

TELEPHONE SET
A.E.CO. TYPE 90M
INSTALLATION AND FIELD MAINTENANCE

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Figure 1. Type 90M Telephone Set.

1. GENERAL

1.01 This section provides installation and field maintenance instructions for the A.E.Co. Type 90M Telephone Set. This section is re-issued to include coverage of manufacturing changes and radio frequency interference correction techniques. Due to extensive changes, marginal arrows are not used.

1.02 The Type 90M Telephone Set (Figure 1) is a wall mounting set with an integral ringer. There are three general series of the basic set. They are:

- (a) Series NA-902 is a manually adjusted set with a potted transmission unit and a Type 81 handset.
- (b) Series NB-902 is a self-compensating set with either a potted, or a Type

WA-1120 printed wiring board transmission unit and a Type 810 handset.

- (c) Series NC-902 is a self-compensating set with a Type WA-1154 printed wiring board transmission unit and either a Type 810 or 811 handset.

1.03 Schematic and wiring diagrams of the Series NA-902 Telephone Set are shown in Figure 2. Figure 3 contains the schematic and wiring diagrams of the Series NB-902 set with a potted transmission unit. The same series, but equipped with a printed wiring board transmission unit, is shown in Figure 4. The Series NC-902 set schematic and wiring diagrams are shown in Figure 5.

1.04 With a few simple wiring changes, the Type 90M Telephone Set can be used with either

- NOTES
- 1- "X" CONTACTS TO BREAK LAST
 - 2- IF BELLS OF BIASED RINGER TAP WHEN DIALING FROM ANOTHER TELEPHONE ON THE LINE REVERSE RINGER CONNECTIONS AT L1 AND 5
 - 3- IF NO DIAL IS USED CONNECT BL AND YEL DIAL WIRES TO TERMINAL 2, WHITE TO TERMINAL 3 AND RED TO TERMINAL 4 OF DIAL BLANK
 - 4- WITH STANDARD DIAL WIRING AT TERMINAL STRIP SHOWN FOR METALLIC (BRIDGED) RINGING FOR GROUND (DIVIDED) RINGING L1 (-RING) TO GROUND MOVE BLACK CAPACITOR LEAD AT TERMINAL STRIP FROM TERMINAL L2 TO 4G. TO RING FROM L2 (+TIP) TO GROUND MOVE BLACK CAPACITOR LEAD FROM TERMINAL L2 TO 4G AND REVERSE TIP AND RING LEADS OF INTERIOR WIRING
 - 5- FOR HOOKLATCH OPERATION CHANGE WIRING AS FOLLOWS:
 - (A) MOVE GREEN SWITCH WIRE FROM NETWORK TERM 2 AND CONNECT TO L2 OF TERM STRIP
 - (B) MOVE WHITE SWITCH WIRE FROM TERMINAL L2 AND CONNECT TO NETWORK TERMINAL 2
 - (C) MOVE ORANGE SWITCH WIRE FROM 3 OF TERMINAL STRIP AND CONNECT TO NETWORK TERMINAL 1
 - (D) MOVE BLACK SWITCH WIRE FROM L1 OF TERMINAL STRIP TO 3 OF TERMINAL STRIP
 - (E) REMOVE VIOLET SWITCH WIRE FROM NETWORK TERMINAL 13 AND TAPE.
 - (F) MOVE YELLOW DIAL WIRE FROM NETWORK TERMINAL 11 TO 3 OF TERMINAL STRIP.
 - (G) ADD STRAP FROM L1 OF TERMINAL STRIP TO TERMINAL 11 OF NETWORK
 - 6- WITH SATT DIAL:
 - (A) SPOTTER SPRINGS TO OPERATE WHEN PULSING SPRINGS ARE CLOSED.
 - (B) MONOPHONE IS FURNISHED WITH RINGER WIRED FOR METALLIC (BRIDGED) RINGING TO RING FROM L1 (-RING) TO GROUND MOVE BLACK CAPACITOR LEAD FROM TERMINAL L2 TO 4G OF TERMINAL STRIP TO RING FROM L2 (+TIP) TO GROUND MOVE RED RINGER WIRE FROM L1 TO 4G OF TERMINAL STRIP
 - (C) DO NOT REVERSE LINE LEADS. POLARITY OF LINE MUST BE MAINTAINED AS SHOWN.

