STRAPPING AND CROSS CONNECTIONS

WIRING AND CABLING

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1. GENERAL AND DEFINITIONS

1.01 This section covers the general equipment requirements for wiring connections, commonly known as strapping, and for cross-connections. ◗Strapping requirements for electronic type apparatus are covered in Section 800-612-150.◖

1.02 This section is reissued to make changes which are listed under Reasons for Reissue at the end of this section.

1.03 The requirements covered in this section should be followed except as modified by applicable specifications and drawings.

1.04 Straps have been generally recognized and accepted as a distinctive form of wiring which is easily made and may be used where it is convenient and economical to do so, provided dress, accessibility, or insulation considerations are not overriding. Generally the use of straps, as such, is not considered as a design matter except in the case of common straps which are specified for a specific purpose or for connections which are subject to periodic changes and the like. However, when specified on wiring drawings (by convention or note), the straps shall be run and connected in accordance with the requirements specified herein.

1.05 A method of wiring which provides flexibility in tying in connecting circuits is commonly referred to as "cross-connections." The assignments of terminals, lead multipling, and cross-connecting information are generally design matters which are furnished on the circuit schematic drawing and/or supplementary information. Due to their proximity, certain terminals within the scope of the cross-connecting arrangement may be cross-connected by the use of wiring similar to strapping methods. Despite this similarity between "straps" and "cross-connections," the requirements specified herein for cross-connections shall be followed for such wiring.

1.06 *Straps:* The term strap, as defined in Section 005-150-101, is applied to a form of direct wiring used for connecting apparatus terminals where the use of local cable or other forms of wiring would be cumbersome or cause congestion. Straps are also used for extending connections such as battery, ground, etc, or to make repetitive or other types of connections on the same or through closely associated similar apparatus. ◗Straps are classified as individual straps or common straps.

(a) *An individual strap* is a strap that connects two or more terminals in the same individually numbered circuit.

(b) *A common strap* is a continuous piece of wire which connects one or more terminals within an individually numbered circuit to terminals on succeeding or preceding numbered circuits for the purpose of supplying battery, ground, or other common potential, or serves as a common lead for testing, ringing, listening, etc.◖

1.07 *Loop Leads:* Loop leads, as defined in Section 005-150-101, are colored leads used for the same purpose as straps in cases where the location of the terminals, the voltage, or some wiring condition, such as congestion resulting from an excessive number of straps, preclude the use of straps.

1.08 *Extended Skinner Connections:* The term extended skinner connection is applied to a connection between adjacent terminals which is established by extending the bare end of a wire terminating on one of the terminals to the adjacent terminal or the next terminal in line in order to avoid the use of a separate strap or loop lead.

2. REQUIREMENTS FOR STRAPPING

A. General Strapping

2.01 *Use loop leads* as follows:

(a) *Use loop leads* (rather than straps run from strip to strip) for apparatus such as relays,

jacks, lamp sockets, and keys mounted on several strips or mounting plates. Where separate terminals for the termination of the common lead are provided on the mounting plate, ♦loop leads should not be used but♦ the common lead should be run directly from mounting plate to mounting plate.

(b) *Use loop leads* instead of straps for common ringing leads between pieces of apparatus in one mounting plate, except where the apparatus served is located on close centers (such as 18- or 19-type resistors on 1/2-inch centers). In these latter cases, straps may be used.

(c) ***Loop leads*** may be used instead of straps where congestion resulting from excessive straps or where insulation requirements prohibit the use of type "J" wire, such as for leads that carry potentials exceeding 48 volts, except under conditions covered in (b) above.

(d) For loop leads between adjacent terminal strips on distributing frames, see 2.59.

2.02 *Strapping on surface-wired units (SW1 wiring) of equipment* shall be limited to connections that can be and are normally made with bare wire (including extended skinner connections), and to apparatus equipped with strapping terminals (A-, EA-, and similar type relays). All other connections should be made as surface wiring.

(a) Surface wiring between terminals on the same relay or similar piece of apparatus may be run from terminal to terminal and dressed back from the apparatus terminal near, or against the mounting plate, provided it does not obscure designations. If this practice is not feasible, the wiring may be run on the outside of the terminals and dressed along the edges of the plate. On apparatus or groups of apparatus such as keys, jacks, Tenite assemblies, and resistor mounting boards where the points of termination are a considerable distance from the mounting plate or panel, it is sometimes impracticable to dress the wiring between terminals back against the mounting plate. In such cases, it will be satisfactory to run the wiring in the same manner as would be used for standard strapping.

2.03 *D3 wiring* (and sometimes D2 wiring) designates wiring dressed back against the mounting plate in the same manner as SW1 wiring. In shop parlance, wiring dressed back against the mounting plate is not called surface wiring unless No. 24 gauge type "BG" or "BW" wire is used; hence, the symbol D3 rather than SW1 is used for wiring disposed of in this manner when some other type of wire is used. Unless otherwise specified, equipment using this type of wiring shall follow the strapping practices outlined in 2.02 for (SW1) surface wiring.

Kinds of Wire for Straps

2.04 ♦Straps may be either bare or insulated wire, depending on the clearance between the straps and other terminals or uninsulated metal work, and the distance between the points of connection.

(a) For apparatus with terminals requiring soldered connections, insulated straps may be used as follows.

(1) Type "BW" or "C" colored black for general use.

(2) Type "BG" colored black for general use where Underwriters' Laboratories approval is necessary or where the higher voltage rating is required.

(3) Type "J" for necessary applications where push-back wire is desirable and where the voltage does not exceed 48 volts.

(4) Bare, tinned solid wire sleeved with black varnish-impregnated sleeving per KS-7851, or equivalent.

(5) Type "AM" or "KS-13385" wire where No. 18 through 14 gauge insulated straps are required. For larger than No. 14 gauge, use "KS-19195, L1" or "KS-5482-01" wire.

(b) For apparatus with terminals approved for solderless wire wrapped connections, insulated straps may be type "C", "BU", "BG", or "BW" wire.♦

(c) In general, the kind of wire (insulated or bare) required shall be determined in accordance with the following. However,

exceptions specifying the application of bare wire which may not be in accord with the following clearance requirements are covered under "Strapping Specific Apparatus." Examples are strip mounted apparatus such as jacks, keys, lamp sockets, etc and apparatus with terminals designed with a strapping notch such as A, EA, and similar type relays with strapping terminals.

SEPARATION BETWEEN POINTS OF CONNECTION	KIND OF WIRE	
	BARE	INSULATED
Over 1"	Clearance 3/4" or more	Clearance Less than 3/4"
Over 1/2" to 1"	Clearance 1/4" or more	Clearance Less than 1/4"
1/2" or Less	Clearance 1/16" or more	Clearance Less than 1/16"

Size of Wire for Straps

2.05 For gauge of strap wire on terminal strips, see 2.56. Except for terminal strips, the standard gauges for strap wire are as follows.

(a) *No. 16 gauge wire or larger* is used where the leads connecting to the apparatus are No. 16 gauge wire or larger. The strap should be the same size as the connecting lead unless there is obviously no need for so much current-carrying capacity, as for example on WECo coded apparatus such as relays, voltage relays, capacitors, resistors, transformers, keys, etc. In such cases, the sizes outlined in (b), (c), and (d) should apply.

(b) *No. 18 or 20 gauge* is used where the mechanical strength and stiffness of the strap are necessary to insure adequate separation between the straps and other terminals or metal parts. It is generally used as follows.

(1) Bare formed straps between nonadjacent apparatus.

(2) Bare straight straps serving an entire mounting plate of apparatus.

(c) *Either No. 18 or 20 gauge* is used for strength and stiffness for insulated straps, either straight or formed.

(d) *No. 22 or 24 gauge* is used for strapping between terminals of the same piece of apparatus or between terminals on adjacent pieces of apparatus within the same circuit, except where a larger gauge is required as indicated above. Generally, the gauge of wire is the same as that used for the major part of the unit or equipment.

(e) No. 26 gauge tinned copper strip, 1/8 inch wide, is used by the shop on strip type lamp mountings.

Arrangement, Placing, Dressing, and Soldering Straps

2.06 Straps should be run directly from terminal to terminal and should meet the following requirements as far as possible.

(a) Allow proper access to the wiring terminals of other parts of the apparatus.

(b) Avoid interference with the operation of the apparatus.

(c) Allow removal of apparatus for maintenance or inspection purposes.

(d) Avoid obscuring designations.

(e) Allow sufficient slack in any strap on apparatus having floating terminals in order to insure free movement of the terminals. The strap may be dressed in the most convenient manner, provided the dress is consistent with the requirements outlined in (a), (b), (c), and (d). The straps should not interfere with the insertion of the guide pins of electronic tubes.

(f) Solder straps to terminals so that they can be unsoldered and removed with minimum disturbance to other wiring.

(g) Solder straps on the right or top side of the terminal, except where a simple one-half wrap connection is used and the wire end terminates on the left or underside of the

terminal, in which case apply solder to enclose the wire on both sides of the terminal.

2.07 *Insulated straps* should be so run as to meet the requirements in 2.06 and the following additional requirement.

(a) Except where the type of insulation permits, such as type "C", "BG", "BU", or "BW" wire, straps should not rest against any metalwork other than the terminals to which they are connected. In cases where straps are dressed between rows of terminals on relatively close spacing, as usually encountered at terminal strips, relays, or at bifurcated terminals (two prong) such as the magnet terminals on crossbar switches, the straps may touch other terminals. In no case, however, should any straps be dressed across the edges of other terminals so tightly as to result in pressure between the wire and the terminal which might cause insulation breakdown.

Position of Insulation

2.08 The insulation of straps should extend close to the point of soldering but should be excluded from the holes of perforated terminals (where such connections are permitted) and from the notches of notched terminals. No insulation should exist on the soldered side of a wrapped connection so as to prevent a good soldered connection. The bare portion of a wire between the point of soldering to a terminal and the insulation of the wire should not be longer than the clearance between adjacent terminals at that point and no longer than 1/8 inch.

(a) Due to the loose push-back insulation of type "J" wire, it is not always feasible to meet the "no longer than 1/8-inch requirement" on short and/or straight-formed straps. In such cases, the insulation should extend as close to the terminal as necessary to prevent other terminals or bare wire from coming in contact with the bare portion of the wire, and a reasonable effort should be made to meet the "no longer than 1/8-inch requirement."

Connecting Individual Straps

2.09 Individual straps may be connected with pliers or may be machine wrapped.

(a) *Plier-connected end terminations* are generally made with a simple half-wrap connection. However, it is permissible to connect with a full wrap or a maximum of 1-1/2 turns of bare wire. The following connections may also be used.

(1) A simple hook connection through the hole of the terminal in accordance with 2.13.

(2) An extended skinner connection in ccordance with 2.14.

(3) Adjacent terminals drawn and held together by the wire in accordance with 2.14(b).

(4) Adjacent terminals soldered directly together in accordance with 2.15.

(b) *Plier-connected intermediate connections* may be made as follows.

(1) One complete turn of bare wire around each terminal.

(2) A formed loop in the bare wire as shown in Fig. 5 and 15 for common straps.

(3) Laid across the flat side or edge of the terminal. See Fig. 9, 13, 16, and 18.

(4) Adjacent terminals drawn and held together by the strap wire in the same manner as described for intermediate connections of common straps in 2.11(a).

(c) *Wrapped Soldered Connections:* The requirements in Section 800-612-154 shall apply.

(d) *Solderless Machine-Wrapped Connections:* Refer to Part 4 of this section.

Connecting Common Straps

2.10 Common strap connections are made in a manner that will permit removal of the strap, without affecting its continuity, in accordance with 2.11.

(a) *Common strap end terminations* are generally made with a simple half wrap or one full wrap of bare wire.

(b) *Common strap intermediate connections* may be made as follows.

(1) A formed loop in the bare wire as shown in Fig. 5 and 15.

(2) Laid across the flat side or edge of the terminal as shown in Fig. 6, 9, 13, and 15.

(3) Adjacent terminals drawn and held together by the strap wire, in accordance with 2.11(a).

2.11 *Common straps should be run straight* wherever possible, and should not be wrapped entirely around a terminal or passed through the holes of the terminals so as to prevent disconnecting one terminal without disturbing adjacent terminals or breaking the continuity of the strap.

(a) Where adjacent terminals of the same piece of apparatus are to be connected to the common strap, and they are so close to each other that the flat sides of the terminals can be easily drawn and held together by the strap wire (as in the case of relay spring terminals), the common strap may be formed around the two terminals and connected as if to one terminal. Particular care should be taken to insure that each terminal is securely soldered to the wire.

2.12 *Provide a connecting loop in common straps as follows:*

(a) Provide a loop as shown in Fig. 15 when the straps serve apparatus in more than one circuit, such as in the case for battery and ground supply straps to ten relays on a mounting plate of a 10-circuit unit. The primary purpose of the connecting loop is to provide continuity of service over the common strap while a piece of apparatus, such as a relay, is disconnected from the group.

(1) The loop is not required in such a strap when a separate terminal is provided for terminating the incoming lead and strap.

(b) A loop may be provided as shown in Fig. 9 and 13 on strip-mounted jacks, lamp sockets, keys, or other apparatus which are not individually removable but require removal of the entire strip. In this case, the strap is classified as an individual strap and the loop is not required from a requirement standpoint but is provided to facilitate connecting the feeder lead.

Individual Straps

2.13 *Individual straps may be connected back of the hole in a terminal or passed through the hole in a terminal,* provided there is no interference with the connection or removal of other wiring. However, both ends of the strap should be treated in the same manner; that is, if one end is connected back of the hole in the terminal because a wire is connected in the hole, the other end of the strap should also be connected back of the hole.

2.14 *Individual straps between two adjacent terminals, or the next terminal in line* on the same piece of apparatus (except terminal strips), may be the continuation of the skinner to the first terminal instead of a separate piece of bare wire. Where this method is used, the lead shall be connected through the hole in the first terminal and wrapped around the first and second terminals, as shown in Fig. 1. Refer to 2.57(a) for requirements for the continuation of the skinner at terminal strips.

(a) Adjacent terminals of separate pieces of apparatus closely associated in the same circuit, such as the answering and calling supervisory lamp sockets in a keyshelf, may also be strapped in this manner. In such cases, use the same arrangement of strapping for all similar circuits of the same group.

(b) Where the adjacent terminals are so close to each other that the flat sides of the terminals can be easily drawn and held together by the wire, as in the case of relay spring terminals, they may be connected to and soldered as one terminal. Particular care should be taken, however, to insure that each terminal is securely soldered to the wire and that the holes in both terminals are completely filled with solder.

(c) The use of the continuation of a skinner as an individual strap instead of a separate piece of bare wire may be applied to pigtail leads of pigtail apparatus. Where heavy gauge pigtail leads are too stiff to permit wrapping around the terminal in the usual manner, the connection may be made with a formed loop at the first terminal and a one-half-wrap connection at the second terminal.

2.15 Closely adjacent thin flexible terminals, such as those of the line and cutoff relays of No. 11 switchboards, and some types of multiunit capacitors where the terminals can be slightly bent to make contact without injury to the

apparatus, may be soldered directly together instead of being strapped, provided no other wiring, other than a strap, is to be connected to the terminals. Such terminals should be bent so that they are in contact before soldering. However, the terminals should not be so bent as to increase the liability of accidental crossing of the terminals with the mounting plate or other terminals.

Extending Common Straps to Added Apparatus on Partially Equipped Mounting Plates

2.16 *Where apparatus is equipped in consecutive order,* straps should be of sufficient length to reach only the equipped apparatus. When apparatus is added, disconnect the strap from the last equipped piece and extend it by means of a straight splice between the last two pieces of the original equipment, connecting the strap to the added apparatus in the usual manner.

