

DISTRIBUTING FRAME CROSS-CONNECTIONS

GENERAL

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1. GENERAL		
1.01 This section covers general information regarding cross-connection work on main distributing frames and carrier cross-connection cabinets in central offices.		1.03 Cross-connection work is one of the most important operations performed in the central office. In the interest of good service and economical maintenance, each craftsman should be familiar with the methods and practices described in this section. In addition, the craftsman should be familiar with the cross-connection features of the various circuits in the particular office or offices in which he is employed in order that the work may be completed promptly and correctly. The number and arrangement of conductors of the cross-connections are shown on the circuit drawings.
1.02 This section is reissued for the following reasons:		1.04 The method of sharpening the external notches of the Bell System V-notch diagonal pliers is covered in Section 075-110-301.
● To add 1.06		1.05 Methods of skinning and preparing cross-connections used on distributing frames are covered in Section 069-120-811.
		● 1.06 For the method of making connections to connecting blocks equipped with quick-connect terminals refer to the appropriate BSP covering the specific connecting block. For example, the 66- and 78-type connecting blocks used on the Electronic Switching System are covered in Sections 069-125-811 and 069-126-811, respectively. ♦

2. TOOLS, MATERIALS, AND TEST SETS

CODE OR SPEC NO.	DESCRIPTION	CODE OR SPEC NO.	DESCRIPTION
TOOLS			
32 (2 reqd)	1/4-inch Hex Single-End Socket Wrench (for 444-type jacks)	KS-14539 L5 through L9	Guards (for other than the 300-type connector or the replaced 121-type protector)
110 (2 reqd)	9/32 and 5/16-inch Hex Double End Socket Wrench (for other than the 300-type connector or the replaced 121-type protector)	KS-16576 L5 and L6	Designation Plate (red) (for the 300-type connector or the replaced 121-type protector)
216B	Combination 3/8- and 7/16-inch Hex Double-End Socket Wrench and Screwdriver	KS-16604	Insulators (for the 300-type connector or the replaced 121-type protector) <i>Note:</i> No longer available, replaced by KS-16576 (L5)
477A (2 reqd)	Protector Wrench and Adjuster (for other than the 300-type connector or the replaced 121-type protector)	KS-19918 L1	Guards (for solderless wrap-type terminal strips)
448A	Cross-Connection Wire Puller	—	Cement, Metal Set A4 Epoxy Resin Metallic available from Smooth-On Manufacturing Company, Jersey City, New Jersey
624B (2 reqd)	Terminal Connectors (for the 300-type connector or the replaced 121-type protector)	KS-19922 L1, L2, L3, and L4	Connectors (for connecting subscriber lines to intercept trunks)
KS-3320 or R-1102	Orange Stick Fiber Spudger	KS-20132 L1 through L22	Guards (for solderless wrap-type terminal strips)
KS-8740	Soldering Copper	KS-20053 L1	Guard (for 444-type jacks)
KS-14546	Number Plate Remover	KS-16847 L1	Indicators (spiral-band type)
—	P Long-Nose Pliers	KS-20107 L1 and L2	Guard (for 336-type terminal strip)
—	V-Notch Diagonal Pliers	KS-20108 L1 and L2	Guard (for 336-type terminal strip)
—	Skinning Tools, as required, per Section 069-120-811	KS-20308 L1	Clip (for 336-type terminal strip)
—	Tools for Making Solderless Wrapped Connections per Section 069-132-811	KS-20309 L1	Hinge (for 336-type terminal strip)
MATERIALS			
37-Type	Shields	P-16E564	Caps (red) (for the 300-type connector or the replaced 121-type protector)
KS-6660	Indicators	P-31A904	Sleeve (blue)
KS-7851	Sleeving (No. 14 yellow) Sleeving (No. 14 black) Sleeving (No. 18 black)	P-31A905	Sleeve (yellow)
KS-14090 L4	Gray Plastic Adhesive Tape	P-31A906	Sleeve (green)
KS-14534 L7	Number Plate Holder	P-314952	22-Gauge Bare Tinned Copper Wire

CODE OR SPEC NO.	DESCRIPTION
MATERIALS	
No. 1, 2, and 3	Binding Post Insulators
No. 4, 5, 7, 8, and 9	Terminal Punching Insulators
769A	Distributing Frame Bag
—	Distributing Frame Wire per Table A
—	Fiber, Sheet, Gray, 22 by 34 by 1/64 inch (RM-591862)

3. CODES AND COLOR OF DISTRIBUTING FRAME WIRE

3.01 Table A gives the color arrangement and other details concerning distributing frame wire.

4. REUSE OF DISTRIBUTING FRAME WIRE

4.01 U-type wire with red tracer which has been removed from distributing frames may be reused. U-type distributing frame wire with blue or yellow tracer should not be reused because they burn more readily.

5. RUNNING JUMPERS

5.01 When running in or when handling jumpers, do not allow the wires to become kinked. Jumpers that become caught on terminals or other objects should be freed with care so that the wire will not be damaged and the terminals will not be bent.

5.02 In general, avoid any practice that will cause jumpers to tangle or otherwise introduce conditions that may be harmful to good service, working facilities, or appearance.

5.03 Jumpers should be run in the most direct way and on top of other jumpers, except as noted below, on the horizontal and vertical sides of the frame to avoid interference with other jumpers. Jumpers being transferred from one set of terminals to another should not be allowed to catch or twist around other jumpers.

Note: Short cross-connections should be run underneath or behind other cross-connections under the following conditions.

(1) On the horizontal side of the frame where they do not extend beyond six verticals either to the right or left of the distributing ring. It is not necessary, however, to lay these cross-connections at the bottom of the pile-up.

(2) On the vertical side of the frame where they do not extend more than two horizontal shelves above or below the distributing ring.

5.04 Pull the jumpers through the distributing rings, then carefully pass the jumpers through the holes in the fanning strip associated with the terminals to be used. The 448A tool may be used for pulling jumpers through the distributing rings.

Caution: Do not pull the jumpers through the holes in the fanning strip. Abrasive damage may occur to the jumper insulation and fanning strip if the jumpers are pulled along the edge of the holes.

5.05 Do not run jumpers through the holes with cable wires unless this condition is specified in an approved instruction.

Note 1: In general, each end of the jumper should be cut off approximately 6 inches beyond the face of the terminal strip clamping strip. The 6-inch excess wire is for the required slack in the cross-connection when connected and for connecting it. The excess wire should be anchored until required by bending it back over the fanning strip and looping it with a single turn around the jumper. Do not leave the ends of the wire projecting beyond the front of the terminal strip.

Note 2: When more than one cross-connection is run through one hole in a fanning strip, the cross-connections which serve the second and third circuits, etc, on the rear terminals may be identified by means of one and two knots (or a figure eight), tag, or by cutting the jumpers to a shorter length. This identification will preclude transpositions when the cross-connections are connected.

5.06 The conductors of the jumper should be untwisted so that none of the twist remains within the fanning strip after the wire is terminated. However, the jumper should not be untwisted more than one regular twist back of the fanning strip. (See Fig. 2.)

TABLE A

CODE			COLOR			
TYPE OF WIRE	NUMBER OF CONDUCTORS	AWG	TIP	RING	SLEEVE	LAMP OR MESS. REG
PVC						
U 20 S ⁴	1	20	BR			
U 20 P	2 ¹	20	BR	BK-BR		
U 22 P	2 ¹	22	W	BK		
U 22 PA	2 ¹	22	R	BK		
U 22 T	3 ¹	22	W	BK	R	
U 22 F	4 ¹	22	W	BK	R	G
U 22 M	4 ²	22	BK-W	BK	R (tip of second pair)	G (ring of second pair)
SHIELDED						
W 22 S ⁷	1	22	BR			
W 22 P ⁷	2 ¹	22	Y	BL		
W 22 T ⁷	3 ¹	22	Y	BL	O	
W 22 M ⁷	4 ²	22	Y	BL	O (tip of second pair)	BR (ring of second pair)
SHIELDED						
BF ⁵	2	22	W	BL		
761A	2	24	W ⁶	BL ⁶		

Note 1: Conductors are twisted together in a spiral.

Note 2: The black and black-white conductors form one twisted pair, the red and green conductors form another twisted pair, and the two pairs are twisted together to form a quad.

Note 3: Yellow and blue conductors form one twisted pair, the orange and brown conductors form another twisted pair, and the two pairs are twisted together to form a quad.

Note 4: When cross-connecting phantom groups with multiple twin wire, the black-white and black wires should be used for side 1, and the red and green wires for side 2.

Note 5: BF wire consists of 22- or 24-gauge, polyethylene insulated conductors which are covered with a braided shield and a PVC jacket. Several other conductor color combinations are available in addition to the blue and white pair.

Note 6: 761A1 to 761A17 cables consist of two 24-gauge polyethylene insulated conductors which are twisted together, covered with two braided shields, and a PVC jacket. The suffix numbers 1 to 17 distinguish the different color combinations which are available.

Note 7: W-type distributing frame wire is used only on ESS type frames.

5.07 A horizontal-to-vertical jumper should be run along the shelf on which the horizontal terminal is located, then through the distributing ring and up or down the vertical, as required, to the proper terminal.

5.08 A horizontal to a different horizontal shelf jumper should be run through the distributing ring immediately behind one of the terminals, then up or down the vertical, as required, through the distributing ring at the other horizontal shelf and then to the proper terminal.

5.09 A cross-connection between nonadjacent terminals on the same horizontal shelf should be run through the distributing ring immediately behind either terminal and then along the shelf to the other terminal.

Note: Exceptions to this procedure are:

- (1) Where the terminals are not more than 20 rows apart, the jumper should be run parallel with the terminal strip and about 4 inches back of the fanning strip.
- (2) In connection with intercepting trunks in dial offices as described in sections covering associated connector terminals and associating vacant final terminals with intercepting trunks.

5.10 A vertical to a different vertical jumper should be run through the nearest distributing ring, then along the horizontal shelf to the distributing ring at the other vertical and up or down, as required, to the proper terminal.

5.11 A cross-connection between nonadjacent terminals on the same vertical should be run up or down, as required, from one terminal through a convenient distributing ring, preferably one about midway, and then to the other terminal.

Note: An exception to this procedure is the same as case (1) in the note of 5.09.

5.12 A cross-connection between adjacent terminals on the same terminal strip should be made with 22-gauge bare strap wire.

5.13 On combination distributing frames, the horizontal to protector jumpers should be run to the left of the pins, where provided, between verticals; the horizontal-to-vertical and

horizontal-to-horizontal terminal strip jumpers should be run to the right of the pins facing the vertical side. The object is to draw the horizontal-to-horizontal jumpers to the right side of the distributing rings to avoid congestion. (See Fig. 1.)

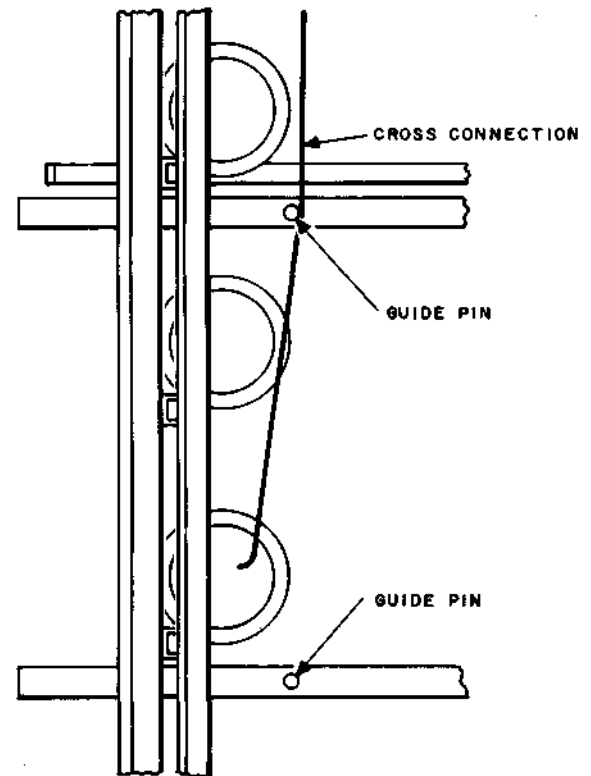


Fig. 1—Position of Cross-Connection Behind Guide Where Run Between Shelves at Combination Distributing Frame

Note: On frames having terminal strips in the upper portion of the vertical side and protectors below them, cross-connections from these terminal strips to the lower portion of the frame should be run through the No. 3 distributing ring located at each vertical immediately below the terminal strip to prevent sagging over the upper end of the protector fanning strip. Below the No. 3 ring, these jumpers will naturally fall to the right of the guide pins.

