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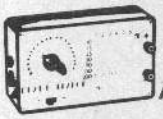

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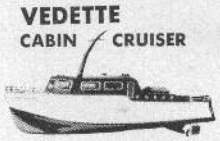

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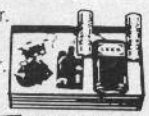

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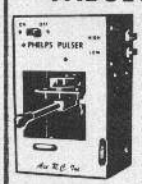
Plus: All units harness wired, factory tested and ready to install without any additional electrical work!

WEIGHT 3½ oz. total including battery (Fully Guaranteed)

FABULOUS PHELPS PULSER KIT



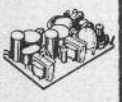
For some time the Phelps Pulser has been used in various forms by modelers throughout the country with outstanding success. John Phelps, Applications Engineer for General Electric, has updated the design and we are proud to bring you this first in a series of Phelps kits, which will be added to the LEE's line from Ace R/C during 1964. Using a unijunction transistor, this pulser may be used for rudder only or for Galloping Ghost. Has both rate control and width control, and rate and width trim. Is temperature stable from 140 down to 10 degrees. Uses new silicon GE devices.

Kit comes with the spring centering Protrol dual stick assembly so that you have a self-centering snappy action on the box.

The deluxe kit contains all components required and is highly prefabbed, and instructions are exceptionally complete.

No. 15A11—Phelps Pulser Kit **28.95**

CONTROLAIRE 5



The Controlaire 5 is a 3 volt relayless all transistorized receiver. The physical specifications on this receiver are: 9/16 x 1⅛ x 1⅜ inches. Weight, ⅜ 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.

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DON BROWN'S QUADRUPLEX!

All for only— **389.95**

Charger **15.95** extra

AVAIL. IN 6 METER OR 27 MC.

The new, all new, **Quadruplex Mark II** is still priced way under the other comparably advertised proportional systems. Set consists of transmitter with nicad batteries, receiver with nicad batteries, 3 surface servos 1 motor control servo.

THE NEW SUPER-HET DEE BEE QUADRUPLEX MODEL #21

ENDORSED FOR QUALITY AND PERFORMANCE BY LEES.

★★★★★★★★★★★★★★★★★★★★★★★★★

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.

SUPER HET 27 MC. CHANNEL

TOTAL SYSTEM CHARGES **479.00**

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CONTENTS

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GRID LEAKS AT PLAY

● This has been one of those months! First, we were favored by a visit from Wittich Holloway, art director of GRID LEAKS. There were many items to be settled and decided, but mostly we want you to know that the people behind GRID LEAKS, Bill Winter, our editor; Witt Holloway; and our own people here at Higginsville, are all very receptive to your ideas. GRID LEAKS always has been the reader's publication. And we are delighted at the reader response that GRID LEAKS is getting.

The last two issues came to you without holes punched. We have received only one written objection to this, and one phone call. This being the case, we have decided to go ahead with the narrower layout, and without the holes, since it is a considerable saving for us.

Also, we have *applied,* for a second-class permit for the mailing of GRID LEAKS, rather than a third-class bulk rate under which it has been going.

This will probably facilitate your receiving your copy, but we'd like to call again to your attention the fact that we need to know from you if you are going to change addresses. The Post Office, whether it is a third-class mailing, or second-class, does not automatically forward copies, nor do they notify the publications involved. Instead, it seems to us, these publications are merely tossed out, and then both publisher and subscriber are losers.

We received a very interesting communication from an old friend in Vidalia, Georgia, who has been flying the B & D system—which incidentally has the transmitter portion featured in the recent issues of *Model Airplane News*—and we got a kick out of one comment.

The correspondent, Ronald Little, makes the statement that I highly recommend the B & D rig to anyone wanting to get their feet wet in feedback proportional, but lack the $500.00 for a bathing suit!" This ties in with an article in the last issue of GRID LEAKS, by Phil Kraft. If you have not read it, we would earnestly suggest that you do so. There are some very meaty thoughts to ponder. (*Continued on page* 23)

THE MONITOR

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

■ The little black square that began this sentence is about 5/64 of an inch in size. A similar square appears in the center of a page ad by Fairchild Semiconductor.

"This small square is the exact size of a new Fairchild custom-integrated microcircuit," the ad stated. "Three hundred of them would barely fill a thimble. Yet each is a complex electrical circuit with as many as 15 transistors and 21 resistors—all inside a single chip of silicon. These tiny devices do the same job as the conventional circuits they replace—except that there are no wires or connections (a major source of circuit failure). They use less power, and they are only 1/20th as big."

There is something unnerving about the notion of carrying a receiver around like the star of a flea circus, but many a truth is uttered in jest. About 10 years ago the first circuit using a transistor appeared in a model mag—to replace the relay-tube in a Lorenz two-tuber. Now receivers are shrinking in size to the point where neither size nor weight need be considered. In theory it is quite possible for them to be still smaller—but what about servos? Will 5½-foot contest multi's go on forever?

● Speaking of squares 7/16 of an inch is the size of a microelectronic computer circuit in IBM's new System/360, the latest in data processing. Operating speeds of the system are expressed in "nanoseconds"—billionths of a second. Circuits are printed on these tiny ceramic tiles called substrates. IBM also talks of thimbles, because 50,000 transistors and diodes would barely overflow a thimble! (The last one did it!)

These minuscule components are produced on an assembly line which combines electronics, physics and graphic arts. Typical operations include: the growing of silicon crystals from which hundreds of thousands of diode and transistor chips are fabricated; positioning of microscopic copper pellets, .005 of an inch in diameter, on the tiny chips; placing a protective film of glass, 60-millionths of an inch thick, on more than a thousand chips at a time; using electrically-conductive inks containing gold and platinum to screen printed circuits onto the tiles.

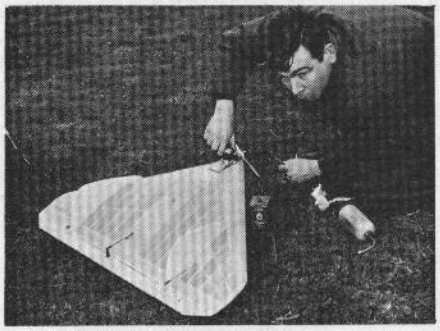
A machine positions transistor and diode chips on the circuit modules; pellets less than 1/64th inch apart on each chip make perfect contact with printed circuits 1/100th inch wide. Some of the diodes can switch, or change their electronic state, in six billionths of a second. Completed modules are coated with plastic, mounted on circuit cards which plug into larger cards, then installed in various elements of the System/360 equipment.

IBM says, "Printed circuits on the larger cards eliminate much conventional wiring." The largest system configuration sells for a mere $5,500,000!

● Over the June 6-7 weekend the (*Continued on page* 2)

CHAMPIONSHIP STYLES IN ENGLISH PYLONS. RCM&E PHOTOS.

Clipped wing pylon special by C. Ralph used the RCS "Galloping Ghost" system.



This is Chris Olsen with one of those you-know-what deltas — Cox .15 power.

Geoff Franklin flies strip ailerons in Oliver Tiger .15 job. Twin nose wheel.

THE MONITOR

LIDS (Long Island Drone Soc.) held their Annual contest. After all that magazine publicity—including a full-page ad on the back cover of *Model Aviation*, donated by Lee's of East Meadow, N.Y. (there are two Lee's) every modeler in the land must have known about this meet. Preplanning took months, and this is a 98-member outfit. Bob Dunham and Ed Kazmirski were flown in to judge, with Leon Shulman, Don Brown and others. Newspaper publicity, and radio plugs. The site was a one-time Air Force Base with concrete runways. There were people delegated for all kinds of jobs, parking for one. A PA system. Concessions. Zippy, the TV chimp, put on his act. County officials gave out prizes. *MAN* and *American Modeler* covered. There were classes for multi (novice and expert), scale, pylon, Class I and II—demonstration flights including a big flying boat with a smoke bomb that dropped a parachute.

The entry list barely broke 40! While the meet apparently fulfilled its primary purpose of demonstrating interest in radio to county officials, it proved to modelers that there are only so many guys who will fly present-day equipment, under present day rules, in a contest. A great many flyers come only to watch!

More people turn out for some fly-for-fun get-togethers. Many modelers are sobered by the idea of matching experienced flyers in performing a formal flight routine with machines which cost many hundreds of dollars or, in Class 1, the one-time beginners event, of flying yet another multi-channel craft, a tricky, overpowered kite.

In almost all competitive events today, radio and otherwise, it is inflexibly believed that only the best should compete, that the Nationals are for champions, etc. This is valid if you are a champ, or can give a champ a run for his money. If you are not, you pass. To each authority GL met, we made a provoking statement that there was no longer a connection between contests and the mass of modelers. Not ready to believe this ourselves, GL was shaken by the quick, flat replies that this was absolutely so.

There probably is no turning back. If any set of rules from yesterday again applied, the turnout could be worse. Since this would confirm the correctness of present rules, it must be concluded that the times, and contests, are changing—

Frank Van Den Bergh's racer used all-sheet wing, one-piece frame! Cox .15.

quite beyond the ability of any of us to say how and why.

R/C contests begin to resemble golf tournaments, with the "touring pros" competing and the rest of us watching—if we do that.

● A letter now from reader Ray Hottinger; and from *Clanking Armor* (Lincoln, Neb., Sky Knights) a reprint of an article by their former editor, John Davidson, appear below. We sympathize with John, but feel he's unfair with AMA (by AMA he really means all contest flyers who have a say in the rules). He certainly should not give up RC which is fun for many thousands, with or without contests. But if we have drop-outs those who protest need to be heard.

"I've been model building since 1938," begins Ray Hottinger, "and have been in RC since '59. I didn't have the opportunity to enter an RC contest until last year when I moved here. I drove to Denver and when I saw what I was up against, I did not take the ship out of the car.

"I live in Colorado Springs, and belong to the only model club. I could be the only single-channel man. I do not fly multi because I haven't got the money; I also feel that the hobby should be a minor part of, not the only thing, in the budget.

"Because of the rush to multi around here about a year ago, several men quit flying and the rest with single equipment became lepers of the colony. Needless to say, I am the last single-channel flyer. Incidentally, I'm one of the youngest in the club, and I'm 31 years old.

"The last few single boys I have talked to have no intention of entering the contests or AMA, because they haven't got a chance to even place," claims Ray. "They refrain from writing because they are of the opinion 'What's the use, the guys on the east coast and west coast set the rules and what can we do about it.' You know, I feel the same way.

"I don't think a contest should be judged on the price of the equipment, and I haven't seen a group of judges yet that didn't show that oh-well-let-him-fly attitude when a man came out with an escapement. I have a proposal for rules, but it may not be worth anything.

I. Single-channel escapement: this would allow the man to do anything he wants to as long as he first drives an escapement with the receiver off one single tone. (Probably a million loop holes in that statement for some guys.)

II. Multi-Intermediate, six channels, anything goes. This includes the $200 plus $300 single prop. boys. (Rudder or CAR, elevator, motor, wheel brakes, tobacco chewing, pilot, etc.)

III. Multi, present-day rules."

The idea that "they" make the rules, we have no voice, is a fallacy. The AMA is divided into 11 geographical districts. Each has a Contest Board RC representative who votes on rules proposals in accordance with what his constituents tell him. If you are an AMA member you know your representative.

If you belong to AMA and say nothing, you have no beef. If you are interested in competition and don't belong, you can't expect to have influence. If the Hottingers and the Davidsons drop out, what is left inevitably must constitute a more one-minded group. If you want to influence rules proposals—and you can—the first step is to keep, or obtain, your AMA membership.

● "In the early twenties I was introduced to model planes by a classmate," wrote John Davidson. "Ah, the days of kiln-dried spruce and tissue paper and silk binding of fish-glued joints, not to mention the prop that had to be hand-carved, usually for each flight, and the horrible job of trying to find rubber . . . frequently from dissected golf balls. A flight of one minute was a record- (*Continued on page* 30)

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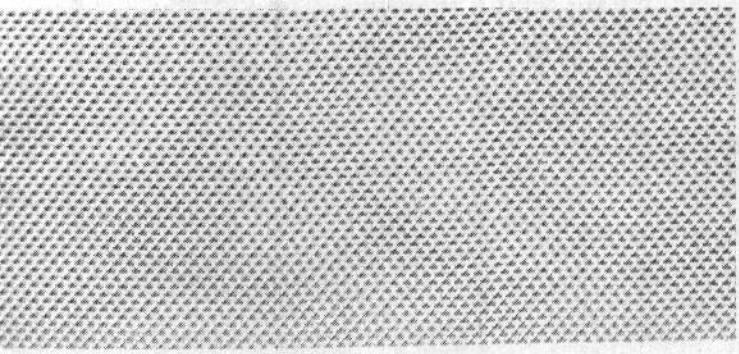
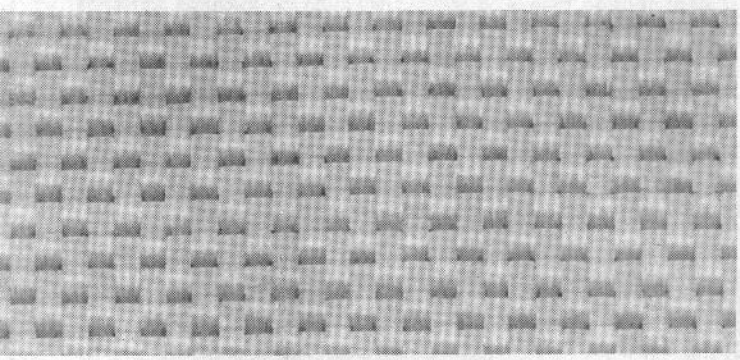
Modern



Woven fabric, the material most widely used in modeling.

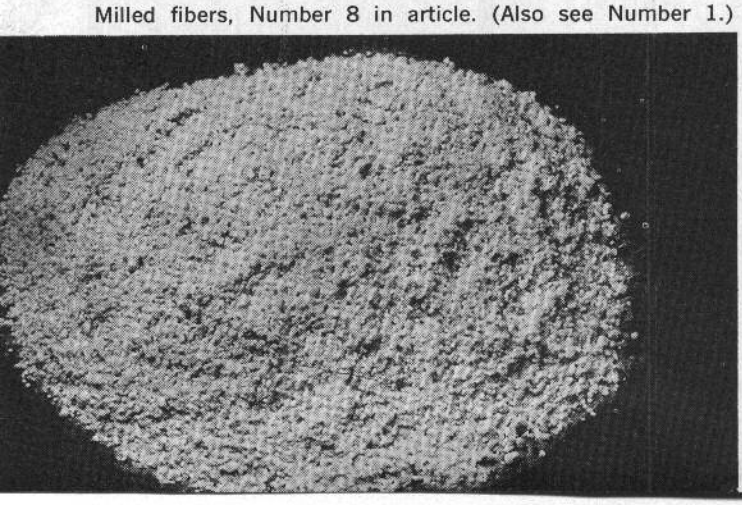
Fiberglass



Woven roving—roving woven into squares. See 3 in text.

Techniques

Milled fibers, Number 8 in article. (Also see Number 1.)



Reinforced fiberglass fuselage of Mac Beauchamp's multi weighs only 1

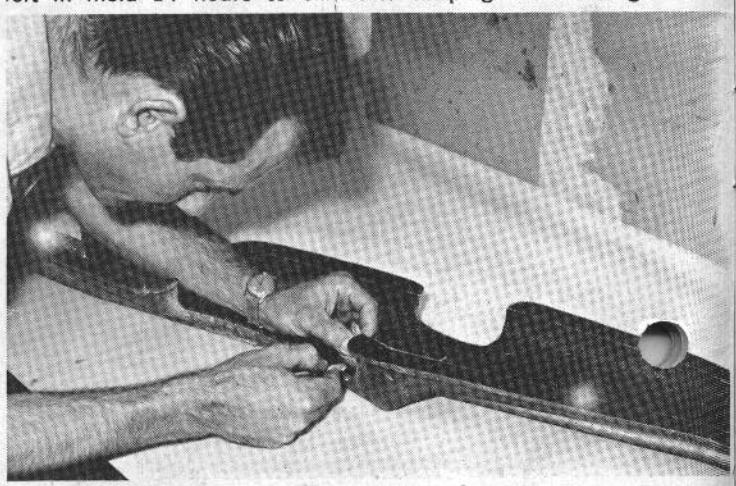
Superior strength is but one of the many advantages which explain the constantly increasing use of this ultra-modern material. This badly needed review contains much previously "confused" material.

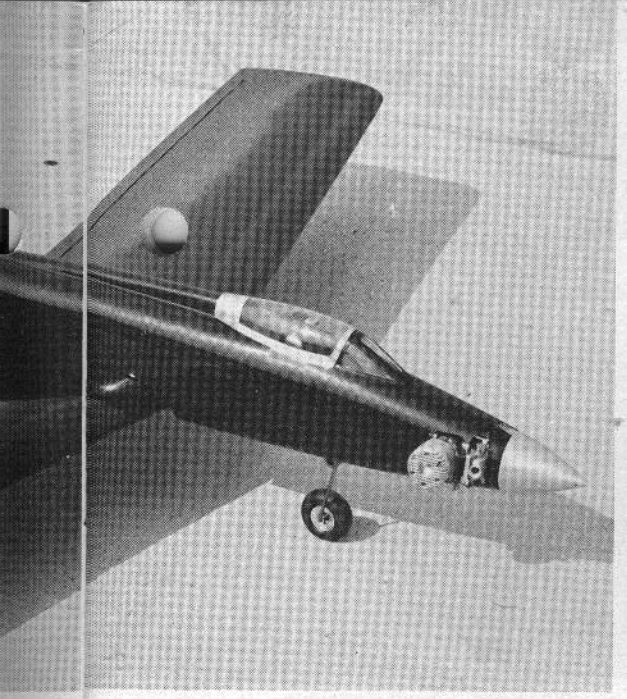
by DALE WILLOUGHBY

■ THE PERFORMANCE OF Cliff Weirick's "Candy" at the 14th Annual Southwestern Regional Model Airplane Championships, held at Buckeye, Ariz., when he piloted it to a first in multi against the stiffest competition on the West Coast, proved to me the worth of the fiberglass fuselage. Dwight Hartman, of Argenta, Ill., has developed his "Zeus" fuselages, model skis and floats in three sizes and, from all reports, enjoys a world-wide demand for his products.

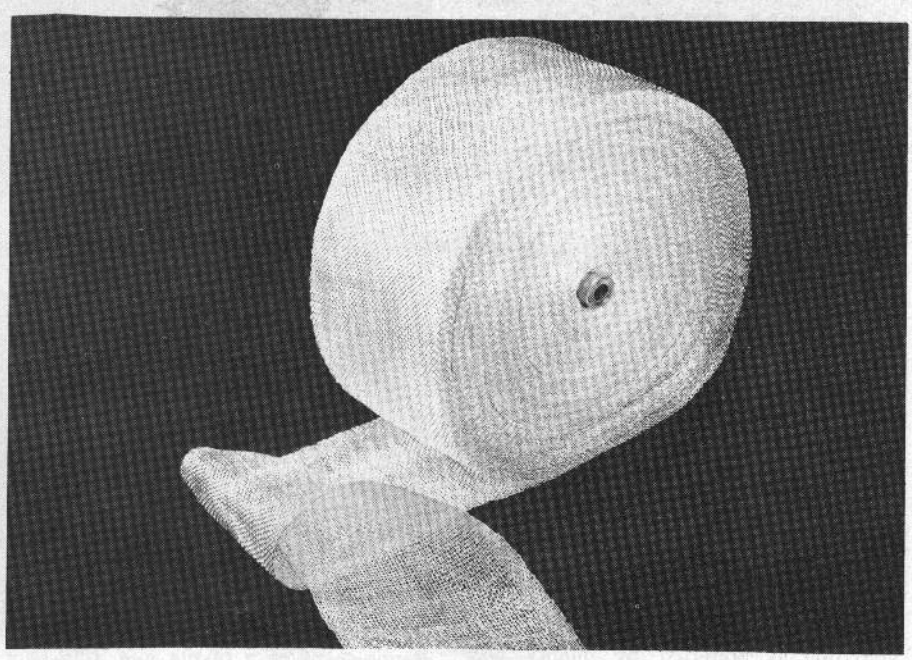
Recently, several model airplane magazines carried comments (after the R/C Internats at Genk, Beligum) that the Europeans were ahead of the Americans in the use and application of fiberglass and other synthetic materials—styrofoam and polyeurethane forms reinforced with hardwoods or plywoods. But perhaps American modelers are not so far behind.

Trimming Viper fuselage with knife. The fuselage half is left in mold 14 hours to eliminate warping while curing.





weighs only 19 ozs. using techniques here explained.



Woven fiberglass tape is similar to woven fabric but is limited to 1-6 in. widths.

