With one WARC band on line, it's time to prepare for the other two. If you're into a little lathe work, W1HXU has an interesting antenna project for you.

The HR-52 Antenna

A 5-Band 2-Element Beam For 14, 18, 21, 24.5, 28 MHz

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The new generation of transceivers offers three additional nicely spaced bands. To make proper use of these expectant WARC frequencies will require some new antennas.

For various reasons, most amateur antenna farms have been limited to a triband beam for 10/15/20 meters and a trap or multiple dipole for the lower frequency. Of particular interest are the new 18 and 24.5 MHz bands (when we eventually get them). The logical solution will be to fit them into the tribander frequency spectrum, all in one neat package.

At the time of this project the only commercial beam available with this extra band coverage was the log periodic, which only a few could afford because of its cost and awesome dimensions. However, by staying with the tuned trap element and adding one more set of traps we got two new bands.

Looking at fig. 1, we see two separate wire and trap combinations. The top wire element with one pair of traps is for the 24.5 and 14 MHz bands. The central wire element is a tribander for the 28, 21, and 18 MHz bands. Connecting them to a common feedline ends the triband beam era.

Construction

I have been partial to the wood spreader and wire-type element because of its low cost, mod-flexibility, and simple "Brooklyn Bridge" construction. The spreader span, supported by the combination antenna and guy wires, holds up nicely during the winter season.

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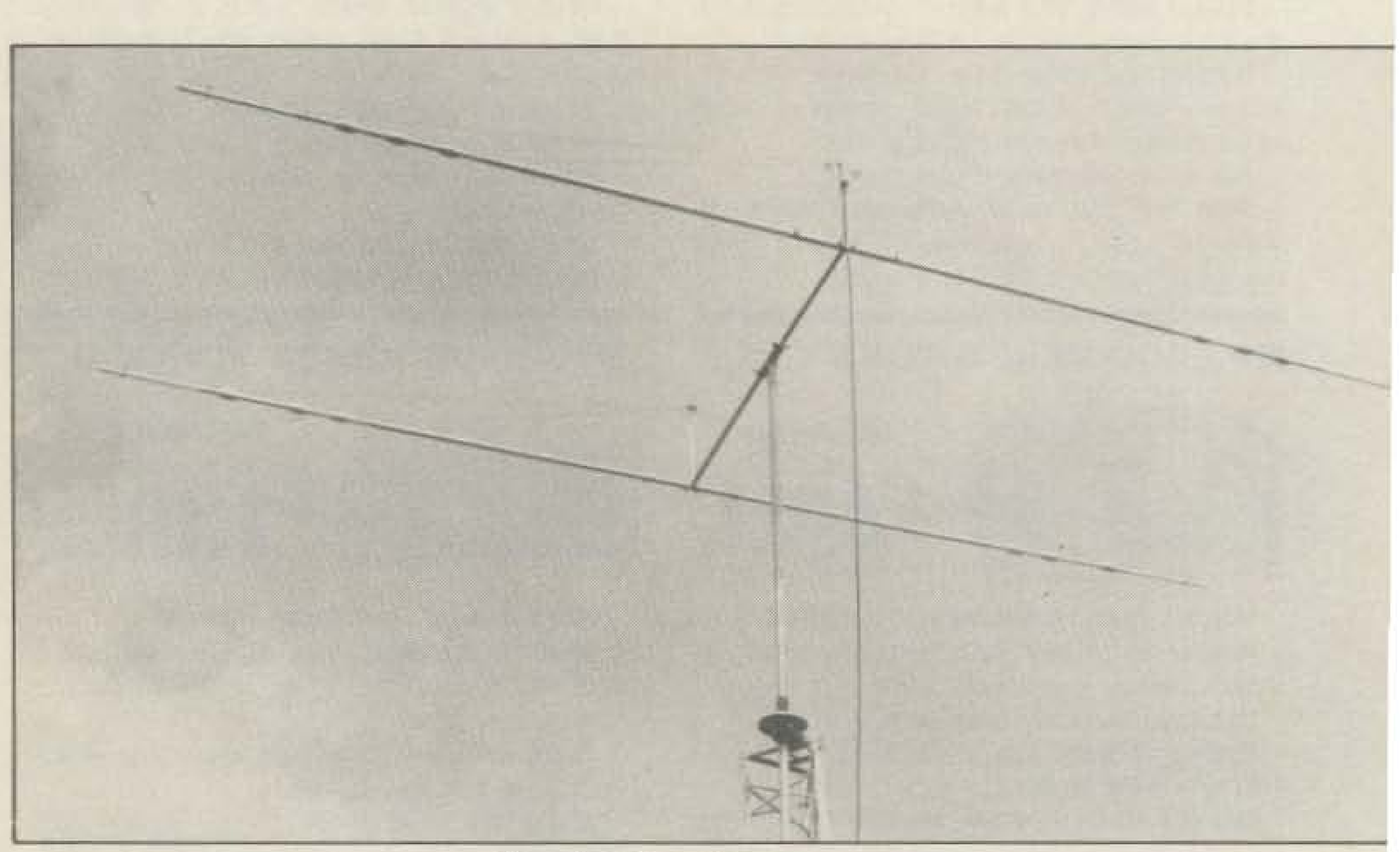


