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The Cap'n Crunch LOWFER Loop

This lightweight longwave antenna could become a classic.

Many readers may ask, "Why a special loop receiving antenna covering just 65 kHz in the LF spectrum, where there is nothing to hear anyway?" Well, there is a vast amount of activity in the band 130 kHz–195 kHz (2308–1538 meters). It is just 65 kHz wide, but looking at that in good old-fashioned meters, the segment is 770 meters wide!

Why "lightweight"? Well, most LF loops use a stout and heavy timber frame, plus a large amount of copper wire. The result is *heavy.* In this design, a lightweight cardboard frame is used, which is nearly weightless in itself. It is simple, cheap, and quick to construct. The one heavy item is a reel of copper wire 100 meters (333 feet) long.

What is there to be heard?

You might be amazed at the amount of activity to be heard between 130 kHz and 195 kHz, plus periodic spasms of atmospheric QRN — also QRM. It is quite a different ball game than listening on the HF bands. The following is some of that activity:

1. The 136 kHz amateur radio band (135.5–137.8 kHz), which originated in Europe and is gradually spreading worldwide.

2. Between 130 kHz and 160 kHz, there are many largely unidentified strange-sounding repetitive signals, many of which are, no doubt, navigational aids. Some enthusiasts specialize in investigating and identifying these signals.

3. The USA-originated 1750 meter LOWFER band (160–190 kHz). LOWFER stands for Low Frequency Experimental Radio stations.

4. A bonus is some of the various European longwave high-power AM broadcast stations. It has been possible to list at least nine stations between 150 and 195 kHz, of which all but two share the same band as the USA-originated LOWFER band. These stations provide possible DX listening for the North American–based listeners, and others outside Europe. Conversely, it means that for European listeners, they swamp the very low power LOWFER stations in the USA and elsewhere.

