GRID LEAKS

R/C DATA SERVICE

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BOOM IN RC BOATS

It doesn't take a crystal ball to foresee that there is a boom in R/C boat modelling heading our way. This is due to two things. First, the major model manufacturers have been producing excellent kits which beginners have little difficulty in assembling into realistic models. This is largely due to the excellent work being done with plastics. Secondly, radio control is serving as an added interest in boat modelling. Not only do many pilots want also to have boats, but outsiders who have never been in R/C before are coming in and choosing model boating as the easiest way to get their feet wet literally and figuratively.

Also the appearance of ultra dependable low priced radio control kits coupled with concern on the manufacturer's part to make them really simple and easy for the novice to assemble has done much to help increase the boom in R/C model boating.

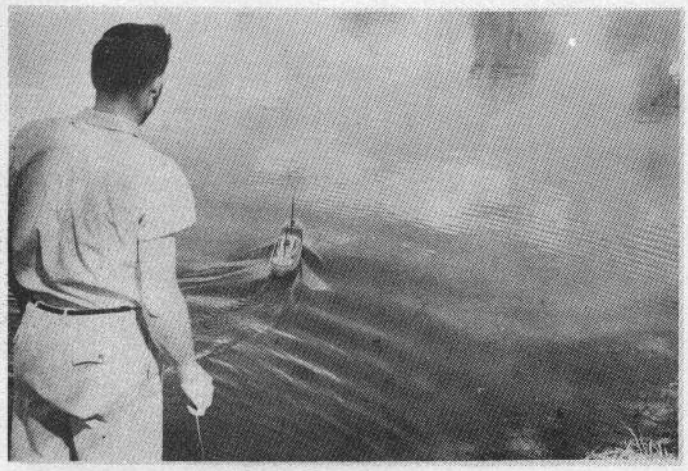
One of the major problems for the beginner is to select the right model. It is generally wise for the R/C boat fan to begin on the larger type of kit such as Babcock's North Star Trawler or Little Breeze, Veco's two tugs and some of Sterling's easier to assemble kits. While it is perfectly possible and practical to get R/C into a boat smaller than twenty inches, it becomes trying for a rank beginner to do so. This, coupled with the fact that to get realistic performance he must work with much smaller batteries, work in closer quarters and go to subminiature equipment all the way through, can mean frustration.

In the larger category, the Babcock North Star Trawler has much to recommend it for a beginner. It goes together like a dream, holds quite a good payload, and need not skimp on batteries so that in the long run it will have an economy of operation not possible with a small boat. With electric power it travels at an excellent clip on the water. It has, however, an important draw back. For the beginner it would be advisable to leave off the hardware and make the entire deck lift off. Otherwise with the hardware small access hatches must be cut.

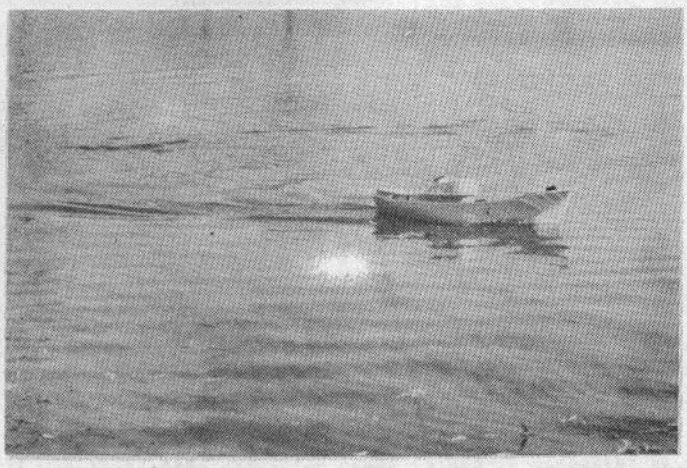
As with planes, the simplest control can furnish quite a bit of fun and to most of them motor control may later be added. The Dmeco 3PN servo will give left and right rudder and also provide for the later addition of 3P for forward, reverse, and stop. The Dmeco 2PN may be used for rudder only. Proportional control requires only the use of a Mighty Midget actuator and a simple pulser at the transmitter.

Our photos show how a Babcock North Star Trawler may be used with the 3PN and the 3P servo for left, right, forward, reverse, and stop.

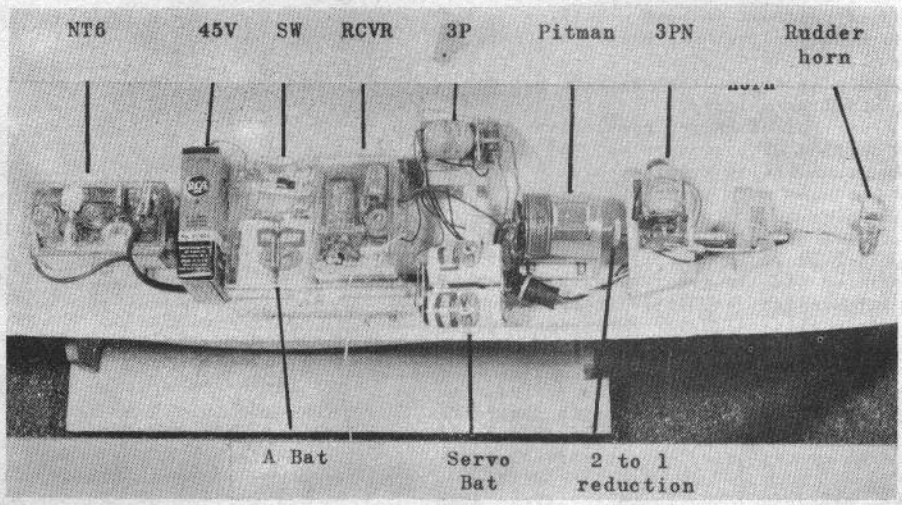
Get started now on your boat for this summer.



Away she goes. Paul Ziegelbein of Concordia, Missouri watches as the electric powered Trawler moves away out on the lake. Key is in his right hand.



Realistic, the Trawler powered by a Pittman Super Panther moves at better than scale speed judging by its wake. An NT6 or Aristo 64 battery is used.



With deck removed, the North Star Trawler hull proves to have plenty of space for even heavy batteries. Small wooden platforms are contact cemented in for the various servoes, receiver, batteries. Small piano wire hooks on the bottom of these, provide anchors for rubber band "hold downs".

Reduction of the motor by 2 to 1 has much to recommend it. Tests show that battery drain is almost half of the drain when direct driven, but speed is only slightly reduced. Small nylon gears of 12 and 24 tooth, are simply press fit on the shafts.

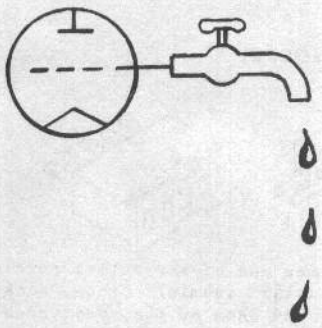
When using an NT6 or Aristo 64, it is important that they be kept charged, whether they are used or not! It is advisable to charge these batteries once every 2 to 4 weeks when not in use. Never store in a discharged condition. Also never exceed the charge rate specified on the battery. This is generally .4 amp. Higher charge rates will deteriorate them rapdily. Properly used, this type of battery can give you many hours of service.

Always tune receiver with the hull in the water. Water has a loading effect and tuning of both sensitivity (on hard tubers) and the tuning coil may be changed.

A stand of some type will be found indispensable to use at the lake for tuning up and just plain resting.

Make sure all items in the boat are mounted a small bit away from the lowest point in the hull. This, if not carried to extremes, will insure equipment remaining dry if the hull ships a bit of water.

Grid Leaks At Play



We are extremely proud to bring you this issue since we believe that Grid Leaks scores a number of important firsts. Amont them are MarcyTone Receiver and modulator circuits, an eight channel transistorized reed receiver, an eight channel simultaneous transmitter, and a 30 to 45 volt power converter.

This plus the other regular features which are of interest to not only beginners but experts and we believe we have one of the best issues yet in the four issue history of Grid Leaks. We invite your comment. Any items that you would like to see in Grid Leaks, won't you please write us. Share your circuits with other experimenters.

ALL TRANSISTOR RECEIVER

There is an interesting all transistorized 27¼ receiver detailed in the March, 1958 Radio Electronics, on page 109. The receiver is unique in that it must be pulsed. Any long hold signals will allow the relay to drop out again so it is doubtful that it is of value for escapement type systems. It uses four transistors and an eight volt battery. The transistor bugs will get a kick out of this system. Clearly transistorized circuits are pointing up as one of the coming things. However, temperature and other factors are playing a holding influence and we feel that for stability a hybrid type of receiver will be with us for some time to come but more and more of them will include power converters to use the actuator batteries for both filament and B supply.

NEW ELECTRONIC MAG

Electronics Illustrated, by the publishers of Mechanics Illustrated, made its debut on the news stand March 21. Initially it appears to be an excellent magazine and it appears also that it will cater to some R/C. There were two articles of interest to the R/C fan in the initial issue and promises of more to come in future issues. One was a radio garage door opener by friend Ed Lorenz which looks quite simple and should be very reliable. A general R/C article by Bill Winter entitled "Radio Control Hobby Extraordinary".

FCC RENEWAL

On the short circuit page you will note the mention of the form that is required for the FCC license renewal. The reason we mention it in two places in this particular issue is because many licenses will become due this year since five years ago the R/C spot became available and licenses must be renewed before they expire. Inasmuch as we are attempting to get additional frequencies from the FCC, it behooves all of us to co-operate and get on the ball and get our renewals in on time.

"MODEL BOAT RC"

From across the Atlantic through the good offices of Harry Hundleby, editor of the Aeromodeller, we received very courteously several copies of some of the Aeromodeller publications. Among them was a comparatively new radio control boat book which we can heartily recommend for American boat fans since it contains unique ideas which have much to recommend them for the serious R/C boat modeller. That the R/C boat fraternity is increasing is evidenced daily. However, many beginners are stymied in getting information. They want to know how to install what, and to do what. The radio control boat book by Aeromodeller does a good job of explaining.

AEROMODELLER'S WAG

We were also extremely interested in reading in the Aeromodeller Annual of the miniature tube version of Walt Good's receiver. Apparently 1AG4's or CK5672's and 1AH4's are not available in England in any appreciable quantities or low price and therefore miniature tubes were resorted to. Actually when considered, this isn't too bad since the 1S type tubes were used and drain was kept very low. The bulk, however, is up.