(a) Where flat-type resistors, or other closely spaced apparatus are added, and it is impracticable to entend the common strap by means of the straight splice specified above: (1) connect a separate piece of strap wire to the strapped terminal of the next to the last piece of apparatus in the original equipment, (2) extend it to the last piece of apparatus in the original equipment and to the added apparatus in the usual manner. The strap wire should be of the same size and type (insulated or bare) as the original strapping, and should be connected to the strapped terminals of the original apparatus between the original strapping and the mounting plate.

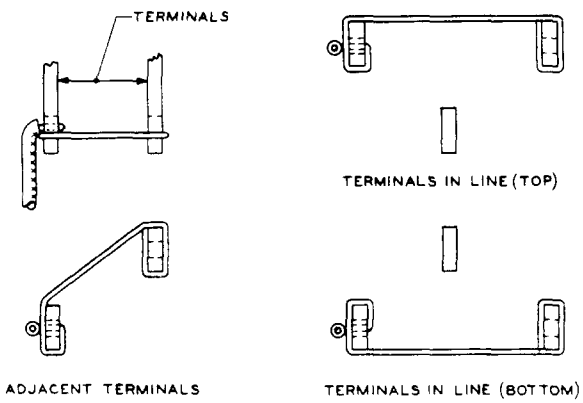


Fig. 1 – Straps – Extended Skinner Connection

(b) On terminal strips where additional terminals are to be strapped, extend the common strap by connecting a separate piece of strap wire from the last strapped terminal to the added terminals in the usual manner. The strap wire should be of the same size and type (insulated or bare) as the original strapping.

2.17 *Where the apparatus arrangement is irregular,* form the straps for intervening unequipped apparatus positions and protect the bare portion of the straps with tape. The straps should not be formed or run beyond the last equipped apparatus, but should be spliced out in the usual manner when the apparatus is added.

2.18 *Straps should be supported* at every second and end unequipped apparatus position, by tying with twine to (but not directly against) the mounting plate, the twine being passed through the holes in the mounting plate. Where an apparatus position is unequipped at both sides of the loop in the strap for connecting common leads, the strap should be supported at both unequipped positions.

B. Strapping Specific Apparatus

Coded Apparatus Panels

2.19 Straps specified as a part of the coded apparatus wiring and placed by the shop on terminal strips of apparatus panels are located on the local cable or maintenance wiring side. This is an exception to the usual practice on terminal strips.

Banks

2.20 *15 and Similar Types:* Where it is necessary to reconnect the cutting loops, the gap in the loops should be bridged with solder. The width of the solder across the gap should not be less than 3/64 inch (at least one half the width of the cutting loop) and a clearance of at least 3/64 inch should be maintained between the solder and the nearest terminal.

2.21 *40, 41, 42, and Similar Types:* Strap as shown in Fig. 2. Where straps run between different levels of the same bank, they should be run similar to the regular bank wiring, making the change in level at the most convenient point.

2.22 *26, 27, and Similar Types (Including Bank of 204-Type Selector):* Strap in accordance with Fig. 3.

Capacitors

2.23 ▶Fig. 4 illustrates the strapping of 187- and similar-type capacitors.◀

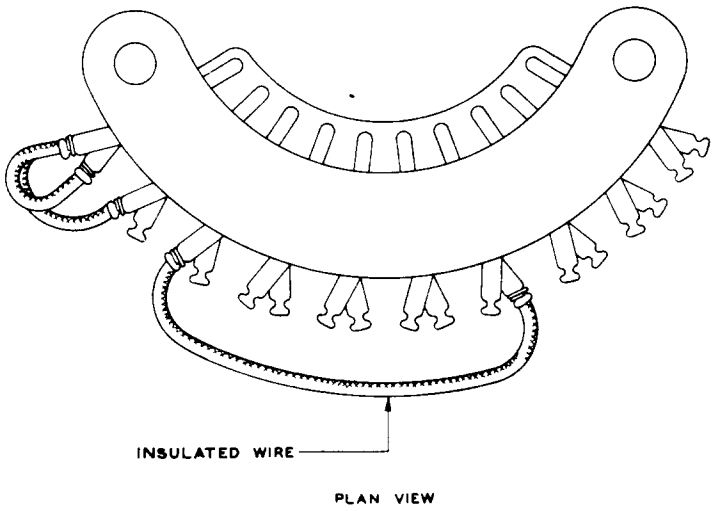


Fig. 2 – Straps at 40-, 41-, 42-, and Similar-Type Banks

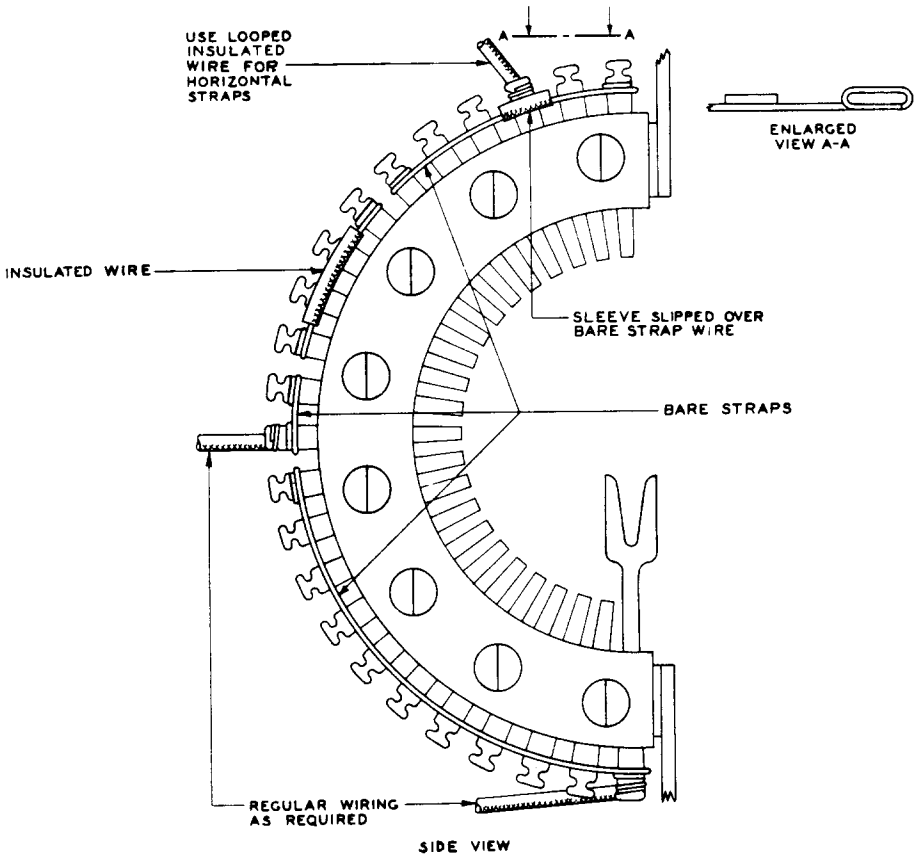


Fig. 3 – Straps at 26-, 27-, and Similar-Type Banks (Including Bank of 204-Type Selector)

2.24 *445-, 447-, and 449-type capacitors* should be strapped similar to the 187 type shown in Fig. 4.

Connecting Racks

2.25 Strap as shown in Fig. 5. Conditions not covered in Fig. 5 should be strapped in accordance with Fig. 21 covering terminal strips. The connection to the screw terminal shall be in accordance with the requirements for screw type terminals in Section 800-612-154.

Fuse Panels – Terminals Not Arranged for Solderless Wrapped Connections

2.26 Strap fuse posts of the 5, 6, and similar types, the ground terminals and alarm studs on fuse panels, as shown in Fig. 6. Provide a connecting loop in such common straps for the

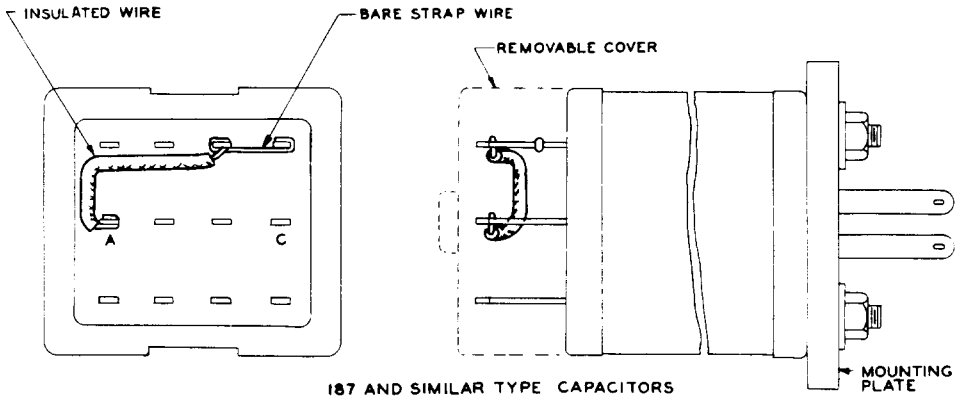


Fig. 4 – Straps at 187- and Similar-Type Capacitors

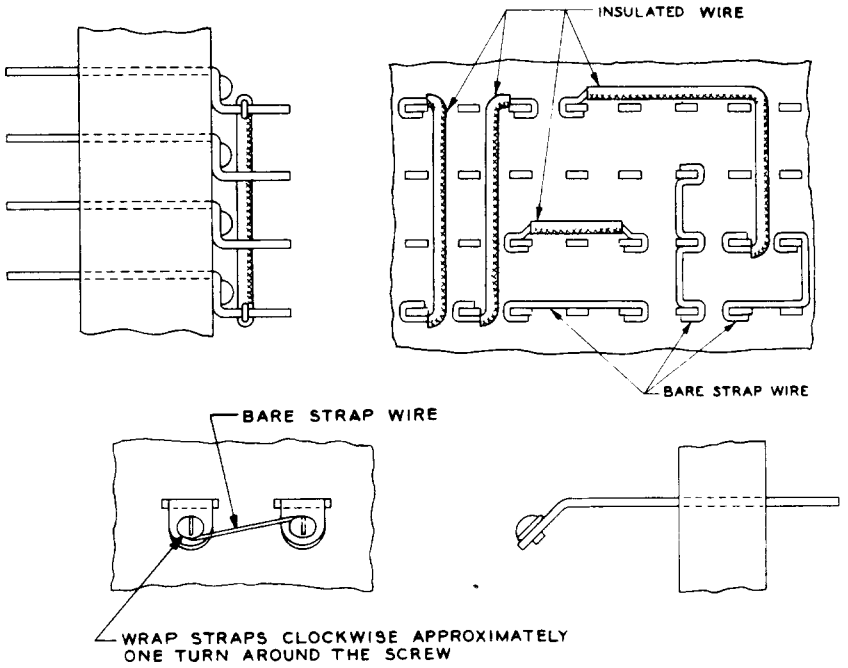


Fig. 5 – Straps at Connecting Racks

attachment of the incoming supply leads. In general, this loop shall be located between the first two fuse posts in each group strapped together. When the incoming supply leads are larger than No. 14 gauge, they should be connected to terminal punchings as provided. Strap the fuse alarm lamps or associated resistors, which are in line vertically on adjacent panels, together with an insulated straight strap, providing a connecting loop for the attachment of the incoming lead. Locate the loop between the two top panels initially installed. Where alarm circuit lamps or resistors are mounted so as to prevent running these straps straight, the straps should be formed out sufficiently to clear the lamps or resistors.

Interrupters – 165 and Similar Types

2.27 Strap as shown in Fig. 7.

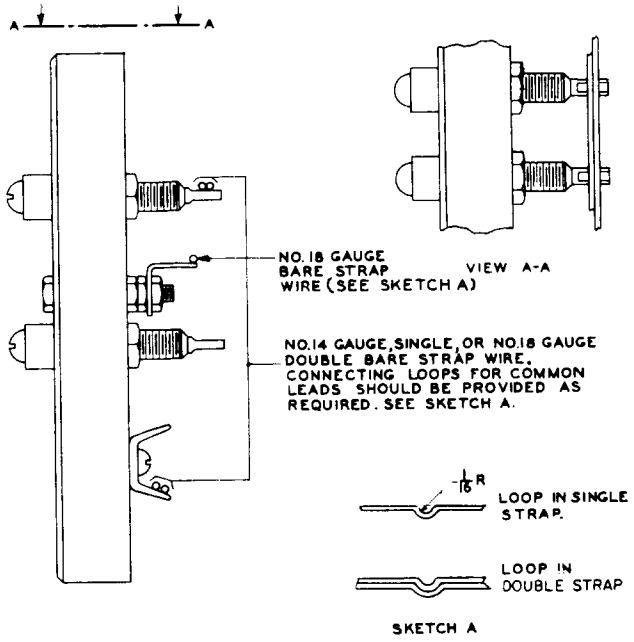


Fig. 6 – Straps at 5-, 6-, and Similar-Type Fuse Posts – Terminals Not Arranged for Solderless Wrapped Connections

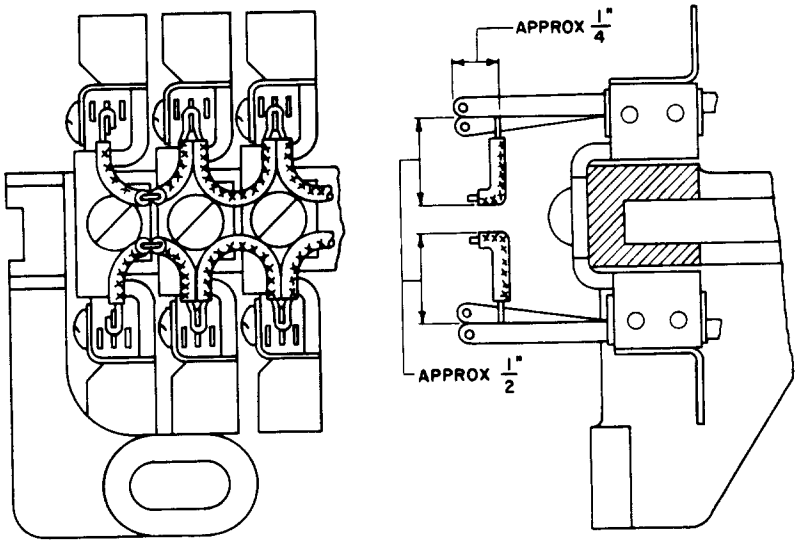


Fig. 7 – Straps at 165- and Similar-Type Interrupters

Jacks

2.28 *The straps between individually mounted jacks* should be run as loop leads in the forms, unless otherwise specified.

2.29 *Strip-mounted jacks* should be strapped directly from terminal to terminal unless the straps cause interference with other terminals, in which case loop leads are used.

2.30 ◗*In telegraph and data systems,* jacks of all types◖ should be wired with loop leads except in cases where bare straps can be used.

Keys

2.31 Ordinarily, straps on keys should be connected at the special terminal notch or hole provided for them. They may be connected at the regular wiring terminal notch or hole instead of at the strapping notch or hole in cases where the straps will not interfere with wiring or maintenance of the key. In all cases, the location of the straps should be uniform throughout the particular unit of equipment.

2.32 *On A, B, and C unit-type keys* straps between terminals on the same key may be run directly from terminal to terminal as shown in Fig. 8, provided the number of straps required will not cause congestion and liability of breakdown due to cutting of the strap insulation by adjacent terminals. If the number of straps exceeds six at any cross-section, some of the straps should be run as loop leads.

