COAXIAL CABLE MAINTENANCE PRECAUTIONS

Contents

1. GENERAL

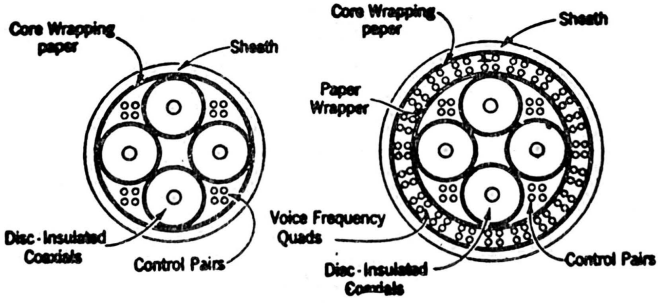
1.01 This Section describes the various features of coaxial cable and auxiliary repeaters which are of interest from a cable maintenance standpoint. The instructions outline the procedure to be followed in connection with cable maintenance operations, including safety precautions that must be observed to avoid contact with the power supply circuit and prevent interruption of service over the coaxials.

1.02 The mechanics of splicing coaxial cable, opening the sheath to obtain access to the coaxials in repair operations, testing for insulation resistance and clearing troubles due to slivers are outlined in Section G71.187, which should be considered a supplementary part of these instructions.

2. DESCRIPTION OF CABLE AND ASSOCIATED APPARATUS

2.01 **Coaxial Main Cable:** The coaxial portion of the main cable consists of two or more coaxials and the associated paper-insulated control pairs arranged as illustrated below. The sketches show two typical cable makeups.

2.02 The coaxial portion of the cable is wrapped with heavy paper. Voice frequency quads or pairs, or exchange pairs may be laid over the paper wrapper, depending on the layout of the cable.



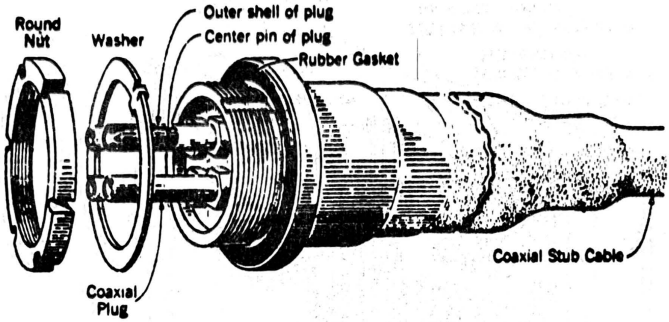
2.03 **Repeaters:** One repeater is used with each two coaxials in the cable. At auxiliary repeater points, the repeaters associated with the regular or alternative coaxial lines are housed in separate steel apparatus cases. The apparatus cases may be located in small huts of steel or masonry construction, mounted on a pole, or in some instances, in a manhole. The connections between the repeater and the coaxials are made by

means of plugs and jacks to facilitate disconnecting the coaxials for testing purposes. The control pairs are terminated on a binding post panel.

2.04 At main repeater points and terminal offices the coaxials are brought out individually in gas-tight terminals located at the equipment bays with the associated power separation filters.

2.05 **31-A Coaxial Cable Terminal:** The coaxials are carried into and out of the associated repeater at auxiliary points through a 31-A cable terminal which is illustrated below. This terminal is gas-tight.

