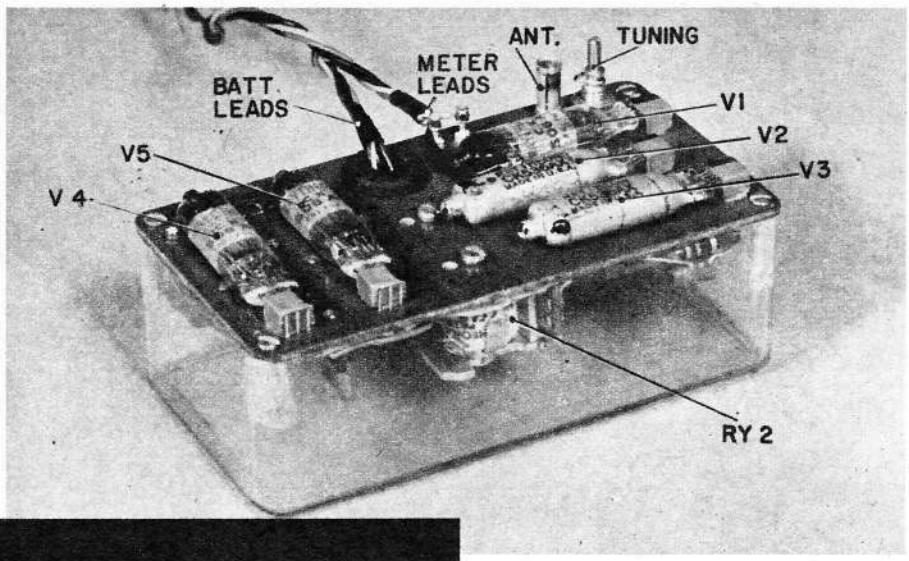


Note compactness of tiny tuned relay 5-tuber. Although this is an audio-selection receiver there are no audio frequency chokes.

For The Advanced Radio Control Fan— The Lighweight, Constant Carrier Band Pass . . .

TWO-CHANNEL "TR" RECEIVER

Everybody gets in the act; it turns out to be a big hit!

By VERN S. JUENKE

Note to the Editor: When we first saw this receiver in action at the Nationals, and got the data on it from Howard Bonner, we felt it would be of real interest to large numbers of R/Cers. Howard didn't feel he should write up the receiver as an article, however, since it had been originally developed by Vern Juenke. Vern, though, had only used his original version that would not work very well with the Babcock transmitter, and because we felt the receiver would be of most use to our readers if it could be operated by this widely available and standard make of transmitter, we decided to use the Bonner version. To see just how effective this would be, we built one up, and it is this one which appears in the photographs. The ensuing data, then, is the result of cooperation between Juenke, Bonner and Yours Truly, and we feel this receiver is one that will start a new trend in lightweight multi-channel operation.