My own trials and tests in molding model racing yacht hulls gained me experience in fiberglass techniques. Modelers first must recognize that construction of a fiberglass mold is a long and painstaking affair. While there are few that are really dedicated enough to design an *original* R/C model, transfer the shape and form into a pine-block male pattern, correctly engineer this into a suitable, long-lasting female mold, lay up fiberglass and resin with a minimum of errors (and bubbles), then join the two halves with no warps or twists for a real slick fuselage . . . it can be done. While we will try to detail our own experiences and those of others with whom we have discussed their techniques (in particular, Mac Beauchamp of GlasKraft, developers of his own "Talon" and "Viper"), this information will be general and only will be specific regarding the products we have used.

Let's first examine the materials and their composition. One fiberglass strand ranges from .00035 to .00055 inch in diameter, and requires over eight miles to make one pound! Of course, you hardly ever see a single strand offered on the market. Most of the material is sold in one of the following forms:

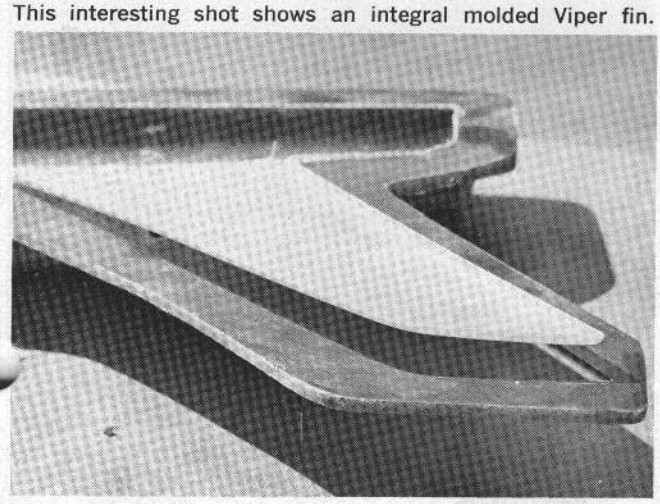
1. Chopped strand reinforcing mat.
2. Roving—each strand contains 204 fiberglass filaments.
3. Woven roving—heavy skeins of fiberglass roving woven into square patterns.
4. Woven fabric—strands containing from 14 to 30 filaments and normally woven and sold by weight (oz. per sq. ft. or sq. yd.).
5. Woven fiberglass tape—similar to woven fabric but limited to stock widths from 1" to 6" wide.
6. Roving and chopped strand for premix molding—¼" lengths of fiberglass roving mixed with filler and resin.
7. Non-woven unidirectional fabric—composed of parallel, continuous longitudinal strands of glass fiber, cross-bonded every 3 inches with cross stands or resin-laden fill.
8. Milled fibers—milled by a hammermill into 1/32, 1/16, ⅛, 3/32 & ¼" lengths.

While the uses of fiberglass are numberless, with more applications being made daily, the average model builder should only be concerned with numbers 1, 2, 4, and possibly 5, listed above. Those interested in the use of other types of fiberglass will find many good books on the subject in the city or county libraries. *Fiberglas Reinforced Plastics* by Ralph H. Sonneborn, 1954, is highly recommended for those requiring further study.

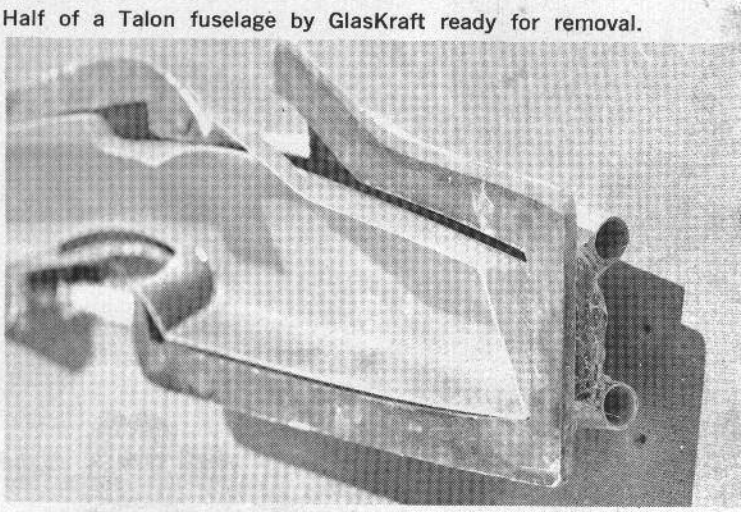
The use of chopped strand reinforcing mat in model molding is increasing, because this mat conforms to curves, wets readily and does not have a bias. In other words, once put into place, wetted with molding resin, the chances of bubbles are remote if a brush is used for resin application. Normally, the mat is composed of 2-inch lengths of chopped strand, blown onto a continuous chain conveyor, with the resinous binders applied, then passed through a curing oven, and onto a roller. Because mat has fibers running in all directions, it provides equal, uniform strength.

Roving is used on corners and curves where a high strength joint is required, and light weight is necessary. For instance, a small length of roving is used as a beading for stabilizing a

This interesting shot shows an integral molded Viper fin.



Half of a Talon fuselage by GlasKraft ready for removal.



MODERN FIBERGLASS TECHNIQUES . . . cont.

plywood bulkhead for the nose wheel or motor mounts. Curiously, roving can generate static electricity when placed in contact with various types of equipment or by movement through the air.

The woven fabric fiberglass is already known to most model builders, and has enjoyed popularity as a covering over balsa for high resistance to impact. Yarn is twisted or plied to weave this fabric and, in order to provide sufficient lubricity for this process, a starch and oil sizing is applied to the glass fibers. Since this sizing interferes with the adhesion of laminating resins to the glass fibers, it must be removed from the woven fabric. A heat cleaning treatment is employed to burn away this organic sizing, leaving the woven fiberglass fabric bare and void. Subsequently, resizing treatments (according to the application of the bonding resin) are offered, and are about eight in number. One that is preferred by quality boat builders (full size) is called permanent loom finish and is compatible with polyester and epoxy resins. Woven fabrics range from ½ oz. per sq. ft. to 2-1/3 oz. per sq. ft. It must be kept in mind that the strength come from the fiberglass, not the resin. So if stresses are expected from all angles, lay up the fabric accordingly. We will describe lay-up methods later.

Let's take a look at the resin. The reaction of organic acids and alcohols produce a class of material called esters. When the acids are polybasic and the alcohols are polyhydric (for example glycerine and phtralic anhydride) they can react to form a very complex ester (generally polyesters). Normally called alkyds, they have long been important in surface coating formulations because of their toughness, erosion resistance and endurance. When the alcohol and acids used contain an unsaturated carbon bond, the polyesters formed can react further with other unsaturated materials. The result of such a reaction is to interconnect the different polyester units to form the three-dimensional cross-linked structure that is characteristic of thermosetting resins. The commercially available polyester resins are solutions of these alkyds in the cross-linking monomers.

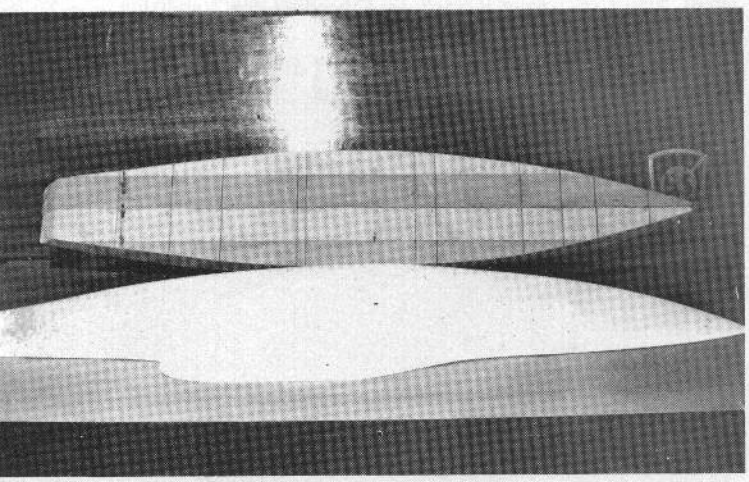
Reminiscent of a textile mill, this shot actually shows a roving machine at work.

The "curing" of the resin is the reaction of the monomer and the alkyd to form the cross-linked structure. As an elevated temperature cure takes place, the resin passes through several transisitory stages: First, a syrupy liquid to a (b) thin liquid, to (c) a soft gel, to a (d) hard frangible gel, to finally a (e) hard solid. The most common form of resin, formulated from a variety of alcohols, acids and cross-linked monomers, is referred to as "general purpose polyesters." The polyesters are normally mixed with a pigment and filler on a batch basis, only needing the catalyst to start the curing process. The curing chemical reaction is controlled in rate and degree by a catalyst system, usually organic peroxides.

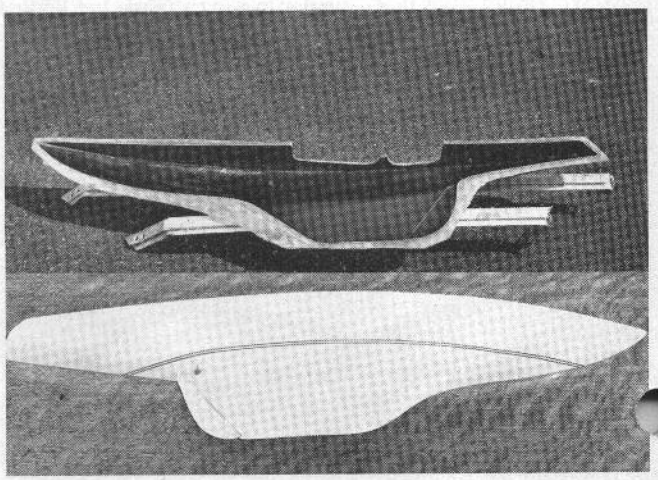
Depending upon the catalyst, a wide range of curing schedules can be obtained. During the curing, temperatures range from 70 degrees F. to 500 degrees F., and times ranging from 15 seconds to 30 days. The rate of cure can be controlled by temperature and ultra-violet light. It cannot be stopped, though it can be slowed down.

The chemical reaction begins when the catalyst is added, and the period during which it is useful can be as short as a minute or as long as several days, before turning to a solid. Normally only a 6 percent by volume (16-to-1 ratio) catalyst is needed for starting the curing process, and can be as little as .25 percent. Of course, "kick-off" times will be greatly prolonged by using such a small ratio. I recommend that you follow the directions, or advice where you purchase the resin, and mix accordingly. Known as M.E.K. to the trade, the catalyst I have been using is Methyl Ethyl Ketone Peroxide. Being a peroxide, it will collect oxygen when stored on your shelf in an uncapped bottle. Higher temperatures hasten the curing process (as with ultra-violet light), but with these high temperatures, there is the possibility of warping the mold, especially if the female mold is also made of fiberglass and resin.

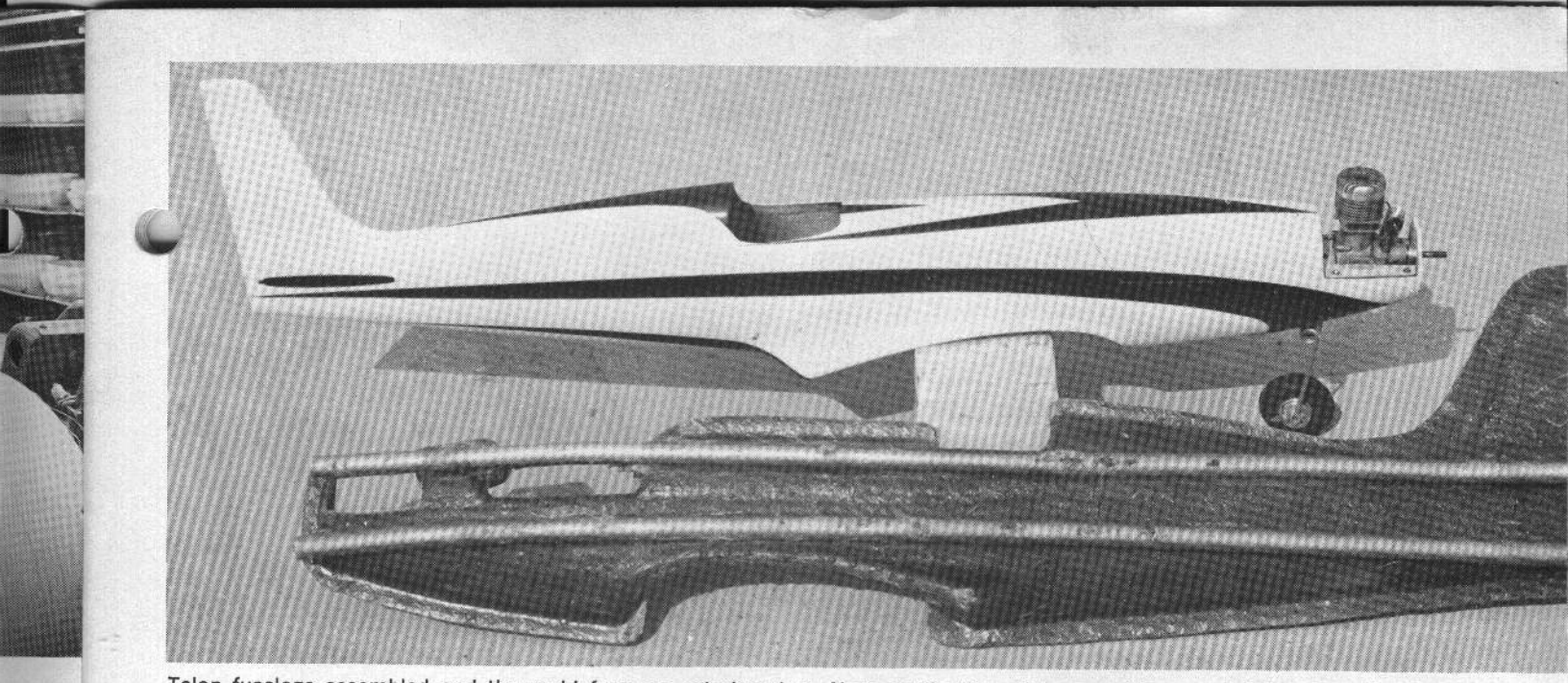
I have found that this curing, although apparently set solid after a couple of days,



Laminated wooden form for a racing yacht mold, top, and a finished mold, foreground, for "half model" display item.



Here, the finished mold appears in the background and a molded hull, bottom. Article simplifies mold making.



Talon fuselage assembled and the mold from an exterior view. Note application of house wiring conduit to strengthen mold.

can go on for two weeks or more. As a matter of fact, Dwight Hartman, in his instructions that accompany a "Zeus" fuselage, recommends that the fuselage not be sanded or worked until three weeks from the date of manufacture, which is furnished with fuselage.

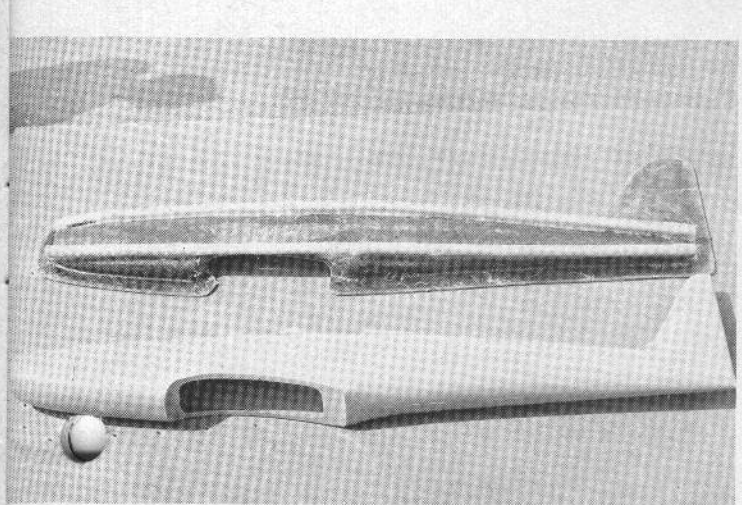
To my regret, I worked a female mold of a racing yacht too soon and found the weave of the mat came to the surface as the mold cured. The female mold was layed up on Monday, then taken off on Wednesday, and worked the following Saturday. It should have been put aside for nearly a month, according to advice received *after* the mold was ruined. But this points up the need for adequate curing time for fiberglass, be it a mold or a finished product, which is at least 14 days. Polyesters cure at normal temperatures and with no pressure, other than normal atmospheric pressure. No adverse effect on curing time has been noticed when under higher pressure, such as a small toy balloon used to mold a round engine nacelle and force the resin to surround the fabric until cured.

In molding, you will find that a small amount of residual resin will not cure (5 to 8%) but remains on the outside of the article. Because of the peroxide in the catalyst, the unreacted double bonds will take up oxygen due to the action of the sunlight, and will create a yellowish or amber tint to the model. Some resins (such as those used on surf boards) gradually exude a surface wax during curing, and others used on fiberglass yachts remain tacky for several days. This characteristic tackiness is used to good advantage because the next layer of fabric stays in place until another application of resin is made. Thus, lamination is made easier, especially on compound curves occurring in a female mold.

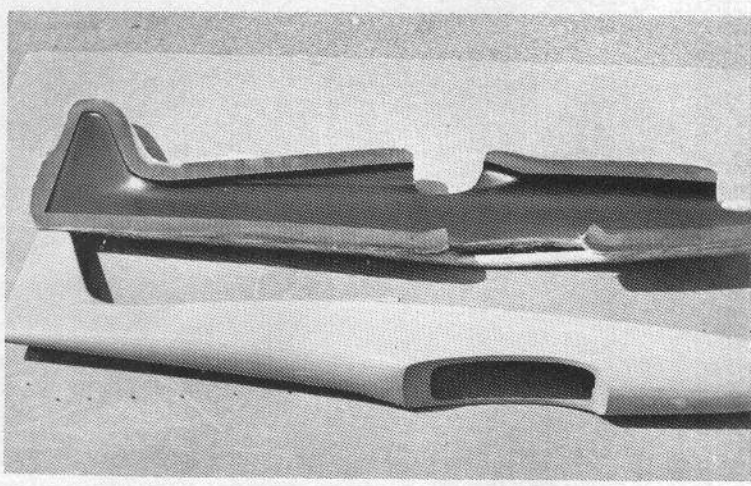
No mention has been made of painting or finishing a typical fuselage because there are two methods that can be used. One is called Gel Coat—which must be applied *first* to the female mold. Generally this is a pigmented resin, which is thinned with acetone to a spraying consistency, the M.E.K. added and then sprayed on the inside of the female mold, the surface first waxed thoroughly to insure separation. When this has cured to a hard solid, then the mat or glass fabric is applied, and at elevated temperatures during the curing process, the residual polyesters react with the Gel Coat, making a further cross-linked structure of high strength. The smoother the surface of the female mold, the more glass-like will be the exterior of the molded article. (Preparation of a mold will be discussed later.)

The use of Gel Goat has one disadvantage; the pigmented outer surface of the molded fuselage is difficult to join, due to the lack of visibility required to correctly join the fuselage halves. This disadvantage can be surmounted if the mold is made of more than three sections, but this set-up presents quite an engineering problem. Fuselage parts are flexible to some degree, allowing for some mis-match, but care must be exercised to insure proper alignment upon assembly.

The second method for finishing the fuselage is the accepted method—spray or brush enamel, dope, or Hobby Poxy. Interestingly enough, Hobby Poxy is a "kissin' cousin" (*Continued on page* 25)

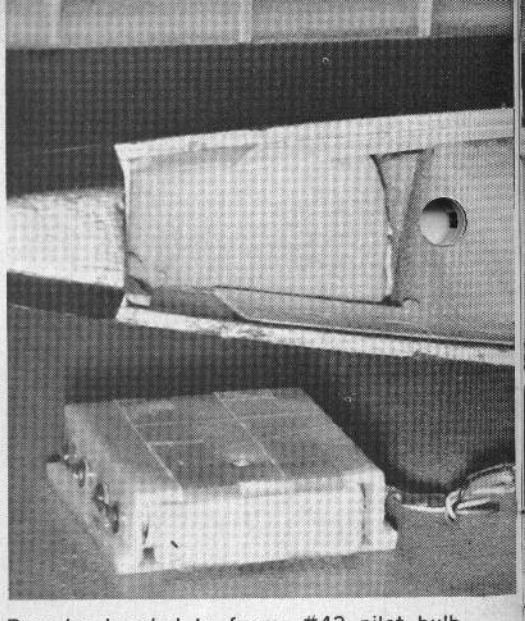


The two half fuselage shells for a Robin are joined for a really beautiful job — the reenforced fuselage mold, top.



Internal view of GlasKraft's Robin mold indicates smoothness of surface, obtained by techniques given in article.

Superhet front end linked with servo amplifiers for proportional system, using feedback circuitry. Low-battery-drain setup shown in Grant Munsey's Bergfalke.



