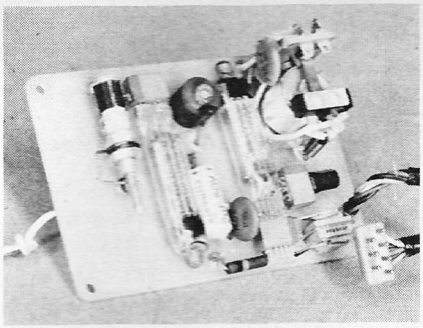
Mac-Tone
Radio Control
Receiver
Part Two



Author Howard McEntee's "Mac-Tone" R/C receiver. Full size baseplate drawing appeared in previous issue.

■ Part Two . . . An epoxy fiberglass material was used here, but linen phenolic would do fine, though it isn't as sturdy. The drawing shows the holes needed, assuming the exact same parts as specified are employed.

The relay is a "Bramco style" Gem, a type that gives a certain amount of wiping contact action; the more standard style Gem is just the same size, of course. A strip of cellophane tape was cemented over the magnet core, to prevent any troubles with risidual magnetism. Mounted right on the relay terminal board are parts R3 and C9.

All sockets are a type we have found very reliable; they hold the tube wires with a very snug but velvet smooth grip. These sockets were intended for P.C. board use, but modified as shown they do fine in our "point-to-point" assembly. The pins are filed down so the socket body is about 1/16" above the base plate; lightly soldering the flat side of the pins (it isn't necessary to remove them from the socket body) to a scrap of sheet brass held in a vise will make this filing operation much easier. Of course the sockets may be used as they come, but this raises the pin end of the tubes fairly high above the chassis. If you leave the tube pins long enough to go right through the socket and come out the back side, then bend a couple of them outwards, the tube is there to stay—till you want to remove it. Same goes for V3.

L1 is held by soldering the lugs into two eyelets, it is so small and light that this form of mounting has been found simple and safe. Rather than use the lock nut that comes on this form, we remove it and bend a lock wire of 1/32" music wire, that presses firmly against the slug threaded shank (not needed on form from Ace R/C). The tap on this coil is just a little kink, formed with small long nose pliers while the winding is in progress. *Do not* let the coil turns touch either end lug, except where the leads are soldered to the latter.

In order to get a fairly sharp AF peak, we used a tiny cup core choke for L2. The core is a stock item from several R/C firms, comes in two halves with a tiny nylon winding form, and the necessary screw and nut to hold the whole works together. The form was mounted on a round head machine screw, clamped in the chuck of a hand drill, latter clamped in a bench vise. 650 turns of #44 Formvar wire were put on the bobbin; this wire came from the coil of a Gem 2500 ohm relay, and short pieces of the lead wire from the relay coil were soldered to each end of the #44 wire; if you use real care, these lead wires probably are not necessary. The core cups and winding bobbin come from Rameco Products, and they will offer a finished choke to the above specs, for this specific receiver. Unfortunately, none of the standard Rameco chokes have enough inductance for our use. For the technically minded, this choke has an inductance of about 520 mh, and a Q of about 11 1/2.

L3 is secured to the baseplate by a dab of "Goo" (cement sold in most hobby shops) under the core, and a loop of wire (about #22 or so, solid) around the core, twisted and soldered under the base. Just run the leads down through the holes indicated.

Quite a few eyelets have been used to make connections between various circuit parts. These eyelets are shown as double circles on the base drawing. As C3 through C9 are put in place (except C5, which stands upright) a dab of Goo is applied to them, to keep them from shifting under vibration. It's just as well to leave the Goo off C1 and C2—their leads are husky enough to hold them tight anyhow. In the set shown, it was desired to tune the AF response exactly to an existing transmitter on 2200 cycles, hence the use of the two capacitors in parallel that are seen in the underside photo for C4.

