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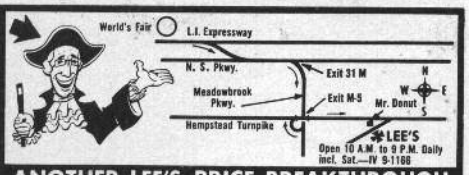

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ENDORSED FOR QUALITY AND PERFORMANCE BY LEES.
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This makes full house proportional practical in an entirely new field of smaller aircraft designs such as Goldberg's Falcon and Skylark.
The servos with this set is the modified version of the Bellematic servo with its Micro Mo Motor providing a direct pulse servo system that virtually eliminates control surface dither. The ingenious self-contained torsion spring gives the system its superior infinite resolution. The Bellematic slip clutch is also modified to take heavy air loads, yet provides protection against pinion damage.
The superhet front end was developed and test flown over an entire flying season. This final version of the Quadruplex receiver overcomes the problems usually encountered in combining the superheterodyne R. F. section with multi-channel simultaneous proportional tone separation. The receiver is transistorized throughout and is powered by the same 4.8 Volt pack that is used for servo operation. Solid state servo amplifiers are employed to drive rudder, aileron, and elevator servos. Temperature immunity has been achieved through conservative design, and high quality components.
The transmitter, drastically reduced in size, features sealed new 4 amp. hour nicads. Batteries are charged through a front panel charge jack. Control is via single control stick for rudder, aileron and elevator. Engine advance and retard buttons are used for trimmable throttle position. Trim is provided for aileron and elevator by two knobs on the front panel. One interesting feature is that trim knob position does not affect servo position at extreme extension. This means, in effect, that if an airplane is set up for properly sized inside and outside loops at full elevator position, this end position will not be changed by adjusting for proper neutral stick position trim.
The entire system is furnished pre-wired. Elevator and rudder servos are mounted on the servo amplifier card that measures 2¾ by 5 inches. Receiver dimension 2¼ by 1⅞ by 3⅜ inches. Aileron and motor control servos plug into the servo card. On-off switch is also premounted on the servo card. Total airborne system weight 21 ounces.

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Both models are fully tunable.

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27 MC ___ **19.95**
6 METER___ **24.95**

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Kit comes with the spring centering Protrol dual stick assembly so that you have a self-centering snappy action on the box.
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Here is a radio control receiver that has so many good things going for it, it's hard to describe adequately. It is a super-regen circuit, but is narrow band and is **tone selective** at 3500 cps, it **rejects CB interference almost as if it were a superhet.**
Carrier cannot be captured as can be done with other super-regen equipment, so that CB class D signals are rejected almost as if it were a superhet.
For single channel equipment this is one you can't beat because of the economy afforded by super-regen equipment, as well as the ease with which it goes together.
Silicon transistors mean a temperature stability of from 0 to 120 degrees.
Uses reed switch instead of a relay, so that pulsing up to 300 pulses per second are possible! Has provisions on the PC base for adding electronic switcher when it is to be used with motors for actuators. These components are not furnished with the kit, but are available separately.
Measures 1⅝ x 2½ inches. Kit is complete with diode and transistors, drilled PC base, instructions, ⅛ watt resistors, capacitors, reed switch.

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RX. KIT

The Controlaire 5 is a 3 volt relayless all transistorized receiver. The physical specifications on this receiver are: 9/16 x 1⅛ x 1⅞ inches. Weight, ⅝ oz. The fact that this receiver does not have any noticeable swamping characteristics differenciates it from many 3 volt receivers. This receiver is very reliable and quite sensitive. The receiver design is excellent for rudder only control, particularly of tiny airplanes such as .010 powered Top Flight Models.
TONE: The Controlaire 5 responds to transmitters preferably with modulation above 80% at frequencies of from approximately 500 to 1000 cycles per second.
READY BUILT—TESTED ___ **12.95**

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KIT **$7.95**

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This Pulser may be used for Rudder Only or for Galloping Ghost when using unijunction transistor.

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For battery-powered R/C boats, cars and trucks.
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CATALOG IS SO DESIGNED THAT **SUPPLEMENTS CAN BE ADDED.** SUPPLEMENTS WILL ALSO BE MAILED AS THEY BECOME AVAILABLE, THROUGHOUT THE ENTIRE YEAR.

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NO ADDITIONAL MONEY CHARGES FOR ORDERS OF ANY SIZE!
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DEALER ORDERS WELCOMED... WRITE FOR COMPLETE DETAILS.

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PAUL RUNGE, Publisher—WILLIAM WINTER, Editor
WITTICH HOLLOWAY, Art Director—BOBBIE RUNGE, Sec.-Treas.
Contributing Editors: Gordon Flenniken—Phil Kraft
Frank Schwartz—Dale Springsted—John Worth—John Phelps

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GRID LEAKS AT PLAY

● The last issue of GRID LEAKS contained no ringbinder holes. This was done as an experiment to get reader reaction. As this is being written it is, of course, too early to say whether or not there will be a reaction or, if there is, to predict what that reaction will be. We'd be interested in your comments.

Phil Kraft's article "Proportional Control in Perspective," page 11, we feel is extremely timely, and we have presented it exactly as written by Phil, and recommend you read it attentively.

This article reminded us of a shirt worn by Gordon Gabbert, who is well known in R/C circles, and caused us to dig out a photograph which appeared in a 1960 issue of GRID LEAKS. The shirt says distinctly, "Smile Dammit, It's Just a Hobby." Food for thought?

● Progress is being made on the FCC front. If you have not read it elsewhere, you will be pleased to know that your contributions have made it possible to retain Jeremiah Courtney, a Washington, D.C. communications attorney and that his retention is on a continuing basis.

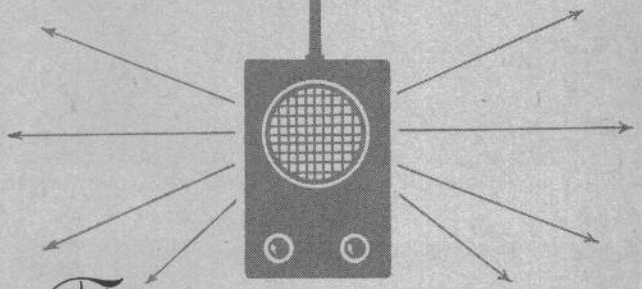
We'd like to point up one thing here, however, and that is that any actions before the FCC do take time, and we feel patience is of extreme importance. Your AMA-FCC Committee is functioning, and we feel functioning very well. Your interests are in the hands of a capable communications representative.

This is just another one of the many little factors which we feel should demonstrate that the AMA is in there pitching for all your interests. In connection with AMA we'd like to pass on a word of commendation to John Worth, new Executive Director, and the new President, Maynard Hill, for the job that they have begun to do.

● This issue of GRID LEAKS marks an innovation in that we are offering for the first time a full-size plan of a model airplane. (R/C Jay, multi, page 15.) Check our listing elsewhere as to how these plans may be obtained. Lest any of our readers assume that this will mean that there will be a downgrading of the electronic articles for the home builder, this is just not the case. With an expanded number of pages, GRID LEAKS is trying to round out its policy, and still (*Continued on page 26*)

THE MONITOR

Regular round-up of new and overlooked aspects of the growing R/C field ● Shop talk and just talk ● A discussion corner.



THERE WAS ONCE A SAYING, that what the world needed was a good five-cent cigar. What we need in radio control today is a good $50 multi-proportional rig. As you will discover from Phil Kraft's timely "Proportional Control in Perspective" on page 11 we may yet see a $1000 radio. What Vernon Macnabb pointed up in his March-April GL article "What Level of Excellence," Phil now puts into sharper focus and that is, what we demand, costs a lot of money.

At this late date only a few manufacturers are expected to deliver production they are capable of this year. Their lot is not a happy one. Having read both the Macnabb and Kraft articles you will find the reasons obvious. Perhaps it is time to put all radio control into perspective, and not just proportional multi.

Cost always is important. Whether a radio system costs $75, $150, $250, $500—or a $1000—the investment is a serious matter to most modelers. The appeal of radio control is something we all understand from firsthand experience and most of us know that, once started, there is a, shall we say, a yearning for something better—more controls and more realism in controls. Those of us who are living it up on top of the pyramid seem little concerned that the overwhelming majority of hobbyists must have a maximum of guaranteed success, regardless of equipment cost.

Is multi—that is 10 and 12 channels and full-proportional—all that matters? Not long ago a magazine published a multi design only when some significant advance had been made—the Smog Hog, Astro Hog, Orion, Sequence for example—but today all publications seem caught in the same bind as the equipment manufacturers who, in the case of proportional, must make a move only because competition forces them to. No one even remembers now all the multis that have been published in recent times, and only a few are built by many people. Contest rules, even in so-called rudder-only, reflect this preoccupation. Flying is not fun unless the equipment, airplanes, are complex and costly.

Stu Babcock tells us that a quarter-million of his compound escapements have been sold. It is conceivable that over a half-million escapements have been manufactured. Where did they go? How many single-channel radios have been produced? How many are in use today? What happened to the others? Judging by the relatively low number of 505's filled out, most of this equipment never got into the air, or into a boat. Why?

It is well, we think, to ask whither proportional. But there are other more important questions we should be asking. The hobby, the industry, is failing the beginner, the typical less-talented, and perhaps untalented, builder who is our most important customer.

A Science and Mechanics reader tells us: "I received a Concord for Christmas but have not started building it because I wasn't sure what size engine to use. I am new in R/C flying, having built only a Live Wire trainer and have only one flight on that. All of us here are new to R/C. None can agree on what size engine to use since this plane seems so much smaller than the 'trainer.' What should I use, as a beginner in R/C?"

A *MAN* reader tells us: "I started out by buying a lot of model magazines and reading every word several times over, hoping in this way to learn. Due to (*Continued on next page*)

At a St. Louis contest, L. to R.: Don Dickerson, John Rawlings, Norm Beeler, Jim Reuter. System is first model of the B & D.

THE MONITOR ...continued

the way most of the articles are written, I have learned very little. You buy a magazine because a certain article strikes your fancy and if you are just getting started, as I am, the whole thing is over your head.

"What on earth is a P.O.D. control? Or a Galloping Ghost? Or an REM servo or for that matter, a compound escapement, to a greenhorn like me?"

That this chap is an MAN reader is of no special significance, he probably reads all the books, and the problem is universal. The public's chief beef is the jargon we all speak. Even the advertisers, who should know better, describe their products in a mysterious language—and it might not help understanding of the gadget and its function even if it was better termed. All editors receive such letters. Suppose we follow the career of this particular tyro. What did he do next?

"I decided to seek out someone that would explain these things to me," he told G.L. "A trip to the local hobby shop was a total zero." (An industry problem is that most retailers don't comprehend the merchandise they handle.) He didn't even have any gas models in stock and absolutely no knowledge of gas-powered aircraft.

"After a few weeks of searching I got wind of a modeler living 50-odd miles away. I drove over to see him but he was away on business. So I wrote him. My questions must have been stupid because I never got an answer. There was only one course left, and that was to write a dealer in New York, order a bunch of stuff and try to figure it out for myself."

Tony, for that is his name, says the model building was not a problem, because basically there isn't a great deal of difference between a rubber job and a gas job, and the glow engine people give a lot of information on the care and feeding of their babies. His problem was figuring out the R/C end of it. By chance he picked a good subject—a deBolt Super Cub.

Tony built from a kit a large tube-type receiver and he stuck a KB 19 in the four-pound airplane. (It seems you can't convince anybody in the business that we over power all beginner airplanes, or, put another way, make them undersize for power specified.) Tony's Cub got to 5,000 feet (he thinks) in 1½ minutes before he thought what to do. When he spiralled

(*Continued on page 31*)

Tom Shortt, Ireland, made twin-screw boat with 12V motor. Gear box 3-to-1 on Meccano gears. Two MM motors for actuation purposes. Hull length is 46 inches.

THE GL ARTICLE "STYROFOAM — THE MATERIAL OF THE Future" in the March-April issue — a reprint from the **Montreal Model Bugs** and incidentally, held out of several preceding issues for lack of space — appeared just two weeks before the excellent and most comprehensive feature by Ed Izzo and Ray Olsson was published in MAN. In deference to the then forthcoming MAN coverage, GL confined reporting of the Izzo demonstrations at the Bisons' Conference exhibition to certain facts released by Ed, and included in Joe Niedermayr's GL article one of the Izzo drawings of a multi wing detail. While GL was permitted to trace that drawing it developed afterwards that, while approval for the tracing had been given, the exhibiting personnel had not cleared it with Ed, who thus had no knowledge the drawing was "out" until its "double-exposure." To make things worse for poor Ed, the GL drawing lost its credit line somewhere along the way, with the resulting implication that operator "X-9" was on the scene! Poor Ed and Ray, who had raised these techniques to a truly scientific level, might even have been assumed by innocent readers, to have borrowed Ed's own wing, and construction, from the Canadian control-line people who had already published their earlier but less developed techniques in their club paper. GL is anxious that our friends from Syracuse lose no prestige because of that lost credit line on the drawing which appeared on page 24 in the last issue.

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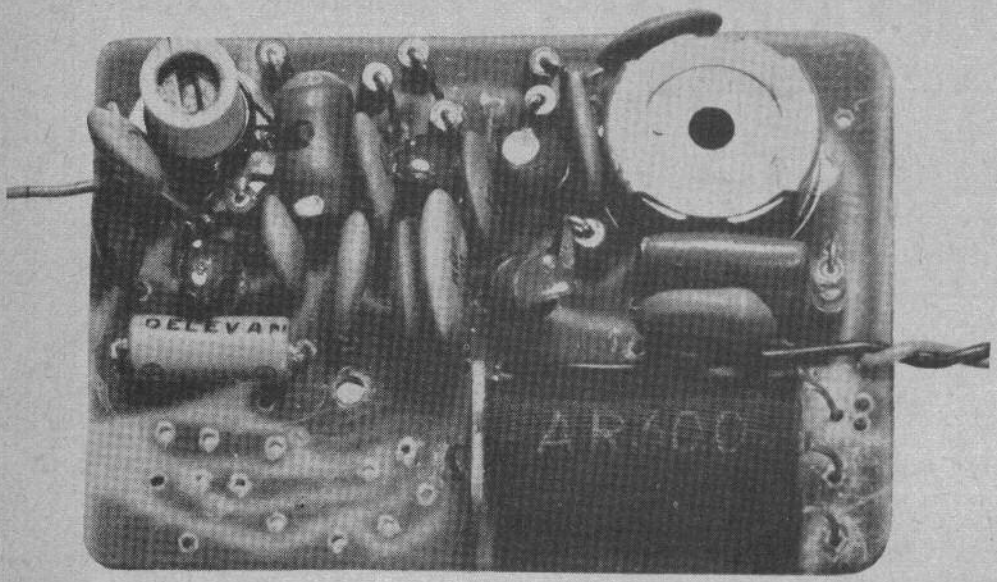
AN INTERFERENCE RESISTANT RECEIVER



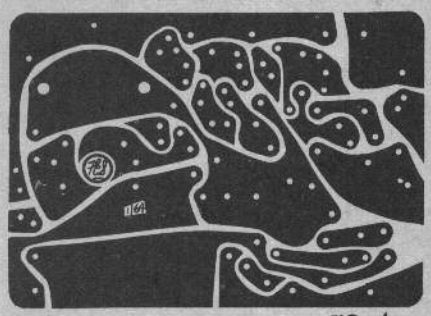


FIG. 4

NINE OUT OF 10 MODELERS IN ALL LOCALITIES WILL HAVE COMPLETE SECURITY FROM CBERS WITH THIS FINE, SUPER-REGEN CIRCUIT.

Editor's Note: *This is a truly revolutionary receiver for radio control usuage. Repudiating the accepted belief that super-regens cannot be selective enough to minimize interference, it was operated during a two-week test within 1000 feet of two CB base stations. Involving a number of new concepts in design, it is, moreover, easily modified to higher frequency allocations which may open up, if the AMA committee succeeds in its mission.*

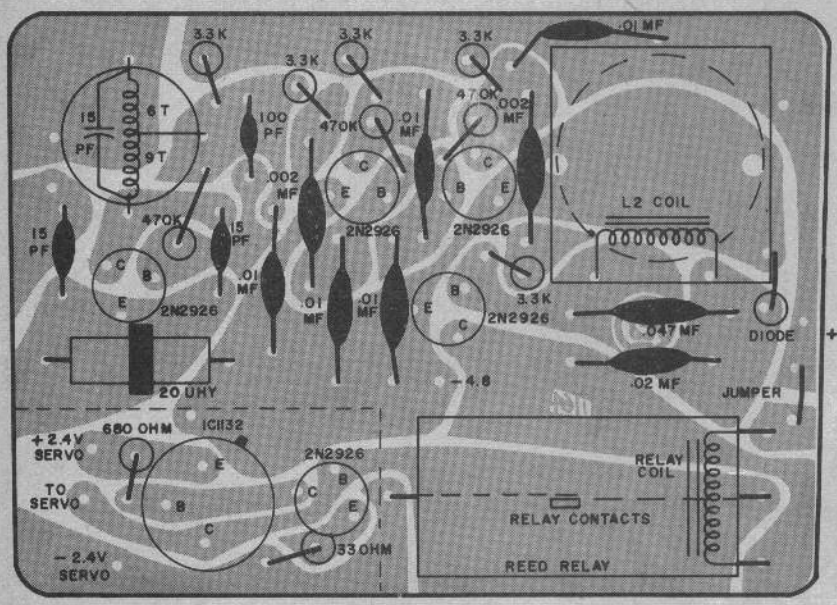


FIG. 5

By J. H. PHELPS

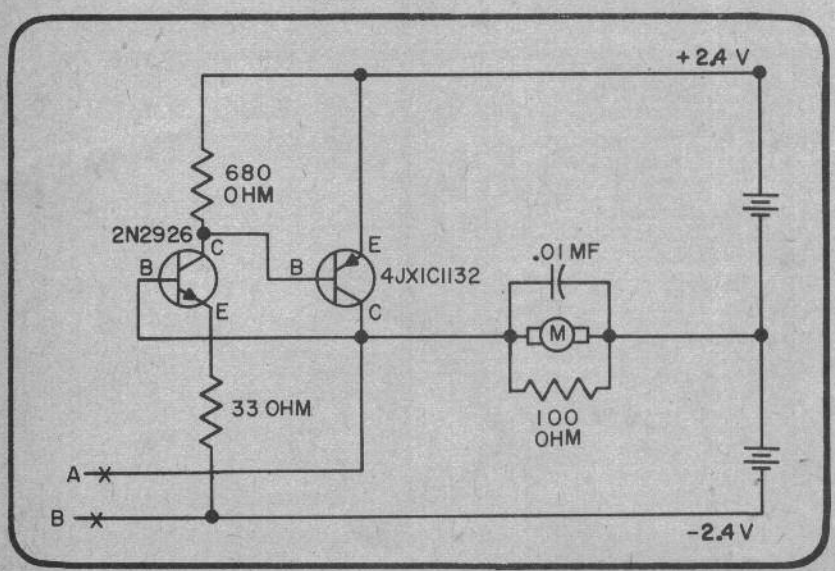


FIG. 3

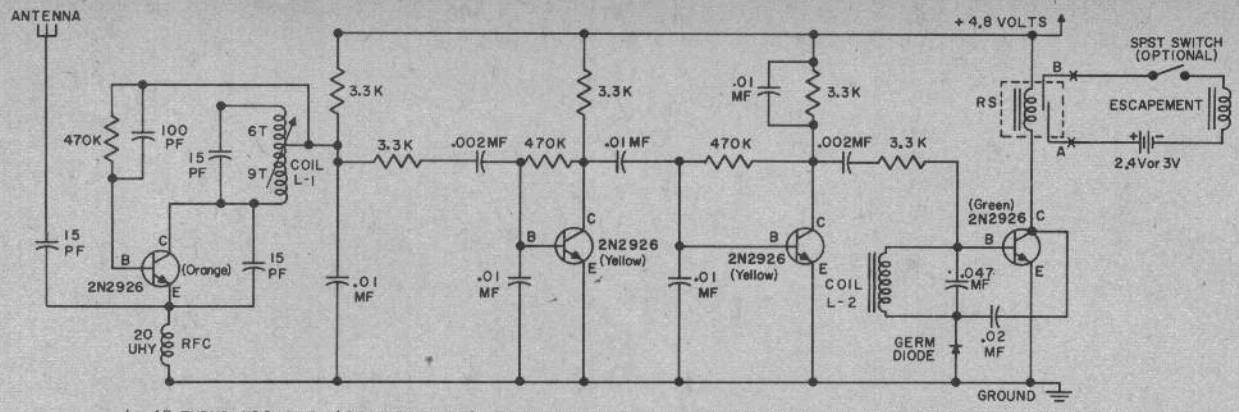
■ THE RECEIVER DESCRIBED in this article was developed during the period of AMA activity to spur action needed to examine present interference problems and seek new frequency allocations.

In the form described, it represents the author's best attempt to provide a secure (interference resistant) superregenerative receiver capable of holding its own in all but the most unusual interference conditions. For nine out of ten flyers, in all locations, it should provide complete security. Further, it is capable of performing with minor modification in any higher frequency allocation which may open (up to 80 mc). All transistors are rugged, reliable high-temperature silicon units having 200 mc gain-bandwidth products (f_t) and exceptional uniformity.

The detector, a fresh design, contributes in good measure to the overall performance of the unit. About five months ago the first "narrow" detector was developed by the author. By individually adjusting each transistor an operating bandwidth of less than 250 kc at 1000 μv could be achieved with 500 kc bandwidth, the usual rule. Figure 1 repeats this detector, correcting errors in its first printing. The basic circuit is a common base Colpitts oscillator, biased common collector and quenched by a base leak to form a self-quenched logarithmic mode superregenerator. High operating "Q" is preserved by deliberate collector mis-match (relative to "power-match" optimum). The real benefit of this mis-match, however, results from the lowered collector current conduction angle. Contributing also to this smaller conduction angle is the base bias network which provides high turn-off current to reduce storage time.

In the latest detector, the oscillator is still a common base Colpitts. Common base operation assures the best opssible use of the transistor's capability and, in this case, a capability to 100 megacycles with actual operation at one-third this frequency. The direct and quench frequency circuit is common emitter and employs

FIG. 2



L_1–15 TURNS #30 AWG (SOLDEREASE) TAPPED AT 6T, PROPORTIONED AS SHOWN ON CTC SPC11-4L

L_2– 50MH FERROXCUBE CUPCORE

RS–OMEGA SALES HR 300 REED MAGNETIC SWITCH.