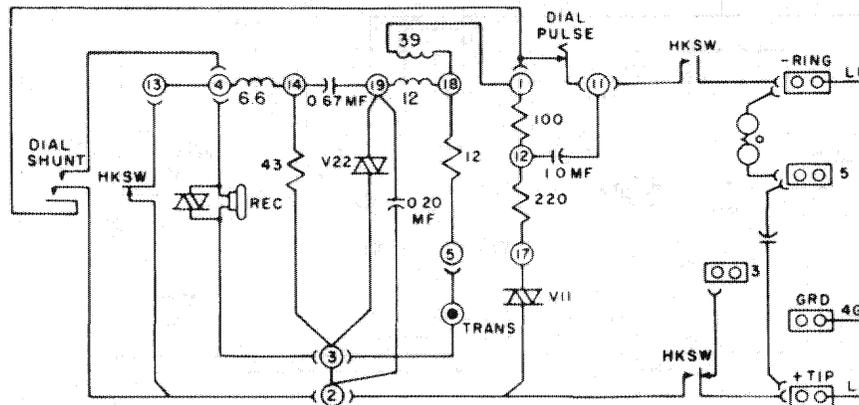
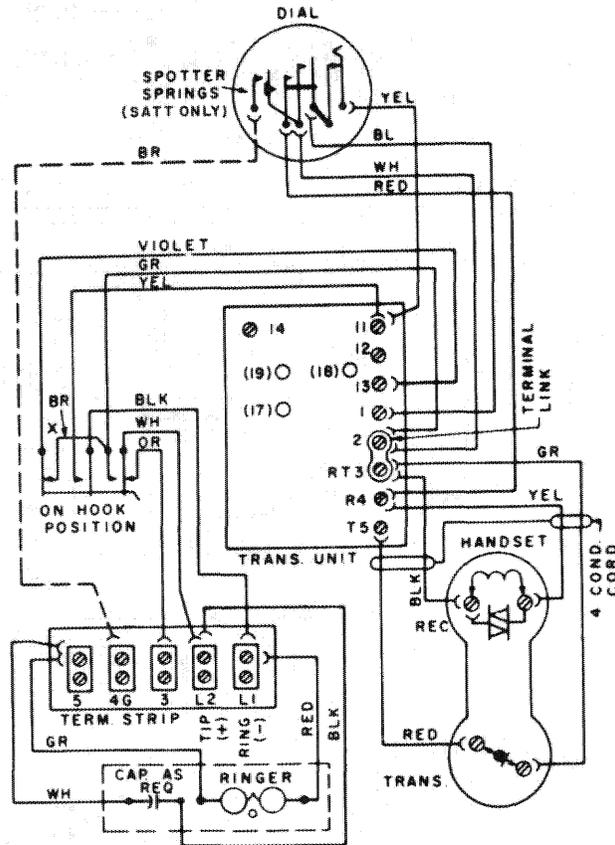
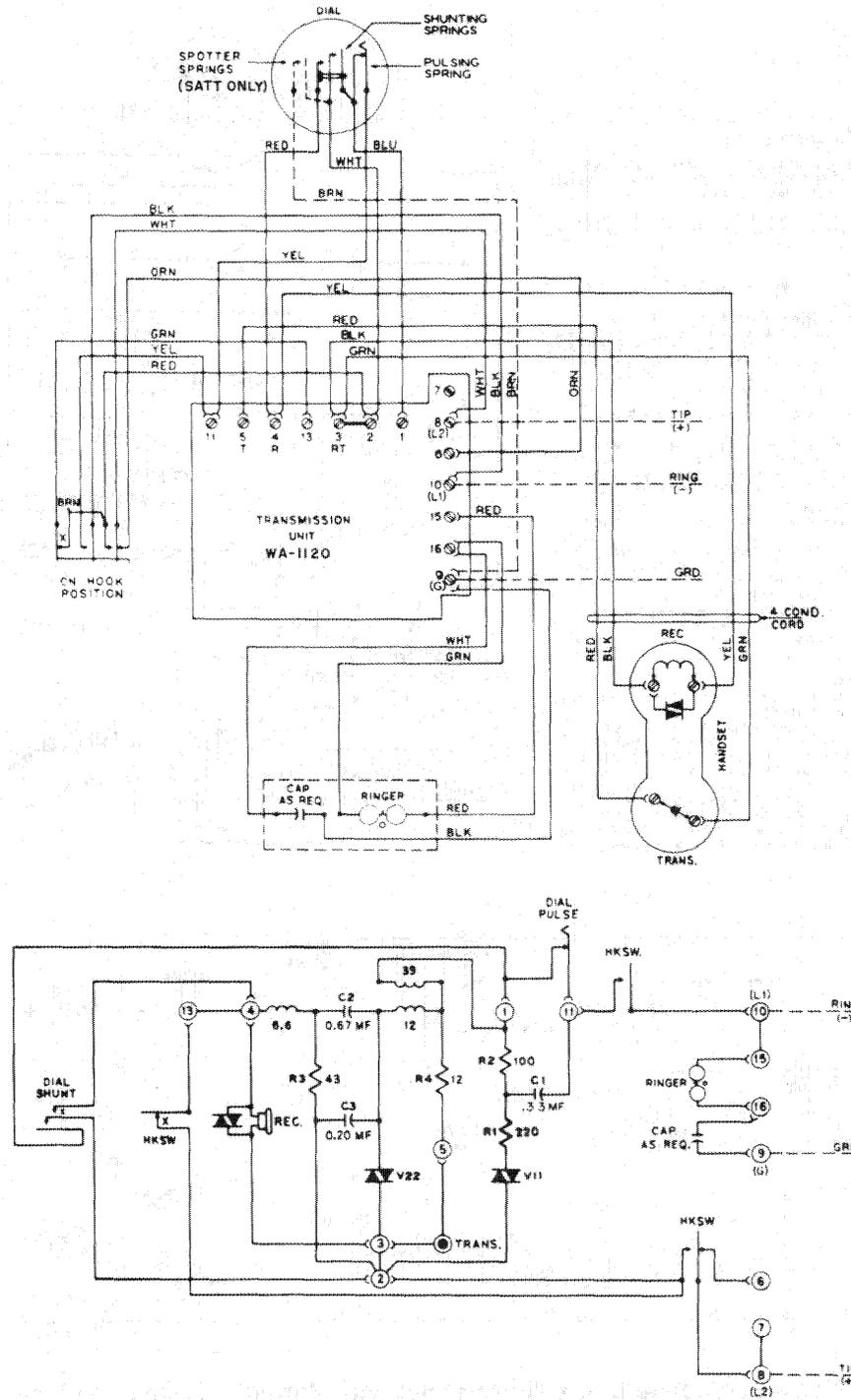


Figure 3. Type 90M Self-compensating Telephone Set with Potted Transmission Unit (Series NB-902), Schematic and Wiring Diagrams.

(4) As the dial returns, listen for clicks in the hand test telephone. If no click is heard, the station telephone set is properly connected. If one or more clicks are heard, reverse the station wires at terminals L1 and L2 in the set, or reverse the drop wires at the station protector.

2.03 Either of two general methods of installing the Type 90M Telephone Set may be used. One method consists of mounting the set on a plain wall. With this method, the station wire is brought in to the set either through the wall and set baseplate, or along the surface of the wall to enter the set at the bottom. The second method consists of mounting the telephone set over an

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- NOTES:
1. X CONTACTS TO BREAK LAST.
 2. IF BELLS OF BIASED RINGER TAP WHEN DIALING FROM ANOTHER TELEPHONE ON THE LINE REVERSE RINGER CONNECTIONS AT 15 AND 16.

Figure 4. Type 90M Self-compensating Telephone Set with Printed Wiring Board Transmission Unit (Series NB-902), Schematic and Wiring Diagrams.

