GRID LEAKS

R/C DATA SERVICE

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JULY-AUGUST

25C

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Francis Bradbury of Higginsville operates the radio controlled Greyhound bus.

All of us, here at Grid Leaks, have been having a ball with L. R. Purdy's little Greyhound MarX bus.

L. R. kindly loaned this to us. L. R., as you may know, is the presiding light of Cobb Hobby Manufacturing Company and, quite naturally, used Cobb products in it.

The bus, as it is, is 14½ inches long and comes equipped with a drive motor with built-in reduction for additional power. It also has a steerable front end which means very few adjustments will have to be made. This was purchased at a drug store for around $3.95. A look at the dime stores, drug stores, and super markets etc. in your areas will probably reveal one of these. It is a Greyhound bus manufactured by MarX Toy Company.

In practice, L. R. has used a 3P and an Electro Compound to provide directional control to give right, left, forward, stop, and reverse. The wiring diagram is shown for the Electro Compounds. The only switch L. R. has made on the unit is a copper board which provides the reversing switch for the motor and, incidentally, this was done on a piece of copper laminate by sharpening music wire and scratching out the design for the particular reversing switch that was designed around the 3P as shown in detail and in full size.

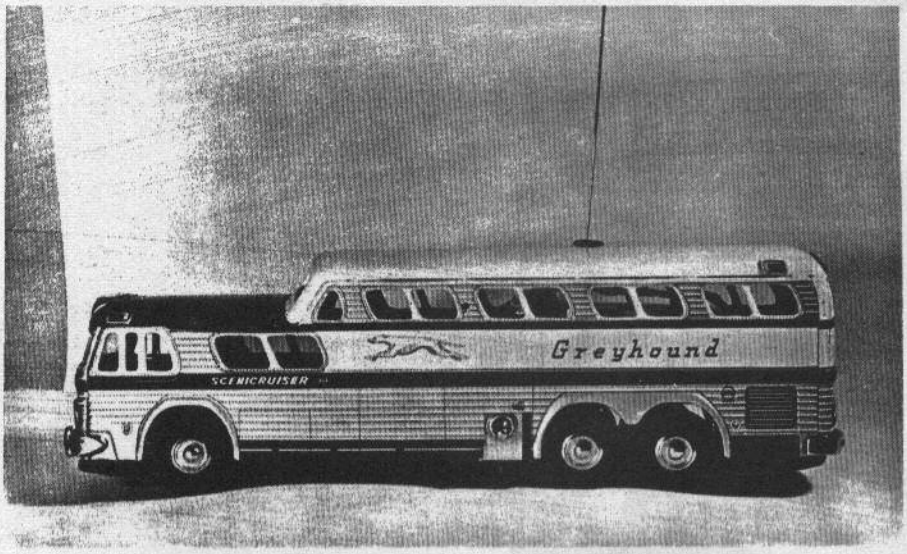
One control position on the 3P gives no connection, second control position gives minus polarity, third control position gives plus polarity. The motor is driven (and this is quite ample speed) with two V0.500's, center tapped as shown in the schematic. Power for the actuator and the receiver, which was a TR 4.5 in this instance, is taken from a Hillcrest Type A battery box.

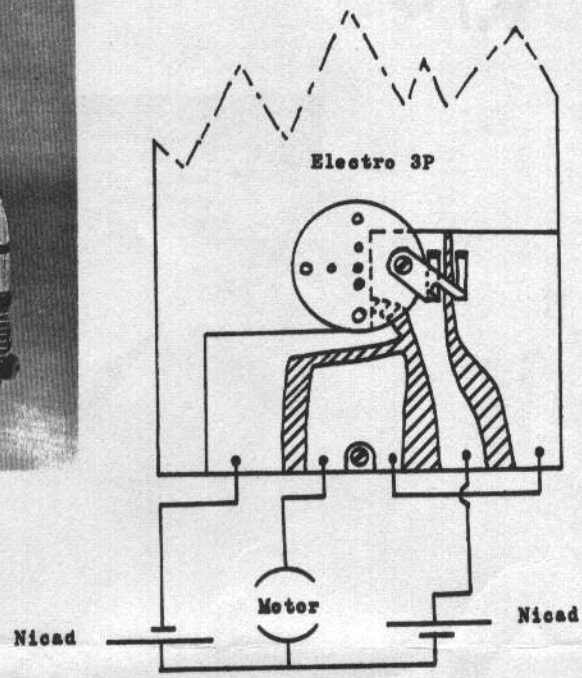
In operation, the unit is sleek in performance and a joy to handle. We believe that you'd have a barrel of fun with a unit similar to this.

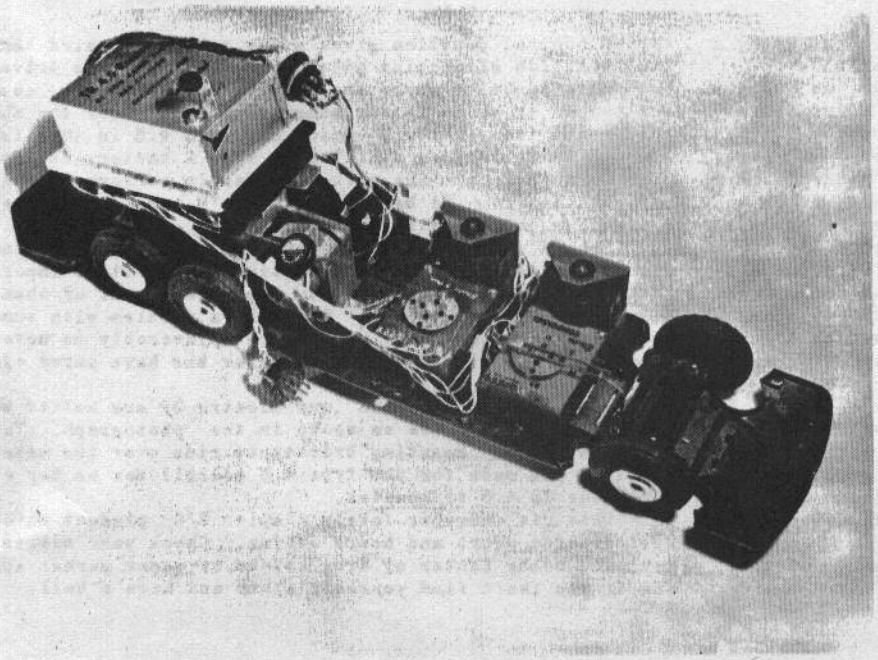
The TR 4.5 receiver is hooked up as per the diagram with the receiver and it is mentioned that it is important to add an .01 condenser to the motors, all of them, to remove sparking noise. This is a problem with some receivers and some TR's react more unfavorably to noise than others. .01s in this particular bus have cured all the problems.

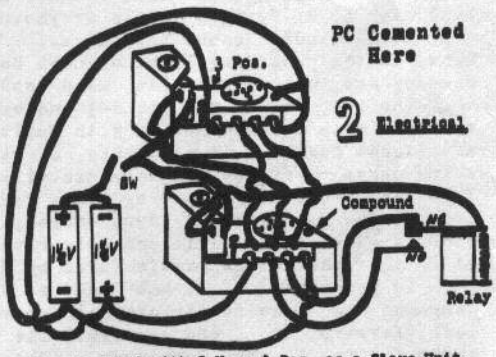
The Electro Compounds and Electro 3P are bolted to the bottom of the case as shown in the photograph. The separate battery mounting bracket to ride over the motor housing was made for the Type A 6 pencell box on top of which the TR 4.5 is mounted.

This is another fairly simple R/C product which will provide hours and hours of fun. Check your nearest toy and hobby center or drug store or super market and see if you can't find yourself a bus and have a ball.









For Compound with S-N or 3 Pos. as a Slave Unit.

MarcyTone Twin Simul Pulsers

In the previous issue, Volume I, Number 10, of Grid Leaks, we presented the MarcyTone Twin Simul receiver as merely a two-channel receiver. The beauty of the MarcyTone is that either one channel or both channels may be pulsed simultaneously. Here is Marcy's Twin Simul Pulser. No detail in wiring instructions will be given because this is designed for the more experienced builder and we feel, with the photographs and connection chart presented, the advanced R/C'er can complete it.

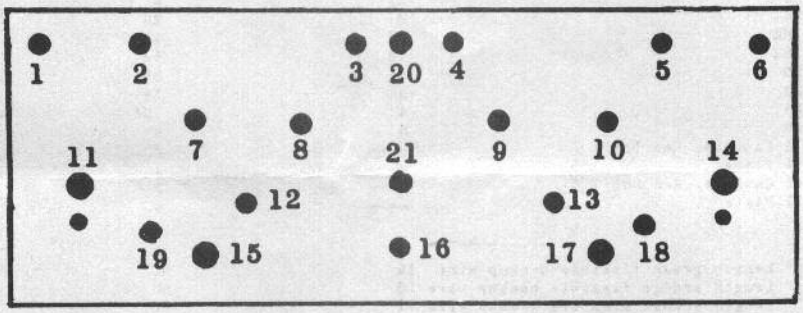
It is perfectly feasible to pulse one channel and leave the other as a straight command channel for motor control such as in Galloping Ghost systems. It should also be at least theoretically possible to fly two different planes at the same time with one Marcy transmitter using two receivers set on two different frequencies.

