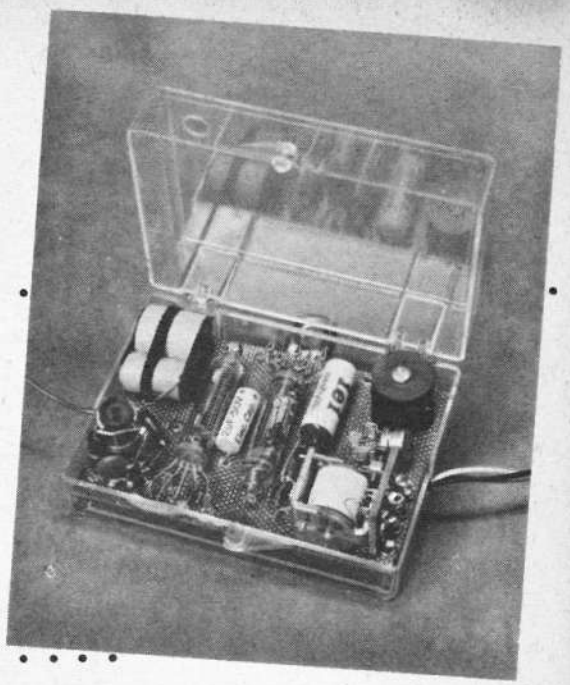
Here's the radio control receiver that will make the R/C gang fire up those soldering irons!



Howard McEntee's newest...

Tech-Two 27

■ In the two years since the Tech Two receiver was presented to R/Cers (1957 A.T. Model Annual) it has been used in many different versions, both home made and commercial. Quite a few modifications were shown in a later article (A.M. January '58). Now is the time to bring the set up to date with still further improvements. The original Tech Two was for use on 50-mc and gained its name from the fact that 50 had at that time just been made available to ham Technician licensees—and many were R/C modelers. Many more of these receivers have been used on 27¼ mc, of course, and our 1959 Model is intended for that frequency.

Best of all, it will also cover the five other R/C spot frequencies announced last Fall by the F.C.C. Like most other super-regen receivers it tunes too broadly to be used simultaneously with another receiver and transmitter, even though one outfit is on 27.255 and the other as far away as we are allowed—26.995 mc. We feel, though, that a lot of modelers will still want a receiver of more or less the type they are accustomed to; after the first flurry of excitement over the new R/C rules it has turned out that home builders and commercial R/C manufacturers intend to go right on making and operating super-regen receivers as they have for many years. Sharper-tuning receivers will come before too long; meanwhile let's take a look at an up-to-date receiver you can make right now.

