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CONNECTING SOLDER LUGS, PUNCHINGS AND SPLICES

CONTENTS

1. INDEX	5. LUGS
2. GENERAL	5.1 Preparation
2.1 Scope	5.2 Tinning and Sweating Operation
2.2 Cautions When Using Propane Torch	5.3 Inverted Lugs
2.3 Special Cautions When Using Soldering Coppers	5.4 Taping Soldered Lugs
2.4 General Cautions	5.5 Sealing Lugs Connected to Wet Cell Batteries and Wet CEMF Cells
3. INSTALLING EQUIPMENT	6. SPLICES
4. TOOLS	6.1 General
4.1 Thermo-Grip Pliers	6.2 Splicing Sleeve
4.2 Propane Torch - R-3105	6.3 Pig-Tail Splice
	6.4 Western Union Splice
	6.5 "T" Splice
	7. TERMINAL PUNCHINGS

1. INDEX

Subject	Figure	Paragraph
Cautions		
General		2.4
Propane Torch		2.2
Soldering Copper		2.3
Lugs		
Cleaning	2	5.21, 5.23
Handling		5.12
Inverted		5.3
Preparation		5.1
Pressed Type		5.23
Protection		5.35
Sweating		5.2
Taping		5.4
Tinning		5.2
Verification		5.24
Propane Torch	1	2.2, 4.2, 6.12
Storage and Disposal		4.27, 4.28
Protection		4.24, 4.25, 6.14
Splices		
Connecting		6.11, 6.13
Insulation		6.15
Pig-Tail	5	6.3
Protection		6.12, 6.22
Sleeves	4	6.2
Tinning		6.13, 6.22
"T" Splice	7	6.5
Verification		6.14
Western Union	6	6.4
Supplies		3.1
Terminal Punchings	8, 9	7
Verification		7.4
Thermo-Grip Pliers	3	4.1, 6.12
Tools		3.1

2. GENERAL

2.1 Scope

2.11 This section describes methods for terminating power wire ends to connectors by soldering or sweating operations. It also contains information on soldering splices and solder type sleeves.

2.12 Securing solder type connectors, lugs, punchings, etc., to studs, bus bars, bus bar details, stud connectors, etc., are regarded as mechanical connections and are covered in Section 7E.

2.13 Instructions covering the use of the R-2733 soldering copper are given in the Wiring and Connecting Handbook.

2.2 Cautions When Using Propane Torch

2.21 When using the open flame, determine the extinguishers and protection to be used in accordance with Handbook 0, General Information.

2.22 The open flame is approved for use in locations where there is no danger of damage from the flame.

2.23 If adequate protection can be provided in places where cabling, wiring, apparatus and woodwork would otherwise be in danger of being ignited, the use of the propane torch is permissible.

2.24 Before starting any operation involving the use of an open flame obtain the supervisors approval. If in a working office, the telephone company representative should approve the plan to be followed and the time designated for such work.

2.25 Do not use the torch in sunlight as the flame may not be visible.

2.26 Tape R-3134 propane cylinder when used near electrically alive equipment or when splicing live leads. Apply tape to bottom and extend up side of cylinder to safety valve. Do not tape over safety valve. See Figure 1.

2.3 Special Cautions When Using Soldering Coppers

2.31 Soldering coppers to be used on live power leads shall be tested for crosses while hot and immediately before being used. Use the R-2816 test box for electrical appliances, as described in Handbook 28.

2.32 When only a few punchings are involved, the power cord may be disconnected immediately before each soldering operation in lieu of making the above tests.

2.4 General Cautions

2.41 When splicing or adding punchings and lugs to live circuits, which cannot be temporarily disconnected, adequately protect all live parts, metalwork,

