GRID LEAKS

R/C DATA SERVICE

VOLUME I NUMBER 3

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1/4A RC

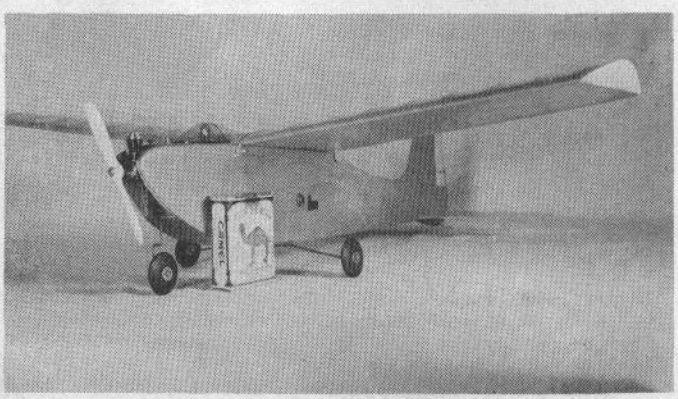
With the advent of a smaller engine and light weight R/C gear, planes are being built much smaller than ever before.

When L. M. Cox announced the PeeWee .020 displacement engine and Deltron announced a transistorized receiver requiring only a small half ounce B cell the race was on. It was only a question of time as to who would be in the air first with 1/4A ships.

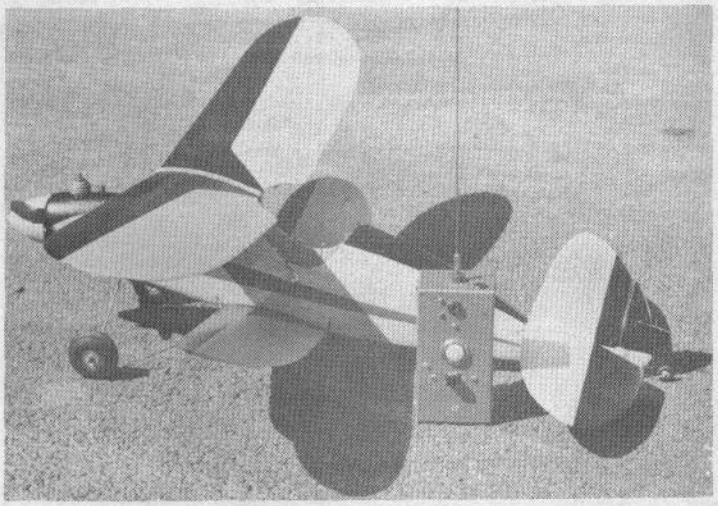
Word of a 24 inch span monoplane reached us late fall of 1957. Tracking it down through Don and Jack Josaitis, Detroit, Michigan, it was learned that this was a 2/3 version of the Breathless, a design by Ken Willard which appeared in the August 1957 issue of Model Airplane News. The model was built by George Poggen, 8517 Asbury Park, of Detroit. The model weighs nine ounces completely equipped ready to go. Airplane less engine, receiver, escapement and batteries is 4½ ounces. Escapement used is a Bonner SN and battery complement is a Burgess Y-15 and two #7 submini pencells.

About this time word came from Ted Strader on a 26 inch bipe that he was flying using a Torp .035 (an obsolete engine but one that should easily be replaced by a .020 Cox since the .020 is quite a hot engine for its displacement).

A check with Ted reveals that he is using a subminiaturized version of the Lorenz Two Tube circuit, two Y-15 cells, three Magnalux cells and an SN type escapement. The plane was one that appeared in the December, 1956 issue of Model Airplane News called Droopy. It was shown primarily as a free flight sport but Ted has had many beautiful flights with it.



George Poggen's 2/3 version of the Breathless, using PeeWee .020 and Deltron R109.



Ted Strader's 26 inch bipe, using Submini Lorenz Two Tube Receiver

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A check with Bill Winter, editor of Model Airplane News, reveals that the plans for the Breathless and the Droopy are still available in the full size version. To refresh your memories on these plans we show reproductions of the line drawings that were in the December, 1956 and the August 1957 issues of Model Airplane News. Full size plans may be had from MAN for 50¢ each. The Breathless 1/4A is a 2/3 version. Strader's Droopy is a full size version of the plans as they appear.

1/4A R/C planes have much to recommend them from a building standpoint in that they are fairly easily built by even beginners; they go together much quicker than the huge multi R/C ships; their expense is considerably less and the space they require to fly in is considerably smaller than the larger ships.

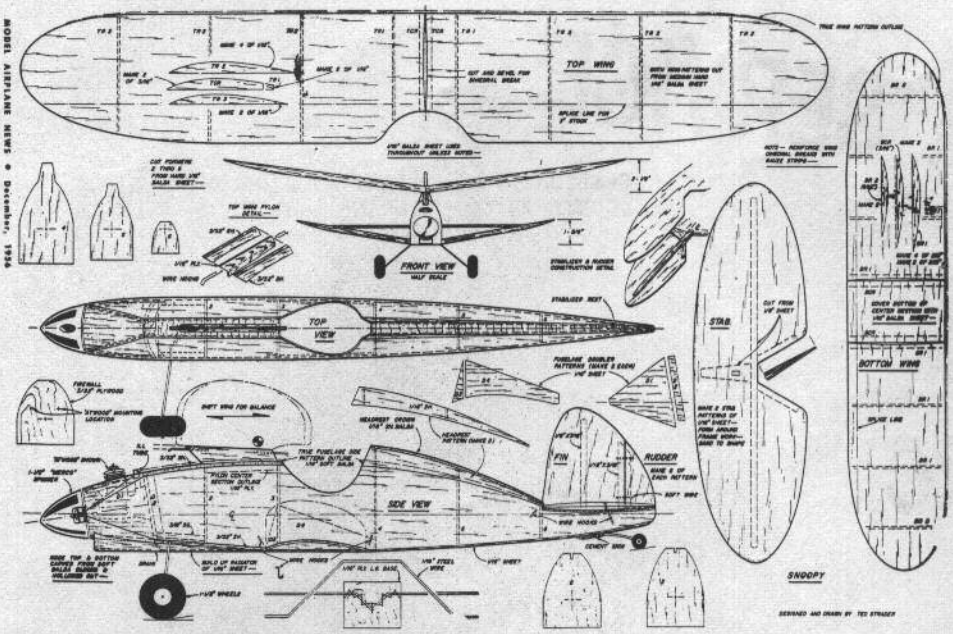
Contrary the opinion of many beginners in R/C, a terrific lot of fun may be had in flying rudder only for just plain fun flying.

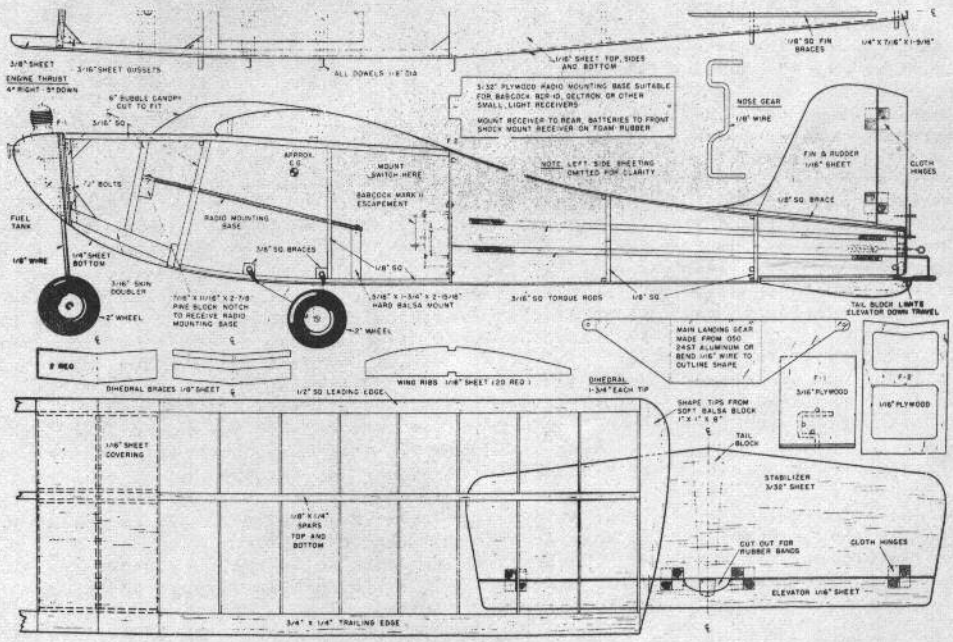
1/4A flying isn't the easiest type of flying in the world because of the smallness of the ship. As a matter of fact, the smallness means that you have got to develop into a pretty hot pilot in order to handle this little job because they as a rule do quite fast and scoot along like scalded cats.

If you have been considering building something out of the ordinary for next summer's flying why not consider a 1/4A ship. The foregoing ships give you ideas of radio gear which may be used for a lot of fun.

Here are some quotes from John Worth, one of the designers with a lot of small ship experience.

"Weight control is important, but it does not necessarily mean using the very lightest components or skimping on structure. Sound construction is required which is simple to repair rather than flimsy structure which requires delicate handling and frequent repair. Small models cartwheel easily on landing and sheet balsa stabilizers are required to take the beating. Cabin window areas also need beefing up with plywood bulkheads or reinforcing dowels. It's easier to save weight by building strong at first than to try to beef up a weak





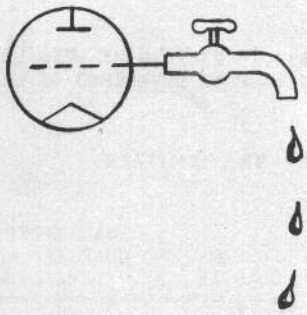
Strader's Droopy and Willard's Breathless as they appeared in Model Airplane News. This material is copyrighted by Model Airplane News and is reproduced by permission. Fullsize plans of both of these are still available from MAN.

structure later. Good doping and fuelproofing practice can also save a lot of weight. Use colored paper or dye rather than heavy pigmented dope--one coat of the latter can add several ounces! One good initial fuelproofing will save weight pickup from fuel soaking or the need for refuelproofing later. Having the C.G. come out right is also important--adding weight just for ballast is a real penalty to avoid if at all possible.

"Wrapping the receiver in foam rubber and simply stuffing it into the fuselage is a very satisfactory method of installation, but get it up against something solid on the front so that it will not be tossed around on an impact. The batteries may be mounted similarly, but be sure they are forward of the receiver, preferably up against a solid bulkhead and padded with at least 1/4 inch foam rubber in between. The rubber helps to distribute the weight on the bulkhead so that the force is spread out. Mount the escapement extremely solid--if permitted to move it will likely tear loose and plow through the receiver before it flattens out against the batteries!

"Small models take more of a beating than larger jobs and will still be around after an accident that washes out a big ship, but since space and weight is at a premium there is less equipment protection. But 1/4 inch motion is plenty for shock protection if forces can be taken up and spread out over a solid resistance, such as a bulkhead. Stretching of rubber bands as a means of restraint is bad as it causes rebound that often does more damage than the original force of impact! A small solid package of an R/C model is required--when achieved it will be no fair weather flyer, but a rugged high performance job that will beat upwind with the best of the big crates."

