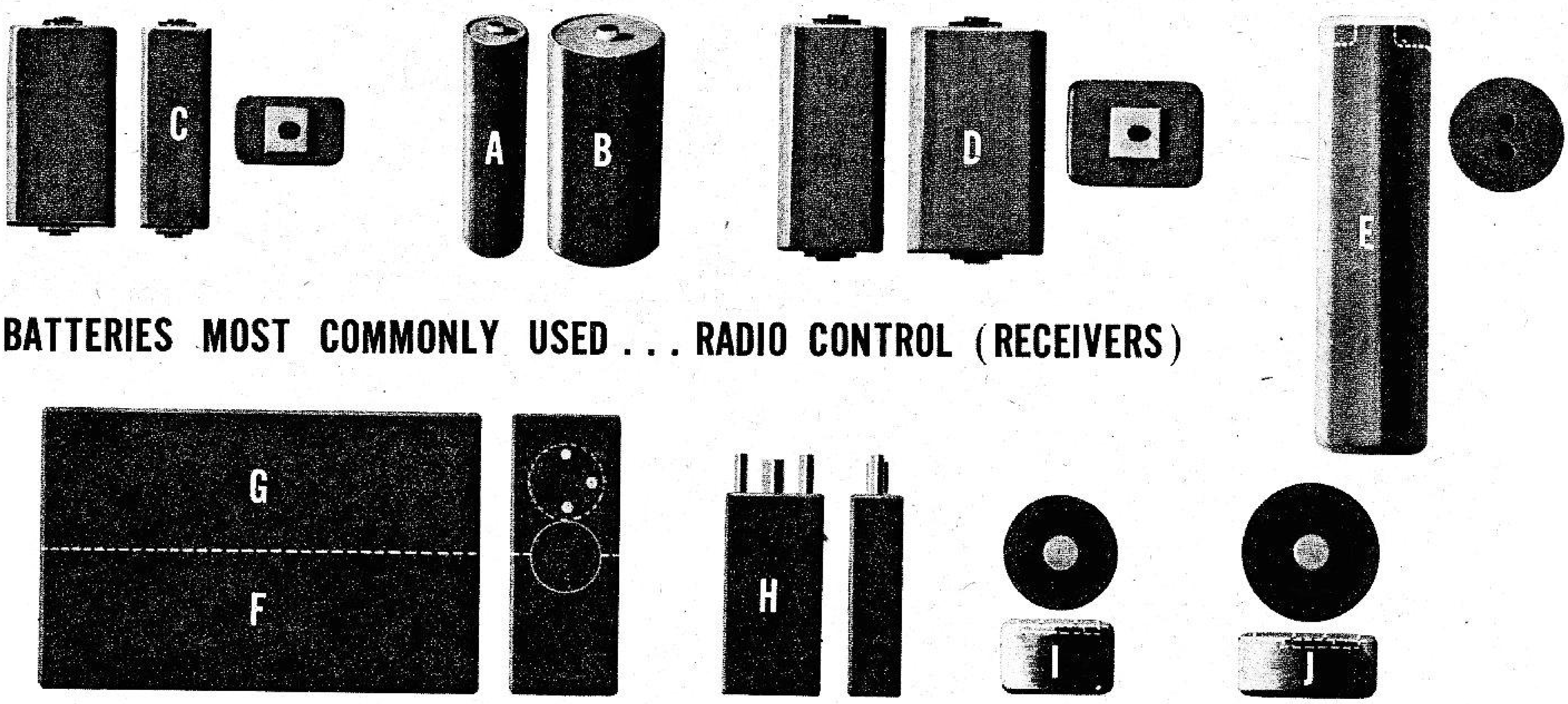
BATTERIES FOR RADIO CONTROL



BATTERIES MOST COMMONLY USED . . . RADIO CONTROL (RECEIVERS)

by E. J. LORENZ

BATTERIES—which one shall I use? Will one penlight cell be enough? What is the smallest 45-volt battery obtainable?

