRIPTION

Mechanical Description

The line tuner is mounted in a cabinet suitable for outdoor installation. Knockouts are provided on each side of the cabinet for the capacitor lead-in bushing. Knockouts for 1½ inch conduit for the coaxial cable are located in the bottom of the cabinet. The outline, mounting dimensions and the location of the knockouts are shown in Fig. 2.

All electrical components are mounted on a hinged panel which can be opened for making the coaxial cable, capacitor lead-in and ground connections. The grounding switch, spark gap, tuning controls, metering jacks and all tap connections are accessible from the front of the panel.

Electrical Description

The electrical circuit is shown in Fig. 1. The coaxial cable connects through Jack, J-1 to the primary of matching transformer, T-1. The secondary winding of the transformer connects through Jack, J-2, to two line tuning coils, L-1. The trap circuit consists of the tapped inductance L-2, which has an adjustable powdered-iron core, and tuning capacitors C-3 and C-4. Links on the front of the panel provide for connecting the tuning capacitors in series, one capacitor alone, or both capacitors in parallel. The protector unit, consists of an adjustable spark gap SG-1 and a knife switch S-1.

The spark gap protects the equipment from excessive voltage surges. The knife switch is provided for grounding the lead-in from the coupling capacitor while adjustments are being made.

The JZ 72.364 tuner includes a 0.006-mfd. capacitor in series with the output lead to the protector unit. This allows the tuner to be used with coupling capacitors up to 0.015 mfd. When a drain coil is supplied with the tuner, it is identified as a Type JZ 72.36D tuner. If both capacitor and drain coil are included, the tuner is Type JZ 72.364D

CHARACTERISTICS

Frequency Range:	30 to 200kHz.
Input Impedance:	50 to 70 Ohms
Output Impedance:	100 to 1000 Ohms
Power Rating:	100 Watts Carrier-Unmodulated 25 Watts Carrier-100% Modulated
Coupling Capacitor Range:	JZ 72.36 — .00075 to .004 mfd. JZ 72.364 — .00075 to .015 mfd.
Minimum Frequency Separation	25% of the lower frequency

INSTALLATION

It is recommended that the Line Tuner be located as near to the coupling capacitor as possible. The mounting dimensions are shown in Fig. 2.

Remove the upper knockout from the side of the cabinet nearest the coupling capacitor and install the porcelain bushing for the capacitor lead-in as described in the following section.

CAUTION

Before making any connections to this equipment, turn off the power switch of the carrier transmitter and ground or open circuit the lead-in at the coupling capacitor.

Connections

✪ The assembly of the Style 719B629G01 lead-in bushing for the coupling capacitor lead-in in cable is shown in Fig. 8. Run the lead-in cable through the bushing and into the cabinet. Allow sufficient length of cable to connect to the grounding switch contact stud *with the panel swung open.*

Remove the connection of the tuning unit from the terminal stud of the jaw contact of the grounding switch. Connect the capacitor lead-in cable to this terminal stud using the cable terminal supplied with the

bushing. Tighten the nut securely. Replace the connection from the tuning unit using the second nut. This will permit disconnecting the tuning unit without disturbing the coupling capacitor lead-in cable connection.

Coupling Capacitor Lead-In Cable

Since the lead-in cable between the coupling capacitor and the line tuning unit is in a high-impedance carrier-frequency circuit, care must be exercised to keep the leakage to a minimum value.

The lead-in cable should be supported with as few insulators as possible. The insulation of this lead-in cable with respect to ground must be much better than is ordinarily employed for the voltage which exists between these points, as it effectively shunts the reactive elements of the resonant circuit at carrier frequency. The impedance of this resonant circuit may be as high as five thousand ohms and leakage resulting from rain, snow, sleet, too long a lead-in cable, or too many supporting insulators will reduce the effective power output of the transmitter and the sensitivity of the receiver.

An installation which limits this leakage to a minimum will have less signal strength variation under adverse conditions, when reliable operation is of the greatest value.

The insulators used for supporting the lead-in cable should have at least a 7.5 Kv rating. Care should be taken not to break the insulation of the cable when clamping it to the insulators. At least once a year the insulators should be washed to remove the accumulation of dirt.

For the lead-in, use a good quality rubber covered cable with a conductor equivalent to No. 14 gauge or larger. This cable is usually supplied with the coupling capacitor.

Coaxial Cable

Two screws are mounted in the left wall of the cabinet for securing the coaxial cable. Connect the shield of the cable to terminal #2 and the center conductor to terminal #3. Connect a good ground to the cabinet and to terminal #1 of the terminal board. Ruh a copper bonding cable from the cabinet to the base of the coupling capacitor.

Follow the instructions given in Fig. 1 for the connection of the coaxial cables. Remove the shield braid so that one to two inches of the inner insulation is exposed. The outer jacket of the coaxial cable should cover the shield braid as much as possible to insulate it against the high voltage that may exist between the shield braid and the tuner cabinet during a fault. Connect the cable shield to terminal 2 as indicated in Fig. 1 *but do not ground these leads to the tuner cabinet.* See that the coaxial cable leads are positioned so that the exposed portion of the cable shield and its lead are spaced away from the metal cabinet proper. The coaxial cable is grounded at the carrier equipment end only. The use of two-winding transformers allows grounding of the coaxial-cable shield braid at the carrier-set end only, and this eliminates any path for the flow of 60-hertz current (during a ground fault) through the coaxial cable and transformer winding.

PRELIMINARY ADJUSTMENTS

CAUTION:

When making any tap adjustments or changing any connections in this tuner, make certain that the grounding switch is closed. Do not depend on the drain coil for personal safety. Do not touch any terminal when the transmitter is on.

The first consideration in adjusting this tuner is to determine the two operating frequencies. In general, to prevent excessive losses and poor tuning, the higher of the two frequencies should be at least 125 per cent of the lower frequency.

The following procedure will determine the approximate adjustment of the line tuning coils and trap circuit. The section with the single line tuning coil should be tuned to the lower frequency while the section with the trap and line tuning coil should be tuned to the higher frequency.

For these calculations:

F1 = lower frequency in KHz.
F2 = higher frequency in KHz.
*Co = capacitance in MMF of coupling capacitor.
Ct = capacitance in MMF of trap circuit at frequency F2.
L1 = inductance in MH of tuning coil for frequency F1.
L2 = inductance in MH of tuning coil for frequency F2.
Lh = inductance in MH required to resonate capacitance Co at frequency F2.
Lc = inductance in MH required to compensate capacitance Ct at frequency F2.
Lp = inductance in parallel with inductance L1 to resonate coupling capacitor Co at frequency F2.

*For the JZ 72.364 and JZ 72.364D Tuners, Co is the

series combination of C5(.006 MFD) and the coupling capacitor. For this case use the formula

$$Co = \frac{(.006)\ (\text{value of coupling capacitor})}{(.006) + (\text{value of coupling capacitor})}$$

Matching Transformer Taps	*Coaxial Tap*	*T1 Taps*	*Line Impedance*
	2	4-5	100
	3	4-5	139
	2	6-7	193
	3	6-7	268
	2	8-9	372
	3	8-9	517
	2	10-11	720
	3	10-11	1000

The average power line impedance is 500 to 600 ohms, and the usual coaxial cable impedance is 50 to 70 ohms. If the impedance of power line is known, connect the TUNER and COAX leads of the transformer to the corresponding taps. If the power line impedance is not known, connect the COAX lead to tap 3 and the TUNER leads to taps 8 and 9.

A. Calculation of adjustment for the lower-frequency section.

1. Refer to Fig. 7 and determine the LC product for frequency Fl.
2. Divide the LC product by the value in micro-microfarads of the coupling capacitor Co.

$$L_1 = \frac{LC}{Co} = \text{MH inductance for resonance at F1.}$$

3. Refer to Fig. 4 for the tap number on the line tuning coil for this value of inductance.

B. Calculation of adjustment for the higher frequency section.

1. Refer to Fig. 5 for the capacitor combination and the trap coil tap number required to tune the trap circuit to frequency F1.
2. Determine the percentage that the trap frequency Fl is below the line tuner frequency F2 by using the following formula:

$$\frac{F2 - F1}{F2} \times 100 = \text{percentage}$$

3. Refer to Fig. 6 and determine the capacitance, Ct, of the trap circuit, for the trap tuning capacitance, and per cent separation determined above.
4. Refer to Fig. 7 and determine the LC product for frequency F2. .
5. Divide the LC product by the value of capacitance determined above to obtain the inductance value, LC, required in the tuning coil to compensate for the capacitance of the trap circuit.

$$Lc = \frac{LC}{Ct} = \text{MH inductance}$$

6. Divide the LC product by the value in micro-microfarads of the coupling capacitor to determine the inductance value, LC, required to resonate the coupling capacitor at frequency F2.

$$Lh = \frac{LC}{Co} = \text{MH inductance}$$

7. Calculate the value of inductance, Lp, which must be paralleled with the inductance, L1, of the low frequency section (from A-2 above) to obtain the inductance, Lh, determined above.

$$Lp = \frac{(L1)\ (Lh)}{L1 - Lh} = \text{MH inductance}$$

8. Add the inductance values Lc and Lp to determine the inductance L2, required in tuning coil in the high frequency section of the line tuner.

   L2 = Lc + Lp = MH inductance

9. Refer to Fig. 4 for the tap number on the line tuning coil for this value of inductance.

Sample Calculation

Assume

Fl = 160K Hz
F2 = 200K Hz
Co = 4000 MMF

A. Low Frequency Section

1. Refer to Fig. 1 and determine LC product for F1: LC = 980.
2. $L1 = \frac{LC}{Co} = \frac{980}{4000} = 0.245$mh. For resonance at 160K Hz
3. Refer to Fig. 4 for tap number on tuning coil 0.245 mh = Use tap 67 and short unused taps.

B. Higher Frequency Section

1. Refer to Fig. 5 for the capacitor combination and the trap coil tap number to tune trap circuit to F1. Trap at 160K Hz = 1100 MMF and tap 100.

2. Determine the percentage that the trap frequency Fl is below the line tuning frequency F2.

$$\frac{F2 - F1}{F2} \times 100 = \frac{200 - 160}{200} \times 100 = 20\%$$

3. Refer to Fig. 6 and determine the capacitance, Ct, of the trap circuit for the trap tuning capacitance and percentage as determined in B-1 and B-2 above.

   At 20% and 1100 MMF, Ct = 390 MMF.

4. Refer to Fig. 7 and determine the LC product for F2: LC = 630.
5. $Lc = \frac{LC}{Ct} = \frac{630}{390} = 1.61$ mh to compensate for capacitance of trap.
6. $Lh = \frac{LC}{Co} = \frac{630}{4000} = 0.157$ mh for resonance at 200 kHz.
7. Determine the value of inductance Lp, to be paralleled with L1, the low-frequency section of A-2 above, to obtain the inductance Lh, determined in B-6 above.

   $$Lp = \frac{L1 \times Lh}{L1 - Lh} = \frac{0.245 \times 0.157}{0.245 - 0.157} = 0.392 \text{ Mh}$$

8. Add the values Lc + Lp to obtain the inductance L2 required in higher frequency tuning coil section of line tuner.

   L2 = Lc + Lp = 1.61 + 0.392 = 2.00 Mh

9. Refer to Fig. 4 for the tap number for inductance of L2 = 2.00mh use tap 184, short unused taps.

NOTE:

The instructions in Fig. 4 state that the unused taps are to be shorted when a tap lower than 100 is used and also when the frequency is above 150 kHz.