Grid Leaks At Play



With this issue of Grid Leaks we are changing the format of the regular letter to you and calling it Grid Leaks at Play. No relation to Man at Work.

We hope in this Grid Leaks at Play to bring you some of the new ideas in R/C that are being offered by various manufacturers, to bring you our very frank appraisal of some of these new items and to point up some of the things which will be covered in future issues of this data service.

CK1054

Raytheon has introduced a new tube labeled the CK1054. This is essentially an improved RK61. Our tests indicate it is quite a fabulous tube and should do much to stimulate the interest in the Lorenz two Tube type circuit, which fell into disfavor with the varying characteristics of the RK61. We hope that the CK1054 will stabilize this situation so that individual components in the receiver will no longer have to be matched.

NEW RC BOOK

E. L. Safford is readying a new book which will be published by Gernsback Library, which sounds like it will fill a real need. He also will have a new transmitter circuit which will appear in a forthcoming issue of Radio-Electronics. This will be worth looking for.

The book starts with the most fundamental concepts in showing an absolute new comer how a radio control system works and what components are necessary. Then into general requirements for coding devices and decoding devices and basic concepts concerning transmitters, antennas, receivers, and even dissertations on the causes and cures of interference.

After this section the book becomes more practical and presents to the reader the concept of using transistors in R/C with an explanation of each type of circuit. A complete chapter of all types of transmitters for every frequency and varying from simple one tube to powerful multi tube type, both modulated and un-modulated.

The section on receivers is to be as complete as the transmitter section and covers the same dope.

There is a section on the practical construction of coders and decoders and finally a section on complete systems, both single channel, multi channel, and proportional simultaneous systems of which Walt Good's will be one.

The author says, "I have tried to make this the most complete book possible covering every type and kind of control system presently used in the model field written in such a way that a person who has never been in this field before, yet with slight knowledge of electronics, can start with it. The complexity increases until there are systems which I feel will intrigue the most advanced R/C enthusiasts."

The book is not available yet but will probably be out sometime this spring. It looks like it will be worth watching for.

LOOK MA, NO REEDS!

We were privileged to be visited by Mr. and Mrs. Marcy Inkmann of Racine, Wisconsin and given a preview of a brand new audio receiver system which will be available either late spring or early summer on the American market. Using no reeds, no heavy expensive toroids the system has a discrimination between audio channels which allow up to ten channels to be used.

Each relay stage idles at around 100 microamps which on signal rises to 4 mils.

The system uses a discriminator type of audio network which allows a band width on each channel of at least 20[illegible] cycles so that drift of the transmitter is no big problem. It is not at all tricky to adjust since it is very easy to tune into the carrier and then the pots are merely adjusted for maximum deflection on the needle for each channel.

Another beauty of the circuit is that quite simple transmitter circuitry may be used and a standard power pack without voltage regulation may be used quite successfully for economic operation.

The receiver circuit uses a vacuum tube detector followed by two transistor audios and then three components, one transistor, and one relay for each audio channel desired. This will make a truly fabulous impact for the R/C fan since it will offer, we feel, the finest multi channel work with far less fuss and feathers than any system has up till now. Circuit wise the receiver is quite simple. The copyright on the circuit is retained by Mr. Inkmann and kitting rights will be restricted.

8 CHANNEL COMING

The next issue of Grid Leaks will contain an eight channel simultaneous transmitter and is one for which some requests have been received.

Meantime keep us posted on what you would like to see on the pages of Grid Leaks and we will do our best to come up with them. We are most grateful to the many of you who have shared your circuits with us and we invite you to send us your brain-child. In this manner the R/C experimenters throughout the country can share their circuits very readily for improvement and for bringing radio control to the ever increasing number of fans. See you next issue.

Yours sincerely,

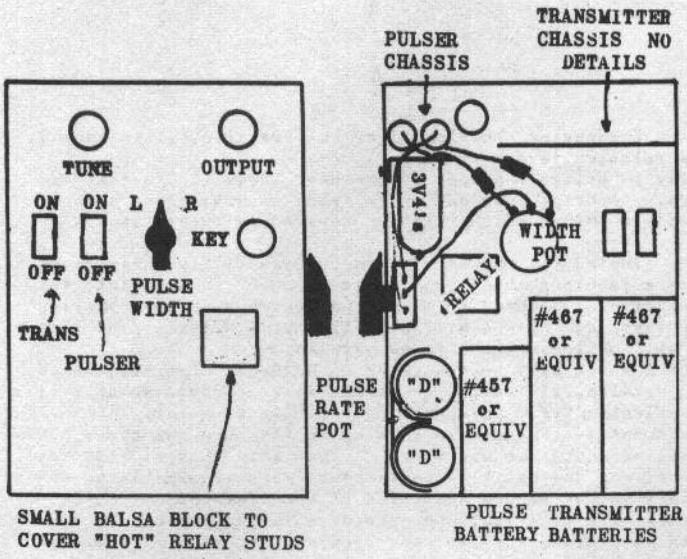
Paul

Paul F. Runge

SHORT CIRCUITS

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

PULSING THE COMMANDER TRANSMITTER



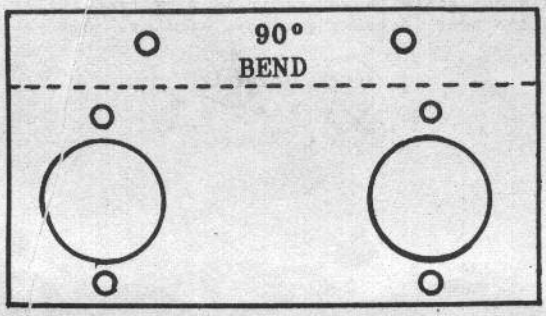
As in any pulser system, the normally open relay contacts connect across the key to become an electronic "thumb".

"The small WAG Pulser chassis will fit very neatly into the Commander Transmitter case making a handy hand held transmitter, which can be used for either pulse or regular CW.

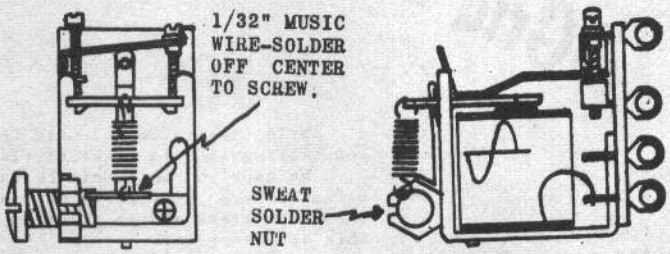
"In the enclosed sketch you can see how I fitted the pulser in. The regular two 467B batteries are used for the transmitter plus a 457 for the pulser. On the side is an Acme battery box for two size D cells. One is for transmitter filaments and one for pulser filaments giving entirely separate battery supplies for the pulser and transmitter. The regular key is in parallel with the relay. Normally open points. So if you don't want to pulse just don't turn on the pulser filament."----Ted Van Tassel, 417 South Pleasant, Centralia, Illinois.

From inquiries received at Grid Leaks, many users have wished to convert their Commander Transmitter to the Stick-Trol as appeared in Volume 1, Number 2. Ted's basic idea could be used provided a smaller chassis would be used. In place of the pulse width pot you would merely place the nine prong socket so that the Stick-Trol control box could be plugged in and all wiring would then be much as Ted shows. This would allow the Stick-Trol to be used with the Commander or other hand held transmitters of like size.

A full size drawing of the smaller twin 3V4 chassis is shown below.



MICRO MICRO GEM RELAY



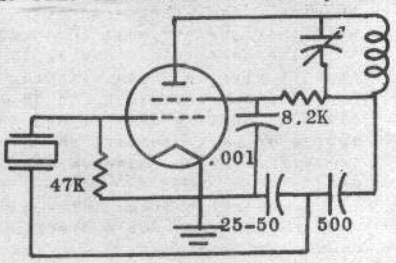
From Red Costlow, 1709 Lagoon Avenue, Minneapolis, Minnesota comes this idea of making a Micro Micro Gem relay. The Micro Gem as it comes from Jaidinger Manufacturing Company has adjustable contact points but the spring tension must still be worked by bending either the spring or the ground lug.

By sawing a slot in a nut and squeezing together to provide vibration proofing, a simple relay spring tightener is provided. The illustration shows a 6/32 nut and bolt in use. However, the original as designed by Red used a 3/48. Any convenient size that is handy may be used.

The relay spring is removed from the bottom anchor A pin of 1/32" music wire is soldered on the side of the screw used. Bottom end of spring solders to this which will tighten tension as it is turned anti-clockwise.

IMPROVING COMMANDER AUDIO

From Dale Springsted, Schenectady, New York comes a very simple circuit change on the Commander Audio Transmitter which improves performance. The modulator remains the same and hooks in exactly the same way.



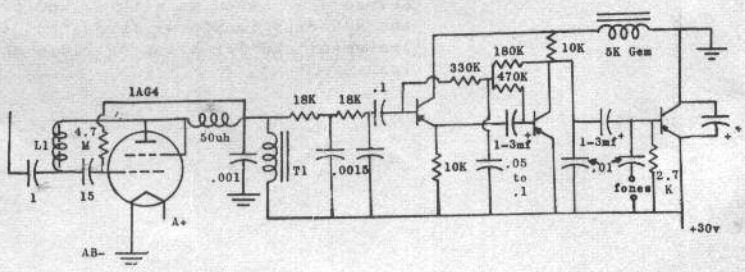
UNMARKED VALUES REMAIN THE SAME

BOO BOOS

Errors will happen and this is one reason editors get gray headed. We thank the readers who called them to our attention and show the corrections for them below.

Polarity was shown incorrectly on the battery charger in the article about the CG Voltabloc cells. The polarity will be exactly reversed.

Several values were omitted from the transistorized audio receiver of Max Boal's in Volume 1, Number 2. The complete schematic is reproduced again with the corrected values in place.