5.14 The cross-connections of single-sided distributing frames are run similarly to the cross-connections of double-sided distributing frames except that the cross-connections to the vertical portions of the frame should be run through the additional distributing rings provided for the vertical terminal strips.

5.15 The cross-connections of distributing frames on which the terminal strips are mounted vertically on the horizontal side are run similarly to the cross-connections of the double-sided distributing frames covered by 5.01 through 5.13, except that the cross-connections to the terminal strips on the horizontal side are run through the two additional insulated holes in the upper right of the terminal strip mounting bracket. This hole serves as a gathering point for jumpers as they approach the terminal strip from any direction of the shelf and to retain the jumpers on the shelf. The guide angle connecting the tops of the terminal strips on the horizontal side serves two purposes. It provides rigidity to the terminal strips and serves, as the name implies, to guide the jumpers into place as they are run along the horizontal shelves.

5.16 Carrier Circuits: Cross-connections for circuits on one side of carrier equipment should not be run through the same distributing rings as cross-connections for circuits on the other side.

6. AMOUNT OF SLACK

6.01 Three to four inches of slack should be left in all jumpers except that, when a jumper is transferred, the slack may be used but the jumper should not be taut. The slack should be dressed back from the terminal strip. Excessive slack in jumpers along the length of frames should be avoided.

Note: ♦An exception to this procedure is distributing frames of short length and case (1) and (2) in the note of 5.03. The slacks in these jumpers should be 1 to 2 inches.♦

6.02 Jumpers should not be stretched. Trouble may be caused by jumpers being pulled too tight. While it is possible to stretch a jumper, in so doing there is the likelihood of straining or injuring the insulation of that jumper or other jumpers with which it may be interlaced. This practice also weakens the wire to a point where an "open" may result either at the time or at some later period. Tight jumpers will not allow change of position and are exceedingly hard to trace. They also tend to cause pile-ups.

7. REMOVING INSULATION

7.01 Before starting the work of removing insulation, place the distributing frame bag on the shelf below that on which the work is to be done. In removing the insulation from distributing frame wire, it is important that this be accomplished, so far as practicable, without fraying the insulation. Care should be taken to ensure that a minimum of textile fibers is released during the skinning process since they may cause contact troubles by being carried through the air to other equipment in the terminal room. As much as possible of the removed insulation should be placed in the distributing frame bag.

7.02 Detailed procedures for removing insulation from cross-connection wire are covered in Section 069-120-811.

8. CONNECTING WIRES TO TERMINALS

Terminals Arranged for Soldered Connections

8.01 Before starting the work of connecting wires to terminals, place the distributing frame bag on the shelf below that on which the work is to be done. See that the terminals and notches in the terminals are thoroughly cleaned and free from excess solder before connecting wires to them. Use a soldering copper and the orange stick or fiber spudger for removing solder.

8.02 When terminating the wire, hold the jumper back of the fanning strip. Adjust the wire so the insulation comes up close to the notch of the terminal. Wrap the skinned wire around the terminal and cut or break off the excess wire. With this arrangement, the insulation overlapping the terminal will be held firmly in place. Fig. 2 through 10 show typical terminations.

8.03 In breaking off the excess wire (prior to soldering), the following method should be used. With the jumper supported against the fanning strip, the wire should be broken off on the terminal by a series of up and down motions for horizontal terminal strips or left and right motions for vertical terminal strips. The motions should be in a direction parallel to the flat surface of the terminal to avoid strain on the terminal in a sidewise direction. The breaking off of the wires, as above, after they have been connected to the terminals avoids crossing the wires with

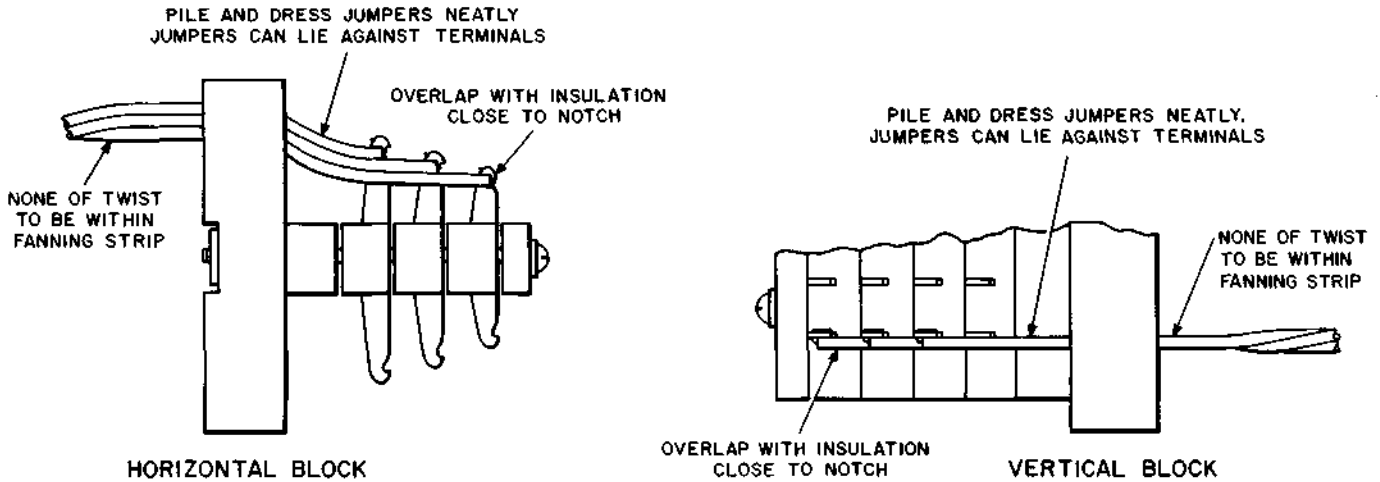


Fig. 2—Termination of U-type Wire on Terminal Strip

other terminals of the terminal strip or crossing the pliers with terminals when cutting the wire.

Note 1: 20-gauge wire may be cut instead of broken.

Note 2: The excess wire cut or broken off should not be allowed to fall on terminal strips, protectors, floor, etc. If a distributing frame bag is provided, the excess wire should be placed in the bag.

8.04 To terminate a wire on the terminal of a protector where the notch appears on the underside of the terminal as shown in Fig. 3, bring the wire under the terminal, up through the notch, along the front of the terminal, over the top edge, or through the back notch where provided, and down the rear side, making one complete turn of bare wire around the terminal. Cut or break the excess wire at point "X".

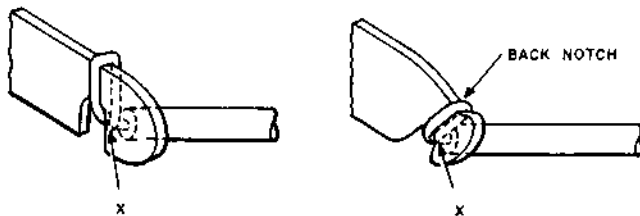


Fig. 3—Termination of Wire on Protector (notch on underside of terminal)

8.05 To terminate a wire on the terminal of a protector where the notch appears on the upper side of the terminal as shown in Fig. 4, bring the wire through the notch, down the front side, and up the rear side, making one complete turn of bare wire around the terminal. Break the excess wire at point "X". 20-gauge wire may be cut instead of broken.

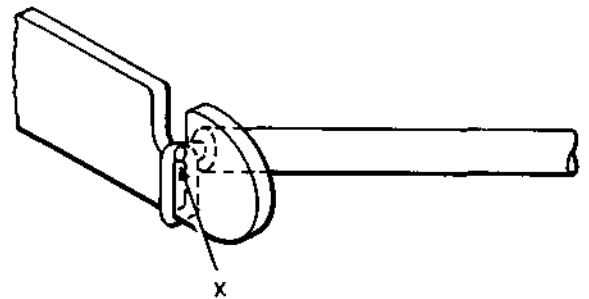


Fig. 4—Termination of Wire on Protector (notch on upper side of terminal)

8.06 In case a protector is broken, replace the defective terminal (or spring) using two 447A or 110 tools. Refer to the section covering piece-part data and replacement procedures for MDF protectors and protector mountings. *Do not terminate the jumper wire on the spring on the cable side of the protector, since this will remove the protection on the side of the line affected and result in a fire risk.*

8.07 To terminate a wire on a 444-type jack, pass the wire through the proper hole in the fanning strip as shown in Fig. 5. Bring the wire under the terminal, up through the notch, across the top of the terminal, and down through the back notch as shown in Fig. 6. Cut or break the excess wire at point "X".

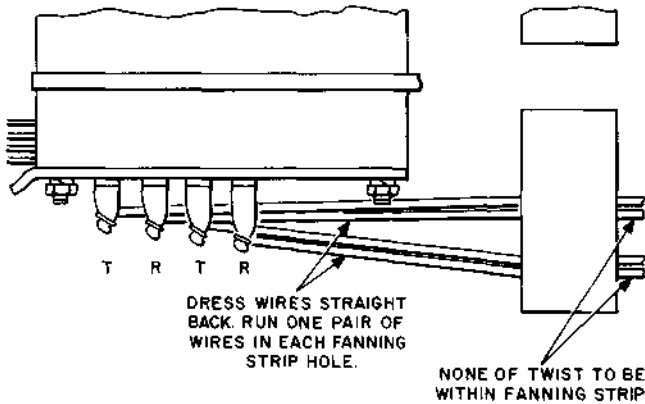


Fig. 5—Termination of Wire on 444-Type Jacks at MDF

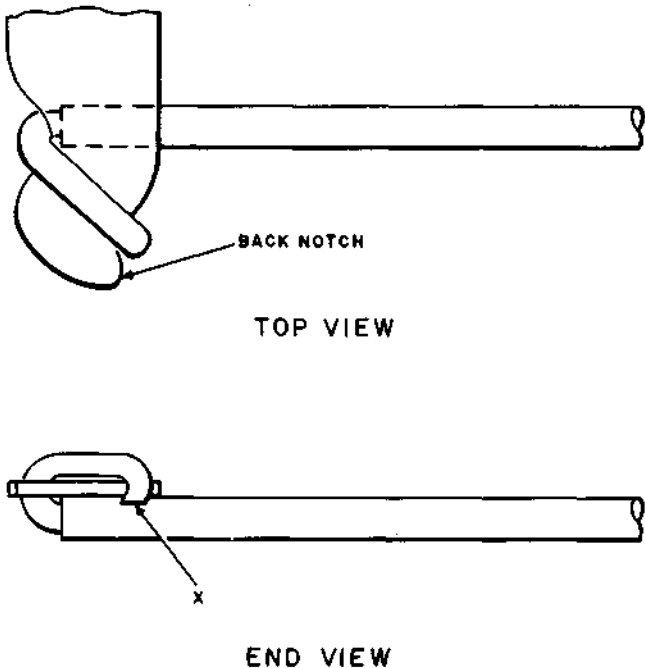


Fig. 6—Termination of Wire on Terminal Having a Back Notch

8.08 In case a jack terminal is broken, replace the broken terminal (or spring) using two 32 tools. Refer to section covering 444-type jacks.

8.09 To terminate a wire on a terminal of a 65- or similar type terminal strip, bring the wire along the left side of the terminal, through the notch, back along the right side of the terminal, and across the top as shown in Fig. 7. Cut or break the excess wire at point "X". 20-gauge wire should be cut instead of broken.

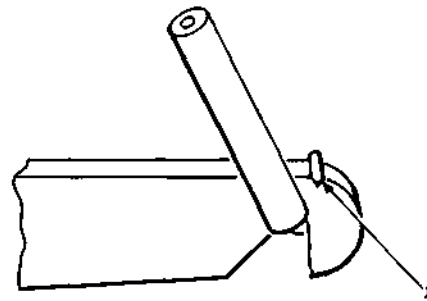


Fig. 7—Termination of Wire on Terminal of a 65- or Similar Type Terminal Strip

8.10 When terminating jumpers on terminal strips of the type shown in Fig. 2, connect the wire on the terminal nearest the front first and work toward the rear of the block.

Note: An exception to this procedure is in the case of IDF jumpers of subscriber lines in dial offices as covered in 16.24.

8.11 To terminate a wire on a terminal which is in a vertical position (such as horizontal IDF) having a single notch (either with or without back notch) such as those on a 35- or similar type terminal strip shown in Fig. 8, bring the wire along the left side of the terminal, through the notch, along the right side of the terminal, and across the back, or through the back notch where provided. Break the excess wire at point "X". 20-gauge wire may be cut instead of broken.

