GRID LEAKS

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Build a Monitor and FSM

With audio seeing an increasing use, a monitor is one of the most helpful things that the audio fan can have.

This article idea was born in a letter that was received from William Luscombe, Ft. Lauderdale, Florida and published in Grid Leaks Volume I, Number 8.

After considerable experimenting with Bill's circuit, it was decided to use a 4" speaker instead of a small subminiature speaker for the very simple reason that it provided about 100% increase in the sound.

Wiring on this unit is straight forward. We show the regular circuit and also show a circuit which was obtained from the VECA "Orbit", a club news letter on a circuit basic just as being more sensitive than the one originally shown. It presents no great problem.

We had our cabinet maker make us a special cabinet, $2\frac{1}{2}$ x $4\frac{1}{2}$ x 8 but there is no special reason why a standard 3 x $5\frac{1}{2}$ x 8 cabinet such as is used for the Commander Transmitter won't make an ideal unit for housing your monitor and combined FSM. We felt it advisable to go all out and include both the meter and the loud speaker so that you would have a versatile instrument.

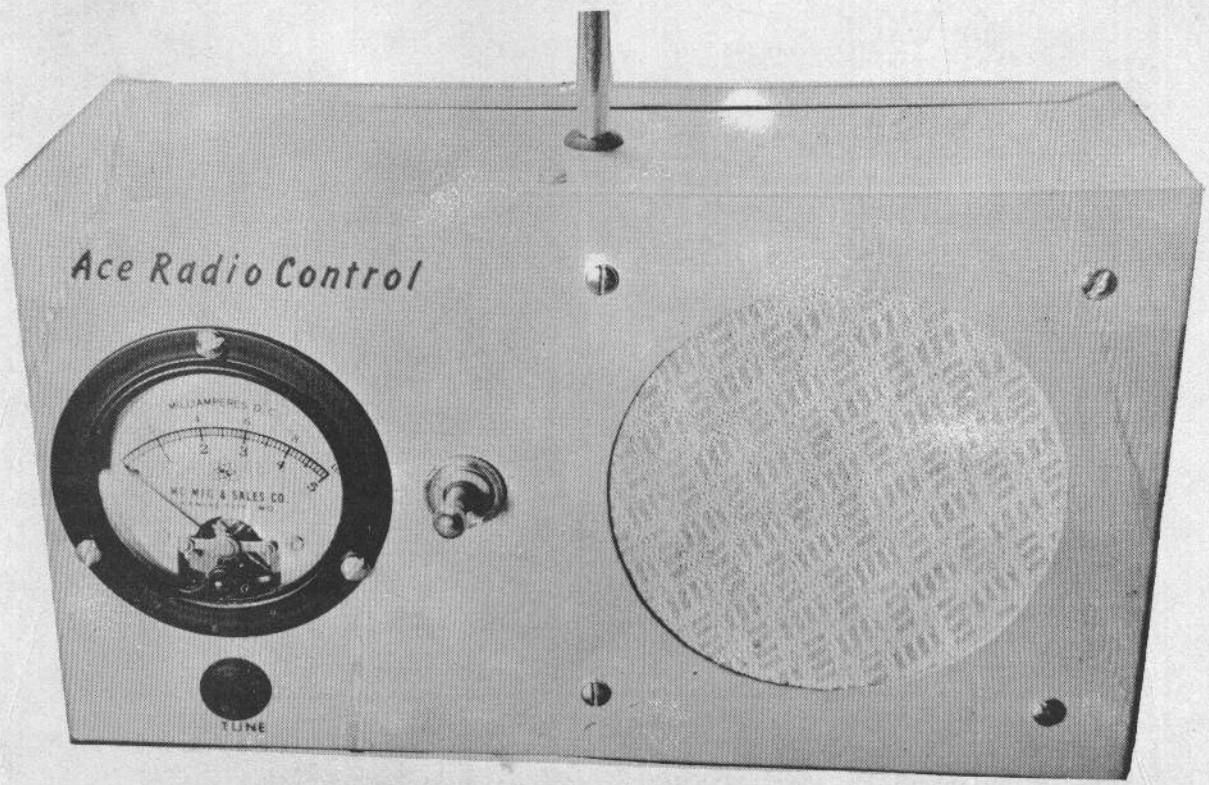
Jerry McGeorge's circuit which appeared in Volume I Number 3 "FSM, Versatile Test Instrument" also would be a good circuit to try. Particularly if you wanted to adapt it for 50-54 mc since coil winding data for that is included.

No particular construction hints will be given since the circuitry is so extremely simple. The unit is nice appearing and not only nice in appearance but is very functional. We personally don't see how anyone can get away without using a field strength meter and using it regularly.

In practice, a field strength meter is placed at the same spot, a certain distance away from your transmitter so that you can measure your relative output. It provides the best known way of knowing that you transmitter is performing as it should be.

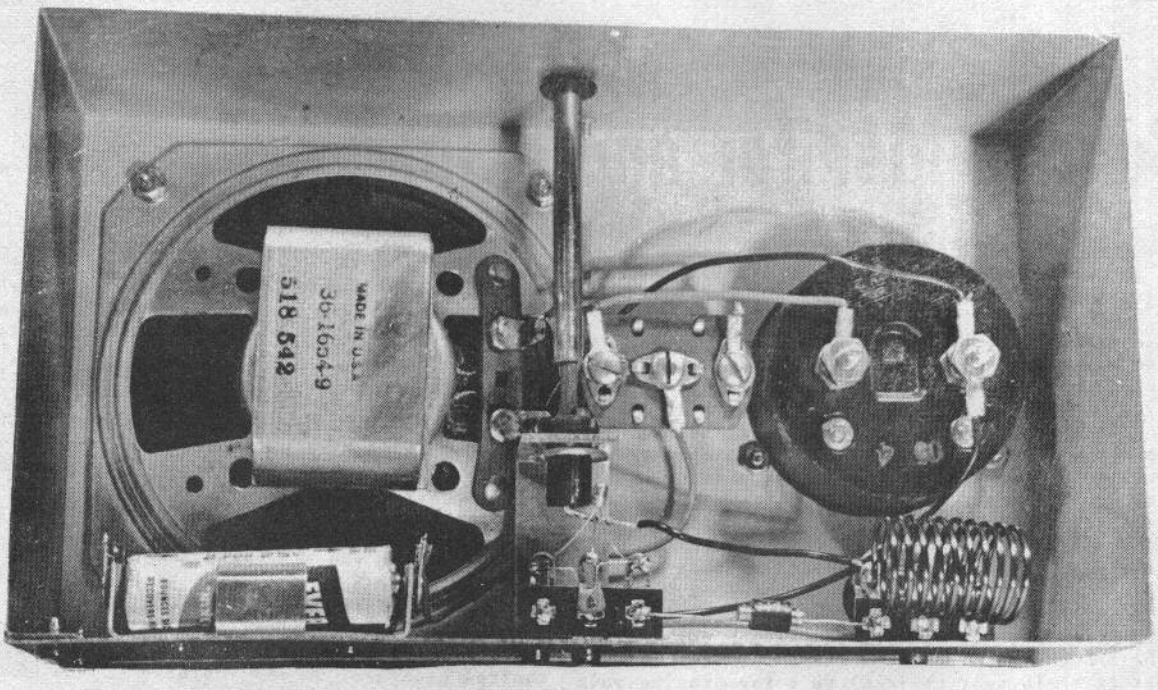
The cost, too, is relatively low when you count it against a possible fly-away airplane including the radio control equipment to say nothing of the hours that went into the design.

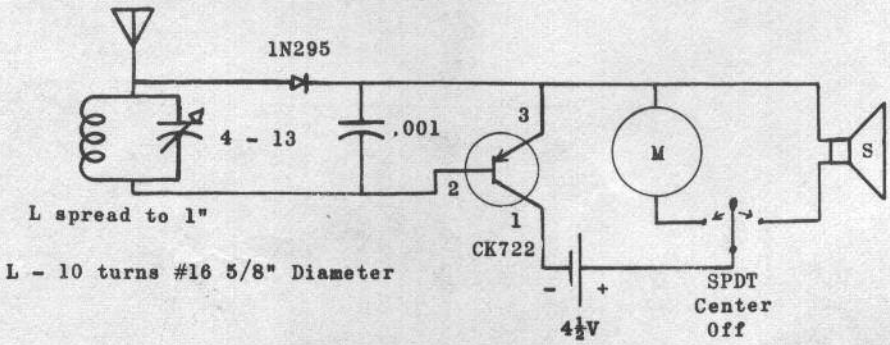
It would be perfectly feasible, of course, to use the Argonne small speaker and use a small plastic case



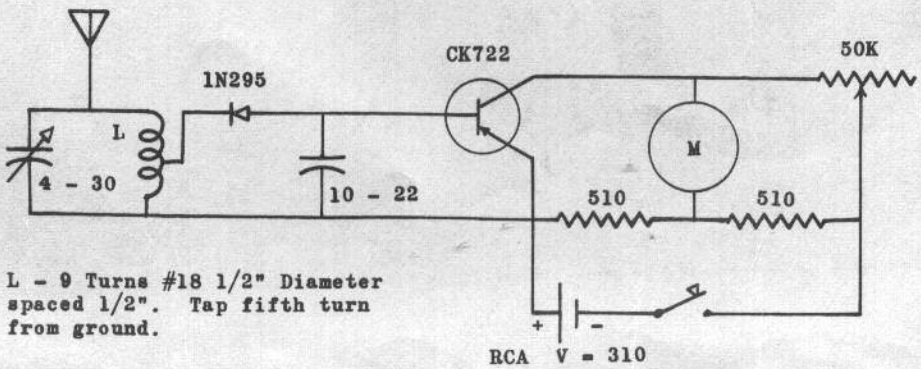
and come up with a hand held unit such as is suggested by Bill in his original article. The design shown here is one, we feel, however, to be a little superior since it may be ground based and not quite as easily tipped with the 3 foot antenna wire.