Decoder bonded to foam, #43 pilot bulb

in ser

A VERSATILE SUPERHET SYSTEM

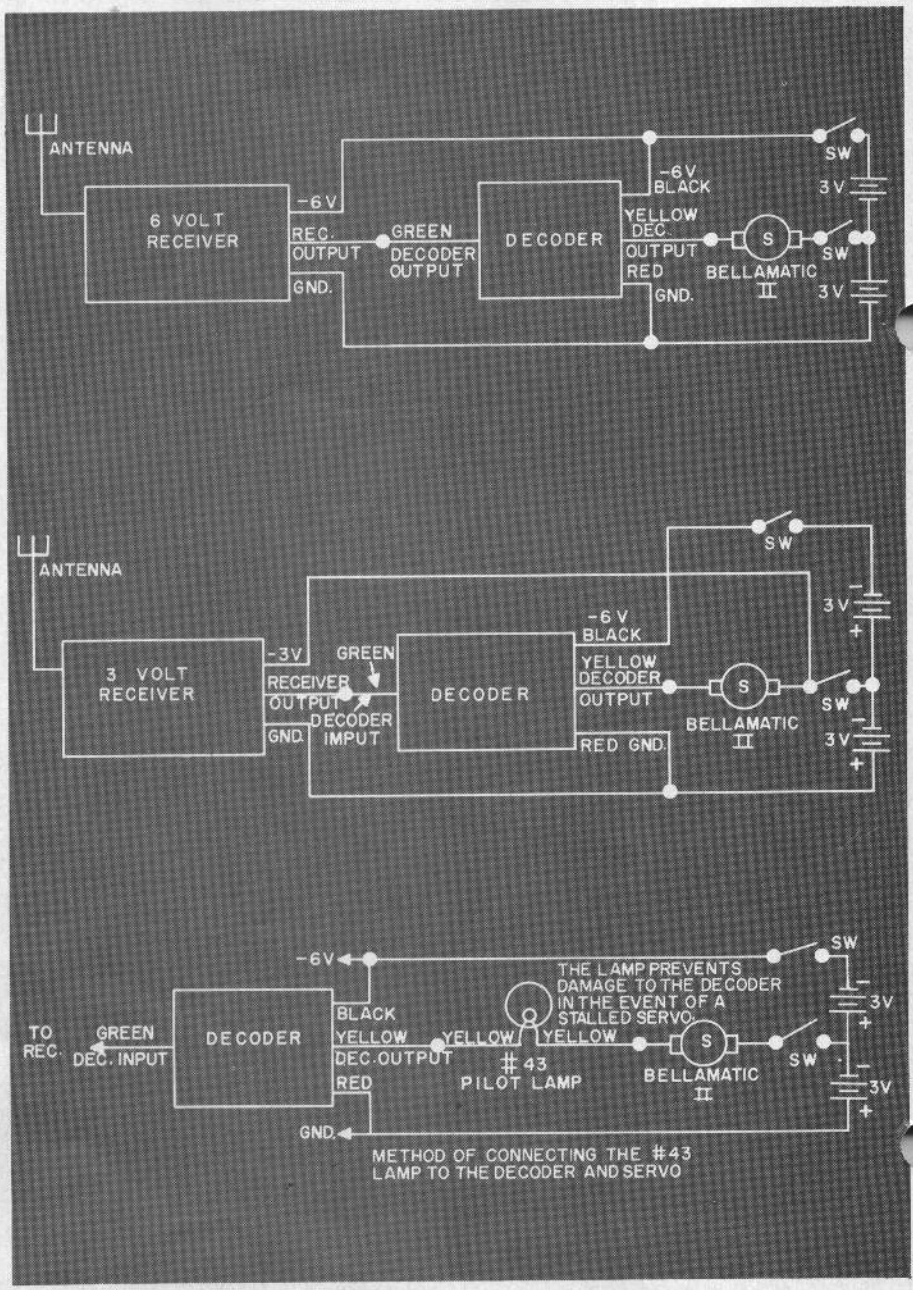
By FRANK COLVER

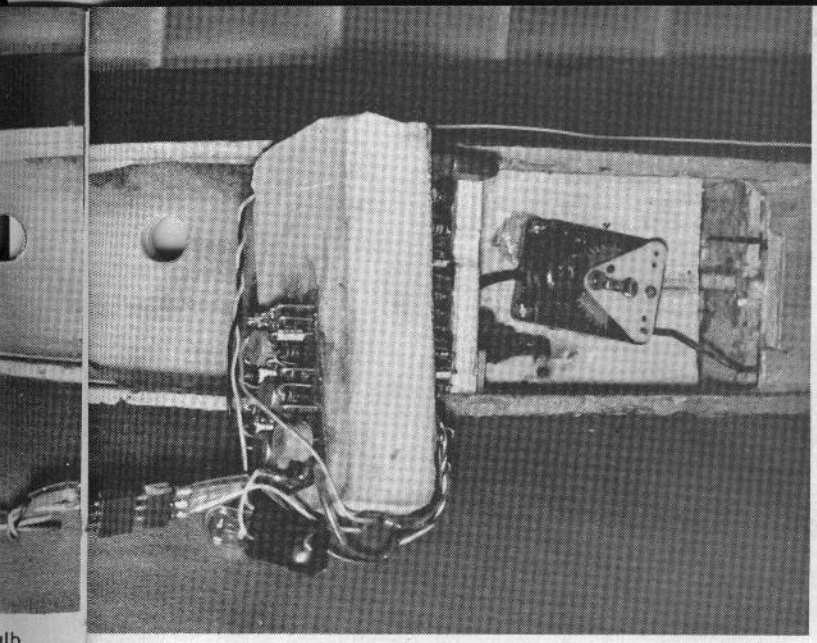
Wanting more than manufactured equipment offered, the author created a sensitive and stable receiver of many uses.

■ AFTER EXAMINING the circuit design of several of the all-transistor superhet receivers on the market, I decided to design and build my own, not in an effort to save money, but to eliminate the short cuts in circuit design that manufacturers are making in order to reduce costs and facilitate rapid production. However, in constructing this receiver I have discovered that I did save money over the cost of many superhet receivers. The receiver described herein is the result of many hours of design and development time.

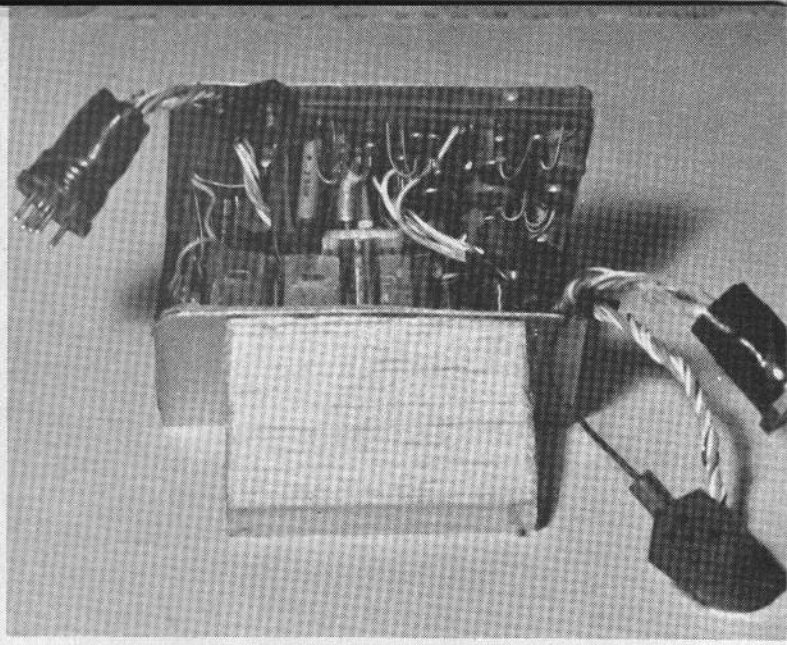
After completion, two receivers have undergone a number of hours of actual flying time in two different R/C gliders, with the results reported by Dale Willoughby on the opposite page. I feel gratified that one receiver was used to operate two feedback-type proportional servos. I believe that proportional control places the most stringent requirements on receiver operation. Both receivers have operated without trouble since installation in the gliders and, in the course of field testing, have undergone many different environmental conditions.

There are (*Continued on page* 30)





in series to Bellamatic servo. Receiver, battery decoder 6½ oz.

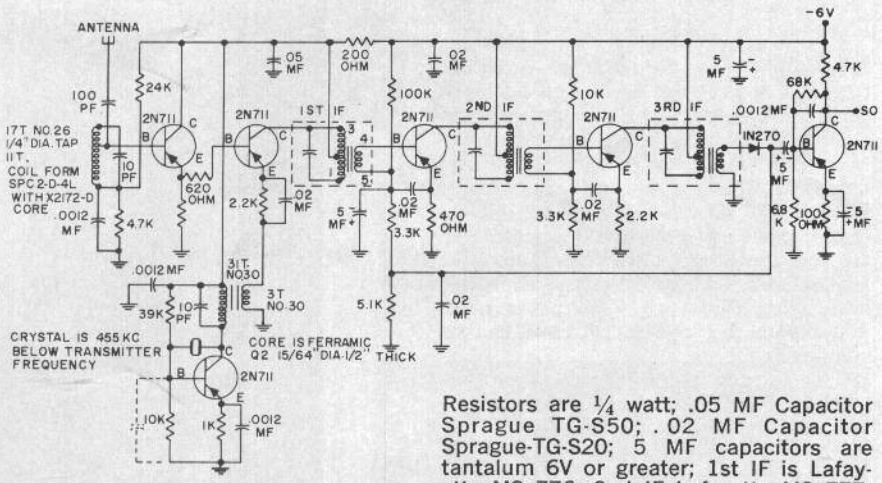


Front end with I.F. cans held to metal mount by threaded bolts, amplifier circuitry opposite side. Plugs connected to Micro T 03 motors coupled to feedback pots. (Munsey).

TEST REPORT ON THE COLVER FRONT-END

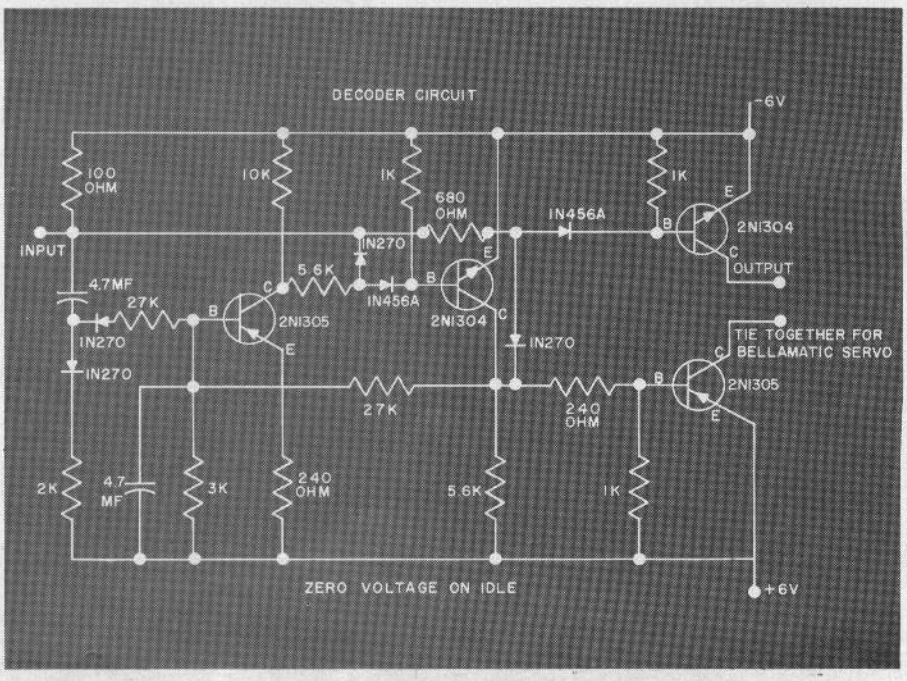
By DALE WILLOUGHBY

Colver's system has met an enthusiastic response locally. Dale, himself a user, compiled these notes in interviews.



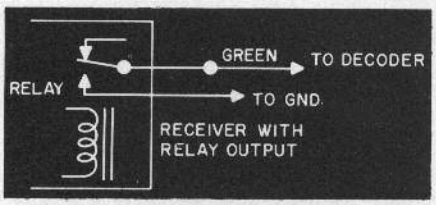
Resistors are ¼ watt; .05 MF Capacitor Sprague TG-S50; . 02 MF Capacitor Sprague-TG-S20; 5 MF capacitors are tantalum 6V or greater; 1st IF is Lafayette MS 776; 2nd IF Lafayette MS 777; 3rd IF Lafayette MS 778. NOTE: Dots indicate connections. Broken-line rectangles are enclosures.

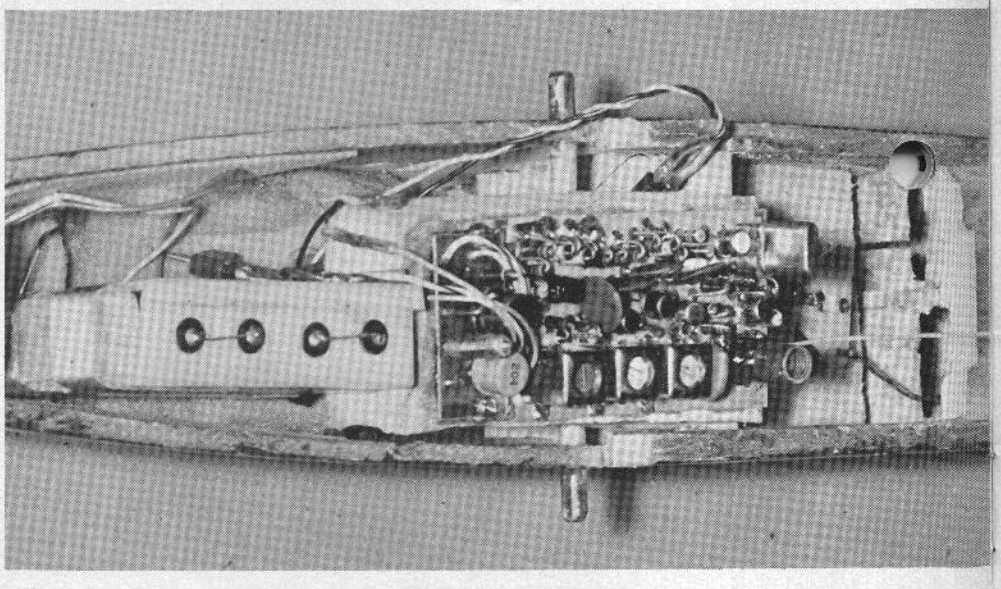
■ FRANK COLVER IS an employee at Ford's Aeronutronics plant near Costa Mesa, Calif., and is an officer in the Harbor Slope Soaring Society. Last summer at one of the first meetings of the Society, he brought this superhet front end for examination. It is our club policy to bring new gliders, new designs and new equipment for all the Society members to examine. At that time I was using a Graupner Ultratron (encapsulated super-regen receiver) with some moderate success in a Pelican Glider, but the range was marginal. So I was in the market for a superhet receiver. Not recognizing that here was a "home brew" superhet receiver that had great possibilities. I failed to capitalize on its availability. Subsequently, this first receiver was sold to Clarence Munsey, a fellow employee, who, though possessing the capability of designing his own receiver, used it in his "home-built" proportional system using Micro-Mo motors to drive rudder and elevator through servo amplifiers. Clearance was contacted regarding the performance of Frank's superhet and gave the following comments: (*Continued on next page*)

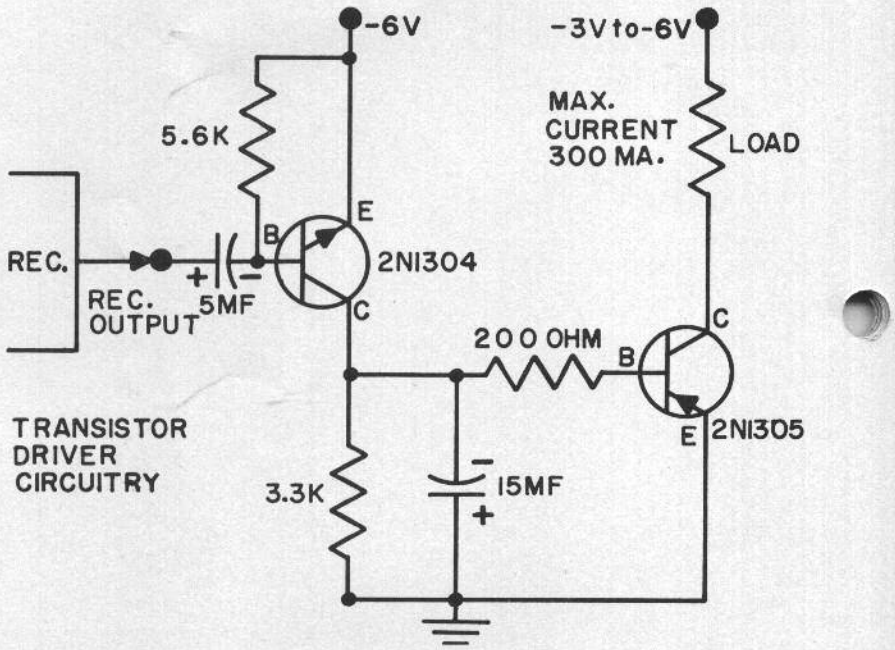


TEST REPORT ON THE COLVER FRONT-END

. . . continued







"This receiver has good fidelity—a definite requirement for pulse work. This fidelity is achieved, in part, by the elimination of the audio transformer. It also has broad frequency response and yet in the six months flying this front end with my equipment in R/C gliders, there has been no swamping problems while close to the transmitter. Generally, proportional receivers are quite sensitive to swamping but, perhaps, because I am using such a low power transmitter with this receiver, I have had no swamping.

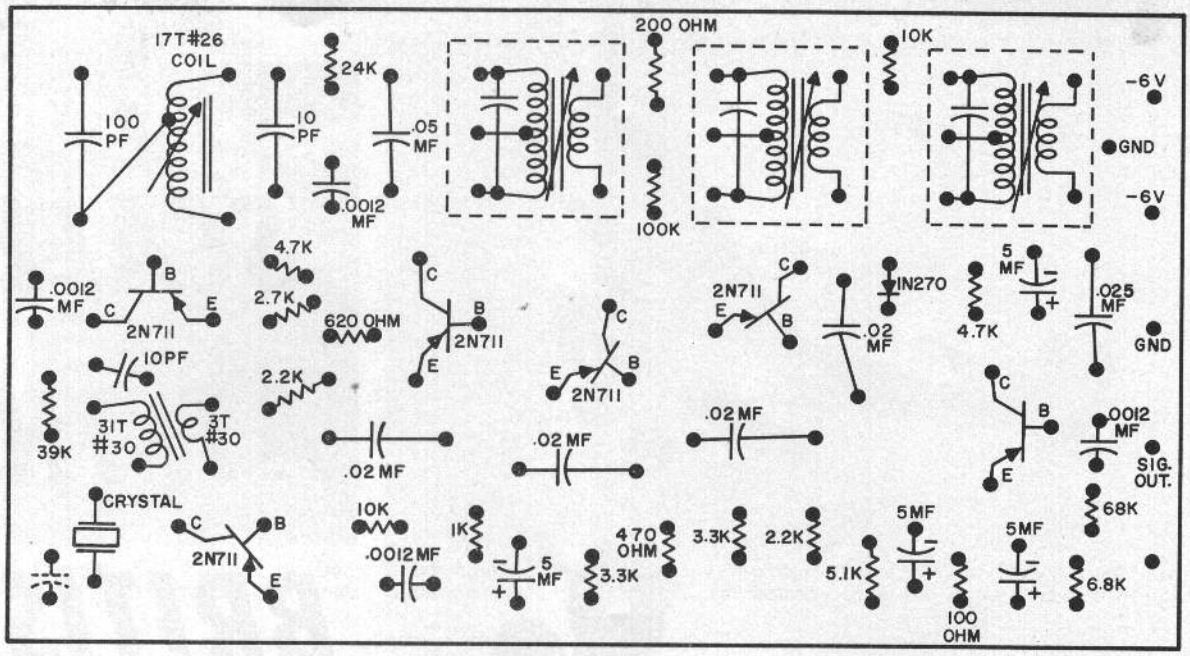
"My own designed transmitter puts out under 100 milliwatts of power and we (my son and I) have yet to experience range problems. And with feedback servos, the same battery has been in use almost six months, with two gliders flying almost every Sunday. We interchange this receiver coupled with servo amplifiers, between my Pascha and Grant's Bergfalke. I highly recommend this superhet to any one desiring a reliable, low-battery-drain receiver.