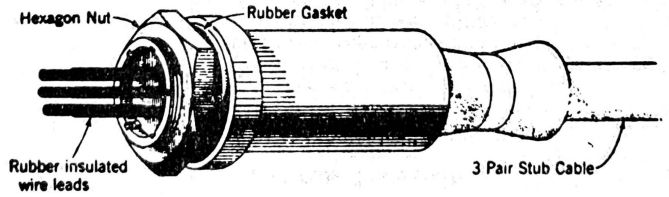
31-A CABLE TERMINAL



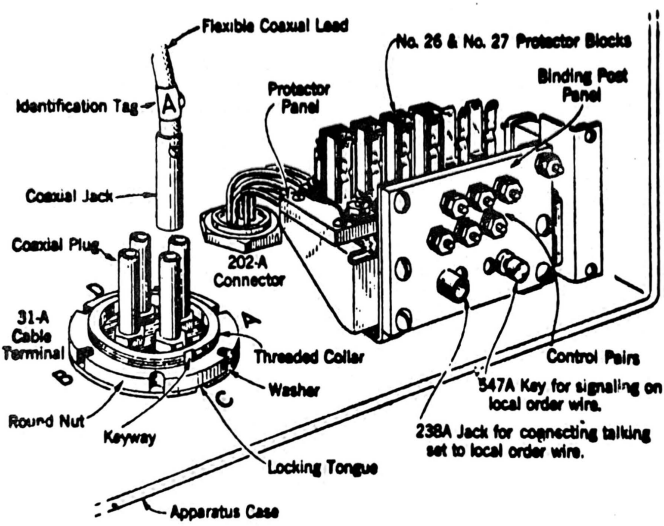
2.06 The stub cable of the terminal contains four coaxials. The outer conductors of the coaxials are bonded together and connected to the metal shell of the terminal.

2.07 **The 202-A Connector** is used to carry the control pairs associated with the coaxial repeater into the apparatus case. The 202-A connector is gas-tight. It has a three-pair stub cable.

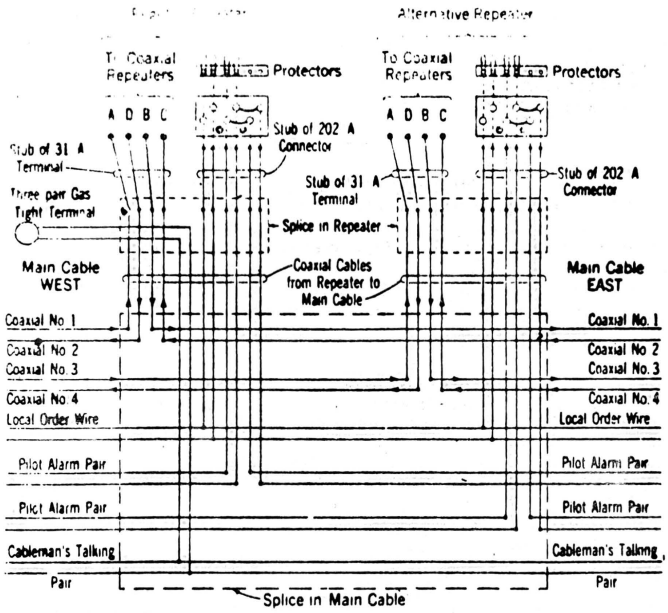
202-A CONNECTOR



2.08 **Coaxial and Control Pair Termination:** The following sketch indicates the relative position of the coaxial plugs inside the housing at the "regular" and "alternative" auxiliary repeaters. In the regular repeater, the terminal plugs designated A and B are associated with coaxial No. 1 in the main cable; the plugs designated C and D are associated with coaxial No. 2. In the alternative repeater, terminal plugs A and B are associated with coaxial No. 3, and plugs C and D with coaxial No. 4 in the main cable. The sketch also shows the terminating arrangements for the control pairs, and the talking and signaling facilities.



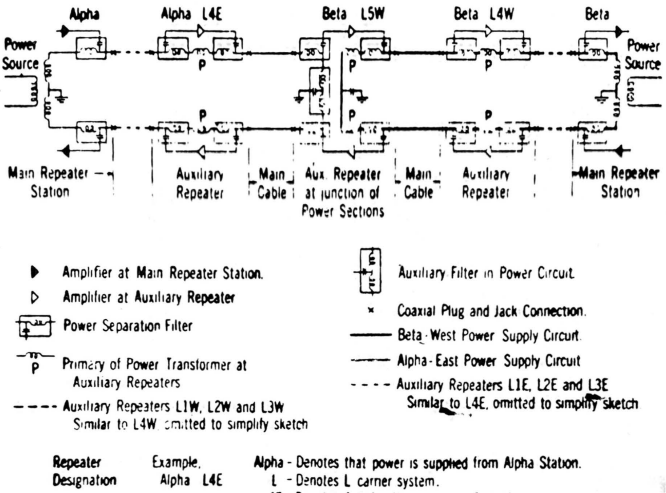
2.09 The following sketch shows the schematic splicing arrangement at the regular and alternative repeaters as well as the function of the control pairs associated with the coaxial system, and location of the associated binding posts in the regular and alternative repeaters.