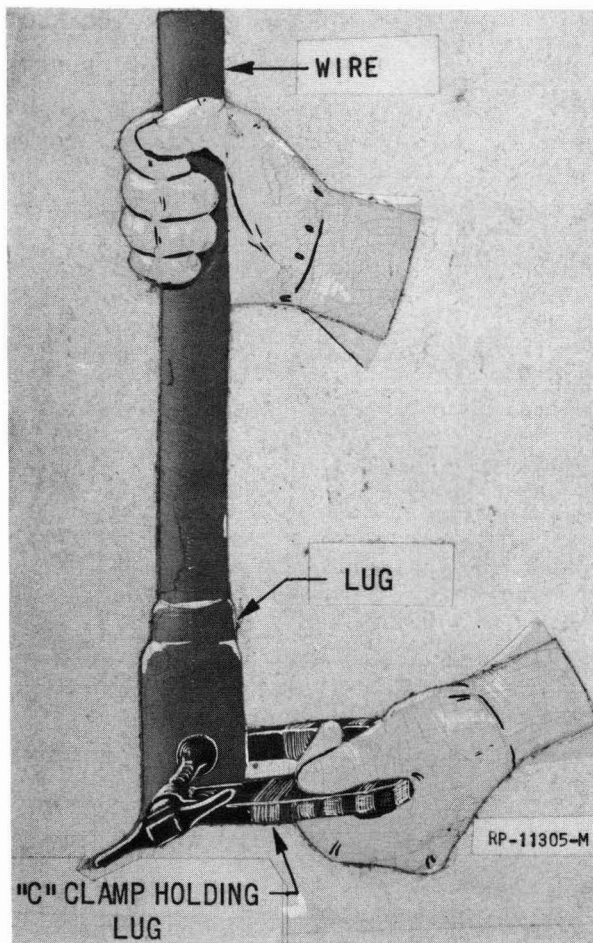


FIG. 1 PROPANE TORCH - R-3105
(PARS. 2.26, 4.22)

etc., to prevent accidental crosses, or short circuits with tools or falling parts. Use only tools that have been adequately insulated.

2.42 Wrap the lug holding tool with strips of cloth and hold in place with friction tape to prevent heat from affecting the hand. See Figure 2.

2.43 To avoid burns when sweating lugs use RM-669152 gloves and keep sleeves rolled down.

2.44 When cooling a hot lug with a wet cloth use a large enough piece of cloth to minimize any steaming and exercise care against the burning of hands or wrists by any steam from the cloth or by contact with the hot lug.

2.45 To prevent falling solder from injuring persons underneath, or to protect equipment when sweating lugs in an elevated position, provide a layer of fiberboard or light board.

3. INSTALLING EQUIPMENT

3.1 The required tools and supplies are shown in Section 7A.

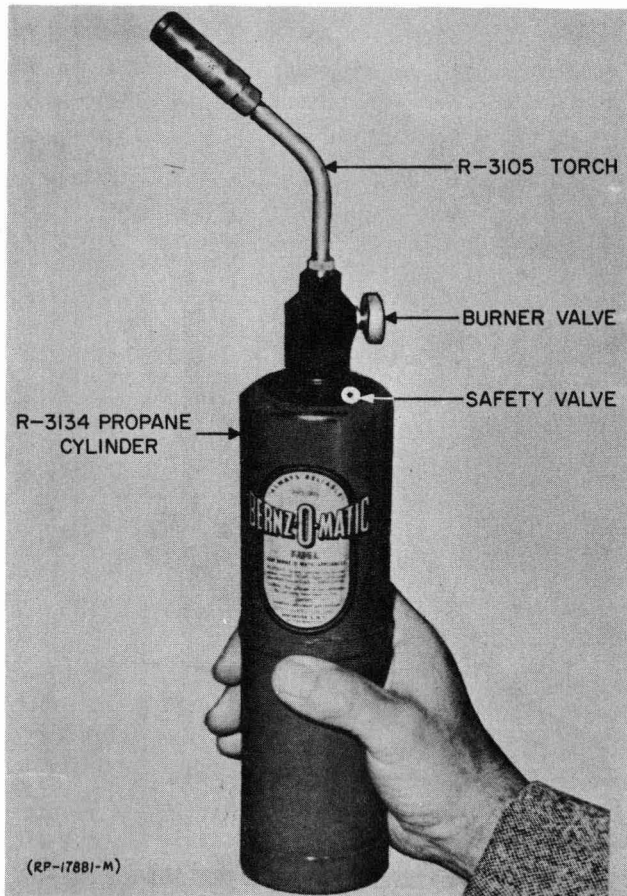


FIG. 2 C CLAMP USED TO HOLD LUG WHILE SWEATING (PARS. 2.42, 5.12)

4. TOOLS

4.1 Thermo-Grip Pliers

4.11 To heat terminal lugs with R-2666-A thermo-grip pliers (Figure 3) clean the surfaces of the lug to insure good electrical contact with the carbon jaws of the pliers.