Scheduled for our next issue are a transistorized Tech Two still using the 6007 detector, however, followed by a transistorized second stage. Here is a really unique receiver. Many other exciting things are in the works.

Yours sincerely,

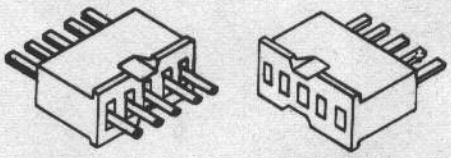
Paul

Paul F. Runge

SHORT CIRCUITS

A REGULAR FEATURE OF GRID LEAKS, THIS PAGE PRESENTS SHORT NOTES OF IMPROVEMENTS DEVELOPED BY OUR READERS. SEND US YOUR BRAIN CHILD!

SUBMINI PLUG AND SOCKET

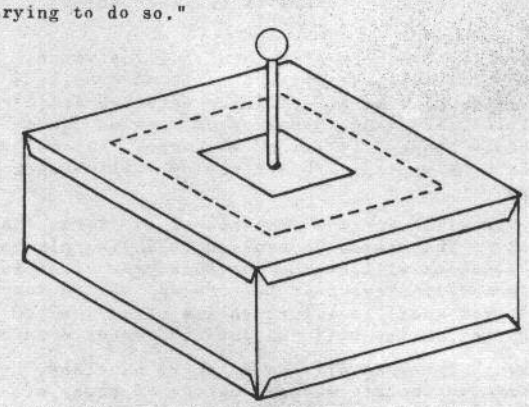


From Dale Root comes one of the cuties developed by Bob Leininger. By using submini Cinch sockets of either 5 or 7 prong, the gang on the West coast makes quick disconnect plugs and sockets by shoving in .020 brass wire into one for a plug and using the other as a conventional socket. Mold fiberglass resin around bases for a heat sealed plug or socket. Dale says, "Works real good!"

TTPW TIPS

Gene Britzius, developer of "proportional motor control for the WAG TTPW", which appeared in Volume 1, Number 1 of Grid Leaks, comes up with a couple of good ideas.

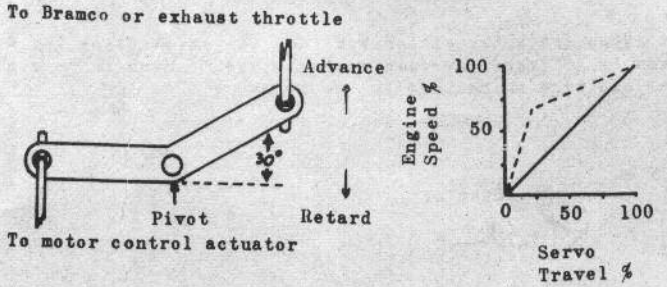
"Have developed an excellent self-centering deal for the stick control box. It consists of two layers of dental dam rubber (obtain from your dentist) bonded to the inside of the control box with contact cement. (Prestretch the rubber slightly.) Mark center of square hole in the box and punch 1/8" hole in rubber with a sharpened piece of 1/8" tubing. Stretch hole out to insert a 3/16" ID rubber grommet. Slide onto control stick and bolt cover to box. You've got a simple self-centering device which also acts as a dust cover. So far I haven't been able to make the rubber tear even when trying to do so."



To make the linear drive for the throttle control developed by Gene, he suggests the following bell crank be used. The differential bell crank will give linear throttle control for the same movement of throttle, servo or actuator. The drawing below is self explanatory.

With direct link ----- servo to throttle

(Desired) with different ——— link servo to throttle



FCC LICENSE RENEWALS

Many licenses will expire during 1958 due to the fact that the examination free 27.255 spot was made available to R/C about five years ago and the licenses are issued for a period of five years.

The FCC points out that this renewal should be made on their form 405-A-1. The renewal must be made before the license expires or else it can not be validated.

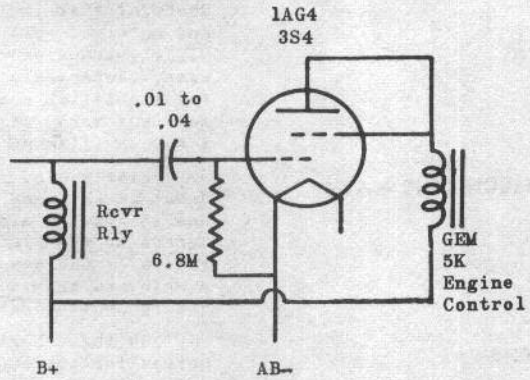
Form 405-A-1 is available from Grid Leaks upon receipt of a stamped self addressed envelope.

In order to keep straight with the FCC and have the hope of additional frequencies later on, let's make sure that our renewals go in on time.

TECH 27 TIP

Position of the transformer has been found to be on the critical side on some Tech 27 Receivers--Grid Leaks Vol. 1 No. 2. If the transformer is place so that the secondary is on the same plane and windings are in the same phase--or both are in the same direction--the second stage does not always perform correctly. It wants to rise, but in most cases does not go more than 2 ma on signal. To cure, place transformer on end, with secondary on the bottom, making sure windings of the coil and relay are opposite each other, second stage will go to $3\frac{1}{2}$ to 4 ma on signal.

PULSE SYSTEM MOTOR CONTROL



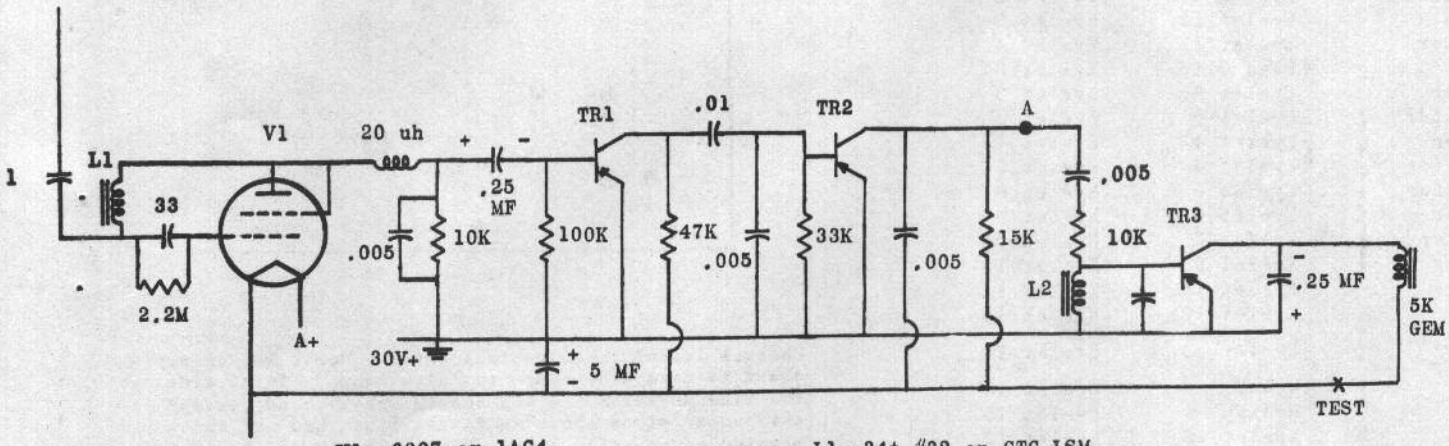
The system shown here will add motor control to almost any pulse system. We believe it was originally developed by Bob Quick of Miami, Florida. The only added piece of equipment to your pulse box will be a normally closed switch. When this is pushed into off and pulsing is not transmitted, the relay in the circuit above pulls in operating the motor control.

Since motor control relay needs to be actuated only a short bit at a time and is seldom held on, the momentary loss of pulsing will not affect the operation of the rudder in ordinary rudder. In dual pulse systems such as the Stick-Trol or Simpl-Simul, no harmful effects will be felt.

The system may be incorporated in any reliable CW receiver. Hook it into receiver circuit at the point shown. It has been tried on single gas tubers, two tubers of the Lorenz type, the Mac Simple Single, Commander, and MC100 with equal success.

How to mount the tube you plan to use depends on your present receiver. Another chassis may be made to house the components used and mounted next to your present receiver chassis. Or both receiver and motor control unit may be built onto one chassis large enough for both. Circuit shown is not fussy as to placement, and only component which may require changing is the coupling condenser. With an .01, there is a 1/3 second delay, and if pulsing is below 3 cps, motor control will act. Increase the size of this capacitor until relay does not pull in for slower pulsing. The larger the condenser, the more delay on the pull in.

MaRCytone Single Channel System



V1--6007 or 1AG4
TR1--CK722
TR2, TR3--T0037

L1--34t #32 on CTC L&M
L2--See Text

Minimum of complexity, wide band audio, simple transmitter requirements, low AB drain, temperature stability, lower cost are but a few of the features of the MaRCytone Audio receiver shown here.

Developed by Marcy Inkmann of Racine, Wisconsin, the system has had an almost five year successful history of flying.

While there is nothing new in the basic principle used by Marcy for his MaRCytone, the application of it in the circuit shown is different. Toroids have been successfully used in circuits using vacuum tubes. And toroids work fine. The World War II drone employed a similar discrimination circuit. But toroids are not cheap, they are heavier than the components used, and they like higher impedance than transistors do.

By taking advantage of the low impedance likes of transistors, this circuit uses special coils wound on a ferrite core. Because they are layer wound and not the toroid type, they are much less expensive to produce. They are also less in weight. When they are coupled with the .47 capacitor they present a discrimination network which is selective to the audio presented to it.

Even though selective, they are broad in response when compared to reed selectors. With reeds you MUST have transmitter stability within several cps for any given audio used. Here you can drift almost a 100 cycles and you are still in business! A truly remarkable feat and one which does much to point up the reliability and unfussiness of the MaRCytone.

A look at the single channel receiver shows the simple straightforward super regenerative detector. It is a familiar circuit to all who construct their own gear. The detector is coupled to two transistor amplification stages. Although there is considerable mismatch between the tube and the transistor it does not bother the receiver, since there is far more audio developed than is needed. This is coupled to the network. The relay transistor is held cut off until the moment an audio signal appears of the resonant frequency. When this happens, the relay is triggered, jumping from .1 milliamps to over 4 ma for a really reliable and satisfactory "whack". This, on 30 volts of B, too.

