Fig. 1—Inexpensive phono-type connectors like the one on the back of this kit transmitter are adequate for hi-fi applications, but are highly undesirable for r.f. applications. Accidental damage to the connector and dielectric occurs easily, and could possibly result in a blown final due to a shorted output.

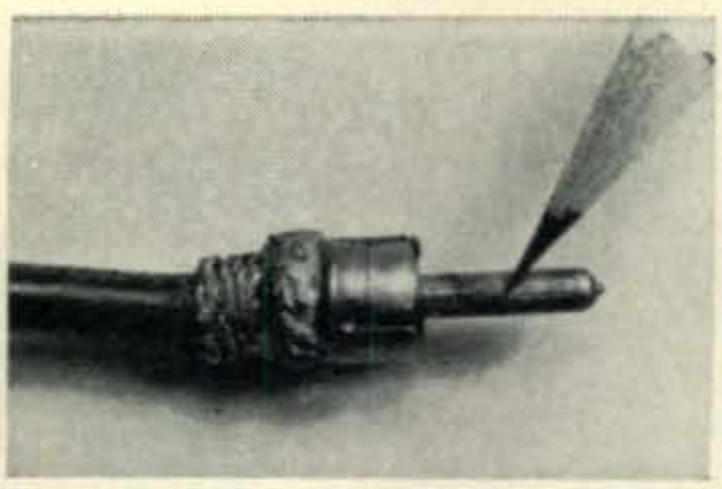


Fig. 2—Flimsy phono plugs like this one are trouble sources because they are not designed for r.f. applications. Shorting between the braid and center conductor may occur because of poor separation between shield and pin. Also, environmental abuse can loosen the fit of the shield over a chassis connector.

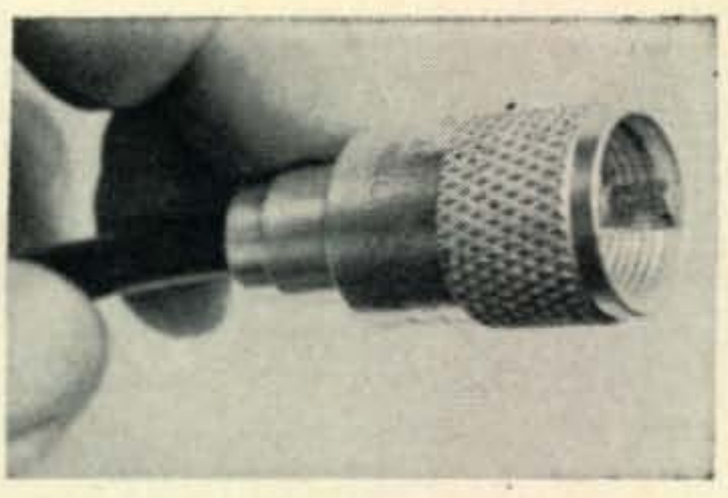


Fig. 3—This is the UHF-type connector most popular with amateurs conscious of the need for adequate r.f. connectors. Although well machined and offering good protection from accidental disconnection on low- and medium-power rigs, UHF-type connectors are low in cost and easy to install.

A Close Look At
Connectors

BY FRANK MacKINNIS,* WB2INM/1

The selection of proper r.f. connectors when building equipment is generally left to chance or the junk box. The author, an authority on r.f. coaxial connectors, has pin pointed the dangers in the use of inadequate connectors as well as introduced several models and applications probably not familiar to some amateurs.

"CONNECTORS?—Oh, I'll grab a couple when I pick up the chassis and some bolts."

Unfortunately, that's the impunity with which most radio amateurs select the coaxial and power connectors they use. And amateurs aren't the only ones responsible for the inadequate, often under-rated connnectors which appear on amateur gear and cables. Some kit and equipment manufacturers set a poor example by flagrantly disregarding these not-so-lowly items of "hardware."

No one would think of putting a tin-sheet buckle on seat belts, no matter what the dollar savings might be—because when seat belts are needed most, they're only as strong as the buckle connecting them. And yet, both hams and equipment manufacturers often disregard this philosophy when it comes to connectors.

*Amphenol Borg Electronics Corp., 33 E. Frankiin Street, Danbury, Conn.

Fig. 4—A handy connector unknown to most amateurs, this right-angle u.h.f. plug makes it easy to connect cables to chassis connectors on the back of low- and medium-power equipment. A right-angle plug is shown as it is connected to the back of an antenna tuner.

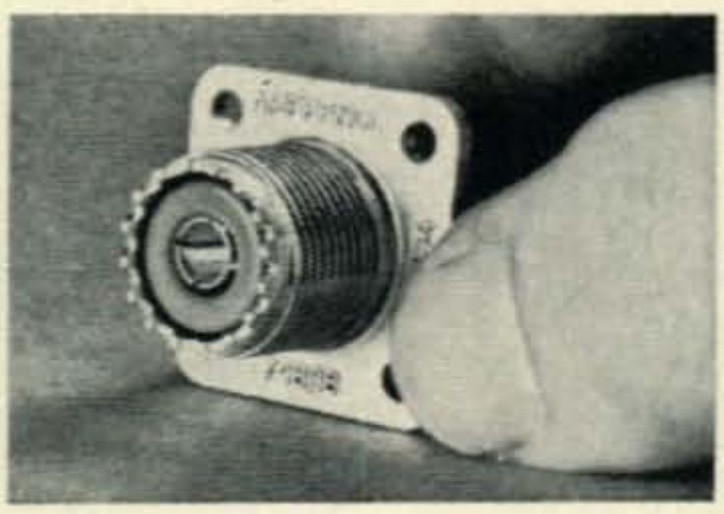


Fig. 5—The most common type of u.h.f. chassis connector, the SO-239 is a mica-filled, bakelite-insulated model with excellent environment-resisting characteristics. Like all UHF-type connectors, it is made of silver plated brass. These two metals provide a rugged combination.

