PUNCHED- OR WIRE-TYPE TERMINALS
(NOT HAVING NOTCHES OR PERFORATIONS)
METHOD OF MAKING AND REMOVING WRAPPED CONNECTIONS

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1. GENERAL

1.01 This section covers the approved method of making and removing wrapped connections on punched- or wire-type terminals which do not have notches or perforations.

1.02 Revision arrows are used to emphasize significant changes. The Equipment Test List is not affected. The reasons for reissue are listed below.

(a) To add KS-22681 wire-wrapping tool

(b) To rate 635B wire-wrapping tool Mfr Disc.

(c) To rate the KS-16363, L1 and L2, wire-wrapping tool Mfr Disc.

(d) To rate the KS-16920, L1 and L2, insulator Mfr Disc.

(e) To rate the KS-20962, L1, connecting bag Mfr Disc.

(f) To revise Fig. 15

(g) To update the practice to standard format.

1.03 ➧The 635B wire-wrapping tool is rated Mfr Disc. and replaced by the KS-22681 wire-wrapping tool. The KS-16363, L1 and L2, wire-wrapping tool is rated Mfr Disc. and replaced by the KS-16363, L3, wire-wrapping tool. There will be no further reference to these tools being Mfr Disc.➧

1.04 The KS-16450, L1, heated wire-unwrapping tool is used for removing soldered-wrapped connections. The KS-20827 wire-unwrapping tool (which supersedes the KS-16492 wire-unwrapping tool) and the KS-20551, L2, wire-unwrapping tool are used for removing solderless-wrapped connections. Maintenance information for the KS-16450, L1, and superseded KS-16492, L2, wire-unwrapping tools is covered in Sections 075-121-802 and 075-121-801, respectively.

1.05 ***Make-Busy Information:*** Make the circuit busy in accordance with approved procedures.

1.06 ***Solderless-Wrapped Connection:*** A solderless-wrapped connection is made with a qualified wire-wrapping tool on a terminal approved for this type of connection, as described in Part 3 in conformance with the requirements covered in Part 5.

1.07 ***A Soldered-Wrapped Connection:*** A soldered-wrapped connection is made with a wire-wrapping tool or with pliers and then soldered in conformance with the requirements covered in Part 6.

1.08 The KS-16363, L1, L2, and L3, wire-wrapping tools, KS-21232 wire-wrapping gun with their associated sleeves and bits, KS-22681 wire-wrapping tool, and the KS-16450, L1, KS-20551, L2, and KS-20827 wire-unwrapping tools are precision tools and should be handled with care.

2. APPARATUS

2.01 ***List of Tools and Materials:*** The following tools and materials are used in this section.

TOOLS	DESCRIPTION
769A	Distributing frame bag (Mfr Disc.)
AT-7825	4-inch E screwdriver
AT-7860	B long-nose pliers
KS-6320, L1	Orange stick (wood)
KS-6320, L2	Orange stick (plastic)
KS-16346, L1	Soldering iron (includes KS-16368, L1 or L3, transformer) (E/W 9-foot cord)

TOOLS	DESCRIPTION
KS-16346, L2	Soldering iron (includes KS-16368, L2 or L3, transformer) (E/W 19-foot cord)
KS-16363, L1, L2, and L3	Wire-wrapping tool (does not include wrapping bit and stationary sleeve)
KS-16450, L1	Wire-unwrapping tool (heated) for removing soldered-wrapped connections
KS-16734, L1*	Wrapping bit (for 22- and 24-gauge wires) (red band)
KS-16902, L1	Wire strippers
KS-16903, L1*	Wrapping bit (for 26-gauge wire) (yellow band)
KS-20551, L2	Wire-unwrapping tool for removing solderless-wrapped connections
KS-20620 L1, L2, L3, L4, L5, and L6	Wire strippers
KS-20827, L1	Wire-unwrapping tool for removing solderless-wrapped connections (or the superseded KS-16492, L2, wire-unwrapping tool)
KS-20962, L2	Connecting bag (replaces KS-20962, L1)
KS-20963, L2*	Stationary sleeve (for 22- and 24-gauge wires) (red)
KS-20963, L3*	Stationary sleeve (for 26-gauge wire) (yellow)
KS-21232, L1	Wire-wrapping gun (electric)

*Bits and sleeves having the same color code as indicated by a painted band on the bit or a plastic band on the sleeve are used together with the following exception. The KS-20963, L3 (yellow) sleeve is used with the KS-16903, L1 (yellow) bit. On earlier KS-16903, L1, bits, the color was green.

TOOLS	DESCRIPTION
KS-22035	Spudger (plastic)
◗KS-22681	Wire-wrapping tool (manual rotated type)◖
—	Modified No. 625 Wiss cutting pliers†

MATERIALS	
P-12B265	Terminal (for 22- and 24-gauge wire splices)
KS-14666	Cloth

3. TYPES OF TERMINALS APPROVED FOR WRAPPED CONNECTIONS

3.01 The types of terminals approved for solderless-wrapped connections are illustrated in Fig. 1: (A) and (B) are punched terminals; (C) is a drawn-wire terminal; and (D) and (E) are wire-spring terminals. Terminal D is a single wire serrated on one side to give the cross section shown. Terminal E consists of twin wires twisted together, after which their surfaces are coined. Wire-type terminals are less rigid than punched type and, therefore, greater care must be taken not to distort the terminal while making or removing a connection. It is particularly important to avoid starting the wrapped connection on the offset portion of this type of terminal.

3.02 The size 26-gauge wire may be used on all approved terminals except those having a hard gold finish listed in ED-84818-01.

3.03 The size 24-gauge wire may be used on all approved terminals.

3.04 The size 20- and 22-gauge wires may be used on the following terminals:

(a) Square cross-section wire-type terminals equal to or greater than nominal 0.045 by 0.045 inch

(b) Punched flat cross-section terminals equal to or greater than nominal 0.030 inch thick.

†In order to have the jaws of the Wiss cutting pliers closed when the pliers are not in use, manually remove the spring from between the handles of the pliers and discard the spring.

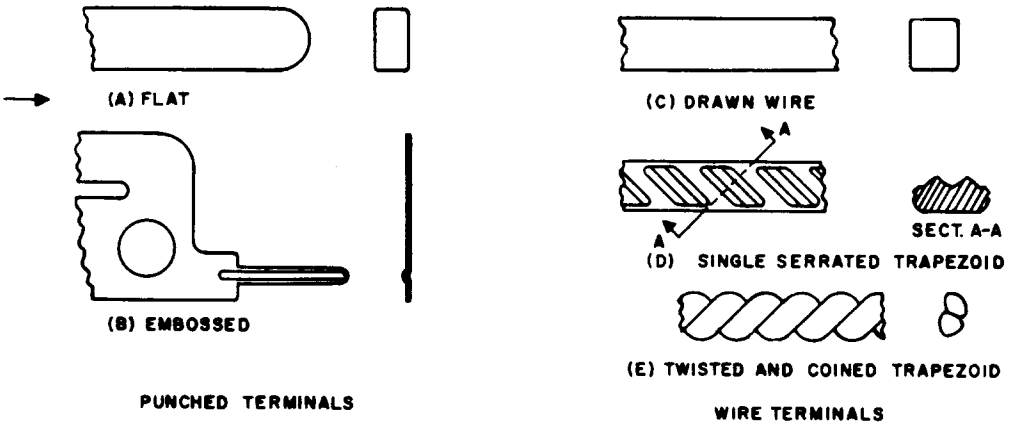

Fig. 1—Punched- and Wire-Type Terminals for Wrapped Connections

3.05 The sizes of wire authorized for solderless wrapping on terminals of the types shown in Fig. 1 are listed in Table A. In general, equipment has been wired during manufacture in accordance with the information in the table.

4. POSITIONING OF WRAPPED CONNECTIONS ON TERMINALS

4.01 Figure 2 illustrates the positioning of typical wrapped connections on punched-type terminals. One, two, and three solderless-wrapped connections on a terminal are illustrated in Fig. 2 (A), (B), and (C), respectively. A solderless-wrapped connection requires approximately 1/4 inch of terminal length. The first connection, whether solderless or soldered, should be made as far back on the terminal as practical even if only a single connection is to be made at the time. This will provide space for additional connections if these are required later. Each additional connection should be made within 1/32 inch of the preceding connection in order to permit the application of three solderless-wrapped connections on terminals of sufficient length. Failure to follow this procedure may result in the necessity for making the third connection of 1-1/4 turns, as shown in Fig. 2 (D) and (E). Such connections should be avoided wherever possible for the following reasons.

(1) All of the connections on the terminal must be soldered.

(2) All subsequent connections made on the terminal must be soldered.

