

BELL SYSTEM PRACTICES
Outside Plant Construction
and Maintenance

SECTION G71.199
Issue 3, November, 1940
AT&T Co Standard

DISTRIBUTING FRAME

CROSS-CONNECTIONS

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1. GENERAL

1.01 This Section covers general information regarding cross-connection work in central offices and has been prepared primarily for use by the cable splicing or construction forces in placing distributing frame cross-connections in those cases where it is not practicable to have this work done by the central office maintenance forces. This section corresponds to Section A502.001, Issue 6 of the Central Office Practices.

1.02 Cross-connection work is one of the most important operations performed in central offices. In the interest of good service and economical maintenance, each person

who has occasion to run cross-connections should be familiar with the methods and practices described in this section.

1.03 This issue differs from the previous one in that L-22-M distributing frame wire has been added to the table in Paragraph 3.01, No. 22-gauge wire is specified for multiple conductor cross-connections on all frames, and it covers the method of making cross-connections on main distributing frames equipped with 444 type jacks.

2. TOOLS

2.01 The tools required for running jumpers and maintaining equipment on distributing frames are listed below:

Note: Some of these tools are not carried by cable splicing forces but when required they can be obtained in the central office.

- | | |
|---------------------------------------|---|
| Canvas: | Piece of 8 oz. canvas about 3 ft. x 3 ft. A strip of wood may be fastened to one end of the canvas. The strip, when laid behind the horizontal terminal strips, will hold the canvas in place. It may also be used to roll the canvas when it is not in use. Distributing frame bags, where provided locally, may be used to catch wire clippings, loose pieces of solder, etc. |
| Copper, Soldering: | May be obtained in the central office. |
| Guard, No. 9: | For use on main distributing frames equipped with jacks to mark special circuits and prevent accidental insertion of a plug. |
| Guard, No. 11: | For use on main distributing frames equipped with jacks to prevent interference with special circuits. |
| Insulator, Punching, Terminal: | Per Specification 6798—For protecting special circuits at terminal strips. |
| Indicator, KS-6660: | For designating special circuits. |
| Pliers, Diagonal, Notch V: | For removing insulation, cutting and cleaning wire. |
| Pliers, Nose, P-Long: | For general use. |

- Puller:** No. 448-A Tool for pulling cross-connection wires.
- Set, Test, No. 62-A:** or equivalent—For use in transferring jumpers and in connection with making new assignments. (The 52-A dialing unit for use in conjunction with the 62-A test set will be required in dial offices.)
- Spudger, R-1102:** or KS-6320 **Orange Stick**—For use in dressing jumpers and cleaning terminals.
- Wrench:** Two No. 447-A (or No. 28) Tools—1/4 inch Hex. Socket Wrench. For use on protector and jack nuts.

Note: Use two No. 110 Tools for 5/16 inch nuts.

3. CODES AND COLOR OF DISTRIBUTING FRAME WIRE

3.01 The following table gives the color arrangement and other details concerning distributing frame wire.

CODE		COLOR						Lamp or Mess. Reg.
Lacquer Treated	*Flame- proof	No. of Conductors	B. & S. Gauge	Tip	Ring	Sleeve		
L-20-S	E-20-S	1	20	Brown				
L-20-P	E-20-P	2	20	Brown	Black			
L-20-T	E-20-T	3	20	Brown	Black	Red		
—	E-20-F	4 Spiral Four	20	Brown	Black	Red	Green	
L-20-F	—	4 Multiple Twin**	20	Brown	Black	Red (Tip)	Green (Ring)	
L-22-P	E-22-P	2	22	White	Black			
L-22-T	E-22-T	3	22	White	Black	Red		
L-22-F	E-22-F	4 Spiral Four	22	White	Black	Red	Green	
L-22-M	—	4 Multiple Twin**	22	White	Black	Red (Tip)	Green (Ring)	

*Purified textile insulation may be identified by the orange tracer.

**When cross-connecting phantom groups with multiple twin wire, the brown and black or black-white and black wires will be used for Side 1, and the red and green wires for Side 2.

4. KINDS OF WIRE TO BE USED

4.01 No. 22-gauge distributing frame wire should be used on all frames except that No. 20-gauge wire should be used for single conductor jumpers because of its increased mechanical strength.

