# Multiband Antennas Using Loading Coils

BY WILLIAM J. LATTIN,* W4JRW

***Two-band operation can be obtained by using plain loading coils, with considerable constructional simplification as compared with the equivalent trap arrangement. This article discusses the principle, and gives dimensions for several 3.5-7-Mc. combinations.***

MANY amateurs operate from locations at which it is impossible to put up a full-length doublet antenna for 80 meters. A doublet antenna can be shortened as much as desired by the use of loading coils. The effect of loading coils is discussed very completely, with graphs and formulas, in *Bureau of Standards Circular C74, Radio Instruments and Measurements*, published in 1924 and reprinted in 1937. (Many an old-timer in radio will remember this as a standard reference book back in the '20s and '30s.) It is shown that in addition to decreasing the natural frequency of an antenna, the use of loading coils results in the fact that "the harmonic frequencies are no longer integral multiples of the fundamental as in the case of the simple antenna." In Fig. 62, page 76 of the *Circular*, a graph shows how the next higher resonant frequency differs from the fundamental in one particular setup.

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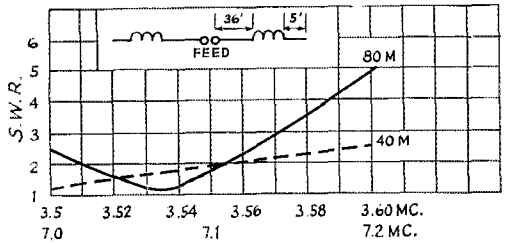


Fig. 1

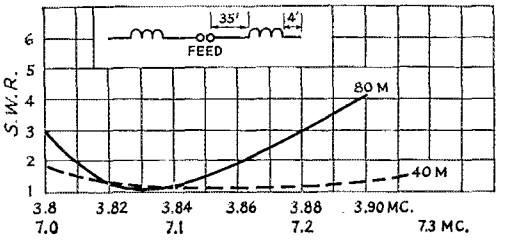


Fig. 2

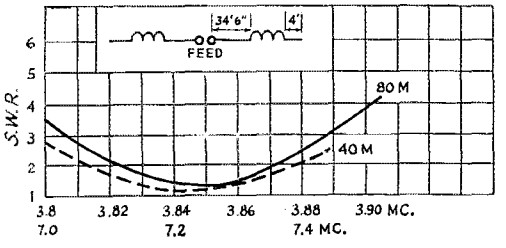


Fig. 3

Fig. 1-3, inclusive—Three two-band antenna configurations using 120-μh. loading coils, showing effect of small variations in the lengths of the straight portions of the antenna. Dimensions and construction of the sides to the left of the feed terminals are identical with those shown to the right. Standing-wave ratio measurements made with RG-8/U cable (52 ohms) and Micromatch.

An antenna for 80 and 40 meters was made up according to this principle. A few trials with various values of loading inductance indicated experimentally that with 120-microhenry coils placed as shown in Fig. 1, resonance occurred near the lower ends of both bands. With a small change in lengths, as shown in Fig. 2, an antenna which resonated higher in both bands was obtained. Another small change in lengths resulted in the antenna shown in Fig. 3, which is more satisfactory for phone operation. This antenna is 77 feet long, plus the lengths of the coils and insulators.

The coils were close-wound with No. 18 Nyclad wire on bakelite tubing ⅞ inch in outside diameter, 14 inches long. A winding length of 12 inches was used. These coils measured approximately 120 μh. Some other coils were tried, 80 μh. being the lowest value. Resonance in both bands was again obtained but with longer lengths of wire. If the inductance of the coils is too low, the resonance at 40 meters may be too high in frequency, although the 80-meter resonance can be gotten with longer lengths of wire on the ends. With various values of coils and lengths of wire, antennas can be made for 80 and 20, 80 and 15, 80 and 10, 40 and 20, and similar combinations.

As an antenna is made shorter it has sharper resonance. This may not be too much of a handicap for hams who operate over only 100 kc. or so in the 80-meter band, as many s.s.b. addicts do. The antenna of Fig. 3 is actually just slightly longer than a regular doublet at 40 meters, up to the loading coils, and can be operated over the entire 40-meter band with a fairly low s.w.r. on the feeder. The advantage is two-band operation with an antenna 77 feet long without traps.

This antenna has been used on the air for

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meters. IW had modulator trouble and was assisted back to normal by AY, ye old faithful on the banks of Dead Horse Creek. EG is back on the air from his new dwelling. Congratulations to TX, who prominently assisted the Ice Island Expedition. (See Feb. issue *QST*). IW, at Manitou, has started a class in his area. FB, Bill. Your SCM would welcome more material for these reports. Send us your news. Traffic: VE4KN 29, PE 23, JY 21, AN 6, QD 6, TW 5, AY 4, RB 4, RM 4, TE 2, XY 1.

