CONVENTIONAL DISTRIBUTING FRAMES
METHOD OF MAKING CONNECTIONS

CONTENTS PAGE

1. GENERAL

1.01 This section covers general information pertaining to cross-connection work on main distributing frames, carrier cross-connection cabinets, and multipling outside plant cable conductors for PBX battery feeders and station ringing supply feeders on main and combined distributing frames in central offices. Methods are described for Distributing Frames as follows:

(a) Distributing Frames equipped with protectors.

(b) Distributing Frames having separate protector frames.

(c) Distributing Frames equipped with jacks instead of protectors.

1.02 This Section includes the information formerly contained in Sections 069-120-801, 069-120-803, and 069-120-804.

1.03 The information contained in this section is based on SD-90232-01, SD-95667-01, and SD-90233-01. In offices where bunching blocks on the horizontal side of "B" type main distributing frames are provided on a special basis, the cross-connections should conform to SD-90233-01.

1.04 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 craftperson should be familiar with the methods and practices described in this section. In addition, the craftperson should be familiar with the cross-connection features of the various circuits in the particular office or offices 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.

1.05 When terminating cross-connections covered in this section, information in the following sections may be useful:

- 069-120-811—Skinning and Preparing Wire for Cross-Connections on Distributing Frames and Cross-Connection Fields
- 069-132-811—Punched Type or Wire Type Terminals (Not Having Notches or Perforations)—Method of Making and Removing Wrapped Connections
- 069-133-801—Straps and Cross-Connections—Solderless Wrapped Connections—Method of Placing
- 069-140-811—Soldered Connections—Using Soldering Coppers—Method of Making and Removing
- 075-110-301—"V" Notch Diagonal Pliers Per Specification 6433—Sharpening External Notches

1.06 The method of making connections to the 66- and 78-type connecting blocks with quick-connect terminals used on ESS systems and COSMIC systems is covered in the sections which cover the specific systems.

2. TOOLS AND MATERIALS

2.01 Table A lists the types, color arrangement, and other details of distributing frame wire.

Reuse of Distributing Frame Wire

2.02 Only U-type wire with red tracer, W-type and DT-type (irradiated PVC) may be reused. Older types of wire ***must not be*** reused because it lacks fire retardant properties.

2.03 Tools and materials needed are as follows:

CODE OR SPEC NO.	DESCRIPTION
32 (2 required)	1/4-inch hexagon single-end socket wrench (for 444-type jacks)
110 (2 required)	9/32 and 5/16-inch hexagon double-end socket wrench (for other than the 300-type connector or the replaced 121-type protector)
447A (2 required)	Protector wrench and adjuster (for other than the 300-type connector or the replaced 121-type protector)
448A	Cross-connection wire puller
624B (2 required)	Terminal connections (for the 300-type connector or the replaced 121-type protector
AT-8749	B or C short-nose pliers
KS-6320 or R-1102	Orange stick or Fiber spudger
KS-8740	Soldering Copper
KS-16902-L1	Wire stripper
KS-20620-L1-L7	Wire strippers

TABLE A

CODE			COLOR				
TYPE OF WIRE	NUMBER OF CONDUCTORS	AWG	TIP	RING	SLEEVE	LAMP OR MESS. REG.	NOTES
PVC							
U20S	1	20	BR				
DT20S	1	20	BR				
DT20P	2	20	BR	BK-BR			1
U20P	2	20	BR	BK-BR			1
U22P	2	22	W	BK			1
U22PA	2	22	R	BK			1
841506009	2	22	W	R			
841506017	2	22	W	BL			
841506025	2	22	W	G			
841506033	2	22	W	O			
U22T	3	22	W	BK	R		1
U22F	4	22	W	BK	R	G	1
U22M	4	22	BK-W	BK	R (second pair)	G (second pair)	2, 3
DT22M	4	22	W	BL	R (second pair)	G (second pair)	2
DT22P	2	22	W	BL			7
DT22P	2	22	W	R			7
DT22P	2	22	W	G			7
DT22P	2	22	W	O			7
DT22S	1	22	S				
DT22T	3	22	W	BL	R		
SHIELDED							
BF	2	22	W	BL			4
DL	2	24	W	BL			6
761A	2	24	W	BL			5

Note 1: Conductors are twisted together.

Note 2: The tip and ring conductors form one twisted pair; the sleeve and mess. reg. conductors form another twisted pair; and the two pairs are twisted together to form a quad.

Note 3: 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 4: BF wire consists of 22- or 24-gauge, polyethylene insulated conductors which are covered with a braided shield and PVC jacket. Several other conductor color combinations are available in addition to the white and blue pair.

Note 5: 761A1 through 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 through 17 distinguish the different color combinations which are available.

Note 6: DL wire consists of 24-gauge, polyethylene insulated conductors which are covered with a silver-coated braided shield and a PVC jacket. Several other conductor color combinations are available in addition to the blue and white pair. The preparation and termination for DL wire is the same as for BF-type wire. See Section 069-120-811.

Note 7: DT wire is irradiated PVC wire. DT 22 P wire is the replacement for U 22 P wire. DT 22 P wire is the replacement for W 22 P wire in ESS offices with connecting blocks equipped with 78-type quick-connect terminals. DT 22 T-type wire also replaces corresponding U-type wire.

CODE OR SPEC NO.	DESCRIPTION
KS-14546	Name Plate remover
KS-21257	Pliers
—	B long-nose pliers
—	V-notch diagonal pliers (see note)
KS-7851	Sleeving—No. 14 yellow, No. 14 black, and No. 18 black.
KS-14090-L4	Gray plastic adhesive tape
KS-20590 L1-L7	Connectors (for connecting subscriber lines to intercept trunks)
P-31A904	Sleeve (blue)
P-31A905	Sleeve (yellow)
P-31A906	Sleeve (green)
P-314952	22-gauge bare tinned copper wire 20-gauge bare tinned copper wire
KS-20962	Distributing frame bag
RM-591862	Gray fiber sheet 22 by 34 by 1/64 inch thick
—	Distributing frame wire per Table A

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

2.04 Refer to Section 069-132-811 for tools.

3. SAFETY PRECAUTIONS—PROTECTION FROM PERSONAL INJURY, EQUIPMENT DAMAGE, AND SERVICE INTERRUPTIONS

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

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

3.03 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.

3.04 Exercise care when connecting or removing jumpers and when cleaning terminals to avoid accidental contacts or shorts to adjacent terminals with pliers, bare jumper wire, or soldering equipment.

3.05 Use extreme care when working on or near battery and ringing supply feeders. Contact with these terminals with tools or other metallic objects may result in personal shock or injury. Also, carelessness may operate fuses and deny service to a large number of subscribers.

3.06 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. ***Do not*** connect a hand test set or receiver to terminals associated with lines of this nature as interrupted service may result. These special lines should be designated on the vertical and horizontal side of the frame by means of indicators and protected at terminal strips and protector terminal punchings with insulators and guards as covered in the appropriate section in the 201 division.

3.07 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.

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

3.09 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.

3.10 If the cross-connection wire does not feed from the KS-8047 L1 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 a 7/16-inch socket wrench and screwdriver.

3.11 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 outer turning effort should be applied to the rim rather than the spokes of the reel. Never rewind wire by turning the rim closest to the support arm.

3.12 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.

3.13 Exercise care when removing shielding or trimming shielded wire to avoid puncturing skin or fingers with the ends of the small wires.

3.14 If a jumper is found connected to a set of terminals assigned to an order, do not disturb the jumper without ascertaining that it is "dead". The fault is usually due to an error in the assignment or execution of some previous order. The exact procedure for checking such errors cannot be given since the cause of the error may determine the procedure to be used. The procedure will vary with the type of order and equipment involved. Generally, 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 to its termination. Tracing short jumpers is easiest and should be the first method tried. Where other methods fail, it may be necessary to trace long jumpers which are covered by a large number of other jumpers. It is more convenient for two craftpersons to work together in tracing jumpers; one person pulling the jumper at short intervals while the other feels for it in its indicated direction of run.

(c) Using a shoe or test clips, connect the terminals of the jumper in question to the test desk. The test deskperson may then determine the type of equipment to which the jumper is connected and possibly 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 to identify 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 switchperson to trace the call in order to determine to what equipment the jumper is connected.

3.15 ***Do not disconnect or open a busy line.*** On a line other than one of the types mentioned in 3.06, connect a test set to determine if it is busy. To listen on dial system lines, always use a test set with a capacitor or resistor connected in series.

3.16 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 and ring conductors should be opened first and the ring conductor last. When closing through a cross-connection of a line that has been temporarily disconnected, the sleeve should be closed through first, followed by the tip and ring conductors. The sleeve should not be left open longer than necessary. This procedure is necessary in some offices to avoid the possibility of irregular operation of dial equipment.

3.17 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 it will not be selected on a terminating call and 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.

3.18 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.

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

4. REMOVING INSULATION

4.01 Before 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. The removed insulation should be placed in the distributing frame bag.

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

5. AMOUNT OF SLACK

5.01 Three to four inches of slack should be left in all jumpers except when a jumper is transferred. When a jumper is transferred, slack should be left if the jumper is long enough but in this situation, the slack may be omitted but the jumper should not be taut. Slack should be dressed back from the terminal strip. Excessive slack in the jumpers along the length of the frames should be avoided.

> ***Note:*** An exception to this procedure is distributing frames of short length and conditions (1) and (2) in 6.03. The slack in these jumpers should be 1 to 2 inches.

5.02 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 pileups.

6. RUNNING JUMPERS

6.01 When handling wire or running jumpers, do not allow the wires to become kinked or caught on terminals. Jumpers that become caught on terminals or other objects should be freed carefully so the wire will not be damaged and terminals will not be bent or broken.

6.02 Jumpers should be run in the most direct way on top of other jumpers and well behind terminal blocks so as not to block access to terminals for future cross-connections. Jumpers being transferred from one set of terminals to another should not be allowed to catch, twist, or be split around other jumpers.

6.03 Short cross-connections should be run beneath 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 to lay these cross-connections at the bottom of the pileup.

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

6.04 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 ***vertical*** 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.

6.05 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.

6.06 The conductors of the jumper should be untwisted so 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.

6.07 A horizontal to vertical jumper should always be run on the shelf on which the horizontal terminal is located. Temporarily tie the horizontal side of the jumper to the fanning strip and then run the jumper along the horizontal shelf through the vertical ring. Terminate the vertical side first and then the horizontal side. The local procedure for running jumpers may vary from this procedure.

6.08 Avoid running jumpers on lower shelves as a convenience. This could congest lower shelves and make future work very difficult. If jumpers are terminated on the vertical side first, it may be necessary to develop local detailed methods of procedure for running jumpers which includes a list of equipment terminals and shelf locations so that the correct shelf is selected.

6.09 DT22P wire has a slight springiness which may cause some difficulty in flipping the wire onto the shelf when running from horizontal to vertical. Therefore, when using the DT22P wire, an individual craft may find that it is more convenient to run the jumper from vertical to horizontal which has the added advantage of laying the wire toward the rear of the shelf and greater assurance that the slack will be on the horizontal side.

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

6.11 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 except as follows:

(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.

6.12 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.

6.13 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 6.11.

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

6.15 On combination distributing frames, the horizontal-to-vertical 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.

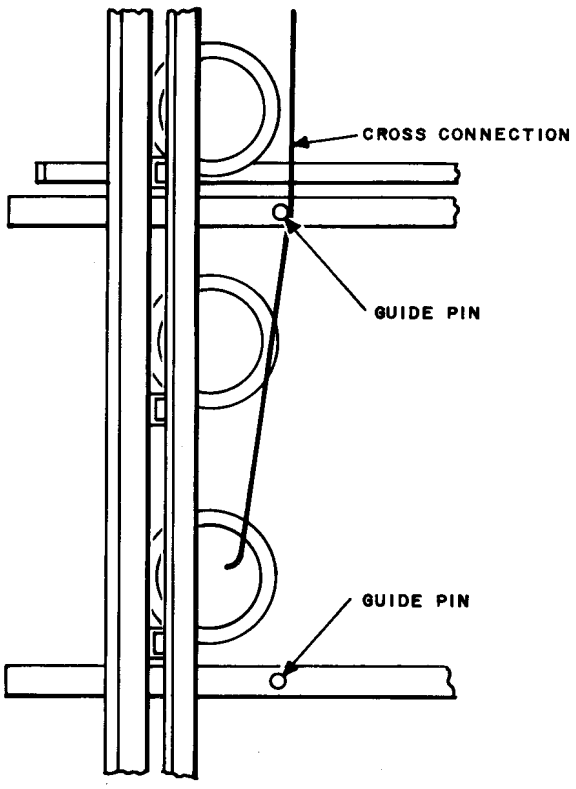


Fig. 1—Position of Cross-Connection Behind Guide Where Run Between Shelves at Combined Distribution Frame

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

6.17 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 6.01 through 6.14, except 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.

6.18 ***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.

7. CONNECTING WIRES TO TERMINALS

A. Procedure for Soldered Connections

7.01 Before terminating any straps or jumpers on telephone equipment, place a distributing frame bag on a shelf below the work to prevent solder and scrap from coming in contact with active terminals or falling on the frame or floor. Assure that terminals and terminal notches are thoroughly clean and free from excess solder before connecting wires. Use a soldering copper and an orange stick or fiber spudger for removing solder.

7.02 When terminating jumpers, hold the wire back of the fanning strip and adjust the wire so the insulation is close to the terminal notch. Wrap the wire around the terminal in the notch and solder. Break or cut off the excess wire. Figures 2 through 10 show typical terminations.