Note: The manufacture of No. 20-gauge 3 and 4-conductor distributing frame wire and all flameproof insulated wire has been discontinued. However, flameproof wire may be used for all cross-connections and No. 20-gauge wire may be used for multiple conductor cross-connections on separate toll frames until existing stocks of such wire are exhausted.

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

4.03 Non-phantomed toll circuits should be cross-connected with multiple twin distributing frame wire if available, or with individual pairs.

4.04 For all carrier circuit cross-connections and for all toll cross-connections in switching pad offices, lacquer treated wire should be used. Lacquer treated wire or flameproof wire having purified textile insulation (with orange tracer) should be used for all other toll cross-connections.

Removed Wire—All Frames

4.05 All distributing frame wire, except rubber covered wire, which has been removed from frames may be returned to the supplier for splicing, or if in good condition, it may be reused directly in accordance with Paragraphs 4.01 to 4.04. Flameproof wire, without orange tracer, should not be reused for toll cross-connections.

5. RUNNING JUMPERS

5.01 **When running in or when handling jumpers, do not allow the wires to become kinked.** Jumpers that become caught on lugs or other objects should be freed with care so as to avoid damaging the jumpers or bending the terminal lugs.

5.02 In general, avoid any practice that will cause jumpers to tangle or otherwise introduce conditions that may cause service interruptions, restrict the working space or detract from the appearance.

5.03 Jumpers should be run in the most direct way and on top of other jumpers on the horizontal or vertical sides of the frames so as to avoid interference with the jumpers already in place. Jumpers being transferred from

one set of terminals to another should not be allowed to catch or twist around other jumpers.

5.04 The No. 448-A Tool may be used for pulling jumpers through the distributing rings on large distributing frames.

5.05 Pass the jumper through the hole in the fanning strip associated with the terminal used. Do not run jumpers through holes with cable wires unless this condition is specified in an approved instruction.

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

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

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

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

Note: An exception to this procedure is made where the terminals are not more than 20 rows apart, in which case the jumper should be run parallel with the terminal strip and about 4 inches back of the fanning strip.

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

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

Note: The exception given in the note under Paragraph 5.09 also applies in this case.

5.12 **On combination distributing frames** the horizontal to protector jumpers should be run to the left of the pins between verticals and the horizontal to vertical and horizontal to horizontal terminal strip jumpers should be run to the right of the pins, facing the vertical side.

5.13 **Carrier Circuits:** Cross-connections for circuits on the east side of the carrier equipment should not be run through the same distributing rings as cross-connections for circuits on the west side of this equipment.

6. AMOUNT OF SLACK

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

6.02 Jumpers should not be stretched. Trouble might be caused by jumpers being pulled too tight. While it is possible to stretch a jumper, in so doing there is likelihood of straining or injuring the insulation of that jumper or of 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 excessive pile-ups.