8.12 To terminate a wire on a terminal which is in a horizontal position (such as vertical IDF) having a single notch (either with or without back notch), bring the wire along the bottom of

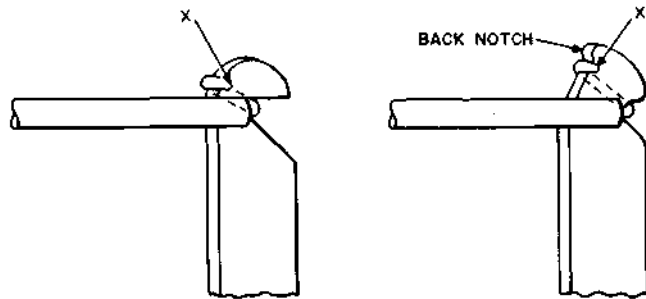


Fig. 8—Termination of Wire on Vertical Terminal Having a Single Notch

the terminal, through the notch, back along the top of the terminal, and terminate at the back, or back notch where provided as shown in Fig. 9. Cut or break the excess wire at point "X". The 20-gauge wire may be cut instead of broken.

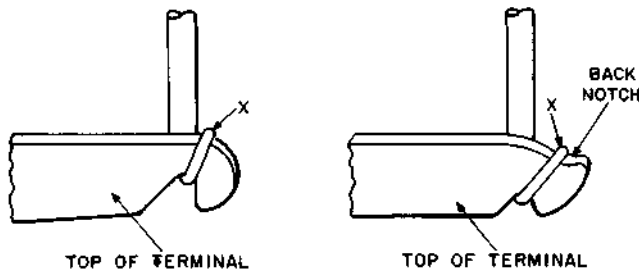


Fig. 9—Termination of Wire on Horizontal Terminal Having a Single Notch (Top View)

8.13 To terminate wires on a terminal strip provided with terminals having twin notches or double twin notches where only one set of leads is required, connect them in the outer notches unless it is necessary to reserve these notches for strapping subject to change in service. The jumpers should be terminated as described in 8.11 and 8.12 and as shown in Fig. 10.

8.14 Where a second jumper is to be terminated on the same terminal with another jumper, the first jumper should be unsoldered and removed and both the terminal and the notch in the terminal freed from all excess solder. The two jumpers should then be terminated in the same notch.

8.15 Immediately after connecting the wire to the terminal, it should be soldered as described in Section 069-140-811. An exception to this practice may be made in the case of trunk or cable transfers

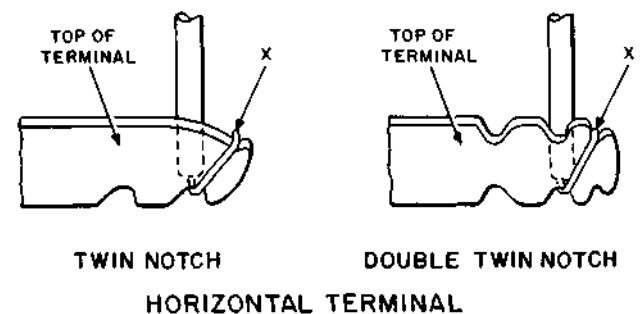
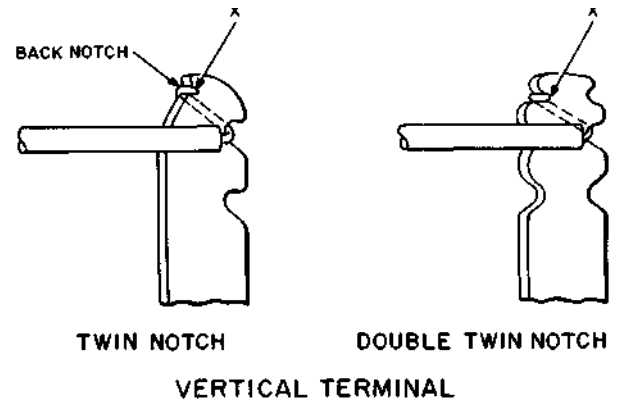


Fig. 10—Termination of Wire on Terminal Having a Twin Notch or Double Twin Notch

when the equipment associated with the jumpers is not in service or when a large number of jumpers is being terminated on the same or adjacent blocks. In cases of this kind, it may be more economical to terminate all the wires first and either leave the excess wire in place or otherwise mark the terminals. Then solder the entire group of connections and remove the excess wire or marker when soldering.

Note: When soldering BF-type wire, considerable care must be taken that the soldering copper is not applied to the connection any longer than is necessary to make a good connection, since the polyethylene insulation has a tendency to recede with excessive heating. The insulation should not be allowed to come in direct contact with a terminal which is being soldered. Special care should be exercised to avoid even momentary contact between the soldering copper and the insulation of the adjacent cross-connections. Service failures may result from damaged insulation due to excessive heating.

8.16 Take particular care to see that loose solder or pieces of wire are not left on the terminals or block. Use the orange stick or fiber spudger to remove loose wire or solder. The equipment on the shelves below should be protected by the distributing frame bag. Do not allow loose pieces of solder or wire to fall on other equipment.

Terminals Arranged for Solderless Wrapped Connections

8.17 All connections should be made in conformance with Section 069-132-811 which describes the techniques, requirements, and precautionary measures involved in making solderless wrapped connections.

8.18 All solderless wrapped connections should be made with the KS-16363 wire-wrapping tool.

8.19 Solderless wrapped connections may be made on only those terminals which have not been used previously for soldered connections.

8.20 While making a wrapped connection on an offset terminal, the connection should be started on the straight portion of the terminal in front of the bend.

8.21 Although Section 069-132-811 suggests the splicing of wire and other measures where there is not sufficient slack in the wire for a solderless wrapped connection, jumpers on distributing frames should be replaced to obtain sufficient slack.

8.22 When terminating 20-gauge wire for PBX battery feeders in accordance with Section 069-120-803, proceed as follows. Skin the wire for approximately 3/8 inch in accordance with Section 069-120-811 using the P long-nose pliers; form a closed loop with the skinned portion of the wire; place the performed loop on the terminal and crimp it firmly in place at the bend in the terminal; solder the connection.

9. PREPARING BF SHIELDED WIRE AND 761A-TYPE SHIELDED CABLE FOR CARRIER CROSS-CONNECTIONS

Caution: Carrier systems in service may have potentials up to 260 volts across the cable conductors or the terminals associated with the carrier terminal or repeater. Before doing any cross-connection work, the + 130 volt fuse and the - 130 volt fuse (if provided)

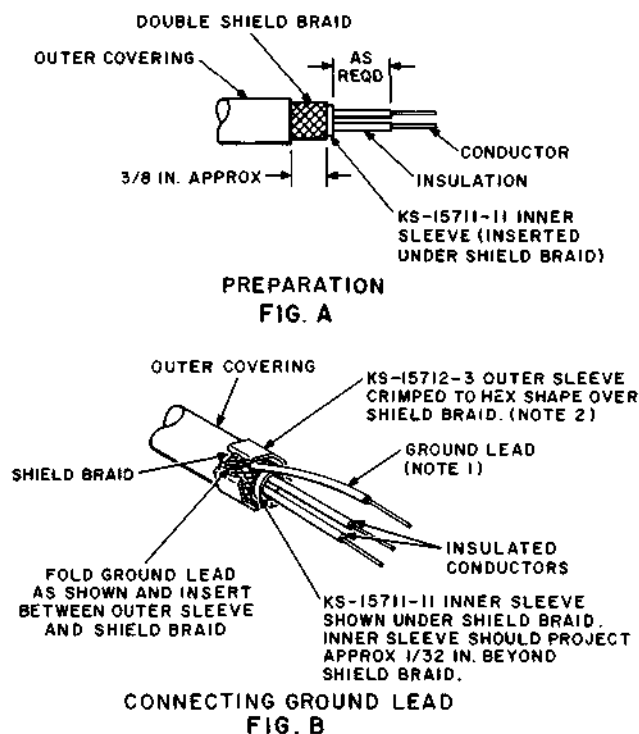
should be removed at the carrier terminal or repeater from which the power is supplied.

BF-Type Shielded Wire

9.01 When shielded carrier cross-connections are required BF wire should be used except for wide-band data circuits. BF wire consists of two 22-gauge conductors and a braided metal shield. It is suitable for carrier cross-connections under certain conditions as specified in 10.01.

9.02 Prepare the wire for termination in accordance with Section 069-120-811.

9.03 Connect ground lead to BF wire shield by the same method used for 761A Cable (See Fig. 11). Appropriate shield connectors and installing tool are listed in Section 800-612-164, Fig. 9A.



NOTES:

1. USE 22 GAUGE SWITCHBOARD WIRE UNLESS SPECIAL CONSIDERATIONS REQUIRE A HEAVIER GAUGE, SUCH AS IN THE CASE WHERE EXTREMELY LOW IMPEDANCE TO GROUND IS A REQUIREMENT.
2. BUTT APPROX FLUSH WITH END OF OUTER SLEEVE.

Fig. 11—Connecting Ground to Shield of 761A-Type Shielded Cable

761A-Type Shielded Cable

9.04 All intra-office cabling carrying wideband baseband signals between equipments should be 761A-type shielded cable. 761A-type shielded cable consists of two 24-gauge conductors of copper wire which are insulated with a coating of polyethylene. The insulated conductors are twisted into a pair which is covered with two braided shields of tinned copper wire and a polyvinyl-chloride jacket.

9.05 Prepare and connect ground lead to the shielded cable as shown in Fig. 11. The ground lead and two conductors may then be terminated as outlined in Part 10 for BF-type wire.

10. TERMINATING CARRIER CROSS-CONNECTIONS

10.01 The wiring associated with carrier systems is very sensitive to interference in the form of noise and crosstalk. This sensitivity is reduced by using a metallic shield around the conductors. The most effective shield is the sheath of a lead covered or alpeh cable. Accordingly, the preferred arrangement is to extend the cable to the carrier equipment. Since it is not practical to do this in all cases, it is sometimes necessary to terminate the cable at a distributing frame and run shielded cross-connections to the carrier equipment appearances on the frame. To be effective in reducing interference, the shield must be properly terminated. The most desirable termination is one which is continuous with the sheath of the cable enclosing the carrier conductors.

10.02 Provisions for terminating the shield on distributing frames will vary from office to office; therefore, it would not be practical to make specific recommendations for the treatment of shields. Specific instructions and/or procedures should be established locally in conformance with whatever means are available on each particular distributing frame. In each case, however, the shield should be terminated at each end (either to the central office cable sheath, the underground cable sheath, or central office ground).

10.03 Protective heat coils are not to be included in carrier circuits. Where the circuits terminate on a protector other than the 300-type connector or the replaced 121-type protector, provide "TP" protection and strap the protector as covered in Part 11. Where carrier circuits are terminated on 300-type connectors or the replaced 121-type

protectors, the protector unit should be equipped with conducting dummy heat coils and protective carbon blocks; straps are not required.

Carrier Circuits Terminated on Terminal Strips

10.04 Prepare BF wire as covered in Part 9. Two methods are provided for terminating the three wires on the terminal strip as shown in Fig. 12, Methods A and B.

Method A—Where no spare terminals are provided between working terminals: Using KS-7851 sleeving, place a No. 18 black sleeve over the bare ground wire, a No. 14 yellow sleeve over the tip wire, and a No. 14 black sleeve over the ring wire. Insert the sleeving over each conductor so as to extend from the butt to a distance not more than 1/8 inch from the point of connection to the terminals. Terminate the wires as shown in Fig. 12A.

Method B—Where two rows of spare terminals are provided between working terminals: Sleeving may be omitted and the wires connected with one complete turn around the terminal as shown in Fig. 12B. Break off the excess wire at the front end of the terminal.

Carrier Circuits Terminated at Protectors or Line Jacks

10.05 Prepare the ground wire as covered in 9.03 and terminate in accordance with local procedures (see 10.02). This ground wire should be kept as short as possible and run in the most direct manner.

10.06 Using KS-7851 sleeving, place a No. 14 yellow sleeve over the tip wire and a No. 14 black sleeve over the ring wire. Terminate in accordance with approved procedures for the particular type of terminal.

