DISTRIBUTING FRAME CROSS CONNECTIONS
GENERAL

CONTENTS

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.

1.02 This section is reissued for the following reasons:

(a) To revise information covering the type of cross-connection wire used on distributing frames.

(b) To show the use of plastic adhesive tape.

(c) To include cross-connection information covering the carrier cross-connection cabinet.

(d) To include the use of the KS-16847 spiral ring type indicators.

(e) To include the use of the KS-14534 number plate holder.

(f) To revise procedure for making a PBX line busy in a No. 1 crossbar office.

(g) To revise the list of tools and materials.

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 craftscan 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.

1.04 The method of sharpening the external notches of the Bell System V-notch diagonal pliers in covered in Section 075-110-301.

1.05 Methods of skinning and preparing cross connections used on distributing frames are covered in Section 069-120-811.

2. TOOLS, MATERIALS, AND TEST SETS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
(2) 32	9/32-inch and 5/16-inch Hex. Double-end Socket Wrench (for 444-type jacks)
(2) 110	1/4-inch Hex. Single-end Socket Wrench (for other than the 300-type connector or the replaced 121-type protector)
216B	Combination 3/8-inch and 7/16-inch Hex. Double-end Socket Wrench and Screwdriver
(2) 447A	Protector Wrench and Adjuster (for other than the 300-type connector or the replaced 121-type protector)
448A	Cross-connection Wire Puller
(2) 624B	Terminal Connectors (for the 300-type connector or the replaced 121-type protector)
1011G	Dial Hand Test Set equipped with:

(1) W2DB cord, 4 feet long, equipped with one 471A jack and two KS-6780 clips and two 108A cord tips (2W37A cord) for connecting to protectors other than the 300-type connector or the replaced 121-type protector

or

(2) W2CJ cord, 4 feet long, equipped with one 360A tool, one 360B tool and one 471A jack (2W41A cord) and 624B tools for connecting to the 300-type connector or the replaced 121-type protector.

KS-6320 or	Orange Stick
R-1102	Fiber Spudger
KS-8740	Soldering Copper
KS-14546	Number Plate Remover
—	Long-nose Pliers
—	V-Notch Diagonal Pliers
→ —	Skinning Tools, as required, per Section 069-120-811
—	Tools for making solderless wrapped connections per Section 069-132-811

CODE OR SPEC NO.	DESCRIPTION
MATERIALS	
12A and 12B or replaced 9A, 9B, 9C, and 11A	Guards (for 444-type jacks)
37-type	Shields
KS-7851	Sleeving (No. 14 yellow) " (No. 14 black) " (No. 18 black)
KS-6660	Indicators
↱ KS-14090	Gray Plastic Adhesive Tape
KS-14534, L7	Number Plate Holder
KS-14539 (Lists 5 through 9)	Guards (for other than the 300-type connector or the replaced 121-type protector)
KS-16576, L1	Designation Plate (red) (for the 300-type connector or the replaced 121-type protector)
KS-16604	Insulators (for the 300-type connector or the replaced 121-type protector)
KS-16847, L1	Indicators (Spiral band type)
P-16E564	Caps (red) (for the 300-type connector or the replaced 121-type protector)
P-31A904	Sleeves (blue)
P-31A905	" (yellow)
P-31A906	" (green)
P-314952	22-Gauge Bare Tinned Copper Wire
No. 1, 2, and 3	Binding Post Insulators
—	Canvas, 8 ounce, 3 feet by 3 feet, with a piece of wood molding fastened to one end, or, distributing frame bags, where provided
—	Distributing Frame Wire per Table A
—	Fiber, Sheet, Gray, 22 in. x 34 in. x 1/64 in. (RM-591862)
No. 4 and 5	Terminal Punching Insulators
TEST SET	
67C (or equivalent)	Test Receiver

3. CODES AND COLOR OF DISTRIBUTING FRAME WIRE

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

TABLE A

CODE			COLOR					
TYPE OF WIRE	NUMBER OF CONDUCTORS	B & S GAUGE	TIP	RING	SLEEVE		LAMP OR MESS. REG.	
PVC								
U 20 S	1	20	BR					
U 20 P	2	20	BR	BK-BR				
U 22 P	2	22	WH	BK				
U 22 T	3	22	WH	BK	RD			
U 22 F	4 Spiral Four	22	WH	BK	RD		GN	
U 22 M	4 Multiple Twin	22	BK-WH	BK	RD	(tip of second pair)	GN	(ring of second pair)
SHIELDED								
BF	2	22	WH	BL				

Note 1: 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 2: BF wire consists of shielded wires, the individual conductors of which are insulated with polyethylene, with a 24-gauge bare ground wire woven into the shield and an outer covering of cotton braid.

4. USE, RECOVERY, AND REUSE OF DISTRIBUTING FRAME WIRE

Kinds of Wire To Be Used

4.01 22-gauge distributing frame wire should be used on all distributing frames, except that single-wire jumpers should be 20-gauge; 20-gauge paired jumpers may be used under certain conditions for PBX metallic battery and ground return feeders as covered by Section 069-120-803. ←

4.02 The line side of the phantom groups should be cross-connected with multiple twin wire if available; otherwise use two pairs run side by side for their entire length. Spiral four distributing frame wire should not be used for this purpose.

4.03 Nonphantomed toll circuits or a circuit of any type containing two talking pairs should be cross-connected with multiple twin wire if available, or with individual pairs.

4.04 For all cross connections (except N1 carrier line circuit cross connections), U-type ← wire should be used.

4.05 For N1 carrier line circuit cross connections, 22-gauge paired, shielded BF wire should be used.

Removed Wire — All Frames

4.06 With the exception of KS-13645, KS-13646, and KS-14628 flameproof and rubber cov- ← ered wire, all distributing frame wire, which

has been removed from frames and is in good condition, may be reused directly in accordance with 4.01 through 4.05 and 4.07.

4.07 In general, all lengths of good wire in excess of 10 feet should be reused either in the offices from which they were removed or in other smaller offices. Wire not suitable for reuse should be returned to the Western Electric Company as junk. No wire should be returned for splicing.

4.08 Distributing frame wire suitable for reuse, which is removed from distributing frames, should be stored in locations at which facilities have been made available for that purpose, such as, brackets attached to the under side of the horizontal shelves of the distributing frames, reels, hangers or other similar arrangements. In the small offices where brackets, reels or hangers, etc, are not provided, they may be coiled individually and hung on suitable hooks or placed in lockers until reused.

4.09 The length of the jumper wire required to cross-connect any two terminals on the distributing frame may be estimated by the use of charts. These charts, generally in loose-leaf book form or card files, show the location of each block or terminal on the distributing frame with reference to two fixed locations, usually the nongrowing end of the frame and the bottom horizontal shelf on the frame. When a jumper is to be run, the location of each termination for that jumper (as for example, call number and cable pair or equipment) with respect to the reference location must be obtained from the chart; that is, it will be determined from the chart that each terminal is horizontally a certain number of feet from the nongrowing end of the frame and vertically a certain number of feet from the bottom horizontal shelf. By subtracting the smaller horizontal distance from the larger, the horizontal separation of the two locations will be obtained. A similar procedure with the vertical figures will give the vertical separation. The sum of these two figures, plus the width of the frame and a fixed allowance for tying in and slack will equal the length of the jumper required for that particular cross connection.