These are only a few of the questions asked by a person starting on radio control of model airplanes. As batteries constitute the bulk of the weight and space in a radio control receiver, this article will deal exclusively with power requirements for receivers. A large percentage of radio control transmitters in operation today are battery-powered, but since weight and space are not so critical, the larger the battery the better.

Before continuing, a word about charts. They are self-explanatory and all computations were made under laboratory conditions with standard fresh batteries. Field tests and flights also were made to substantiate the laboratory figures. Since Eveready and Burgess make the only complete line of small batteries suited to all phases and types of radio control models, these batteries are the ones used for compiling data on the 45-volt "B" supply. All makes were tested and the results averaged, since the values were close.

There is one other type cell which may prove to be very popular for radio control use: the Mallory mercuric-oxide cell which made its debut during the war. At present they come in two sizes: 1" diameter x .671 high; and 1-1/4" diameter x .575 high; they weigh 1 ounce and 1-1/4 ounce respectively. Tests are now being made to ascertain their value for radio control work.

The peak voltage of these mercuric-oxide cells, which varies under load, is but 1.3 volts at maximum. This should not be a detriment since tests have been run on receivers using an RK-61 tube with a filament voltage as low as 1.05 volts. With proper adjustments in the circuit, the tube and receiver continued to function perfectly all the way from 1.3 down to 1.05 volts.

The cells themselves are compact in design and have a steel outer case, which is the positive terminal. They are non-corroding and their method of construction and design give them an exceedingly long life at moderate current drains (up to about 200 milliamperes). At current drains of 50 to 125 mils, their life is up to 100 times that of pencells or intermediate size flashlight cells.

The majority of model builders seem to be interested in what is best as to size, weight and workability. This being the case, the technical workings of wet and dry cells will be passed over and just the highlights, such as the everyday practical information on batteries, will be given. Those desiring detailed information on these two type cells may obtain it from high school text books or at the library.

As most modelers know, one "battery" or cell, has a theoretical potential of 1.5 volts for the "dry cell type" and 2.1 volts for the lead-acid type wet cell. Due to improved mixes now used in dry cells, all of those tested were over 1.5 volts, some being as high as 1.75 volts. The wet cells, fully charged, were up as high as 2.5 volts per cell. Even though the initial voltage on cells may be high, it drops off rapidly, and the cell then maintains a fairly steady though somewhat lower voltage output. This downward voltage curve becomes steeper as the current drain is increased. By adding cells in parallel, the current drain per cell is less, and due to the given resistance in the circuit a higher voltage is maintained over a greater period of time. Hence it is best to use as large a battery, or group of cells, as possible. The life of the battery, consisting of a group of cells connected in parallel, is greater than it would be if the same number of cells were used individually, although the voltage remains the same in either case.

Perhaps you have noticed that your batteries seem to hold up better during summer than during cold winter flying. Heat increases the chemical action of all cells and thus temporarily increases the cell output. All cells are tested at a standard temperature of 70° Fahrenheit. The voltage of a cell increases approximately .01 volts for each 13° F. rise. The amperage also increases, but this varies with size of the cell. When the temperature of a cell is increased, the voltage/current characteristics are increased and take on the capacity for that temperature. The maximum temperature for this is approximately 105° to 115° F. When a cell has been overheated, for one reason or another, lowering its temperature will decrease its capacity; subjecting a cell to low temperature also decreases its capacity. Although any temperature above 20° will not harm batteries for model work, it is interesting to know that at

15° to 20° below zero, a cell has only about 15% to 25% of its rated capacity, as measured at 70°. Keep your cells and batteries in a cool place in order to prolong their shelf life. Continual warm or hot temperatures will increase local action in the cell itself and also contribute to loss of moisture.

A given size cell is rated at a certain current drain. An attempt to obtain a higher current drain will only tend to heat the cell and thus shorten its life. For example, an attempt to draw three amperes from a penlight cell will result in a life for the cell of but a few minutes. It will also become warm to the touch. But three amperes drawn from a large number six dry cell will have little or no effect on the cell for the same period of time. This heating of a cell, under high current drain, is due to internal resistance of the cell. The smaller the individual cell, such as used in small hearing aid batteries, the greater should be the care in seeing that the current drain for that size cell or battery is not exceeded, in order that maximum life be obtained from the battery. Of course if economy of operation is of no importance, a larger current drain may be used, but it will be available for a much shorter period of time.

