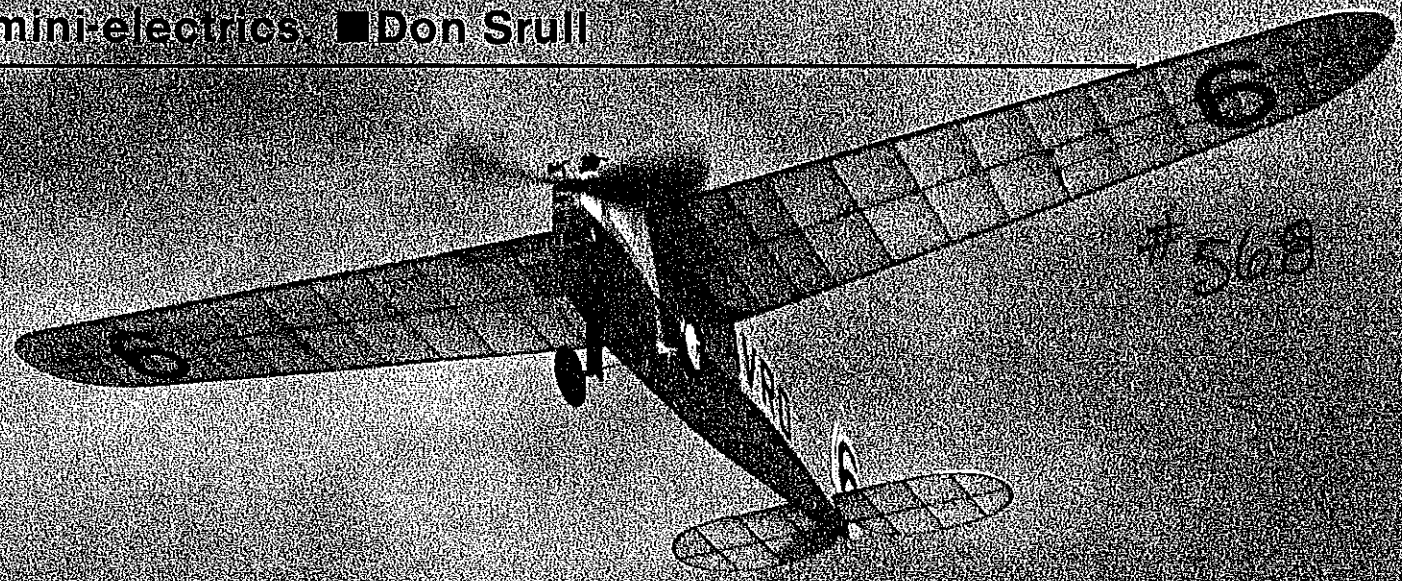
mini-electrics

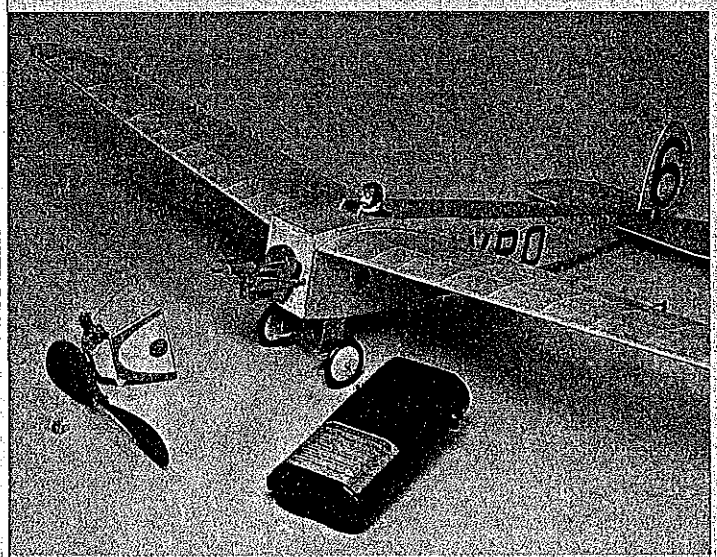
One of the newest forms of electric-powered modeling is now becoming established and forming its niche with Free Flighters. Take a look at what's available in the new world of mini-electrics. ■Don Srull

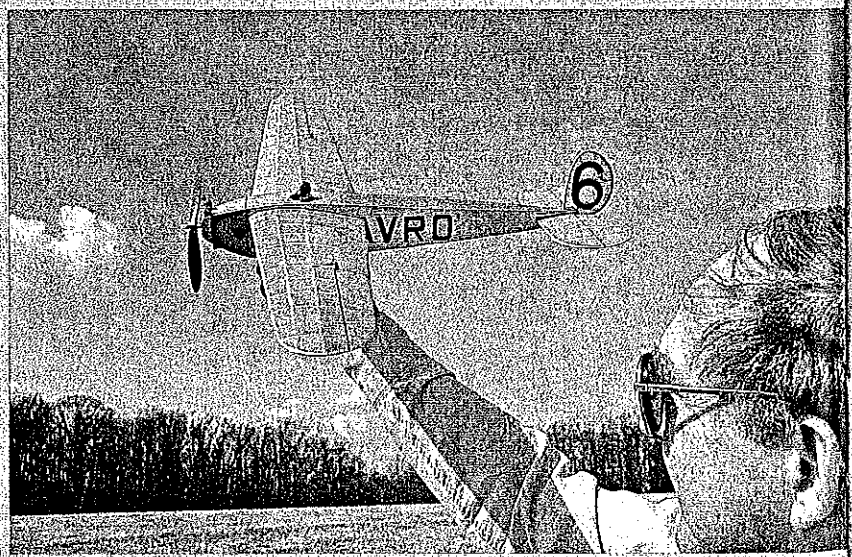


OVER THE PAST several years, a new type of power source for small models has quietly emerged. While not yet especially well-known, the mini-electric motor promises to become a very popular resource for Free Flight Scale and sport fliers. The diminutive electric motors, geared down and powered by tiny rechargeable nickel-cadmium (Ni-Cd) cells, are quiet, clean, very easy to use—and *powerful!*