After wiring and a careful check of same, you are ready to fire up. Since these tubes are intended for use on 1.25 volts, it is best to use a single nickel-cad cell on them. However, countless thousands of sub-mins have been used on ordinary dry cells, so if that's what you will use in your plane, use 1.5 volts when tuning up the receiver. Make first trials with just V1 in its socket; plate current should be about .18 to .25 ma, depending on the tube used, and it should drop a tiny but noticeable amount when L1 is tuned to a nearby transmitter. If it does, and if the current shoots up to a much higher value when you touch a finger to either lug on L1, you can put V2 in its socket. This tube will add about .2 ma to the total B current drain of the two tubes. The plate current of V2 will drop a tiny amount when a tone of the proper value to pass through the AF tuned circuit comes along.

Now insert V3 (open the B circuit when you are doing this). With no transmitter signal tuned in, the current through the relay will vary according to the value of C6; the value we specify was right for this particular receiver, and with quite a variety of tubes, but C6 is the final adjustment that makes up for all the little differences in the tubes, transistor, and small circuit parts, and should really be tailored to each set. Once chosen, it will not need change, over quite a wide range of A and B battery variations, even with changes in the tubes and the transistor. With no input signal, we like to see about .2 ma in the relay, and the current will be very unsteady, since it is caused by the rough hiss of the super-regen tube V1. With a CW signal tuned in, the current should drop to zero (if it is much higher, check V3 to see if it is leaky—see where the relay current reads when V2 is out of its socket, or the A battery circuit opened).

Now key on the tone, when relay current should rise to a high value—about 2.9 or so with a 7500 ohm relay and over 4 ma with a 5K relay. Last check is to vary the AF frequency of the transmitter, to see where your receiver peaks up (or tailor receiver to match your transmitter).

For the 7500 ohm Gem, we set the relay to close at 1.8 ma, and to open at about 1.2 ma. This allows quite heavy spring tension.

Now, what can be done to lower the AF response, so the receiver will work with transmitters that have a fixed AF output somewhat lower? You can either put more turns (of finer wire) on L2, or raise the value of C4, or both. While we consider L2-C4 to be a tuned filter, it really isn't too sharp, but is naturally a lot more so than the so-called "untuned" AF receivers, which generally peak up around 500 to 800 cycles. At the expense of a little broader AF response, you can easily get your receiver to operate in this AF range, simply by using a second transformer identical to L3, but connected as a choke, in place of the Rameco unit we have specified for L2.

One possible problem that can beset a receiver of this type is "ringing"; this is a singing sound (which will hold the relay operated) and is caused by the reaction of the V1 hiss on the tuned circuit—the rough peaks of the hiss cause L2-C4 to respond at their own resonant frequency. With the values we show this problem is extremely unlikely; we found it with just a couple of "dog" 1AG4 tubes, usually when the filament voltage was quite high and the B voltage low. It should be very rare indeed, but since it can happen, we thought it should be mentioned.

As noted some paragraphs back, this receiver was designed especially for 50 mc. However, Harrison Morgan (who has for several years been an enthusiastic user of our Tech 2 . . . he has made quite a few on both 50 mc and 27 mc) not long ago decided to go to tone for the same general reasons we did—tone is all the "style" nowadays, and furthermore, it is considerably safer due to increasing problems of interference. Harrison has made several of the Mac-Tone 50 mc receivers, using our circuit and general layout, but spread out a little, and with a larger relay. At this writing he has flown three of these sets on 50 mc and

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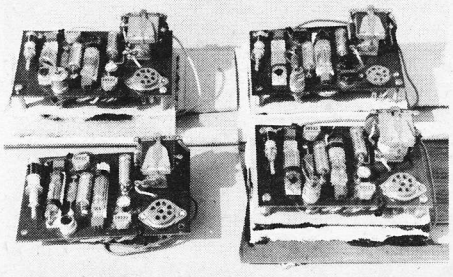

Harrison Morgan's copies of McEntee's new rcvr. Lower left set is on 26.995, rest on 52.5-mc. Upper right was first one built, has Telex xformers, G.E. 2N44 PNP xistors. Others have Johnson xformers, NPN xistors.

Mac-Tone

(*Continued from page 30*)

is most happy with the results. In all of them he has used the Johnson transformer at L2, and .0047 mf for C4. Transformer connections for various tone ranges are shown and of course, more variation may be had by using different values of C4 (but we wouldn't suggest going much lower than .004 mf here).