As stated before, the charts are self-explanatory as to current drain and voltage at any desired time. All tests were continuous and therefore the life of the cell or battery will be greatly increased if used intermittently. The actual total life will depend, of course, on how long the cell or battery has been "on" compared to its "off" period.

Dry cell type batteries cannot, as a general rule of theory, be recharged after they have been in use for any length of time. They can, however, be boosted temporarily by placing them across a larger capacity battery for a short time. The negative terminal of the smaller battery must be connected to the negative terminal of the larger, and likewise for the positive terminals. For example, if you employ the usual two cells in series as a flight battery, use three No. 6 dry cells in series as a booster. Also, have your booster plugs so arranged that the booster will always be connected directly across the flight battery whenever used.

A dry type cell will "recharge" itself, due to the depolorization action of the mix, when left disconnected after having been in use. This accounts for the much longer life obtained from cells and batteries when they are used intermittently instead of for continuous duty.

The radio control enthusiast would do well to look into wet type cells for low voltage power sources. The prime advantage of this type cell is the high ampere capacity, resulting in longer life, as compared to a comparable size dry cell. As a power source for ignition escapements, solenoids or motors, the author has found them unexcelled. The main disadvantage of wet type cells is the spilling of the electrolytic and the fact that they need to be charged. The first item may be solved one of these days, thereby making a wet cell as "dry" as a dry type cell. The second item should be of little concern to the model builder since all that is needed is an inexpensive charger which the modeler can make or purchase from most of the manufacturers of these type batteries. Since all wet type cells are sold in a dry condition, the electrolytic, as specified by the particular manufacturer, must be added and the battery then recharged. Once the liquid

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BATTERY DRAIN CHART

BATTERY	NUMBER	INITIAL VOLTAGE	CURRENT DRAIN	END POINT VOLTAGE	LIFE IN MINUTES	REMARKS
EVEREADY "AA"	915	1.63	50 ma.	1.2	88	NEW TYPE CELL
EVEREADY "AA" SINGLE CELL	1016-E	1.62	50 ma.	1.2	95	HEARING AID CELL WITH LONG LIFE "MIX."
EVEREADY "AA" TWO CELLS	1016-E	1.62	50 ma.	1.2	280	CONNECTED IN PARALLEL
EVEREADY "C"	935	1.63	50 ma.	1.2	425	NEW TYPE CELLS
MALLORY	RMB-3	1.3	50 ma.	1.1 1.2	16 HRS. 4 HRS.	MERCURIC OXIDE CELL
MALLORY	RMBZ-4	1.3	50 ma.	1.1 1.2	23 HRS. 4 HRS.	MERCURIC OXIDE CELL
BRIGHT STAR "AA"	P59	1.65	100 ma.	1.2	105	2 PHOTO FLASH CELLS; CONNECTED IN PARALLEL.
RAY-O-VAC "C"	I-LP	1.6	100 ma.	1.2	110	
EVEREADY	950	1.62	100 ma.	1.2	260	
MALLORY	RMB-3	1.3	100 ma.	1.1 1.2	2.7 HRS. —	MERCURIC OXIDE CELL
MALLORY	RMBZ-4	1.3	100 ma.	1.1 1.2	6 HRS. 45 MIN.	MERCURIC OXIDE CELL
EVEREADY "AA" TWO CELLS	1016E	1.61	125 ma.	1.2	77	CONNECTED IN PARALLEL
RAY-O-VAC "C"	I-LP	1.68	125 ma.	1.2	112	
MALLORY	RMBZ-4	1.3	125 ma.	1.1	4 HRS.	
M.WARD PENCELL	–	1.66	220 ma.	1.1	47	2 IN PARALLEL
FIRESTONE "D"	T-C-1	1.7	220 ma.	1.1	192	
EVEREADY "D"	950	1.6	260 ma.	1.2	155	
VITAMITE	–	2.2	300 ma.	1.4	130	
BRIGHT STAR "C"	P-11	3.2	500 ma.	2	42	2 PHOTO FLASH CELLS; IN SERIES
BURGESS	TE	1.67	1 AMP	1.2	32	HEARING AID
BURGESS	TE	3.4	1 AMP	2	40	2 CELLS IN SERIES
EVEREADY EVEREADY (2 EACH)	412-E OR 412	48	1.25 ma. 1.5 ma. 1.8 ma.	41	14 HRS. 10 HRS. 6 HRS.	2 BATTERIES IN SERIES
EVEREADY EVEREADY BURGESS (2 EACH)	420-P OR 420-E OR K15-E	48	1.25 ma. 1.5 ma. 2 ma. 3 ma. 4 ma. 5 ma.	41	150 HRS. 95 HRS. 75 HRS. 42 HRS. 25 HRS. 10 HRS.	2 BATTERIES IN SERIES
EVEREADY BURGESS BURGESS	455-P OR XX30E OR XX15E	48 48 24	1.3 ma. 1.8 ma. 2.5 ma. 3 ma. 5 ma. 7 ma.	41	345 HRS. 240 HRS. 155 HRS. 135 HRS. 75 HRS. 45 HRS.	XX15E IS HALF SIZE OF XX30E