FSM--A Valuable, Versatile Test Instrument

AUTHOR JERRY MCGEORGE SAYS ONCE YOU HAVE USED A FSM

IT'S A SAFE BET YOU'LL NEVER BE WITHOUT IT ON THE FIELD OR BENCH

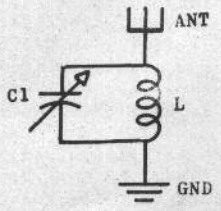


FIGURE 1

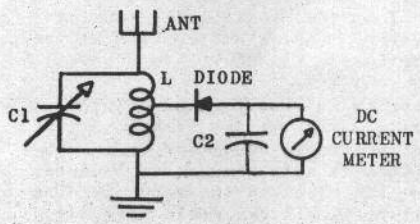
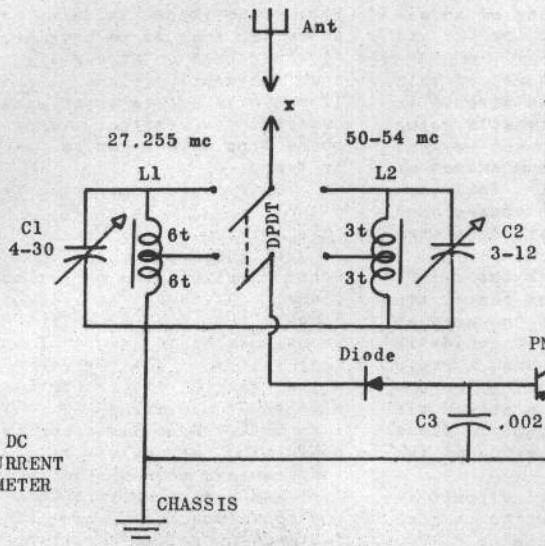


FIGURE 2



L1 and L2--CTC-LSM forms #30 wire, center tap
C1 and C2--Ceramic Trimmers
Antenna--6 to 24" as desired.
Battery--1½ to 4½ volts (see text)
Phone tip jacks marked x x x
MA--0-1 up to 0-5 MA
Diode--GE 1N48, Raytheon 1N66
PNP Transistor--GE 2N107, Ray CK722, CK721

NOTE: If only 27¼ mc operation is to be used, eliminate C2, L2 and DPDT switch

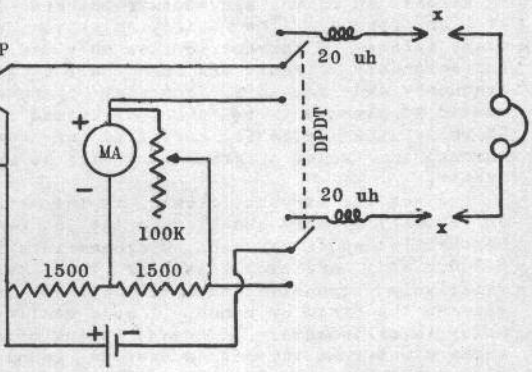


FIGURE 3

SEE TEXT

Every R/C'er wants to know how well his transmitter is functioning particularly when he is out in the field. It's probably safe to say that before, during and after launching an R/C ship every flyer is bothered to some degree by this haunting question. All shades of concern about transmitter performance exist between the levels of first-timer and old-timer. When the first few signals sent to that ship "up there" produce proper results the first-timer's pulse drops from 125 to 124 and the old-timer gets that smug, satisfied look on his puss.

One way to reduce the pressure on the nervous system regarding the reliability of the most important link in the radio control system, namely the transmitter, is to have a second (telltale) receiver on the ground nearby where the quantity and quality of the radiated signal is displayed to the operator. This second and relatively inexpensive ground-based telltale receiver has been named a "field strength meter" in R/C parlance. Since it is isolated distance wise from the transmitter the F/S meter operates for all practical purposes in the same environment as the receiver in the plane. And if you learn how to use this simple yet reliable transmitter performance meter you'll never launch a plane if it says "Uh-oh, something's not quite right with the signal source". On the other hand, if the FSM says "Signal source is OK" you'll launch the ship convinced that at least <u>half</u> of the control system is OK--and you'll concentrate on the really important business of flyin' that darned thing which is what you came out to the field for in the first place. So why not get to know and use this simple device? Once you do it's a safe bet you'll never be without it at the field or on the bench.

A very brief review of the basic concepts of radio wave generation and reception might be helpful at this point because we are dealing with an energy source and a special receiving device which if used properly will provide a degree of performance measurement of that source.

When electrons are made to accelerate in the transmitting antenna by virtue of the transmitter circuit a changing electric field exists and a constantly changing electric field is equivalent in it's electromagnetic effects to an actual flow of current. Where? Into space in the form of a radio wave which is composed of constantly changing electric and magnetic fields where the energy of the wave is equally divided between these two fields. When this wave sweeps across a receiving antenna the magnetic flux induces a voltage in that antenna and if it is properly connected to a "measuring" device some useful results can be expressed as a function of this induced voltage.

Voltage, which is [illegible] for electrical pressure, can be made to do something worthwhile if a path or circuit is provided for electron movement. If we connect our receiving antenna to a suitably sized inductor having a variable capacitor across it (as in Fig. 1) with a connection to ground; and if we tune C1 to resonance with the transmitter frequency of, say, 27.255 mc then there will be electron movement, or in other words, a current flow in the system.

This is an alternating current flow at 27.255 mc in the antenna-ground system via L and C1. What we have actually done here at point of resonance is equalize the

capacitive and inductive reactances of the entire system. Now the trick is to make some use of this tiny rf current.

Since there is no resonance indicating device in Fig. 1 the operator would never know when he actually had the receiving circuit in tune (resonance) with the transmitter frequency. However, if L and C1 are properly sized a resonance point does really exist. Let's put an indicator on it.

Note in Fig. 2 that Fig. 1 has been repeated but that it now has a secondary circuit consisting of an alternating current rectifier (diode), a capacitor C2, and a direct current indicating meter.

What we want to do in Fig. 2 is send some of this received energy flowing in the antenna-ground circuit in the direction of our dc meter so we can see what's going on. By tapping down on L to about midpoint we can transfer for all practical purposes a maximum amount of available energy to this secondary circuit. This tap-down matches the high impedance of the antenna-ground circuit to the low impedance of the crystal diode circuit.

Now, when C1 is tuned to resonance with the 27.255 mc signal an rf voltage appears between the center tap of L and ground. The rectifying action of the crystal diode allows rf current to flow only on half cycles in our secondary circuit and each half cycle has a radio frequency and an audio frequency component. The unwanted rf component is "short-circuited" to ground via C2 while the desirable rectified af component flows through the meter to ground causing an up swing of the needle.

Since the current flowing in the meter circuit is quite small a very sensitive meter is required to give worthwhile needle movement. Microammeters ranging 0-100, 0-500, etc. are excellent for this purpose but are relatively expensive and a bit delicate for rough service on the field or bench. A good quality 0-1 milliammeter is satisfactory. Anyone owning or caring to purchase a meter in this class need to go no further than Fig. 2 to have a good single purpose field strength meter.

The circuit shown in Fig. 3 repeats the basic circuit, Fig. 2, but shows a simple DPDT slide switch which allows selection of either the 27.255 mc spot or the 50-54 mc band. A direct-coupled transistor amplifier has been added to increase the sensitivity of the milliammeter. The meter is connected in a simple bridge circuit which can be balanced to zero meter reading under "no signal" conditions by means of the 100K pot. A second DPDT slide switch disconnects the meter and cuts in a pair of phones for audio-tone monitoring.

This circuit represents only one of many variations that may be applied to the basic circuit Fig. 2 but it is quite adequate for R/C with respect to versatility and sensitivity. It need not be too expensive since milliammeters in the 0-1 to 0-5 range can be used. The writer uses a 0-1 ma and one pencell in the battery position. Choice of battery voltage depends on the range of the milliammeter used. Use only enough voltage to drive the meter to full scale reading when the instrument is reasonably close to the transmitter, meaning within visual range. There is nothing critical about the parts layout or wiring of Fig. 3. A small standard metal box 4"x5"x3" or similar will permit installation of the meter on one of the 4"x5" faces. The other external components such as the phone tip jacks, switches and pot can be mounted on the sides. A small formica panel can be rigged on the inside to hold the internal components. Provision should be made to tune L2 and C2 from the outside since they must be variable over the 50-54 mc band. Two small holes in the case will allow entry of a tuning wand.

Now lets see what we have here and what we can do with it. In the first place, turn on your 27.255 mc transmitter with full antenna connected and tune L1 and C1 to maximum up-swing of the meter needle. If the needle bangs the up peg then get far enough away from the transmitter to get a mid-scale peak reading. When properly tuned you'll never have to touch this setting again. Next, call in a friend who has a rig on the 50-54 mc band and tune in his signal using L2 and C2. Since you've made arrangements to tune these items from the outside of the case you can find these Ham guys quite easily.

Now flip the output switch from meter to phones and if you're using audio tones you'll hear them loud and clear. This is better than having to connect your phones to the receiver in the plane to find out what your transmitter is doing tone-wise. A crystal diode detector such as we have here gives very faithful (hi-fi) response on strong signals such as you might hear when reasonably close to a tone modulated transmitter. If you have access to an oscilloscope you might try connecting the vertical input of the scope across your phone tips. Then you can see as well as hear those audio tones.

This audio-tone reception feature of Fig. 3 has a bit of novelty about it. Never the less you can use this service at the bench to good advantage by listening to your tones and relating what you hear (or see on the scope) against the performance of your receiver in the plane. Obviously any odd-ball squeals, howls, cracklings, put-puts or chirps that may be heard in the phones can serve no useful purpose in an audio tone control system. Their presence indicates trouble at the signal source, the transmitter, and they should be eliminated or minimized.

While phone listening is interesting and helpful in evaluating the quality of the tone signal it has serious shortcomings because the individual human ear is a peculiar and non-scientific device with respect to loudness and tone frequency. So let's look to the meter reading for more useful information to all concerned regardless of the type of amplitude modulated signal being used. And this includes everything in the R/C line from simple on-off carrier-only up through those fancy pulsers with or without tone and those fat cats using 8 or more tone channels. All can use the FSM in their own peculiar way to check transmitter output performance.

How do you interpret this needle position or action? The first thing to do is to place the FSM approximately the same distance from your transmitter every time you use it. This effectively eliminates the exponential variable in the radiation equation. If you take this same position every time you check the transmitter output any significant change in the needle position or action from your normal standard will likely be caused by battery potential depreciation or a tuning change within your transmitter. How far do you let this radiation indicator go in the "wrong" direction? No one but you the operator of your particular type of AM transmitter can answer this question. If you relate needle position or action to what you know to be good R/C system performance a standard will soon emerge. When system trouble occurs and the transmitter is at fault you'll see it on the FSM. On the other hand, if system performance is off and the FSM is reflecting a normal radiation standard then you should look to the receiver for trouble.