The HR-52 antenna.

A selected 12 foot (3.61 meter) length of 2×4 (3.72 cm×8.9 cm) of medium weight, or 10 pounds (4.5 kg), provides the four spreaders. Each spreader has been step-tapered to eliminate unnecessary wood and to provide the proper cross section for the wire anchor points and traps. The 40 in. (102 cm) long B section has beveled edges to permit a loose, slip-on fit for the tuned traps. Spreaders and pylons are protected with latex paint or varnish.

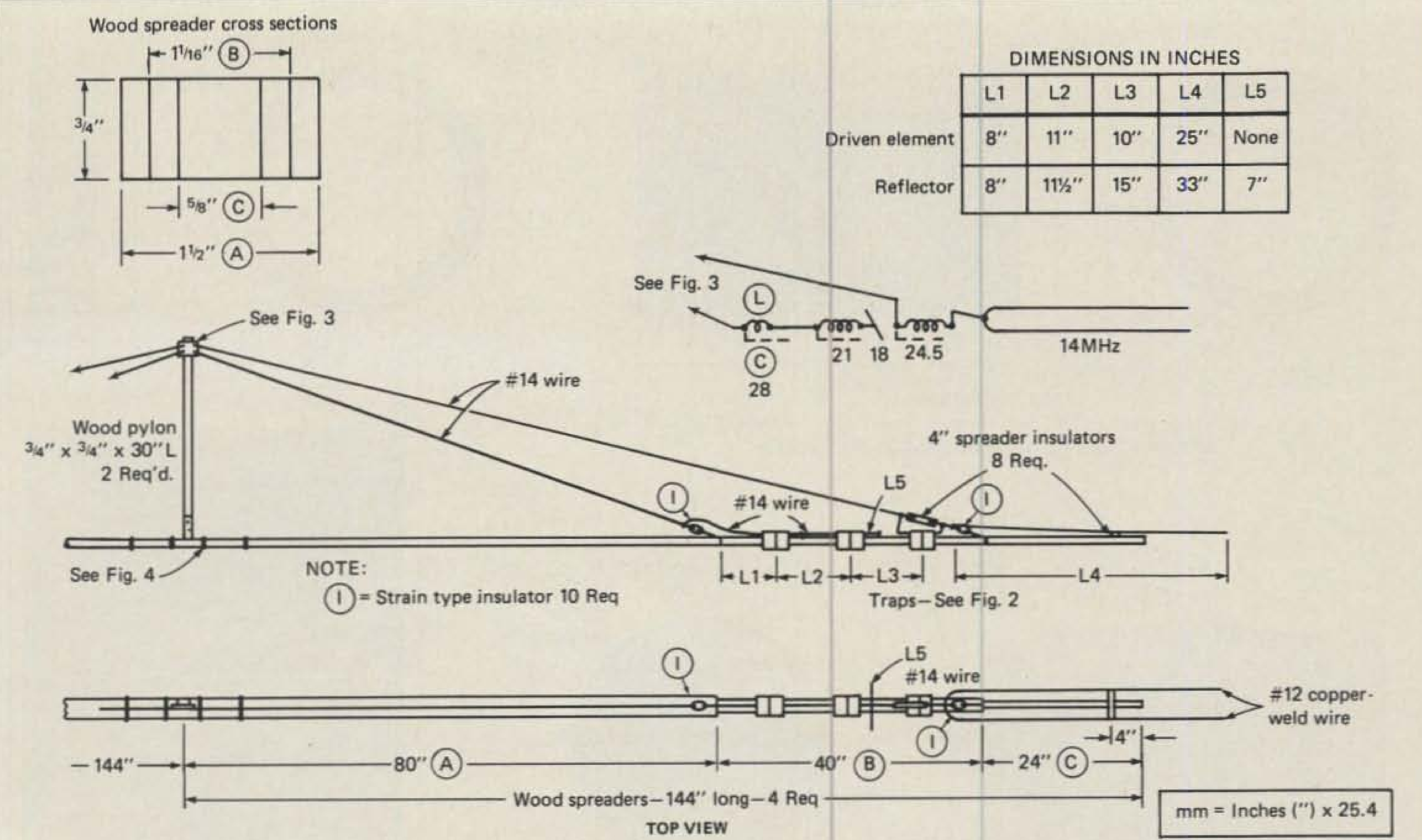
Tuned Traps

The tuned traps shown in fig. 2 differ from the customary "handbook" type. Our LC circuit is tuned by a slit metal sleeve connected to *one* end of the coil. The effective capacity is determined by the sleeve surface area, thickness of the coil form or dielectric, and distributed capacity of the coil winding.

A closed or cylindrical sleeve looks like a shorted turn, with increased r.f. losses and a higher resonant frequency. The trap is compact, easily installed, and not subject to any mechanical stress.

The original plan was to have the coils exposed to the weather, *a la* Reyco Traps. This eliminated using natural polystyrene or polyethylene coil-form material, because this material will deteriorate under sunlight. The ridiculous asking price for a short length of Plexiglas-Lucite tubing steered us to a plumbing supply shop, not for PVC tubing, but for black **ABS** (**a**crylate **b**utadiene **s**tyrene), the dielectric properties of which are better than polyvinyl chloride.