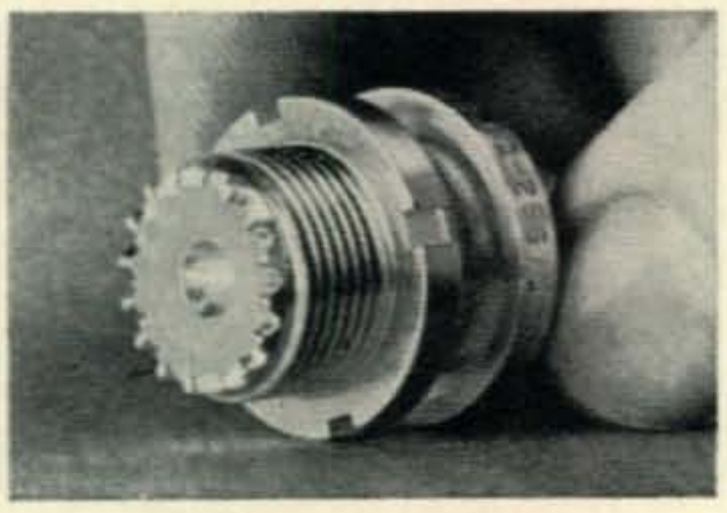


Fig. 6—An excellent choice for converting rigs with phono connectors to safer u.h.f. connectors, this bulkhead receptacle can be installed on commercially-built gear merely by enlarging the chassis hole left after removing a phono-type connector. It is very simple to install.

Phono Connectors: Cheap Trouble-Makers

The phono-type chassis receptacle (fig. 1) seen on some of the most sophisticated s.s.b. transceivers, and practically all kit transmitters, is the best example of expensive penny-pinching. These tiny shielded plugs are adequate for hi-fi, where voltages range in the microvolt levels for which the plugs were designed. But thousands of hams try to force 200 watts p.e.p. and more through these tiny sockets and plugs—power levels far beyond the capabilities of the dielectric and the conductor spacing.

Little better are phono connectors with ceramic dielectrics. Although providing somewhat better protection against breakdown, they still possess several characteristics which make them highly *un*desirable for r.f. applications.

Because the plug shields depends on a friction fit over the female chassis receptacle, a considerable strain is put on the dielectrics of both connectors whenever the slightest tension is put on the cable to which the plug is attached. The process of mating and unmating these plugs and sockets, combined with cable strains on the mated connectors, can crack dielectrics and short out the conductors.

Another danger exists with phono-type connectors: they are easily damaged by mating and unmating, and by such mundane environmental calamities as being stepped on. Since the connection depends upon the pressure of the plug shield against the chassis receptacle, a damaged shield may permit connectors to unmate without being detected. This does no damage if the connectors link a receiver to a coax relay—but if they link a final amplified to an antenna, real damage can occur.

A third danger exists—the possiblity of braid-to-conductor shorting. The simple nature of the plug makes it practically impossible to solder the braid to the shield without risking a short. The distance between the braid and the center conductor depends upon the neatness of the person preparing the cable for the plug. Tiny slivers of braid can easily short out the connector, causing that strange insensitivity in receivers and those blown final amplifier tubes.

Emerging from this example of poor connector selection are several basic criteria each ham should consider in picking a connector.

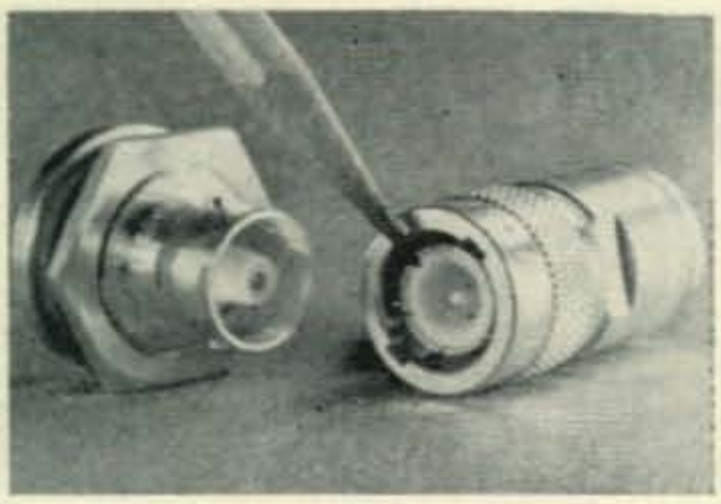


Fig. 7—For the amateur running high power, and even medium power above two meters, the protection of "C" type connectors is highly recommended. The secret to the low s.w.r. and high-power capacity of these connectors is in the dielectric design. The "C" connector is also good for power applications, and as a weatherproof connector. The assembly technique is shown in fig. 11.