7.03 In breaking off the excess wire, 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: At times there may not be excess wire to break off. In such cases, it is permissible to wrap the wire on the terminal prior to soldering. Break or cut excess wire.

Note 2: 20-gauge wire should be cut instead of broken.

Note 3: Excess wire cut or broken off and any scrap should be placed in the frame bag. Do not allow scrap to fall on terminal strips, protectors, floor, etc.

7.04 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".

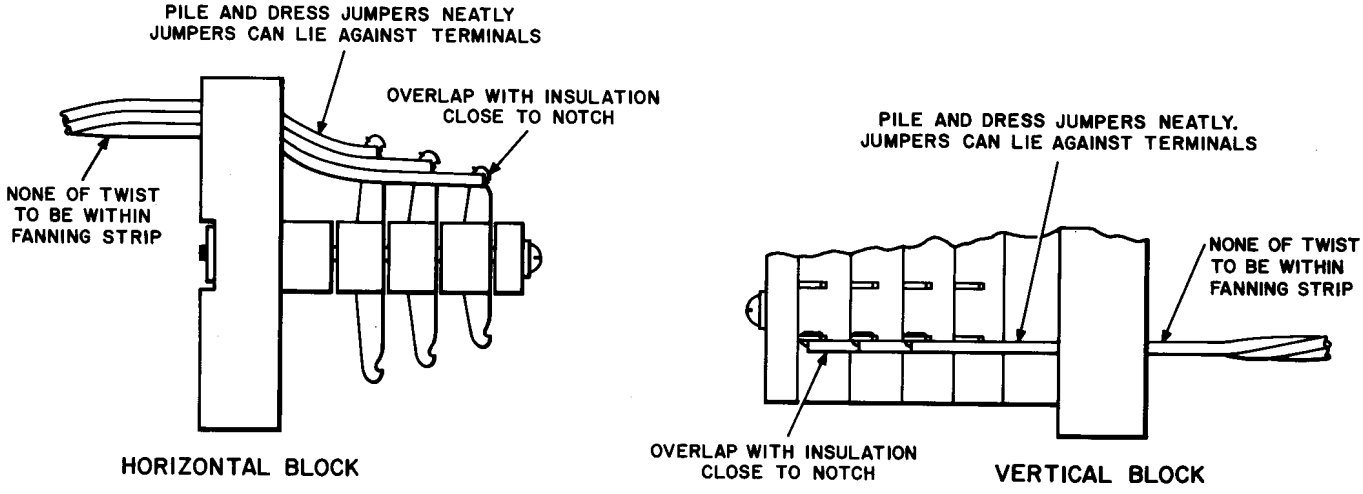


Fig. 2—Termination of U-Type Wire on Terminal Strip

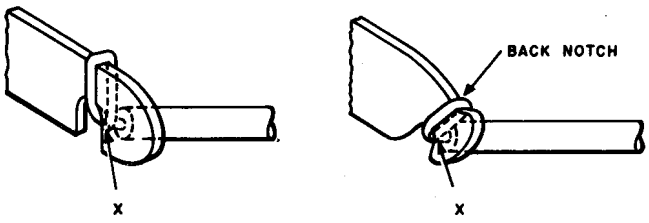


Fig. 3—Termination of Wire on Protector (Notch on Underside of Terminal)

7.05 To terminate a wire on a protector terminal where the notch appears on the top as shown in Fig. 4, route the wire through the notch, down the front side and up the rear side, making one complete turn around the terminal. Break the excess wire at point "X". Cut the wire if it the 20 gauge.

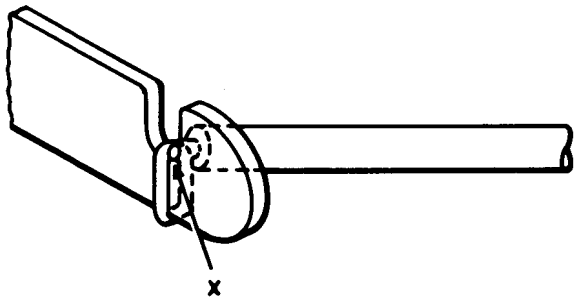


Fig. 4—Termination of Wire on Protector (Notch on Upper Side of Terminal)

7.06 If a protector terminal or spring is broken, replace the defective part using two 447A or 110 tools. Refer to the section covering piece-part data and replacement procedures for MDF protectors and protector mountings.

Caution: Do not terminate the jumper wire on the spring located on the cable side of the protector. Doing so will remove the protection on the line and result in a fire hazard.

7.07 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".

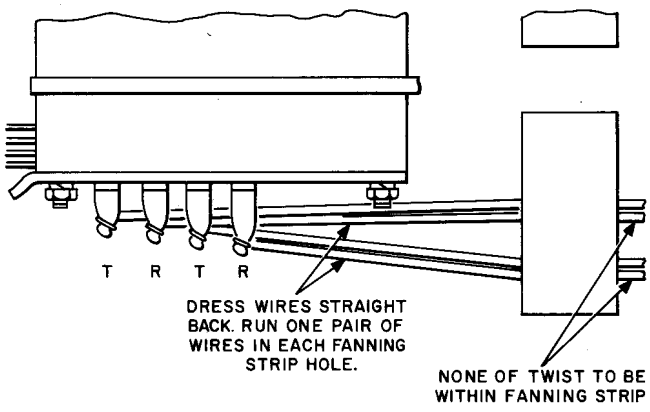


Fig. 5—Termination of Wire on 444-Type Jacks at MDF

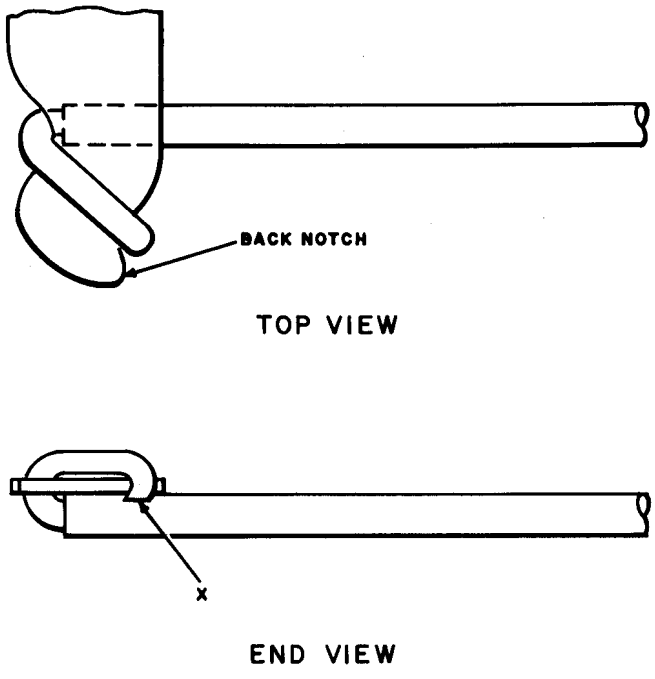


Fig. 6—Termination of Wire on Terminal With a Back Notch

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

7.09 To terminate a wire on a 65- or similar-type terminal strip, route 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.

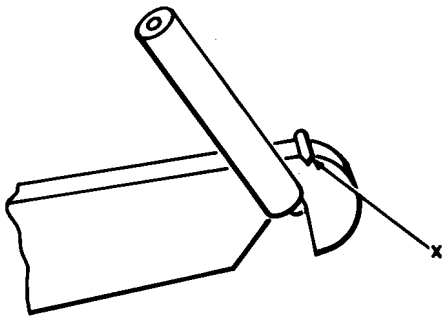


Fig. 7—Termination of Wire on Terminal of a 65- or Similar-Type Terminal Strip

7.10 When terminating jumpers on the type terminal strip shown in Fig. 2, connect the wire on the terminal nearest the front first and work towards the rear of the block. An exception to this procedure is in the case of IDF jumpers of subscriber lines in dial offices.

7.11 To terminate a wire on a terminal in a vertical position with a single notch with or without a back notch (such as on a 35-type or similar terminal strip, Fig. 8), route the wire along the left side of the terminal, through the notch, along the right side of the terminal and across the rear or through the back notch. 20-gauge wire should be cut instead of broken.

7.12 To terminate a wire on a terminal in a horizontal position with a single notch with or without a back notch (such as a vertical IDF), route 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 as shown in Fig. 9. Cut or break the wire at point "X". 20-gauge wire should be cut.

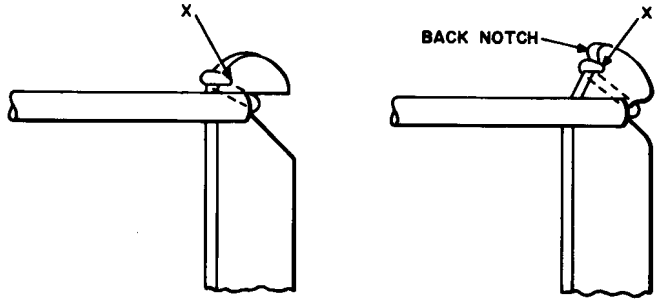


Fig. 8—Termination of Wire on Vertical Terminal With a Single Notch

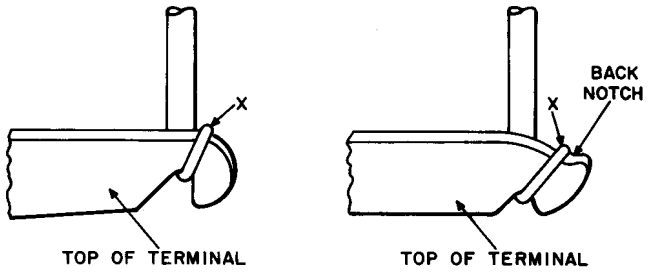


Fig. 9—Termination of Wire on Horizontal Terminal With a Single Notch (Top View)

7.13 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 7.11 and 7.12 and as shown in Fig. 10.

7.14 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.

7.15 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 is being terminated on the same or adjacent blocks.

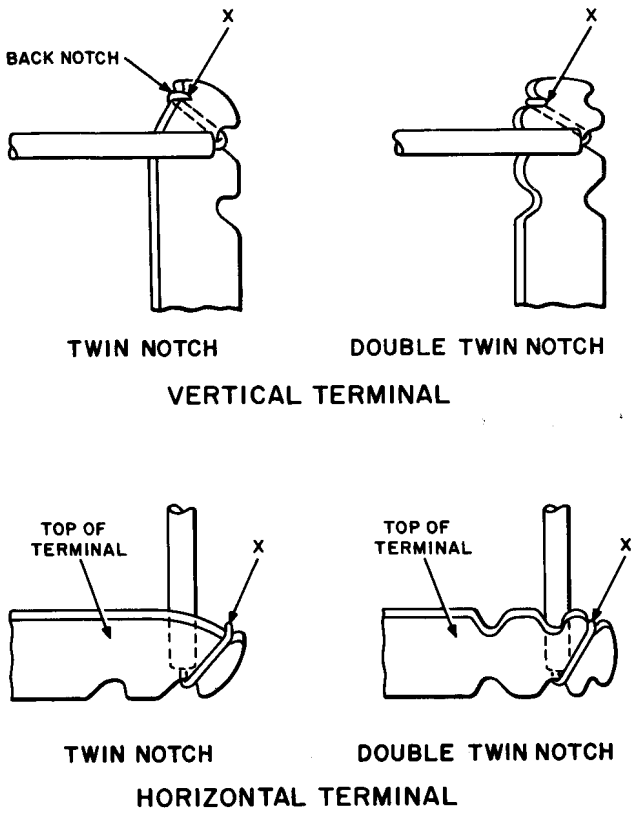


Fig. 10—Termination of Wire on Terminal With a Twin Notch or Double Twin Notch

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- and DL-type wire, do not apply heat to a connection longer than necessary to make a good connection. The polyethelene insulation has a tendency to recede with excessive heating. The insulation should not come in physical contact with the terminal being soldered. Exercise care to avoid touching the soldering copper to the insulation of adjacent cross-connections. Excessive heating or searing of insulation may cause shorts and service failures.

B. Solderless Wrapped Connections

7.16 All solderless connections should be made as described in Section 069-132-811 which describes tools, techniques, requirements and precautionary measures involved in making solderless-wrapped connections.

> *Note:* Do not make solderless-wrapped connections on terminals which have previously been soldered.

7.17 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.

7.18 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. PLACING STRAPS ON PROTECTORS

8.01 Due to engineering reasons, some circuits require that metal dummy heat coils be replaced with wire straps. When straps are used, the metal dummy heat coils should be removed.

> *Note:* Some local procedures require that circuits which require straps be equipped with insulating green plastic dummy coils.

8.02 Due to improved design of essential components, the 300-, 302-, and 303-type connectors or the Manufacture Discontinued 121-type protectors do not require straps. Protector units with dummy heat coils are used on these connectors. See the appropriate section in the 201 division for the proper protector units with dummy heat coils to be used in place of the straps.

8.03 Where straps are used, except on C-type protector mountings, Fig. 11A and B, 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.

8.04 Where running the 6-inch cross-connection 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 with a single screw as on the 77-type (3/8-inch) protector mounting, a bare strap wire may be substituted between the two tip terminals as follows.