2.10 **Three-Pair Terminal:** The talking pair associated with the gas alarm system is usually brought out in a 3-pair terminal at pressure-contactor points and at each auxiliary repeater point, to permit communication with the attended repeater stations in connection with maintenance operations. The alarm circuit in coaxial cable is operated at a higher potential than on other cables. For this reason Binding Post Insulators per Drawing ESA-775377 should be placed on the binding posts associated with the gas alarm circuit. Insulators should not be applied to the talking pair posts.

2.11 **Power Supply:** Power for operating the auxiliary repeaters is obtained from the main repeater stations over the two associated inner coaxial conductors at relatively high potential. Power for half the auxiliary repeaters is usually supplied from one main office, and power for the other half is supplied from the other main office. The sketch shows a typical repeater layout in which power for the repeater at the

junction of the two power supply circuits (Beta L5W) is supplied from Beta station. The junction repeater may be in either the Alpha or Beta power sections, depending on the power facilities available at these stations. The junction repeater is designated accordingly.



2.12 Because of the method in which power is supplied, there is a relatively high voltage between the two inner conductors and from both inner conductors to ground. **It is, therefore, imperative that anyone who has occasion to work on the coaxial cable be thoroughly familiar with the safety precautions outlined in this Section and that the work be carried out precisely in accordance with the instructions.**

3. SPECIAL PRECAUTIONS

3.01 No one is permitted to open coaxials or the associated pilot alarm pairs without specific authorization from the designated testboard attendant immediately before the work is started. Under no circumstances shall the cableman open other coaxials or control pairs than those specifically authorized by the testboardman

3.02 If voice frequency toll quads or pairs, or exchange pairs surround the coaxials and control pairs, work may be done on these quads or pairs without taking the precautions applying to the coaxials and pilot alarm pairs. The workman should, of course, obtain permission from the testboard to open the cable and report to the testboard before closing the cable. When it is necessary to open the cable at other than splice points, arrangements should be made to communicate with the testboard over one of the voice frequency or exchange pairs in order to avoid disturbing the core wrapping paper around the coaxials and control pairs.

3.03 Before opening a splice or the sheath of a cable containing coaxials, a bonding cord connection should be established to make the sheath continuous across the opening.

3.04 If it is necessary to open all the coaxials in connection with maintenance work at one point, a bond connection should also be established on two of the outer coaxial conductors to maintain continuity across the splice.

4. CALLING THE TESTBOARD

4.01 Before opening a cable to work on the coaxials or control pairs, the workman shall call the testboard by one of the following methods and obtain permission:

(1) By means of the cableman's talking pair at a contactor-terminal or at a three-pair terminal associated with the gas alarm circuit.

(2) By means of a local public telephone.

(3) By means of the local order wire at an auxiliary repeater point. In this case the testboard can be called by depressing the signaling key on the terminal strip in the repeater housing: one short ring signals the office to the east or north; two short rings signal the office to the west or south of the auxiliary repeater point. After signaling, connect the line terminals of the local battery talking set to the local order wire jack by means of a two-conductor cord terminated in a No. 110 plug.

(4) If these facilities for calling the testboard are inoperative or are not practicable where the work is to be done, the testboard can arrange to put tone on a pair or quad in the cable with a signaling arrangement which will operate when the cableman connects to the pair. In this case the cableman should open the cable and after he has identified the pair or quad, he should connect his talking set to the pair (or the other side of the quad) and communicate with the testboard.

5. RESPONSIBILITY FOR DISCONNECTING AND CONNECTING POWER

5.01 When a coaxial has to be opened for any reason at a splice or in a section between splices, the power **must be disconnected** from the two associated coaxials at the office from which power is supplied to the section of cable involved. The direction from which power is supplied to the cable at any point can be determined from the designation of the auxiliary repeaters which is indicated on the sketch in Paragraph 2.11. For example, in the repeater designation "Alpha L4E," the abbreviation "Alpha" indicates the office from which power is obtained; "L" indicates the type of repeater; and "4E" indicates that the repeater is the fourth east of Alpha. The designation "Beta L3W" would refer to the third repeater west of Beta, the power being supplied from Beta. These designations are found on the repeater housings.

5.02 Each crew doing work on the cable must make its own arrangements with the designated office to disconnect power. If two or more crews are working in the cable simultaneously, each crew must call to ask for disconnection of power and when finished, each crew must call to report completion of the work. Power will not be restored on the circuit until all of the crews working have reported in.