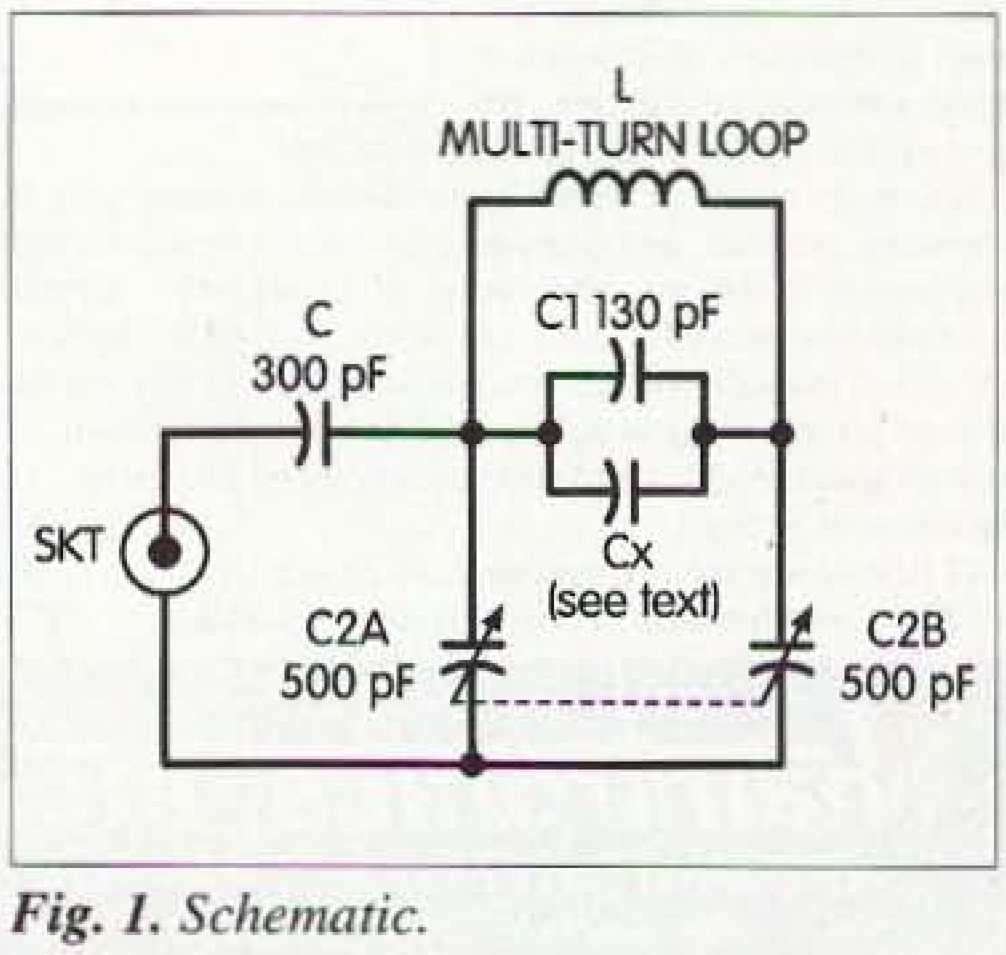

Fig. 1. Schematic.

Summarizing: Wherever you live on Planet Earth, there is always something heard between 130 kHz and 195 kHz.

A good receiver is required to get the best results, plus a sensitive loop antenna with excellent nulling to remove or greatly reduce the fiendish atmospheric noise and other QRN that often occurs. Also, believe it or not, you can often experience QRM between stations. The "Cap'n Crunch" loop goes a long way towards providing the necessary antenna facilities.

The schematic

Fig. 1 illustrates the somewhat unusual schematic and unusual circuitry.

A multiturn loop (L) is resonated in a balanced circuit by a 2-gang x 500 + 500 pF variable capacitor, with the addition of C1 across the winding. C1 is a 130 pF capacitor, across which is wired a small padding capacitor to make final adjustment to get the loop into the 130/195 kHz spectrum (see text). These capacitors can be ceramic disc, silver mica, or mica, and the voltage rating is not important, making it possible for most to find them in the junk box. The coaxial feedline is