EXAMPLE	FEET HORIZONTAL	VERTICAL		
Call number	15	10		
Cable pair	47	8		
Difference	32	2	=	34
Width of frame				3
Allowance for tying in and slack				1
Length of jumper required				38

Note: The required length of jumper may be determined in the office or placed on the service order by the assignment force.

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 so as 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 The 448A tool may be used for pulling jumpers through the distributing rings.

5.05 Pass the jumper through the hole in the fanning strip associated with the terminal to be used. Do not run jumpers through 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), a 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.)

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, thence up or down the vertical, as required, through the distributing ring at the other horizontal shelf and thence 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 thence 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; and (2) in connection with intercepting trunks in dial offices, as described in sections covering associating 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, thence 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.)

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.

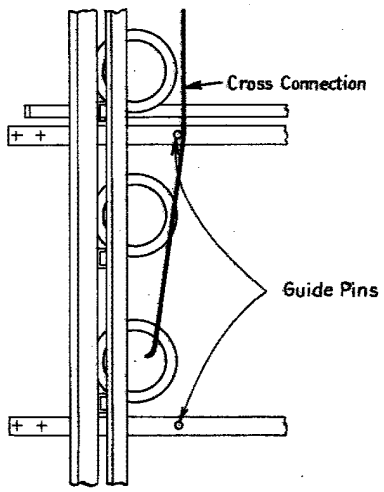


Fig. 1 – Position of Cross Connection behind Guide Pin Where Run between Shelves at Combination Distributing Frames

5.14 The cross connections of single-sided distributing frames are run similar 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 similar 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 the east side of carrier equipment should not be run through the same distributing rings as cross connections for circuits on the west side of this equipment.

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.

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, spread a piece of canvas on the shelf below that on which the work is to be done. Distributing frame bags, where available, may be used for this purpose. 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 insure that a minimum of textile fibers are 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, if provided.

7.02 Detailed procedures for removing insulation from cross-connection wire are cov-
→ered 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, spread a piece of canvas on the shelf below that on which work is to

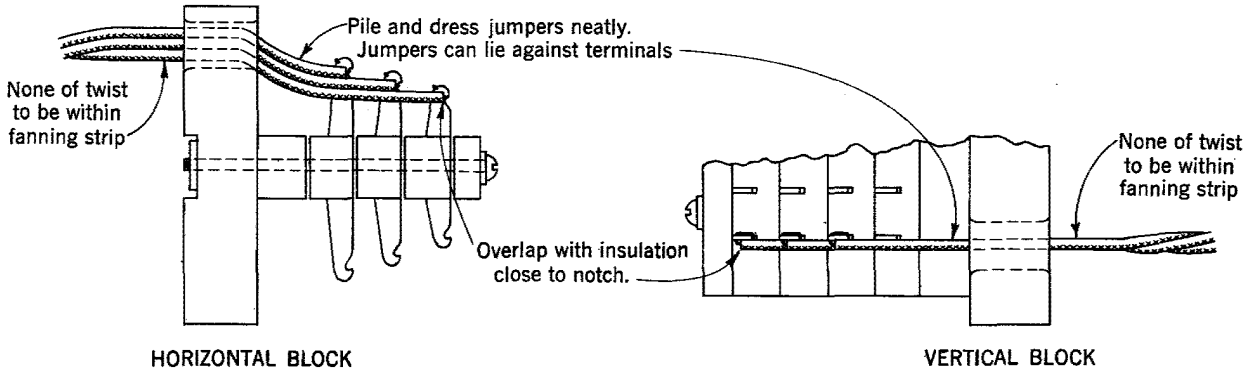


Fig. 2 – Termination of U-type Wire on Terminal Strip

be done. Distributing frame bags, where available, may be used for this purpose. 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 that 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. Figs. 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 other terminals of the terminal strip or crossing the pliers with terminals when cutting the wire.

Note 1: 20-gauge wire should 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 under side 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".

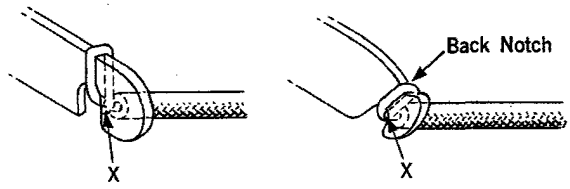


Fig. 3 – Termination of Wire on Protector (Notch on Under Side of Terminal)

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 should be cut instead of broken.

8.06 In case a protector terminal 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.***

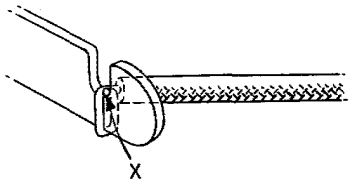


Fig. 4 – Termination of Wire on Protector (Notch on Upper Side of Terminal)

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".

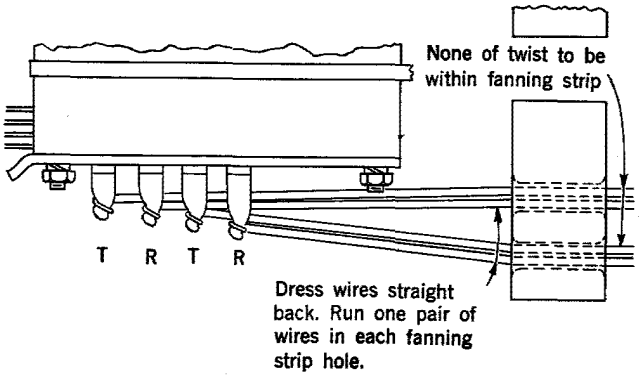


Fig. 5 – Termination of Wire on 444-type Jacks at MDF

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 No. 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.

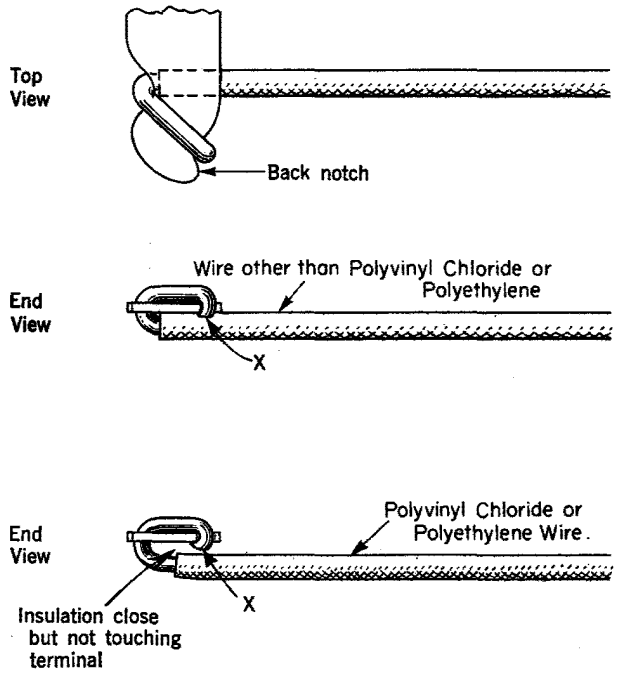


Fig. 6 – Termination of Wire on Terminal Having a Back Notch

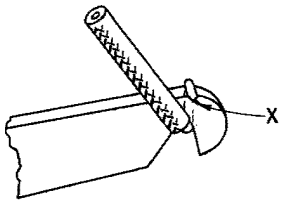


Fig. 7 – Termination of Wire on Terminal of a No. 65 or Similar Type Terminal Strip

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 pointed out in 15.20.