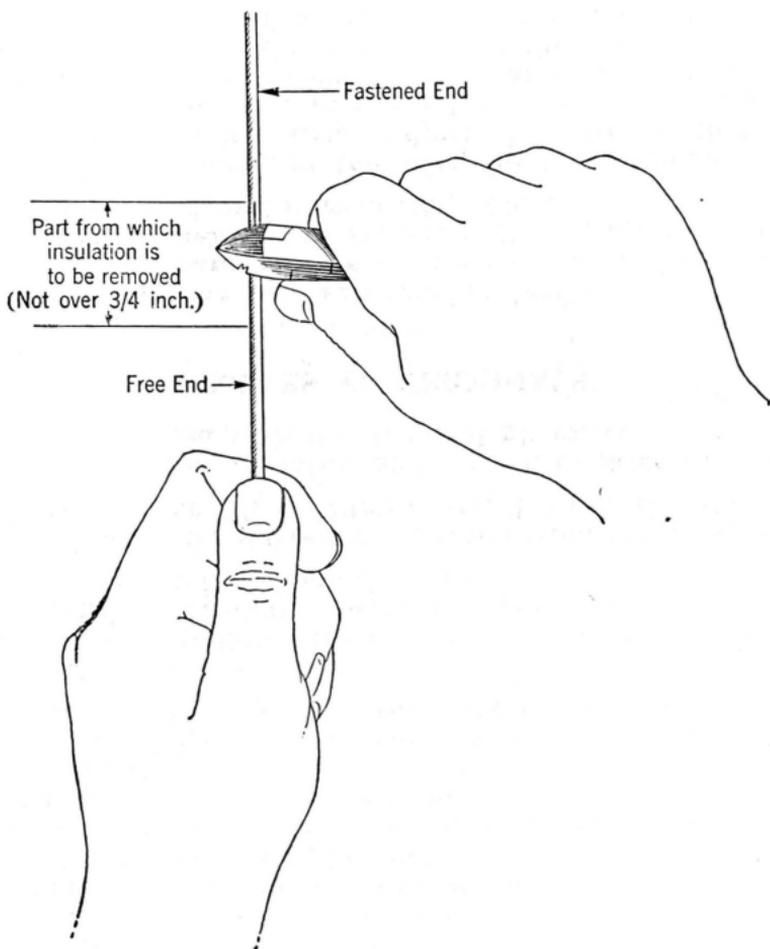
7. REMOVING INSULATION

7.01 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 fibres is released during the skinning process since they may cause contact troubles by being carried through the air to other equipment in the terminal room. As much of the removed insulation as practicable should be placed in the distributing frame bag or other receptacle.

7.02 The "V" notch diagonal pliers are equipped with both internal and external notches to be used for removing insulation. The external notches should be used on lacquer treated wire and the internal notch, on flameproof wire.

Using External Notch of Pliers

7.03 Make the wire fast in such a manner that the end from which the insulation is to be removed can be held taut. Hold the wire taut with one hand and with the other hand press the farthest external notch of the pliers against the wire at the point where the removal of insulation is to be started, as shown below. Pull the pliers forward, slitting the insulation for not more than $3/4$ inch.



7.04 After slitting the insulation, thoroughly remove both insulation and enamel from the wire using the cutting edges of the pliers. Do not nick the wire.

- 7.05 Any frayed insulation at the point of skinning should be trimmed with the diagonal pliers.

Using Internal Notch of Pliers

7.06 Make the wire fast in such a manner that the end from which the insulation is to be removed can be held taut. Hold the wire taut and determine the skinning point. Place the wire in the jaws of the "V" notch diagonal pliers with the wire at right angles to the jaws and against the hinge joint. Close the jaws firmly, thus splitting and crushing the insulation. Release the grip and move the pliers the width of the jaws toward the end of the wire and crush at this point. Repeat the crushing action on the length of insulation (usually not more than 3/4 inch) which is to be removed.

7.07 After completing the crushing operation, remove the crushed insulation with the jaws of the diagonal pliers, starting at the skinning point.

7.08 Thoroughly remove the enamel from the wire, using the cutting edges of the pliers. Do not nick the wire.

7.09 Any frayed insulation at the point of skinning should be trimmed with the diagonal pliers.

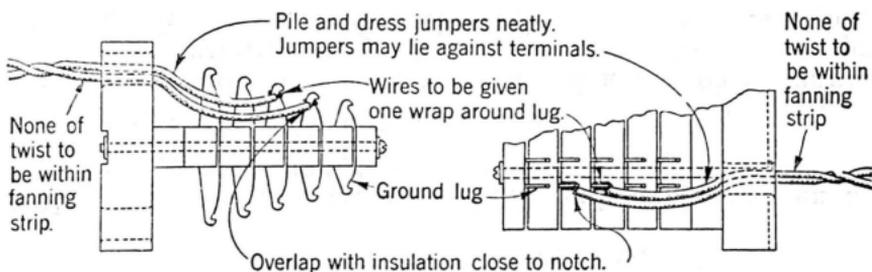
8. CONNECTING WIRES TO TERMINALS

General

8.01 See that the lugs and notches in the lugs are thoroughly clean and free from excess solder before connecting wires to them. Use a soldering copper and the orange stick or fibre spudger for removing solder.

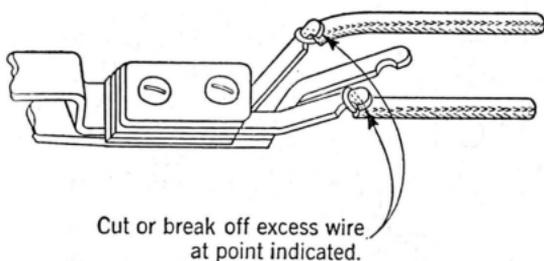
8.02 When terminating the wire, hold the jumper back of the fanning strip. Adjust the wire so that the insulation comes up close to the notch of the lug. Wrap the skinned wire one turn around the lug and cut or break off the excess wire. With this arrangement the insulation overlapping the terminal will be held firmly in place. The following illustration shows a typical termination.