4.12 Use only on 50 or 60 cycles, 110-120 volts ac. Pliers will not operate on direct current.

4.13 Wire up to 500,000 cm may be satisfactorily sweated with the unit.

4.14 If necessary the carbons may be immersed in water for cooling purposes after first disconnecting ac line cord.

4.15 Use only the replacement carbons furnished.

4.16 Avoid continuous use for more than 7 minutes.

4.2 Propane Torch - R-3105

4.21 Close the burner valve and connect the burner and cylinder together, setting up hand tight. Do not use a wrench.

4.22 Face the torch in a safe direction (See Figure 1) and open the valve slowly until the sound of escaping gas can be heard. Ignite the gas with a cup type flint lighter (R-2137). Adjust the flame as required. The blue cone at the center of the flame should be about 1-1/2 inches long for the best efficiency. The size of the flame depends on the size of the lug to be sweated and is determined best by experience.

4.23 The torch can be lighted quickly, therefore, when an appreciable amount of time will elapse between operations turn it out.

4.24 Remove the work, when feasible, to the bench or other location where there is no hazard of fire, in preference to performing the heating operations at a place where extensive protection must be provided.

4.25 For protection, use sheet rock or other fire resistant material so arranged as to prevent the transmission of injurious heat to the cabling, wiring, apparatus or framework.

4.26 Refer to Handbook 28 or the instruction sheet on the cover of kit No. 3 for information on how to clean the burner.

4.27 When a propane torch is not to be used for an appreciable time store the cylinder without the burner to avoid accidental venting through the valve. The automatic seal in the cylinder will prevent gas escape. Do not store or place cylinders near heat.

4.28 Drain nearly empty cylinders out of doors by means of the burner valve. When the cylinder is empty it should be discarded locally. A full cylinder weighs 32 ounces (900 grams) and an empty cylinder approximately 21 ounces (600 grams). The cylinder may be weighed with the 79B gram gauge.

5. LUGS

5.1 Preparation

5.11 It is essential that all tools and materials be assembled within reach before the tinning and sweating operations are started.

5.12 Additional preparation for torch: Hold the lug during the sweating operation with a R-1748 or R-1455 C clamp as illustrated in Figure 2 or with