Hold the coil length of ABS tubing in the



	L1	L2	L3	L4	L5
Driven element	8"	11"	10"	25"	None
Reflector	8"	11½"	15"	33"	7"

Fig. 1– Element construction detail and antenna wire-trap schematic.

lathe by the chuck and a large diameter conical tailstock center. ABS tubing is not a precise extrusion, and therefore the wire groove will vary in width and depth. The first cut is the thread-stop groove, ½ inch (12.7 mm) from the edge of the ABS tube. Advance the round-nose cutter until 25 percent of the tube is scored. Note the cross-feed dial reading and use it for the reference or zero mark.

Make the groove 30 mils deep and do the 6-pitch-thread wire groove with two passes. Set the first cut for 20 mils and finish with a 10 mil cut. At the intersection of the spiral and stop groove, drill a tight hole for the #14 bare or enameled copper wire; also drill the other wire hole and the ⅛ in. (3.18 mm) diameter hole, 40 degrees from the first wire hole, as shown in fig. 2.

Wind the wire tightly around the form using the "stretched wire" method. Crimp the inner leads close to the form and have them extend 2 in. (51 mm) beyond the form's edge. Dress leads with 1 in. (25.4 mm) long sleeve insulation.

Compression Rings

The compression rings (fig. 2) are machined from ABS tube stock and are sliced off with a thin parting tool. Make two extra rings ¼ in. (6.35 mm) wide. Saw a segment approximately 45 degrees wide out of each ring.