Another feature of the receiver is the fact that it uses "high fidelity" as far as present audio receivers are concerned. Its lowest tone begins at 1900 cycles, while its highest tone is over 5000 cps.

Because the coil should be matched with an audio generator with the .47 used to exactly determine the audio frequency required to prevent any harmonic trouble no winding data is given. It is highly recommended that a matched set of coil and capacitor be purchased in a frequency matched pair for the best performance.

The receiver is quite fast in response to signal, and may be pulsed for any application desired. With the exception of the specially wound L2, other components are standard and available everywhere.

For the single channel receiver follow the layout shown for trouble free performance. No step by step instructions are given.

On the transmitter side, the simplest of circuitry may be employed. A multivibrator modulator has been used by Marcy in his successful flights. This was hooked up to a standard WAG MOPA (Single Channel) transmitter. Many MOPA Transmitters may be converted using the multivibrator circuit shown. Also some one tube transmitters may be converted, among them the Commander Audio.

Modulation minimum is 85%. Square or sine wave may be used with equal success. It is in the transmitter end that the greatest economy may be affected, since no highly stable temperature compensated circuitry need be employed. Just a simple MOPA with the multivibrator VFO (variable frequency oscillator) may be used. Don't worry about drift. Your receiver is broadminded!

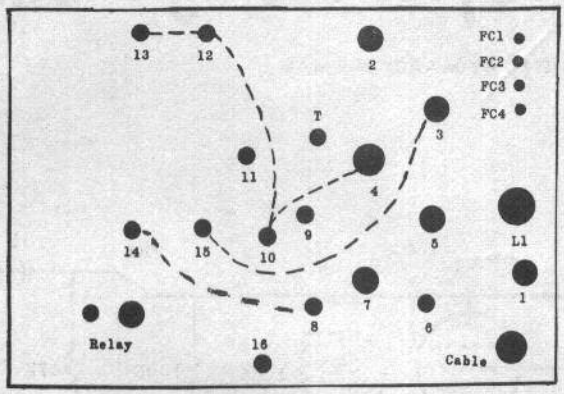
Tuning is just a little different from tuning a conventional receiver since we must tune both the RF and audio section. On the schematic for the single channel will be found a mark called test. This is designed for use after the initial tuning has been accomplished.

To tune initially, hook 0-5 milliammeter in B plus lead as with conventional receivers. Now turn on carrier of the transmitter, leaving the audio button alone. Tune the slug until you get a slight dip in current. This will be approximately 1.8 ma drop to 1.7 ma. This is resonance. Another way of tuning is to hook a head set in the B plus lead and listen for the superregen audio hiss. Tune the receiver until the hiss disappears.

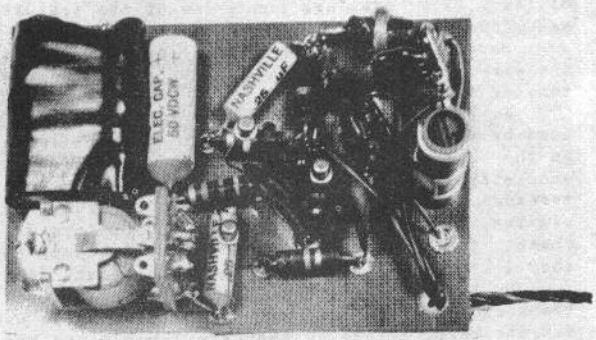
Now key audio. Vary the pot at the transmitter until a deflection of the needle is had to approximately 6 mils plus.

Now meter may be inserted at point marked test on schematic and tuning done at range. There is no sensitivity adjustment and once receiver has been tuned to the transmitter and the transmitter audio tuned to the receiver L2 coil and .47 audio discriminator there is no need for a lot of complicated retuning.

Component	Connects From	To
R. F. Choke	Flea Clip 1	Eyelet 2
10K Resistor	Eyelet 4	Eyelet 2
.005 Capacitor	Eyelet 4	Eyelet 2
.25 Electro	Eyelet 11	Eyelet 2
100K Resistor	Eyelet 11	Eyelet 4
Jumper	Flea Clip 4	Eyelet 3
15K Resistor	Eyelet 5	Eyelet 3
.005 Capacitor	Eyelet 5	Eyelet 3
33K Resistor	Eyelet 4	Eyelet 7
.005 Capacitor	Eyelet 4	Eyelet 7
.005 Capacitor	Eyelet 5	Eyelet 6
10K Resistor	Eyelet 6	Eyelet 8
.01 Capacitor	Eyelet 7	Eyelet 9
47K Resistor	Eyelet 9	Eyelet 15
5 mf Electro	Eyelet 15	Eyelet 12
.25 Electro	Eyelet 10	Eyelet 16
Filter Coil and Capacitor	Eyelet 13	Eyelet 14
Relay Lead	Relay	Eyelet 15
Relay Lead	Relay	Eyelet 16
Jumper	Eyelet 13	Eyelet 12, 10 and 4
Jumper	Eyelet 14	Eyelet 8
Jumper	Eyelet 15	Eyelet 3
Jumper	Flea Clip 1	Bottom Coil Lug
33 mmf Capacitor and 2 meg Resistor	Flea Clip 3	Top Coil Lug
1 mmf Capacitor	Eyelet 1	Top Coil Lug
TR1 Emitter	------	Eyelet 4
TR1 Base	------	Eyelet 11
TR1 Collector	------	Eyelet 9
TR2 Emitter	------	Eyelet 4
TR2 Base	------	Eyelet 7
TR2 Collector	------	Eyelet 5
TR3 Emitter	------	Eyelet 10
TR3 Base	------	Eyelet 8
TR3 Collector	------	Eyelet 16
Red Battery Lead	------	Eyelet 4
Black Battery Lead	------	Eyelet 3
Brown Battery Lead	------	Flea Clip 2



Chassis layout is shown full size. Refer to connection chart to determine component placement. This side is the side on which all components are mounted, except for the jumper wires shown in dotted lines and V1 which are mounted on opposite side. Flea clips should be inserted so that components may be wired in on this side. Hole marked T is for the tube clamp screw.



Do not solder connections until all parts are in place.

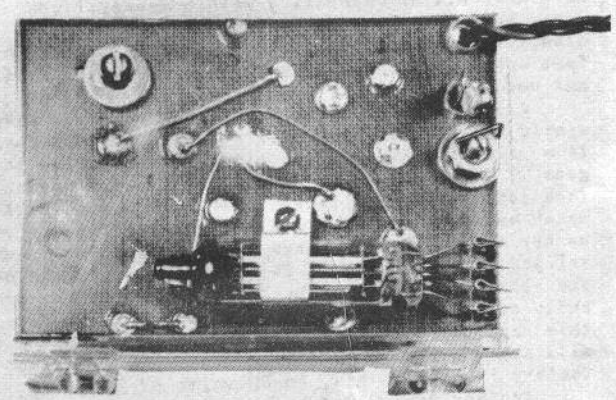
When soldering transistors into circuit, always use a long nose pliers on the lead between transistor and iron to prevent excessive heat from damaging transistor --a mini gator clip may also be used.

The red lead from the receiver goes to B+, brown to A+, black to AB-.

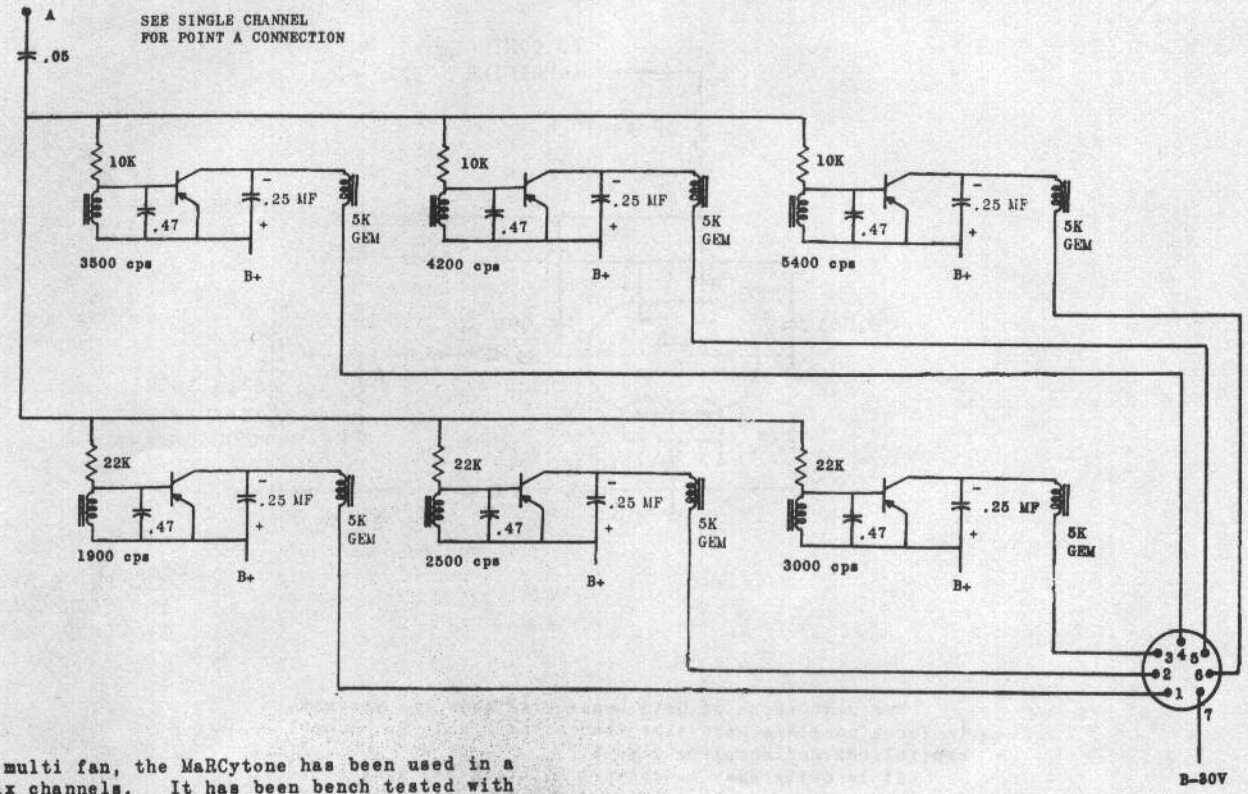
Antenna of 20 to 24 inch length connects to eyelet number 1.