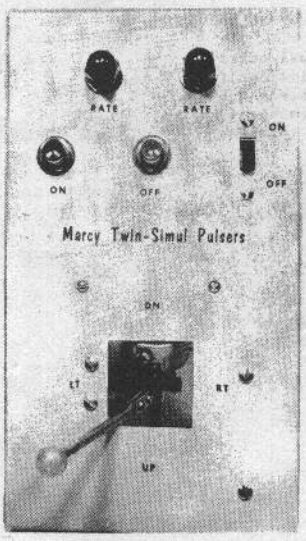
The pulser itself is of unique origin. The transistors are matched for best operation and, as you see from the schematic, it is quite a simple multi-vibrator circuit using only one 30 volt B. Relays will require no adjustment since there is more than ample current change through the Gems to operate. The pulsers will pulse quite fast and the MarcyTone receiver accepts the fast pulsing.

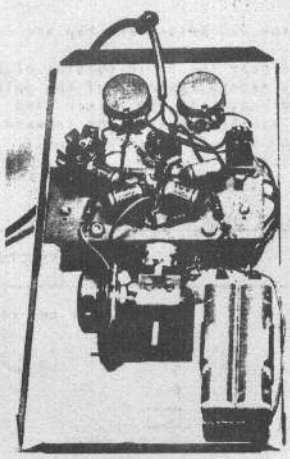
It should be pointed out that the .25 capacitors, as well as the 22K resistors, should be closely matched as in any multi-vibrator circuit.

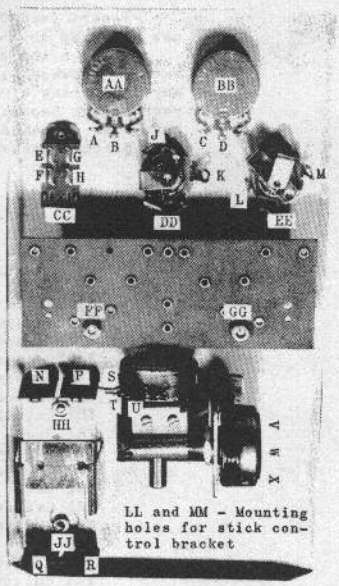
Marcy has his particular Mighty Midget on the rudder hooked up as the servo switcher as well. Full on provides a complete 180° cycle rotation with only a momentary blip of the rudder to drive the Bonner Servo in one direction through a set of batteries hooked up for that polarity. With full off signal, again the rudder flips 180° in the other direction and provides the reverse direction on the Bonner Servo to provide trimmable motor control. The plane itself does not suffer from the cycling of the rudder since it simply doesn't care if the rudder is going through 180° angle. The way his servo switcher is rigged is that the top of the arc is where the rudder linkage is hooked and at the bottom are switches which simply close battery connections to the Bonner Servo to give them trimmable position.

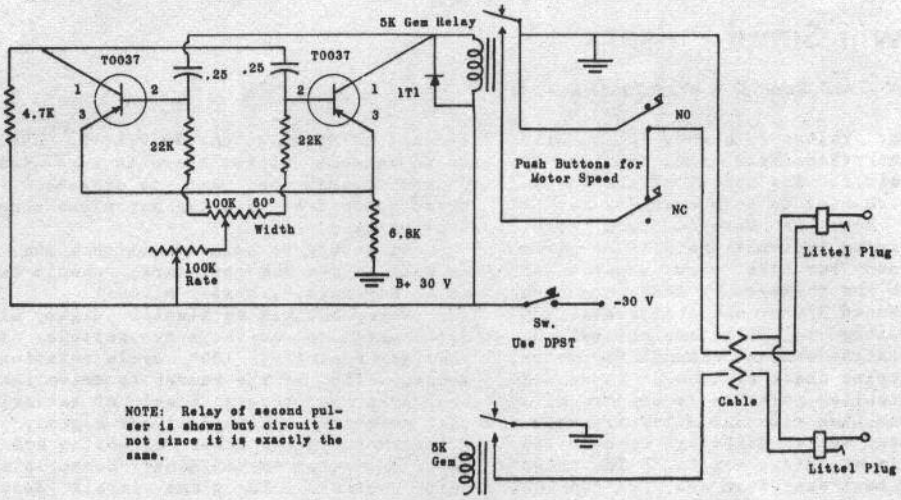
The .25's used may be either metal, paper, or electrolytic. They should, however, be matched.











NOTE: Relay of second pulser is shown but circuit is not since it is exactly the same.

CONNECTION CHART

COMPONENT	FROM	TO
4.7K	4	6
4.7K	3	1
22K	7	19
22K	10	18
22K	21	9
22K	8	20
6.8K	16	13
6.8K	16	12
.25	2	8*
.25	3	7*
.25	4	10*
.25	5	9*
1T1 Cathode, Red Dot	----	2
1T1 Plate	----	1
1T1 Cathode, Red Dot	----	5
1T1 Plate	----	6
1½" Length green flexible hookup wire	19	NC
2½" Length orange flexible hookup wire	18	NC
3" Length orange flexible hookup wire	21	NC
3" Length green flexible hookup wire	20	NC
6" Length red flexible hookup wire	16	NC

Insert two 30 volt batteries in the #20 holder and replace covers. Your pulser should now be ready to go.

Turn on the switch and you should hear the rapid pulsing of both relays. Adjust pulse rate to between 10 and 12 cycles per second on each of the pulsers so that very little if any fluttering of the surfaces will be had. If the pulser does not operate, double check your wiring because it is quite a simple and straight forward circuit and all components have been selected and matched for use in this particular unit. The pulsers plug into the open circuit jacks on the tone generators.

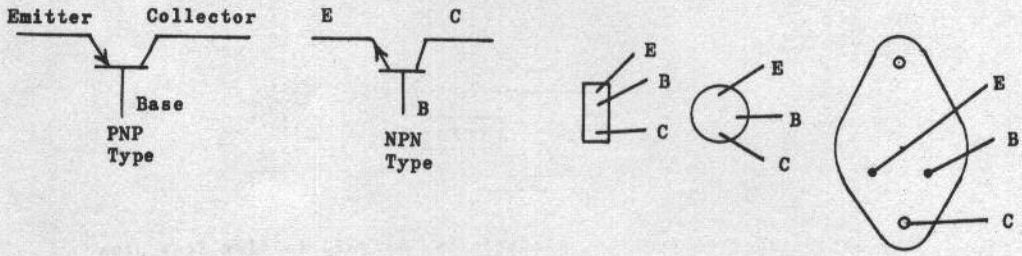
RELAY SIDE CONNECTION CHART

COMPONENT	CONNECTS FROM	TO
3½" Black flexible hookup wire	Connect the two relay armatures together	
3/8" Jumper wire	1	Closest relay lug
3/8" Jumper wire	2	Closest relay lug
3/8" Jumper wire	5	Closest relay lug
3/8" Jumper wire	6	Closest relay lug
TR1 Collector	----	2
TR1 Emitter	----	12
TR1 Base	----	7
TR2 Collector	----	3
TR2 Emitter	----	12
TR2 Base	----	8
TR3 Collector	----	4
TR3 Emitter	----	13
TR3 Base	----	9
TR4 Collector	----	5
TR4 Emitter	----	13
TR4 Base	----	10

Testing Transistors With an Ohmmeter

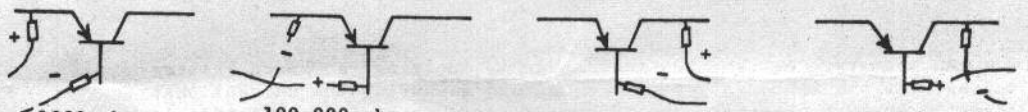
FOR BEGINNER AND EXPERT

In the hustle and bustle of all the activities here at Grid Leaks, unfortunately, we have lost the author's name on this article. We know the idea originated in the Baltimore area and is being used by the Baltimore club quite a bit. The principle is sound and, if the author will step forward and identify himself, we will give him proper credit in a future issue of Grid Leaks. Meantime, we consider this top reading for the beginner, advanced, and pro.



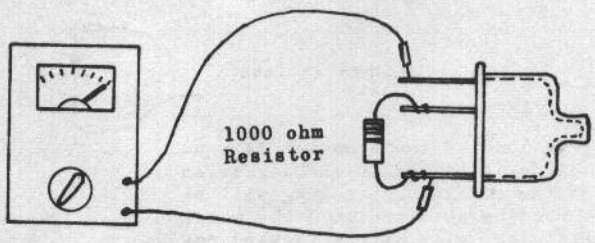
Base Connections For Both Types - Bottom Views

A transistor is really two diodes back-to-back. It owes its amplifying properties to the fact that the center section (base) is a single crystal of material. The arrow on the transistor symbol indicates the direction of "easy" current flow between emitter and base.



Since a transistor consists of two diodes back-to-back, the resistance between collector and emitter should be many thousands of ohms regardless of which way the meter leads are applied. This follows from the fact that in this connection, one of the diodes will be biased in the reverse direction.