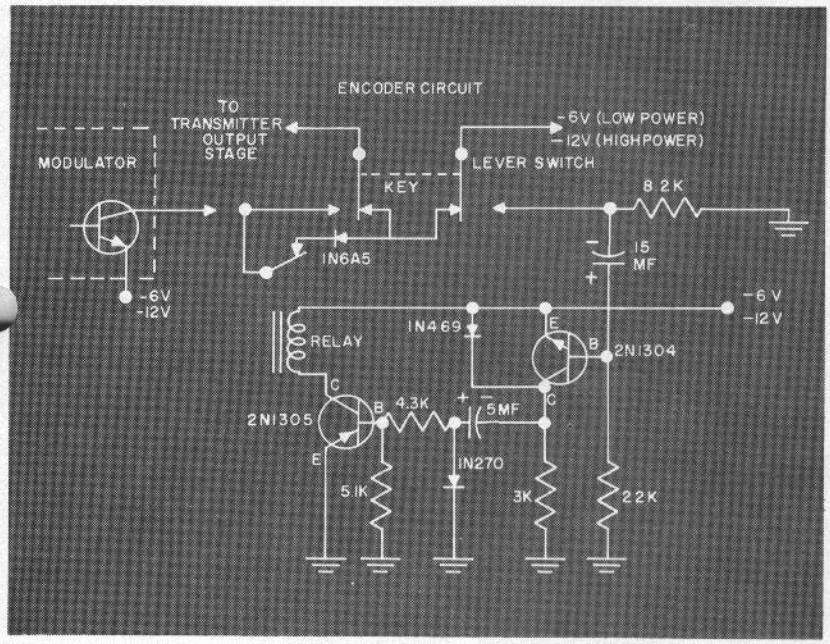
"As for my superhet front end, Frank added a transistor driver so that I could use the decoder, also designed by Frank. This decoder electronically performs the same basic function as the positioning commutator on a compound servo but without any mechanical wipers or contacts. It uses no relays to perform this function, eliminating most of the unreliability inherent in mechanical functions. With a hold I get right rudder and with pulse and hold, left. Reversing the power leads to the Bellamatic naturally reverses the direction of the rudder. The schematics and construction article appeared in the *December* issue of the *Zephyr,* which we quote."

"Use of the circuitry described in this article obtains two channels from a single channel receiver/transmitter combination or it can be used to obtain an extra channel from a multi-channel system. Anyone who has used a single-channel compound servo has probably experienced some trouble at one time or another due to poor operation of the positioning commutator. Also, many of these servos are slow operating and many of us wished that we could get right or left without having the servo run through both positions each time. The following decoder circuit electronically performs the same basic function as the positioning commutator on a compound servo, but without any mechanical wipers or contacts. This makes it possible to use the fast Bellamatic II multi-channel servo as a single-channel compound servo without making any changes in the servo or the receiver.

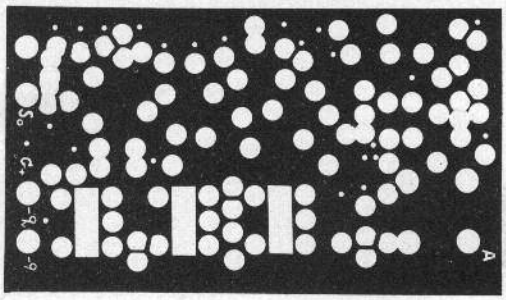
"One pulse and hold will drive the servo one way, or two pulses and hold will drive it the other way. On the two-pulse command, the first pulse can be quite short so that the servo only moves a small amount toward the first position before starting toward the second position. The decoder uses no relays and can be operated from any relay or relayless receiver that has an output that goes from *negative to positive* when a command is received. The decoder can also be used to drive two separate servos in one direction each. This system can be expanded to include an electronic encoder in the transmitter case, pushing the key to the right then always gives right rudder and to the left always gives left rudder. This gives to the single-channel flyer all of the ease of operation that the multi-channel flyer enjoys.

"The transmitter encoder circuit shown here, I designed to work specifically with my home-built transistor transmitter" said the *Zephyr,* "however, the circuit could be modified to work with many types of transmitters. This decoder has been tested to 130 degrees F and has worked well. The entire system is being flight tested now and has performed without trouble. The maximum length of time that can elapse between the first pulse and the second pulse/hold, and still get the two-pulse position has purposely been made short. If desired, this time can be lengthened by increasing the size of C_1 by a few microfarad. The maximum load current for the decoder is 300 ma. The decoder, completely built and tested on a 1 x¾ x 1/32" glass-base epoxy printed circuit





ACTUAL SIZE



board can be purchased from: Frank Colver, 434 Lenwood Drive, Costa Mesa. California. 92626, for $15.95. The printed circuit board alone can be had for $2.95.

"A method of connection to the Bellamatic that I recommend for any control system using the Bellamatics is also shown. Due to variations in the clutch system in the servos, these motors can sometimes be loaded quite a bit at the end of the servo travel and draw large amounts of current. With the #43 lamp in series with the motor, the lamp does not light during normal operation of the servo and the resistance of the bulb remains low. However, if the servo starts to draw more current, the lamp lights the resistance goes up, and the current will be limited to 300 ma. The rated bulb life is 3,000 hours, so it could be expected to outlast many airplanes. A PR2 flashlight bulb may also be used, however, its rated life is only 15 hours."

In testing my own superhet (Dale resumes), I can only add a hearty Amen to the advantages set forth in Clarence's statement. Complete reliability and low weight, 2 oz. for the bare reeciver, 2½ oz. with the decoder mounted on sponge rubber and wired to the receiver, and 6½ oz. total weight using four E-91 pencells in a battery box. With the decoder, I can use the new Bellamatic II servo with its slipping clutch feature. Frank prescribes the use of a #43 pilot lamp between the decoder and the servo to prevent damage to the decoder in case the Bellamatic II motor stalls. I found that this is an extremely wise recommendation because the clutch on my Bellamatic will begin to tighten up, when run for any length of time. And when it does, the pilot bulb lights up, growing brighter as the load increases on the servo motor. Of course, in flying a glider, there seldom is need to hold for more than five seconds.

The range of this superhet is very desirable. I used a Kraft Custom 10 transmitter. I tested it wtih the antenna collapsed and found complete control at a distance of over 500 yards on the ground. Generally speaking, the receivers used in R/C gliders must possess a longer range capability, due to the nature of slope soaring.

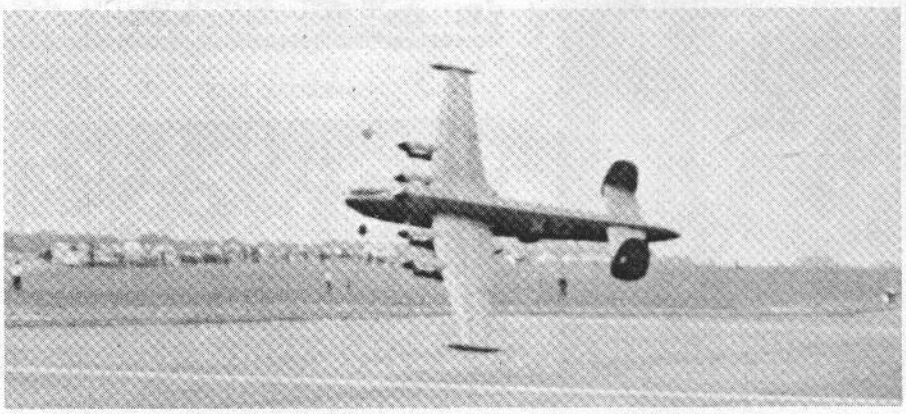
In flying powered models, especially in competition, the model must stay pretty close to the pilot. But in flying gliders the search for lift goes on constantly and sometimes this takes the glider (and receiver) up into the "Wild Blue Yonder."

My next step up in the refinement of equipment for slope soaring is likely to be proportional equipment. And of course, I plan to use this same superhet due to its good fidelity characteristics as the front end.

Readers may keep abreast of our progress by sending $2.00 for a year's subscription to the *Zephyr*. If you are only mildly interested, send 25¢ in coin for a sample copy to: Editor, The *Zephyr*. 14695 Candeda Place, Tustin, Calif. 92680. It is devoted to our chosen sport. . . . SLOPE SOARING. ●

SCALE AT THE BRITISH NATS

David Walker's 122-in. 16½ lb. Avro Shackleton thrilled in demonstration flights. Four K&B .19's, F&M Matador/Midas gear. Takeoff run is 150 ft.



On four demonstration hops the big bomber proved its stability and controllability. Realism was tremendously enhanced by flight at near scale speeds.

Mr. Walker and his Avro. Visible parting line indicates fuselage with wing, forward of trailing edge, detaches. He took 20 minutes to synchronize K&B's.

■ The annual "Whitsun" National Championships, held at RAF Barkston Heath, seems to have been blessed by that English rarity, two successive sunny days (for a model meet anyway) and, of interest to GL readers, a remarkable array of R/C scale jobs. While those which entered and flew were exciting enough, some of the more remarkable aircraft did not fly officially, or fly at all, for one reason or another. Two four-engined Handley-Page Hannibals were seen, but not flown, as was an exciting Focke-Wulf Fw. 190 by Pete Russell. Some craft qualified but do not appear in the results—such as Anderson's beautiful Cessna 172.

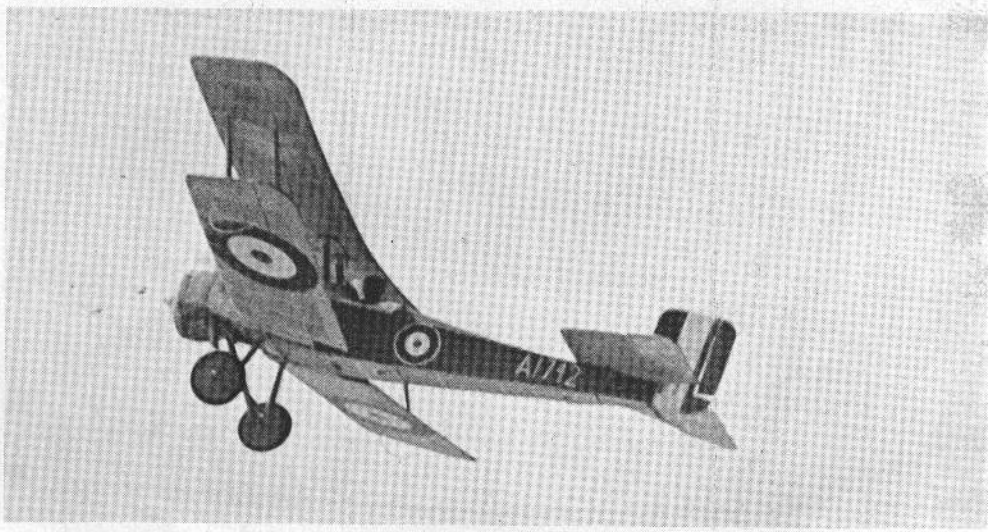
It was said that some of the fearful pilots "had too high a regard for their property to risk it in front of a mad crowd of enthusiasts anxious to get close, and over a sea or ropes, stakes, tents, ice cream vans, dealers' stalls, and all the etcteras that make our Nats such a jamboree."

The FAI scale rules did not seem ideal, placing, as they do, such a stress on aerobatics. Anderson's Cessna, which probably would have placed high, cannot do aerobatics—and why should it? One spokesman explained it to GL this way: "The points are too loaded in radio toward the aerobatic model, regardless of its scaleness, and we shall have to set a minima of qualifying points in the scale department.

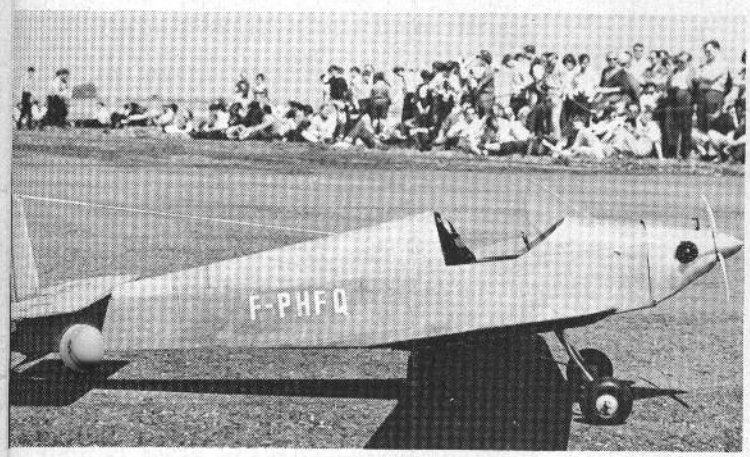
"When you realize that Morton's Tiger Moth got 898 flight points, 39 for scale and 45 for workmanship, against Thumpston's 200 for scale and 208 for workmanship, the disparity between flight points and scale become more evident."

And again: "Obvious division of standeards comes. (*Continued on page* 29)

A superb Sopwith 1½ Strutter by Den Thumpston highly detailed on 4-channel.



Single-channel Bristol Scout D by Dan Bateman placed fourth with compound escapement. Shown here during climb-out, the Scout had a hand-beaten cowl.

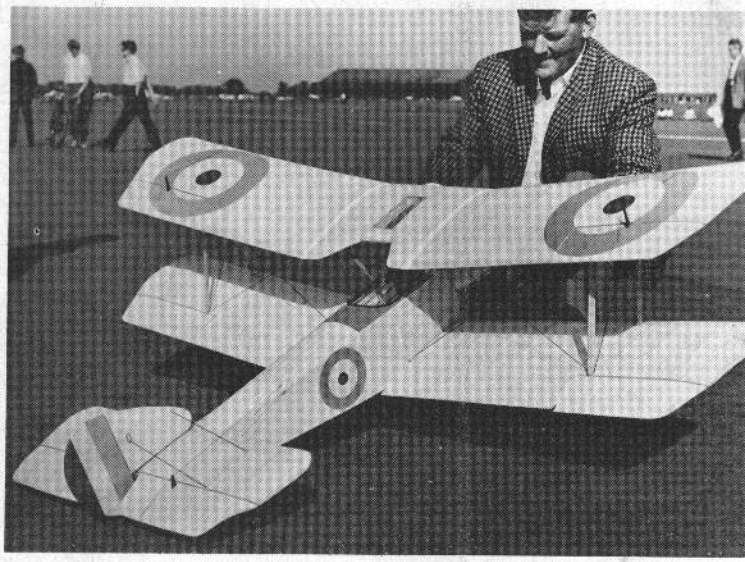


This Druine Turbulent in quarter scale by R. Clarke, had Enya 29 power. Radio was Kraft 10—using six channels.

How's this for atmosphere? Gipsy Moth DH-60 in black and yellow was the work of brothers, Derek and Bernard Denial.

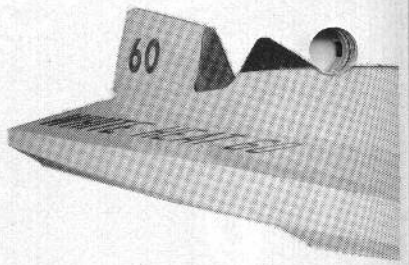
***The flying scale model traditionally occupies a special place in the heart of the British modeler—in all events. This year, radio produced some showcase projects. (Pics by British magazines,* Aeromodeller *and* Radio Control Models and Electronics.)**

Real racy performance distinguished Dennis Bryant's Miles Sparrowhawk. Span 60 in., Merco .49. F&M Matador/Midas.



Not in contest, remarkable Sopwith Pup by Peter Dunham—Taplin Twin driving 20 x 6 mahogany prop. Grundig 4-chan.

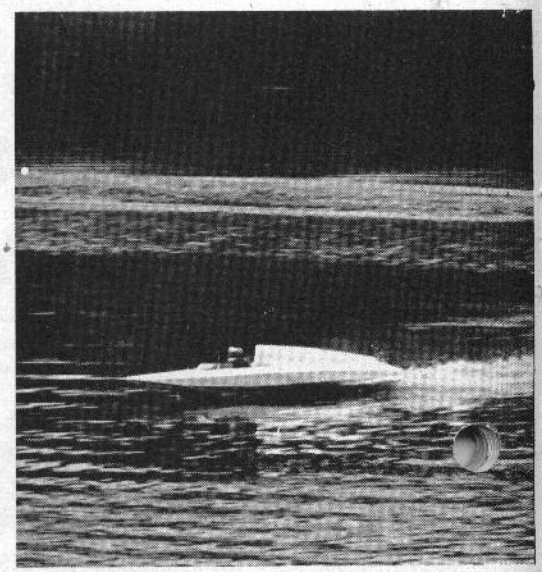
...WHITE H



THE ULTIMATE IN INBOARD-POWERED GAS-ENGINED HYDROPLANES, THIS BOAT CAN BE OPERATED AT ANY DESIRED SPEED WITH A FOUR-CHANNEL RADIO SYSTEM. USE YOUR .45-.60.

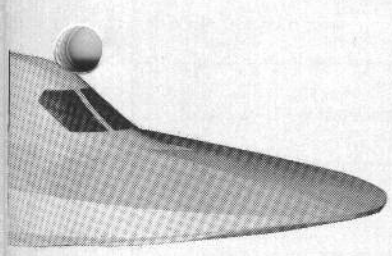
Many model builders interested in RC would like to build a boat as their initial venture into this fascinating field. A boat offers many advantages for RC enthusiasts. Its operation hasn't the "all or nothing" aspect of learning to control a radio-control airplane. A boat can be operated at idling speed on the water, and it can be run at thrilling speeds as well—if the engine stops it remains floating on the water. Even the possibility of running the boat up on the bank is not too damaging other than to the pilot's ego and perhaps a propeller.

Many potential boat builders have radio-control airplane engines of .45 to .60 cu. in. displacement, plus servos, receiver, battery packs, etc. but lack the plan for a boat of proven performance. We do not mean that the new White Heat 60 is the only boat in the world. But, first of all, we are talking not of cabin cruisers, fishermen, and the like, but of a craft with a range of performance which allows one to make a successful beginning, by easy stages, with the capability of achieving a lively performance of interest even to the advanced airplane man.



During a high-speed steering test the WH 60

E HEAT 60

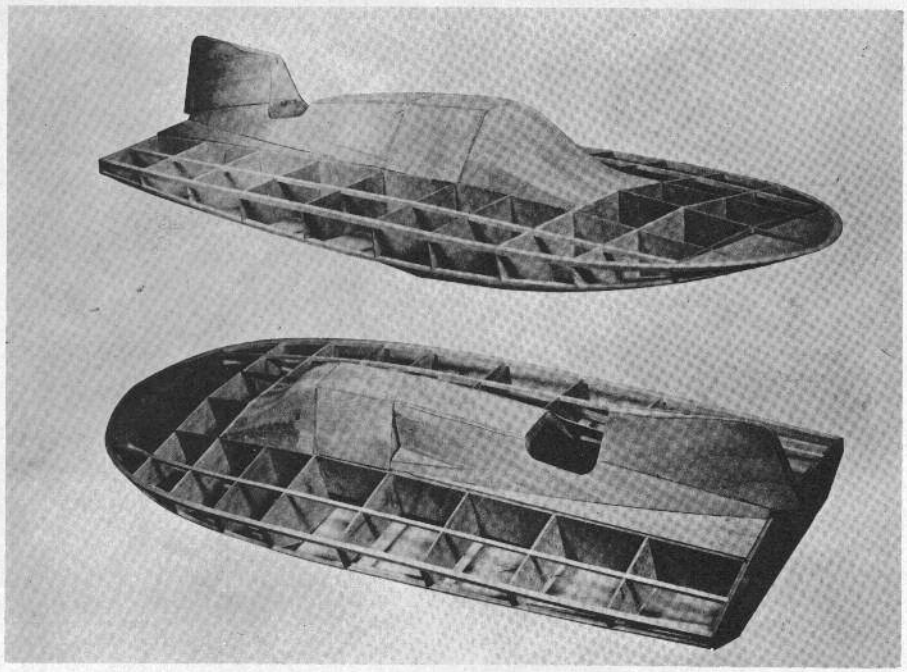


Designed to perform with engines of from .45 to .60 displacement, the White Heat 60 is easy to build, as such boats go, but is capable of speeds of more than 30 miles an hour with a .60 glow plug engine. A minimum of four-channel equipment is required because the control response necessary is too fast for single-channel equipment and the usual rudder steering devices used with such simple radio control systems.