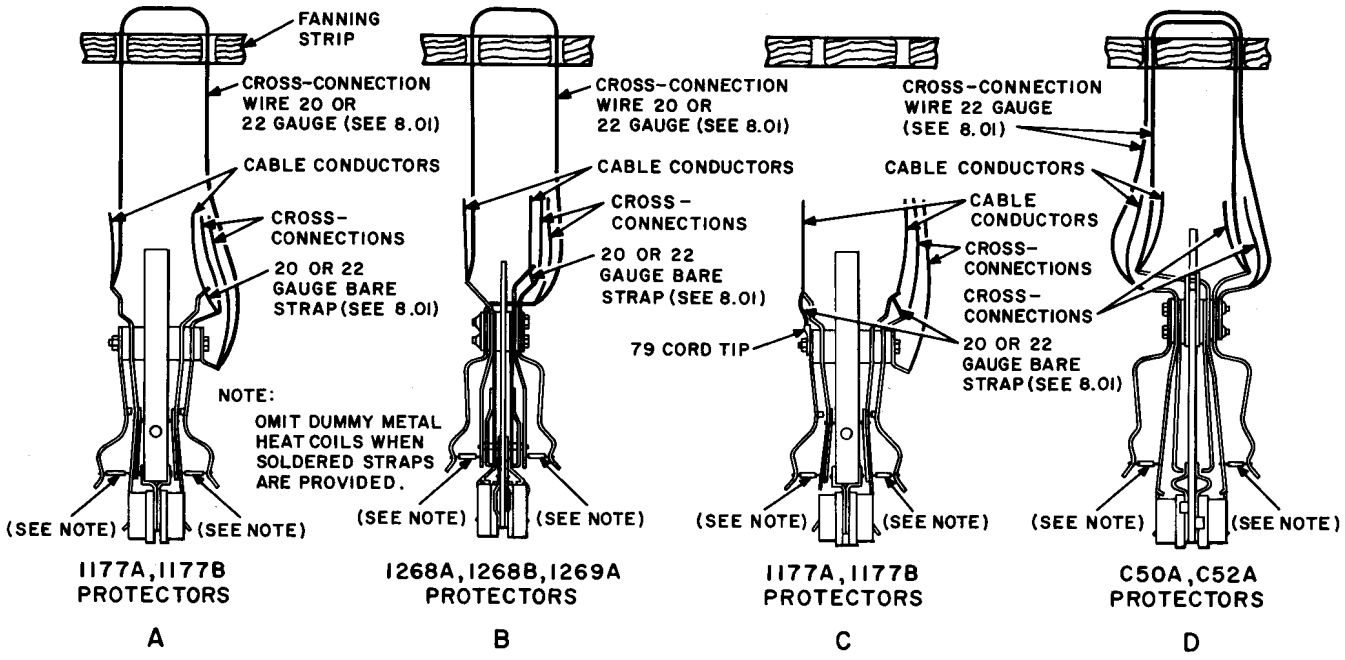


Fig. 11—Strapping on Protector Mountings

(a) On the tip (left) side of the protector mounting, a bare 22-gauge wire about 2-inches long shall be used with a 79 cord tip soldered to one end.

(b) Loosen the protector screw nut with a 447A tool and insert the 79 cord tip under the ***head*** of the screw and tighten the protector screw nut (Fig. 11C).

(c) The other end of the wire shall be soldered to the tip spring terminal.

8.05 Where straps are used on the C-type protector mounting, a pair of 22-gauge cross-connection wire about 6-inches in length shall be soldered to the tip and ring terminals on the left side of the mounting. The wires shall be run through the holes in the fanning strip and soldered to the respective tip and ring terminals on the right side of the mounting (Fig. 11D).

Note 1: Soldering is not required on equipment with wire-wrap type terminals.

Note 2: E-type protector mountings are different from the C-type mountings. The E-type protector mountings do not have heat coil springs and the protector block springs have two sets of terminals which are multipled together within the pile-up. One set projects to the left side for termination of the outside plant cable pair. The opposite side is for connection to the jumper.

9. TEMPORARY (BACK-TAP) CROSS-CONNECTIONS

9.01 It is often necessary to make use of temporary (back-tap) cross-connections when making transfers or rearrangements. Fig. 12 through 17 show the methods for terminating these cross-connections on terminals arranged for soldered connections.

9.02 "Temporary" as used herein refers to the jumper which is to be removed when the permanent arrangement is completed.

9.03 Both the temporary and permanent jumpers should be routed through the same hole in the fanning strip. The required amount of slack should be used for each jumper.

9.04 Jumpers which are to remain after a transfer is completed should be connected to the terminals in a permanent manner.

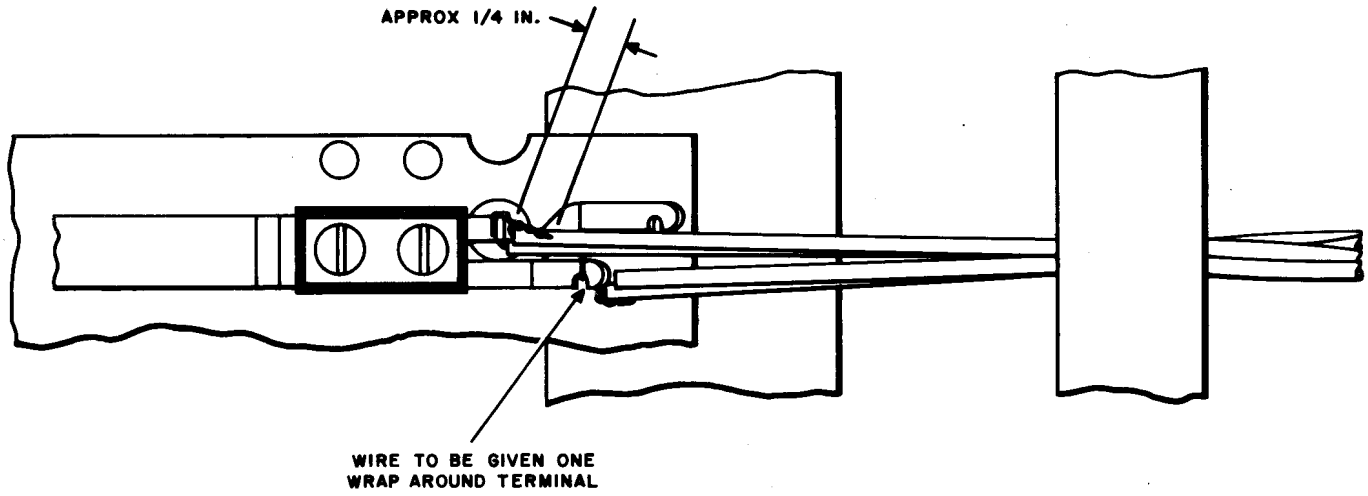


Fig. 12—Temporary Cross-Connections on Protectors

Protectors (Except 300-, 301-, 303-, or 121-Type) or Jacks

9.05 On protectors (except 300-, 301-, 303-, or 121-type) or jacks, leave a short tail of wire on the permanent jumper at the terminal (Fig. 12). Connect the temporary jumper to the tail by twisting the wires together and soldering. Cut the twisted connection to about 1/4-inch and bend the twisted connection back along the jumper to avoid snagging.

9.06 To remove the temporary jumper, cut off the temporary jumper at the terminal, including the wire splice, leaving a satisfactory permanent termination.

Terminal Strips Provided With Extra Terminals

9.07 On terminal strips provided with extra terminals, connect the temporary jumper per Fig. 13. Local instructions should specify which terminal to use for the temporary jumper. Identify the temporary jumper with a chicken ring or by tagging. Use the other terminal for the permanent jumper.

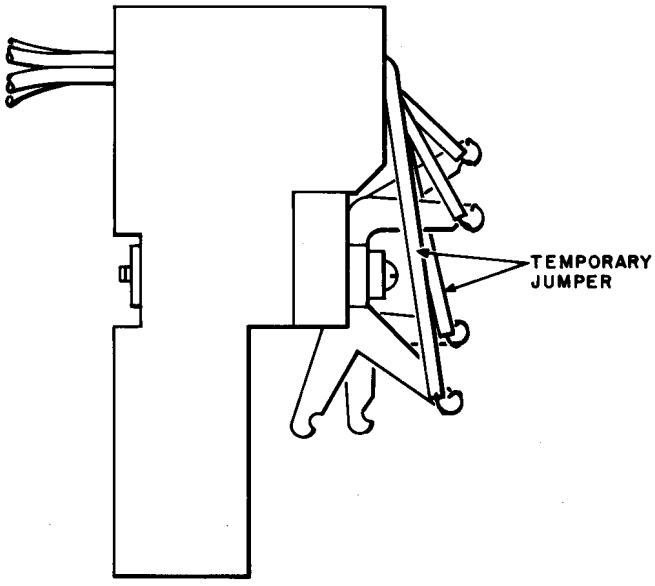


Fig. 13—Temporary Cross-Connections on 65- or Similar Type Terminal Strip Without Back Notch Terminals

Terminal Strips Without Extra Terminals or Back Notches

9.08 On terminal strips without extra terminals and the terminal does not have a back notch (Fig. 14), route the jumper along the top of the permanent jumper, through the notch, up and across the top of the terminal and solder. Cut or break the wire at point "X".

Terminal Strip Without Extra Terminals with Back Notch

9.09 On terminal strips without extra terminals and the terminal has a back notch (Fig. 15), route the jumper along the top of the permanent

jumper, through the notch, along the right sidé of the terminal and through the back notch and solder. Cut or break the wire at point "X".

Terminal Strips with Terminals Having Twin or Double Twin Notches

9.10 On terminal strips having twin or double twin notches, the temporary jumper should be connected to the extra notch. See Fig. 16 and 17 and paragraph 7.13.

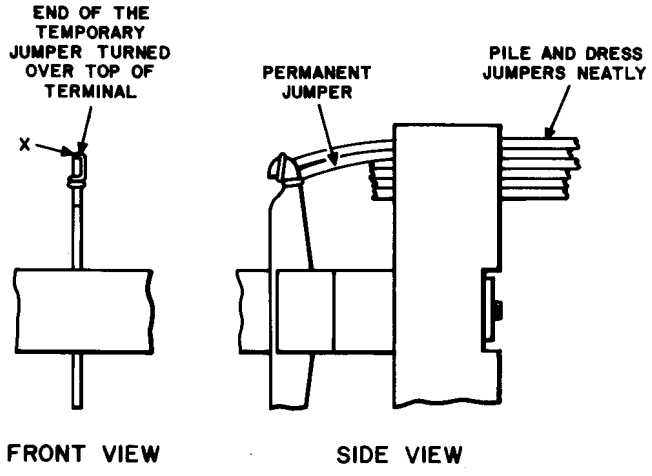


Fig. 14—Temporary Cross-Connections on 35- or Similar-Type Terminal Strip Without Back Notch Terminals

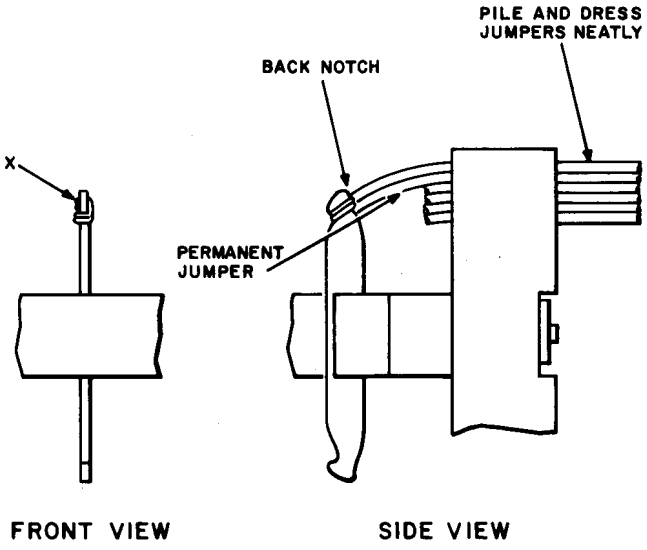


Fig. 15—Temporary Cross Connections on 35- or Similar-Type Terminal Strip With Back Notch Terminals

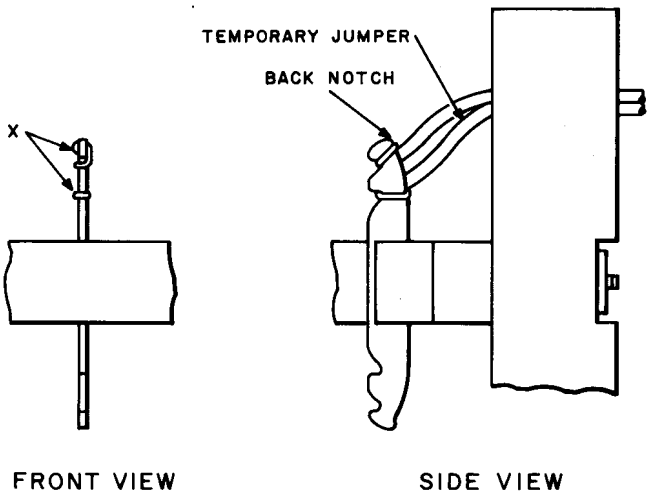


Fig. 16—Temporary Cross-Connections on 183C- or Similar-Type Terminal Strip with Twin Notch Terminals

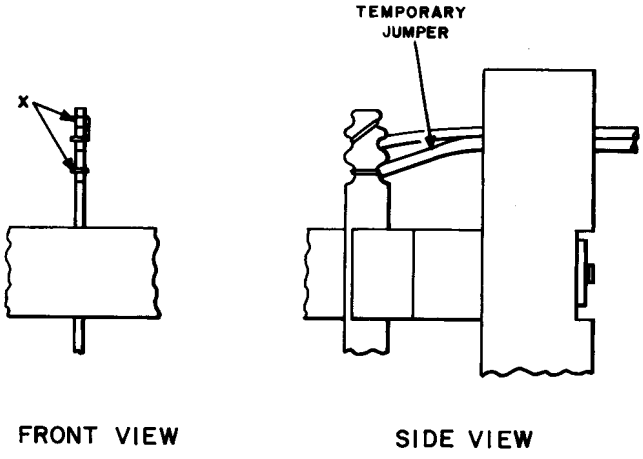


Fig. 17—Temporary Cross-Connections on 35- or Similar-Type Terminal Strip With Double Twin Notch Terminals

9.11 To remove the temporary jumper, an attempt should be made to strip the wire from the terminal without heating. Pull the slack from the fanning strip and remove by hand or grasp with pliers and untwist from the terminal. Apply heat if necessary.