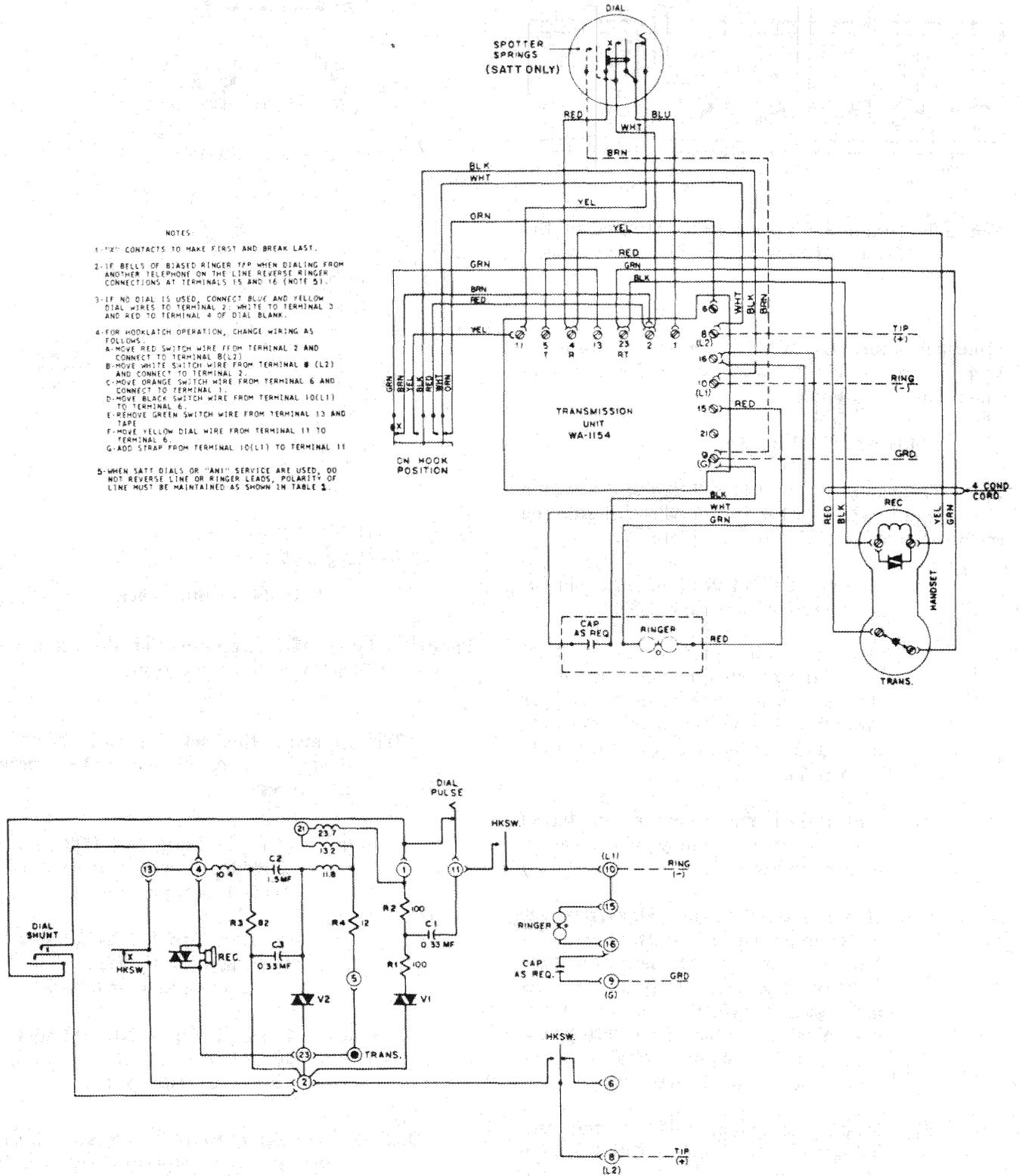


Figure 5. Type 90M Self-compensating Telephone Set with Printed Wiring Board Transmission Unit (Series NC-902), Schematic and Wiring Diagrams.

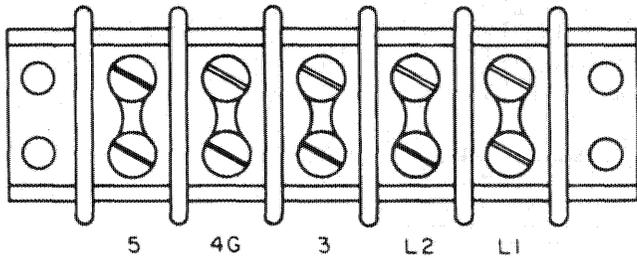


Figure 6. Terminal Strip which is Mounted on the Tripod of Sets with Potted Transmission Units.

electrical outlet box. With this method, the station wire is brought in through the outlet box and telephone set baseplate.

Installing on a Plain Wall

2.04 To install the Type 90M Telephone Set on a plain wall, with the station wire entering the set through the wall and set baseplate:

- (1) Remove the telephone set housing as instructed in Paragraph 4.01.
- (2) Hold the telephone set in its final position against the wall, and mark the locations of one of the two upper mounting holes, the lower mounting hole, and the station wire entry hole (Figure 7).
- (3) Drill a clearance hole for the station wire at the wire entry hole location marked in Step 2.
- (4) If the material of the wall permits use of wood screws, drill starting holes for No. 8 screws at the mounting hole locations marked in Step 2. If anchors are required, drill the necessary holes and install them at the mounting hole locations. Use anchors which will accommodate Number 8 screws.
- (5) Mount the telephone set on the wall, using two No. 8 screws with a thread type appropriate for the type of anchorage.
- (6) Pull in the station wire through the wall and telephone set baseplate wire entry hole.

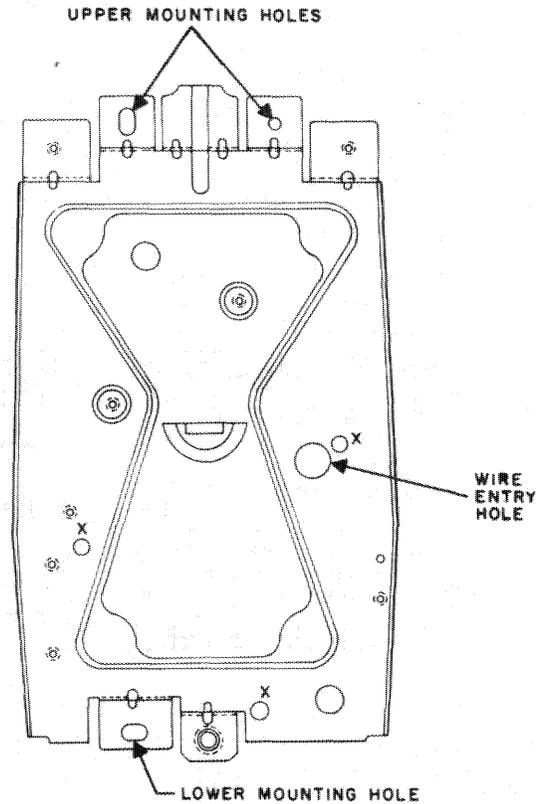


Figure 7. Type 90M Telephone Set Mounting and Wire Entry Hole Locations.

- (7) Connect the set for the type of service, ringing scheme, and set series as follows:
 - (a) Connect Series NA-902 sets in accordance with Figure 2, and Table 1 as appropriate.
 - (b) Connect Series NB-902 sets in accordance with Figure 3 and 4 and Table 2 as appropriate.
 - (c) Connect Series NC-902 sets in accordance with Figure 5, and Table 3 as appropriate.

NOTE: If superimposed ringing is used, the telephone set is equipped with a cold cathode tube. Modify the set wiring in accordance with Table 4.

- (8) Install the housing on the telephone set as instructed in Paragraph 4.02.

Table 1. Lead Connections for Series NA-902 Telephone Set.