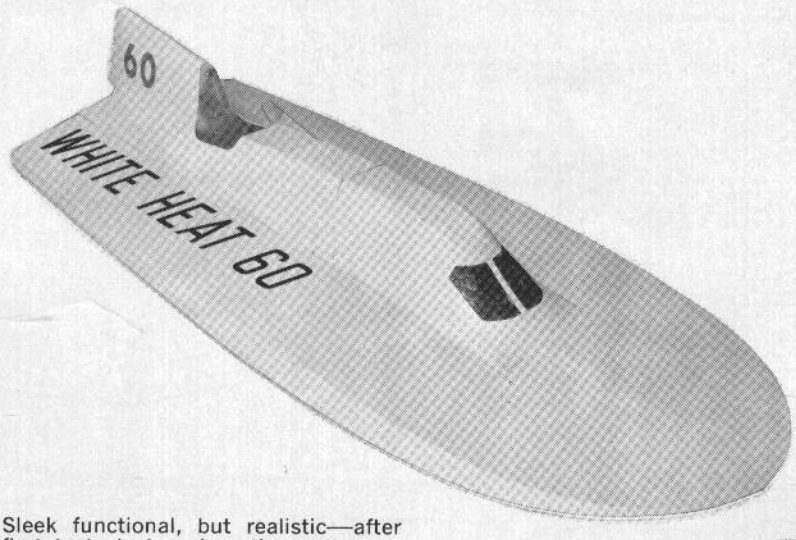
The full-size patterns shown in a reduced scale on the opposite page also were rearranged to suit GL space requirements. The plans, in a very much reduced scale on the next two pages, approximate the layout of the full-size sheets available, but again are rearranged to some extent for space reasons.

No doubt a reasonably adept modeler can scale up these plans, but for those who prefer full-size plans, Octura has two huge sheets (parts and plans) for $4,50. (Obtainable through GRID LEAKS.) If you can work from the plans in this issue but need full-size patterns and complete instructions, these can be obtained for $2,50. Instructions consist of three long sheets—two printed both sides. We suggest obtaining the full instructions because of the numerous tips included—all of which will be new to anyone who has never constructed a boat.

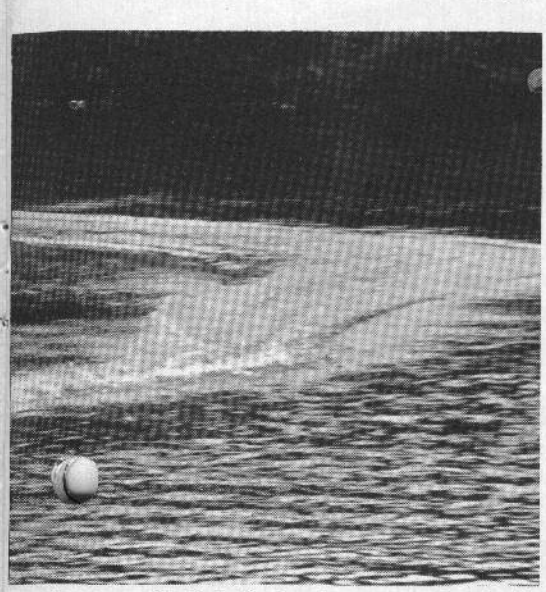
The White Heat 10 is made almost entirely from waterproof plywood, and spruce or pine. These are the materials you will need: (*Continued on next page*)



Bow and stern quarter views of a hull framework help make clear the placing of the parts which would be made with the patterns (reduced scale) opposite.

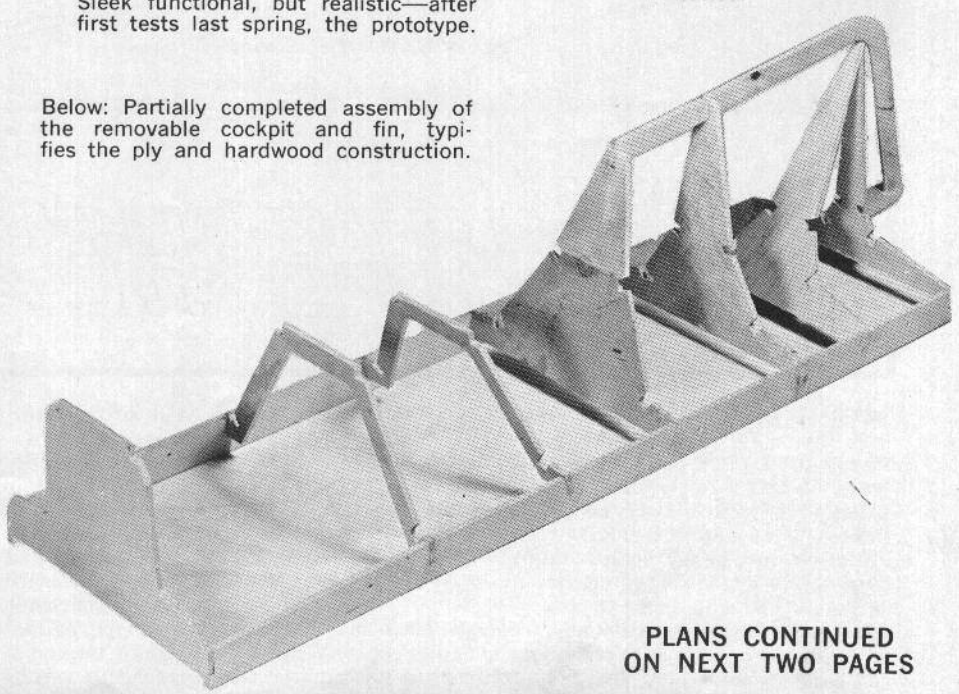


Sleek functional, but realistic—after first tests last spring, the prototype.

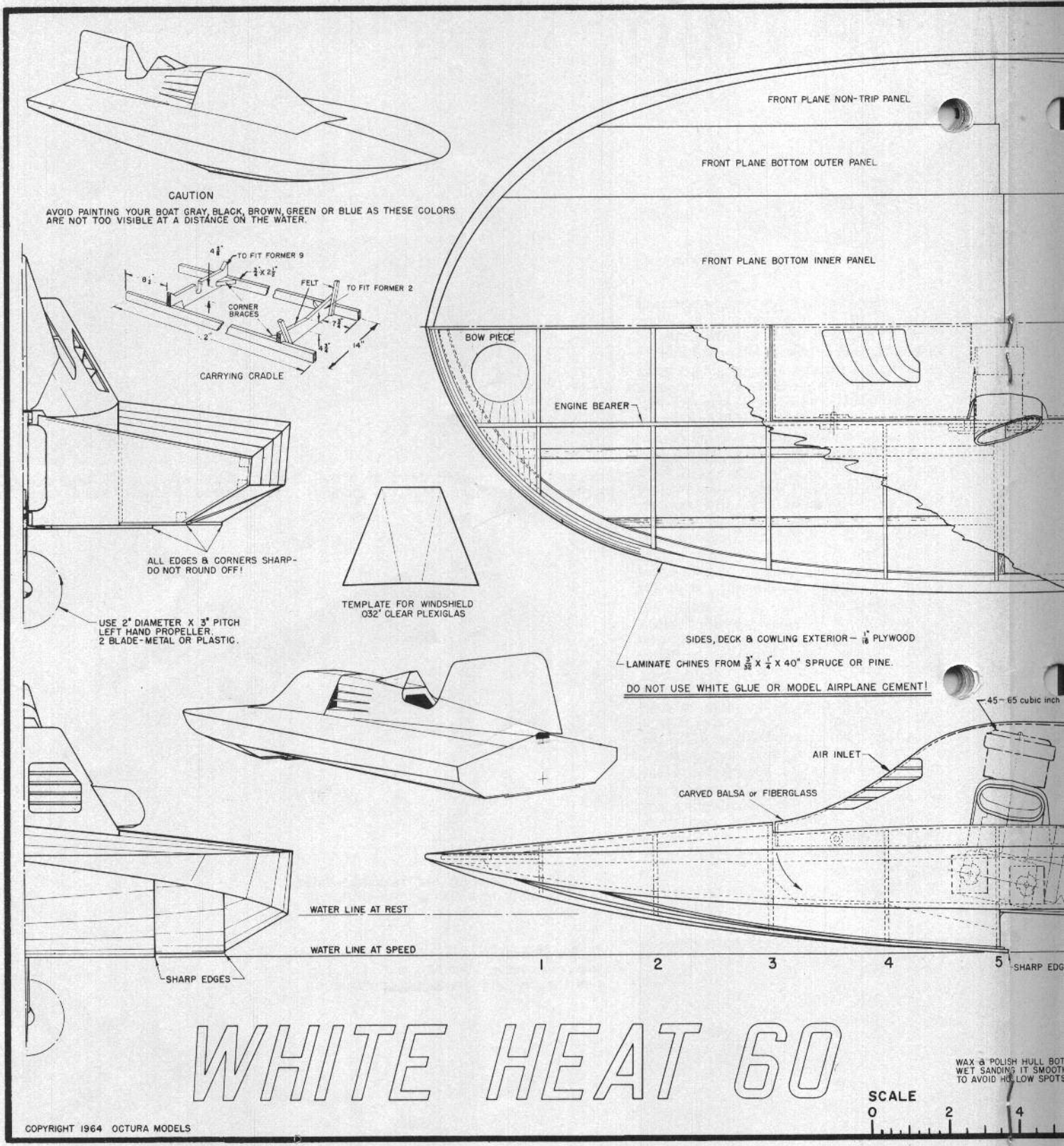


planes well. But first, slow runs for feel!

Below: Partially completed assembly of the removable cockpit and fin, typifies the ply and hardwood construction.



PLANS CONTINUED ON NEXT TWO PAGES

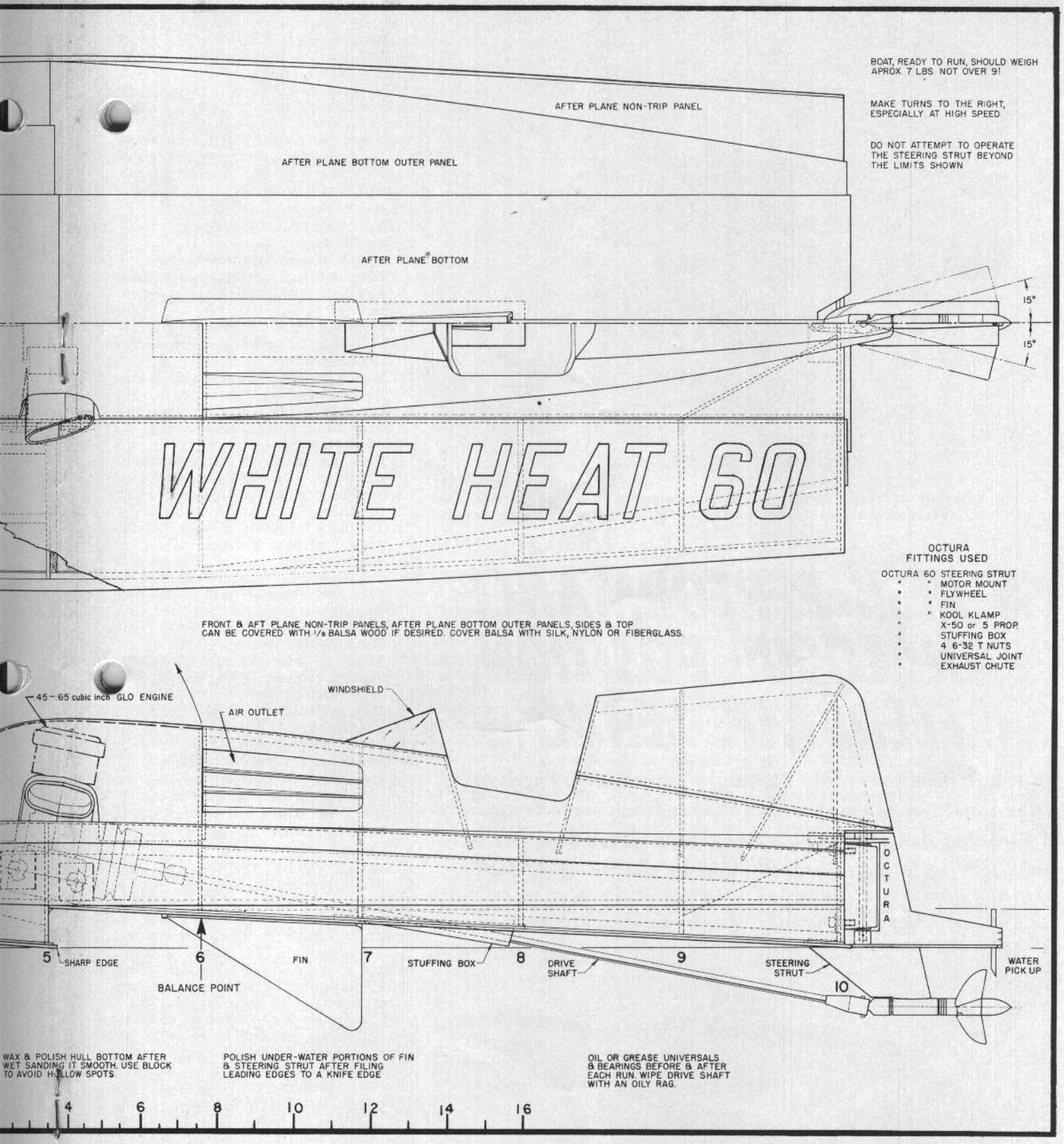


WHITE HEAT 60 . . . Continued

2 sheets—3/32 x 12 x 48 plywood (waterproof)
1 sheet—⅛ x 12 x 24 plywood (waterproof)
2 sheets—1/16 x 12 x 48 plywood (waterproof)
2 sheets—⅛ x 6 x 36 hard balsa
12 strips—1/16 x ¼ x 40 spruce or pine
3 strips—3/16 x 3/16 x 36 spruce or pine
2 strips—¼ x ¼ x 36 spruce or pine

Waterproof glues are required, of course. There are many that can be used, such as Weldwood, Cascimite, epoxy. Weldwood packages some of their waterproof glues in foil packets. Full-size patterns are rubber-cemented to the plywood prior to cutting out parts.

What airplane fans call "flight test" is an interesting procedure with a powerful boat like this one. The engine is started with the servo in low speed, the boat lowered until the prop is in the water, and then the throttle is opened part way. If the engine dies, the needle valve is opened slightly before restarting. Now, if the engine takes the load, the throttle is opened to full. (Brace yourself!) Now the needle valve is adjusted for maximum rpm in the water—the boat held at all times, of course. Return throttle to idle to see if engine will turn prop at this setting. If engine stops, increase throttle opening until it will



FULL SCALE PLANS AVAILABLE — SEE PAGE 23

just turn prop at slow-speed setting. This is the starting point for RC runs.

To begin, release boat at idle. It should ride with bow low on water. Immediately check steering controls. Operate the craft over the course and distance anticipated before increasing speed, checking left and right response as it goes. Now speed is increased slightly and checking repeated. With several hundred feet of water ahead, open throttle gradually with rudder in neutral. Bow should rise and boat begin to plane. With boat just planing, make a left and right turn, straighten out and increase throttle opening.

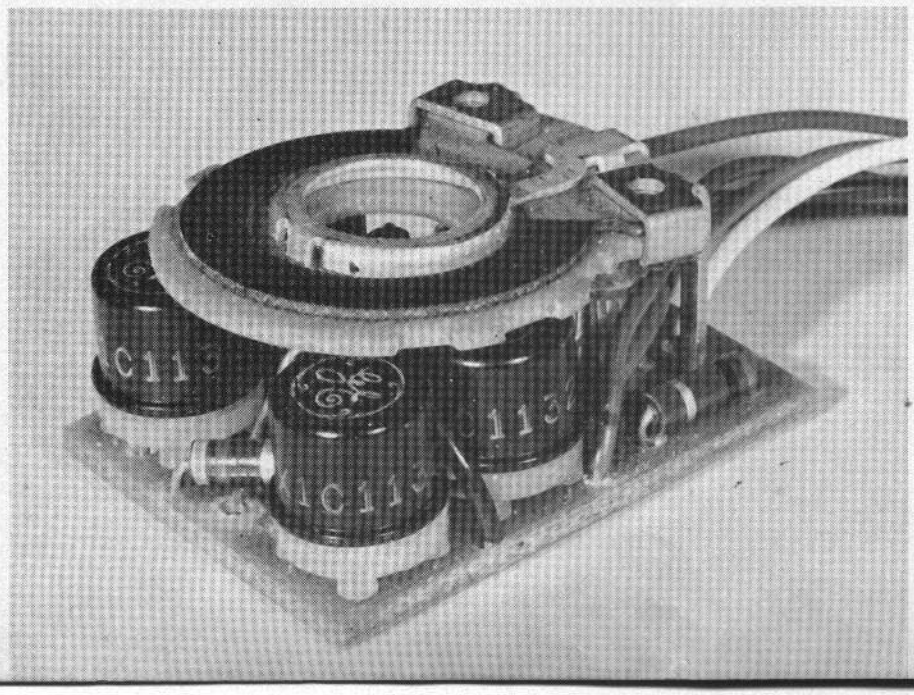
Double check handling before any full-speed runs. At high speeds, turning radius is greater, it may turn tighter to left than right, and may tend to veer. If hull does not break into a plane with slow acceleration, reduce to idle, causing stern to drop and bow to rise. Gradually accelerate, while swinging stern from left to right until planing occurs. If hull is not waxed and polished it may not plane. In extreme cases, planing will result when slight downthrust is imparted to the shaft. This is done by loosening the strut mounting bracket and placing about a 3/64-in-thick washer or shim between the lower part of the bracket and the stern. The upper universal joint is then adjusted to retain 1/64-in. end-play. Steering is tested once more and after you have feel of the boat, speed is increased. ●

Phenolic follower provides electrical isolation, converts crank travel from simple harmonic to a linear motion—as can be readily discerned from picture.

A HIGH PERFORMANCE ANALOGUE POSITION FEEDBACK SERVO

By J. H. PHELPS . . . Now that multi proportional "arrived" it is the consensus of opinion that the feedback servo frequently is a trouble spot. The technically equipped will find this well-tested project a major contribution to control dependability.

The transistors and circuitry fit compactly into this subassembly which may be found in the top photo, underneath gearing. Servo mounts upright or flat.



THE INTRODUCTION of simple, useful position-feedback servo-mechanisms has sparked system subtleties which would not be possible without the servo's capabilities.

The servo design to be discussed was undertaken to provide certain features considered essential to spread the advan made with the presently available models. For the sake of simplicity we will divide these features into two categories, mechanical and electrical.

Mechanical Features:

1. High usable "thrust" or torque.
2. Rapid response.
3. Rugged, efficient, long-lived motor.
4. Strong, tough gear train with good wear properties and jam-resistant construction.
5. Easy mounting of the servo assembly.
6. Connection to metal pushrods electrically isolated.
7. Output direction easily reversible to correct installation oversight or errors.
8. Output connection which is not as "neutral-sensitive" as is the simple crank.

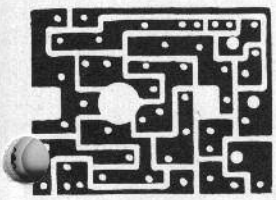
Electrical Features:

1. Equal torque in both directions of output travel, thus equal response times.
2. Smallest practicable "dead-band" (high resolution).
3. Tolerance for errors in wiring to supply and reference batteries.
4. Easily alterable transfer function with highest practical basic sensitivity.
5. Very low neutral drift with wide temperature extremes (−20 to +70° C).
6. Good transient response.
7. Ability to withstand motor armature blocking without failing one or bot output transistors.
8. High input impedance (high resistance low capacity).
9. RF noise suppression.
10. Freedom from spurious oscillation.