5.03 **Procedure for Disconnecting Power**

(1) Call the testboard (see Paragraph 4.01) and give name, location and nature of work to be done and request that power be disconnected from the coaxials involved.

(2) Make a written note of the coaxials to be worked on so as to facilitate identification.

(3) When the testboardman indicates that the power is off, proceed as outlined in Part 6 below.

6. IDENTIFYING COAXIALS AND VERIFYING DISCONNECTION OF POWER

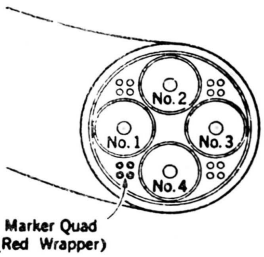
6.01 **Identification by Number:** Upon opening the coaxial cable to test or do repair work on the coaxials or control pairs, the cableman should pick up the cableman's talking pair by means of tone applied at the office or at a nearby three-pair terminal, and a 107-A Amplifier. Then call the testboard for instructions.

6.02 At splices, the coaxials are tagged for ready identification. When the cable is opened at some point between splices, the coaxials can be identified by means of the numbering plan illustrated below. The identification thus made at

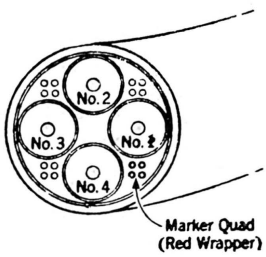
splices or at points between splices should in all cases be verified as outlined in subsequent paragraphs using the 79-A Test Set, which is described in Section G72.262.

Line Assignment (see Sketch Paragraph 2.09)

Pairs 1 and 2—Regular Line
Pairs 3 and 4—Alternative Line



Coaxial Count toward the Westerly or Southerly office

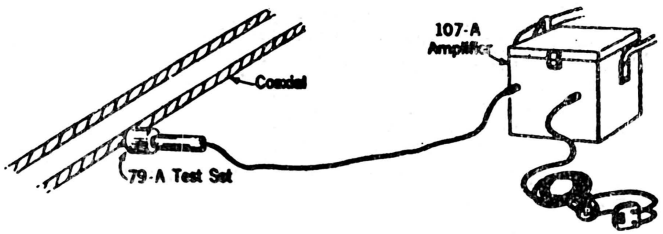


Coaxial Count toward the Easterly or Northerly office

6.03 The power is usually disconnected from the coaxials to be worked on only at the office supplying power to the cable section involved, as indicated by the repeater designation —see Paragraph 2.11.

6.04 **Verifying Coaxials with 79-A Test Set:** The working coaxials can be identified by listening for power hum on each coaxial in the cable, using the 79-A test set (exploring coil) and 107-A amplifier applied as shown in the following sketch. A loud hum will be heard on each working coaxial; no hum or a low hum will be heard on the non-working coaxials from which power was disconnected at the testboard.

6.05 There should always be a large difference in the intensity of hum heard on the working and non-working coaxials. If little or no hum is heard on all coaxials, there is a possibility of trouble in the exploring coil or amplifier. The operation of these should be checked, for instance, by holding the coil near a 76-A or 20-C test set. If the exploring coil and amplifier are operating properly, the testboard should be called to determine whether power has been removed. No coaxial shall be opened until a positive identification has been made.



6.06 When the coaxials have been identified in the cable, a further test should be made on each coaxial that is to be worked on, as outlined below, in order to ensure that power has been removed.

(1) Crimp the non-working coaxial with diagonal pliers at the center of the coaxial sleeve if at a splice, or at the point where the coaxial is to be opened at other than a splice point. The crimping should be done firmly to ensure that the outer and inner coaxial conductors are short-circuited.

(2) Then apply the exploring coil to the crimped coaxial, first on one side of the crimped point and then on the other. The hum should be low and of the same intensity on both sides of the crimped point; also, the hum should be very much less than that heard on the working coaxials.

(3) If these conditions are met, the power has been disconnected and the non-working coaxials may then be opened as outlined in Section G71.187, Part 5. If a loud hum is heard on one or both sides of the crimped point, advise the testboard and await further instructions.