	Transmission Unit Terminals					Terminal Strip Terminals												Dial Wire
	Hook-switch Leads	Dial Leads				Ringer Leads	Capacitor Leads	Hookswitch Leads	Station Wires									
Type 90M Standard Manually-Adjusted Telephone Circuit Label D-530253-A																		
	Yel	Grn	Red	Wht	Blu	Yel	Grn	Red	Wht	Blk	Orn	Wht	Blk	Red	Grn	Yel	Brn	
Bridged Ringing (Std Dial)	11	13	R(4)	C(3)	1	11	3	L2	5	L1	3	5	L1	L1	L2			Connect loop compensator blue lead to terminal strip terminal L2.
Divided Ringing +(L2) to Ground (Std Dial)	11	13	R(4)	C(3)	1	11	3	R4	5	11	3	5	L1	L2	L1	4		Connect loop compensator blue lead to terminal strip terminal L2.
Divided Ringing -(L1) to Ground (Std Dial)	11	13	R(4)	C(3)	1	11	3	R4	5	L1	3	5	L1	L1	L2	4		Connect loop compensator blue lead to terminal strip terminal L2.
Type 90M SATT A System Telephone using Ringer Capacitor for Spark Suppression Circuit Label D-530255-A																		
Bridged Ringing	11	13	R(4)	C(3)	1	11	3	L2	5	L1	3	5	L1	L1	L2	4	4	
Type 90M SATT B System Telephone with 1.0MF Spark Suppression Capacitor Circuit Label D-530256-A																		
Bridged Ringing	11	13	R(4)	C(3)	1	11	3	L2	L1	3	5	L1	L1	L1	L2	4	4	
Divided Ringing +(L2) to Ground	11	13	R(4)	C(3)	1	11	3	L2	L2	3	5	L1	L1	L1	L2	4		
Divided Ringing -(L1) to Ground	11	13	R(4)	C(3)	1	11	3	4	L1	3	5	L1	L1	L1	L2	4		
Type 90M Non SATT and SATT A System with 1.0MF Spark Suppression Capacitor Circuit Label D-530258-A																		
Bridged Ringing (Non SATT)	11	13	R(4)	C(3)	1	11	3	L2	3	5	5	L1	L1	L1	L2			
Bridged Ringing SATT A	11	13	R(4)	C(3)	1	11	3	L2	3	5	5	L1	L1	L1	L2	4	4	
Divided Ringing +(L2) to Ground	11	13	R(4)	C(3)	1	11	3	L2	3	5	5	4	L1	L1	L2	4		
Divided Ringing -(L1) to Ground	11	13	R(4)	C(3)	1	11	3	4	3	5	5	4	L1	L1	L2	4		
Hooklatch	NO WIRING CHANGES																	

2.05 To install a Type 90M Telephone Set on a plain wall with the station wire approaching the set along the surface of the wall:

- (1) Remove the telephone set housing as instructed in Paragraph 4.01.
- (2) Hold the telephone set in its final position against the wall, and mark the locations of the lower mounting hole and one of the upper mounting holes (Figure 7).
- (3) If the material of the wall permits the use of wood screws, drill starting holes for No. 8 screws at the locations marked in Step 2. If anchors are required, drill the necessary holes and install them at the mounting hole locations. Use anchors which will accommodate No. 8 screws.
- (4) Mount the telephone set on the wall, using two No. 8 screws with a thread type appropriate for the type of anchorage.
- (5) Using (558533) adhesive backed flat station wire, bring in the service to the telephone set. See the appropriate section in the 434-400 Series of the General System Practices for instructions for installing adhesive backed flat station wire.

Table 2. Lead Connections for Series NB-902 Telephone Sets with Potten Transmission Unit.

	Transmission Unit Terminals					Terminal Strip Terminals								
	Hookswitch Leads					Ringer Leads		Capacitor Leads		Hookswitch Leads				
	Orn	Wht	Yel	Grn	Vio	Grn	Red	Wht	Blk	Orn	Wht	Blk	Grn	
Bridged Ringing (Std Dial)			11	2	13	5	L1	5	L2	3	L2	L1		
Divided Ringing +(L2) to Ground (Std Dial)			11	2	13	5	L1	5	4G	3	L2	L1		
Divided Ringing -(L1) to Ground (Std Dial)			11	2	13	5	L1	5	4G	3	L2	L1		
Bridged Ringing (SATT Dial)			11	2	13	5	L1	5	L2	3	L2	L1		
Divided Ringing -(L1) to Ground (SATT Dial)			11	2	13	5	L1	5	4G	3	L2	L1		
Divided Ringing +(L2) to Ground (SATT Dial)			11	2	13	5	4G	5	L2	3	L2	L1		
Hooklatch	1	2	Same as for ringing scheme used, except remove Vio switch wire from transmission unit terminal 13 and tape.								3	L2	Add strap from terminal strip terminal L1 to transmission unit terminal 11	
	Interior Wires			Dial Wires										
	Terminal Strip			Transmission Unit			Terminal Strip							
	Red	Grn	Yel	Red	Wht	Blu	Yel	Yel		Brn				
Bridged Ringing (Std Dial)	L1	L2		R4	2	1	11							
Divided Ringing +(L2) to Ground (Std Dial)	L2	L1	4G	R4	2	1	11							
Divided Ringing -(L1) to Ground (Std Dial)	L1	L2	4G	R4	2	1	11							
Bridged Ringing (SATT Dial)	L1	L2	4G	R4	2	1	11		4G					
Divided Ringing +(L2) to Ground (SATT Dial)	L1	L2	4G	R4	2	1	11		4G					
Divided Ringing -(L1) to Ground (SATT Dial)	L1	L2	4G	R4	2	1	11		4G					
Hooklatch	L1	L2	SATT 4G	R4	2	1		3		Add strap from terminal strip terminal L1 to transmission unit terminal L1				

- (6) Connect a short length of GT-4 station wire to the telephone set in accordance with Paragraph 2.04, Step 7, as appropriate.
- (7) Using a (551076) transition connector, connect the adhesive backed flat station wire (Step 5) to the GT-4 station wire (Step 6). Install the tran-

sition connector as instructed in the appropriate section in the 434-400 Series of the General System Practices. Locate the transition connector as follows:

- (a) On sets equipped with printed wiring board transmission units, remove the ringer, and install

Table 3. Lead Connections for Series NB-902 Telephone Sets with Printed Wiring Board Transmission Unit.