Note: The end of the wire should always be cut off before pulling the jumper to prevent damage to other jumpers.

300- or 303-Type Connector or Replaced 121-Type Protector

9.12 Where a permanent jumper has been previously connected to a terminal, terminate the temporary jumper on the front end of the terminal.

9.13 To remove a temporary jumper from solderless wire-wrapped terminals, use the wire-wrapping tool (see Section 069-132-811).

10. PERMANENTLY BRIDGED CROSS-CONNECTIONS

10.01 On terminal strips where two permanent jumpers are to be connected to one terminal, both jumpers shall be connected as shown in Fig. 18 through 21. Refer to 7.14.

Note: Refer to Section 069-132-811 for connecting jumpers to solderless wrapped connections.

10.02 Both jumpers should be routed through the same hole in the fanning strip. Leave adequate slack in each jumper.

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

10.03 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.

10.04 To assist in identifying jumpers for different parties at the line terminal strips, different 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.

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

11. INTERCEPT CONNECTOR CROSS-CONNECTIONS

11.01 The KS-20590 L1 through L7 connectors (Fig. 22) are used in lieu of wire straps to connect subscriber lines to their associated intercept trunks on HIDF and CDF terminal strips. The KS-20590 connector replaces the KS-19922 connector which is Manufacture Discontinued.

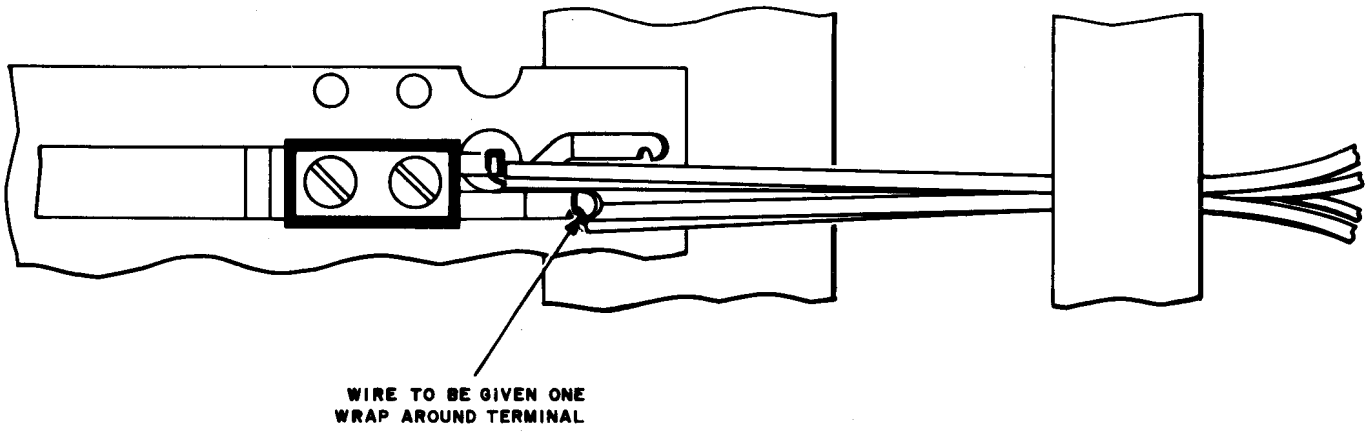


Fig. 18—Permanently Bridged Cross-Connections on Protectors (Other Than the 300-Type Connector or the Replaced 121-Type Protector)

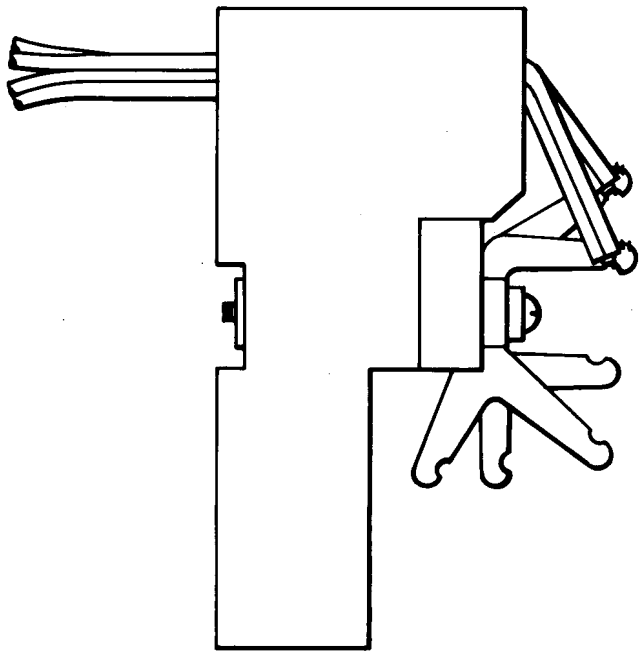


Fig. 19—Permanently Bridged Cross-Connections on 65- or Similar Type Terminal Strips

11.02 The KS-20590 connectors consist of a rectangular, printed wiring board equipped with either six or seven spring contacts. The six spring contact units have springs arranged with three rows of two spring contacts each that provide two sets of tip, ring, and sleeve connections. The seven spring contact units have springs arranged with two rows of two spring contacts each, and a third row with three spring contacts that provide two sets of tip, ring, and sleeve connections and one message register connection. The list numbers of the connectors are as follows.

L1—Six spring contacts connect tip, ring, and sleeve to tip, ring, and sleeve, respectively. It is used in Panel and Step-by-Step offices with operator intercept.

L2—Six spring contacts provide a tip and ring reversal with straight sleeve-to-sleeve connections. It is used in Panel and Step-by-Step offices with recorded announcement intercept.

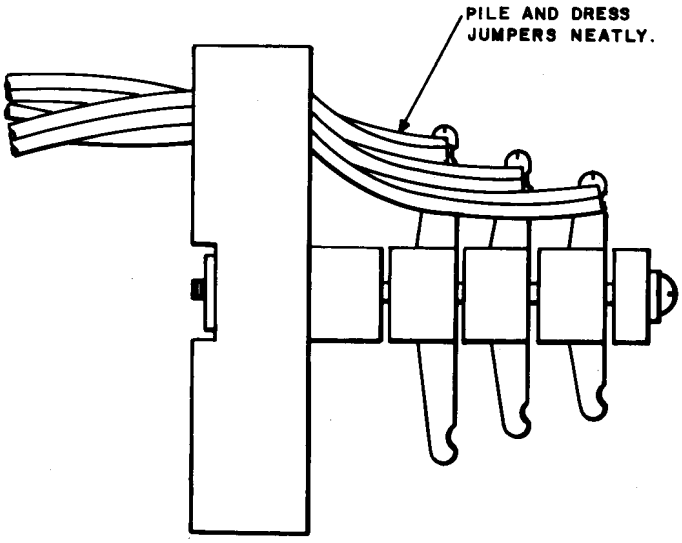


Fig. 20—Permanently Bridged Cross-Connections on 35- or Similar-Type Terminal Strips Without Back Notch Terminals

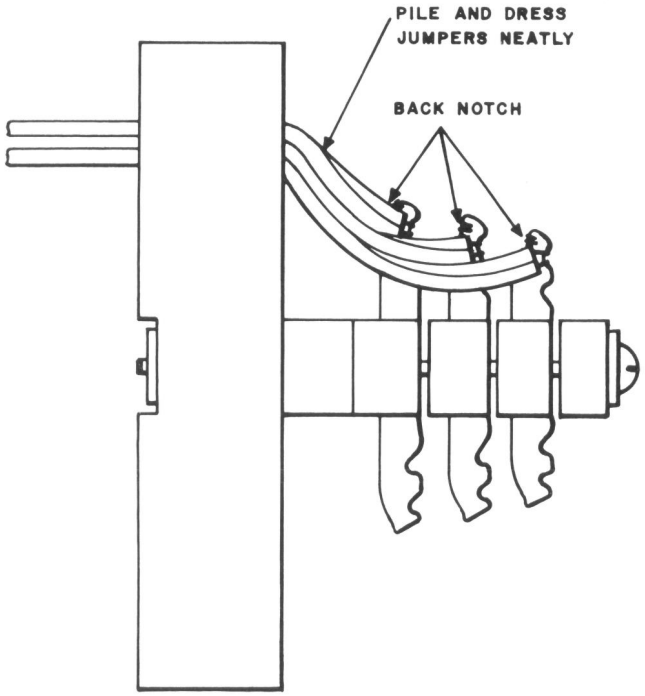


Fig. 21—Permanently Bridged Cross-Connections on 183C- or Similar-Type Terminal Strips With Twin Notch Terminals

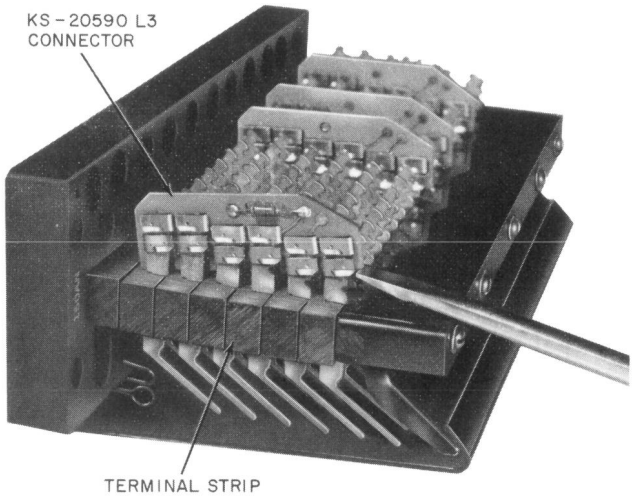


Fig. 22—Removal of KS-20590 Connector from Terminal Strip

L3—Six spring contacts connect tip, ring, and sleeve to tip, ring, and sleeve, respectively, except the sleeve spring contacts are connected by a 446T 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 beveled end of the connector. It is used in Panel offices associated with an Automatic Intercept System only.

L4—Same as the L3 except the diode between the sleeve contacts is reversed. It is used in Step-by-Step offices associated with an Automatic Intercept System only.

L5—Has seven spring contacts and is equipped with a 446T diode polarized in the same direction as the L4. It is used in Step-by-Step offices associated with Automatic Intercept Systems equipped with seven point blocks, and connections to the number network frames are made from the M lead and strapped on the cross-connection side of the distribution frame blocks.

L6—Is similar to the L4 except a different diode is used. It is used in No. 1 Step-by-Step

automatic message accounting offices that are associated with the Automatic Intercept System.

L7—Is similar to the L5 except a different diode is used. It is used in No. 1 Step-by-Step automatic message accounting offices associated with Automatic Intercept Systems equipped with seven point blocks, and connections to 1000 number frames are made from the M lead and strapped on the cross-connection side of the distribution frame blocks.

11.03 The terminals on the terminal strip must be cleaned prior to using the above connectors. A notch is provided in the front edge of the connector (Fig. 22) to facilitate removal by using a flat-blade screwdriver.

12. REMOVING CROSS-CONNECTIONS

12.01 Removing cross-connections requires that several precautionary measures be observed. Before disconnecting jumpers from terminals, the distributing frame bag should be mounted on the shelf below the work.

12.02 All "dead" jumpers must be promptly removed from distributing frames upon completion of work orders. Remove jumpers from horizontal side of the frame. Avoid pulling jumpers through terminal strip fanning holes. Do not remove jumpers from vertical side except for vertical-to-vertical ties or if the jumper is less than approximately 20 verticals long.

12.03 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 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.

12.04 When removing jumpers from terminals arranged for solder connections, the ends should be removed with the aid of a soldering copper and B long-nose pliers. The terminals and 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.

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

13. PREPARING BF-TYPE 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

13.01 When shielded carrier cross-connections are required, BF wire should be used except for wideband 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 14.01.

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

13.03 Connect ground lead to BF wire shield by the same method used for 761A cable (Fig. 23). Refer to the appropriate section in the 800 division for shield connectors and installing tool.

761A-Type Shielded Cable

13.04 All intraoffice cabling carrying wideband baseband signals between equipments should be 761A type. A 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 PVC jacket.

13.05 Prepare and connect ground lead to the shielded cable, as shown in Fig. 23. The ground lead and two conductors may then be terminated, as outlined in Part 14, for BF-type wire.

