Keith Woodward VK2BAU
Flat 28, 48 Morehead St.
Redfern 2016
New South Wales, Australia

A 146 MHz MOBILE ANTENNA

Here is a very inexpensive antenna which uses your car body as the ground.

In Australia, mobile operation on 146 MHz FM, using discarded mobile radiotelephones, is very popular. As with all amateurs the author has given considerable thought to getting the most signal out with a minimum outlay. The units available restricted the actual power available, without major modifications, so the next important link in communications, the antenna, received my attention.

The most used antenna is the quarter-wave whip. This antenna leaves a great deal to be desired especially if it is mounted on the mudguard where shielding reduces its effectiveness. After all, not all of us like to carve holes in the center of the roof. An antenna which has some appeal is the coaxial dipole, an efficient radiator, which could be elevated above the car roof to minimize shielding. However, this antenna has problems with feed lines in its standard form. Below is the story of how these difficulties were overcome to produce a gain antenna utilizing a cheap base connector.

The normal coaxial dipole consists of a quarter-wave whip on top of a metallic supporting pole which is metallically and electrically joined to a quarter-wave sleeve. The coaxial cable inner is connected to the bottom of the whip and the braid to the pole and the sleeve. This system produces a strong ground wave but also produces standing waves on the supporting pole. By placing radials a quarter-wave below the bottom of the sleeve they act as an rf choke to reduce the standing waves on the pole. A secondary effect of these radials is to utilize the standing waves to reinforce the original radiated signal. Thus the radials add to the gain of the antenna.

If such an antenna could be used with the car body acting as the ground plane we would achieve a very efficient mobile radiator. The feed impedance of a coaxial dipole antenna is a nominal 75Ω and normally it would be necessary to feed the coaxial cable up the center of the supporting pole to the feed point. This necessity would make the antenna a rather messy one to attach to a car. On studying the suggested antenna it was realized that the distance from the ground plane to the feed point is approximately a half wavelength.

One fact emerges from this discovery. Because impedances are repeated each half wavelength on a transmission line it is