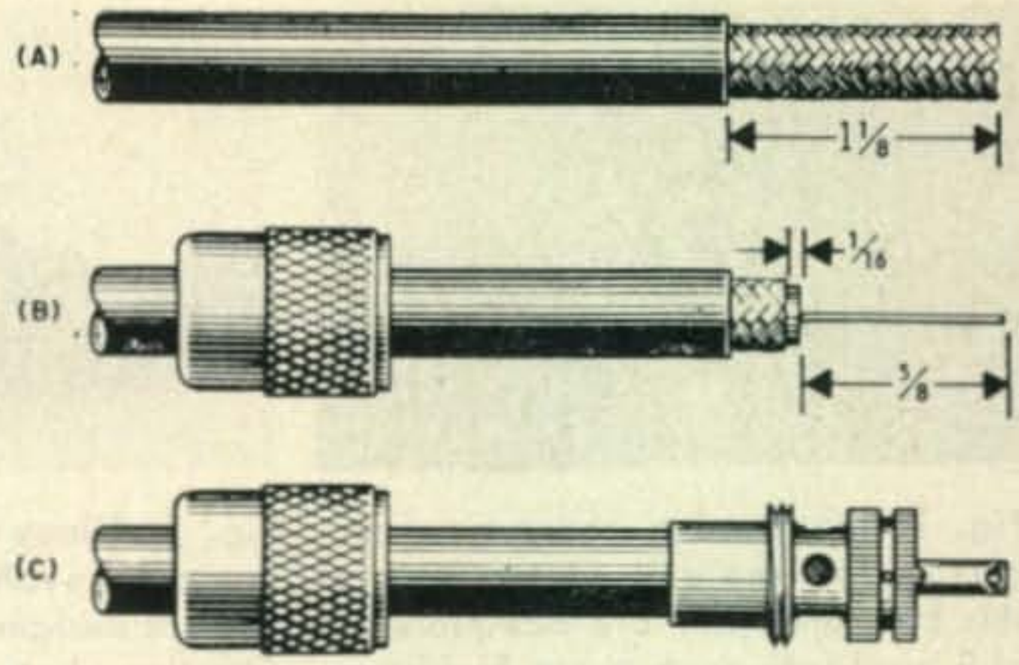


Fig. 8—Instructions for connecting UHF type connectors to RG-8/U (top) and RG-58/U coaxial cables. Amphenol plugs, type 83-1SP and 83-822, are described on top. In (A) the vinyl jacket is cut back 1⅛" (for 83-1SP remove 1¼"). Prepare the center conductor, insulation and braid as shown in (B). Slide the coupling ring on the cable and tin the center conductor. (C)—Screw the sub-assembly on the cable and solder to the braid through the solder holes. Also solder the center conductor to the contact pin. Do not use excessive heat Screw the coupling ring up on the sub-assembly.

1. *Electrical*: Dielectric and conductor spacings must be capable of the maximum voltage and current to be passed at operating frequencies.

2. Physical: The connector structure must be able to withstand the harshest physical demands which might be made on it, which include mating and unmating abuse and environmental abuse.

3. Environmental: Weatherproofing (where necessary).

4. Speed of Disconnection and Connection: For power applications, quick-disconnect. For r.f. application, most positive connection.

5. Size: Connectors may have space limitations on chassis, *etc.*

Probably the commonest connector for low frequency amateur use—other than the phono-type—is the UHF series (Amphenol 83-1SP), illustrated in fig. 3. Designed for non-constant impedances and medium-power r.f. applications, they are good general-purpose connectors when line unbalance and slightly increased standing wave ratio are not important. The center conductor is insulated with either mica-filled bakelite or Teflon.

Space and Patience Savers

U.h.f. plugs work well when there's plenty of room behind the equipment to which they are attached. But if you've ever tried to couple a connector to its receptacle in tight areas, you'll appreciate the little-known angle plug (Amphenol 83-1AP) shown in fig. 4. Not an easily-misplaced right angle adapter, the angle plug simplifies the connection of coaxial cable to receptacles on the backs of equipment.

The common receptacle used with u.h.f. plugs is the military-designated SO-239 (Amphenol 83-1R), illustrated in fig. 5. It requires four ⅛" mounting holes, and a ⅝" hole for the receptacle itself.

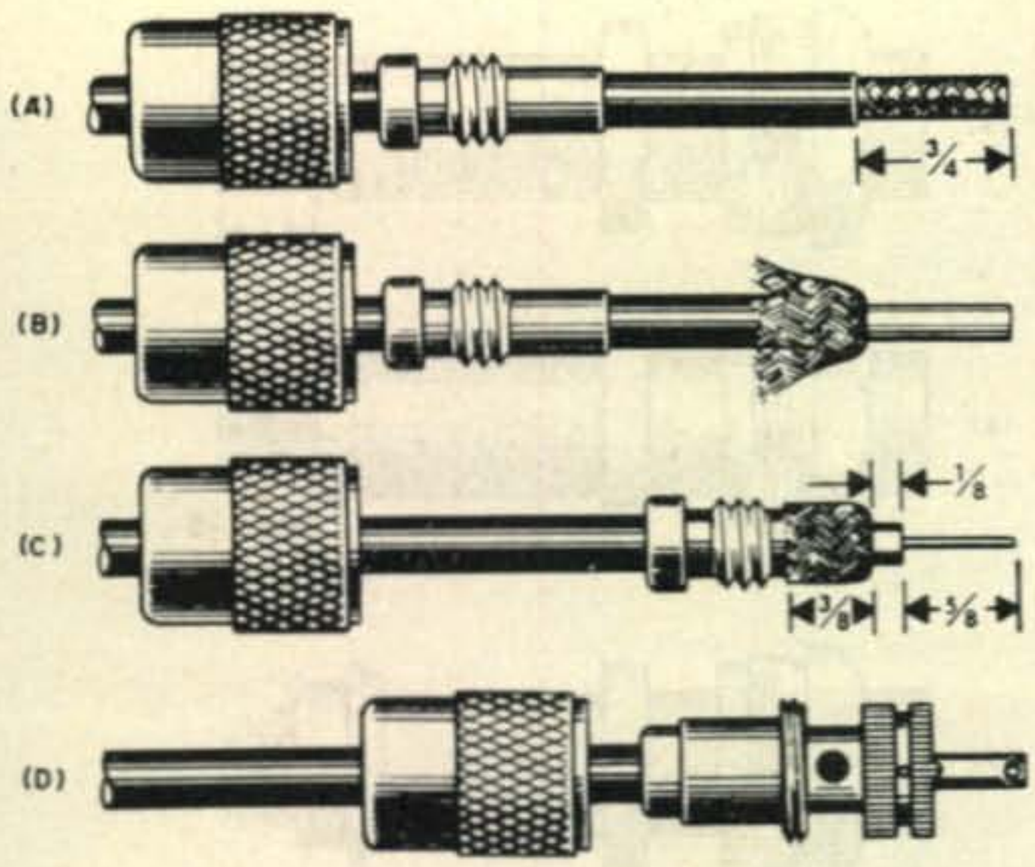


Fig. 9—Instructions for connecting Amphenol 83-1SP, 83-822 and 83-750 connectors to RG-58U, using the 83-168 or 83-185 adapter, is shown above. In (A) the coupling ring and the adapter are placed on the cable and the vinyl jacket is cut back. In step (B) the braid is fanned out and folded back. Position the adapter to the dimension shown in (C) and trim the braid as shown. Screw the plug sub-assembly on the adapter and solder the braid to the shell through the solder holes. Be sure to use enough heat to bond the braid to the shell. Solder the center conductor to the contact pin and screw the coupling ring on the plug sub-assembly.