This procedure will leave a gap in the inductance range between tap 100 with the unused turns not shorted and tap 88 with the unused turns shorted. Continuous inductance adjustment can be obtained by using tap 113 with unused turns shorted as the next lower inductance tap below tap 100 with the unused turns not shorted.

✪ CAUTION:

Failure to short the unused taps may damage the coil and cause a failure of the tuner.

Final Adjustments

After making the connections of trap capacitors, trap coil taps, and line tuning coil taps as determined under Preliminary Adjustments, the circuits must be adjusted to meet the requirements of the particular installation.

Fig. 3 illustrates the preferred method of tuning the equipment. The dummy load resistors used must be of sufficient wattage to dissipate the transmitter output power. Please note: *The differences in magnitude of the current, I6, obtained in 7 (A) and that of I6 obtained in 7 (B) may be due to the variation of line impedance with change in transmitter frequency. If this is so, use taps on T1 which produce current values as close as possible.*

As an alternate means, the following procedure may be used for tuning the equipment.

Tuning Procedure

A. Low-Frequency Section

1. Set tap on L1 as calculated in A-3 of calculations.
2. Adjust transmitter to F1, the low frequency.
3. Open the link of Jack J-2 on the right of the panel, the low-frequency section of the tuner, and connect a thermocouple ammeter to the terminals. Open the link of other jack J-2, the high frequency section.
4. Turn on the local transmitter adjusted to frequency F1. Adjust the core of the tuning coil L-1 for maximum current in jack J-2. If the current is increasing with the coil all the way in or all the way out, change the connection to next higher or lower tap, respectively. This section is now tuned to resonance at low frequency F1.
5. Adjust the matching transformer, T-1, taps so that maximum current in jack J-2 is obtained. For each transformer tap change, recheck the adjustment of the tuning coil. If two transformer taps give the same reading of current, use the higher impedance connection.

B. Higher Frequency Section

1. Remove power from local transmitter and close grounding switch. Remove links of both jacks J-2. Connect lead on front of panel from trap unit to the left terminal of jack J-2 on left of panel. Remove connection of trap unit from terminal stud of S-1 on rear of panel. Connect this lead through a milliammeter to ground.

2. Adjust trap unit capacitor links and tap connection as determined in B-1 of calculations.

3. Turn on power of local transmitter, still adjusted to the lower frequency F-1. Adjust core of trap unit coil for minimum current in the milliammeter.

4. Remove power from the local transmitter and adjust the frequency to F-2, the higher frequency.

5. Reconnect the trap unit to switch S-1 terminal stud. Replace links in both jacks J-2. Connect a milliammeter to jack J-1. Adjust the tap connection of the line tuning coil on the left to tap determined in B-9 of the calculations.

6. Open grounding switch and turn on power of local transmitter. Adjust the core of the tuning coil on the left for maximum current in J-1. If the current is increasing when the core is moved all the way in or all the way out, change the tap connection to the next higher or lower, respectively.

C. Adjustments for By-Pass

A line tuner which is used to by-pass a circuit-breaker should be adjusted with the circuit-breaker open. However, since this may be difficult to arrange, an alternate method is to disconnect the coupling capacitor from the line and connect its high potential side to ground through a resistor. If the impedance of the line with circuit-breaker open is known, use a resistor of this value. If the line impedance is not known, use a 500-ohm resistor.

D. Adjustments of Protective Device

Adjust the spark gap, SG-1, to 0.015 inch spacing. Observe the gap while transmitting full carrier power. If the gap arcs over, increase the spacing until the arcing stops. The minimum spacing for the gap depends upon the carrier power, the capacitance of the coupling capacitor and the impedance of the power line.

MAINTENANCE

Routine Checks and Records

This line tuner requires very little maintenance. It should be inspected occasionally to see if there has been excessive burning of the spark gap. If the discs show signs of burning, rotate the discs to a new position and readjust the gap. Usually a semi-annual or yearly inspection is sufficient.

A permanent record should be kept of the tap settings and the position of the tuning coil core so that they can be restored to the correct positions in case of unauthorized changes.

Ordering Replacement Parts

Replacement parts for this Line Tuner may be ordered through the nearest Westinghouse District Office.

When ordering, include:

1. The following data from the nameplate of the Line Tuner: (a) the type number; and (b) the style number.

2. The (a) Electrical parts list symbol; (b) the function; (c) the description; and (d) the manufacturers designation.

ELECTRICAL PARTS LIST

Circuit Symbol	*Function*	*Description*	*Style Number*
		SUB-ASSEMBLIES	
L-1	Line Tuning Coil	Line Tuning Coil Assembly	1474218
T-1	Transformer	Transformer Assembly	407C741G02
—	Low Frequncy Trap	Trap Unit Assembly	6294D16G01
—	Protector Unit	Protector Unit Assembly	1474014
		COMPONENT PARTS	
C-3	Capacitor-Trap Tuning	Mica-2200 mmf. ±5% 5000V	290B762H02
C-4	Capacitor-Trap Tuning	Same as C-3	
J-1	Jack-Coax Metering	Binding Post Type	
		2 Binding Posts	185A431H01
		1 Shorting Link	1474455
J-2	Jack-Line Metering	Same as J-1	
SG-1	Spark Gap	Disc Type	2 of 183A358H20 (discs only)
		OPTIONAL	
L-3	Drain Coil (When Used)	20,000 ohms minimum impedance over 30-200 kHz.	607B800G03
C-5	Series Capacitor (When Used)	Mica, 0.006 mfd., ±5%	584C256H03

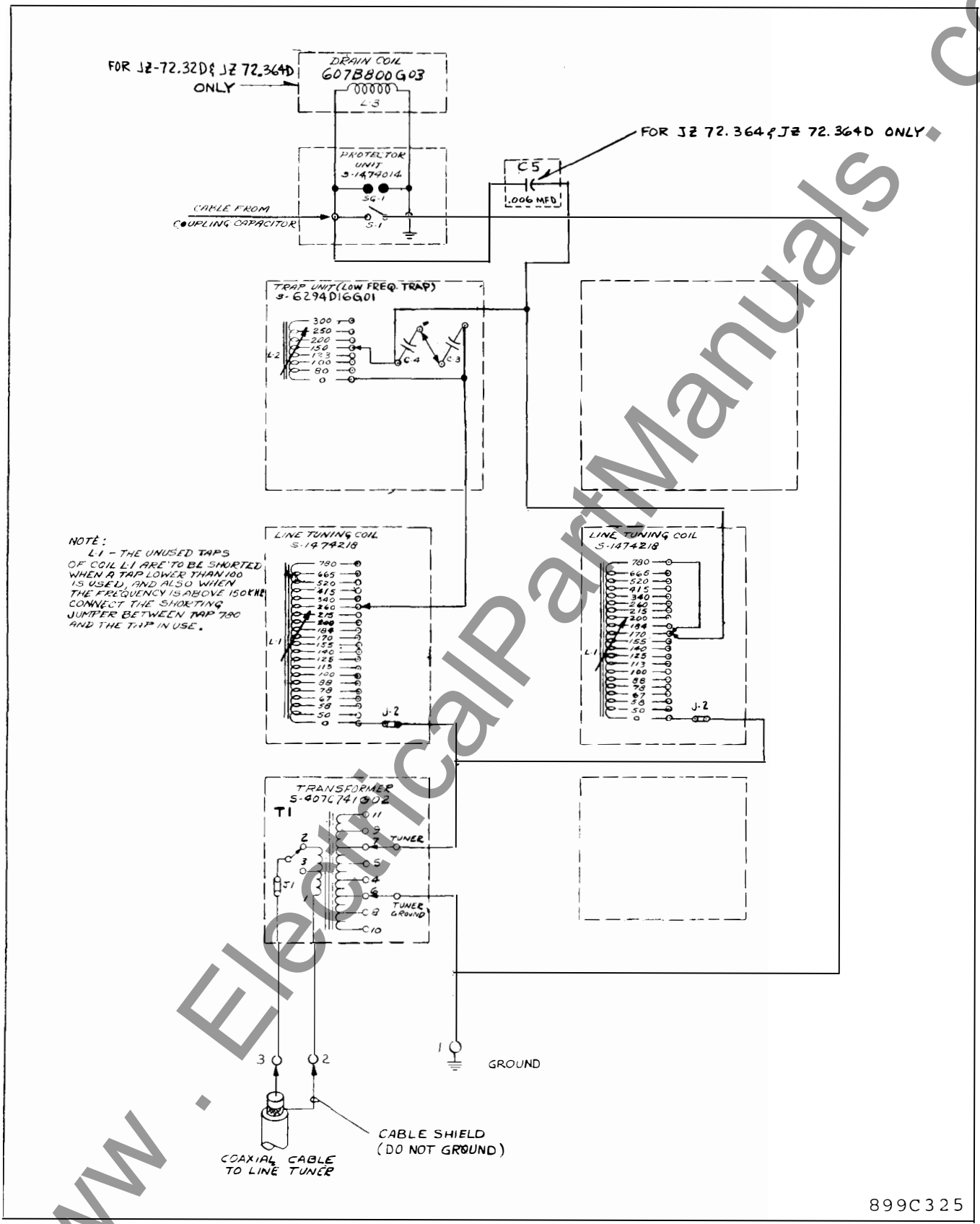
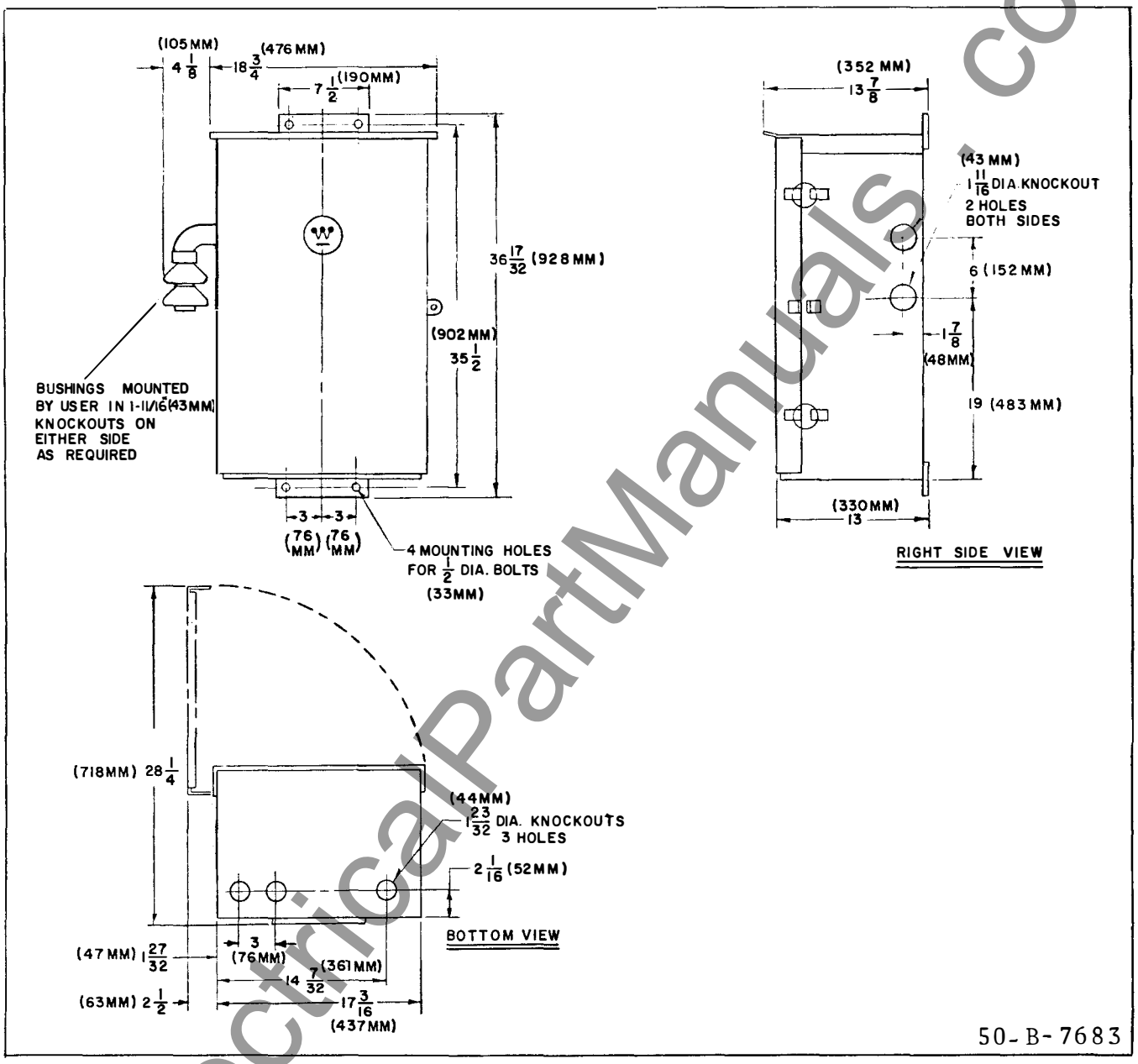