Harry's sets seems to work better with 18T #28 E. wire on the form we specify, and 2.2 mf at C2. Also, of course, the vital capacitor C6 must be adjusted to obtain the desired no-signal current in V3, for any changes that are made to the front end of the receiver.

Latest experiment reported from the Morgan labs is to put the set on 27 mc. Since they work fine on 27, he used two 6007 tubes; C1 is 1.5 mmf, C2 is 1.8 mmf, L1 is 32 T #32 E, wire on a CTC LS-6 coil form with white core tapped at 12T. All his flight tests were made with the transformer at L2 connected for 600 cycles, and .002 mf was required at C6. He feels this is a top grade 27 mc receiver (with those two 6007's you have only about 25 ma filament current).

To go back to a few final words about our own 50 mc outfit—we find it will work down to about 1 volt on filaments and 16 volts B, both these voltages being dependent to a considerable extent on the 1AG4 used at V1. In any case, you have considerable leeway in these voltages. The set is not at all temperature sensitive, the relay current changing only a very few tenths of a ma. over a wide temperature range. All in all, we feel it is a most satisfactory outfit. Give it a try and let us know what you think.

Parts List: C1, 0.5-mmf ceramic (CRL type TCZ); C2, 4.7-mmf (same); C3, 50-mmf cer. disc (CRL DD); C4, depends upon exact tone frequency desired, .01 and .0022-mf used in parallel here, mylar film capacitors (CD type WMF); C5, .001-mf (CRL DD); C6, .0033-mf mylar (CD WMF); C7, ½-mf. electrolytic (Ace); C8, 2-mf electro. (Ace 50 volt submin.); C9, double section .01-mf cer. disc (CRL type DD3—or use two single section units). R1, .39-meg; R2, 10-meg; R3, 10-ohm (all resistors 1/4W carbon). L1, 16 T #28 E. wire close-wound on CTC type LST form, white core, tapped at 6 T from plate end (form from Ace); L2, choke wound on 3/8 x .180" pot core, (core and matching bobbin or finished choke, Rameco Prod.); L3, Johnson submin AFT, 20K to 1K (Ace); RY, 7500 ohm Bramco type Gem relay (Jaico). V1, Raytheon 1AG4; V2, Raytheon CK522AX; V3, Ray. 2N132 (or any good PNP type). RFC, 10-UH (Ace RCA type); eyelets, 3/32" D x 3/32" L (Ace SE-33); 1/16" thick base material; sockets, Cinch-Jones 46A22452; cable plug, Crescent 7 pin. Coil and hookup wire, Goo, etc. Note—it is possible that one of the R/C supply houses will carry most of the special parts needed to build this receiver; substitutions may be made; of course, but we feel the above parts are best for the job.

U-2

(*Continued from page 21*)

ally to a 10-in diameter at the filter paper location. The filters are secured in a ringholder with a wire mesh fore and aft to provide rigidity and to prevent tearing. Four sample holders are placed in a circular rack by which the filters may be rotated sequentially into the duct by the pilot.

An independent detachable hatch duct has also been installed. It is similar in design to the nose duct and provides a capacity of 6 additional 16" filter papers. Two of the U-2s have also been fitted with a dust impaction probe. This sampling probe contains coated electron microscope grids and/or small glass slides. The probe is loaded and unloaded in the laboratory and is designed for minimal contamination during times when it is not exposed to stratospheric air. Exposure is made during normal HASP missions.

In the past, this specialized aircraft has been referred to as just U-2, but of late there has been reference to a U-2B and U-2D, as well as single-seat and two-place versions. Early Lockheeds were powered by a single 11,000-lb thrust P&W J57; later models are reported to have the more powerful J75-P-13. Wingspan is 80' 2"; length 49' 8". Forward landing gear is dual pneumatic type, approximately 20" diameter, is non-steerable; rear gear is dual hard rubber of approximately 8" diameter and steerable. A lightly stressed thin skin covers the U-2. J57 powered U-2 has a 3000-mi range at 475-mph at 70,000-ft altitude and flight endurance of 7½-hr. Speed is Mach .73 to .80.