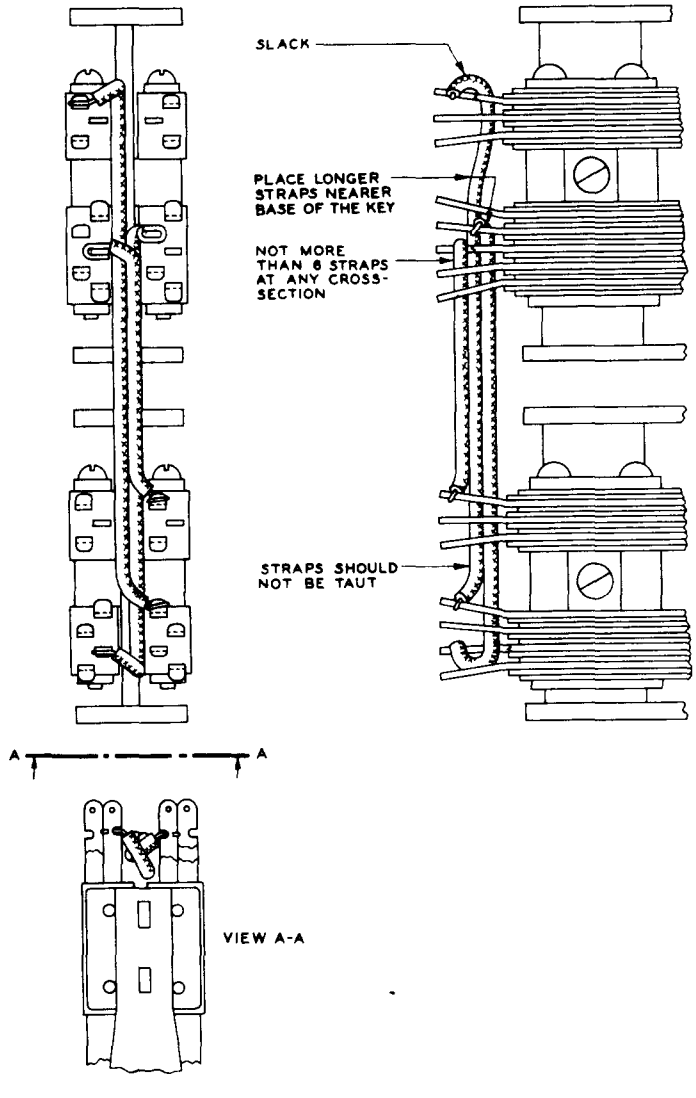


Fig. 8 – Straps at A, B, C, and Similar-Type Keys

2.33 *On A3 and similar strip-type keys* straps are used only between corresponding springs in adjacent spring groups, as shown in Fig. 9. Use loop leads between nonadjacent groups and noncorresponding springs.

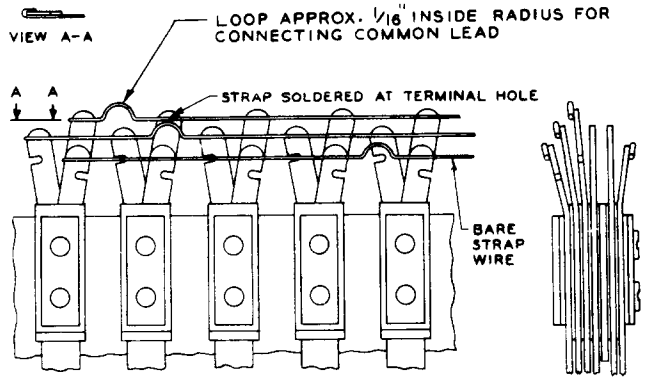


Fig. 9 – Straps at A3 and Similar-Type Keys

2.34 *On A10 and similar-type narrow base keys* with 9/16-inch base, use formed straps located as shown in Fig. 10 to avoid congestion and to permit proper removal of the keys from the keyshelf mounting. Tie the longer straps together with one strand of No. 6 sewing twine (as shown) to prevent them from spreading apart. The long straps should be dressed approximately 7/8 inch from the terminals.

2.35 *On A36 and similar-type wide base keys* with 27/32-inch base, straps may be run directly from terminal to terminal, as shown in Fig. 11, provided requirements in 2.32 can be met.

2.36 *On type E keys* loop leads are used instead of straps, since the number of straps usually required on this type of key would cause considerable congestion.

2.37 *Strap 378- and similar-type keys* as shown in Fig. 12.

2.38 *In telegraph systems, keys of all types* should be connected with loop leads except for adjacent terminals on a key where bare straps may be used.

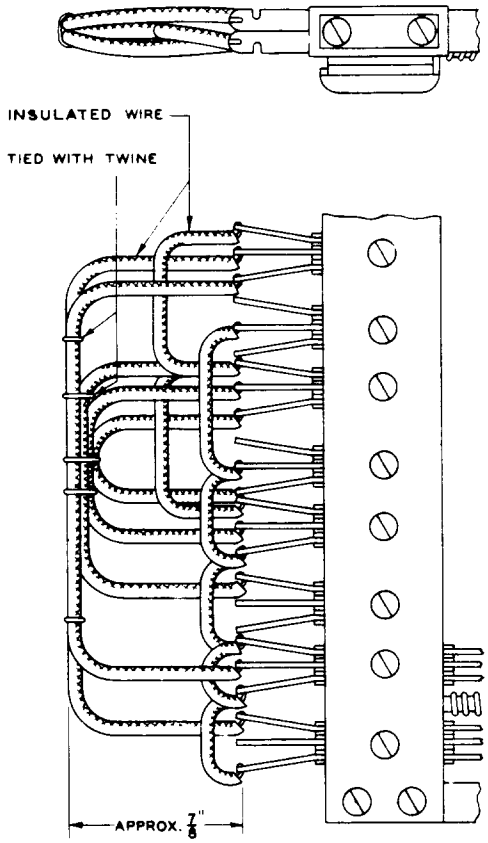


Fig. 10 – Straps at A10 and Similar-Type Narrow Base Keys

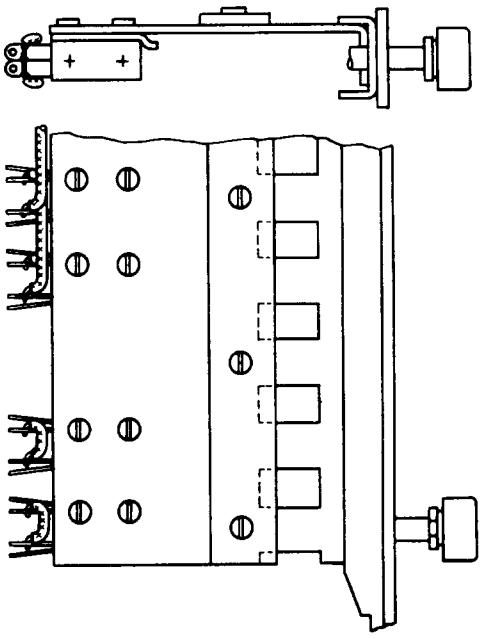


Fig. 11 – Straps at A36 and Similar-Type Wide Base Keys

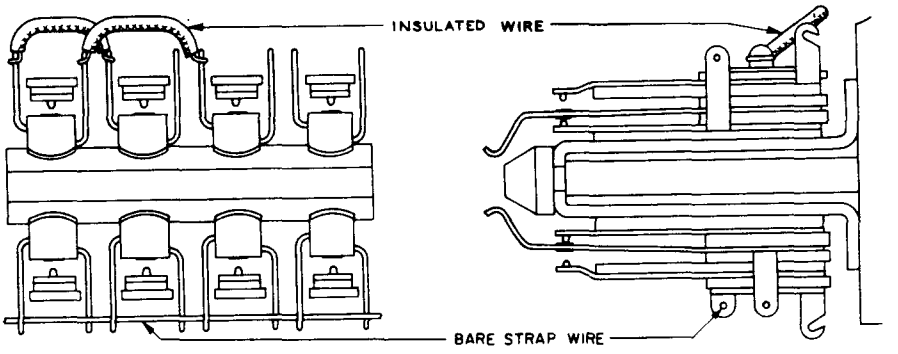


Fig. 12 – Straps at 378- and Similar-Type Keys

Lamp Sockets – 46A and Similar Types

2.39 When mounted on strip mounting plates or panels, straps may be used instead of loop leads.

(a) Straps may also be used in the case of 49 and similar lamp sockets, mounted in a row as in switchboard keyshelves.

Lamp Socket Mountings

2.40 When required, bare straps are placed on the lower terminals as shown in Fig. 13. Connecting loops, as shown, may be provided to facilitate connection of the feeder leads. Lamp sockets, such as the 43A and similar types, are strapped in the shop with a flat ribbon-type wire. In this case, the connection for the common lead is made at the hole in a terminal since no connecting loop is provided in flat ribbon-type wire straps.

Message Registers

2.41 Straight straps (bare or insulated), as required, are used for strapping message registers on strip mounting plates. A loop with 1/16-inch inside radius should be provided at the center of the strap for the connecting of the incoming leads.

◗Networks

2.42 *Strap 187- and 189-type networks* similar to the straps for 187-type capacitors shown in Fig. 4.◖

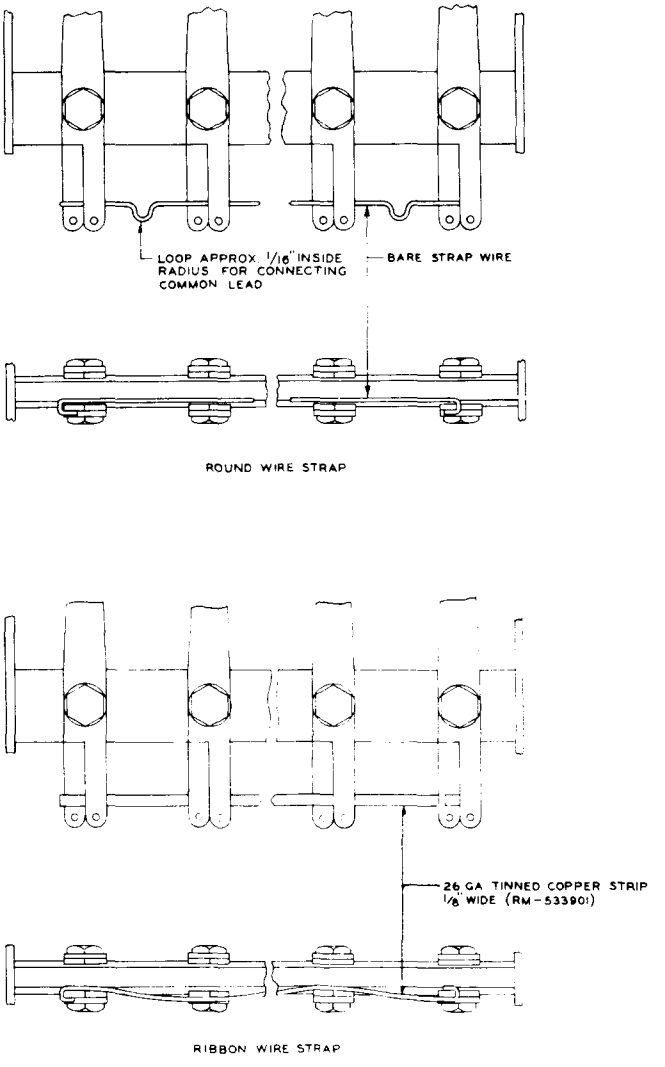


Fig. 13 – Straps on Strip-Type Lamp Mountings

Protectors

2.43 On toll distributing frames, the heat coil mounting springs of the protectors are strapped to eliminate placing dummy heat coils on certain toll lines not requiring heat coil protection in order to reduce the noise that might be caused by contact resistance of the coils. Where such straps are specified, solder a bare No. 20 or 22 gauge strap between the two ring lugs of the protector, and solder a piece of No. 20 or 22 gauge type "U" distributing frame wire about 6 inches long between the tip lugs of the protector, as shown in Fig. 14.

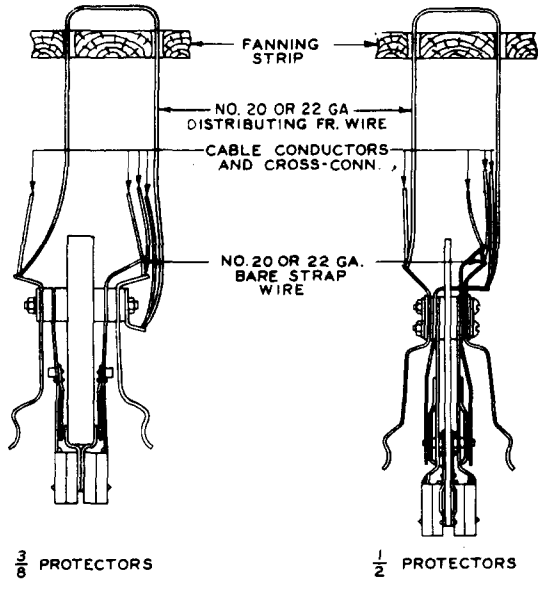


Fig. 14 – Straps at Protectors

Relays

2.44 Fig. 15 illustrates straps for relays on strip mounting plates. Either bare or insulated straps may be used.

2.45 Straps may be run directly from terminal to terminal on the same relay, provided they do not interfere with other apparatus or obscure designations.

2.46 The number of straps at any one relay should be kept to a minimum in order to avoid wiring congestion.

2.47 *On relays equipped with thin flexible* terminals, closely spaced (such as the U- and Y-type relays), straight bare straps may be run through the holes in adjacent terminals of the same group of terminals provided no other wiring, except the incoming lead, is connected to the terminals. If the number of terminals exceeds two, the incoming lead should be a separate wire terminating in the hole of one of the terminals. Particular care should be taken to insure that all terminals strapped in this manner are securely soldered to the strap wire and that the holes in the terminals are completely filled with solder.

(a) An alternate method of strapping terminals of relays consists of making one complete turn of bare strap wire around each terminal to be strapped. In using this method, the terminals should be spread sufficiently before applying the strap wire to insure clearance between the wrapped portion of the strap and adjacent terminals not connected to the strap.

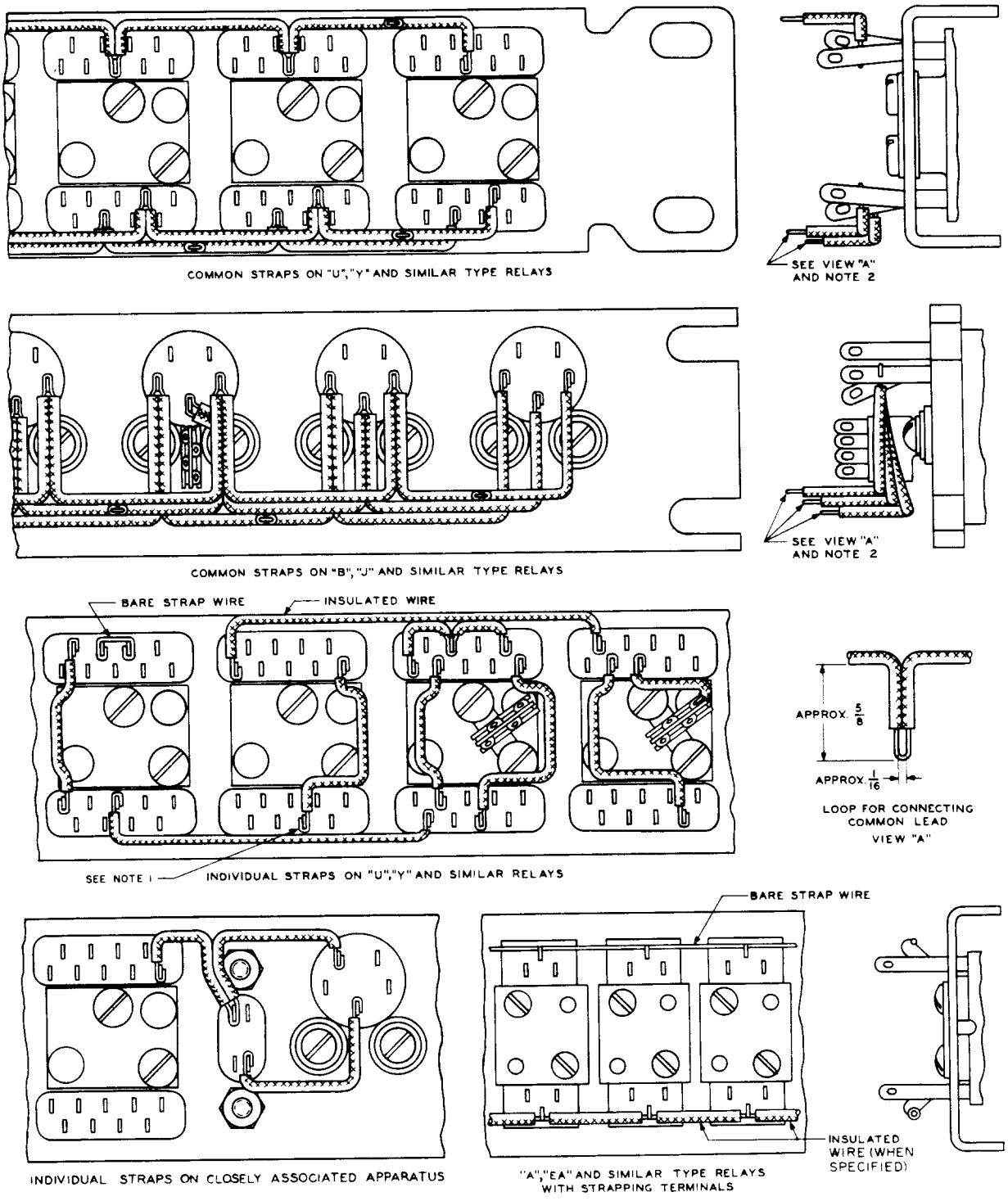
2.48 Where bare straps are used on B-type relays to connect a terminal from the upper row to a terminal in a lower row, it will be permissible to use the extended skinner connection as described in 2.14 and shown in Fig. 1. The terminals to be strapped in this manner may be bent to line up approximately one above the other in order to maintain necessary clearances.