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 No. 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 should be cut →instead of broken.

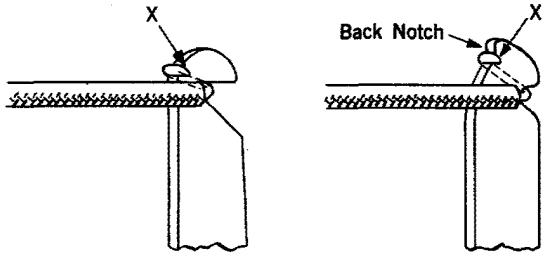


Fig. 8 – Termination of Wire on Vertical Terminal Having a Single Notch

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 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". 20-gauge wire should be cut instead of broken. ←

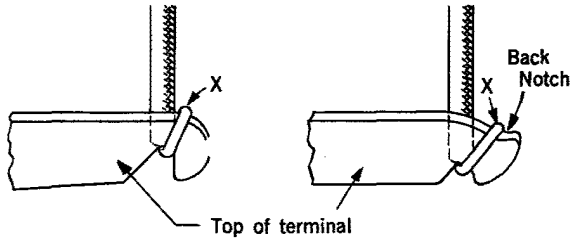


Fig. 9 – Termination of Wire on Horizontal Terminal Having a Single Notch (Top View)

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.

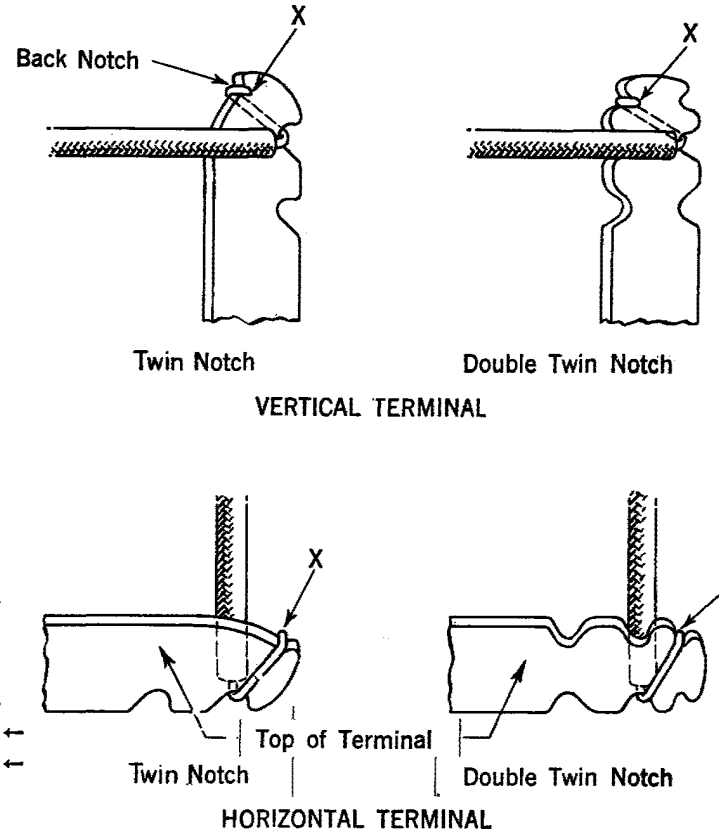


Fig. 10 – Termination of Wire on Terminal Having a Twin Notch or Double Twin Notch

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 when the equipment associated with the jumpers is not in service, or when a large number of jumpers are 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 means of a piece of canvas (or a distributing frame bag if provided). 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. Wrapped connections made with the 635A tool must be soldered.

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 long-nose pliers; form a closed loop with the skinned portion of the wire; place the preformed loop on the terminal and crimp it firmly in place at the bend in the terminal; solder the connection.

9. PREPARING BF WIRE FOR CROSS CONNECTIONS FOR CARRIER CIRCUITS

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.

9.01 When shielded carrier cross connections are required (see 10.01) BF wire should be used. BF wire consists of two 22-gauge conductors, and a bare ground wire woven into 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 If the shield is to be terminated at a point other than a terminal strip which the ground wire will reach, connect a length of 22-gauge paired distributing frame wire to the ground wire with a 1/2-inch splice 1/4 inch from the end of the butt. Solder the splice and bend the splice back, laying it along the plastic adhesive tape at the butt (see Fig. 11). This wire should be kept as short as possible and be run in the most direct manner.

9.04 Place a wrapping of 3/8-inch KS-14090 gray plastic adhesive tape over the butt end, covering any exposed shield wires and splice.

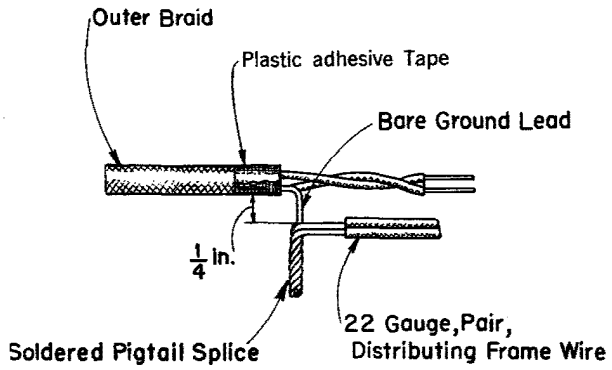


Fig. 11 – Splicing Bare Ground Wire

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 alpeth 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 practicable 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. In those cases where cable pairs terminate on 444-type jacks and are assigned to carrier circuits, the jack contacts should be strapped 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.