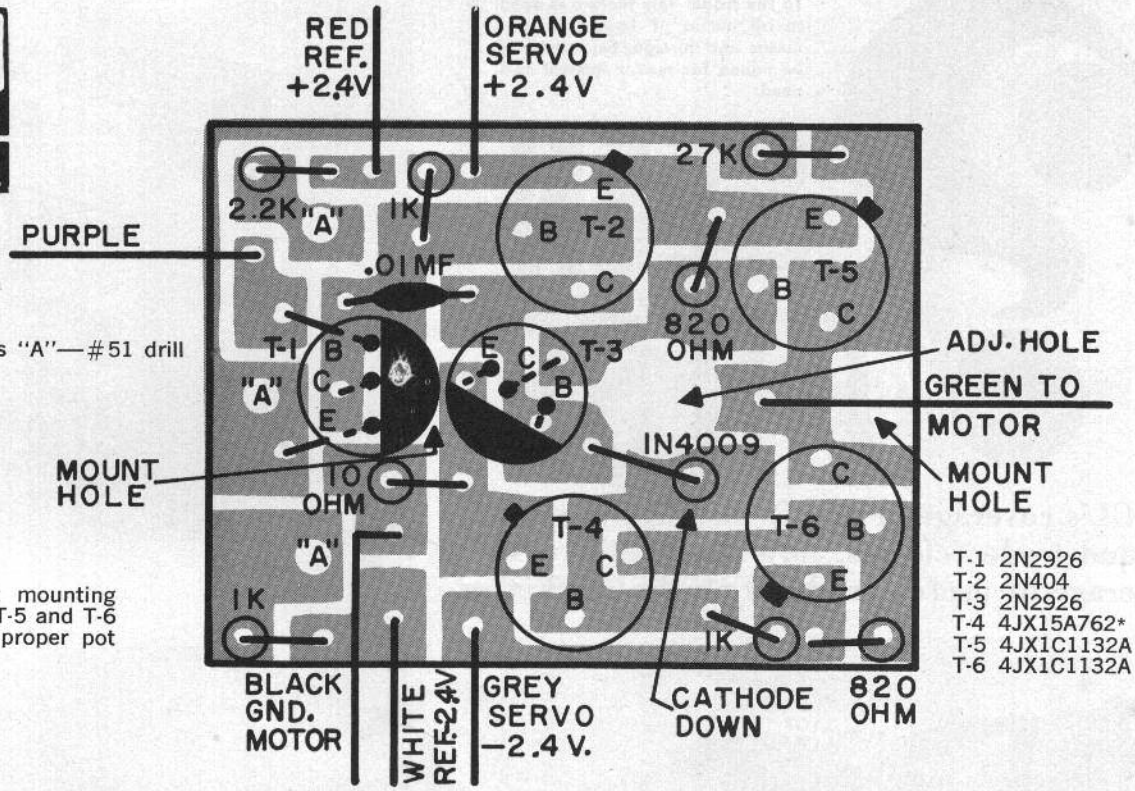
Since all of the foregoing features are largely lost if they are achieved at the expense of cost, a third and cardinal objective was to achieve the desired features with a simultaneous reduction in cost!

Mechanical Design: The first and most formidable problem lay in motor. Existing motors are considered generally serviceable but each lacks certain properties and, although reasonable in cost, are certainly not "inexpensive." The motor ultimately selected is rugged, efficient, has high torque and is inexpensive. In fact, the only feature it lacks is very small size—but then torque sacrifice is the price ordinarily paid for small armature diameter. Immediately following Howard McEntee's deeply appreciated introduction to the FM 170 series of motors, samples were procured and the 1820 model selected as optimum for the job at hand. In June, 1963, the torture tests to establish the mechanical suitability of the motor were begun. The most severe, was actual flight test, using the motor as a Galloping Ghost actuator with *uncushioned* stops.

In addition, the motor was fastened rigidly to the fuselage bottom (plywood) and an unbalanced prop mounted on both the motors used in the test. Flights were terminated by cold weather with no failure and were resumed in the spring. Static no-load running tests are still in progress and at this writing have yielded no failure. The



ACTUAL SIZE



Mount holes and holes "A"—#51 drill
Adjust hole #9 drill
All others #67 drill

3 holes "A" for pot mounting tabs. Mount T-2, T-4, T-5 and T-6 1/8" off of board for proper pot support height.

T-1 2N2926
T-2 2N404
T-3 2N2926
T-4 4JX15A762*
T-5 4JX1C1132A
T-6 4JX1C1132A

nature of the motor brush configuration is ingenious and brush examination reveals *no perceptible-wear* at 100 hours. Further, the commutator segment overlap provided by the brushes makes the motor free of dead spots.

Mechanical design was solved very early in development with the discovery that the natural mechanical configuration for the FM 170 motor already existed in the form of Don Steeb's current servo configuration. His unit has for sometime enjoyed a fine reputation and is considered to provide a nearly ideal mechanical arrangement. The two most significant modifications were in the number and kind of gears and the addition of a phenolic "follower" to provide the convenience of electrical isolation, easy direction reversal and removal of neutral sensitivity. (Converts crank travel from simple harmonic to linear motion.)

The motor itself is held tightly by a cut-out in the servo base and self-tapping screws in the deep plastic shoulder. The heavy aluminum alloy base is sprung slightly to firmly attach the cover, and the entire structure is strong and impact resistant. Further, since it is all metal, electrical noise can be confined entirely to the interior of the box and a new low level of both conducted and *radiated* radio noise achieved.

The servo may be mounted upright or flat with its long dimension fore and aft. The nature of the phenolic follower adds the convenience of nylon chord drive for controls, since it provides push-pull action. This action permits directly driven aileron pushrods in installations such as the Viscount or Taurus.

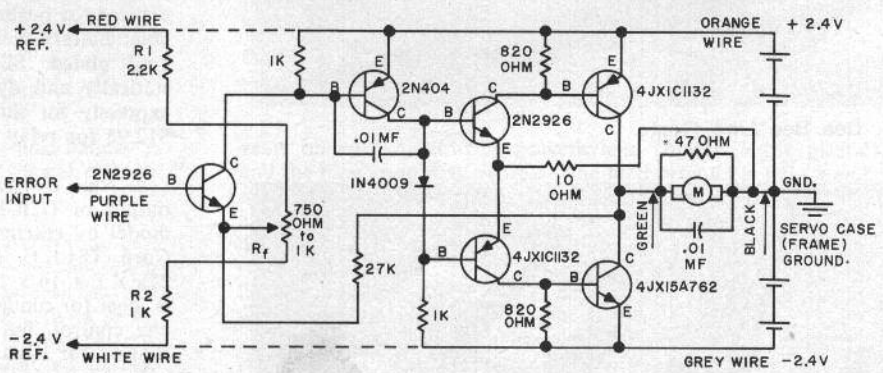
Finally, the exceptionally high vibration resistance of motor and gear train allows firm servo mounting to the servo tray.

Electrical Design: Motor load current is provided by ± 2.4 volts supplied by nickel cadmium cells. The direction of current flow is determined by the output transistor selected to conduct, and special measures are taken to insure that both transistors never conduct simultaneously. This guarantee is carried to high ambient temperature by controlling output transistor Icbo and by operating in *forced* saturation rather than at or near saturation. This base overdrive permits very low "on" drop and high efficiency performance.

In order to achieve forced overdrive it is necessary to operate both switch transistors in the common emitter configuration, and design their specifications to complement that of the driver transistors. Further, the emitters of the common collector driver transistors *must* return to ground, (the battery tap) and *not* through the motor. Since this necessary practice opens a "lightening" path (one through which emitter current in the driver is limited only by the emitter and base bulk resistances) a 10-ohm current limiting resistor is provided.

The use of complementary symmetry in both output and driver stages has arranged things so that driver bases may be electrically connected together. Elevating or depressing their base potential by an amount greater than ± 200 mv (approximately) causes one pair or the other to conduct. Further, the shared emitter resistor provides additional reverse bias for the "off" driver base-emitter junction. The 400 millivolt offset or barrier potential does, unfortunately, set a .4 volt "dead-band." If as in actual final design a silicon NPN unit is used in the lower driver position, this dead band jumps to .9 volt and becomes troublesome. The situation is easily remedied and dead band reduced to a safe, nearly ideal, value of 200 mv by using the voltage rise furnished by a silicon diode placed between driver bases as shown. The identification and removal of at least half of usual practice dead band and the provision for output transistor overdrive are simple obvious measures which have performance effects which belie their simplicity.

The next stage (*Continued on page* 28)

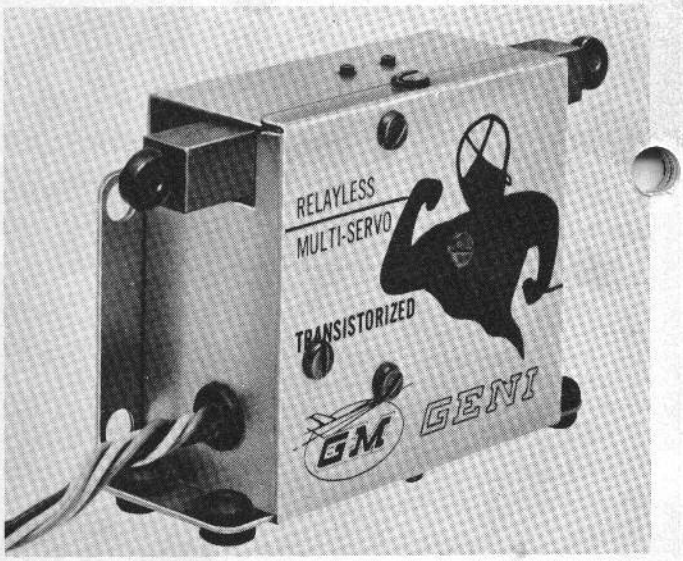


With R_1 and R_2 as shown ± 90 degrees of output shaft travel is caused by ± 500 mv of error voltage change above ground. This specification can be changed at will by altering R_1, R_2, and Rf. The need for a separate reference (shown by broken — and + 2.4 volts busses) is established by the system. The arm of 1K-100K pot may be used to supply an error voltage for test. M equals FM170-1820 motor.
*Do not operate without this resistor.

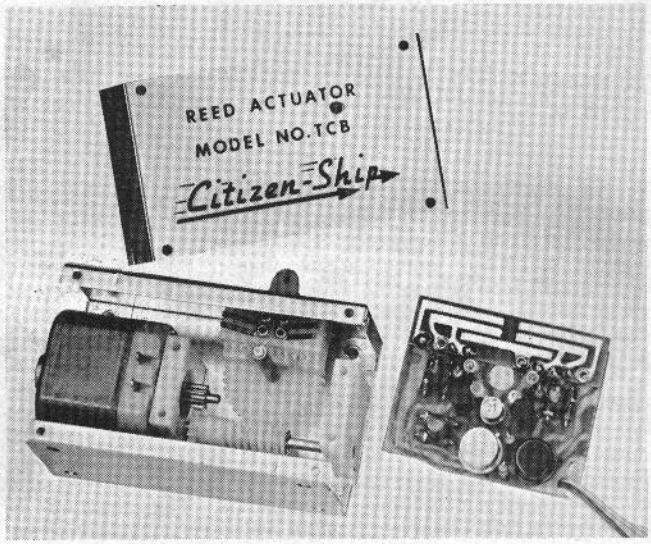
To the trade: This feature is open to all makes of equipment, domestic and foreign. Selection will be edited for reader interest and need.

? SEEN THESE

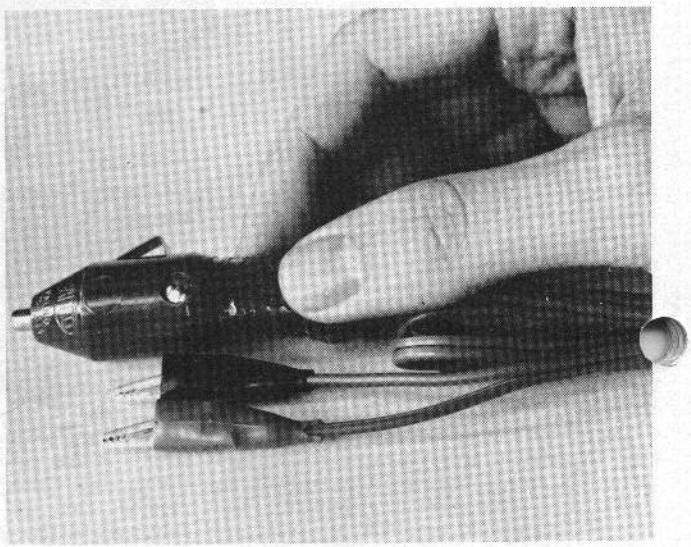
GL's coverage of new items, information and trade releases, now includes a coverage of useful products on the market.



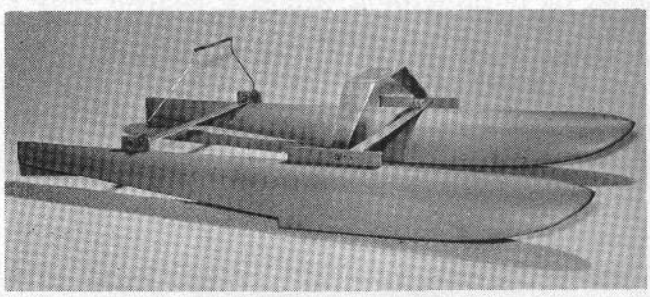
1. GM Geni Servo



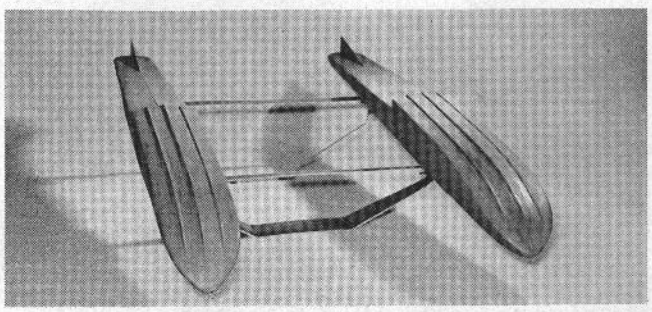
2. Citizen-Ship TLB & TCB Servos



3. Spacetron Plug-in Mobile Charger



4. Gee Bee Line Floats



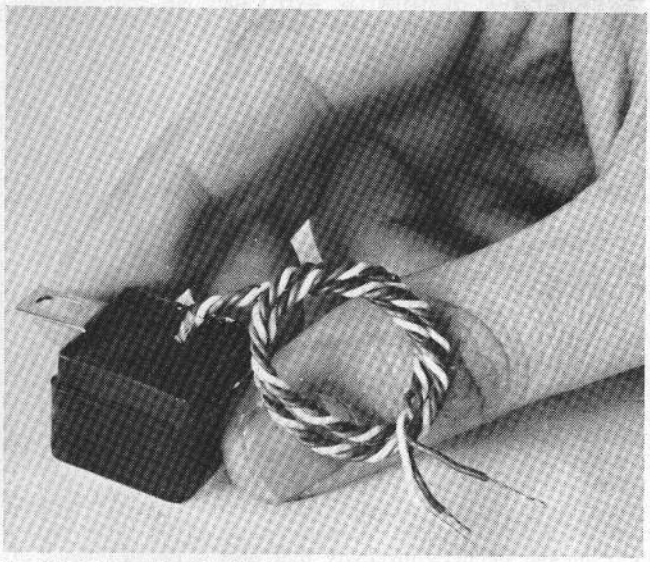
5. Gee Bee Line Floats

1. Geni Servo: Small size and light weight characterize the GM Geni. (GM Hobby Specialties Inc., 2072 Front St., East Meadow, L.I., N.Y.) for either relayless or relay equipment, self-neutralizing for rudder, aileron, elevator, or trim for engine and elevator, for any plane from .049 to .60 power, states the manufacturer's release. Size is 1¾ x 1 9/16 x ¾; weight less than 2 oz., current drain 180 to 450 MA. Linear travel, convenient for pushrod attachment, is ¾ in.; travel time is adjustable. Battery power required is 2.4 to 3.6V. Wiper boards are gold plated. Silver brushes and silver collector. Armature statically and dynamically balanced. All-new motor designed expressly for this servo. Prices: $29.95 for relayless version, $12.95 for relay version.

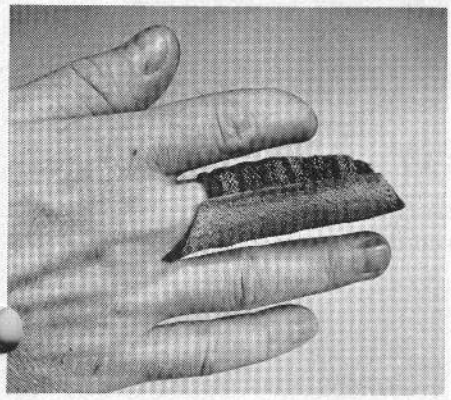
2. New Citizen-Ship Servo: In two models, TLB for linear output, or TCB for cam action output (either converts to other model by rearranging parts), this servo by Citizen-Ship Radio Corp. (810 E. 64th St., Indianapolis, Ind. 46220) measures 2⅝ x 1 9/16 x 1. Weight is 2¾ oz. Cam action TCB (shown) is ideal for rudder, elevator and aileron control; TLB, good for any control, but ideal for motor and trim. Rack and pinion gearing for linear action.

Features include integral amplifier board and switcher plate to eliminate interconnecting wires inside servo; nylon gears and parts, low-drain motor with dual brushes and self-aligning bearing; positive burn-out protection from transistors in case both reeds make simultaneous contact; trim adjustable; direct operation any reed receiver regardless of receiver voltage. Outstand-

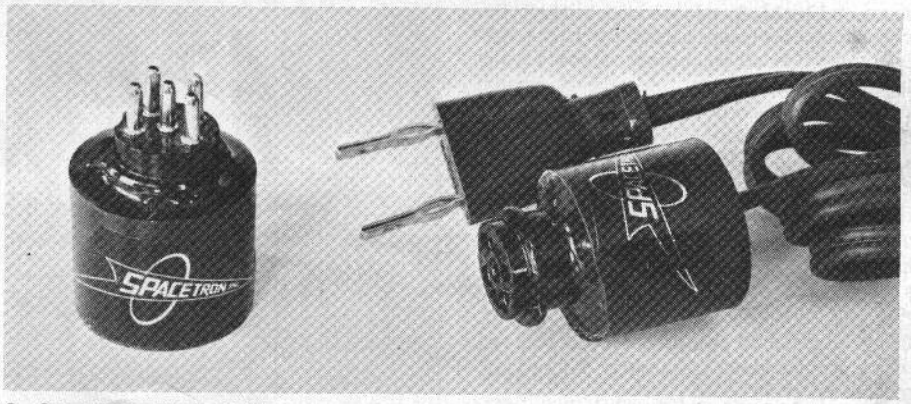
6. AHC's Astro 33



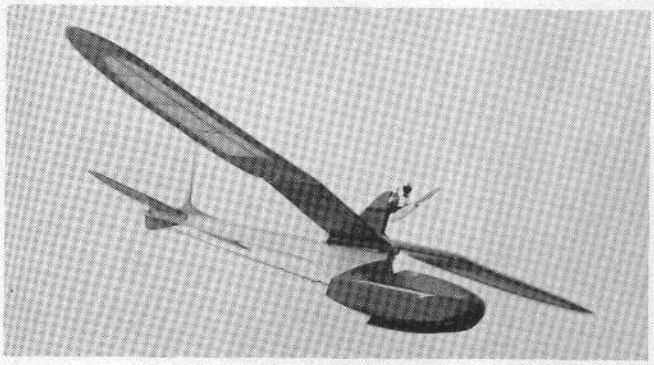
7. Spacetron Double-Ender



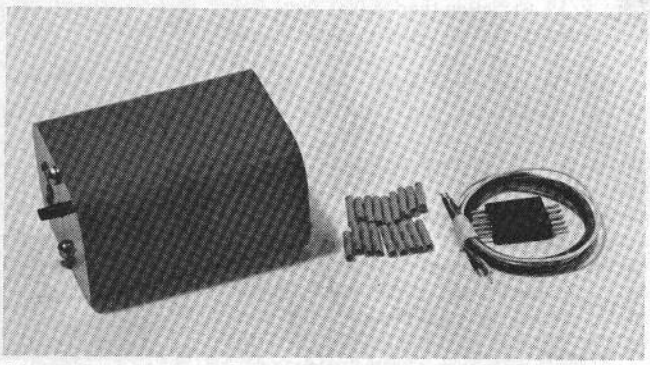
8. Flight Line Prop-Gard



9. Spacetron Pack & Charger



10. Custom Kits Gulliver



11. P & D. Battery Box

ing feature in manufacturer's opinion is that no bias battery is required with transistorized multi servo—uses 4 nickel cads or pencells. Price, $25.95.

3. Mobile Charger: Plugs into cigarette lighter of your car, for quick boost of battery packs on field, or full overnight charge. Simultaneously charges as many packs as desired—add 75 cents for each extra pack. Takes from 1 to 8 cells in series (10V) with 12V car battery; 1 to 4 cells (5V) on 6V battery. Charging rates 0 to 300MA, upper limit depending on battery pack voltage and car battery. When ordering specify: 6 or 12V car battery; whether auto battery ground is positive or minus; charging current desirable or MAH capacity your battery pack; battery pack voltage. Price $2.95. By Spacetron, Inc. (Box 84, Broadview, Ill.).

4. and 5. Gee Bee Line Floats are the result of over two years of work in utilizing polyethylene (bleach bottle plastic) and the blow-moulding process. The final product is light weight and virtually indestructible. Complete and ready to mount, with all hardware, on any conventional model landing gear—just drill 3 holes in each float tap to accept the model axle and spreader-bar bolts. Floats attach as easily as wheels. Each float is mounted independently of the other so that no damage will result from a hard landing or crash.

Operate equally well off water, snow or land. On rough terrain they will function better than wheels and the model will not tip over on any decent approach.

Floats are available in two sizes, from the Gee Bee Line (P.O. Box 347, Forest Park Station, Springfield, Mass.) The 19½-inch is for ½A's. Weight per float is aproximately 1¾ oz.; and the 28-inch for .09 up to small .20's, weight per float approximately 3 oz. Both sizes mount (*Continued on page* 24)

World's Record-Breaking Attempts Becoming Popular New Sport!