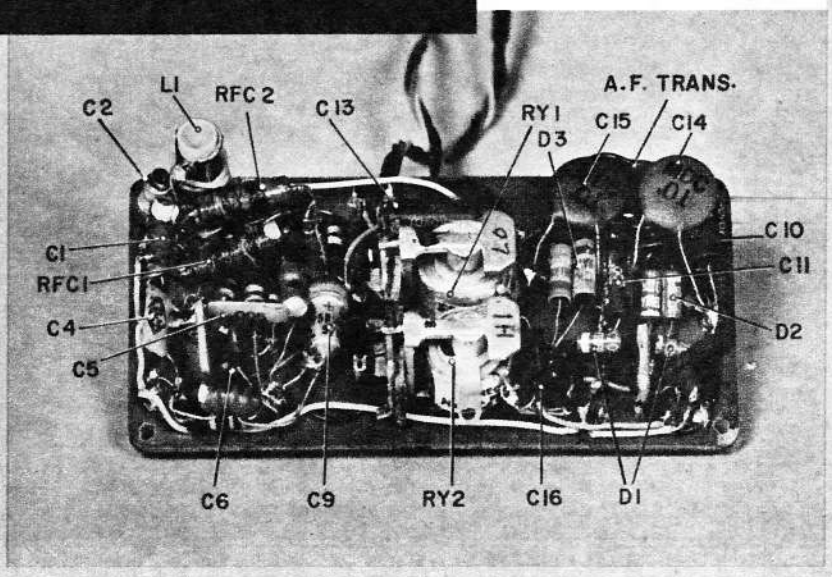
—H. G. McENTEE

■ During the past few years there has been an ever increasing desire among serious radio-control modelers for a lightweight reliable two-channel receiver. The big problem in the past has been the weight factor involved, both in the necessary tuned filters, and in A and B battery drain. We feel we have such a receiver now, and as proof of its worth, the 2nd and 4th placers at the hotly contested 1954 Nationals R/C event both used this receiver. Second-place man Howard Bonner's receiver was very similar to that illustrated here, while Colby Evett used a 50 mc. version. To show that the receiver will go in small planes Bonner used a little 3 lb. Beam; the receiver makes small multi-control planes very practical, since it weighs only about 4½ oz. The tube line-up shown can be altered to lower battery drain, too, but it was felt that the readers would be most interested in the receiver as depicted, for this is the version that has been so successful in both contest and sport flying.

Technically, the receiver might be called a constant-carrier band-pass job; five tubes are utilized, the first three being a standard super-regen. detector V1, a voltage amplifier V2, and an AF output tube V3. The remaining two tubes operate the relays, and it is here that some most unusual circuitry may be seen. Although this is an audio-selection receiver, there are no AF chokes. Instead, the two relays are tuned to the desired frequencies; since they tune very broadly, it is possible to work both relays at once, by sending a suitable intermediate tone.

A look at the curves in Fig. 1 will show roughly how this works; the high-tone channel—1600 cycles—goes to a greater value of current, since the relay for this circuit is only 5000 ohms. Both relays receive enough current so that relay settings are not critical, and enough spring tension may be used to prevent vibration troubles.

There is a DC feedback arrangement in each relay tube plate circuit. The tubes are normally biased close to cut-off by the 9 V. battery. When an audio tone of the desired frequency comes through, it is amplified by the tubes; if it is the correct high tone, for example, the tuned relay RY2 in the plate circuit of the high channel acts as a high impedance to the amplified AF, blocking its passage to ground through the B battery. The AF therefore builds up a positive DC voltage across the two diodes D3 and 1 meg. resistor R2, which voltage is passed back to the grid of the tubes, allowing V5 to draw a lot more plate current.



Vern Juenke of Reno, Nevada, a 29-year old gunsmith, is president of the Reno Dazed Diodes R/C Club. First flew free flight in '41. Married, has 2 daughters.