* –.047 MF MYLAR CAPACITOR

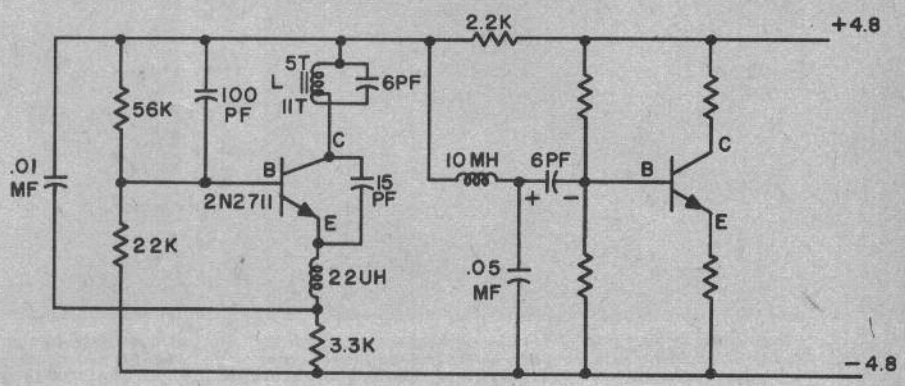
negative current feedback to stabilize the operating point against temperature and transistor variations. This mode of operation was chosen because of the instabilities inherent in common collector operation, particularly when attempting to achieve high capture resistance and high recovery efficiency. Further, this mode gives an extra bonus in gain by virtue of its higher current and voltage gain at envelope frequency.

Common to superheterodynes and superregenerators the phenomenon of capture is an important one and deserves explanation. The simplest way of viewing capture is to see it as an unwanted reduction of receiver sensitivity to the command signal caused by an unwanted signal. Thus an unmodulated Citizens phone station, transmitting no voice, can paralyze a receiver by de-sensitizing it. In the case of a superregenerative receiver it carries the quench PRF to its limit and no command modulation can recapture it. The detector used in this receiver will operate, in the air, at the same time as a standard base unit (1000 μv meter) at a distance of 4000 feet while receiving command from a fully modulated carrier at 100 μv meter. Stated another way, you need not worry about stations you cannot see if you fly in a large field with an unobstructed view of one mile in all directions. The remainder of the means to provide this security will be discussed in a bit.

Following the detector is a simple quench filter and two very stable high-gain audio amplifiers. Both stages not only stabilize temperature and transistor variations as they affect operating point but also they affect signal gain. Thus, the summer and winter "range's" are identical for all practical purposes and no treacherous temperature "cliff" exists which can cause unexplained loss of control.

The last stage is the familiar reflex circuit updated to narrow bandwidth and eliminates resistor selection. Until this stage, all coupling capacitors have been .01mf. Here a .001mf capacitor is used to provide a sharp low frequency droop to help prevent subharmonic frequencies (contained in C.B. voice signals) from causing trouble. Further, the pull in frequency range of only several hundred cycles per second at 3.5 kc rejects noise and even female voice components. During a two week test, a receiver was operated within 1000 feet of two "lady operated" C.B. base stations. The receiver was connected to a "Veeder Root Counter" and only one false

2N2711 30 MC DETECTOR



L = LS6 COIL FORM 16T NO. 28 TAPPED AS SHOWN

Fig. 1: This is the first narrow detector developed by the author. The circuit has now been finalized, as shown in fig. 2, which shows the reed switch hooked up to an escapement. The Omega reed will need to pull in at 10 ma or less; Fig. 3 shows the two extra transistors that are required to make the SPST action of the Omega reed switch into an SPDT action for use by the proportional boys. Fig. 4 is a full sized PC layout base, which may be used for duplicating the receiver. Fig. 5 shows the layout of the component parts for the receiver. The material within the dotted line is the switching material.

count was rung up. This count occurred during the first five minutes of operation and is still unexplained.

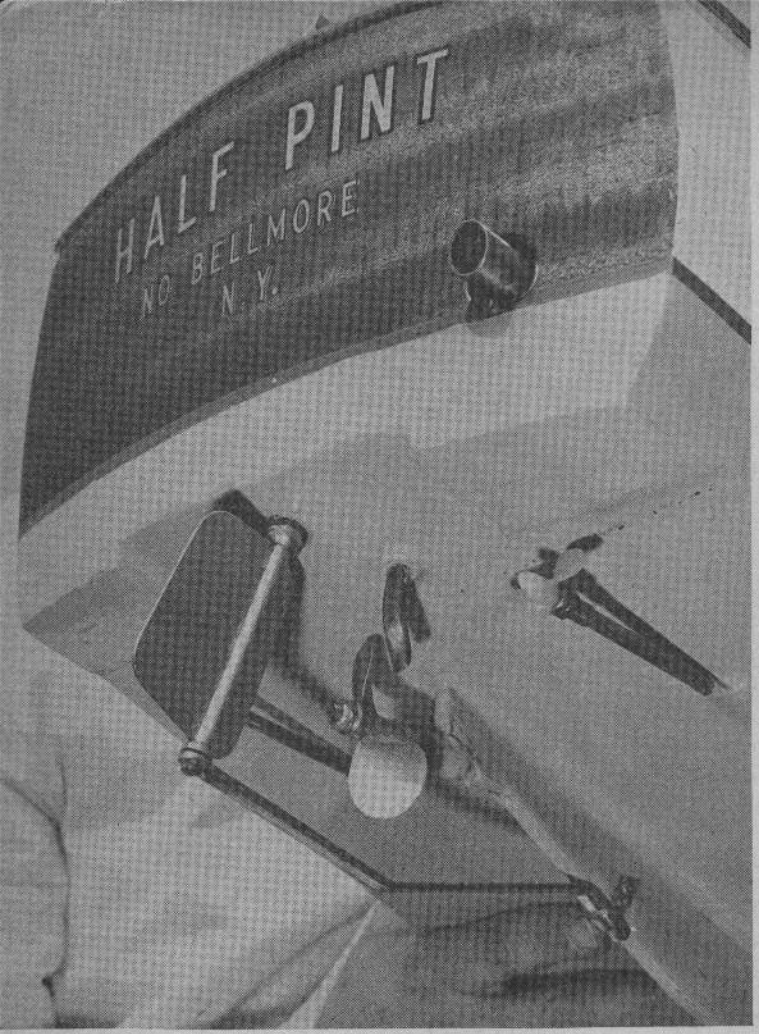
Reviewing them, both the first and last stages team together to resist capture and ignore the noises of Citizens band stations. Incidentally, the same selectivity applies to brush and pushrod noise and this receiver has provisions to please the pulse-prop man. Since a reed switch and short coupling and smoothing time constants have been chosen, pulsing to 100 cp is easy. When used with the companion pulser, and feedback servos to be described in another article, superb proportional control results, free of temperature drift and as low in cost as a concerted effort can make it.

The printed circuit board has been laid out to incorporate a simple electronic switching device if more than the single-pole single-throw action of the reed switch is required. By simply adding two additional resistors and two transistors, an SPDT (single-pole double-throw) action will be had for operating devices such as the Mighty Midget and other actuators of this type.

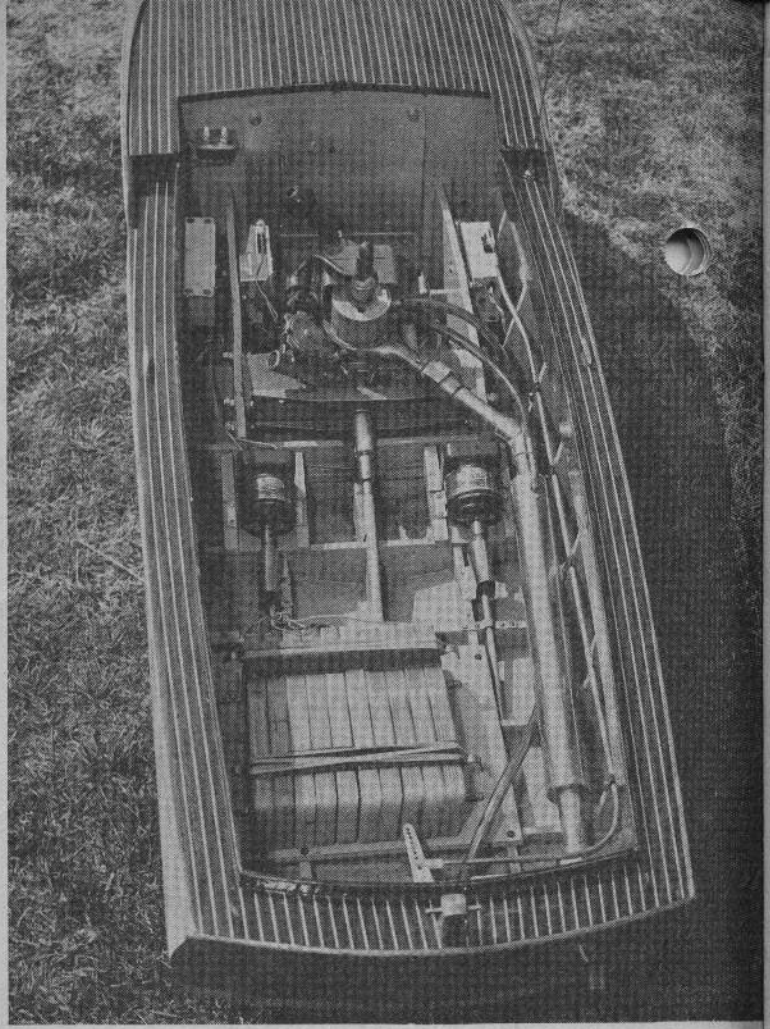
This is one of the most versatile designs that has been presented, and it is hoped at a later date to use portions of this for multi channel and multi proportional receivers. When and if additional frequencies become available, we will present the conversion data.

Tuning this receiver requires a slightly different technique than one you may be used to. But once mastered, it is sure-fire.

Set your VOM meter on the lowest DC voltage scale you have (0-1, 0-3, 0-5). Clip the minus black lead of the VOM to negative, and the positive red lead to the base of the final 2N2926. Apply voltage to the receiver and turn on the carrier of the transmitter. Voltage will read approximately .25 volts with or without carrier. Tune the slug of L1 on the receiver for a dip. This will be about half of the idling current or about .125 volts. Now key any tone and the voltage should increase to .5 volts. Tune slug of L1 for peak. Adjust audio CPS of the transmitter for final peaking. This will increase the voltage reading to .75 volts or so. Adjust the receiver L1 and the transmitter CPS for final peaking at range. ■

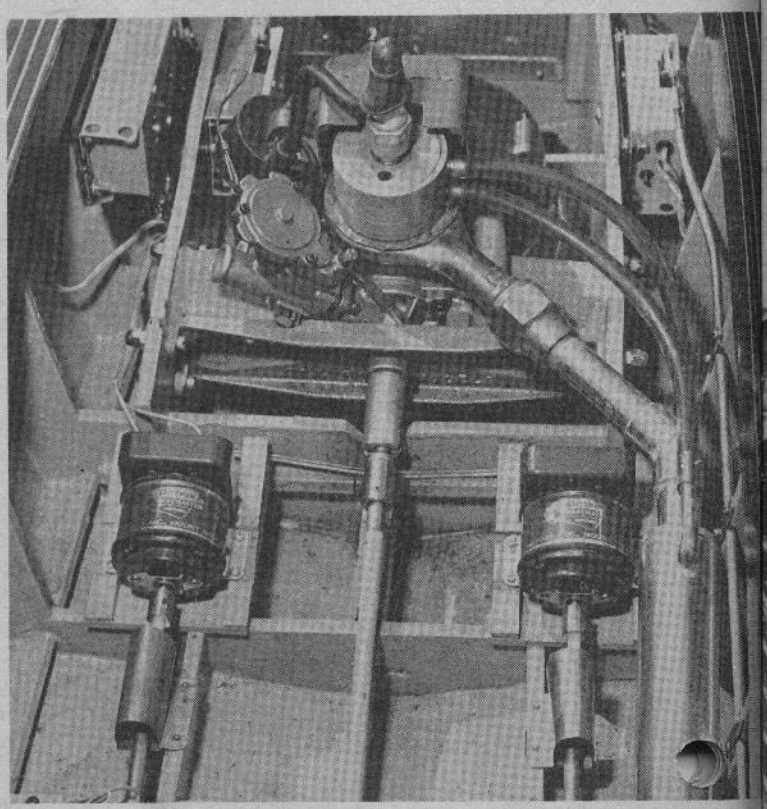


Prop for O & R is 2½ x 2½ Octura aluminum, others 1⅜ nylon by Sterling. Skeg and rudder homemade. Note water pick-up tube. Corner pads on hull were added to trim for more level ride at maximum.



O & R watercooled Compact sits on Octura mounts. Electric motors are Pittman Boatmasters. Three of four servos show, L to R: Electric motor switching, speed (choke was better than throttle), steering.

Tank made from half-pint can—hence the boat name—clamped to a hatch which closes radio compartment under foredeck. Visual fuel-level gauge and quick-fill caps. Servos placed forward clear of spray.



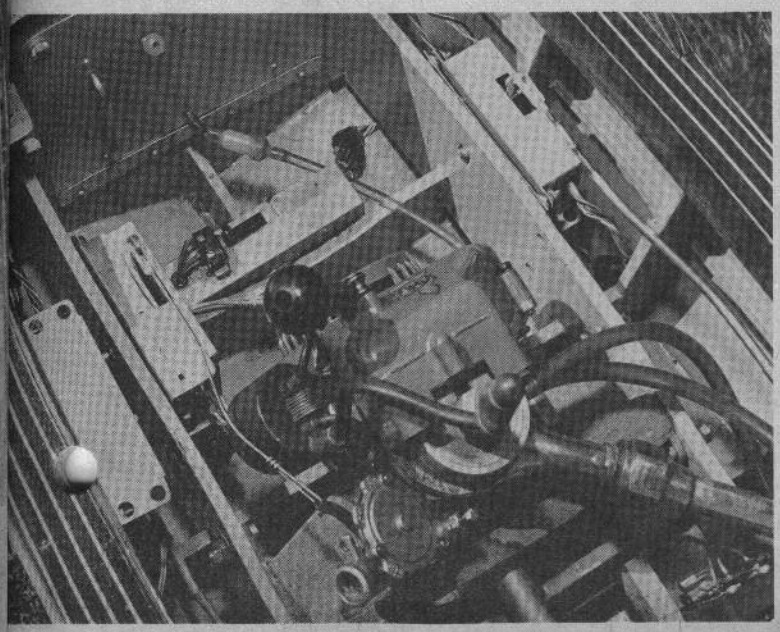
Muffler is homemade from copper tubing; outside is 1¼ in. plumbing waste tube machined to fit. Waste water from jacket empties into muffler to keep cool. No baffles—muffler filled with fiberglass cloth.

This picture of Al with the Half Pint suggests the size and realism of the cabin cruiser. It is based upon a modified Sterling Corvette hull with substantial fiberglassing for strength. Pull-starting works well with the inboard engine and good muffler keeps interior immaculate.

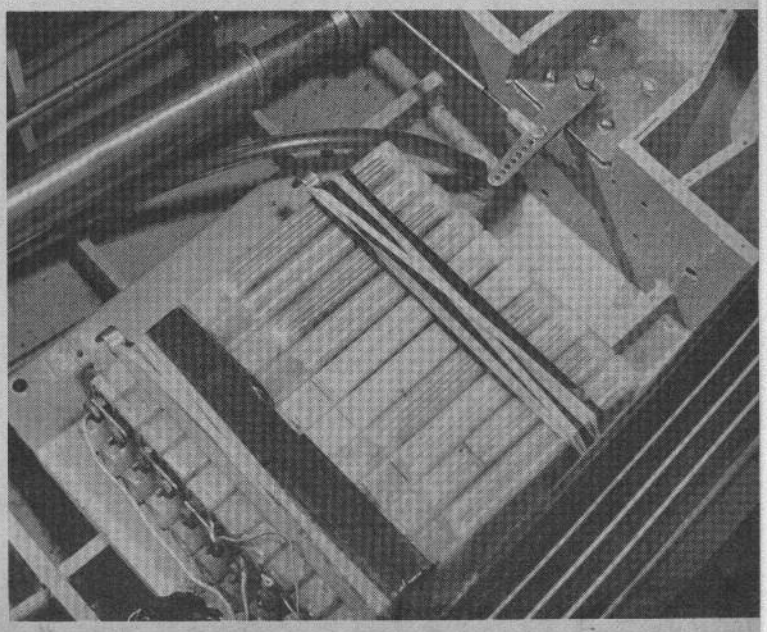
Half Pint

by **AL SEIDENBERG** . . . OUTSTANDING PERFORMANCE AND A UNIQUE CONCEPT OF CONTROL WITH 10-CHANNELS IN THIS CABIN CRUISER MAKE THE PROJECT A SHOWCASE OF FEATURES FOR MARINE HOBBYISTS. AN O & R COMPACT YIELDS AN EXHILARATING TURN OF SPEED. IN EVENT OF ENGINE FAILURE, ELECTRIC DRIVE MOTORS CAN BE SWITCHED ON FOR A RETURN TO "PORT."

Servo (beamwise) just forward of gas engine cuts ignition by shorting. Moving servo arm engages microswitch mounted on top of servo. Deck is carefully planked—dark material rosewood. Note fuel filter.

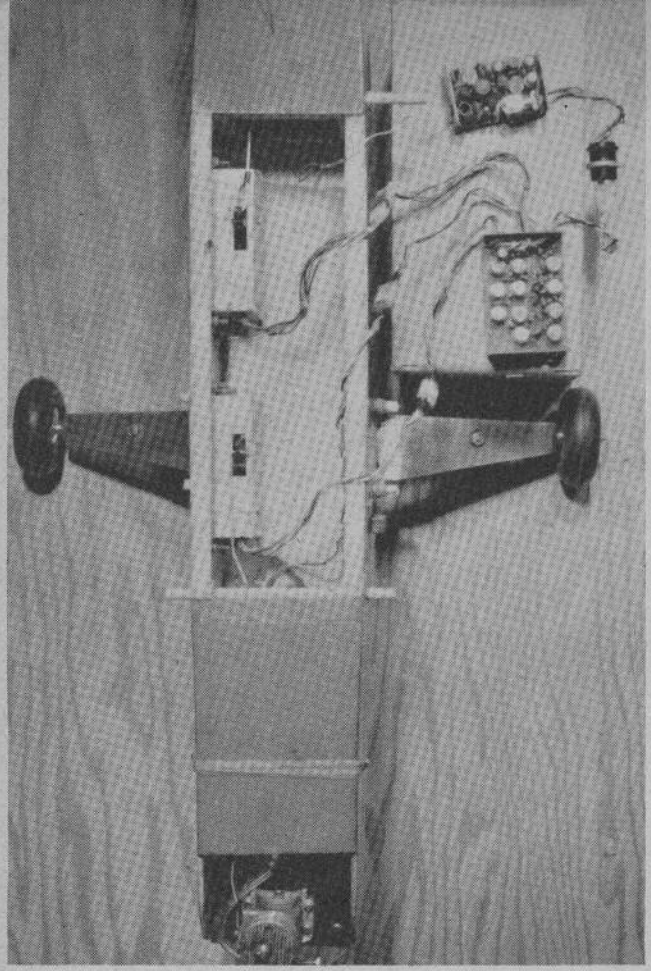


Ten nickel-cad 4 amp/hr batteries are tapped so that five will supply 6 volts for receiver and servos, and five 6 volts to motors. A simple tiller is homemade. Steering via flexible cable through conduit tube.



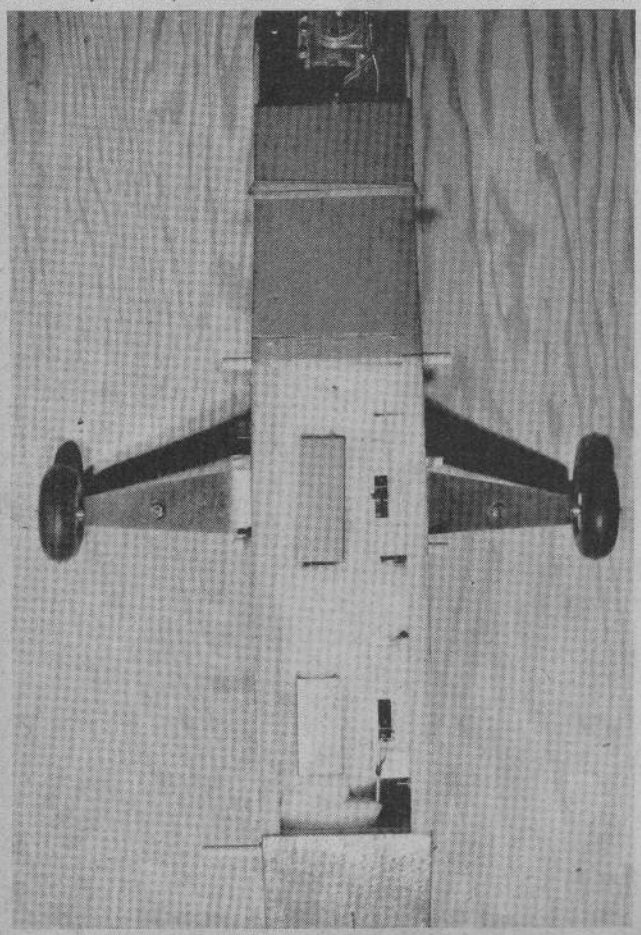
The GEMINI Single-Channel TRANSMITE SWITCHER

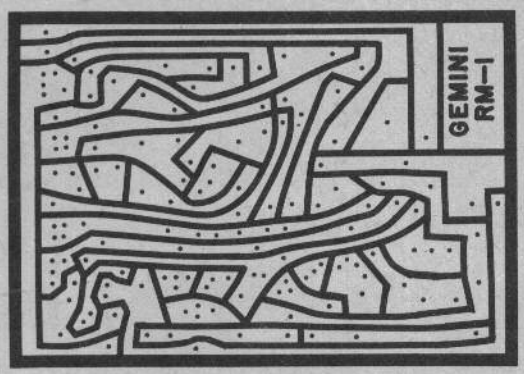
Two hundred hours of engineering design and lab testing went into this single-channel system— it provides reed-like operation of the Transmite for rudder and three-position motor control with a second Transmite. Offered to a single-channel flier is extreme reliability and, for some, an economical entre to multi.



Engine and rudder servos mount in tandem on right side of author's craft. Switcher and receiver are shown exposed.

Below: In this installation the switcher is placed in the forward position, receiver aft—and surrounded with foam.