	Transmission Unit Terminals																	
	Ringer Leads		Capacitor Leads		Hookswitch Leads						Dial Leads					Station Wires		
	Grn	Red	Wht	Blk	Orn	Wht	Blk	Yel	Grn	Red	Red	Wht	Blue	Yel	Brn	Red	Grn	Yel
Bridged Ringing (Std Dial)	16	15	16	7	6	8(L2)	10(L1)	11	13	2	4	2	1	11		10(L1)	8(L2)	
Divided Ringing -L1 to Ground (Std Dial)	16	15	16	9(G)	6	8(L2)	10(L1)	11	13	2	4	2	1	11		10(L1)	8(L2)	9(G)
Divided Ringing +L2 to Ground (Std Dial)	16	15	16	9(G)	6	8(L2)	10(L1)	11	13	2	4	2	1	11		8(L2)	10(L1)	9(G)
Bridged Ringing (SATT DIAL)	16	15	16	7	6	8(L2)	10(L1)	11	13	2	4	2	1	11	9(G)	10(L1)	8(L2)	9(G)
Divided Ringing -L1 to Ground (SATT Dial)	16	15	16	9(G)	6	8(L2)	10(L1)	11	13	2	4	2	1	11	9(G)	10(L1)	8(L2)	9(G)
Divided Ringing +L2 to Ground (SATT Dial)	16	7	16	9(G)	6	8(L2)	10(L1)	11	13	2	4	2	1	11	9(G)	10(L1)	8(L2)	9(G)
Hooklatch*					1	2	6	11	Tape	8(L2)	4	2	1	6		10(L1)	8(L2)	9(G)

*On hooklatch also add strap from Terminal 10(L1) to Terminal 11.

the station wire and transition connector as shown in Figure 8a. Re-install the ringer as shown in Figure 8b.

- (b) On sets equipped with potted transmission units, bring the GT-4 station wire out through the bottom of the telephone set housing, and install the transition connector at some inconspicuous location external to the telephone set.

- (8) Re-install the housing on the telephone set as instructed in Paragraph 4.02.

Installing on an Outlet Box

2.06 The Type 90M Telephone Set may be installed on any one of several standard types of electrical outlet boxes, by use of a special adapter plate (Figure 9). The total material requirement in addition to the telephone set, for such an installation consists of one (556124) adapter plate which is supplied with the necessary attaching hardware included.

2.07 To install a Type 90M Telephone Set on an electrical outlet box:

- (1) Remove the cover of the outlet box on which the telephone set is to be mounted.

Table 4. Lead Connections for Series NC-902 Telephone Sets.

	TRANSMISSION UNIT TERMINALS						
	Ringer Leads		Capacitor Leads		Station Wire		
	Grn	Red	Wht	Blk	Red	Grn	Yel
Bridged Ringing (Std Dial)	16	15	16	8	10(L1)	8(L2)	
Divided Ringing -L1 to Ground (Std Dial)	16	15	16	9(G)	10(L1)	8(L2)	9(G)
Divided Ringing +L2 to Ground (Std Dial)	16	15	16	9(G)	8(L2)	10(L1)	9(G)
Bridged Ringing (SATT Dial)*	16	15	16	8	10(L1)	8(L2)	9(G)
Divided Ringing -L1 to Ground (SATT Dial)*	16	15	16	9(G)	10(L1)	8(L2)	9(G)
Divided Ringing +L2 to Ground (SATT Dial)*	16	8	16	9(G)	10(L1)	8(L2)	9(G)

* Party identity pulse must be on positive side of the line.

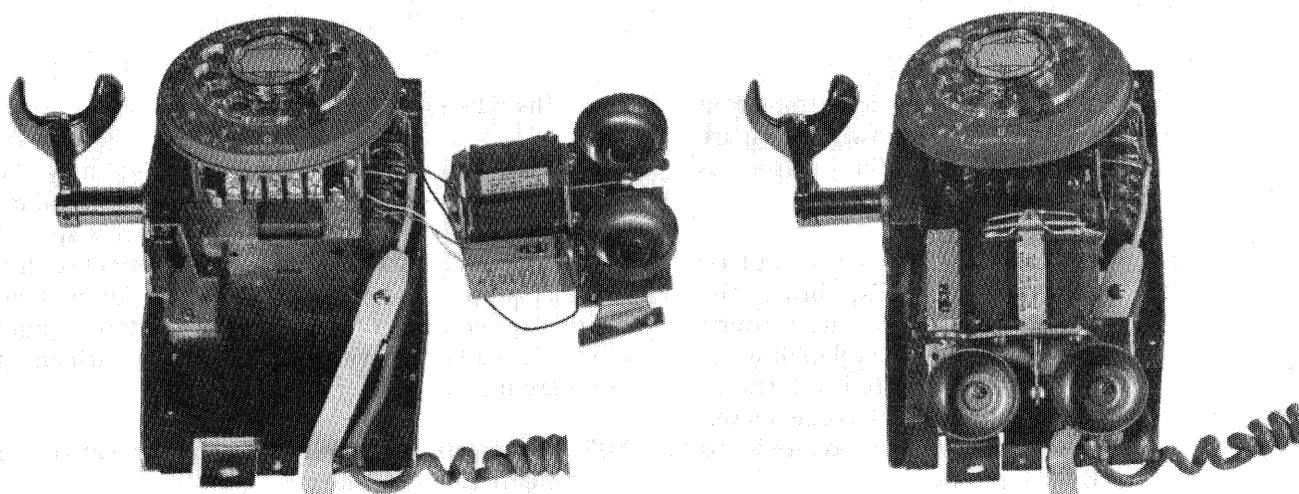


Figure 8. Installing Transition Connector on a Type 90M Telephone Set Equipped with a Printed Wiring Board Transmission Unit.

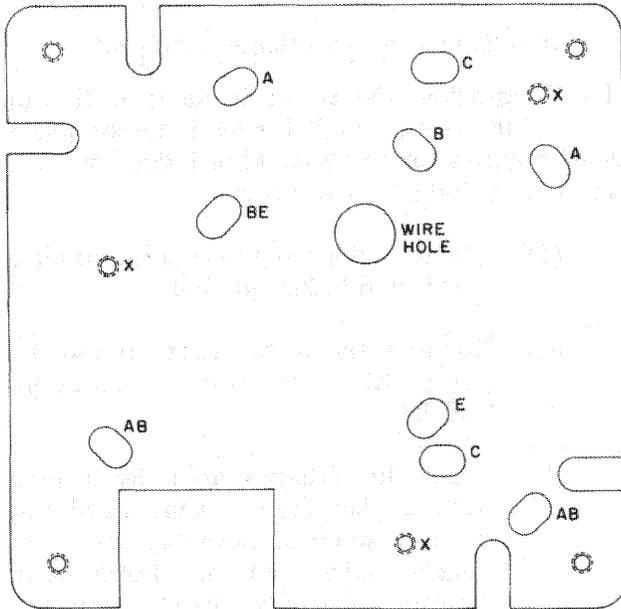


Figure 9. Outlet Box Mounting Adapter Plate.