Tube is inserted as shown with red dot side going to Flea Clip 1. Insert both leads 1 and 2 (Plate and SG)into FC 1. Other leads into 2, 3 and 4.

On T0037 Red line is adjacent to lead number 1.



MaRCytone Multi Channel System



For the multi fan, the MaRCytone has been used in a plane with six channels. It has been bench tested with 10, although not flown with them. This should cause no problem, however.

Initially coils will be available in 6 audio ranges --these are 1900, 2500, 3000, 3500, 4200, and 5400 cps. Each coil and capacitor combination weighs in at an average 1/2 ounce. Average because the lower tones require a greater winding. In developing the system, literally hundreds of coils were wound to find optimum performance. Marcy discovered it advisable to vary the windings and keep the capacitor the same for the best and most uniform results.

While the weight will slightly exceed comparable reed equipment, the type of plane it is to go into does not mind the scant few extra ounces. When the added advantages are considered, the weight amounts to no problem whatever.

Smaller coils are being worked on and are in the developmental stage. Remember, this is not an unproven circuit but one that has been flown successfully over four years. It was felt that lighter weight coils at the expense of proven dependability was a foolish gamble.

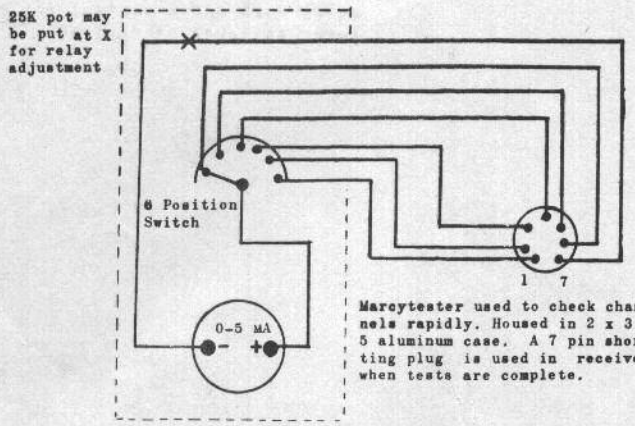
The multi channel MaRCytone layout will be shown in the next issue. However, enough of Grid Leaks's subscribers have the savvy and know how to proceed on their own. A few general hints are provided. The coils do not like metal and if metal is used as a case, it must be kept a minimum of 1/2" away from them. A sandwich type of construction is recommended using linen base or epoxi resin material. In laying out the coils, always alternate them. Oppose one coil with a condenser and vice versa.

The multi schematic shows the ultra simple circuitry required. Layout, except for opposing coils, is not critical. If you can't wait for the multi layout, go ahead. Nothing ventured, nothing gained.

A six channel transmitter will be presented in the next issue of Grid Leaks, but again this need not prevent any advanced R/Cer from proceeding on his own.

Simultaneous operation does not yet seem feasible in one receiver. The circuit clips strongly and one signal is lost.

However, when using a simultaneous type of transmitter, with two modulators and a Class A amplifier, (see Max Boal's job in this issue), it should be theoretically possible at least to fly two receivers from one transmitter with two different control boxes. This



Marcytester used to check channels rapidly. Housed in 2 x 3 x 5 aluminum case. A 7 pin shorting plug is used in receiver when tests are complete.

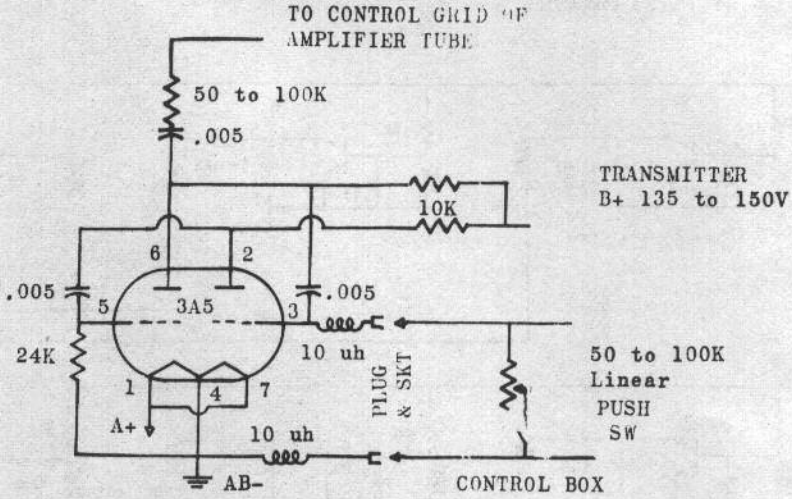
coupled with the fact that t... hi-fi" aspects of this receiver make it virtually interference free in heavy interference areas make it one of those dreams come true.

For the multi channel transmitter a special test box is highly recommended. This will allow you to switch through each of the six channels with a very minor operation. A shorting plug is used on the receiver. A seven prong socket is mounted in the receiver itself and the MarcyTester has a seven prong plug which is wired as shown in the schematic so that the meter is inserted at the point test in the circuit by merely plugging it in.

A shorting plug is then inserted in the receiver itself for actual flight.

A control box may also be made for transmitters of the WAG Single Audio type or other audios using 3A5 multi-vibrators, simply housing the pots and the push switches or lever switches, whichever are desired in the control box itself away from the transmitter.

For complete tuning instructions see the single channel article elsewhere in this issue.



ADD POT & SWITCH
FOR EACH CHANNEL
REQUIRED

The next issue of Grid Leaks will show the schematic for a complete Marcytone transmitter and 6 channel control box and complete layout.

It is quite easy to convert existing WAG single audio transmitters to the Marcy receiver. The multivibrator modulator will need to be changed as shown below. In multi work add a control box containing pot and push or lever switches as desired.

RELAYS--THEIR ADJUSTMENT AND CARE

FOR THE BEGINNER AND THE EXPERT

The relay in your radio control receiver is the means of translating the small electrical energy change, which takes place in your receiver upon receipt of a transmitted signal into mechanical energy.

It provides a form of electromagnetic switch which although operated by a weak current, can open and close contacts carrying the more powerful current needed for the actuating of control surfaces.

Unfortunately, the adjustment of a relay is also one of the most misunderstood items, particularly to the beginner in R/C.

How many times have you seen a malfunction of an R/C plane only to have it come down and to have the beginner begin prodding with the screwdriver in the direction of the relay assuming that the adjustment of the relay was at fault? Actually, malfunction of the receiver in the plane can be traced generally to anyone of a number of things, such as a loose connection, faulty receiver and relay placement with relation to vibration problems, and many other factors. Just because a malfunction is had does not mean the relay is necessarily out of adjustment.

And unless you know what you are doing, adjustment of a relay can pose some problems. In order to adjust a relay it becomes 100% necessary to understand what you are trying to accomplish.

In spite of the fact that transistor triggers appeared in late 1957 to replace relays, these will be found satisfactory at the present stage of the game only as SPST devices. They are not operable yet as SPDT without a great deal of complexity. For the average beginner in R/C complexity is something he will avoid.

We feel that the relay will be here for some time yet in spite of transistor progress (we still like the horse, too.) There are several basic types of relays illustrated. First is the adjustable Sigma 4F. This is one of the old standbys and is still very hard to beat for its ease of adjustment. Both upper and lower contact may be adjusted as well as spring tension. Also illustrated is the standard Gem relay available in several ohmages. Adjustment here is a matter of bending the required parts. The Micro Gem relay, introduced some time ago, makes the adjustments a little bit easier but it too must be understood to be adjusted correctly.

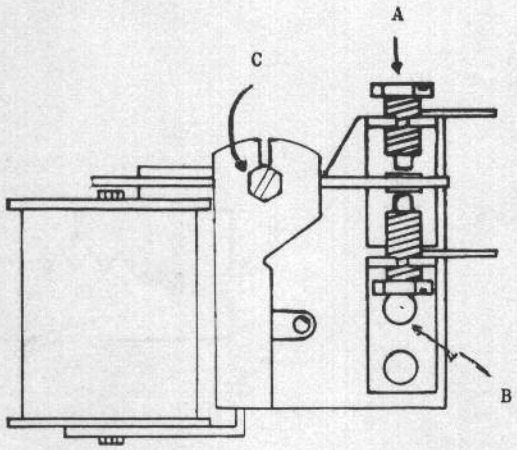
The same broad principle applies to all relays in R/C operation; when current is passed through the coil the iron core becomes magnetized and the armature is attracted. The armature is generally balanced or is pivoted at some point along its length.

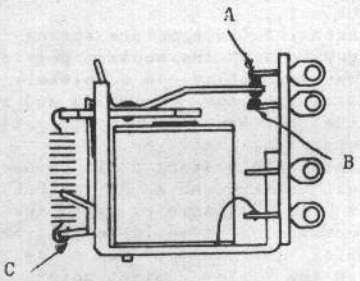
This brings the armature against the lower contact and it stays in this position as long as current is flowing through the coil. When current drops, the return spring will pull the armature away from the core so that it hits the upper contact.

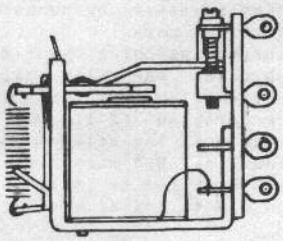
It must be pointed out that the armature should never be allowed to make a full contact with the core or the pole piece of the coil. Contact A is used to hold it just off of the core. The reason for this is that the core or pole piece will retain a certain amount of residual magnetism even after the current is lowered. In some receivers this doesn't present as much of a problem as it does in others since the current change is virtually to zero. However, in receivers of the hard tube type where the drop is to .6 to 1 mil upon receipt of signal this does present an adjustment problem.

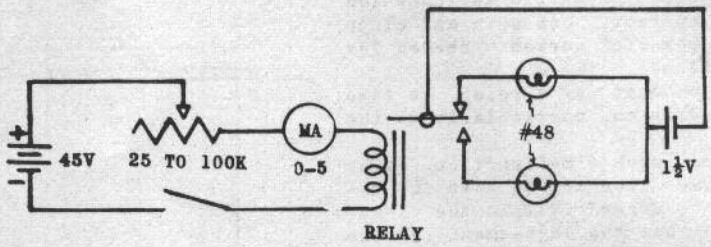
It is generally acknowledged that the higher ohmage of the coil will provide a more sensitive relay. The higher the sensitivity the less milliamps are required for the same operation of pull in.