4.02 If the length of the terminal is not sufficient for three solderless-wrapped connections, the third connection is made, as shown in Fig. 2 (D) or (E). In (D) the third connection consists of at least 1-1/4 wrapped turns near the outer end of the terminal. In (E) there is not sufficient space at the outer end of the terminal to make the connection shown in (D). In this case the third connection is made by winding at least 1-1/4 turns of wire over the outer wrapped connection using pliers. All connections shown in (D) and (E) must be soldered to the terminal using the method covered in Part 13 of this section.

5. REQUIREMENTS FOR SOLDERLESS-WRAPPED CONNECTIONS

5.01 Solderless-wrapped connections shall be made with the KS-21232 (electric) wire-wrapping gun or the KS-16363, L1, L2, or L3, wire-wrapping tools equipped with the proper bit and sleeve. A solderless-wrapped connection shall be made only on a terminal approved for this type of connection with the size wire approved for solderless wrapping on this terminal. The wire used shall be suitably stripped, standard Western Electric coded insulated (or bare) tinned, solid copper wire, or approved equivalent. The gauge of the wire depends upon the size of the terminal. (See paragraphs 3.02, 3.03, and 3.04.) The terminal shall not previously have had a soldered connection on it. The connection shall consist of the number of nonoverlapping turns for the respective wires shown in Table B. Overlapping turns before the start and after the end of the count of the minimum number of successive turns are permissible.

TABLE A (NOTE 1)

SHAPE OF TERMINAL	TERMINAL DIMENSIONS (INCHES) (NOTE 2)	APPROVED WIRE GAUGES			
		20 (NOTE 3)	22	24	26
Punched Terminals: Flat [Fig. 1 (A)]	0.025 by 0.062			X	X
	0.032 by 0.062*	X	X	X	X
	0.040 by 0.057	X	X	X	X
	0.050 by 0.050	X	X	X	X
Embossed [Fig. 1 (B)]	0.009 by 0.062			X	X
	0.010 by 0.062			X	X
	0.013 by 0.062			X	X
	0.014 by 0.062			X	X
	0.016 by 0.062			X	X
	0.018 by 0.062			X	X
	0.020 by 0.062			X	X
	0.023 by 0.062			X	X
	0.013 by 0.052			X	X
Drawn Wire Terminal [Fig. 1 (C)]	0.045 by 0.045*	X	X	X	X
	0.050 by 0.050	X	X	X	X
Wire-Spring Terminal [Fig. 1 (D) and (E)]				X	X
				X	X
Crossbar Switch Crosspoint Terminal	0.009 thick	Repair connections should be soldered. (See paragraph 6.04.)			

Note 1: Sizes of wire not covered in the table are not approved for solderless-wrapping on solderless-wrapped type terminals. When necessary to connect heavier gauge wire to these terminals, the wire should be connected and soldered in accordance with Section 069-140-811.

Note 2: These terminal sizes are approved only for certain terminal materials and grades of material. It can be assumed that any terminal of an approved size on Bell System apparatus is made of an approved grade of material. Specific apparatus approved for solderless-wrapped connections is listed in ED-94818-01.

Note 3: The KS-21232, L1, wire-wrapping tool is available to wrap 10-gauge wire only.

* Untinned bare 22- and 24-gauge wires may be used for solderless-wrapped connections on electrotinned brass terminals at PBXs only where the life requirement for the connection is a much shorter interval than for central offices.

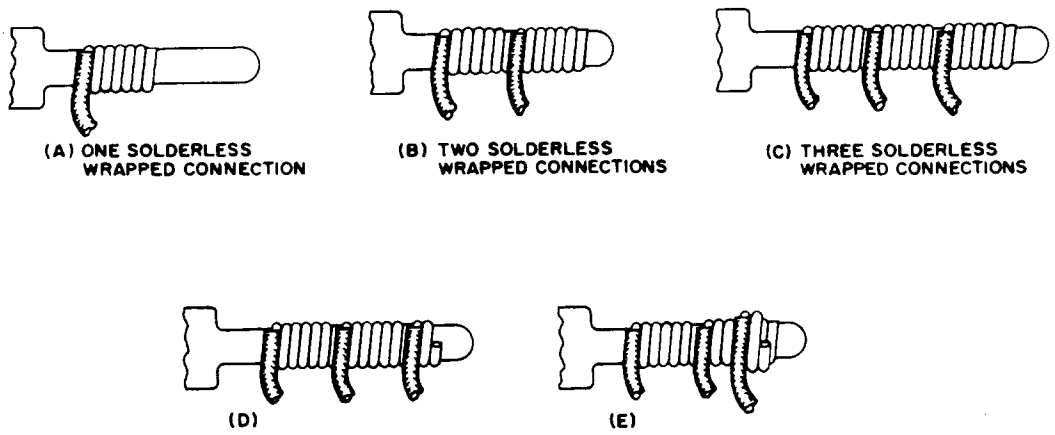

Fig. 2—Positioning of Typical Wrapped Connections on Terminals (Punched-Type Terminals Shown)

TABLE B

WIRE	MINIMUM SUCCESSIVE NONOVERLAPPING TURNS
26-gauge, bare, tinned copper	8
24-gauge, bare, tinned copper	6
22-gauge, bare, tinned copper	5
20-gauge, bare, tinned copper*	5

* To be wrapped using the KS-21232, L1, wire-wrapping tool only.

Note: Untinned bare 22- and 24-gauge wires may be used for solderless-wrapped connections at PBXs on the terminals that are 0.045 by 0.045 inch and 0.032 by 0.062 inch, where the life requirement for the connection is a much shorter interval than for central offices.

5.02 For 22- and 24-gauge wires, the separation between four adjacent turns viewed from any one side of the terminal at the closest point may be no greater than 0.005 inch, gauged by sight. For 26-gauge wire, the same separation may exist at no more than six adjacent turns.

5.03 While it is not a requirement that the end of the wire lie flat against the terminal, there shall be a clearance of at least 1/64 inch between a projecting end of wire and an adjacent terminal or wire, and in no case shall a wire end project more than 1/8 inch away from the terminal.

5.04 The bare portion of a wire between the point of connection to a terminal and the insulation of the wire should be less than the clearance between adjacent terminals at that point and no longer than 1/8 inch. The insulation may, however, overlap the terminal.

5.05 The wire shall be dressed to conform with the associated wiring. There shall be at least 1/64-inch clearance between the bare wire and connections on adjacent terminals.

5.06 The portion of a wire previously used for a solderless-wrapped connection shall not be reused for subsequent solderless-wrapped connections. This portion must be cut off if the wire is to be reconnected by solderless wrapping. Except in cross-connection fields, it will be necessary to splice the wire if there is not sufficient slack to provide the number of turns required for a solderless-wrapped connection. In cross-connection fields, the wire shall be rerun to provide sufficient length for a solderless-wrapped connection.

5.07 The life expectancy of a solderless-wrapped connection made with tinned wire is approximately 40 years. The use of untinned wire will reduce the life requirement approximately one-half. In addition, under certain environmental conditions, the use of untinned wire may result in noisy and unreliable connections. Therefore, the use of untinned wire for solderless-wrapped connections is limited to certain applications in specifically authorized equipments and apparatus.

5.08 In order not to disturb the connection after it is made, test clips, connecting tools, etc, shall not be placed on the helix portion of the solderless-wrapped connection.

5.09 In general, the length of the terminal designed for solderless-wrapped connections is such that two solderless connections can be conveniently made. When it is necessary to make a second or third connection and there is sufficient space on the terminal to make a proper number of turns, the second or third connection may be wrapped in the same manner as the previous connection. As a standard practice, the turns of any connections shall not overlap the turns of any previous connection on the same terminal.

5.10 Where a solderless-wrapped connection is to be made with a wire which has been previously connected, a new shiner of proper length shall be used.

5.11 It is not permissible to reapply the wrapping tool over a solderless-wrapped connection to try to correct nonconformance with the requirements specified herein.

5.12 The working length (straight portion) of any terminal to be solderless wrapped shall be essentially straight and free of angular bends or crimps. However, a small amount of bowing is permissible provided the width of the bowed portion does not exceed 0.075 inch when measured along the working length in line with the position assumed by the terminal. (See Fig. 3.) This can be checked when using any solderless-wrapping bit having a 0.075-inch terminal hole, such as KS-16734. The terminal must fit freely into the bit without bending or binding in any way.