Note: The excess wire that is cut or broken off should not be allowed to fall on terminal strips, protectors, etc.

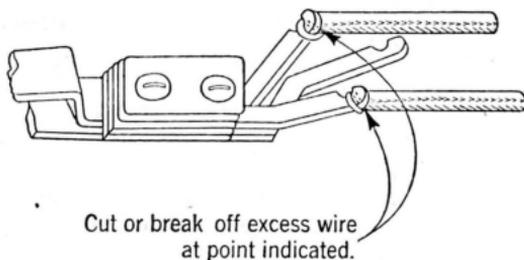


Terminating Wire on a Protector

8.03 To terminate a wire on the terminal lug of a protector, where the notch appears on the under side of the lug, as illustrated below, bring the wire under the lug, up through the notch, along the front of the lug, over the top edge and down the rear side, making one complete turn around the lug. Cut or break off the excess wire at the point shown.



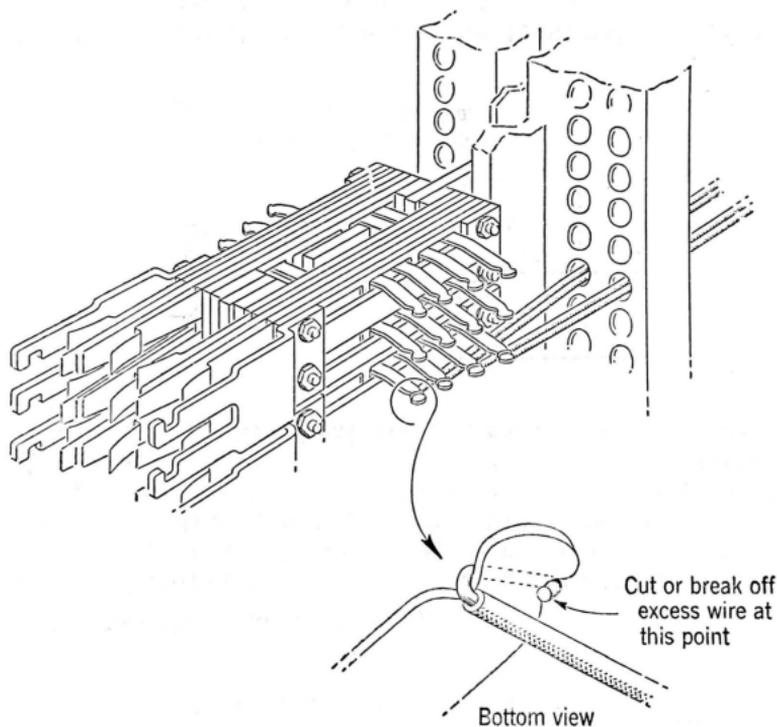
8.04 To terminate a wire on the terminal lug of a protector, where the notch appears on the upper side of the lug, as indicated in the following figure, bring the wire through the notch, down the front side and up the rear side, making one complete turn around the lug. Cut or break off the excess wire at the point shown.



8.05 In case a protector lug is broken, replace the defective lug (or spring) using two No. 447-A (or No. 28) or No. 110 Tools. Do not connect the jumper wire to the spring on the cable side of the protector, since this will remove the protection on the side of the line affected and will also result in a fire risk.

Terminating Wire on a Jack

8.06 To terminate a wire on a jack, pass the wire through the proper hole in the fanning strip as shown in the following figure. To terminate the wire on the terminal lug, bring the wire under the lug, up through the notch, across the top of the lug to the notch at the back and down the back side making one complete turn around the lug. Cut or break off the excess wire.

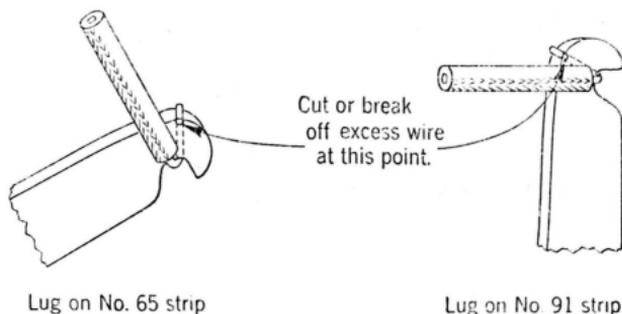


8.07 In case a jack lug is broken, replace the broken lug (or spring) using two No. 447-A (or No. 28) Tools.

Terminating Wire on a Terminal Strip

8.08 To terminate a wire on a lug of a No. 65 or similar type terminal strip, illustrated below, bring the wire along the left side of the lug, through the notch, making one

complete turn around the lug. Cut or break off the excess wire at the point shown.