The example shows test results you can expect from a good PNP transistor. For NPN units, the polarities are reversed.



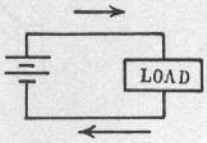
To determine the current gain (BETA) of a PNP transistor, set the ohmmeter to the "low ohms" scale. Attach the positive lead to the emitter and the negative lead to the collector. Touch the leads of a 1000 ohm resistor to the base and collector and read the ohms indicated on the scale. Divide 1200 by this number to determine BETA.

For NPN transistors, reverse the meter leads and follow the same procedure.

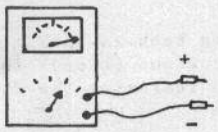
Testing Diodes With an Ohmmeter

FOR BEGINNER AND EXPERT

In the hustle and bustle of all the activities here at Grid Leaks, unfortunately, we have lost the author's name on this article. We know the idea originated in the Baltimore area and is being used by the Baltimore club quite a bit. The principle is sound and, if the author will step forward and identify himself, we will give him proper credit in a future issue of Grid Leaks. Meantime, we consider this top reading for the beginner, advanced, and pro.

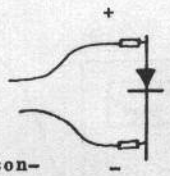


By established convention, electricity is said to flow from plus to minus.

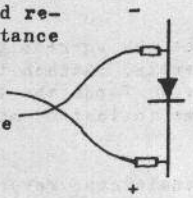


An ohmmeter determines resistance by applying a known battery voltage to the component to be tested and measuring the current that flows. On most ohmmeters the "common" lead is positive but this is not always true, so be sure to determine the polarity of your own particular instrument.

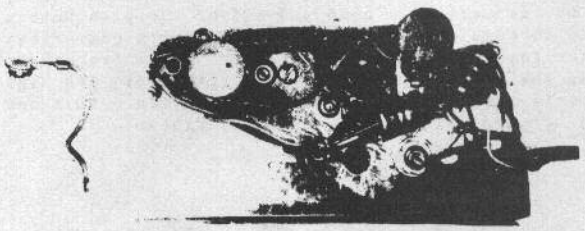
The arrow on the diode symbol indicates the direction of "easy" current flow.

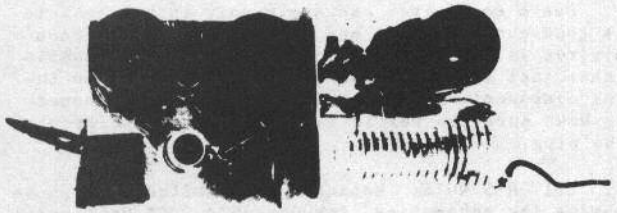


Thus, when the positive lead of the ohmmeter is connected to the anode, the diode is biased in the direction of "easy" current flow and the resistance reading will be many times lower than the reading obtained when the meter leads are reversed. Most diodes will have a forward resistance of less than 1000 ohms and a reverse resistance of more than 100,000 ohms.



GROGAN PULSER





By virtue of the fact that the heavy response from the last issue of Grid Leaks, Volume I, Number 10 on advanced vs. the beginner theory has proven in favor of the advanced articles, we are presenting, in full, the pulser section developed by William Grogan which may be used in either single proportional or dual proportional and does away with the problems of relays. We make no apologies for presenting this in its entirety since we feel that we are rendering a service to the builder by a study of this system and even to the beginner on his simpler system. The unit is designed to plug into the TTPW (two-tone pulse width) WAG dual transmitter, but may be used for single channel equipment, can be adapted to pulse carrier, or pulse single audio, or pulse TTPW.

In addition to the obvious advantages of this transmitter system of not using relays for keying there are other advantages.

1. It will work as a straight carrier transmitter for escapement use and can be adapted to pulsed carrier by use of the WAG pulser kit.
2. It can be used for escapement or proportional control of tone receivers by use of the single proportional transistor kit.
3. It can be used for TTPW dual proportional use by plugging in the dual proportional control box kit.
4. Because the current requirements of both A and B supply has been reduced to one-half of the regular TTPW transmitter, a practical hand-held TTPW transmitter can be made.
5. As a result of the neon pulsers not being susceptible to interaction and sharp voltage spikes, the transmitter can be converted to use a vibrator power supply and wet cell and the only dry battery will be the 9 volt supply which will normally last all season because the current drain is about 5 ma.
6. But the most important advantage is that a person starting in R/C can have a transmitter to fit his needs when using escapement and as he progresses in R/C to single proportional, then to dual proportional, he can simply adapt his transmitter to fit the new requirements by plugging in the proper control box and thereby saving himself money that would have been lost in other transmitters.

Install the modulator tube and components and make the two required cables as indicated on the schematic diagram. If this is a modification of a completed TTPW transmitter, then remove the old pulser and modulator deck and adjust the battery required to fit the new transmitter.

SINGLE PROPORTIONAL

This pulser consists of a tone oscillator using neon bulbs 13 and 14 to produce a tone of about 400 cycles and a pulser oscillator using neon bulbs 1 and 2 that keys the tone oscillator and then the signal is amplified by a transistor (16). The speed of pulsing is varied by adjusting the potentiometer #7. The control potentiometer (4) can be moved for full on tone on one side and full carrier on the other side. If it is placed in the full tone on side, the push button can be used for keying the tone and therefore can be used for escapement type control with a tone receiver. Some like to have a push button for full on tone and one for full carrier and this can be done by placing break type push buttons at point "A" and point "B" and connecting a wire from "G" to "H".

This type of pulser does not use a relay for keying and therefore eliminates one source of trouble.

Mount the component board on the back of a small metal box and the control potentiometer and pulser speed potentiometer on the other side. The push buttons are mounted at one end and the connector plug is mounted at the other. The component board is cleaned with a fine abrasive, such as a typewriter eraser or household cleanser and the components are installed and soldered as indicated by the layout diagram. Install the diode and transistor last and apply a heat sink of wet cotton to them when soldering to prevent damage by excessive heat. Now finish installing and connecting wires, making sure the metal box is connected to point "X" or pin #8 on plug. Then plug into transmitter cable and test.

FOR TTPW

The dual proportional control system developed by Dr. Walter A. Good requires a somewhat complex type of signal to be generated and sent to the receiver in order to provide independent simultaneous proportional control of two functions. This complex signal is somewhat limited by the capabilities of the generating devices. Since Dr. Good presented this system, a search has been made to devise circuitry which would extend this system. The first and major problem is to eliminate the relays used in the pulsers and thereby prevent malfunction as a result of mechanical contact. Second, to provide pulsers which allow full stopped control in the extreme positions. Third, to reduce the power requirements so that a practical hand held transmitter can be achieved, with dry batteries or with vibrator supply.

The tone generator, pulser and modulator consists of six functions: 1. Tone oscillator using two transistors in a multivibrator type circuit capable of a 20/80 pulse at 100 cycles and 500 cycles. 2. A transistor stage used as a switch to change the tone frequency. 3. A pulser consisting of 2 neon bulbs to control the tone frequency transistor switch. 4. A transistor gate consisting of two transistors to enable the selection of a 80/20 or a 20/80 signal. 5. A pulser consisting of two neon bulbs to determine the selection of the transistor gate. 6. A modulator tube to amplify and apply the generated tone to the RF carrier.

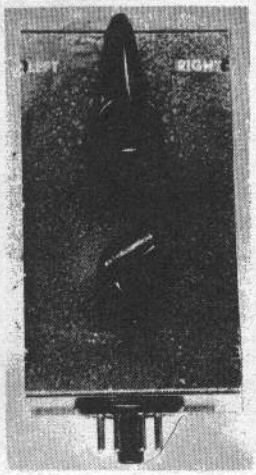
A metal box that is 3 x 4 x 5 is used for the controls and to house the pulser circuitry. A plug is mounted on one end for connection to the transmitter cable. The component boards are mounted on the sides of the box making sure that they are spaced away from the metal sides to prevent shorting. The tone and symmetry adjustment potentiometer (parts 5, 6 and 7) are mounted at the bottom so that adjustment can be made by removing

the bottom cover. The control potentiometers are 2 meg mallory migetrol linear units having each end painted with silver conducting paint to reduce the total resistance to one meg. The fail safe push button is mounted on the other end from the cable plug.

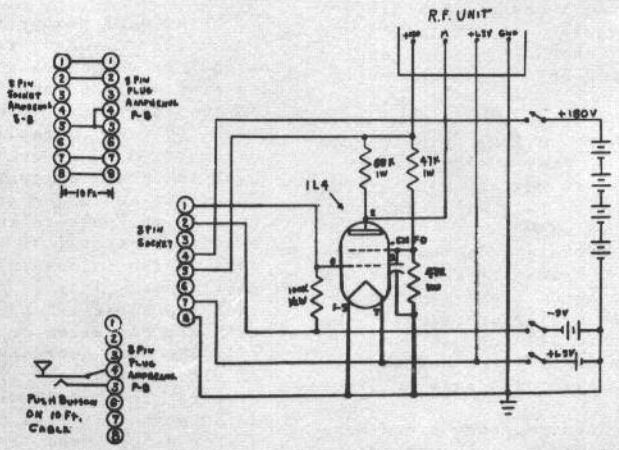
The component boards are cleaned with a fine abrasive such as a typewriter eraser or household cleanser and the components are installed and soldered as indicated by the parts list and layout diagram. Keep the diodes and transistors until the last and then install them by carefully checking polarity and applying a heat sink of wet cotton to them during soldering to prevent damage. Use a small iron and apply only enough heat to insure a good connection. Now solder in the interconnection wires as indicated in the wiring diagram, while making sure that they are the correct length. Now install the component boards and finish the interconnections. Make sure the box is bonded to point "X" or pin #8 on the plug.