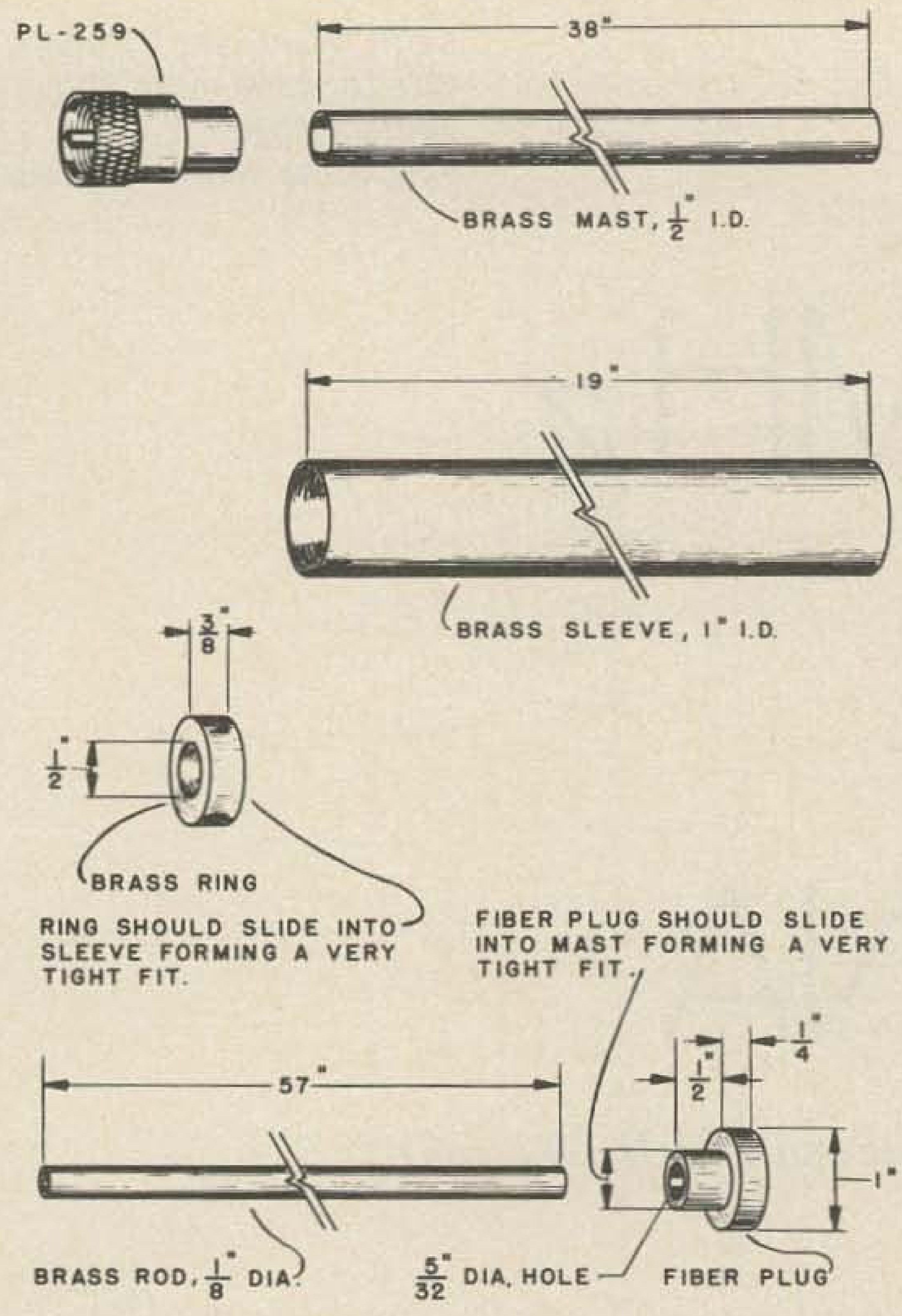

Fig. 1. Sub-assemblies for 146 MHz coaxial dipole Items shown are not drawn to scale and most critical dimensions have been left out.

possible that a feed point impedance at the ground plane could be repeated in impedance at the junction of the whip and sleeve. However, because of velocity factor effects on transmission lines, it would be impossible to use ordinary coaxial cable for this purpose. The transmission line must have a velocity factor close to unity.

A transmission line with a velocity factor of unity is air spaced coaxial cable. By now the reasoning may have become clear to the more astute. The support pole can become the sheath of an air spaced coaxial cable so that a wire fed centrally through its half wavelength will produce the required unity velocity factor half wavelength transmission line. The impedance of this line is not critical as it will repeat the impedance seen at one end to the other. This means that the materials used can be governed by the fittings and facilities of your own workshop.

In practice the inner conductor will need the support of two or three beads along its length. These could be pieces of poly from coaxial cable. This will tend to reduce the velocity factor very slightly. The bottom section of the antenna due to end effect is slightly less than a half wavelength. You will find that these two factors just mentioned tend to cancel each other out.

There are many ways of fabricating the antenna and one suggested method is shown in the accompanying sketches. For economy the PL239 plug assembly was chosen for a base connector. The half wavelength supporting tube is brazed or soft soldered to the tailpiece of the connector. Incidentally, pick a connector with an insulation material that is not susceptible to heat. Also note that the bottom section length should make due allowance for the length of the connector used. A brass spacer ring is brazed or soft soldered to the top of the support pole. This brass ring is drilled and tapped at three or four points to allow the brass sleeve to be screwed into position.

The inner conductor and whip is made from one piece of material. One end of this material is reduced to fit into the inner of the connector. Slip the support beads on the inner conductor, insert it into the support pole and solder the end to the connector. Next a small fiber, or similar material plug is fed over the whip end of the inner conductor and pushed to the top of the support pole. A generous application of an epoxy based glue at this point will complete the construction.

When installed the SWR may be shifted slightly by varying the length of the whip section. On the few antennas made by the author the whip length was deliberately made long, about 22 inches, and then reduced bit by bit till a minimum SWR was achieved.

In-operation tests were made by comparing against a standard quarter-wave whip, both mounted on the center of an automobile roof. In all tests, changing from the quarter-wave whip to the coaxial type antenna more than doubled the limiter current of the FM receiver used for signal strength comparisons. Some of these antennas with normal quarter wave radials have been used as home station antennas with excellent results.

. . .VK2BAU