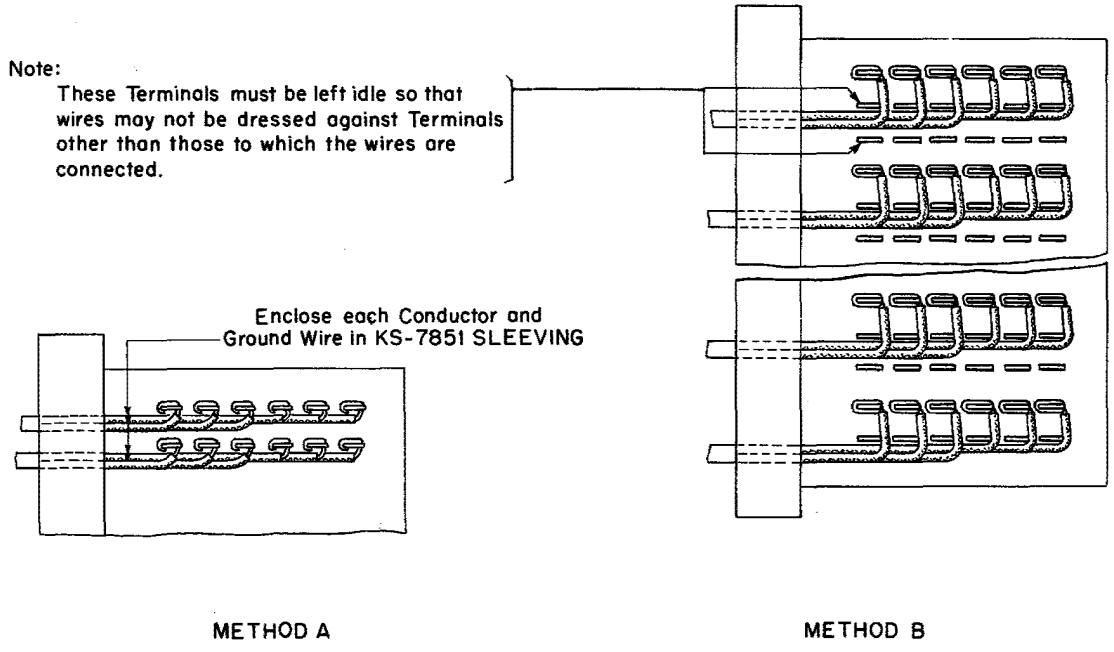


Fig. 12 – Connecting BF Wire to Terminal Strips

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 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 AND 444-TYPE JACKS

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 11.02 Note.)

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 Figs. 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 the tip side of the protector mounting, use a bare 20- or 22-gauge wire approximately 2 inches long with a 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

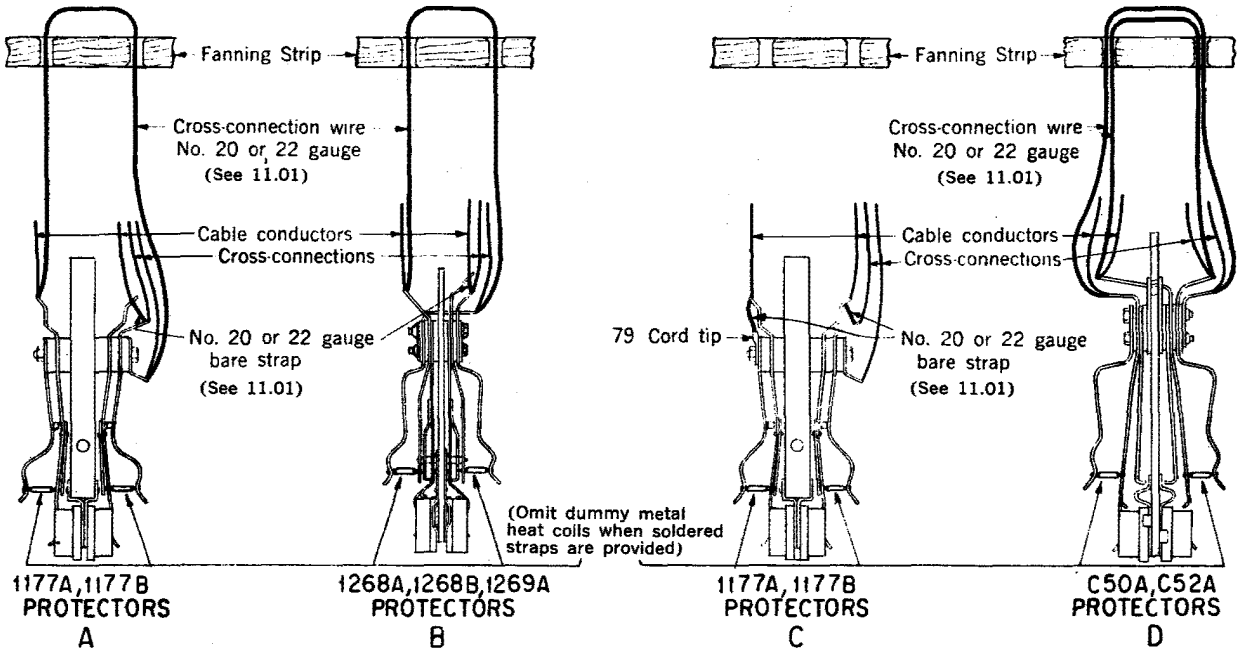


Fig. 13 – Strapping on Protector Mountings

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 20- or 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.)

11.06 Where cable facilities terminated on 444-type jacks are used for circuits which require that the jack contacts be strapped out, the straps should be placed as shown in Fig. 14 using U 20 S cross-connection wire. Leave approximately 1/2-inch slack.

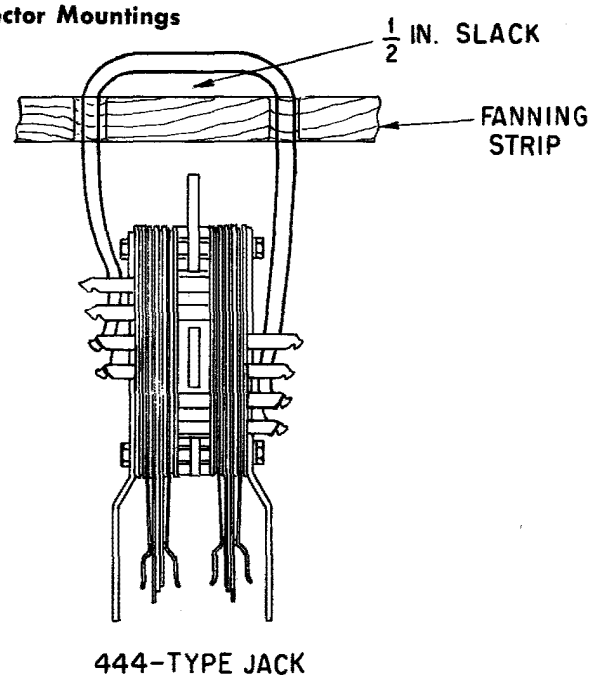


Fig. 14 – Strapping on 444-type Jacks

11.07 Fig. 15 shows the method of placing straps using U 20 S cross-connection wire, where the use of shielded cable conductors and shielded cross-connection wire does not permit the passage of additional conductors through the fanning strip holes. Prior to placing straps in this manner, insulation from the grounded framework and grounded portions of the jack should be provided by the use of gray sheet fiber.