Happy listening, happy landings.





Monitor - FSM Circuit



FSM Circuit with balancer as it appeared in November 1958 Vanguard "Orbit"

How to Observe and Measure Quench Frequency Of a Super-regenerative Receiver

BY JERRY MCGEORGE

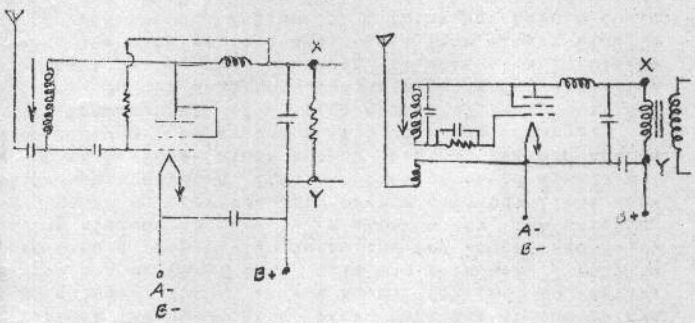
Here at Grid Leaks, we are asked all sorts of questions. One of the most frequent, how do we effectively use the scope in R/C; how do we tell the quench frequency of a super regen detector and many others. Jerry McGeorge has written what we consider an excellent article on the latter. Since the super regen is used in almost every R/C receiver we've used up to date, a knowledge of the quench frequency, we feel, has universal interest.

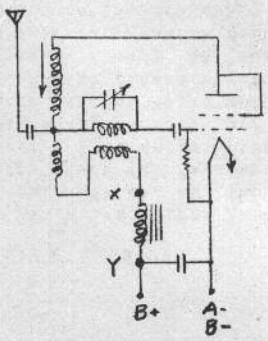
Number 1, the quench frequency is probably the most important frequency component in the super regenerator because of its relationship to sensitivity. It is often times the most mysterious one.

Number 2, by observing and measuring the quench frequency, the performance of the detector can be evaluated as grid resistor and grid capacitor are varied.

Number 3, when a desirable quench frequency has been established, it is possible to design a filter which will lessen the effect of the quench voltage particularly in audio tone performance. It is with a great deal of pleasure that we present this article by Jerry and we feel that a close study of the article will result in a much better understanding of the old superregen that many of us have just taken for granted.

1. Connect the vertical input of a scope across the plate lead device at X and Y. Three examples are shown:



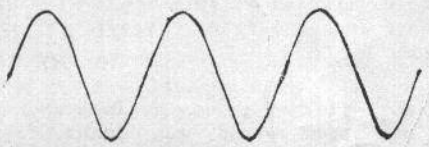


2. Set the scope sync selector at (+) internal. Set the coarse horizontal frequency selector at 50 or 100 KC.

3. Turn the receiver ON and adjust the vertical and horizontal gain controls to give a suitable size picture of the characteristic "hiss", or noise.

4. Turn the transmitter ON, carrier only, no tone.

5. Adjust the fine horizontal frequency vernier until 3 full cycles of the quench voltage appear on the screen. Like this:



6. Turn both the transmitter and the receiver OFF. Disconnect the vertical input of the scope from the receiver. This connection was made in (1).

7. Let the scope continue to operate. DON'T TOUCH ANY OF THE CONTROLS. The scope, as set, has information built into it which we want to expose.

8. Now connect the output of an audio generator to the vertical input of this previously adjusted and constantly operating scope. Again, don't touch any of the scope controls.

9. Set the voltage output of the audio generator at 10 volts or less and tune the generator across the span of 10 KC to 100 KC. Set the output voltage of the generator to give approximately the same picture height as seen in (5).

10. A point will be found where 3 full cycles <u>again</u> appear on the screen. They may not have exactly the same character as those seen in step (5) but the interesting thing is that you can now:

11. Read the quench frequency of the superregenerative detector on the dial of the audio generator.

<u>Note</u>:

When making comparisons of ac voltages on a scope it is considered good practice to set the horizontal frequency selector to show 3 full cycles. The reason is that cycle #1 and cycle #3 are sometimes distorted or are incomplete. Cycle #2, the one in the middle, is most representative of the going voltage.

Bits and Pieces

BONNER SERVOES, EVETT'S RECEIVER

Will try to dash off a few lines in answer to your letter of a few days ago. We're in the middle of our Christmas rush for the next few days so forgive me if it's scribbled and short. I'll write between customers.

I think you are doing a very good job with Grid Leaks. I know how hard it must be to get enough on all the different likes in R/C to please everyone. There's one article in the present copy on "new" hook up for Bonner Servos that in all fairness to Bonner needs some disadvantages pointed out to the readers. This hook up was used on the first couple of hundred of Bonner Servos and the West Coast R/C who got the most flying out of the first bunch of servos were clobbering right and left due to lock ins due to the back contacts on the relays not matching. T... as you know, depends on spring pressure and we found that this was much more likely to happen than a properly adjusted and arc suppressed relay sticking closed in use. In other words, the sticking closed could be overcome with proper care but light contact pressure with a little corrosion could always put you out of business since a back contact failure and no return could not be overcome with opposite control.

At the request of a large number of West Coast R/C Modelers, Bonner went to quite an expense to retool for his circuit board and contacts to make it possible to override the back contact and center from either side in case of back contact failure. I think you have a 10 to 1 chance of back contact failure on the type of relays used in our multi sets and our experience out here proves it. This circuit you show in Grid Leaks comes from the "Aeromodeller" from England about 1954 and I thought it very good for the reasons stated in your article until we started using Gem relays. Then we found it "dynamite". Remember, you are going through two back contacts in series to center from one direction.

On my band pass receiver, I'm not ready to release the information yet. It was developed with the thought in mind of manufacturing it but I find my time so limited that I'm not sure I want to go through with it yet or not. The receiver for 5 channels with relay measures $2\frac{1}{2}$ x 4 x 1 and weight is slightly over four ounces. Uses 30V and $1\frac{1}{2}$V. It is being check flown in a Breezy Senior 5 channel that weighs 3 pounds all up. This ship has a system that might be of interest to your readers. I have two Bonner VariComps modified to work with two channels each so that they work like servos. Push the stick left and it snaps to left. The same with right, up, and down. No pulsing or counting. It brings 5 complete channels to a total of eight ounces of gear which could be handled by $\frac{1}{2}$A.

The detector and amplifier stages will be made with one channel then additional channels will be available that can be slipped into a box through connections made as per dotted lines. Each channel is the width of the relay and the length of the base, less than 1 ounce. The filter can be made at a cost of about 50¢ plus condenser. All I need is a 48 hour working day! I would like to change it to low voltage operation as that seems to be the trend.

Well, I've been about four days getting this written so I'd better sign.

I think a good subject for Grid Leaks would be for power supplies for hand held transmitters. That seems to be the next step with the west coast experts. They are going to nickle cadmium batteries and power supplies in their ships and a number are working on small ones for transmitters.

Yours very sincerely,

Colby W. Evett
Santa Monica, California

COMPACT ACTUATOR

We have had considerable good results with the Aristo Compact A actuator as a proportional actuater with very little rubber band for centering. One strand was enough. At the present one of the boys is using two with his Walt Good outfit. There is very little flutter in the control surfaces and the movement is precise with no sway and, the price is right.

Yours sincerely,

Phil's House of Hobbies
Tampa, Florida

CHARGING VOLTABLOCKS

You may be interested in an idea of Capt. Frank Burnett, Donaldson AFB, Greenville, South Carolina for the initial charging of Voltablocks. He uses several of the TV antenna "clothespin" connectors and wires them in series and clamps them to the cells. A neat and easy way to charge two or more cells simultaneously.

Yours truly,

Jack Landers
Greenville,
South Carolina

DETERMINING PPS

To determine the speed of a pulser, you can record the pulses on a two-speed tape recorder. For example, "record the sound from the ear piece of the TR 4.5 as it is being pulsed. This is done at the 7.5 speed and when it's played back at the 3.75 speed, you can count the pulses and multiply by two." This idea comes from Red Costlow of Minneapolis, Minnesota and Red says, "I start the recorder going and, using a sweep second hand, run it for 30 seconds or a minute. At the beginning and end of one minute you record another sound or click as a marker. When you play it back--at low speed--you listen for the marker, count the pulses until the end marker comes up. Sounds complex but it is real simple."

BACK ISSUES OF GL

If you will please excuse the sexy blue paper and crazy red pen, I would like to request the back issues Volume I, Numbers 1 through 5. Why I didn't buy these issues when I originally subscribed is beyond me--but now I'm sorry I didn't. I'm a beginner in this radio game and find your mag of invaluable assistance. Am flying pulse as designed by Howard DeLong and Bill Gaul of Chillicothe, Ohio in a "Sea Cat" and "Esquire". Very successful! (Paul--you may know Bill?)

Enclosed is my check for $1.75 for the five back issues.

Sincerely,

F. W. Benbow
Columbus, Ohio

Thanks very much for your comments. A lot of our readers are taking advantage of the back issues. In the event that you missed the back issue deal in Volume I, Number 8, we are rerunning Volume I, Numbers 1 through 6 and will have a complete stock for a limited time of these issues at 35¢ each. These may be had by remitting directly to Grid Leaks. Yes, I do know Bill and I had hoped to have something from Bill on his super-duper transmitter before now but hope it will be tied in before too long.