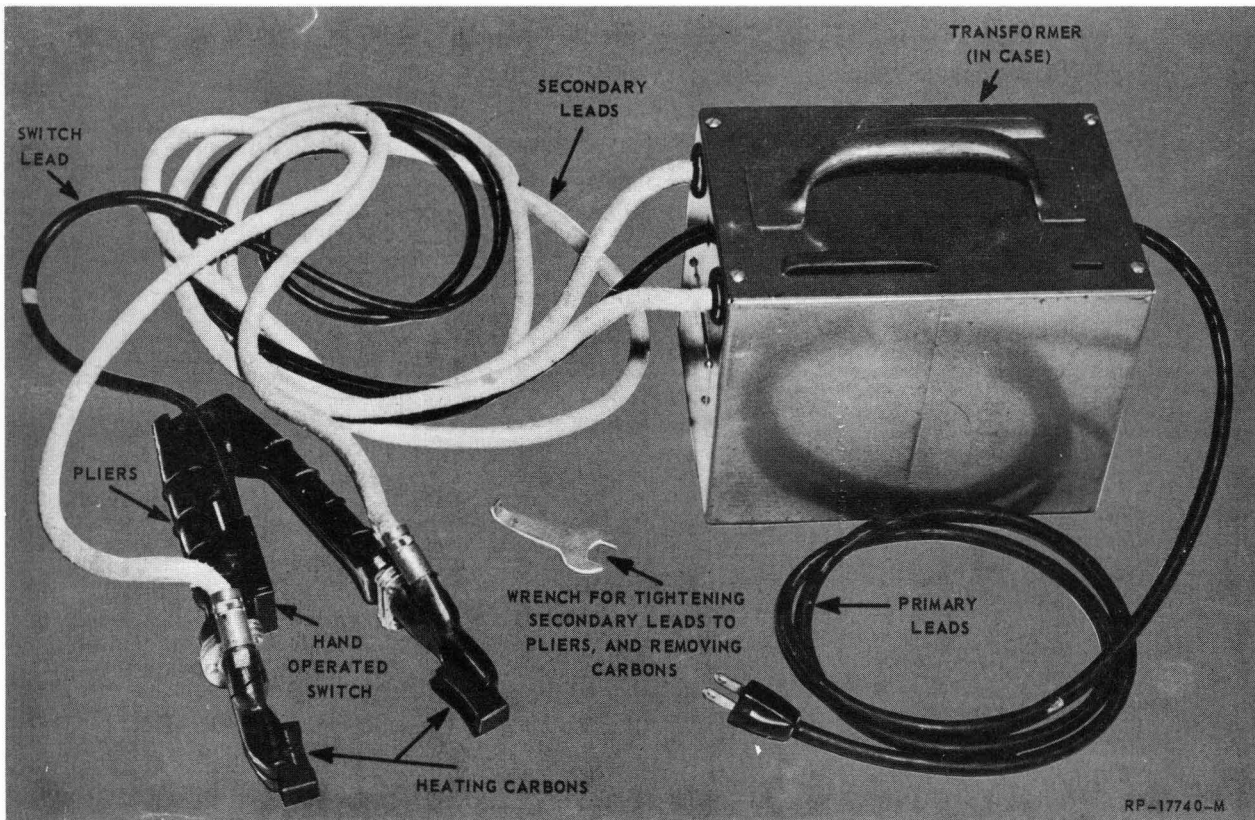


FIG. 3 R-2666-A THERMO-GRIP PLIERS (PAR. 4.11)

the R-7890 gas pliers. Do not use line-man's pliers for this operation. Wrap the handles of the pliers or C clamps during the sweating operation first with strips of canvas and then with friction tape to prevent the heat from affecting the hand.

5.13 Cut the wire long enough to be inserted the full clear depth of the lug. Mark and remove necessary insulation per Section 7A. Tape the insulation with friction tape even with the butt mark. Check to see that the wire end enters the lug loosely before applying heat to the lug. With a yellow pencil, mark the correct alignment between the lug and the power wire to insure final positioning once soldered.

5.14 As an aid in inserting fine stranded power wire into a lug such as generator and motor leads, wrap a few turns of No. 32 gauge tinned copper wire or a strand removed from a discarded end of the power wire around the bare strands near the cut end. Finish with a pigtail and fold toward the insulation butt.

5.15 Before starting the sweating operation, have a receptacle with water and a cloth nearby and floor and equipment protection in place as required.

5.2 Tinning and Sweating Operation

5.21 To tin and sweat the lug and wire end, put a small amount of Allen's soldering stick RM-641552 in the lug and on the heated end of the wire. Heat the lug with thermo-grip pliers or propane torch and nearly fill with strip solder. Insert the wire end slowly, allowing the heat to transfer and tin the wire. Remove slowly and check for complete tinning of the lug and wire end.

5.22 Once tinned, again add strip solder until lug is $1/2$ to $3/4$ full and reinsert wire slowly, allowing heat and solder to thoroughly penetrate the strands. Position lug with alignment mark. Being very careful not to disturb lug or wire, remove heat and cool with wet cloths. Do not remove protective tape until lug and wire have COMPLETELY cooled.

5.23 On commercial type pressed lugs, pay particular attention to the tinning operation. This type of lug, which has not been tinned by the manufacturer, is generally oxidized and it is usually necessary to scrape or sandpaper the inside surface of the cup before attempting to tin. Rosin core solder is not economical and therefore not recommended for sweating lugs.

5.24 Observing the thoroughness of the tinning operation of both lug and wire, and the assurance of ample solder in the lug, insures a reliable connection and constitutes its verification.

5.3 Inverted Lugs

5.31 Tin lug and wire end as covered in Paragraph 5.21. When lug has cooled, drill a 1/4" or 5/16" hole, depending on the size of lug, through the bottom of the cup.

5.32 Place the lug over the wire end then wrap friction tape around the wire close to the bottom part of the lug and along the wire for about 4 inches to prevent melted solder from flowing out and to prevent damage to the insulation during heating.

5.33 Heat the lug and feed strip solder into the hole until the wire will absorb no more. Use a wet cloth which is large enough to cool the lug without excessive steaming.

5.34 When the lug has cooled, remove surplus solder from around the hole in the lug and finish flush with the surface. Verify that the contact surface and bolt holes are clear of solder.

5.35 Do not remove friction tape until the wire is thoroughly cooled to avoid fraying the braid at the end.

5.36 If the lug is discolored due to heat, clean with fine abrasive paper. As these lugs are castings, it is not necessary to secure a highly buffed finish, but rather a workmanlike appearance.