In cases where some jumpers are already in place, the fiber may be placed in strips 6 inches long by 2 inches wide. On new facilities where there is no interference from existing jumpers the fiber may be applied in pieces 7 inches wide to fit between the horizontal members of the supporting framework. In either case the fiber will be held in place by the straps which should be run with approximately 1/2-inch slack.

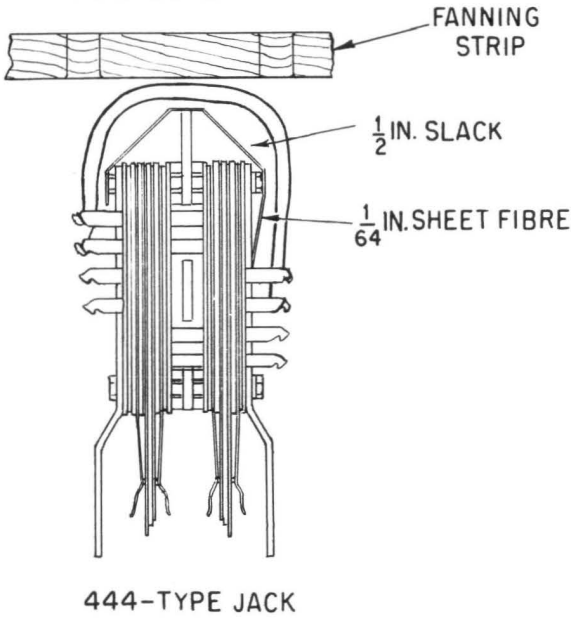


Fig. 15 – Alternate Method of Placing Straps on 444-type Jacks

11.08 When the methods outlined in 11.06 and 11.07 cannot be used on 444-type jacks, the only other possibility is to run the straps through the slots in the front of the assembly. (See Fig. 16.)

> ***Note:*** This method should be used only as a last resort. The wire should be dressed through the shorter slot in the front of the assembly, in such a manner that it will not interfere with the use of guards or plugs. Dressing the wire through the shorter slot prevents it from being forced back into the assembly and being damaged.

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. Figs. 17 through 22 show 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.

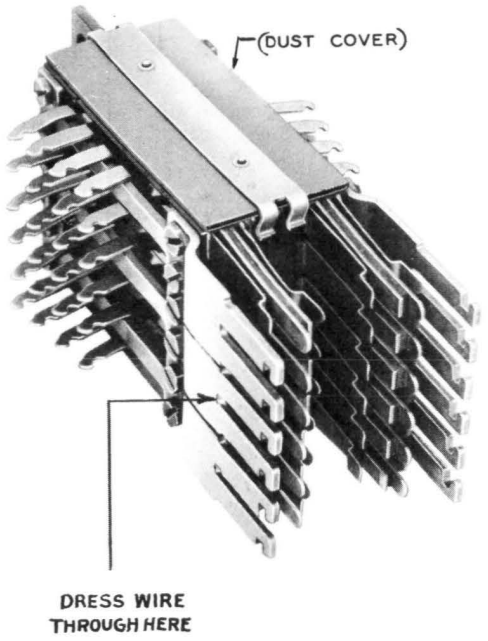


Fig. 16 – Location of Short Slot Used When Dressing Strap Forward on 444-type Jacks

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. 17.)

12.05 To remove the temporary jumper, it will only be necessary to cut off the tail of the permanent jumper, which leaves 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. 18. Where local instructions specify that either the upper or lower terminals should be used for the permanent jumper, identify the temporary jumper for subsequent removal by

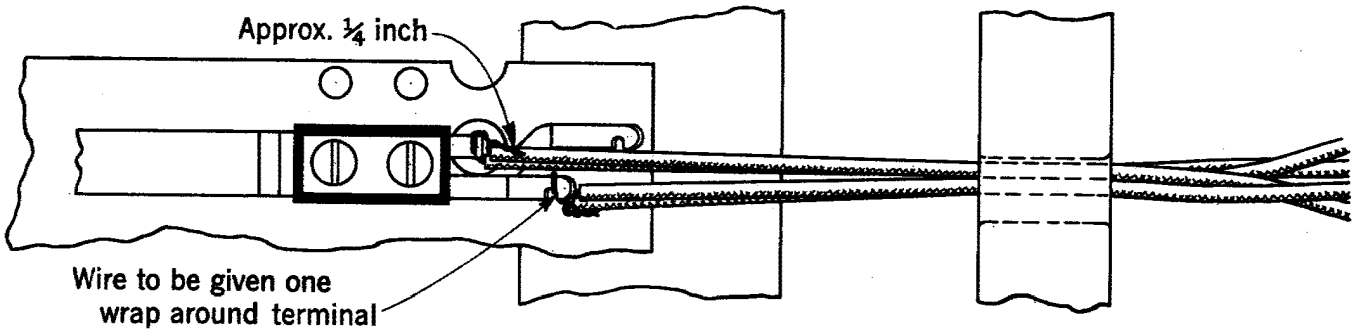


Fig. 17 – Temporary Cross Connections on Protectors

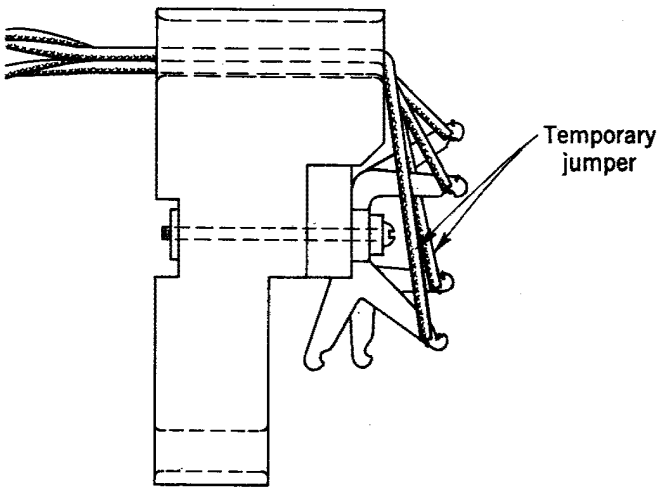


Fig. 18

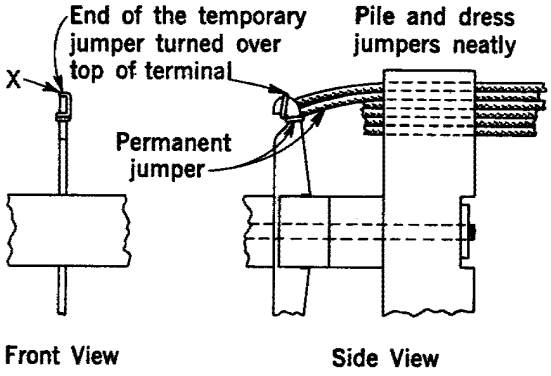


Fig. 19

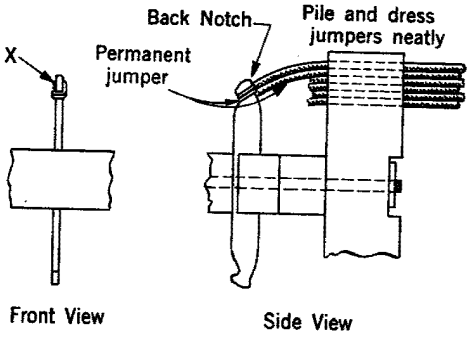


Fig. 20

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. 19. 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".