Drilling and mounting the SO-239 can be a tricky job on a blank chassis, and even trickier if you've decided to put one on an already-built piece of equipment. Before drilling five holes in a piece of commercially-built gear, check to see if you need *all* the features of the SO-239. The four mounting holes make possible the installation of a shielding hood (the flange) on the back of the receptacle. If the receptacle is to be used in a piece of v.h.f. or u.h.f. gear, if it will be close to unshielded power cables, or close to interstage wiring, this hood is important. Without it, the r.f. circuit isn't really "bottled up."

But if interstage coupling is unlikely, and if the cable runs a safe distance from power cabling, the SO-239 and hood is unnecessary, and a bulkhead-type receptacle (Amphenol 4575), with a large threaded nut instead of a mounting plate, makes an excellent substitute. Because it mounts in a single hole, an old phono-type receptacle can be removed, its chassis hole enlarged to ⅝", and the new bulkhead-type screwed into place (see fig. 6). Just make sure to use substantial lock washers between the chassis and the nut, and between the chassis and the shoulder of the receptacle, so mating and unmating can't unscrew the receptacle.

There's More Than One Type

Although u.h.f.-type connectors are the most universally applied among the ham ranks, they're not as all-purpose as many believe. Let's take a look at typical u.h.f. connector characteristics:

Electrical

Impedance . . . non-constant (but good match on low amateur bands).

Frequency range . . . 0-200mc, (0-500mc with caution).

Voltage . . . 500 volts peak.

Environmental

Thermal limits, Mica-filled bakelite: —67°F to 300°F.

Weather protection . . . non-weatherproof.

Clearly, u.h.f. connectors are not the optimum type for use above 220 mc, nor are they the proper connector for carrying plate voltage into a kilowatt rig. And because of their non-weatherproof nature, they're unsuitable for any place where exposure to elements is involved.

The u.h.f. enthusiast running high power might consider switching to a connector without the frequency limitations of a u.h.f. coaxial connector. A "C" connector such as Amphenol's 82-530 (Fig. 7) offers low v.s.w.r. up to 10,000 mc, as well as constant 50 ohm impedance, providing a much better match to 52 ohm coaxial cable. The combination of these factors, along with a 1,500-volt peak and 3,000-volt r.m.s. rating, make the "C" connector excellent for high-power u.h.f. and near-microwave applications. The "C" connector is just one of many connectors with higher voltage ratings than the UHF type.

Weatherproof Connector

The weatherproof connector is practically unheard of among amateurs, yet there are many instances when it could simplify a normally difficult job.