Lug on No. 65 strip

Lug on No. 91 strip

8.09 When terminating jumpers on terminal strips of the type shown in Paragraph 8.02, connect the wire on the lug nearest the front first and work toward the rear of the block.

8.10 To terminate a wire on a vertical lug of a No. 91 (shown in Paragraph 8.08) or similar type terminal strip, bring the wire along the left side of the lug, through the notch, along the right side of the lug and across the back, making one complete turn around the lug. Cut or break off the excess wire.

Terminating Two Wires on the Same Terminal

8.11 Where a second jumper is to be terminated on the same terminal lugs with another jumper, the first jumper should be removed by heating the connections with a soldering copper. The terminal lugs as well as the notches in them should be freed of all excess solder. The two jumpers should then be terminated as described previously for one.

9. SOLDERING WIRES TO TERMINALS

9.01 Immediately after connecting the jumper to the terminal, solder the connections in accordance with the instructions given in the practices on cable terminating. An exception to this procedure may be made in the case of trunk or subscriber cable transfers when, for the time being, the equipment associated with the jumpers is not in service, and also when a large number of jumpers is being terminated on the same or adjacent blocks. In cases of this kind, it may be more economical to terminate all wires first and leave the excess wire in place or otherwise mark the terminals. Then solder the entire group of connections and remove the excess wire when soldering.

9.02 Take particular care to see that loose solder or pieces of wire are not left on terminal lugs or blocks. Use the orange stick or fibre spudger to remove loose wire or solder. The equipment on the shelves below should be protected by means of a piece of canvas or a distributing frame bag. Do not allow loose pieces of solder or wire to fall on other equipment.

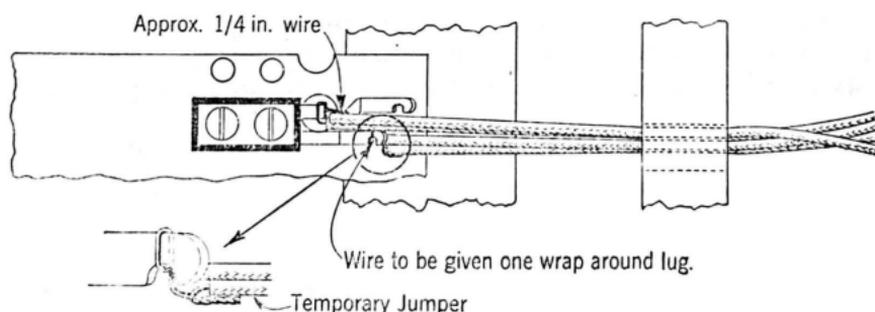
10. TEMPORARY (BACK-TAP) CROSS-CONNECTIONS

10.01 When making transfers or rearrangements, it is often necessary to make use of temporary (back-tap) cross-connections. The word "temporary," as used herein, refers in each case to the jumper which is to be removed after the transfer or rearrangement is completed.

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

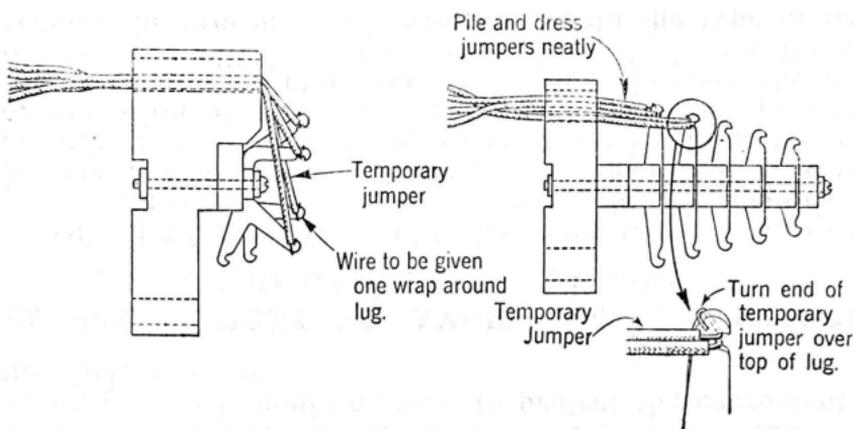
10.03 The jumpers which are to remain after the transfer is completed should be connected to the terminal lugs in a permanent manner.