Fig. 1 *Schematic*



✪ Fig. 2 *Outline*

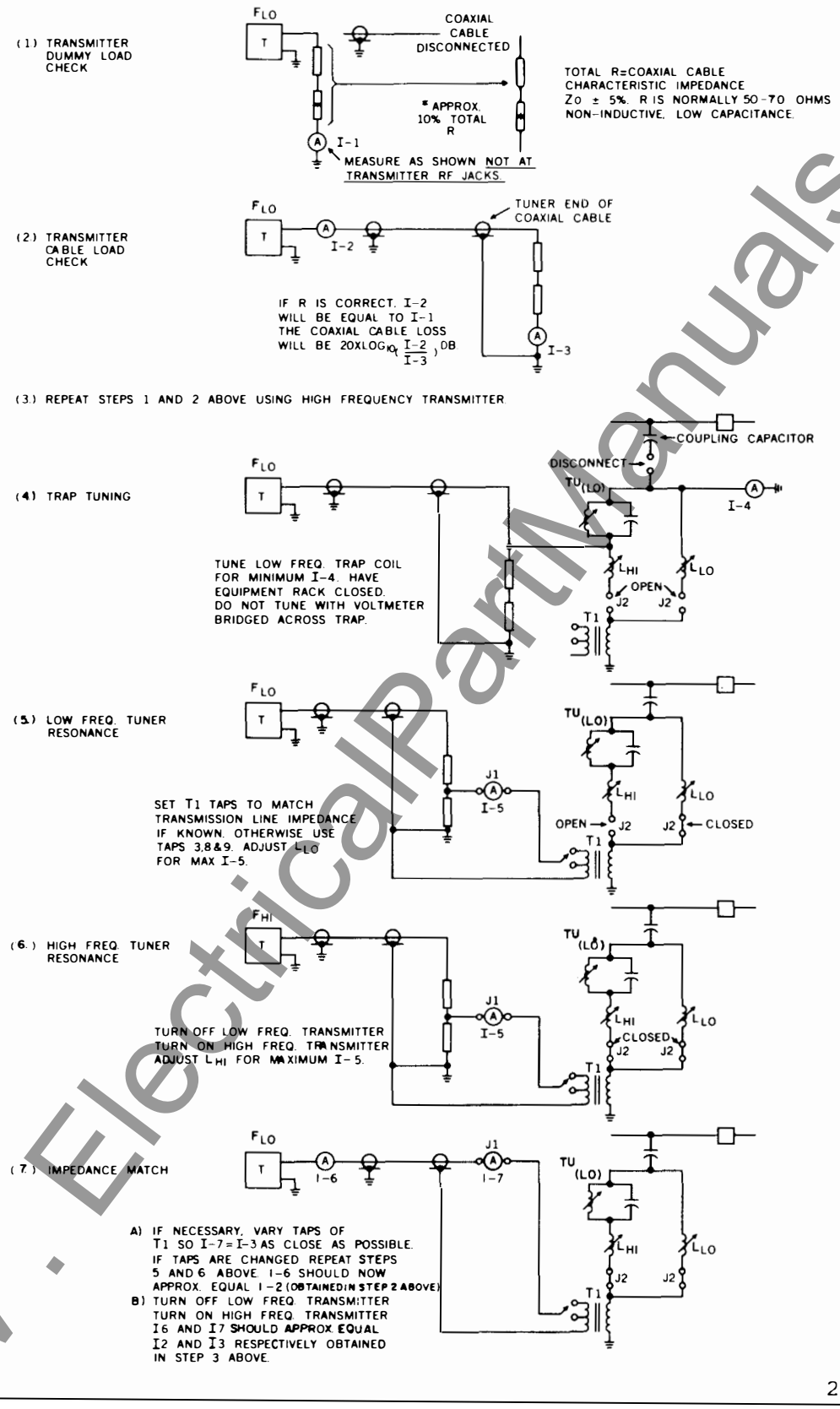


Fig. 3 *Line Coupling Tuner Adjustment*

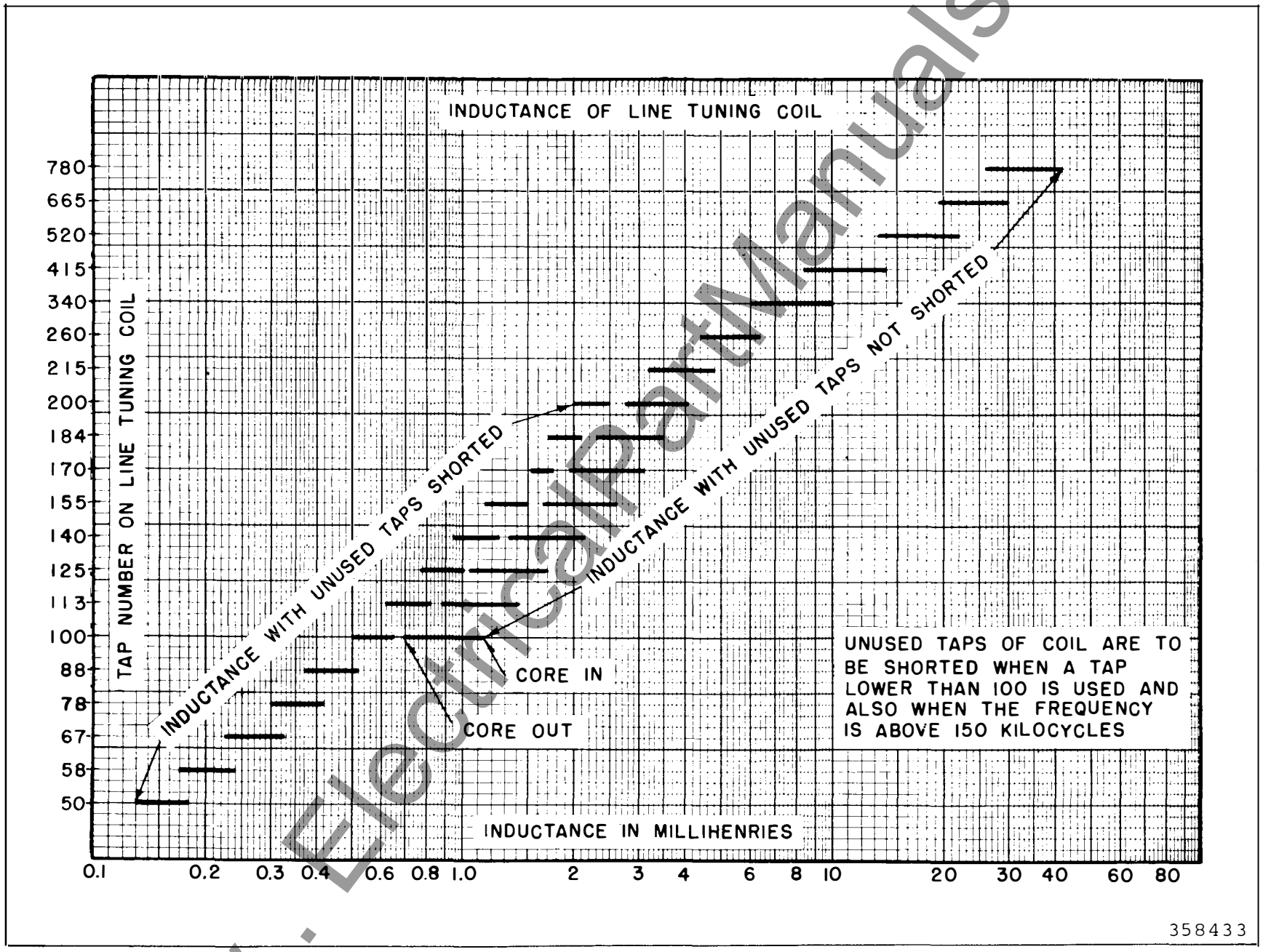


Fig. 4 *Inductance of Line Tuning Coil*

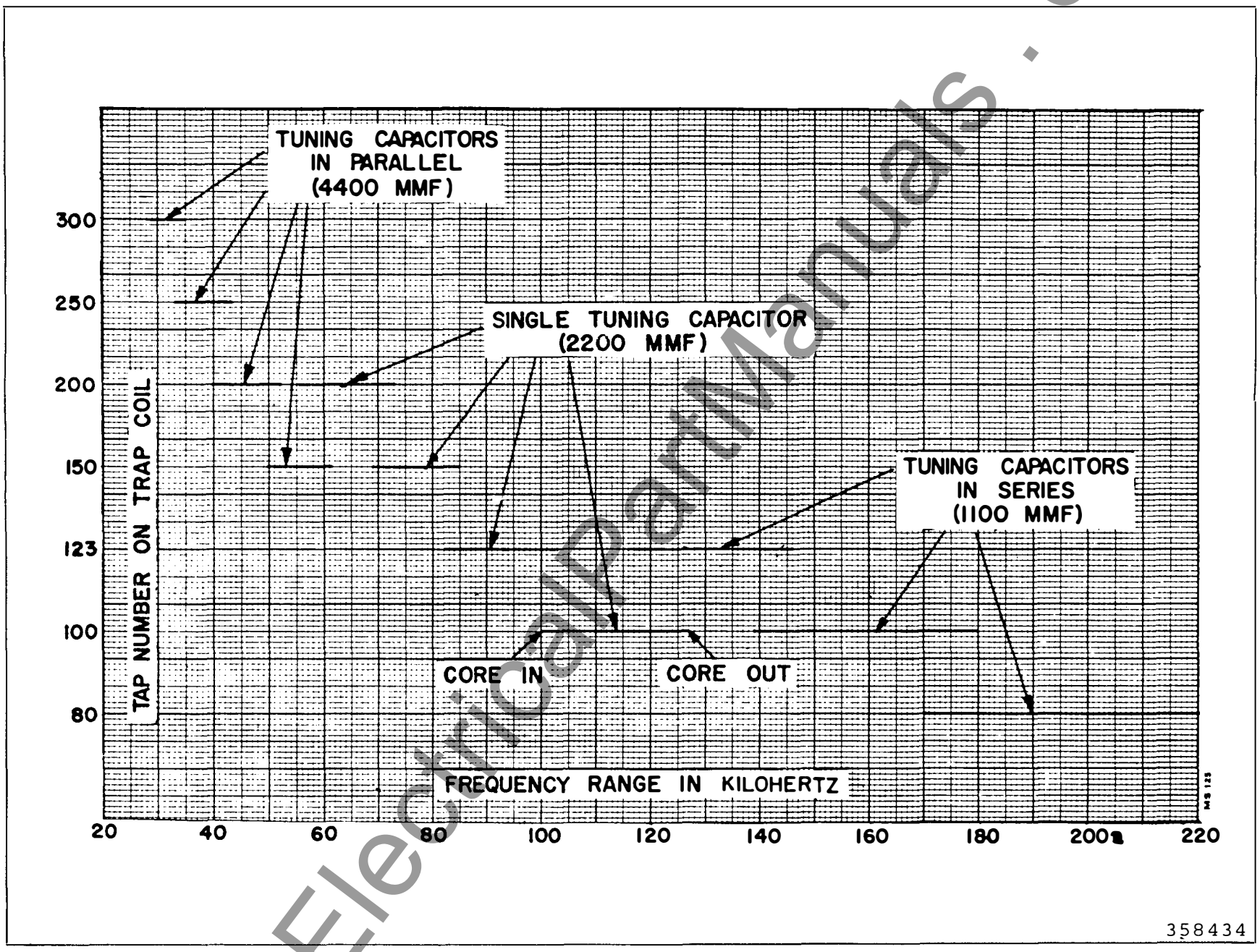


Fig. 5 *Frequency Calibration of Trap Circuit*

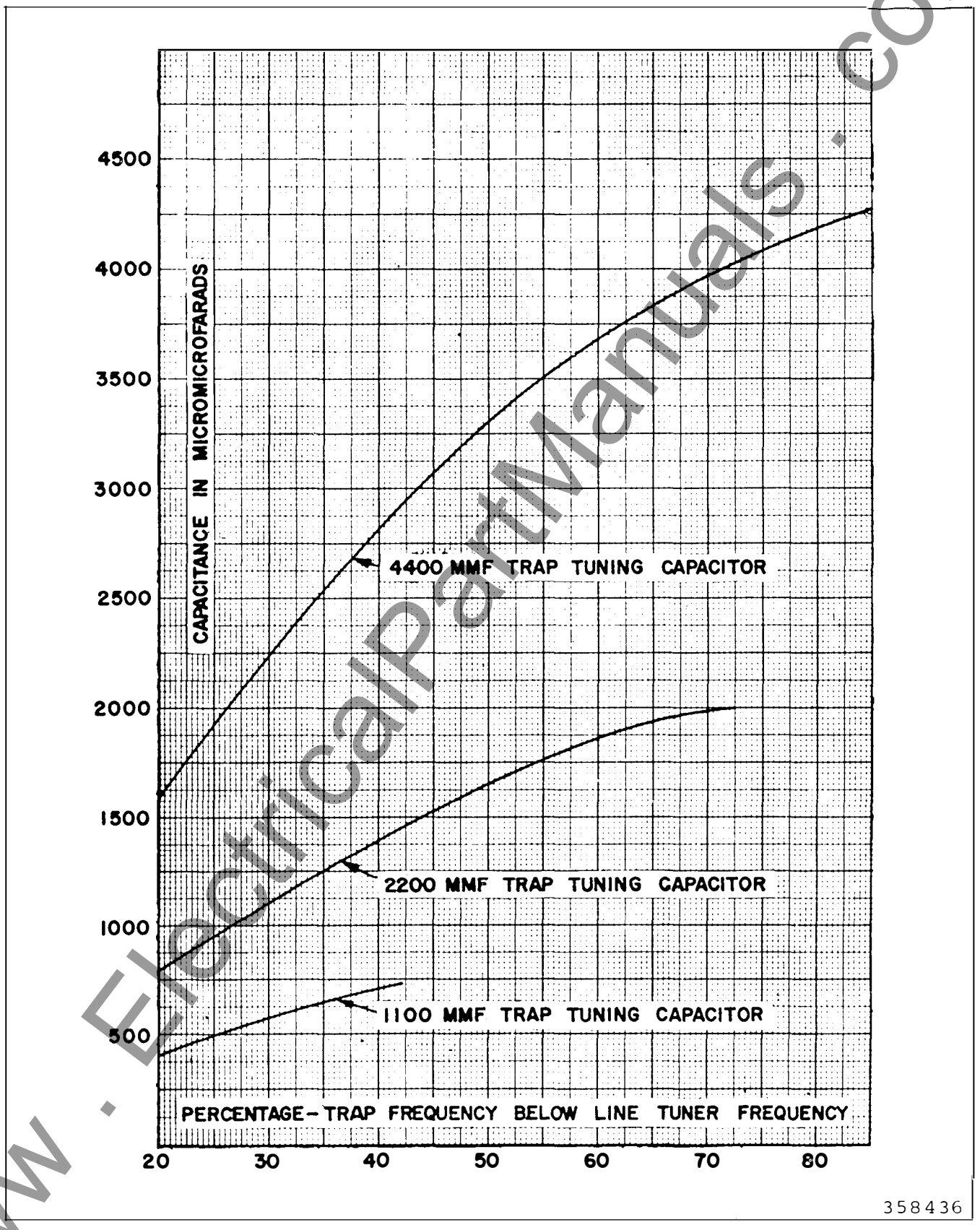


Fig. 6 *Capacitance of Trap Circuit at Line Tuner Frequency*

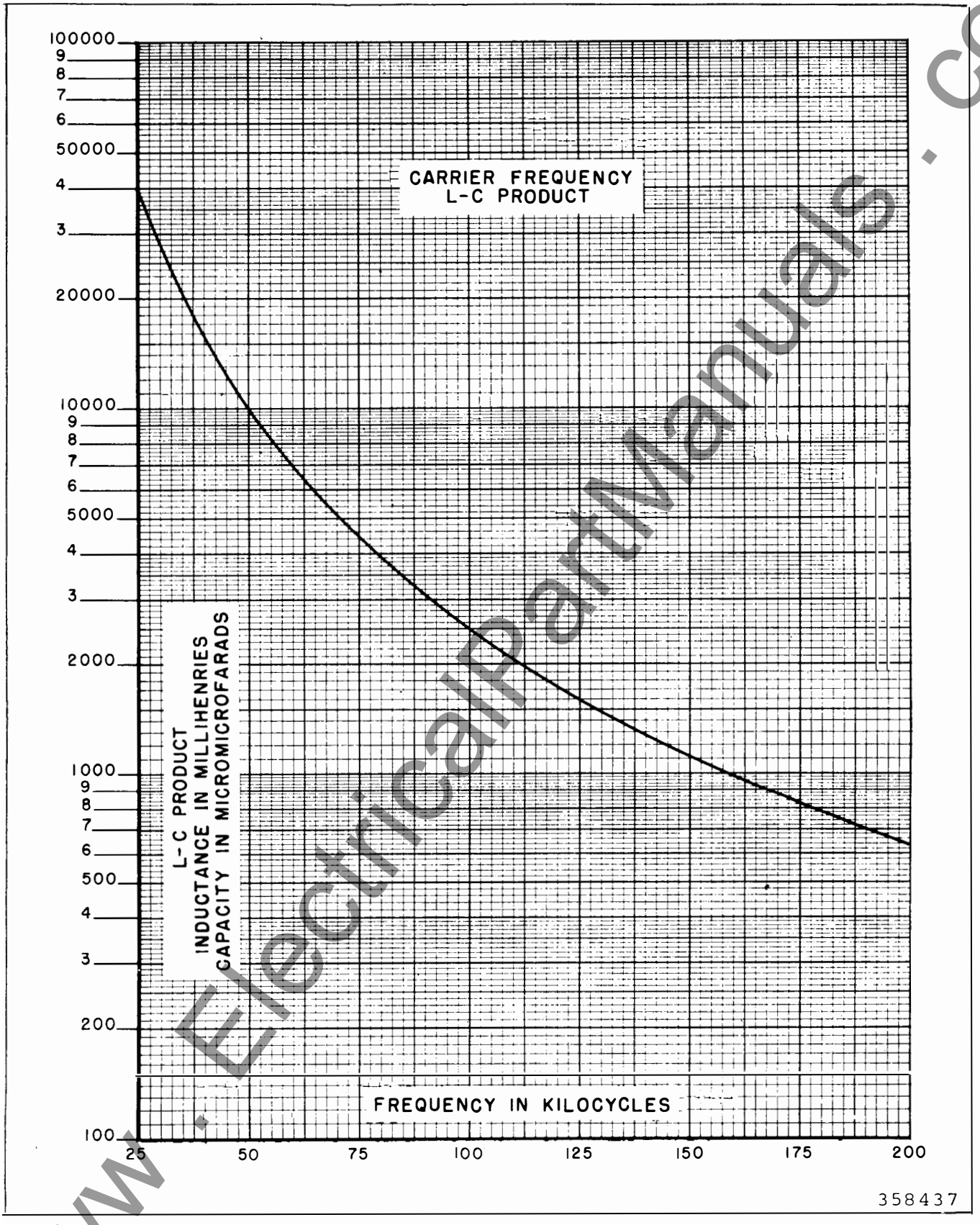


Fig. 7 *Carrier Frequency L-C Product*

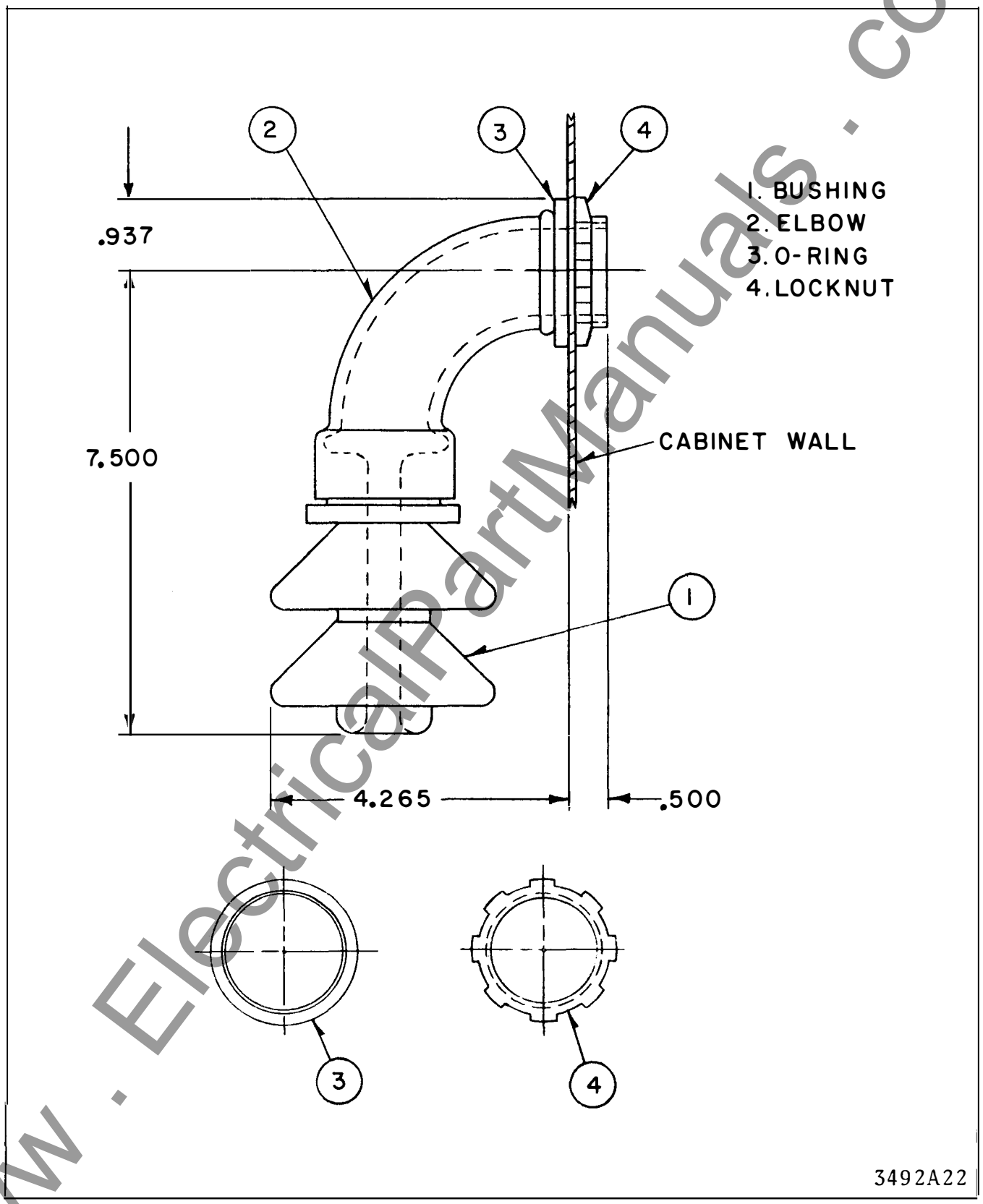


Fig. 8 *Lead-In Bushing Assembly*

WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE JZ—71.6 LINE COUPLING TUNERS

SINGLE-FREQUENCY PHASE-TO-GROUND
LINE COUPLING TUNERS
WITH TWO-WINDING MATCHING TRANSFORMER

TYPE JZ 71.6	- STYLE 290B883A12	-	WITHOUT DRAIN COIL
TYPE JZ 71.6D	- STYLE 606B363A09	-	WITH DRAIN COIL
TYPE JZ 71.64	- STYLE 606B363A14	-	WITH 0.006 MFD. SERIES CAPACITOR
TYPE JZ 71.64D	- STYLE 606B363A19	-	WITH DRAIN COIL AND 0.006-MFD. CAPACITOR

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

SUPERSEDES I.L. 41-949.1F
✪ Denotes change from previous issue

EFFECTIVE JUNE 1977

SAFETY WARNING!

Protect your life while making adjustments! Before handling any part of the electrical circuits:

1. BE SURE THE GROUNDING SWITCHES IN THIS ASSEMBLY ARE IN THE "GROUNDED" OR CLOSED POSITION.

2. BE SURE THAT ALL POWER SWITCHES IN THIS ASSEMBLY ARE TURNED "OFF".

Protect the equipment against damage by not applying power until thoroughly familiar with the ADJUSTMENTS described in this book.

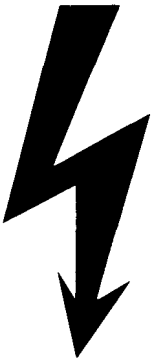
SAFETY FIRST!

CAUTION

FOR YOUR SAFETY

DO NOT ATTEMPT TO HANDLE, INSTALL, USE OR SERVICE THIS PRODUCT BEFORE READING INSTRUCTION BOOK

To Do So Will Lead to Bodily Injury or Property Damage or Both



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APPLICATION

The Type JZ-71.6 Line Coupling Tuners are designed for phase-to-ground coupling of a single carrier frequency from a coaxial cable through a coupling capacitor to a power line. The impedance matching transformer and line tuning coil, in conjunction with the coupling capacitor, provide a low loss circuit for coupling a carrier transmitter to the power line.

DESCRIPTION

Mechanical Description

The tuner is mounted in a cabinet suitable for outdoor mounting. Knockouts are provided on each side of the cabinet for the capacitor lead-in bushing and in the bottom of the cabinet for 1½ inch conduit for the coaxial cable. The outline, mounting dimensions and the location of the knockouts are shown in Fig. 3.