Most R/C relays run in ohmage from 4000 to 10,000









There are three factors which govern the adjustment of a relay.

They are number one, the gap between the armature and the pole piece of the coil.

Number two, the tension of the armature spring.

Number three, the gap between the contact points.

If you are sure that your relay is completely out of adjustment, let's start from the beginning and give the method in sequence that has been evolved for setting a relay to the desired operating condition.

In order to facilitate this setting up it is necessary to connect a 45 volt battery and a 25 to 100K pot in series with a 0-5, or 0-10 milliammeter with the relay as shown in the schematic. It would be extremely helpful if a pilot lamp of the #48 type and a 1½ volt pencell are connected on the relay contact points because this will indicate then that the relay is making adequate contact.

Study the drawings of the relays again. Screw or bend contact A down so as to adjust the magnetic gap between the pole piece and the armature. This should be approximately .004 inches. If a shim feeler guage is available this should be used. However, ordinary bond typewriter paper of 20 pound weight is very close to .004 and may be used instead. Slip the guage or paper between the armature and pole piece and screw or bend A down until it grips but not so tightly that the guage or paper can not be removed.

Now turn on the relay adjuster by connecting the battery. Have pot set first at zero.

Slowly raise the current watching your meter very carefully. Note at which point the relay pulls in. If we assume that you are attempting to adjust your relay at a 1.8 ma pull in and a drop out of 1.4 the following procedure would be followed. If the relay does not come in until the current reads say 2.5 mils, then we must adjust the spring. With a Sigma 4F this is done by screwing C between an 1/8 to 1/4 of a turn.

This will decrease the tension on the armature return spring. The adjustment on the Gem in either Standard or Micro variety must be made by bending the spring. If the relay clicks in too low then tighten the tension a fraction at a time.

Contact B must now be adjusted. With a potentiometer again at zero, switch on and slowly raise current until the relay pulls in at 1.8 ma. Then gradually reduce and note the figure at which it drops out. If it is less than your desired 1.4 ma screw in contact A or bend it and repeat the check. The amount of movement at the points should be not more than .002 of an inch. If it is impossible to reach the desired pull in to drop out, then the armature is too close to the pole piece. In other words, the magnetic gap is too small. It becomes necessary then to repeat the whole of the foregoing procedure again until the desired settings are obtained. However, this is easier to do than to describe.

The magnetic gap in relation to the armature return spring governs the operating point of the relay and the air gap between the contact point governs the in-out ratio of the relay.

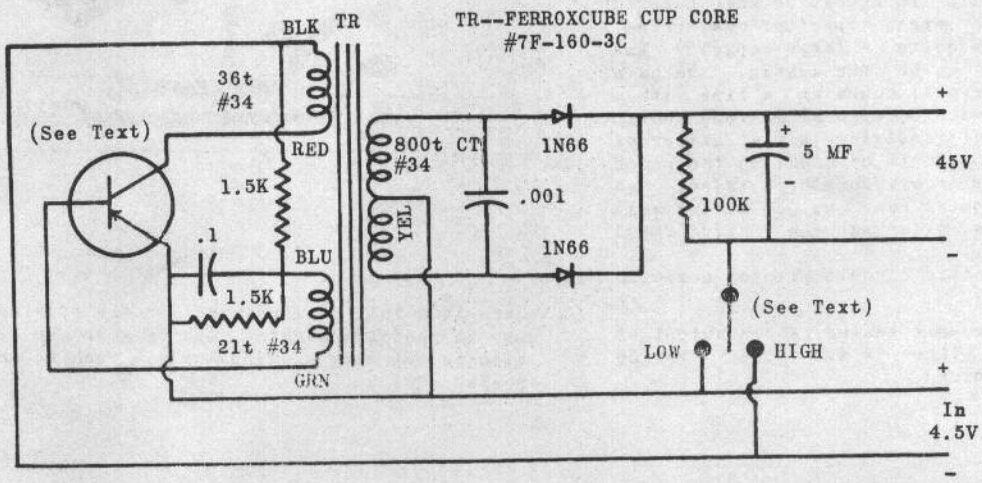
Relay contact points must be kept clean. Good arc suppression should be used. This may be either a resistor or a capacitor as used in many convention circuits as shown or a diode. To check for spark suppression and its effectiveness, it is advisable to do this in a completely dark room and observe the blue sparks of the relay and see whether your method of suppression is efficient for your particular actuating system.

To clean relay points, never use abrasives, instead bond paper has been found to be an excellent cleaning item. Simply use small strips of bond paper and insert between relay contact points and while asserting pressure on these points, slowly draw the paper between them. This will effectively clean them.

Treat your relay with respect. Give it proper care and it won't let you down.

Transistor Power Converter

DESIGNED BY JOE CURTIS, THIS UNIT ELIMINATES B BATTERIES



The transistor power supply for model application is a comparatively new approach to the "B" battery problem. For the last three years a considerable amount of information has been printed in the engineering and semiconductor publications on transistor converters, both DC to DC and DC to AC. However, almost none of this information could be construed as useful in the design of an inexpensive converter for the R/C trade. The most nearly applicable information we were able to obtain was an article in the "Electronic Applications Bulletin" Volume 16, No. 2. This publication is published in Europe and was obtained for me by the local Amperex representative.

From the first, we had established a number of requirements of musts that this converter had to meet if such a unit were to be of any real value to the R/C trade. (1) Must be inexpensive. (2) Must be reliable. (3) Must be small and compact. (4) Conservative in power requirements. (5) Sturdy. Able to stand as much abuse as the other components in the electronic system.

After a considerable amount of data was accumulated and compared against the requirements we had to meet, these things became apparent: In order to be inexpensive we would use printed (etched) circuitry; one transistor, and a powdered iron or ferrite not a tape core for our transformer; although at this stage we had planned to use a toroid. About a dozen toroid transformers were tried of different materials and windings with varying degrees of success, but none would meet the standards established. Next the "pot" or cup core was tried, again a number of compounds or mixes in both powdered iron and ferrite were tried. The Ferrox cube representative came to our aid and supplied us with cores of several different compositions. We were able to compare and choose the one that produced most nearly the voltage and current we needed.

In the design of the transformer winding we were assisted in the initial stages by Al Kennedy, electrical engineer for the Telecom Company of Kansas City, Missouri. Al has had considerable experience with transistor converters, for this company has been making commercial 12 and 24 volt converters for the past 18 months.

After the correct core and material was established only the routine job of finding the proper winding relationships to produce the desired voltages and current plus starting remained. Starting the transistor to oscillate under full load proved the most difficult.

A collector winding to feed back winding ratio of about two to one produced the best wave form, almost a perfect square wave under load. (It might be of interest here to say that the oscillator circuit we use is nothing more or less than the good Hartley. Also that the square wave (under load) is produced by saturation of the core). The two to one relationship, however, will not start under more than about thirty percent load. Therefore, it was necessary to increase the feed back winding to a ratio of approximately nine to five to get consistent starting under full load. This distorted the wave form some, but seemingly had little or no effect on the output.

Another problem was regulation. As we manufacture a current drop type of receiver and we are using this converter with that receiver, it was necessary to design for a regulation not to exceed about three volts from receiver idling to full drop. Here again our initial plans went astray, for in order to keep the cost down we had established in our mind that half wave rectification would be satisfactory considering the small amount of current needed. But the voltage variation from no load to full load proved too great. Inasmuch as we had to make the winding anyway, a center tapped winding was chosen over a full wave bridge, even though it required twice as many turns for it would save two diodes. A center tapped full wave rectification circuit was employed--800 turns center tapped and tuned with a .001 capacitor, which helps substantially in producing a good wave form. This change improved greatly our quest for good regulation, but it still was not up to the values needed for best operation. Therefore, we started looking for a gimmick to better the regulation under normal operating loads. We tried some trick circuits with feed back diodes. They helped, but also increased power consumption and were discarded. The input batteries seemed to offer the next best bet, and it was found that if we

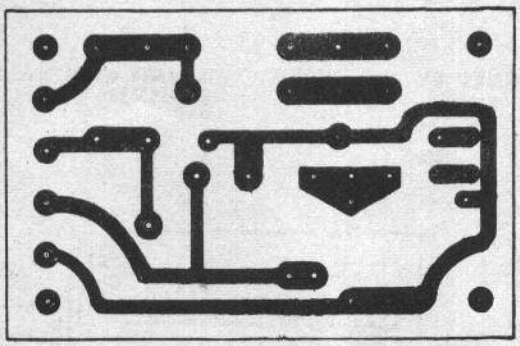
used the 4½ volt boost for loads in the order of 3 to 5 ma and operated straight through (without battery boost) on loads of 1 to 3 ma. we could maintain a less than three volt change. Thusly, on the converter chassis are jumper provisions for low and high current.

One other detail that caused some trouble was the filter capacitor. It could be presumed that as long as the circuit oscillates at approximately 5500 cycles per second 1 mfd of filter would have been adequate, but the receiver proved to be erratic in operation when powered from this converter, and a larger capacitor was tried. Inasmuch as batteries have quite a large capacity and low impedance this proved to be the answer. We have operated a receiver for several hours at a time with a mechanical keying device, with no sign of malfundtioning.

The selection of the transistor was a matter of finding an inexpensive one capable of handling the power need. Again, a number of transistors were tried, and all those that were rated at or near our job worked well. Probably the best of those tried was the Philco 2N223 and Texas Instrument 2N185.

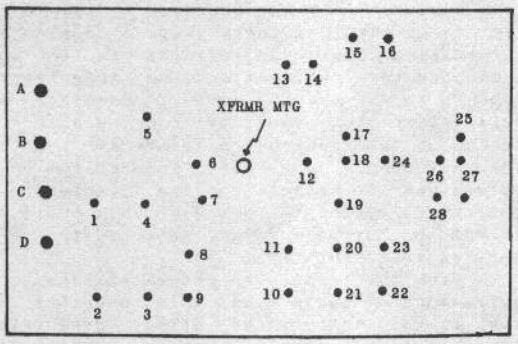
The accompanying schematic circuit printed herewith tells the rest of the story.

ED. NOTE: A sample of the unit tested shows output of 45 volts at 5 ma. output. Input is 4.5 volts. For 30 volts only 3 volts are required.