2.49 *Multicontact relays of the 229, 230, and similar types,* where arranged for vertical strapping from relay to relay as on the panel system decoder connector frame, should be strapped as shown in Fig. 16.

2.50 *Multicontact relays of the 263, 286, 287, and similar types* shall be strapped in accordance with the requirements covered in Section 800-612-163.

Repeating Coils – 62, 93, 94, and Similar Types

2.51 Strap as shown in Fig. 17.



NOTES:
1. THE LOCATION, CONNECTION, AND DRESS OF STRAPS SHOWN ARE TYPICAL AND MAY BE VARIED TO SUIT PARTICULAR CONDITIONS, FOR EXAMPLE IT WILL BE SATISFACTORY TO TERMINATE THE END OF A STRAP ON EITHER SIDE OF A TERMINAL TO FACILITATE THE CONNECTING OPERATION.
2. THE CONNECTING LOOPS IN COMMON STRAPS SHOULD BE LOCATED AT RIGHT OR LEFT END OF PLATE AS REQUIRED.

Fig. 15 – Straps on Relays on Strip Mounting Plates – Perforated Terminals

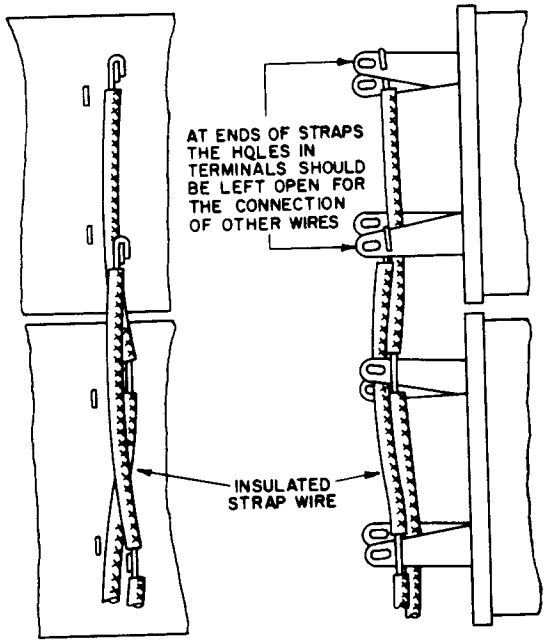
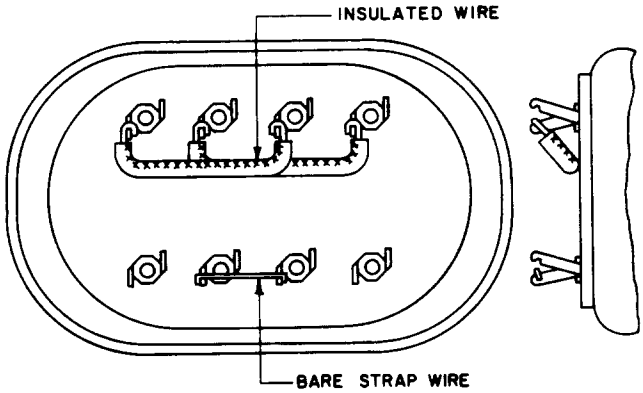
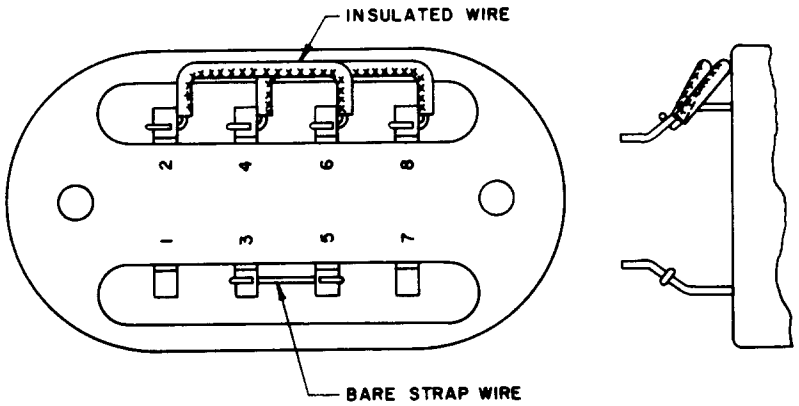


Fig. 16 – Straps on 229- and Similar-Type Multicontact Relays



62, 93 AND SIMILAR TYPE REPEATING COILS



94 AND SIMILAR TYPE REPEATING COILS

Fig. 17 – Straps on 62-, 93-, 94-, and Similar-Type Repeating Coils

Resistors – 18, 19, and Similar Types

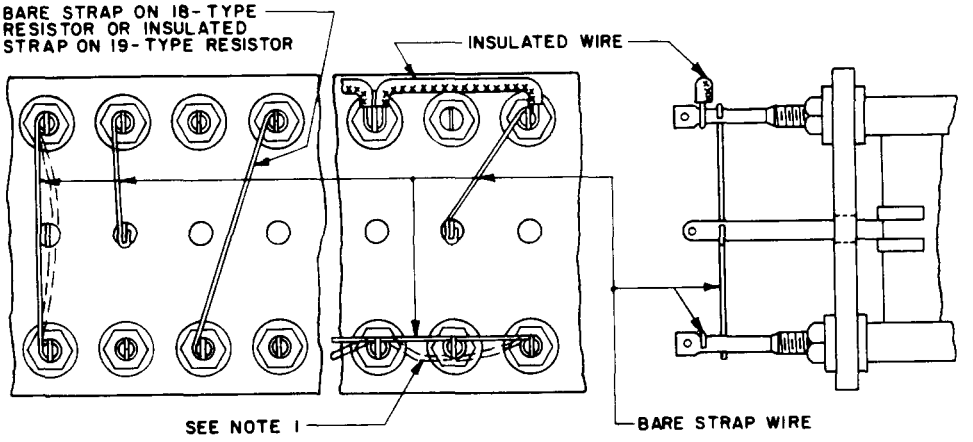
2.52 Strap as shown in Fig. 18.

Screw Terminals

2.53 Strap as shown in Fig. 19

Signals – 42 and Similar Types

2.54 Strap as shown in Fig. 20. Old style 42A signals, having terminals in the same line, require a formed strap with the horizontal part of the strap below the terminals.



RESISTORS WITH PERFORATED TERMINALS SHOWN (SEE NOTES 2 & 3)

NOTES:
1. THE COMMON BARE STRAP WIRE, CONNECTED TO THE UPPER SIDE OF THE RESISTOR POSTS (AS SHOWN BY SOLID LINES), MAY BE CONNECTED TO THE UNDER SIDE OF THE POST ON ALTERNATE RESISTORS (AS SHOWN BY DASH LINES). A SIMILAR ARRANGEMENT MAY ALSO BE USED WHEN APPLYING INDIVIDUAL STRAPS VERTICALLY TO THE TOP, MIDDLE AND BOTTOM POSTS OF THE SAME RESISTOR OR THE WIRE MAY BE WRAPPED AROUND THE MIDDLE POST.
2. WHERE RESISTORS HAVING TERMINALS DESIGNED FOR SOLDERLESS WRAPPED CONNECTIONS ARE FURNISHED AND THE EQUIPMENT IS IN THE SOLDERED CONNECTION CATEGORY, PLACE THE STRAPS SIMILAR TO THAT SHOWN FOR PERFORATED TERMINALS.
3. WHERE THE WIRE IS LAID ACROSS THE EDGE OF THE CENTER ROW OF TERMINALS ON 19-TYPE RESISTORS HAVING TERMINALS ARRANGED FOR SOLDERLESS WRAPPED CONNECTIONS, THE MIDDLE TERMINAL IS NOT ORIENTED AND AT TIMES PRESENTS ONLY MARGINAL CONTACT FOR SECURITY OF THE SOLDERED CONNECTION. IN SUCH CASES A FORMED LOOP IN THE WIRE SHOULD BE USED FOR COMMON STRAPS OR THE STRAPS SHOULD BE PLACED ON THE UNDERSIDE OF ALTERNATE TERMINALS. IN THE CASE OF INDIVIDUAL STRAPS, EITHER A FORMED LOOP OR A COMPLETE TURN OF WIRE AROUND THE TERMINAL MAY BE USED.

Fig. 18 – Straps on 18-, 19-, and Similar-Type Resistors

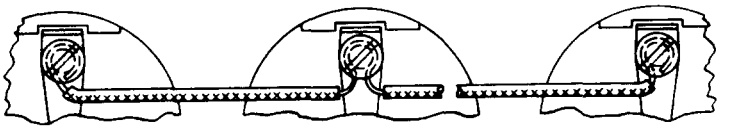


Fig. 19 – Straps on Screw Terminals

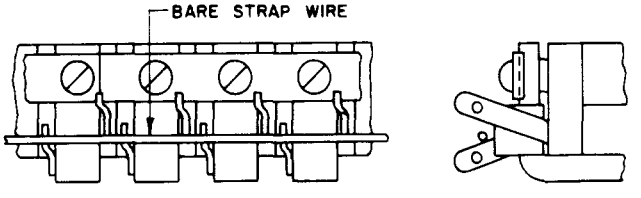


Fig. 20 – Straps on 42- and Similar-Type Signals

Switches – Crossbar

2.55 Strap crossbar switches in accordance with the requirements covered in Section 800-612-163.

Terminal Strips – Notched Type Terminals

2.56 Straps should ordinarily be No. 22 gauge, located as shown on wiring diagrams. Fig. 21 shows typical ways of placing straps on terminal strips.

2.57 Connect base straps approximately 1/8 inch from the base of terminals as shown in Fig. 21, except where conversion or other service changes make it necessary to provide a more readily accessible strapping arrangement. In the latter case, surface strapping is specified on the manufacturing circuit drawings and the straps should be connected at the outer notch of the terminal as also shown in Fig. 21.

(a) A regular strap between two adjacent terminals may be an extended skinner connection, as covered for surface straps in (c) below, provided there will be no other wiring terminating at the notch of the terminal to which the skinner is extended.

(b) Surface straps should not be specified for terminals having other wiring terminating at the notch, except for the terminal at which the common or feed wire for the group of terminals is terminated.

(c) Surface straps between two adjacent terminals in the same row perpendicular to the fanning strip may be an extended skinner connection as follows.

(1) Where the lead-in wire is to be terminated at the rear terminal of the two adjacent terminals, draw the bare wire into the notch of the rear terminal, wrap it one turn around the terminal, extend it to the notch of the front terminal, and complete the connection in the usual manner.

(2) Where the lead-in wire is to be terminated at the front terminal of the two adjacent terminals, draw the bare wire through the notch and along the side or over the top of the front terminal, extend it to the rear terminal, and wrap it one and one-half turns around the rear terminal at the notch.

(d) On terminal strips such as 140 type having terminals too short to obtain a 1/8-inch clearance between the strap and the base of the terminal, connect the strap in the notch of the terminal.

(1) Where the short terminals are twin notched (as on the 137B terminal strip), connect the strap in the notch nearest the base of the terminal strip.

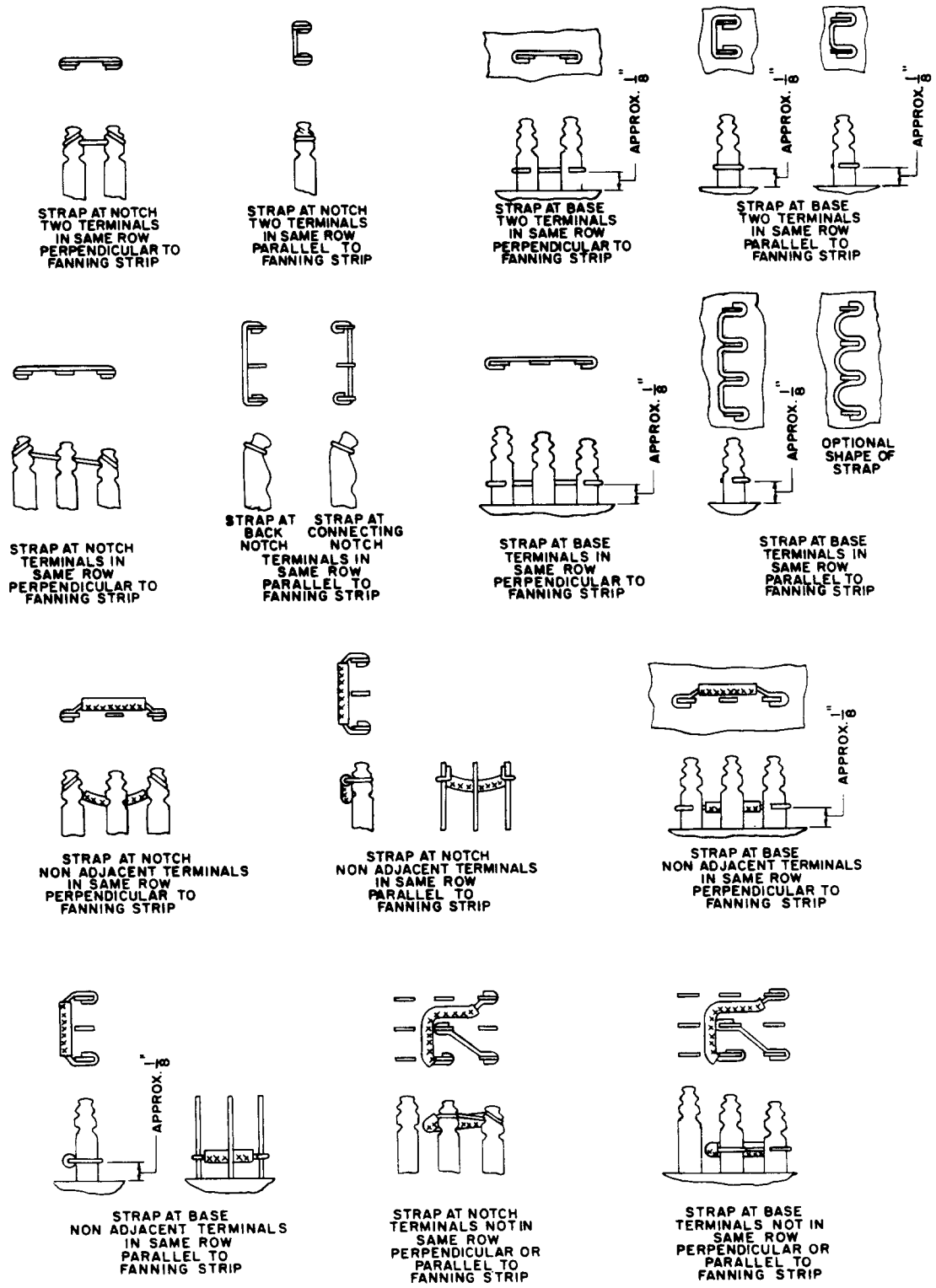
2.58 *Where rows of terminals are to be strapped to other rows of terminals,* and a particular consecutive arrangement must be maintained, use separate pieces of insulated strap wire between the strapped rows, as shown in Fig. 22.