**SASKATCHEWAN**—SCM, Harold R. Horn, VE5HR—The C.W. Net is doing very well on 3685 kc. The net now is known as PEN (Prairie Emergency Net). Officers are NQ, net mgr.; AH, associate mgr.; and EO, net recorder. Liaison with RN7 is maintained by MS, KZ, GW and NQ. NCSs are AG, AH, MS, EO, GW and NQ. Net time is 0200Z. EA and LM were both hospitalized at the same time. EA had a portable set to keep him occupied while convalescing. KJ is on a two-month holiday visiting in VE2- and VE3-Land. HR has a new Johnson Matchbox and now keeps the antenna well matched with low s.w.r. RQ made his DX-20 plate modulated and is heard on 10, 15 and 20 meters. MF has been working ZLs on 75 meters. VL is doing FB on 50 Mc., with 9 states and Yukon confirmed. Others on 50 Mc. are XP, JF, KP, EE, CU and MN. How about some OES appointments, fellows? We are sorry to learn that AD has to dispose of his gear because of inability to use his equipment after a stroke. Our sincere sympathy to 5VB and 7AP and their families following the loss of their father. Traffic: VE5NQ 49, MS 29, EO 19, AH 12, VE6AEN 11, II 6, AG 5, VE4RF 4, VE5BW 2, NX 2.

## 150-Watt Amplifier

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brilliance as the amplifier is loaded. Maximum plate current is 200 ma., or two-thirds of full-scale reading.

Be careful in loading up the bulb if you have 750 volts on the plates of the amplifier, because if you go too far you might burn out the lamp. The same procedure should be followed for checking on the other bands.

With the power transformer used in the unit shown here, the plate voltage under load was 720. Screen voltage was 300 volts. When excitation is removed, the screen voltage drops to less than 100 volts. In order to get maximum output from the 1625s, the screen voltage should be about 300 volts when drive is applied to the amplifier. If you should have a power transformer that gives you only somewhere near 600 volts under load, then the screen-dropping resistor $R_3$ should be less than 20,000 ohms. A 15,000-ohm 25-watt unit will give a screen voltage of about 300 with a plate voltage of about 600. We say "about" because a variation of plus or minus 20 volts would not materially affect the performance of the amplifier.

One other thing the Novice usually wants when getting his General-Class ticket is a v.f.o. As pointed out earlier, this amplifier requires a few watts of drive but it should be stated here that the average commercial v.f.o. does *not* have enough power to drive the amplifier. In order to drive the amplifier and use a v.f.o., an intermediate stage would be required. QST

## Multiband Antennas

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several years and the reports have always been just about the same as those obtained with regular doublets. Obviously the loading coils

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should be made as low-loss as possible by using good insulation and as large wire as is practical. There are no capacitors to break down as in traps, and the 120-μh. coils have been used with a kilowatt transmitter input with no difficulty.

We have not found any exact formulas to determine the relationship between the lengths of wire, loading coils, and the two frequencies. The antennas are very simple to adjust with a grid-dip meter coupled to a single-turn loop connected to the feed terminals, as quite small changes in the wire lengths result in appreciable changes in resonant frequencies.

This principle can be extended; that is, by using two sets of coils, operation on three frequencies is possible, on four frequencies with three sets of coils, and so on. However, these get very complicated to adjust, since the second set of loading coils changes operation of the first set somewhat, and the adjustment process gets rather tedious. QST

## Three-Band Quad

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### *Materials*

The total cost of materials for the quad is about $55.00. A 30-foot length of 2-inch irrigation pipe can be obtained from Sears for approximately $8.50. Material for the spider is generally available from dealers in metal stock — look in your phone book. "Heliarc" and other welding facilities are becoming more numerous every day and are now located in most cities. Again — consult your telephone directory. The author obtained the bamboo spreaders from the Mohawk Venetian Blind Co., 36 Cameroon Ave., Cambridge, Mass. There are other sources in both east- and west-coast areas. Be sure to ask for poles that are free from cracks. Aluminum clothesline is available in hardware stores. You will need about 350 feet. The brand I happened to find is called Aluminum Dog Run and is manufactured by Nichols Aluminum and Wire Co., Davenport, Iowa. It is guaranteed not to oxidize — an advantage in this application as well as in the originally intended one.

Both electrically and mechanically, this quad has performed in excellent fashion. The first night on its Field Day christening at K1DRX/1 set up at Mt. Ascutney, Vermont, it withstood 40- to 50-m.p.h. gales, remnants of a tornado, with no damage. QST

## More Sock for Cents Antenna

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had been depleted of solder. So we made the only cash expenditure necessary in assembling this antenna: we bought 25¢ worth of solder at the local solder shop.

So that's it! MORE SOCK FOR CENTS!

Ridiculously simple, isn't it? Proof once again of the fabulous innovations that can result from a little perseverance and that ubiquitous Aladdin's lamp of ham radio: the junk box! QST