10.04 On protectors and jacks leave a short tail of wire on the permanent jumper at the terminal lug. Connect the temporary jumper to this tail of wire by twisting the two wires together. Solder the twisted wires and cut off the excess leaving approximately 1/4 inch of the wires. Then bend the wires back along the jumper wire to avoid snagging, as illustrated in the following figure.



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

10.06 On terminal strips provided with extra lugs, the temporary jumper should be connected to the extra lugs, as illustrated in the left-hand figure below.



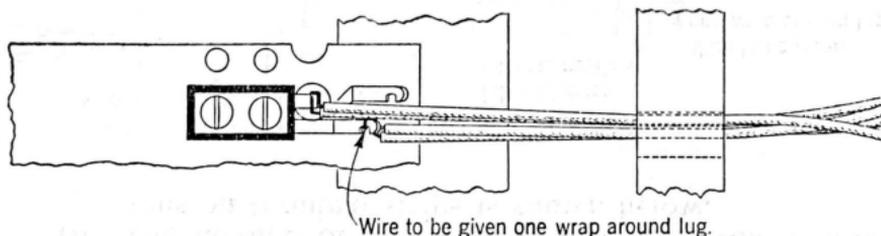
10.07 On terminal strips which are not equipped with extra lugs, connect the temporary jumper as shown in the right-hand figure in Paragraph 10.06. Bring the wire along the top of the permanent jumper through the notch, then up and across the top of the lug. Solder the connections to the lug, being careful not to leave any excess solder. Then cut off the excess wire of the temporary jumper close to the lug.

10.08 To remove the temporary jumper, untwist the wire from the lug without using a soldering copper, either by pulling the slack through the fanning strip and removing the wire by hand, or by grasping the wire on top of the lug with pliers and untwisting it from the lug.

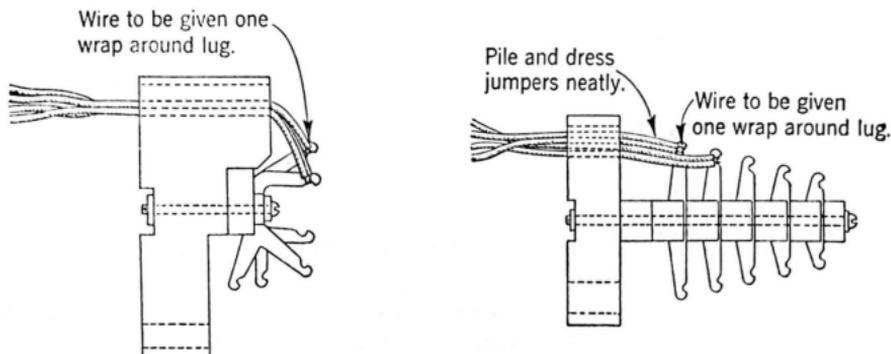
11. PERMANENTLY BRIDGED CROSS-CONNECTIONS

11.01 Where it is necessary to terminate two permanent jumpers on one set of terminals, both jumpers should be connected to the terminal lugs.

(a) The illustration below shows the method of permanently bridging cross-connections on protector terminals.



(b) The method of permanently bridging cross-connections on terminal strips is shown below.



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

12. REMOVING CROSS-CONNECTIONS

12.01 All "dead" jumpers should be removed promptly from the distributing frame.

12.02 When disconnecting jumpers, about two inches of wire should be left attached to the terminal lugs and should be pulled out from the terminal strip so that they may be seen readily. The jumpers should then be pulled clear of the terminal strip. The ends should be removed with a soldering copper and both the terminal lugs and the notches in the lugs should be cleared of all excess solder. Care should be taken to avoid spattering solder on terminals or other equipment. A piece of canvas or a distributing frame bag where provided should be used to protect the equipment on the shelves below.