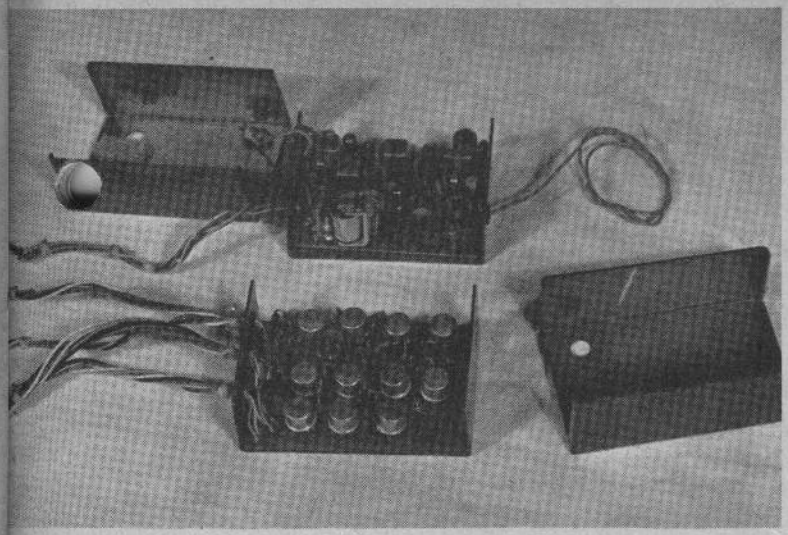
AFTER EXPERIENCING NUMEROUS difficulties in obtaining reliable operation from the simpler forms of single-channel actuators, and particularly in finding a suitable engine throttle actuator, I decided to try doing something about the situation. Reliability of the control system and use of existing single-channel transmitters and receivers were the most important considerations.

The highly regarded Bonner Transmite multi servo was selected and its circuitry studied for signals which could be used with digital (on-off) logic circuitry to obtain the controls desired. The Gemini switcher is the result of over 200 hours of engineering design and laboratory testing. Gemini switchers have totaled over 200 successful flights during the past year. A Gemini switcher controlled aircraft placed eighth in Rudder-only Open at the 1962 Chicago Nationals.

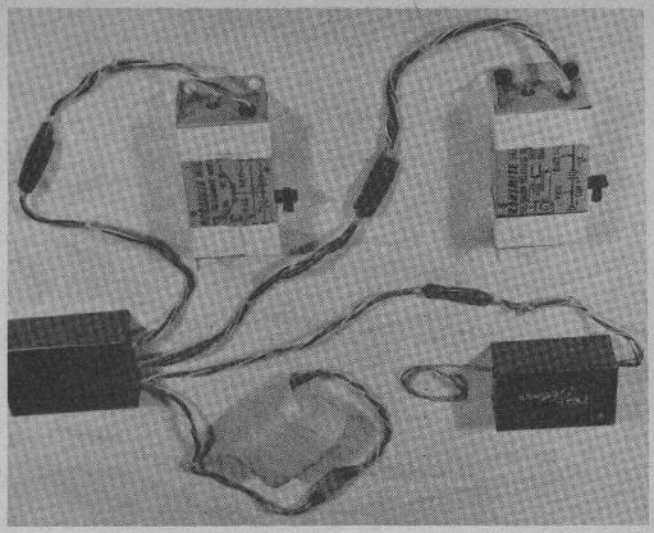
Gemini switchers are specificaliy recommended for the flyer with single-channel equipment who is planning to "go multi" eventually, but needs a reliable single-channel system now. The Bonner Transmites used with the Gemini switcher may be converted at any time for multi operation.

The Gemini RM-1 (rudder-motor) switcher provides fully reliable control of two Bonner Transmite self-neutralizing multi servos for positioning the rudder and the engine throttle of a single-channel radio-controlled miniature aircraft or boat. As with "bang-bang" multi, the rudder servo can be pulsed left or right for smooth turns. Full rudder throw is available when desired and four pounds of thrust is available for operating a steerable nose gear. The rudder travels only a little toward right before going left. The engine servo gives three-speed engine control and can be changed from one speed to any other speed during a single control sequence.

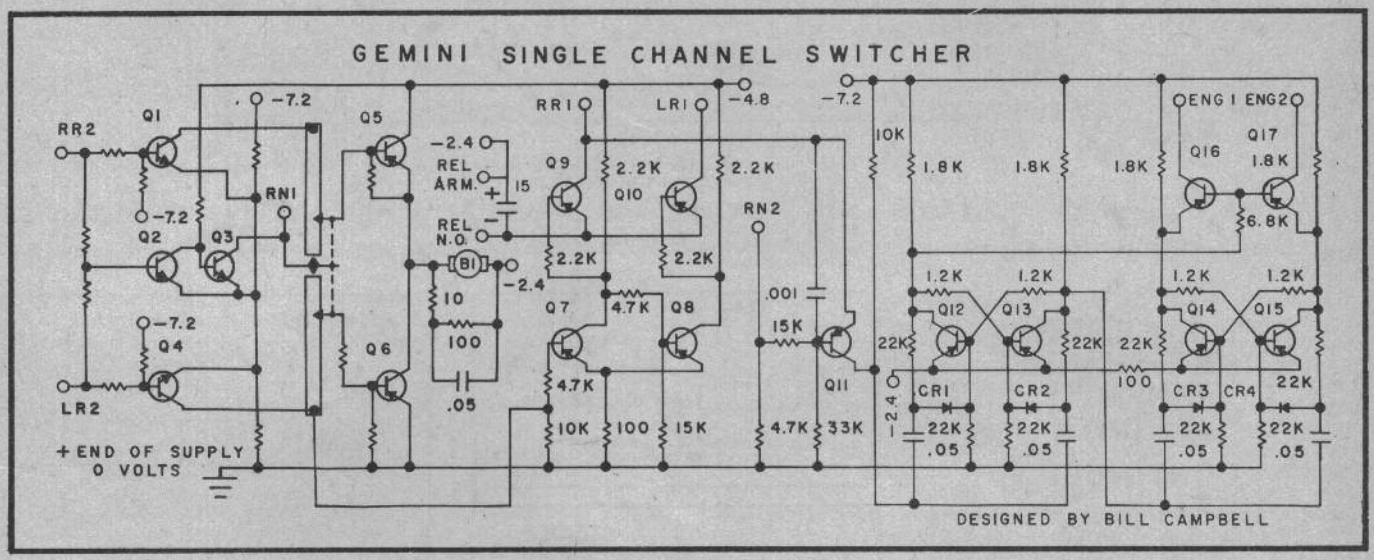
Any single channel transmitter and relay receiver can be used without modification. Simple modifications are required



Receiver, top, and switcher with covers removed. Any single-channel relay receiver, transmitter may be utilized.



Complete system with battery pack is readily removed for checking. Tape wrapping on servos a recommended procedure.



on the Transmite servos. Transmitter keying is similar to that for a compound escapement.

Flying the Gemini Switcher: The Gemini switcher controls a multi servo and must be flown with this in mind. As with multi, smooth turns are accomplished by giving a series of short commands (pulsing) to make the turn. The rudder servo has a longer transit (travel) time than an escapement, so controls must be released a little earlier than with an escapement to prevent overshooting. This is the first thing a multi flyer learns.

Transmitter keying is simple, but as with escapements, careful timing is important.

With "all systems go" depress the transmitter key. The rudder servo will run to right and remain there until the key is released. Release the key and the rudder servo will return to neutral. When pulsing short rights, allow time for the rudder servo to return to neutral between pulses. To key a left, depress the transmitter key and drive the rudder servo far enough toward right to give you time to release the key (which starts the rudder servo back to neutral) and then again depress and hold the key before the rudder servo has returned to neutral. The rudder servo will now drive on through neutral and go to left and remain there as long as the key is held. Release the key and the servo will return to neutral. With a little practice, lefts can be keyed with only a slight right rudder movement. Lefts are most easily insured by driving the rudder servo toward right for twice the time it takes you to release the key and then depress again the second time for the left. Pulsing smooth lefts requires a little more practice than for rights since double keying is required. This can easily be mastered.

The engine-speed sequence is from low to medium to high, to medium to low, etc. For engine speed changes, key the rudder servo to left far enough that you can then release the key (which starts the rudder servo back to (*continued on next page*)

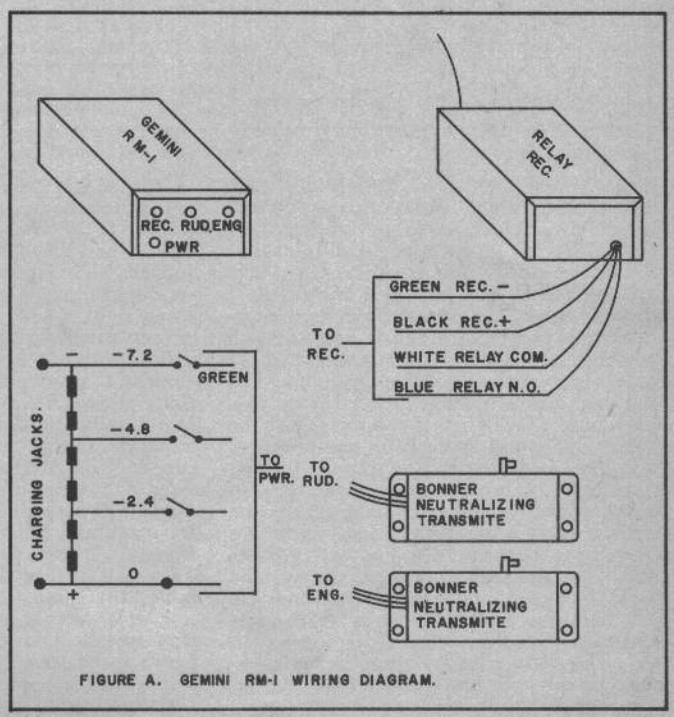
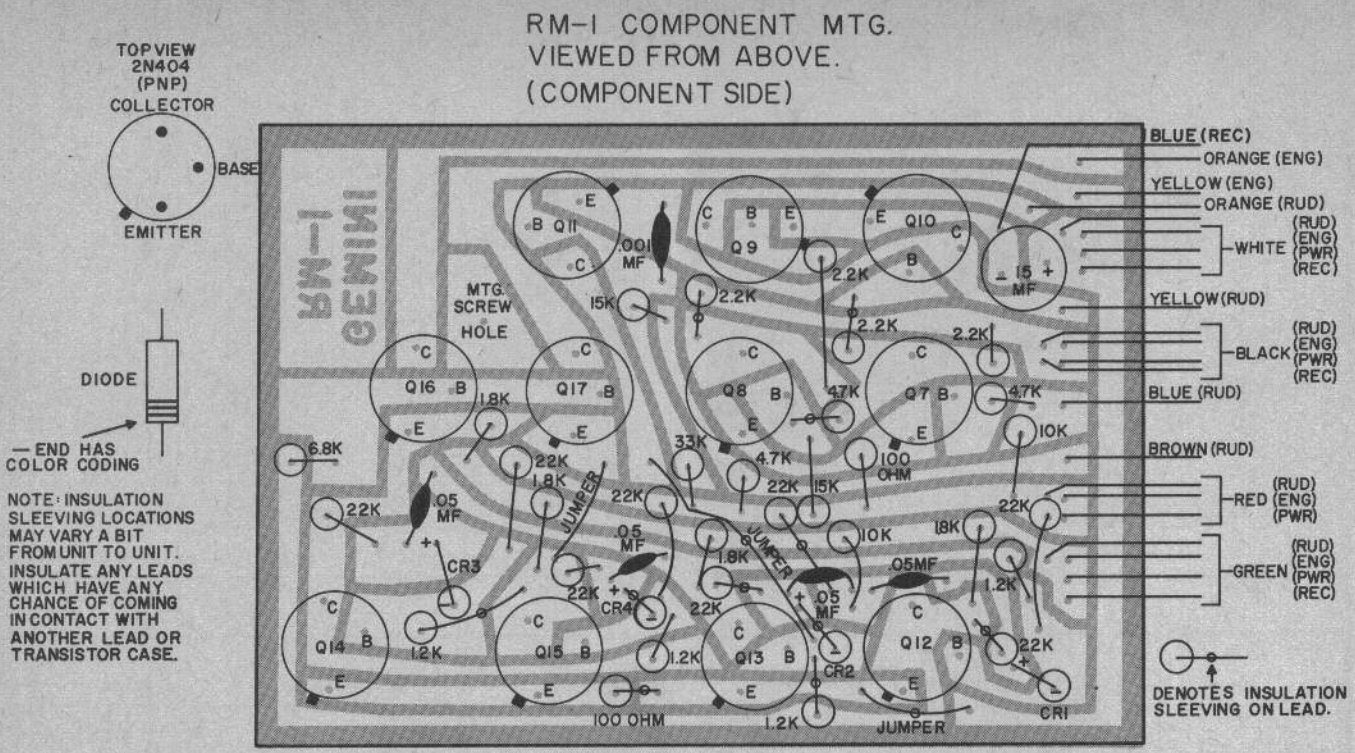


FIGURE A. GEMINI RM-I WIRING DIAGRAM.



RECOMMENDED ASSY. SEQ.

1=ALL TRANSISTORS: TRY TO LOCATE TO CLEAR OTHER NEARBY COMPONENTS AS MUCH AS POSSIBLE.
2= THE THREE JUMPER WIRES
3= CERAMIC CAPACITORS
4= RESISTORS, DIODES, AND ELECTROLYTIC
5= HOOKUP WIRES

FIGURE G.

THE GEMINI SINGLE-CHANNEL TRANSMITE SWITCHER CONTINUED

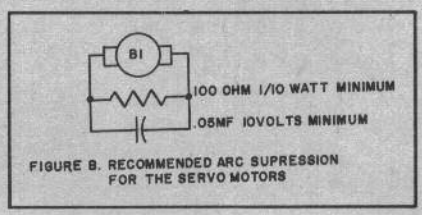


FIGURE B. RECOMMENDED ARC SUPRESSION FOR THE SERVO MOTORS

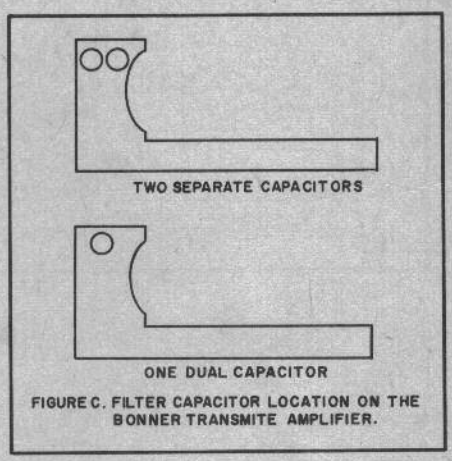


FIGURE C. FILTER CAPACITOR LOCATION ON THE BONNER TRANSMITE AMPLIFIER.

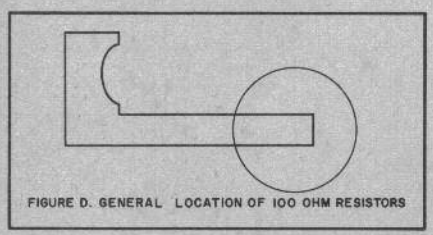


FIGURE D. GENERAL LOCATION OF 100 OHM RESISTORS

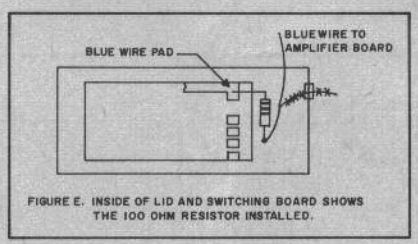


FIGURE E. INSIDE OF LID AND SWITCHING BOARD SHOWS THE 100 OHM RESISTOR INSTALLED.

neutral) and then *pulse* it once for each in-sequence engine speed change desired before the rudder servo has returned to neutral from left. Each pulse will advance the engine speed one position. One, two, or three pulses may be keyed as desired.

Installing the Gemini Switcher: Four separate color-coded wire cables exit through grommets from the switcher RM-1 case.

1. The *power* cable contains four wires and runs through the switcher to the battery pack. Three of the wires must be switched. See Fig. A for color coding.

2. The *receiver* cable supplies 2.4 volts, if required, for a 3-volt receiver. It also contains two wires which connect to the receiver relay normally open and armature (common) contacts. See Fig. A. If other than a 3-volt receiver is used, simply tape back the green and black wires and use only the blue and white wires which connect to the receiver relay.

3. The *rudder* and *engine* cables color code directly to the rudder and engine servo cables. The yellow and orange wires in the rudder servo cable *cannot* be reversed to change the direction of rudder throw. If necessary, the rudder pushrod should be moved to the other side of the rudder. The Gemini switcher puts a signal on the yellow wire to the rudder servo when right rudder is keyed. The direction of servo travel when a signal is on the yellow wire is marked on the cover of the Bonner Transmite servo case.

Batteries: Six series-connected 450- or 500-MAH minimum capacity nickel cadmium batteries must be used for the power supply. Fig. A shows the battery connections and wire color coding to match the Gemini power cable. Solder all connections for maximum reliability.

Bonner Transmite Servo Modifications: Two self-neutralizing Bonner Transmite multi servos must be modified as follows:

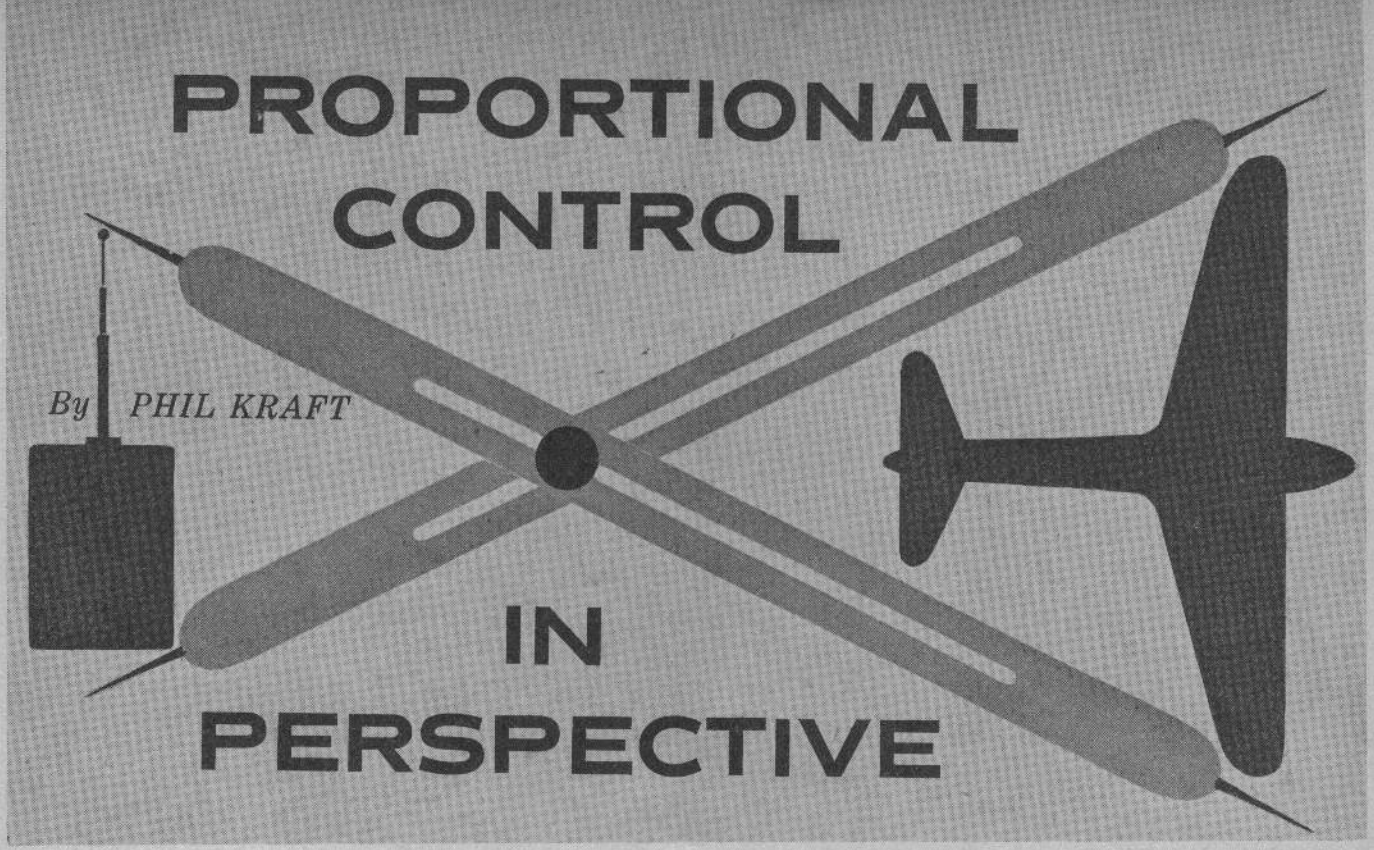
1. Both servos must have arc suppression installed to prevent any interaction between the servo motors and the receiver. Recommended arc suppression is shown in Fig. B. Goo (a rubber cement) or epoxy the components to the motor case to prevent their breaking loose from vibration. Solder the leads directly across the motor-brush covers being careful not to overheat the nylon motor case. The arc suppression need not be removed if the servos are ever used in a multi system. No further modification is required to the engine servo.

The rudder servo is further modified as follows:

If no engine servo is to be used with the Gemini switcher, step 2 may be omitted. Step 2 is absolutely essential, however, when an engine servo is used with the RM-1.

2. Remove the amplifier board from the servo case. (See *R/C Modeler*, November 1963, "Probing the Transmite Servo.") Unsolder and remove the filter capacitors located approximately as shown in Fig. C. On the newer Transmites both filter capacitors are located inside one container and have three leads to be unsoldered. Keep the filter (*continued on page* 28)

PROPORTIONAL CONTROL IN PERSPECTIVE



By PHIL KRAFT

Caught between consumer demand for proportional multi and the high cost of making what he considers good equipment, the manufacturer shows a growing concern.

TODAY'S MAIN TOPIC of conversation among enthusiasts is, of course, proportional control. A whole new vocabulary of exotic words is becoming part of the vernacular; i.e., feedback, logic, digital, phase-shift, glitch, subcarrier, spike, etc. It would seem that the long awaited era of proportional control is finally here, or is it? Is this emphasis on expensive, sophisticated control systems good for a hobby? I believe it is time to re-evaluate this "new era" to try to gain a reasonable perspective.

There are no "experts" on proportional control. The field is too complicated and too new to make positive statements regarding methods and systems. However, I believe the experience of those in our organization is such that perhaps we can draw definite conclusions pertaining to certain aspects of the overall picture.

For the past two years we have had the pleasure of working with Jerry Pullen towards the development of a commercial proportional system. Pullen was the first to fly a true feedback proportional control system some six years ago. His early systems were largely responsible for creating West Coast interest in proportional control. Recently, Don Mathes became part of our company. His proportional control experience dates back to preliminary work on the early Space Control System. In the past three years he has worked on the prototype development and final production of the Digicon System. Mathes with Doug Spreng originated the digital concept of proportional control. It is now being initiated by other manufacturers. Based on the experience of these men and two years of concentrated effort on our part, I believe we have reached some valid conclusions. However, before continuing this discussion of proportional control as applied to our hobby, consider the history of other hobbies and sports.

