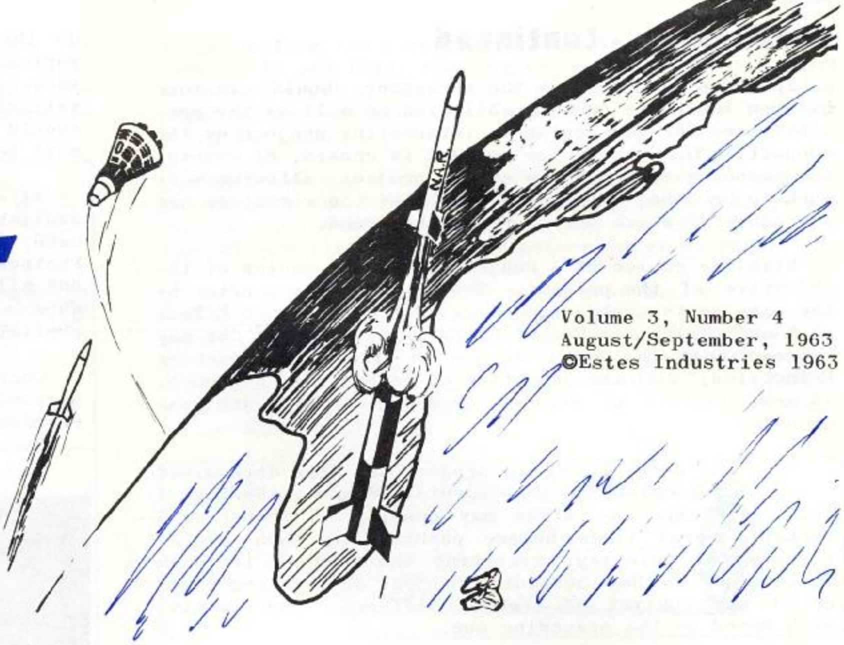
# MODEL ROCKET NEWS




Volume 3, Number 4
August/September, 1963


## Schmidt Project Named Best In Science Fair Contest

"Reducing Drag on an Astrodynamic Vehicle," a science fair project by Roy Schmidt of Denham Springs, La., received first place honors in the recent Science Fair Contest sponsored by Estes Industries. Roy's project was a study of the effect of paint on rocket performance. In the project he measured the performance of a rocket before and after painting, and discovered that the rocket performed considerably better after painting, even though the paint increased its weight. For a picture of Roy's project, see V3, N3 of the Model Rocket News.

Second place in the contest went to "Model Rocketry and the Effects of Acceleration on Mice" by Terry Krumm of Dayton, Ohio. Terry's objects, as he states at the beginning of his report, were to (1) build and fly model rockets capable of lifting payloads in excess of three


This display by Terry Krumm is especially well done, and shows all equipment used in his project.

ounces and (2) to use these rockets to study the effects of acceleration on trained mice. Experimentation in the project included the construction and use of a camera carrying rocket, training a mouse to run a maze, testing the mouse in a home-made centrifuge, and finally testing the mouse in actual rocket flight.

Continued page 2

## Developing a Winning Science Fair Project

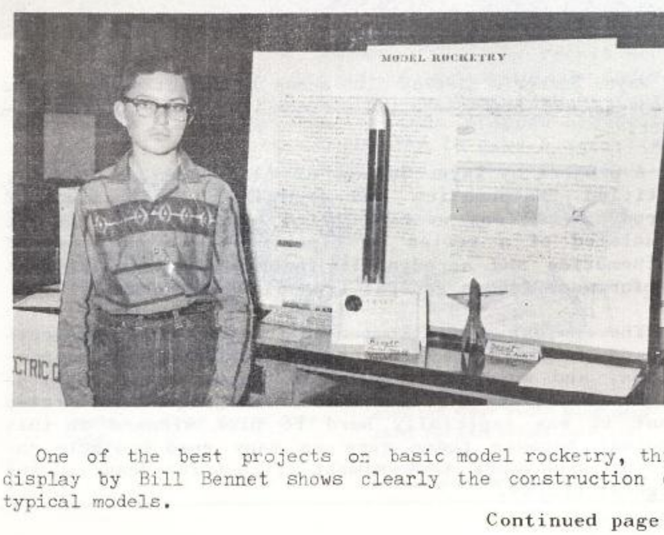
What makes a winning science fair project? What can a person do to improve his chances of winning?