5.4 Taping Soldered Lugs

5.41 When taping lugs such as in motor junction boxes, etc., apply rubber tape and friction tape half-lapped extending tape on to the wire insulation. The combined thickness of the tape should total at least the thickness of the wire insulation. Except when the connection is in an enclosure, finish with one coat of shellac.

5.42 Taped lugs within enclosures, under covers or behind barriers shall be formed and dressed so as to prevent undue pressures from metal edges and corners and contained so as not to interfere with closure of doors, placement of covers, barriers, etc.

5.5 Sealing Lugs Connected to Wet Cell Batteries and Wet CEMF Cells

5.51 All types of lugs to be connected directly to alkaline type (wet) CEMF cells, or to battery posts, or to details which in turn are connected directly to CEMF Cells or battery posts, shall be treated as follows:

5.511 After the wire is secured to the lug and no further forming is required, immerse the lug in one of the following compounds to a distance of about 1/2" above the end of the lead insulation:

1st Choice - Clear Varnish R-4059

2nd Choice - Acid Resistant Enamel RM-646317

The contact surface of the lug may be temporarily covered with tape to eliminate unnecessary cleaning of the sealing compound. This is especially recommended when dipping plated lugs.

5.512 Any lug used with dry type CEMF cells need not be immersed in one of the above-mentioned sealing compounds. R-3126 Silicone Compound is

required on the contact surface of all lugs connected to wet or dry type CEMF cells as called for in Section 7E.

6. SPLICES

6.1 General

6.11 Splices consisting of small battery and ground feeders with wires up to and including No.6 wire, can be soldered with the R-2733 soldering copper. When soldering the larger sizes of wire (#10, #8, #6) the use of a worn or "stubby" soldering iron tip will impart more heat. If the solder does not melt readily, more heat can be applied with the assistance of a second soldering iron.

6.12 Splices in wire sizes above #6 can be soldered with the thermogrip pliers, however, the propane torch is preferred when used with caution and with sufficient protection.

6.13 It is essential that the wires and sleeves be tinned and that sufficient heat is applied for the solder to flow in all the recesses between the strands.

6.14 Verification consists of a visual inspection before taping.

6.15 Insulate by applying rubber tape and friction tape half-lapped extending tape on to the wire insulation. The combined thickness of the tape should total at least the thickness of the wire insulation. Except when the connection is in an enclosure finish with one coat of shellac. Shellac prevents the tape from drying out and fraying when subjected to subsequent contacts with tools and personnel.

6.16 Splices may also be made using solderless connectors and wire connectors as described in Section 7D.

6.2 Splicing Sleeve

6.21 Wires to be spliced in a sleeve should be skinned so they will touch at about the middle of the sleeve. Proceed as shown in Figure 4.

6.22 A spare solder type lug will be satisfactory as a vessel for use in tinning. If wires have a smaller diameter than the standard wire fit loosely in the splicing sleeve it is recommended that they be wrapped with bare tinned copper wire to increase the diameter for a closer fit and then tinned again. This will reduce connection resistance, strengthen the connection and permit centering the wire ends in the sleeve. Place the tinned ends of the wire in position in the sleeve with the insulation against the sleeve ends and wrap friction tape around the insulation on both sides of the sleeve to prevent solder from flowing out and prevent damage to the insulation due to heating. Heat and feed in solder until filled. Cool with a wet cloth without disturbing wires or sleeve. Do not remove protective tape until splice has completely cooled.

6.23 Apply tape within the dimensions shown in Figure 4 and as described in Paragraph 6.15.

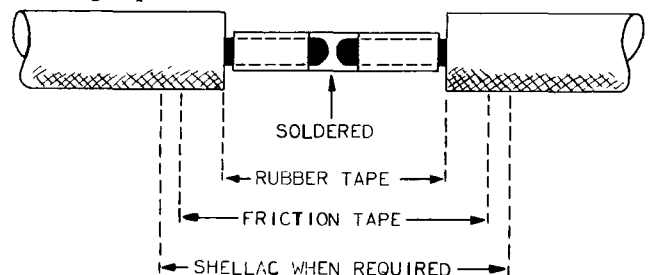


FIG. 4 SPLICING SLEEVE (PARS. 6.21, 6.23)

6.24 A table covering various sizes of sleeves (split wire connectors) and ordering information is shown in Handbook 22, Section 92.