Fig. 4

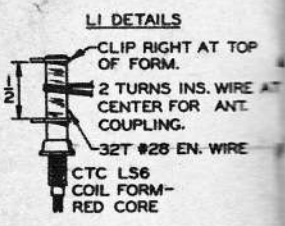


Fig. 3

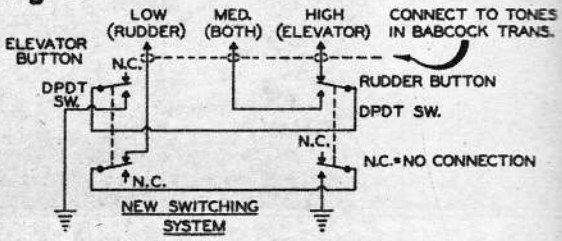
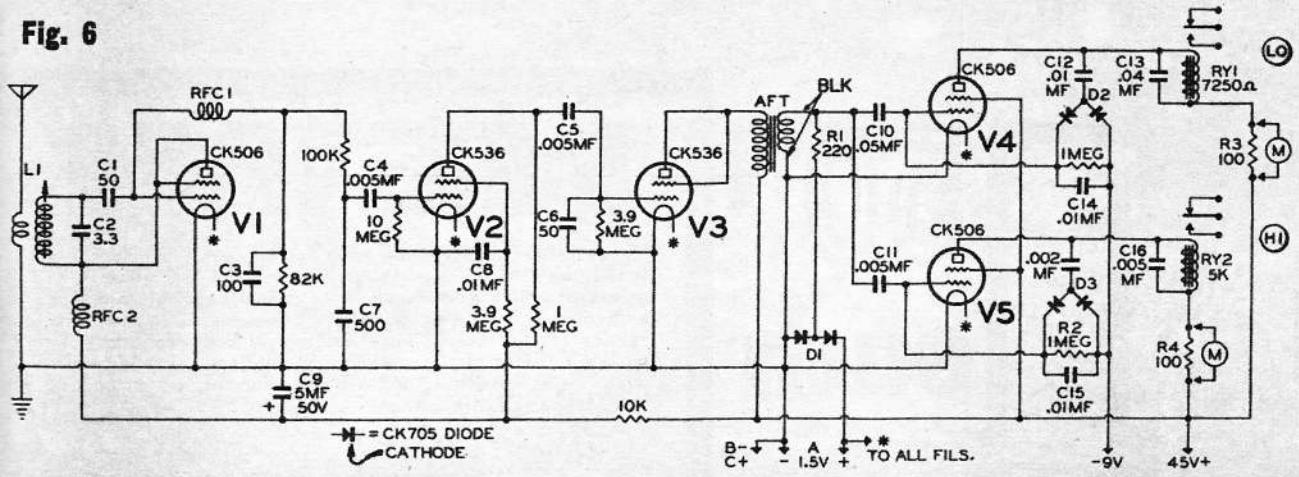


Fig. 6



This feedback merry-go-round continues until the tube is drawing the maximum plate current possible, for the value of B voltage in use. Of course, the low frequency tube amplifies the tone at the same time, but since its plate circuit is not resonant at the high frequency, what little AF it passes goes on to ground through the relay RY1, its parallel condenser C13 and the B battery.

Before we get into actual construction, there are a few conclusions that should be offered. First, the receiver is primarily useful as a selective job that will work on *either* of two audio tones; because the tuned circuits are so broad, there is nothing at all critical about operation. Drift of the tones at the transmitter, hot or cold weather, and even dropping battery voltages that might shift the tones, make absolutely no difference in operation. The first receivers of this type that were used had a somewhat different circuit for the first three tubes, and the transmitter was a homemade grid-modulated job. However, when Howard Bonner wanted a two-channel receiver for his new Beam, it was found that the receiver "front end" did not work so well with the standard Babcock BCT-4 3-channel transmitter. Since Howard did not want to build a new transmitter, he adapted the front end of the Babcock 3-channel receiver to the tuned-relay output arrangement, changing the tubes to sub-miniatures, and altering a few component values to fit these tubes. With a little further simplification, this is the receiver which we show. Since it will work very nicely with the Babcock transmitter, we do not describe any special 3-tone transmitter here.

You will note that we have mentioned only *two* channels so far. But the Babcock has a third tone in between those high and low ones which work our two relays—can we do anything with this third one?

The answer is both yes and no. As the Babcock transmitter comes, the middle tone (about 720 cycles) is a bit too low for good simultaneous operation of both relays. Also, for most uses (as for example the single or simultaneous operation of two Compound escapements, as on Bonner's Beam) a different switching system must be used. Both these problems may be taken care of quite easily, as will be explained in detail later. Suffice to say, by raising the middle tone and adding a special switching hookup, the Babcock transmitter can be adapted quite well to simultaneous operation. There's one caution on this, though; *any tampering with the insides of the Babcock transmitter (or any other reputable make, for that matter) will void the maker's guarantee.*

So—you can use the transmitter as it is sold, and get very reliable two-channel operation; you can tinker with the receiver circuit a bit (data on this later) and still using the transmitter as it comes, get perfect two-channel operation, with fair simultaneous use.

Or you can add the double-button switching system and raise the middle tone, and get pretty good simultaneous action. Users of this receiver have found the high and low operation to be most reliable; the simultaneous operation of both relays on the intermediate tone is considered as somewhat of a bonus—useful, but don't stake your life (or that of your plane) on it. Of course, if you want to make your own transmitter, you can set the frequencies as you like, for best overall results.