A survey of some of the projects entered in Estes Industries' Science Fair Contest shows many of the features which a winning project should have. While it is impossible to predict the choice of the judges, a properly conducted science fair project in almost any of the areas related to model rocketry should have an excellent chance in any fair.

There are three parts to any acceptable science fair project; research, report, and display. A good project has to be good in all three areas.

RESEARCH

The first step in any project is to choose a subject. While this may sound obvious, many people fail here and as a result fail in their projects. Some of the better subjects which have been used include the application of mathematics and aerodynamics to the development of a high performance model rocket, a study of model rockets and the effects of acceleration on mice, a study of the effect of paint in reducing drag, a study of the effect of fin shape on rocket performance, and research on the design requirements of boost gliders.




One of the best projects on basic model rocketry, this display by Bill Bennet shows clearly the construction of typical models.

Continued page 2

## Developing - - Continued

In choosing a subject the rocketeer should consider his own interests and capabilities as well as the possibilities for developing an interesting project on the subject. The sooner the subject is chosen, of course, the sooner work can begin on the project, allowing more work to be done, with the result that the rocketeer has a project of which he can really be proud.

With the choice of a subject comes the choice of the objective of the project. The objective may often be the same as the subject, such as "Determining the Effect of Rocket Weight on Rocket Performance," or the one may proceed from the other as in "A Study of Augmenter Principles," with the objective of determining how much, if any, benefit is derived from the use of a jet pump on a model rocket.

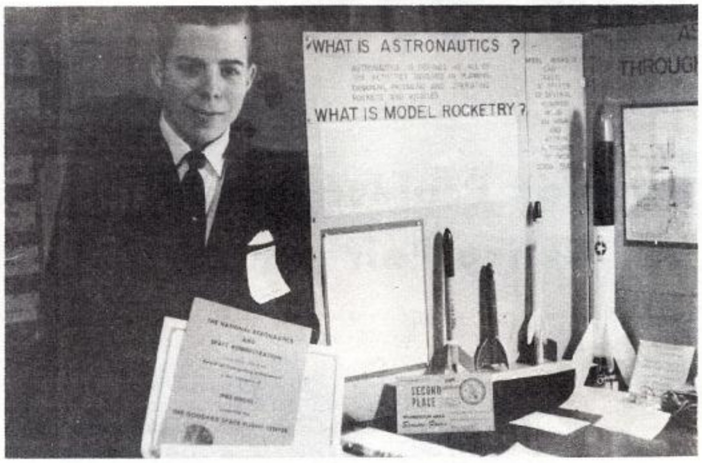
When the objective of the project has been determined it is time to plan the experimentation and gathering of data. The experimentation may consist of launching a rocket several times before painting and then several times after painting, recording the altitude for each flight, as in Roy Schmidt's project on reducing drag, or it may consist of several different experiments, each based on the preceding one.

The nature of the experiments will be determined by the subject which is being studied. It is necessary to sit down and decide what information is needed and how it may be obtained. These experiments must be conducted in such a manner as to determine the truth, not to support a previously formed opinion.

In any project actual research should be conducted if the work is to have any merit at all. Part of the purpose of the science fair is to determine who can do the best job of performing this research. All experiments must be performed carefully; accuracy is very important. Enough tests must be performed to provide reliable data. Everything that can be photographed should be. After the tests have been made the results must be checked carefully to insure their reliability.