Capacitor Sleeve

The capacitor sleeve is made from a 12 fl. oz. (354 ml) seamless drawn aluminum beer or soda can. This item is perfect for this application. The lacquer around the corner hole must be scraped off to ensure good contact with a soldering lug. The lug should be cadmium plated or made from galvanized sheet metal.

Insert the capacitor sleeve into the coil form and align the ⅛ in. (3.18 mm) holes. From the inside, push through a 6-32 × ⅜ in. (M3.5 × 9.5 mm) long pan head screw with a soldering lug and use a large-size outside nut. Carefully solder the lug to the adjacent coil lead wire. Insert the ¼ in. (6.35 mm) wide ABS comp. ring edgewise and flip it over 90 degrees; also do this with the other narrow comp. ring. Position each ring approximately ⅝ in. (15.88 mm) from the edge of the coil form. Later on the narrow rings will be discarded and replaced by the permanent wider rings, the functions of which are to press the sleeve firmly against the inner wall and serve as insulated spacers.

Before proceeding with further construction notes, the following will be of interest. After I completed the set of 12 tuned traps, I finally decided to check a trap when exposed to soppy-wet conditions. It was submerged in a jar of tap water, and the grid dip meter reading showed a drastic frequency shift. For an all-weather beam, it will be necessary to protect the trap with a non-metallic outer casing. This will permit using polystyrene coilform material in the event the ABS fails when operating at high power. The maximum d.c. input here is 500 watts, and the ABS does not show any stress.

Trap Frequency

The trap frequency is determined by the desired section of a band. For c.w. and low-end phone, I chose 14.10, 18.12, 21.20, 24.94, 28.40 MHz. There appears to be some confusion among trap tuner-uppers as to the correct technique. Some tune up for the center of a band, and a *QST* tri-band beam article used an 800 kHz lower frequency for greater bandwidth. I picked 500 as a nice number for the driven element, which tunes our coils to 20.70, 24.44, 27.90 MHz.

A graph in the *ARRL Handbook* shows that reflector length varies with element spacing. Our 20 meter band reflector with ⅛ wave spacing will be 7% longer than the driven element, and the 10 meter band reflector, with ¼-wave spacing, will be increased to 4%. The reflector frequency targets are 13.20, 17.20, 20.20, 23.80, 27.00 MHz. Due to some interaction within a five bander, there will be some apparent shift from theoretical values. The reflector element traps will be tuned for 19.70, 23.30, 26.50 MHz and completed before adjusting the driven element traps. If one gets hasty with the tin snips and overshoots the desired frequency, the capacitor sleeve can be salvaged and used for the driven element.

Fig. 2 indicates the trimming edge, which may come close to the coil leads. The clearance here should be at least ¼ in. (6.35 mm); therefore start with the corners. When removing the sleeve, do not unsolder the lug to lead connection.