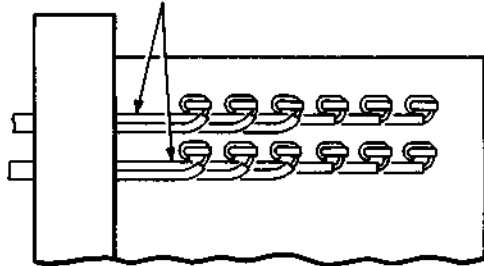
Carrier Circuits Terminated in Cross-Connection Cabinet

10.07 The cross-connection cabinet is used for making cross-connections between N1 Carrier Terminal Systems or N1 or ON Repeater Systems and the cable conductors. The cable conductors are terminated on either a terminal strip or on a 300-type connector if line protection is required; in the latter case, the heat coil shall be removed and replaced with a conducting dummy heat coil. The cable conductor terminal strip shall be cross-connected

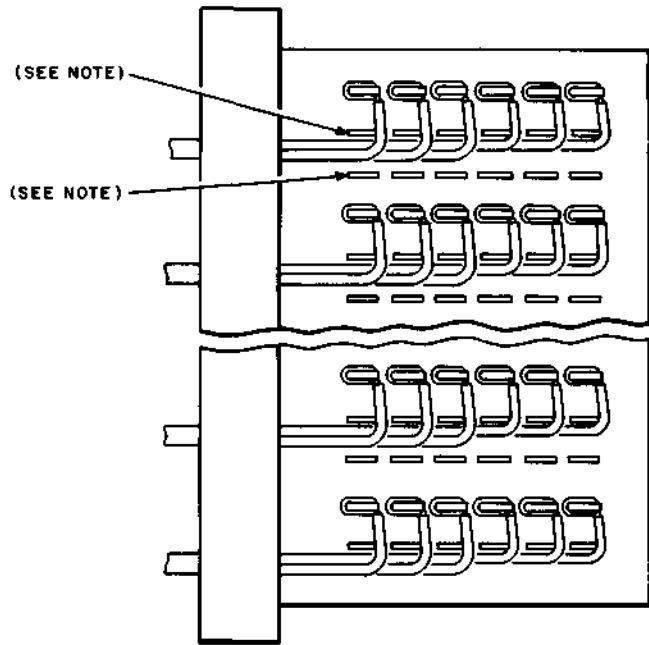
NOTE:

THESE TERMINALS MUST BE LEFT HOLE SO THAT WIRES MAY NOT BE DRESSED AGAINST TERMINALS OTHER THAN THOSE TO WHICH THE WIRES ARE CONNECTED.

ENCLOSE EACH CONDUCTOR AND GROUND WIRE IN KS-7851 SLEEVING



METHOD A



METHOD B

Fig. 12—Connecting BF Wire to Terminal Strips

either directly to the LINE terminal strip or through span pads build-out equipment, or noise control units as required. The LINE terminal strip shall be cross-connected to the EQUIP terminal strip according to assignment. A trunk cross-connection cabinet may be provided where there is more than one cross-connection cabinet and it is necessary to interconnect equipment in one cross-connection cabinet with conductors in another. Use U 22-type distributing frame wire for all connections within the cabinet.

11. PLACING STRAPS ON PROTECTORS

11.01 Some circuits, for engineering reasons, ordinarily require that the metal dummy heat coil be replaced by a wire strap. When straps are used, the metal dummy coils are ordinarily removed. (See note of 11.02.)

11.02 Due to improved design of essential components, the 300-type connector or the replaced 121-type protector does not require straps; the 77A1 conducting dummy heat coil is used with this protector in place of the strap.

Note: Some local procedures require that circuits which require straps be equipped with insulating (green plastic) dummy coils. It is to be understood that this does not apply to offices equipped with the 300-type connector or the replaced 121-type protector.

11.03 Where straps are used, except on C-type protector mountings, solder a bare 20- or 22-gauge strap between the two ring terminals of the protector and solder a piece of 20- or 22-gauge cross-connection wire, about 6 inches long, between the two tip terminals of the protector. (See Fig. 13A and 13B.)

11.04 In offices where the running of 6-inch cross-connection wire outlined in 11.03 would be difficult due to the close proximity of the cable form to the fanning strip and where the protector and heat coil springs are assembled by means of a single screw which is connected to the tip spring of the heat coil, such as on the 77-type (3/8 inch) protector mounting, the 6-inch cross-connection wire may be eliminated between the two tip terminals and bare strap wire substituted as follows. On

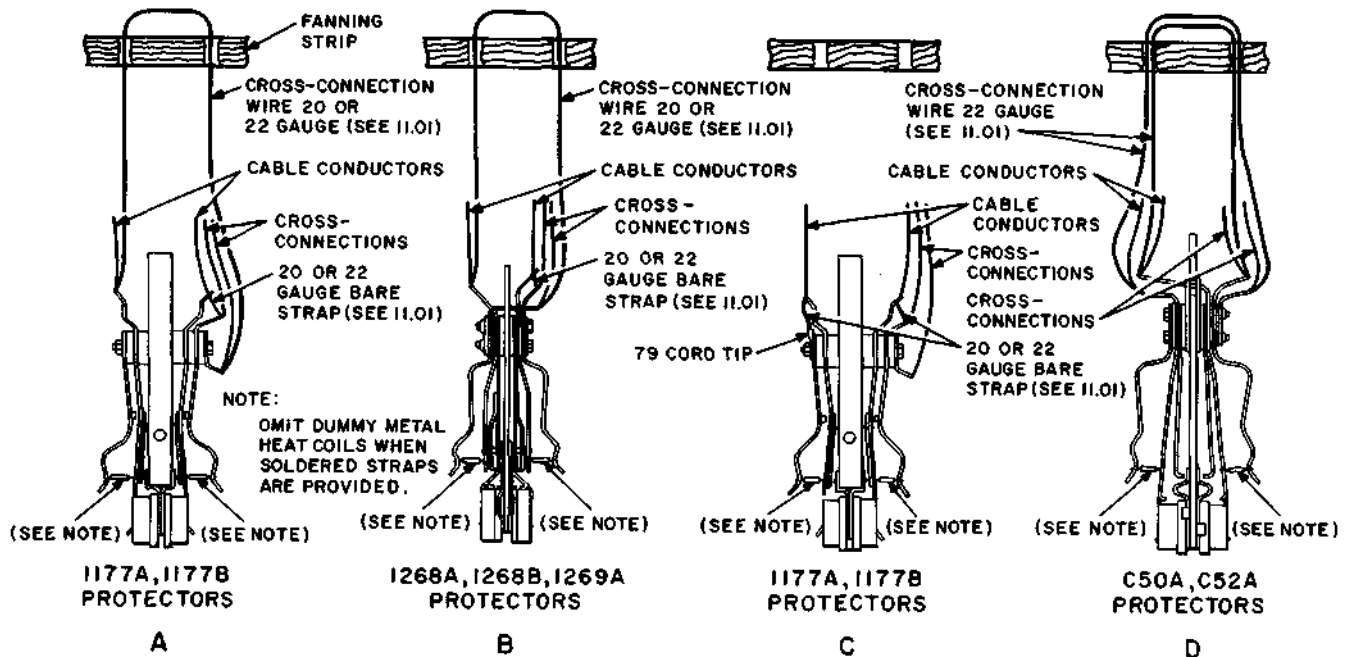


Fig. 13—Strapping on Protector Mounting

the tip side of the protector mounting, use a bare 20- or 22-gauge wire approximately 2 inches long with 79 cord tip soldered to one end. Insert the 79 cord tip under the head of the protector assembly screw on the tip side of the protector mounting and solder the other end of the wire to the tip spring soldering terminal. Use a 447A tool for loosening and tightening the protector screw nut. (See Fig. 13C.)

11.05 Where straps are used on the C-type protector mounting, solder a pair of 22-gauge cross-connection wires about 6 inches long on the tip and ring terminals on the left side of the mounting, run the wires through the holes in the fanning strip, and solder them on the heat coil spring terminals on the right side of the mounting. (See Fig. 13D.)

12. TEMPORARY (BACK-TAP) CROSS-CONNECTIONS

12.01 When making transfers or rearrangements, it is often necessary to make use of temporary (back-tap) cross-connections. Fig. 14 through 19 shown the methods for terminating these cross-connections on terminals arranged for soldered connections. The word "temporary" as used herein refers in each case to the jumper which is to be removed when the permanent arrangement is completed.

12.02 Both the temporary and permanent jumpers should be brought through the same hole in the fanning strip, leaving the required amount of slack in each jumper.

12.03 The jumpers which are to remain after the transfer is completed should be connected to the terminals in a permanent manner.

On Protectors (other than 300- or 121-type) or Jacks

12.04 Leave a short tail of wire on the permanent jumper at the terminal. Connect the temporary jumper to this tail of wire by twisting the two wires together. Solder the twisted wires and cut off the excess, leaving approximately 1/4 inch of the wires. Then bend the wires back along the jumper wire to avoid snagging. (See Fig. 14.)

12.05 To remove the temporary jumper, it will only be necessary to cut off the tail of the permanent jumper, leaving a satisfactory permanent connection.

On Terminal Strips Provided with Extra Terminals

12.06 The temporary jumpers should be connected to the extra terminals as shown in Fig. 15. Where local instructions specify that either the upper or lower terminals should be used for the

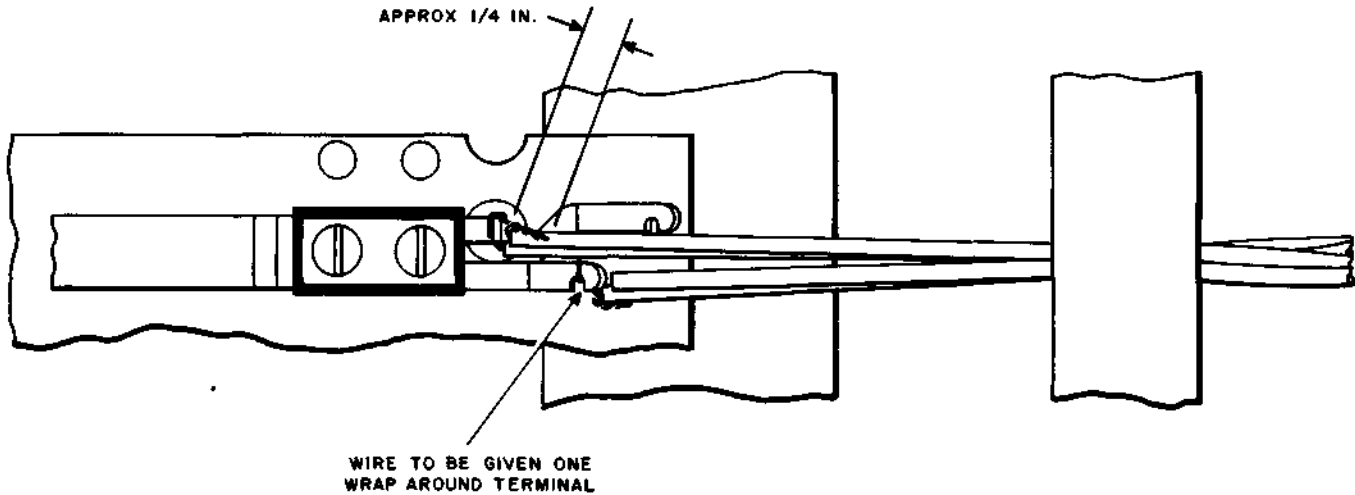


Fig. 14—Temporary Cross-Connections on Protectors

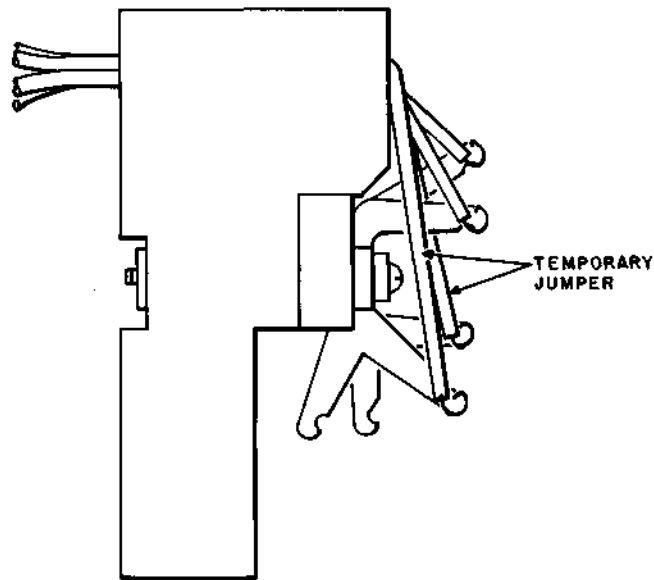


Fig. 15—Temporary Cross-Connections on No. 65 or Similar Type Terminal Strip Without Back Notch Terminals

permanent jumper, identify the temporary jumper for subsequent removal by tying a small loop of wire around it immediately above the terminals and connect the permanent jumper to whichever of the two sets of terminals is available.