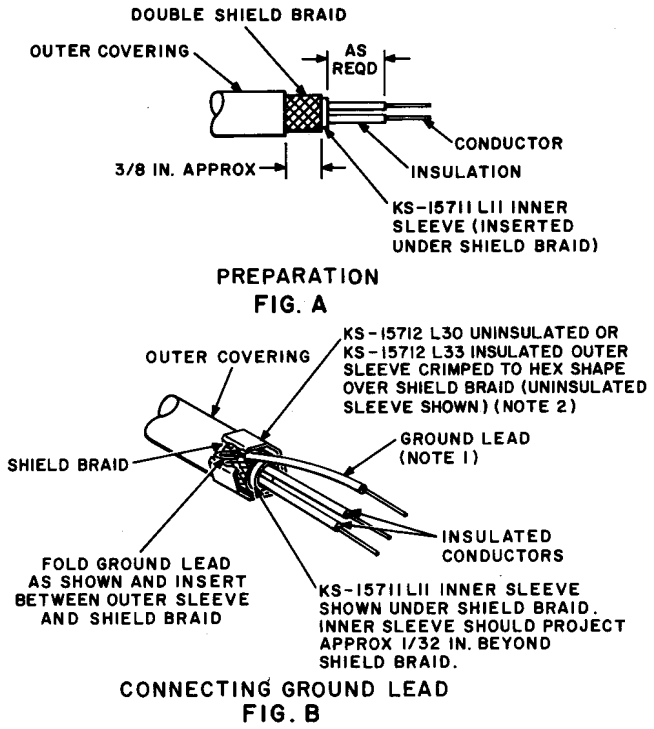


Fig. 23—Connecting Ground to Shield of 761A-Type Shielded Cable

14. TERMINATING CARRIER CROSS-CONNECTIONS

14.01 Carrier systems wiring is very sensitive to interference in the form of noise and crosstalk. Sensitivity to interference is reduced by enclosing the conductors within a metallic shield. The most effective shield is the sheath of a lead covered or alpeth cable. The preferred arrangement is to extend the cable to the carrier equipment. Since it is not always practical to do this, 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.

14.02 Provisions for terminating shields on distributing frames vary from office to office. Therefore, it is impractical to make specific recommendations for the treatment of shields. Specific instructions and/or procedures should be established locally for each particular distributing frame. In each case, the shield should be terminated at each end, either to the central office cable sheath, the underground cable sheath or central office ground.

14.03 Protective heat coils are not used in carrier circuits. Where the circuits terminate on a protector other than the 300-, 302-, and 303-type connectors or the manufacture discontinued 121-type protectors, the protector unit should be equipped with dummy heat coils and protective carbon blocks. Straps are not required. See the appropriate section in the 201 division for the proper protector units to be used.

Carrier Circuits Terminated on Terminal Strips

14.04 Prepare BF wire, as covered in Part 13. Two methods are provided for terminating the three wires on the terminal strip, as shown in Fig. 24, 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 14 yellow sleeve over the tip wire, and a 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. 24A.

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. 24B. Break off the excess wire at the front end of the terminal.

Carrier Circuits Terminated at Protectors or Line Jacks

14.05 Prepare the ground wire, as covered in 13.03, and terminate in accordance with local procedures. (See 14.02.) This ground wire should be kept as short as possible and run in the most direct manner.

14.06 Using KS-7851 sleeving, place a 14 yellow sleeve over the tip wire and a 14 black sleeve over the ring wire. Terminate in accordance

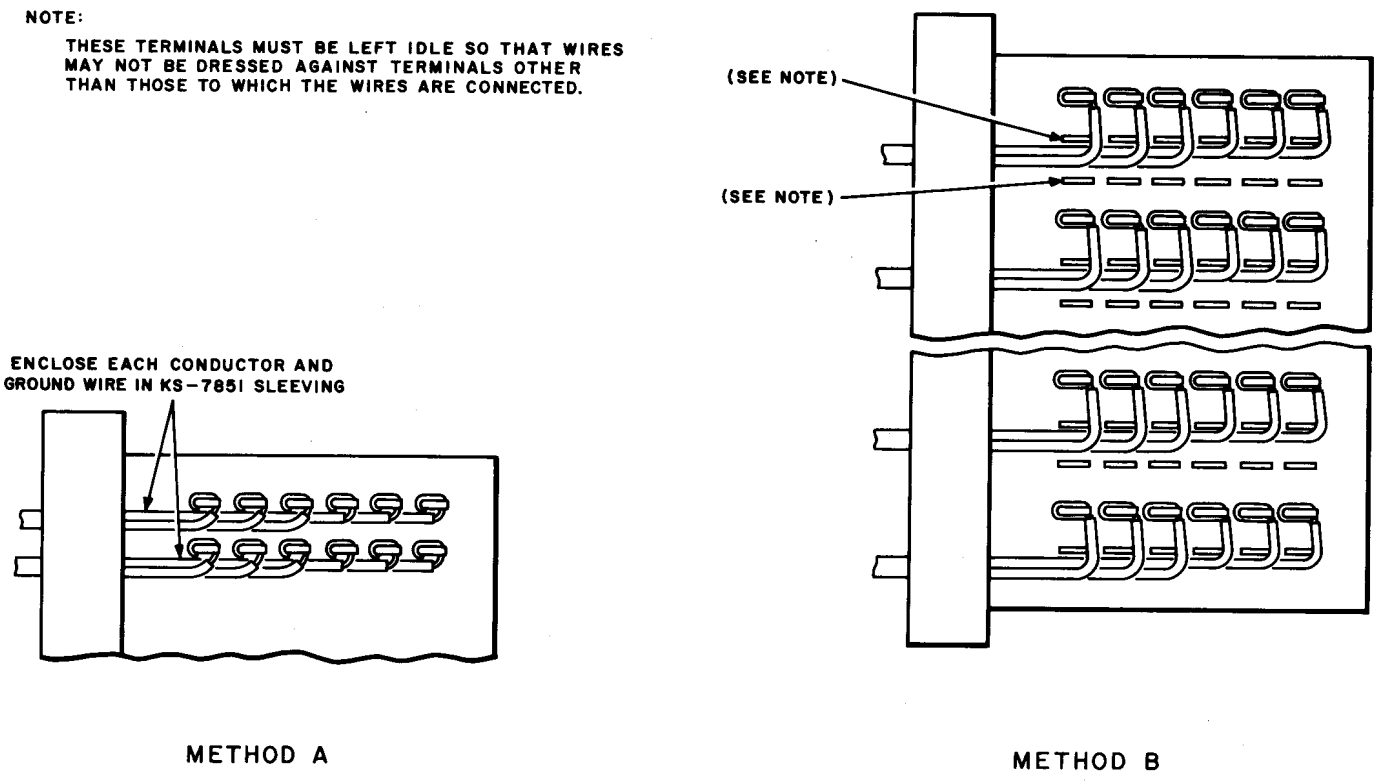


Fig. 24—Connecting BF Wire to Terminal Strips

with approved procedures for the particular type of terminal.

Carrier Circuits Terminated in Cross-Connection Cabinet

14.07 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, 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 are two or more cross-connection cabinets, and it is necessary to interconnect equipment between cross-connection cabinets. Use U22-type distributing frame wire for all connections within the cabinet.

15. PBX BATTERY FEEDERS

15.01 Information pertaining to PBX battery feeders is based on SD-90232-01. In offices where bunching blocks on the horizontal side of "B" type main distributing frames are provided on a special basis, the cross-connections should conform to SD-90233-01.

15.02 Combined distributing frames shall be considered the same as "B" type main distributing frames for the purpose of cross-connecting and multipling cable conductors for PBX battery feeders in this section.

15.03 For "A" type main distributing frames, the methods of cross-connecting and multipling cable conductors for PBX battery feeders are described in the section covering main frame protection.

15.04 The battery and ground supply for PBX battery feeders on "B" type main distributing frames and on main distributing frames having separate protector frames, are wired to adjacent No. 65 or similar type terminal strips on the HMDF and the terminals are numbered to correspond to the associated fuse circuit numbers. The terminal strips are usually located at several points along the frame and cross-connections should be run to the closest available terminals strip in order to minimize the resistance in the cross-connections.

15.05 Both the metallic return and ground return feeder arrangements are covered herein. To minimize noise effects on PBX stations and to prevent possible electrolysis damage to lead sheath cables or underground pipes, the ground return feeder arrangement should not be used when additions or changes in the PBX facilities are involved unless authorized by specific local instructions.

15.06 Where sufficient conductivity is provided by a single cable conductor or pair of conductors in ground and metallic return feeder arrangements, respectively, the maximum current to be supplied should not exceed 1.2 amperes where heat coils are provided. Where heat coils are not provided, the maximum current must not exceed the capacity of the fuse.

15.07 Where the multipling of cable conductors is required to provide conductivity or heat coil current carrying capacity, the maximum current must not exceed the capacity of the fuse. Where the maximum current requirement exceeds the capacity of a single fuse, several groups of feeders or individually fused pairs will be required.

15.08 Metallic feeders from a central office battery should not be used where the charging rate is over 2-1/2 amperes in order to prevent possible fire hazards due to a trouble ground on the return side of the battery supply circuit.

16. WIRE TYPES FOR PBX BATTERY FEEDERS

16.01 All cross-connections between the cable conductors and the battery and ground supply terminals on distributing frames, shall be run with 20-gauge distributing frame wire. In cross-connecting ground return feeders, use 20-gauge single wire. In cross-connecting metallic return feeders, 20-gauge paired wire may be used if the number of jumpers warrants its provision in the office, otherwise two 20-gauge single wires may be used.

16.02 All cross-connections between non-adjacent pairs and groups of pairs making up a PBX battery feeder group, shall be run with 20-gauge distributing frame wire.

16.03 Bare tinned copper wire, 22 gauge per P-314952, shall be used for non-insulated strapping.

16.04 Insulated tinned copper wire, 22 gauge per P-26991, shall be used for sleeved strapping.

17. METHODS OF CONNECTING PBX BATTERY FEEDERS

A. Distributing Frames Equipped with Protectors

Metallic Return Feeders

17.01 Connect the jumpers from the battery and ground supply so that battery is connected to the ring terminal and ground to the tip terminal of the protector.

17.02 If more than one pair of outside plant cable conductors are to be used to make up a feeder group, they shall be multipled at the protectors. The jumper from the battery and ground supply shall be run to the lowest numbered (uppermost) protector in the group. Only one jumper shall be run from the supply terminals to the group of cable conductors.

17.03 Adjacent terminals in a group of conductors shall be connected together using 22-gauge bare tinned copper wire as follows:

(a) Terminals of 300-type connectors (or earlier 121-type protectors) shall be strapped in accordance with methods previously described and as shown in Fig. 31.

Note: When terminating 20-gauge wire for PBX battery feeders, skin the wire for approximately 3/8-inch. Using B long-nose pliers, form a closed loop with the bare portion of the wire. Place the loop on the terminal and crimp in place at the bend in the terminal and solder the connection.

(b) On other than 300-type connectors (or earlier 121-type protectors), one end of the wire shall be wrapped around, and terminated at the notch of the ring terminal of the lowest-numbered protector in the group. The wire shall then be extended to the notches of the ring terminals of the other protectors in the group, making a complete turn around each terminal, in a clockwise direction, until all ring terminals are connected with a continuous piece of wire. The strapping wire shall be soldered at each terminal. The tip terminals shall be treated in a similar manner (see Fig. 25).

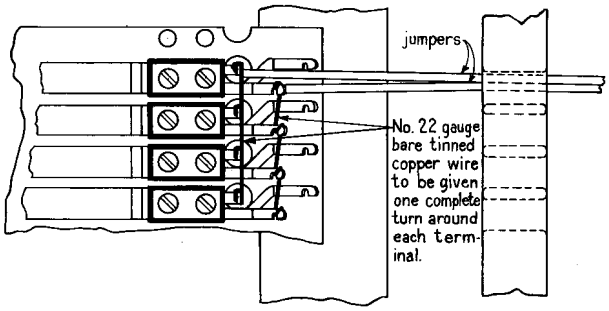


Fig. 25—Metallic Return Feeders or Ringing Supply Feeders—Distributing Frames Equipped With Protectors

17.04 When multipling non-adjacent pairs or groups of cable conductors at the protectors, for a PBX battery feeder, proceed as outlined above for the pairs in the group which are adjacent and run the jumpers between non-adjacent pairs or groups, as previously described.

Ground Return Feeders (See 15.05)

17.05 Connect the jumper from the battery supply to the tip or ring terminal of the protector.

17.06 The method of multipling adjacent and non-adjacent pairs and groups in connection with ground return battery feeders is similar to that described for metallic return feeders, with the exception that the tip and ring terminals of the protectors of the individual pairs or the terminals of the lowest numbered protector in the individual groups shall be connected together by means of 22-gauge bare tinned copper wire. Fig. 26 and 32 show the arrangement for the ground return feeder.

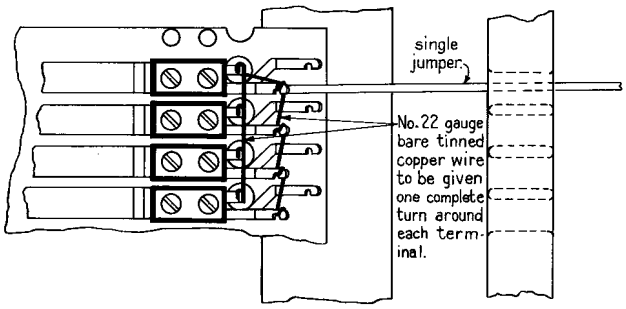


Fig. 26—Ground Return Feeders—Distributing Frames With Protectors

17.07 When ground return battery feeders are to have individually fused pairs, the jumper from the battery supply shall be run to the tip or ring terminal of the protector. The ring terminal of the protector shall be connected to the associated tip terminal with 22 gauge bare tinned strap wire.

B. Distributing Frames Having Separate Protector Frames

Metallic Return Feeders

17.08 Connect the jumpers from the battery and ground supply so that battery is connected to the ring terminal and ground to the tip terminal.

17.09 If more than one pair of outside plant cable conductors are to be used to make up a feeder group, they shall be multipled at the cable (vertical) side of the main distributing frame on the terminals of the 198A or similar terminal strips. The jumper from the battery and ground supply shall be run to the lowest even numbered cable pair in the group. Only one jumper shall be run from the supply terminals to the group of cable conductors.