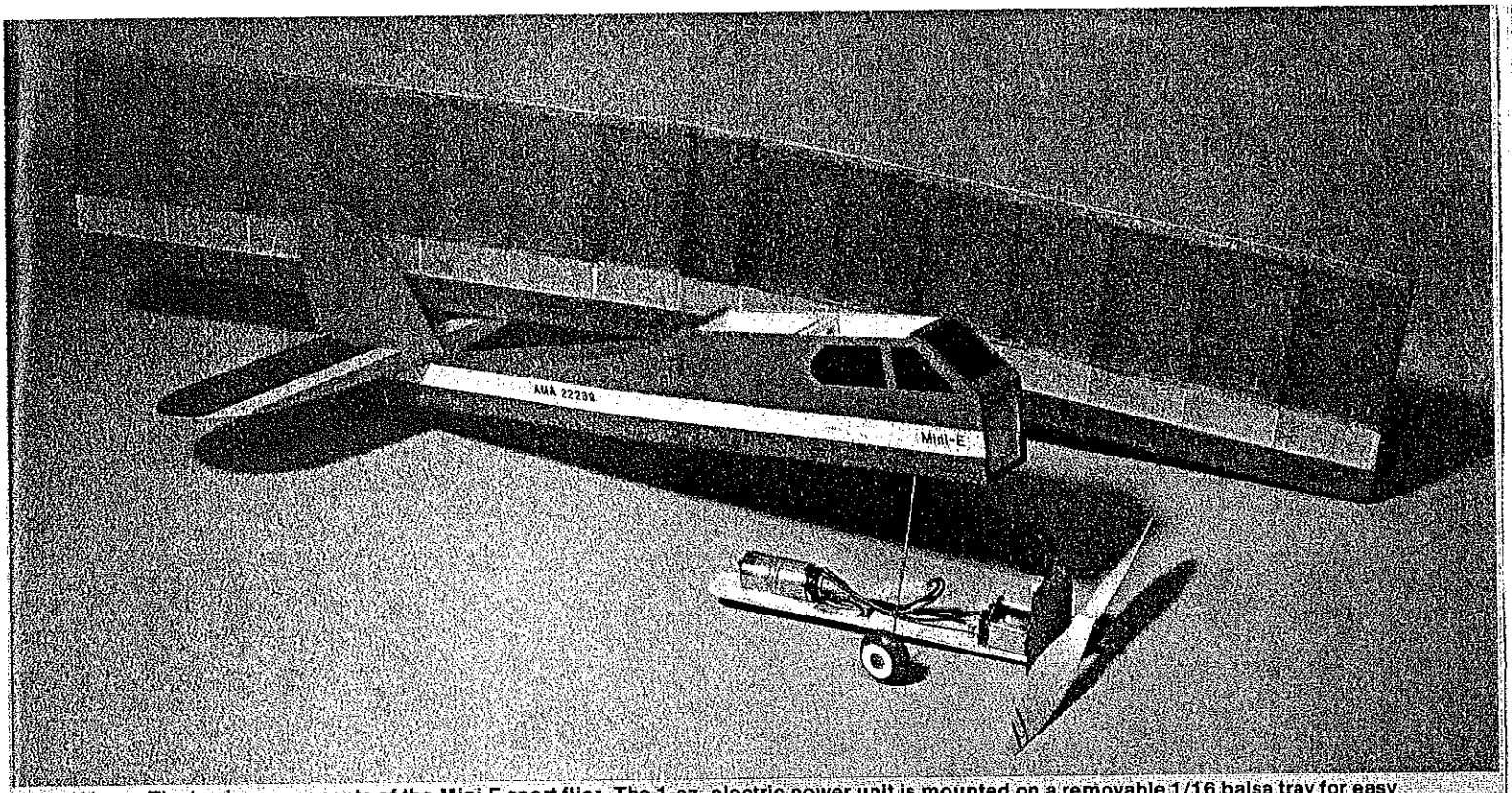
These little guys put out enough power (about .003 shaft horsepower!) to fly models having two to three ounces of total weight and 75- to 100-sq.-in. wing areas; and yet the whole power package, including motor, prop, batteries, switch, etc., weighs only about an ounce. With a 30- to 60-sec. charge the power will sustain flights of longer than one minute.

This idea isn't brand-new of course; small electric motors have been available for Free Flight models before. The old Mattel Toy Company's electric-powered Super Star was a foam-and-plastic airplane, and probably the first really practical rechargeable electric model. And VL Products' Hytork motor system, which used the same motor and battery as the Super Star, has been available to Free Flighters for over 10 years.

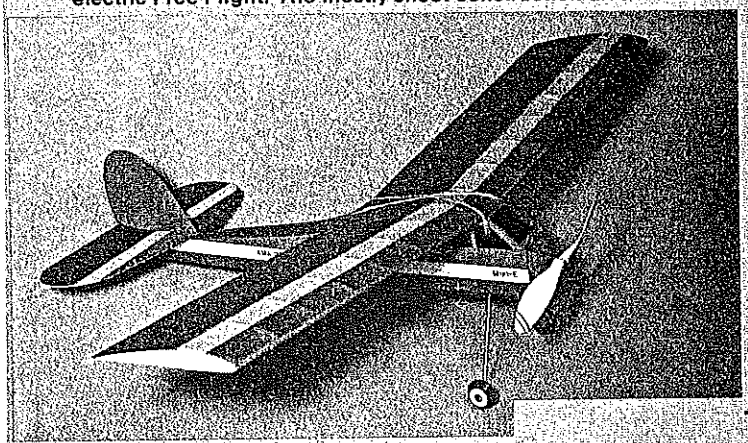


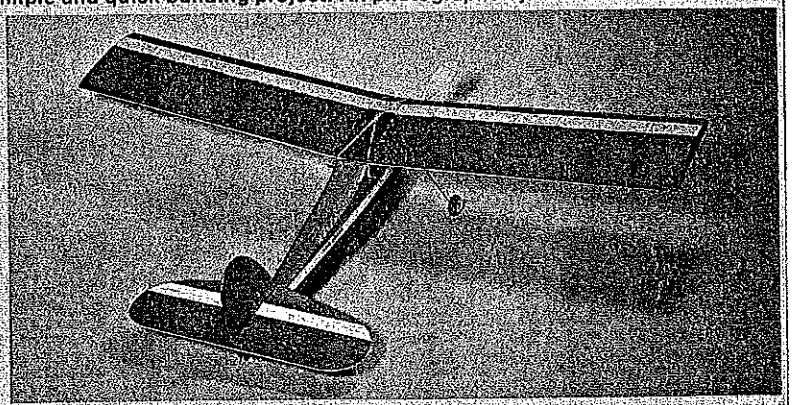


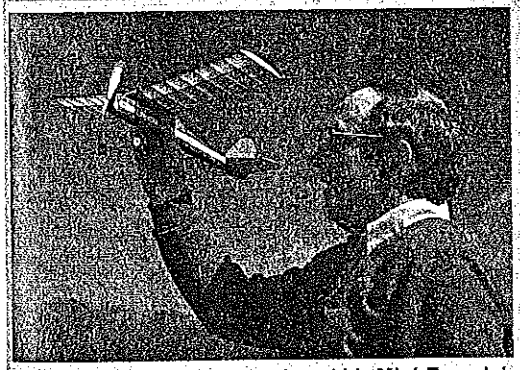
Top: The Avro 560 cruises overhead to the hum of the geared electric motor. It couldn't have looked better at the Lympne trials back in the 1920s! Left: The simple installation of the MRC motor incorporates offset for built-in thrust adjustment. The field charger shown uses four C-size dry batteries to charge the flight pack. Right: Avro 560's short nose is less than ideal for rubber power, but it's a great mini-electric.