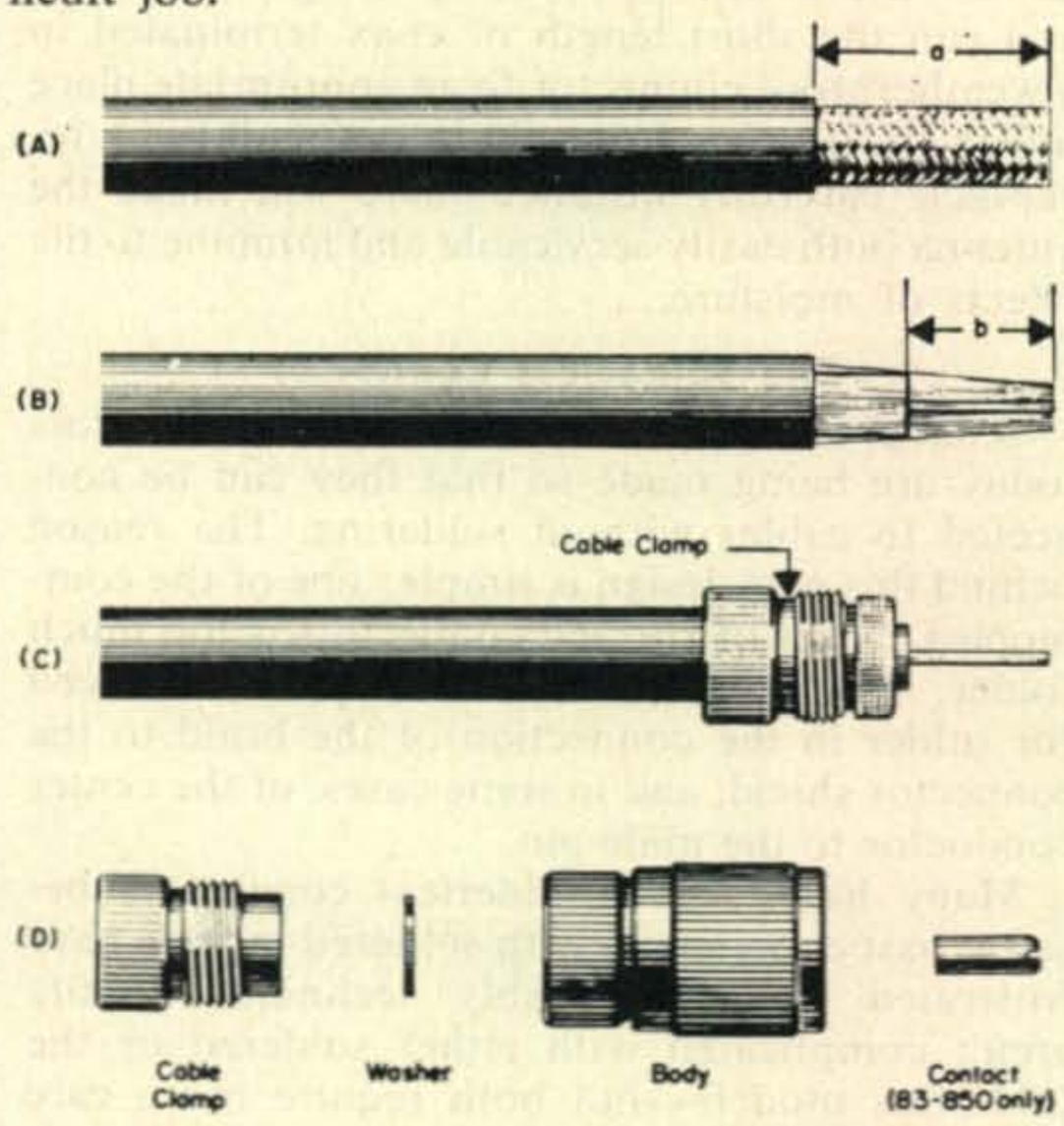


Fig. 10—The proper assembly instructions for solderless and semi-solderless connectors, Amphenol 83-850 and 83-851 are shown above. Trim off the vinyl jacket as shown in (A). For the 83-850 dimension *a* is 15/16" and for 83-851 it is 31/32". Comb out the braid as shown in (B) and cut the dielectric so the dimension *b* is 35/64" for type 83-850 and ⅝" for type 83-851. (For the 83-851 only, pre-tin the center conductor.) Taper the braid forward as shown. Screw the cable clamp onto the jacket of the cable so that the inner shoulder butts up against the end of the vinyl jacket. Fold the braid back over the cable clamp, trim and smooth out as shown in (C). Place washer into body cavity and screw the body tightly onto the cable clamp. For the 83-850 only, screw the contact on to the center conductor. For the 83-851, soft solder the center contact quickly and carefully to avoid damaging the insulator.

Take the old problem of getting a coax feedline into the shack—hams have labored long over elaborate tarred-pipe monstrosities, giant ceramic wall-penetrating feed-throughs, etc. But, a straight-through feed-line isn't the answer.

The answer is weatherproof bulkhead connectors. Merely drill a one-inch hole through all but a quarter-inch of the shack window frame, then drill a centered ¾" hole through the last quarter inch. A "C" bulkhead adapter will seat perfectly in the ¾" hole, offering a weatherproof fitting on both sides of the window. Rain, sleet, and snow won't affect the exposed connection, and you'll be able to connect a new feedline to the bulkhead adapter at a moments notice.

Another application for weatherproof connectors is between a bumper-mounted mobile antenna and the car body. Too many hams fail to weatherproof the base of their bumper-mounted antenna because to do so would make its removal for servicing a difficult task. So they leave the base connection exposed, and punch a hole in the bottom of the trunk for the antenna cable. The result is corrosion both at the base of the antenna and at the punched hole. The latter is merely annoying, but the former can result in unstable loading and high s.w.r. due to moisture and r.f. leakage, especially in coastal areas.

The solution is simple—waterproof the antenna base connection with potting compound, and run the short length of coax terminated in a weatherproof connector to an appropriate place under the trunk. A weatherproof bulkhead receptacle carefully installed there will make the antenna both easily servicable and immune to the effects of moisture.

The Solderless Connector

A large number of r.f. and power connectors today are being made so that they can be connected to cables without soldering. The reason behind this new design is simple: one of the commonest causes of shorted connectors is too much solder. The new connectors eliminate the need for solder in the connection of the braid to the connector shield, and in some cases, of the center conductor to the male pin.

Many hams select solderless connectors because past experiences with soldered models have frustrated them. Assembly techniques really aren't complicated with either soldered or the solderless models—but both require more care than that normally given them.

Common varieties of UHF connectors are designed for use with coaxial cables about a half inch in diameter, such as RG-8/U. Figure 8 shows how to connect a soldered plug to RG-8/U, and fig. 9 shows RG-59/U-size cable. The reducing adapter used for RG-58/U in fig. 8B is very important because it firmly grips the cable, distributing excessive strain on the brand and conductor to the jacket and plug assembly.

Figure 10 illustrates the proper assembly procedure for solderless and semi-solderless connectors. Both connectors use a washer to firmly clamp the combed braid against the connector shell. But the solderless plug uses a screw-on contact to hold the center conductor while the semi-solderless variety uses soft solder. Like completely soldered plugs, the solderless and semi-solderless models are designed for RG-8/U-sized cables. When RG-59/U-size types are used, they must be reduced with the proper adapter.