All of the electrical components are mounted on a hinged panel which may be opened for making the coaxial cable and capacitor lead-in connections. The transformer taps, tuning coil taps, grounding switch and spark gap are accessible from the front of the panel.

Electrical Description

The electrical circuits are shown on the Schematic Diagram Fig. 2. The coaxial cable center conductor is connected through jack J-1 to the matching transformer T-1, The coaxial cable shield is connected to terminal 1 of the matching transformer. The shield is not grounded, but may be by connecting a short jumper between terminals 1 and 2 of the cabinet terminal block. The high impedance tap of the transformer is connected through jack J-2 to the line tuning coil L-1. An adjustable spark gap SG-1 protects the equipment from excessive voltage surges. The knife switch S-1 is provided for grounding the lead-in from the coupling capacitor while adjustments are being made.

The JZ 71.64 tuner includes a 0.006-mfd. capacitor in series with the output lead to the protector unit. This allows the tuner to be used with coupling capacitors up to 0.015 mfd. When a drain coil is supplied with the tuner, it is identified as a Type JZ 71.6D tuner. If both capacitor and drain coil are included, the tuner is Type JZ 71.64D.

Typical response curves for the type JZ 71.6 tuners are plotted on Fig. 1. These curves were taken with an 1870-mmf. coupling capacitor and a 300-ohm resistive load. The tuner was adjusted for resonance (f_r) at 30, 100, and 200 KHz. respectively, for the three curves.

CHARACTERISTICS

Frequency Range:	30 to 200 kHz.
Input Impedance:	50 to 70 Ohms
Output Impedance:	100 to 1000 Ohms
Power Rating:	100 Watts Carrier-Unmodulated 25 Watts Carrier-100% Modulated
Coupling Capacitor Range:	JZ 71.6 — .00075 to .004 mfd. JZ 71.64 — .00075 to .015 mfd.

INSTALLATION

It is recommended that the Line Tuner be located as near the coupling capacitor as is practical. The mounting dimensions are shown on Fig. 3.

Remove the knockout from the side of the cabinet nearest the coupling capacitor for installation of the porcelain bushing for the capacitor lead-in.

Connections

CAUTION

Before making any connections to this equipment, turn off the power switch of the carrier transmitter and ground or open circuit the lead-in at the coupling capacitor.

The assembly of the Style 719B629G01 accessories for the coupling capacitor lead-in cable is shown in Fig. 7. Allow sufficient length of cable to connect to the grounding switch contact stud with the panel swung open.