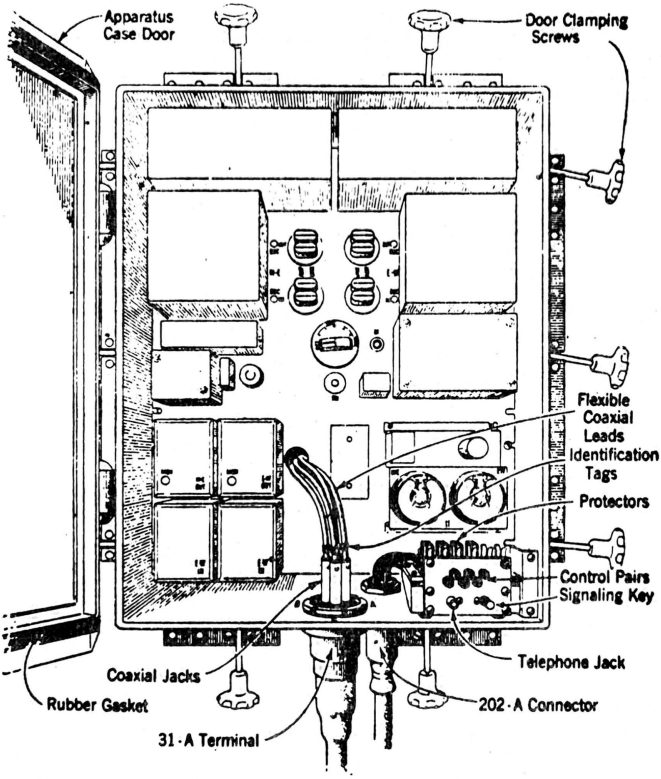
6.07 When the non-working coaxials have been positively identified by the tests outlined above, the cableman may proceed with his work. If more than one coaxial is to be opened at one time, the associated coaxial ends should be suitably marked using tags or otherwise, to ensure that they will be connected correctly on completion of the work. This same precaution should be taken in opening the control pairs if the color of the insulation does not provide the necessary distinction.

6.08 If the workman has instructions to open all of the coaxials, he should first establish a bond connection on the outer conductor of two coaxials as specified in Paragraph 3.04.

7. ISOLATING COAXIALS BETWEEN REPEATERS

7.01 When it is necessary for testing purposes or other reasons to isolate the coaxials between two repeaters, proceed as follows:

7.02 Go to the repeater nearest the office from which power is supplied to the cable section in which work is to be done (see Paragraph 2.11) and open the repeater housing in which the coaxials involved are terminated. For instance, if the section to be isolated is between repeaters "Alpha L3E" and "Alpha L4E," the workmen should first go to Alpha L3E. The interior of the repeater housing is illustrated below.



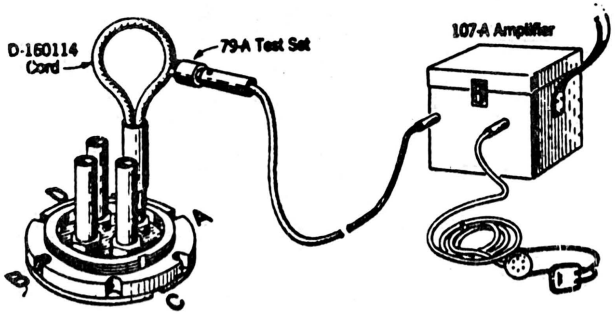
7.03 In the case of the repeater at the junction of the East and West power sections, power voltage enters this repeater from both directions and the power should be disconnected from both ends. If, for example, the section on either

side of repeater Beta L5W is to be isolated, go first to the repeater Beta L5W.

7.04 Then call one or both power supply offices, as the case may be, and arrange to have power disconnected.

7.05 When the office has reported that the power is off, disconnect the four flexible coaxial leads from the plugs of the cable terminal of the repeater by withdrawing the jacks. Insert a D-160114 Cord in one of the coaxial plugs of the cable terminal. Apply the 79-A Test Set to the looped wire of the cord, placing the coil over one side of the loop as shown in the following sketch. Make a similar test on each of the other three coaxial plugs of the terminal. No hum or only a slight hum heard on all of the four plugs indicates that the power is disconnected. If a loud hum is heard on any of the four plugs, advise the testboard and await further instructions.

Caution: Be sure that the exploring coil and amplifier are in good operating condition before making this test.