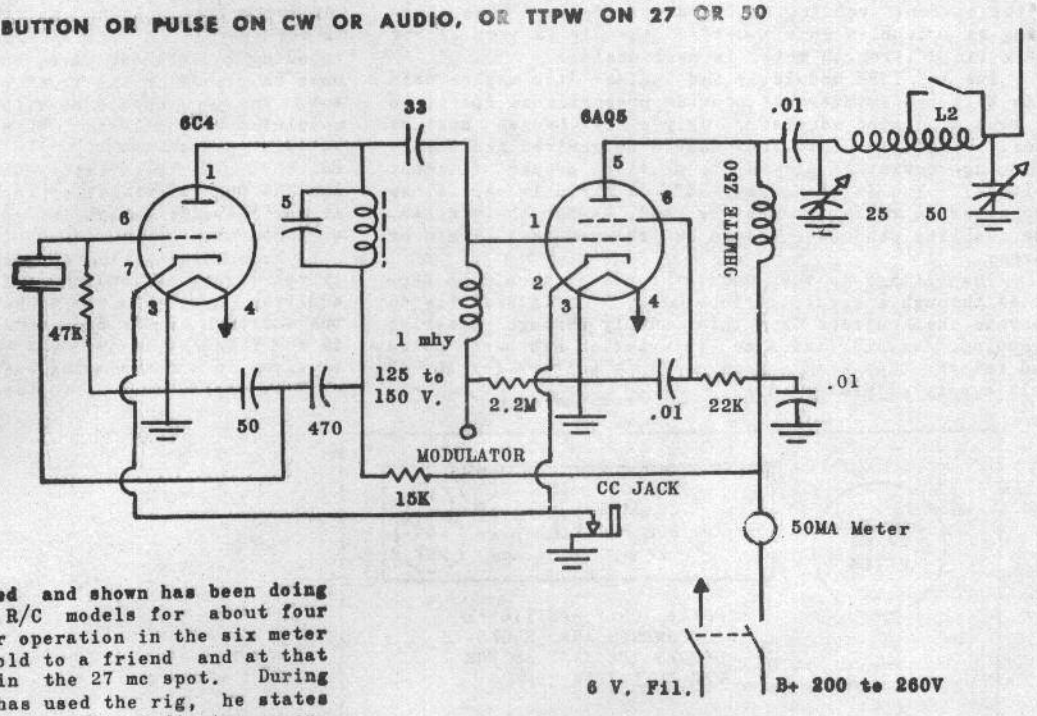
So in summary, a field strength meter as we use it in R/C is simply a close-by telltale receiver with an indicating meter on it. And being close-by the transmitter at an always constant distance it can be considered for all practical purposes that part of the transmitting system which indicates the radiation performance. Since the transmitter is the most important link in the R/C system why not build a field strength meter and learn how to use it? This is good advice to both newcomer and old timer in R/C.

References:

R/C Combo Meter, McEntee--Air Trails, Sept., 1953, p.53
Vacuum Tube FSM, Lorenz--Model Airplane News, May, 1954 p. 27
FSM for Radio Control, Runge, Popular Electronics, Oct. 1955, p. 48
FSM Adapter, McEntee, AT Hobbies for Young Men, July, 1955, p. 52
R/C Handbook, McEntee, page 149

SPRINGSTED'S VERSATILE X

DALE'S RIG ALLOWS PUSH BUTTON OR PULSE ON CW OR AUDIO, OR TTPW ON 27 OR 50



L1--17 turns #22 on LS3 form
L2--18 turns #16 5/8" diameter, tap at 7 turns
L2--at 7 turns for 50-54 mc.
L2--at 18 turns for 27 mc.

The transmitter described and shown has been doing an excellent job of flying R/C models for about four years. Originally built for operation in the six meter band, it was subsequently sold to a friend and at that time changed for operation in the 27 mc spot. During the time the current owner has used the rig, he states that it has never been retuned. This indicates exceptional stability, and as for power it has several times been used to regain control of models that have flown out of range of oth[illegible] transmitters.

Recently finding use for transmitters on both of the popular R/C bands, we decided to use this circuit again. This edition uses a switchable pi tank, so that to change bands it is simply necessary to throw the tank circuit switch, plug in the proper crystal, and retune the oscillator tank circuit. One meter indicating total B plus current is all that is necessary to make tuning adjustments. A field strength meter is used to tune the final for maximum output.

It would have been perfectly possible to include switching for the oscillator for really fast band hopping, but the additional effort was not deemed worth while since seldom ever will high speed changing be necessary. Further requirements for our purpose were that the unit be able to operate a W[illegible]W system, since we are proportional fans. All of this has been accomplished, plus several other features. In its present state the transmitter will operate almost any current receiver except reed bank gear. This would only require an additional modulator. The following functions are available: hand keyed CW or tone; standard variable width pulsed CW or tone; TTPW operation. All on EITHER frequency, for a total of ten separate operating conditions.

The original transmitter used practically the same physical layout of components as Dr. Good's WAG TTPW RF deck, so a spare chassis from a WAG kit was used to build this final. This layout is ideal for any transmitter of MOPA style, the oscillator tank coil and associated parts at one end of the chassis and on the bottom side, while the amplifier tank circuit is at the opposite end and located on top of the chassis. The chassis becomes the necessary shielding. Operation of the circuit as a straight through amplifier is possible without the bother of neutralizing components. The 6C4 tube should have a shield can over it however, to complete the isolation between stages.

Only a few changes have to be made in the chassis. First, a closed circuit jack is mounted between the switch and the normal plate tank capacitor. Second, an additional condenser (APC-50) is mounted alongside the present condenser at the outside edge of the chassis. There is just room to mount an SPST slide switch over the plate tank condenser in a horizontal position. The latter part is only necessary if two band operation is required.

The tank circuit components were picked to operate on six meters and to load a low impedance antenna such as a 1/4 wave vertical, between 50 and 53" long. We were pleasantly surprised to find that it was only necessary to add enough inductance in the tank to obtain resonance on 27.255 and use the same value of antenna tuning condenser to load a 1/8 wave 50-54" vertical on 27.

If one desires to operate the 27 mc frequency with a 1/4 wave whip 9½ foot it will likely be necessary to add a parallel mica condenser of about 100 mmfd to the APC-50.

On 27 mcs the power output compares favorably with a good Mac II as measured with a relative indicating field st[illegible]th meter. On six meters the power output is down a bi[illegible]e to the final doubling in frequency but is far more than required for any normal modeling use. With 250 volts on the plate the 6AQ5 is easily loaded to 5 watts input.

Remember the tuning meter is reading total B plus current, so a plate current meter should be temporarily hooked up and the actual plate current noted, as compared to total curren[illegible] the whole unit. The 6C4 will draw about 6 mils and the 6AQ5 screen about 5 mils. Plate current of the 6AQ5 should be 20 mils for a total of 31 mils. On 27 mcs it will be possible with a well matched antenna to load up over the legal 5 watt maximum allowed so the builder will have to make this test to assure legal operation.

Once knowing the total current values desired, tune up is very easy. Turn both condensers to minimum value, (unmeshed) unscrew oscillator slug all the way. Apply voltage, and quickly adjust the slug until sudden drop in plate current is noted. This indicates the crystal has started oscillating. Never operate the unit in the untuned condition for a period longer than a few seconds as the high current is almost sure to pop a tube.

Next adjust the tank tuning capaciter for a dip in

addition to the one already noted. The oscillator should stay in tune, but may need to be retouched a bit. Then adjust the antenna condenser to pull a bit of load, and retune the tank condenser for dip once more. Repeat until the desired loading value is reached, as indicated by the current reading as the dip is found. When operating as a doubler on six meters the dip is very slight and a field strength meter is most useful.

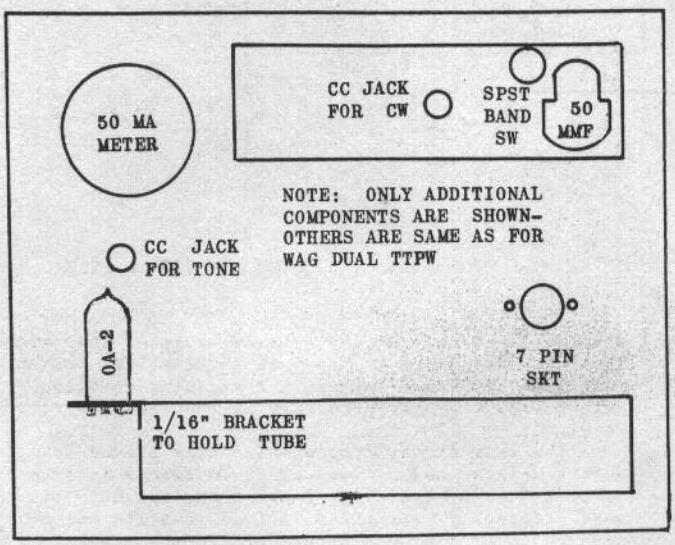
The WAG TTPW modulator and pulser deck may be used with this transmitter to provide proportional operation or tone modulated carrier. Only a few changes must be made. First, the filaments should be rewired and series dropping resistors placed to provide proper filament voltage. The filaments may NOT be wired in series, so two separate resistors must be used, as per the diagram. The coupling condenser should be changed to a .1 mfd or larger.

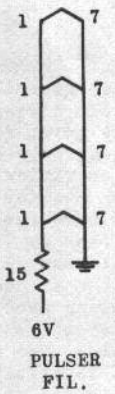
The voltage to the modulator plates should be supplied through a regulator tube 0A-2. It is possible to operate the pulsers from this supply through a series dropping resistor but some interaction has been noted and rather than risk a good model a battery for the 45 volt supply is preferred.

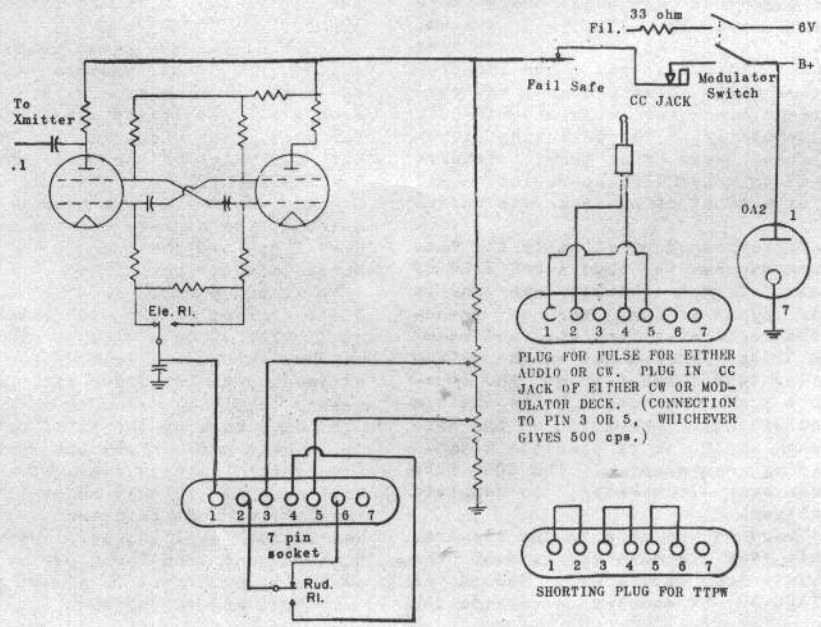
A plug system is used to enable the control box to operate as the stick control. This can be done by means of a switch or with a plug system since it is a permanent part of our transmitter. The plug arrangement is shown. A wedge of cardboard is used to stop the elevator relay from pulsing and the 80% signal 20% off seems to work best. A duplicate closed circuit jack corresponding to the one used on the RF chassis for keying must be placed in the front panel near the nine pin socket. The jack should be wired in series with one of the modulator B plug leads. This serves as the key jack for keyed or pulsed tone.

ED. NOTE: It is perfectly feasible to change the regular WAG Dual Transmitter to provide the same functions as Springsted's Versatile. Simply follow same switching arrangements.

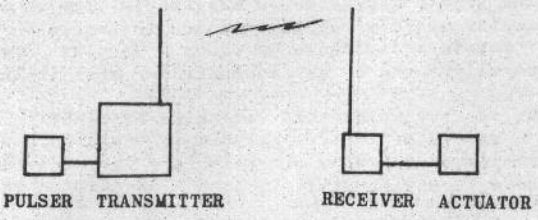
No special wiring diagrams are shown since basically the wiring follows that of Dr. Good's transmitter. In addition, operation can be had from a 12 volt battery by the addition of the proper values of dropping resistors in the filament leads. Six volt power supply plans will be given in a forthcoming issue. Additional information will be supplied if anyone needs it.