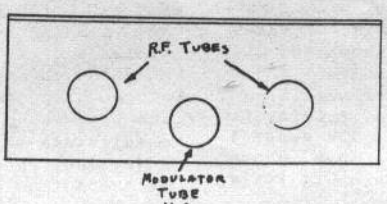
The adjustments are made by removing the bottom and plugging to the transmitter. Turn on the transmitter and connect an oscilloscope to the push button, move the control handle to give high tone and adjust to 500 cycles with high tone adjust pot (part #6) and then adjust the symmetry adjust pot (part #7) for 20/80 or 80/20 pulse. Then move control to low tone and adjust to 100 cycles with low tone adjust pot (part #5). If an oscilloscope is not available, connect a vacuum tube volt meter to a dual proportional receiver at the pulse width test point and, with the control to give high tone, adjust symmetry for maximum bias after tones are adjusted by connecting a head phone from the push button to ground through a .1 capacitor and using a comparison oscillator for adjustment to proper tone frequency. Sometimes the electrolytic capacitor (part #41) has high reactance to RF and interaction takes place. This can be cured by paralleleing it with a .01 discap.

EDITOR'S NOTE: Because of limited space, we are leaving the schematics for Grogan's TTPW unit until the next issue. Sorry, but there just isn't enough space to give the adequate coverage required. Advance copies of the circuit will be available at 10¢ if any readers desire. Otherwise, they will appear in Volume II, Number 2, the September-October issue.

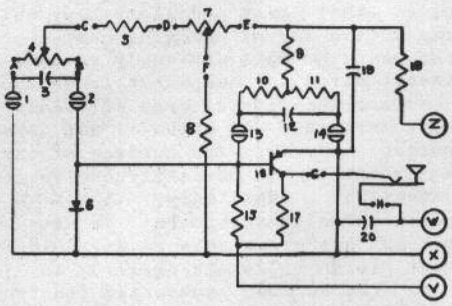


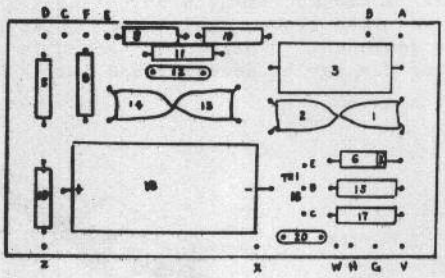
SINGLE PROPORTIONAL PULSER



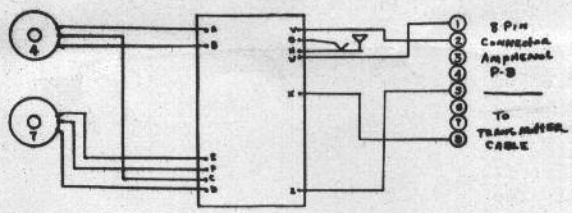


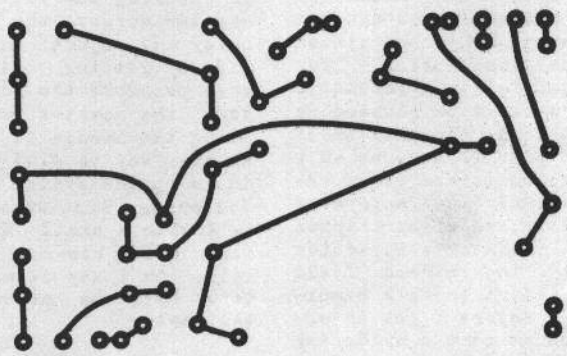
TOP VIEW OF R.F. DECK





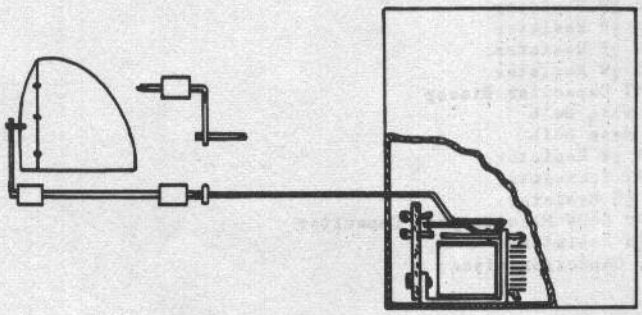
NE2 Neon Bulb
NE2 Neon Bulb
.2 mfd 200 V Capacitor
1 Meg Linear Pot
220K ½W Resistor
Germanium Diode
100K Linear Pot
150K ½W Resistor
330K ½W Resistor
470K ½W Resistor
470K ½W Resistor
.0047 Capacitor Discap
NE2 Neon Bulb
NE2 Neon Bulb
220K ½W Resistor
T0037 Transistor
15K ½W Resistor
4 mfd 240V Electrolytic Capacitor
1K ½W Resistor
.001 Capacitor Discap





BITS PIECES

We heard of a simple actuator-less ship flying in the Oklahoma City area and we wrote to Jerome L. Asner of Eureka Enterprises, Inc. and asked him how he had done it. His reply--"Been too lazy to answer this one sooner. Send some pictures at a later date. The take off for the rudder is described below. The pulser is nothing but a Sigma relay and a variable pot at the transmitter. This is tied into the keying switch of the MarcyTone. Hook up is extremely simple, we just simply loosen the relay spring and open the contact points to get the necessary throw to provide for rudder action on our little 020 ship. Our model can actually be flown without the aid of the pulser pulsing the key by merely pulsing it with your fingers."

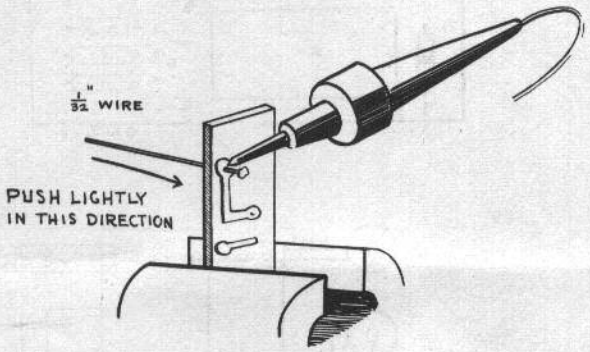


I enjoy your Grid Leaks very much. Not many of us R/C'ers in this area but in the past year we've started getting into Galloping Ghost and WAG dual. So many of your articles are particularly helpful.

Any chance of taking on strictly R/C ads so that it would pay to come out once a month with Grid Leaks? Two months is a long wait between issues.

I think you scare away too many potential buyers of WAG dual equipment. You did me anyway and now my money is tied up in an 8 channel outfit. Wish I had tried the WAG dual first, though. A month ago I finished building the receiver and transmitter kits for another fellow and they worked out 100% right off the bat. So I'm now going to build a receiver from your basic kit and use his transmitter. I almost have another R/C'er convinced that he should be flying WAG dual come spring. You could advertise that anyone who can follow a schematic can build the WAG dual. Probably I can't be classed as a beginner, but two years ago I had never flown or built a gas model plane and I didn't know plus from minus on a flashlight battery. Since then I've built and flown escapement rudder only planes, Simpl-Simul (most enjoyment for least cost and sweat) and five and eight channel multi. For equipment I've built McEntee's Direction Finder, Gerry Gauge's excellent logarathmic field strength meter (you should kit it), John Worth's Simpl-Simul pulser and Good's WAG dual. Before I got interested in R/C I had never so much as used a soldering iron. I've had no one to help and lead me except from what I've been able to pick up from Grid Leaks, American Modeler, Flying Models, and Model Airplane News. So it can be done all right and I think it proves my point that with a little experience and patience a lot of guys could be using the WAG dual that up until now have been afraid of trying it.

Since printed circuit boards are now prevalent in construction of R/C kits, as service representative, I have noted that most modellers have quite a time doing anything in the way of changing components without damaging the board. This obviously results from attempting to reinsert wires and component leads through the board while keeping the little drop of solder hot so the lead will slip through. As often as not, the copper foil is then pushed away from the surface of the board and then is in condition to be easily broken resulting in loss of connection. Admittedly, it is a chore to drill through these holes again but we have stumbled on an easy method that seems to work very nicely. Most of the component lead holes are drilled to just over 1/32". After we remove the suspected faulty component, the board is clamped in a vise, carefully, of course, and then a short piece of 1/32" music wire is placed in the hole to be cleaned from the component side of the board. Now just a touch of the soldering iron on the dab of solder and thus leave a nice neat clean hole to remount the new component. Since the board is already tinned, soldering may now be accomplished with a minimum of heat.