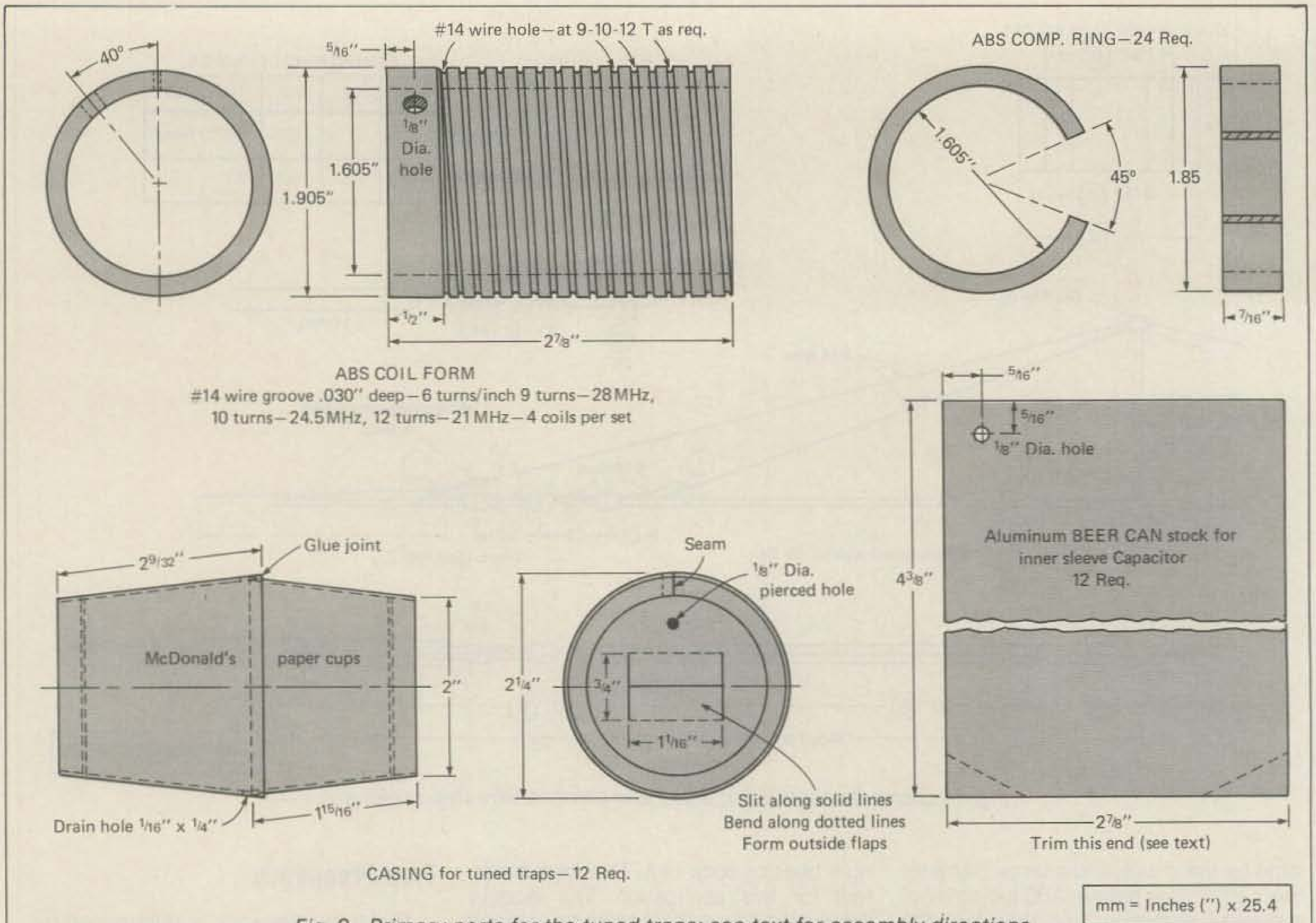


Fig. 2– Primary parts for the tuned traps; see text for assembly directions.

As the frequency gets closer to the magic number, check the grid dip meter calibration and, finally, use the 7/16 in. (11 mm) wide ABS comp. rings.

Trap Casing

The trap casing can be made from a plastic bottle or thin-wall tubing. The glove compartment in my car was stuffed with used McDonald's coffee cups, which were modified as shown in fig. 2. Before assembly spray the cup interior and outside of end header and flaps with clear Krylon. Assemble the trap and casing on a piece of wood 6 in. (152 mm) long and similar to cross section B fig. 1. Make six such holders to expedite production. Mark the trap frequency on the outer and longer half of the casing, and slip it over the capacitor connector end of the trap. Fit the cups together and seal the joint with model cement. Finish with an overall Krylon spray.

Tuning Coils

The tuning coils and attachment detail at the top of the pylon for the driven and reflector elements are shown in fig. 3. The strain-type ceramic insulators used here and throughout the beam are 1.5 in. (38 mm) long. The antenna and coil wire is plastic-covered #14 copper "house wire." The connector block is a phenolic or hard rubber to resist heat during the soldering operation.