MORE NOTES ON THE TR 4.5

BY RED COSTLOW

EDITOR'S NOTE

Grid Leaks has presented service articles before. However, we felt the need for specific and special service techniques as evolved for equipment that is more than a little out of the ordinary. We commissioned Red Costlow, one of the designers of the TR 4.5, to give us such a service article to show you how the pros do it. Our question to you is, "Would you like to see other articles of this nature in Grid Leaks on other equipment?"

Quite a bit of interest has been created in the TR 4.5 since it first appeared in Grid Leaks (Volume I, Number 5). Reports have come in from all over the country from modellers who are using this receiver. The information that has been gathered is passed on here for the benefit of those interested.

I. Inoperative or erratic performing receiver:

Probably is due to improper soldering or cold solder joints, the most common being the transistor leads. Either the solder didn't flow, the PC base isn't clean, or when the high spots are filed off some connections are broken. In most cases just hitting suspected joints with an iron will cure these ills. This is a tough one to locate for most of the connections look all right. Some of the erratic conditions are: sensitivity to hand capacity, inconsistent level of the receiver tone, or unstable tuning.

II. Receiver breaks into audio oscillation:

This is characterized by a loud howl in the earpiece, relay pulling in with no signal, and maximum current drawn. This may happen with or without carrier. The receiver may not oscillate on a lower voltage or with fresh batteries. Old batteries may throw the receiver into oscillation so check these or substitute fresh ones. Another characteristic is excessively high idle current, indicating the threshold of oscillation. Later on we will see how to handle this situation.

III. Some receivers quit at cold temperatures:

This is surprising for all the original receivers responded well at all temperatures. Symptoms are: no range, lowered relay current, or the receiver is completely inoperative. Investigating this problem provided the answer and is the main reason for this article. At the same time the overall performance can be improved.

IV. Oscilloscope traces:

The photographs of the scope traces are of a receiver in normal working condition. The conditions that existed at the time the scope traces were made are: supply voltage 4.3V, receiver idle current 5 ma, with carrier 3 ma, and with tone 43 ma. The transmitter was sine wave modulated at 450 cycles. A 0-50 ma meter (with a 100 mfd capacitor across the terminals) monitored the receiver current. A Heathkit VTVM took care of the voltage measurements. All tests were made with full transmitter power (just under 2 watts) and with a dummy load to simulate a range of 1500 feet. Relay current should remain fairly constant with full power or with a dummy load. Three patterns are shown for each stage measured from collector to ground (See Fig. 1) These patterns are: no signal, carrier, and with tone. Modulation percentages were also checked and it was observed that the receiver current rise remained constant with modulation percentages of 70% to 100%. Below 70% the rise current started to fall off. Figures 5A and 5B show the transmitter carrier and modulated carrier. Figure 4 is a special shot of the actual carrier and modulated carrier. Figure 3A shows the simultaneous waveforms of no signal conditions at the collectors of the two T0037's and Figure 3B shows the same conditions with modulation. The upper trace is TR2 and the lower trace is TR3.

V. Temperature tests:

Extensive research revealed that temperature stability depended on the transistors and the biasing conditions. In germanium transistors as the ambient temperature goes up the collector current increases. Since collector current is proportional to the bias current it is logical that as the collector current increases we want to decrease the bias current. The converse is true as the temperature drops. There are other complex factors involved in the physical nature of the transistor but are beyond the scope of this article. Again we are dealing with the extreme conditions.

Continually changing the biasing resistors for temperature tests is a slow process so two 100K pots are substituted for R10 and R13. A third 100K pot is connected from the collector of TR3 to the junction of R13 and R14. (See Figure 2). This is marked Ra. Cardboard discs are fastened to the pots and pointers attached to the shafts. The pots are then calibrated in 10K steps with an ohmeter. Tak-solder the pots into the circuit on stiff wire standoffs long enough to clear the other components. Start any adjustments with the pots set at mid-scale. Conduct the tests at the temperature you are concerned with. At average temperatures the settings are not critical. It is a good idea to also observe the receiver current at all times. This gives an indication that the receiver is responding properly. At the same time you will be able to adjust for the best current idle and current rise. Whenever the pots are changed, check the operation with and without signal and with range checks. Some settings give good operation but kill the range. A simple way of checking range is to ground the transmitter antenna with your hand. If the current rise drops off when you do this, try other pot settings. There should be little or no difference. It takes a little while for the "parts" in the receiver to adjust to a large change in temperature so don't rush any observations.

An example of one such setup is as follows. The receiver started acting up at about 30 degrees and oscillated on 4.5V. Reducing R10 to 22K, leaving R13 at 47K, and setting Ra at 63K the receiver worked perfectly from room temperature to below zero. However, as the temperature was raised above 80 degrees performance dropped off. It became apparent that no one biasing condition would cover from extreme cold to extreme heat. The R/C man, therefore, will have to take into consideration the conditions in which he will be using the receiver. You may find that the value of Ra will have to be increased to more than 100K for operation at high temperatures. Resistor Ra will cure any audio oscillation but overall performance should be checked after inserting this resistor. It may even be necessary to adjust R10 and R13. Once the proper settings of the pots are determined note the readings on the cardboard scales. (Try and get these readings in the vicinity of standard resistor values.) Remove the pots from the circuit and substitute equivalent resistors. Drill holes in the PC lands of the collector of TR3 and the junction of R13 and R14. (Caution! Drill the holes from the bottom side of the base. It is easy to push the foil away from the base when drilling from the top.) Stand resistor Ra on end in the holes drilled.

Those who are concerned with low battery drain or improved performance can get idle currents in the microamp range while still retaining a high current rise.