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. 20. Bring the wire along the top of the permanent jumper, through the notch

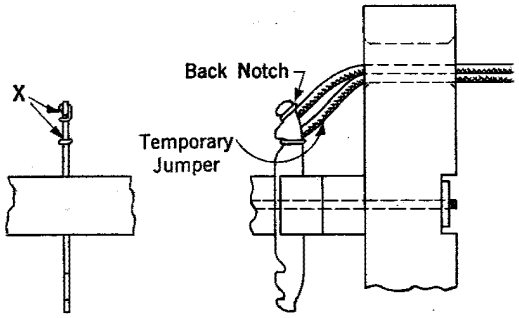


Fig. 21

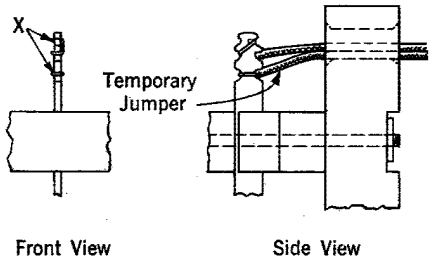


Fig. 22

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.

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 Figs. 21 and 22. 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 (see 12.03), place the temporary jumper on the front of the terminal.

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 Figs. 23 through 26. See also 8.14.

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.

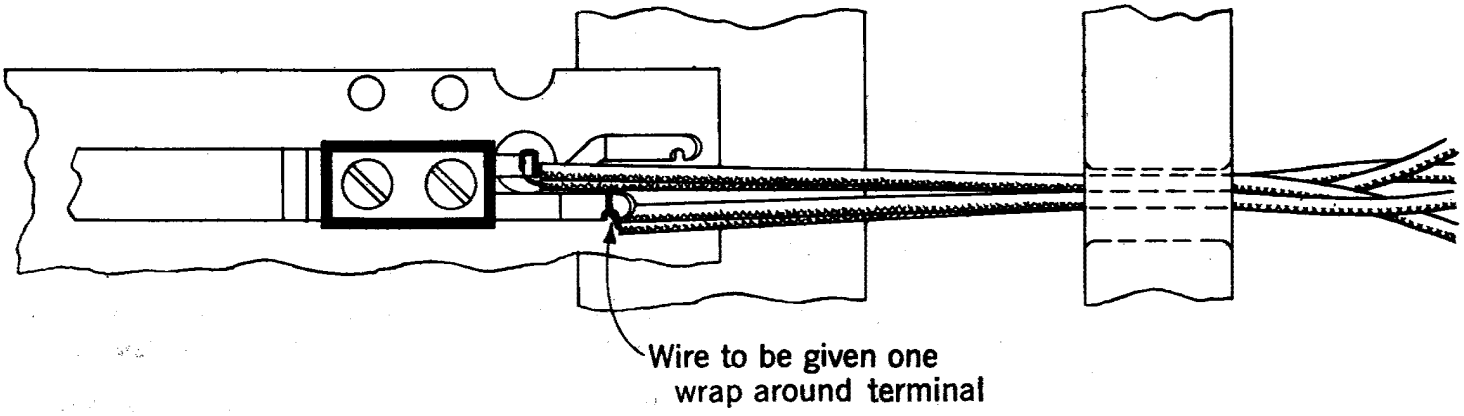


Fig. 23 – Permanently Bridged Cross Connections on Protectors (Other Than the 300-type Connector or the Replaced 121-type Protector)

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.

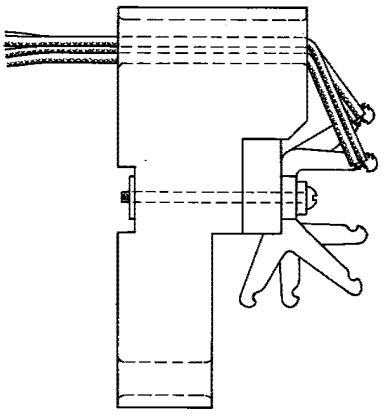


Fig. 24 – Permanently Bridged Cross Connections on No. 65 or Similar Type Terminal Strips

14. REMOVING CROSS CONNECTIONS

14.01 Before starting the work of disconnecting jumpers from terminals, a piece of canvas, or a distributing frame bag where provided, should be used to protect the equipment on the shelves below.

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

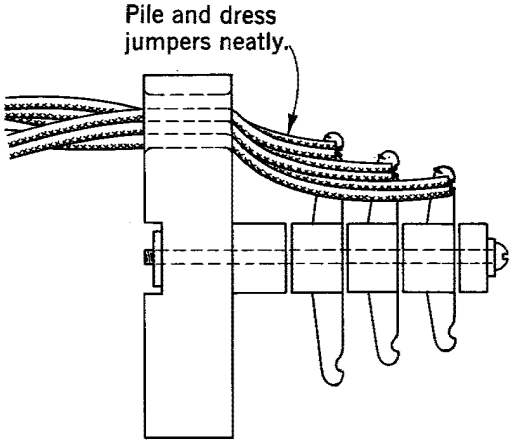


Fig. 25 – Permanently Bridged Cross Connections on No. 35 or Similar Type Terminal Strip, without Back Notch Terminals

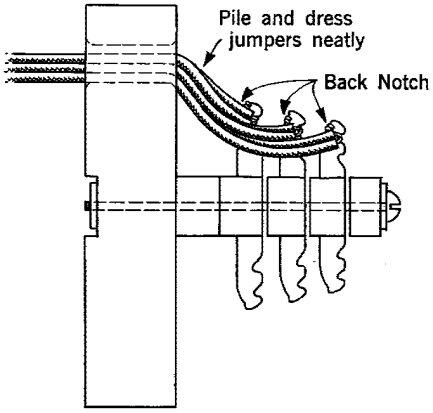


Fig. 26 – Permanently Bridged Cross Connections on No. 183C or Similar Type Terminal Strips with Twin Notch Terminals

14.03 When disconnecting jumpers, cut the jumper so that 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.

14.04 When removing jumpers from terminals arranged for soldered connections, the ends should be removed with the aid of a soldering copper and long-nose pliers. The terminals and the notches in the terminals should be cleaned of all excess solder. Care should be taken