What Is Proportional Control?



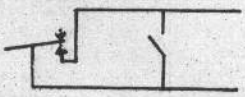
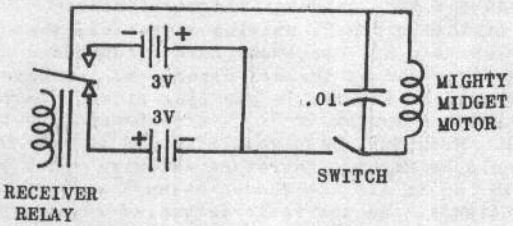


FIGURE 1

PULSER RELAY IS WIRED ACROSS KEY SO THAT PULSER ACTS AS AUTOMATIC THUMB



TWO SETS OF BATTERIES ARE REQUIRED TO OBTAIN POLARITY CHANGE FOR MOTOR REVERSAL

FIGURE 2

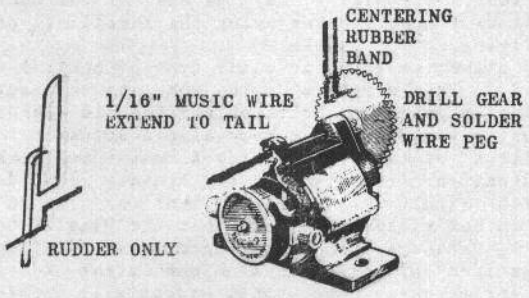


FIGURE 3

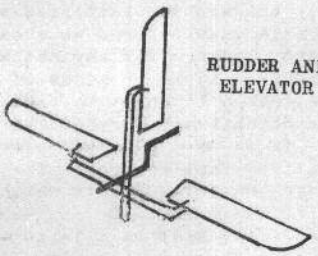


FIGURE 4

FIGURE 5 — 50-50--NEUTRAL RUDDER
2 CPS--FULL UP ELEVATOR

FIGURE 6 — 50-50--NEUTRAL RUDDER
8 CPS--FULL DOWN ELEVATOR

FIGURE 7 — 40-60--PARTIAL LEFT RUDDER
3 CPS--PARTIAL UP ELEVATOR

FIGURE 8 — 60-40--PARTIAL RIGHT RUDDER
7 CPS--PARTIAL DOWN ELEVATOR

Proportional control interest is mounting throughout the country if correspondence received by Grid Leaks is any indication. Many want further information on both simple and proportional control for rudder only, and also simultaneous dual proportional control with a dual pulser such as shown in the last issue of Grid Leaks, Volume 1, Number 2, in the articles entitled "Simple Dual Proportional With Stick-Trol" and "Make Your Own Control Box".

Proportional control has been a favorite of many flyers throughout the country. The biggest stumbling block for an escapement man in wanting to try proportional control is probably the mental block because it is hard to visualize the ease with which proportional may be flown as compared to escapement. The systems depend on waggling surfaces. Here is where some of the objection comes in since many escapement flyers feel that the waggling is objectionable and affects the flight pattern.

Flight pattern is seldom affected if the minimum of two cycles per second is held as a rigid rule of thumb. Any attempt to pulse slower than this will result in an unpleasing flight pattern. However, at rates of faster than 2 cps the model simply doesn't care whether the surfaces are pulsing. There is enough mass in the plane itself so that the waggling surfaces do not affect the flight pattern whatever. It is only in the dwell time of the rudder that flight action is affected.

Surfaces are generally a little larger than would be used for escapement flying and movement is generally in an arc of 20 to 30 degrees.

Since the surface must be constantly waggled it is essential that the transmitter signal be constantly turned on and off. Proportional control has been successfully flown with the thumb keying the transmitter button but this is tiring to say the least. It also becomes difficult to do fast enough over the long period of time while the plane is in the air.

As shown in the block diagram, a pulser of some type is required across the key to provide a mechanical thumb. (Figure 1)

Mechanical pulsers may be used quite adequately for rudder only systems. They are not, however, so satisfactory for dual systems. The electronic pulser as developed by Walt Good and as used in his dual system is by far the best electronic circuit which has been developed. This circuit was shown in the article "Simple Dual Proportional With Stick-Trol".

If you will regard the pulser as a mechanical thumb this will help clarify your thinking. The transmitter

must be keyed on and off regularly.

If the transmitter signals are even, that is if the amount of signal on and off is 50% on and 50% off, the plane will assume a straight away flight pattern.

As soon as this width of pulsing is varied, that is the ratio to on to off becomes more pronounced in either the on direction or the off direction, the actuator within the plane assumes a position either to the left or right, with a longer dwell corresponding to the pulsed signal. With full on signal it would be left, full off signal would be right. Therefore as pulse width becomes 60 to 40 on to off the rudder assumes a 60-40 degree dwell attitude. As the ratio is varied 70% to 30% on to off it assumes a 70 to 30% dwell attitude and the plane assumes a sharper turn. The same is true with the off to on ratio.

The system is actually a little more difficult to explain on paper than it is in actual operation. As a matter of fact, simplicity may be one of the mental blocks that keep many from enjoying the thrill of proportional flying.

In the plane itself an actuator type of control device is used. This may be a device such as the Southwestern Actuator, the Sage Actuator; or the old standard Mighty Midget motor provides a very simple actuator. If the limitations of the Mighty Midget motor are taken into consideration; that is that the brushes should be either seated firmly with contact cement or tied in so that they can not vibrate out and that the plastic base is subject to breakage upon a landing and thus reinforcement is required by using an aluminum strap to fit around the entire case, the Mighty Midget will perform admirably. (See Doubled Geared version this issue.)

Actuators of the Sage and Southwestern type however, require only one set of batteries while with the Mighty Midget two sets must be used as shown in Figure 2.

The best linkage for any actuator system is generally considered to be by means of a torque rod. Push rod systems have a tendency to bind. See Figure 3.

Many combinations of receivers and transmitters are possible. It is, of course, possible to pulse almost any transmitter fast enough. The key is simply connected across the relay points which act as your mechanical thumb.

The receiver must be able to follow pulsing up to ten times per sedond. Virtually all hard tubers will. Many gas tubers, too, are all right but they should be checked to make sure that at least ten cycles per second may be had.

Audio transmitter and receiver combos are also fine but the receiver must be checked to see if it will accept pulsing up to ten times per second.

With the simple rudder only proportional, of course stick control is not entirely necessary. In this event a conventional pot may be used and only the pulse width pot is required to be adjusted for the amount of rudder control desired. The pulse rate is set fast enough so that there is no tendency for the plane itself to do any waggling. Only the control surface.

With Walt Good's Dual Proportional system placing near the top at the last two Nationals and first place at 1957 King Orange Meet, there has built quite a bit of interest in the simultaneous dual systems. However, many builders lacking radio experience are reluctant to get into Walt's system at the present time and this is commendable since the system does require electronic experience in order for the user to build.

A simple simultaneous system was developed in New Jersey and taken by the Virginia, Florida, and New York boys and refined to a beautiful simple system to provide both rudder and elevator control proportionally.

The secret of the system is in two things. Number one, the pulser should be of the WAG type since this lends itself quite easily to changing both the pulse rate and the pulse width simultaneously which must be done for this system.

The other secret of the system is as shown in figure 4. This is the Mighty Midget motor with its ultra simple hook up to the rudder and elevator to provide both rudder and elevator control. The jack shaft and pulley of the Mighty Midget motor are simply removed and a 1/16" diameter music wire is inserted instead and run through the fuselage to link as shown. A 5/8" crank will be generally found to be adequate for most installations.

Linkage is set up so that there is absolutely no bind. As a matter of fact, some people would call the linkage normally used sloppy since it is a very tolerant fit. If there is any tendency to bind this must be corrected.

Slow pulse rate is hooked up to give up. This moves the motor through an arc of about 270 degrees. The full 270 degree arc of travel is had when pulse rate is slowed to two to four cycles per second as shown in figure 5. The dwell time is longer in up elevator position than in any other spot. Therefore, proportional up is had. Assuming that the pulse width is still 50-50 neutral rudder is had.

Down comes when fast pulsing of about eight to ten cycles per second is used and figure 6 shows the travel limited to about 10 degrees. Dwell time naturally is longest in down elevator position.

Any proportional dwell time between either extremes will give an appropriate position on the elevator for proportional up or down.

While rate governs the elevator the width controls the rudder just as in any simple rudder proportional system. The two may be had in any degree simultaneously. Figure 7 shows the combination width 60 to 40% and 3 cycles per second to give a combination of partial left rudder and partial up elevator. Figure 8 shows a 60-40 percentage pulse width and pulse rate of 7 cycles per second for partial right rudder and partial down elevator.

There is only a slight interaction between the two pots controlling pulse width and rate and this works out advantageously. At the extreme limits of rudder control which are normally not used if rudder is large this results in some up elevator action. Actually in a tight turn this is an advantage since it will provide for some degree a compensation of up and will not result in a sharp spiral.

In the airplane itself the control surface elevator are generally recommended to have a 10% total area.

A centering rubber should be used. In either system this may be mounted on the large gear of the Mighty Midget motor by soldering in a pin which is used as a stop or a crank may be bent into the torque rod and linked. This should be a light rubber band stretched rather tightly from a small radius.

It is essential that a good ground check should be made carefully before flying. With a sharp eye one may readily see if the effective control position on the model duplicates the control stick attitude. In some cases it may be necessary to restrict stick motion if excessive mixing occurs.

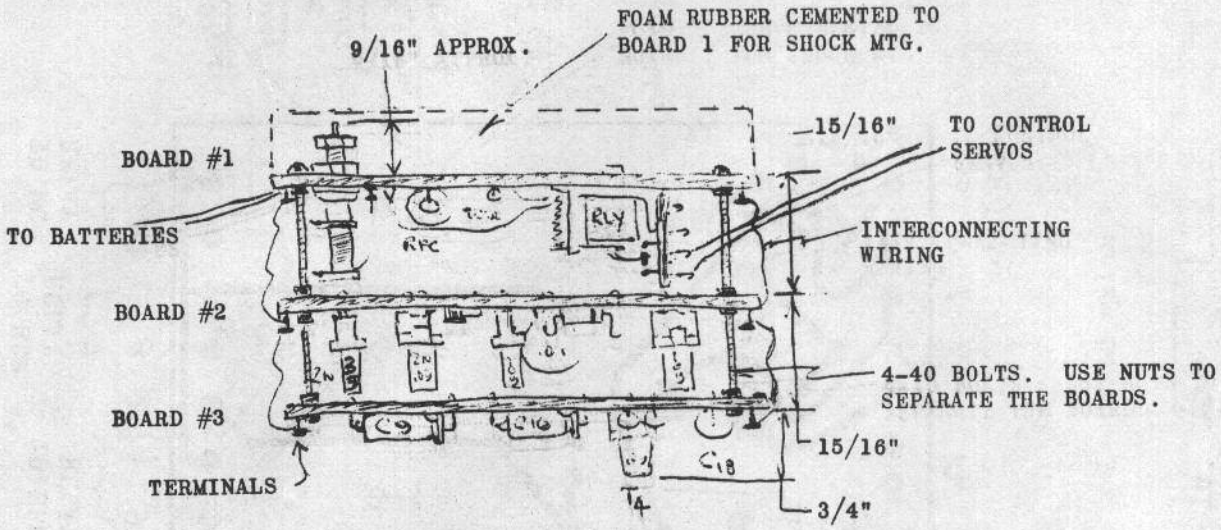
Any flying should be begun with test glides with radio system in operation and a pilot at the stick. The model is trimmed for a normal glide when the stick is in neutral. This may be accomplished by shims under the wing or weight shifting but never with any excessive angular wing tail difference since this makes elevator control difficult.