Whether you choose the soldered or solderless variety is quite unimportant from a safety point of view. Both have similar dielectrics and conductor spacing, and both are non-weatherproof. The important thing is that you take a good, hard look at your rig, and ask yourself the following

[*Continued on page 104*]

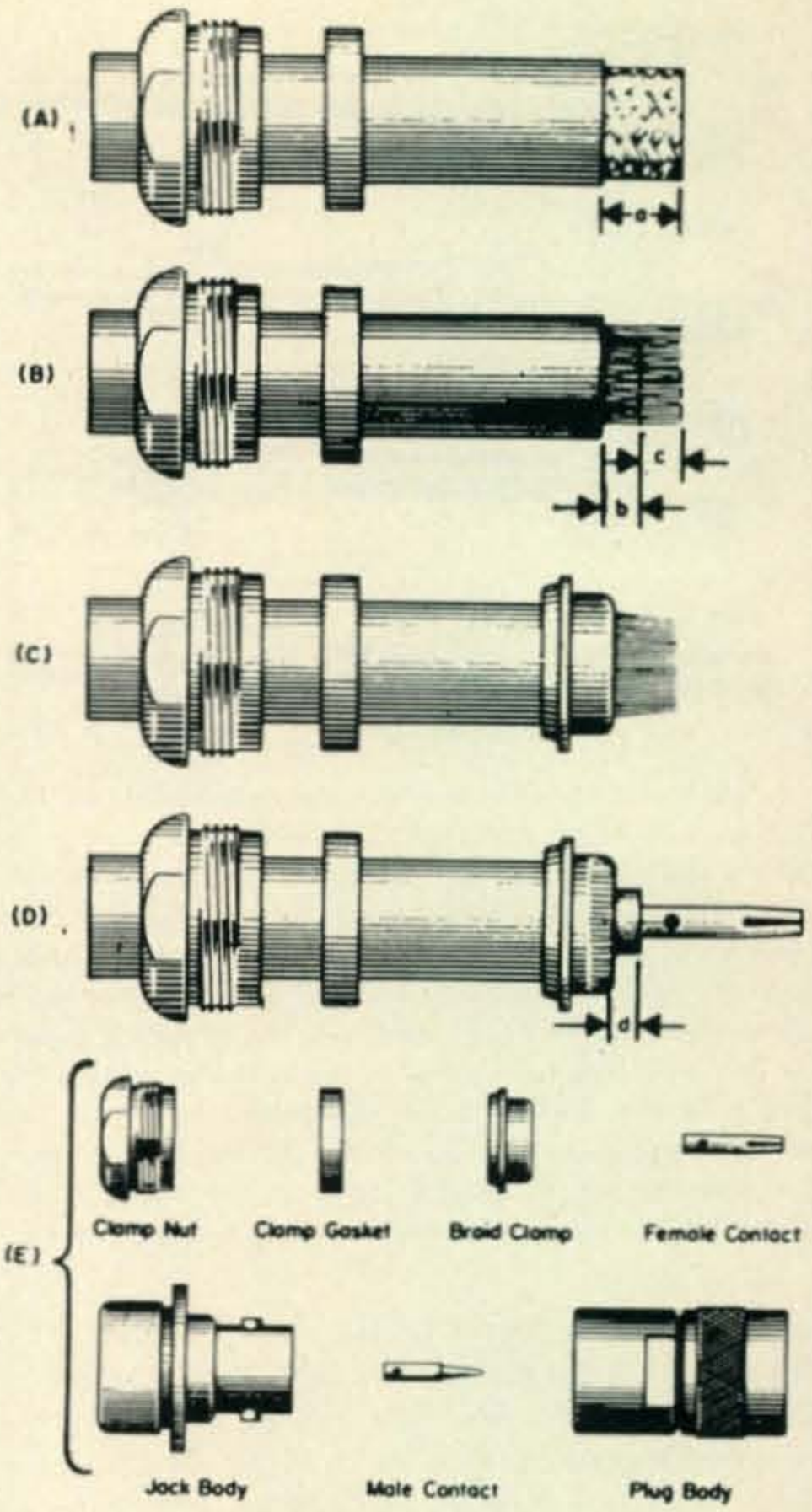
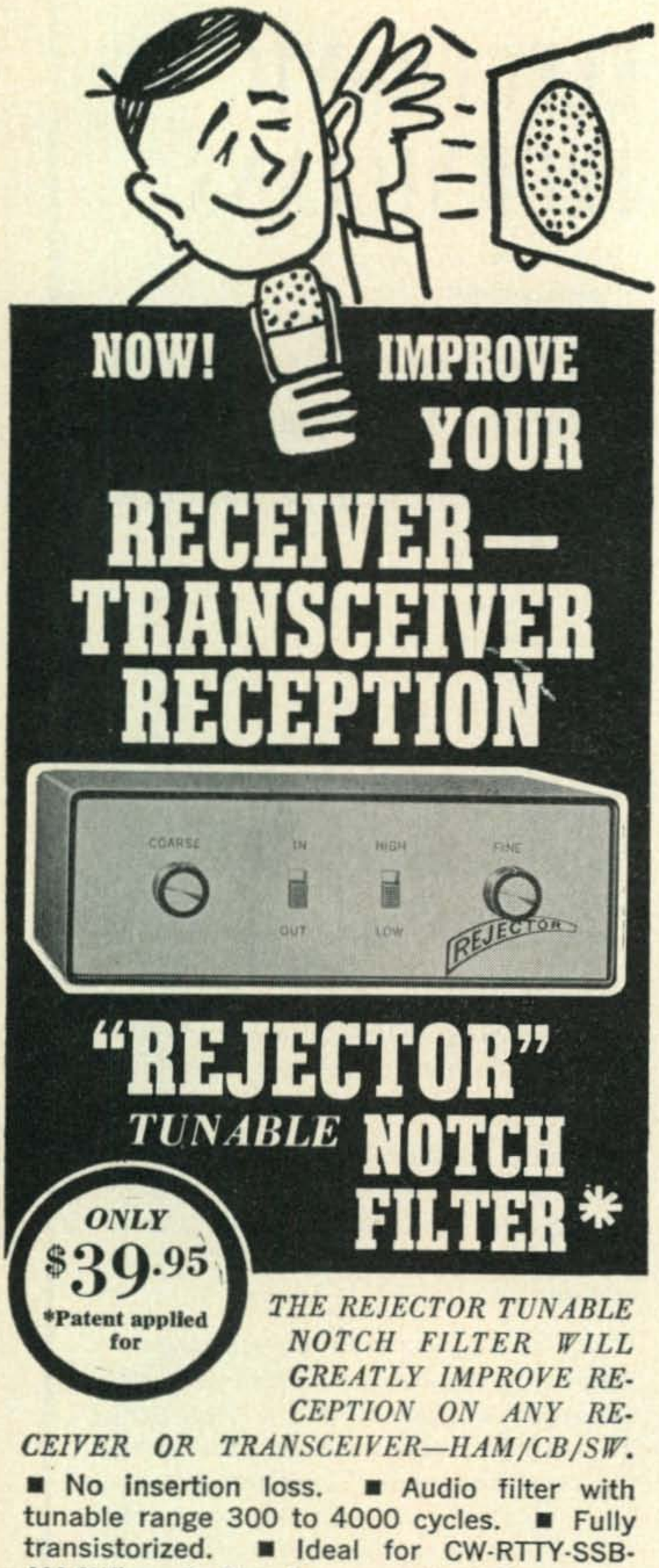