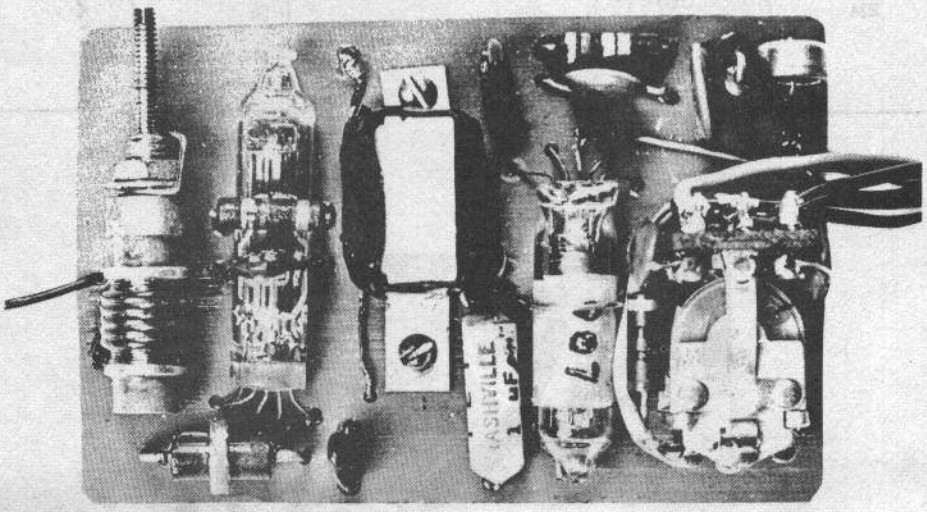
This may be of interest to Grid Leaks readers or it may be so simple and obvious as not to be worth bothering with. Anyway, it was original with me and is useful in checking the pulsing relays in GG and WAG. I put my ohmeter across the points and armature of the pulsing relay and adjust the circuit to center--50% on and 50% off--by getting the ohmeter needle to deflect at the same point of the scale as I try each side of the relay. When the center has been found use the Ohms adjust to bring the needle to the center of the ohms scale. It's an easy way to find and adjust the center of the relays in a pulse system and to see if the receiver relay is following the transmitter relay okay. It has worked well with a small Eico multitester and with the Phaostron 555 I now use so I assume any ohmeter would do as well. As I say it may be too obvious to bother with but it's been my method of testing without a zero center test meter.

Yours truly,

Bill Burdwood
Cornish, Maine

P C TECH TWO

IMPROVING AN OLD FAVORITE



Charles Bybee, 1322 South 19th Street, Quincy, Illinois, visited Grid Leaks the other day and had a printed circuit version of the Tech Two receiver which was beautifully done. We prevailed upon Charles to give us some details on how he had worked up this receiver. Charles cuts his base to the full size as shown.

He drills all holes with #75 to #78 drill or 1/64" except the tuning coil, transformer, and relay holes. Use 3/32" drill for the last mentioned holes. Use eyelets for mounting in tuning coil holes. Place eyelets in from top and crimp on "painted" side.

After drilling the board, paint on copper side where dark areas are shown after the board is steel wooled to a bright gloss. This is painted with ordinary Testors nitrate dope and a brush.

It is etched in a ferrous chloride, removed, washed in water, dried and steel wooled again to a bright finish.

With steel wool, Charles finds that Testor's dope removes quite rapidly.

The version Charles had here for our edification was a 27¼ version. However, we show how it may also be used with the 50 mc version using a CK533 and a 1AG4 tube. Charles' version for 27¼ uses 6007 and P-4R.

The receiver idles at about a combined idle of both stages of 1 mil and which goes up on signal to about 3.8 mils.

This is with straight CW. If this receiver is to be used for an audio receiver which it can quite easily be using any 100% modulated tone transmitter of about 400 cycles per second, the idle will be high at about 3.8, dropping to about .8 upon receipt of a tone signal. Since this is a respectable current change through the relay, and since this receiver accepts pulsing quite well, there is no objection in our opinion to the high idle on it since on proportional control you're roughly on 50% of the time anyhow.

Charles claims that this method of using Testor's dope will save 300 to 400% of the time required to make a PC board over the tape and masking tape method.

*This is a wire jumper on 6007 - P-4R. It becomes 22K resistor on CK533 - 1AG4 50 mc version.

**There is NO connection in the 6007 - P-4R set but in the CK533 - 1AG4 set this is a .02 submini. Howard McEntee, in his original article, recommended a .1 but physical space is at a premium and Charles finds that the .02 works fine for him.

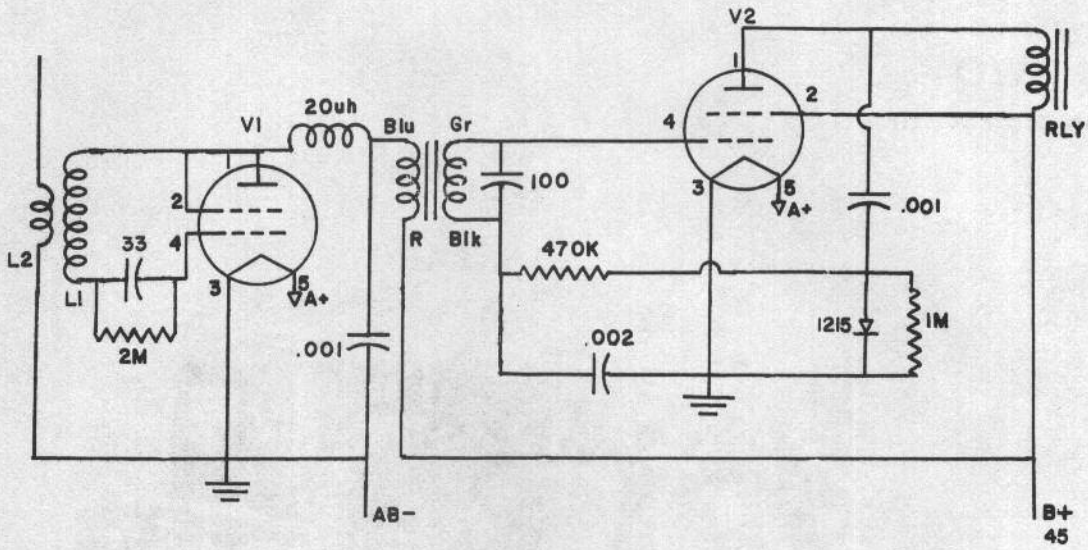
***Note that the 33 mmf and 2M resistor are placed over the 6007 tube to act as hold downs. This provides a very neat way of making a hold down without any crossovers at all. The Tech uses the standard Tech Two transformer and all other components are standard. L1 is 34 turns #32 on a CTC LSM red dot coil core form for 27¼ operation. L2 consists of 4 turns placed on top of this coil and fastened with coil dope.

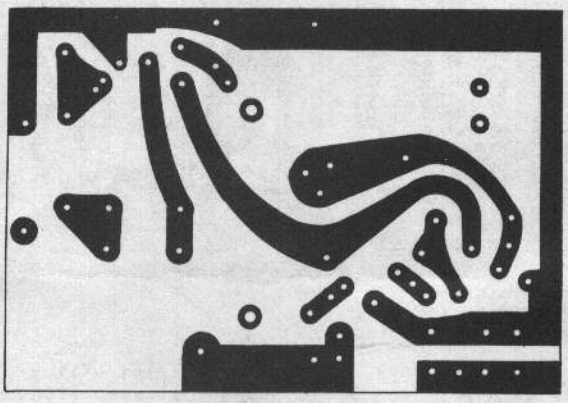
As with any printed circuit receiver, it is advisable to use good soldering techniques. An Ungar type iron and Ersin multicore solder are highly to be recommended.

The receiver is housed in a plastic box 2 x 2 7/8 x 1 inches.

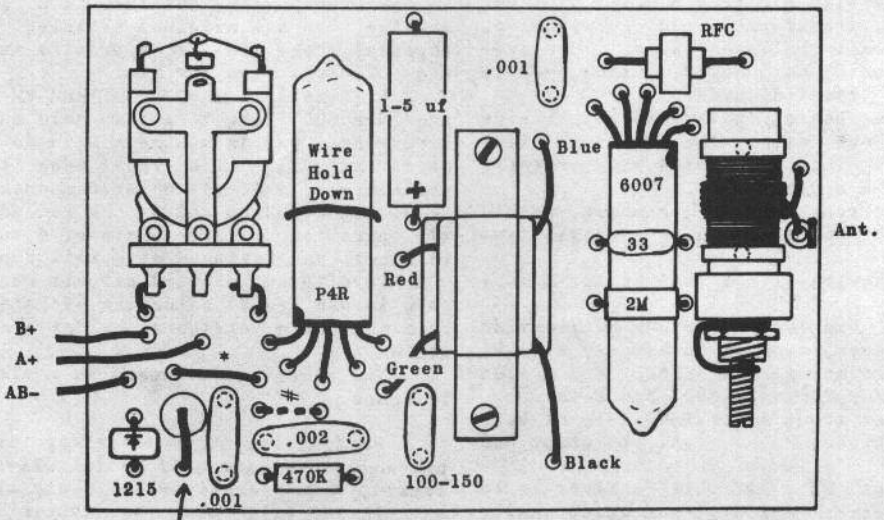
We feel that this receiver is a distinctive improvement over any kits so far offered and if there is a demand, we may consider seriously kitting the unit.