Fire up the engine and make your first dual proportional flight. Use the stick to compensate for any trim problems in the flight making permanent changes after you land.

The ability to fly increases with practice in any system. The flyer will generally find that his flight procedures will be entirely different than with rudder only ships. Two hundred feet will be found to be the maximum altitude and instead of an occasional command for either left or right rudder the pilot is actually flying the model all the time.

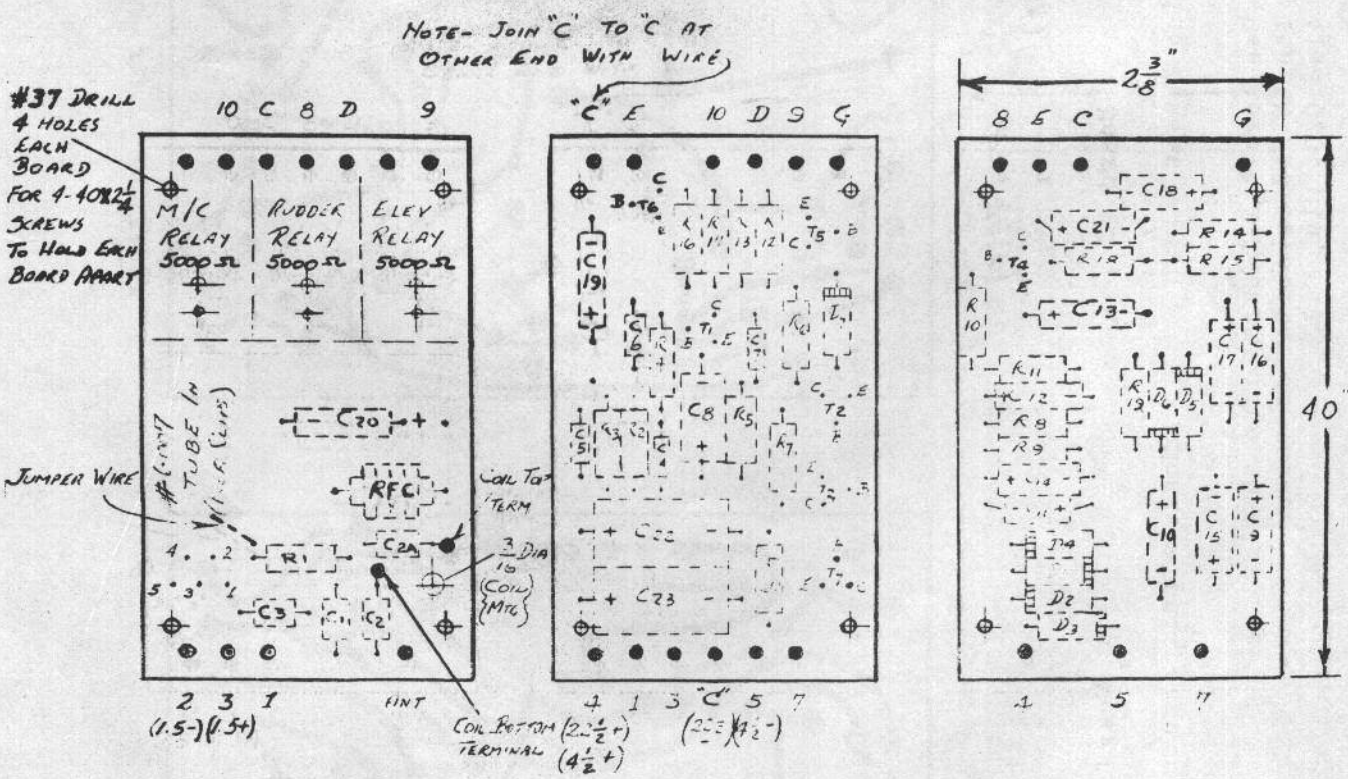
Printed Circuit Boards for Herzog's Transistorized WAG TTPW

L. D. MC MULKIN GIVES FULL SIZE ETCHING PATTERNS



OVERALL HEIGHT 3 3/16" MAY BE MADE SMALLER IF TRANSISTORS ARE SOLDERED IN DIRECTLY USING FISHPAPER BETWEEN BOARDS TO PREVENT SHORTS.

DIODE MOUNTING. NOTE BENDS FOR EXPANSION AND SHOCK ISOLATION



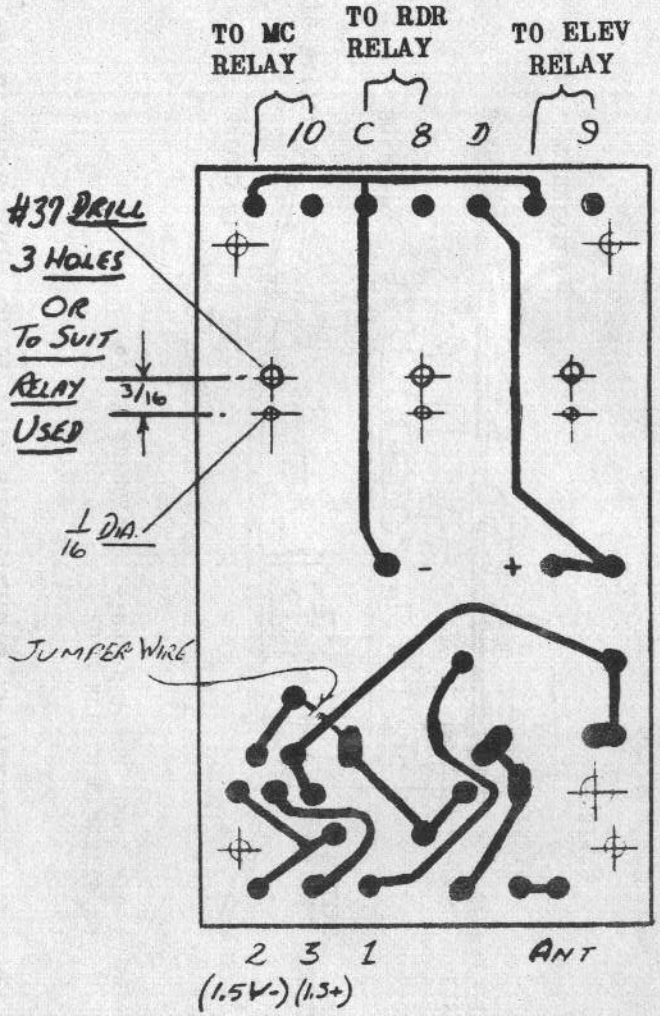
Relay Board #1

Board Material
XXXP Phenolic

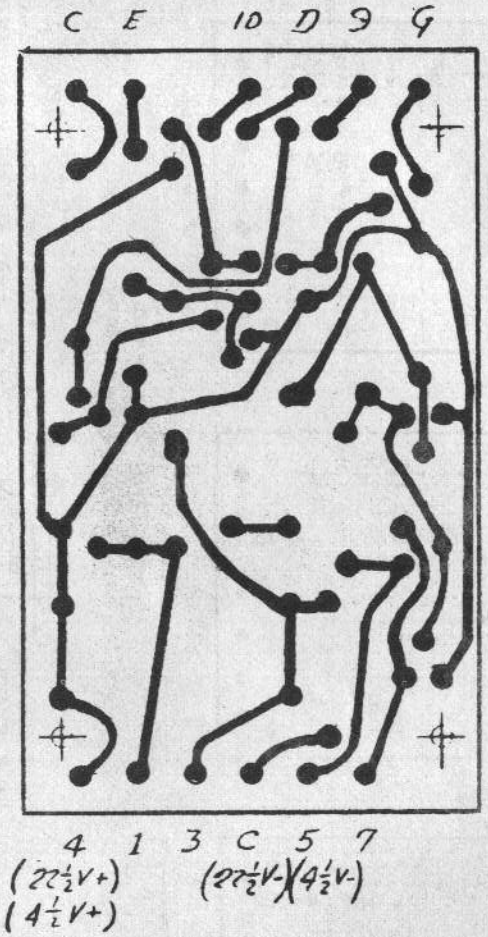
Board #2

Board #3

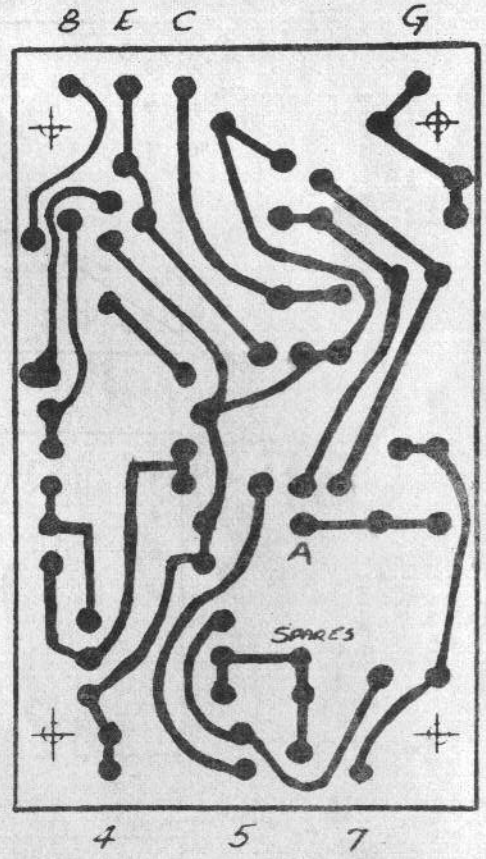
All boards show printed side (components are on opposite side)
All terminals( )stand on component side
All component mounting holes #55 (.052) drill
Interconnect all same letter or number terminals
Schematic from American Modeler December, 1957



Relay Board #1



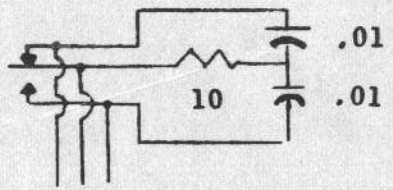
Board #2



Board #3

WAG Wiring Layout

Scale - Full Size



Spark Supression Circuit
(Install on each relay)

Note: Use holes (A- spare) if a shorter length C10 capacitor is used. Also C20, C19, C13.