On Terminal Strips Where Extra Terminals Are Not Provided and the Terminals Do Not Have Back Notches

12.07 Connect the temporary jumper as shown in Fig. 16. Bring the wire along the top of the permanent jumper through the notch, up, and across the top of the terminal. Solder the connections to the terminal, being careful not to leave any excess solder. Then cut off the excess wire of the temporary jumper close to the terminal at the point "X".

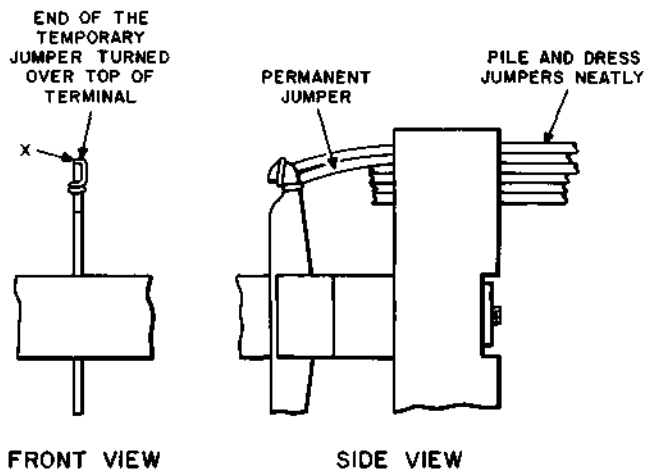


Fig. 16—Temporary Cross-Connections on No. 35 or Similar Type Terminal Strip Without Back Notch Terminals

On Terminal Strips Where Extra Terminals Are Not Provided and the Terminals Have Back Notches

12.08 Connect the temporary jumper as shown in Fig. 17. Bring the wire along the top of the permanent jumper, through the notch along the right side of the terminal, and through the back notch. Break the excess wire at point "X". 20-gauge wire should be cut instead of broken.

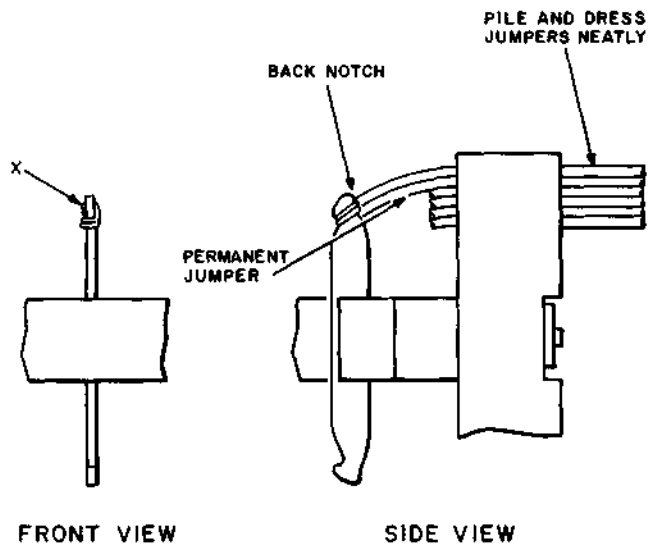


Fig. 17—Temporary Cross-Connections on No. 35 or Similar Type Terminal Strip With Back Notch Terminals

On Terminal Strips Provided With Terminals Having Twin Notches or Double Twin Notches

12.09 The temporary jumper should be connected to the extra notch as shown in Fig. 18 and 19. See 8.13.

12.10 To remove the temporary jumper, untwist the wire from the terminal (without using a soldering copper) either by pulling the slack through the fanning strip and removing the wire by hand or by grasping the wire with pliers and untwisting it from around the terminal.

On the 300-Type Connector or the Replaced 121-Type Protector

12.11 Having previously placed the permanent jumper on the terminal (12.03), place the temporary jumper on the front of the terminal.

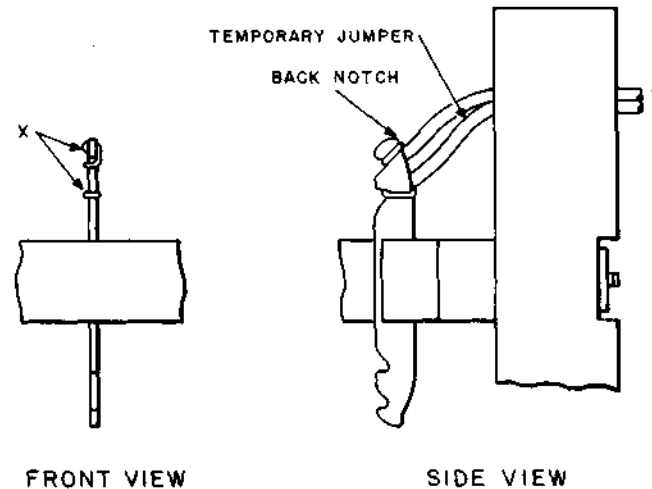


Fig. 18—Temporary Cross-Connections on No. 183C or Similar Type Terminal Strip With Twin Notch Terminals

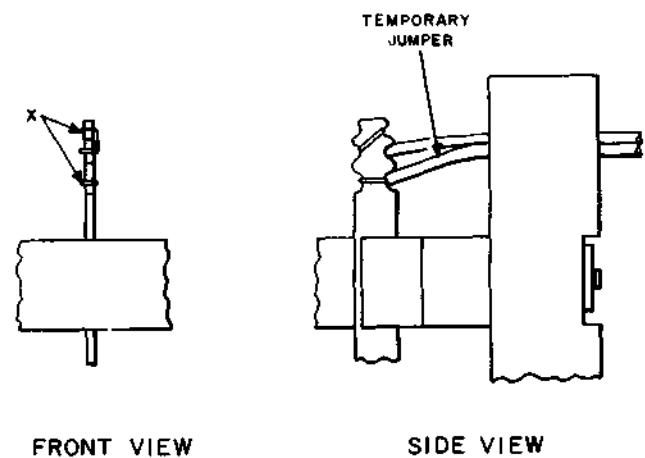


Fig. 19—Temporary Cross-Connections on No. 35 or Similar Type Terminal Strip With Double Twin Notch Terminals

12.12 To remove the temporary jumper, use the wire-unwrapping tool.

13. PERMANENTLY BRIDGED CROSS-CONNECTIONS

13.01 When it is necessary to terminate two permanent jumpers on one set of terminals, both jumpers shall be connected to the terminals as shown in Fig. 20 through 23. (Refer to 8.14).

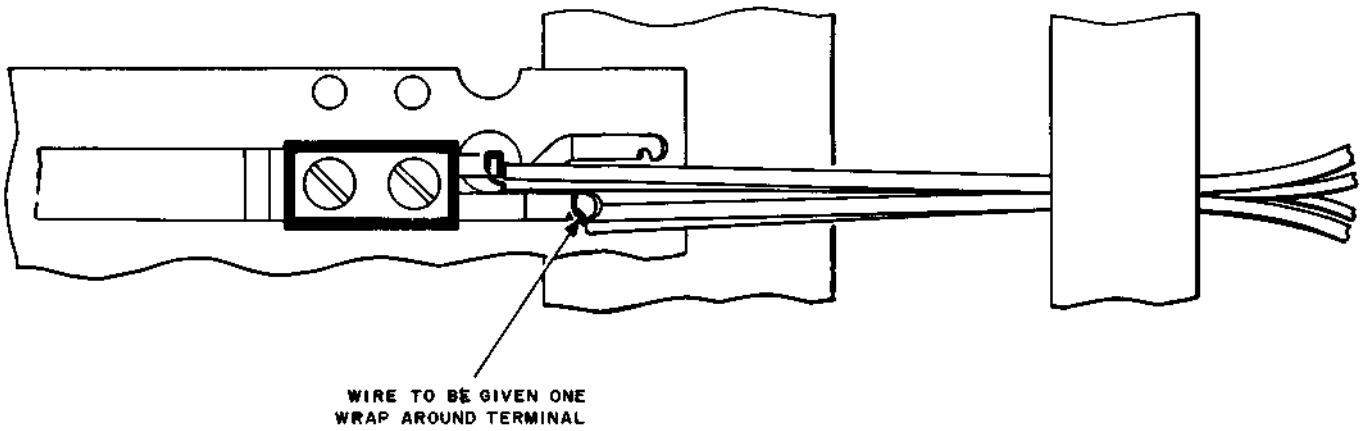


Fig. 20—Permanently Bridged Cross-Connections on Protectors (other than the 300-type Connector or the Replaced 121-Type Protector)

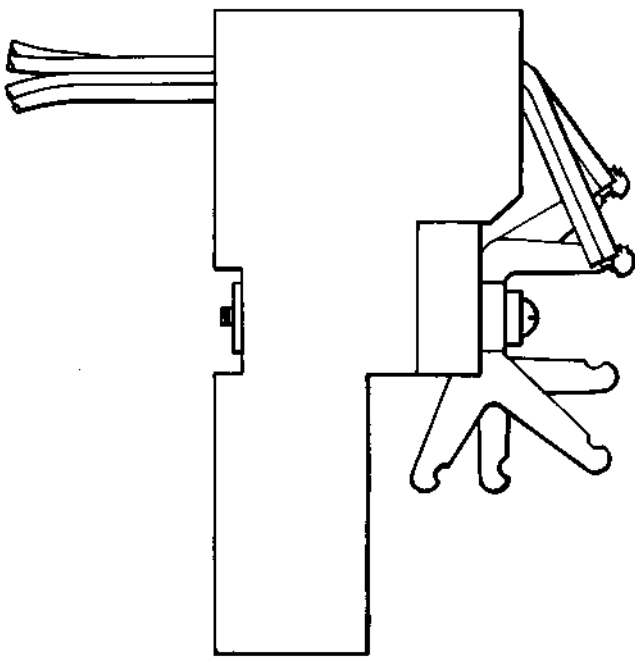


Fig. 21—Permanently Bridged Cross-Connections on 65- or Similar Type Terminal Strips

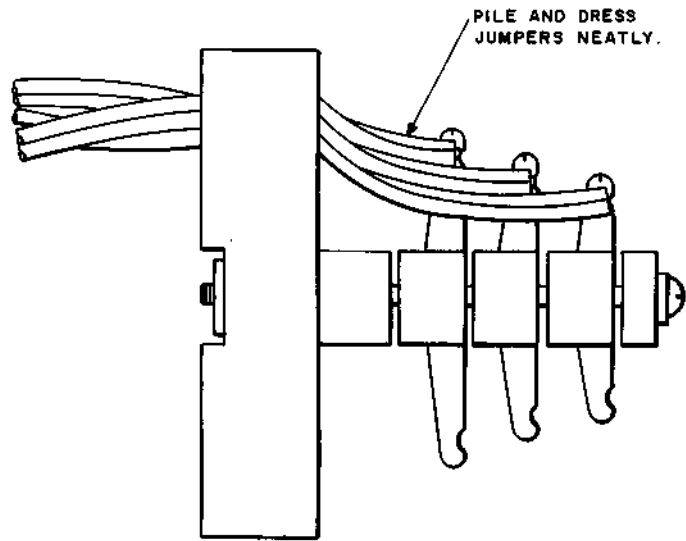


Fig. 22—Permanently Bridged Cross-Connections on 35- or Similar Type Terminal Strip Without Back Notch Terminals

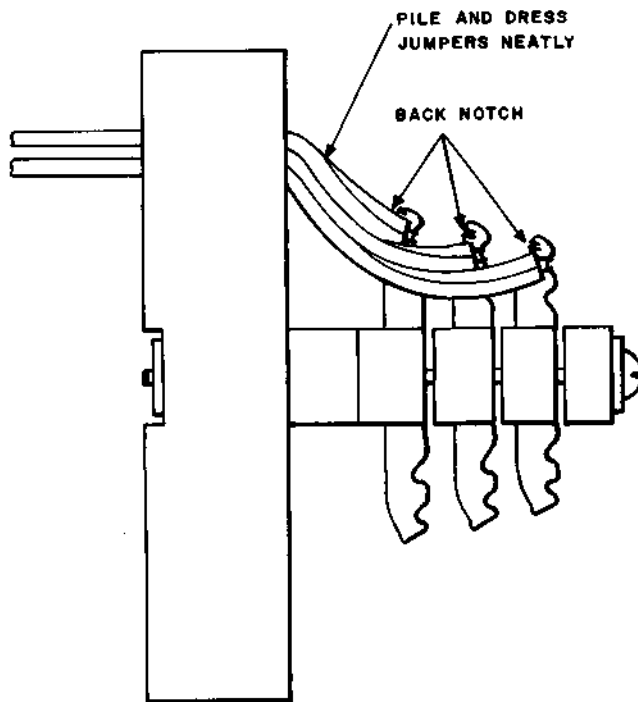


Fig. 23—Permanently Bridged Cross-Connections on 183C- or Similar Type Terminal Strips With Twin Notch Terminals

Note: The method of placing two or more connections on terminals arranged for solderless wrapped connections is covered in Section 069-132-811.