These will also be available on a custom built basis from Charles Bybee at $20.95.





Relay coils through holes under lugs.



IM on end. Note: Stand on through hole nearest relay from edge.

We Build The P C Tech Two

BY DALE SPRINGSTED

Ever since the Tech 27 receiver series appeared on the market, the unit intrigued us greatly. Apparently here was the answer to the simplified R/C carrier operated receiver containing all of the advantages of the twin gas tubers with none of the disadvantages. Let's balance the pros and cons briefly before continuing. For it are: low current consumption for both filament and plate supply; low idle current, combined with a good rise on signal to trigger the relay solidly; long tube life inherent in hard vacuum tubes; lack of fussyness as regards B battery voltages; no sensitivity adjustments; single control tuning; not particularly sensitive to outside capacity influences; small and compact in size, and light in weight.

What??? All these advantages and no disadvantages? Not true. One of the biggest troubles is that it is a bit tricky to set up for proper operation initially, as many kit builders have discovered. Secondly, the proper placement and orientation of components is very important to correct operation. Simple things like mutual coupling of the transformer and relay coils render operation nil. Perhaps some of these difficulties will diminish now that the printed circuit version is here and this is the unit we are now dealing with.

The printed circuit board eliminates most of the difficult soldering tasks, and as long as good grades of solder are employed along with a small pencil type soldering iron, no problems should arise here. We attacked it from the front end and worked on through the unit, mounting first the coil, choke, transformer, and relay. Following this with the capacitors, resistors, diode, and tubes. Since the tubes are soldered in this version; we placed both in their proper location and made our first tests with them in place. Having in the past crossed filaments etc., we were most thorough in double checking the filament and plate leads to be sure the tubes were located correctly. Perhaps we were fortunate, but the unit operated quite nicely on the first try.

A couple of tips here might be in order. First, when winding the tank coil, one should remember that it should be wound nearest the open end of the form, not down near the metal base. This location allows the widest range of tuning adjustment. The transformer should be mounted in place so that the two coils are piled one on top of the other. It does not matter too much which is on top, as long as the coils are in this position, in the bracket holding them. We found it convenient to tape the coils to the bracket prior to installation. One must also be careful to orient the diode properly, else the unit will draw maximum plate current immediately on turning it on. Before turning on any power to the unit there are a couple of quick checks that can save tubes and money. A simple ohmmeter to multimeter will suffice. Test the red and blue windings on the transformer as well as the green and black windings for continuity. The red and blue winding will show less resistance than the black and green. Also check for shorts within the set by checking for continuity between the B plus battery lead and both the ground and filament leads. These should show NO resistance reading at all. IF a reading is obtained, in all likelyhood you have a crossed connection, misplaced component or some other defect. No power should be applied until these tests are tried.

Let us now consider what makes this receiver tick. This is sort of a brief description of what happens in the set. The first stage is a regenerative detector and, as such, several things are occurring at once. It oscillates at RF frequencies and at the same time at audio frequencies a bit above the range of hearing. These two frequencies interact in such a manner as to result in a hissy noise which may be heard at audio levels of normal hearing. You may hear this noise by touching one lead of a headphone set to ground or B minus and the other lead to the power or transformer end of the RF choke. We can vary the tuning of the RF frequency by changing the values of the coil and parallel capacitor and we can also change the super audio frequency by changing the value of the grid leak resistor and its parallel capacitor. This latter is actually the sensitivity control, but note that it is fixed, and once properly set needs no further adjustment. Coupling this stage to the nest is a transformer which serves a twofold purpose. First, it is a matching transformer to more efficiently couple the two stages and, secondly, it serves us as a bandpass transformer allowing only the audio frequencies desired to pass beyond it, quenching or attenuating all others. Thus, this transformer serves as a gate opening up to only frequencies in the audio or hearing range and closing to any frequencies below or above. The second or last stage includes a tube, diode, along with other capacitors, resistors etc. The function is to take any audio voltage passing through the transformer and rectify it (makes DC from AC) and apply the resulting DC voltage to the grid of this tube as negative voltage or bias. As this bias is applied to the tube the stage can not draw current but when this bias is removed current can flow and does so through the relay which is then energized and closes giving us our desired control function.

From the above, let's see what happens in this circuit. The first stage is regenerating and developing this audio hiss sound. This hiss happens to be (not accidentally) at the bandpass frequency of the transformer so it is passed to the second stage. The diode and tube amplify and rectify this audio or AC voltage and the resulting negative bias is applied to the tube grid holding back any current flow so the relay is not energized. When we tune in a signal, regeneration ceases,along with this action the hiss or audio voltage disappears. There is now no audio or AC voltage to be rectified and thus no resulting bias, therefore the tube starts to draw plate current and the relay is pulled shut. Now we can see two controlling factors that may be adjusted to govern the overall function of the receiver. First, we must tune the transformer so it passes the hiss or audio frequency generated in the first stage. Secondly, we must tune the first stage to provide this hiss voltage in the proper amounts so that the last stage is neither over nor underbiased.

Now, if the theory is correct, we should be able to juggle the fixed components to provide the correct amounts of voltage for the job. By altering slightly

the grid leak capacitor and resistor, (the 33 mmfd and 2 megohm resistor) we can change the super audio frequency and vary, to some degree, the audio or hiss voltage. At the same time we can change the transformer bandpass by changing the capacitor across the secondary in value, thus tuning the bandpass to different frequencies.

Let us now assume we have built the receiver and made such initial tests as outlined. We have no short circuits, the transformer shows both coils okay, tubes are installed correctly, and we have checked all batteries to be sure they are correctly hooked up. Turn on the power, with a 5 milliamp meter in series with the B plus lead. Immediately you should show an idle current of from .5 ma to 1 ma. Suppose your test shows 4 ma. Check first the diode to be sure it is placed properly since it may just be reversed. If this is okay, then it follows that somewhere there is not enough bias being applied to the second stage tube grid. At this point, it would be wise to remove the second stage tube and check only the first stage. Try the headphone test to assure that there is regeneration present as well as carefully watching the plate current meter. It should read about .5 ma and there should be just the tiniest dip in current as a transmitter is turned on and off if the coil is tuned to frequency. Here a grid dip meter is valuable since then we have a variable frequency source, and can watch the plate meter while tuning the GDO. Usually the dip can be noted as the signal passes the tuned frequency of the receiver. Having once become assured that the first stage is operating, check carefully for poor solder joints or open or shorted capacitors and resistors.

Suppose on the other hand that the initial test shows proper idle but no rise on signal. First check must be the tuned frequency range of the coil. If this is correct, the assumption must be that the audio voltage that biases the second stage is NOT being removed on receipt of signal. There are two places where this problem may be attacked. First would be to try lowering the 33 mmfd capacitor in value in 5 mmfd increments. One may go as low as 15 mmfd at times. The other change would be to try altering the 100 mmfd capacitor at the secondary of the transformer to various values from 50 to 150 mmfd, retesting after each change. Also, one of the first changes to try is to reverse the black and green secondary transformer leads. One of these three changes should start to show improvement in operation. Once an indication of proper operation is found, the condition may be noted and further work done in the same direction to improve on it.

At this time one may find that the amount of antenna coupling used will become important. If the plate current meter now shows the relatively stable condition where a little change can be had, try increasing the number of turns of antenna coupling to 6 or 7, plus the use of a longer antenna. If the unit will show to be unstable as indicated by a very wobbly plate current indication, try reducing the number of turns by one or two at a time. Again, changing the grid leak capacitor here helps.

For stable conditions, reduce, and for highly unstable conditions, increase. This is about as much as a person with a limited amount of test equipment can do in the nature of trouble shooting. Beyond this, it would be best to ship the unit to the manufacturer or a service center for repair.

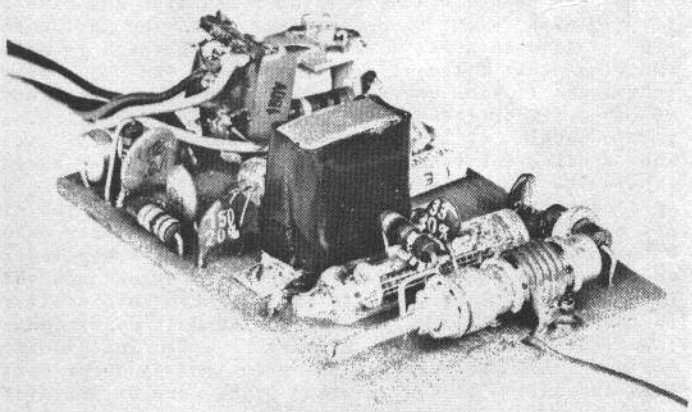
Let's review very briefly now.

A high idle
- Causes - Front end not regenerating, reversed diode, shorted or open component.
- Cures - Decrease antenna coupling, reverse diode, new tube, replace faulty part.

Idles around correct current but is relatively unstable, indicated by very wobbly plate current.
- Causes - Improper bias of second stage due to first stage operating improperly.
- Cures - Reverse transformer secondary leads, decrease antenna coupling turns, increase 33 mmfd capacitor, new 6007 tube.