Above: The basic components of the Mini-E sport flier. The 1-oz. electric power unit is mounted on a removable 1/16 balsa tray for easy access. Below left: The 20-in.-span, 80-sq.-in. wing of the Mini-E is ideal for a high climbing, small, electric sport model. With a total weight of under 2 oz., it is a potent flier. Below right: Clean lines and rugged construction make this a good first model and test bed for trying small electric Free Flight. The mostly-sheet construction also makes it a simple and quick building project. All photographs by Tom Schmitt.







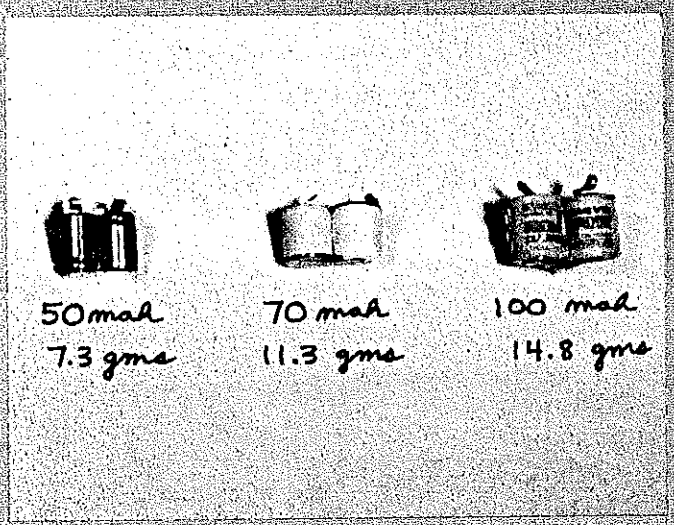
Our author prepares to set his Mini-E model free. The flight potential of this little bird is good enough to warrant the addition of some sort of dethermalizing (DT) system.

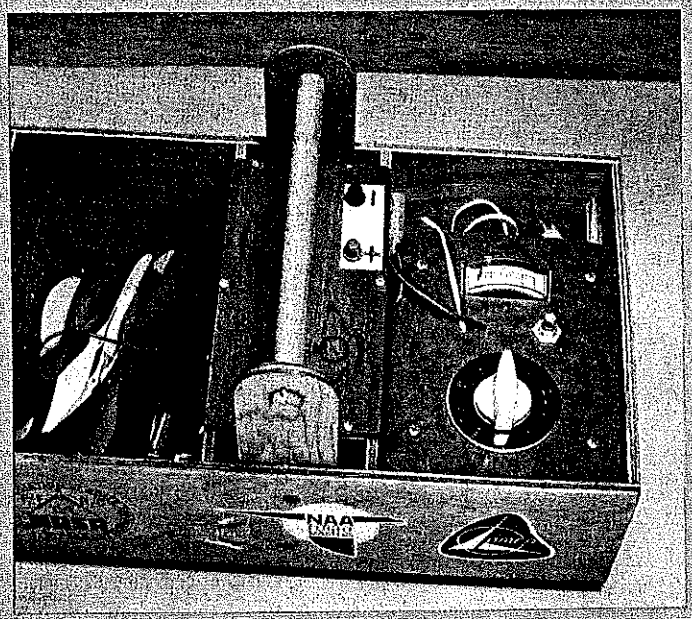
With a total weight of about 2½ oz., however, these earlier systems were somewhat larger and heavier than the new one-ounce mini-electrics. On the other hand, the bulkier early versions delivered about 50% more power and were best suited for models quite a bit larger than those for which today's mini-electrics are designed. The original small electric systems did best

Table 1: Mini-Electric Motor Systems

		MRC	VL	FE
Motor-to-prop gear ratio		4.5 : 1	7 : 1	4.5 : 1
Flight battery cells		Two 50 mAh	Two 70 mAh	Two 70 mAh
Propeller		6-in. Peck	6-in. Tern Aero	5½-in. Williams Bros.
Current (with full charge)[1]		~2 amps	~2 amps	~2 amps
Weight (grams)	Motor & gears	18	16	14
	Battery	7	13	11
	Total weight with prop, switch, etc.	34	32	28
Type of switch		Toggle, integral to charge jack & battery box	None	Tiny PC rocker switch
Provision for charging		Charger battery box with two external contacts	Wired charger clip soldered to dry cells	Battery box with Molex plug
Charger battery		Four "C" dry cells	Four "C" dry cells	Three "C" dry cells
Nominal charge time[2]		30 - 60 sec.	40 - 80 sec.	50 - 100 sec.
Approximate cost of motor system, including simple charger		$25-$35[3] (full kit includes foam airplane)	$43[4]	$36[5]

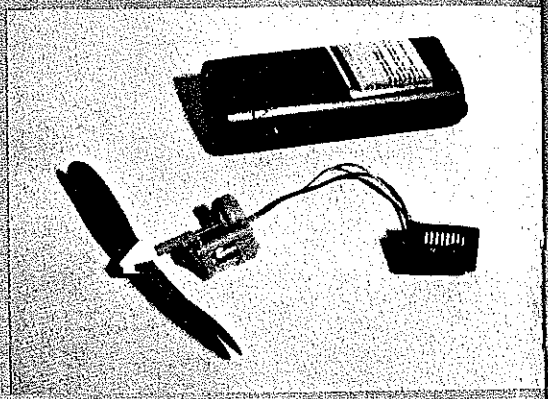
[1] Initial current during test run on the bench, using the recommended propeller. Current under flight conditions would be somewhat lower.
[2] Charge times shown assume fresh charger battery cells and completely discharged flight battery cells. Times will give about half to three-quarters of maximum charge.
[3] Retail price for full kit is $35, but it can often be found for around $25. Replacement motor system is available for about $12.
[4] Includes HY70-A motor, B-52 battery (two 70 mAH cells), and EFC-600 four-dry-cell charger. Cost without charger is $25.
[5] Includes .007 motor, two 70 mAh cells, harness, and three-dry-cell charger.





Above: Mini-electric flight batteries typically are one of these 2-cell combinations. Lightweight but plenty of power for their size. Right: The larger field-box charger from VL is a real convenience with ammeter, charge rate adjustment, and automatic timer shut off.

The MRC mini-electric ARF kit is a good simple way to start. Everything is included but the four C-size alkaline batteries for the charger. See text and drawing for Ni-Cd conversion.



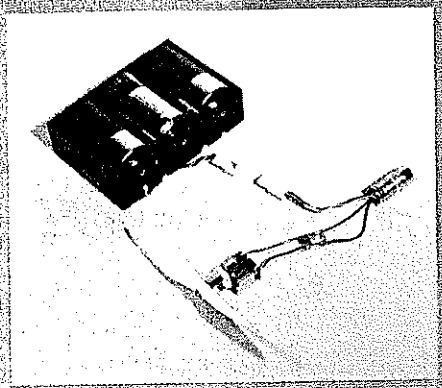
The MRC motor system plus charger is a first-class engineered package. Battery box, switch, and charging terminals are all combined to make installation an easy operation.