17.10 The terminals associated with the even-numbered pairs of the battery feeder group shall be connected together by using 22-gauge bare tinned copper wire. One end of the bare tinned wire shall be wrapped around the notch of the ring terminal of the lowest even-numbered pair in the group. The wire shall then be extended through

the notches of the intermediate ring terminals of the other even-numbered pairs in the group and the other end then wrapped around the notch of the ring terminal of the highest even numbered pair. The strapping wire shall be soldered at each terminal. The tip terminals of the even pairs and the tip and ring terminals of the odd pairs in the group shall be treated in a similar manner. See Fig. 27A.

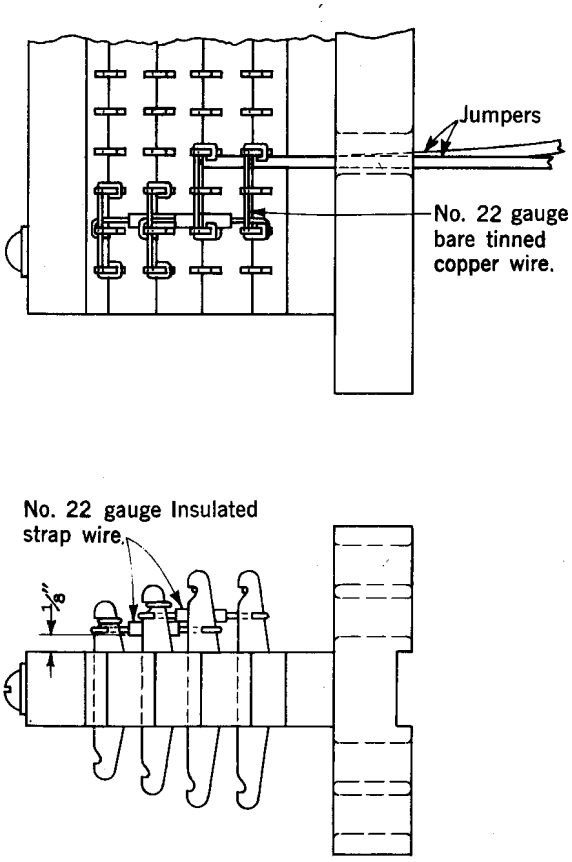


Fig. 27—Metallic Return Feeders or Ringing Supply Feeders—Distributing Frames Having Separate Protector Frames

17.11 The tip terminal of the highest odd or even numbered pair in the group shall then be strapped to the tip terminal of the pair of the group in the same horizontal row, using 22-gauge insulated strap wire. The ring terminals of the two pairs shall be strapped in a similar manner. See Fig. 27A and 27B.

17.12 The insulated strap wire shall not be pulled tightly against the terminal which it bridges and the insulation on the strap shall extend to approximately 1/16 inch from the terminal to which the strap is connected.

17.13 When multipling non-adjacent pairs or groups of cable conductors, for a PBX battery feeder group, proceed as outlined above for the pairs in the group which are adjacent and run the jumpers between non-adjacent pairs or groups as described in Section 069-120-801.

Ground Return Feeders (See 15.05)

17.14 Connect the jumper from the battery supply to the tip or ring terminal.

17.15 The method of multipling adjacent pairs and non-adjacent pairs and groups in connection with ground return battery feeders is similar to that described for metallic return battery feeders, with the exception, however, that the ring terminal of the highest odd or even numbered pair is connected to the tip of the same pair which in turn is connected to the ring and tip of the pair of the group in the same horizontal row with 22-gauge bare tinned copper wire. See Fig. 28A and 28B.

17.16 When ground return battery feeders are to have individually fused pairs, the jumper from the battery supply shall be run to the tip or ring terminal. The ring terminal of each pair shall be connected to the associated tip terminal with 22-gauge bare tinned strap wire.

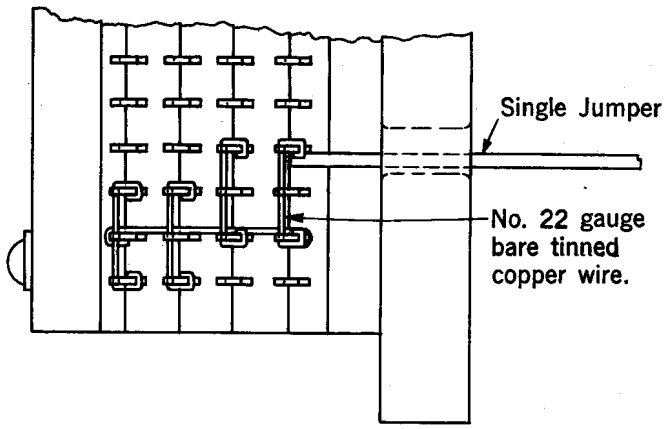
C. Distributing Frames Equipped with Jacks Instead of Protectors

Metallic Return Feeders

17.17 Connect the jumper from the battery and ground supply so that battery is connected to the ring terminal and ground to the tip terminal.

17.18 If more than one pair of outside plant cable conductors are to be used to make up a feeder group, they shall be multipled at the jacks. The jumper from the battery and ground supply shall be run to the lowest even-numbered cable pair in the group. Only one jumper shall be run from the supply terminals to the group of cable conductors.

17.19 The terminal associated with the even-numbered pairs of the battery feeder group



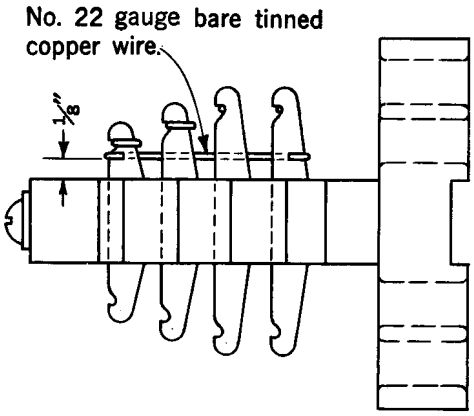
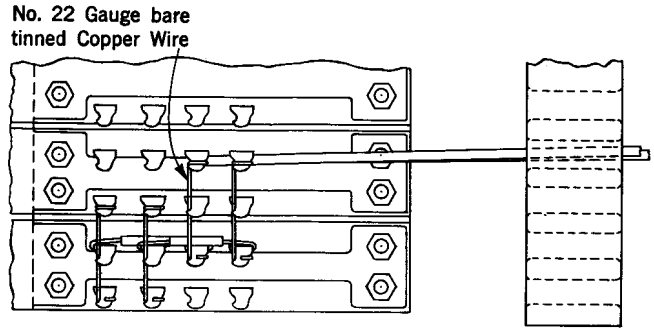


Fig. 28—Ground Return Feeders—Distributing Frames Having Separate Protector Frames



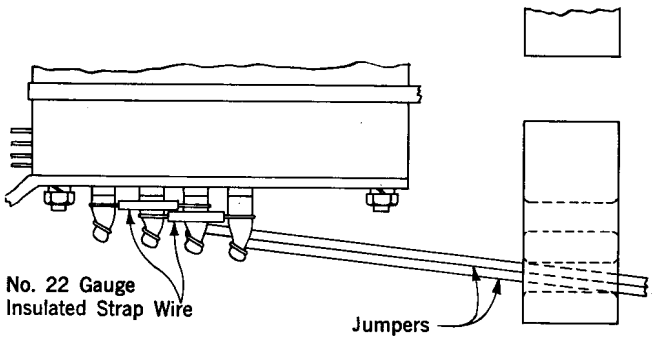


Fig. 29—Metallic Return Feeders or Ringing Supply Feeders—Distributing Frames Equipped with Jacks Instead of Protectors

shall be connected together by using 22-gauge bare tinned copper wire. One end of the bare tinned wire shall be wrapped around the notch of the ring terminal of the lowest even numbered pair in the group. The wire shall then be extended through the notches of the intermediate ring terminals of the other even-numbered pairs in the group, and the other end then wrapped around the notch of the ring terminal of the highest even-numbered pair. The strapping wire shall be soldered at each terminal. The tip terminals of the even pairs and the tip and ring terminals of the odd pairs in the group shall be treated in a similar manner. See Fig. 29A.

17.20 The tip terminal of the highest odd or even numbered pair in the group shall then be strapped to the tip terminal of the pair of the group in the same horizontal level, using 22-gauge insulated wire. The ring terminals of the two pairs shall be strapped together in a similar manner. See Figs. 29A and 29B.

17.21 The insulated strap wire shall not be pulled tightly against the terminal which it bridges. The insulation on the strap shall extend to approximately 1/16 inch from the terminal to which the strap is connected.

17.22 When multipling non-adjacent pairs or groups of cable conductors to make up a feeder group, proceed as outlined above for the pairs in the group which are adjacent, and run the jumpers between the non-adjacent pairs or groups as previously described.

Ground Return Feeders (See 15.05)

17.23 Connect the jumper from the battery supply to the tip or ring terminal.

17.24 The method of multipling adjacent pairs and non-adjacent pairs or groups in connection with ground return battery feeders is similar to that described for metallic return battery feeders, with the exception, however, that the ring terminal of the highest odd- or even-numbered pair is connected to the tip of the same pair, which in turn is connected to the ring and tip of the pair of the group in the same horizontal row with 22-gauge bare tinned copper wire. See Figs. 30A and 30B.

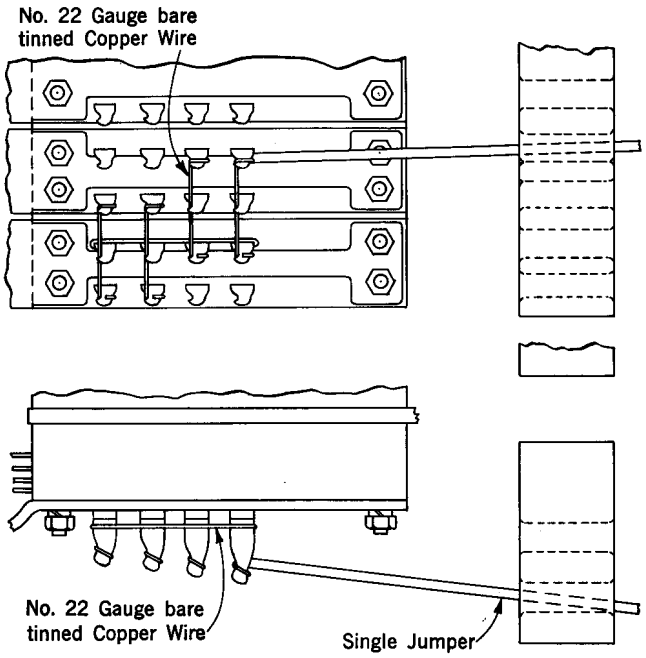


Fig. 30—Ground Return Feeders—Distributing Frames Equipped with Jacks Instead of Protectors

17.25 When ground return battery feeders are to have individually fused pairs, the jumper from the battery supply shall be run to the tip or ring terminal. The ring terminal of each pair shall be connected to the associated tip terminal with 22-gauge bare tinned copper wire. See Fig. 31 and 32.

18. PBX AND STATION RINGING SUPPLY FEEDERS

18.01 Information pertaining to PBX and station ringing supply feeders is based on SD-95667-01.

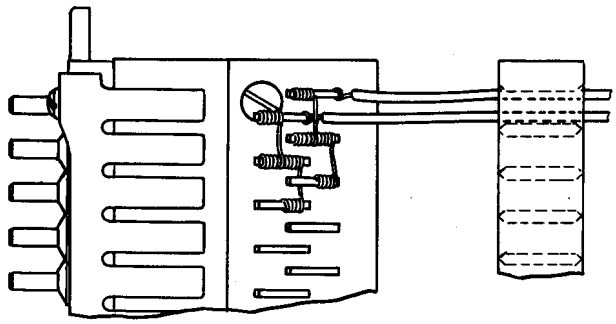


Fig. 31—Metallic Return Feeders—300-Type Connectors (or Earlier 121-Type Protectors)

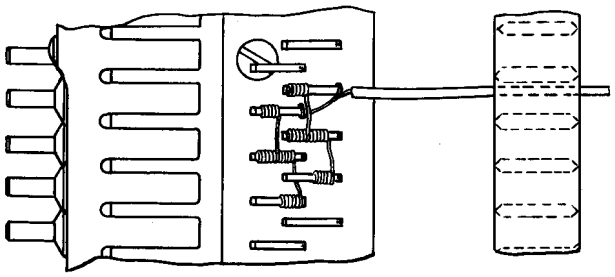


Fig. 32—Ground Return Feeders—300-Type Connectors (or Earlier 121-Type Protectors)

18.02 On "B" type main distributing frames and on main distributing frames having separate protector frames, the ringing supplies for PBX and station feeders are wired through either a resistance lamp or a 74A heat coil.

18.03 Three resistance lamps designated A, B, and C are usually wired through one fuse on the fuseboard. (In certain small offices ringing fuses are omitted.) Each lamp and an associated ringing ground are wired to one pair of terminals at the HMDF and may be multipled by means of straps to two additional pairs of terminals. The terminal strips are designated to correspond with the resistance lamps.

18.04 In offices with large ringing machines (over 1/2 ampere capacity), the lamps designated A, B, and C are usually No. 12G or No. 13G. The use of these lamps in offices with small machines (1/2 ampere capacity or less) could, in the event of a trouble ground on a ringing feeder, overload

the machine to the extent that a complete failure of ringing power would result. To prevent such possible failure, 12D or 13D lamps are usually used in offices with small machines.

18.05 Because PBXs equipped with ringdown tie trunks require more ringing power than can be obtained through a 12D or 13D resistance lamp, ringing feeders to these PBXs must be connected to a ringing supply circuit equipped with a 74 heat coil in offices with small ringing machines.