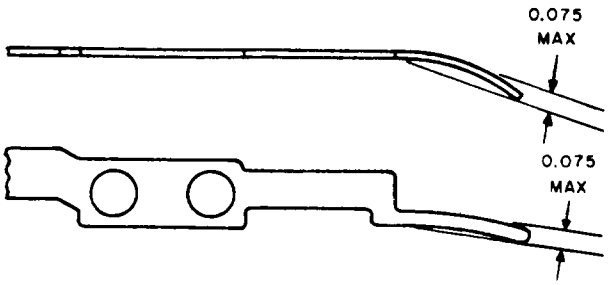

Fig. 3—Permissible Bow in Terminals

5.13 Apparatus which has closely spaced punched-type terminals approved for solderless-wrapping, such as EA-, U-, Y-, and similar-type relays, shall have terminals sufficiently spread so the connection can be placed at the desired position on the terminal and meet clearance requirements. A solderless-wrapped connection may be damaged if it is disturbed. For this reason, it is desirable that any movement of the terminals, such as spreading, after the connections have been made should be avoided.

5.14 Where only one connection is specified on any terminal designed for more than one connection, the connection shall be placed in far enough on the terminal to permit at least one additional solderless-wrapped connection.

6. CONDITIONS UNDER WHICH WRAPPED CONNECTIONS ARE SOLDERED

6.01 Wrapped connections made with the KS-21232 (electric) wire-wrapping gun or a KS-16363, L1, L2, or L3, wire-wrapping tool, except those in cross-connection fields (paragraph 6.03), shall be soldered as covered in Part 13 if any of the following conditions exist:

(a) If there is insufficient space on the terminal for eight turns of 26-gauge wire, six turns of 24-gauge wire, or five turns of 22-gauge wire.

(b) All connections on terminals that have been previously soldered or repaired shall be soldered.

(c) If one connection on a terminal is soldered, all connections on that terminal shall be soldered except as follows:

(1) Where a strap is soldered beyond the working length of the terminal (straight portion), a solderless-wrapped connection may be placed on the working length of the terminal provided that the strap is soldered first. In this case, there shall be no solder or solder splashes on the portion of the terminal designed to accommodate the solderless-wrapped connection. Thin, smooth films of rosin or slight discoloration due to rosin along the solderless-wrapped portion of the terminal are permissible.

(2) On distributing frame terminal strips where the strapping arrangement is part of the coded strip and the straps are placed in the strapping notch and soldered, solder and/or solder splashes are permitted on the solderless-wrapped portion of the terminal to a limited degree as indicated in notes on the apparatus drawing. When these terminal strips are used in wired equipments, it may be assumed that the soldering restrictions specified in the notes on the apparatus drawings have been met, and a solderless-wrapped connection may be made on these terminals.

(3) It is permissible to solder a connection made on one prong of a 2-prong terminal, without soldering the connection on the other prong provided that extreme caution is taken in the soldering operation so the heat from the soldering copper will not damage the solderless-wrapped connection on the other prong of the terminal. It is important that the soldering copper be applied to the terminal just long enough to ensure a good soldered connection using a minimum amount of solder.

(d) If the length of wire is not sufficient for eight turns of 26-gauge wire, six turns of 24-gauge wire, or five turns of 22- or 20-gauge wire.

(e) If the separation at more than four turns for 20-, 22-, and 24-gauge wires and six turns for 26-gauge wire is greater than 0.005 inch.

(f) If the connection on the terminal is obviously loose.

(g) If enameled wire is used.

(h) If apparatus terminal ends having color dye, usually red, do not meet requirements for solderless wrapping, then all such connections to such terminals shall be soldered. These markings

usually indicate repaired apparatus but may appear on nonconforming terminals of new apparatus.

6.02 All turns of the connection shall be soldered to the terminal if practicable, but in every case, at least two adjacent turns shall be soldered to the terminal.

6.03 Wrapped connections in cross-connection fields that do not meet the requirements covered in Part 5 shall not be soldered. These connections shall be rerun and new solderless-wrapped connections made which meet the requirements.

6.04 It is necessary to solder replacement connections made on 0.009-inch thick terminals since these terminals are axially twisted and subject to taking a permanent set when wrapped solderless connections are made. Subsequent rewrapping would aggravate this condition resulting in a low quality connection.

7. FACTORS GOVERNING APPLICATION OF SOLDERLESS AND SOLDERED CONNECTIONS

7.01 ***General:*** In some cases, consideration must be given to the relative desirability of using a solderless-wrapped or a soldered-wrapped connection. In general, if a wire is of sufficient length and space on the terminal and a KS-21232 (electric) wire-wrapping gun or a KS-16363, L1, L2, or L3, wire-wrapping tool is available, the solderless-wrapped connection should be used. However, there are cases, such as those covered in paragraphs 7.02, 7.03, and 8.06, where it may be expedient to use a soldered connection. It should be noted, as covered in subparagraph 6.01(b), that the use of solder on a terminal prevents all future use of solderless-wrapped connections on this terminal.

7.02 ***Slack in Wire:*** If the wire to be connected is part of a sewed cable and the slack in the wire is insufficient to provide the number of turns required for a solderless-wrapped connection, consideration should be given to splicing the wire to provide for the solderless-wrapped connection. The method of splicing wire using solderless-wrapped connections is covered in Part 10. It may, however, in certain cases be expedient to use a soldered connection. In the case of surface wiring, it may be preferable to rerun the wire and apply a solderless-wrapped connection.

7.03 ***Accessibility of Wrapped Connection:*** If there are two or three solderless-wrapped connections on a terminal and the inside connection must be changed or repaired, unwrapping this connection would necessitate first unwrapping the outer connections. In such a case, it may be expedient to cut the lead to the inside connection provided the lead can be readily identified and is sufficiently accessible to be cut without damage to adjacent wiring. Then a new soldered connection to the terminal would be made and the remaining original connections also soldered.

8. DESCRIPTION OF TOOLS

KS-16363, L1, Wire-Wrapping Tool

8.01 The KS-16363, L1, wire-wrapping tool with associated wrapping bit and stationary sleeve, shown in Fig. 4, is manually operated for making solderless-wrapped connections of 22-, 24-, and 26-gauge wires on terminals approved for this type of connection. The tool is operated by a hand grip which drives the wrapping bit through a train of gears enclosed in the housing of the tool.

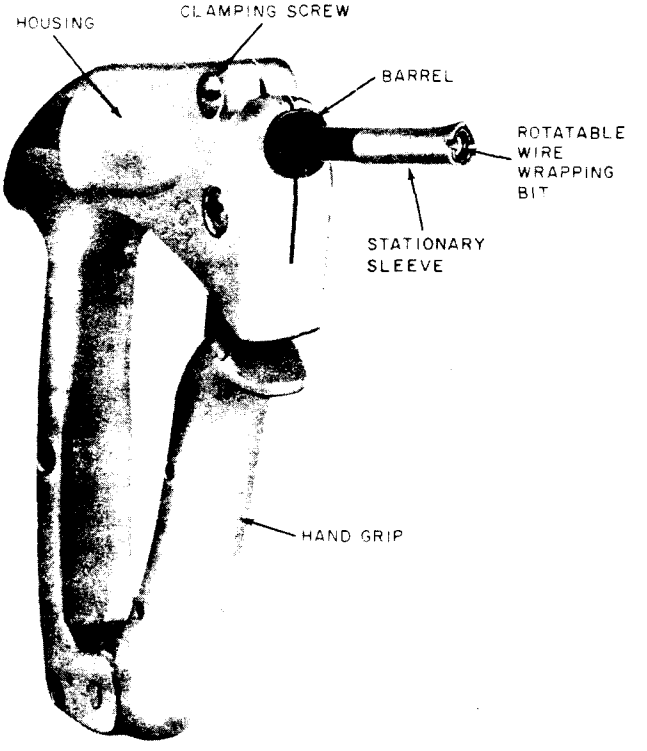

Fig. 4—KS-16363, L1, Wire-Wrapping Tool With Associated Wrapping Bit and Stationary Sleeve

8.02 As shown in Fig. 4, the stationary sleeve extending from the barrel of the tool encloses the wire-wrapping bit and holds the bit in engagement with the driving member. As shown in Fig. 5, the bit has a large hole which fits over the terminal on which the wire is to be wrapped and a smaller hole into which the skinned end of the wire is inserted. When the hand grip is in its unoperated position, the wire-insertion hole is at the top, as shown in Fig. 5. The end of the sleeve is funnel shaped just above the normal position of the wire-insertion hole in the bit to facilitate insertion of the skinned wire. Two wire-retaining notches are provided in the end of the sleeve for holding the wire either at the left or right of the tool during the wrapping operation.