Today's smaller mini-electrics have a good chance for broad acceptance. They're just the right size for the extremely popular 20- to-30-in.-span sport and Scale Rubber models that can be flown in the local schoolyard or soccer field. There are literally hundreds of currently available kits and plans that fit the bill. Most of the old 25-in. Comet, Megow, Peerless, and Cleve-

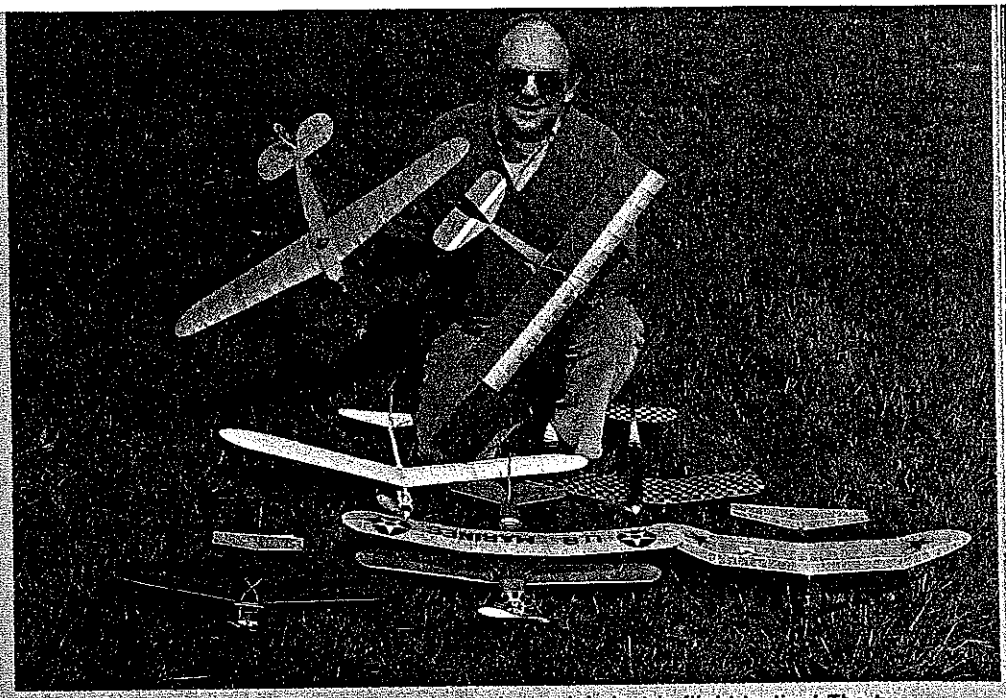
MRC's hand-held field charger unit is easy to use and works quickly. The flight batteries of the Avro 560 are being charged for 30 sec. and will result in dependable and repeatable power runs of between 35 and 40 sec.

in planes up to 10 oz. in total weight and with 200 to 300 sq. in. of wing area—the equivalent of a Jumbo Rubber Scale model.

MRC's charger is typical of the simple dry-cell chargers. Upgrading to Ni-Cds will save money in the long run, but don't forget to install the 1-ohm, 10-watt current-limiting resistor.



Ferrell Enterprise mini-electric system with 2-cell 70-mAh flight battery. Ferrell's charger comes standard with a 3-cell arrangement.



To say the least, Don Srull has done some serious mini-electric flight testing! The two models he's holding are featured in this article, and the others (including the 5 oz. Curtis OC-2 in the foreground) were used to test the various motor and battery combinations.

land designs are ideal. Model magazine plan services are also good sources of suitable plans for the scratch-builder. For the less experienced, or those who simply prefer to build from kits, there is a wide variety of kits that can be easily converted to mini-electric. Some of the old Comet kits can still be found, and there are good candidates from Peck-Polymers, Flyline, Sig, and Golden Age, to name just a few.

Mini-electrics provide a welcome alternative for use in the many airplanes, particularly Scale models, for which rubber power is difficult or impossible. These aircraft take the small electrics easily. In fact, very short-nosed airplanes (like the Sopwith Camel), models with strut-mounted engines (like the Macchi M3), and especially multi-engine designs (like the Grumman Skyrocket or the DC-3) are ideal for this form of power.

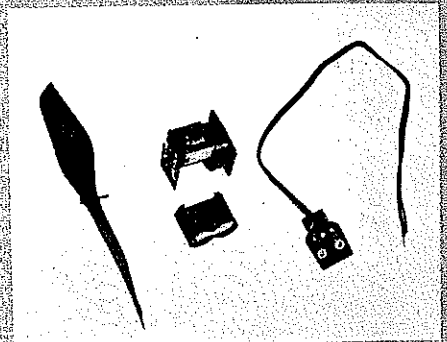
I don't want to imply, though, that this new stuff is better than, or will ever supersede, rubber power. Heaven forbid! Mini-electric power can't, won't, and shouldn't be thought of as a replacement for that queen of the modeling arts. However, it does have a legitimate place, alongside both Rubber and CO-2, as one of the new and interesting forms of power for small, sport Free Flight models. It may even nudge CO-2 into a slightly lesser spot, especially in regions where the weather often puts a crimp in that category of flying.

Available Systems. Exactly what are these little electric power packs and where are they available? Currently, there are three companies marketing mini-electric power systems in the U.S.: Model Rectifier Corporation (MRC); VL Products; and a brand-new company, Ferrell Enterprise. All of these systems employ the very small, rectangular electric motors produced by Mabuchi. The motors are about ⅜ x ¾ x ¾-in. in size and weigh about 12 grams. Technically, they are three-pole motors, wound for one to three volts and using carbon brushes and bronze oilite bearings.