The receiver is built entirely from standard parts. We haven't given highly detailed drawings of the chassis, Fig. 2, since this receiver is something that we would not recommend for the beginner to tackle. Parts placement has not been found critical, but the usual techniques of reliable receiver construction should be followed. Howard Bonner mounted the bias battery right in the receiver—taped to the audio transformer, while it is external on the outfit shown here.

The five sub-min tube sockets are held to the base plate by the prongs that pass through, and also by an application of a substance known to the model railroaders as Walther's "Goo," obtainable at most hobby stores. After the set has been checked out and is ready for installation in your model, a spot of Goo will hold the tubes securely to the base; if you want to remove them at any time, a razor blade will do the job, since Goo never gets really hard.

(*Continued on page 88*)

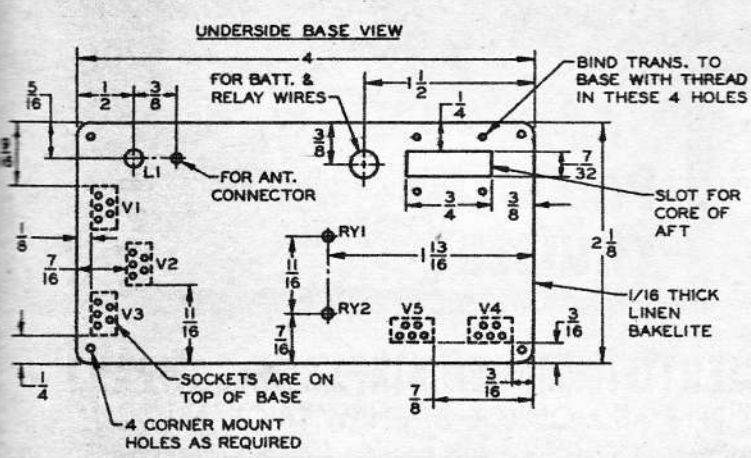


Fig. 2

Fig. 1

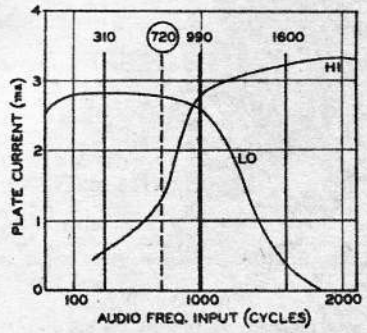
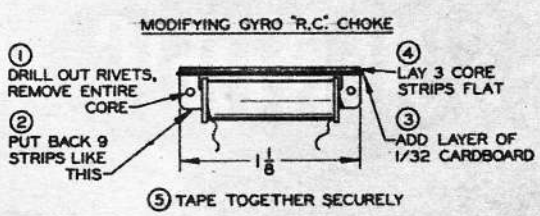


Fig. 5



Under Control

(*Continued from page* 77)

ready to use. Receiver is canned for protection and the relay is inside the case. There is only one adjustment—for tuning. Companion transmitter operates at low current drain on 135 V. B. battery; utilizing two-tube circuit, it sells for $34.95 in finished form. H & M are putting in stock of all sorts of R/C parts and equipment, to be of greater service to radio control experimenters.

Two gas tube receivers are available from Raytrol (51 Hamilton Pl., New York 31, N. Y.). Single tube style is Model 100 and sells for $9.95; Model 200 is a two-tuber selling for $15.95. Both receivers are protected by high-impact plastic cases and feature a special inductance that allows very high sensitivity. Antennas may be as short as 6".

Several new items from Citizen-Ship Radio Corp. (Indianapolis, Ind.) include a kit with printed-circuit base plate for a single hard tube receiver; uses Sigma 4F relay, has slug-tuned coils for tuning and sensitivity. This is the PR receiver kit. A new escapement that has a "governor" wheel and gives right or left turns without any sequence is the SE model; very light and compact. Another new one is a lower cost 465 mc. transmitter—Model CC1. Looks about same as the former 465 transmitter, but sells for $34.95, with tube and antenna; hand held, of course.

Two-Channel "TR"

(*Continued from page* 53)

Needless to say, the smallest possible commercial parts must be used. Some hints on suitable parts are given at the end of this article for your convenience. All the diodes are of the same type, and those of recent production are much smaller than earlier ones, measuring about ⅛" x ⅜" in size. The diodes must be polarized exactly as shown; the straight line on each diode represents the cathode, which is marked by a line on the actual units. When soldering these parts in place use no more heat than necessary, and hold the diode leads with a pair of long-nosed pliers, to keep the heat from damaging the elements.