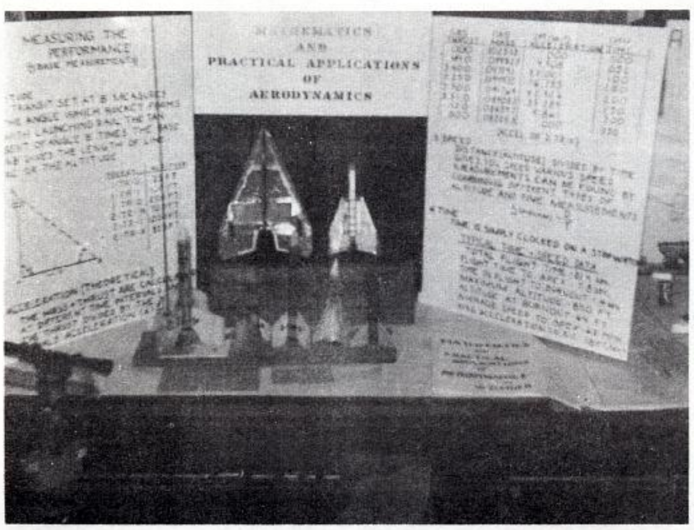
After all data has been collected and a study of all available printed material relating to the subject has been completed, it is time to compile the results. Photographs are developed, graphs and charts are drawn, and all observations are written down in logical order. When all this has been done it is time to draw some preliminary conclusions.

Once these preliminary conclusions have been formed some more tests which will check the validity of the conclusions should be devised and carried out. This




"Astronautics Through Model Rocketry," by Douglas Frost, featuring live payload and camera launchings, was concerned with the use of model rockets in studying astronautics.

## Contest - - Continued




Wayne Sumner's display also shows equipment used in his project, and emphasizes the mathematical aspect of the project.

A project by Wayne Sumner of Albert Lea, Minnesota, entitled "Mathematics and Practical Applications of Aerodynamics" was awarded third place. This project consisted of a series of experiments in the use of mathematics and aerodynamic theory to obtain the best performance from a general type of model rocket.

The contest judges commented that all three projects showed considerable thought and care in their preparation, and were outstanding in their various applications of the scientific method. The judges also stated that it was especially hard to pick winners in this contest because there were so many good projects entered, and added that almost all entries deserved the highest praise.

## The Model Rocket News

| Vernon Estes | William Simon | Gene Street |
|---|---|---|
| Publisher | Editor | Illustrator |

The Model Rocket News is published approximately six times annually by Estes Industries, Inc., Penrose, Colorado. It is distributed free of charge to all the company's mail order customers from whom a substantial order has been received within a period of one year. The Model Rocket News is distributed for the purpose of advertising and promoting a safe form of youth rocketry, and for informing customers of new products and services available from Estes Industries. Rocketeers can contribute in several ways towards the publication of the Model Rocket News:

(1) Write to Estes Industries concerning things you and your club are doing in this field which might be of interest to others.

(2) Continue to support the company's development program by purchasing rocket supplies from Estes Industries, as it is only through this support that free services such as the Model Rocket News, rocket plans, etc., can be made available. This support also enables the company to develop new rocket kits, engines, etc.

(3) Write to the company about their products, and tell what you like, what you don't like, new ideas, suggestions, etc. Every letter will be read carefully, and every effort will be made to give a prompt, personal reply.

(4) Participate in the Writer's Program (described in Volume 2, No. 3 of this publication). Not every article submitted will be accepted, but it is through trying that one gains skill, and those which are accepted contribute greatly to the enjoyment of model rocketry by other persons also.

may seem a rather drawn out procedure, but the accuracy of the results more than pays for the effort. The best science fair projects show this devotion to accuracy.

REPORT

Most reports on science fair projects can be divided into three parts, introduction, body, and conclusion. The report is usually a step by step account of the research work conducted, with any additional material which may be necessary to explain the project.

The introduction should normally explain the objectives of the project and the approach taken in carrying out the objectives. The body is an account of the experiments and methods used, and should contain the data gathered in the experiments. The conclusion contains a statement of the results of the project as related to the objectives (the conclusions which may be drawn from the experimentation and study).