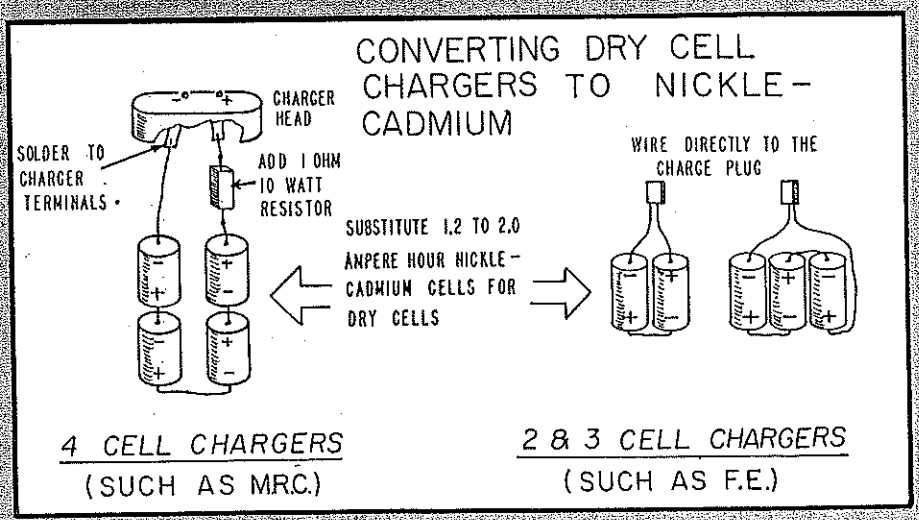
In recent years the cost of little motors of this quality has dropped dramatically, due to the tremendous quantities used in small, battery operated toy cars sold throughout the world. These little cars are ubiquitous in our area. They can be found in toy stores, hardware stores, and drugstores in amazing variety, and sell for around $2 to $6. In addition, versions of these motors are used in many small cameras, such as the Kodak disc camera, which has also helped to bring their price down while pushing their quality up.

Moreover, today's battery packs for mini-electric motors are far more compact than the classic AA pencell size which had been the standard, most readily available rechargeable cell for many years. Owing, again, to their use in the massive toy and camera market, Ni-Cd cells of 50, 70, and 100 milliamp hours (mAh capacity) are no longer laboratory curiosities. These very small cells are only about ⅓ to ⅒ the size and weight of an AA pencell. The flight battery pack for a mini-electric motor consists of two 50- to 100-mAh cells and weighs a measly 15 to 20 grams. So, good little motors and good little rechargeable cells, both at a low price, equals very accessible mini-electric model airplanes!

Let's take a look at each of the available motor systems. MRC sells an all-foam, ready-to-fly model kit containing a complete power package, including motor, prop, flight battery, switch, and charger box. The airplane is a 20-in.-span, semiscale version of the Cessna Cardinal. It uses a six-inch plastic Peck-Polymers prop, and the flight battery is a pair of 50 mAh cells. Add four C-size dry cells to the handy charger and you can be trying mini-electric Free Flight



The very compact and very simple VL mini-system. Author Srull suggests you invest in the model HY-70AR because it allows more flexibility in battery location. Free-wheeling prop on VL systems is a nice touch.

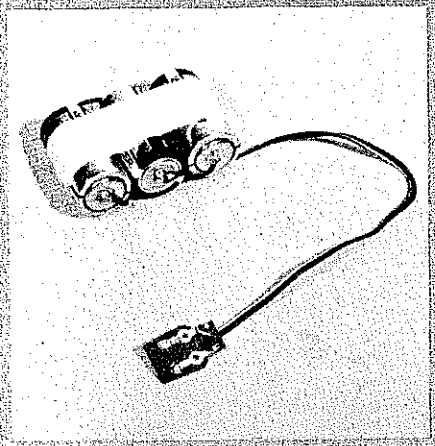


in a flash.

I highly recommend this package. It is a well-designed and carefully engineered ARF model, and an easy way to get started for about $30 total. You can also use the motor in other airplanes long after you demolish the little foam airplane. Look out, though: That little foam model flies awfully well and can easily be lost from a small field in windy weather. By the way, should you lose the airplane or break the motor, MRC will sell a replacement motor packet, including motor, batteries, props, gears, charger, etc., for about $12. Write to Model Rectifier Corp., 2500 Woodbridge Ave., Edison, NJ 08817; Attention: Customer Service.

The VL model HY-70 uses a higher gear ratio than MRC (7:1 versus 4.5:1) and a somewhat less sturdy motor housing. The principal difference, however, is that it has no switch as such. The little two-cell 70 mAh battery pack clips directly onto the motor. To charge, the battery is removed from the motor frame and attached to a charging clip which is wired to a three- or four-cell dry battery pack. After charging, the battery is clipped back onto the motor and the model is launched.

While this is about the simplest arrangement possible, it does limit both installation flexibility and the type of models (only short-nosed ones in which you have direct access to the motor and battery pack) that can be used with this motor. Also, because the battery is only clipped to the motor, and is exterior to the model, it is easy to lose it in a hard landing—mine only lasted nine or 10 flights before disappearing in the weeds. For this reason VL has introduced the HY-70AR, a model in which the battery is connected to the motor by wires in the more conventional way. With this version the battery location can be inside the model and remote from the motor.



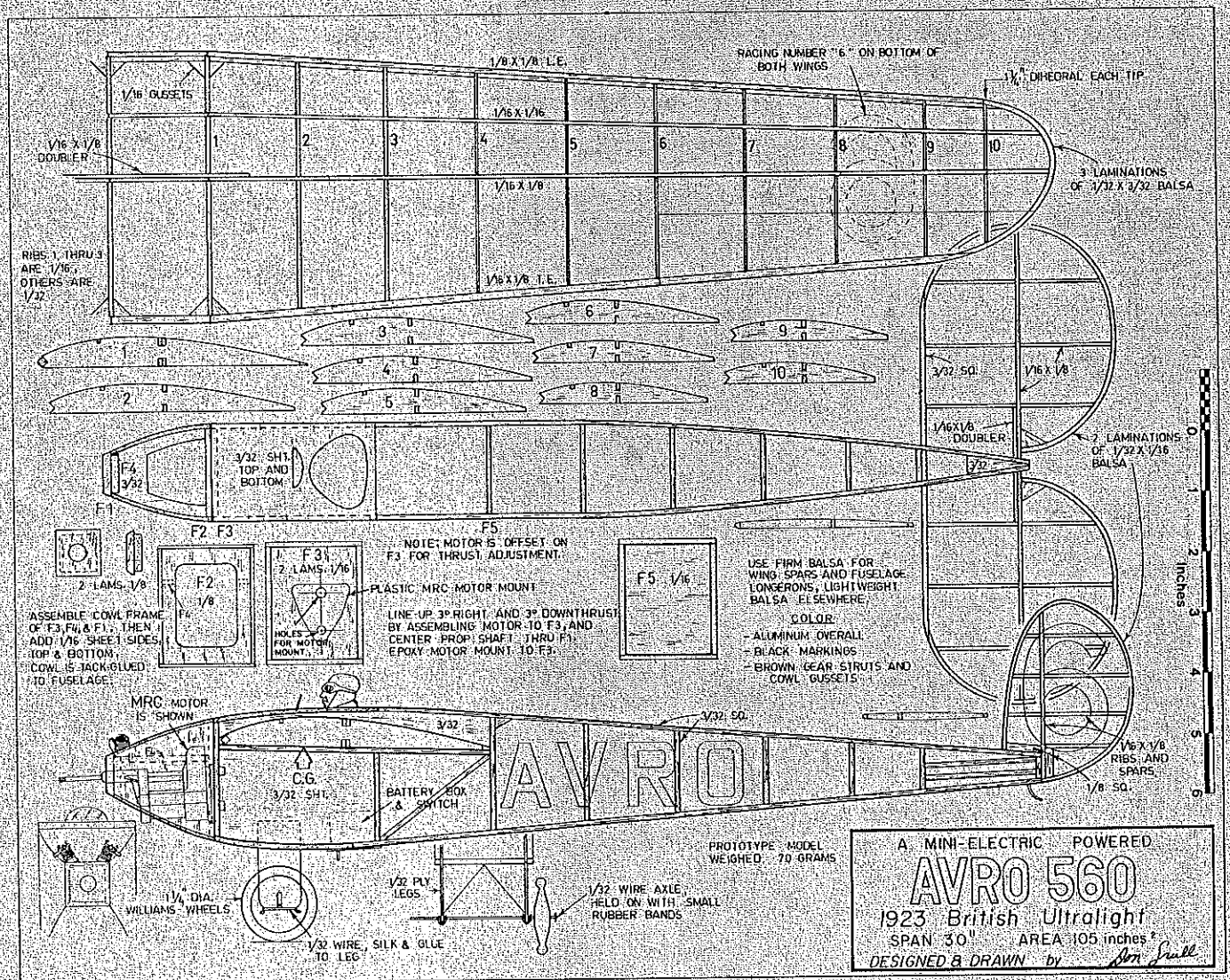
A simple charger can be made by wiring the charge clip to three dry cells as seen here.