Remove the connection of the tuning unit from the terminal stud of the jaw contact of the grounding switch. Connect the capacitor lead-in cable to this

terminal stud using the cable terminal supplied with the bushing. Tighten the nut securely. Replace the connection from the tuning unit using the second nut. This will permit disconnecting the tuning unit without disturbing the coupling capacitor lead-in cable connection.

Two screws are mounted in the left wall of the cabinet for securing the coaxial cable. Connect the shield of the cable to terminal #2 and the center conductors to terminal #3. Connect a good ground to the cabinet and to terminal #1 of the terminal board. Run a copper bonding cable from the cabinet to the base of the coupling capacitor.

Coupling Capacitor Lead-In Cable

Since the lead-in cable between the coupling capacitor and the line tuning unit is in a high-impedance carrier-frequency circuit, care must be exercised to keep the leakage to a minimum value.

The lead-in cable should be supported with as few insulators as possible. The insulation of this lead-in cable with respect to ground must be much better than is ordinarily employed for the voltage which exists between these points, as it effectively shunts the reactive elements of the resonant circuit at carrier frequency. The impedance of this resonant circuit may be as high as five thousand ohms and leakage resulting from rain, snow, sleet, too long a lead-in cable, or too many supporting insulators will reduce the effective power output of the transmitter and the sensitivity of the receiver.

An installation which limits this leakage to a minimum will have less signal strength variation under adverse conditions, when reliable operation is of the greatest value.

The insulators used for supporting the lead-in cable should have at least a 7.5 kv rating. Care should be taken not to break the insulation of the cable when clamping it to the insulators. At least once a year the insulators should be washed to remove the accumulation of dirt.

For the lead-in, use a good quality rubber covered cable, with a conductor equivalent to No. 14 gauge or larger. This cable is usually supplied with the coupling capacitor.

ADJUSTMENTS

CAUTION

When making any tap adjustments or changing any connections in this tuner, make certain that the grounding switch is closed. Do not depend on the drain coil for personal safety. Do not touch any terminal when the transmitter is on.