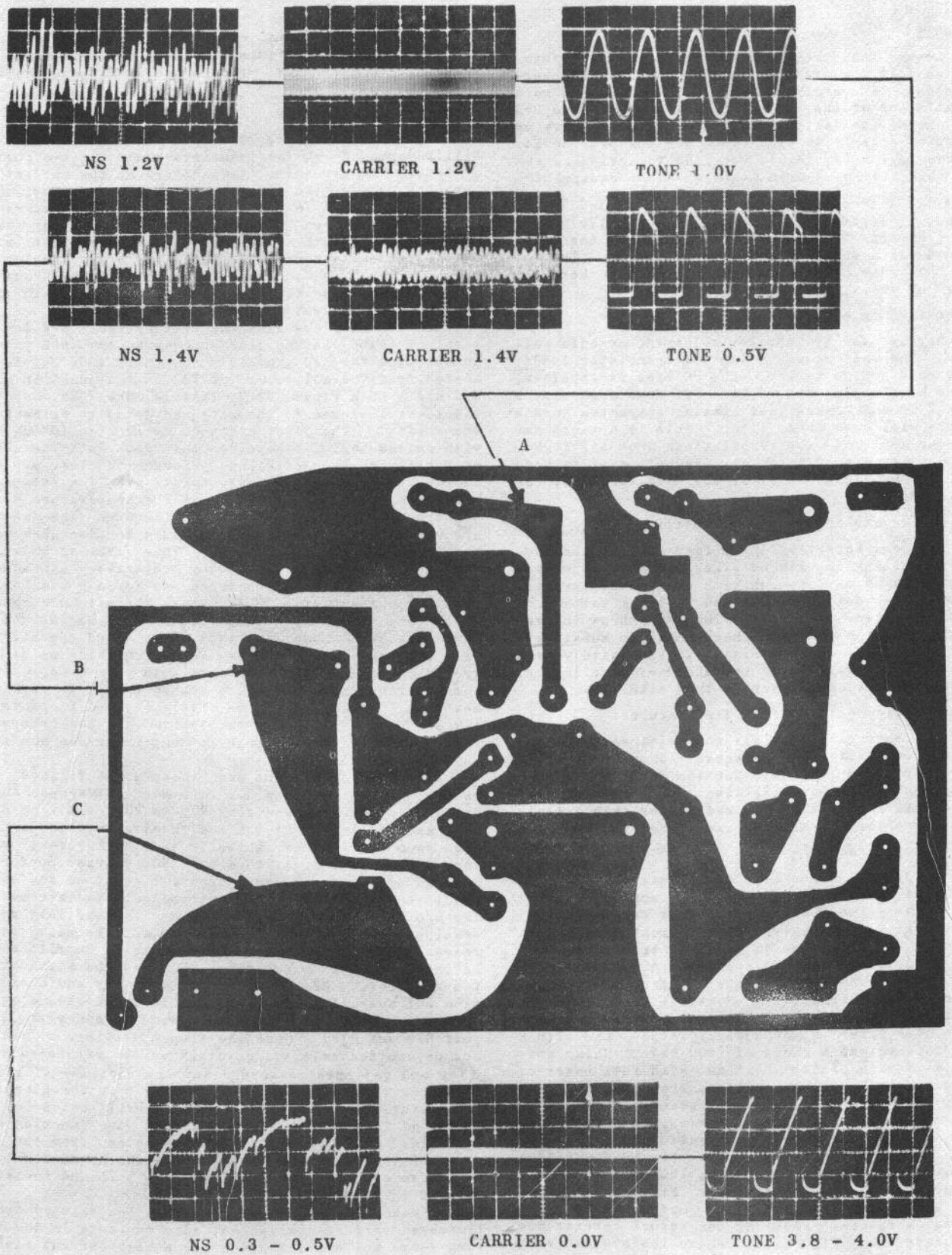

NS 1.2V
CARRIER 1.2V
TONE 1.0V
NS 1.4V
CARRIER 1.4V
TONE 0.5V
A
B
C
NS 0.3 - 0.5V
CARRIER 0.0V
TONE 3.8 - 4.0V

FIG 1

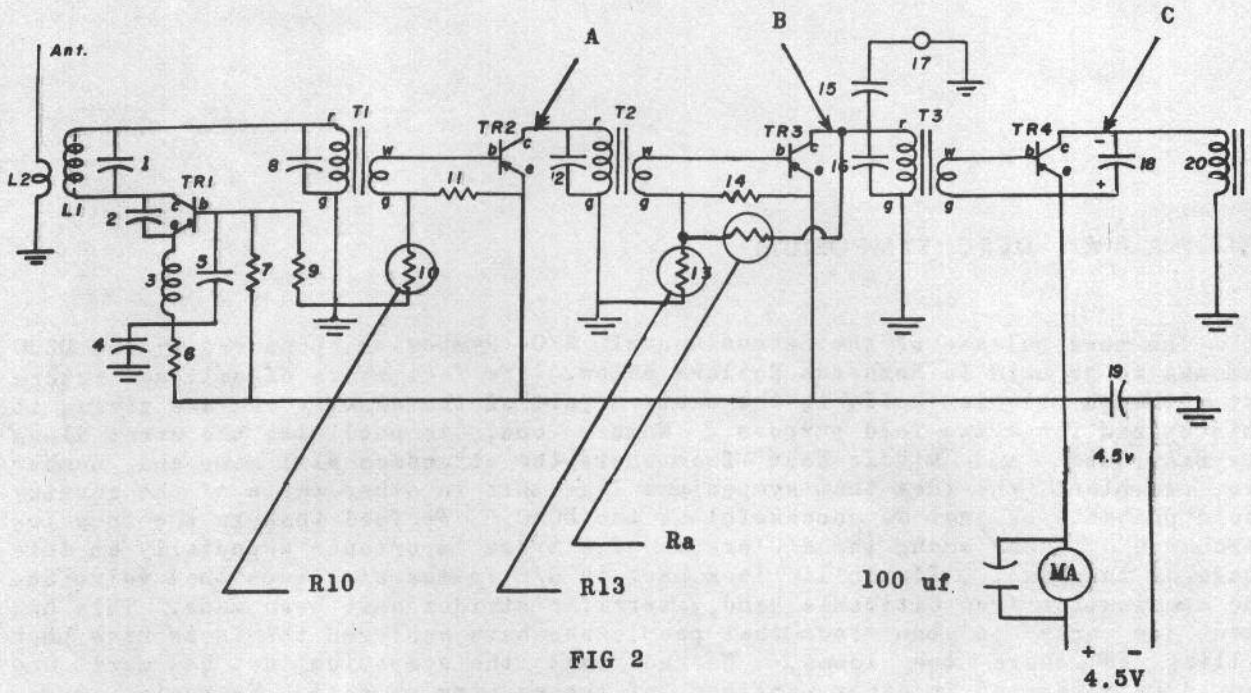


FIG 2

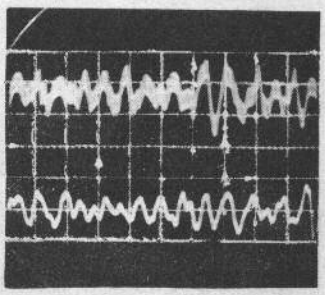


FIG 3A

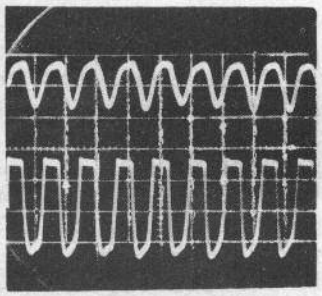


FIG 3B

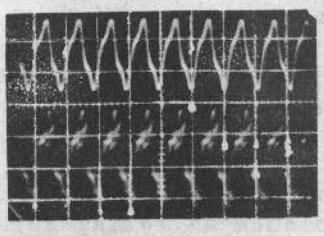


FIG 4

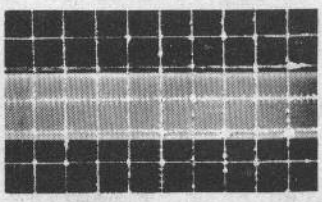


FIG 5A

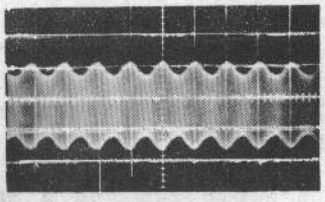


FIG 5B

SECOND AMA DCRC SYMPOSIUM

The news release of the Second Annual R/C Symposium sponsored by the DCRC and AMA to be held in Bethesda follows below. We feel it is of national interest although it is held in the eastern part of the country and are giving it this spread for a two-fold purpose. Number one, to publicize the event along the East Coast and Middle West from where the attendees will come and, number two, to plant the idea that symposiums like this in other parts of the country would probably be just as successful as the DCRC. We feel that in the free interchange of ideas among top R/C'ers is of extreme importance especially at this stage of the game. If you'll look back in R/C in the six years that we've had the examination free Citizen's Band, terrific strides have been made. This has been due only to the fact that people who have achieved the ideas have been willing to share the ideas. We feel that the symposium idea has merit and should be attempted in other portions of the country as well. We would appreciate being advised of any of these and would like to get an invite, HI!

The program for the Second Annual R/C Symposium, sponsored by DCRC and AMA, has been announced by Hank Bourgeois, DCRC president.

On Saturday, April 11, two technical sessions will be held at the Perpetual Building Assn., Wisconsin and Montgomery Aves., Bethesda, Md., starting at 10 a. m. The symposium dinner will be held Saturday night, and there will be flying demonstrations on Sunday.

Among the speakers who will give technical talks, keyed to the average R/C builder, are: Woody Blanchard, NASA, Hampton, Va., aerodynamics of R/C models; Maynard Hill, Pittsburgh, Pa., metallurgy for R/C; John Worth, NASA, Hampton, Va. Simpl-Simul; Larry Herzog, RCA, feedback applied to dual proportional; Howard McEntee, Norwood, New Jersey, R/C transmitters and antennae; and Harold DeBolt, Buffalo, N. Y., R/C engines.

Other presentations will also be made, and there will be displays of new commercial and home-built R/C equipment.

Attending the symposium can be a family affair, according to DCRC, as the weekend is also the date for the famous Cherry Blossom Festival in Washington. A committee has been formed to assist wives and families who want to go sightseeing while the men attend the meetings.

The symposium dinner on Saturday night will be a church supper, family style, at a cost of $2 per person, with a special rate for children. There will be an after-dinner speaker and entertainment, including skits by the R/C fraternity.

On Sunday, the flying demonstrations will be held at 10 a. m. at the DCRC flying site. Similar maneuvers such as rolls, spins, etc. will be accomplished for comparative purposes by models having free ailerons, coupled rudder-ailerons, dual proportional, reeds, simple simul and other systems. Flight-line flying will be allowed before and after the flying demonstrations for those who would like to bring their models.

The symposium fee is $2, and includes a copy of each of the papers presented at the technical sessions. Those attending are expected to make their own reservations. Motels in the Bethesda and Silver Spring, Md. areas will be most convenient.

DCRC advises that the Washington area will be crowded with tourists during this Cherry Blossom weekend, and strongly urges that reservations be made as soon as possible.

A copy of the program and a map of the area showing meeting sites and motels has been sent to eastern R/C clubs. This information is also obtainable by writing to George Wells, 10004 Thornwood Rd., Kensington, Md.

Meters are MUSTS in RC

STRICTLY FOR THE BEGINNER

In a casual conversation at one of our hobby jobbers the other day, we ran into a dealer from an isolated community where there is little R/C. He was complaining about a well-known make radio controlled receiver (manufactured by one of the oldest and largest manufacturers) and the difficulty the boys were having in his community.

He admitted frankly there were no radio men in the crowd and further conversation with him revealed that they were attempting to tune by ear!

We asked further details. "Oh," he said, "we listen for the relay click and then try to tune to see that we get the relay click." We inquired further as to whether they used meters. Came the question: "Meters? Are you supposed to use meters?" It came as a surprise to us that instructions which were furnished by this particular and other manufacturers could be so obviously bypassed. Any CW receiver (and these were all CW receivers) can be tuned by ear but it is extremely a haphazard proposition and very unlikely.

The use of the meter is to be highly recommended to the beginner in R/C. The meter is just as essential as the battery for his engine glo-plug starting. Old timers couldn't and don't do without either.

What type of meter to use is another question that we were asked. We expressed our opinion of a moving coil type of probably a 0-5 milliamps would provide the best bet. The moving coil being chosen for the reason that it had the least internal resistance and it would not detune the tuning. Some of the iron vane meters that are fairly inexpensive have an internal resistance of from 300 to 500 ohms and while they will tune the receiver can easily cause a detuning when the meter is removed from the circuit as it would have to be.

We asked further, if he had a volt meter to check his battery voltages to make sure that the battery voltages were up to the required minimum as specified by the manufacturer. No, they didn't have but they were using fresh batteries and they should be perfectly all right.

Here again, was an instance of the manufacturer's instructions not having been followed.

Meters are essential for enjoyment in R/C. Buy the best meter you can afford in the milliamp range required or, if possible, buy a multitester which will provide milliamp ranges as well as volts and also give you a continuity check through the ohm meter.

These are quite inexpensive and some are on the market for as low as $16.50. Of course, the higher priced ones manufactured by such names as Simpson, Triplett, and RCA and others are much to be desired but the inexpensive jobs are adequate and will do a nice job for radio control.

Now, how do you use meters in radio control? Why are they so essential? Why can't you tune up a CW receiver using the relay click as the indication? In practice, the 0-5 milliamp meter or multimeter with roughly that same scale is inserted in the B plus lead of most CW receivers. It may also be inserted in the relay stage of audio receivers although these are easily tuned by using headsets.

The receiver is then switched on and the meter reading observed. On most single hard tubers the idling current varies between 2 and 3 mils depending on which receiver it is. Upon receipt of signal, when properly tuned in, this will drop from .5 to 1 milliamp depending again upon the make of the given receiver.