6.3 Pig-Tail Splice

6.31 The soldered pig-tail splice, now replaced by a solderless type wire connector, is made with small gauge power wires as shown in Figure 5. It should be used when called for in job papers or on drawings and most frequently used in enclosures, however, it may be exposed such as when sewed into wire forms in which case apply one coat of shellac to the taped portion. This type of splice may be required in receptacle and junction boxes when the solderless type wire connectors are not available or when there is insufficient room for the solderless type.

6.32 Arrange the leads that are to be spliced in any conduit, or box, so that the completed taped splices will fit into the conduit, or box, without having to be forced by the cover when it is screwed into position. This may be done by staggering the splice locations, that is, make the splices in different locations in the box. Proceed as shown in Figure 5 making sure entire splice takes the solder.

6.33 Apply tape as shown in Figure 5 and as described in Paragraph 6.15.

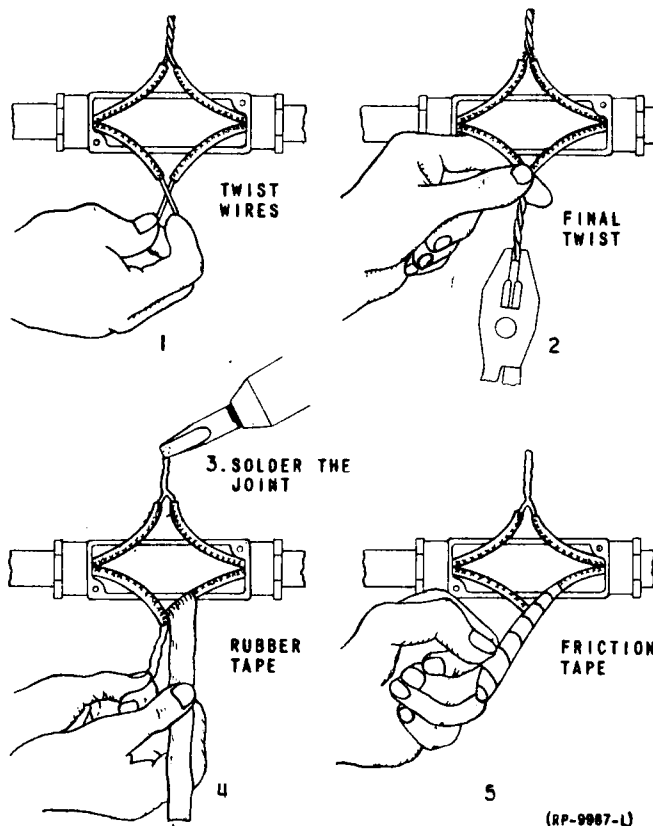


FIG. 5 "PIG-TAIL" SPLICING
(PARS. 6.31, 6.32)

6.4 Western Union Splice

6.41 The Western Union splice is a straight or in-line splice used with small gauge power wires and made as

shown in Figure 6. Determine that the entire splice takes the solder. The size of wire will determine the length of the splice. When drawings indicate a solder splice or job information calls for a soldered splice, the Western Union splice is preferred over the pig-tail splice especially when appearance is a factor or when the splice may be subjected to strain.

6.42 Apply tape within the dimensions shown in Figure 6 and as described in Paragraph 6.15.

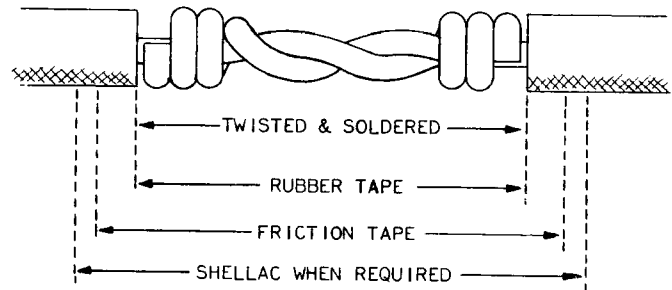


FIG. 6 STRAIGHT SPLICING - SOLDERED
(WESTERN UNION SPLICING)
(PAR. 6.41)

6.5 "T" Splice

6.51 The solder type "T" splice is used for tapping small gauge power wires to a continuous power wire run of a small gauge. Make as shown in Figure 7. Determine the entire splice has taken the solder.