The first consideration in adjusting this tuner is to determine the operating frequency and the capacitance of the coupling capacitor. The value of inductance required for resonance can then be determined as follows:

Refer to Fig. 6 for the L-C product at the carrier frequency. Divide the L-C product by the value in micro-microfarads of the coupling capacitor (Cc).

$$\frac{\text{L-C Product}}{\text{C in Unit}} = \text{mh inductance for resonance.}$$

Refer to Fig. 5 for the tap number of the tuning coil L-1 for this value of inductance.

For the JZ 71.64 tuner, in determining the required inductance, do not use the rated capacitance of the coupling capacitor for Cc. Because of the 0.006-mfd. capacitor (C1) in the tuner output circuit, the net capacitance must be calculated from the formula:

$$Co = \frac{(.006)\,(Cc)}{(.006 + Cc)}$$

where Cc is the rated capacitance of the coupling capacitor, and Co is the calculated value to use in the procedure described in the previous paragraph. (All values are in microfarads) For example, if the coupling capacitor is 0.006 mfd., then the net value of Co is 0.003 mfd. Similarly, for a 0.005 mfd. coupling capacitor, $Co = \frac{.006 \times .005}{.011} = .0027$ mfd. (Now use 2700 mmf. in determining required inductance.)

The final tuning may require changing the tuning coil connection to a higher or lower tap than the tap determined previously due to stray capacitance of the lead-in cable from the coupling capacitor to the tuner or to a slightly reactive power line.

The impedance of the different taps of the transformer T-1 are given in the following table:

Coaxial Tap	Tuner Taps	Line Impedance
2	4-5	100
3	4-5	139
2	6-7	193
3	6-7	268
2	8-9	372
3	8-9	517
2	10-11	720
3	10-11	1000

The average power line impedance is 500 to 600 ohms, and the usual coaxial cable impedance is 50 to 70 ohms. If the impedance of power line is known, connect the TUNER and COAX leads of the transformer to the corresponding taps. If the power line impedance is not known, connect the COAX lead to tap 3 and the TUNER leads to taps 8 and 9.

Open the link of jack J-2 and connect a thermocouple ammeter to the terminals.

Turn on the local transmitter and adjust the core of the tuning coil L-1 for maximum current in jack J-2. If the current is increasing with the core all the way in or all the way out, change the connection to the next higher or lower tap, respectively.

Adjust the transformer taps to obtain as nearly the same current in J1 as would be obtained with a 60-ohm resistive load on the coaxial cable. For a 10-watt transmitter, this current value is 0.41 ampere. For each transformer tap change, recheck the adjustment of the tuning coil for maximum current at J2. If two transformer taps give the same reading of current, use the higher impedance connection.

A procedure for more exact impedance match is shown in Fig. 4, Line Coupling Tuner Adjustment. The dummy load resistors must be of sufficient wattage rating to dissipate the transmitter output. Use the transformer tap connections given in this Instruction Book.

A line tuner which is used to bypass a circuit breaker should be adjusted with the circuit breaker open. However, since this may be difficult to arrange, an alternate method is to disconnect the coupling capacitor from the line and connect its high potential side to ground through a resistor. If the impedance of the line with circuit breaker open is known, use a resistor of this value. If the line impedance is not known, use a 500-ohm resistor.

Adjust the spark gap SG-1 to 0.015 inch spacing. Observe the gap while transmitting full carrier power. If the gap arcs over, increase the spacing until the arcing stops. The minimum spacing for the gap depends upon the carrier power, the capacitance of the coupling capacitor and the impedance of power line.

With some combinations of coupling capacitor values and the higher carrier frequencies, the tuning of the line tuning coil will be so broad that the exact adjustment for resonance is very difficult to determine by normal measurements. However, under these conditions, the frequency response curve for the coupling circuit will be so flat that an exact adjustment of the inductance of the line tuning coil is not necessary. For carrier frequencies above 150 kHz. and for coupling circuits with a Q of less than 2, adjust the inductance of the line tuning coil to the calculated value. Then adjust the ratio of the matching transformer T-1 so that the current in jack J-1 is approximately the same as the current measured when the coaxial cable is terminated in a 60 ohm resistor.

To determine whether or not the above adjusting procedure is applicable, calculate the Q of the coupling circuit as follows:

Calculate the reactance of the coupling capacitor at the operating frequency.

$$X_C = \frac{1}{2\pi FC}$$

Determine the approximate power line impedance.

For a single trapped line use a value of 500 ohms. For lines which are not trapped, divide 500 ohms by the number of lines leaving the bus.

Divide the reactance of the capacitor by the impedance of the line to determine the Q of the circuit.

$$Q = X_C/R$$

(Since this calculation is only an approximation, the possible reactance of the power line is neglected.)

Example: Coupling Capacitor — .00275 mfd.
Operating Frequency — 165 kHz.
Single Trapped Line — use 500 ohms

$$X_C = \frac{1}{2\pi FC} = 350 \text{ ohms}$$

$$Q = 350/500 = 0.7$$

For this installation, calculate the inductance required to resonate the coupling capacitor.

$$L = \frac{X_L}{2\pi F} = 0.34 \text{ mh}$$

Refer to Fig. 5.

For 0.34 mh use tap 78, with core at center of travel. Short unused turns.

NOTE

The instructions in Fig. 5 state that the unused taps are to be shorted when a tap lower than 100 is used and also when the frequency is above 150 kHz.

This procedure will leave a gap in the inductance range between tap 100 with the unused turns not shorted and tap 88 with the unused turns shorted. Continuous inductance adjustment can be obtained by using tap 113 with unused turns shorted as the next lower inductance tap below tap 100 with the unused turns not shorted

CAUTION

Failure to short the unused taps may damage the coil and cause a failure of the tuner.

MAINTENANCE

Routine Checks and Records

This line tuner requires very little maintenance. It should be inspected occasionally to see if there has been excessive burning of the spark gap. If the discs show signs of burning, rotate the discs to a new position and re-adjust the gap. Usually a semi-annual or yearly inspection is sufficient.

A permanent record should be kept of the tap settings and the position of the tuning coil core so that they can be restored to the correct positions in case of unauthorized changes.

Ordering Replacement Parts

Replacement parts for this line tuner may be ordered through the nearest Westinghouse District Office.

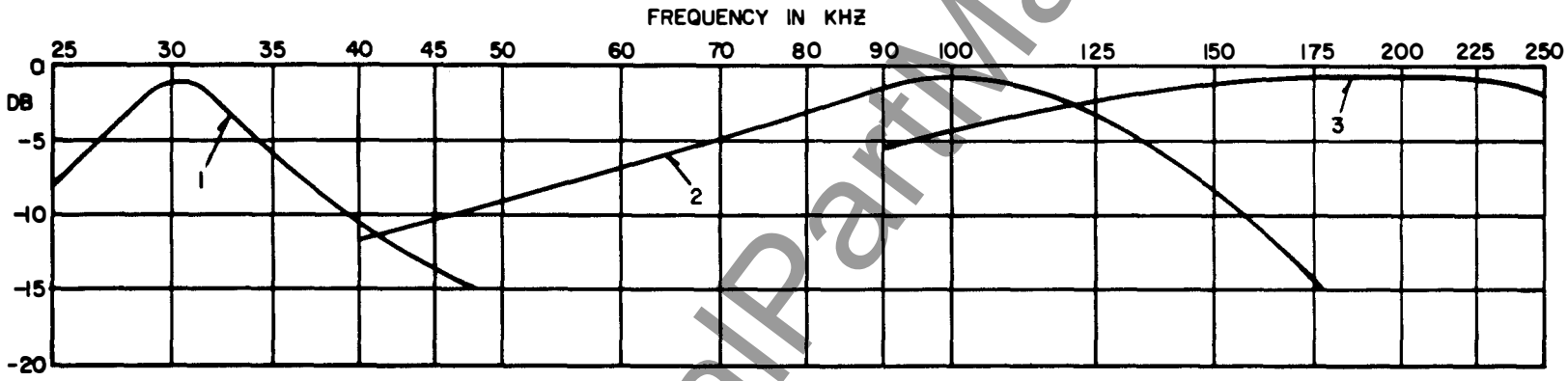
When ordering, include:

1. The following data from the nameplate of the line tuner: (A) the type number, and (B) the style number.

2. The (A) electrical parts list symbol, (B) the function, (C) the description, and (D) the style number.

ELECTRICAL PARTS LIST

CIRCUIT SYMBOL	FUNCTION	DESCRIPTION	STYLE NUMBER
		SUB-ASSEMBLIES	
L-1	Line Tuning Coil	Line Tuning Coil Assembly	1474218
T-1	Transformer	Transformer Assembly	407C741G02
	Protector Unit	Protector Unit Assembly	1474014
		COMPONENT PARTS	
J-1	Jack-Coax Metering	Binding Post Type 2 Binding Posts 1 Shorting Link	 185A431H01 1474455
J-2	Jack-Line Metering	Same as J-1	
SG-1	Spark Gap	Disc Type	2 of 183A358H20 (discs only)
		OPTIONAL	
L-3	Drain Coil (When Used)	20,000 ohms minimum impedance over 30-200 kHz.	607B800G03
C1	Series Capacitor (When Used)	Mica, 0.006 mfd., ± 5% 3000V, PACW.	584C256H03



FREQUENCY RESPONSE
TYPE JZ 71.6 TUNER

CURVE	TUNED TO
1	30 KHZ
2	100 KHZ
3	200 KHZ

COUPLING CAPACITOR 1870 MMF.
LOAD RESISTANCE 300 OHMS

Sub. 1.
(Dwg. 862A346)

Fig. 1. Response Curves of JZ 71.6 Tuner.