It has been found to avoid fly-aways that range checks must be made with the meter in the installation. This is quite readily done by using a phono type jack and using two plugs one of which is connected to the meter, the other of which is shorted and is used while the plane is in flight.

Simply fasten the RCA plug in such a way that it is permanently afixed to the small 0-5 meter if this is what you are planning to use. Many builders connect the strap of synthane or other insulated material across the two terminal points of the meter and mount the RCA phono plug permanently on this insulator strip so that it may be readily inserted in the jack.

Another recourse is to use the standard closed circuit type of jack which, of course, requires no shorting plugs since when the phone plug is removed, the jack automatically closes its circuit.

These are available in sub-miniature sizes as well as miniature sizes. The miniature size has much to recommend it if the installation can bear the weight.

To tune, follow the manufacturers instructions to a letter, but generally, the procedure is to take a range check in excess of 300 yards to make sure that you have range in the air. The range check is done by having a buddy key the transmitter while the plane is being taken away observing the meter periodically. See Volume I, Number 4 of Grid Leaks "Develop Your Own Count Down" for further details.

Battery voltages also must be checked and kept at the operating levels for satisfactory results since flyaways can result when the battery voltages become marginal since receiver malfunction happens quite easily.

All in all, we told our friend that they shouldn't blame the receiver until all these possible points were checked. Current radio receivers today from the simplest to the more complex are getting more and more dependable but we still must take in account the human element.

It is quite possible by using a simple 0-5 milliamp meter to construct a multitester at home. A moving coil 0-5 D'Arsonval type is highly recommended. These may be purchased with an already wound shunt although a shunt may be quite readily wound for it by referring to the article on "Meters, Internal Resistance, Shunts" in Vol. I, No. 8 of Grid Leaks by Jerry McGeorge.

To use this as a volt meter, it is necessary to use the meter less shunt and add resistors in series to increase the range. By adding resistors of different sizes, different voltage ranges may be had--5, 50, and 250 volts being probably the best ranges available for R/C work.

To find the required value of resistance when the milliamp meter is to be used as a volt meter, the value of series resistance can be found by Ohms Law. This is $R = \frac{1000E}{I}$ where E is the desired full scale voltage and I the full scale reading of the instrument in milliamperes.

The accuracy of a volt meter depends on the calibration accuracy of the instrument itself and the accuracy of the multiplier resistors. Precision wire-wound resistors are to be recommended in high quality instruments but for most purposes, the standard ½ watt composition resistors will make an acceptable and economical substitute. Such resistors are supplied in tolerances of either plug or minus 5% and these are to be recommended. To obtain a voltage reading of 5 volts on the 5 milliamp scale, let's do some substituting in the formula we had shown above. If $R = \frac{1000 \times 5}{5}$, this comes out to 1000 showing that a 1000 ohm resistor is required.

Further substitution for 50 volts will show that

this will come out to R equals 50,000 over 5 or 10,000 ohms resistance required in series.

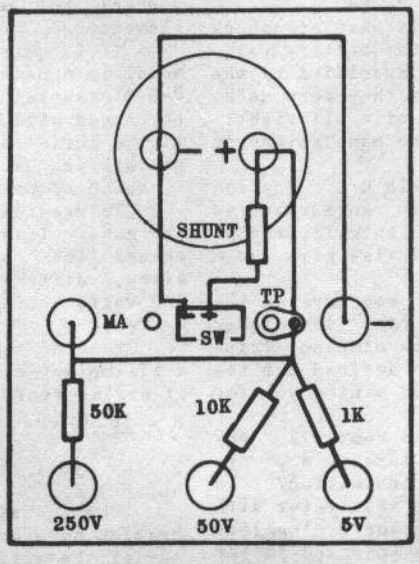
For 250, the formula comes out R equals 250,000 over 5 or a showing that a resistor of 50,000 ohms is required.

Thus, using this formula it is a simple procedure to convert your 0-5 precision meter to a simple and economical multitester. A diagram is shown. No particular construction details are given. The unit may be housed in a metal box or a wooden cabinet of any convenient size, provided the size is large enough to accommodate the meter. It would be recommended that pin jacks be used at the ends of each of the resistors to avoid the complexity of a multiple selector switch. In practice, then, the negative lead is left in negative and with the positive lead being plugged to the desired voltage or current range required.

To use the 50 ma shunt, a switch is added so that it may be put into the circuit. On voltage readings, be sure the switch is in off position so shunt is not in the circuit.

No construction details will be given since much of this can be built from junk box material and should provide for an instrument which will greatly increase your R/C knowledge and R/C fun.

Yes, meters are an integral part of R/C as any oldtimer will tell you.



SUPERHET RC RECEIVER

BY LEONARD CHIOMA

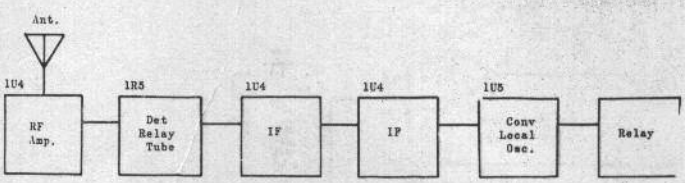
For a number of years the gas tube was used almost exclusively as a superregenerative CW detector for radio control receivers. This type of circuitry exhibited a rather high degree of sensitivity, however, the selectivity left much to be desired. In addition, aging would alter its oscillating capabilities often to the point of complete failure to operate. Many modellers need not be reminded of the end result!

Of the hard tubers, single tube jobs, sensitivity was always a problem and selectivity was still very broad because straight superregen detectors are roughly plus or minus 300 KC.

The other receivers of the audio type, single and multi channel, also used the superregen detector which although hard tube still was on the non-selective side. After asking many of the modellers, in 1951, spending a considerable amount of flying day in continuously range checking and always with a small degree of confidence in what will happen next, a new approach was taken. This was the beginning of the first 27.255 mc super het. Constant reliability rather than maximum sensitivity was the main prerequisite in this design.

The superhet, while more complicated, provides considerable advantages over the simple superregenerative receiver. First is the inherent selectivity which is of utmost consideration. Secondly, once set up this type receiver needs no continually adjustments prior to flying.

A description of a superhet operation is as follows See the block diagram--



The incoming RF signal is coupled to a RF transformer tuned to the desired frequency. This signal is fed to the grid of the RF amplifier. At these frequencies, low gain is achieved in this stage, however, two factors make the use of an RF stage desirable. One is the reduction of antenna capacity effects on the receiver, second is the isolation of the oscillator from the antenna. This prevents radiation of the oscillator frequency.

The RF signal is tuned in the RF amplifier plate circuit and capacitively coupled to the signal grid of the converter tube. This circuit also helps provide selectivity and gain to the desired input signal.

The converter is where the incoming signal is heterodyned to a new radio frequency, the intermediate frequency (IF). One portion of the converter tube is a Hartley oscillator and coupling of this oscillator voltage is accomplished by the electron stream. The incoming RF and oscillator voltage are combined, the difference frequency being the IF frequency. Actually there are four signals at the plate of the converter, the RF signal, the oscillator signal and the sum and difference of these two RF frequencies. A selective circuit in the plate of the converter picks out the difference frequency and discards the others.

Some tubes are called detectors or mixers as well as the converter type. The main difference is the manner in which the local oscillator voltage is developed and coupled to the particular tube.

The output of the converter is now at a much lower frequency (IF) and here again additional selectivity, but at much higher gains occur. To provide good receiver sensitivity, two IF stages are utilized. This encompasses two tubes and three IF transformers. The output of the last IF transformer is coupled to the diode section of the detector-relay amplifier tubes (1U5). The IF signal is rectified, filtered and directly coupled to the grid of the relay amplifier section of the tube. When a CW signal is received by the receiver the rectified output of the diode becomes a negative voltage, the amount being dependent on the strength of the incoming signal. This negative voltage cuts off the relay amplifier section which is normally drawing maximum plate current thereby maintaining the plate relay closed. Once the tube is cut off, the relay opens and activates a control device such as an escapement.

This detector voltage is a measure of the receiver's sensitivity and the voltage should be as high as possible upon receipt of a signal. This means that range is proportional to signal, the greater available the further it is possible to activate a control system. Nominally, a weak coupled signal to the antenna lead will produce about -30 volts at the detector.

The additional weight of the superhet is outclassed by reliability of operation. Certainly one who spends months in preparing a first class model is quite interested in its safety and longevity of operations. This, the superhet will certainly provide. While this present model is only set for one channel operation, future models will be designed for tone operation with multiple channels.

No construction data will be given since this is not a job for a beginner. A full size chassis layout has been provided while construction is straight forward to the more experienced by merely following the schematic.