13. PRECAUTIONS TO AVOID SERVICE INTERRUPTIONS AND DAMAGE TO EQUIPMENT

13.01 If a jumper is found to be connected to a set of terminals assigned on an order, do not disturb the jumper without first ascertaining that it is "dead." The fault in such cases is usually due to an error in the assignment or execution of some previous order. The exact procedure for checking such cases cannot be given because the cause of the error will, in a great many cases, determine the procedure; the procedure will also vary with the type of order

and equipment involved. In general, one or more of the following checks will be necessary to determine whether the jumper should be removed or whether a new assignment is necessary.

- (a) Check the order with the cable and line or trunk records.
- (b) Trace the jumper in question from the point at which it is found, to its termination. In the case of short jumpers, this will be the easiest and, therefore, the first method to be tried. In some cases where the other method fails it may be necessary to trace long jumpers which are covered by a large number of other jumpers. In some of these cases it will be found more convenient for two workmen to work together in tracing the jumper, one man pulling on the jumper at short intervals while the other man feels for it in its indicated direction of run.
- (c) By means of the test shoe or test clips, connect the terminals of the jumper in question to the test desk. The test deskman may then test the line and determine, in most cases, the type of equipment to which the jumper is connected and, in some cases, the location of the equipment.
- (d) In the case of manual equipment, connect a hand test set to the terminals of the jumper in question. If the jumper happens to be associated with a subscriber line, the line number may then be obtained from the operator, except in the case of a one-way line, in which case the jumper should be traced.
- (e) In panel offices, connect the 62-A test set with a 52-A dialing unit to the terminals and, after dial tone is heard, dial the code which will route the call to a permanent signal holding trunk (or dial an operator or the test desk). When the call is answered, request that the connection be traced in order to determine the line finder group and terminal and the subscriber line number.
- (f) In step-by-step offices, connect the 62-A test set with a 52-A dialing unit to the terminals, and, after dial tone is heard, dial the number associated with a switch-room telephone. When the call is answered, request the switchman to trace the call in order to determine to what equipment the jumper is connected.

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

13.03 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, etc. These special lines should be designated on the vertical and horizontal sides of the frame by bead indicators of the proper color (KS-6660 Indicator). The indicators should be located between the fanning strip and the terminal lug. Protect special circuits at the terminal strips with insulators, such as the terminal punching insulator (Specification No. 6798). On main distributing frames equipped with jacks, such special circuits should be further protected by using a No. 9 type guard to prevent accidental insertion of a plug into the jack, or a No. 11A guard to prevent interference with the circuit. Serious trouble may result from a momentary cross or short-circuit on some of these lines and, therefore, **not even a test set should be connected to the terminals associated with lines of this nature.**

13.04 Do not disconnect or open a line that is busy. On a line, other than one of the types mentioned in Paragraph 13.03, connect the 62-A test set or head receiver to it in order to determine whether it is busy. For listening on dial system lines or trunks, always use a test set with a condenser connected in series with the circuit.

13.05 When it is necessary to open a tip (T), ring (R) and sleeve (S) cross-connection of a dial system subscriber line at the I.D.F., the tip (T) and ring (R) conductors should be opened first and the sleeve (S) conductor last. When closing through a cross-connection of a line that has been temporarily disconnected, the sleeve (S) conductor should be closed through first, the tip (T) and ring (R) conductors last. The sleeve wire should not be left open longer than necessary. This procedure is necessary in some offices in order to avoid the possibility of final selection or connection overstepping and calling the wrong subscriber. In other offices open sleeves may cause connector lockups and other trouble conditions.

13.06 In panel dial offices having ground on the cut-off relay, when it is necessary to open the tip or ring of a cross-connection on a P.B.X. line (other than the last line of a group), a "make-busy" cord should be connected to the sleeve terminal on the under side of the I.D.F. terminal strip. This is to prevent interference with the selection of other lines in the same P.B.X. group. Under no circumstances shall the sleeve wire of a P.B.X. line be left open.

13.07 When it is necessary to open a trunk cross-connection or when making a trunk transfer, the circuits involved should either be made busy or, in the case of manual equipment the proper Traffic Department employee should be advised in order that the equipment may be marked in such a way that it will not be used. Before opening a trunk cross-connection, listen on the trunk to determine that it is not busy by using a 62-A test set with the condenser in series. Trunks should be properly released upon completion of the work.

13.08 Take particular care, when working on or near battery and generator feeders, not to cross the terminals with tools, wire or other metallic object, as an operated fuse may deny service temporarily to a large number of subscribers.

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

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