Before the war and immediately after, hot-rodding was, if somewhat ill-famed, a great sport. The average enthusiast with skill and a few hundred dollars could compete at the "Lakes" or drag strips. Today, only those professionals with commercial sponsors stand a chance in competition. There was a time when one could climb into an MG-TD with his girl friend and drive to the sports car races to compete. Perhaps he might bring home a trophy. Today, sports car racing is confined to factory teams, millionaire department store heirs, or Texas oilmen. Go-carting started with lawn mower engines on crude frames. Soon, twin engines of special design and several thousand dollars were mandatory. This sport died as quickly as it grew.

Is there a parallel between this sport and radio control? I feel there is. Fortunately, however, I believe that 99 out of 100 radio control enthusiasts are primarily interested in flying for fun, not for competition. Therefore, let's stop deceiving ourselves about proportional control, and realistically evaluate our sport in terms of control systems best suited to the average enthusiast. In this light, proportional control is not at this stage of development for the average model builder, simply because of cost. Also, our experience indicates that this picture is not likely to change in the near future. Our multi-channel reed systems have developed to an exceptional standard of reliability. Yet many so-called "experts" are proclaiming reeds to be obsolete. We disagree. With our proportional system finished from the electronic design standpoint, we at Kraft R/C are concentrating on development of our reed system line, because we believe that reeds are still the most practical approach to flying from the standpoint of cost and reliability.

There are many misconceptions regarding proportional control, probably because, in our opinion, there are no true proportional systems in production at this writing. Some say that with proportional control, it is hard to land the aircraft, more difficult to do consecutive maneuvers on heading, etc. This is simply not true. With true proportional controls, flying becomes a matter of the pilot's skill and handling of the aircraft. The degree of precision that can be attained is beautiful to watch. There is no question, assuming equal ability, the reed flyer cannot compete with true proportional flyers. Note, however, the emphasis on true proportional control. A proportional system which does not respond or track well, or is subject to dead spots, neutral drift, etc., is harder to fly with precision than a reed system. It is also true that a good reed flyer will score more contest points than an average proportional flyer no matter how good the proportional system.

Since the proportional control system is obviously superior to reeds for contest use, why can't we produce one at reasonable cost? Actually, the answer should be obvious. The average 10-channel reed system sells for approximately $400.00 complete and ready-to-install. Our reed transmitter has six transistors, our proportional transmitter has 23 transistors and 11 diodes. The reed transmitter has lever switches for control; the proportional transmitter has a relatively complex control stick operating control potentiometers. The reed receiver has six transistors and a reed bank; our proportional receiver has 28 transistors and 34 diodes. The reed servo has seven transistors and a switch plate. The proportional servo has seven transistors and an extensive feedback potentiometer element. These comparisons, naturally, do not take into account the vast difference in other necessary components.

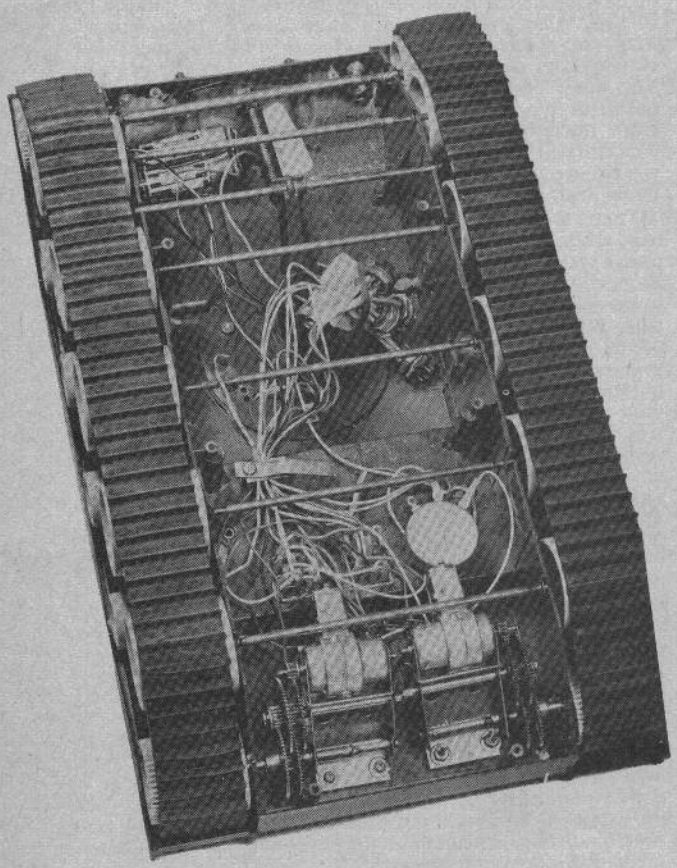
Our reed system with servos takes approximately seven and one-half manhours, including set up, to complete. The proportional system takes approximately 40 hours. Because of the proportional system's complexity, (*Continued on page* 27)

R/Cing the Bulldog Tank

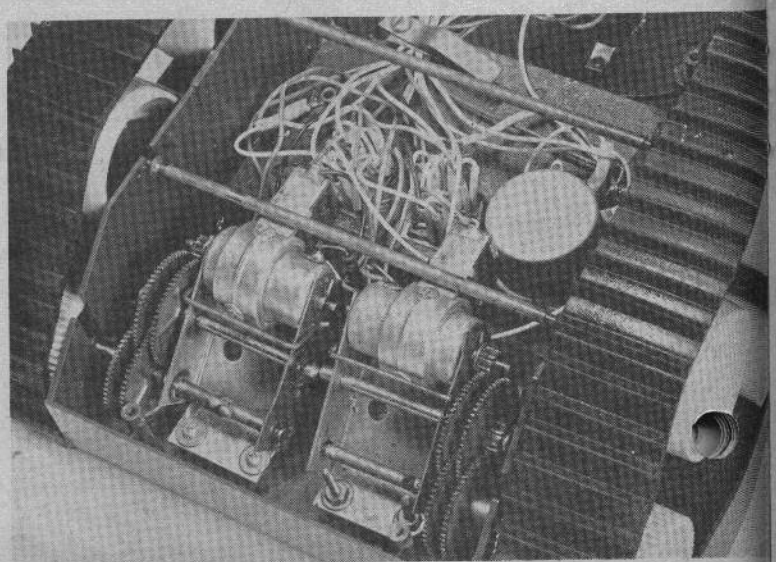
The large size of this realistic tank is evident from a comparison with the 10-channel transmitter. Note the vertical whip.

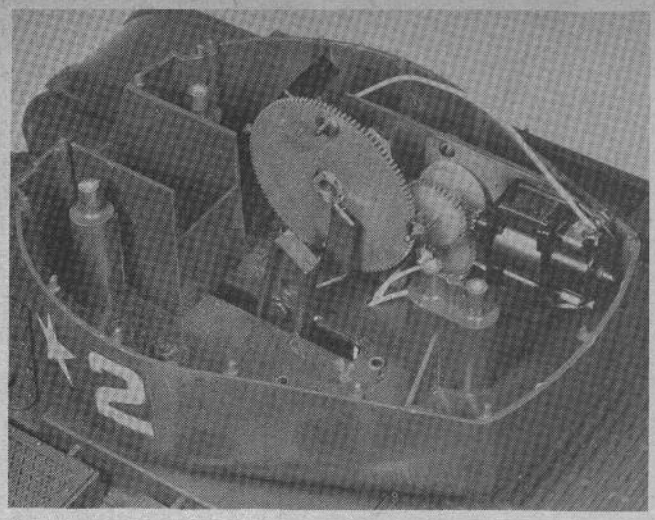
How Phil Canterra and Kern Bowyer installed radio gear in two toy Army tanks and then fought tank battles with guns which work. It takes six-channel control—and the ideas adapt to all tracked vehicles.

■ OFFERING MANY UNEXPLORED and interesting possibilities are the many amazingly realistic motor-driven toys available from supermarkets and toy stores, which can be easily converted to radio control. This Remco U.S. Army Bulldog tank is an outstanding example. Actually, all these non-aircraft projects, including electric-powered boats, pose basically similar challenges.



The cannon-cocking spring, and cocking lever just below it, show at top of picture. Receiver, nickel-cad pack, metal tank bottom not shown. Right: Pot—above right motor—used to adjust the speed of faster motor for straight running.



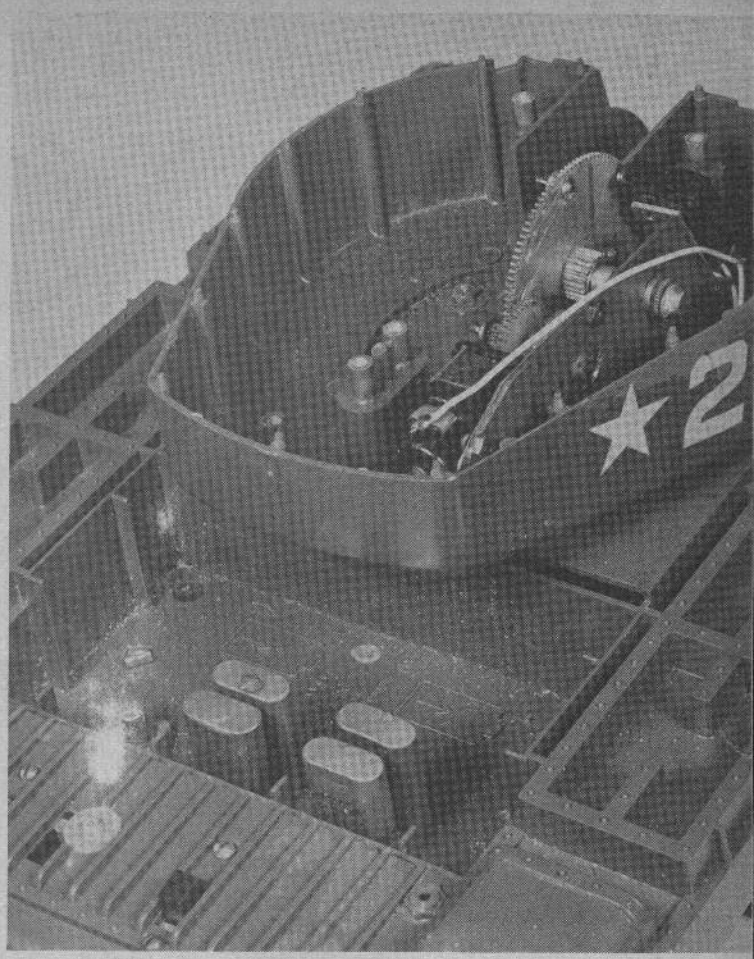


Cocking motor assembly Bonner servo parts except for large gear which moves cocking lever. Gun recocks automatically.

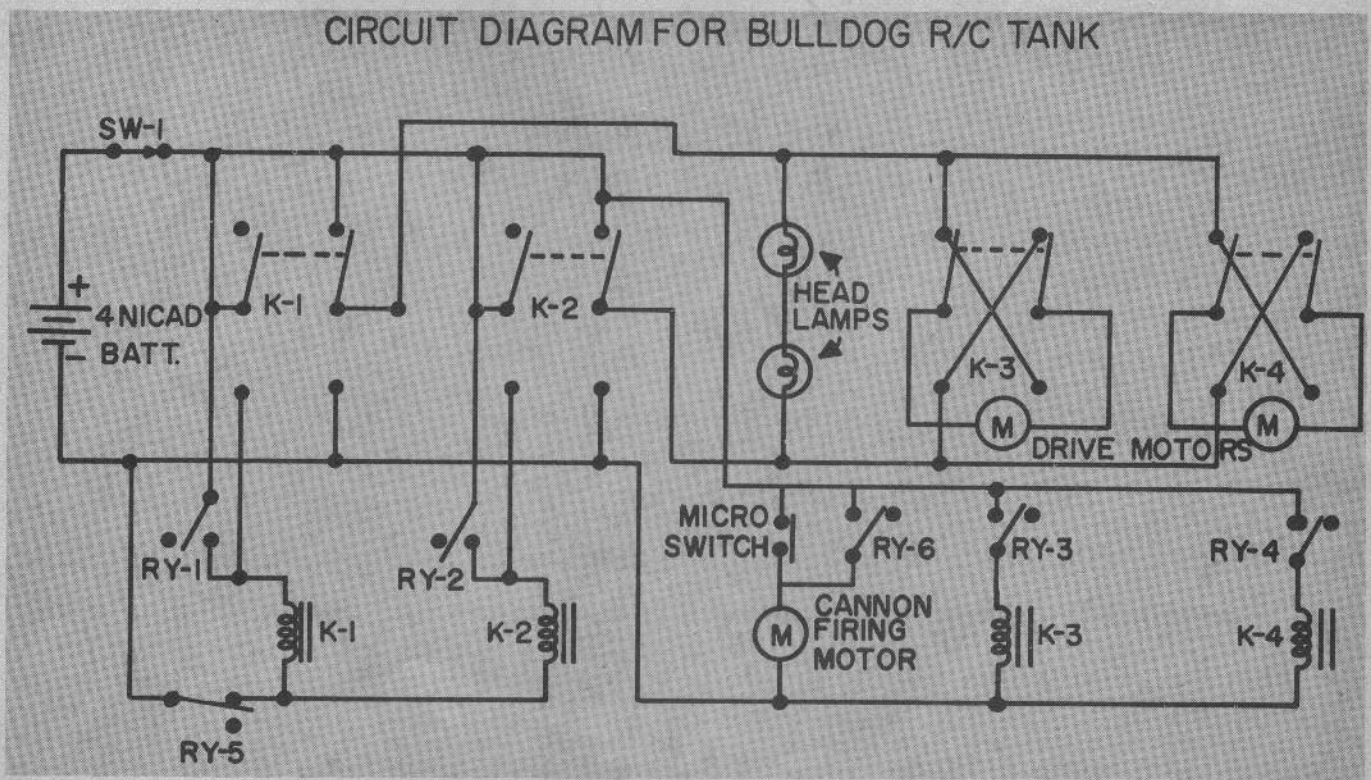
When high-drain drive motors are involved some suitable means must be found to prevent overloads from damaging relay contacts, transistors, etc. in receivers and actuators, usually accomplished, as in this case, by switching relays. Tracked vehicles, such as dozers, tractors and tanks, depending upon separate drive to each track in order to steer, require splitting the drive axle, with each half gear-driven by its own motor.

Canterra and Bowyer first demonstrated their pair of Bulldog tanks at the Bisons, DC/RC and Weak Signals conferences in 1960. Phil and Kern graciously made this information available to GL after digging out one remaining forgotten tank which was rehabilitated for these pictures—the radio, etc. being replaced after some hasty picture making.

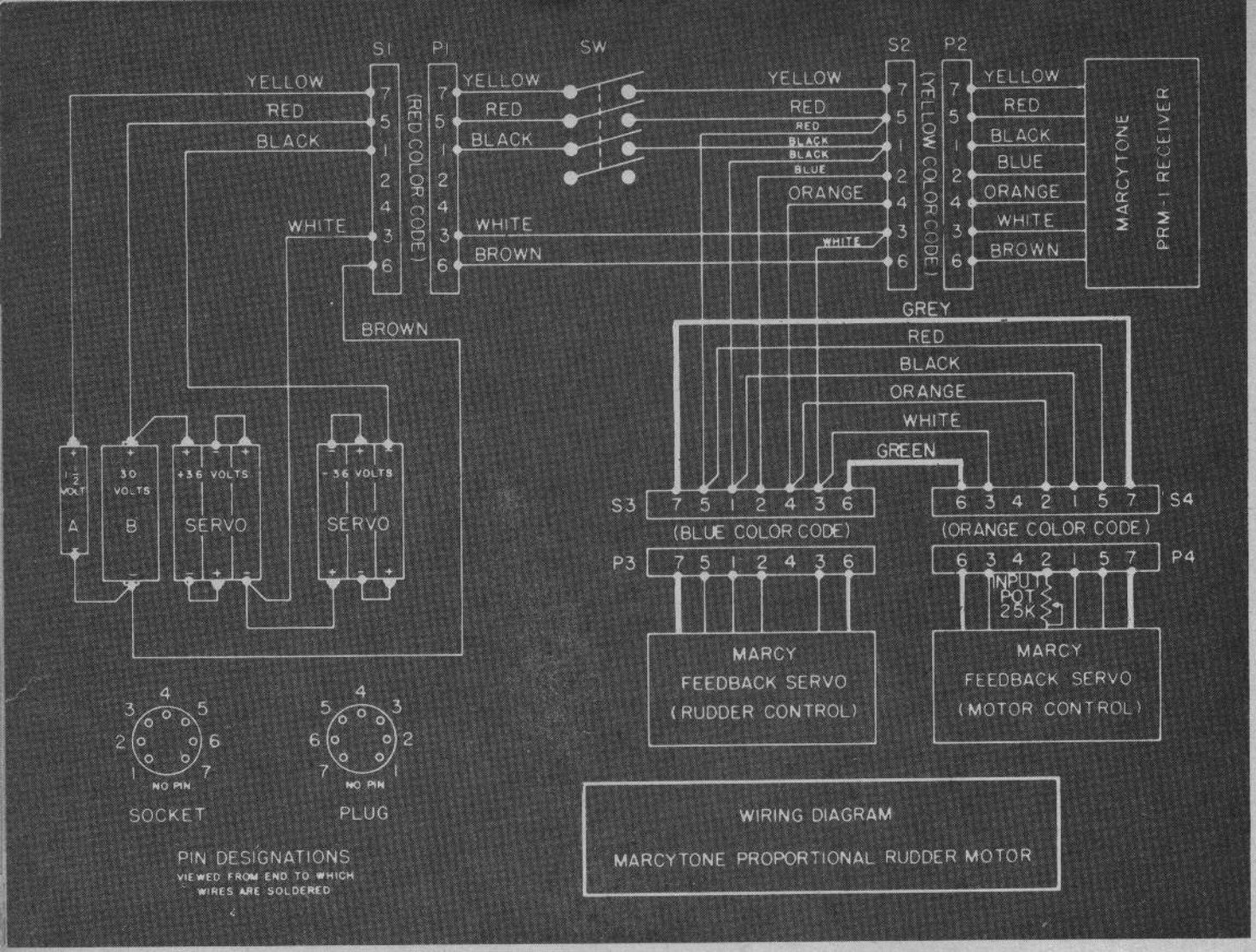
"In late 1959, when the weather was closing in on us," Kern recalled, "and flying was stopped, Carl and I looked around for a winter project. After visiting a number of toy stores, we settled upon the larger of two Remco tanks. They appeared large enough to hold all the gear and batteries that would be required and offered the possibility of full forward and reverse, left and right operation, in addition to (*Continued on page* 26)



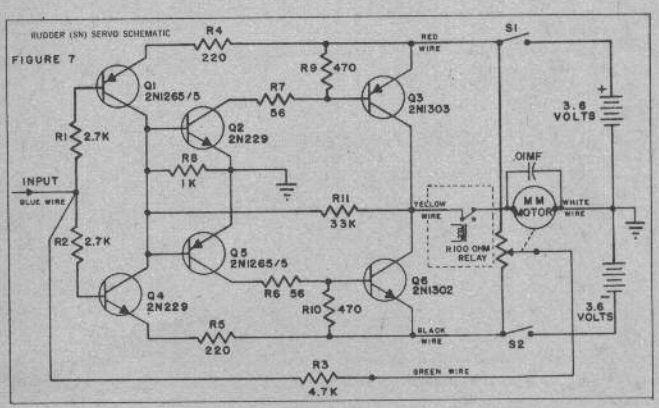
This view shows special cocking motor metal mount and microswitch, to right of big gear, which shuts off motor when gun ready to fire. To rear of turret are four motor-control relays, switches and an antenna pin-jack on rear decking.

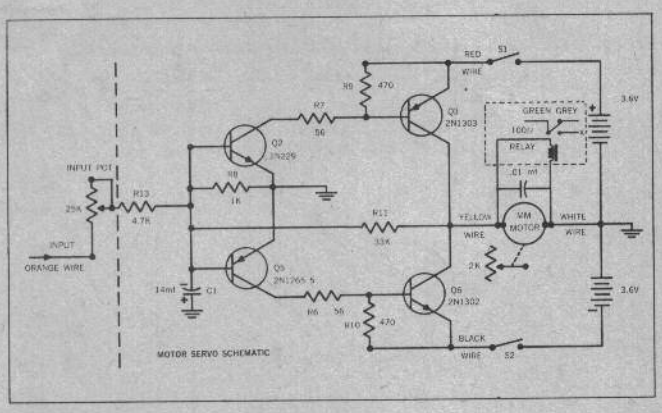


Receiver power wiring not shown; depends on unit. All relays shown in un-energized position. Key: K-1, forward drive relay; K-2, reverse drive relay; K-3, left turn relay; K-4, right turn; Sw-1, main power switch; Ry-1, down elevator rcvr. relay, starts tank forward; Ry-2, up elevator rcvr. relay, starts tank in reverse; Ry-3, left rudder relay for left; Ry-4, for right; Ry-5, low-motor rcvr. relay stops tank; Ry-6 high motor, fires cannon (by starting cocking motor).



IMPROVING The Marcy PRM-1 System





The addition of 100-ohm relay provides for simultaneous control function and eliminates objectionable cycling or partial cycling in rudder when motor is commanded.

BY PUTTING A 100-OHM RELAY of the Deans type across the Mighty Midget motor used for motor control in the Marcy PRM-1 System, and wiring in its contacts to the Mighty Midget rudder servo, performance of the system can be improved.

With the addition of this relay and its contacts in the servo circuit, the current is immediately taken off of Mighty Midget rudder motor when motor control is commanded.

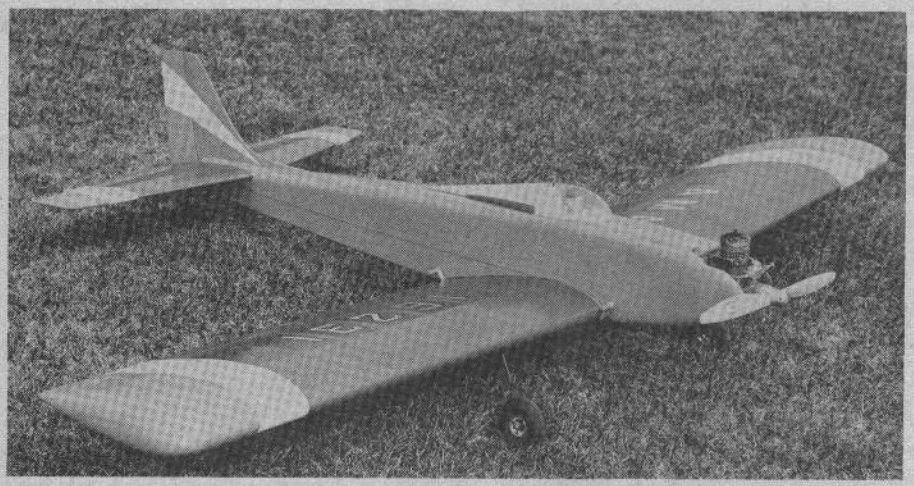
Even if the rudder is in a turn and motor control is commanded, the rudder will retain the degree of turn at the time of command. This affords simultaneous function and improves the performance considerably. It also gets rid of the objectionable cycling or partial cycling that has been an inherent quality of the rudder servo on motor command.