Here is a full size printed circuit etching pattern. It may be photographed for etching your own or laminate may also be cut with a sharp knife, such as an Exacto, and peeled off.

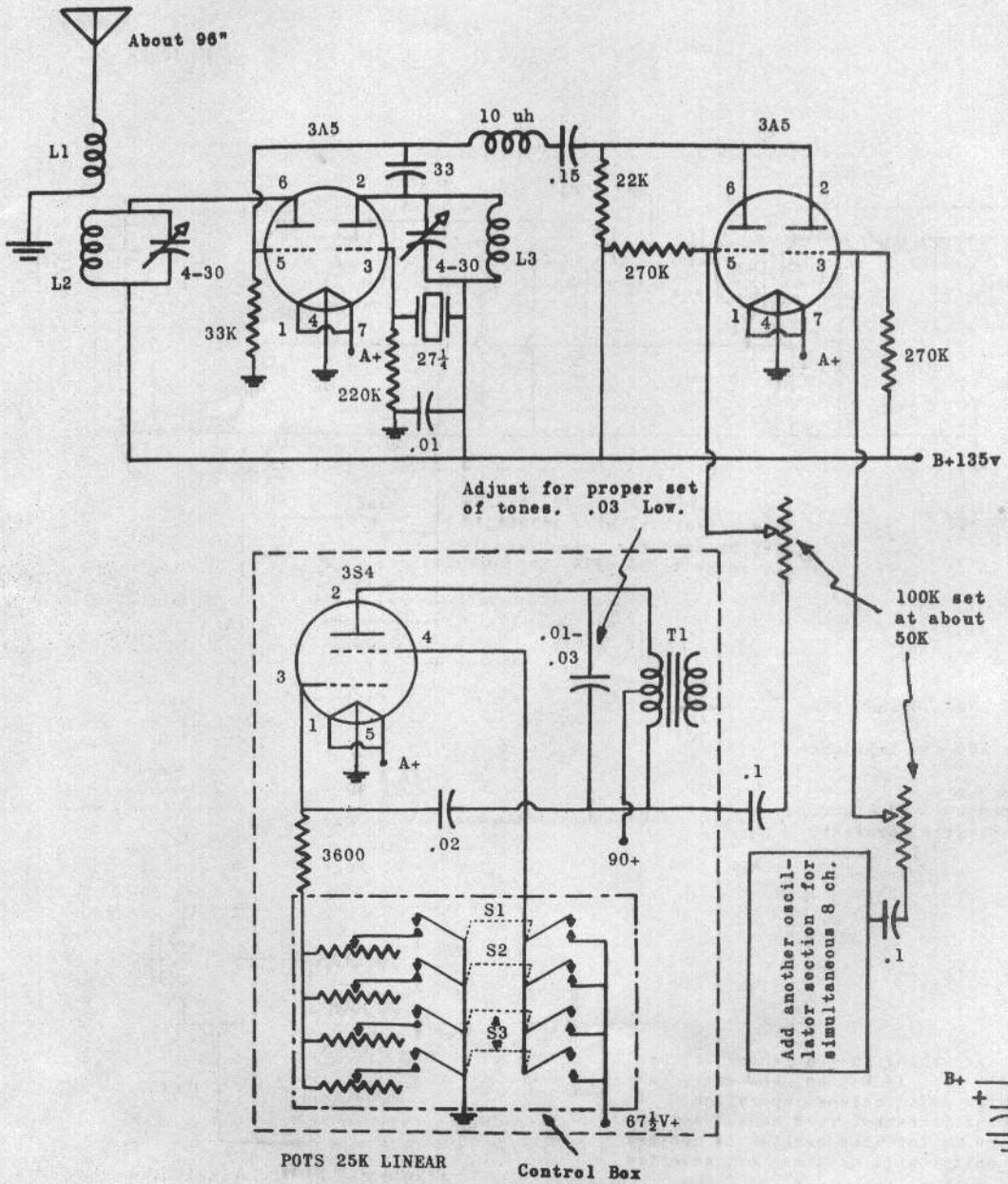
Component	Connects From	To
Transformer Lead (Plain)	-----	21
Transformer Lead (Plain)	-----	20
Transformer Lead (Yellow)	-----	19
Transformer Lead (Red)	-----	28
Transformer Lead (Green)	-----	26
Transformer Lead (Blue)	-----	17
Transformer Lead (Black)	-----	13
100K Resistor	1	2
5 mfd Electro	3	5
1N66 Diode	8 (K+)	11
1N66 Diode	9	10 (K+)
.001 mfd Capacitor	22	23
1.5K Resistor	12	14
.1 mfd Capacitor	18	15
1.5K Resistor	24	16
Transistor Leads		
Collector	-----	29
Base	-----	27
Emitter	-----	25
Battery Leads		
Yellow A+	-----	A
Brown A-	-----	B
Black B-	-----	C
Red B+	-----	D



This is the opposite side of the board from the one shown above and all components are placed on this side. Refer to the parts placement chart at left.

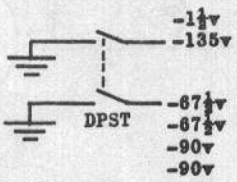
8 CHANNEL SIMULTANEOUS TRANSMITTER

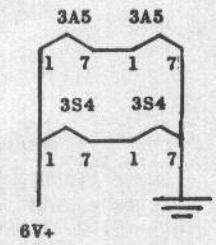
DESIGNED AND BORROWED BY MAX BOAL

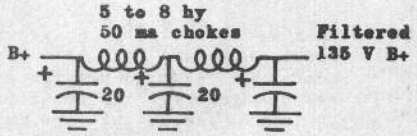


L1--5t #16 enamel 1/2" dia. couple close to plate end of L2
L2, L3--11t #16 1/2" dia.

T1--Output Transformer Stancor A-3850 or equivalent.
S1, S2, S3--2 pol, 3 pos. CRL 1455 or Switchcraft 3037







No layout or detailed instructions are given. Placement of parts will not be found to be critical. It is only necessary to follow good R/C transmitter design. It is not a circuit to be tackled by one without R/C experience, and with the advanced builder good building procedure comes naturally.

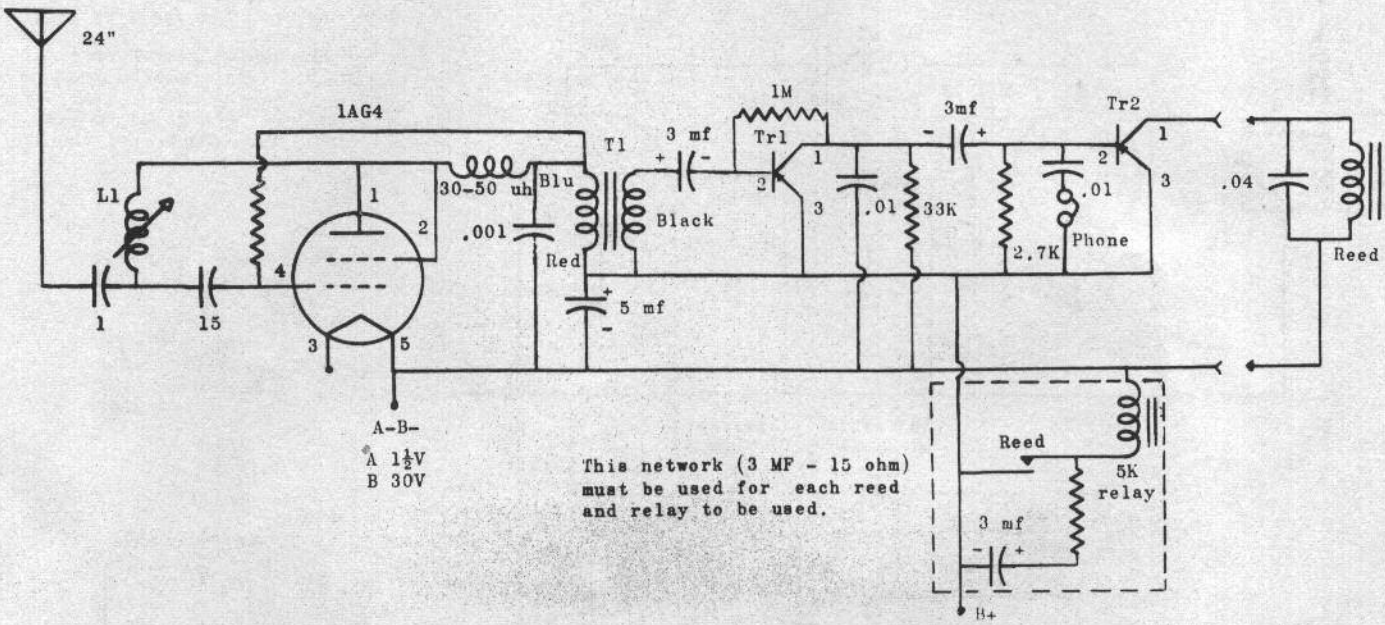
The 67½ volt battery must be a separate battery for each oscillator section. Since the tone stability depends on this battery, they must be in good tip top shape. DON'T use a power supply. Drain is .5 ma on idle. On a tone this increases to 10 ma.

The 90 volt source may be taken from power supply, but this is not recommended, because most power supplies do not put out enough current--about 20 ma is used on the 90 volt batteries when two tones are used simultaneously

I use a 6 volt power supply for the RF section, and the Class A amplifier, and use separate 67½ volt and 90 volt batteries for each audio oscillator. For use with a 6 volt power supply, hook up the filament as shown in the sketch at right above. When using a power supply, it is absolutely essential that it be well filtered. The filter used very successfully is shown above.

Multi or Single Channel Audio Receiver

BY MAX BOAL

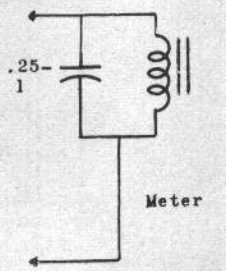


L1--36t #34 on 1/4" CTC LSM. Ground slug to AB-
T1--UTC SS03 or 200K to 100 ohm impedance
TR1, TR2--CK722 or
TR1--2N192, TR2--2N188A
Reed used is Deans 8 channel. If other manufacture is used, capacitor across it must be as specified.

This receiver is the outgrowth of the one shown in Grid Leaks in Volume 1, Number 2. It may be used with any number of reeds to provide multi channel operation. It was designed for the Deans 8 channel reed bank, and the .02 shown across the reed is for that bank. If another make is used, this capacitor will need to be selected for it.