Though they are not shown, spark suppressors should be installed on the relay contacts that are in use.

A vital part of the circuit is the "clipper," those two diodes D1 and the resistor R1 connected across the output side of the AF transformer. Some experiment with the resistor value may be needed; if you get considerable reading (say, over a half ma. or more) on one output channel, when the other tone is being sent, this resistor should be reduced. The clipper acts to hold all signals going into the relay tubes to a fairly constant level, regardless of signal strength. If you have a VT voltmeter, it should show a reading of about 1.5 V AC across the output winding of AFT. If it is much lower than this, the simultaneous operation of both channels will suffer, while if much over 1.75 V., the current reading on one channel (when you are keying for the other one) will be too high.

When you first connect up the receiver, it is a great help to have two meters (0-5 ma. is just right), one for each channel. Since there are 100 ohm resistors across the meters—to make possible use of single circuit meter packs—the meters will read a little low, so take this into consideration when setting your relays. On a good hot 45 V. battery, the receiver shown gives about 4 ma. on the high channel, and 3-plus on the low; fairly close to the transmitter, the simultaneous meter readings will be about the same or a bit lower. If the clipper is set for good simultaneous operation at good distances, the receiver tends to overload (the unwanted channel current goes over 1 ma.) with the transmitter very close by.

Now about this simultaneous operation; first off, if you want to work two escapements, as did Howard Bonner, you'll have to use a DPDT switch for each tone, as shown in Fig. 3. Trace this out and you'll see that a push on either button will send the tone marked, while if you are holding either button down and push the other, the third tone (the middle one) is always transmitted. This is handy for stunting, when you might want to hold rudder operation, while applying some elevator, and makes possible some breathtaking maneuvers. To work this successfully, the switches must shift very rapidly, so the tones won't be momentarily cut off, while you are switching from high or low to medium. Bonner and Everett worked out an arrangement of four SPDT micro-switches, connected as shown and worked two at a time, that has proven very satisfactory.

As noted earlier, simultaneous operation was found to be much more satisfactory, with the middle tone of the Babcock transmitter raised about 300 cycles (original Babcock middle tone shown dotted on Fig. 1). The easiest way we could find to do this was to shunt a small choke across the tuned circuit in the transmitter that provides the middle frequency; unfortunately, just any choke will not do the job. One we found to work well is listed at the end of this article; it has to be modified a bit, as shown in Fib. 5. Modified as shown, it was taped to the bias battery in the transmitter to hold it up against the under side of the chassis. The two leads go to the contact on the control stick which is closed when the lever points to "UP," and to the lug to which the blue wire from the choke case is connected.

If you want to try the receiver with the Babcock transmitter tones as they come, we suggest the following circuit changes; C15 to .002 mf.; C13 to .06 mf.; R2 to 2 meg. If you will be happy with straight two-tone operation without the simultaneous feature, raise C13 to .06 mf. cut R1 to 100 ohms.

Parts Suggestions: All capacitors less than 100 mf., CRL type D6, except C2, which should be CRL type TCZ. Capacitors from 199 mmf. to .01 mf., CRL type DM. Over .01 mf., Aerovox type P83Z. 5 mf. 50 V. electrolytic cond. C9, Barco. All resistors ½ W. or smaller. RFC, National R33, 10 microhenry. AFT, UTC type SSO-3. Tube sockets, Cinch 5WC. Relays, Neomatic. All diodes, Raytheon CK 705. All tubes, Raytheon sub-miniatures; three CK506 (or 5672), two CK-536 (or 533); 506's & 536 available from ESSCO. 9 V. bias battery cut down from Eveready type 404E. Choke for raising Babcock transmitter center frequency, Gyro No. RC., see Fig. 5. Coil form, CHC LS6 with Red core, see Fig. 4. Contact ATH advertisers for these parts.

"Roll-o"
R/C Plane Model
by Vince Bonema
NEXT ISSUE