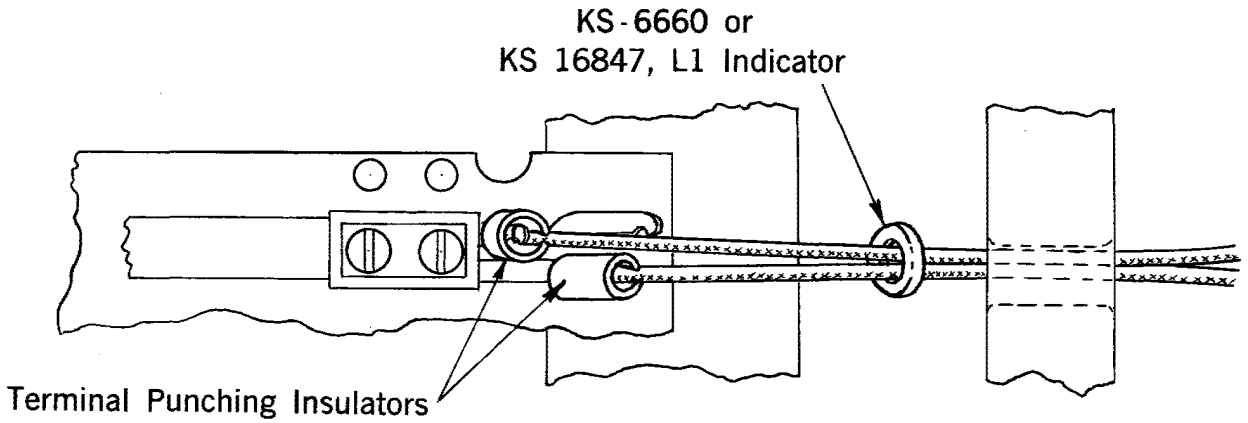


Fig. 27 – Indicator and Terminal Punching Insulators on Protector Mounting

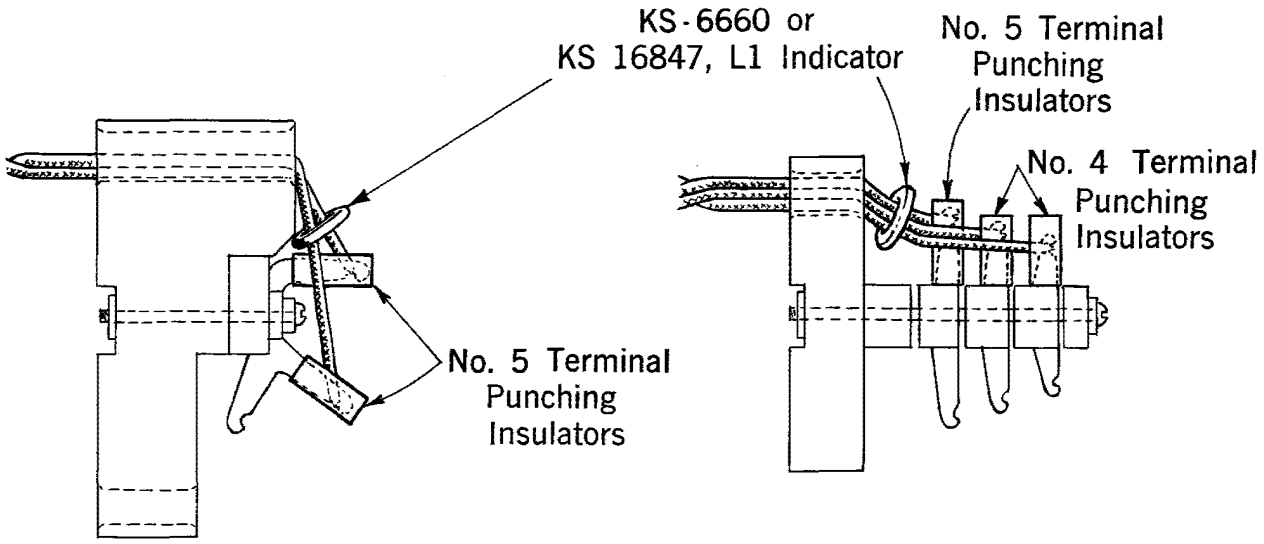


Fig. 28 – Indicator and Terminal Punching Insulators on Terminal Strips

to prevent solder from spattering on terminals or other equipment. Loose pieces of solder or wire should also be prevented from dropping on other equipment.

14.05 When removing jumpers from terminals arranged for solderless wrapped connec-
→tions, 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.

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

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

15.02 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.

15.03 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.

15.04 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, as personal shock may result and an operated fuse may deny service temporarily to a large number of subscribers.

15.05 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 and No. 5 terminal punching insulators, and protected at the protector side with the appropriate guards (see 15.06, 15.07, and 15.09). The KS-6660 or the KS-16847, L1 indicators should be located between the fanning strip and the terminals. (See Figs. 27 through 30.)

15.06 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. 29). 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 List 1)	1177
6 (" " 2)	C type after 1946
7 (" " 3)	1268, 1269
8 (" " 4)	C type prior to 1946
9	E

15.07 On main distributing frames equipped with the 300-type connector or the replaced 121-type protector, the KS-16576, L1 (red) designation plate, the KS-6660 or KS-16847, L1 indicator, and the KS-16604 insulators are used to protect the special lines. The red cap is used with the protector unit to indicate a special line and forestall accidental opening of the line (see Fig. 30).

Note: The List 1 (red) designation plate is long enough to cover the test contacts.

15.08 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, such special circuits should be further protected by using a

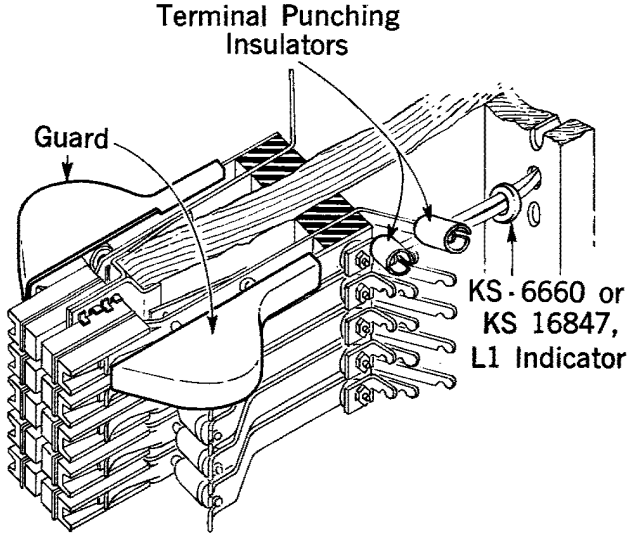
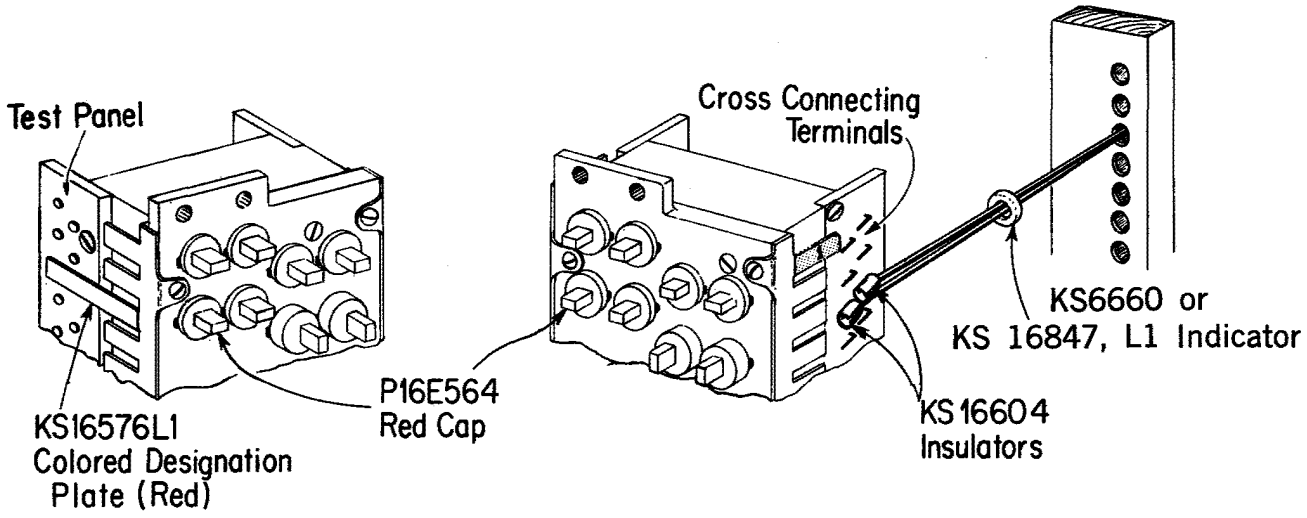