No layout is shown, since this circuit is not designed for beginners. In the unit now flying, all relays are mounted on one board, while the RF and audio section and reed are mounted on another. These are then sandwiched together using bolts and nuts as spacers. This makes a very compact and rugged receiver.

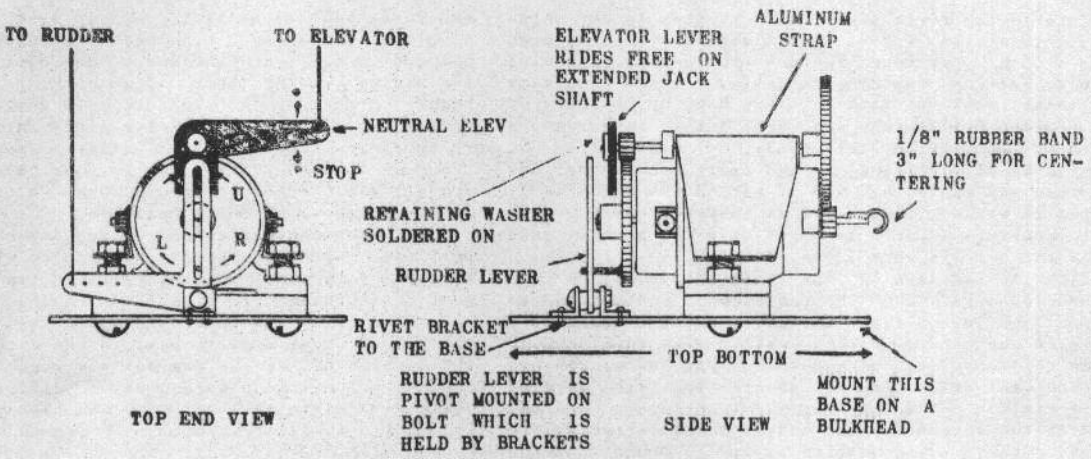
The design also lends itself for single tone audio work, the change is quite simple and does not use a reed at all. Simply substitute a 5K Gem relay in place of the reed as shown at right, and select a capacitor that will give high enough current, consistent with the pulse requirements desired.



For single tone audio about 600 cycles

Delafield's Semi Dual Proportional Actuator

NEAL'S SIMPLE JOB PROVIDES PROPORTIONAL RUDDER AND SELECTIVE UP OR DOWN WITH SINGLE CHANNEL EQUIPMENT



The actuator shown above is easily constructed and will give proportional rudder with either full up or full down on the elevator when full off or full on signal is sent from the pulser.

Study of the diagrams above show a small music wire pin soldered to the end gear of a double geared Mighty Midget motor. The pin is engaged in the rudder rocker lever as shown.

The elevator rocker arm rides free wheeling on the extended top shaft. It must be spring centered either on the arm or on plane itself back at the elevator hinge line as the individual builder desires.

The pin extending from the face of the final gear moves back and forth with the pulses sent and received by the relay. As width is varied this varies degree of dwell of the rudder in either right or left. Elevator, being spring loaded remains in neutral.

Press full off button the relay in the receiver will open and connect say a + voltage to the motor which will cause it to rotate all the way around 180° giving you neutral rudder again and pin will hit the outside edge of elevator rocker arm and push it against the stop, giving up elevator. With full on signal the opposite happens on the other side giving down elevator and neutral rudder. Simple?

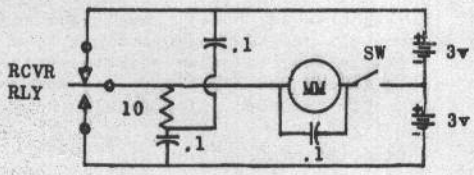
A 3" long 1/8" rubber band is used on the motor shaft to return the pin back 180° to rudder pulsing position. This band can be experimented on as to size and length according to motor power, etc.

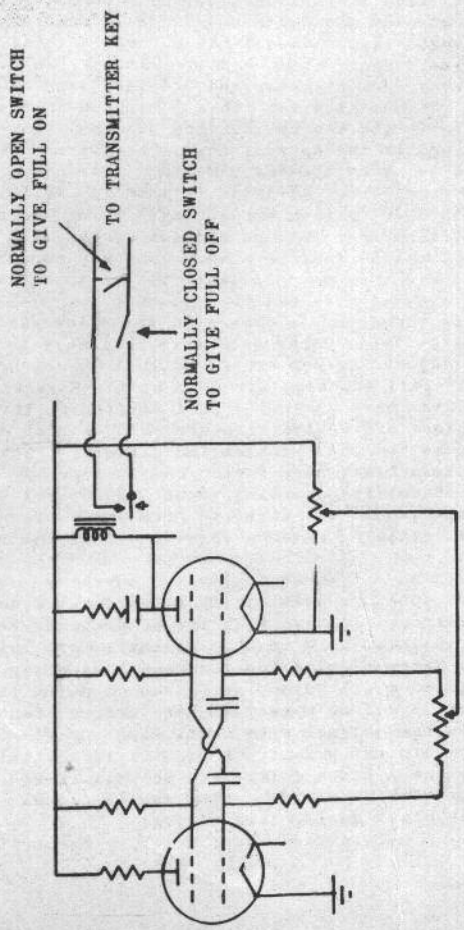
A thin sheet of aluminum is used to hold down the Mighty Midget motor on the Synthane base to help prevent plastic base from shattering on hard landing.

A study of the drawings should enable builder to construct unit without too much trouble. For simple approach to basic double geared motor see "Simpler Double Geared Mighty Midget" in Grid Leaks, Volume 1 Number 3.

Familiar Wag Pulser is used as keyer at transmitter. Diagram shows how the Normally On and Normally Off push switches are added to the circuit to give Up or Down. Only the Pulse Width pot is used to give left or right. --Pulse Rate is set so that the rudder gives virtually no wiggle. If pulsed fairly rapidly, the actuator will not wiggle rudder, but will follow the stick control box like it was glued to it.

Hookup in plane is shown at upper right.





LETTERS

HINTS ON TRANSISTORIZING THE COMMANDER

"This is the first time I have written to any magazine, but this time I feel that I should. I have been working with R/C for some time now and have been having difficulty getting anything reliable. I can make many of the ideas work but usually they hang up, sooner or later. Since Grid Leaks has come out I have found a boost in my moral with this hobby. I guess I am not alone with my difficulties! I had built a Commander Receiver some six months ago and it worked but not like I had hoped it would. I had laid it away but now you have my hopes soaring. Could be that this is a very good deal now for here is what I did.

"First I ran down to the radio supply store and got the necessary CK722, the resistors, and started to rewire. I got along fine until I broke the condenser lead. You see when I wire I really make them strong. One time job! So I ran back down and got new condensers then found the error in the description (the word by word description of installing the transistor does not agree with the schematic--the schematic is correct--Editors note.) So I tried it both ways. I found that the only way mine would work was in agreement with the schematic. Not only did it work, but it worked real well.

"Then I found that my 3S4 tube was a little worse for the wear, having crashed once. So I got another tube. Only I couldn't get a 3S4, so I got the only other that would fit, a 3Q4, the same socket connection.

"Now for a big surprise. I got twice as much relay current as a 3S4 would produce. You should hear that relay clack.

"Out for a test run on a board. I found that the range was not so hot but I noticed something about a choke, so I tried to buy one. But no such thing in this area. So out came the Amateur's Handbook and the formula concerning chokes. Soon I had a formula that looked possible considering what I had available. So I made a form about one inch diameter and 3/4 inch long and wound it full of #34 enamel wire. This I mounted in place of the tiny one in the set by mounting it in a 45 degree angle, low end at the antenna post, it fits very well in the plastic box that the set came in. Now the range turned out excellent. At least I know it will range check out to 3000 feet on our runway, using the regular Commander Transmitter with no changes except for a nine foot antenna. 3000 feet is a very long way for this type of radio it seems to me. At least it beats all of the commercial ones we have had out this way.

"I also found that a change in the relay was in order. At least mine works much more reliably this way. I tried to adjust the Gem and found that the higher signal tends to pull the armature down on the core well after the points have closed. So I stiffened the point arm as it comes off of the armature with a blob of solder. This solved the problem immediately. Now I can adjust the relay anywhere I wish and it repeats like a metronome. Beautiful clacking sound! 3000 feet too!

"By experiment way down the run way I found that just twelve inched of antenna worked best on the receiver.

"Here is how I tuned. First, anywhere near the transmitter, tune the sensitivity screw first down tight and then start out slowly with the meter in series with the relay in location M in the schematic of Volume 1, Number 2 on Transistorize Your Commander Receiver.

"The meter starts dropping. Keep on until it stops around .5 or .6 mil on my set. Now turn on transmitter and tune in the signal with coil slug until current rises to the highest point. On mine it is a little over 5.0 ma. Since I had a relay set to pull in at 2.5 ma and drop out at 1.4 ma the relay really closes with a very audible clack during this tuning.

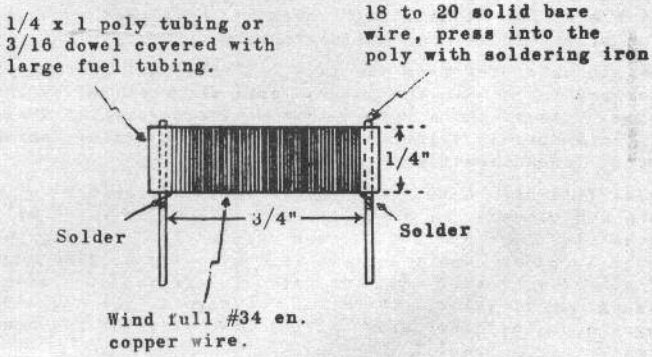
"Now--you can put away your meter. Seems like you can check your sensitivity and it need not bother your slug tuning at all. Mine hasn't changed even a little bit and it has been knocked around considerably including riding on the floor of my pick up truck over the washboard road to the airport. To range check, all you do is tighten the sensitivity screw until you hear the relay close, then loosen it until it opens and then continue in the same direction for one fourth turn and you are all set. Bang it around, drag it by the wires, fly it--it seems to be quite reliable.