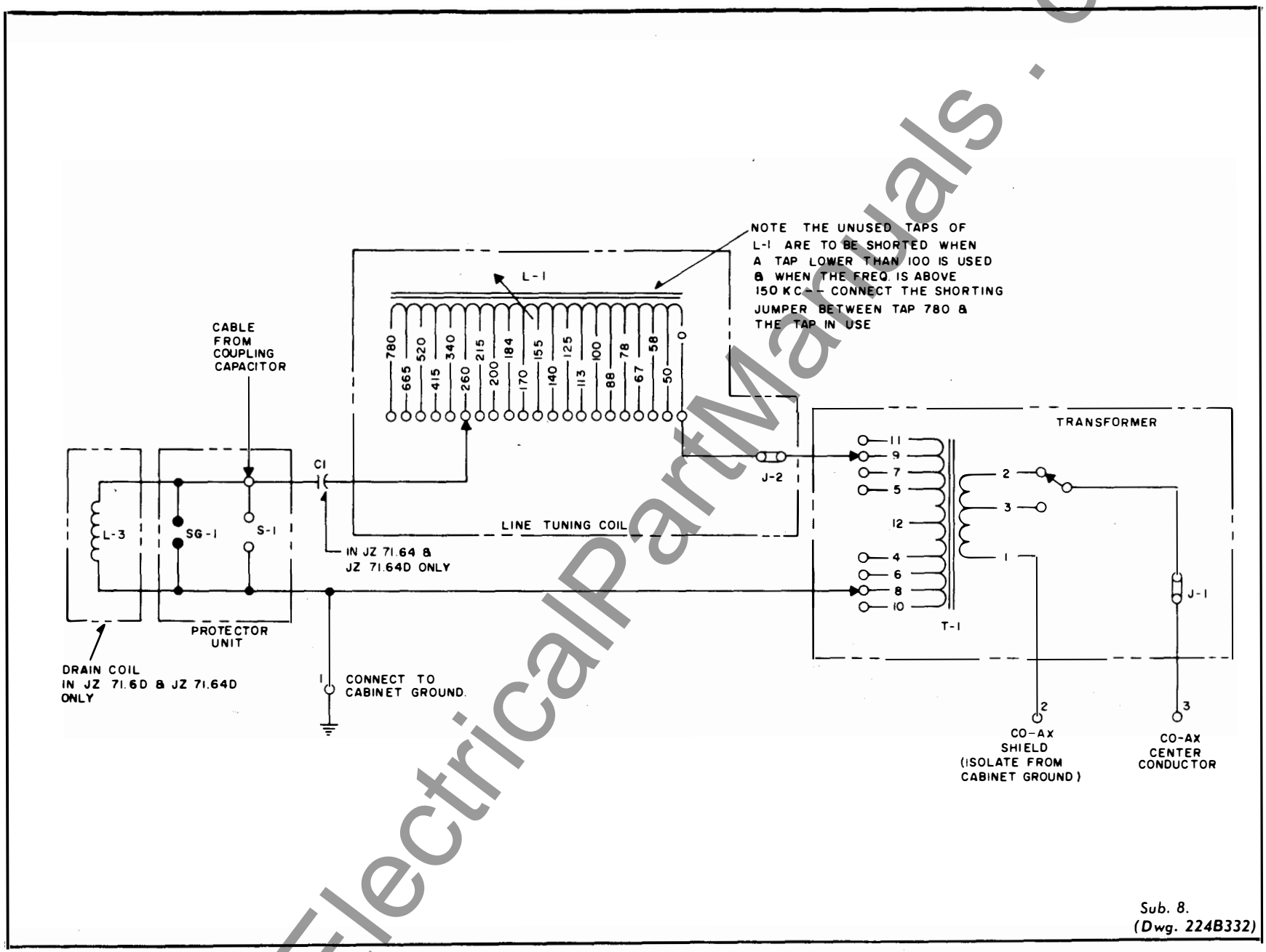
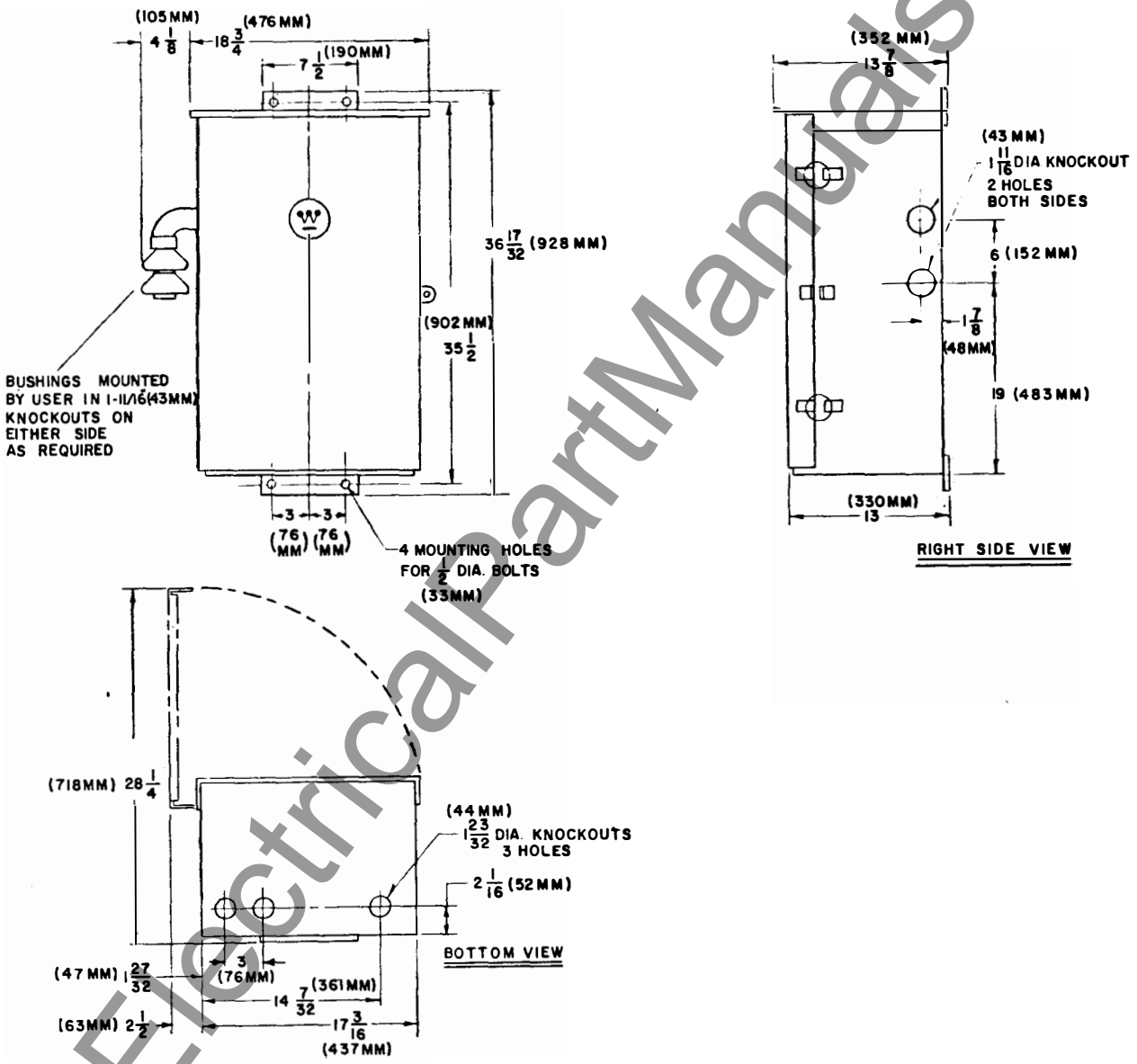


Fig. 2. Schematic Diagram



Sub. 10.
(Dwg. 50-B-7683)