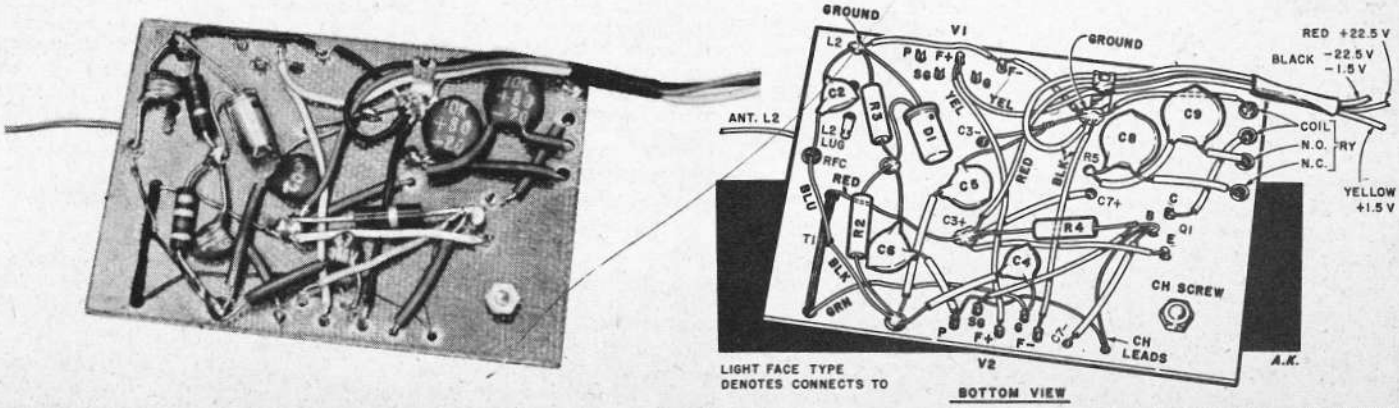
Those who have been in R/C for awhile will note that the circuit shown here is very similar to that for the original Tech Two—as far as the plate circuit of V2. Something new has been added in the form of a transistor relay circuit, plus a few changes in other places to allow more leeway for parts that are a bit "off" in tolerance. Without going too deeply into technical details, here are the advantages of the new outfit over the original: 1) Very wide range of relay current change, about .2 ma to 4½ ma; 2) Wider allowance for parts, tubes and transistor variation, while still obtaining reliable operation; 3) New job operates on 22½ B supply volts, and its total idling current is much lower than the original—about .3 to .4 ma; 4) New set pulses much faster, an advantage for both proportional operation and escapement uses which require fast action (quick blip motor control, etc.); 5) Filament battery drain reduced considerably—it is now only 24 ma. A very big advantage enjoyed by present builders is that the special interstage transformer T1 may be had from R/C suppliers ready to use; in fact a kit of the exact parts used in the receiver shown here is available.

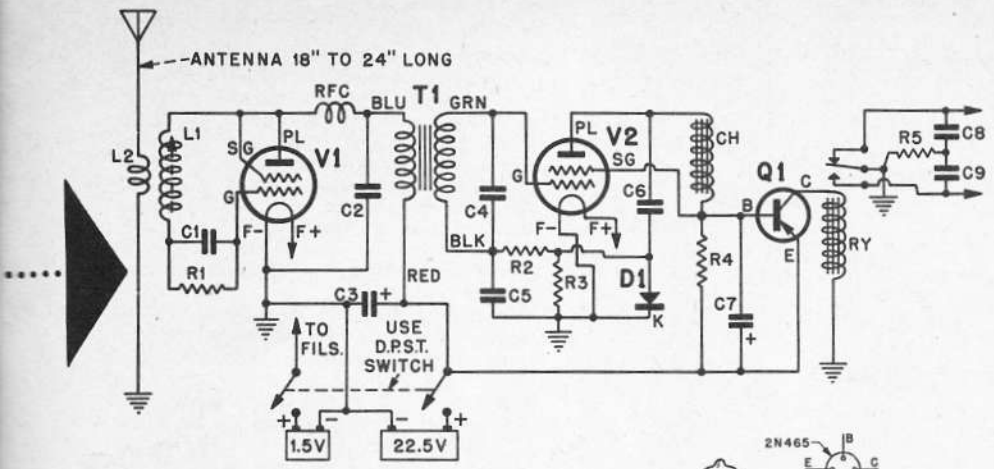
No effort has been made to skimp on parts cost; in fact a few extra-cost frills have been added with the feeling they will produce a better receiver and one that is more easily adjusted and serviced. For example, the base board is epoxi fiberglass, and a relay with screw adjustments for the contacts is specified. In the hope that this receiver will be tackled by builders who are not exactly electronics experts, it has been made considerably larger than would have been possible using the very smallest sub-miniature parts now to be had; we feel this large size will prevent some hair-tearing!

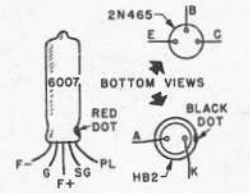
The transistor is a recent type which is ideal for this receiver; cheaper units will work, but give considerably higher idling current. They may also require parts value changes, especially resistor R4.