6.52 Apply tape within dimensions shown in Figure 7 and as described in Paragraph 6.15.

6.53 Connections to small gauge battery distributing feeders shall be made with the "T" splice in unprotected locations.

6.531 In protected locations these connections are made with the solderless wire connectors. See Section 7A. A protected location is a position such that normal maintenance operations or pulling in future cables will not disturb the splice.

7. TERMINAL PUNCHINGS

7.1 Skin wire ends to be soldered to terminal punchings long enough to fit into the entire length of the soldering channel but not long enough to interfere with the clamping nuts. See Figure 8. Insert tinned end of wire into channel of punching so that the insulation is flush with the punching.

7.2 Wire up to No. 10 may be soldered to punchings. Use the R-2733 soldering copper. Punchings mounted on bus bar or other large details may have the heat carried away too rapidly for satisfactory soldering. Remove such a punching while soldering.

7.3 Exercise care so as not to disturb the wire or punching until the solder solidifies. Small gauge power wire and

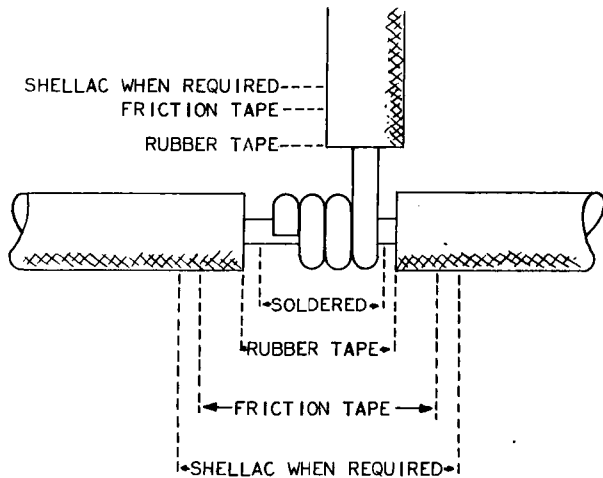


FIG. 7 "T" SPLICE (PAR. 6.51)

terminal punchings may be held in position for soldering by a job made soldering block such as the one shown in Figure 8.

7.4 Verify the soldered connection as follows: The lead when grasped approximately 1/2" from the punching shall remain fixed when a pull is applied, the pull to be enough to test the connection but not enough to twist or bend the wire.

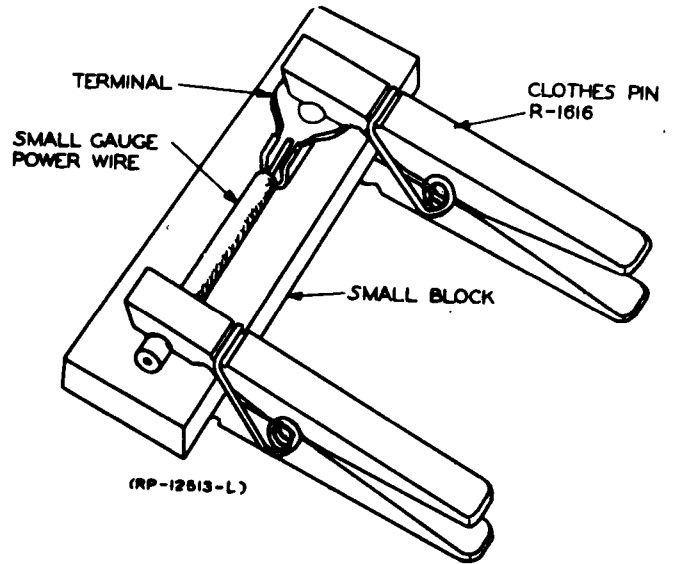


FIG. 8 JOB MADE SOLDERING BLOCK (PARS. 7.1, 7.3)

7.5 Tape soldered terminal punchings installed in open cell battery rooms with an overlapping layer of rubber tape for a distance of 1-1/2" over the wire and one half the distance of the soldered portion of the punching. Cover with one layer of friction tape and shellac. Paint with 2 coats of RM-646317 gray acid resistant enamel.

→ Arrowed lines indicate new or changed information.

[Vertical lines at side of paragraphs indicate requirements.

Manager, Product Engineering

Reason for Reissue:
To add additional information, so that all type of lugs are protected with sealing compound.