Spider

The spider and boom construction is shown in fig. 4. The builder may improvise his or her own version, depending on material available and workshop equipment. I found the angle iron, pipe, strap iron, and EMT (electrical metallic tubing) at a scrap-metal yard. Good welding practice requires that joining pieces have a beveled edge to ensure deep weld penetration. New steel EMT and the #14 type TW wire are stocked at electrical supply stores. The 3/4 in. (19 mm) pipe stub requires some lathe or grinder work to fit into the EMT tubing.

Assembly

The assembly begins by bolting the pylon and spreaders to the spider. Suspend it with a line from a tower leg at a convenient height. The inboard set of strain insulators and antenna wire is attached at the first corner step 80 in. (204 cm) from the pylon (see fig. 1). At the connector block, make a firm but simple wrap for any final adjustments.

Slip on the traps in the proper order over section B. Locate dimension L1, with the coil centered within casing, as indicated by an equal length of protruded lead wire having formed the hook ends. Solder a connector wire from the antenna wire to the trap. Spot and center the coil for L2 and solder in the connector wire. At L3 temporarily tape the casing to the spreader. The outer wire includes a 4 in. (10 cm) long spreader-type insulator inserted directly above the 24.5 MHz band trap. At the connector block, make all adjustments for proper wire tension and spreader alignment. Bend the wire leads from the last trap towards its insulator and solder in connector wires. If a porcelain "Zepp" type insulator is unavailable, use a 3/8 in. (9.5 mm) diameter Plexiglas-Lucite rod or wood dowel boiled in parafin—days of H.P. Maxim.

Double or hairpin form the #12 copperweld wire 14 MHz extension to increase the end capacity loading and thereby shorten the span. Attach its insulator with a plastic wire clamp and one screw, or make a clamp from 5/8 in. (15 mm) wide sheet metal. Bind the hairpin to the antenna wire with bare copper wire and solder.

Getting back to the pylon and fig. 3, install the jumper wire and 7-turn coil across the reflector connector block and complete the wiring and twin 5-turn coils for the driven element. I added a homemade air-core 1:1 balun to equalize r.f.