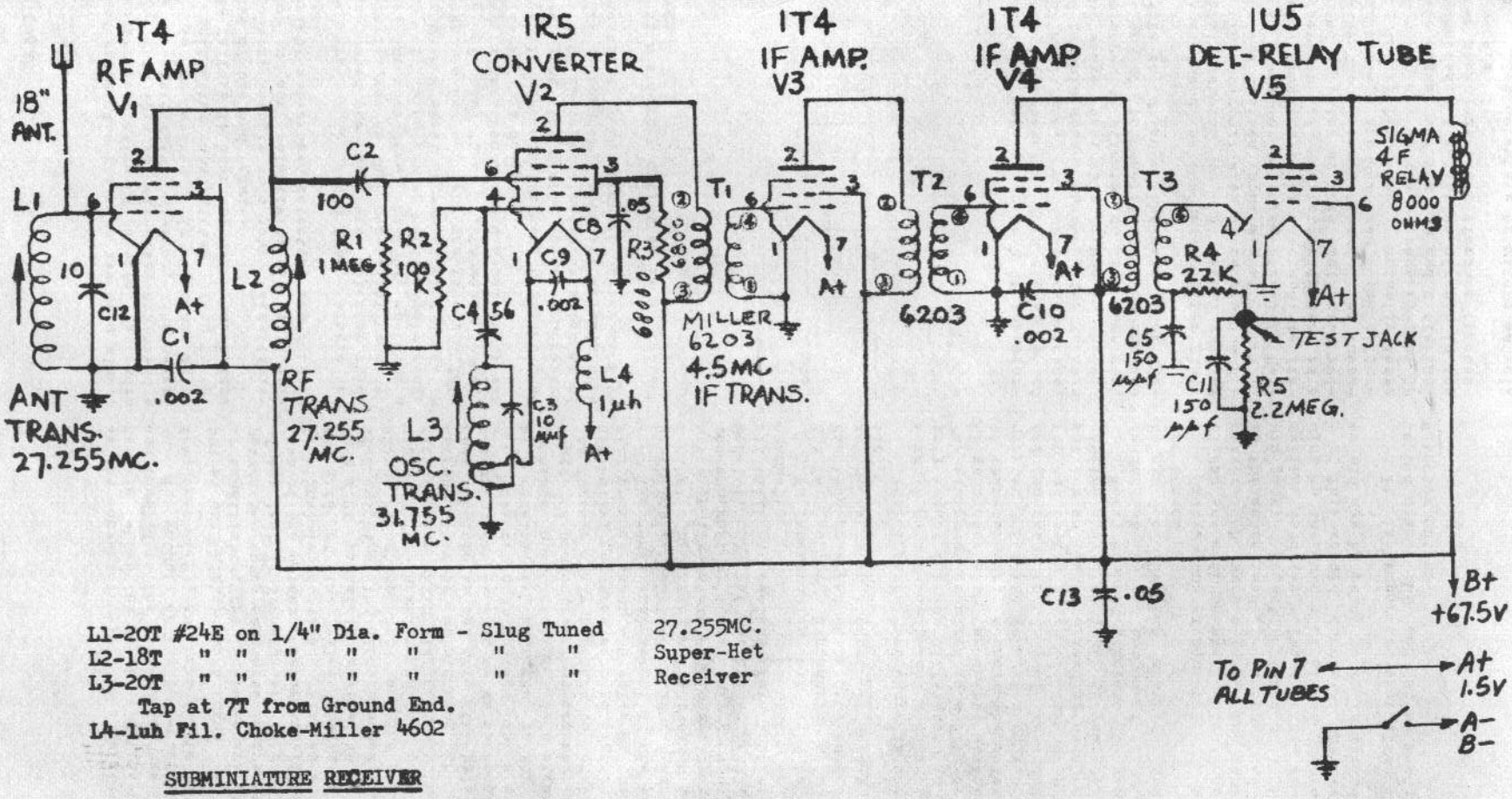
The alignment procedure is very similar to aligning a small portable superhet receiver of the broadcast variety except for the differences in frequencies involved. The equipment required is a VTVM or a Simpson 260 and an RF generator with an output attentuator. To align the IF transformers, connect the meter to the detector test points. Set the generator to 4.5 mc and connect a signal generator to pin 6 of the second IF tube. Adjust top and bottom slugs of T3. Keep signal generator output low so that overloading does not occur. This precaution should be taken as you progress.

Next connect generator to pin 6 of first IF tube and adjust top and bottom of T2. Connect the generator to pin 6 of the IR5 converter tube and adjust T1, top and bottom.

Change the frequency of the signal generator to 27.255 and clip to the insulated antenna lead of the receiver. Be sure a lead, the same length as to be used in the actual model, is connected to the antenna input pin jack. Adjust antenna coil L1 and RF coil L2 for maximum detector voltage. This reading will vary depending on the output of signal generator used.

This should complete the tuning and the receiver should now be ready to be installed.

It is important that after the receiver is placed in the model, L1 and L2 be readjusted for the maximum detector output.



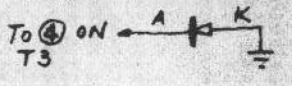
L1-20T #24E on 1/4" Dia. Form - Slug Tuned — 27.255MC.
L2-18T " " " " " " " — Super-Het
L3-20T " " " " " " " — Receiver

Tap at 7T from Ground End.
L4-1uh Fil. Choke-Miller 4602

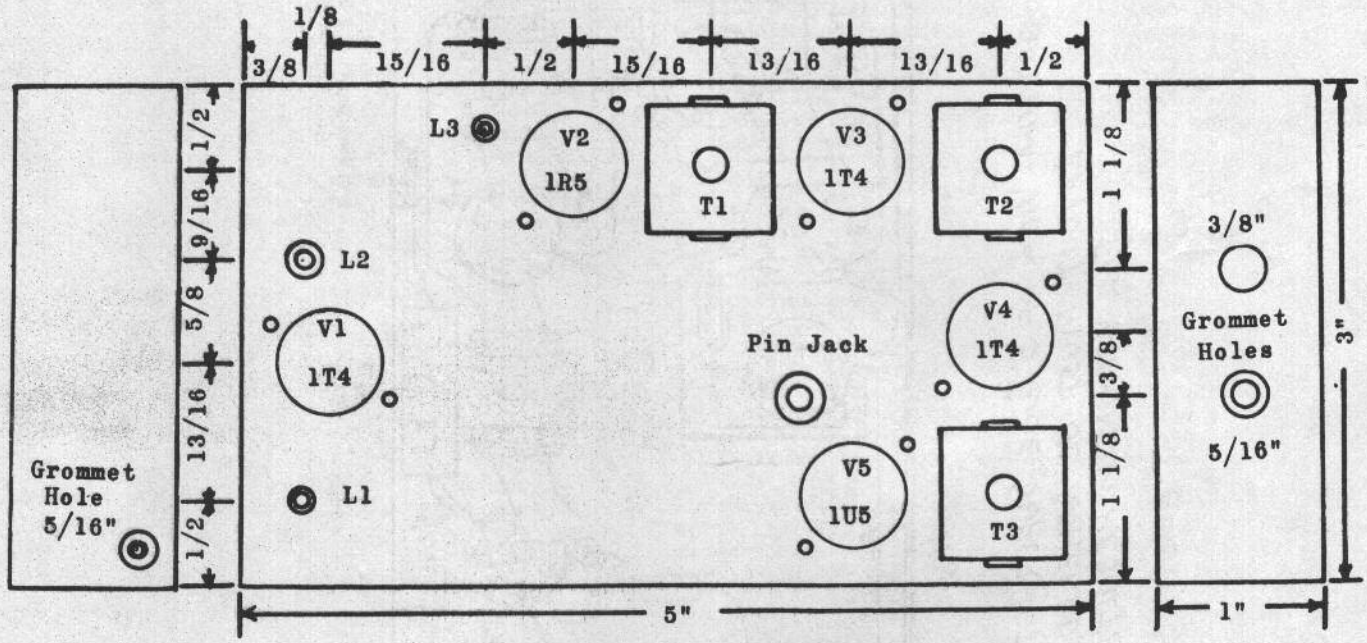
SUBMINIATURE RECEIVER

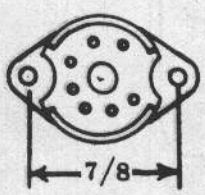
V1, V3, V4 = 5678
V2 = 1R5
V5 = 5672*

* DIODE REQ'D TO (IN70, IN34A)
REPLACE DIODE SECTION OF 1U5

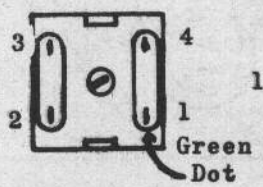


Leonard Chioma

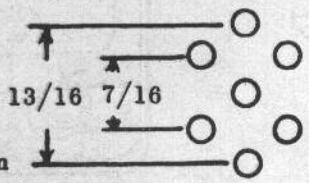




Mtg. Centers Typical for all Tubes. 5/8" Hole Required.