2.59 *Where the connecting straps between rows of strapped terminals* would interfere with the regular wiring, run them on the rear of the fanning strip, as shown in Fig. 22. Straps may also be placed on the rear of the fanning strip to facilitate changing the connecting straps between terminals in different rows or where congestion would otherwise result if the straps were run directly between terminals.

2.60 Where necessary to strap common terminals located on two or more adjacent terminal strips on distributing frames, a loop lead ◗of No. 20 or 22 gauge type "BH" wire, or larger "AM" wire, should be run◖ from the highest-numbered terminal on one terminal strip to the lowest-numbered terminal on the other, through the fanning strip holes serving the rows of terminals involved. The leads between adjacent terminal strips should be run without appreciable slack but not taut.

(a) When strapping adjacent terminal strips on the horizontal side of toll distributing frames where the terminal strips are mounted vertically, the loop leads should be run from the insulating fanning hole in the terminal strip mounting bracket of one terminal strip to the similar fanning hole in the bracket of the adjacent terminal strip, instead of directly from fanning strip to fanning strip.

2.61 *Terminals With Hole and Notch:* When the manufacturing circuit drawings specify



NOTE:
THE LOCATION, CONNECTION AND DRESS OF STRAPS SHOWN ARE TYPICAL AND MAY BE VARIED TO SUIT PARTICULAR CONDITIONS.

Fig. 21 – Straps on Terminal Strips – Notched Terminals

straps to be placed on the local cable side of the terminal strip, the straps may be connected in the notch in back of the hole in the terminal (as shown in Fig. 23), instead of at the base of the terminal.

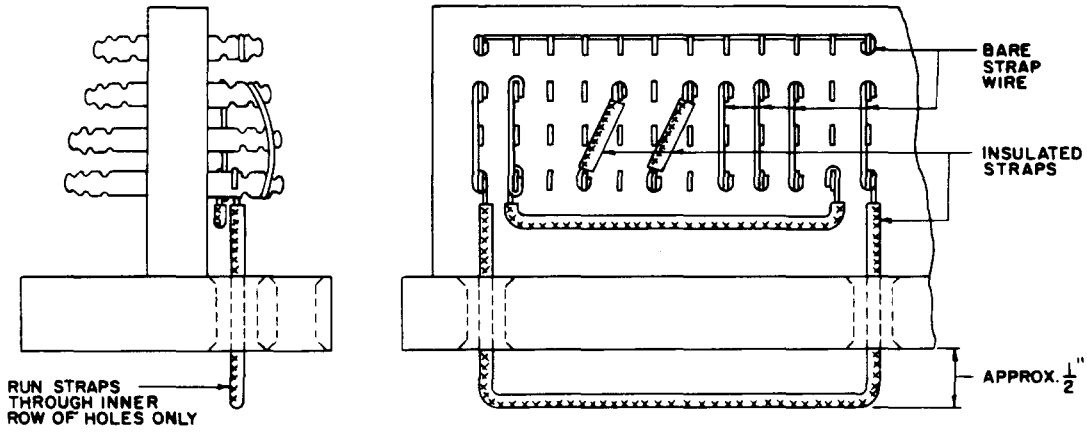
2.62 *165, 180, and Similar Types:* Strap as shown in Fig. 24.

2.63 *203A Type (16 Point)*

(a) *Use direct straps between terminals* in cases where the entire side of the terminal strip is free from incoming leads (reserved for strapping or cross-connections) and also in cases where there are only a few segregated incoming leads, thus leaving the major part of the strip clear for strapping. In these cases, the straps may be either soldered in the holes of the terminals or located back of the holes as shown in Fig. 25.

(b) *Use loop leads* where the entire side of the terminal strip or a major part of it is not clear for strapping.

(c) *Surface Wiring:* All connections between terminals on the same terminal strip should be run as surface wiring leads and dressed back



NOTE:
THE LOCATION AND CONNECTION OF STRAPS SHOWN ARE TYPICAL AND MAY BE VARIED TO SUIT PARTICULAR CONDITIONS

Fig. 22 – Straps Connecting Rows of Strapped Terminals on Terminal Strips

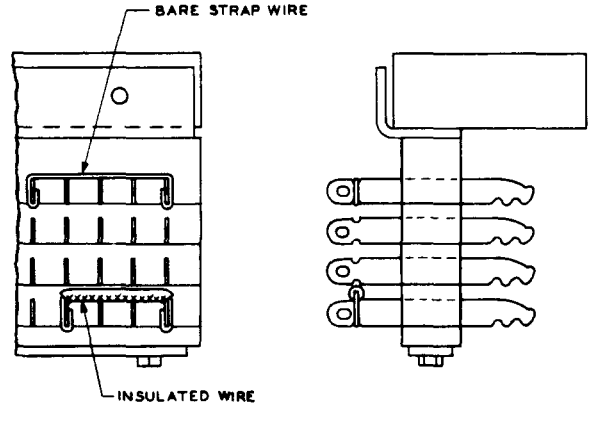


Fig. 23 – Straps on Local Cable Side of Terminal Strips – Terminals With Hole and Notch

to the plate with the other surface wiring, except as follows.

(1) Use bare strap wire between adjacent terminals.

2.64 *203B Type (8 point):* Strap as shown in Fig. 25. Use loop leads instead of straps, however, for connections between terminal strips.

2.65 *224 F and G Type (Cable Well Terminal Strip – Fabricated Type Perforated Terminals).* Strap as shown in Fig. 26.

3. REQUIREMENTS FOR CROSS-CONNECTIONS

A. Distributing Frame Wire

3.01 *Use No. 22 gauge type "U" distributing frame wire* for distributing frames in all offices except for single-conductor cross-connections which should be No. 20 gauge type "U" distributing frame wire. "Multiple twin" 4-conductor wire (U22M) should be used for quadded cross-connections such as on the line side of the transformers in phantom groups. It is not permissible to use spiral four (U22F) for this purpose.

(a) No. 20 gauge paired wire is used for metallic return PBX battery feeders.

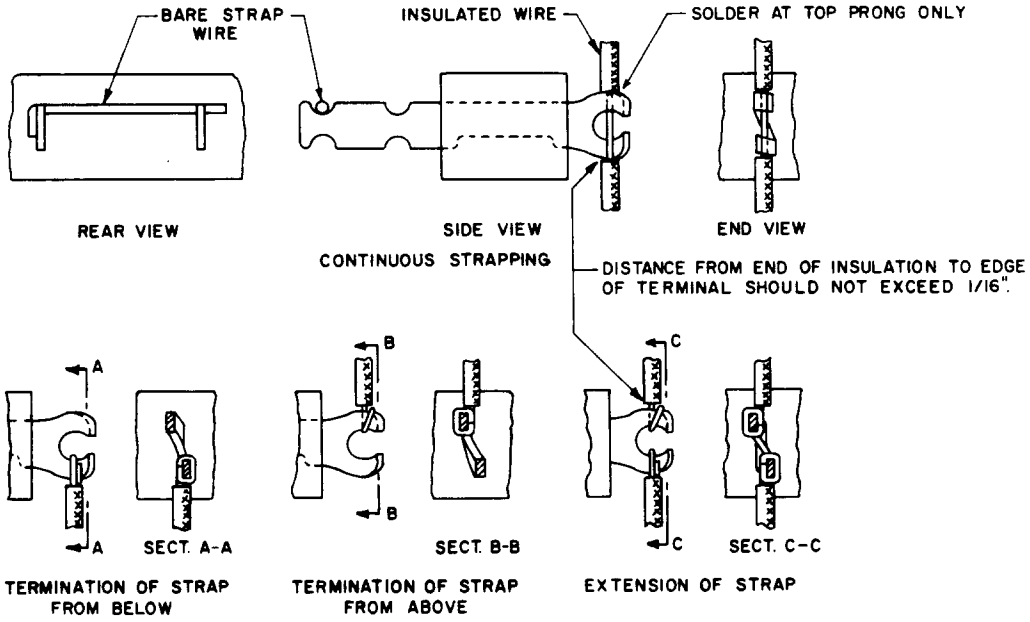


Fig. 24 – Straps on 165-, 180-, and Similar-Type Terminal Strips – Distributing Terminal Assemblies on Step-by-Step Frames

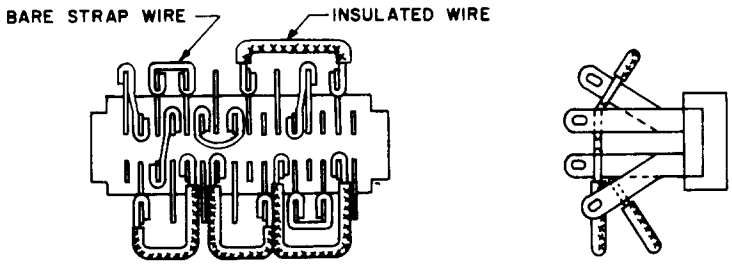
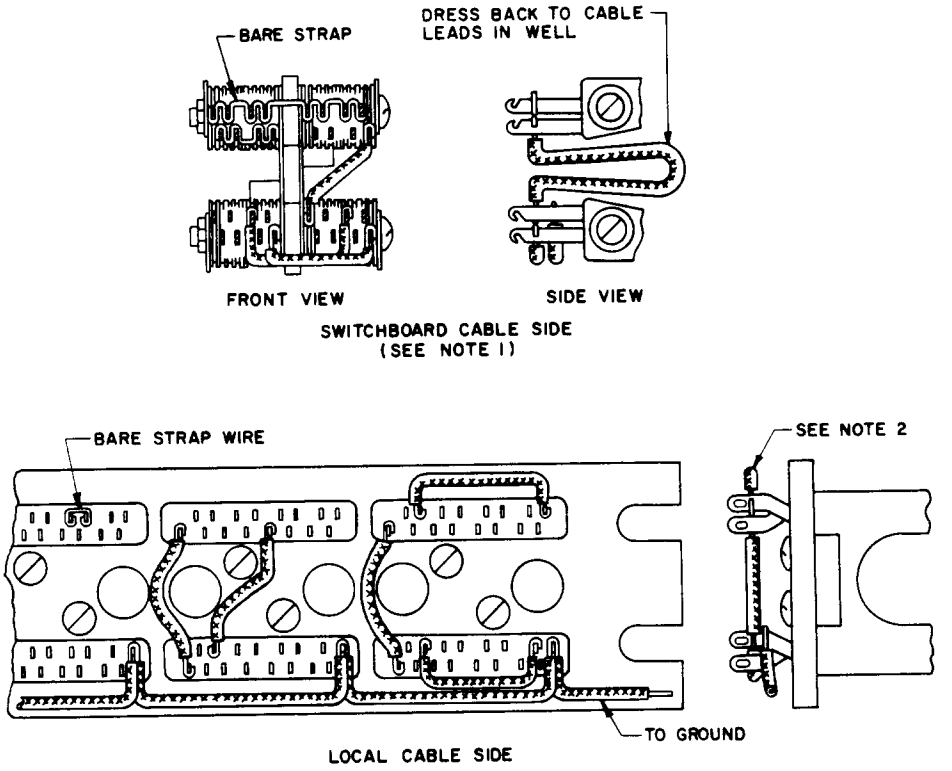


Fig. 25 – Straps on 203- and Similar-Type Terminal Strips



NOTES:
1. STRAPS RUN BETWEEN TERMINAL STRIPS ON THE APPARATUS SIDE OF THE BAY SHOULD BE PLACED IN THE WELL.
2. THE NUMBER OF STRAPS SHOULD BE KEPT TO A MINIMUM TO INSURE AGAINST PROJECTION BEYOND MOUNTING PLATE LINE.

Fig. 26 – Straps on 224 F- and G-Type Terminal Strips – Fabricated Type Perforated Terminals

3.02 When distributing frame wire is used for cross-connections, the colors used for particular conductors are as follows:

DISTRIBUTING FRAME WIRE	NO. OF COND	COLOR			
		TIP	RING	SLEEVE	LAMP OR MESS REG
(20 Ga)					
U20S	1	Brown			
U20P	2	Brown	Black-Brown		
(22 Ga)					
U22P	2	White	Black		
U22T	3	White	Black	Red	
U22F	4 (Spiral Four)	White	Black	Red	Green
		SIDE 1		SIDE 2	
		TIP	RING	TIP	RING
U22M	4 (Mult Twin)	Black-White	Black	Red	Green

B. Distributing Frame Cross-Connections

General

3.03 *Vertical to horizontal cross-connections* should be run up or down the vertical, through the distributing ring at the horizontal shelf on which the horizontal terminal is located, and thence along the shelf to the proper terminal.

3.04 *Horizontal shelf to a different horizontal shelf* cross-connections should be run through the distributing ring immediately behind one of the terminals, thence up or down the vertical side through the distributing ring at the other horizontal shelf, and thence to the proper terminal.

3.05 *Horizontal shelf to nonadjacent terminals on the same horizontal shelf* cross-connections should be run through the distributing ring immediately behind either terminal and thence along the shelf to the other terminal. (See 3.09.)

3.06 *Vertical to different vertical* cross-connections should be run through the nearest distributing ring, thence along a horizontal shelf to the distributing ring at the other vertical, and up or down to the proper terminal.

3.07 *Cross-connections between nonadjacent terminals on the same vertical* should be run up or down from one terminal through a convenient distributing ring, preferably one about midway to the other terminal. (See 3.09.)

3.08 *Cross-connections between adjacent terminals* on the same terminal strip should be made with No. 22 gauge bare strap wire.

3.09 *Cross-connections between nonadjacent terminals,* not more than 20 rows apart on the same or an adjacent terminal strip, should be made with distributing frame wire run parallel with the terminal strip and about 4 inches back of the fanning strip. Where possible, such cross-connections should be run under some of the regular cross-connections.

3.10 *On combination distributing frames* having horizontal to horizontal cross-connections, these cross-connections should leave and enter shelves through the regular distributing rings, but in passing vertically between shelves, they should be run to the right of the guide pins provided. The object is to draw the horizontal to horizontal cross-connections to the right side of the distributing rings to avoid congestion.

(a) 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 strips) to prevent sagging over the upper end of the protector fanning strip. Below the No. 3 ring, these cross-connections will naturally fall to the right of the guide pins referred to above.

3.11 *The cross-connections of single-sided distributing frames* are run similar 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.

3.12 *Arrange cross-connections* to prevent undue piling on the shelf and to avoid

interference with other cross-connections. In general, they should be run in the most direct way and on top of other cross-connections except under the following conditions.

(a) On the horizontal side of the frame, short cross-connections that do not extend beyond six bays to the right or left of the distributing ring shall be run underneath, but not necessarily at the bottom of the pileup.

(b) On the vertical side of the frame, short cross-connections that do not extend more than two horizontal shelves above or below the distributing ring shall be run behind other cross-connections.

3.13 *Three or four inches of slack should* be left in all cross-connections, the slack to be dressed back from the terminal strip.

(a) *In crossbar offices, cross-connections on office, district, and line junctor grouping frames* should be run without slack, but not taut.