L. D. McMulkin - 1957

LETTERS

TRANSISTOR TEMPERATURE TIP

"I wish to offer my congratulations on your Data Service sheets. This is the greatest stride in R/C I have seen. In regard to Volume 1, Number 1 article 'Aero Modeller Receiver Circuit' I believe you will be interested in the January, 1958 issue of 'Radio Electronics', page 112; an article by Edwin Bohr seems to have the answer to transistor temperature sensitivity.

"I am new in the field of transistors and do not have the facilities for combining Mr. Bohr's ideas into the already mentioned receiver.

"I hope that I have been some help to someone in this problem."

Very truly yours,
J. A. Combes, Jr.
San Diego 17, California

Jerry McGeorge also mentioned this in connection with another receiver that he was going to develop. How about it? Have any of our readers used this circuit and applied it to the Aero Modeller? If you have, won't you share this with us?

WANTS GG MOTOR CONTROL

"On a recent trip to Wichita, Kansas I had occasion to drop in to the Fad Shop. I talked with Frank Dixon (Mr. Hobby himself) and through him I met Austin Shumway and Ev Schoenberg, president and vice-president of their organization. Also Dean Zongker, the ex-president.

"During the course of our talk session the Galloping Ghost system came up. Man, dual proportional for nuthin'. Well, anyway almost nuthin'!

"So when I got home I got out good ole Grid Leaks--the R/C mans bible and lifesaver--Volume 1, Number 2, Bernard Fox's article. But I still don't understand the Galleping Ghost system.

"Would it be possible to have an article explaining the GG system in more detail? Here is my vote for the schematic on a pulse omission detector for motor control.

"Thanks million for your equipment (quality), advice (Ineed it) and general effort to enlighten the poor souls in the R/C field. I feel quite free to say this for the whole gang here at Roswell.

Thanks again,
Jimmy Simpson
Roswell, New Mexico

Check the article on "What Is Proportional Control" found in this issue. The motor control pulse omission detector will be forthcoming.

WARNING!

"Volume 1, Number 2 Grid Leaks great! Except as an old timer electrician I can't see the use of full 110 volt AC for battery charger for the hook up of the DCRC. An R/Cer of limited experience (and old timers too) can get an awful jolt from the series hook up using the 100 watt bulb.

"The charger can do a lot of damage. You did point out the danger of getting across the 110 volt to ground but the best of us can sometimes get careless and pffft! Suggest a note in the next issue of the danger and would suggest that it would be better to use a 110 volt to 24 or 12 volt step down transformer instead."

Regards,
Irv Megeff
New York 13, New York

LIKES RELAY ELIMINATOR

"I have tried Oscar L. Shulz's article on transistors replacing relays that appeared in the first Grid Leaks. This hook up surely eliminates vibration trouble. Do you have any information on the use of motor control using quick blip on a compound escapement with this arrangement?

"Several men in Cleveland are subscribers to Grid Leaks and we all think it is tops."

Mills L. Rogers
Cleveland, Mississippi

To date we believe no one has developed a single pole double throw transistor. However, we urge you to look on page 23 of the March, 1958 Model Airplane News in the Lorenz column. While this system is primarily developed for servos, it is entirely possible that it might be worked as a DPST relay with a little fiddling.

WANTS TROUBLE SHOOTER'S PRIMER

"Received my second copy of Grid Leaks today and was thrilled with it although I understand all too little about radio. My chief difficulty lies in such things as trouble shooting. How does one check malfunction of pot or relay? What items besides tubes might be the first to suspect when things go wrong?

"I mentioned the foregoing for the vast army of beginners (those so close and yet so far). Maybe some information on basic texts for beginners and where these are obtained could be included.

"I have talked to a lot of modellers who would plunge if such obstacles as installations, and more inportant, trouble shooting were problems they could lick by themselves. There is a thrill in finding and rectifying a malfunction--a trouble shooter's primer, perhaps."

Sincerely,
Willis Hanson
Hallsville, Missouri

Suggest you read the article by John Worth in this issue on Trouble Shooting Gas Tube Receivers. This is a step in the direction you suggest. However, the trouble shooting primer appeals and we will see if something can be done.

WANTS TRANSISTOR RECEIVER

"Allow me to congratulate you people on 'Grid Leaks --R/C Data Service'. I think it fills a badly neglected gap; the exchange of experimental data between different modellers in the country.

"I am most interested in articles dealing with the use of transistors in R/C. I would especially like any dealing with transistorized receivers with the complete elimination of tubes.

"Incidentally, Sonotone did make a flat version of the P-4 which preceeded the P-4R (the R signifies round). Many thanks and good luck."

Cordially,
Lester W. Nelson, Jr.
Croton-on-Hudson, New York

The all transistorized receiver is being worked on. We have heard of several in certain parts of the country which are giving imminent success. Neil Delafield of Beaumont, Texas tells us he has developed two and will share the circuits with our readers as soon as they have been completely wrung out. Sonotone no longer makes the flat P-4 we understand.

CONSTRUCTIVE AND APPRECIATED

"Received the first and second issue of Grid Leaks and enjoy it very much. It fills a real need for the R/C fan and you are to be congratulated for its general excellence.

"You asked for comments and I assume criticism is justified, so here goes.

"Transistor-many faults in your presentations. Number one, an NPN is always shown as at left below not as at right below which designates a PNP. Number two, Commander Receiver (Volume 1, Number 2) CK721, 722, Philco A02, T0037 are PNP not NPN transistors. Polarity is important.

NPN

PNP

"WAG Dual Receiver tests (Volume 1, Number 2), this references 45 and 67 volt receivers the first time I've read it. I built the TTPW in the spring when it first came out. Like it and have had very little trouble with it except I learned early that 45 volts is not always enough. I use 6 to 9 volts in series with an Eveready #455. Walt Good says he does the same--I saw him this summer at Syracuse. I think a tip to the field is in order.

"Suggestions for Grid Leaks article--a DC converter, transistor oscillator (5 KC) power converter. Recommend a 12 or 15 to 1 step up transformer. A good 100% modulator for use with the Good TTPW Transmitter. The present modulator is fine for the TTPW system but is lacking when used with reeds. Or a good modulator--100%--for a one tube transmitter.

"For the record I built Bill and Walt Good's first R/C set up with 3A5 tubes in 1940. I flew it in a nine foot Forster 99 powered plane and play with R/C off and on over the years. Periodically--and involuntarily--renewing my membership in the down elevator club! Have flown big ships for years but every now and then think models are harder to fly! One of my major gripeswith modelling is the way so many young modellers become discouraged too soon. Faulty equipment and faulty magazine articles help this.

"Example of faulty equipment "Jewel relays"! So I hope you won't mind my criticism."

Yours sincerely,
Eugene T. Wilson
Rome, New York

This is the kind of a letter we like to see Thank you very much. It helps us improve our thinking concerning what you want for Grid Leaks.

That is an excellent tip on the WAG Dual TTPW Receiver and all the TTPW fans should take note.

We have a good 100% modulator coming up in an eight channel reed receiver and transmitter article by Max Boal of Kansas City, Missouri. Part of this is scheduled for the May-June issue of Grid Leaks.

The DC converter article is still very much in the experimental stage and not yet ready to be presented.

MORE ON GG SYSTEM

"I want to tell you that I enjoyed your first two issues of Grid Leaks very much. I don't quite understand the Galloping Ghost installation in the airplane and want to see more information on proportional systems and simple dual systems in your magazine. Keep up the good work."

Very truly yours,
William A. Thienes
Pampa, Texas

Suggest you look for the article in this issue entitled "What is Proportional Control?". Hope this explains the system a little more fully.

R116-ARW-26 CONVERSION?

"Have a suggestion I think a lot of people would like to see. How about showing a conversion for the front end of the R116/ARW-26 surplus control unit (sold by C and H Sales Company) from 68 megacycles down to 27.255.

"For some of the people that are holding back on the WAG Dual equipment because it looks a little complicated I would like to say that I am not a radio man but I built a complete WAG Dual Transmitter and Receiver and they worked well. I had a little trouble getting the modulator tuned but once set is adjusted it stays.

"I also built a speed control somewhat like your front page feature on Volume 1, Number 1 except using one battery instead of two and a double pole double throw switch at the center of pot."

Oran W. Frye
Shalford, England

How about it? Any of our other readers desire a conversion on this unit? Has any one worked one out that you would share?

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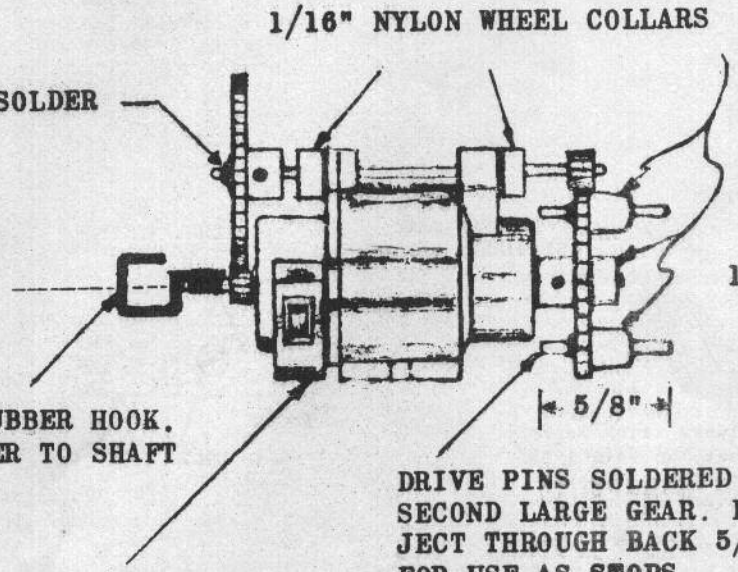
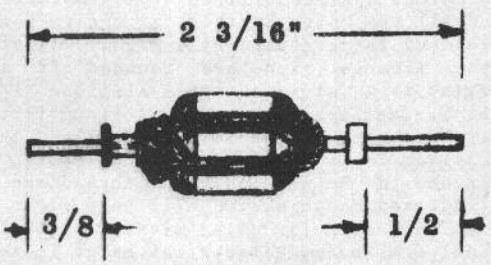
SIMPLER DOUBLE-GEARED MIGHTY MIDGET ACTUATOR

THIS ONE, BY BILL DAVIS AND BOB SCOTT, DOESN'T TAKE A MACHINE SHOP TO BUILD



DRAWN BY WM. R. DAVIS, JR.



MAKE NEW ARMATURE SHAFT OF 1/16" MUSIC WIRE AND POSITION AS SHOWN.

Dozens of methods have been shown in the model magazines over the past several years for converting the Mighty Midget motor to an actuator with an extra 7 to 1 reduction. At Grid Leaks we had two that looked very good and were scheduled for publication. However, a really simple method showed up in a recent mail from Bill Davis and the other two are being scrapped. Not because they are ineffecient or no good. Simply because the Adams method is far superior in constructing a device of this kind.

Our staff took Bill's instructions and within less than one hour with parts at hand constructed the servo so that it would perform. This, compared to the other methods, is fabulous. There are no endless hours of drilling, adjusting, and resetting or spacing.