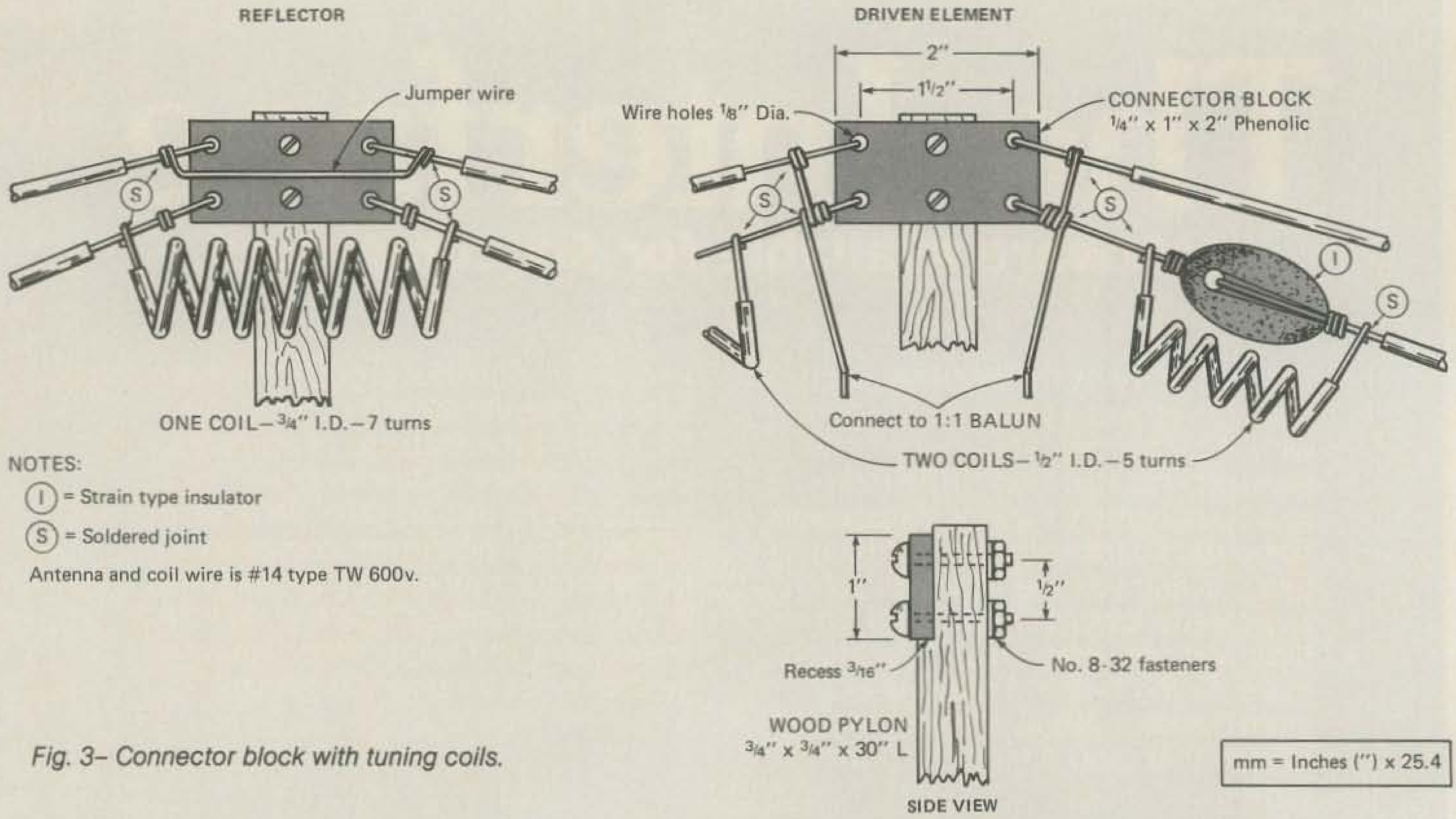


Fig. 3– Connector block with tuning coils.

current distribution. Feed line is the usual RG-8 or RG-8X, a lighter cheaper cable.

Tune-Up

Tune-up for a perfect match would require a clutter of five antenna gamma sections, which quickly draws itself to death. By using the transmatch correctly and "tuning" the coax with additional random lengths of cable, the v.s.w.r. readings are better than tolerable.

If the builder desires to center the working bandwidth in the 10/15/20 meter bands considerably lower or higher than my design frequency, a basic understanding of how the combination trap-loading coil functions will ease the pain of spotting the 10 resonant frequencies.

The 24.5 MHz band dipole is insulated from the 14 MHz extension by the resonant traps. Therefore, any changes beyond the trap have a negligible effect at the higher frequency section of the dual-band dipole. Altering the 24.5 MHz section also affects the 14 MHz end, and the trap becomes a loading coil. This extra series inductance results in a shorter 14 MHz band dipole.

The triband section on 28 MHz uses the inner set of traps. On 21 MHz these traps change into loading coils and the 21 MHz band traps take hold. On 18 MHz it's an end-loaded dipole.

Frequency shift is done by altering the length of the antenna and trap connector wires (L1 through L5), as well as the inductance of the 10 meter band tuning coils. The lead wires intended for the balun are temporarily connected together, and a calibrated grid dip meter, when coupled to one of the 10 meter band coils, will reveal the various resonant frequencies of both driven elements. At the reflector, if the 14 or 24.5 MHz band grid dip meter reading is weak and uncertain, replace the plain jumper wire with another having a one-turn coil for tighter coupling.

After the beam is raised skyward, the real fun begins. Dust off the antenna noise bridge and s.w.r., pwr, f.s. meters, find the lab notebook, sharpen pencils, and activate the rig with the low-power switch.

At the time of this article, the 18 and 24.5 MHz bands are "off limits" and no test transmissions were made. If HR-52 (son of HR-5, July 1981 *CQ*) happens to peak near the outskirts of these relatively narrow WARC bands, the system will still work FB.