There is a slight quick nervous jump of the rudder servo with this relay, but it has no appreciable deflection.

There is room on the motor control-servo PC board to mount the 100-ohm Deans relay, and the heavy wires (see wiring diagram) show how the relay connections may be made on pins 6 and 7 of the two plugs and sockets for both motor and rudder control.—*Marcy Inkmann*

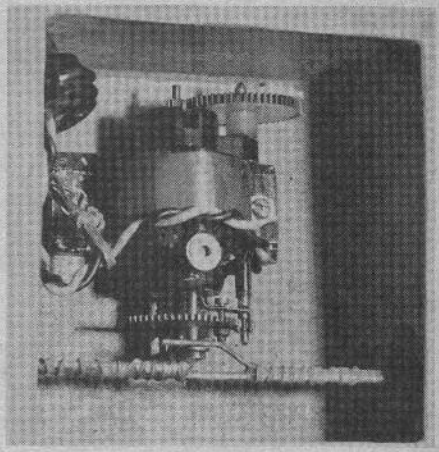
...R/C JAY

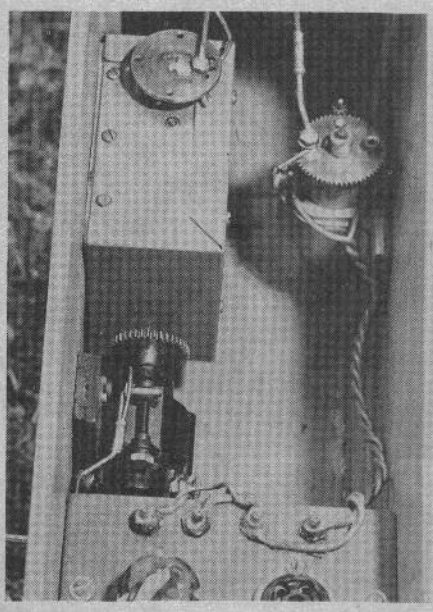
When this picture was taken the ship had just completed its 200th flight. Bob specialized in all forms of proportional.



The two-wheel gear, in this instance, presents no takeoff or landing problems.

Main change in aileron MM is 90-degree rotation of motor on its base (epoxy).





For elevator the DeeBee servo is used. Pulse fans will appreciate the others.

by BOB FERRIS . . . ***An extremely easy-to-fly advanced multi stunt trainer with especially nice handling traits for proportional. Grid Leaks is happy to present this basic plan of an honest plane for your favorite gear.***

GRID LEAKS is rather proud of the fact that neither the magazine nor the designer of this airplane claim it to be still another multi capable of gunning down all before it. However, it is a fine airplane or it would not be here.

Bob Ferris, TWA jet pilot, is a long-time modeler who went into radio control via rudder-only pulse, Galloping Ghost, dual proportional; and for the past two seasons, full-house via Don Brown's DeeBee equipment. He flies for fun and he goes to contests. He knows how an airplane should fly—and on proportional.

Now, really good airplanes get built by other people without benefit of magazine articles. After GL spotted an R/C Jay in the hands of another TWA pilot, a veteran multi man, then a third and a fourth with folks who learned to fly multi with them on DeeBee, the design was studied and evaluated over a 12-month period. It flies right, handles well, is safe, and the construction adheres to general practice in all major components.

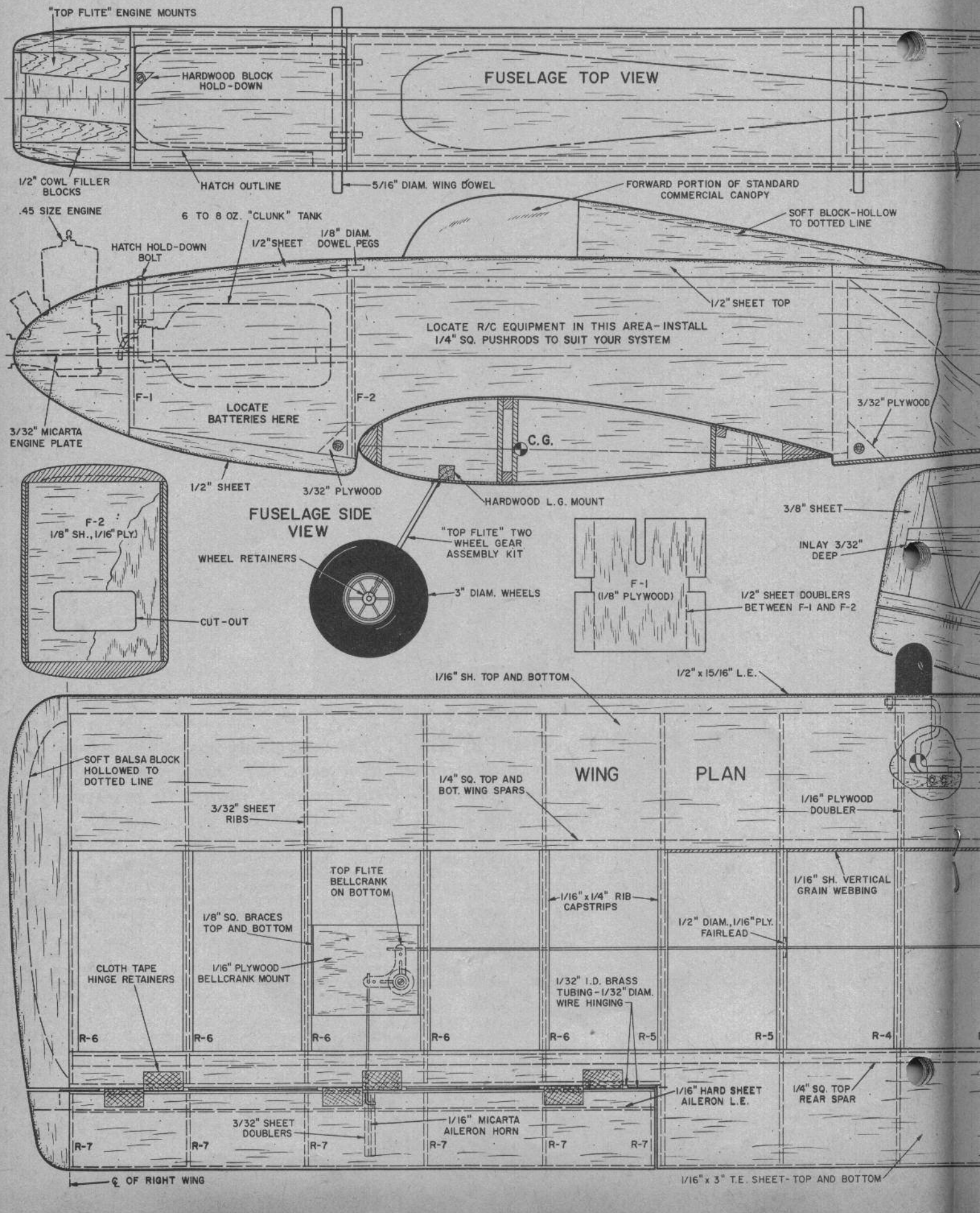
GL does not compete with the popular magazines so an airplane plan—even if basic and without specific building instructions—is a landmark, and it is our policy to publish only occasional plans for airplanes—and perhaps other "things"—provided there is a real need for the project. Anyway, we hope you like this plan and use it to get some fun out of your dual-prop or full-house gear. Or stick that reed set in it!

The original plane has 3-ply 1/16th sheet fuselage (*Continued on page* 25)

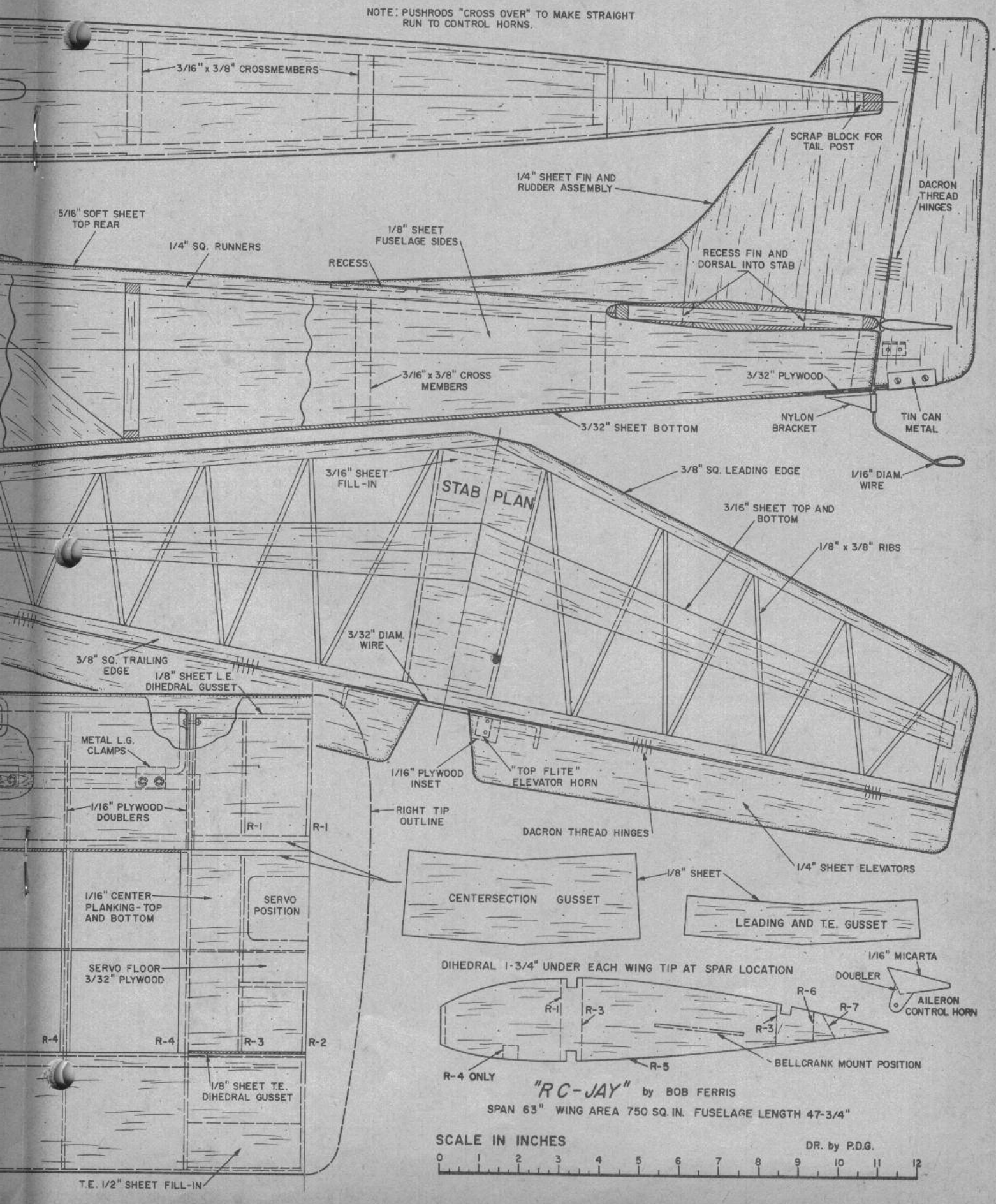
PLANS FOR R/C JAY ON NEXT TWO PAGES

FULL-SIZE PLANS OF THE R/C JAY ARE AVAILABLE!

These plans are individual prints—they are not folded—shipped to you in a mailing tube. Send $2.00 to GRID LEAKS, Box 301, Higginsville, Missouri. Outside of the United States add 50 cents extra.



R/C JAY . . . Since this design is presented in basic plan form, a radio installation is not shown. Those who install proportional can easily approximate DeeBee setup in the pictures. For reeds, a standard servo group on removable mounting tray is recommended. Hardwood rails will be the only addition.



"R C - JAY" by BOB FERRIS

SPAN 63" WING AREA 750 SQ. IN. FUSELAGE LENGTH 47-3/4"

SCALE IN INCHES

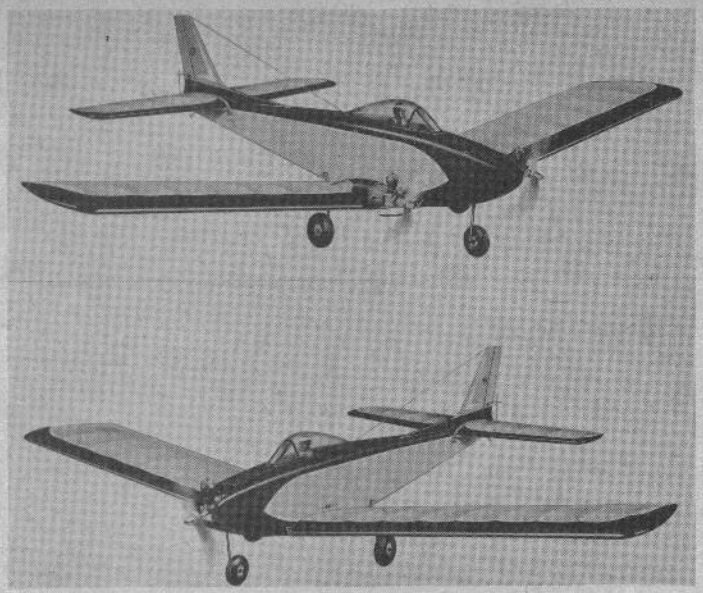
0 1 2 3 4 5 6 7 8 9 10 11 12

DR. by P.D.G.

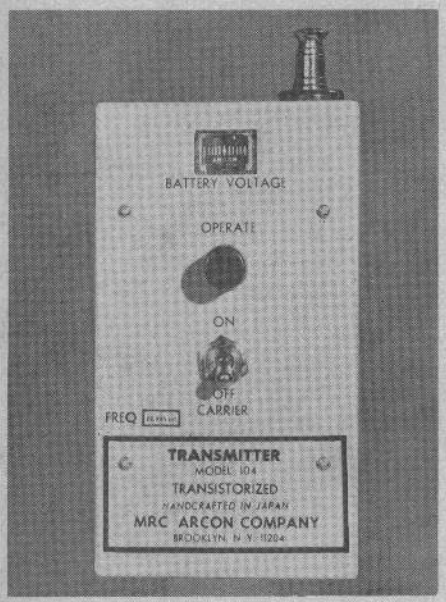
To the trade: This feature is open to all makes of equipment, domestic and foreign. Selection will be edited for reader interest and need.

SEEN THESE

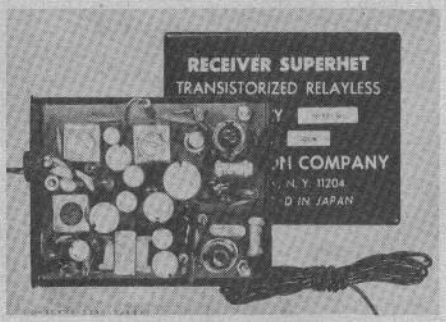
GL's coverage of new items, information and trade releases, now includes a coverage of useful products on the market.



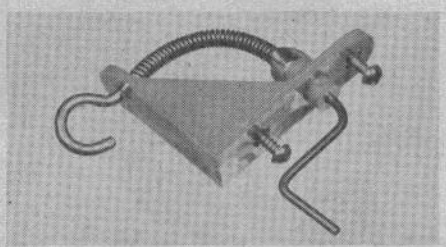
1. Goldberg Models Skylark Jr.



2. MRC Arcon Transmitter



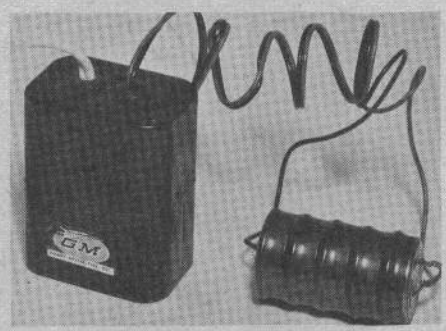
3. MRC Arcon Receiver



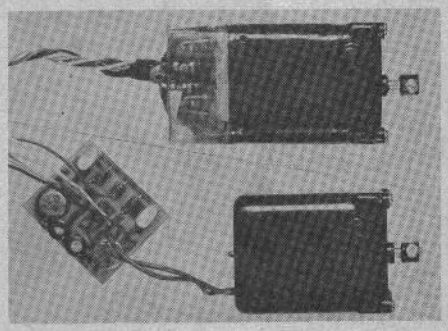
4. International's Side-Winder

Skylark Jr. (Carl Goldberg Models, Inc., 9847 S. Claremont, Chicago 43, Ill.) for single channel, optional twin or single engine, .01 to .049, 37 in.; 2-3: MRC Arcon (MRC-Enya Co., 5300 21st Ave., B'klyn, N.Y. 11204) 18V x-mitter, matched superhet, relayless, 9V rcvr ($79.95), built-in monitor; 4: Side-Winder escapement rubber winder (International Model Products, 33 Union Sq. W., New York 3, N.Y.), $1.25, is 1⅜ in. long dimension, weighs 1/6 oz.; 5: Adams proportional actuator (Ace dealers) for up to ½A, wgt. 29 grams, 2 center-tapped 30-ohm coils, 100 ma at 3V, $6.95; 6: G.M. charger (G.M. Hobby Specialties, 105 Clifton Blvd., Clifton, N.J.) handles 20 to 40 ma, up to 9V, small in size—compare with servo nickel-cadmium battery pack—plugs into 110 AC household outlet ($6.95); 7: Relayless version of Hillcrest Motor Control servo (Jerry Wellborn, P.O. Box 7258, Oklahoma City, Okla.) in two versions shown, one amplifier including servo, other encapsulated version with Acryjel. Encapsulated unit with Acryjel molding, $14.95. Kit, including servo, $12.00. Amplifier kit alone, $8.00. Amplifier alone (assembled) $10.00.

5. Adams Proportional Actuator



6. G.M. Hobby Charger



7. Relayless MC Servo

● Fuel Caddy from G.E.M. Models (48 W. Le Moyne, Lombard, Ill.). Chiefly concerned with manufacturing of fiber-glass boat kits, G.E.M. noted the need for an effective method for refueling boats and planes. The Fuel Caddy can be used for both transportation and dispensing of fuel —it holds a quart. The fuel syringe is eliminated. To fill the tank, the fuel line is removed from the solid fitting on the caddy, placed over tank inlet, then caddy is inverted and squeezed.

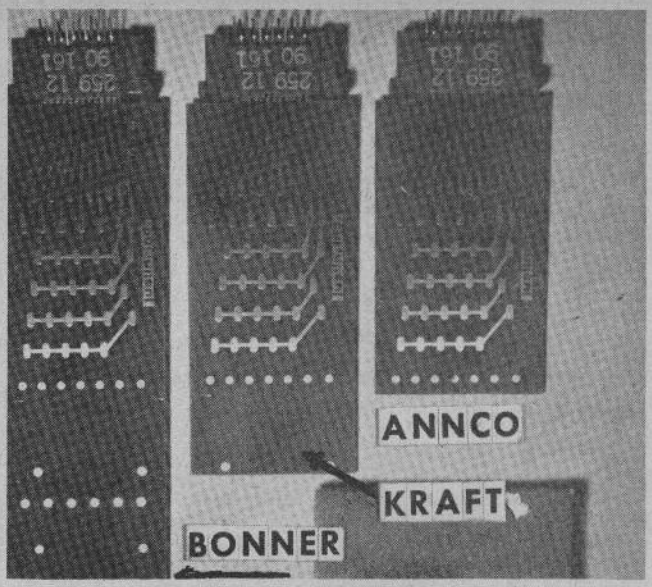
While Gary Preusse neglected to mention price, GL can certify that the Fuel Caddy is quality merchandise—sample is excellent. In addition to the boat kits, G.E.M. handles Cameron and O&R engines, Octura, and G.E.M. fittings.

Gary also showed GL G.E.M.'s new heavy-duty green neoprene tubing for water hoses on boats or as fuel line for large glow engines. This tubing is ⅛" I.D. and ¼" O.D., and is priced at $.15 per foot.

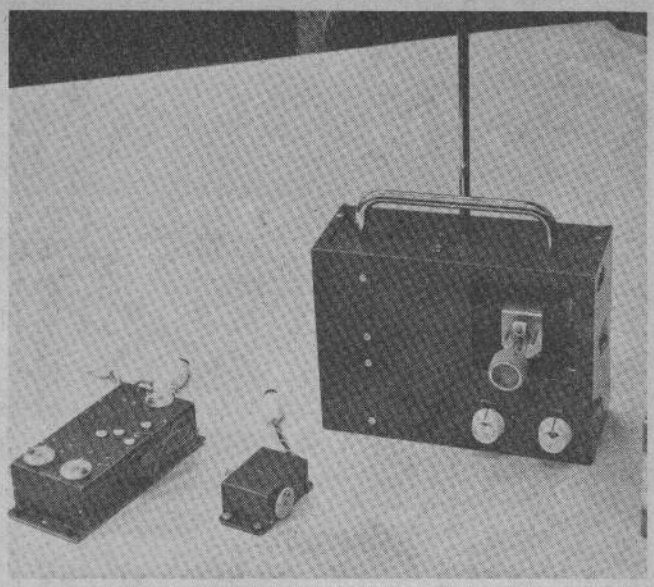
G.E.M. also has a limited number of surplus 2/5 HP ball-bearing electric motors. They are 4⅛" long, 2⅜" dia., weigh 2¼ lbs. and draw 24 amps 24 volts at 10,000 rpm. These motors have powered 5 out of 8 winners of IMPBA records for electric speed boats. May also be used as model airplane engine starters; run well on 6 or 12 volts. Cost $6.00, and a matching steel universal joint which fits a 3/16" shaft is $2.95.