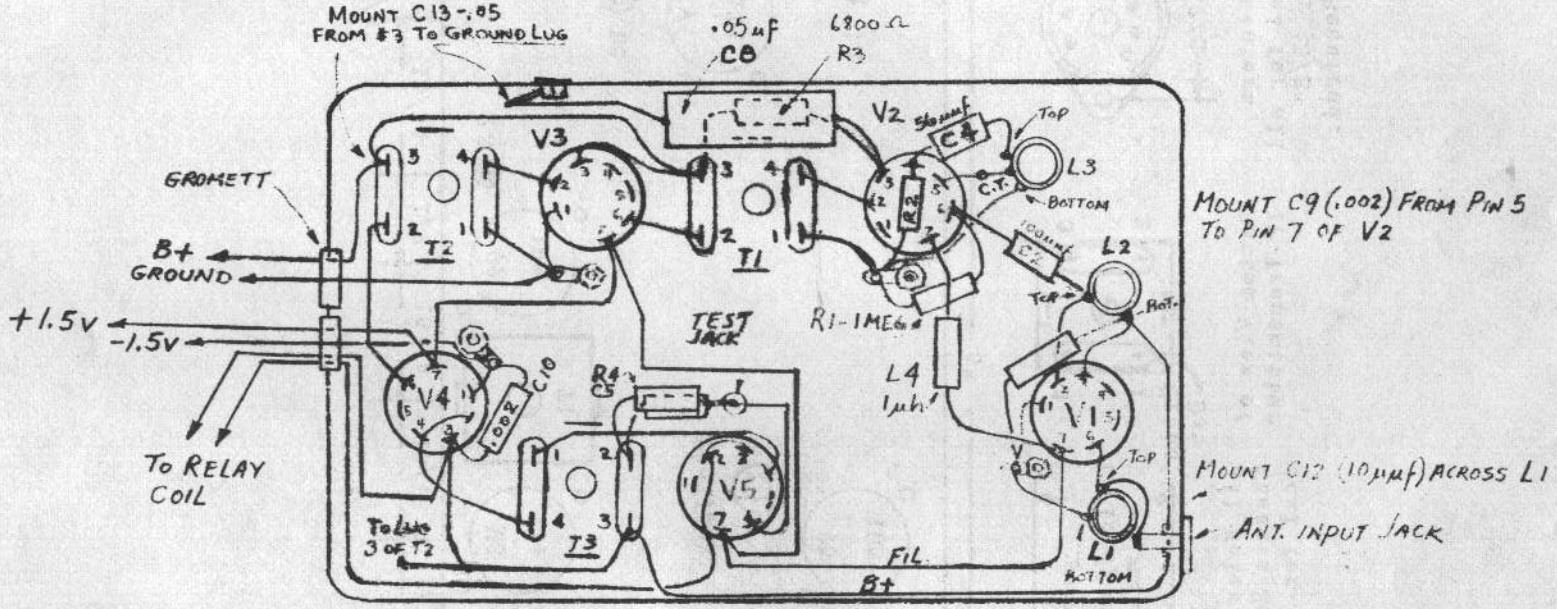


Bottom View of IF Transmitter



All Holes 3/16" Diameter Chassis Hole Layout Typical for T1, T2, and T3.

(Alternate Cutout)

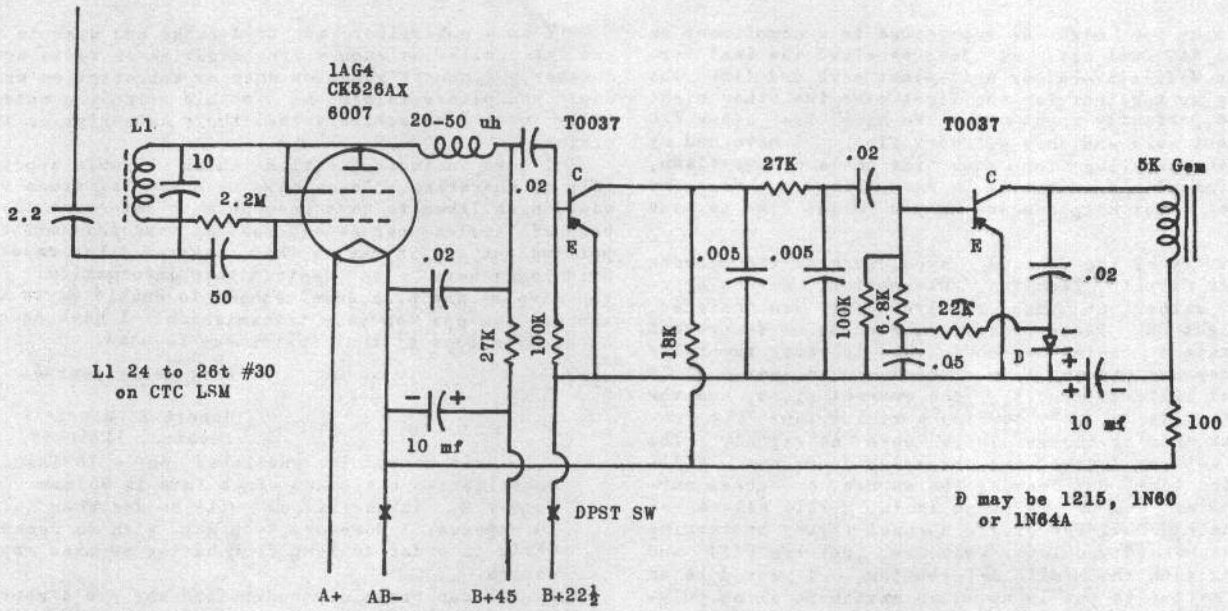


BOTTOM VIEW OF 5 TUBE SUPERHET
LAYOUT MUST BE ADHERED TO
FOR MAXIMUM RESULTS

LEONARD D. CHIOMA

Fail Safe Tone Receiver

BY NEIL DELAFIELD



Neal Delafield of Beaumont, Texas is with us again with two variations of the same circuit. Neal calls this his fail safe tone receiver and the circuit shown at the top of the page is for 45 volt operation and the bottom of the page is shown for 22½ volt operation.

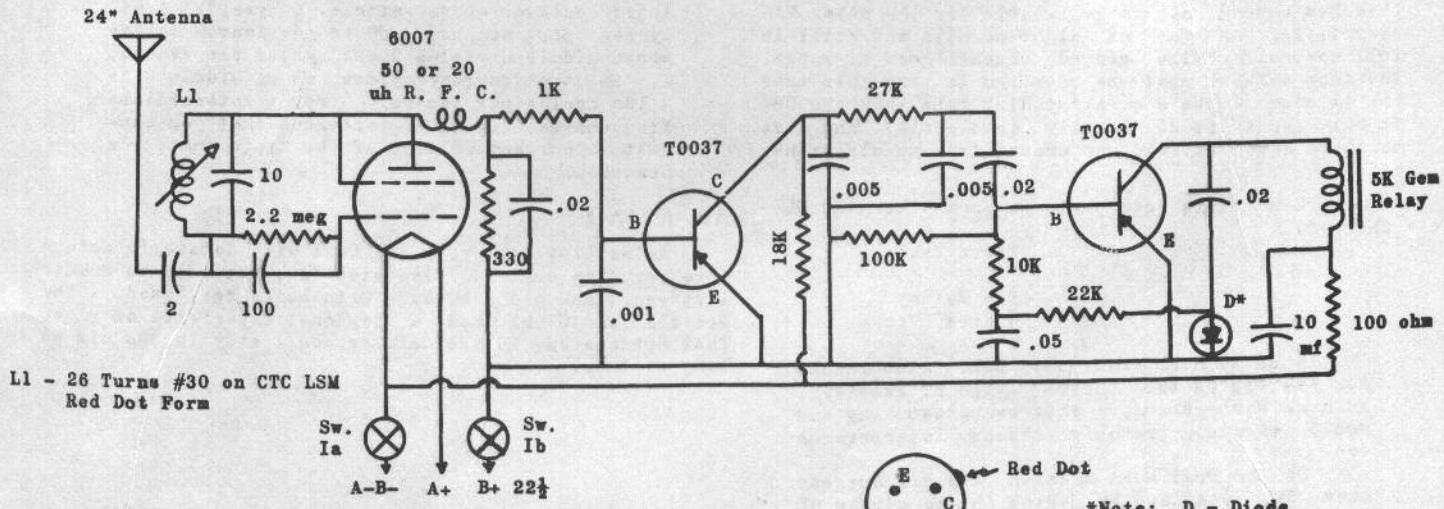
Both of the circuits should be used with a constant carrier transmitter with the key in the tone circuit or with a key in the carrier circuit of the CW transmitter in a normally closed key. When a carrier is broken relay will pull in from the rectified hiss which develops a negative (minus) voltage across the diode and applies it to the base of the last transistor causing it to draw current and close the relay.

No base layouts are given since only good building practices should be used. This includes the separation of the tank coil and the rf choke and keeping them away from the balance of the components.

With some tubes it may be necessary to substitute a 33 or a 51 mmf in place of the 100 mmf grid resistor.

The selection of the diode is not critical. Neal has tried the Federal #1215, Sylvania 1N160, CBS 1N64A, and says only that all diodes as with transistors should be checked for optimum performance in regular circuits.

Both circuits are current rise receivers and we are offering them for the serious R/C experimenter, not as tried and proved circuits, but circuits that have worked well for Neal and which other R/C experimenters may want to try to see what luck they have.



Bottom View of Transistor

*Note: D = Diode
May be Federal #1215, Sylvania 1N60 or CBS 1N64A, etc
Not too critical, but some work better than others.

BITS & PIECES

CW RECEIVERS BECOME AUDIO

Thought you might be interested in a compliment on your fine WAG Dual kit. I just received the last portion--the Modulator-Pulser unit--last week and fired the whole rig up together for the first time the other night It worked perfectly right off. We have two other WAG systems out here and they all work fine. I have had my RF section operating for some time now and have flown, using a friend's transmitter. From this, I have a few hints that might help someone or you might like to pass along.

1. Receivers of the "noise" type, such as the Babcock "Magic Carpet", Tech Two, Wavemaster, may be operated either as tone receivers or, as designed, straight CW. These receivers, when no CW is present, generate a "noise" which is used to cause the relay to drop out and the idle current to be lost. A CW signal kills this noise, the current rises, and the relay pulls in. By sending a steady tone, the receiver acts as though there were no signal. The tone acts as "noise" and the relay drops out. Killing the tone, but leaving the carrier on causes current rise and the relay pulls in. This allows use of the WAG Dual for single channel flying by turning on the RF and Modulator switches (pulsers off) and keying with the fail safe button. It would be an easy matter to put in an extra switch to allow pulsing of only one tone on or off for single channel pulse work.
2. The WAG Dual MOPA section was apparently never designed to be pulsed CW by pulsing B+, as it takes a fraction of a second for the RF to "build up" and unless the pulse rate is very slow, this will not work unless the oscillator slug is backed off about two turns. This causes the 3B4 to draw too much current resulting in short tube life for this expensive tube. It may be possible to pulse the 3B4 separately but I haven't tried this.
3. The 3B4 in the WAG is a fine tube but expensive and completely unavailable from local radio parts houses. I switched to a 3A4, as did one other WAG user here. This causes about a 5% to 10% drop in output, but this has caused no range trouble for the other WAG user flying as far as sight permits and still in full control. Mine ground checks good at range. The tube socket must be rewired to take this tube but it seems to be a more "stable" tube than the 3B4. It only costs $1.25 locally (wholesale) and most modelers have an old one around from an old transmitter.