- (2) Pull in the station wire into the outlet box.
 - (3) Pass the station wire through the wire entry hole in the adapter plate from the back.
 - (4) Place the adapter plate over the outlet box. Referring to Figure 9, align the proper holes in the adapter plate with the tapped holes in the outlet box as follows:
 - (a) For a 4-inch square outlet box, use the holes designated A.
 - (b) For a 4-inch octagonal outlet box, use the holes designated B.
 - (c) For a 2 x 4 inch handy box, use the holes designated C.
 - (d) For a 4-11/16 inch square outlet box, use the holes designated D.
 - (e) For the Suttle Type 63A junction box, use the holes designated E.
 - (5) Attach the adapter plate to the outlet box by installing the original outlet box cover securing screws in the holes aligned in Step 4.
 - (6) Remove the housing of the Type 90M Telephone Set as instructed in Paragraph 4.01.
 - (7) While holding the telephone set up next to the outlet box, pull the station wire through the wire entry hole in the telephone set baseplate.
 - (8) Place the telephone set into position with its baseplate against the outlet box adapter plate. Align the telephone set mounting holes with the holes designated X in Figure 9.
 - (9) Attach the telephone set to the adapter plate by installing three No. 8-32 x 25/64 inch long round head screws (provided with the adapter plate) in the holes aligned in Step 8.
- NOTE: Install a bushing (provided with the adapter plate) on the mounting screws between the baseplate and the adapter plate.
- (10) Connect the telephone set and station wires in accordance with Paragraph 2.04, Step 7.
 - (11) Install the housing on the telephone set as instructed in Paragraph 4.02.

Installation of Hooklatch

2.08 A hooklatch permits the checking of a party line for busy without disturbing any call which may be in progress on the line. The material requirement for installing a hooklatch on a Type 90M Telephone Set consists of:

- (a) One hooklatch, Type D-58065-A
- (b) One shoulder screw, Type D-760774-A
- (c) One washer, Type D-17473-A.

2.09 To install a hooklatch on the Type 90M Telephone Set:

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- (1) Remove the telephone set housing as instructed in Paragraph 4.01.
- (2) Attach the hooklatch to the telephone set as shown in Figure 10, using the shoulder screw and washer provided.
- (3) Wire the telephone set as indicated for hooklatch in Table 1, 2, or 3, as appropriate.
- (4) Lift the telephone set handset from the cradle with the hooklatch lever lifted, and observe that the positions of the hookswitch springs are as shown in Figure 11, as appropriate for the type of set.
- (5) Install the housing on the telephone set as instructed in Paragraph 4.01.

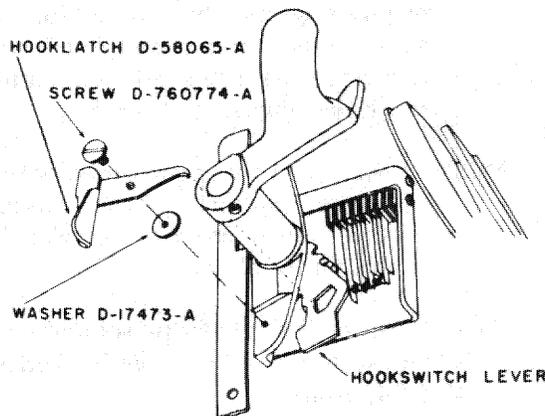


Figure 10. Hooklatch Installation.

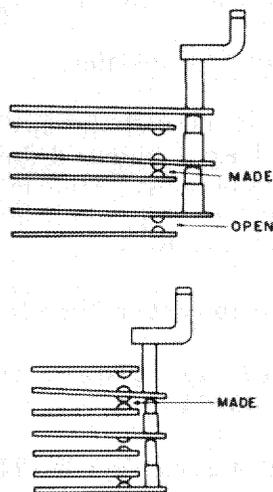


Figure 11. Partial Operation of Hookswitch Springs when Controlled by a Hooklatch.

ANI Tip Party Identification (NC-902)

2.10 To provide ANI tip party identification on NC-902 sets, a D-284686-C inductor assembly is required for the 2650-ohm inductive mark. To install the inductor assembly:

- (1) Remove the telephone set housing as instructed in Paragraph 4.01.
- (2) Remove the lower screw in the cast iron handset hanger mounting bracket.
- (3) Place the inductor assembly in position so that the larger untapped hole in the inductor assembly mounting bracket aligns with the lower screw hole in the handset hanger mounting bracket.
- (4) Secure the inductor assembly to the handset hanger mounting bracket, using the screw removed in Step 2.
- (5) Connect the black inductor lead to transmission unit terminal 21. Connect the gray inductor lead to transmission unit terminal 9. Tape and store the red inductor lead.
- (6) Re-install the housing on the telephone set as instructed in Paragraph 4.02.

Stamping the Telephone Number

2.11 The telephone number card on a Type 90M Telephone Set is located under a transparent plastic excutcheon in the center of the dial. Access to this card must be obtained in order to stamp the telephone station number on it. For the method of obtaining access to the telephone number card, see the appropriate section in the 473-820 Series of General System Practices.

Ringling Tests and Adjustments

2.12 After the telephone set installation has been completed, call the central office and request a ringing test. If the set is equipped with a straight-line ringer with a volume adjustment wheel, adjust the volume of the ringer to the customer's satisfaction while this test is in progress. See Paragraph 2.13 for instructions for adjusting ringer volume.

2.13 To adjust the volume of a straight-line ringer equipped with an adjusting wheel:

- (1) Remove the telephone set housing as instructed in Paragraph 4.01.
- (2) Turn the plastic wheel located at the base of the ringer as follows:
 - (a) To increase ringer volume, turn the wheel so that the distance between the ringer armature and the wheel is increased.
 - (b) To decrease the volume, turn the wheel so that the distance between the ringer armature and the wheel is decreased.

2.14 Occasionally, when two or more straight-line ringers are connected to the same line, the ringer on one station may tap when another station dials. This is due to the charge and discharge of the ringer capacitor during dialing. To correct this, remove the housing of the telephone set in which the ringer tapping occurs, and reverse the ringer leads at the transmission unit terminals. Re-install the housing on the telephone set as instructed in Paragraph 4.02.

3. LOOP COMPENSATION ON MANUALLY ADJUSTED SETS

3.01 Type 90M telephone sets of earlier manufacture were equipped with a slotted-shaft rheostat to limit the transmitter current in short loops. These telephone sets can be identified by codes beginning with either the letter N, or the letters NA stamped on the baseplate. The location of the rheostat is shown in Figure 16. The shaft slot has an arrowhead shape to facilitate indexing with designations 0 through 4 which appear in a circle surrounding the shaft hole. These index points correspond roughly to rheostat settings of 0 through 400 ohms of series resistance inserted into the loop.