The A.M.A., who processes F.A.I. Sanction applications, reports on interesting differences between record trials and regular meets.

BEFORE THE SUMMER is over, the Academy of Model Aeronautics expects to verify some new world's records in R/C. Several FAI record sanctions have been applied for, and indications are that record trials will become a popular new dimension in competition flying. It even appeals to many R/Cers who are not particularly interested in regular contest competition, AMA has observed.

There are two basic differences in record trials and contests which may explain their appeal. One is the competitive atmosphere. Unlike the rush, rush, emotion-charged atmosphere of most contests, record trials tend to be a more relaxed form of competition. The object is to beat a performance record rather than another individual's general flying ability as determined by judges.

The second difference, and one that should appeal to GRID LEAKS' readers, is that breaking a record depends much more on the builder's ingenuity that does present day contest winning. Here is a fresh new field for the gadgeteer. Now that R/C has shaken down to highly reliable equipment and highly pre-fabricated aircraft, the contestant of slender means often is hopelessly outclassed by money alone at the larger contests.

Not so in record trials. Although Maynard Hill used Sampey equipment in his record breaking altitude flight last year, his aircraft was an inexpensive, slab-sided job, using a non-tapered wing having his own airfoil design. He built it in a week, after breaking the first altitude ship.

Walt Good flew to better than 10,000 feet, also breaking the old Russian record, using his original five-tube WAG receiver, and a ground based transmitter dating back to the early 50's.

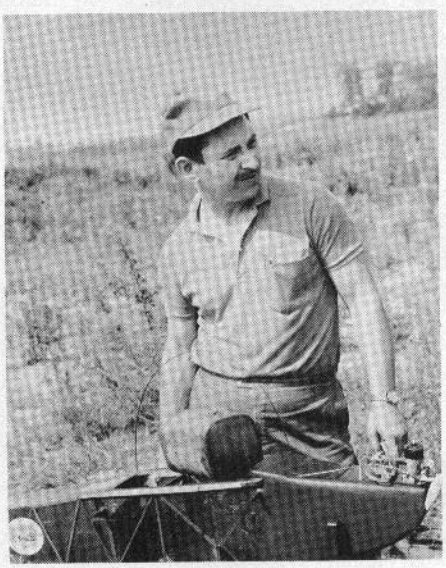
In fact, Fremont Davis flew a little Kraft-equipped single-channel ship powered by a .19 to better than 5,000 feet. Bob Scott in breaking the world's speed record used home-built reed equipment in a modified Hustler-type delta. The McCoy .60 was pressurized, but otherwise stock.

Besides speed and altitude, world's records in R/C include duration, distance in a straight line, and closed course distance. Every existing record is well within range of being broken, the Academy says. Except in speed, new records must beat preceding record by at least 10 percent. Speed is 2 percent. Here are the latest available records as compiled by FAI for the two R/C categories (Below, right):

Setting up a worlds record trial event is a bit more complicated in terms of paper work and verification than the conventional AMA sanctioned contest. The reason being that FAI demands as much proof as possible of actual attainment before granting the international honor. In many countries the central government sponsors model competitors, and therefore becomes directly involved in the record race. By the same token, AMA as the United States representative to the world body, must insure that the international organization's standards are met.

Nevertheless, once the procedure is learned, it can be accomplished quite easily with the help of AMA, the organization says. Here is a (*Continued on page 32*)

The editor took this pic of CD, J. D'Amico, second from R; N. Rosenstock, R, partner in duration attempt; and official observers. Engine quit after 2½ hours.



Close-up shows 84-oz. tank. K&B .35 cruised at 7 ozs. per hour. Duration on a .15 Diesel, approximately 18 hours. Many attempts verify problem is engine run.

Maynard Hill, AMA prexy, about to start his Fox .59 during 1963 DC/RC trials. He got big ship up to 13,000 feet plus, using Sampey proportional system—a record.

Class F3 A, Radio Control			
Altitude:	Maynard Hill, United States and Don Jehlik, United States	13,328 feet	July 1963
Speed:	Bob Scott, United States	126.9 mph	July 1963
Duration:	N. Malinkov, Russia	6 hrs. 13 min.	Aug. 1962
Distance: (Closed Course)	N. Malinkov, Russia	113.17 miles	June 1963
Distance: (Straight Line)	P. Velitch Kovsky, Russia	114.96 miles	June 1962
Class F3 B, Radio Control Glider			
Altitude:	Nicolai Prejjine, Russia	1,978 feet	June 1959
Duration:	Ian Barber, New Zealand	9 hrs. 4 min.	Oct. 1960
Distance: (Straight Line)	Zdenek Taus, Russia	19.28 miles (Apparent)	Mar. 1962

GL At Play

(*Continued from page* 1)

The Mrs., and I, were not able to attend the May 16 and 17 Symposium of the DC/RC this year, as we had done in years past. We are grateful to receive from Frank Schwartz, of Nashville, a run down on the technical talks.

"One needs to remember that this meeting, or more properly, a Symposium, is not a manufacturers' show," Frank began. "It is rather a series of lectures relating directly to several of the many phases of radio control.

"Held again at the Johns Hopkins Applied Physics Lab, there were representatives from Citizenship, A.C.L., Acutronics, Klinetronics, Top-Flite, Sterling, Pettit Paint, Bonner, Sullivan, Dee Bee and others. But these are always more on the standpoint of participation, rather than presenting items that they have for the public.

"The first lecture was presented by Dick Jansson. Subject was R/C Interference. He spoke on the problems encountered with the present-day superhets, as well as with Citizens-Band Operators. Bob Elliott from California spoke on a basic digital proportional system, and while he did not demonstrate any equipment, his material related to the digital (as distinguished from the tone systems of such systems as Sampey and Klinetronics) and was extremely well presented and well received. Bob pointed out that basically all digital systems are alike, and vary only probably in configuration and packaging. Dave Adney, from Motorola, demonstrated and lectured on a high power (5- to 10-watt) transistor transmitter. While this was not strictly a radio control transmitter, it was felt that his subject did show the progress on transistor technology.

"Matty Sullivan of Sullivan Products showed some of the amazing properties that will undoubtedly show up in R/C products. One of these was a plastic called Lexan, which can be laminated into fuselages or wings, and will make a very strong and light structure.

"Bernie Murphy of Accutronics demonstrated how styrofoam wings are made. This was a follow up on two previous excellent presentations by Ed Izzo, at the Syracuse and Toledo conferences.

"E. J. Lorenz reported briefly on the AMA-FCC committee progress in working with the Federal Communications to secure additional frequencies for the R/C fans. His report indicates that real progress is being made, and it was pointed out again that this is being entirely financed from donations from individuals, clubs and manufacturers.

"Carl Swaab spoke on the Quadruplex system," continued Frank, "explaining how it worked, and went into the system's operation, and also into detail on the new non-feedback servos used with it. Following this, Al Kline of Klinetronics lectured and demonstrated his proportional gear.

"Sid Axelrod of Top-Flite Models then spoke on propellers, and this writer concluded that there is much more to just cutting a prop out of any old piece of wood.

"The concluding paper was presented by Fred Muscino, who covered the potting of R/C components. Fred had many samples of potted gear, and much of his demonstration also touched on the subminiaturization, as well as encapsulation.

"Some new items were discussed as being just around the corner, and for our readers we are presenting this brief rundown: Sterling had their single-channel Class I system on display. This is a pulse system—it was shown also at the Toledo affair.

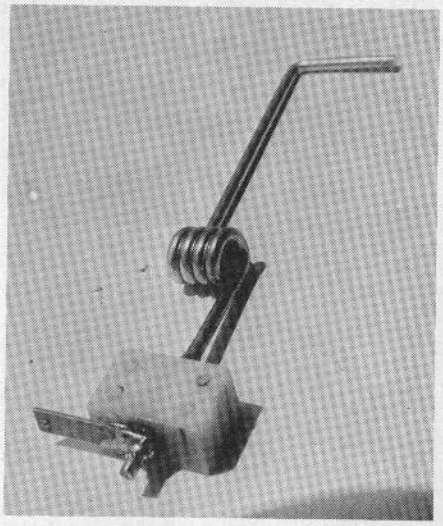
"ACL had their Mark II proportional system displayed. Citizenship had a new servo for reed systems, which deserves mention—it has a linear (straight) throw, requires no bias battery, since only four nickel cadmiums total are needed, and is compatible with any reed receiver. A 4.8 volt potential with a center tap is all that is required for this all nylon gear bit, and the individual user also has the option of setting this for slow action around neutral, or normal speed throughout the entire travel for trim. All wiring is practically eliminated inside the servo, and even the motor terminals are soldered directly to the printed circuit board, which also contains the switcher plate. The units are smaller than the present Citizenship servos, and by their very construction, in my opinion, should have extremely long service life.

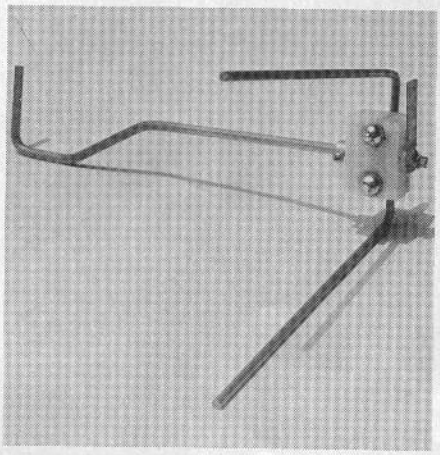
"Lloyd Sager was on hand to demonstrate Bonner's new proportional system, which will be tagged with the name of 'Digimite'. The first test model of the new system was demonstrated. There are four normal functions: rudder, aileron, elevator and motor. There is the option of four additional auxiliary controls independent of the first four. The system apparently will come with four servos, but with plugs for eight! Owner's option will dictate how many servos are to be used. The transmitter has a unique dual stick mechanism with a magnificently molded assembly, which is revolutionary in appearance.

"Our opinion is that the stick assemblies alone would be a big demand item for home builders of proportional systems. The Bonner Digimite receiver is small and compact, utilizing silicon transistors throughout for temperature stability.

"The Digimite System weighs in at 26 ounces, with four servos, harness, batteries, and receiver, and, according to reports, is to be priced competitively."

We can say of affairs of this kind that they seem to us to be exceptionally worthy club projects, and should be considered by all R/C Clubs in the nation looking for worthwhile endeavors to tackle. — *Paul Runge.*





Top: Candy-type steerable nose-wheel gear, claimed unbreakable, excellent for Stormers, the Candy, and all rail-type mounts—$4.95. Above: The smaller gear for trainers, steerable, but has no coil spring—$3.50. (R & L Specialties, P.O. Box 253, Camarilla, Calif.) R & L also has new multi-trainer which features fiberglass construction.

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Seen These?

(*Continued from page* 21)

in exactly the same way and are fully adjustable both fore and aft for width. On the 28-in. size provision has been made to incorporate a movable water rudder. Free Flight, U-Control or Radio Control, the Gee Bee Line Float will put another dimension into your modeling fun. Prices: 19½ in., $5.95; 28 in., $8.95.

6. Astro 33 Transmitter and Receiver: Introduced by America's Hobby Center (146 W. 22nd St., New York 11, N.Y.), transistorized transmitter and relay-type transistorized superregen receiver come in matched pairs, at AHC's price of $39.88 (value is stated as $80.00). Transmitter takes 18V, receiver 9V. Relay in receiver provides flexible use with escapements, or pulse proportional servos or actuators.

Transmitter: Size is 1½ x 3⅛ x 5⅜; weight, 13½ oz. with batteries (metal case). Off-on toggle switch, pressure-type microswitch for keying. Crystal earphone plug-in for monitoring tone (500 cycles per second), was considered more important than monitoring voltage. Self-contained, collapsible, 12-section, 50-in. antenna.

Receiver: Glass epoxy printed-circuit board, receiver pre-wired to the connector —just hook up to actuator and batteries. Complete installation kit includes double-pole, double-throw slide switch; battery connector; 7-pin plug; miniature plug-and-jack set. Size is 1¼ x 1⅛ x 2½. Weight, 2¾ oz.

7. Transistorized Quick Blip: Encapsulated unit by Spacetron, Inc. (Box 84, Broadview, Ill.) provides double-ended output of such receivers as Opal 400, allowing them to be used for quick-blip motor control or with magnetic-type actuators for proportional control. Size is 13/16 x 13/16 x 21/32; weight .4 oz. Price $4.95.

8. Prop-Gard: Soft, flexible but tough leather held securely to finger by band of elastic, protects your finger from the prop when flipping the engine. $1.00 from Flight Line Industries, Inc. (Box 853, Lincoln, Nebr. 69501.).

9. New Battery Backs, Charger: By Spacetron, Inc. (Box 84, Broadview, Ill.), packs consist of American-made nickel cadmium batteries with mating connector. Two models: 250-2.5V—two cells, 250 MAH, 1 3/32 x 1, 1/3 oz. $6.95; 250-3.75 —three cells, 250 MAH, 1 3/32 x 1⅜, 1.9 ozs., $9.45. The 3-cell pack also is tapped for 2.5 minus.

Charger: Right in pic, similar appearrance to the pack—note mating plug on pack. Fully charges any number of 250 MAH cells—up to 30V—in 24 hours, or a 500 MAH pack in 48 hours. Encapsulated, $4.95.

10. Custom Kits Gulliver. Manufacturer of the Chicken Hawk and the Gypsy airplanes, is debating putting out a Gulliver. According to Ted Strader, designer, this has a wing span of 48 in., total weight of 11 oz. It is of the pod and boom type,

with a gentle gull wing. Wings are almost two-thirds sheet-balsa covered. The tail and wing is removable. Designed for hot .020, .024, and .049 engines.

Custom Kits (2 Troy Place, Schenectady, N.Y.) is interested in your reaction. If sufficiently favorable, this would be ...tted at about $5.95. (This is a reader response inquiry, and you are invited to correspond with Mr. Strader directly.)

11. New Battery Box: From P & D Manufacturing Co. (Chino, Calif.) announcement of a 600 SC battery box, designed for reed use. This battery box is of a high-impact crash-resistant plastic, and will hold the popular Gould-National 600 cylindrical centered cells in a 6V reed pack. Many multi flyers are going to the 600 MAH cells for that extra safety that they provide. Available from Ace R/C, this is catalog #3853—P & D 600 Battery Box, $3.25.

Miscellaneous: From Midwest Products Company (400 S. Indiana, Hobart, Ind.), announcement of a vibration lock screw. (Midwest packages Fu-seal and other hard-to-get items.) The new lock screw has a nylon insert, and cannot vibrate loose. It may be used over and over again. These screws are ideal for mounting motors. Package consists of 4-4/40 x 1⅛ in. panhead screws, with 4 washers and 4 nuts. Price, 45 cents per package.

From Almega Company (Box 110, Caldwell, N.J.) announcement of GLUZ-IT, a precision liquid cement applicator for the hobbyist, available in two sizes, a fine tip of 3/32 in. and a standard tip of ⅛ in. Test marketed in a number of hobby shops, has been reordered consistently. The manufacturer states that GLUZ-IT has many advantages over the usual hypodermic type gun: 1) Holds 3 oz. of liquid cement and does not require constant refilling; 2) Precision-ground bevelled tip delivers either a round or a flat ribbon of cement; 3) Delivers the exact amount of cement required, since releasing the pressure on the plastic bottle stops the flow instantly; 4) Not affected by any cement or solvent and the tip cannot come loose.

Almega is the manufacturer of this device, and GLUZ-IT should be available at your hobby shops.

Fiberglass Techniques

(*Continued from page 7*)

to the resin used in fiberglass layups, being an epoxy polyamide compound, and is quite compatible to fiberglass.

Now that we are acquainted with the materials and their characteristics (even though only slightly), let's run through the entire process of building a fiberglass model. While some of the photos show the steps of a racing yacht, my description will be directed toward a multi fuselage, and is equally applicable to most other applications—serving trays, trailer or camper covers, outhouses, water tanks, car bodies, etc.

First, an accurately shaped wooden mold must be constructed. This involves taking the cross sections or bulkheads from the plans and marking off each station on the block. I perfer to spend a bit more and get a good clear piece of soft white pine about four inches longer than the projected fuselage. As each half of the fuselage must be made separately, mark the centerline plainly. As an alternate, sometimes I have the block cut into two equal sides and then spot tack it lightly with white glue at each end at approximately where the nose and tail will fall. Using templates for each station, the entire fuselage is roughed out. Proceed carefully with the file and sandpaper, checking periodically with the templates to insure an accurate cross section. When completed finish with at least 320 sandpaper, removing all bumps and irregularities.

Split the fuselage halves, and cut 1/16-inch deep groove about ½ inch wide along one edge of the right hand side of the mold, all the way around, thus providing a lapping edge for joining the fuselage halves. The wing and tail cut-outs should be accurately marked by a raised portion of the mold. You may want to include a dorsal fin as an integral part of the fuselage mold. This should be smoothly faired in, keeping in mind that any convex surfaces are nearly impossible to form, as they tend to "hold" the fabricated part in the mold, and are most difficult to remove. Avoid 90-degree angle bends in your design (if possible) and always allow a little taper to each side of the male mold. Round or ellipitical fuselages are the best and easiest to work, and also the strongest for the least weight. Just as multi flyers are finding that a model designed for reed equipment is not quite as responsive

when using proportional equipment, so must you accept the fact that working with a fiberglass fuselage requires a different force set-up than a conventional balsa and silk stunt ship. Mac Beauchamp's "Viper" was designed to use a stabilator, what the Marines use to call a "flying tail" on the Crusader F-8A. This ship has been te flown with the new Orbit Proportional equipment with great results. It does the complete AMA stunt pattern using a Super Tigre .56.

But back to the male mold of your dream ship. Secure a sheet of aluminum or sheet steel with sufficient rigidity to preclude any warps, and drill so that each wooden fuselage half can be bolted to the surface with about six inches between the fuselage halves and also from the outer edges. Such space is required for a proper edge to the female mold. As I indicated earlier, the female mold will take on the same degree of smoothness as is on the male mold. Because pine is used on my molds, I spray on a black molding gel coat and, when cured for a couple of weeks, block sand it first with 320 wet or dry, graduating to 600 wet or dry; rub it out with a good auto rubbing compound, finishing with a hard carnuba wax and a sheepskin buffing wheel. The wax is called Meguiar's "Mirror Glaze," and is used to wax up the female mold each time before the next part is layed up to insure a good separation, when cured.

Wax the sheet aluminum plate so that the finished mold will come off easily and, using wood screws, firmly fasten the mold to the plate, allowing the proper spacing. For some reason, fingerprints will cause the sprayed or brushed gel coat to separate and run—called "fish-eye" condition. So before the next step, buff again with a sheepskin buffing wheel to remove all perspiration. As a matter of fact, one more coat of wax would not be amiss—a full coat reaching all portions of the male mold. If you miss a spot, the next coat of black molding gel coat will join with the one already applied. Now, just in case you cannot obtain molding gel coat for the male mold, it will be OK if sanding sealer, butyrate dope and lots of albow grease are used for obtaining a glass-like finsh. But the two or three coats of hard wax must be applied over all the portions of the mold.

If you have black molding gel coat, fine, but either black gel coat or clear resin will do for the next step. Experience has shown that with a black background in the female mold, the white bubbles, in the resin and fiberglass fabric are very apparent. These bubbles form because of improper wetting of the fabric and result in a weak spot and a defect that is quite difficult to repair, especially on the final fuselage, so add the catalyst to the material you plan to use for the first coat of the female mold. It can be brushed, though I prefer a spray gun to apply a heavy coat to all portions of the wood mold, even down to the very edge. After a good heavy coat of resin (tooling gel coat preferred) has been applied to both halves, let it cure for six hours or even overnight. Then with 1-oz. mat, begin to cover the fuselage halves, using rubber gloves on the hands, a dish of acetone handy for sticky mat, and a 4-inch bristle brush to apply the

laminating resin.

(Laminating resin differs in viscosity from ordinary resins and, if properly catalyzed, will form a uniform surface of resin over the mat.)

Do not expect a smooth appearing coat on the outside of the male mold in forming the female mold. And do not try to apply too much resin for that reason. Let each coat of resin and fiberglass fabric cure overnight, then apply no less than eight coats. Before the last coat, cut two equal lengths of thin wall conduit for each fuse-half, bending slightly to conform to the curve of the fuselage mold now built up with eight layers of fiberglass cloth (1 oz./sq. ft. weight). Make sure that this thin wall conduit (used for house wiring) extends to each end of the nearly finished mold. This adds strength and rigidity to the mold and provides a backbone for handling the mold.