(b) *In crossbar offices, cross-connections on line distributing frames and traffic register distributing frames* should be provided with 1 to 2 inches of slack, the slack to be dressed straight back at the rear of the horizontal terminal strips. In the case of cross-connections pulling through closed rings, enough slack should be provided to allow the cross-connections to lie flat on the shelf.

(c) *On toll trunk distributing frames* having terminal strips on the horizontal side mounted vertically, cross-connections should be provided with 3 to 4 inches of slack dressed back from the grommet in the terminal strip supporting bracket.

3.14 *On HIDF terminal strips equipped with three rows of additional terminals,* cross-connect the vacant final or connector terminals to the intercepting trunks as follows.

(a) The T1, R1, and S1 terminals in the group associated with one intercepting trunk should be strapped with No. 22 gauge bare straps placed on the cable side of the terminal strips (lower side). Extension of these straps between adjacent terminal strips should be with No. 20 ◗or 22 gauge◖ "BH" wire run through the fanning holes on the underside of block and looped close to terminal strip support details. Extension of these straps to nonadjacent terminal strips should be with distributing frame wire run in the standard manner, except with the T and S colors reversed.

(b) Terminate the cross-connection from the intercepting trunk on the cable side of the terminal strip.

(c) The vacant terminals should be strapped to the intercepting trunk terminals as required, depending upon whether the calls are arranged to be routed to an operator or to an announcement machine. Unsoldered hand-wrapped connections should be made as shown in Fig. 27. The ends of the strap shall be tightly wrapped two and one-half turns clockwise on the rear terminal and two and one-half turns counterclockwise on the front terminal.

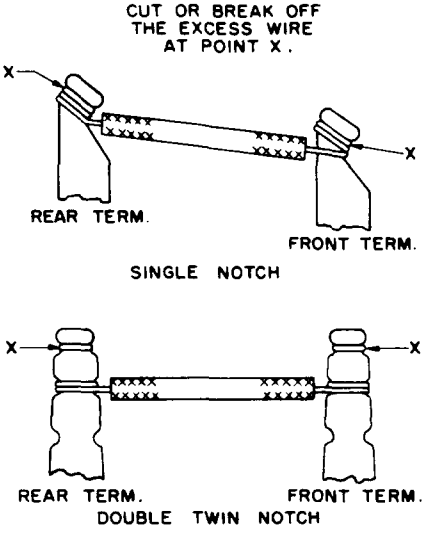


Fig. 27 – Termination of Intercepting Straps on HIDF Terminal Strips for Unsoldered Connections (Step-by-Step)

Step-by-Step Offices

(1) *Calls Routed to Operator:* Use three P-450295 (24 ga) straps for unsoldered connections or three P-420380 (22 ga) straps for soldered connections. Connect these

straps T to T1, R to R1, and S to S1 in the order named.

(2) *Calls Routed to Announcement Machine:* Use a P-30A390 (24 ga) strap to connect the regular ring terminal to the intercepting tip terminal (R to T1). Use a P-30A389 (24 ga) strap to connect the regular tip terminal to the intercepting ring terminal (T to R1). Use a P-450295 (24 ga, unsoldered connection) or a P-420380 (22 ga, soldered connection) strap to connect the regular sleeve terminal to the intercepting sleeve terminal (S to S1). Make the connections in the order named.

Panel Offices

(1) Except for the order of connecting, the vacant terminals should be strapped as described above for step-by-step offices. Since an open sleeve will cause terminal hunting of any final selector that may be directed to an unguarded terminal, these straps should be connected as follows.

(2) *Calls Routed to Operator:* Connect S to S1, R to R1, and T to T1 in the order named, unless otherwise specified.

(3) *Calls Routed to Announcement Machine:* Connect S to S1, R to T1, and T to R1 in the order named, unless otherwise specified.

3.15 *On terminal strips not equipped with three rows of additional terminals,* cross-connect the intercepting trunk to both the first and last sets of terminals in the group assigned to it. Terminate these cross-connections on the cross-connections side of the terminal strips and reverse the T and S colors to distinguish them from working lines.

(a) Nonadjacent vacant terminals should be connected together with No. 22 gauge distributing frame wire run parallel to the terminal strips about 4 inches back. The T and S colors of these cross-connections are also reversed.

C. Frame Cross-Connections (Other Than Distributing Frames)

3.16 Type, gauge, and color of wire used have been included on more recent SD drawings. Whenever existing SD drawings are reissued, consideration should be given to the inclusion of this type of information.

Step-by-Step Frames

3.17 Cross-connections at the distributing terminal assemblies of selector frames should not be taut, but the amount of slack should be kept to a minimum so that the cross-connections will stay in place in the cross-connection rings. This requirement will generally be met by the provision of 1 inch of slack in the cross-connections.

Panel Decoder Frames, Crossbar Marker, Block Relay, Other Crossbar Frames, and AMA Cabinets Employing Terminal Strip Cross-Connections

3.18 *Cross-connections between terminals on the same terminal strip* should be made with bare No. 22 gauge tinned copper wire where the terminals are adjacent (except as otherwise covered below), and with insulated wire where the terminals are not adjacent.

(a) On crossbar frames, where the terminals to be connected together are in different vertical rows (that is, rows perpendicular to the fanning strip), the cross-connections, whether between adjacent or nonadjacent rows, should be run through the fanning strip as shown for strap connections in Fig. 22. Where the number of cross-connections involved is such as to cause congestion if all wires are passed through the inner fanning strip holes, the outer set of holes also may be used.

(1) On terminal strips without fanning strips, these cross-connections should be dressed to the top or bottom of the terminal strip and carried horizontally to the row in which the terminal to be connected is located.

(2) On incoming trunk test connector frames, adjacent terminals in adjacent vertical rows (that is, adjacent terminals in the same horizontal row) are connected together as required with bare strap wire.

3.19 *Cross-connections between terminals on different terminal strips* should be made with No. 22 gauge type "K" wire. All cross-connections should be run through the

fanning strip hole associated with the particular row of terminals to which they connect. Red, white, black, brown, and green singles are available for this purpose.

3.20 *Cross-connections should be run without slack*, but not taut.

3.21 All cross-connections should be terminated in the notch of the terminal.

Block Relay Frame and Number Group Frame – NF and NC Fields

3.22 *Where several terminals are to be connected to one cross-connection point*, strapping should not be used, but separate cross-connections should be run from the common terminals to each of the terminals to be connected. Run only one wire to any one terminal other than the common terminals.

No. 1 Crossbar Originating Marker and Panel Decoder Frames – C Fields

3.23 *When a group of adjacent terminals in the same vertical row (that is, a row perpendicular to the fanning strip) are to be connected to one cross-connection point*, the cross-connecting wire should be run first to the farthest terminal in the group, the end stripped bare, and then connected as a strap to the remaining terminals of the group as shown in Fig. 28.

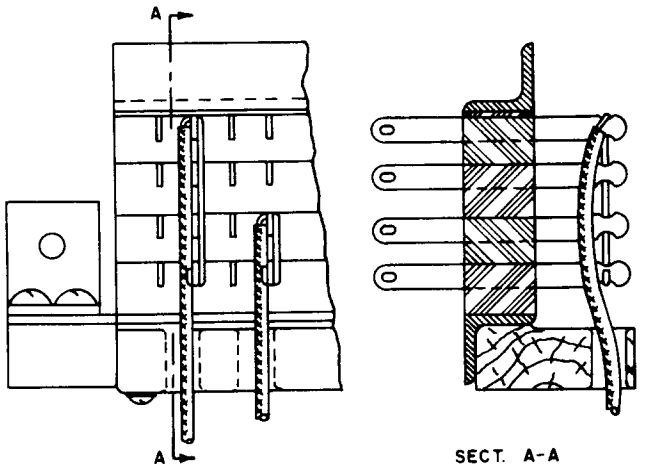


Fig. 28 – Connecting One Cross-Connecting Wire to a Group of Adjacent Terminals

3.24 *Where nonadjacent terminals in the same vertical row are to be connected to one cross-connection point*, separate cross-connections should be run from the common terminals to each of the terminals to be connected.

3.25 *Where terminals in different vertical rows are to be connected to one cross-connection point*, they should be connected together by means of strapping within the vertical row, and a cross-connection wire run from each such row to the common terminal (decoder type) strip.

Other Crossbar Frames

3.26 Make cross-connections as specified in the supplementary specifications and drawings for the particular type of frame.

Panel Decoder Frame

3.27 Use white, black, and red wire for the lower, middle, and upper rows, respectively, of three-row terminal strips.

3.28 On code group terminal strips use:

(a) White for rows No. 1 to 8 and 10 to 17, inclusive.

(b) Black for row designated RC.

(c) Red for the three rows numbered 9.

(d) Brown for the extra routing required on tandem frames.

3.29 Where two or more terminals are strapped together and served by one cross-connection, use the color for the row of terminals at which the insulation terminates.

Program Transmission Bays

3.30 On program transmission equipment bays, 1- to 1-1/2 inch slack should be provided in cross-connections in the cross-connection ducts.

4. REQUIREMENTS FOR STRAPPING USING SOLDERLESS MACHINE-WRAPPED CONNECTIONS

A. General

4.01 The connection shall be made in accordance with the requirements for solderless machine-wrapped connections as covered in Section 800-612-154.

4.02 It will not be necessary to differentiate between individual and common straps because solderless wrapping precludes the use of common strapping.

4.03 The use of loop leads shall be the same as for soldered straps. See 2.01.

4.04 Either insulated or bare wire may be used depending upon the clearance between the straps and other terminals or uninsulated metalwork. See 2.04.

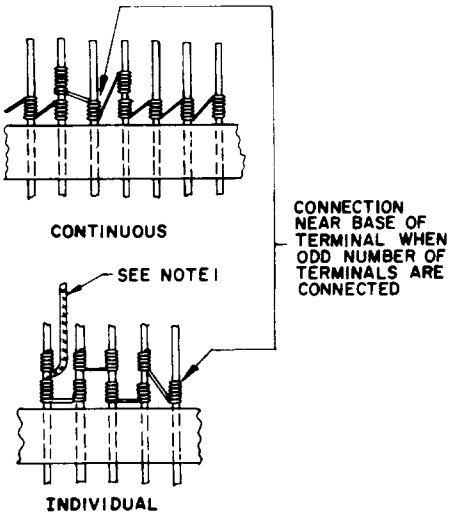
4.05 *Size of Wire for Straps:* The size of wire used for solderless wrapped connections is limited to No. 20, 22, ◗24, and 26 gauge in accordance with Section 800-612-154. Where◖ larger gauge of wire is specified, the connection shall be soldered.

4.06 The arrangement, placing, and dressing of straps shall be the same as covered in 2.06 and 2.07 for soldered connections, except as follows.

(a) When four or more terminals are interconnected by means of a strap wire (insulated or bare), it is desirable that the wire ends be connected so that a minimum number of wires need be disconnected when future changes are made in the grouping of the terminals or when a piece of apparatus has to be replaced. This can be accomplished as shown in Fig. 29 and 30.

(b) When insulated straps are used, they are usually of sufficient length to minimize the difficulty of connecting with short pieces of wire. The slack is disposed of as covered herein under specific apparatus.

4.07 In general, the length of terminals designed for solderless wrapped connections (except for terminal strips) is limited to two solderless wrapped connections. In such cases, when two incoming leads are connected to a group of terminals on the same piece of apparatus which are strapped together, one of the incoming leads should be connected to the first strapped terminal and the other to the last strapped terminal.



◗Fig. 29 – Arrangement of Straps When Four or More Terminals Are Interconnected – (Bare Straps Shown)◖

B. Strapping Specific Apparatus

Relays

4.08 *Wire-spring relays (general purpose)* should be strapped as shown in Fig. 30.

4.09 *Multicontact relays 286, 287, and similar types* shall be strapped in accordance with the requirements covered in Section 800-612-163.

4.10 *U-, Y-, and Similar-Type Relays:* When the terminals are arranged for solderless wrapping, the straps shall be placed as shown in Fig. 31.

Resistors

4.11 *Resistors – 18 and 19 types* should be strapped as shown in Fig. 32.

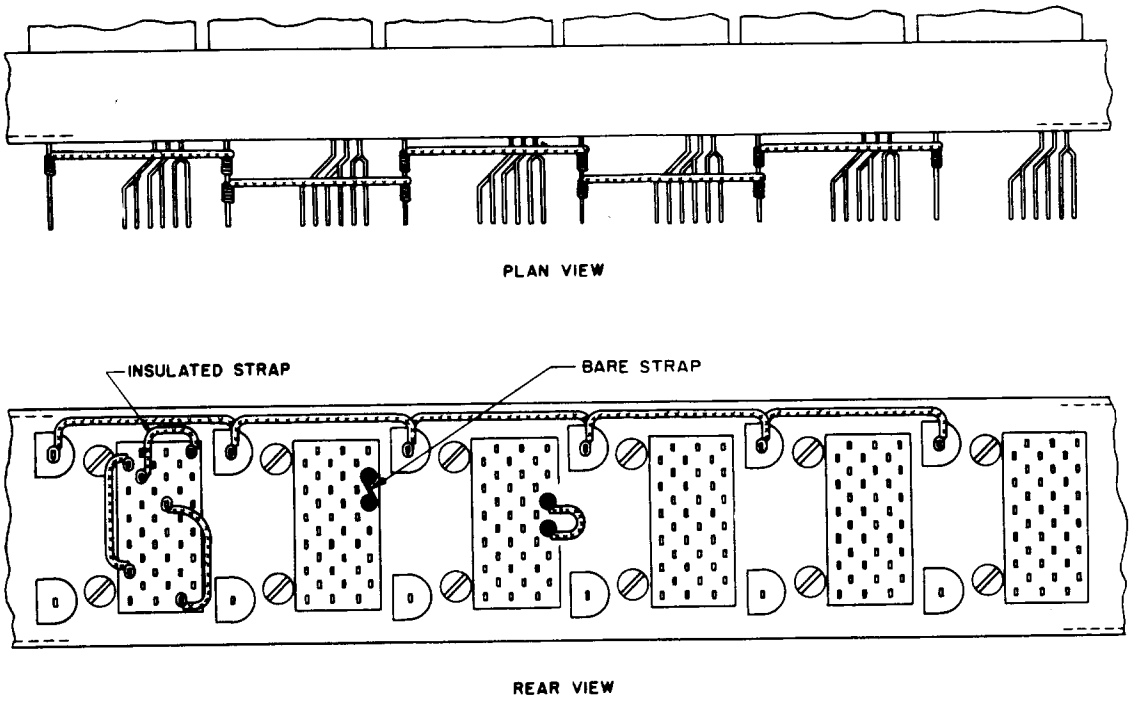
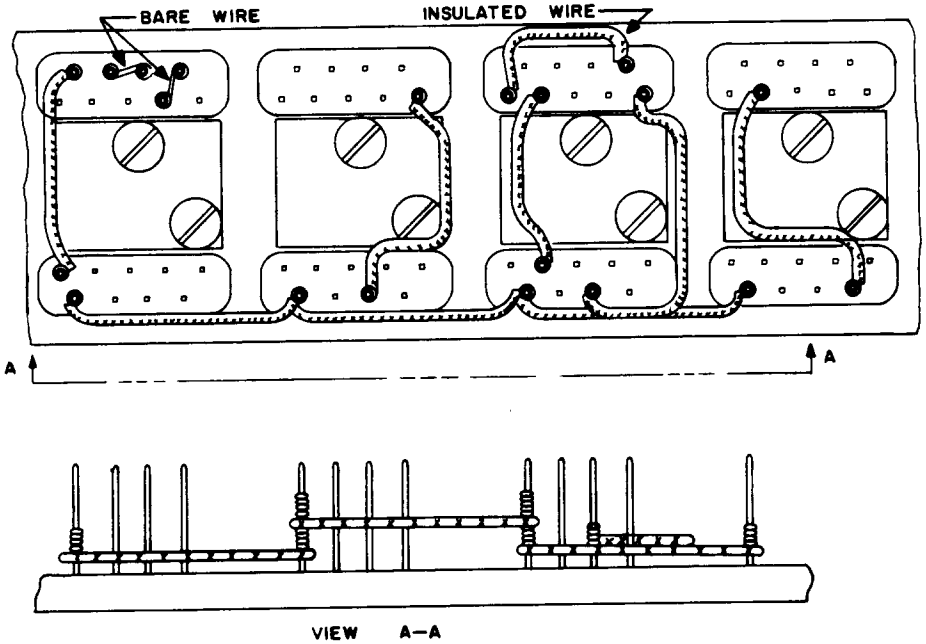


Fig. 30 – Straps on Wire-Spring Relays (General Purpose) Local Cable Wired



◗Fig. 31 – U-, Y-, and Similar-Type Relays◖

Switches – Crossbar

4.12 *324- and similar-type switches* shall be strapped in accordance with the requirements covered in Section 800-612-163.