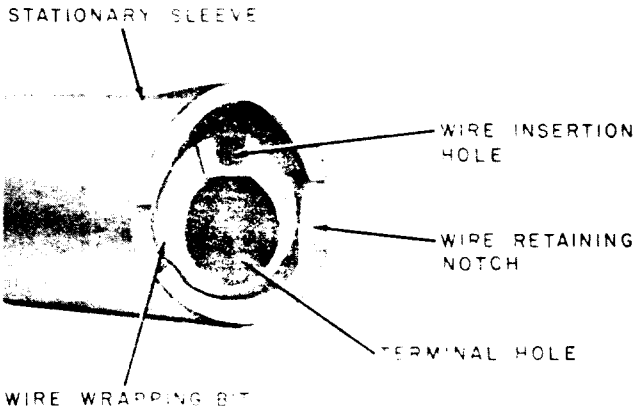

Fig. 5—End View of Stationary Sleeve and Wrapping Bit for KS-16363, L1, Wire-Wrapping Tool

8.03 Loosening the slotted head clamping screw in the housing permits withdrawal of the sleeve and bit. When mounting the older type sleeve bit, the bit is inserted in the barrel with the wire-insertion hole at the top and rotated slightly, if necessary, to engage the driver member. Then, the sleeve is inserted directly over the bit so that the shoulder of the sleeve seats against the barrel. If using the new KS-20963 type sleeve, insert the sleeve into the barrel chuck with the flared portion of the sleeve in the "12 o'clock" or top position. Make sure the sleeve does not restrict the rotation of the bit, as no shoulder is provided on these sleeves. Tighten the clamping screw to hold the bit and sleeve in position.

KS-16363, L2, Wire-Wrapping Tool

8.04 The KS-16363, L2, wire-wrapping tool, shown in Fig. 6, has been changed from the screwdriver-tightened chuck to a universal hand-tightened chuck which simplifies the attachment of the KS-20963 sleeves. It should be noted that the old wire-wrapping sleeves, KS-16363, L32 and L33 (rated Mfr Disc.), will not fit into the new chuck.

8.05 To prevent jamming of the wire-wrapping tools caused by the sleeves pressing up against the tang of the wire-wrapping bit, a wire-retaining ring has been added to the KS-20963, L2 and L3, wire-wrapping sleeves. The retaining ring on the sleeve will prevent this as the ring butts up against the end of the collet.

KS-16363, L3, Wire-Wrapping Tool

8.06 The KS-16363, L3, wire-wrapping tool (Fig. 6) has a plastic housing for use on "live" equipment. This tool supersedes the L1 and L2 tools.

KS-21232 (Electric) Wire-Wrapping Gun

8.07 The KS-21232 (electric) wire-wrapping gun is used for 20-gauge through 30-gauge wire. It is double insulated and can be used on or near any "live" equipment, including Electronic Switching System (ESS).

▶KS-22681 Wire-Wrapping Tool

8.08 The KS-22681 wire-wrapping tool (Fig. 7) is used for wrapping 22- or 24-gauge wire onto 0.03 inch by 0.06 inch maximum terminals. This small manually operated tool is primarily for repairing wrapped connections which are to be soldered. The handle is made of a hexagonally shaped red plastic for easy visibility and gripping. The handle is designed to permit two-handed, uninterrupted turning of the wire around the terminals (this provides a tighter connection in less time). The KS-22681 wire-wrapping tool has an insulated bit and an external marking on the sleeve to locate the wire slot. The KS-22681 wire-wrapping tool replaced the 635B wire-wrapping tool.◀

KS-16450, L1, Wire-Unwrapping Tool—Heated

8.09 The KS-16450, L1, wire-unwrapping tool, shown in Fig. 8, is a heated tool designed for

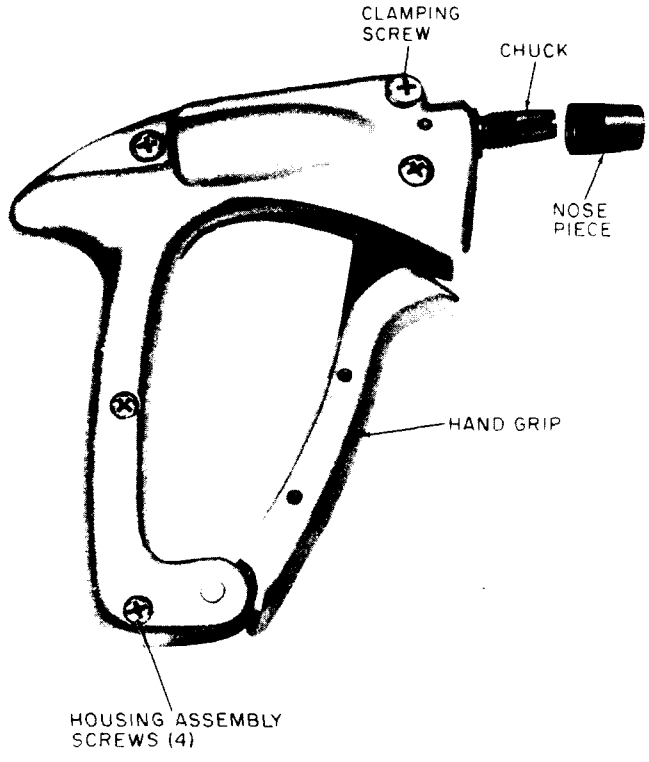

Fig. 6—KS-16363, L2 and L3, Wire-Wrapping Tool

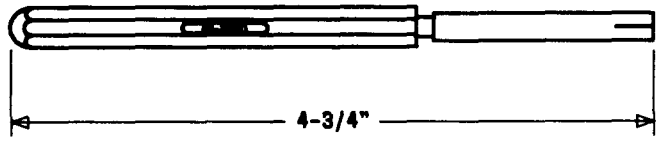

Fig. 7—KS-22681 Wire-Wrapping Tool

loosening and removing soldered-wrapped connections of 22-, 24-, and 26-gauge wires from terminals. As shown in Fig. 9, the tool has a heat-insulated sleeve with internal threads extending approximately 1/8 inch in from its outer end. These threads are engaged by the coils of the connection during the unwrapping operation to permit withdrawal of the connection from the terminal. The inner sleeve is mounted rigidly on the unwrapping bit and shank of the tool. The outer end of the unwrapping bit has three axial teeth, adjacent to the inner end of the threads in the sleeve, to engage the first turn of the wrapped connection.

8.10 A heat element, mounted in the unwrapping bit at the end of the shank, heats the unwrapping bit and threads at the end of the sleeve sufficiently to soften the solder on the wrapped connection. The handle is secured to the shank with a knurled nut and is used to rotate the shank while unwrapping a connection. The shank and handle rotate on the swivel assembly so the leads to the heating element will not twist when the shank is turned to remove the connection. The swivel assembly secures the power cord.

8.11 The cord is connected to the power supply through the KS-16368, L1, transformer which reduces 115 Vac to 6 volts and isolates the 6-volt circuit from ac ground. The transformer has three prongs for plugging into a power outlet. The support prong is provided to support the transformer in the outlet and may be unscrewed from the transformer when an outlet is not available to accommodate this prong. This prong is not a ground connection.

KS-20551, L2, Wire-Unwrapping Tool—Solderless-Wrapped Connections

8.12 The KS-20551, L2, wire-wrapping tool, shown in Fig. 10, is to be used as a secondary tool to the KS-20827 tool. This tool is uninsulated and is to be used in areas of heavy wiring such as on the automatic message accounting (AMA) translator frame.

KS-20827 Wire-Unwrapping Tool—Solderless-Wrapped Connections

8.13 The KS-20827 wire-unwrapping tool, shown in Fig. 11 and 12, is provided for loosening and removing solderless-wrapped connections of 22-, 24-, and 26-gauge wires from terminals. The tool consists essentially of the following parts which are designated in the figures.

8.14 ***Unwrapping Spindle:*** This is a hollow spindle which fits over the terminal and which has three teeth extending axially from its outer end. These teeth engage the first turn of the wrapped connection to be removed from the terminal. Counterclockwise rotation of the spindle expands each turn of the connection until it is loosened from the terminal.

8.15 ***Sleeve:*** The sleeve, which is insulated on the outside, is threaded on the inside and encloses the unwrapping spindle. The threads engage and hold the turns of the wire being unwrapped from the terminal. The unwrapped wire is released from the tool by pulling back on the thrust knob.