7.06 When it has been positiv ly determined that the power is disconnected, tie a tag to the flexible coaxial leads, marked to indicate the name of the workman, the date and the time the coaxial pairs were opened, the reason for opening and "Do Not Disturb." The repeater housing should then be closed and bolted, unless connections must be brought out of the repeater case.

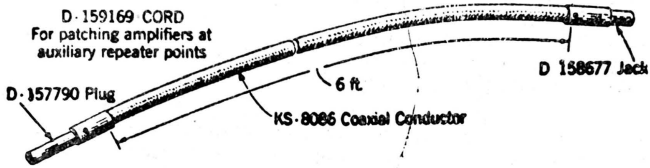
7.07 Proceed to the corresponding repeater at the other end of the section, remove the flexible coaxial leads, make verification tests with the 79-A Test Set and D-160114 Cord, and tag the repeater as outlined in Paragraph 7.06. Then the splicer may proceed with his work in the cable between repeaters, identifying t e coaxials to be worked on as outlined in Part 6.

8. TEST CONNECTIONS AT REPEATERS

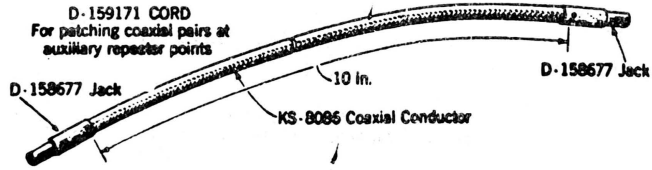
8.01 Before making any connections for testing purposes at repeaters, the coaxials involved should have power disconnected from them as outlined in Part 7.

8.02 Four types of cords have been made available for patching and test purposes at auxiliary repeater points.

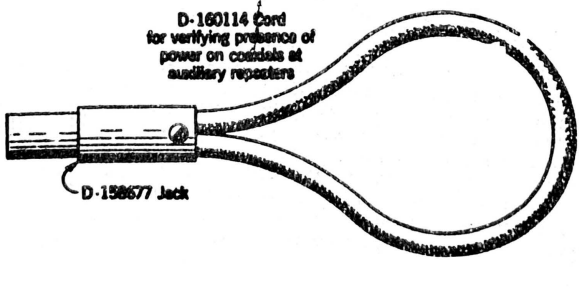
8.03 **The D-159169 Cord** is equipped with a coaxial jack at one end and a coaxial plug at the other. It is used for patching an amplifier of one repeater to the coaxial terminal of the other repeater. Patching work of this nature is normally done by the repeater maintenance forces.



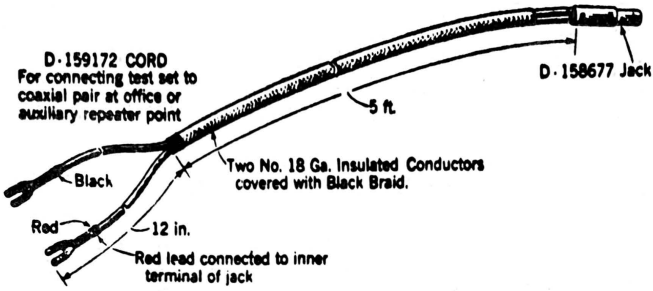
8.04 **The D-159171 Cord** is equipped with a coaxial jack at each end. It is used to make connections between coaxial pairs in the coaxial terminals at auxiliary repeaters.



8.05 **The D-160114 Cord** is used at repeater points as outlined in Paragraph 7.05, to verify whether power has been disconnected from the coaxials.



8.06 **The D-159172 Cord** is a two-conductor rubber insulated lead equipped with a coaxial jack at one end and two spade type cord tips at the other. This cord is used to permit the connection of testing apparatus to the coaxials at auxiliary repeaters, for making Wheatstone bridge measurements, applying tone to identify coaxials between repeaters, measuring insulation resistance and making breakdown tests. The lead with the red marker is connected to the inner coaxial conductor and the other lead, to the outer coaxial conductor.



9. MAKING REPAIRS AND TESTING COAXIAL CABLE

9.01 The method of opening coaxials in the splice or at points between splices and the splicing procedure are outlined in Section G71.187. That Section likewise outlines the use of the high voltage test set in clearing slivers and the method of closing the cable and protecting the splice.

9.02 In burning slivers with the high voltage test set or in making Wheatstone Bridge measurements in the field to locate faults in the coaxials between repeater points, the coaxials involved should first be isolated by opening them at the repeaters adjacent to the faulty section, as described in Part 7.