● Omega Sales, Box 321, Racine, Wisc., advises they will have their popular reed switches available in SPDT configuration

(*Continued on page* 23)

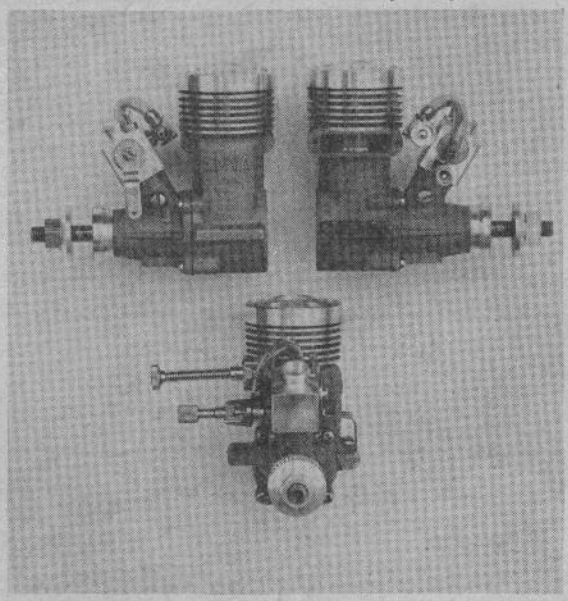


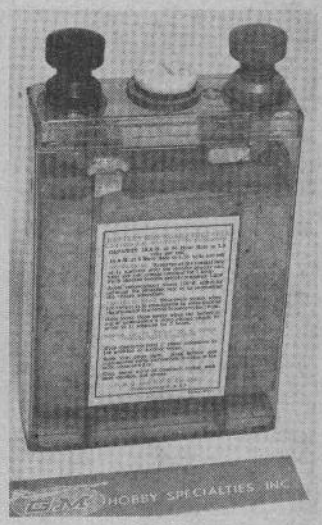
8. Justin Micro-Tie Mk II



9. Yates Multiplex System

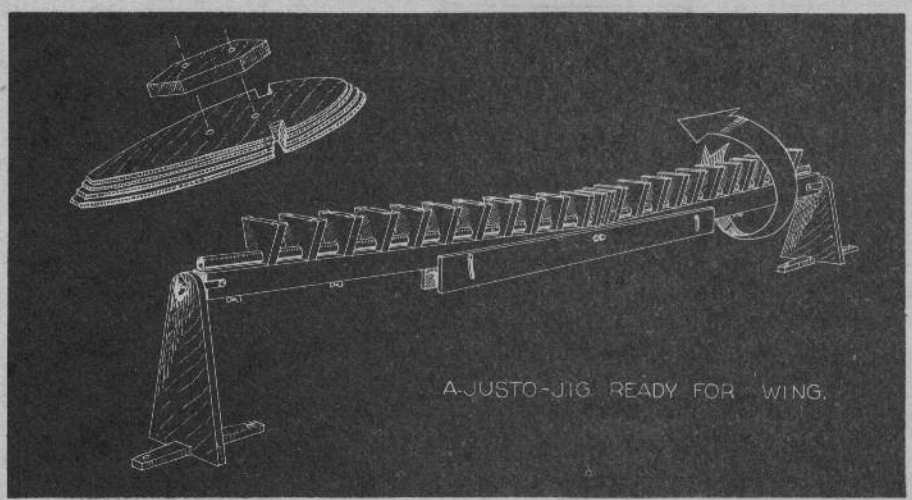
8: Micro-Tie, Mark II (Justin Inc., 418 Agostino Rd., San Gabriel, Calif.) has greater versatility than company's old printed circuit board, thanks to redesign. Suits various servos—see article; 9: Bob Yates Multiplex 4-channel transistorized proportional (Bob associated with Reynolds Engineering, 2712 Greenway Ave., Winston-Salem, N.C.) sells direct to consumer at $395.00 complete with 4 servos illustrated. Three servos can also be mounted in one case as shown. Feedback servos use Micro-Mo motor geared 60 to 1, bevel gear with total output ratio of 240 to 1. Weight 2 ozs. The elevator and rudder servos $29.95, double-ended aileron servo $32.95. See text; 10: MRC-Enya 45 R/C engine (MRC-Enya Co., Inc., 5300 21st Ave., B'klyn, N.Y. 11204) features separate idling and high performance ranges; double valve system eliminates compromise needle setting and stoppages on low-motor. Claimed 2000 to 13000 rpm, 7/10 h.p. Weight 10 oz. $25.95 with throttle. (At dealer); 11: New 2V, 18 amp/hr acid cell battery (G.M. Specialties, 105 Clifton Ave., Clifton, N.J.) Use as booster for engine starting, or in multiples for boat drive. (4 x 1½ x 7—$4.95.)



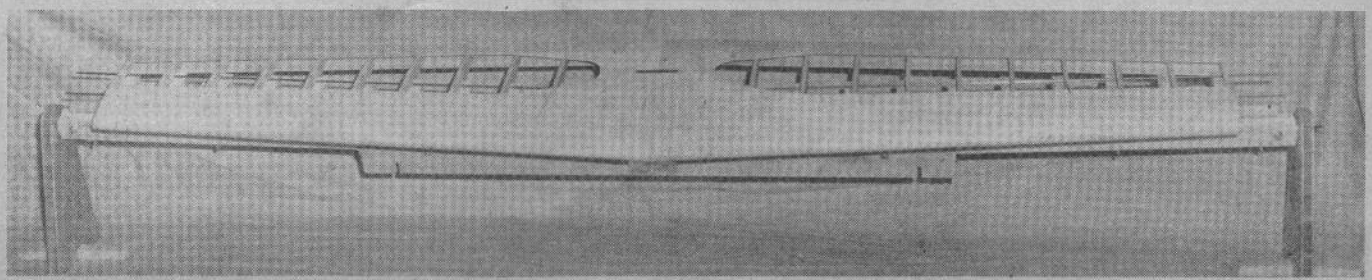


11. G.M. Acid Cell Battery

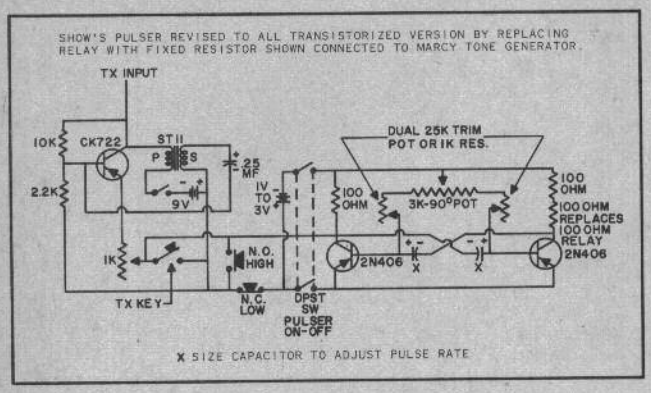
10. MRC-Enya 45 R/C



A-Justo-Jig (52 E. Washington St., Frankfort, Ind.) displayed the trundle-type fixture jig, shown in drawing and picture, left and below, at Toledo Weak Signals Conference. It insures accuracy, rotates 360 degrees to permit access to any portion of wing during assembly. Price will be under $30 and the manufacturer will be guided by the interest you show in the device. It is described at length in the text. If such a jig is of interest to you, GL suggests you drop a line to A-Justo-Jig. The device was developed by James Kennedy, Jim Ellis, Bergen Hardesty.



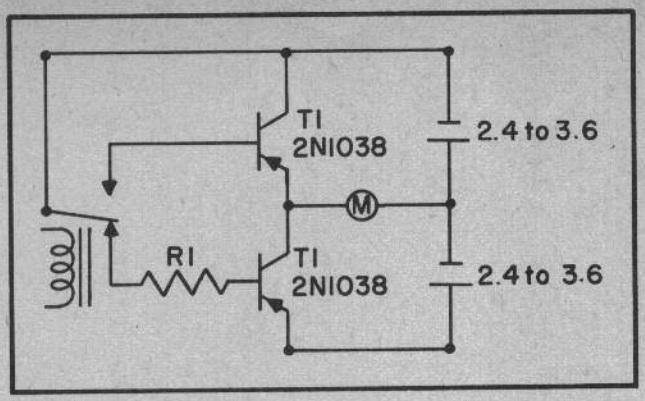
BITS AND PIECES...



SHOWS PULSER—MARCYTONE GENERATOR

by Roland C. Rhein, Speedway, Ind.

■ Here is a diagram for a Shows pulser—with the relay removed—connected to a Marcytone generator. The pulser has been used all last summer, performs very well with any transistorized low-voltage tone generator. This scheme eliminates relay adjustments, and as noted, will work all the way down to 1 volt on the pulser. I hope someone else can find a use for this hookup that operates as reliably as I found it to.



PROPORTIONAL CIRCUIT ELIMINATES ARCING

by Donald C. Fisher, Whitewater, Wisc.

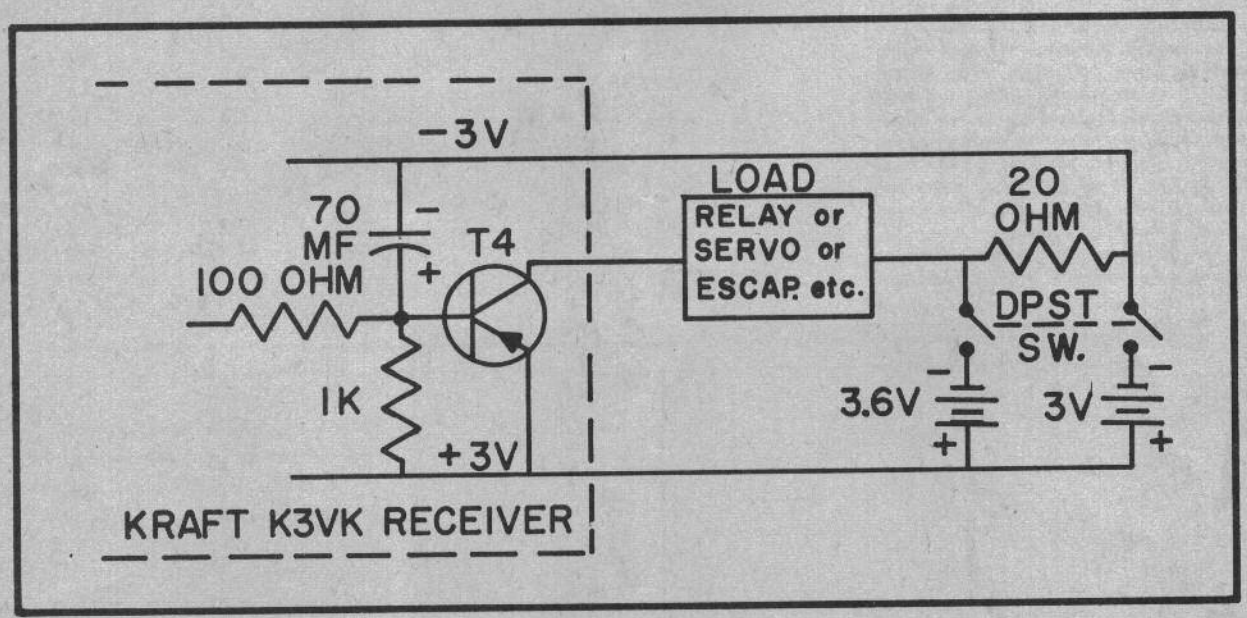
■ This circuit answers the proportional fan's problems as far as relay contacts are concerned. It eliminates the necessity for cleaning, since it completely eliminates the biggest cause for the cleaning requirement—arcing.

R1 must be adjusted so that at 50-50 pulsing it will give neutral rudder. On 3.6 volts, this generally will be about 820 ohms. On 2.4 volts, 680 ohms is about right.

This circuit has several advantages over relayless circuits. The transistors are always driven to saturation, and do not tend to overheat, as in relayless circuits. Maximum power is always available for any given pulse rate, and high pulse rates do not cause relay points to carbon up.

I have flown this circuit for over a year and have found it extremely reliable. In fact, it has been so reliable that during the summer of 1963 I didn't have a single crash that was due to equipment failure.

I prefer the TI 2N1038, but I am sure that any 500 mil rating transistor would be found satisfactory.



K3VK MODIFICATION

by Allan K. Scidmore, Madison, Wisc.

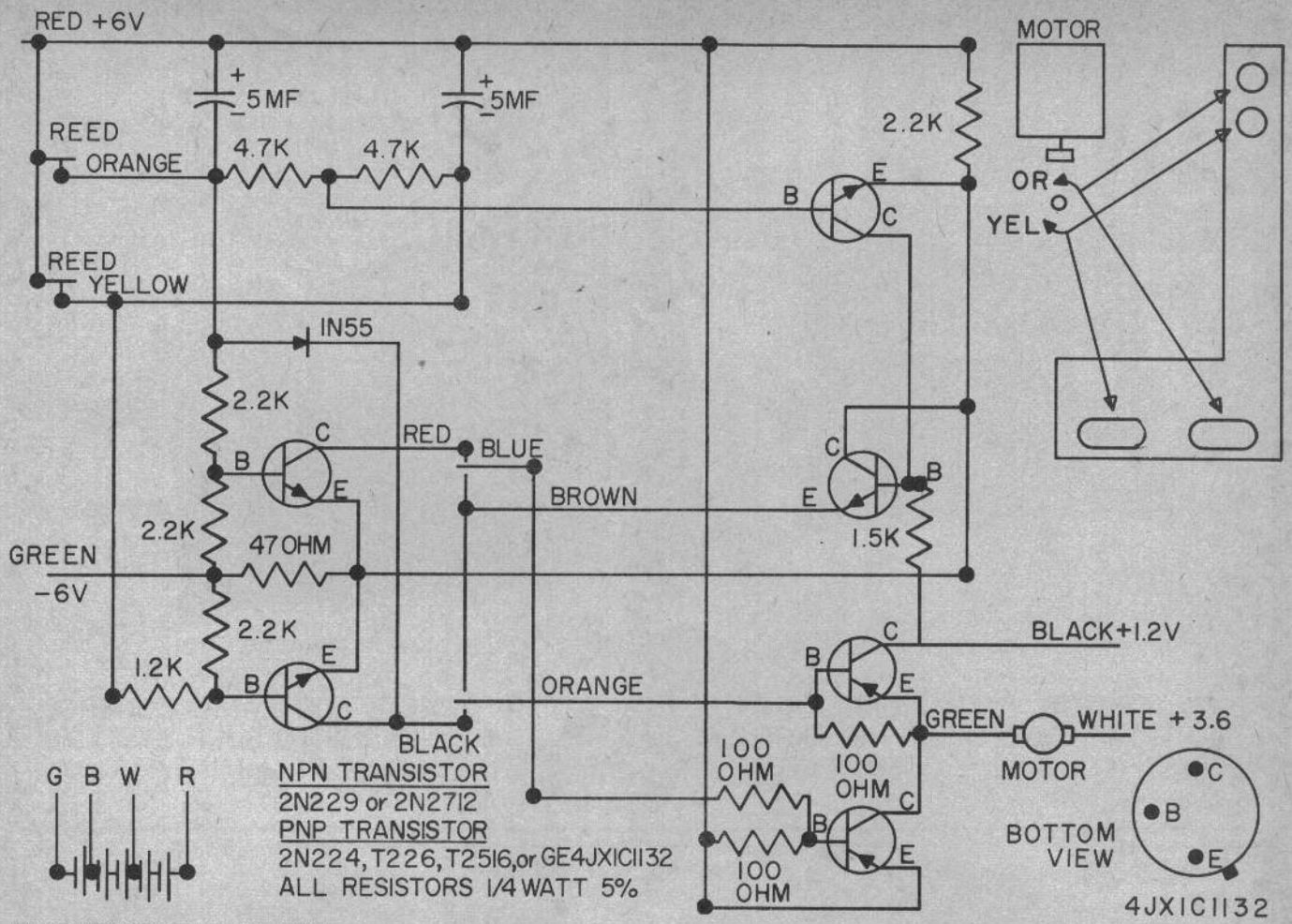
■ Quite a few of us (MARCS) have one or more ships with the Kraft K3VK receiver and in general these have turned out to be quite reliable warm weather receivers. A few of us have yet to solve the below 50-degree operation problem, but that's beside the point. On several occasions we have observed interaction between the receiver and the escapement, relay, or servo that is being driven by the receiver signal (directly or indirectly). I have been using a separate supply to solve this oscillation problem now for two years and it appears to give satisfactory results to others who have tried it. The problem is quite similar to "motorboating" in audio power amplifiers and the usual solution is adequate decoupling of the hi-gain low signal stages from the power stages. If the last transistor on the receiver (T4) is supplied from a separate or isolated supply, the problem has vanished. (The accompanying diagram should clarify these remarks.)

Note that the receiver drain is quite small if the last transistor is supplied from a separate supply. In my particular application the separate supply, V, was three Nicads for 3.6 volts and I used a 20-ohm resistor (shown dotted) to maintain the receiver batteries (2 AAA cells) in a charging rather than a discharging state. Although I had to charge the Nicads there was no need to replace these two small cells (about 0.3 oz. each) during the year.

CHANGING CONVERTER INPUT

by Frank J. Pisano, Staten Island, N.Y.

■ Just to let you know that 3.6V input transistorized power converter (GL Vol. IV, No. 3) can be changed to 6V input quite easily by removing 250 turns from secondary of transformer. All components remain same output—same 135V at 20 to 25 ma. Some people still prefer 6V input as I do. I have series filament on my Orbit 10-channel so that I don't need dropping resistors on filaments.



TROUBLESHOOTING TRANSMITES

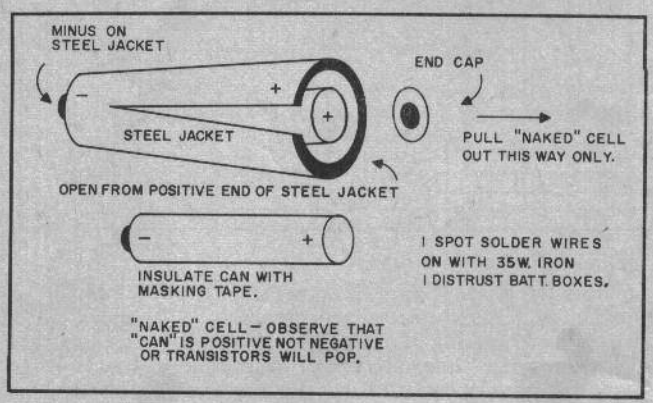
■ Mike Gossett and Bud Atkinson have developed some tips for troubleshooting Transmite servos with results attested to by other members of KC/RC.

If the servo will drive in one direction only, refer to upper right in drawing. Normally, the orange wire drives the servo in a counterclockwise direction, and the yellow wire clockwise. The arrows point to the transistors associated with the direction. The round symbols are the PNP drivers, oblong the NPN switchers.

Replacing the *opposite* drive transistor will generally cure driving in one direction. If not, try replacing the switching transistor as well. If servo works intermittently, Mike and Bud check for loose wiring and for solder joints subject to vibration troubles.

If the servo works correctly when the reed bank is bypassed, the capacitors are suspect. When a motor draws in excess of 300 ma it is replaced.

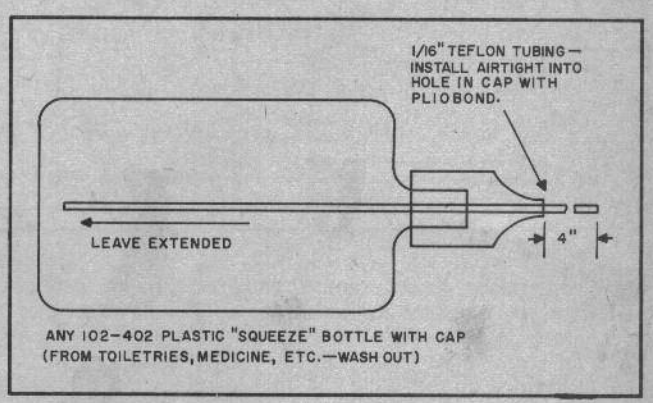
The new General Electric 4JXIC1132 transistor has been found to be one of the best for the drive circuit and will stand in excess of 300 ma without heating. It replaces the older Philco 2N223 and 2N224, and T2516 which are no longer manufactured. Basing on the 4JXIC1132 will be found different. A drawing of the 4JX is included.



WATCH THOSE E91 ENER-GIZERS

by Bob Gaede, Baltimore, Md.

■ One more R/C tip: The E91 *Ener-Gizers* (alkaline batteries) so highly touted for ¼A and ½A have the *same* ills as all the other double-cased steel-jacket cells—intermittent contact! After going nuts one Sunday with a buddy's Kraft 3 volter (it would work only with motor *not* running), I decided to experiment and take off the steel jackets. However, these EGI's are booby-trapped!! The polarity reverses with the "can" off and will blow out transistors if goofed! (See sketch.) Also, can must be removed as shown or loose end laps (causing all the trouble) will slip and short out half the "oomph" of the cell.



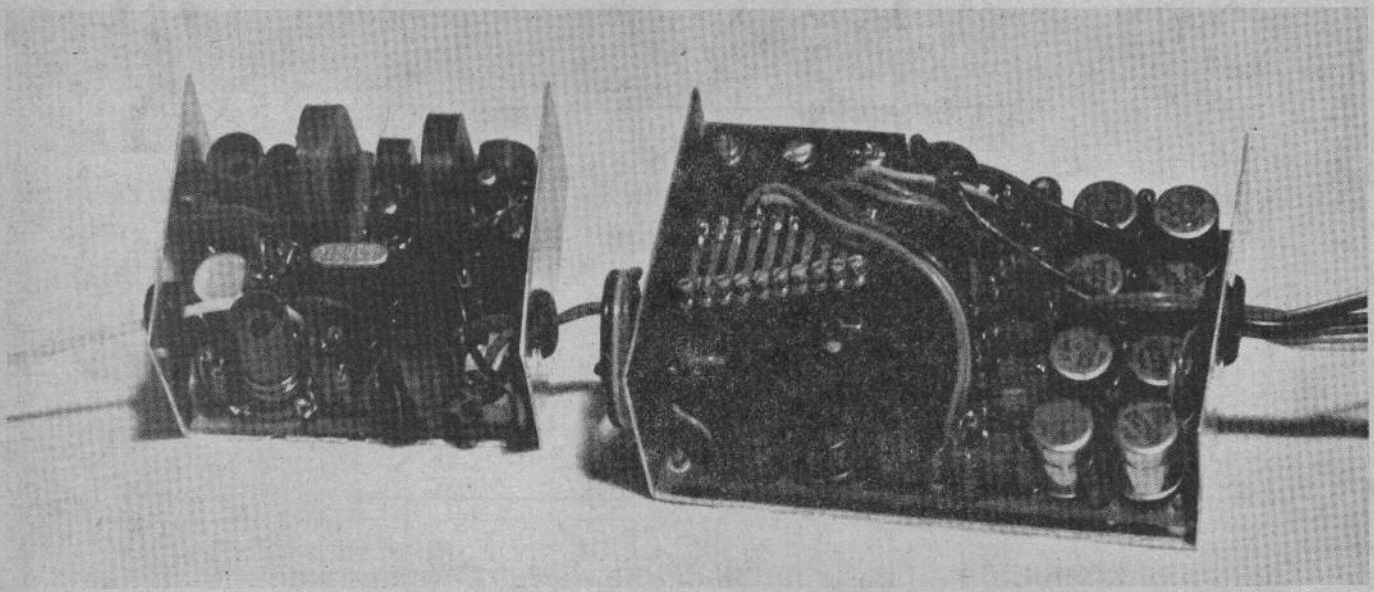
REMOVING EXCESS SOLDER

by Bob Gaede, Baltimore, Md.

■ Here is the solution for removing excess solder from P.C. boards, and relay, tube and socket terminals, etc., especially when switching *components* or repairing crash damage. This device does not leave excess solder in set to short out parts!