A unique and nice feature of each of the VL motors is that they incorporate a simple propeller freewheeling device. The prop is automatically decoupled from the motor gear when power is exhausted. This reduces drag in the glide (if it's still airborne after the power runs down) and keeps the windmilling, six-inch plastic prop from possibly damaging the flight batteries.

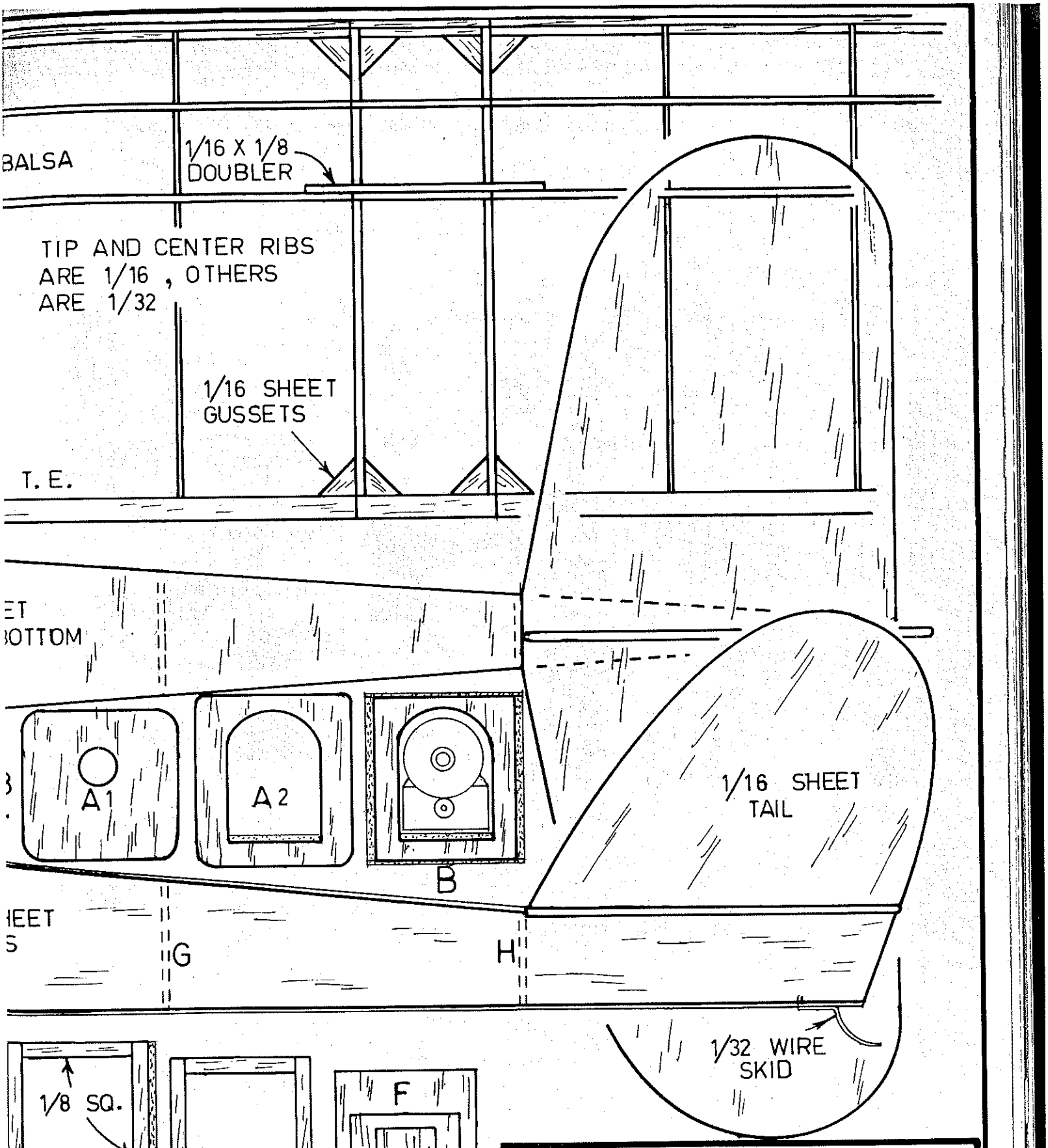
Ferrell Enterprise (FE) sells three different motor/battery combinations. Model .007 (two-cell), which we'll describe, is the basic system and is similar in performance to the MRC and VL systems. FE motors use a very simple frame and uncomplicated gear system with a 4.5:1 reduction ratio. A Williams Brothers' 5½-in. white nylon prop, designed for use on CO-2 motors, is included. A two-cell 70 mAh battery pack is standard, and a mini on/off slide switch is wired to the motor. Total airborne weight is about 28 grams, or one ounce. Write to Ferrell Enterprise, 300 W. Lincoln #82, Orange, CA 92665.