Well - hope this can help someone - keep up GL--it's the best.

Yours truly,

Bob Talley
Groves, Texas

Good to hear from you, Bob, and thanks for the tip on the "noise" type of receiver, such as Babcock etc. This bears watching and would certainly probably reduce interference too.

On the Dual MOPA section, I would suggest that CW be pulsed by keying in the screen of the 3B4 allowing the 3V4 to be oscillating all of the time.

Keep your tips coming.

DETERMINING AUDIO CPS

I am a subscriber to Grid Leaks and wish to thank you for publishing such a fine magazine on radio control. However, I cannot remember when my subscription expires. Could you please inform me on this or do you automatically notify subscribers that their subscription is expiring?

I have another question which I would appreciate help in answering. There have been several times when I would have liked to have been able to determine the number of cycles per second that my tone transmitter was putting out and it may be that several other readers of Grid Leaks have also desired this information. Could you give me any procedure methods to enable me to obtain the various cps on tone transmission. I have access to an oscilloscope if that instrument is used.

Very truly yours,

Robert S. Monroe
Decatur, Illinois

Grid Leaks is published on a 10 issue subscription basis and since this is Volume I, Number 9, subscriptions will be due when No. 10 appears. However, you may wish to renew early in order to keep from having to miss any copies.

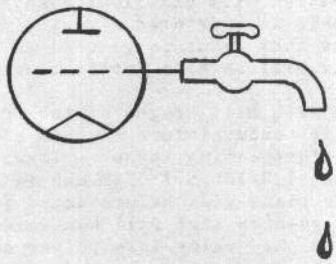
I can certainly understand why you'd want to know your audio cps and lacking an audio generator, this can create quite a problem. However, the simple solution is found in the Radio Amateur's Handbook published by the ARRL. The system simply uses a piano. It means, however, that a receiver capable of receiving the audio frequency signals must be available. Or the monitor which is featured elsewhere in this issue could quite easily be used. On a piano, G#2 which is in the first octave below middle C will yield audio cps of approximately 208 cycles per second. Middle C is 262 cycles per second and G#3 is up in the first octave above middle C yields a cps of 415 cycles per second. C4 in the second octave above middle C yields 523 cycles per second. C5 in the third octave above middle C yields 1,047 cycles per second. C6 in the fourth octave above middle C yields 2,093 cycles per second. C7 in the fourth octave above middle C is 4,186 cycles per second. For intermediate frequencies, we would recommend that you consult a current edition of the Radio Amateur's Handbook.

HAD A BALL

Am setting in your WAG Dual with Tomoser's actuators for this summer. Flew with WAG, but only on rudder last year and had a ball. Grid Leaks real good. The article on UPOMA had a personal experience of mine. That Springsted is the main reason I stay in the air as long as I do.

Glad to hear you had a ball with rudder only. Wait'll you try elevator, friend! This will really give you a ball. Glad you liked the UPOMA article. Take a bow. Dale.

Grid Leaks At Play



Dear GL Reader:

Bobbie and I have just returned from the HIAA show in Chicago at the Hotel Sherman where we took in what's new for 1959 in the hobby industry.

Of course, our chief interest was in the radio control end and the hottest items apparently from the standpoint of interest were the superhet receivers offered by both CG and CitizenShip.

CG, with their single channel Mercury, will give selectivity on all of the newly assigned frequencies of the FCC.

To change from one channel to another, it is merely a matter of changing the subminiature plug-in crystal which, we understand, runs approximately $13.00. The price of the single channel Mercury, using five transistors is $54.95 less crystal. It operates on 3 volts.

The 8 channel Atlas uses an 8 channel reed bank and features simultaneous operation on all six of the FCC frequencies. Again, it too is crystal controlled using a subminiature crystal. To change tuning, simply plug in a new crystal. Operates also on 3 volts, uses 13 transistors, and is $139.50 less crystal.

Also new from CG is a single channel pioneer all-transistor receiver 3 volt operation which is 1½ x 2 3/5 inches, using no relay, but operating the actuator directly for $21.95. It is not housed in a case but should be fine for the smallest of R/C models.

CitizenShip, in showing their new superheterodyne selective transistorized receiver have a price tag of $69.95. It, too, is crystal controlled and may be used on any of the six frequencies. Uses a single 9 volt battery and is a neat, compact unit.

Their new model SS-MSR-8 is their superheterodyne selective multi simultaneous 8 channel receiver for $149.95.

Also new from CitizenShip is their all-transistor tone receiver for 3 volts on the 27 band. This is not selective but is a superregen that sells for $39.95. CitizenShip also introduces a matching transmitter, the CTX which may be either used for tone or CW on single channel at $39.95.

Among the other new items that took our eye was the new Wavemaster receiver replacing the old two tube job carried by Aristo Craft and Polk's. This is a one tube two transistor job and requires only 1½ volts A and 22½ volts B. Idle is .6 mil and upon receipt of CW signal relay current change is 4 mils. Uses a new XF34 imported tube, has only an 18 mil filament drain. Total weight in a protective case is 1 3/4 ounce and according to Gil Rose the price will be attempted to be kept at $19.95 which was the price of the old Wavemaster assembled.

Also from Aristo, a complete new series of Cermag motors going from ridiculously low prices for the ultra small ones to the Pitman size type at $5.00. These will be available about March 10 it is estimated.

Also noted that Eveready has a nickle cadmium battery in the AA pencell size that sells for $2.10 list, which has a 450 milliamp hour rating. This should find approval with the modeler provided they stand up under modeling use because we have commercially available battery boxes which will fit these.

Attending the Trade Show was a fine experience because it gave us an opportunity from our standpoint to chat with many fine people. We had an opportunity to talk to some of our top designers and the hotel room was one of those typical smoke filled room for all of the afternoons and evenings. In the morning is when we attended the Trade Show.

Here at Grid Leaks, we are extremely thrilled with the way you readers have responded to us by sending us your material. We are at a point now where we don't have to scratch for every issue and we feel that we are bringing you increasingly diverse material because of the increasing number of high grade contributions. This is most gratifying especially in view of the fact that Grid Leaks still is not in a position to pay contributors by virtue of the fact that we definitely want to keep advertising out because of your many requests.

We go along with you, this is your magazine. We want to make it a sounding board for R/C and our main purpose in having it is to breed the exchange of R/C ideas, experimental and proven, which leads to the development of a better radio control program throughout the country.

Among the many exciting things that are in the works and on the drawing boards for future issues is the new twin simul receiver and transmitter by Marcy Inkmann. Those of you who have had the fantastic luck that many of you have had with the single and six channel Marcy receivers will be pleased to note that Marcy has developed a very simple receiver using two of the channels into a twin simul receiver when used with the twin simul tone generators. The twin simul tone generators generate the two tones required and they may be either operated separately or together. This offers many fine applications for use since many times it would be well to have an extra channel without too much added expense.

Also with the series of articles coming with this will be how to convert the present Marcy single channel transmitter to the new system without a great deal of fuss and feathers. It's simply a matter of changing the 3A5 multivibrator to a two tube amplifier. This, then, is fed by the transistorized signal generator which may be activated by push button or by a new twin simul pulser.

We will also show in the succeeding issues how to use this as a dual dimultaneous control along with motor control using the rudder actuator as a servo switcher to drive a Bonner servo in either retard or extend for motor control so that you have not only twin proportional control but trimmable motor control with the least fuss and feathers of any we've seen yet.

Also in is a printed circuit base for a transistorized pulser which, apparently, is proving out very well in the California area. We'll have more about this in future issues.

We also have from Dale Springsted, a printed circuit board and a very neatly assembled 8 channel reed receiver built around the Pierce receiver which appeared

in the January, 1958 issue of Model Airplane News and which many of you have assembled with excellent results. We feel that, by offering this as a printed circuit, it will enable many of the boys that want to go reed to go reed the easiest way. This will be also forthcoming in another issue.

By special arrangement with Bill Grogan of the DCRC area, we will present his subminiature Micro-X all-transistor receiver in a forthcoming issue. The receiver with relay measures 1 3/16" x 1 3/4" and is as tall as the relay. Complete plans will be presented for this as well as some other goodies that Bill has worked up for the TTPW system such as relay-less pulser and modulator.

Many other fine contributions have come from you and they are just too numerous to list or mention.

We hope, however, the fact that we've bragged about how many contributions we have will not deter you from sending yours because this is your magazine. Grid Leaks was founded with the idea in mind that there should be some intelligent interchange of ideas among the R/C fraternity and it would help the entire crowd. While many of the circuits presented in Grid Leaks are strictly experimental circuits, they do offer much to help the development of R/C in this country.

We've had many requests to go monthly. We wish this were possible but there are two factors. One is first off, there has been a lack of material which does seem to be curing itself but there is also a further lack of time. We are not crying on your shoulders but we wonder how many of you realize how much time goes into an individual issue of Grid Leaks!

Until such a time that Grid Leaks reaches a stature where it can afford to hire an editor and someone to devote full time to it, it must remain on a bi-monthly proposition. We're sorry about this but we just feel that we cannot break faith with you by accepting advertising and therefore increasing the revenue. Fortunately, Grid Leaks subscribers are increasing daily and it is entirely possible that one of these years we may reach that point.

Meanwhile, it is fine to share with you many of the exciting things that are happening in 1959 in radio control and we look forward to being with you the rest of the issues during 1959.

Yours sincerely

Paul

Grid Leaks

HIGGINSVILLE, MISSOURI