The conduit is fastened to the mold with woven fiberglass tape or strips of fabric cut about two inches wide properly wetted with resin. Position it on the mold with an eye to maintaining an all round strengthening of the mold, i.e., make it serve a useful purpose. After the last coat has cured a week, remove the wooden male molds from the female molds. This should not be difficult, providing the proper amount of engineering has gone into the male mold and no un-relieved spots occur in the mold. As I indicated early in the text, working a female mold too soon will result in the mat strand appearing inside the mold. So wait at least 14 days before sanding the inside of the mold with 600 wet or dry emery paper, and then only wet sand the rough spots out. Rubbing compound and lots of energy are next on the program, finishing up with that good carnuba wax in three or four coats. By now you have fully realized that making a fiberglass fuselage is not the easiest method in the world for your dream ship. However, once you have progressed this far, you have the world on a string.

The next step, insofar as developing a light weight, properly stressed fiberglass fuselage is concerned, is very important. If you are using a three or more part fuselage and want to gel coat it for an extremely good finish, thin the gel coat of your color choice to a spraying consistency with acetone, and add the catalyst. Immediately spray a thin even coat vertically first, then re-spray horizontally during the same spray application. Don't skimp on the edges, but apply a good cover coat. If you are not using gel coat, but prefer to paint or spray after the part is taken from the mold, begin with a fairly wet coat of resin and mat. You will find that the 1-oz. weight mat will be too heavy for certain applications, particularly near the tail. It is possible to split the mat into equal halves, but this and the cutting to shape should be done in advance of the actual working with the female mold. Keep in mind that the mat provides the necessary strength, and the resin the bond. When there is no mat or fabric to strengthen the fuselage, the resin-rich area lacks flexibility and will crack when stresses are applied.

You probably will need a layer of 1-oz. fabric near the area of the horizontal stabilizer, and two or more around the wing area. Using a wing fillet complicates the design, but makes a good platform for the wing to rest upon, particularly in a low-wing design. In some designs, this opening is the only break in the fuselage after the canopy is installed, and the tank and power pack is installed through this opening. Of course, shoulder wing designs need more layers of cloth in the immediate area, but a word of caution, fiberglass bonded in resin is very strong; so strong that the U. S. Army military specifications require laminated fiberglass transmission drive shafts and other applications, claiming that properly engineered, the strength exceeds that of dural or aluminum, with comparable

weight. So go easy when building your first fuselage. I recommend that the hardwood motor mounts be installed, whether you have chosen the motor or not, because a breakaway engine plate can be used. Match the nose to the spinner diameter. And do not overlook a side-mounted engine with the exhaust pointing down and the needle valve up for a clean configuration.

Again recall that the final product should remain in the mold at least 10 to 15 hours, then be carefully removed, joined with the other half and not sanded nor painted until at least two weeks—preferably three. If, when removed, in preparation of the surface for painting, you find some bubbles (this will happen), break them out and patch with Marson "Rez-zin" (whose plant is in Revere, Mass.). Dwight Hartman, of Argenta, Ill., 62501, has kits selling for $1.00 for this purpose. When all is ready for that final coat of Hobby Poxy, Fuller Plast, butyrate dope, or enamel, rough the surface with 320 or 400 wet paper and apply the coat. Again, if you find that the "fish-eye" condition appears—the paint or enamel runs away from the fingerprints —a small amount (2-4 drops) of DuPont Fish Eye Eliminator will solve the problem.

A short-cut that will save hours of laying up the female mold and will prove that your male molds are correctly engineered, is the use of Polyvinyl Alcohol sheet. This comes in large rolls and is called PVA by the trade. A fairly new material on the plastics market as far as volume production is concerned, the properties that make it useful to the model builder are that it can be stretched considerably, and is a very thin sheeting (.0003" to .0008"). However, generally speaking, it is water soluble. Some PVA is soluble in cold water, and some formulations take 100 degree temperature. This characteristic is an advantage, for in working it, if wrinkles form, a wet finger can rub them out.

Now to the "short-cut" method. Take a piece of wood and, placing the fuselage half of the male mold on it, trace the outline and cut out—so that you have a flat, uniform surface below the inner half of the fuselage when placed on the block. This forms a firm base on which to staple the PVA. Again, the reminder that the ideal mold has no reverse curves. Take a sheet of PVA large enough to cover the male mold and the pedestal block, and tack or staple this to the bottom edge of the pedestal block, insuring that no wrinkles appear over the surface of the male molds. Now apply a layer of resin impregnated mat or fabric to the male mold, covering the entire surface. It doesn't matter if the fabric or mat overlaps the pedestal block. This will be trimmed to shape after the curing process is complete. Now take the second sheet of PVA and tightly wrap it over the mold, squeezing out all the excess resin, allowing it to run down through the bottom of the pedestal mold. Of course, any wrinkles you allow to remain in this application of PVA will have to be sanded away.

After curing properly (overnight preferred—10 to 15 hours) cut the molded fuselage half with a scribe just at the parting line. Be careful here in the parting; you can end up with a ragged edge on top of the fuselage. The Dremel Power Tool with a small carbide saw will do the trick, or even a broken hack-saw blade, if used with care. After the prototype molded fuselage halves are completed and joined, using this method, you will fi any corrections necessary before makin the female mold. I have not tried polyvinyl chloride nor polyethylene sheet for this short cut method—but they may work providing that the elevated temperature in the curing process does not exceed the melting point of the material used. If they do, the gloss and smoothness will be missing when the molded fuselage is completed. But we encourage model builders to keep an open mind on new materials, new products, new tools, and new procedures.

One of the most useful tools I have found in working the molds for fiberglass, and also in trimming the finished mold, is a Razor Plane. There are several kinds of Razor Planes on the market. Most of them use the new stainless steel double-edge blades, and mine had a real good work-out on the pine mold, for I can adjust it right down to the very minimum cut for precision work. You may wonder if it is really wise to buy or build a fiberglass fuselage. Properly engineered fuselages will save the radio receiver and the servos in cases of bad crashes to a degree not possible with balsa, especially when the servos are mounted on a servo board and glassed to the inside of the fuselage. I know one individual who, in learning to fly, totaled two balsa models. The repair bill was over $100. Match that with the cost (if you buy) of a glass fuselage, presentl selling at from $15.00 to $34.50. As for building your own fiberglass fuselage, this depends upon your source of supply and the amounts of material purchased.

Phelps Servo

(*Continued from page* 19)

to add is voltage amplifier. Since this stage at equilibrium must hold the bases of drivers near ground, its stability of current gain is of great importance. One is tempted to use low leakage, high stability silicon here but economy demands germanium (over PNP silicon) and the NPN silicon *must* be reserved for input amplifier which is hFE (35 to 250) times more critical. The units used for the output and driver slots are not suitable for best results here and a unit with special Icbo test at 80 degrees C has been chosen. Its cost is only several cents more than the output units. Provision is made, at gain sacrifice, to divert Icbo and further stabilize the level of collector set by any chosen value of base current.

The input amplifier makes giant strides by using the new, small, high-performance silicon units now widely available at cost comparable to the lowest cost germanium. The input amplifier sums across the base emitter junction. This scheme is used b cause of its isolating properties in separat ing the effects of signal source variations from feedback loop variations by the current gain of this stage. The practical result is a high error signal input resistance, which sets a voltage position transfer

function which is largely independent of the measures needed to solve the transient problems of the closure of the loop.

Loop power or current gain is adjusted to less than unity by the feedback resistor R_2. This closure stabilizes the low frequency gain of all but the lead transistor and a single value is possible in all but approximately 2 percent of the servos built. Although error rate (0 degrees) damping can be rationalized from this connection, its contribution is so small that its effect is academic. Servo action, even unloaded, is quite acceptable and quite an effort is needed to improve performance the tiny bit needed for perfection in settling.

An insidious enemy always present is the possibility of high frequency oscillation. This is possible, since the motor load is inductive (or parallel resonant if a shunt capacitor is placed across the motor brushes) and loop power gain can soar at resonance. The invariable result is excess output transistor heating, leading to ultimate failure. Gain at higher frequency must be decreased and the "miller-multiplied" capacitor at the voltage amplifier helps decrease high frequency gain. In addition a 47-ohm resistor shunted across the motor brushes limits the impedance rise of the motor's winding inductance and provides (with the previously mentioned capacitor) unconditional stability. A note of caution: if a silicon epitaxial output unit (NPN) is used in place of the NPN germanium unit shown, its added high frequency gain demands further gain reduction. The same is true for lower values of Rf—pursue additional gain "reduction" with care—and a scope across the motor.

The resistors either side of the 750- to 1,000-ohm feedback pot set the basic voltage/position transfer sensitivity at ± 500 mv for full travel (±90° of crank movement). Further, their unbalance complements the 700 mv drop across the base emitter summing junction and so sets ground as the mid-position of the output crank (an arbitrary but popular standard). Having provided high impedance (100K) and high gain, changing to say ± 1.0 volts for full travel involves choosing a simple input divider. A 33K-ohm resistor to ground with, a series 33K-ohm error input resistor, sets the 2:1 division needed to have voltage sensitivity. This provision is an exceptionally easy way to trim for equal response in systems using mixed decoders—or in the case of existing equipment, to fit its particular needs. This voltage division does *not* destroy the exceptional resolution or temperature stability set by the basic design. Further, it is far simpler than changing R_2, R_1 and Rf and risking high frequency oscillation with each change. The presence of *any* series resistance in the error input places current limiting in the last of four critical "lightening" paths commonly ignored and responsible for a high mortality during accidental battery lead transposition (simultaneous reference and drive supplies).

In first development samples, a "pie" RF noise filter was used to remove conducted RF noise. For several years the need for the full filter was not investigated. Recent tests have shown that equal noise removal is afforded by a simple ceramic disc bypass at (very short lead) the brush terminals *and* a low inductance short lead to motor and servo case. These simple provisions keep radiated RF noise at home by double shielding and use brush and lead inductance to drop the bulk of the conducted noise voltage.

The servo amplifier described represents a very close approximation to the ideal "no-holds" barred approach from which many features were borrowed. The latter shares common driver and output circuitry, but differs in the means used to sum position and error currents. The use of a differential amplifier with differential base summing provides temperature tracking so that drift cannot be detected or measured. It lacks, however, the "standard" feature of grounded input neutral. This feature if provided by passive summing then makes the position sensitively dependent on error voltage source resistance which can be equally baffling to the unwary.

All things considered, the circuit as presented should delight even the most critical and provide a base for further performance extension.

safe and stable."

Caption space did not permit us to sufficiently describe Den Thumpston's Strutter. It has extensive cockpit and pilot detail, which even included a map of World War 1 battlefields. Though it had top points for scale and craftsmanship, and flew, it managed only to place third against the flying specialists. Power was a Rivers 2.5cc Diesel.

Said the Aeromodeller report (we quote from air mailed tear sheets now): "Blue skies brought a curious public to view our hobby and no doubt half went away blissfully dreaming of a radio-controlled Shackleton for the lad when he reaches his 12th birthday, and the other half still wondering what on earth it was all about."

British Nationals

(*Continued from page* 13)

with single-channel flyers who produce genuine scale with bags of detail and multi entrants who tend to produce semi-scale. What we need are a few rabid scale enthusiasts to get sufficient finance for a multi outfit, but then, that is exactly what happens to a Russell and a Thumpston who won't risk their jobs at a fairground like the Nats."

Radio was won by J. Morton, whose DH Tiger Moth ("with an offensive McCoy 60 cylinder protruding") did scale-like rolls, loops and Cuban-eights; followed by Bryant's Sparrowhawk and Thumpston's Sopwith 1½ Stutter (see pix).

Sensation of the meet was the demonstration by David Walker who flew his 10-foot-plus Avro Shackelton on four K&B 19's through some amazingly scale-type flights at realistic air speeds. (Being overweight, special insurance was required for him to fly.) Rudders were fixed. Engines were tac-tuned to synchronization—a 20-minute process.

"This was the star of the weekend," GL was told, " . . . . the 'Shack' came back to earth as tenderly as the real thing . . . here in the flesh, flying at scale speed, seemingly under full control, perfectly

Versatile Superhet

(*Continued from page* 8)

several features in the circuit design of this receiver which make it extremely sensitive, very stable and compatible with a variety of applications, including voice reception. The first feature in the printed circuit layout is that the circuit lays along a straight line with the input at one end and the output at the other, thereby reducing the chance of unwanted feedback. I used a printed circuit board which is double sided with one side covered entirely by a ground plane. In addition to eliminating voltage drops in the ground line, this feature also helps to provide shielding from one part of the circuit from another. Consequently this design feature contributes to making the receiver more stable and provides higher sensitivity without danger of oscillation from internal feedback.

The R.F. amplifier is rather unusual in that it is an untuned emitter follower, the only tuning being in the input filter. Using this circuitry high gain was achieved with fewer components and with good A.C. and D.C. stability.

The mixer is straight forward with signal injection at the base, oscillator injection at the emitter and the collector tuned to the 455-kc I.F. frequency. The oscillator is crystal controlled. A broad-tuned toroid-wound transformer is used for the tank circuit, consequently this tank circuit does not need tuning for any of the oscillator frequencies in the Citizen's Band; merely plug in the proper crystal.

The I.F. amplifier is a tuned 455-kc amplifier which uses transistors with low collector to base capacity in an unneutralized common emitter configuration. No collector resistors are used, thus providing a higher available voltage swing at the collectors. In studying the schematic, you will notice that throughout the receiver, voltage divider bias networks are used in the transistor bases and fairly large emitter resistors are used, thus providing good D.C. gain and temperature stability.

The audio amplifier was designed without the use of audio transformers in order to maintain good fidelity and also to reduce weight and increase reliability. The receiver terminated at the output of the first audio amplifier so that it could be used as a basic receiver for any type of control system. A transistor driver is shown for single channel systems. If desirable, this driver could drive a reed bank for multi-channel operation.

A 6-volt battery is required for the receiver which draws only 3 ma of current. Receiver sensitivity is one microvolt. When used with the decoder, the battery is center tapped to three volts, thus providing power to drive the Bellamatic II servo.

Alignment of the receiver should be done by someone familiar with such procedure. But don't let that scare you; alignment can be done quite well by using the following method. Connect a pair of headphones through a .5μf capacitor or larger to the output of the receiver. Tape the tone switch closed to a tone-modulated transmitter at a range of six to 10 feet, tune each coil, starting at the antenna end, for maximum signal heard in the headphones; then move the transmitter to a spot where the tone can barely be heard and repeat the tuning procedure. Continue to repeat this process until the receiver is tuned for maximum output with the transmitter at its greatest distance. Once tuned, there is little need for re-tuning unless some components are replaced.

I hope that this schematic will be of some benefit to other radio control experimenters. I will be happy to answer any inquiries concerning this superhet receiver. Just address your letters to me in care of GRID LEAKS.

Monitor

(*Continued from page* 2)

breaker!

"Then in college modeling went by the boards until I had the pleasure of sponsoring a high school model club. For a while we were ankle deep in balsa shavings (ah, what a change from spruce!) and were continually peeling cement or dope from our fingers. Gas power was the hot thing, complete with spark plugs and timers, but we couldn't afford the price. However, we were thrilled with the availability of good rubber, and with balsa, cement, and Japtissue. Flights of three minutes were not uncommon.

"Time out again for marriage and the raising of a family, until the number-one son was old enough to start modeling. He wanted to start building an Astrohog, but Dad put his foot down and set up a sequence of achievements to master, the first being a 90-second flight wih a tow-line glider; once that had been passed, he could try powered free flight. When the boy said that the glider standard was too high, Dad started building gliders, and we flew them together until Dad hit his 90 seconds (plus five more minutes and a lost ship!). The free flight standard was either a 10-minute flight with 10-second motor run, or two consecutive five-minute flights. Achieving this was the entry for radio control.

"As with most of the fellows I know, I started with single channel, and had a ball," John recalls. "Also, as with most, I have never been able to fly up to the capabilities of the plane. Unlike most of our friends, I have never been enamoured of multi. Unfortunately for me, single channel as a class is no longer existent as far as AMA is concerned. They very effectively booted me out!

"Now that they have me out, I wonder if I promised to join, would they (that's YOU!) consider including single channel as a class in R/C? This could be a fourth class, since there is no reason for limiting the number of classes in stunt. It would offer, as it used to, a less expensive entry to the hobby, and thus bring in some of our less well-heeled brethren. At the same time, if it were designated as "aircraft controlled by a single channel" one could start with rudder only and add engine control (as we used to), but couple a steerable wheel with the rudder; could ailerons if desired; use pulse or the old mickey-mouse intermediate—any control as long as it were governed by the one channel. I admit it, I'm prejudiced, but don't you think there's room for such a

class—and interest?

"Well, I had to get in my last two-bits worth while I'm still a member in good standing. Maybe I'll be back . . . but I sure got a boot out of the AMA. It was swell knowing you guys, and thanks for helping [illegible]e pick up the wreckage so often. Wave [illegible]you see a Cessna overhead . . . BCNU."

● The following is part of a questionnaire sent out by J. B. Young, of Lawrence, Kansas, to quite a number of AMA members, and related fields, and it contained one question that bears pondering.

"Do you believe that the new Class I is honest? That it offers fair and equal competition to the new young novice with single channel escapement? Yes ——— No ———."

The above was brought to our attention by publisher Paul. If it were only this simple! True or false, those who defend the present rules say that contest attendance in Class I and Class II was falling off and they claim further that such attendance now is on the upgrade. Perhaps it is. One wonders who it is that is entering Class I with multi-channel outfits.

We do have many clubs. Why can't these clubs organize special events and sustain such events long enough to see if they catch on. The writer recalls CDing a single-city RC event in which 205 flights were made by 2 p.m. In those days everybody wanted to compete, and thought they had a chance. Cost was not prohibitive. Multi changed all that. Since then the gap between sport flying and contests has widened constantly. There are no simple answers any more. No panaceas. And quite pos[illegible]ly no turning back.

SPECIAL NOTICES

The U.S. Bureau of Standards announced recently that the International System of Units has been adopted, with reference to kilocycles and megacycles. The official abbreviation for kilocycles is Kc, and for megacycles, Mc. This replaces the older version where kc and mc were abbreviated by using lower case letters.

Also adopted is the term *hertz*, abreviated as Hz—this to designate cycles per second.

* * *

Plans for the deBolt Live Wire Cruiser are available at $2.75 from Fran Ptaszkiewicz, 23 Marlee Drive, Tonawanda, N.Y., through special arrangement with DMECO. The kit has been out of production for sime time.

DeBolt's new bipe handles like a low-wing: 57 in., 1050 area, Super T .46.

World Records

(*Continued from page* 22)

general rundown of requirements furnished by AMA for setting up a record trial, either for an individual attempt or get-together type of trial:

1. Obtain copy of FAI Rule Book from AMA Headquarters or FAI Headquarters in Paris. (Cost, $1.50 from AMA, 1025 Connecticut Avenue, N. W., Washington, D.C. 20036).

Study general regulations covering record attempts, and specific regulations governing record categories of interest. Book describes aircraft and engine limitations, flying procedures, and scoring and verification procedures.

2. Obtain an FAI record attempt sanction from AMA specifying record categories which will be attempted and location of trials. Sanction is valid for one year or until record is broken, whichever comes first, and AMA insurance applies to all aircraft flown in approved manner. Due to the amount of paper work, postage and involved extended period covered, the cost of the sanction is $10 per record category.

3. Obtain the necessary measuring equipment, check it for accuracy and obtain AMA certification if necessary.

4. Line up AMA leader members or suitable officials to serve as necessary official observers.

Notify AMA within two days of attempt, its location and those participating.

5. Conduct the meet in accordance with AMA and FAI regulations.

6. If a record is broken, a dossier giving detailed report of flight, equipment used and signatures of officials must be made up. Rule book gives format for dossier. All necessary pre-flight information for dossier should be obtained as required, and after-flight information gathered before another attempt is made. Loss of the aircraft in a second attempt could prevent obtaining necessary data.

7. AMA must be notified of records broken within 5 days, and it in turn will notify NAA and FAI in Paris. Also, it will notify news media of tentative record.

Here are some of the FAI aircraft limitations: Maximum Weight: 11.023 lbs.; Maximum Wing Loading: 24.51 oz. per sq. ft. (stabilizer area included); Maximum Engine Displacement .61 cu. in.; Fuel: Any type permitted by AMA; Landing Gear: Not necessary. Model may be hand launched.

It is interesting to note that the United States holds only five International records, while Russia holds 14. Aside from the fun of it, AMA would like to see more record attempts so that the U.S. will get its share of the records. In full scale aircraft records, National Aeronautic Association figures show the U.S. with 289, and Russia with 122.

PARDON US. . . . Who wrote the Gemini Transmite Switcher article in May-June GL? The sharp-eyed may have noted Bill Campbell's name on one of the schematics, but the usual bold-type byline credit was missing. We owe Bill Campbell an overdue hand of applause for his impressive job in the last issue.

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