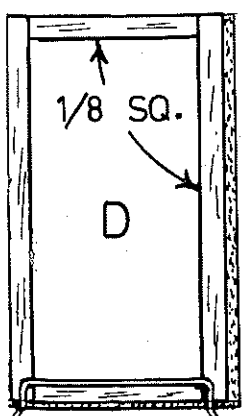
Both VL and FE offer several different flight battery pack combinations, including three-cell packs and higher capacity two-cell packs. For our purposes, however, the

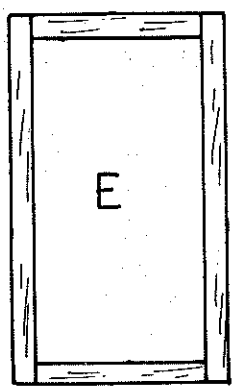
Continued on page 178

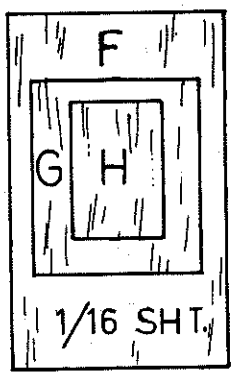


Full-Size Plans Available . . . See Page 188







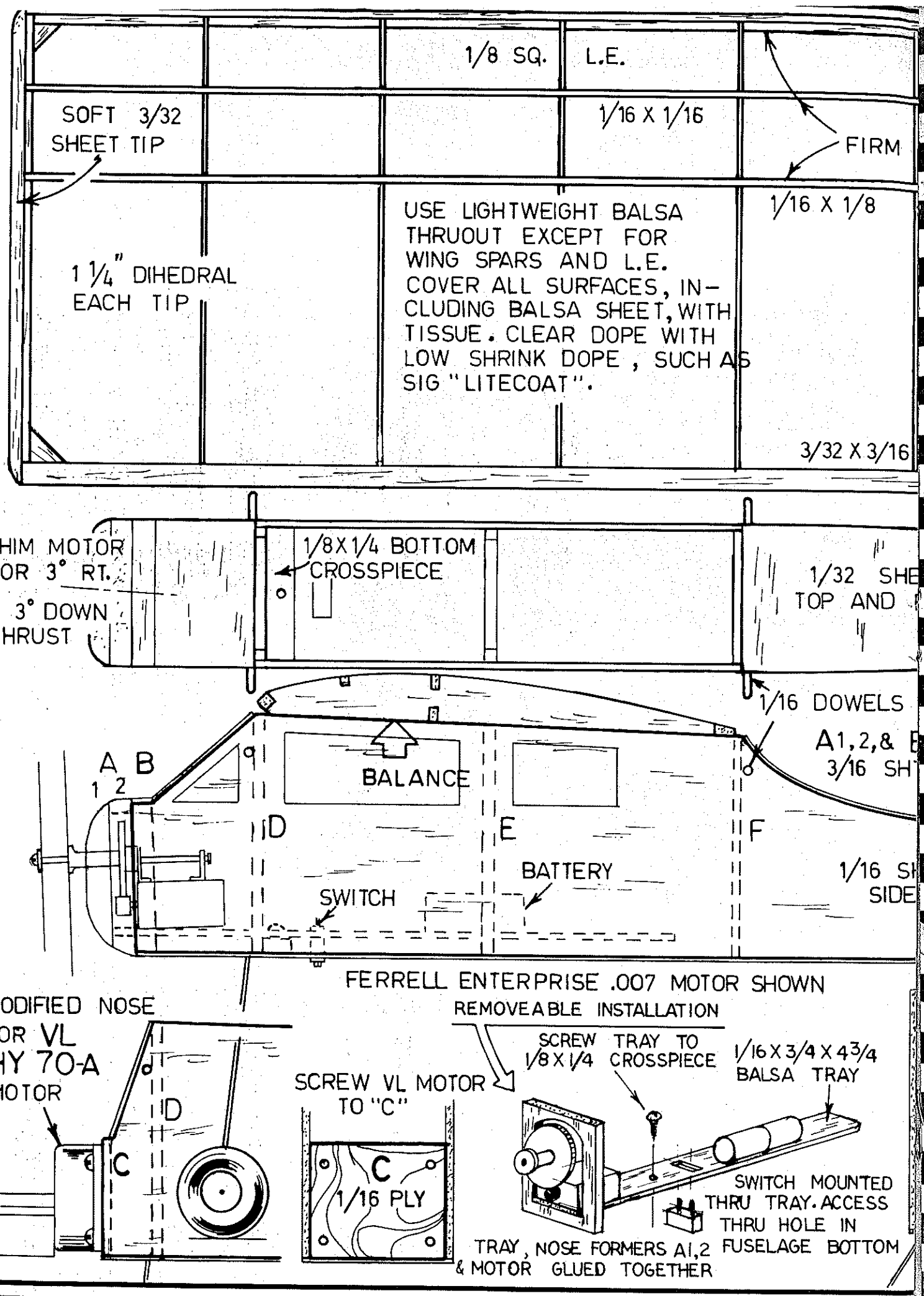


1/32 WIRE GEAR, 4" TREAD

"Mini-E"

A MINI-ELECTRIC SPORT FLYER
SPAN 20" AREA 80 IN.²

Designed & Drawn by Don Sulle


1/8 SQ. L.E.
SOFT 3/32 SHEET TIP
1/16 X 1/16
FIRM
1/16 X 1/8
1 1/4" DIHEDRAL EACH TIP
USE LIGHTWEIGHT BALSA THRUOUT EXCEPT FOR WING SPARS AND L.E. COVER ALL SURFACES, INCLUDING BALSA SHEET, WITH TISSUE. CLEAR DOPE WITH LOW SHRINK DOPE, SUCH AS SIG "LITECOAT".
3/32 X 3/16
SHIM MOTOR FOR 3° RT. & 3° DOWN THRUST
1/8X1/4 BOTTOM CROSSPIECE
1/32 SHE
TOP AND
1/16 DOWELS
A1,2,& E
3/16 SH
A B
1 2
BALANCE
D
E
F
BATTERY
SWITCH
1/16 SH
SIDE
FERRELL ENTERPRISE .007 MOTOR SHOWN
MODIFIED NOSE FOR VL HY 70-A MOTOR
D
C
SCREW VL MOTOR TO "C"
C
1/16 PLY
REMOVEABLE INSTALLATION
SCREW TRAY TO 1/8X1/4 CROSSPIECE
1/16X3/4X4 3/4 BALSA TRAY
SWITCH MOUNTED THRU TRAY. ACCESS THRU HOLE IN FUSELAGE BOTTOM
TRAY, NOSE FORMERS A1,2 & MOTOR GLUED TOGETHER

young Tom Cruise flying in the "Danger Zone," Ralph pushed it to the limit to win in the 12-in. Catapult Glider category with his sleek, vee-dihedral, red-finished birds. It was hard to decide who had the biggest grin, Junior IHLG winner Jim Buxton (who had to use his young-arm) or senior citizen Ralph Schlarb with his tiny rubber catapult, when they collected their awards from genial Tony Italiano. Like your reporter, we all plan to be back flying under the Mini-Dome next year.

FF Mini-Electrics/Srull

Continued from page 92

standard two-cell 50 mAh and 70 mAh flight packs are near-optimum. We will discuss some of the alternative battery combinations a little later on. Table 1 summarizes the three mini-electric systems.