Caution: Care should be exercised while working on or near ringing supplies equipped with 74A heat coils as a short circuit or ground cross may cause the heat coil to operate.

18.06 Each ringing supply circuit (lamp or heat coil) may be arranged for distributing the supply with or without bunching blocks. Bunching blocks are generally provided when it is necessary to distribute the supply from one lamp, or heat coil, to several PBX positions over more than one cable pair or to provide the required conductivity for one PBX. Each bunching block, where provided, is designated serially "PBX GEN BB-." The pairs of terminals on each bunching block are numbered from one upward, and are designated to correspond to the associated lamps or heat coils on the fuseboard.

18.07 Table B indicates the number of PBX positions or small dial type PBXs that may be connected to one resistance lamp, or 76A heat coil, and the number of cable pairs that may be connected to one lamp or heat coil, for the various types of PBXs.

19. WIRE TYPES FOR PBX AND STATION RINGING SUPPLY FEEDERS

19.01 All cross-connections between the cable conductors and the ringing supply terminals as well as all cross-connections between non-adjacent pairs and groups of pairs making up a PBX or station feeder group, shall be run with 22-gauge paired distributing frame wire.

19.02 See 16.03 and 16.04 for wire types.

20. METHODS OF CONNECTING PBX AND STATION RINGING SUPPLY FEEDERS

A. Distributing Frames Equipped with Protectors

Supplying Continuous Ringing to Station Equipments, Manual PBXs, Manual Positions of Dial PBXs or 740 PBXs with Long Dial Lines or Trunks

20.01 Connect the jumpers so that the generator is connected to the ring terminal and ground to the tip terminal.

20.02 Where the ringing supply circuit terminates on a single pair of terminals on the horizontal side of the distributing frame, run one paired jumper from these terminals direct to the protector when one pair of outside plant cable conductors is used, or to a bunching block when more than one pair of outside plant cable conductors are used. In the latter case a paired jumper shall be run from each protector to the bunching block. Fig. 33 and 34 show typical arrangements of the cross-connections.

Note: The jumper between the ringing supply terminals and the bunching block shall be terminated on the under side of the bunching block. Where this cross-connection is already provided, due to a previous assignment, disregard this operation.

20.03 Where the ringing supply circuit is terminated by means of strapped connections on three adjacent pairs of terminals on the horizontal side of the distributing frame, and bunching blocks are not provided, run one paired jumper from each pair of terminals associated with the ringing supply to the protector serving each pair of outside plant cable conductors when three or fewer cable pairs are used. See Fig. 35. If four or more pairs of outside plant cable conductors are used, run one paired jumper from each protector to a bunching block and run one paired jumper from the bunching block to the first pair of strapped terminals associated with the ringing supply circuit. See Fig. 36. Also see Note under 20.02.

20.04 Connect the jumpers so that the generator is connected to the ring terminal and ground to the tip terminal.

TABLE B

TYPE OF PBX OR STATION EQUIPMENT	TYPE OF RINGING	NO. PER LAMP OR HEAT COIL	NO. AND TYPE OF LAMP OR HEAT COIL		NO. OF CABLE PAIRS CONNECTED TO ONE LAMP OR HEAT COIL
			RING. MACH. CAP. 1/2 AMP. OR LESS	RING. MACH. CAP. GREATER THAN 1/2 AMP.	
Manual or Manual Position of Dial PBX No Ringdown Tie Trunks	Cont.	10 Pos.	One 12D or 13D Lamp	One 12G or 13G Lamp	1 to 10 pairs
Manual or Manual Position of Dial PBX Ringdown Tie Trunks	Cont.	10 Pos.	One 74A Heat Coil	One 12G or 13G Lamp	1 to 10 pairs
740-A, 740-B, 740-C Dial	Mach.	1 PBX	One 12D or 13D Lamp	One 12G or 13G Lamp	One or more pairs to provide the required conductivity.
740-E, 750, 755 Dial	Cont.	1 PBX	One 12D or 13D Lamp	One 12G or 13G Lamp	
Dial Long Line Circuits at 740-A, 740-B, 740-C PBXs	Cont.	10 circuits	One 12D or 13D Lamp	One 12G or 13G Lamp	1 to 10 pairs
Station Equipments: Station equipment supplied from one ringing lamp located at the station equipment should be considered as the equivalent of one PBX position.					
Note: Lamps and heat coils may supply combinations of equipments listed in the above table, not to exceed a total of 10, except that not more than 1-740-A, B, C, or E, 1-750 or 1-755 PBX shall be served by one lamp or heat coil.					

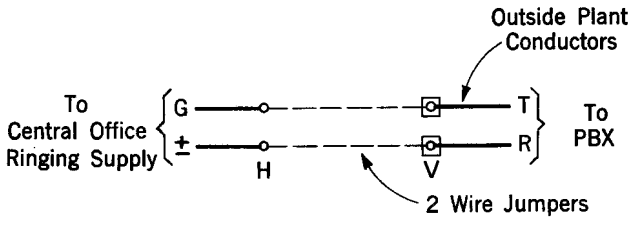


Fig. 33—Single Pair Termination of Ringing Supply Without Bunching Block—Distributing Frames Equipped With Protectors or Jacks—1 Cable Pair

Supplying Machine Ringing to 740 Dial PBXs and Continuous Ringing to 750 and 755 Dial PBXs

20.05 Where the ringing supply circuit terminates on a single pair of terminals on the horizontal side of the distributing frame, run one paired jumper from the supply terminals to the protector or group of protectors when one or more pairs of outside plant cable conductors are used. If more than one pair of outside plant cable conductors are required for conductivity to make up a feeder group, they shall be multipled at the protectors. The jumper from the ringing supply circuit shall

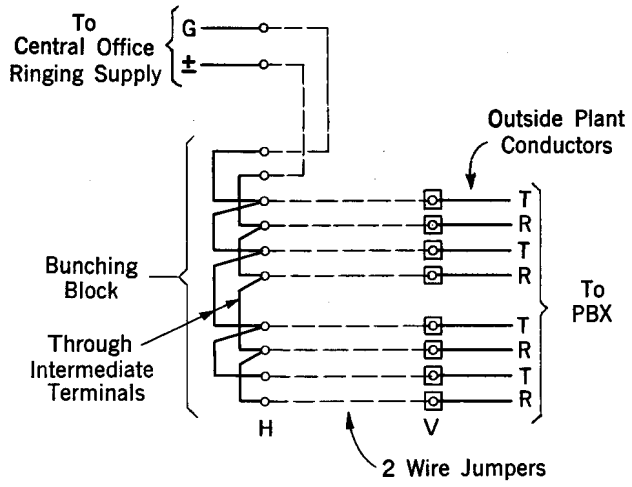


Fig. 34—Single Pair Termination of Ringing Supply with Bunching Block—Distributing Frames Equipped with Protectors or Jacks—More Than 1 Cable Pair

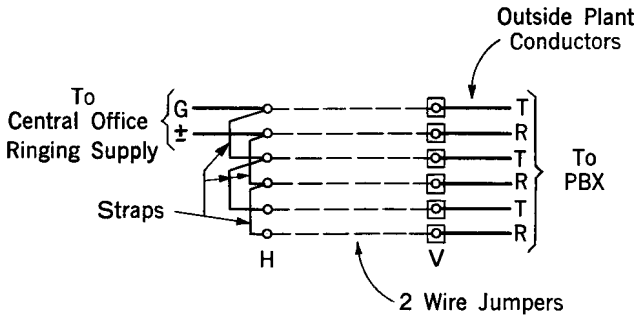


Fig. 35—Three Pair (Strapped) Termination of Ringing Supply without Bunching Block—Distributing Frames Equipped with Protectors or Jacks—1 to 3 Cable Pairs

be run to the lowest-numbered (uppermost) protector in the group. Only one jumper shall be run from the supply terminals to the group of cable conductors. See Figs. 33 and 37.

20.06 Adjacent terminals in a group of conductors shall be connected together using 22-gauge bare tinned copper wire as follows:

(a) Terminals of 300-type connectors (or earlier 121-type protectors) shall be strapped in accordance with methods outlined in Section 069-133-801 and as shown in Fig. 31.

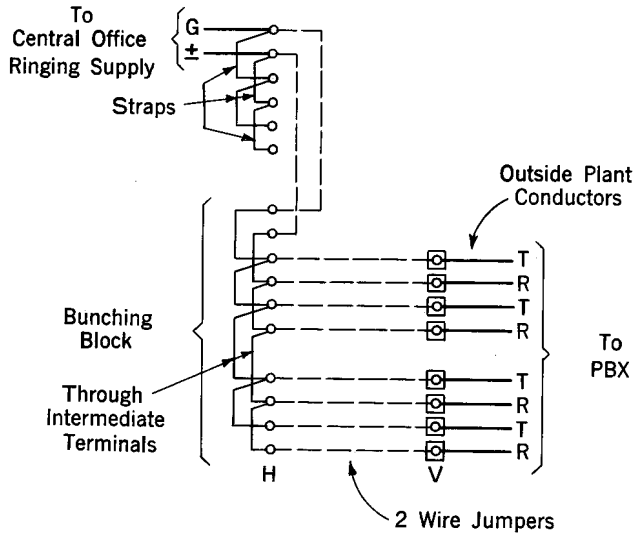


Fig. 36—Three Pair (Strapped) Termination of Ringing Supply with Bunching Block—Distributing Frames Equipped with Protectors or Jacks—More Than 3 Cable Pairs

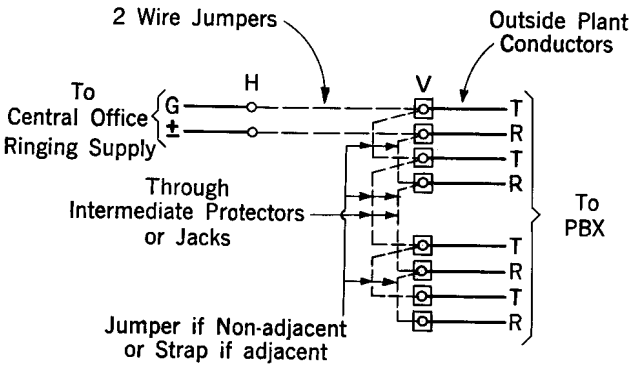


Fig. 37—Single Pair Termination of Ringing Supply without Bunching Block—Distributing Frames Equipped with Protectors or Jacks—More Than 1 Cable Pair

(b) On other than 300-type connectors (or earlier 121-type protectors), one end of the wire shall be wrapped around, and terminated at the notch of, the ring terminal of the lowest-numbered protector in the group. The wire shall then be extended to the notches of the ring terminals of the other protectors in the group, making a complete turn around each terminal, in a clockwise direction, until all ring terminals are connected

with a continuous piece of wire. The strapping wire shall be soldered at each terminal. The tip terminals shall be treated in a similar manner. Fig. 25 shows the strapping arrangement at other than 300-type connectors (or earlier 121-type protectors).

20.07 When multipling non-adjacent pairs or groups of cable conductors at the protectors, for a PBX ringing supply feeder, proceed as outlined above for the pairs in the group which are adjacent and run the jumpers between non-adjacent pairs or groups, as previously described.

20.08 Where the ringing supply circuit is terminated by means of strapped connections on three adjacent pairs of terminals on the horizontal side of the distributing frame, run one paired jumper from each pair of terminals associated with the outside plant cable conductors when three or fewer cable pairs are used. See Fig. 35. If four or more pairs are required for conductivity to make up a feeder group, they shall be multipled at the protectors. One paired jumper shall be run from the first pair of strapped terminals associated with the ringing supply circuit to the lowest-numbered (uppermost) protector in the group. Only one jumper shall be run from the supply terminals to the group. See Fig. 38. The methods of strapping and connecting adjacent and non-adjacent pairs are the same as covered in 20.06 and 20.07.

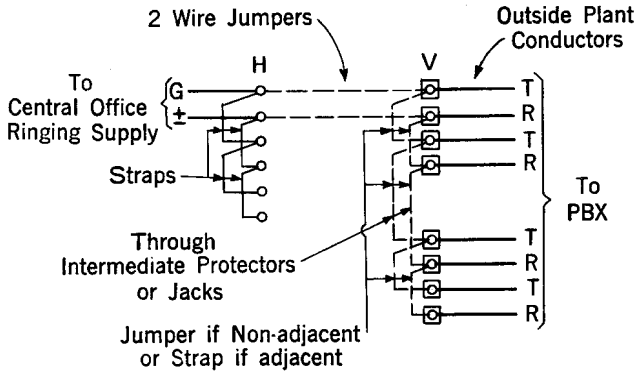


Fig. 38—Three Pair (Strapped) Termination of Ringing Supply without Bunching Block—Distributing Frames Equipped with Protectors or Jacks—More than 3 Cable Pairs

B. Distributing Frames Having Separate Protector Frames

Supplying Continuous Ringing to Station Equipments, Manual PBXs, Manual Positions of Dial PBXs or 740 PBXs with Long Dial Lines or Trunks

20.09 Connect the jumpers so that the generator is connected to the ring terminal and ground to the tip terminal.

20.10 Where the ringing supply circuit terminates on a single pair of terminals on the horizontal side of the main distributing frame, run one paired jumper from these terminals direct to the terminals of the 198A or similar type terminal strips on the cable (vertical) side of the main distributing frame, when one pair of outside plant cable conductors is used, or to a bunching block when more than one pair of outside plant cable conductors are used. In the latter case a paired jumper shall be run from each pair of terminals assigned on the cable (vertical) side of the main distributing frame to the bunching block. Fig. 39 and 40 show typical arrangements of the cross-connections.