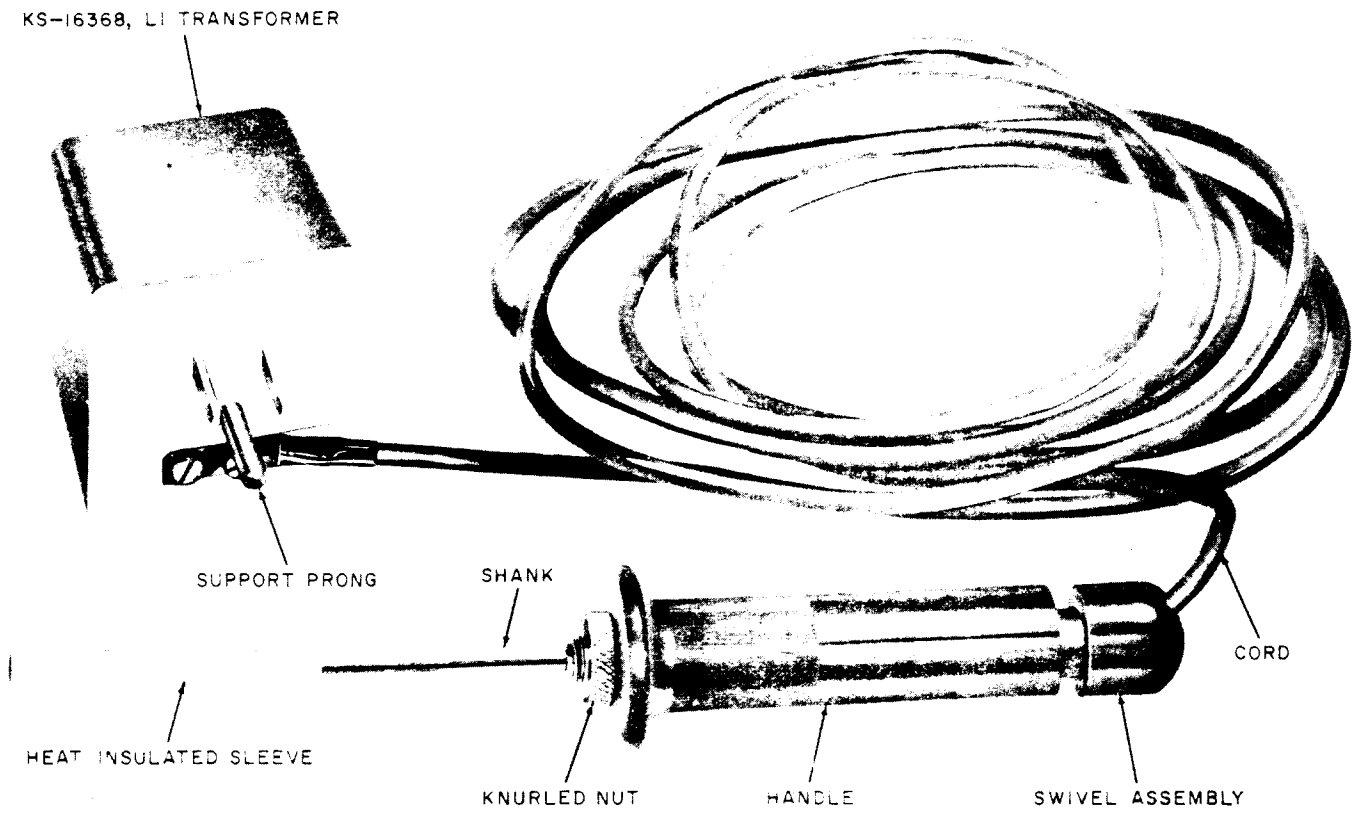

Fig. 8—KS-16450, L1, Wire-Unwrapping Tool—Heated

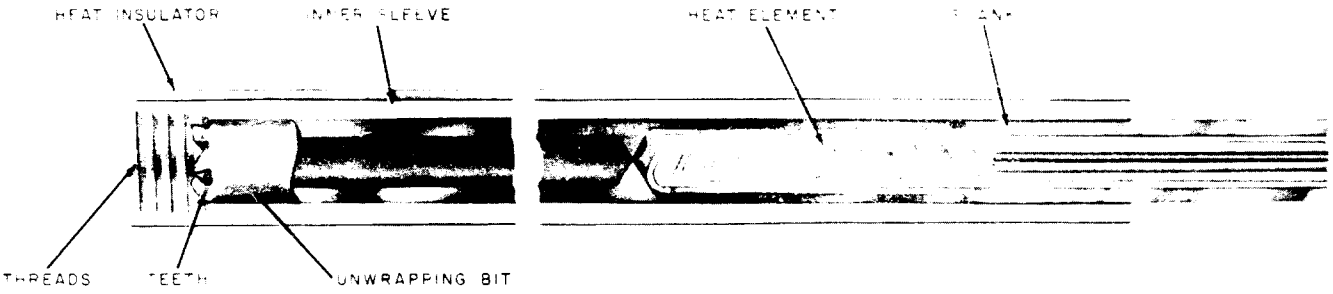

Fig. 9—Cross-Section View of KS-16450, L1, Wire-Unwrapping Tool

KS-16346, L1 and L2, Soldering Iron

8.16 A soldering iron suitable for soldering wrapped connections is shown in Fig. 13. This iron is designed for use on closely spaced terminals without damaging the insulation of the wiring. A 6-volt heater unit in the iron is connected to power through a KS-16368, L1, transformer at the end of the cord of the iron. The KS-16368, L1 and L3, has a 9-foot cord and the L2 has a 19-foot cord. The transformer is plugged into a suitable power outlet. The support prong is provided to support the transformer in the outlet and may be unscrewed from the transformer when an outlet is not available to accommodate this prong. This prong is not a ground connection.

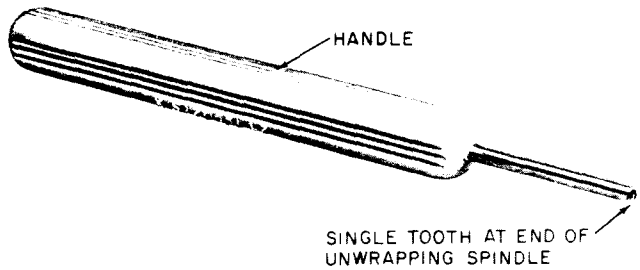

Fig. 10—KS-20551, L2, Wire-Unwrapping Tool (for Removing Solderless-Wrapped Connections)

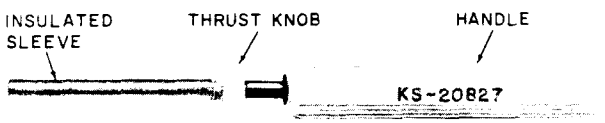

Fig. 11—KS-20827 Wire-Unwrapping Tool (for Removing Solderless-Wrapped Connections)

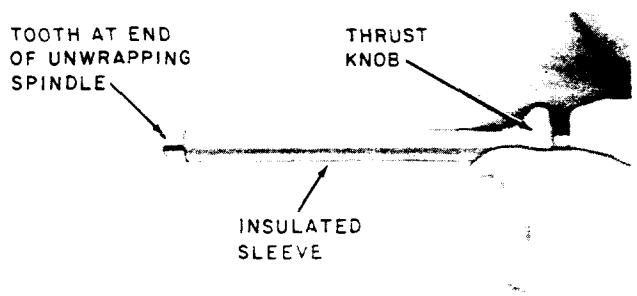

Fig. 12—KS-20827 Wire-Unwrapping Tool—End View Showing Unwrapping Spindle Pushed Forward

9. APPLICATION OF TOOLS

9.01 Table C lists the applications which may be made of tools covered in this section in making or removing wrapped connections on terminals arranged for this type of connection.

10. MAKING WRAPPED CONNECTIONS USING THE KS-16363, L1, L2, OR L3, WIRE-WRAPPING TOOL OR THE KS-21232 (ELECTRICAL) WIRE-WRAPPING GUN

General

10.01 ***Caution:*** ***Under no circumstances should a wrapping bit and sleeve be used other than those specified for the size of wire being used.*** Wrapped connections made with the KS-21232 (electric) wire-wrapping gun or the KS-16363, L1, L2, or L3, wire-wrapping tool equipped with proper bit and sleeve should not be soldered unless they fail to meet the requirements covered in Part 5. The conditions under which solderless-wrapped connections are soldered are detailed in Part 6. Before making any connections, the size of the wire should be determined and the proper wrapping bit and stationary sleeve placed in the tool. Make sure that the wrapping tool meets the requirements in Section 075-120-701.

Single or First Connection on Terminal

10.02 Skin the wire in the approved manner with a skinned length of 1-9/16 ±1/32 inch for 22- and 24-gauge wire. If 26-gauge wire is used, a skinned length of 1-9/16 ±1/32 inch is required for 0.013- by 0.052-inch and wire-spring terminals (see Table A), and a skinned length of 1-7/8 ±1/32 inch is required for all other terminals. This will provide at least eight nonoverlapping turns of 26-gauge wire, six nonoverlapping turns of 24-gauge wire, or five nonoverlapping turns of 22-gauge wire on the terminal.