BATTERY CHART

"A" & "B" BATTERIES

MAKE & NUMBER	VOLTAGE	SIZE	WEIGHT	ILLUSTRATION OR REMARKS
•ANY PEN-CELL	1½ V.	9/16" DIA. × 2"	½ OZ.	"A"
EVEREADY 1016-E	1½ V.	19/32" × 1 9/64" × 2 1/16"	1⅛ OZ.	2 PENLIGHT CELLS IN 1-IN WRAPPER
•ANY SIZE "C" CELL	1½ V.	1" DIA. × 2"	1½ OZ.	"B"
EVEREADY 1040, BURGESS "CL" ‡	1½ V.	1" DIA. × 2 25/32"	2⅛ OZ.	ALSO AVAILABLE WITH PLUG-IN CONTACTS
BURGESS "TE", EVEREADY 1052-P ‡	1½ V.	1⅛" DIA. × 3 15/16"	3⅔ OZ.	"E"-PLUG-IN CONTACTS
•ANY SIZE "D" CELL	1½ V.	1 5/16" DIA. × 2 25/64"	3¼ OZ.	
* BURGESS U-10-E, EVEREADY 411-E ‡	15 V.	19/32" × 1" × 1 15/32"	1 OZ.	FLAT CONTACTS
* BURGESS K-10-E, EVEREADY 417-E ‡	15 V.	1¼" × 31/32" × 1 9/16"	1⅔ OZ.	FLAT CONTACTS EVEREADY AVBL. IN PLUG-IN
* BURGESS U-15-E, EVEREADY 412-E ‡	22½ V.	19/32" × 1" × 2"	1¼ OZ.	"C"-FLAT CONTACTS
* BURGESS K-15-E, EVEREADY 420-E ‡	22½ V.	1¼" × 31/32" × 2 3/16"	2⅕ OZ.	"D"-FLAT CONTACTS EVEREADY AVBL. IN PLUG-IN
BURGESS XX15E	22½ V.	15/16" × 1 11/32" × 3 7/8"	4 OZ.	"G"-PLUG-IN CONTACTS
EVEREADY 433P	33 V.	1" × 2 21/32" × 3 1/16"	6⅓ OZ.	PLUG-IN CONTACTS
BURGESS XX22E	33 V.	31/32" × 2 17/32" × 3 1/8"	6¼ OZ.	PLUG-IN CONTACTS
BURGESS XX30	45 V.	31/32" × 2 17/32" × 3 21/32"	7¼ OZ.	SNAP-ON CONTACTS
BURGESS XX30E	45 V.	31/32" × 2 17/32" × 4 1/8"	7½ OZ.	"F"-PLUG-W CONTACTS
EVEREADY 455-P	45 V.	1" × 2 21/32" × 3 29/32"	8¼ OZ.	"F"-PLUG-W CONTACTS
BURGESS XX45	67½ V.	1 9/32" × 2 21/32" × 3 5/8"	11½ OZ.	SNAP-ON CONTACTS
EVEREADY 467	67½ V.	1 5/8" × 2 13/16" × 3 45/64"	12 OZ.	SNAP-ON CONTACTS
SPECIAL BATTERIES				
BURGESS 2Z2SC	3 V.	1 3/16" × 1 5/16" × 2 3/8"	3¾ OZ.	SC-SPRING CLIPS
BURGESS 2Z2PI	3 V.	1 3/16" × 1 5/16" × 2 15/32"	3¾ OZ.	PLUG-IN CONTACTS
BURGESS B2	3 V.	27/32" × 1 19/32" × 2 11/16"	3½ OZ.	
BRIGHT STAR	3 V.			PLUG-IN CONTACTS
MALLORY RMB-3	1.3 V.	1" DIA. × 21/32" HIGH	1 OZ.	"I"-MERCURIC OXIDE STEEL CASE
MALLORY RMBZ-4	1.3 V.	1¼" DIA. × 9/16" HIGH	1¼ OZ.	"J"-MERCURIC OXIDE STEEL CASE
VITAMITE	2.2 V.	½" × 1" × 1 13/16"	1 OZ.	"H"-WET CELL