Fig. 11—Assembly technique for the Amphenol type "C" connector is shown above. This unit is suitable for high power above two meters and is an ideal weatherproof unit. Slide the nut and gasket over the cable as shown in (A) and cut the jacket to dimension *a*. For RG-8/U this is 5/16" and for RG-58/U, ⅜". Comb out the braid as shown in (B) and cut the insulator. For RG-8/U *b* is 5/32" and *c* is 5/32" while for RG-58/U *b* is 7/32" and *c* is 5/32". Pull the braid wires forward and taper them towards the center conductor. Place the clamp over the braid and push it against the cable jacket as shown in (C). Illustration (D) shows how the braid is folded back, trimmed and formed over the clamp. The contact is then soldered to the center conductor. Dimension *d* should be 3/64" for RG-8/U and 9/64" for RG-58/U. Insert the cable and parts into the connector body making sure the sharp edge of the clamp seats properly in the gasket; tighten the clamp nut. The component parts should be arranged in the order shown in (E).



For further information, check number 32, on page 110

Connectors [*from page 43*]

questions:

1. Are your rigs protected with adequately-rated connectors?
2. Are you using connectors, designed to carry audio, for r.f. purposes?
3. Can the connectors on your cables stand common abuses such as being stepped on or being assembled under Field Day conditions, without damage or shorting?
4. Can the connectors on your rigs and cables stand normal unmating and mating abuse?
5. Are you hedging on the use of a weather-proof connector at the risk of a blown final at worst, or high s.w.r. at best?
6. Have you hesitated spending an extra dollar or two for proper connectors to protect a kilo-dollar rig?

If the answers to any of these questions indicate any doubt, it's common sense to install connectors with ratings documented for your particular application.

D.C. to D.C. Converters [*from page 72*]

Obviously the only variable on the right side of the equation for a completed transformer is E. Referring back to the explanation of circuit operation you will note that all input voltage in excess of 11 volts will be dropped across the switching transistors. This means that the *effective* input voltage to the transformer will be 11 volts even though the input battery voltage may exceed this. Therefore, the frequency of oscillation will remain essentially constant for any input voltage of 11 volts or more. This is a simple and inexpensive method of obtaining frequency stability when this feature is desirable.

Figure 3 shows how the output voltages change with input voltage for both no load and full load conditions. The no load condition does not mean that the output current is zero. The output has a bleeder current equal to about 10% of the normal full load. This is necessary for the proper operation of the regulator. If it is necessary to have a condition where the load is completely removed during normal operation a fixed bleeder equal to 10% of full load should be added.

You will note that the no load curve is about the same distance above the full load curve at all points. This difference in no load and full load output voltages is due to voltage drop across the d.c. resistance of the secondary circuit. Since the voltage drop across the diodes is essentially constant the change here is due to the d.c. resistance of $W4$, L_1, and L_2. This emphasizes the importance of minimizing the resistance in the circuit between any regulator and its load. ■

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OUR READERS SAY

Those Would-Be Hams

Editor, *CQ:*

As an avid *CQ* reader (and *QST*) and as an amateur very much interested in amateur radio itself, I feel compelled to toss in my two cents into what promises to become a lively argument.

First, I agree 100% with your deduction that CB Radio has absorbed a great many thousands of would-be hams by offering them the avenue of least resistance into radio. While we hams have ways of policing our on the air activities the CBers do not, therefore the 100,000 would-be hams you speak of have for a long time been living with the constant knowledge that they are breaking the rules as set forth by the FCC and getting away with it quite easily. It is not the individual CBer I am afraid of, but rather this very evident attitude that the CBer knows he can get away with anything on his frequencies.

Any effort to lure away the CB operator in the ranks of amateurs should be made with a complete brain-washing because I for one do not want 100,000 rule breakers suddenly dumped on our bands. One solution which is probably impossible, would be to enforce the rules on 11 meters.

My best wishes go with your plans but remember it is unfair to campare the wide eyed Novice of the 50's with the CBer of today. CBers now have many years experience in busting all the rules. Most of the Novices I had contact with were willing to learn and wanted to abide by the regs. Anyway, lotsa luck es 73,

Ken Mac Neilage, WA2IDH
Westwood, N.J.

Editor, *CQ:*

Just one comment regarding the CB situation in your editorial in July *CQ*. I'm sure that the hams would welcome the CB boys into their ranks if the CB boys would just only learn how to observe FCC rules and regulations. Just think what utter chaos the ham bands would be if the ham operated in violent opposition to every rule and regulation on the FCC like the CB rag-chewers apparently do. We do not desire these 10-4 maniacs in our ranks.

Dick Malanowicz, W2PZI
Hamburg, New York

On page 5, I've begun to outline one aspect of what will have to be the biggest guidance and indoctrination jobs ever, in amateur radio. Our continued existence as a hobby and service could conceivably depend on the success of our efforts.