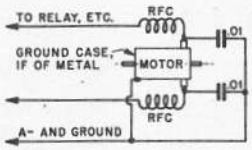
While we're on the subject of parts substitutions, let's get in a very serious warning: The receiver shown is the result of a tremendous amount of experimental work to find an ideal combination of parts and an ideal parts layout. *We strongly advise against any changes whatever.* Experienced radio men might be tempted to use parts they have on hand, and if the set doesn't work right they can probably find out why. Even for them we suggest making a set *as specified* first; if they want to try substitutions later they are strictly on their own.

Let's not kid ourselves that parts can be changed at will; take one simple item such as the RFC. This is a *very critical component* in most R/C receivers and no other one than that specified should be used. In the case of resistors and condensers you can, of course, substitute units of various manufacturers, provided they are exact duplicates in value, voltage rating, tolerance, etc. But *don't* make any substitutions for L1, RFC, T1,









CH, D1 or Q1; try to use close tolerance parts for C1, R1, C4, and R4 as noted in the parts list. Most resistors are marked for tolerance but many condensers are not; some of the small disc ceramics so widely used in R/C can be as much as 100% different than they are marked. They can ruin the operation of any receiver if used in a "sensitive" location.

Okay, now that we have the admonitions out of the way, let's get busy. We specified an epoxy fiberglass base board because this material is almost immune to breakage; 1/16" thick phenolic will do of course, but be sure it is the linen base kind. A full sized layout of all holes is given; you can lay your base plate under this and center punch right through it. Lots easier than transfering all the measurements. After holes are drilled you can wind L1 and L2. Be sure to follow Dwg 2 showing coil details faithfully, including direction of windings and spacing of spring clips. Don't put dope on the windings of L1; you can apply a drop of model cement over the ends of L2, to hold it in place. The core of L1 should be cut shorter so that the outfit can be fitted into the specified case.

Specs are not included for T1 since it may be had ready made. If you prefer to make your own, follow directions in the 1957 ATMA story. A standard Gem relay coil is used for CH but you will have to add the core yourself (though the kit supplier may have this unit in finished form too); core material is the same as specified for the original T1. It is possible that ordinary transformer iron would do here, but the iron we used is called Mu-Metal and we would advise no substitution. Simply cut eight straight pieces ⅛" wide from the small E core sections furnished, bend them to U-shape so they may be slipped into the coil form. Point the inner ends so they will go in easier. A tight wrapping of insulating tape completes CH, which is mounted with a 2-56 screw and nut.

There are eight eyelets on the base and one large solder lug. The latter serves as a common ground point and a wire through it holds the relay frame down. To fit into the plastic case the relay has to be mounted on its side; four wires run through eyelets to lugs on the insulation plate, to hold it firm.

The tubes and transistor are held in flea clips, which snap into #52 drill holes in the base. When soldering wires to the underside of these clips use the greatest care to prevent solder from flowing right through the mounting hole and filling up the other end; it's best to support the base plate vertically when soldering to the flea clips, to prevent this.

T1 is held in place by a wrapping of heavy thread through the two holes as indicated. To make sure it can't slip, you can coat the underside with "Goo" (a cement sold in hobby shops) and a drop of the same material can be put under each tube and also the transistor, when the set has been fully tested and is ready for use. Thread the four leads of T1 through the holes indicated. They will have to be scraped with a razor blade to remove the insulation, but the tiny leads from CH do not require scraping; just hold them against the soldering iron and rub with solder and the insulation will vanish.

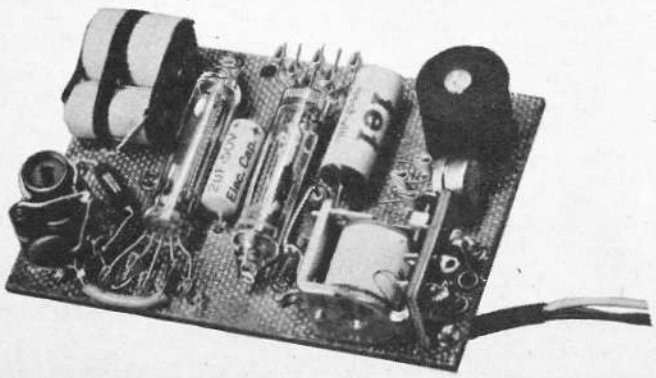
Connections to the plate, screen grid and grid flea clips of V1 are made on top of the base. The wire from RFC can be run to plate and SG clips as well as to the coil end. R1 and C1 are placed vertically alongside L1 and their lower ends joined and run to the grid flea clip, with a piece of insulation to keep this wire from shorting on the two filament clips. Most of the other wiring is entirely straightforward, but the sketch indicates where many of the parts connect, or the holes in the plate to run their leads through. When wiring is complete, put a dot of red dope adjacent to the plate flea clips of V1 and V2, and the collector clip of Q1; also put a dot on the transistor which doesn't have any as it comes.