Terminal Strips

D- and Similar Types

4.13 Straps on rear (wiring side) shall be placed as shown in Fig. 33. This lead dress is parallel to the local cable lead dress specified in Section 800-612-160. Straps shall not obstruct the wire throat of the terminal strip through which switchboard cable leads will be carried later. Bare straps should not interfere with regular wiring.

4.14 Straps on front (apparatus side) should be made with loop leads as shown in example (A) of Fig. 33 in those cases where switchboard cable will also be connected. Where no switchboard

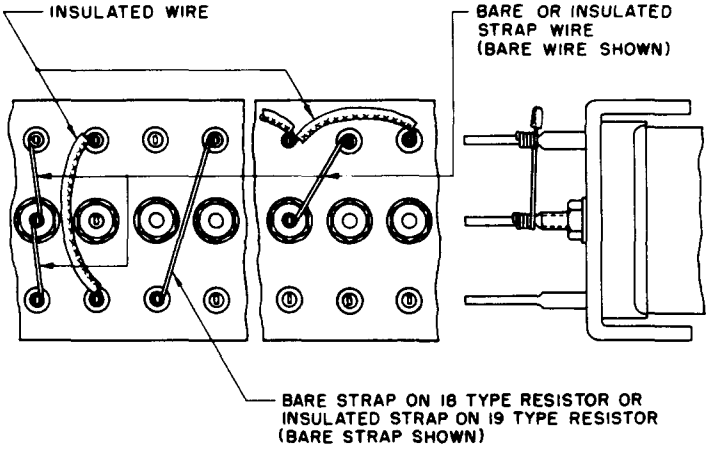


Fig. 32 – Straps on 18- and 19-Type Resistors

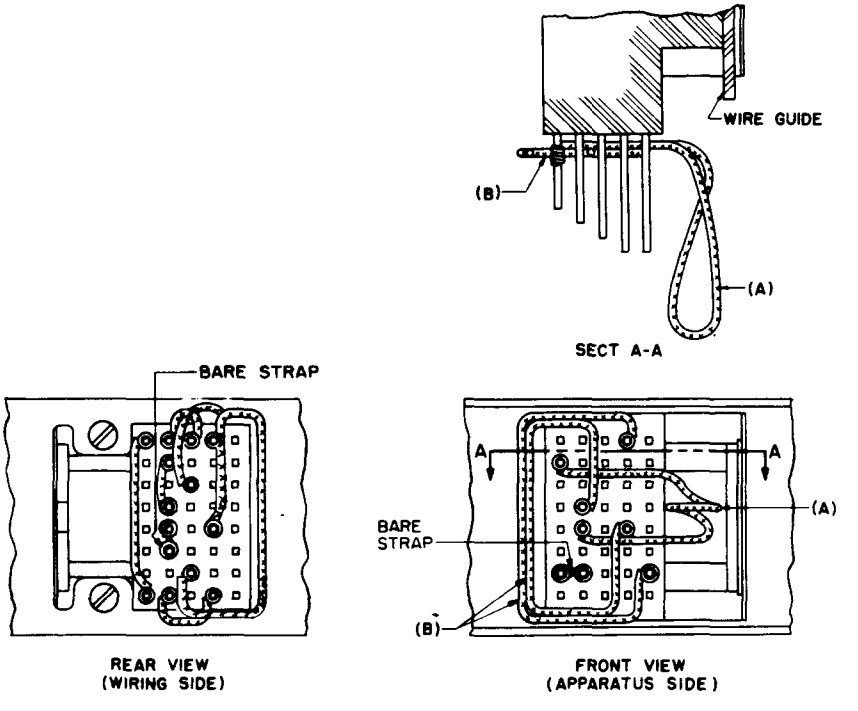


Fig. 33 – Strapping on D- and Similar-Type Terminal Strips

cable wires are connected to the terminal strip, the straps may be run vertically between the rows of the terminals, horizontally above and below the top and bottom rows, and vertically over the space between the terminal strip and adjacent apparatus, as shown in example (B) of Fig. 33. Bare straps are permitted on the front in either case unless they would interfere with regular wiring. If interference with the regular wiring would result from bare strapping, loop straps should be used.

4.15 *224-A and B (Molded Type):* Strap as shown in Fig. 34.

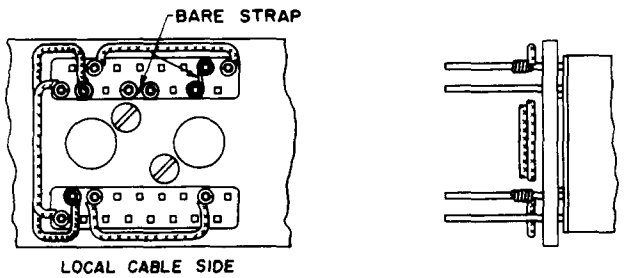


Fig. 34 – 224 A and B Terminal Strips (Molded Type)

4.16 *251, 252, and Similar Types:* To facilitate making future changes in the grouping of terminals, place the connections, as shown in Fig. 29, when four or more terminals are strapped together with either insulated or bare straps.

4.17 *Adjacent Terminals:* Connect with bare wire as shown in example (A) of Fig. 35 unless they would interfere with regular wiring. If interference with the regular wiring would result from direct strapping, loop the straps through the inner fanning strip holes, as shown in example (D) of Fig. 35.

4.18 *Nonadjacent Terminals in Same Row Perpendicular to Fanning Strip:* Run strap directly between the terminals as shown in example (B) of Fig. 35. Provide sufficient slack to prevent wires being drawn tightly across the intermediate terminals to which they are not connected.

4.19 *Nonadjacent Terminals in Different Rows:* Run insulated straps directly between the terminals, as shown in example (C) of Fig. 35, unless they would interfere with the regular wiring. If interference with the regular wiring would result from direct strapping, loop the straps through the inner fanning strip holes, as shown in example (D) of Fig. 35. The loops should project approximately 1/2 inch beyond the outside of the fanning strip. On terminal strips without fanning strips, these straps should be dressed to the top or bottom of the strip and carried horizontally to the row in which the terminal to be connected is located.

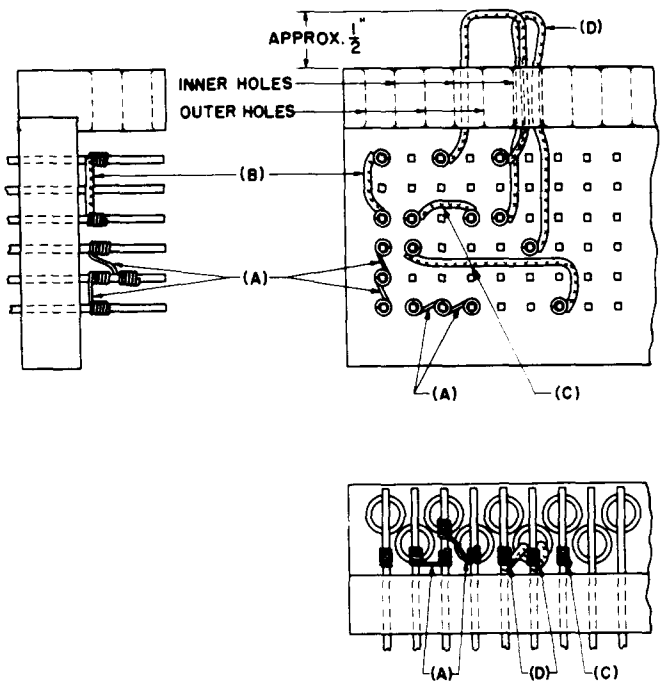


Fig. 35 – Strapping on 251-, 252-, and Similar-Type Terminal Strips

Distributing Frame Terminal Strips

4.20 Straps applied on the base portion of the terminal, in the notch provided, shall be soldered. There shall be no solder or flux on the wire-wrap portion of the terminal.

4.21 *Adjacent Terminals in Same Row Perpendicular to Fanning Strip:* Connect with bare wire as shown in Fig. 36.

4.22 *Adjacent Terminals in Same Row Parallel to Fanning Strip:* May be connected with bare wire when it will not be required to run switchboard cable leads or insulated straps over or under the bare straps. See examples of permissible and nonpermissible situations in Fig. 37.

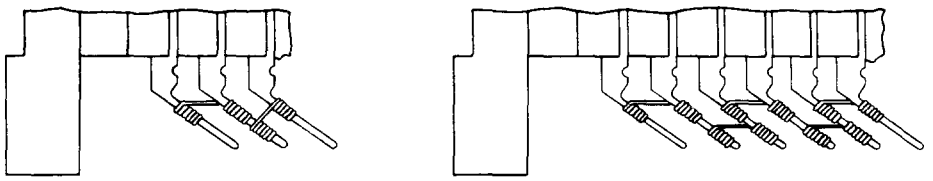


Fig. 36 – Adjacent Terminals in Same Row Perpendicular to Fanning Strip – Distributing Frame Terminal Strips

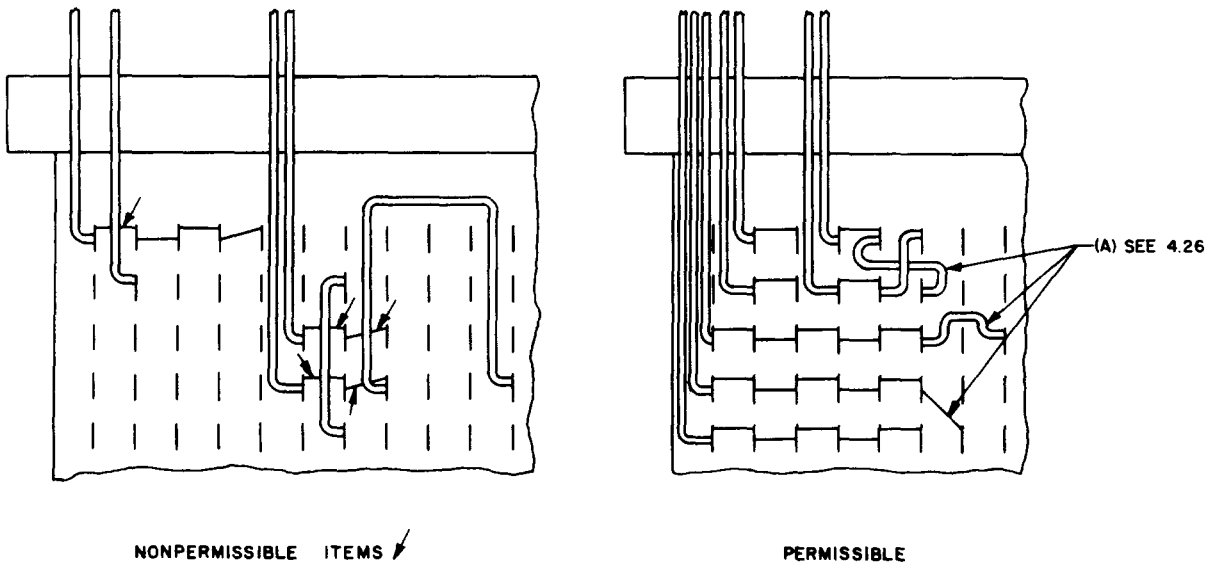


Fig. 37 – Typical Layouts – Distributing Frame Terminal Strips

4.23 Adjacent terminals should be connected with insulated straps when the conditions set forth for bare straps in 4.22 cannot be applied. Insulated loop straps may be used when direct insulated strapping would prove difficult to apply.

(a) On terminal strips having fanning strips where the inner fanning hole is 1/2 inch or more from the base of the pileup, insulated loop straps should be run and dressed to the fanning strip as shown in example (A) of Fig. 38.

(b) On terminal strips having fanning strips where the inner fanning hole is less than 1/4 inch from the base of the pileup, insulated loop straps should be run through the inner fanning holes and dressed approximately 1/2

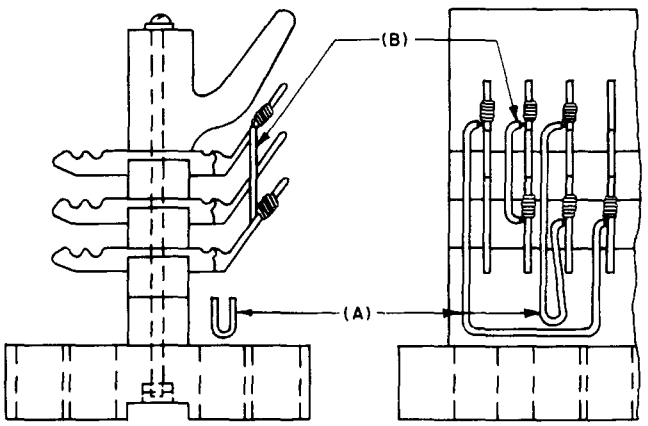


Fig. 38 – Nonadjacent Terminals in Same Row Perpendicular to Fanning Strip – Distributing Frame Terminal Strips

inch to the rear of the fanning strip as shown in example (A) of Fig. 39.

4.24 *Nonadjacent Terminals in Same Row Perpendicular to the Fanning Strip:* Connect with insulated straps as shown in example (B) of Fig. 38 and 39.

4.25 *Nonadjacent Terminals in Same or Different Rows Parallel to the Fanning Strip:* Insulated loop straps shall be run per example (A) of Fig. 38 and 39 dependent upon the proximity of the fanning holes to the base of the pileup. See 4.23.

4.26 Bare or insulated direct straps may be run as shown in example (A) of Fig. 37 provided the conditions set forth in 4.22 can be met.

5. REQUIREMENTS FOR CROSS-CONNECTIONS USING SOLDERLESS MACHINE-WRAPPED CONNECTIONS

A. Common Requirements

5.01 *Type, gauge, and color of cross-connection wire* should be determined from the supplementary specifications and drawings for particular types of frames.

5.02 *Connecting Cross-Connections:* The connection shall be made in accordance with the requirements for solderless machine-wrapped connections covered in Section 800-612-154.

B. D-Type Terminal Strips

5.03 *Running Cross-Connections:* Cross-connections at D-type terminal strips shall be run and connected on the front (apparatus side) of the terminal strip.

5.04 *Cross-Connections Between Terminals on Same Terminal Strip:* When cross-connections are required between terminals on the same terminal strip, run them between the vertical rows of terminals and then horizontally above the top row and below the bottom row of terminals. Between the top and bottom rows of terminals, run the cross-connections vertically and to the left side of the terminal strip over the area between adjacent terminal strips. See example (A) of Fig. 40. If there is insufficient space between adjacent terminal strips to permit running cross-connections as indicated in example (A), the cross-connections may be run as indicated in example (B) of Fig. 40. To provide sufficient handling length for wire wrapping, run the loop in example (B) to the longer location of above top row or below the bottom row of terminals.