> ***Note:*** The jumper between the ringing supply terminals and the bunching blocks shall be terminated on the under side of the bunching block. Where this cross-connection is already provided, due to a previous assignment, disregard this operation.

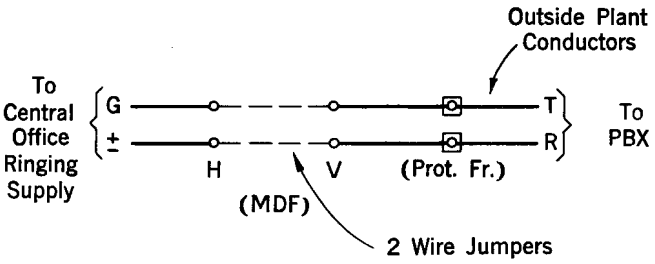


Fig. 39—Single Pair Termination of Ringing Supply Without Bunching Block—Distributing Frames Having Separate Protector Frames—1 Cable Pair

20.11 Where the ringing supply circuit is terminated by means of strapped connections on three adjacent pairs of terminals on the horizontal side of the main distributing frame, and bunching blocks

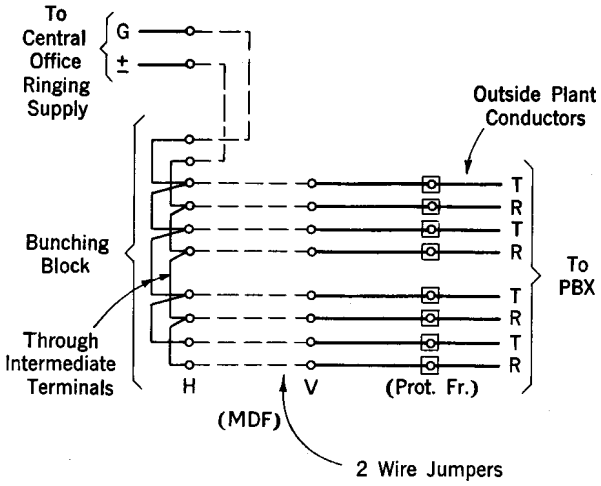


Fig. 40—Single Pair Termination of Ringing Supply with Bunching Block—Distributing Frames Having Separate Protector Frames—More Than 1 Cable Pair

are not provided, run one paired jumper from each pair of terminals associated with the ringing supply to the terminals of the 198A or similar type terminal strips on the cable (vertical) side of the main distributing frame, when three or fewer cable pairs are used. See Fig. 41. If four or more pairs of outside plant cable conductors are used, run one paired jumper from each pair of terminals assigned on the cable (vertical) side of the main distributing frame to a bunching block and run one paired jumper from the bunching block to the first pair of strapped terminals associated with the ringing supply circuit. See Fig. 42 and Note under 20.10.

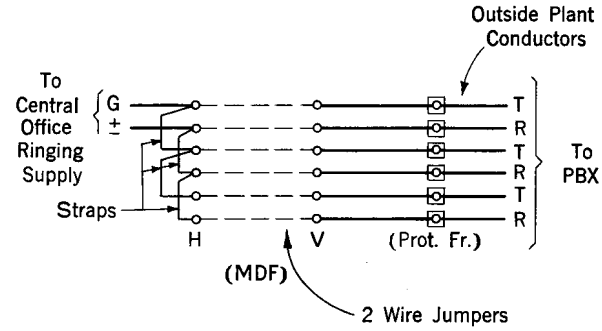


Fig. 41—Three Pair (Strapped) Termination of Ringing Supply Without Bunching Block—Distributing Frames Having Separate Protector Frames—1 to 3 Cable Pairs

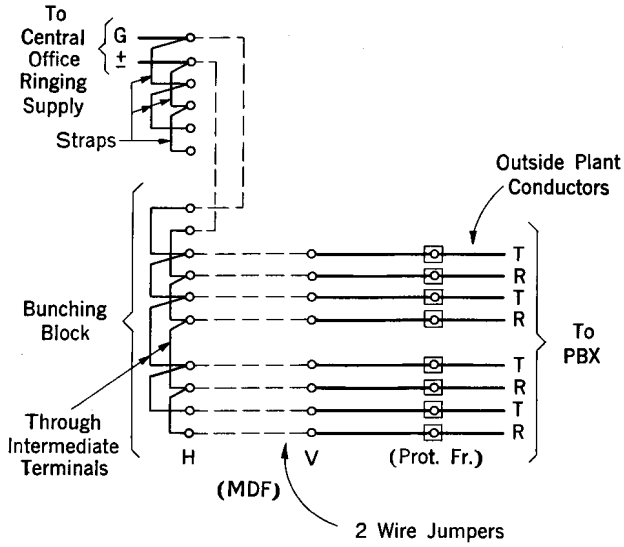


Fig. 42—Three Pair (Strapped) Termination of Ringing Supply with Bunching Block—Distributing Frames Having Separate Protector Frames—More Than 3 Cable Pairs

Supplying Machine Ringing to 740 Dial PBXs and Continuous Ringing to 750 and 755 Dial PBXs

20.12 Connect the jumpers so that the generator is connected to the ring terminal and ground to the tip terminal.

20.13 Where the ringing supply circuit terminates on a single pair of terminals on the horizontal side of the main distributing frame, run one paired jumper from these terminals directly to the terminals of the 198A (or similar type terminal strips or group of terminals) on the cable (vertical) side of the main distributing frame when one or more pairs of outside plant cable conductors are used. If more than one pair of outside plant cable conductors are required for conductivity to make up a feeder group, they shall be multipled at the terminals of the 198A or similar type terminal strips on the cable (vertical) side of the main distributing frame. The jumper from the ringing supply circuit shall be run to the lowest even-numbered pair in the group. Only one jumper shall be run from the supply terminals to the group. See Fig. 39 and 43.

20.14 The terminals associated with the even-numbered pairs of the feeder group shall be connected together by using 22-gauge bare tinned copper wire. One end of the bare tinned wire shall be connected to the ring terminal of

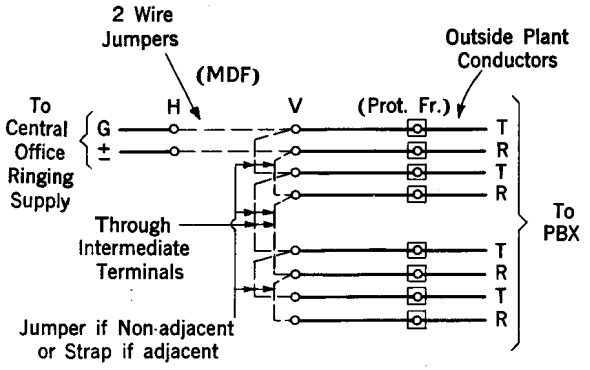


Fig. 43—Single Pair Termination of Ringing Supply Without Bunching Block—Distributing Frames Having Separate Protector Frames—More Than 1 Cable Pair

the lowest even-numbered pair in the group. The wire shall then be extended through the notches of the intermediate ring terminals of the other even-numbered pairs in the group and the other end connected to the ring terminal of the highest even-numbered pair. The strapping wire shall be soldered at each terminal. The tip terminals of the even pairs and the tip and ring terminals of the odd pairs in the group shall be treated in a similar manner. See Fig. 27A.

20.15 The tip terminal of the highest odd- or even-numbered pair in the group shall then be strapped to the tip terminal of the pair of the group in the same horizontal row, using 22-gauge insulated strap wire. The ring terminals of the two pairs shall be strapped in a similar manner. See Fig. 27A and 27B.

20.16 The insulated strap wire shall not be pulled tightly against the terminal which it bridges and the insulation on the strap shall extend to approximately 1/16 inch from the terminal to which the strap is connected.

20.17 When multipling non-adjacent pairs or groups of cable conductors, for a PBX ringing supply feeder group, proceed as outlined above for the pairs in the group which are adjacent, and run the jumpers between non-adjacent pairs or groups as previously described.

20.18 Where the ringing supply circuit is terminated by means of strapped connections on three adjacent pairs of terminals on the horizontal side of the main distributing frame, run one paired jumper from each pair of terminals associated with each pair of outside plant cable conductors when three or fewer cable pairs are used. See Fig. 41. If four or more pairs are required for conductivity to make up a feeder group, they shall be multipled at the terminals of the 198A or similar type terminal strips on the cable (vertical) side of the main distributing frame. One paired jumper shall be run from the first pair of strapped terminals associated with the ringing supply circuit to the lowest even-numbered pair in the group. Only one jumper shall be run from the supply terminals to the group. See Fig. 44. The methods of strapping and connecting adjacent and non-adjacent pairs are the same as covered in 20.14 through 20.17.

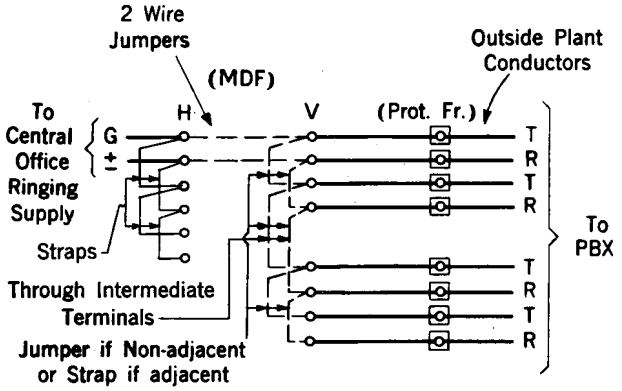


Fig. 44—Three Pair (Strapped) Termination of Ringing Supply Without Bunching Block—Distributing Frames Having Separate Protector Frames—More Than 3 Cable Pairs

C. Distributing Frames Equipped with Jacks Instead of Protectors

Supplying Continuous Ringing to Station Equipments, Manual PBXs, Manual Positions of Dial PBXs or 740 PBXs with Long Dial Lines or Trunks

20.19 Connect the jumpers so that the generator is connected to the ring terminal and ground to the tip terminal.

20.20 Where the ringing supply circuit terminates on a single pair of terminals on the horizontal

side of the distributing frame, run one paired jumper from these terminals direct to the jack when one pair of outside plant cable conductors is used, or to a bunching block when more than one pair of outside plant cable conductors are used. In the latter case a paired jumper shall be run from each jack to the bunching block. Fig. 33 and 34 show typical arrangements of the cross-connections.

Note: The jumper between the ringing supply terminals and the bunching block shall be terminated on the under side of the bunching block. Where this cross-connection is already provided, due to a previous assignment, disregard this operation.

20.21 Where the ringing supply circuit is terminated by means of strapped connections on three adjacent pairs of terminals on the horizontal side of the distributing frame, and bunching blocks are not provided, run one paired jumper from each pair of terminals associated with the ringing supply of the jack serving each pair of outside plant cable conductors when three or fewer cable pairs are used. See Fig. 35. If four or more pairs of outside plant cable conductors are used, run one paired jumper from each jack to a bunching block and run one paired jumper from the bunching block to the first pair of strapped terminals associated with the ringing supply circuit. See Fig. 36. Also see Note under 20.20.

Supplying Machine Ringing to 740 Dial PBXs and Continuous Ringing to 750 and 755 Dial PBXs

20.22 Connect the jumpers so that the generator is connected to the ring terminal and ground to the tip terminal.

20.23 Where the ringing supply circuit terminates on a single pair of terminals on the horizontal side of the distributing frame, run one paired jumper from the supply terminals to the jacks or group of jacks when one or more pairs of outside plant cable conductors are used. If more than one pair of outside plant cable conductors are required for conductivity to make up a feeder group, they shall be multipled at the jacks. The jumper from the ringing supply circuit shall be run to the lowest even-numbered cable pair in the group. Only one jumper shall be run from the supply terminals to the group. See Fig. 33 and 37.

20.24 The terminals associated with the even-numbered pairs of the feeder group shall be connected together by using 22-gauge bare tinned copper wire. One end of the bare tinned wire shall be wrapped around the notch of the ring terminal of the lowest even-numbered pair in the group. The wire shall then be extended through the notches of the intermediate ring terminals of the other even-numbered pairs in the group, and the other end then wrapped around the notch of the ring terminal of the highest even-numbered pair. The strapping wire shall be soldered at each terminal. The tip terminals of the even pairs and the tip and ring terminals of the odd pairs in the group shall be treated in a similar manner. See Fig. 29A.

20.25 The tip terminal of the highest odd- or even-numbered pair in the group shall then be strapped to the tip terminal of the pair of the group in the same horizontal level, using 22-gauge insulated strap wire. The ring terminals of the two pairs shall be strapped together in a similar manner. See Fig. 29A and 29B.

20.26 The insulated strap wire shall not be pulled tightly against the terminal which it bridges. The insulation on the strap shall extend to approximately 1/16 inch from the terminal to which the strap is connected.

20.27 When multipling non-adjacent pairs or groups of cable conductors to make up a feeder group, proceed as outlined above for the pairs in the group which are adjacent, and run the jumpers between the non-adjacent pairs or groups as described in Section A502.001.

20.28 Where the ringing supply circuit is terminated by means of strapped connections on three adjacent pairs of terminals on the horizontal side of the distributing frame, run one paired jumper from each pair of terminals associated with the outside plant cable conductors when three or fewer cable pairs are used. See Fig. 35. If four or more pairs are required for conductivity to make up a feeder group, they shall be multipled at the jacks. One paired jumper shall be run from the first pair of strapped terminals associated with the ringing supply circuit to the lowest even-numbered cable pair in the group. Only one jumper shall be run from the supply terminals to the group. See Fig. 38. The method of strapping and connecting adjacent and non-adjacent pairs are the same as covered in 20.24 through 20.27.