Procedure: 1) Heat joint to be disconnected; 2) Squeeze bottle, then apply tip of teflon to solder "blob." Release bottle and solder will be sucked up into teflon tube to solidify. (Teflon will not burn.); 3) Snip off ¼" teflon, and you are ready for next fouled up joint!; 4) When teflon tube gets short, pull out of bottle and re-seal with Pliobond.

. . . Notes on Superhet Receivers . . .



by **DICK JANSSON** . . . A PIONEER IN THE FIELD OF SUPERHETS FOR RADIO CONTROL, THE AUTHOR IS NOTED FOR HIS APPLICATION OF RIGID STANDARDS TO SUCH SYSTEMS. THIS RECEIVER AND DECODER IS RESULT OF EXPERIMENTS IN PRACTICAL MINIMIZATION.

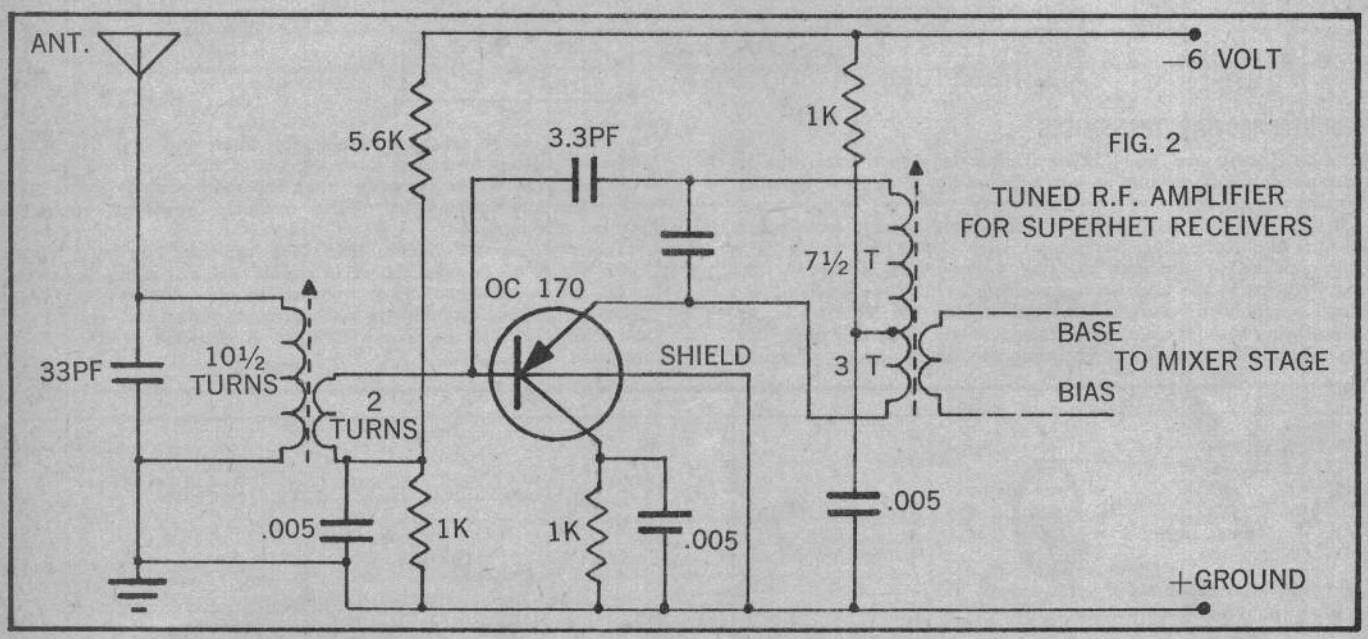


FIG. 2

TUNED R.F. AMPLIFIER FOR SUPERHET RECEIVERS

EXPERIMENTS WERE CONDUCTED recently to determine the practical minimization applicable to a superhet receiver system. Fig. 1 illustrates the flying equipment resulting from these trials. On the left is a receiver front end, assembled on a 1½ by 1¾ inch printed-circuit board, weighing 45 gm. (about 1.6 oz.). On the right is a servo decoder unit consisting of an amplifier, reed bank, and four servo amplifiers, assembled on a 2⅝ by 1¾ inch printed-circuit board and weighing 98 gm. (about 3.5 oz.).

A smaller servo decoder unit could be built but size and weight concessions were made, in the use of the Medco reed bank, to achieve ease in reed bank tuning and adjustment. The servo amplifiers are four transistor units for trimmable servos or self-neutralized servos (Bellamatic II).

Concessions were made also in the receiver size to include an R. F. amplifier to selectivity reject the I. F. amplifier image (between 26.1 Mc and 26.4 Mc for most 27 Mc superhet receivers). Fig. 2 shows the R. F. amplifier, a conventional tuned-neutralized amplifier. The added parts cost is low, making the amplifier worthwhile in preventing I. F. image interference. It is estimated that a conventional transformer tuned I. F. amplifier could be constructed on the same size P. C. board as that illustrated with the transfilter I. F. amplifier.

Where can R/C equipment go from here? Some improvements may be gained from the future availability of smaller components. It may be difficult to use these as the P. C. board soldering techniques used on the illustrated units requires a delicate and skillful hand. More significant gains will be realized in the use of microelectronic circuits now being produced for advanced avionic equipment. These integrated circuits are not yet within the reach of the commercial R/C market, though, and they must remain a future vision. ▪

Seen These?

(*Continued from page 19*)

Weight is 4.5 grams. Vibration can be withstood in excess of 35 g's. Over one hundred million switching actions at one-half ampere resistive load may be expected.

Ken Roberts of Omega states the SPDT was going in production. The 300-ohm version, known as the DT 300, has a maximum pull-in of 10 ma. (Probable price around $6.00.) The DT-HR has a resistance of 3600 ohms, a pull-in of 3 ma, and will be priced around $7.00. Further details from the manufacturer.

● James Kennedy, Jim Ellis and Bergen Hardesty of Frankfort, Ind., have come up with a new jig. Called A-Justo-Jig, it speeds the tedious task of building wings. The jig will accept any type of wing. A trundle type fixture allows 360-degree rotation for easy access to any part of the wing.

For greater accuracy, the A-Justo-Jig employs husky construction. Twenty-four adjustable rib locators are mounted on cadmium plated steel tubes to prevent warpage. The use of pine rib locators facilitates pinning ribs in place. The rib locators and the tubes are attached to sturdy dihedral rails. The dihedral rails are adjustable through a range of zero to 5 degrees. A large-size work bench is not a necessity. The A-Justo-Jig may even be mounted on a wall. It will accept wings of 6 ft., or slightly more, of any chord. Many stabilizers can also be constructed in a similar manner.

A-Justo-Jig was demonstrated at the Weaks Signals R/C Conference in Toledo, O. where many favorable comments were received. Although speed and accuracy are two of the desirable features of A-Justo-Jig, viewers were impressed with its versatility, and particularly that a wing could be constructed almost in its entirety before being removed frim the jig.

The price will be under $30.00, and production will be guided to a large degree by the interest you show in this device. Drop A-Justo-Jig a note at 52 E. Washington St., Frankfort, Ind., if you feel production of this item is warranted.

● Randy McGee of the Oklahoma City R/C Club visited GL and told of an interesting project that he and his fellow club members have taken on—a relayless unit from the popular Hillcrest motor control servo.

Photograph shows two versions. One is the amplifier, including the servo, and the other is the encapsulated version with Acryjel. The input is 0.7 MA. The output transistor will carry 3 amps, and it is reputed that two and three servos have been run simultaneously from one reed pair. Servo has a slip clutch, which makes it ideal for positionable action. The weight is 2 ounces, and it develops 4 pounds of torque.

The encapsulated unit with Acryjel molding is $14.95. The kit, including servo, is $12.00, the amplifier kit alone is $8.00, and the amplifier alone assembled is $10.00. Contact Jerry Wellborn at P.O. Box 7258, Oklahoma City, Okla.

● Dick Adams, an old timer to radio control, has been prevailed upon to reintroduce the Adams proportional actuator, initially introduced at the Nationals in 1953, and commercially available around that time. The new model is about half the size of the old one, and produces twice the torque.

This patented proportional actuator has many features not found on others of its type. It is designed for ⅛A to ½A airplanes. Weight is 29 grams. Has two 30-ohm coils center tapped, and pulls a maximum of 100 ma at 3 volts. May be used with 6 volts. Designed for double-ended relayless or relay-type receivers. Delrin is used as the bearing material, and this is part of the secret for the fantastic performance. Delrin is excellent bearing material, and shows virtually no wear, and will never require lubrication.

This actuator represents a refinement of 11years of testing. Price has been set at $6.95. (Available through your Ace R/C dealer.)

● Justin Inc. has announced their new Micro-Tie, designated Mark II, more versatile by redesign of the printed-circuit board. The Mark I fit the back of a Bonner servo; the Mark II will fit a Bonner, or by cutting off the board at appropriately marked spots, the new Kraft servo or the Annco. In its smallest configuration (cut for the Annco) it makes an ideal unit to mount to the fuselage side or glue to the servo tray.

The same high quality edge connector has been maintained and the new board is compatible with Micro-Tie systems already in use. Price remains $7.95. The manufacturer has reported excellent reception of the Micro-Tie and we can attest to seeing many multi jobs with really sharp looking radio compartments which used it. Justin, Inc., 418 Agostino Rd., San Gabriel, Calif.

● Reynolds Engineering has developed a feedback servo measuring 1 x 1¾ x 2⅛ in. Weight is two ounces. Uses the Micro-Mo 60/1 gear ratio and beveled gear with a total ratio output of 240 to one. Five

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transistors are used in the amplifier. Has nylon bushings on the shaft, and a nylon disc for the hook-up arm. The aileron servo has a double-end disc so that hook up to linkage can be made from each side for strip ailerons. Output power is 4 lbs. Uses 2.4 or 3 volts on each side, and a 2.4 or 3 volt Refance voltage. (Can be used with or without the Refance voltage.)

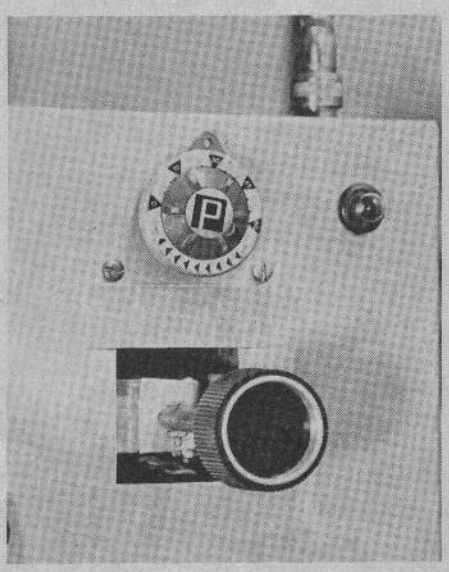
The elevator and rudder servos are announced at $29.95, and the aileron servo, double ended, is $32.95. They were designed by Bob Yates, who is associated with Reynolds Engineering, at 2712 Greenway Ave., Winston-Salem, N.C.

Further information about this, as well as their new proportional 4-channel all-transistorized receiver and transmitter, may be had by writing directly to the manufacturer. The transmitter and receiver sell direct to consumer at $395.00, complete with 4 servos as illustrated. The 3 servos may also be had mounted in one case, as shown in the photograph.

● In conjunction with their 33rd anniversary AHC (America's Hobby Center, 146 W. 22nd St., New York, N.Y. 10011) offers free their special 64-page Bargain Catalog which includes over 10,000 models and items—with it you get free gift coupons (with any order a gift is obtainable by attaching one of the coupons). Free copy of Bargain Bulletin #AB264 may be obtained by sending an unused five-cent stamp for postage and handling to AHC. The address included Dept. GL-AB—a common device to clue an advertiser on a magazine's effectiveness. May we suggest you say you saw it in GRID LEAKS—and do the same when answering any ad. Advertisers make possible more and better material.

● Top-Flite Models, Inc. (2635 S. Wabash, Chicago, Ill.) announces additional accessories available at your hobby shop, including: E37—2″ nylon bellcrank, 25¢; E38—3″ nylon bellcrank, 30¢; E39—4″ elevator horn, 30¢; E40—Tauri landing gear, $1.50; E42—pair of Taurus engine mounts, 50¢; E43—8″ fuelproof canopy, $1.00; E44—elevator horn with bearings (15-degree differential), 85¢; E45—pair formed leading edges, 33″ long, $1.50; E46—pair stripped ailerons, 75¢.

● Looking for Dzus fasteners? Aircraft Plan Co. (P.O. Box 45, Babylon, N.Y.)



Engine run warning timer Bob Ferris' Dee Bee x-mitter (one prototype) came from Lafayette. Real purpose was parking meter warning — buzzes in pocket.

has two sizes, either size 75¢ the pair. The short version AJ4-55 is used in the Whistler R/C, long version in Stark Shark.

● Boat fans attention! Lumba-Lumba is the name of ship operated by Caltex Pacific Oil Co. to speed passengers and freight from Sumatra to Singapore, a graceful looking craft which resembles a cross between a small motorship and a big cabin cruiser. Sterling Models' (Belfield & Wister, Philadelphia 44, Pa.) 40-in. kit for gas or electric power makes a most distinctive R/C craft. A 38-piece metal fitting set sells for $3.95, the boat kit, less fittings, $16.95.

● Ted Strader's Scorpion, a functional looking design for any control from rudder only to multi, is a trike-geared shoulder wing for a .15. Span is 56 inches. GL previewed this one at the Bison's Conference—a nice job. (Special Edition Plans, Box 48, Massena, N.Y.—$12.95.)

● Kraft Custom Battery Packs. Conveniently shaped in a sealed nylon case with a prewired plug (2⅝ x 15/16) these extra capacity 600-mah nickel-cadmium cells weigh 5½ ounces. For 6V reed operation, $24.95; with charger $29.95. Proportional packs will be available to manufacturers' specifications.

Kraft Custom dual-simultaneous, six-channel transmitter with superhet receiver, $119.95. Pre-cabled servo leads require only point-to-point wiring; 9V all-silicon transistor x-mitter. Tone stability from 0 to 140 degrees. Full ½ watt input.

● Aero 35 engine price reduced. This novel horizontal piston engine formerly $34.95 for standard and $40.90 for R/C, now priced at $28.95 and $34.95 respectively.

R/C Jay

(*Continued from page 15*)

sides, center ply grain diagonal. But ⅛ sheet with a 1/16 doubler diagonal, as shown, is acceptable. If this suggests the ship is light, it is—5½ to 6 pounds gross. The use of ½ in. thick top and nose blocking—with ¼ sq. corner strips for rounding—makes for quick assembly and some shaping for appearance. The Top Flite motor mounts incorporate right-thrust as they come from the manufacturer. An 8-oz. clunk tank supplies the Veco 45—or your favorite engine—and should have the feed ½ inch below the needle. Hatch access to tank and battery pack is standard.

Tail surfaces are generally similar to Top Flite kit construction. Control surface areas and movements are correct. The over-and-under spars and sheeting of the wing are standard and require no description.

The steerable wire tail skid works very well on grass and seems to be acceptable on concrete, though a rubber tired wheel—the tread ground flat and with drag imposed—has been used for concrete. The two-wheel gear (Top Flite) does not seem to involve typical nose-over trouble on grass, even for beginners, probably due to the fact that there is not much of a couple between the thrust line and the wheel center, or between the thrust line and the center of aerodynamic drag of the machine—and the wheels are forward!

DuBro Kwick-Links are used for control linkages throughout, even on the aileron bellcranks. There has been evidence of pin wear in the Kwik-Link at the aileron horn, resulting in an excess softness in the setup—easily cured by installing another Kwik-Link. The wear is thought due

AMA

R/C PROGRESS AT 1964 NATS

Radio control was born as a Nationals event the same year the Academy of Model Aeronautics was organized—1936. The Academy and R/C have progressed tremendously since then. The 1964 Nationals to be held July 20-26 at NAS Dallas will be another measure of this progress.

No contestants entered the 1936 R/C event, and in 1937 most of the equipment was plagued by bugs. Chet Lanzo was proclaimed the 1937 winner, although there was only a minimum demonstrated control of his aircraft, it met the only requirement of the event.

In contrast, at the 32nd Nationals held last year at Los Alamitos, Calif., 194 contestants flew in the five R/C events, accumulating 753 flights. Equipment failure was as rare as was controlled flight in 1936. The aircraft flown, and the skill with which they were flown, advanced the state of the art another degree toward the ultimate.

Technological progress is welcomed by the model builder and by the AMA, but it presents problems to both. R/Cers find it difficult to keep current with the latest equipment. The AMA must keep its Nationals procedures ahead of the ever improving and rapidly growing event. Larger numbers of contestants must be handled, and each given adequate opportunity to compete.

At Dallas, all Citizens Band flying will be done on the superhet frequencies, and four flight lines will operate simultaneously. This is expected to double the number of flights possible, two flight lines being the general rule in the past.

All superhet equipment will be checked for frequency accuracy and, if necessary, frequency changes will be made (aided by special facilities on the scene) to equalize flight line distribution of entrants. In response to an appeal by AMA for cooperation, R/C manufacturers are providing service booths for their equipment to expedite any need frequency for adjustments.

In attempting this new procedure, AMA Nationals officials fully realize the potential criticism that might accrue from every crash which remotely could be blamed on interference. They feel this approach should be tried, however, as the preferred method of increasing flights. Another approach would be to limit entries through a qualification system, but it is not desired to restrict entries except as a last resort. Yet a combination of both methods may be desirable for the Naticnals coming up in Philadelphia and Chicago, which usually have a larger attendance.

In any case, AMA expects the 1964 Nats in Dallas to feature the world's greatest R/C sporting event this year, and Academy officials have been planning steadily and progressively to match the contest to the conditions.

to constant quivering, though slight, of the proportional gear. Hardly a problem, this may, or may not, deserve mentioning.

Having an experienced pulse man's way wtih Mighty Midgets, Bob has saved money in the construction of three servos, the principal innovation being the separation of the motor casing from the base, to permit a 90-degree displacement to lie flat, the parts epoxied together in the new position. The type of plugs and sockets (Amphenol) in the pictures (thick, round pins) have proved free of trouble on several of these ships which came to GL's attention.

Bulldog Tank

(*Continued from page* 13)

being able to fire the cannon."

The Bulldog tank comes with solid axles and only one drive motor. It was necessary to cut the axles so that the treads could be driven independently. (The axles were held in line by slipping a length of brass tubing over the severed axle halves.) Naturally, a second motor and gear train was necessary. The boys solved this problem by purchasing a second tank—four tanks in all! This may not have been the most economical approach possible, but it gave them additional ammunition for the cannon and a second rear deck for each tank to cover the power switches and the mounting hardware of the two drive motors. (The shells and cartridge cases are wood and metal respectively and fit into clip.)

If you will study the bottom view photo, the drive motors are seen at the rear. Just forward of them, mounted on the under side of the original battery compartment, are the connections to the four motor control relays and the wire-wound pot. Kern states that he used industrial-type relays available to him, while Phil employed normal modeling relays. The relay specs are not critical provided the relays can handle the electrical load at the voltage indicated.

The same applies to the wire-wound pot (4-watts) which is used to adjust the speed of the faster motor for straight ahead running when no turning signals are given. (It is hand adjusted.) The pot is in series with the motor.

Forward are two compartments which are separated by the plastic hammer and spring arrangement for the cannon. The receiver (six or more channel reeds needed) goes in the compartment on the port side (as seen with the tank in running position) and four surplus nickel-cad batteries fitted into the starboard compartment. Ahead of these, and mounted on the under side of the front apron are the battery holders for dry batteries to power the receiver. The installation on the underside of the tank is completed with the addition of the two headlights (self-focusing 3-volt lamps in series) just ahead of the receiver batteries, two slide switches mounted on the rear deck near the drive motors and a pin jack for the antenna, also located on the rear deck. All of the wheels on which the treads ride are held in place in their respective slots by the metal bottom cover which screws to the under side of the tank (not shown).

The cannon firing mechanism in the turret uses the original hammer and spring but is cocked electrically by an electric motor and gear train. The motor and all of the gears except the large metal one come from a Bonner Duramite servo. The motor runs until the microswitch senses that the hammer has been fully cocked. To fire the cannon, the receiver relay momentarily shorts the open contacts of the microswitch which starts the motor. The hammer is released, firing the cannon, and the motor continues to run until the hammer is again cocked and the gun ready to fire again. When storing the tank for long periods of time, the cannon is fired and the battery power turned off before the cannon re-cocks itself. This leaves less tension on the cannon firing mechanism.

As can be seen from the diagram, the four nickel-cad batteries power all of the relays, the two drive motors and the cannon firing mechanism. (Also the headlights.) The contacts of all of the motor control relays are normally in the up position (K_1, K_2, K_3 and K_4). When energized, they move to the down position. K_1 and K_2 are locking relays that start the tank forward or backward. As shown in the diagram, down elevator would cause K_1 to close and remain locked closed. This starts both drive motors forward and turns on the headlights. If either left or right rudder were actuated, K_3 or K_4 close momentarily, causing one tread drive motor to reverse. The resulting turn is made in the length of the tank due to the tread reversal feature. If the low engine control is called for, the locking circuitary for K_1 and K_2 is released, causing the drive motors to stop and the headlights to go out. If high engine is called for momentarily, the microswitch in the gun turret is shorted and the gun fires and re-cocks itself.

The receiver power wiring is not shown since it will vary with the type of receiver used. The two switches mounted on rear deck of the tank are used to turn off the receiver power and to disconnect the nickel-cad batteries.

Grid Leaks at Play

(*Continued from page* 1)

have as many, or more, technical articles than in the old smaller format. We invite you to look this issue over closely, and since we believe you will find a greater technical coverage than ever before.

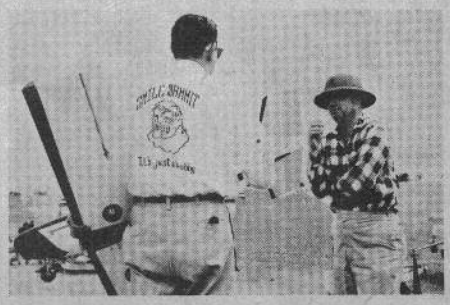
Plans will be presented on an occasional basis whenever there is a clearcut need for a certain type of plane—or boat.

We are very grateful to the many of you who have taken time to have sent us your comments. One comment even went so far as to say that we looked "too pretty" for him to submit any ideas or articles. This is to advise that we will accept pencil scratchings, provided they are legible, and we will do the art. What we are interested in primarily is your ideas which you would like to share with your fellow radio-control modelers.

● The last few issues of GRID LEAKS have been frustratingly late. This has been due to a series of circumstances which cannot be pinpointed in any one cause. However, when your printer moves a physical plant as large as American Press is, there are bound to be unforeseen delays.

We want to assure you that we are making every effort to correct this situation, and hope you will bear with us.