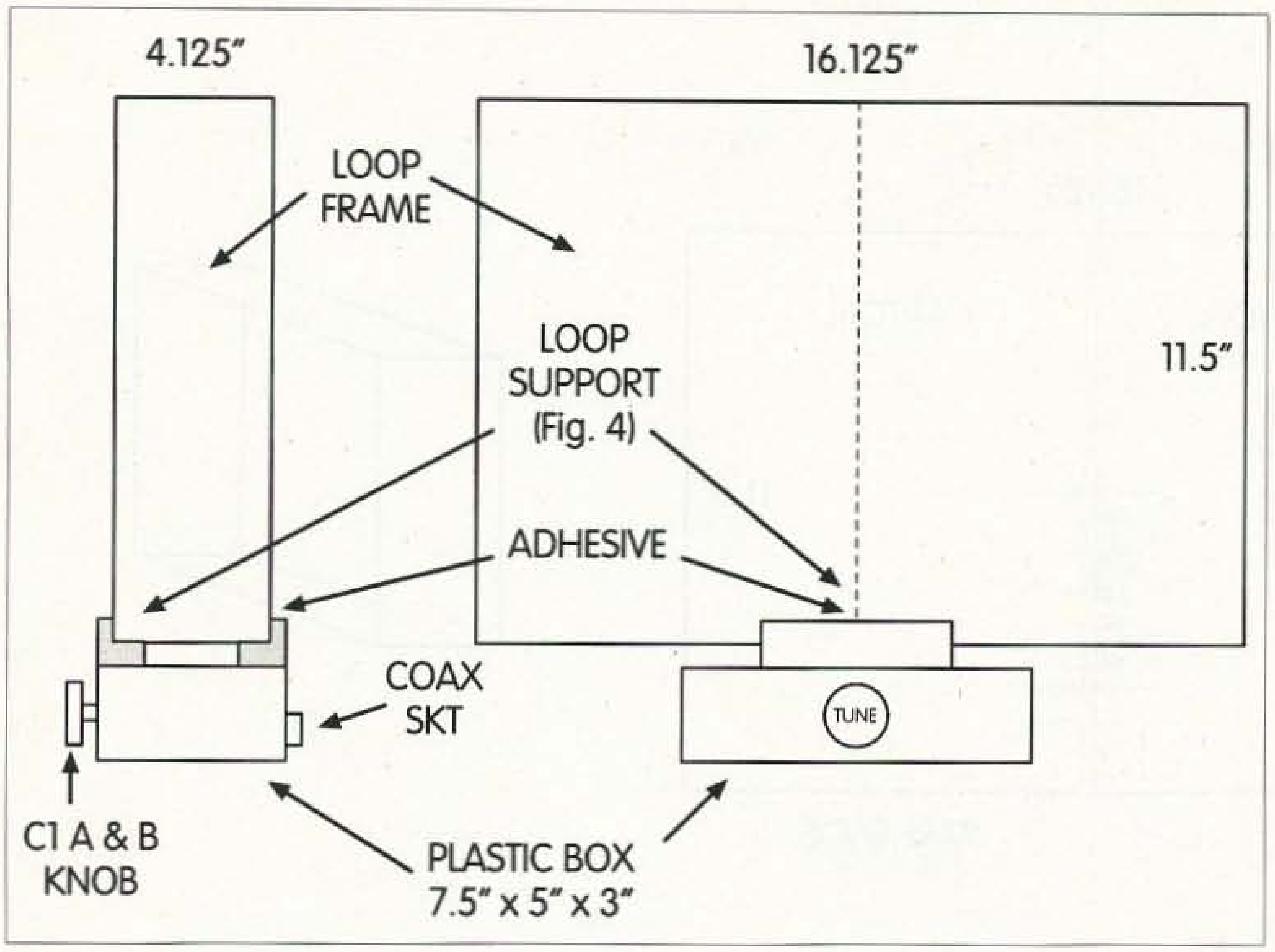

Fig. 2. The assembly.

coupled to the loop with capacitor C1, which is a 300 pF that can also be found in the junk box. SKT is a coaxial socket of a convenient type.

Profile

Fig. 2 shows the profile of the final loop assembly. It consists of a box frame (**Fig. 3**), onto which is wound loop "L". The frame is mounted on an inverted plastic box/base containing the variable capacitor C2A+B, on the front, and the coaxial socket at the rear.

Loop frame winding

The frame used on the prototype was of negligible-weight thin cardboard construction, made from two breakfast cereal (hence the Cap'n Crunch) cartons glued together side by side, as shown in **Fig. 3**. Each carton was the popular size of approximately 11-1/2" x 8" x 4-1/8". After gluing them together, wind two layers of wide masking tape around the circumference. The final dimensions are 16-1/8" x 11-1/2" x 4-1/8". At this stage, you can apply a coat of emulsion paint to the faces of the box frame, to cover the advertising and logos.

The winding consists of a 100-meter (333-foot) reel of PVC-covered hook-up wire, single core 1/0.6 mm (22 AWG) sheathed PVC to an overall diameter of 1.2 mm. The closewound winding should be started about 1/4" from the frame edge, and conveniently fills the width to about 1/4" from the other edge. The whole reel of wire is used. At the center bottom, 8"-long leads should be left for cutting back and soldering later. The use of PVC wire effectively spaces the wire turns.

Around the outside of the winding, wind a layer of PVC insulating tape.

An alternative thin cardboard frame could be made by cutting down larger cartons, or from cardboard sheets, with the aid of scissors, a scalpel, a stapler, sticky tape, and a tube of adhesive.

For those who prefer a wood frame, a simple design is shown in **Fig. 3(b)**. Using this will, of course, multiply the overall weight of the final assembly by several times.