Note 1: Do not distort the skinned portion of the wire since it is difficult to insert a bent wire into the wire-insertion hole in the tool.

Note 2: Exercise care not to nick the wire.

10.03 ***Caution:*** ***Failure to fully insert the skinned portion of the wire will result in the skinned wire extending beyond the terminal after the connection has been made.*** Hold the tool so the wire-wrapping bit faces the end of the terminal on which the wire is to be wrapped and insert the skinned wire in the wire-insertion hole as far as the insulation on the wire permits.

10.04 Bend the wire through one of the wire-retaining notches in the stationary sleeves and hold the wire taut.

10.05 ***Caution:*** ***While making a wrapped connection on an offset wire-type ter-***

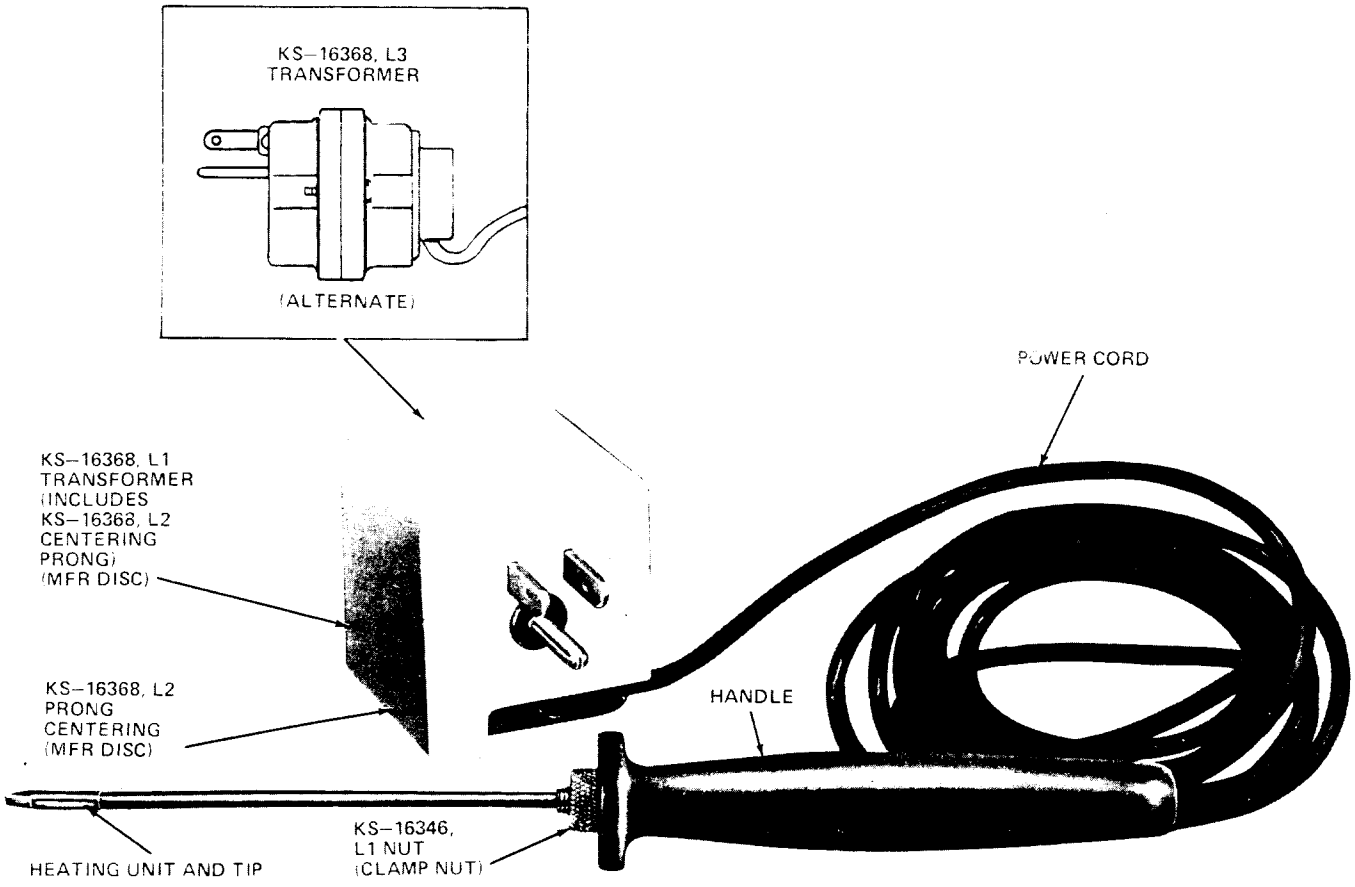

Fig. 13—KS-16346, L2, Soldering Iron and KS-16368, L1, Transformer

minal, make sure the connection is started on the straight portion of the terminal. While holding the wire taut, position the wrapping tool so the terminal on which the wire is to be wrapped enters the terminal hole in the bit as far as possible. Hold the tool in line with the terminal, as shown in Fig. 14, so the bit can rotate freely around the terminal during the wrapping operation; then when the wire is being applied to a flat terminal, the hand grip of the tool is parallel to the wide face of the terminal. Exert a light inward pressure during the wrapping operation to ensure closely spaced turns of the connection. Do not exert excessive pressure on the tool as this may cause the turns of wire to overlap as they are being wrapped on the terminal. If light pressure is not exerted or if the tool is pulled away during the wrapping operation, excessive space between turns will result.

10.06 Squeeze the hand grip to its fully operated position with a smooth, rapid motion. Operation of the hand grip with a slow or jerky movement will produce a poorly wrapped connection.

> ***Note:*** Hold the hand grip in the operated position and withdraw the tool from the terminal. Do not release the hand grip until the tool is free of the terminal.

10.07 ***Caution:*** ***Do not apply the wrapping tool over a wrapped connection to tighten the connection and do not push separated turns together.*** Check the wrapped connection for the requirements covered in Part 5. Dress the wiring as covered in Part 14.

TABLE C

TOOL	RECOMMENDED APPLICATION
AT-7860 B Long-Nose Pliers	For making soldered-wrapped connections where wrapping tool is not used.
KS-16346, L2, Soldering Iron	For general use in soldering wrapped connections or other connections in congested areas.
KS-16362, L1, Wire-Wrapping Tool (equipped with proper bit and sleeve)	For general use in making wrapped connections with 22 to 26 gauge wire
KS-16450, L1, Wire-Unwrapping Tool	For general use in removing soldered-wrapped connections.
KS-20551, L2, Wire-Unwrapping Tool	For general use in removing solderless-wrapped connections in areas of heavy wiring. Supplements the KS-20827 tool.
KS-20827 Wire-Unwrapping Tool (or the superseded KS-16492, L2, Wire-Unwrapping Tool)	For general use in removing solderless-wrapped connections.
KS-21232 (Electric) Wire-Wrapping Gun	For all general work including 20 to 30 gauge wire. It is double insulated and can be used on or near any live equipment including ESS.
KS-22681 Wire-Wrapping Tool (manually rotated type)	For repairing wrapped connections where space on terminal is not available or there is insufficient wire to make required number of wraps for solderless-wrapped connections, as specified in paragraph 5.01. Normally the wraps should be placed at near end of terminal to facilitate soldering. Limited use for solderless-wrapped connections in cross-connection fields of marker, number group, and translator frames of No. 5 crossbar offices. The 2-inch long terminal hole in the bit allows for a maximum number of connections on a terminal.