* MAY NOT BE READILY AVAILABLE AT ALL DEALERS.

‡ DIMENSIONS MAY VARY ± 5/64" ACCORDING TO MANUFACTURER.

• DIMENSIONS MAY VARY SLIGHTLY ACCORDING TO MANUFACTURER. MAXIMUM VOLTAGE OF FRESH BATTERIES MAY VARY UP TO 8-10% OVER GIVEN RATING.

Batteries for Radio Control

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is placed in the cell, the cell must be kept in a charged state; otherwise sulphation will occur, rendering the cell useless.

A fully charged lead acid cell, such as used for model work, loses 1% to 1-1/2% of its charge per day if left in an unused state. If once charged and then left idle, a wet battery should be charged at least once every two weeks to keep it in good condition. Cells have gone as long as 30 to 40 days between chargings, but this is not generally recommended. Vitamite batteries, by tests, have a life cycle of around 300, which means they are good for that many rechargings. Since a penlight cell is not rechargeable, the life span energy of the aforementioned wet cell is equal to the energy expended by the amazing total of 600 penlight cells. Thus it can be readily seen that a wet type cell will last longer than a comparable dry cell under the same conditions.

Modelers probably will obtain more information from the charts and diagrams than from a thousand more words. So in closing, here is a brief summary:

Be sure your batteries are fresh. Check them with a voltmeter, preferably while under load.

Do not attempt to draw too high a current from your cells or batteries unless economy is secondary.

Do not overheat your batteries and expect them to be normal when the temperature again becomes normal. Overheating a cell or battery, either by raising the external temperature or employing excessive drain, will lower the cell capacity. Store your cells in a cool place.

When using "wet" cells, keep them in a charged condition. If left uncharged, after the electrolytic has been added, sulphation will occur and the cell will be damaged.

Whenever possible, use boosters. Be sure to observe polarity when connecting boosters. Positive terminal of booster must be connected to positive terminal of flight cell or battery, and negative terminal connected to corresponding negative terminal.

Remember, cells connected in parallel give far longer life than individual cells.

This article has dealt principally with radio control receiver power sources, and although the author is a firm believer in the bright future of radio control, there is still a considerable amount of work to be done in this field. The more modelers who take up this interesting phase of building the faster and better it will be developed.

Comments on Battery Drain Chart.

All life tests were continuous under full load except for the 22-1/2 or 45 volt "B" batteries, which were computed on a 12 hour per day basis. End point voltages were taken to a conservative 1.1 or 1.2 volts per cell instead of the regular 1.0 or 0.8 volts per cell. A high end point voltage was used for the chart so as to take care of critical circuits or components where a lower voltage cannot be tolerated.