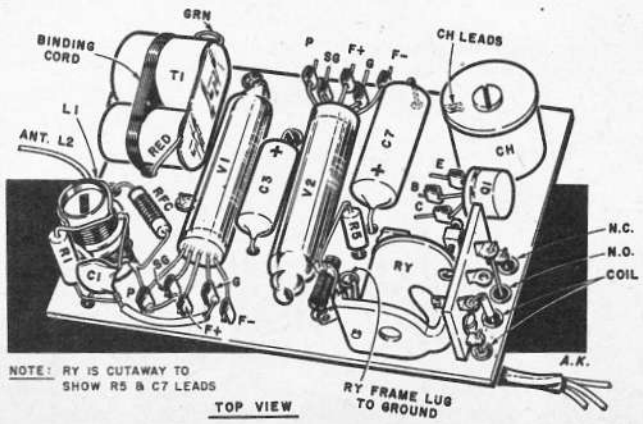
After a most careful check of the wiring (and preferably also a recheck by a friend who might find a mistake that you missed) you are ready for action. Bend the leads of the 6007's and cut them to length, then insert just V1. A meter in the B plus lead should indicate about .17 ma, which should drop to about .15 if a nearby transmitter (with little or no antenna) or a grid dipper is keyed. At this step you should also tune L1 to the proper frequency. Now install V2 and again check total B current; this tube idles (with no signal) at about .13 to .15 ma, and will show a current rise to about .28 ma with signal. You will be reading the total current of both tubes at this point, of course, so your reading will be perhaps .3 to .45 ma or so.

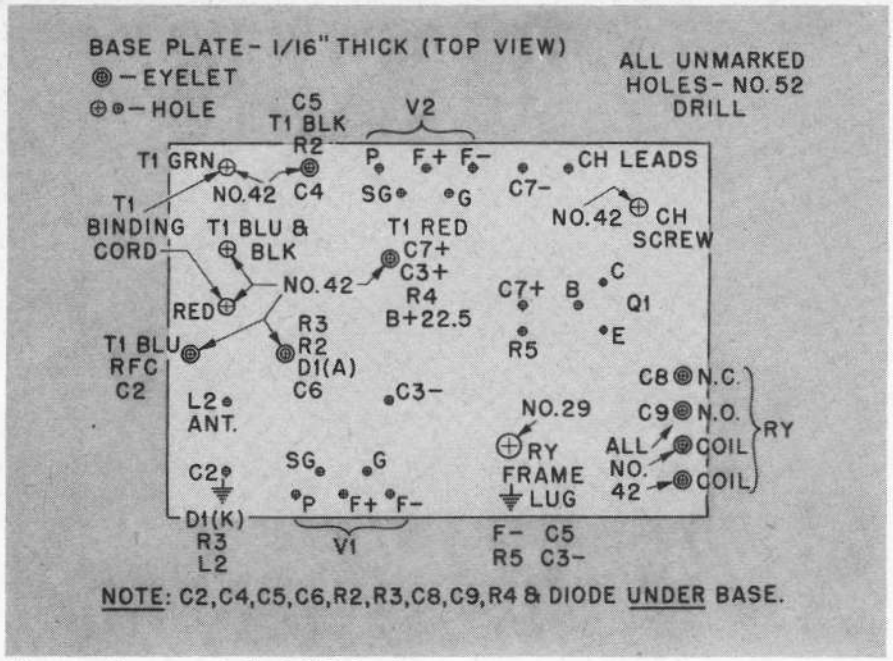
All being well you can now insert Q1 (and make sure it is put in the socket the right way or it will be ruined). Q1 adds from .1 to .2 ma idling current to the total, and with a signal you should read 5 to 5½ ma with a 5K relay, and about 1 ma less with one of 7500 ohms.