✪ *Fig. 3. Outline Drawing*

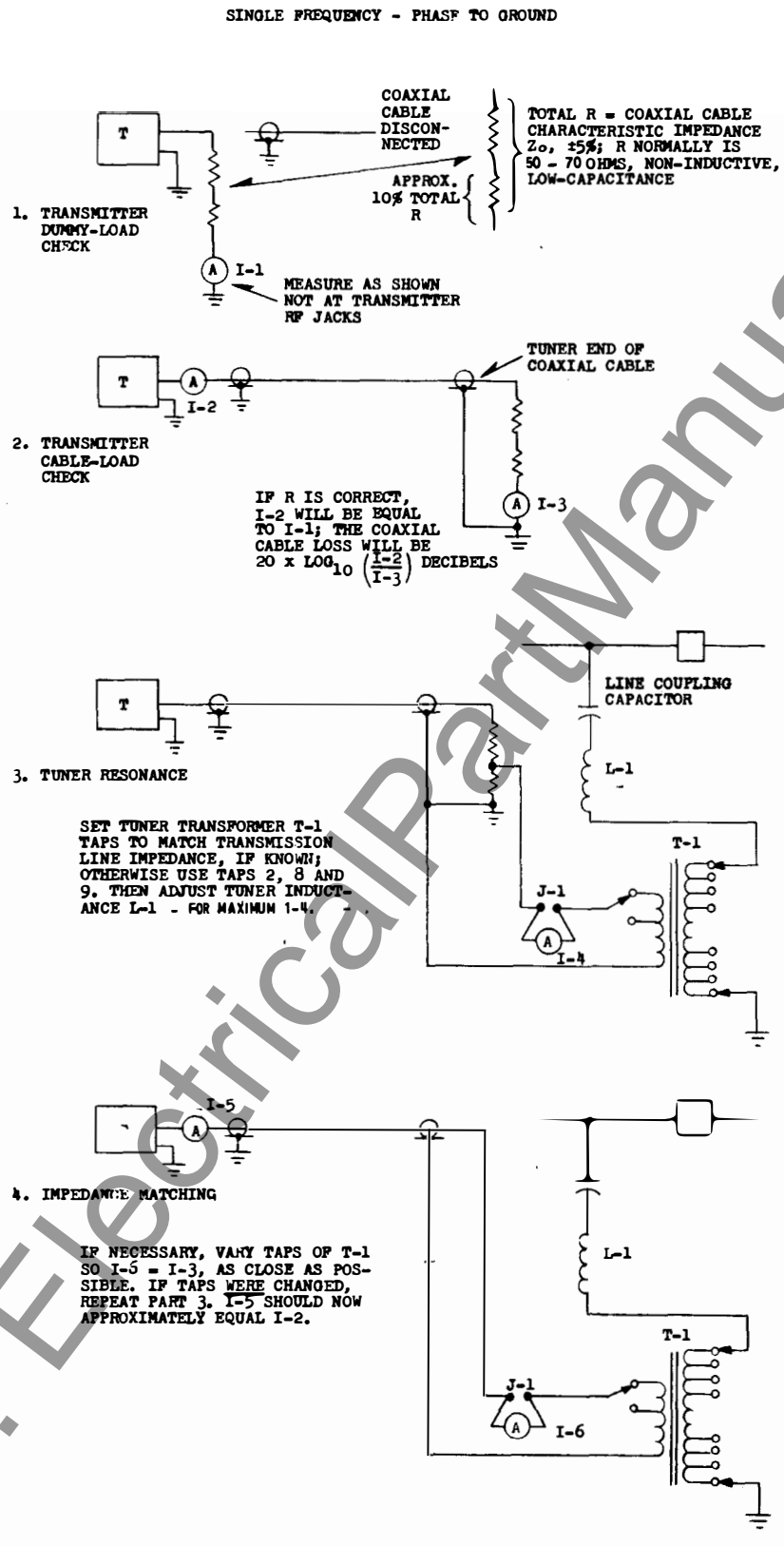


Fig. 4. Line Coupling Tuner Adjustment Procedure

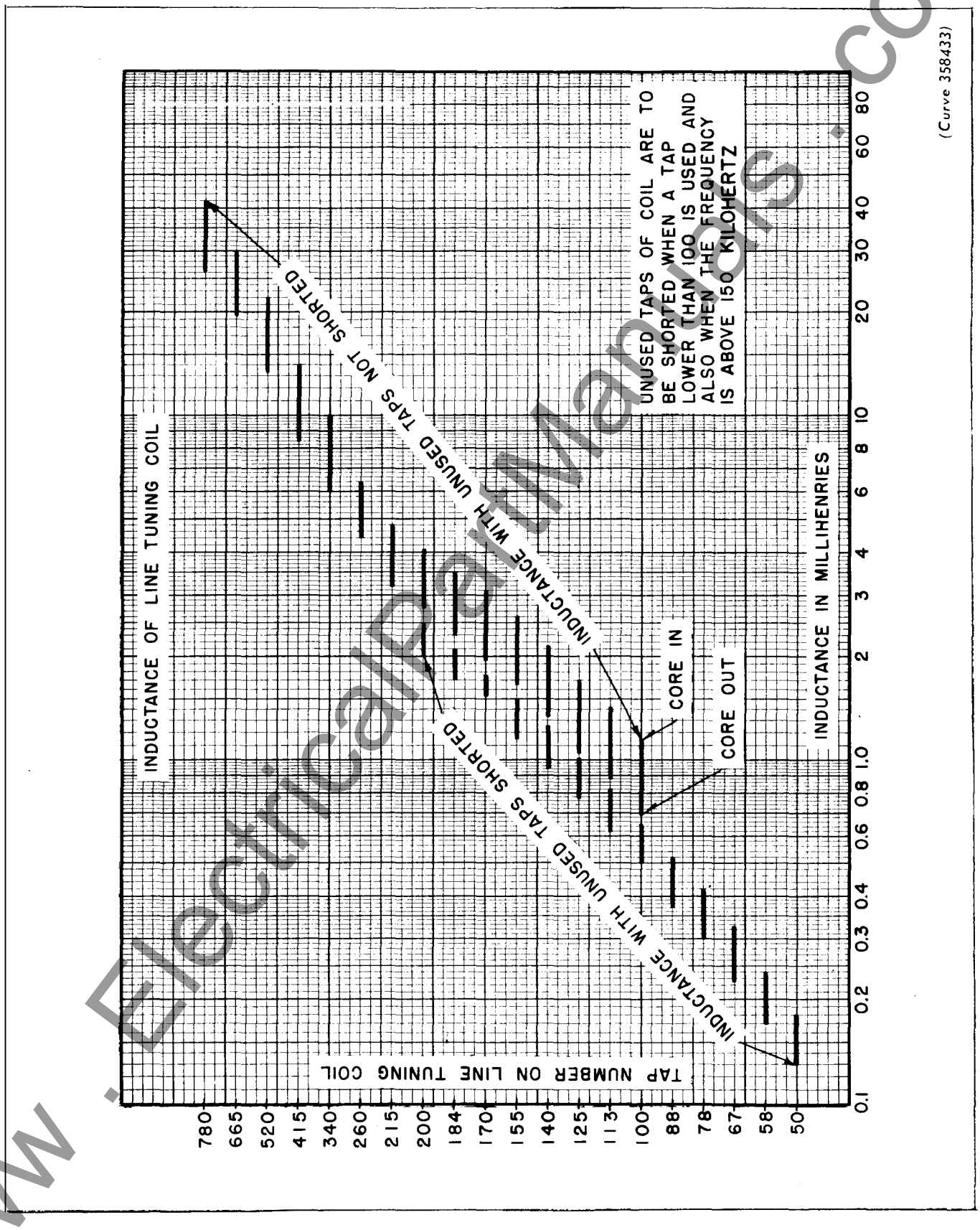


Fig. 5. Inductance of Line Tuning Coil

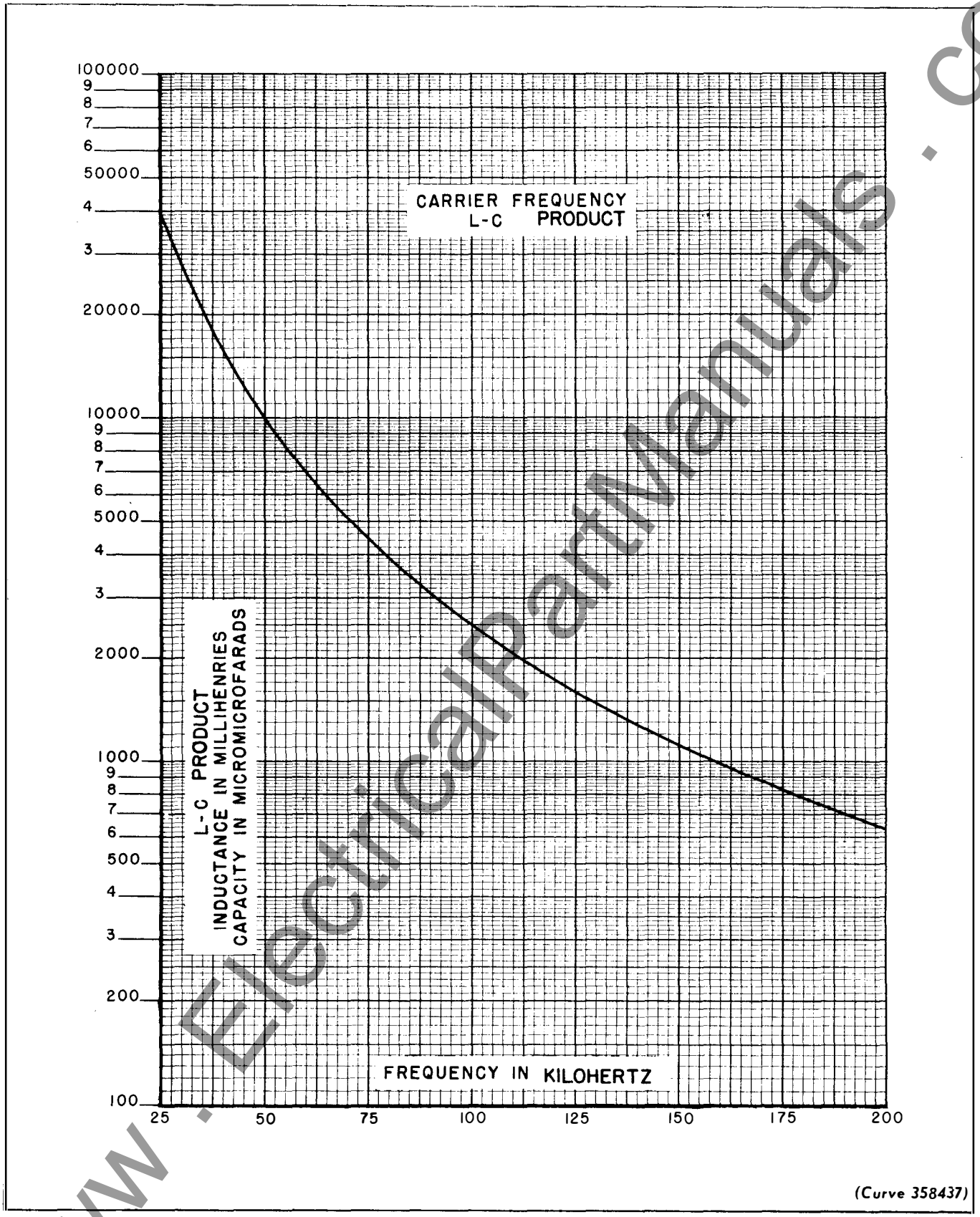


Fig. 6. Carrier Frequency L-C Product

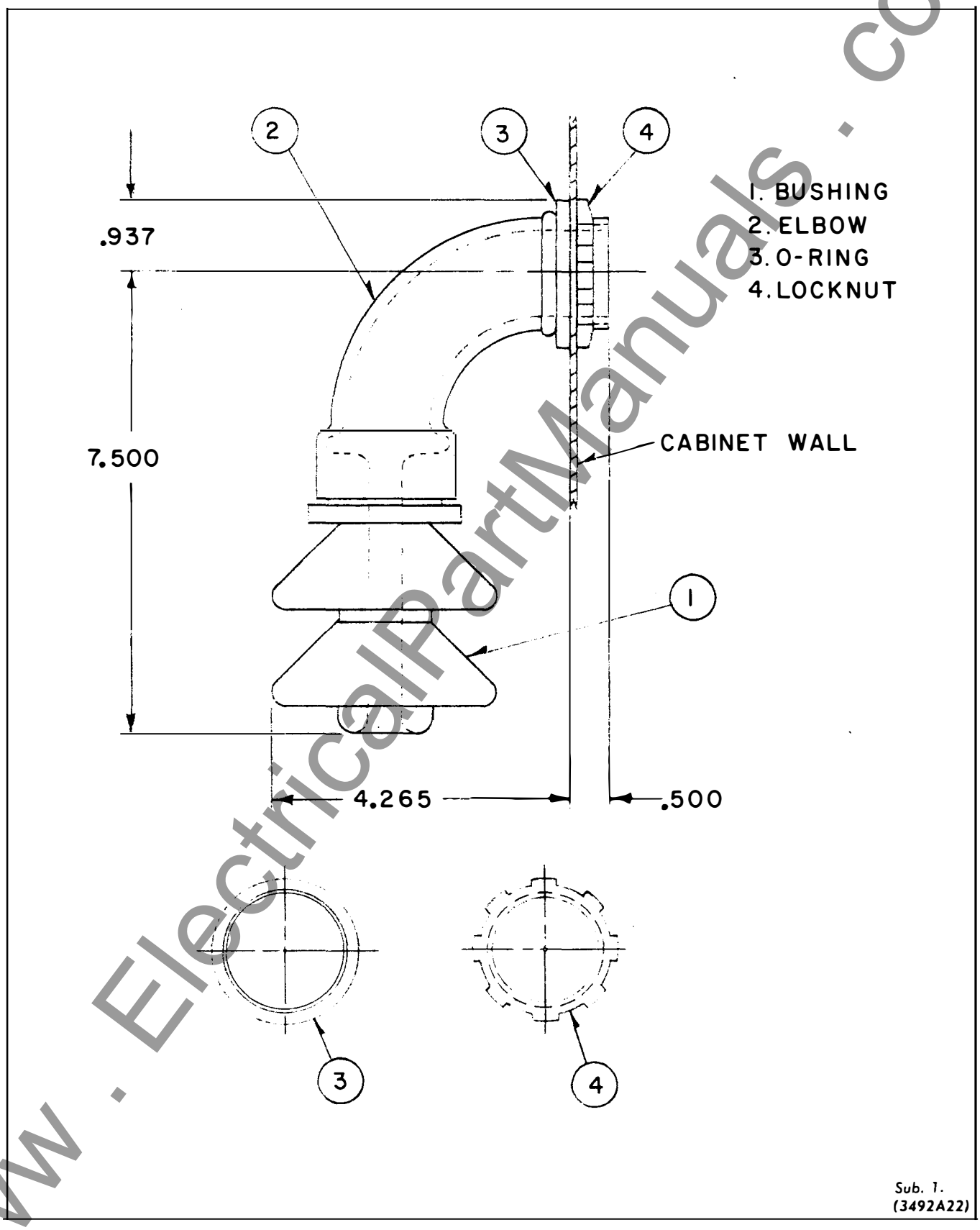
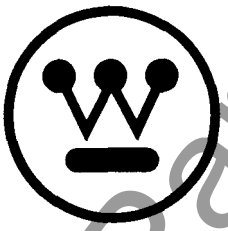


Fig. 7. Lead-In Bushing Assembly



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