PAUL F. RUNGE, PUBLISHER



Perspective

(*Continued from page* 11)

we believe there is absolutely no margin for error. Only our most experienced production workers will be allowed to work on a system, and they will be instructed to take all the time necessary for perfection. There is a close correlation between the number of components in the system and the probability of failure. The only way the failure probability can be reduced is by intensive quality control standards. So far we have considered only production costs. As manufacturers, we must at least try to recoup the tens of thousands of dollars invested in the system's development. Certainly it should be obvious that a true proportional system must sell for several times the price of an equivalent reed system.

As manufacturers we have been guilty of overenthusiasm (because we are enthusiasts). For the past year production of our system has always seemed "just 60 days or less away." Then another 500 or so test flights would show up a weak point and back to engineering went the system. Each time it grew more complex as reliability needs indicated changes. Finally, the system seems to be completed, but our original cost estimates prove much too low. Perhaps we have aimed too high in our standards. We think not for very practical selfish reasons. If we cannot produce a trouble-free unit which the average user can expect to fly for long periods without maintenance, then we are better off to forget it. Manufacturers do not make a profit or good will by repairs on defective systems. The proportional system can be excellent in respect to response, tracking, tight neutral, complete neutrals, complete freedom from drift, reliability, long service life, etc., if the enthusiast is willing to pay.

Why should proportional systems have to be so complex and difficult to produce? As stated before, if proportional systems don't work just about perfectly, one can do a better job of flying with reeds, so why bother. A look at the variety of systems currently under development and some of the problems involved should give an idea of the reason behind the proportional system's complexity.

First, and most difficult, is the RF link between the transmitter and receiver. This link must be analogous to a mechanical connection, yet our aircraft is rapidly moving through widely varying RF field strengths, is subject to out of phase (reflected signals) and interference on our crowded frequencies. Momentary loss of contact results in what we have come to call "glitches" or a short duration hop or twitch of the aircraft. A longer loss of the RF link results in the mating call of the proportional flyer (mating of the aircraft with earth, usually permanent) of "I ain't got it."

Our reed systems do not depend on such a tight RF link. Momentary loss of contact or RF phase reversals are completely unnoticed. Also, reeds are resistant to all but the most severe interference. Consequently, the proportional system requires a more sophisticated and more expensive receiver than do reeds.

It is not the purpose of this article to go into detail regarding the various proportional systems. However, there are three distinct approaches under development or production. One uses variable tones transmitted in alternate sequence for the four channels of information. A second method is best described as CW transmission of either pulse-width variable carrier or spiked off carrier, both of which utilize digital logic techniques for decoding. The third system uses pulse width modulation of a subcarrier or subcarriers in combination with pulse rate changes or, as used in the latest Pullen system, digital logic decoding techniques.

System No. 1 is probably the oldest, and in our opinion, the least practical system. It is difficult to manufacture, tends towards interaction of control, and hard to stabilize. The error output to the servos is limited, and consequently, servo tracking and response is usually poor. The second systems are all variations of the original Digicon. They can feature excellent response, tracking and stability. However, we believe they are subject to interference and are uniquely subject to RF phase problems. The No. 3 systems can have the same features as No. 2 combined with the interference protection provided by the subcarrier. The subcarrier system also eliminates RF phase-shift problems. The major disadvantage to the subcarrier system is the somewhat noisier servo movement caused by the chopped subcarrier. This, however, is

not noticeable at the control, and we believe that the subcarrier is necessary for reliability.

The variety of methods for proportional control under development indicates the embryonic stage of design. They are all complicated and the systems which show promise are much more complicated than the others. Perhaps there may soon be a radical break-through with a simple reliable control system which all of us can afford. It is also possible that we may be entirely too old to enjoy the hobby when this occurs.

In the meantime, I believe those coming into the hobby or now in it and ready to advance to multi-channel control would be well advised to move with caution. It is much more fun to fly reliably with reeds than to suffer with an exotic but unreliable control system. For those where money is no object, we at Kraft Radio Control will offer a custom proportional control system. The price will be $800.00 to $900.00. Is it worth the price for merely enjoying the hobby, which should be our main concern? It most certainly is not. However, if you must have proportional control, we believe it is worth every cent.

(Publisher's comment: Every once in awhile a manufacturer will let his hair down and speak straight from the shoulder. This, in our opinion, is what Phil Kraft has done in this article. His reasoning, we feel, is logical and to the point.

Phil's interpretation of "true proportional control" may not agree with other manufacturers' opinions, or our own. We do believe that the validity of Phil's statement of policy merit the use of the columns of GRID LEAKS, *and we are presenting his article with no cuts.*

Comments are invited from individuals, manufacturers, and other interested parties, on this "perspective" on proportional.)

Gemini Switcher

(*Continued from page* 10)

capacitors, as they must be reinstalled whenever the Transmite is used with a reed system.

3. Locate where the red and brown wires are soldered to the printed circuit switching plate in the lid of the Transmite. Solder one end of an ⅛-in. length of blue insulated hookup wire to the same pad as the red wire on the P/C switching board. Solder one end of an 8-in. length of brown insulated hookup wire to the same pad as the brown wire on the P/C switching board. Lead both new wires out of the servo through the grommet along with the rest of the cable.

4. Inspect the rudder Transmite amplifier board and determine if two or three 100-ohm (brown, black, brown) resistors are used in the area shown in figure D. Transmite amplifiers built since mid 1962 have three 100-ohm resistors and this amplifier requires no further modification. If only two resistors were used the third resistor must be added. Unsolder the original blue wire (not the one just added) from the P/C switching board. Now solder one end of a 100-ohm resistor to the pad where the blue wire was removed. Solder the blue wire to the other end of the 100-ohm resistor as shown in Fig. E. Goo or epoxy the resistor to the P/C switching board. The resistor just added is the resistor shown in series with the base lead of transistor Q6 on the schematic diagram. The 100-ohm resistor need not be removed if the servo is used in a multi system. Reassemble the Transmite for use with the Gemini.

Gemini Schematic and Circuit Operation: For the purpose of simplifying the schematic, Fig. F, several connections were not shown. They can be clearly seen by mentally noting that RR1 ties to RR2, LR1 ties to LR2, and RN1 ties to RN2. RR2 is the yellow signal wire and LR2 is the orange signal wire from the rudder servo. ENG1 and ENG2 tie to the yellow and orange signal wires from the engine servo.

The positive end of a six cell series connected battery pack is designated 0 volts. Connections to O, -2.4, -4.8, and -7.2 volts are shown—1.2 volts per cell.

Transistors in digital circuitry may be thought of as switches. "On" transistors will allow current to flow from the emitter to collector whenever the base-emitter junction is forward biased. For PNP transistors this means the base must be more negative than the emitter, for NPN transistors the base must be more positive than the emitter. "Off" transistors will not allow current flow because their base-emitter junctions are for forward biased. This could mean either that the base and emitter are at the same voltage or that the base emitter junction is reverse biased.

The Gemini circuitry consists of:

1. The rudder servo amplifier Q1-Q6. The circuitry shown is basically that of the Bonner neutralizing Transmite amplifier and is included in the schematic to show its function to the Gemini operation. The engine servo amplifier is identical so it is not repeated on the schematic in the interest of simplicity.

In neutral, signal wires RR2 and LR2 are nonconducting. Q1 and Q4 are biased off by their base resistors which are tied to -7.2 volts. Q2 also sees -7.2 volts on its base and is biased off, which allows Q3 to remain on since its base is tied through a resistor to -4.8 volts and the emitter voltage of Q3 is about -6 volts. If the diamond-shaped neutralizing wiper on Q3 collector contacts either printed-circuit switching pad (located in the lid of the Transmite servo) either Q5 or Q6 will be turned on and the servo motor B1 will drive the P/C pad wipers in the proper direction until the neutralizing wiper runs off the P/C at neutral and opens the base Q5 or

SPECIFICATION FOR THE GEMINI SWITCHER

Ambient Operating Temperature Range: 0 to 130 degrees F.
Weight: Rudder-Motor Version (RM-1) ..... 3 oz.
RM-1 System (Switcher, rudder and engine servos, 3-volt receiver and Nicad batteries) ..... 16 oz.
Size: RM-1 1-13/16 X 2-11/16 X 1
Construction: Glass-cloth epoxy-resin-laminated printed-circuit board. Separate color-coded cables contain complete wiring to batteries, a 3-volt receiver, the rudder and the engine servo. Industrial quality American-made components are used throughout.
Battery Requirements: Six 450- or 500-mah minimum capacity nickel cadmium batteries connected in series and tapped at 0, —2.4, —4.8 and —7.2 volts.
Voltage Range: 7 to 9 volts measured across the six cells.
Current Drain: Approximately 25 ma Idle RM-1
35 ma Signal RM-1

Q6 circuit. The neutralizing wiper and the limit switch wipers from the bases of Q5 and Q6 run in the same direction at the same time and is shown by the dotted line which indicates the wipers are mechanically tied together.

Having shown that with no signal input to RR2 or LR2 that the servo will self neutralize, let's take a look at what happens when a signal is applied. Suppose that RR2 is tied to -2.4 volts. Two things happen. One, Q2 is turned on, which turns Q3 off. No current can now flow through the neutralizing wiper to either Q5 or Q6 even if the neutralizing wiper is on a P/C pad. Two, Q1 is turned on and supplies current through the limit switch wiper to the base of Q5. Motor B1 drives and moves down the P/C pads until the Q5 base limit switch wiper runs off the end of the Q1 collector P/C pad. Base current to Q5 is broken and the motor stops with the rudder at full right.

During the same time the neutralizing wiper has moved onto the Q4 collector P/C pad and the Q6 base limit switch wiper has moved farther down the same pad. The servo will stay in full right until the signal wire RR2 is opened. When RR2 is opened, the initial conditions for neutralizing are set up and Q3 supplies base current to Q6 to drive the servo back to neutral from right. If, instead, LR2 had been tied to -2.4 volts, Q3 would be turned off as before and Q4 would supply base current to Q6 and the servo would drive to left rudder and remain there as long as the signal is held. Neutralizing is the same as for right rudder except Q5 will conduct the motor current. If the signal is released before the rudder servo gets to full right or left, the neutralizing circuitry simply takes over and drives the servo back to neutral. The circuit operation just described applies specifically to the Gemini operation. As a matter of interest, the servo amplifiers operate identically in a resonant reed relayless bang-bang multi hookup except the yellow and orange signal wires are tied to 0 volts through the vibrating reed, and filter capacitors are tied between RR2 and LR2 and 0 volts to filter the DC pulses coming from the vibrating reeds.

2. The Schmidt trigger Q7 and Q8. The Schmidt trigger is a voltage level detector. It determines whether the rudder servo will run toward right or left when the receiver relay is pulled in. If the input voltage at the junction of the 4.7K and 10K resistor is more positive than minus one volt, Q7 is off and Q8 is on. When the input voltage is more negative than minus one volt, Q7 is on and Q8 is off. The collector voltage of the on transistor will be approximately -.5 volts and of the off transistor will be approximately -4.8 volts.

3. The rudder servo "AND" Gates Q9 and Q10. "AND" Gates have two inputs which must be of the correct polarity for the transistor to conduct. The emitters of Q9 and Q10 are tied together and are at -7.2 volts when the receiver relay is open, one input comes from the receiver relay. The receiver relay ties across the 15-UFD filter capacitor and supplies -2.4 volts to the Q9 and Q10 emitters when the relay is closed. (Transmitter key is depressed.) The filter capacitor filters out relay contact bounce which may be as many as a dozen bounces lasting for 2 or 3 milliseconds. All relays and switches exhibit this bouncing when they are closed. Pulsed relay proportional fans take note.

The second input is supplied by the Schmidt trigger. If the rudder servo is resting at neutral when the receiver relay is closed, the input to the Schmidt trigger is 0 volts, since Q4 is turned off by the -7.2 volt bias as described earlier and the Q4 collector pad is tied to 0 volts through the Q6 base limit switch wiper and Q6 base resistors. Schmidt trigger Q7's collector is at approximately -4.8 volt. "AND" Gate Q9 base is tied to Q7 collector through the 2.2K resistor and, since Q9 emitter is now tied to -2.4 volts through the closed receiver relay, Q9 will now conduct to signal wire RR2 and the rudder servo will be driven toward right. Q8 collector is at approximately -.5 volts and "AND" Gate Q10 cannot conduct because Q10 base is tied to Q8 collector through the 2.2K resistor and Q10 base (-.5 volts) is more positive than its emitter (-2.4 volts). The rudder servo will remain right as long as the receiver relay is pulled in. When the receiver relay is released, Q9 can no longer conduct and the Transmite neutralizing circuitry turns on Q6 to drive the servo left toward neutral. The neutralizing current flowing through the resistor between Q6 limit switch wiper and Q6 base causes a voltage drop across the resistor. The voltage on the Q4 collector printed circuit pad becomes more negative than -1 volt (usually -4 to -7.2 volts) and Schmidt trigger Q7, Q8 switches and applies -.5 volts to Q9 base resistor and -4.8 volts to the Q10 base resistor. If the receiver relay is left open, neither Q9 nor Q10 can conduct and the neutralizing circuitry continues to drive the rudder servo back to neutral.

If, however, the receiver relay is once again closed while the neutralizing circuitry is driving the rudder servo back to neutral from right, Q9 and Q10 will now have -2.4 volts applied to their emitters. Only Q10 can conduct and this ties LR2 to -2.4 volts which turns on Q4, which in turn supplies current to Q6 to drive the rudder servo left. Neutralizing circuitry Q3 was turned off as Q4 came on. Since Q4 is now conducting, the Schmidt trigger input continues to stay more negative than -1 volt. When the Q6 limit switch wiper runs off the Q4 collector P/C pad, the 10K resistor from 0 volts to the Q4 collector acts as the Q4 collector load and the input to the Schmidt trigger is maintained at more negative than -1 volt as long as the receiver relay is held in at left rudder. Now, when the receiver relay is released, Q10 ceases to conduct and the Transmite neutralizing circuitry turns on Q5 and drives the rudder servo right toward neutral. As the relay

was released, Q4 collector voltage became 0 volts and the Schmidt trigger resets to drive the rudder toward right the next time the receiver relay is pulled in.

4. Engine storage trigger Q11. Q11 puts out a positive going pulse each time the receiver relay is closed while the rudder servo is running from left to neutral. Only during this phase of operation is RN1 more negative than RR1 which is the condition needed for making Q11 conduct. These pulses are used to trigger the engine speed storage circuitry.

5. Engine speed storage circuitry, bistable multivibrators Q12, Q13, Q14, and Q15. The two bistable multivibrators are similar in operation to the Schmidt trigger in that one transistor is on while the other is off. The difference is that the Schmidt trigger output depends on the voltage level at the input while the bistable multivibrator changes state each time a pulse is received. In others words, say that Q12 is on and Q13 is off. They will remain that way indefinitely until their input circuitry receives a positive going pulse from Q11. Then Q12 will be off and Q13 will be on. The two will reverse outputs each time a pulse is received. The bistable multivibrator is the basic counting circuit in all digital computors. The bistable multivibrator composed of Q14 and Q15 is triggered by a positive going signal from the collector of Q13. The important thing to see here is that while multivibrator Q12, Q13 changes state once for each pulse that comes from Q11, multivibrator Q14, Q15 changes once for *every other* pulse from Q11 since it is triggered only when Q13 collector goes positive, which is every other time multivibrator Q12, Q13 changes. A positive going pulse is one which goes from a given voltage level to a more positive voltage level.

6. "AND" Gates Q16 and Q17. Q16 and Q17 complete the logic circuitry which supplies -2.4 volt signals to the engine servo signal wires, ENG1 and ENG2. A look at the voltage at the bases and emitters of Q16 and Q17 will quickly show their operation. There are four voltage combinations available from the two multivibrators. These four combinations correspond to the engine speed sequence high, medium, low, medium.

For the multivibrators assume the collector voltage of the on transistor is -2.4 volts and of the off transistor is -7.2 volts. These voltages are applied to the Q16 and Q17 "AND" Gates and are as follows in Fig. G.

Q16		Q17		Result
BASE	EMITTER	BASE	EMITTER	
-7.2	-7.2	-7.2	-2.4	High ENG.
-2.4	-7.2	-2.4	-2.4	Med ENG.
-7.2	-2.4	-7.2	-7.2	Low ENG.
-2.4	-2.4	-2.4	-7.2	Med ENG.

In high engine only Q17 is on because its base is more negative than its emitter while Q16 has its base and emitter both at -7.2 volts and thus is turned off. In medium engine neither Q16 or Q17 can conduct since their base emitter junctions are not forward biased. In low engine Q16 is on and Q17 is off.

As each pulse is put through Q11 the engine speeds will be repeated in sequence. When either Q16 or Q17 is on the engine servo will run to one extreme or the other. When both Q16 and Q17 are off the neutralizing circuitry in the Transmite returns the engine to medium speed.

The engine storage multivibrators, then, will count and store the number of engine speed change pulses received and will change the engine speed accordingly and hold it there until the next engine speed change pulses are received.

The Monitor

(*Continued from page 2*)

down finally he made some "100 vertical banks." After it hit the ground he realized in his excitement that he had not let up on the button. While the Cub stood up, the tube receiver, not very well tied down, was smashed and the escapement was a "pretzel."

Reminding us of a remark we'd made in *Flying Models* that "there is no need to teach model building to any reader capable of tackling R/C, etc.," Tony commented, ". . . but it seems all the writers find no need for explaining anything in detail. One is supposed to know all these thing somehow, or one has no business fooling with radio. How does one learn when there is no person around to explain the workings of this highly intricate thing?

"I saw an ad for a new type of pulse set-up. I wrote the manufacturer to please send me some details. Apparently, they just make them. They don't explain them. So I will not buy same. I bought a lot of things that I probably will never use, just to learn the how's and why's.

"There's a young lad here who would like to get into R/C, but the price tags of some of the equipment loom very large since his income is so small. I think this is the biggest problem that is keeping the younger set out of this wonderful sport, even more than a lack of a helping hand from oldtimers."

We since had several long, long letters from Tony. He went through a disastrous big powered glider and, after it settled off a cliff with a tiny engine howling like mad, and cracking it up several times, asks why the manufacturer didn't say it was for experts. He started off with a McCoy 19 on a Freedom 15—a perfectly good model by the way—cut down to a Fox 15 and

The biggest smile in this pic belongs to Harry Sampey, caught talking shop at Toledo Conference by GL photog.

finally a Fox 10 turning a 9 x 4 before he could fly it, and this sort of thing is almost standard procedure with a beginner anyway. He seems to have hit the jackpot with a Skylark with a Fox 15 and a 9 x 4 prop. (Perhaps he has only finally mastered control technique.)

"Now I am interested in a battery complement that is lighter and also rechargeable. But I can't decipher the ads and this is maddening. For example," Tony points out, "a nicad 500 mah, or a 250 mah—what is it? How many volts does it put out? What do I need for running an escapement and a 3-volt receiver? I like to have a separate battery for the receiver and the escapement (you learn by osmosis!). Why can't the manufacturers explain these things? They would sell more if the average guy was able to understand the mumbo-jumbo. Don't they realized that beginners could use nicads? Most beginners use dry cells because they don't know what else to buy. (Tony uses nicad in a general sense—it is a Gould-National tradename.)

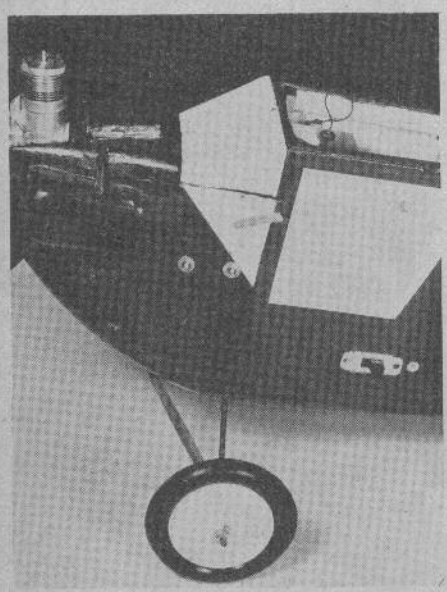
"Someday, I might like to go to proportional with the single-channel gear I now have. But first I have got to know more about what's a good unit, and what isn't. And, more to the point, how does it work? A guy does not have to be an electronics expert to fly R/C but from all that I get out of the ads, it would sure help like. . . ."

Back in the days when everything was single-channel and there was only one make of escapement and everybody used standard dry batteries, it was comparably easy to write useful instructional articles. Today there are so many variations to radio that the story cannot be told properly even in a book. Nor is it very easy, or perhaps even feasible, to prepare a completely honest article about even such a simple thing as single channel.

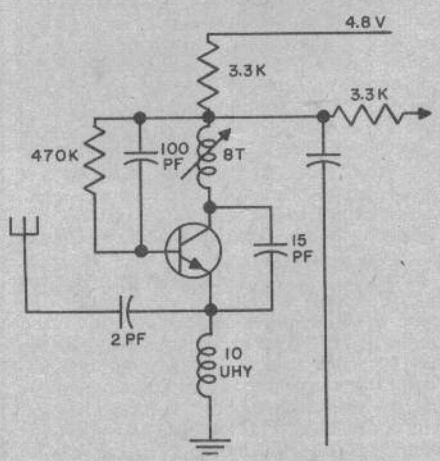
Two summers ago when we designed the Miss America kit, we ran the gauntlet of almost every make of relayless receiver, receiver and escapement combination, dry batteries, alkaline batteries, and nickel cads. No beginner looked worse! Do you tell a beginner he must use nickel-cads when the voltage—and it is more when freshly charged—may exceed the safe voltage of a receiver, or that a receiver may not even oscillate (what's that?) at such a voltage. That on a hot day a transistor may leak, due to this voltage, to hold the escapement in, or to lock it in when in the air (interference, you say!). What about dry cells with false bottoms? Ditto on energizers. What about escapement spring tension—sometimes set so low that

even an .049 will cycle the thing until the rubber runs down. The details are legion. Do they really need to be?

What will help? Well, for one thing, we "experts" seem to have forgotten that simple models are just as much fun as the multi missiles, that flying them properly is a special art, that reliability, in any system and for any modeler, is of paramount importance, that we can't take simple things for granted, that people need help, that we all need to explain better and go easy on this insider's jargon stuff . . . ad infinitum.



Williams Bros. wheels lend old-time air to period crates. Great for WW-1. Here, ye ed dolled up an Airknocker.



This schematic shows changes to the Phelps' receiver for 50-54 mc usage.

We suppose the Bulldog tank, to say nothing of the boat pictures, in this issue, and the Nautilus sub in the last, may not interest *every* airplane man. Having built 90-plus R/C planes and at long last losing count, your editor can take or leave things that are aquatic or run on the ground, but to ignore anything as substantial as R/C boating today seems akin to editorial segregation. We have faith, however, that the constructive info and ideas, especially in operational systems, displayed in the relatively few such items published in GL, will not be lost on the most avid plane enthusiast, who we suspect, has moments when he'd like to forget the repairs or the latest interference rumors.

Extra pages allow us to broaden policy without decreasing the things for which GL always has been noted.

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