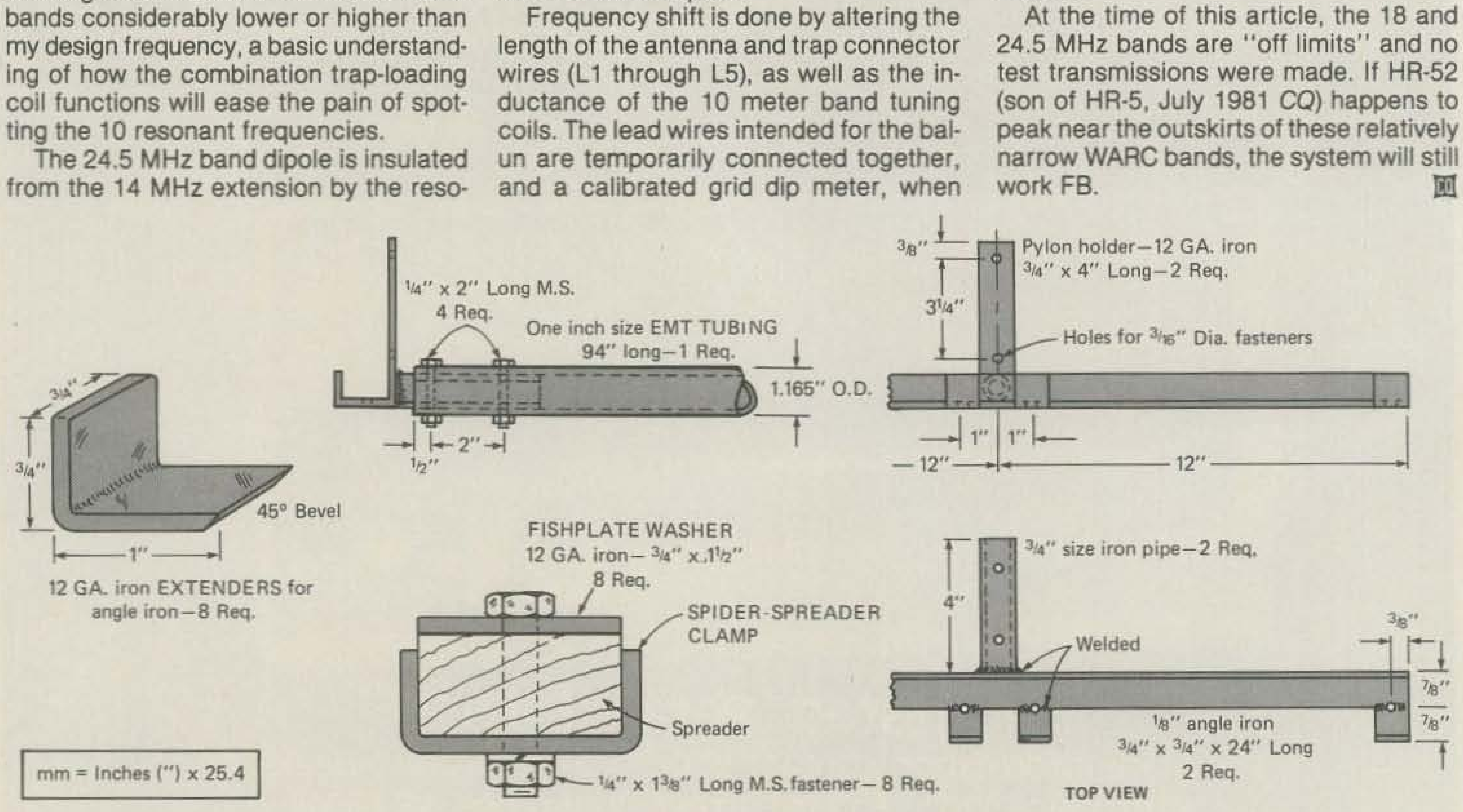


Fig. 4– Construction detail of spider and boom.