Idle current correct, but little or no rise on signal.
- Causes - Second stage overbiased.
- Cures - Increase antenna coupling, reverse transformer secondary leads, decrease 33 mmfd capacitor, alter the 100 mmfd tuning capacitor on transformer.

This is about as much as can be covered easily. There are naturally lots more troubles and indications but these are the basic ones and if a bit of common sense is applied with these changes, most troubles will disappear and the unit will operate satisfactorily. You ask how come one must make all these changes, and the answer is that in all parts there is a little thing called tolerance that creates much difficulty. Parts such as capacitors and resistors are not always exactly accurate as regards their respective value markings, and the same is true of tubes. Variations in manufacture result in variations in operation, thus some extra measures are occasionally required to compensate and restore the circuit to operating balance.



Silk Screening Printed Circuit Boards

BY E.J. LORENZ FOR BEGINNER & EXPERT

EDITOR'S NOTE: As mentioned by Ed in the article, Ace Radio Control, Box 301, Higginsville, Missouri will have the necessary silk-screening supplies, resist, silk, squeegee material, cut stencil film, and block-out solution. Please write for special bulletin on this.

Last issue we told of general printed wiring considerations and materials. This time you will learn how to produce circuit patterns.

Before placing any pattern on the copper surface/x, the copper should be clean and free of oil, grease, fingerprints, etc. For our use, scouring with Ajax, or similar kitchen cleansers, followed by a thorough rinse and drying is satisfactory.

The simplest and most inexpensive way of producing the resist pattern is by painting it on with an acid resistant ink or paint. This requires careful and neat work and may be done with a small brush or speedball pen. Ace supplies acid resist paint in 2 ounce bottles. For painting or pen use it must be thinned with mineral spirits. Keep it as undiluted as possible, consistent with good application. This painting method produces a single pattern at a time and unless additional patterns are produced with most exacting accuracy no two will be idential.

To make your painted process easier for you, the Tech Pen may be used. This is a special ballpoint pen with special ink that dries within seconds after hitting the copper. Use it as you would a regular pen, and with a straightedge, a very presentable pattern may be applied.

Many users have used Testor's Dope applied either by brush or speedball pen as a fine resist solution.

The next "one-up" method of producing a pattern is to cut the conductor areas from pressure sensitive vinyl plastic, such as is sold in hardware and department stores. Strips of varying widths may be cut with a straightedge and razor and circles may be cut using the sharpened end of a piece of brass tubing. Leave the plastic on the paper backing during cutting and try to cut through only the plastic film, not through the paper backing. Peel off the circular bands and conductor strips and apply to the copper surface. BE SURE the tape is in intimate contact with the copper, especially at joints or overlaps. Otherwise the etchant will seep in and produce a break in the pattern.

The easiest method of producing a number of patterns is by screen printing. This method may be used by almost anyone with the minimum amount of effort, time and expense.

Screen printing consists of forcing ink or paint through a stencil, which is supported by a fine fabric or metal mesh directly onto the work surface. Ace can supply the necessary materials for this work.

The screen frame is used to support the mesh, in this case we will use silk. It is a wooden frame with inside dimensions about 2" or 3" greater than the pattern area. For small frames, straight grained white pine or sugar pine having a cross section area of about 3/4" x 1" is satisfactory. It is desirable to miter the corners, glue and nail them, as in Figure 1. Be sure the bottom surface is flat. After assembly, sand and give a coat or two of shellac.

The silk, having a mesh count of between 120 and 165, is stretched evenly across the bottom of the frame. Fold up around the sides and staple in place. It MUST be stretched as even and tight as possible, wetting before stretching will help. Figure 2 shows the method.

The pattern is laid out in heavy pencil or ink on white paper. Place a sheet of Cut-Stencil film over the pattern, backing side down (usually a heavy plastic). Cut the film to fit the inside dimensions of the frame, otherwise a blockout solution must be applied to completely cover unwarrented open areas.

The stencil film itself is a thin layer of a lacquer type material which is resistant to the ink. The film is cut with a razor blade (or Xacto #11 blade) to the outline of the pattern. TAKE CARE not to cut through the backing sheet. After cutting, the pattern area of the film is peeled off, leaving the background of the film on the backing. Circles may be cut with sharpened tubing on special cutters for this purpose.

After the stencil is cut, place it film side up on about 6 to 8 layers of newspaper. Place the screen frame, with silk mounted, on top, centering it properly. The film is now adhered to the silk by daubing the silk from the inside of the frame with a piece of cotton or soft rag moistened with Adhering Liquid. Be careful not to use too much liquid or too much pressure. The Adhering Liquid attacks the film and it becomes cemented to the silk. Be sure the entire area is covered and properly adhered. Set aside to dry. DO NOT attempt to peel away the backing sheet until the film has thoroughly dried. Do not use heat to force dry. When fully dry, the backing sheet will have a tendency to peel off by itself.

When the stencil has been adhered and dried, tape the inside corners of the frame and silk with 1" gummed paper tape. This prevents ink being forced between the frame and the silk. DO NOT use masking type tapes because the ink cleanup solvents will attack the adhesive. Next, use a blockout solution to fill any undesired open areas of the screen. This is generally a water soluble gelatin/glue mixture which is painted on. Figure 3 shows how the stencil is attached and tape is positioned. This operation completes your screen.

Figure 4 shows how the screen is mounted and the work positioned. Also, the dimensions desired and the principle of screening.

The frame is mounted on hinges to a suitable size of 1/2" plywood. When the frame is pulled down on the work there should be a 1/16" gap between the stencil and the work and play or side movement of the screen minimized.

The copper laminate is jigged in position under the screen with pieces of wood or plastic of the same thickness as the work. Registration on two sides is adequate. The work is held down by double sided Scotch tape, since it would otherwise have a tendency to cling to the screen after printing.

Place about a tablespoon of ink at one end of the screen and distribute it evenly across the width of the squeegee. The squeegee is a resilient material which is used to pull the ink across the pattern and force the ink through the stencil onto the work. For good work, the contacting edge MUST be straight and sharp. Make a few passes onto pieces of paper before screening the copper surface.

Screening is an art, therefore do not be discouraged if your first print is not perfect. Some of the variables in the process are: consistency of the ink, sharpness of squeegee, angle and pressure of squeegee during screening and quality of the stencil and screen.

When the run is completed the ink may be reused. Carefully wash the screen with mineral spirits taking care to fully clean the pattern mesh. Don't rub too hard on the stencil side.

After the ink has dried the material is ready for etching and fabricating. This was explained in the preceding issue.

NOTE: In cutting the stencil, try to maintain a minimum conductor width and spacing between adjacent copper areas of 1/32". If the interest is great enough, future articles will explain simplified photoprinting methods, whereby greater accuracy and finer detail of work may be had.