13.02 Both jumpers should be brought through the same hole in the fanning strip, leaving the proper amount of slack in each jumper.

Bridging 4-Party Flat Rate Lines on 6-Point Terminal Strips in Step-by-Step Offices

13.03 When approved, the 6-point terminal strip provided for cross-connecting 2-party lines may be utilized for cross connecting 4-party flat rate lines. Jumpers for the third and fourth parties are bridged at the line terminal strips with jumpers for the first and second parties, respectively.

13.04 To assist in identifying jumpers for different parties at the line terminal strips, differently colored identifying sleeves should be slipped over the jumpers, before terminating, for other than the first party as follows: blue for second party, yellow for third party, and green for fourth party.

13.05 The sleeves should be positioned on the jumpers so that they are approximately centered lengthwise inside the fanning holes.

14. CONNECTOR CROSS-CONNECTIONS

14.01 The KS-19922 L1 through L4 connectors (Fig. 24) are used in lieu of wire straps to connect subscriber lines to their associated intercept trunks on HIDF terminal strips in panel and step-by-step offices.

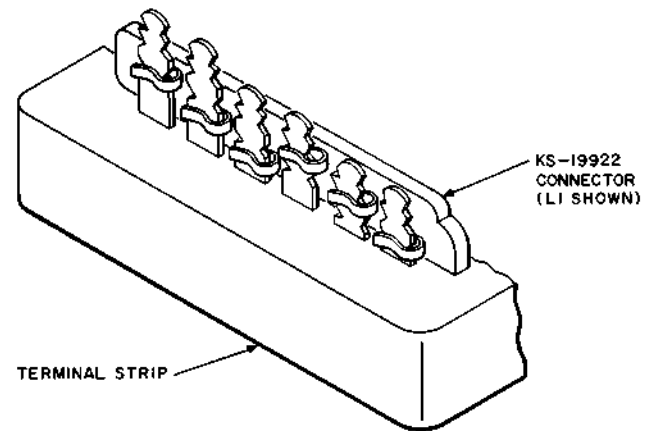


Fig. 24—KS-19922 L1 Through L4 Connectors on Terminal Strip

14.02 The connectors consists of a rectangular base of insulating material equipped with six spring contacts arranged in three rows of two contacts each, that provide two sets of tip, ring and sleeve connections. The base of each KS-19922 L1 through L4 connector is yellow, red, green, and natural, respectively.

14.03 The contacts on the KS-19922 L1 connector (Fig. 25) connect tip, ring and sleeve to tip, ring and sleeve, respectively. The contacts on the KS-19922 L2 connector connect tip, ring, and sleeve to ring, tip, and sleeve, respectively. The contacts on the KS-19922 L3 connector connect tip, ring, and sleeve to tip, ring, and sleeve, respectively, except that the sleeve contacts are connected by a diode. The diode is arranged to permit current flow only from the sleeve contact at the square end of the connector to the sleeve contact at the notched end of the connector. The KS-19922 L4 connector is the same as the KS-19922 L3 except that the diode between the sleeve contacts is reversed.

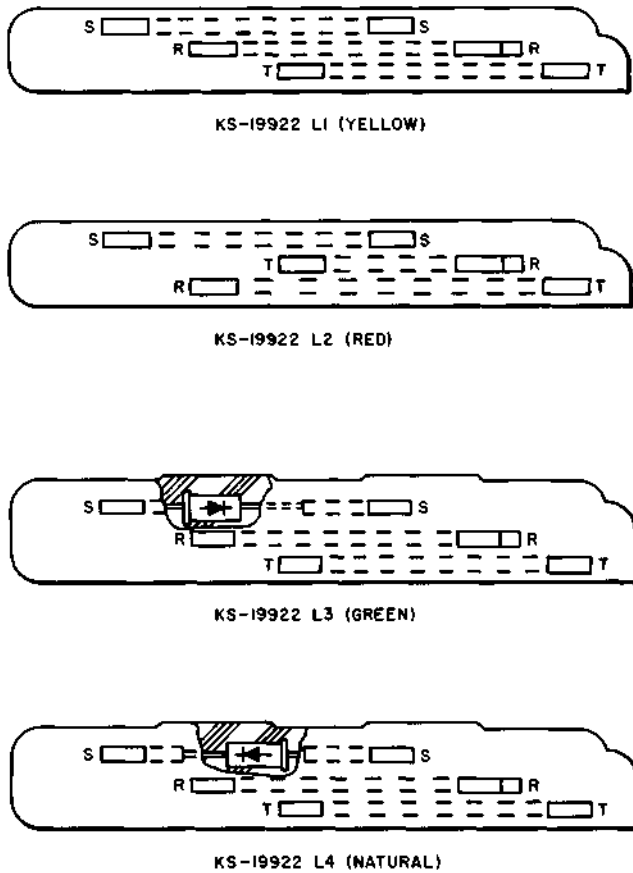


Fig. 25—KS-19922 L1 Through L4 Connectors

14.04 ♦The terminals on the terminal strip must be cleaned *very thoroughly* prior to using the above connectors.♦

14.05 ♦Install the connector on the terminal strip by engaging the connector on the rear two row terminals, with the connector at an angle of approximately 45 degrees to the terminal block and then engaging the connector to the other four terminals.♦

15. REMOVING CROSS-CONNECTIONS

15.01 Before starting the work of disconnecting jumpers from terminals, the distributing frame bag should be placed on the shelf below that on which the work is to be done.

15.02 All "dead" jumpers should be promptly removed from the distributing frames.

15.03 When disconnecting jumpers, cut the jumper so about 2 inches of wire will be left

attached to the terminals. The 2-inch section of wire shall be pulled out from the terminal strip so that it may be readily seen. *Avoid having the wire project beyond the front of the terminal strip.* The jumper should then be pulled clear of the terminal strip.

15.04 When removing jumpers from terminals arranged for solder connections, the ends should be removed with the aid of a soldering copper and P long-nose pliers. The terminals and the notches in the terminals should be cleaned of all excess solder. Care should be taken to prevent solder from spattering on terminals or other equipment. Loose pieces of solder or wires should also be prevented from dropping on other equipment.

15.05 When removing jumpers from terminals arranged for solderless wrapped connections, proceed as outlined in Section 069-132-811.

Note: Soldered wrapped connections are simply cut; subsequent connections are made in front of, or on top of, the old connection and soldered.

16. PRECAUTIONS AGAINST PERSONAL INJURY, EQUIPMENT DAMAGE, AND SERVICE INTERRUPTIONS

16.01 Do not stand or climb on any part of the frames.

16.02 ♦Eye protection of an approved type should be worn by all employees while working on the distributing frame.♦

16.03 Avoid any practice which tends to produce or scatter lint or dust particles, such as dragging wire over terminals or sharp edges of the frame, unnecessary handling of jumpers on the shelves, or dropping coiled wire from elevated positions.

16.04 Care should be exercised when connecting or removing jumpers and when cleaning terminals to avoid accidental contacts or crosses on adjacent terminals with the pliers, soldering copper, or bare jumper wire.

16.05 Take particular care when working on or near battery and ringing supply feeders not to cross the terminals with tools, wire, or any other metallic objects, since personal shock may result and an operated fuse may deny service temporarily to a large number of subscribers.

16.06 Particular care should be exercised when working on or near certain special lines such as telegraph loops, fire and police alarms, radio broadcast lines, private lines, carrier circuits, etc. Serious trouble may result from a momentary cross or short circuit on some of these lines and, therefore, ***not even a hand test set or a receiver should be connected to the terminals associated with lines of this nature.*** These special lines should be designated on the vertical and horizontal side of the frame by means of the KS-6660 or the KS-16847 L1 indicators and protected at terminal strips and protector terminal punchings with insulators such as the No. 4, 5, 7, 8, and 9. The No. 8 and 9 insulators are intended for use on terminal strips where terminal spacing and wire build-up create an installation problem for the No. 4 and 5 insulators. (See 16.07, 16.08, and 16.10.) The KS-6660 or the KS-16847 L1 indicators should be located between the fanning strip and the terminals. (See Fig. 26 through 29.)

16.07 On other than the 300-type connector or the replaced 121-type protector, place the KS-14539 guard so as to enclose the front portion of the heat coil and protector block springs. (See Fig. 28.) These guards are held in place by ridges on the inner surface which engage the heat coil springs. In addition to identifying important circuits, the color will serve as a marker to warn against accidental contact with the circuit involved and against removal of the heat coils and protector blocks during maintenance operations. When the KS-14539 plastic guard is used on a designated cable pair of a C-type protector upon which the

cable number designation plate is mounted, remove the cable number designation plate from the heat coil spring, attach it to a KS-14534 number plate holder, and mount the number plate holder on the associated spring assembly screw threads. The KS-14546 number plate remover may be used to remove the cable number designation plate from the heat coil spring. Guards should be placed on the protector springs in accordance with the following:

KS-14539 GUARD LIST NO.	PROTECTOR TYPE
5 (Supersedes L1)	1177
6 (Supersedes L2)	C type after 1946
7 (Supersedes L3)	1268, 1269
8 (Supersedes L4)	C type prior to 1946
9	E

16.08 On main distributing frames equipped with the 300-type connector or the replaced 121-type protector, the KS-16576 L5 and L6 designation plates (red) and the KS-6660 or KS-16847 L1 indicator are used to protect special lines. The L5 designation plate is for use on the cross-connection side of the connector. If the connector has aluminum fingers, the designation plate should be slipped on with movement toward the front. On connectors with molded fingers, the designation plate should be slipped on with movement toward the rear. The L6 designation plate is for use on the test terminal side. The P-16E564 red cap is used with the protector unit to indicate a special line and to forestall accidental opening of the line. (See Fig. 29).