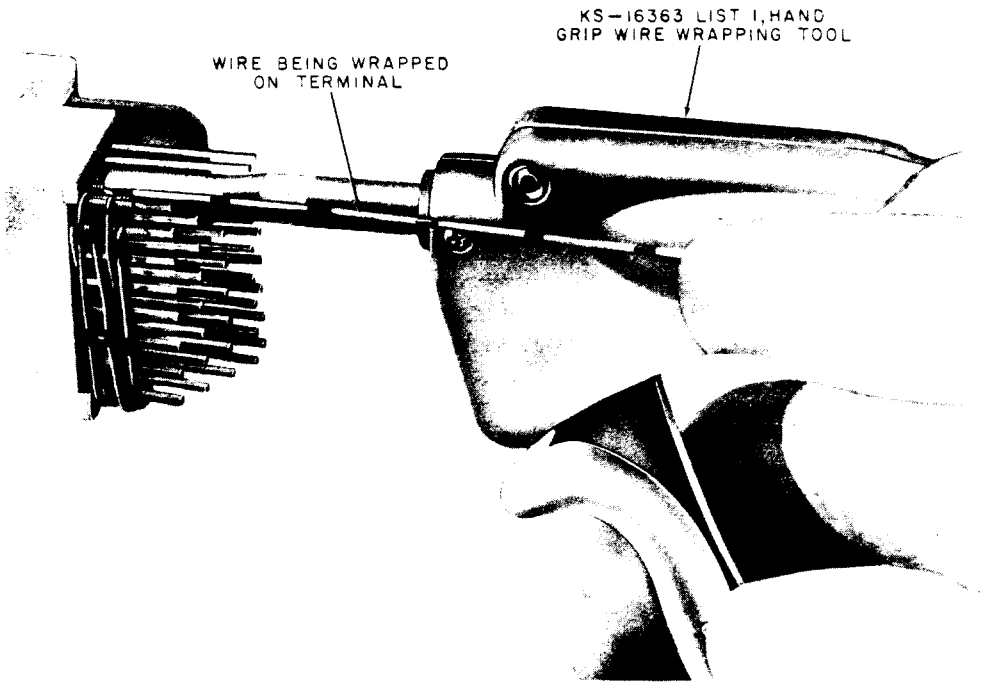

Fig. 14—Making Solderless-Wrapped Connections Using KS-16363, L1, L2, or L3, Wire-Wrapping Tool

More Than One Connection on Terminal

10.08 Make the second and third connections, successively, in front of the first connection following the procedures covered in paragraphs 10.02 through 10.07. Dress the wiring, as covered in Part 14.

10.09 If three connections are required and there is not sufficient space for wrapping the required number of turns for the third connection, proceed as follows. If there is sufficient space at the outer end of the terminal for at least 1-1/4 turns of wire on the terminal, wrap the turns on the terminal in a cw direction and solder all connections on the terminal, as covered in Part 13. Dress the wiring, as covered in Part 14.

10.10 If there is sufficient space at the outer end of the terminal for at least 1-1/4 turns of wire, skin the wire in the approved manner with a skinner length of 3/8 inch. Make the third connection by winding 1-1/4 turns in a cw direction over the outer wrapped connection as near the outer end of the terminal as possible using the B long-nose pliers. Solder all connections on the terminal, as covered in Part 13. Dress the wiring, as covered in Part 14.

Splicing Wire Using Solderless-Wrapped Connections

10.11 If the slack in a wire to be connected to a terminal is insufficient to provide the number of turns required for a solderless-wrapped connection, it may be desirable to splice the wire, as noted in paragraph 7.02. This splice may be made with 24- or 22-gauge wire using the P-12B265 terminal, an insulator, and two solderless-wrapped connections, as described in paragraph 10.12. The P-12B265 terminal, used as a connector, is a 0.045- by 0.045-inch tin-plated brass terminal 7/8 inch long. The insulator which is slipped over the splice is a 1-1/2 inch length of clear, vinyl tubing.

10.12 Splices should be made as close as possible to the cable so they may be tied to the cable form. If more than one splice is required in any group of connections, the splices should be staggered so they do not pile up in the cable run. The splice is made with the KS-16363, L1, L2, or L3, wire-wrapping tool

equipped with the proper bit and sleeve for the wire used. To make the splice, proceed as follows.

(1) Skin both wires to be spliced, as covered in paragraph 10.02.

(2) Slip the proper size insulator on the wire to be spliced extending from the cable form. Point the wire slightly up to prevent the insulator from dropping off.

(3) Hold the P-12B265 terminal with the B long-nose pliers approximately at the center so the terminal is at right angles to the pliers.

(4) With the free fingers of the hand holding the pliers, insert the skinned wire from the cable form into the wire-insertion hole in the bit of the wire-wrapping tool and anchor the wire in the wire-retaining notch, as covered in paragraphs 10.03 and 10.04.

(5) Insert one end of the terminal in the terminal hole in the bit so the side of the pliers contacts the end of the stationary sleeve of the wire-wrapping tool. This will trap the wire in the retaining notch, and the connection can be wrapped without holding the end of the wire. Make the connection, as covered in paragraphs 10.05 and 10.06.

(6) Reverse the terminal in the B long-nose pliers to make the wrapped connection at the other end of the terminal.

(7) Wrap the other connection, as covered in (3) through (5).

(8) Dress the wires against the terminal and position the insulator so it is approximately centered over the splice. In this position, the insulator will extend approximately 5/16 inch beyond each end of the terminal.

11. MAKING WRAPPED CONNECTIONS USING THE ▶ KS-22681 WIRE-WRAPPING TOOL◀

General

11.01 Wrapped connections made with the ▶KS-22681◀ tool must be soldered except in the case of connections in cross-connection fields listed in paragraph 9.01. Procedures for soldering the connections are covered in Part 13.

11.02 While the use of the ▶KS-22681◀ tool, as covered below, is preferable if a soldered-wrapped connection is to be made on a light terminal, the use of B long-nose pliers, as covered in paragraph 12.01, is preferable if a soldered-wrapped connection is to be made on a heavy terminal.

Single or First Connection on Terminal

11.03 Skin the wire in the approved manner with a skinned length of 1-9/16 inches if a solderless connection is to be made. This will provide at least six turns of 24-gauge wire or five turns of 22-gauge wire on the terminal. If a soldered connection is to be made, the skinned length should be 3/8 inch which will provide 1-1/4 turns on the terminal.

Note 1: Do not distort the skinned portion of the wire since it is difficult to insert a bent wire into the wire-insertion hole of the tool.

Note 2: Exercise care not to nick the wire.

11.04 ▶***Caution:***◀ ***Failure to fully insert the wire will result in the skinned wire extending beyond the terminal after the connection has been made.*** Hold the tool so the wire-wrapping spindle faces the terminal on which the wire is to be wrapped. Insert the skinned wire into the wire-insertion hole as far as the insulation on the wire permits. Turn the handle of the tool until the wire-insertion hole is adjacent to one of the retaining notches in the barrel of the tool. While holding the wire in the wire-insulation hole, turn back the wire so the insulated portion is in the notch.

11.05 While holding the wire taut, place the terminal hole of the wrapping tool over the terminal as far as possible. Still holding the wire taut, firmly press the tool against the terminal and turn the handle in a cw direction a sufficient number of times so all of the skinned wire is wrapped on the terminal. This can be determined by freedom of movement of the wrapping tool. Hold the barrel of the tool firmly during this procedure.

11.06 Except in the case of cross-connection fields listed in paragraph 9.01, solder the connection, as covered in Part 13, and dress the wiring, as covered in Part 14.

More Than One Connection on Terminal

11.07 Make the second connection in front of the first following the procedures covered in

paragraphs 11.03 through 11.05. If there is less than 1/8-inch terminal length available in front of the outer connection, apply 1-1/4 turns of wire over the outer connection with the pliers, as covered in Part 12. Dress the wiring, as covered in Part 14.

12. MAKING WRAPPED CONNECTIONS WITH B LONG-NOSE PLIERS

12.01 Skin the wire in the approved manner with a skinned length of 3/8 inch. If there is sufficient space at the end of the terminal for 1-1/4 turns, wind the wire on the terminal in a cw direction with the B long-nose pliers. Then solder all connections on the terminal, as covered in Part 13. If there is insufficient space at the end of the terminal for 1-1/4 turns, wind the wire in a cw direction over the outer connection as near the outer end of the terminal as possible with the pliers. Solder all connections on the terminal, as covered in Part 13. Dress the wiring, as covered in Part 14.

13. SOLDERING WRAPPED CONNECTIONS

13.01 ***General:*** Wrapped connections made with the KS-21232 (electric) wire-wrapping gun or the KS-16363, L1, L2, or L3, wire-wrapping tool should be soldered only when the requirements for solderless-wrapped connections covered in Part 5 cannot be met. All wrapped connections made with the ▶KS-22681◀ tool, except those made in the cross-connection fields listed in Table C, should be soldered. All connections made with pliers should be soldered. The use of solder on a terminal prevents all future use of solderless-wrapped connections on this terminal.

13.02 Place the 769A distributing frame bag, or the KS-20962, L2, connecting bag, or a KS-14666 cloth beneath the apparatus being worked on to protect the equipment below.

13.03 Connect the transformer on the soldering iron cord to the source of power. Hold the KS-16346, L2, soldering iron along the right side of the wrapped connection and feed the solder from the top. Flow the solder over all of the turns of the connection, if possible. Make sure that solder is flowed over at least two adjacent turns. To avoid damaging insulation on the wire being soldered and on adjacent wires, do not hold the iron against the wire any longer than necessary to make a good connection. A good connection can be made by applying the KS-16346, L2, iron for approximately 1 second. Take care that the soldering iron does not come in contact with the insulation on any of the wiring. Solder any other connections on the same terminal that have not been previously soldered.