Suppose your current readings are radically different from those listed above? It could indicate a defective tube or transistor, of course. But most likely you have an incorrect connection somewhere. When you are checking V1 alone, you can try both tubes and use the one which indicates closest to .17 ma with no signal. Other trouble-shooting suggestions are given below:

1. With V1 only in the set, a very high current reading (.5 ma or more) indicates the tube is not oscillating. Check for shorted turns on L1, incorrect parts at C1, R1 or C2, poor solder joints in the circuits around V1. It is highly unlikely you'll get a reading lower than





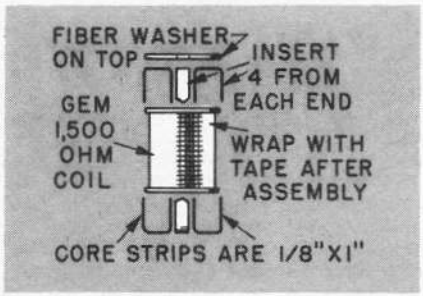


.15 ma unless a part is definitely defective.

2. The current for V1 alone is about as specified but you can't get it to drop slightly when you key the transmitter. Wrong number of turns on L1; wrong type of core (this won't happen if you use the coil form specified); your transmitter isn't "putting out". Many builders will have only a 5 ma meter and the current change of V1 with signal will be rather hard to spot; try putting V2 into its clips, when the added current change should be readily visible.

3. If you don't get about the specified currents with V2 in the set, you probably won't with Q1 in place either. If current is quite high—half ma or more—with V2 in place and no signal, check for wrong parts at C4, C6, R2, R3; also make sure the black dot on D1 goes to B minus and ground.

4. With Q1 in place, but idling current of the whole set is higher than about .6 ma, it is probable that R4 is of too high value. It could also be a sign of a poor transistor. Conversely, if total on-signal drain of the whole set is less than about 5 ma (5K relay), and you are sure your B battery gives an honest 22½ volts, R4 could be of too low value. The value specified for R4 is such that there can be quite a bit of off-tolerance in circuit parts and still you will get the right relay current.



The above takes in the most probable causes of trouble. There is always the "cold-soldered" joint, of course, but we feel most R/Cers should be aware of this problem and know what to look for. While soldering to the flea clips, be sure you do not have tubes or transistor in place; soldering heat could ruin them—and besides, solder could run the length of the clip and fasten them firmly in place! When soldering D1 into the set (make all other connections to the points where D1 connects, and solder it in *last*) hold the diode lead with a pair of long nose pliers, or snap on a spring clip, between the diode and where you are applying the heat; continue to hold the pliers on the wire until you can touch same with your finger. It's smart to wrap a bit of tape around D1 to make sure its metal case won't short on some bare wire.

As with other types of "noise-operated" receivers, this one can be bothered by electrical disturbances in your model. Long torque or push rods from an escapement or other control surface mover can cause such disturbances, especially when vibrated by the engine. Such long rods should be fitted with bonding wires fastened to B minus. Or you can break the long metallic run; for example, put a short section of wood in the rod just to the rear of the servo unit.

If you use a control system which requires connections to both relay contacts, *be sure* you have condenser C8 connected as shown. C8 and C9 act as arc suppressors and should always be used anyway (you won't need C8 at all, if this contact is not in use, of course) but C8 also suppresses a slight disturbance at this contact, which can bother the receiver, even if you have other arc suppression means elsewhere in the model—as for example diodes across the two windings of a proportional actuator.