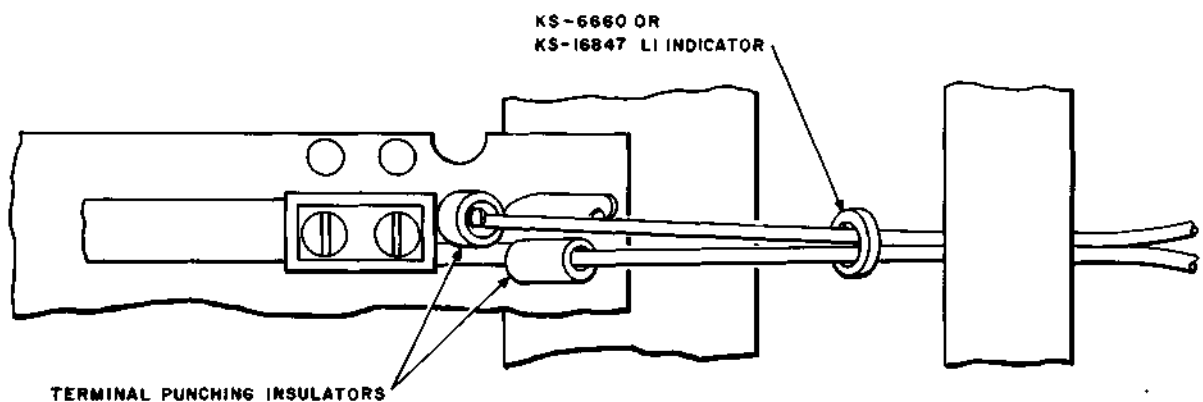


Fig. 26—Indicator and Terminal Punching Insulators on Protector Mounting

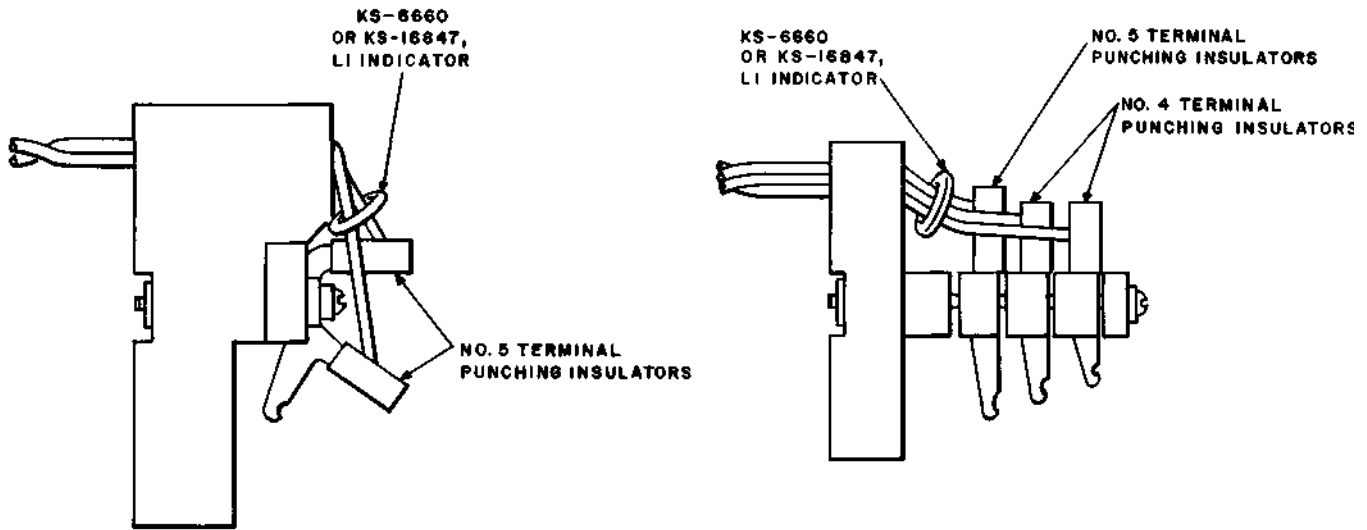


Fig. 27—Indicator and Terminal Punching Insulators on Terminal Strip

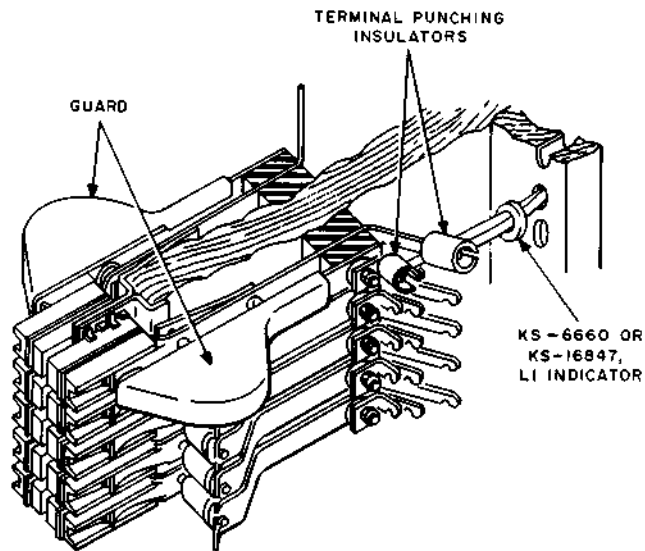


Fig. 28—KS-14539 Guard on Protector Mounting

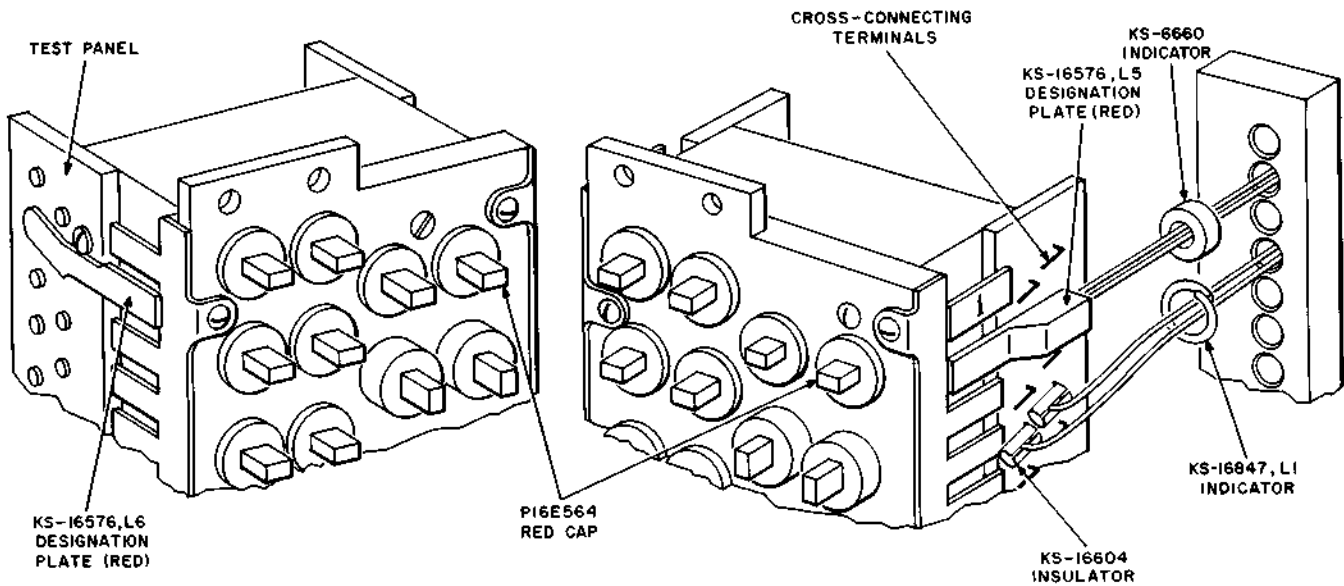


Fig. 29—Protection of Special Lines—300-Type Connector or the Replaced 121-Type Protector

16.09 On main distributing frames equipped with 444-type jacks in addition to the KS-6660 or KS-16847 L1 indicators and No. 4 and No. 5 punching insulators, special circuits should be further protected by using a KS-20353 L1 guard which replaces the 12A and 12B guard. The KS-20353 L1 guard (Fig. 30) consists of a molded red thermoplastic material having a cavity on one side and a rectangular hole through the other. Fig. 31 shows the KS-20353 L1 guard mounted on a 444-type jack.

16.10 The 37-type terminal shields may be used in case where a number of special circuits appear on adjacent rows of terminals on one or more horizontally mounted terminal strips. These shields do not relieve the requirement for individual terminal protection provided by No. 4 and No. 5 type insulators. The 37-type terminal shields may also be used on horizontally mounted terminal strips

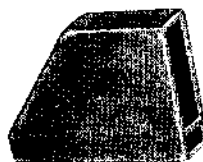


Fig. 30—KS-20353 L1 Guard

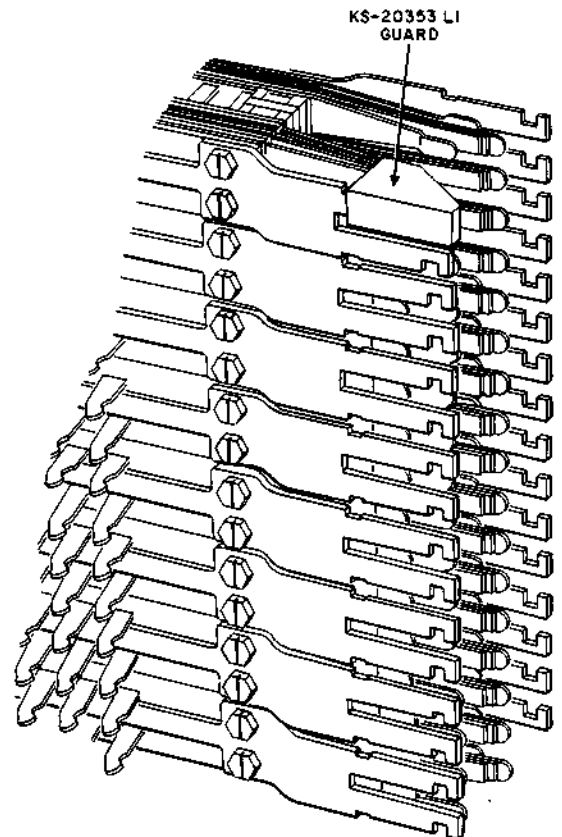


Fig. 31—KS-20353 L1 Guard on 444-Type Jack

where experience has indicated that a high incidence of trouble has resulted from solder and wire clippings. The shield code numbers include the associated hinges. Additional wire hinges per P-467763 may be obtained when required. The 37-type shields may be installed by springing the wire hinges sufficiently to grip the base of the terminal strip at the proper holes (See Fig. 32). The following table lists the shields designed for the particular terminal strips listed.

SHIELD CODE NO.	FITS TERMINAL STRIPS
37A	38, 39
37B	40, 121
37C	41, 178A, 178D
37D	48, 50, 178B, 178C, 178E
37E	51
37F	37, 91, 93
37G	35, 36, 92
37H	183A, 183B
37J	150A, 150B, 150H
37K	183E
37L	183J, 183K, 183P, 183AA, 183AB, 183AF, 183AG
37M	178AA
37N	150AD
37P	183G, 183W

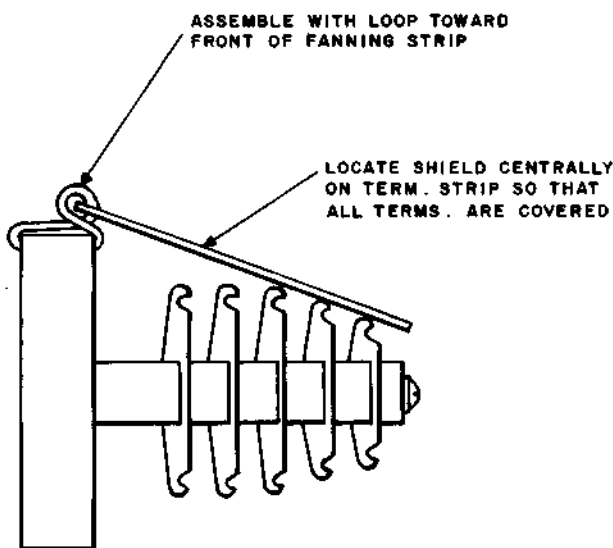


Fig. 32—37-Type Shield on Terminal Strip

16.11 The KS-19918 L1 guard is furnished as a protective device for fastening to the ends of horizontally mounted solderless wrap-type terminal strips, as shown in Fig. 33, on central office distributing frames of miscellaneous switching systems.

Note: This guard shall not be used on the 150-type terminal strips where the 405A plug might be used since it would prevent proper operation of the plug.

16.12 This guard is particularly useful on terminal strips that are in end positions or on those that project beyond adjacent terminal strips. The guard covers the protruding corners and edges of the molded barrier clamping strips and protects the solderless wrap terminals on the cable side from damage while running or removing cross-connections.

16.13 The guard consists of a molded polyvinyl-chloride strip with retaining tabs to serve as guides while cementing to the end of the terminal strip. The guard is furnished in one length and the straight end may be cut with tin snips to fit any existing size of distributing frame terminal strip.

16.14 This cement Metalset A4 Epoxy Resin Metallic is a 2-component type. Prepare for use by squeezing equal lengths of each tube along side of one another on a piece of paper. Mix together thoroughly until all streaks disappear. ***This mixture must be used within 15 minutes.*** Apply the mixture to the end of the terminal strip. Sufficient quantity should be applied to fill all crevices and provide a flat mounting surface. Press the guard into the cement until the tabs overhang the end of the strip sufficiently to support the guard and leave to cure in this position without clamping. After the cement has hardened about 8 hours, the tab portion of the guard not resting on the terminal strip should be cut off with tin snips. When using the cement, physical contact should be avoided and reasonable ventilation maintained.