Among the more important phases of this indoctrination is instilling a strong respect for the law, both international and domestic, governing amateur radio. In view of the reckless attitude most CBers take towards the law, it might seem to be an impossible job, but it shouldn't be. Think about this: 80% of the violations recorded by hobbiest CBers *would not be violations in amateur radio.* Profanity, improper identification, etc., are as illegal on the ham bands as anywhere else, but these actually amount to a minute portion of CB violations.

Attitude and operating procedure are bound to be a problem. However, a firm but gentlemanly hand in dealing with the inevitable breaches of courtesy and tradition should swing most anyone into line. It will be a matter of setting a good example, more than anything else, don't you think—*K2MGA*

"Our Readers Say" welcomes letters about nearly anything of interest to amateurs, whether about *CQ* itself, the state of the hobby, or whatever else you have on your mind. The most interesting letters will be selected for publication each month; just keep them legible, keep them short, and above all, keep them clean! Something bothering you. We're not mind readers, OM, so drop us a line.

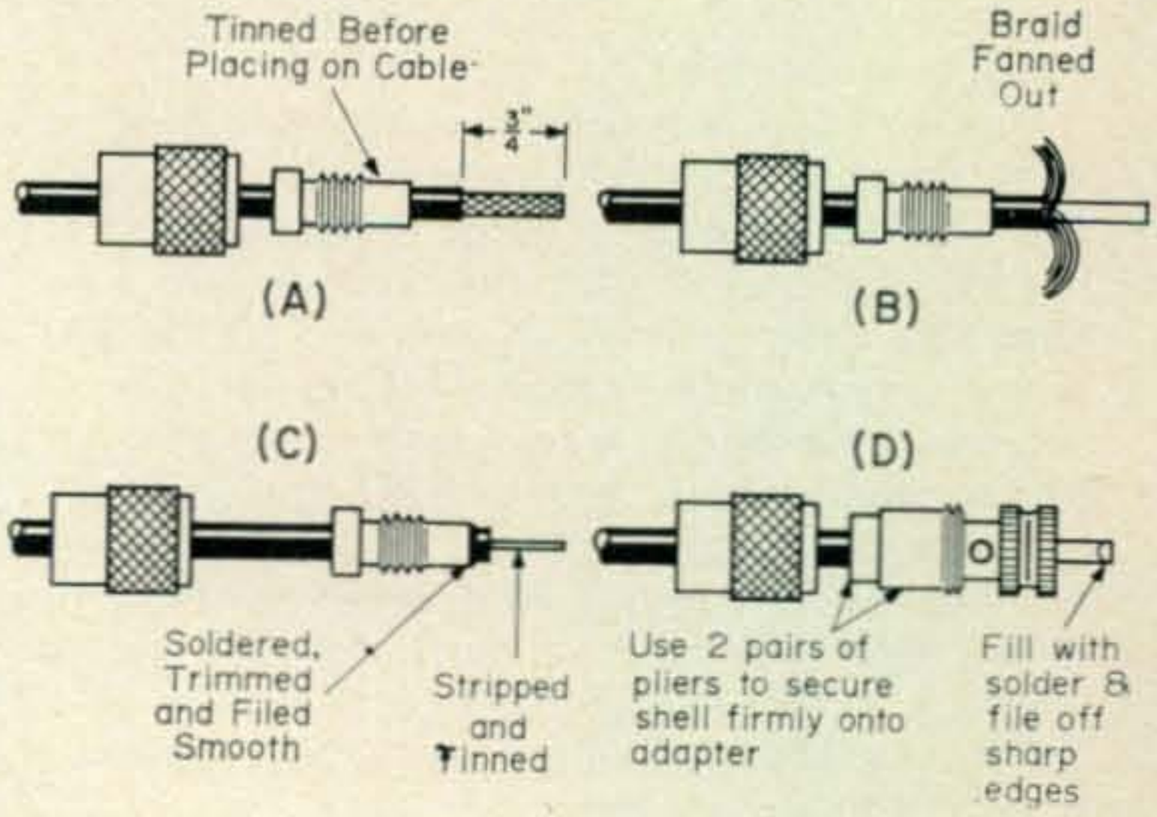
Connectors

Editor, *CQ:*

The article "A Close Look at Connectors" in June *CQ* was informative, however I contend that the method shown in fig. 9 for connecting RG-58 or RG-59 to 83-1SP coax connectors is *not* the easiest, safest, or most reliable way. . . .

The following improved method has these advantages: 1. A better ground connection, with less chance of corrosion. 2. No loose strands of cable braid to cause a possible short. 3. The connector may be easily "cleaned-up" and reused dozens of times. 4. Less heat and resultant insulator damage during soldering. 5. Much neater. 6. Greatly improved physical strength—actual tests of both methods show that it takes considerably more force to physically pull a cable loose from a connector using the improved method of connection.

In the improved method, the cable is prepared as it is in the old method, but the reducing adapter is tinned with a soldering iron before sliding it over the cable (A). The braid is fanned out over the tinned end of the adapter and is lightly soldered all the way around (B). With a pair of "dikes" the excess braid is trimmed off. A small file is used to smooth the solder bead until it will fit into the shell. The center conductor is stripped, leaving about ⅛" of insulation. The center wire is tinned (C). The plug shell is very firmly screwed onto the adapter, using a pair of pliers on the shell and a pair on the adapter. (For connectors being used outdoors, use a little Electraseal compound on the adapter threads.) Holding the center conductor up, fill the center pin with solder. While the solder is still molten, turn the center down so the solder will form a smooth bead at the end. File the two sharp edges on the center pin to avoid damage to the coax jack (D).



To remove and reuse a connector, simply heat the center pin and shake out the molten solder; unscrew the adapter from the shell using pliers again; unsolder the braid from the adapter. The connector is ready for immediate reuse.

Everyone who has tried the *improved* method has been impressed by the simplicity and neatness. We have used this method for years with excellent results.

Jerry Seligman, W7BUN/W5YFS
Tacoma, Washington