Electric motors cause quite an "electrical fuss"—they generate very broad radio disturbances due to brush sparking. One sketch shows how to cope with this. In most cases only the two condensers need be used, and they should be connected as close to the brushes as you can get them and with the shortest possible leads. Try just a single condenser from brush to brush first; if this doesn't work, try the two, with common connection going to B minus. If the motor has a metal shell, try grounding this too. In bad cases, you might require RF chokes in the motor leads; these should be from 20 to 25 microhenries, and only experiment will show which ones are most effective. In any case, it is always smart to mount *any* R/C receiver as far as possible from an electric motor in a model, and to keep the antenna lead as far as possible from the motor and the leads to it.

The relay setting is not at all critical of course, since such a very wide swing in current is available; we suggest setting the 5K relay to operate at around 2 ma and open at perhaps 1¼; the 7500 ohm job could be set to 1 and 1¾. This'll allow safe operation even if the B battery drops radically. We found the receiver was entirely reliable at as low as 16 volts, but the maximum 5K relay current at this voltage would be just a bit over 3 ma. The set will also work with filament voltage as low as 1.1 volts; furthermore it still works with 16 volts B and 1.1 on the filaments. But it is not smart to let your batteries drop this low, as it means they are just about shot. Better replace them at perhaps 19 volts and 1.3 volts.

Well, there is the 1959 model of the Tech Two—it doesn't have tail fins or wraparound glass, but we feel it has features you will like. Give it a try!

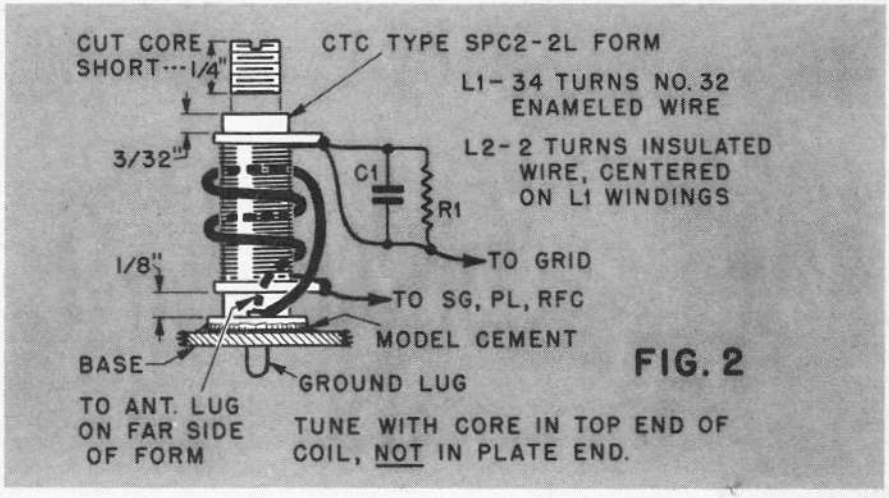


FIG. 2

PARTS LIST: L1, L2, wound on CTC type SPC2-2L form; T1, Ace Tech Two transformer; CH, Gem 1500 ohm relay coil with Mu Metal core; RY, Gem 5000 or 7500 ohm Micro relay; V1, V2, Amperex 6007 tubes; Q1, Raytheon 2N465; RFC, Ace type RCA10 microhenry; D1, Hoffman HB2 (Ace). C1, 50 mmf; C4, 75 mmf; both 10% mica Duramite. C2 and C6, .001 mf; C5, .002 mf; C8 and C9, .01 mf; all Goodall ceramic. C3, 2 mf 50 volt; C7, 5 mf 50 volt; both IEI. R1, 1 meg, 5%; R2, .5 meg; R3, 1 meg; R4, 910 ohms 5%; R5, 10 ohms; all can be ½W carbon or smaller. Epoxi fiberglass base plate, 2 x 2⅞ x 1/16" thick. 13 flea clips. 8 brass eyelets 3/32" dia. and length plus one eyelet lug. Plastic case 2 x 2⅞ x 1" high, Ace PB#2. ¾" long 2-56 screw and nut for mounting CH. Hookup wire for connections, L2, and battery leads.