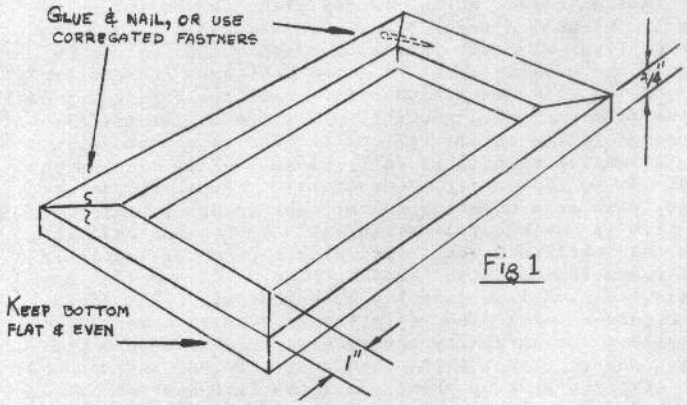


Fig 1

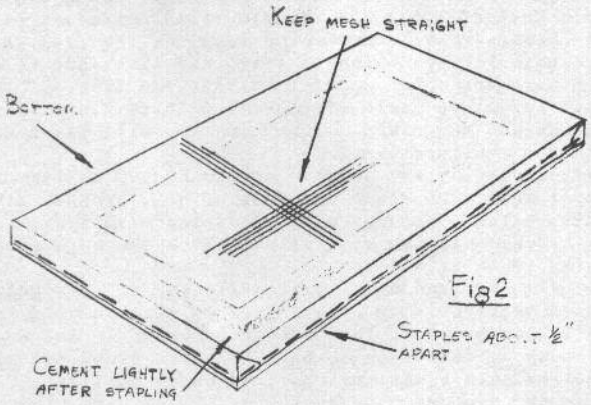


Fig 2

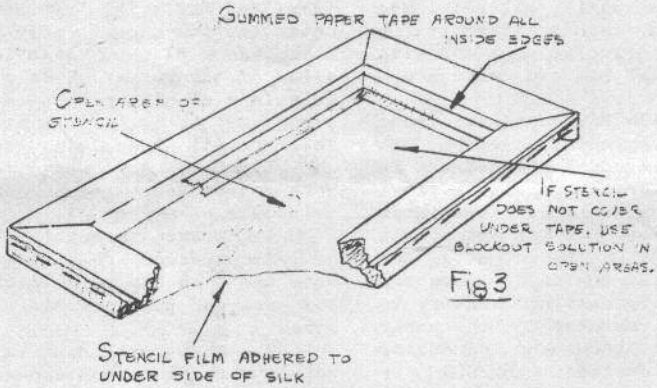


Fig 3

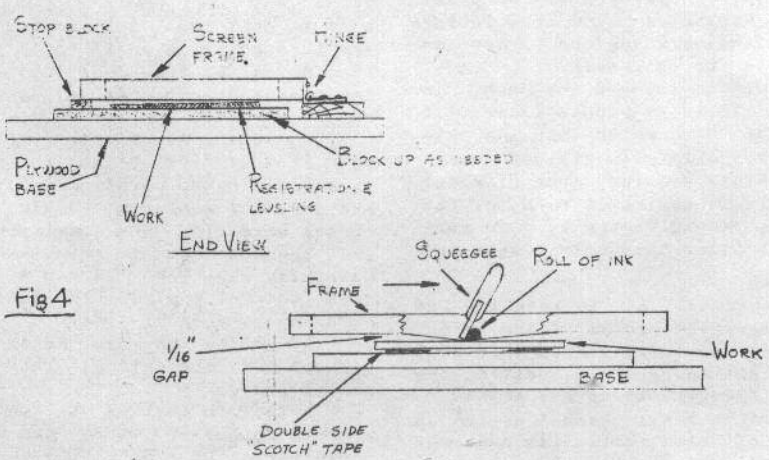
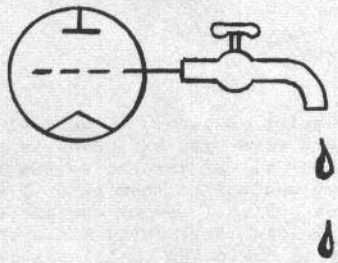


Fig 4

Grid Leaks At Play



And so Volume II of Grid Leaks begins after a most interesting month with the controversy set off in Volume I, Number 10 with relation to the beginner vs. the expert.

We'll have more on this later but we want to touch on a few other items now. We feel that Volume II is bringing you some very exciting things and they are slanted both to the beginner, who needs to know and wants to learn. If he has the ability to dig for himself, he can learn and become a pro.

The AMA DCRC Symposium is history. It was attended by the largest crowd yet, and, from the remarks that we can obtain, it was the most successful of the two held so far.

The important point we want to get across is that the reprints of the 1958 and 1959 Symposiums are now available. These contain a wealth of material along with hundreds of illustrations in each. They cover subjects from airplane design to the newest superhet material.

They are available from the AMA at 1025 Northwest Street, Washington 25, D. C. at $2.00 each to AMA members and $3.00 to non-members of the AMA. We believe that they are worth every bit of it.

We've been privileged to see a preview of the new radio control book by E. L. Safford just off the press from Gernsback. This will replace the old "Model Control by Radio" and is their new #74. It lists at $2.65. This is a book well worth-while for beginner and expert. Although some of the new FCC regulations outmode some of it, there is much to be had from it.

Word comes from Cobb Hobby that a new proportional servo is underway which does not require electrical centering. Also from Howard Bonner comes word that a servo is underway at Bonner Specialties using a pot follower for the most advanced centering devices available. We will keep you posted as more information is available.

We didn't realize what an avalanche of letters we'd encourage with the last "Grid Leaks At Play". Oddly enough, they bore out almost all of our thinking in the field. We would say that 99% of them said, "Keep Grid Leaks as it is! Have an interchange of ideas for advancing the R/C art. Keep an article or two each issue for beginners, but let's use the medium for the advancement of the art. Let's leave the other stuff for the other mags in the field!" Other ideas favored the publication of an R/C Primer utilizing the best of Volume I of Grid Leaks for the beginner. Also the fact that Volume I should be offered in a bound edition.

There were only two dissenting letters from the many received. One was very violent!

So, for the time being, Grid Leaks will follow the policy it has had for Volume I. Just to give you an idea of how some of the mail did run, here are excerpts from some of the letters:

From North Carolina:

"Personally, I prefer advanced circuitry in GL! Seems to me that when the serious novice finally does learn to understand R/C, he will need some good circuits and ideas to help further his hobby. This he can find in the old GL's he couldn't understand 'yesterday'."

"In regard to the controversy between beginners and 'experts', it is impossible to satisfy everyone. Radio control as a hobby must continually step forward otherwise it will stagnate and become lost in the competitive field of hobbies.

"With beginners developing every day, no periodical publication can afford to stand still just to cater to the one class--there would be nothing to keep the activity alive--and only the experts can accomplish that.

"Beginners have access to knowledge through a wide source of publications covering the basics they must have before taking their next steps leading to more complicated subjects.

"Even with my limited knowledge, I am sure I'd lose interest in Grid Leaks if it failed to provide most of its space to what's happening today--not 5 or 25 years ago."

From Texas:

"In your 'advanced vs. beginners' controversy--isn't it possible to have the majority 'advanced' and also have a minority of 'beginners' (or basic) type of information? It probably wouldn't hurt most people to review some of the basic type of information occasionally."

"I have been a GRID LEAKS fan since its inception and have always found it interesting and informative. I have built several pieces of equipment from its pages.

"I feel that the fellow who mentioned the ARRL Handbook had a very good idea. It seems to me that the people who read GRID LEAKS are mainly people with experience and hence, 'experimenters'. However, the beginner needs to start with the fundamentals and should not be forgotten. The handbook is an excellent idea, even if a little futuristic.

"Why not continue to publish the mag for advanced people and include a page for those getting started, which could be collected into a sort of handbook. There are several pages from earlier mags that could well fit into such a scheme.

"I realize this is a lot of work, but I believe that it could help to reach the beginner and help turn him into an advanced R/C'er. Who knows, GL might even become self-supporting!

"I will be interested to see how you decide to go, but which ever way it is, here's my two bucks."

From California:

"I would like to see more articles for beginners and sub-pros, so to speak. Articles on servo adjustment --installations--trouble shooting--and all the other things that plague the average R/C enthusiast. Most of us can build the planes and install the equipment but then our troubles begin. The actuators hang up, vibration problems, range short, spasmotic operation, etc. These are the things that keep us on the ground or cause the crack-ups. There are many tricks the experts use to eliminate these problems. I think more articles on these subjects would be of great interest."

From California:

"I note your remarks about the various publications for beginners. I disagree that the field is adequately covered by what is available. To make it stronger, it most certainly is not covered to the satisfaction of the many beginners that I encounter. I carry Howard McEntee's handbook and feel that it is one of the best, but it needs revision and lots of it. Berkley's was good in its day--very good! I could write a book on the kind of a book that the beginner of today needs, if I could write a book! Since I don't have this kind of talent all I can do is criticize poorly what others have accomplished. Sincerely, I am really grateful to all who have contributed even the least.

"From the R/C'ers point of view: I am real grateful for the foresight and work you have done in promoting GRID LEAKS. I have all of the copies and I guard them with a .32. I just don't loan them out. I have my copies bound into a book which I let my customers refer to, but not borrow. I can truthfully state that the GRID LEAKS intrigued me to the point that I simply began digging into radio, which up to the time I received the first editions, and as I look back over my first year in the hobby business, I was continually confronted with questions that I faked the answers in one way or the other in order to sell radio mdse. helter-skelter to customers that I eventually lost. I have read GRID LEAKS faithfully and although I didn't understand everything and still don't, I think this publication is the greatest and should continue along the lines that it is now being published. I am able to keep up with the developments as they arise even though a great deal of it is over my head by ten feet. I want to see this publication continue. I am sure a great deal of your information follows the thinking of more people in the east and midwest and is not exactly following that is being done out here. But, I can well understand this sort of condition and do not intend to criticize for no criticism is justified in this behalf.

"I hope I am not wasting my time and yours with the above comments, so to sum up my opinion: Every day we interest new people in R/C. We MUST have something for these people to start with. I think an up-to-date book is the answer--to cover basic circuits, to show how the signal gets out of the antenna, travels through invisible wire, climbs down the receiver antenna, flies around and through all of the components, kicks the relay, triggers the escapement, moves the control surface and controls the airplane. This we don't have! This we need! I know it has been done in the past in some fine publications of the day. We need up-to-date info in this day of lightning-fast change and development of R/C. This is a tough task, a risky venture, and probably would be obsolete before the ink is dry, but this sort of thing is needed. The beginner must be continually cultivated, fertilized, and harvested. By the same token, we must depend upon the advanced R/C'er probing into the realm of the unknown to continue the development of this fascinating hobby."

Volume II, Number 2, coming up two months from now will have the continuation of Grogan's pulser for the WAG TTPW system. It will have a revised Kraft circuit board for use with the CR60 transformer. It will have hints on reed receiver operation and adjustment as well as transmitter tuning. It will have a reed receiver and many other articles that we know you will be wanting to read.

We are most grateful for the literal flooding of the renewals that has come in. This does our heart good because it bears out our editorial policy that the majority of you wanted to keep Grid Leaks just as it is. This is your paper! Please share your circuits with other fellow experimenters throughout the country. Until Volume II, Number 2, happy landings!

Grid Leaks

HIGGINSVILLE, MISSOURI