16.15 The KS-20132 L1 through L22 guards (Fig. 34) are furnished as protective devices for fastening to the top and bottom of terminal strips on distributing frames of miscellaneous switching systems. The guard covers the edges of the molded barrier clamping strips and protects the solderless wrap terminals on the cable side

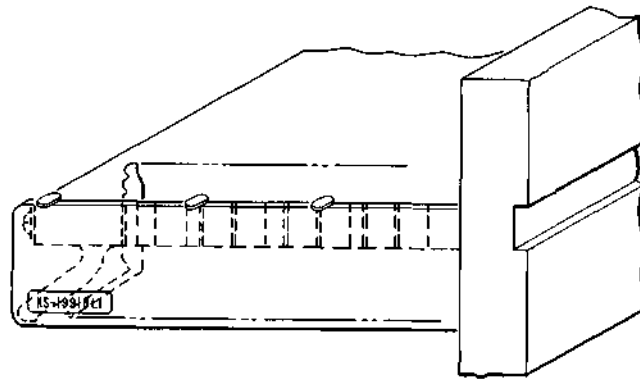


Fig. 33—Method of Mounting KS-19918 L1 Guard on Terminal Strips

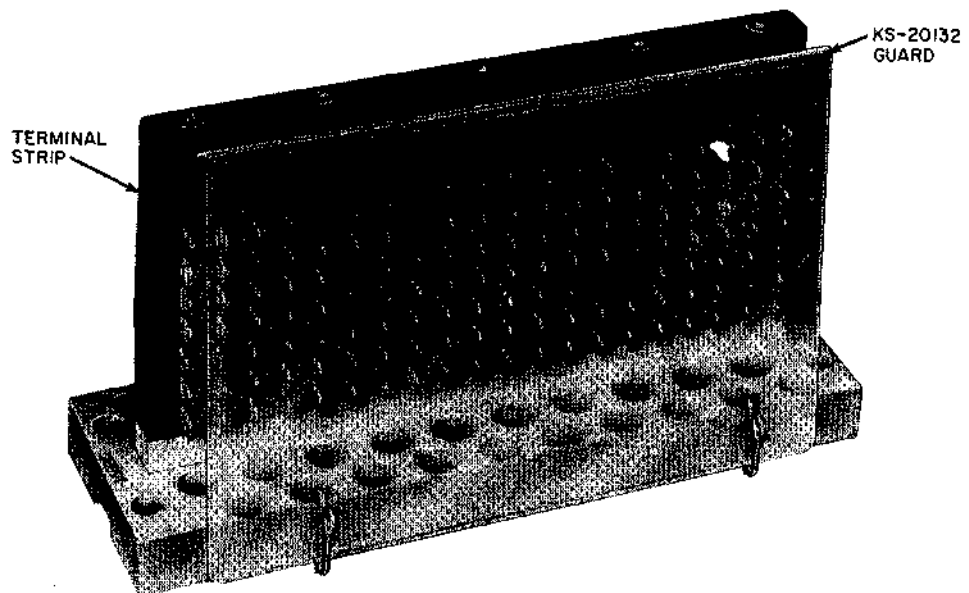


Fig. 34—KS-20132 L1 Through L22 Guards

from damage while running or removing cross connections. It also eliminates the possibility of injury to personnel during heavy maintenance activities.

16.16 The guard is of transparent flame-resistant plastic material with a hook-shaped edge on the long surface and the other end is inserted into KS-20308 L1 clips, which are placed in the holes in the base of the terminal strip. There are

KS-20132 LIST NO.	USED ON TERMINAL STRIPS
1	150AD
2	150AE, 150AF, 150AG
3	150AJ, 150AK, 150AL
4	150AN, 150AP, 150AR, 150AS, 150AT, 150AU, 150AW, 150AY, 150BB
5	150BC, 150BD, 150BE
6	150BG, 150BH, 150BJ
7	150BL, 150BM
8	183R
9	183S, 183AC
10	183T, 198G
11	183U, 198F
12	183W
13	183Y, 183AD, 198J, 198L
14	183AA, 183AF
15	183AB, 198H
16	183AE
17	183AG, 198K
18	268A
19	268B
20	268C
21	268D
22	268E

individual sizes of guards to fit the various terminal strips as shown in the following list.

16.17 On distributing frames equipped with 336-type terminal strips used in ESS and TSPS systems, plastic guards are available to prevent accidental contact with the terminal strip. The guards (Fig. 35) for both sides of the terminal strips are listed below:

◆ GUARD NO.	FITS TERMINAL STRIPS
KS-20107 L1 ¹	336A and B, cross-connecting side
KS-20107 L2 ¹	336C and D, cross-connecting side
KS-20108 L1 ²	336A and B, cable side
KS-20108 L2 ²	336C and D, cable side

Note 1: When using the KS-20107 L1 or L2 guard, a KS-20309 L1 hinge (Fig. 35) is required.

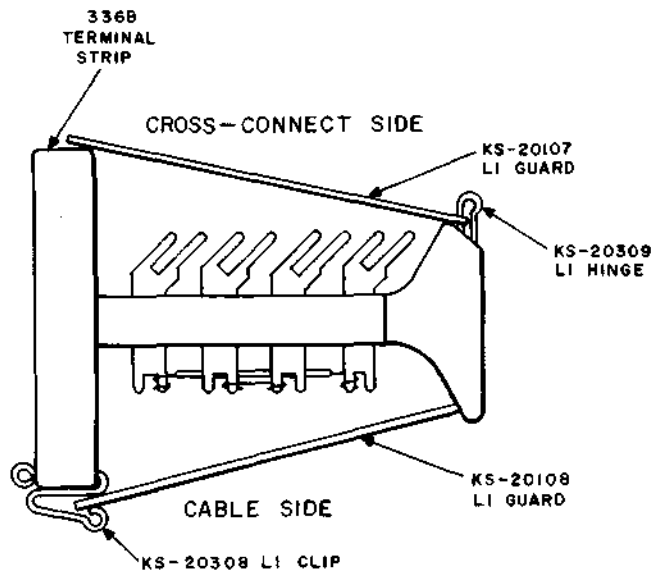
Note 2: When using the KS-20108 L1 or L2 guard, a KS-20308 L1 clip (Fig. 35) is required. ◆

16.18 On main distributing frames equipped with the 7-type fuse protector, the special circuits may be identified at the fuse by the No. 1, No. 2, and No. 3 binding post insulators. The No. 1 insulator is used over the binding posts equipped with hexagonal nuts measuring 3/8 inch across the flats and also the 7T fuse. The No. 2 insulator is used over binding posts having nuts measuring 7/16 inch across the flats and also the 7A fuse. The No. 3 insulator is used over the screw-type binding posts of the BD-type cable terminals. (See Fig. 36.)

16.19 When working from ladders, maintain a secure footing. Use a 448A tool or equivalent for passing cross-connections through rings when necessary to eliminate overreaching.

16.20 When passing or pulling cross-connection, take care to avoid injury to hands or arms on terminals or projecting iron details.

16.21 Before starting to unreel cross-connection wire, double back the end of the wire about 1 inch. This precaution will reduce the risk of injury in handling the wire and running jumpers.



◆ Fig. 35—KS-20107 L1 and KS-20108 L1 Guards on 336B Terminal Strip ◆

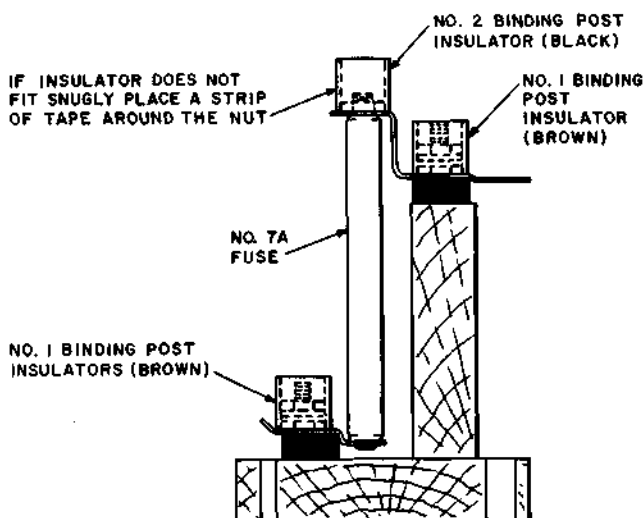


Fig. 36—No. 1 and 2 Insulators on 7-Type Fuse Protector

16.22 If the cross-connection wire does not unreel from the KS-8047 wire reel without overrunning the drum (or causing the reel to be dragged on the floor), adjust the tension of the brake shoe, located on the vertical support near the base, using the 216B tool.

16.23 Use a moderate tension in pulling the wire from the reel and do not attempt to slow

up or stop the reel with the hands or any part of the body.

Caution: To avoid the possibility of injury to the fingers or hands when rewinding wire, the turning effort should be applied to the rim rather than the spokes of the reel.

16.24 When running cross-connections, do not leave the ends of the wire projecting beyond the front of the terminal strip. This precaution will reduce the risk of puncture wounds and eye injuries. (See Note 1 under 5.05).

16.25 Take care when removing and trimming shields of shielded wire to avoid puncturing the fingers on the ends of the small shield wires.

16.26 If a jumper is found to be connected to a set of terminals assigned on an order, do not disturb the jumper without first ascertaining that it is "dead". The fault in such cases is usually due to an error in the assignment or execution of some previous order. The exact procedure for checking such cases cannot be given since the cause of the error will, in a great many cases, determine the procedure; the procedure will also vary with the type of order and equipment involved. In general, one or more of the following checks will be necessary to determine whether the jumper should be removed or whether a new assignment is necessary.

(a) Check the order with the cable and line or trunk records.

(b) Trace the jumper in question from the point at which it is found to its termination. In the case of short jumpers, this will be the easiest and, therefore, the first method to be tried. In some cases where the other methods fail, it may be necessary to trace long jumpers which are covered by a large number of other jumpers. In some cases it will be found more convenient for two craftsmen to work together in tracing the jumper, one man pulling on the jumper at short intervals while the other man feels for it in its indicated direction of run.

(c) By means of the test shoe or test clips, connect the terminals of the jumper in question to the test desk. The test deskman may then test the line and determine, in most

cases, the type of equipment to which the jumper is connected and, in some cases, the location of the equipment.

(d) In the case of manual equipment, connect a hand test set to the terminals of the jumper in question. If the jumper happens to be associated with a subscriber line, the line number may then be obtained from the operator, except in the case of a one-way (terminating only) line in which case the jumper should be traced.

(e) In panel and crossbar offices, connect a hand test set to the terminals and, after dial tone is heard, dial the code which will route the call to a permanent signal holding trunk (or dial an operator or the test desk). When the call is answered, request that the connection be traced in order to determine the line equipment and the subscriber line number.

(f) In step-by-step offices, connect a hand test set to the terminals and, after dial tone is heard, dial the number associated with a switchroom telephone. When the call is answered, request the switchman to trace the call in order to determine to what equipment the jumper is connected.

16.27 Do not disconnect or open a line that is busy. On a line, other than one of the types mentioned in 16.06, connect a test set to it in order to determine whether or not it is busy. For listening on dial system lines, always use the test set with the capacitor or resistor connected in series with it.

16.28 When it is necessary to open a tip (T), ring (R), and sleeve (S) cross-connection of a dial system subscriber line at the IDF, the tip (T) and ring (R) conductors should be opened first and the sleeve (S) conductor last. When closing through a cross-connection of a line that has been temporarily disconnected, the sleeve (S) conductor should be closed through first, the tip (T) and ring (R) conductors last. The sleeve wire should not be left open longer than necessary. This procedure is necessary in some offices in order to avoid the possibility of irregular operation of dial equipment.

16.29 When it is necessary to open the cross-connection on a PBX line in a dial

office, the line should be made busy or otherwise arranged so that it will not be selected on a terminating call and so that no interference will be encountered in the selection of other lines in the terminal hunting group. Proceed as follows:

(a) **Ground Cut-Off Panel Offices:** Connect a make-busy cord to the sleeve terminal of the affected PBX line at the upper side of the HIDF terminal strip.

(b) **Battery Cut-Off Panel Offices:** Open the sleeve jumper of the affected PBX line at the HIDF terminal strip for all except the last line of the terminal hunting group. If the last line of the group is opened, the second to last line of the group should be temporarily arranged as the last line in accordance with local procedures.

(c) **No. 1 Crossbar Offices:** Remove the cross-connection from the sleeve (NS) terminal of the affected PBX line at the VLDF and connect a make-busy cord to the NS terminal from which the wire was removed.

(d) **No. 5 Crossbar Offices:** Open the sleeve jumper of the affected PBX line at the HMDF terminal strip.

(e) **Step-by-Step Offices:** Ground the sleeve terminal of the affected PBX line at the connector multiple terminal strip at the connector frame or the distributing frame.

16.30 When it is necessary to open a trunk cross-connection or when making trunk transfers the circuits involved should either be made busy or, in the case of manual equipment, the proper traffic department employee should be advised in order that the equipment may be marked in such way that it will not be used. Before opening a trunk cross-connection, listen on the trunk to determine that it is not busy by using a test set with the capacitor or resistor connected in series with the circuit. Trunks should be tested and promptly replaced in service upon completion of the work.

16.31 Terminal strips should not be tapped with a screwdriver or other tool to dislodge loose solder or pieces of wire, since this may cause the terminal strip to chip.