The box/base unit

The plastic box I used was a mi-

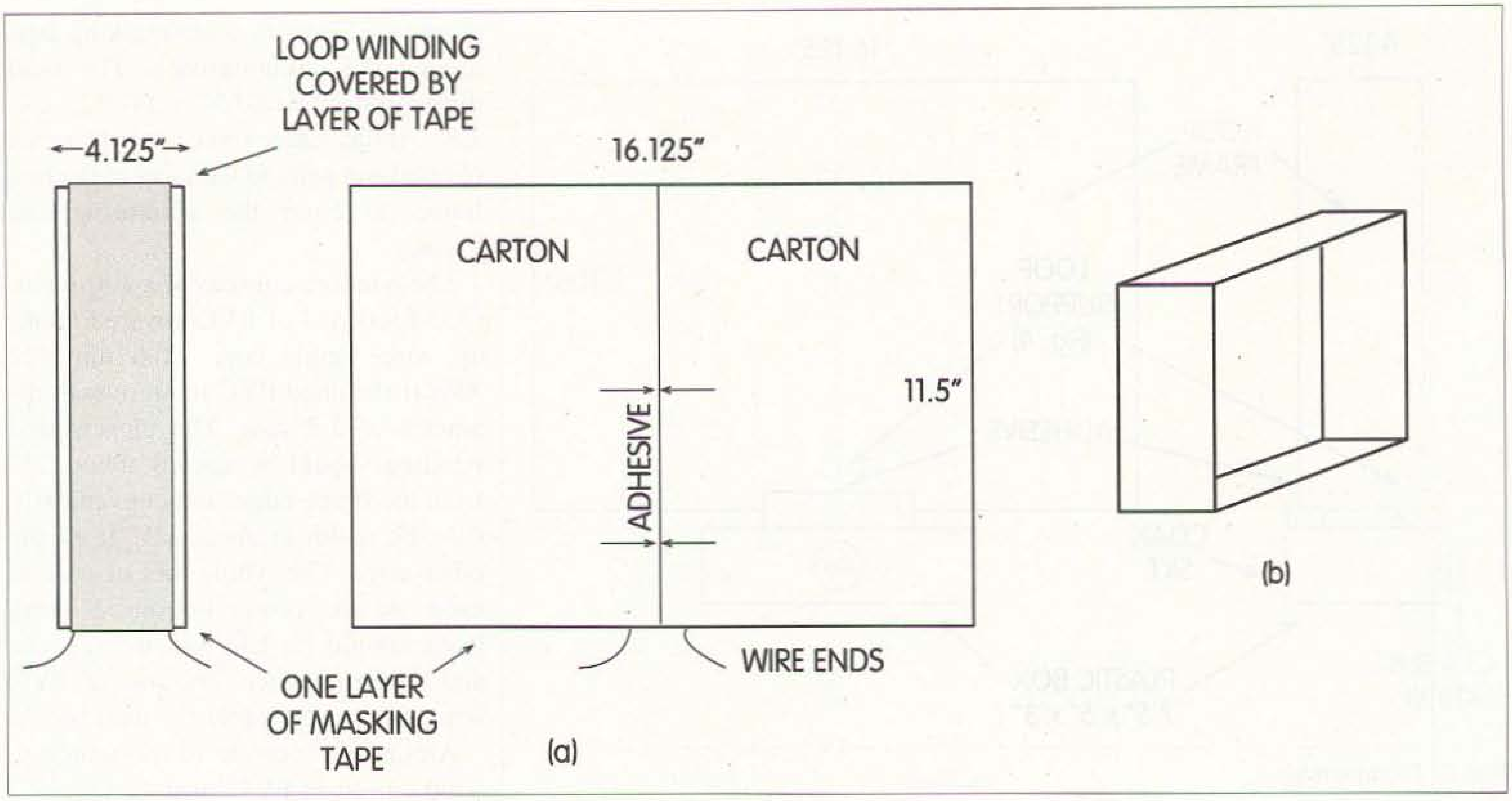

Fig. 3. (a) Loop frame and winding. (b) Alternative wooden frame.

crowave/freezer box 7-1/2" x 5" x 3" (**Fig. 2**). Any similar size of plastic box would do. The variable capacitor C2A+B is mounted at the front. A rigid 500 + 500 pF air-spaced type should be used. The coaxial socket (SKT) is mounted in the center of the rear. The box is inverted so that the original push-on top now forms the base.

Final assembly

Two simple loop supports are required, made of wood (see **Fig. 4**). Screw these to the base unit as shown, so that the loop frame/winding is a snug fit.

Pierce two holes in the top of the box/base, then pass the 8" ends of the loop winding through the holes. The box frame is held in position by a small spot of adhesive, as shown in **Fig. 2**.

The loop ends are cut back and connected to the tuning capacitor (**Fig. 1**). The other wiring should be completed using 18- or 20-gauge tinned copper wire. All connections should be securely soldered. No mechanical joints should be used.

NOTE: Cx is not connected at this stage.