We quote from Bill's letter, "Here is a new method for double gearing a Mighty Midget for use in the WAG TTPW system or other proportional systems. The method was developed by Bob Scott and myself (Lost Controllers, Wilmington, Delaware) and is, as you can see, self aligning and easier to build than earlier methods.

"It is necessary to remove the shaft from the armature and replace it with a longer one of 1/16" music wire. The pinion must be removed. Do this as follows: remove large gear, top shaft, brushes, and back of case from the motor. Place the motor case on top of the vise jaws (pinion up) which are open enough to clear the armature. Lightly tap the end of the armature shaft with a small hammer until there is enough clearance to insert a slotted piece of metal between the pinion and the motor case. This piece of metal is then rested across the vise jaws and the shaft driven the rest of the way out.

"Unsolder the three wires to the commutator and carefully pull it from the shaft. Also pull the brass collar from the other end. The shaft can easily be pulled from the armature as it is only a tight push fit.

"The rest of the drawing is self explanatory. On the motor shown the first pinion was moved to the commutator end for easier access to the brush terminals.

"Fahnestock clips are soldered to the brush terminals which are then glued into the case with contact cement (They can be removed for cleaning). The clips provide a reliable electrical connection without soldering and allow easy removal of the motor if necessary.

"As a final touch, we bushed up all four bearing points with brass eyelets of 1/16" ID to eliminate side play and provide a better wearing surface. The finished actuator draws about 140 ma on 3 volts no load or 90 ma on $1\frac{1}{2}$ volts.

"Incidentally, this actuator is also ideal for rudder only flying. Pulsing at a moderately fast rate, all flap is eliminated, the rudder just vibrates and moves as if it were geared to the control stick."

Editor's Note: While the model shown uses the Sullivan nylon wheel collars, 1/16" ID brass tubing is also perfectly acceptable since this was used in our pilot model at Grid Leaks.

For those who desire it, the extra two centering rubber gands can be used on the first reduction gear (on the same side as the present centering band) for the added centering effect. This was shown in Grid Leaks in the article in Volume 1, Number 1 by Lt. Col. H. M. Bourgeois on WAG Dual Servo Considerations.

We queried Bill Davis as to the linkage used to be recommended for the WAG TTPW and other proportional systems. For his answer see reverse side of this page.

"In answer to your question, I always link to my control surfaces with torque rods because the weight of a torque rod imposes no load on the actuator or control surface during climbing or diving maneuvers as does the weight of a push rod.

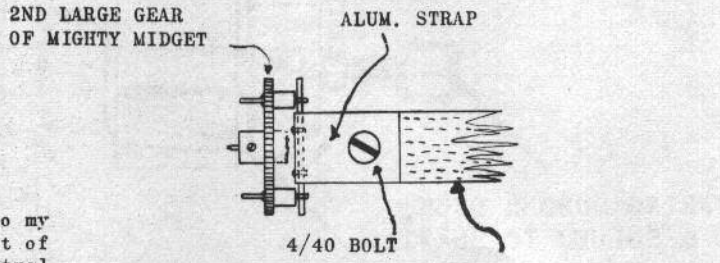
"On my Multi Bug, the torque rods are 1/2" square balsa in the Walt Good tradition, but of course they could be smaller for smaller ships.

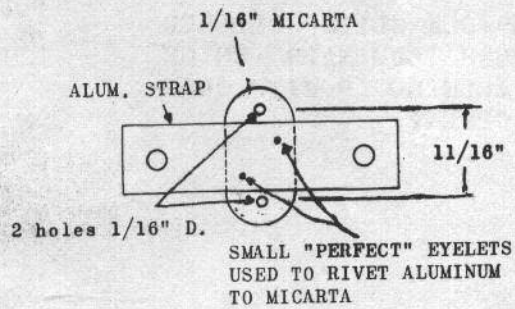
"I cut a piece of 1/16" thick micarta to 1/2" x 7/8" and drill two holes in this to engage the drive pins on the second large gear of the Mighty Midget. The corners of the micarta piece are rounded off and it is then rivetted to a strip of thin aliminum 1/2" x 2" using small Perfect eyelets. The aluminum is then bent back over the torque rod and a hole drilled through aluminum and balsa for a 4/40 bolt. For extra strength, the joint should be wrapped with thread and glued. Maybe the enclosed rough sketch will help clear up things.

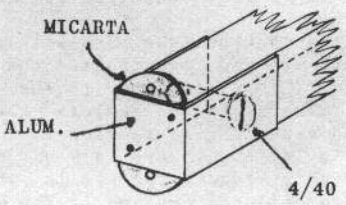
"The reason for using micarta is that it wears well and helps keep down electrical noise in the plane.

"At the tail, conventional pins and yokes are used with one refinement; a piece of Teflon tubing is slipped over the pins. This eliminates another metal to metal contact and also provides a very friction free assembly as Teflon is extremely slick. If you mention this in the article, please be sure to caution that the Teflon be installed only after all soldering is complete on the pins and yokes. The reason is that Teflon, although completely harmless at normal temperatures, gives off a colorless, odorless gas when heated to the vaporizing point. This gas is extremely toxic and can and has caused death.

"The stops that prevent the torque rod from moving fore and aft are both placed at the tail so that the actuator will not have to bear the force of the torque rod in the event of a crash."







TROUBLE SHOOTING GAS TUBE RECEIVERS

JOHN WORTH GIVES YOU SOME VALUABLE TIPS

Editor's Note: Raytheon is now producing a CK1054. This is an improved RK61, which works much better in two tube circuits. Some playing may have to be done with antenna link since some of them like a different antenna coupling than the RK61.

Trouble shooting a gas tube receiver can be frustrating, due largely to interacting components which confuses their function in the circuit. Often a T-S session winds up with practically every component swapped with no better results than at the start. Yet a majority of troubles involve only two circuit components besides the gas tube itself. These are the slug tuner and the tank capacitor (the condenser which is in parallel with the slug coil windings). Togehter, they control the radio frequency of receiver operation and they also establish a sensitivity level which must be matched to the particular tube being used.

Most gas tube operators soon learn that there is an optimum tuning circuit L/C ratio (inductance / capacitance) for a given tube. It's fairly well known that a low tank capacity (5-10 mmf)--which requires a higher tuning coil inductance and thus a high L/C ratio--results in sensitive circuit action. High L/C is good for most new tubes and generally better for XFG1's than most RK61's; the latter is usually more sensitive. Yet, both types get more sensitive with age and an old XFG1 may therefore be more sensitive than a new RK61. Though both types are similar, each individual type requires its own sensitivity matching.

This seems simple: for a rock steady and high idling tube, use a high L/C ratio; for a jumpy erratic idling tube, lower the L/C. Let's see how it works out in practice: our Lorenz receiver was dropped by a neighbor trying to help check out before a Sunday flying session--its old faithful and original RK61 is now just shattered glass. On hand is a still more ancient 61 and a new XFG1, but neither operates in the receiver as desired. The 61 is too wobbly in plate current due to old age sensitivity from lots of high idling in an old single tube receiver, while the XFG1 just sits there with its plate current needle high on the meter scale, hardly twitching when signalled. First we try to get a few more flights out of the 61; since it's too sensitive, we try a higher capacity tank condenser to lower the L/C. It was 15 mmf so now we try 18 mmf, then we reduce the tuning coil inductance to stay on frequency by unscrewing the slug slightly. Once before, with another receiver, this worked nicely but there wasn't too much difference in tube sensitivities. This time, however, the response is confusing for the receiver now acts more sensitive than before! Wha' hoppen?

Well, maybe it's just that the old 61 is just too far gone to behave normally, so we go to the XFG1. It's still rock steady despite the added receiver sensitivity noted with the old 61. Now it seems better to boost the L/C by lowering the tank capacitance to get a still greater sensitivity. XFG1's seem to like about 5 to 10 mmf across the tuning coil, so we try an 8 mmf from the proverbial junk box. This should be better, so we happily switch on the transmitter and retune the receiver, feeding in more slug to raise the inductance to compensate for the reduced capacitance. Does the meter needle now show a little wiggle that we like to see at idle and does it slam down to zero when keyed? Not necessarily! In fact, it may not act more sensitive at all!

Does this mean that the original info was all wet? No--the original statement was correct--high L/C for more sensitivity, low L/C for less. But look at what's hiding in that tuning coil: it's the iron slug that's the culprit. See what the scoundrel does (more or less effectively depending upon the amount and type of iron): when we lower the slug coil inductance (to get lower L/C for less sensitivity) by unscrewing the slug from the coil windings, we actually can make the circuit more sensitive because we change what is called the "Q" of the circuit. Getting involved in understanding the "Q" factor is not necessary if we realize that the key to the situation is the amount of iron in the coil windings. Less iron in the circuit reduces the inductance but increases sensitivity, thus countering the effect of a lower L/C. This is what confused the old 61 tube and the same goes for the XFG1 case: raising the L/C was not effective because we added iron to increase the inductance and thus countered the higher L/C.

Now what? Well, it just means that instead of changing slug position to change inductance, we change the number of turns on the tuning coil. A rough rule of thumb is to increase one turn for each mmf reduced and vice versa. Therefore, if we go up from 15 mmf to 18 mmf, we should add about 3 turns to the slug coil windings. The iron slug should be used only as a fine tuning trim rather than for major inductance changes. Of course, for interchanging tubes of slight sensitivity differences, a slight slug readjustment may do the trick after changing tank capacitance. But somewhere along the line there is a crossover point where further slug adjustment only makes things worse.

There are many other circuit variables affecting sensitivity, but the basic tube matching is mostly a tuning circuit matter. Once a tube operates well in the circuit, sensitivity readjustment as the tube ages is adequate for a good share of the tube's life through antenna coupling variation. One crude external trick may also be helpful at times: this involves the affect of B voltage on sensitivity. 42 to 45 volts is considered desirable for most gas tube operation. Operation at 40 volts or less is risking trouble as a sudden extreme sensitivity condition is likely at any time. This is the lower limit of stable gas tube operation for the RK61 and XFG1 tubes. Higher voltage reduces sensitivity and this may be used to good advantage at times.

Adding voltage gradually will compensate for an aging tube without requiring circuit changes. A pencell or two spliced in series with the B battery may gain a few extra flights--some flyers even tap down a number of cells on a 67½ volt battery, using a straight pin or sharp blade type contact to insert between battery cells to get the desired voltage. This procedure can hardly be recommended as a regular practice or as anything more than a temporary "cure", but it does illustrate the effect of B voltage on sensitivity.

During some old Control Research tests, we took some tubes which would not idle at all on 45 volts and got perfect operation on 67½ volts. Some tubes even required 90 volts! However, when tubes are in this condition they will not be stable at any voltage for very long--they have reached a sharp drop off point on the life curve and no remedy is effective for very long. Probably the most useful effect of high voltage is in providing a quick check as to whether a tube is worth circuit compensation. For instance, when a tube gets too sensitive (as indicated by violent idling or low idling current) and antenna coupling variation is not effective, try adding more B voltage. If not more than 60 volts results in good operation, then the chances are that the tube has enough reliable hours of operation left to justify rematching of the tuning circuit to the tube.