14. METHOD OF DRESSING WIRE

14.01 ***Warning: Try to keep bends in the terminal at the rear of the wrapping length.*** Dress the wire to conform with the associated wiring. Make sure that there is at least a 1/64-inch clearance between the bare wire and connections on adjacent terminals. Examine the connection and make sure no ends of wire interfere with adjacent wiring. If necessary, bend these ends of wire against the terminal using two KS-6320, L1, or L2, orange sticks, as shown in Fig. 15, exercising care not to press against the turns of any of the connections. Do not, under any circumstance, attempt to tighten solderless connections with the pliers or wrapping tool. Remove any excess solder which might interfere with proper clearance between terminals. If any wires which are applied over wrapped connections become loose when removing excess solder, resolder such connections. Bend terminals slightly, if necessary, to ensure proper clearance. When bending terminals, do not touch turns of solderless-wrapped connections.

15. REMOVING WRAPPED CONNECTIONS

General

15.01 ***Warning: Do not use unauthorized tools. Substituting tools for those specified herein will result in damaged terminals.*** If there are two connections on a terminal and it is necessary to remove the inner connection, the recommended procedure is to remove the one at the outer end to gain access to the inner connection. Likewise, if there are three connections on a terminal and it is necessary to remove the one nearest the base of the terminal, the recommended procedure is to first remove the other two connections. However, there may be cases, as covered in Part 7, where it is expedient to cut the lead at an inner connection to avoid splicing wires. This may be done with the modified Wiss cutting pliers provided the lead can be readily identified and is accessible for cutting without damage to adjacent wiring.

15.02 ***▶Warning:◀ Do not attempt to reuse the portion of wire previously wrapped on***

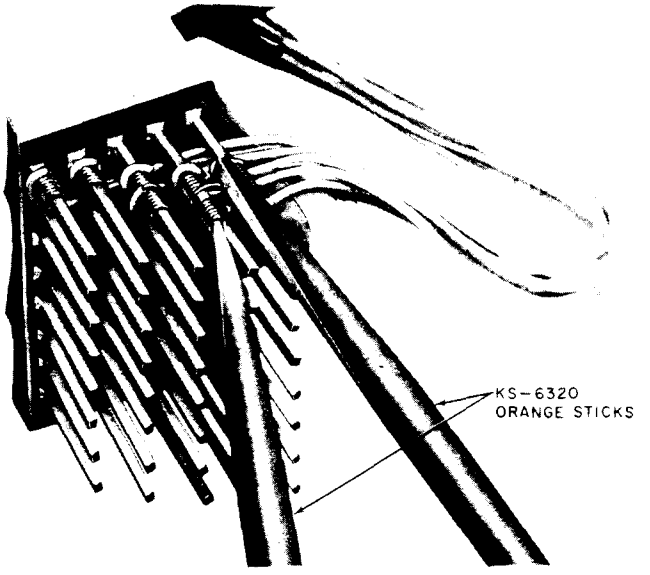

Fig. 15—Method of Bending End of Wire Against Terminal

the terminal for making a solderless-wrapped connection. In general, the portion of the wire previously wrapped on a terminal should not be reused. However, in the case of temporary removal of a soldered- or a solderless-wrapped connection using the KS-16450, L1, KS-20827, or KS-20551, L2, wire-unwrapping tools to avoid rerunning or splicing wires, it may be expedient to place the helix of the wrapped connection back on the terminal. In this case, the connection must be soldered.

15.03 ***Removing Solderless-Wrapped Connections Using the KS-20827 Wire-Unwrapping Tool:*** To remove solderless-wrapped connections using the KS-20827 wire-wrapping tool, proceed as follows.

> ***Note:*** The use of long-nose pliers is not recommended. If long-nose pliers are used to remove a solderless-wrapped connection, the terminal must subsequently be used only for a soldered-wrapped connection.

(1) Referring to Fig. 16, place the tool on the terminal so the sleeve completely covers the wrapped connection, and the end of the unwrapping spindle engages the first turn of the connection.

(2) Maintain light pressure on the tool toward the terminal and slowly rotate the tool ccw until the connection is loose on the terminal. Where a connection is being removed from a wire-type terminal or another light terminal, exercise care not to twist the terminal. Remove the tool with the turns of the unwrapped connection from the terminal.

(3) Eject the turns of wire from the tool by pulling back on the thrust knob toward the handle or by rotating the handle cw.

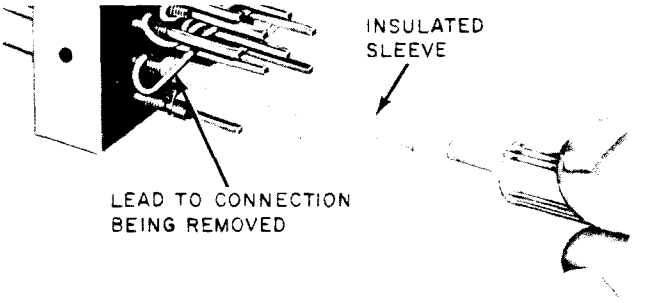

Fig. 16—Removing Solderless-Wrapped Connections Using KS-20827 Wire-Unwrapping Tool

15.04 ***Removing Solderless-Wrapped Connections Using the KS-20551, L2, Wire-Unwrapping Tool:*** To remove solderless-wrapped connections using the KS-20551, L2, wire-wrapping tool, proceed as follows.

> ***Note:*** The use of long-nose pliers is not recommended. If long-nose pliers are used to remove a solderless-wrapped connection, the terminal must subsequently be used only for a soldered-wrapped connection.

The KS-20551, L2, tool is uninsulated, and extreme care should be used to avoid contact with terminals other than those being unwrapped. The tool is used by working the tip of the tooth (Fig. 10) under the tail of the helix; and, as you unwind ccw, the wire will thread itself onto the shank of the tool. The KS-20551, L2, tool will probably take all turns to loosen and remove solderless connections as compared to the 3/4 to 1-1/2 turns needed by the KS-20827 tool.

15.05 ***Removing Soldered-Wrapped Connections Using the KS-16450, L1, Wire-Unwrapping Tool:*** To remove soldered-wrapped

connections using the KS-16450, L1, wire-unwrapping tool, proceed as follows.

(1) Plug the transformer connected to the tool in a 115-volt power outlet and allow approximately 1 minute for heating of the tool.

(2) ***Warning: Take care to avoid contact of the heated tool or soldering iron with adjacent leads to prevent possible damage to the insulation on the leads.*** Carefully move adjacent leads away from the terminal to be worked on using the KS-6320 orange stick. Referring to Fig. 17, carefully work the tool over the terminal so the threaded portion of the sleeve surrounds the wrapped connection, and the axial teeth on the unwrapping bit are against the first turn of the connection. If lumps of solder on the connection prevent working the sleeve of the tool over the connection easily, it will be advantageous to first remove the lumps with the KS-16346, L2, soldering iron. Before using the soldering iron, place a KS-14666 cloth below the apparatus or, if possible, directly below the connection.

(3) ***Warning: Use only light forward pressure and turning force when loosening the connection to prevent twisting or breaking the terminal.*** Exert light pressure with the tool toward the connection and in a ccw direction until the first turn on the connection is released from the terminal. Carefully continue the ccw rotation until the connection is released from the terminal. Then, while maintaining light ccw pressure, withdraw the tool with the turns of unwrapped wire from the terminal. Rotate the tool cw to remove the wire from the tool.

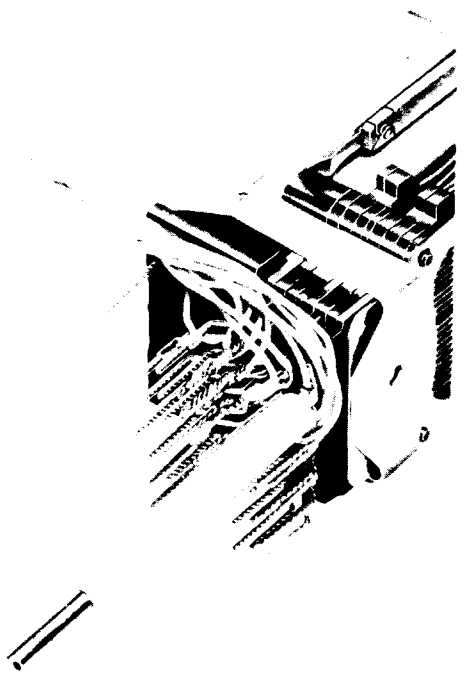

Fig. 17—KS-16450, L1, Wire-Unwrapping Tool Positioned to Remove Soldered-Wrapped Connection