Testing and operation

The loop should be connected, with a short length of coaxial feedline, to a good receiver covering the required frequency range. Stand the loop on a nonmetal surface. Next, check the loop frequency range. You will find that the LF end is a few kHz higher than required. This can be lowered a little, as required, by the addition of capacitor Cx, which on the prototype was a 56 pF silver mica in parallel with C1 (130 pF). This produces the frequency range required —130–195 kHz.

The tuning capacitor is quoted as 500 + 500 pF, but in practice this is the manufacturer's nominal value, which may vary by as much as ±20 pF from manufacturer to manufacturer. It may be necessary to experiment with the value of Cx to compensate for this factor; with the adjacent values to 56 pF (Cx) ±. For example, unlike on HF frequencies, the addition of, say, 20 pF has only a minimal effect on the low frequency end of the tuning range.

Next, check the nulling on a suitable carrier (BFO On) around 140 kHz. The loop, rotated edge-on to this station, will produce maximum signal strength. Rotating the loop to 90 degrees should produce 100% nulling, except on the strongest local signal. Similarly, rotation of the loop should eliminate or greatly reduce QRN of the atmospheric and man-made types, which can on occasion be quite devilish.

The loop is remarkably sensitive for its small size. At my QTH, with a very sensitive receiver, a preamplifier is not necessary. In fact, it produces intermodulation! With less sensitive receivers, a preamplifier may be needed

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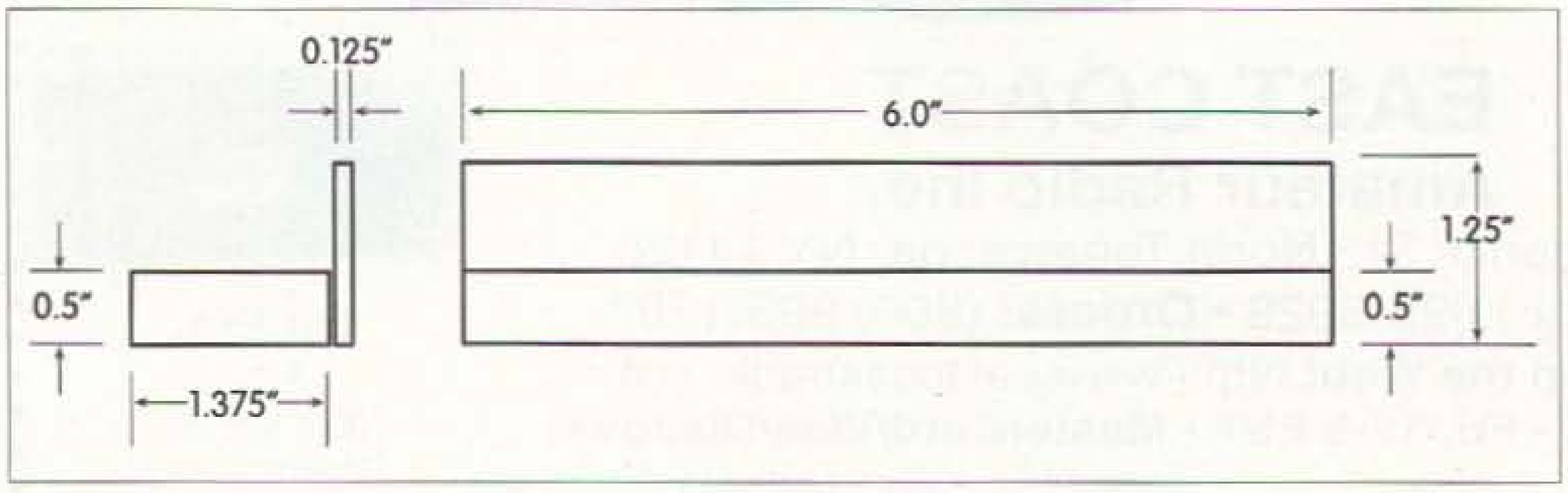

Fig. 4. Loop support.

Windshield Auto-Wiper

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pauses to one, two, three, or more without resetting the pause control.