Fig. 29 – KS-14539 Guard on Protector Mounting



→ **Fig. 30 – Protection of Special Lines — 300-type Connector or the Replaced 121-type Protector**

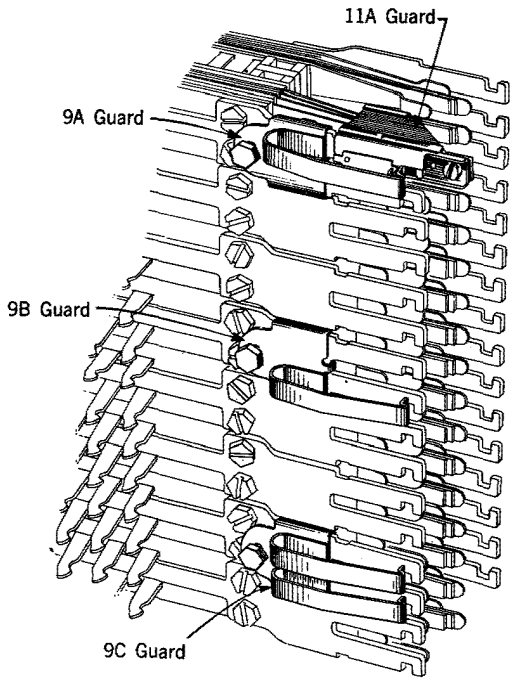


Fig. 31 – Guards on 444-type Jacks

No. 9A, 9B, or 9C marker guard and a No. 11A protective guard; or a No. 12A or 12B guard. The No. 9 guards mark the special circuits, while the No. 11 guard prevents the accidental insertion of a plug into the jack. The No. 12A guard is provided with a latch which may be deflected with the fingers to permit removal from the jack. The No. 12B guard is similar to the No. 12A guard except that it is equipped with a screw which may be tightened with a screwdriver to prevent the latch spring from being deflected. Fig. 31 shows the No. 9A, 9B, 9C, and 11A guards, which are now rated "Manufacture Discontinued." Fig. 32 shows the No. 12A and 12B guards.

15.09 The 37-type terminal shields may be used in cases 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 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

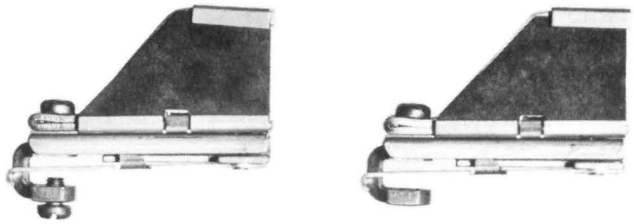


Fig. 32

sufficiently to grip the base of the terminal strip at the proper holes (see Fig. 33). 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

15.10 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. 34.)

15.11 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.

15.12 When passing or pulling cross connections, use care to avoid injury to hands or arms on terminals or projecting iron details.

15.13 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.

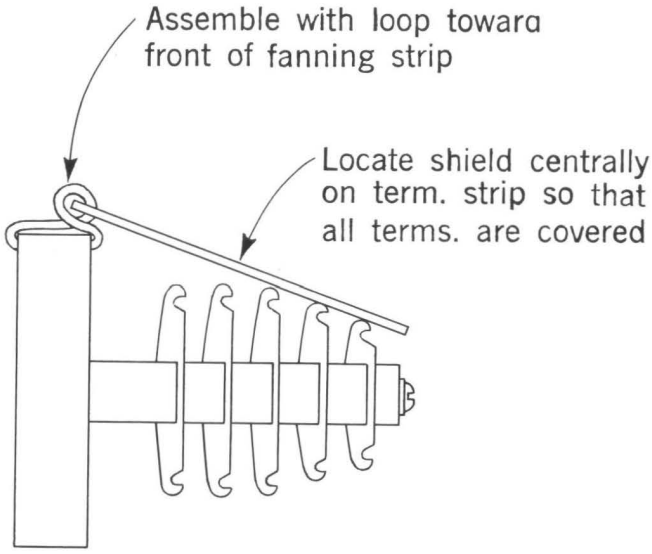


Fig. 33 – No. 37-type Shield on Terminal Strip

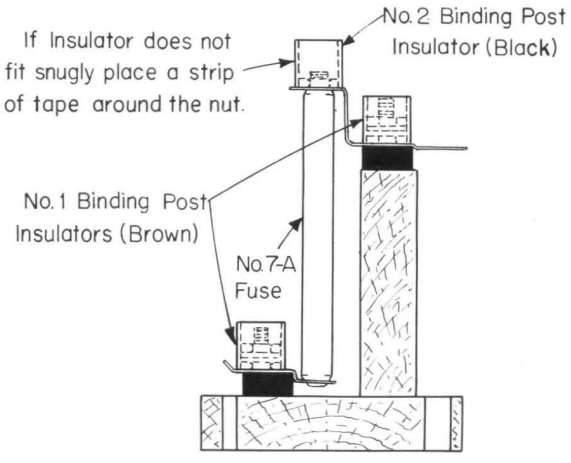


Fig. 34 – No. 1 and No. 2 Insulators on 7-type Fuse Protector

15.14 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.

15.15 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.

15.16 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.

15.17 Use care when removing and trimming shields of BF wire to avoid puncturing the fingers on the ends of the small shield wires.

15.18 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 can not 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 large number of other jumpers. In some of these 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.

15.19 Do not disconnect or open a line that is busy. On a line, other than one of the types mentioned in 15.05, 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.

15.20 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.

15.21 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 Cutoff 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 Cutoff 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.

15.22 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 a 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.

15.23 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.