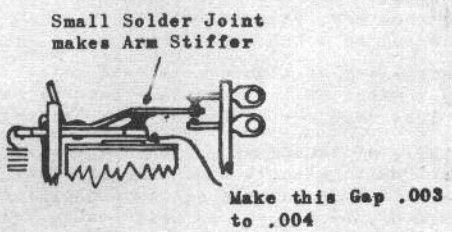
"I made another check, which out here is very important. We have a great difficulty with transistors because of the heat with many of the top transistor jobs just not working here at all.

"I put the Commander transistorized set to the test and put it under a glass bowl in the direct sun in which the temperature of 120 degrees was reached. Then I range checked it. It made absolutely no difference. This is quite remarkable for us. Needless to say, it has spread around and there are a number of Commanders being revamped accordingly."

Very truly yours,
Walter L. Andersen
Tucson, Arizona

Thanks, Mr. Anderson. This is exactly the sort of exchange of information we had in mind when we decided to publish Grid Leaks. Have had a number of readers report on their success with transistorizing the circuit, but none as complete as this.





Set Relay to Pullin 2.5 ma; Dropout 1.5 ma.

LETTERS

RC NEWS FROM SOUTH AFRICA

"Received the first issue of 'Grid Leaks' for which thanks; am glad you are keeping it ad-less. You might however consider a Trade Notes page where NEW items only be written up for a fee; this could help pay your costs.

Most local lads fly on tone with a one tube, two transistor tone receiver which sells here for $10.00 in kit form; very reliable. Also 6 channel simultaneous. I flew Orbit-8 first time this weekend--fabulous!

Want a really hot super-regen tube? Try Mullard or Hivac's DL66--much better than 1AG4 or 6007; built better, too.

Keep up the good work. Personal motto is "Cheaper and better R/C for all".

Yours sincerely,
Pat Wheeler
Pinelands,
Cape Town, South Africa

Good to hear from you, Pat. Can you give some more dope on that tone receiver? Thanks for the tip on the DL66. Thanks to a good buddy, Les Kemp of Sutton, Surry, England, we've got some samples coming and will share our tests.

Incidentally, on things "hot". That new T0037 transistor being manufactured by Philco is one of the best we have run across for use in audio amplification and relay stages. And it is tiny--as small as the head of a match. And it is inexpensive, too; only about $1.50.

PULSE INFO

"Do you have any information on Simpl-Simul by John Worth? Also how does it compare with the Stick-Trol Pulser which appeared in Grid Leaks several issues ago?"

Very truly yours
George F. Kehl
Mexico, Missouri

To the best of our knowledge John Worth's three part article of Simpl-Simul will appear in Model Airplane News in July, August, September 58. It is a series of articles that we can highly recommend to all pulse fans. It goes into considerable detail on the Galloping Ghost system and contains a lot of hints and kinks which have not been published before. Having seen the text we urge all of the Grid Leaks readers to be on the lookout for it because it will become a pulse encyclopedia.

The operation of the Simpl-Simul and Stick-Trol are very similar. The notable exceptions between the two are the Simpl-Simul houses the pulser in the hand held box with the batteries. The Stick-Trol does not. The Stick-Trol uses 3V4 tubes and the Simpl-Simul uses 1AG4 tubes.

"Am having some trouble with the Stick-Trol Pulser which I have wired into a Mac transmitter using a vibrator power supply.

"Everything seems to work fine until I turn the transmitter on and then the pulser goes haywire. Can you give me any suggestions?"

We wrote to the designer, Bernie Fox, and here is his reply. "My answer is based on the fact that the pulser was being fouled up by noise spikes from his transmitter vibrator supply. I have had one experience with this in a conversion job I did for another fellow.

"I advise Mr. Brown to power his transmitter with batteries if possible. I have found the MC vibrator power supply to be sufficiently well filtered to give no trouble. However, other types of power supplies should be very carefully checked. This is the same reason for Walt Good advising use of batteries in his WAG Dual Transmitter. A multi vibrator will lock into any noise pulses presented to it and at the same rate.

BABCOCK FILTER DOPE?

"I have just completed constructing a 3 channel receiver, which is copied from the schematic of the Babcock BCR-4. On the schematic diagram, the circuit for the filter network for separating the three audio tones is not shown. Would you know where I could obtain a copy of the diagram for the circuit, as I have tried several filters of my own design, which do not work as well as they should, and I must resort to the manufacturer's original circuit."

Respectfully yours,
George Boettcher, Jr.
Richmond Hill, N. Y.

Do any of our readers know of filters suitable in this particular circuit? If so, will you please advise us so that we can give Mr. Boettcher the necessary information.

We would like to call Mr. Boettcher's and other reader's attention to the Marcy Tone Receiver contained in this issue. This provides the discrimination in much the same way except that it takes advantage of the transistors low impedence in a very novel circuit.

RC FATHER-SON HOBBY

"In an effort to help my son retain his interest in model planes I try to see that it is not too hard for him to get what he needs to keep his hobby active. This means not only money for parts, paint, motors etc., but transportation to the various hobby shops. Today in our quest for a particular pair of wheels he wanted we chanced to visit a store quite remote from our address and it was in this store I saw my first copy of Grid Leaks.

"I'm very happy to have had the opportunity of learning of Grid Leaks.

"You referred to the DCRC Newsletter. Is this available? I would like to receive any information regarding it."

Yours tryly,
Dana W. Skipworth
Cleveland, Ohio

Thank you for your letter. Congratulations on your father-son hobby. We predict some enjoyable times for you.

For more information on the Washington DCRC Newsletter, write to Editor Don Clark, 4202 Brookfield Drive, Kensington, Maryland.

WANTS MOTOR CIRCUIT

"The Stick-Trol Pulser in the January-February issue of Grid Leaks works fine and the publication is most appreciated. May I vote for the inclusion of the motor control circuit.

Sincerely yours,
Griff Brockett
West Lafayette, Indiana

See elsewhere in this issue.

TRADE NEWS

A ROUNDUP OF NEW RC ITEMS

MARCYTONE

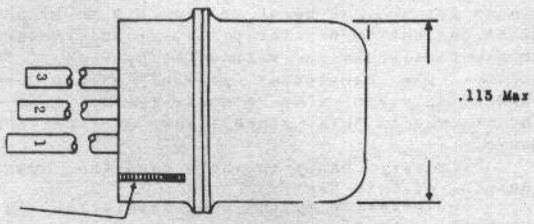
As shown elsewhere in this issue, Ace Radio Control has available now the kit for the single channel MarcyTone Receiver and will very shortly have available kits for the multi-channel MarcyTones.

The single channel is housed in a small plastic case measuring 2 x 2 7/8 x 1 inches. Weight is under three ounces. Has a low filament drain--only 13 mils. Relay current rise on receipt of 85% to 100% modulated signal is from 100 microamps to over 4 ma for positive relay action with only 30 volts of B and the price for the exclusive Ace kit is only slightly more than tube audio receivers. Kit is complete with wound coils, 6007 tube, fabulous new Philco T0037 audio transistors, Gem relay, all capacitors and resistors, and punched base. A fabulous receiver at a low price of only $17.95.

Also available is a matching MarcyTone VFO transmitter for single channel ready for delivery. It features the multi vibrator as shown elsewhere in this issue in a tunable audio circuit to accurately pinpoint the audio frequency for best performance of the receiver. Audio is variable from 1000 to 6000 cycles per second. Modulation is 100%. MarcyTone VFO is housed in an aluminited aluminum metal case measuring 3 x 5½ x 8 for compact but powerful hand held unit. Uses two 467 and one 742 or equivalent batteries for long life. An MC250 power supply may also be used for greater economy. Unit is crystal controlled transmitter, comes with punched silk screened cabinet, tubes, crystals, all components except three foot section music wire for antenna and batteries. Only $18.95.

MarcyTone audio filters sold in matched pairs only with a .47 capacitor which has been completely pretuned for a desired audio frequency. Available in the following six frequencies--1900 cps, 2500 cps, 3000 cps, 3500 cps, 4200 cps, and 5400 cps. Available separate at $1.75 per matched pair.

PHILCO T0037



Red line adjacent to lead No. 1

Philco has been one of the leaders in transistor development which makes the R/C fan happy. They have added to their family a fabulous audio transistor known as the T0037. In physical size it is one of the very smallest that we have seen. Performance wise though it is a fabulous job. When used in low voltage relay stages and low voltage audio amplification stages it out performs many comparable transistors that we have tested. Its superior performance, its low cost ($1.50), will do much to make this a popular R/C transistor of the future.

The junction temperature is sixty degrees Centigrade, collector voltage -12 volts, emitter voltage is -12 volts, collector current is -20 ma, collector dissipation at 25 degrees Centigrade is 40 milliwatts, collector cutoff current is 25 ua, emitter cutoff current is 25 ua, current amplification factor is 14.5.

While the voltage rating is listed at -12 volts, our tests indicate that this can be run considerably over without too much damage provided the milliamp drain is kept within reason.

T0037 are in stock at Ace Radio Control, Box 301, Higginsville, Missouri.

ALPHA 16 STRAND NO. 24 HOOKUP

Now available at reasonable prices. Sixteen strand hook up wire. #24 extremely flexible, this hook up wire is sure to find firm favor in installations demanding ultimate flexibility and ultimate dependability. Available in hanks of ten standard RTMA colors approximately 25 feet total for $.45 at Ace Radio Control.

BONNER 19 STRAND NO. 24 HOOKUP

Bonner Specialties is marketing nineteen strand #24 guage hook up wire available in packages of eight colors total of 24 feet for $.60 at Ace Radio Control.

MC POWER CONVERTER

MC Manufacturing and Sales has performed a real break through with their power converter for use with many of the currently available radio control receivers. With an input of three to four and one half volts, output is thirty to forty-five volts under load of five mils or somewhat better. This rating is conservative and compares very favorably with power converters already on the market.

The good news from MC is that the cup core transformer, completely wound, is available for a $3.00 consumer net price, while the completely wired and tested power converter is available for $11.95.

Now this inexpensive power converter coupled with CG Voltablock cells should end battery worries for some time to come.

This bears out predictions in these columns earlier that the trend would be toward the elimination of expensive B batteries rather than inexpensive A batteries.

Both the MC power converter and the power converter transformer are available from Ace Radio Control, Box 301, Higginsville, Missouri.

Illustrated below is the MCPC2. This is designed to fit piggy back on the MC100B receiver. Also available will be the MCPC1, which will be considerably smaller. Both will be available at the same price.