3.02 The installation of sets with the manually-adjusted rheostat is subject to restrictions imposed by transmission zoning (See the 473-050 Series of the General System Practices). These restrictions may make unnecessary some or all of the adjustments specified in this part, since the application of such sets may be limited to loops requiring little or no rheostat adjustment.

3.03 The objective of loop adjustment is to limit the current flowing in the loop and through the transmitter, to a maximum of 60 milliamperes. This limits the transmitted voice signal to a level which is not likely to cause crosstalk between circuits in the DDD network.

Rough Approximation Method

3.04 When no portable milliammeter is available, and installation is being made at a station served by a tributary central office with no direct testboard trunks, when the resistance of the loop (exclusive of the telephone set) is known only very approximately, set the rheostat according to the following rule of thumb:

- (a) If the loop does not exceed 200 ohms, set the rheostat at its "2" setting.
- (b) If the loop resistance is greater than 200 ohms, set the rheostat at its "0" setting, and note the limitation set forth in Paragraph 3.09.

NOTE: The rough approximation method of adjustment is based on the assumption that the central office battery potential is 50 volts, and the battery feed coil resistance (to be added to the loop resistance in figuring current) is 200 ohms in each winding.

Accurate Methods

3.05 Accurate methods of loop adjustment are preferred when available, because they are based on actual current measurements. When installation is being made in an automatic or manual central office served by a testboard:

- (1) Call the testboard and ask for assistance in adjusting the rheostat.

NOTE: The testman will arrange to feed battery to the line in series with a milliammeter, and coils typical of those used in regular central office circuits.

- (2) Set the rheostat at its zero position and leave it there for a short time.
 - (a) If the testman advises that the current is already below 60

milliamperes in amplitude, leave the rheostat set at zero.

- (b) If the testman does not advise that the current is already less than 60 milliamperes in amplitude, advance the rheostat slowly until advised by the testman that the current is below 60 milliamperes in amplitude.

3.06 In cases where the testboard is not equipped for current readings, the testman can connect his voltmeter across the line and determine the potential drop in the battery feed coil by subtracting the line reading from a reading taken directly across the office battery. If the resistance of the battery feed coil is known, the correct drop for a 60 milliampere drain can be calculated. For example, if the battery potential is 50 volts, and the battery feed coil resistance is 200 ohms per winding, a current of 60 milliamperes produces a drop of $200 \times .060 = 12$ volts per winding in the coil. Thus, the resulting line potential is $50 - 2(12) = 26$ volts.

3.07 When installing a station served by a tributary central office with no direct testboard trunks, an accurate adjustment can still be made by connecting a portable milliammeter in series with one of the line conductors at the connecting block, or at the transmission unit in the telephone set.

Exceptions

3.08 Limitation of the transmitter current to 60 milliamperes applies only to installations in which all sets having access to the same line, whether installed at the same location or at different locations, are of the type with manually-adjusted series rheostat. If telephone sets of other circuit types are to be used on the same line with a manually adjusted set, the rheostat in the manually adjusted set must be set at its "0" position, subject to the limitation stated in Paragraph 3.09.

3.09 The simple induction coil used in conjunction with the manually adjusted series rheostat, does not provide sidetone compensation for changes in line impedance with increasing loop length. That is, there is no element which can counteract each variation in impedance as it occurs. However, at the "0" setting of the rheostat, an internal contact closes, which connects a fixed

resistance and capacitance across the sidetone balancing resistance in the receiver circuit. This change in the balancing impedance is intended to match the rather capacitive impedance of a long cable loop. It is not appropriate for a short cable loop (one which is only slightly higher in resistance than the value which reduces loop current to 60 milliamperes and thus requires the "0" setting of the rheostat), for long open-wire loop, or for a station on a loaded cable loop which lies less than one loading section from the nearest load coil. If a "0" setting is required in such cases, disconnect the violet rheostat wire from terminal 14 of the transmission unit, and connect it to terminal L2 on the terminal strip. Do not attempt to open the rheostat contact by choosing a setting between 0 and 1, as this introduces unnecessary loop resistance.

3.10 Should any transmission complaint be received involving a Type 90M Telephone Set with a manually adjusted series rheostat, replace the set with one which provides automatic sidetone compensation.

4. FIELD MAINTENANCE

Housing Removal and Installation

4.01 To remove the housing of the Type 90M Telephone Set:

- (1) Loosen the housing securing screw located in the front of the housing at bottom center (Figure 1).
- (2) Swing the bottom of the housing forward sufficiently to clear the dial.
- (3) Lift the housing upward to separate it from the telephone set.

4.02 To install the housing on the Type 90M Telephone Set:

- (1) Engage the slot in the upper housing bracket with the stud on the telephone set.
- (2) Lower the housing until it resets on the lower half of the dial.
- (3) Press the top edge of the dial in enough to cause the housing to drop into place.

- (4) Tighten the housing securing screw (Paragraph 4.01, Step 1).

Dial Replacement

4.03 To replace the dial on the Type 90M Telephone Set:

- (1) Remove the telephone set housing as instructed in Paragraph 4.01.
- (2) Press in on the dial and slide it upward until the bayonet lugs disengage from the mounting pins.
- (3) Disconnect the dial leads from the transmission unit terminals, and remove the dial from the telephone set.
- (4) Remove the three dial mounting plate screws, and lift the dial mounting plate off the dial.
- (5) Attach the dial mounting plate to the replacement dial, using the three screws removed in Step 4.
- (6) Connect the replacement dial leads to the transmission unit terminals in accordance with Table 1, 2, 3, or 4 as appropriate. Provide leads as required.

NOTE: If the old dial has screw terminals, leads may be salvaged from it for connecting the replacement dial.

- (7) Place the dial in position on the telephone set, with the bayonet lugs at the point of engagement with the mounting pins.
- (8) Press in on the dial and slide it downward to latch it in place.
- (9) Re-install the housing on the telephone set as instructed in Paragraph 4.02.

Ringer Replacement

4.04 To replace the ringer in a Type 90M Telephone Set:

- (1) Remove the telephone set housing as instructed in Paragraph 4.01.

- (2) Disconnect the ringer and ringer capacitor leads from the transmission unit or terminal strip terminals.
- (3) Remove the three ringer mounting bracket securing screws (Figure 13), and lift the ringer and mounting bracket combination out of the telephone set baseplate.
- (4) Turn the ringer and mounting bracket combination upside down. Remove the two ringer securing screws (Figure 13), and lift the mounting bracket off the old ringer.
- (5) Install the mounting bracket on the replacement ringer as shown in Figure 12.