How it works

As shown in the schematic, the 555 timer IC1 (configured as a gated astable pulse generator with independently adjustable ON and OFF times) derives its feedback from the voltage across the wiper motor. This voltage governed by the park switch pulses in synchronization with the wiper blades. Hence the timer is controlled by the wipers themselves in addition to its ON (WIPES, R1) and OFF (PAUSE, R3) time constants.

When S1 (part of R1) is first closed, low voltage on pin 2 of IC1 triggers the timer into its ON state. MOSFET power transistor Q2 is cut off but Q1 is turned on, allowing power to flow to the wiper motor. Power is also supplied to the motor through the internal diode of Q2 as the park switch cam rotates out of detent. The feedback voltage across the motor charges C1 through WIPES control R1 until the voltage across C1 is clamped by D3 just above the upper threshold of IC1.

As the voltage on C1 rises above the upper threshold of IC1, the timer turns OFF turning Q2 on while cutting off Q1. The wiper motor, still powered through the internal diode of Q2, continues to operate until the park switch cam once more rotates into detent. The result is that the feedback voltage remains HIGH, thus preventing the discharge of C1 until the cam rotates into detent.

When this occurs, C1 is freed to discharge through PAUSE control R3 toward the zero feedback voltage across the wiper motor. The voltage on C1 falls until it crosses the lower threshold of IC1, triggering it ON to start the cycle over again. Also, as the cam rotates into detent, the wiper motor's windings are shorted to ground through the wiper switch and Q2.

The resulting dynamic braking halts the wiper blades in their proper park position. During the interval in which C1 is charging through R1, the park switch cam is free to make more than one revolution; thus time constant R1C1 can be varied to allow 1, 2 , 3, or more revolutions of the cam before the voltage on C1 reaches the upper threshold of IC1. Similarly, as C1 is discharged through PAUSE control R3 toward the lower threshold of IC1, time constant R3C1 varies the discharge time from zero to 60 seconds or more.

Operation

To start a wipe cycle, it is only necessary to pulse Q1 long enough for the park switch cam to rotate out of detent. Therefore, it is only necessary to advance the WIPES control clockwise until the desired number of wipes are reliably swept. Erratic operation may occur if the control is turned beyond this optimum point. When decreasing the number of wipes, always retard the WIPES control to less than the number of wipes you want, and then advance it as above.

Any desired pause of up to 60 seconds is simply set by the PAUSE control. When first turned on, the initial wipe duration will be somewhat longer than set by the WIPES control. This is caused by C1 charging from zero volts rather than from the lower threshold voltage of IC1 as in subsequent cycles. A useful purpose is served, however, in that the windshield is sure to be wiped clean at the start. The original wiper switch is normally not used, but can at any time override Auto-Wiper.

Parts List

Part	Description
C1	8.2 µF 50 V 10% solid tantalum capacitor (Sprague Q-Line #QDT1-61)
C2	0.01 µF 50 V disc
C3, C5, C7	0.1 µF 50 V disc
C4, C6, C8–C10	10 µF 25 V electro
R1	1 meg linear pot
R2	33k 1/4 W resistor
R3	10 meg linear pot
R4	1k 1/4 W resistor
R5, R6	120 ohms 1/4 W resistor
R7	1k 1/2 W resistor
D1–D3	1N914 or 1N4148 diode
D4	1N4001 diode
D5	4.7 V 1 W zener
D6	Red LED 20 mA
IC1	555 timer: SE555 or MC1455 chip
Q1	2N6788 power MOSFET
Q2	2N6849 power MOSFET
S1	SPST switch
F1	6 A fuse and holder

Note: D5 is used with regular NE555 or LM555 chip. If you use the SE555 or MC1455, omit D5 and put a jumper in its place. This is due to the higher voltage rating of these parts.

Table 1. *Parts list.*

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between the loop and the receiver. There are many published designs of simple-to-construct, low-cost preamplifiers of the wideband type. Commercial types are available from suppliers at a moderate cost.

Final note: Remember that the Rx will have to be operated with "BFO On," except when you are listening to the AM broadcast stations.

The DX Forum

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73, Steve KF2TI

Iron Chef DX - Total Master of DX Stadium 10 years running Many challenges, no defeats. Landing, NJ"

Back to Bhutan

This is also hot off the presses. It was provided via the Internet, and is contained in