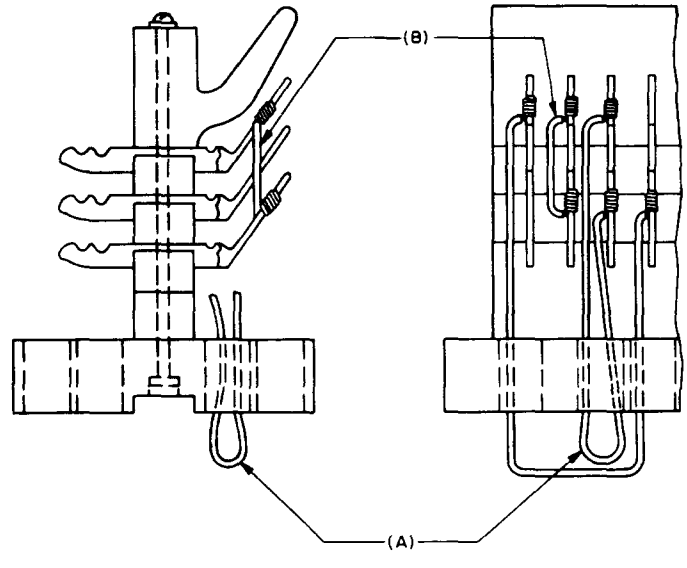


Fig. 39 – Nonadjacent Terminals in Same or Different Rows Parallel to Fanning Strip – Distributing Frame Terminal Strips

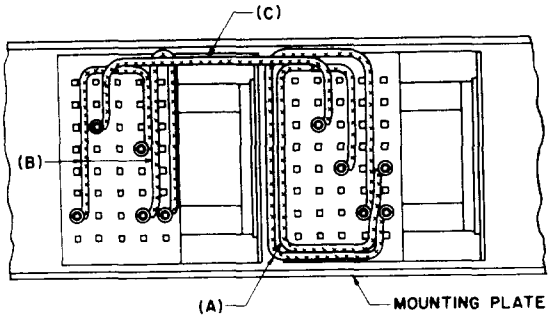


Fig. 40 – Cross-Connections – D-Type Terminal Strips on Same Mounting Plate

5.05 *Cross-Connections Between Terminal Strips on Same Mounting Plate:* When cross-connections are required between terminals on different terminal strips on the same mounting plate, run the cross-connections horizontally above the top or below the bottom rows of terminals between terminal strips and then vertically between the terminals to the desired terminals. See example (C) of Fig. 40.

5.06 *Cross-Connections Between Terminal Strips on Different Mounting Plates:* When cross-connections are required between terminal strips on different mounting plates, run the cross-connections horizontally above the top or below the bottom row of terminals to the terminal strip in the position nearest the frame upright. At this point, the cross-connection wire is run around the wire guide and then run vertically to the mounting plate on which the other terminal strip is located. The cross-connection wire is then run around the wire guide on the terminal strip nearest the frame upright and run horizontally above the top or below the bottom row of terminals to the terminal strip on which the cross-connection is terminated. Weave the cross-connection wire only through the wire guide slots of the terminal strips located near the frame upright at the top and bottom of the vertical run, as shown in Fig. 41.

C. 251-, 252-, and Similar-Type Terminal Strips

5.07 When two or more terminals in a row perpendicular to the fanning strip are connected together and served by a single cross-connection, the cross-connection should be connected to the terminals closest to the fanning strip in the group. See example (A) of Fig. 42 and 44. When the terminals to be connected are parallel to the fanning strip, connect per example (B) of Fig. 42. It is preferable to connect the cross-connection wire between terminal strips before connecting the cross-connections within the same strip.

Cross-Connections Between Terminals on Same Terminal Strip

5.08 *Adjacent terminals in same row perpendicular to fanning strip* shall be connected together with No. 24 gauge bare wire. To connect four or more terminals together, make the connections as shown in example (C) of Fig. 42.

5.09 *Adjacent Terminals in Same Row Parallel to Fanning Strip:* Run insulated cross-connection wire through the inner fanning strip holes with a loop extending approximately 1/2 inch beyond the outside edge of the fanning strip. See example (A) of Fig. 43. When the capacity of the inner fanning strip holes is exceeded, it is permissible to use the outer holes for the excess loops.

5.10 *Nonadjacent Terminals in Same Row Perpendicular to Fanning Strip:* Run No. 24 gauge, black, type ◗"C",◖ "BG", "BW", or "BU" wire directly between the terminals. Provide sufficient length of wire to insure that wire is not drawn tightly over the intermediate terminals to which it is not connected. See example (C) of Fig. 43.

5.11 *Nonadjacent Terminals in Same or Different Rows Parallel to Fanning Strip:* Loop insulated cross-connection wire through inner fanning strip holes with the loop extending approximately 1/2 inch beyond the outside edge of the fanning strip. See example (B) of Fig. 43. When the capacity of the inner fanning strip holes is exceeded, it is permissible to use the outer holes for the excess loops.

Cross-Connections Between Terminals on Different Terminal Strips

5.12 *Cross-Connections Between Terminal Strips Mounted Horizontally on Same Mounting Bar:* Loop insulated cross-connections wire through the fanning strip holes associated with the rows in which the terminals are located with the

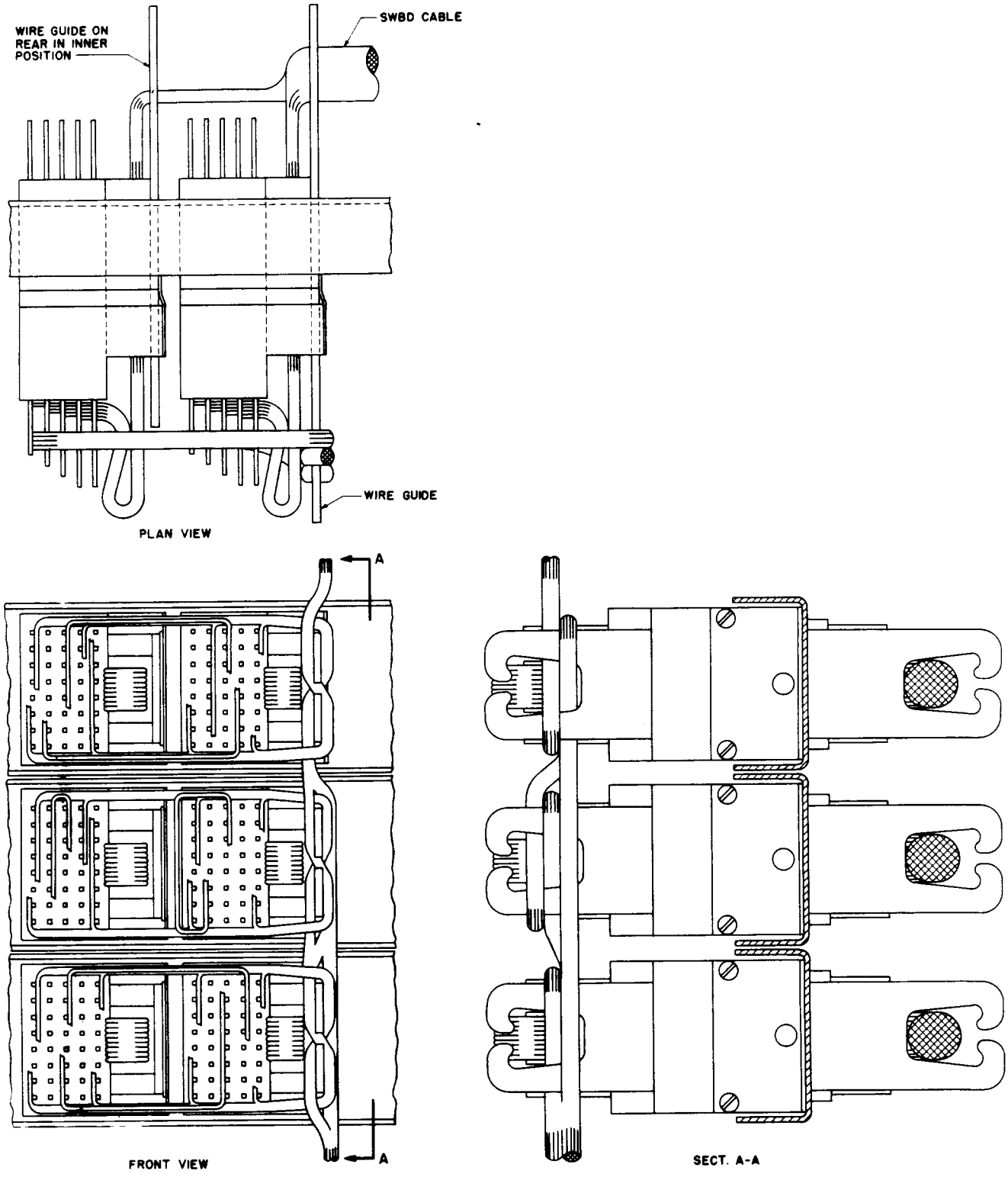


Fig. 41 – Cross-Connections Between D-Type Terminal Strips on Different Mounting Plates

loop extending approximately 1/2 inch beyond the outside of the terminal strip at each end of the wire. See example (B) of Fig. 44.

5.13 *Cross-Connections Between Terminal Strips Mounted on Horizontal Bars One Above the Other, or Mounted on Vertical Bars Opposite*

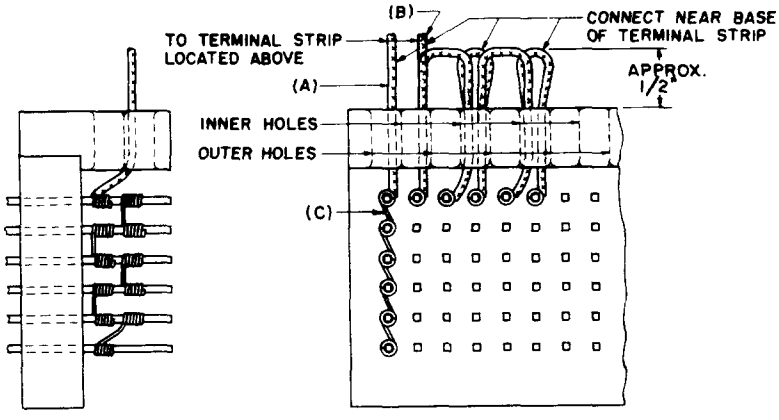


Fig. 42 – Cross-Connections – 251-, 252-, and Similar-Type Terminal Strips

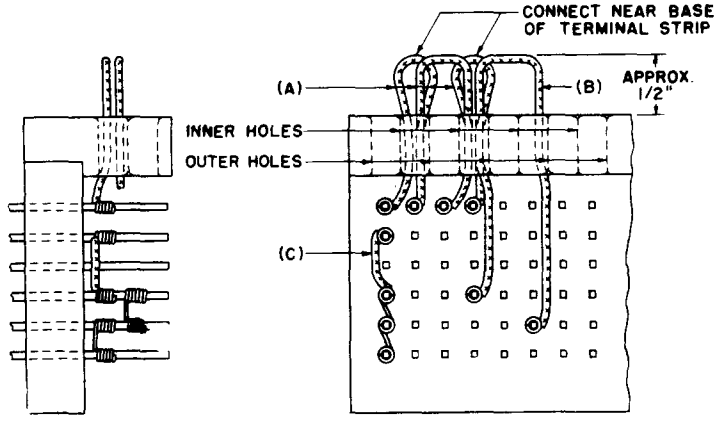


Fig. 43 – Cross-Connections – 251-, 252-, and Similar-Type Terminal Strips – On Same Terminal Strip

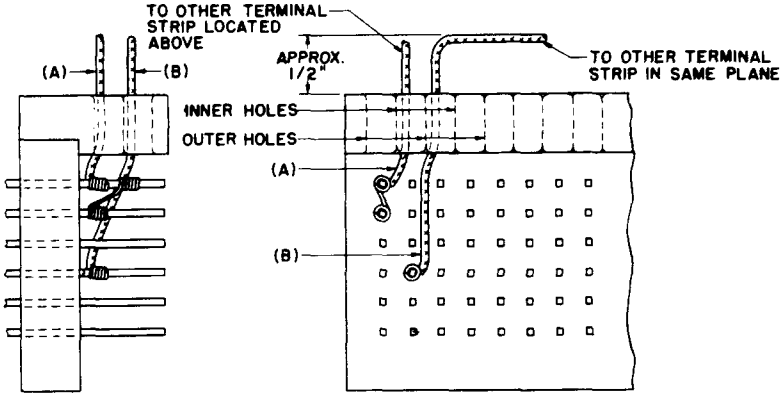


Fig. 44 – Cross-Connections – 251-, 252-, and Similar-Type Terminal Strips – On Different Terminal Strips

Each Other: In either case, run the cross-connections directly between the terminal strips except when fanning rings or wire retainers are provided for the cross-connections. Use the fanning strip holes associated with the rows in which the terminals are located. Run these cross-connections without slack, but not taut.

(a) When fanning rings or wire retainers are provided, distribute the cross-connections through rings or retainers as specified on frame drawings.

6. ▶REQUIREMENTS FOR CROSS-CONNECTIONS USING QUICK-CONNECT CONNECTORS

A. Connections

6.01 The connection shall be made in accordance with the requirements for quick-connect connections covered in Section 800-612-154.

B. Distributing Frame Wire

6.02 Use No. 22 gauge type "W" distributing frame wire for distributing frames equipped with quick-connect terminals.

6.03 When "W" distributing frame wire is used for cross-connections, the colors used for particular conductors are as follows with the yellow and blue wires used for tip and ring respectively.◀

DISTRIBUTING FRAME WIRE	NO. OF COND	COLOR			
		WIRE NO. 1	WIRE NO. 2	WIRE NO. 3	WIRE NO. 4
W22S	1	Brown			
W22P	2	Yellow	Blue		
W22T	3	Yellow	Blue	Orange	
W22F	4 (Spiral Four)	Yellow	Blue	Orange	Brown
		Pair No. 1		Pair No. 2	
W22M	4 (Mult Twin)	Yellow	Blue	Orange	Brown

REASONS FOR REISSUE

1. 1.01 covering general information was revised to add reference to electronic apparatus in Section 800-612-150.

2. Former 2.01 covering definitions of straps was moved to 1.06.

3. 2.01 covering the use of loop leads was revised for clarity.

4. 2.04 covering the kinds of wire for straps was revised for clarification and to bring the requirements up to date.

5. 2.23 and Fig. 4 were changed to delete the 439-, 440-, 441-, and 442- capacitors.

6. 2.24 covering 445, 447, and 449 capacitors was added.

7. 2.25 covering straps at connecting racks was revised to add reference to Section 800-612-154.

8. Former 2.30 and Fig. 8 covering straps on 344 and similar-type jacks are omitted because of no further application.

9. 2.30 covering straps to jacks in telegraph systems was revised to add data systems.

10. 2.42 covering straps to 187- and 189-type networks was added.

11. Former 2.53 covering straps to 11-type resistance lamps is omitted because of no further application.

12. 2.59 covering straps on adjacent terminal strips is changed to bring the requirement up to date.

13. Former 2.66 and Fig. 27 covering 216-type terminal strips are omitted because of no further application.

14. 3.14 covering extension of straps on adjacent HIDF terminal strips is changed to delete "AM" wire and add 22 "BH" wire.

15. 4.05 covering the size of wire for straps is changed to add 26 gauge.

16. Fig. 29 is revised to include continuous bare wire straps.

17. Fig. 31 covering straps on U-, Y-, and similar type relays was revised to add "View A-A".

18. 4.13, 4.14, and Fig. 33 covering straps on the front and rear of "D" type terminal strips were revised for clarity and to change the lead dress on the rear to conform with Section 800-612-160.

19. 4.17 covering straps on adjacent terminals of 251- and 252-type terminal strips was revised for clarification.

20. 5.10 covering cross-connections on 251- and 252-type terminal strips was revised to add "C" wire.

21. Part 6 covering requirements for cross-connections using quick-connect connectors was added.