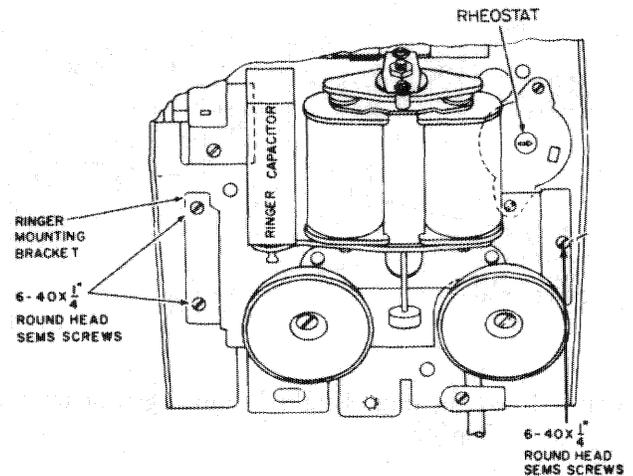


Figure 12. Loop Adjustment Rheostat and Ringer Mounting Hardware Location.

NOTE: To determine the proper type of ringer for a particular application, consult the General Telephone System Standard Material Lists.

- (6) Attach the ringer and mounting bracket combination to the telephone set baseplate, using the three screws removed in Step 3.
- (7) Connect the ringer and capacitor leads in accordance with the instructions in Table 1, 2, 3, or 4, as appropriate, for the set series and ringing scheme used.

- (8) Re-install the housing on the telephone set as instructed in Paragraph 4.02.

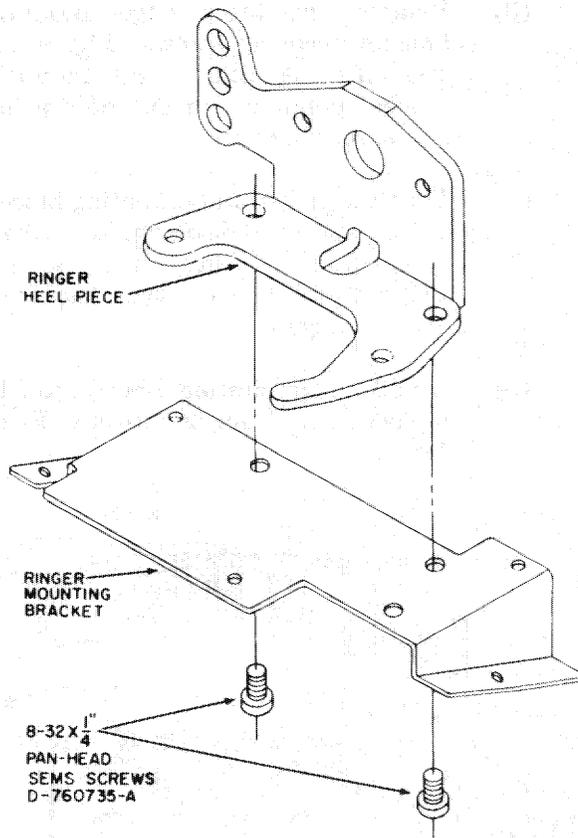


Figure 13. Attaching Ringer Mounting Bracket to Ringer.

Handset Replacement

4.05 When the handset of a Type 90M Telephone Set requires replacing, the handset cord is also replaced. To replace the handset and cord:

- (1) Remove the housing from the telephone set as instructed in Paragraph 4.01.
- (2) Disconnect the handset leads from the telephone set transmission unit.
- (3) Loosen the cord clamp securing screw enough to permit the cord to be slipped through the cord clamp.
- (4) Pull out the old handset cord.

- (5) Insert the cord of the new handset through the handset cord clamp, and under the ringer mounting bracket.
- (6) Connect the handset leads according to Figure 2, 3, 4, or 5, as appropriate, for the series of the set.
- (7) Pull out the excess slack in the handset cord, but leave enough to prevent applying tension on the connections to the transmission unit. Tighten the cord clamp securing screw.
- (8) Re-install the housing on the telephone set as instructed in Paragraph 4.02.

4.06 For instruction for replacing the handset cord at the handset, refer to the appropriate section in the 473-802 Series of the General System Practices.

Radio Frequency Interference Correction

4.07 Telephone sets located near a radio transmitter may be subject to radio frequency interference. The RFI may occur within any of the telephone set components, or in a line connection external to the set. To determine whether RFI is external or internal, refer to the 471-150 Series of the General System Practices and perform the test procedures contained therein. If the RFI is determined to be external, perform corrective measures contained therein under the part entitled "RFI Corrective Measures—External." If the RFI is determined to be internal, perform the corrective measures contained therein under the part entitled "RFI Corrective Measures—Internal," and connect three .03 μ F, 500VDC capacitors in the telephone set for suppression as follows:

- (1) Connect one capacitor between terminals 3 or 23, and 4 of the self-compensating transmission unit.
- (2) Connect one capacitor between terminals 3 or 23, and 5 of the self-compensating transmission unit.
- (3) Connect one capacitor between terminals 1 and 5 of the self-compensating transmission unit.

NOTE: Cover the capacitor leads with insulating sleeving.

Table 5. Lead Connections for Superimposed Ringing.

Station	NC-902 Self-Compensating Set					NB-902 Self Compensating Set With Printed Wire Transmission Unit					NB-902 Self-Compensating With Potted Transmission Unit					NA-902 Manually-Adjusted Set				
	Transmission Unit Terminals					Transmission Unit Terminals					Terminal Strip Terminals					Terminal Strip Terminals				
	Ringer Leads		Tube Leads			Ringer Leads		Tube Leads			Ringer Leads		Tube Leads			Ringer Leads		Tube Leads		
	Grn	Red	Yel	Blk	Red	Grn	Red	Yel	Blk	Red	Grn	Red	Yel	Blk	Red	Grn	Red	Yel	Blk	Red
No. 1 or No. 5 -station on -(ring) Line	15	16	16	9(G)	9(G)	10(L1)	16	16	9	9	L1	3	3	4G	4G	L1	3	3	4	4
No. 2 or No. 6, -station on + (tip) Line	8	16	16	9(G)	9(G)	8(L2)	16	16	9	9	L2	3	3	4G	4G	L2	3	3	4	4
No. 3 or No. 7 + station on -(ring) Line	16	15	9(G)	16	16	16	10(L1)	9	16	16	3	L1	4G	3	3	3	L1	4	3	3
No. 4 or No. 8, + station on + (tip) Line	16	8	9(G)	16	16	16	8(L2)	9	16	16	3	L2	4G	3	3	3	L2	4	3	3