10. RESTORING COAXIAL CABLE TO NORMAL

10.01 **Restoring Coaxial Connections at Repeaters:** If coaxials were opened at one or more repeaters to permit making repairs or doing other work, the cableman should proceed to the repeater point, call the testboard, remove his caution tag from the case, and then restore the coaxial connections at the repeater, subject to the provision in Paragraph 10.02.

10.02 If tags are left in the repeater case by more than one crew, each crew should remove its own caution tag and the last crew to finish should restore the coaxials to normal.

10.03 In restoring the connections, make sure that the jacks and plugs are connected together in accordance with the tag designation on the coaxial jacks and the stenciled markings opposite the plugs in the 31-A terminal, Jack "A" to Plug "A," Jack "B" to Plug "B," etc.

10.04 When the connections have been restored, advise the testboard attendant and wait for his OK before closing the apparatus case.

10.05 **Closing Splices or Sheath Openings:** Before closing the sheath where cable work has been in progress, the cableman shall call the testboard to ascertain whether the cable is in working order. The splice should not be closed until a release to do so has been obtained from the testboard attendant. If more than one crew is working on the cable, each will do likewise and when all have reported, the testboardman will restore power.

11. CLOSING AND PRESSURE TESTING APPARATUS CASE

11.01 **Desiccant is used** to absorb excessive moisture from the air which is trapped in the apparatus case, and thus minimize the possibility of trouble due to condensation of moisture in the case. Just before closing the apparatus case on completion of the work, replace the desiccant in the case with about 50 grams of fresh desiccant. If more than one crew is involved, the last one at the repeater should replace the desiccant.

11.02 **In closing the apparatus case,** tighten the cover clamping screws securely by hand (do not use pliers or a wrench). The screws should be turned down a little at a time in sequence around the cover, to ensure uniform pressure on the gasket. Then the case should be pressure tested as outlined in Paragraph 11.03, (by the last man, if more than one is working at the repeater).

11.03 **Pressure Testing:** Apparatus cases mounted on pedestals, poles or in manholes should be pressure tested as outlined below, after closing the cover. Cases mounted in huts or in a housing above ground need not be pressure tested.

(1) Admit gas through the valve in the cover until the pressure in the case reaches 1-1/2 to 2 pounds per square inch as measured with a gauge or manometer. (Do not exceed two pounds as it may damage the cover.)

(2) Then connect a pressure testing gauge at the valve, (a manometer, if one is available). Observe the pressure reading immediately and after about 10 minutes. If there is no loss of pressure observed during this period it can be assumed that the case is gas-tight.

(3) Do not test the case with soap solution as the construction of the cover is such that bubbles would be difficult to detect, and the use of soap leaves an undesirable residue on the cover and gasket.

(4) If the pressure drops, loosen the cover clamping screws and retighten them as outlined in Paragraph 11.02. If necessary, check the condition of the cover gasket, tightness of the locking nut of the 31-A cable terminal and 202-A connector and condition of the associated rubber gaskets. Then pressure test the case again.

11.04 A fully charged 24-cubic foot nitrogen gas container has sufficient gas capacity to make five or six tests.

12. REMOVAL OF 31-A TERMINAL AND 202-A CONNECTOR

12.01 If it becomes necessary to remove the 31-A terminal or 202-A connector for maintenance purposes, the procedure outlined below should be followed.

(1) Call the testboard attendant and have power disconnected in the usual manner.

(2) Open the coaxial jack and plug connections at the terminal, and, when necessary, disconnect the control wires from the protector panel.

(3) Disconnect the terminal or connector stub cable from the splice in the auxiliary stub cable or main cable.

(4) **31-A Cable Terminal**

(a) Loosen the round nut (shown in sketch in Paragraph 2.05) with a spanner wrench; then remove the nut and washer.

(b) The 31-A terminal can then be taken out. Care should be exercised to avoid kinking the stub cable in this operation.

(5) **202-A Connector**

(a) Loosen the hexagonal nut (shown in the sketch in Paragraph 2.07) using a 1-7/8" open end wrench, or equivalent.

(b) The connector can then be removed, being careful to avoid damaging the stub cable.

(6) The new terminal or connector can be installed by proceeding in the reverse order.