Charging the flight batteries. Let's talk a little more about charging those flight batteries between flights, since this is the most likely trouble-spot for a newcomer. On a typical flight the mini-electric motors will draw about two amperes of current for 30 to 60 sec. This means the battery needs to be charged with one to two ampere-minutes (two amperes x ½-minute = one ampere minute; etc.) of juice. How does a field charger provide the necessary one to two ampere-minutes of charge?

The charger supplied with the MRC airplane package is a typical, simple, dry-cell charger. It contains four standard C-size flashlight batteries connected in series to obtain six volts at the charging terminals. When connected to the flight batteries, a current of about two amperes is pumped in.

That's exactly what the current is when the model is flying, remember? Therefore, if the charger is attached for ½-minute a charge of one ampere-minute (two amps x ½-minute) is obtained, and if the charger is attached for one minute a charge of two ampere-minutes (two amps x one minute) is obtained. Easy, eh?

The small 50 mAh flight batteries can theoretically take a larger charge of three ampere-minutes, maximum; but after a minute of charging at two amperes they become rather warm, and further charging at this high rate can damage them. So it's safest to fast-charge to only 75% or less of maximum capacity on these tiny cells.

Slower charge rates are safer, but of course the time to charge up is lengthened proportionately. For example, at half the charge rate the charge time is doubled. By the way, converting the conventional mAh (milliampere-hour) capacity ratings of cells to the more convenient ampere-minute rating is easy. As an example, a cell rated at 50 mAh can take a charge of 50 milliamperes (50/1,000 amperes) for one hour (60 minutes). The capacity is therefore 50/1,000 x 60 = three ampere-minutes. Likewise, the 70 mAh cell has a 4.2 ampere-minute capacity; a 100 mAh cell has a six ampere-minute capacity.

Although slower than the MRC and VL chargers, the chargers provided by FE are somewhat safer as well. FE sells a simple and nice charger which uses three C-size dry cell batteries. The charge current is about 1½ amperes, so charging time is between 50 and 100 sec. FE also markets a "slow" charger (FE's designation) which uses only two D-size dry cell batteries. Charging in this case is at a much lower rate and takes five minutes or longer, but the danger of overcharging is almost eliminated.

Even with one of these simple dry battery chargers, after a little practice you can begin to tell how long a charge your model needs for a given flight duration. You must, of course, use a watch which shows seconds to accurately keep track of the charge time.

The simple dry battery charger does have two main shortcomings. First, since the dry cells don't have a lot of capacity they soon begin to wear down, necessitating ever-longer charge times. At some point, depending upon how much you fly, new batteries are needed. Second, with no ammeter to measure the charge current the total charge put into the flight batteries cannot be known with any degree of accuracy.

If you decide you like mini-electric flying after giving it a try, I recommend you consider upgrading your charger. One or both of the following types will greatly add to the convenience and enjoyment of electric-powered Free Flight. VL sells a charger system, the FC-401, that fits into a small field box and is powered either by a 12-volt wet cell or by plugging it into your car's cigarette lighter socket. It has a 0- to 4-amp

ammeter for measuring charge current, a rheostat for adjusting charge current, and an automatic clock timer cutoff switch. This system will take care of just about any Free Flight electric motor system you will likely ever use, including the larger VL Hytork motors and the small Astro .02 and .035 ferrite motors. It's about $35 from VL Products, 7871 Alabama Ave. #16, Canoga Park, CA 91304. You can write them for more information.

If you prefer a smaller, pocket-sized charger, consider converting your three- or four-cell dry battery charger to rechargeable batteries. Instead of the C- or D-size flashlight batteries, use nickel-cadmium (Ni-Cd) cells of at least 1.2 to 2.0 ampere-hour capacity. Cells of this size are referred to as "sub-C" and "super-C" and are often used to run electric-powered, radio-controlled cars, boats, and planes. Ready-made packs of four subcells are also used as airborne radio batteries in Giant Scale and other large RC models.

A charger using Ni-Cd cells of this size will provide better and much more consistent charges to your mini-electric models. Moreover, it won't take long for the initially more expensive rechargeable cells to pay for themselves, since the rather short-lived C- and D-size dry cells are quite expensive. Occasionally, you can even find Ni-Cd cells on sale at prices *below* their equivalent dry cells.

If you do convert your dry cell charger to Ni-Cds, one precaution should be taken. The large Ni-Cd cells have much lower internal resistance than dry cells. This means the charging current they put out will be a little higher than that of the dry cells. If you convert a four-cell charger such as the MRC one, I recommend that you add a 1-ohm, 10-watt resistor (available from Radio Shack for about 50 cents) to the charging circuit. This will cut the charging current, which otherwise would be a little high for the very small 50 mAh and 70 mAh flight batteries, to two amperes or less. If however you convert the FE two-cell and three-cell chargers, there is no need for a dropping resistor. See Figure 1.

A few last words on the care and feeding of flight batteries. One way to determine how much charge you're getting into the flight batteries is by their temperature. On a good charge they should get slightly warm, but *not* hot. With a little experience, you can tell if you are approaching a full charge as the little cells become noticeably warm. If however they become *hot* and/or you hear a little "pop," it's likely that at least one cell has been overcharged and is damaged. (The popping sound is caused by the cell venting through a safety valve.) When damaged, they will no longer hold a good charge, and performance will deteriorate. Damaged cells may also leak a little and corrode the positive end cap. When any of these symptoms occur, the battery must be replaced; it can't be repaired.

Suitable models and installations. Models suitable for the mini-electrics can be of almost any type or configuration. The one requirement is that they be built rather light—much more like rubber-powered models than ones powered by glow engines. The best candidate for mini-electric installations will have a wing area between 75 and 150 sq. in. and a total weight, minus power system and prop, of no more than two ounces. A good weight target is 1 to 1½ oz., which is pretty easy to achieve in a rubber-powered-like design. Just for fun, if you have a rubber-powered model with a span between 20 and 30 in., remove the prop and rubber motor and weigh it. Chances are it will weigh less than two ounces and will have a wing area of around 100 sq. in. If so, convert it to mini-electric!

To illustrate the range of model types and various installations for these gadgets, two model designs are shown. The Avro 560 is a 30-in.-span Scale model with a wing area of 105 sq. in. and total weight of 70 grams (2.5 oz.). It is powered by the standard MRC system. The Mini-E is an ultrasimple sport job with a span of 20 in., wing area of 80 sq. in., and total weight of 54 grams (1.9 oz.). Mini-E is powered by the Ferrell Enterprise .007, two-cell motor system.

Both models fly extremely well, and construction should be self-explanatory. The watchword is to keep them light. I'm going to stop writing now and go out flying.

If there is interest, I will describe some do-it-yourself tricks with motors in a subsequent article—such things as rewinding; variations in flight batteries; field chargers; enhancements to chargers, flight batteries, and motors; and supply sources for mini-electric stuff. Meanwhile, get into this new fun thing—you'll get a charge out of it!