DISPLAY

The display should be done just as carefully as any other part of the project. It is important as it must explain the project in terms anyone can understand and must attract the judges' attention to the project.

Among the things which help make the display interesting and should be included are the equipment used in the project, charts and graphs, photographs, and a condensed version of the report. Other things such as thrust-time curves and diagrams of equipment also help considerably. If electric power is available it can be used to operate attention-attracting devices such as a revolving rocket, automatic slide projector, blinking lights, etc.

The entire display must be neat. Clean, large, legible lettering, orderly distribution of charts, pictures and equipment, and attractive colors all help. Here, as elsewhere, the imagination of the entrant is of first importance.

EVALUATING A PROJECT

In the light of what we have learned from the entire group of projects we can study a typical project and consider its good and bad points. "Effects of Acceleration on Rocket Performance," by Jerry Jones is a good example to consider. This project is a study of the relation of acceleration to rocket altitude in rockets with different thrust to weight ratios but identical mass ratios (or identical total power to weight ratios).

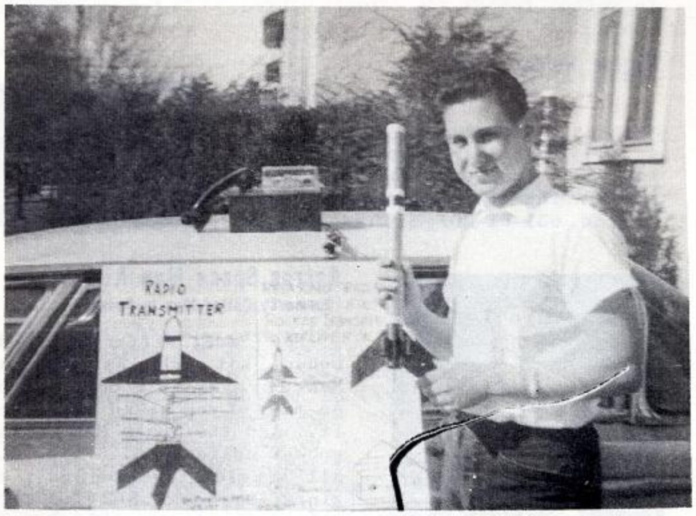
Jerry begins his report by stating that many rocketeers believed that their rockets would go higher with Series II engines than with Series I engines of identical total impulse. His own observations seemed to indicate that this was not always the case, so his object in this project was to determine what effect, if any, the level of acceleration would have on the performance of his rockets.

Jerry's selection of a project is quite good, since he has picked a subject which interests him and covers an area in which he already has considerable experience. Also his subject is one which has not been covered extensively by other researchers, giving him a chance to contribute to the science of rocketry.

In the body of his report Jerry tells how he built a rocket weighing .24 ounce. With a 1/2A.8-2 engine in place the rocket weighed exactly .80 ounce. He fired this rocket twice using one Altiscope 100 feet away from the launcher to determine the rocket's altitude. The first flight was computed at 270 feet, the second at 740 feet.

This variation in altitude appeared to be unreasonable and impossible considering the rocket and the engines used until he noticed that if the rocket had reached an altitude of about 400 feet on both flights but had drifted 50 feet away from him on the first flight and 50 feet towards him on the second he would have gotten approximately the readings he did. For the remaining flights he decided to use a 1000 foot baseline.

The rocket was launched three more times with the same engine-weight combination and altitudes of 316', 325', and 325' were recorded. Then an engine of twice the total impulse (the A.8-3) was placed in the rocket. Lead weights were placed inside the rocket to double its takeoff weight, and it was fired three times to altitudes of 344', 344', and 354'. Following this the rocket was brought up to a weight of 2.62 ounces with a B.8-4 in place and once more fired three times to altitudes of 364', 383', and 364'. Finally the rocket, at the same weight, was fired three times, using B 3-5 engines, to altitudes of 306', 315', and 315'.




Morten Katz developed a rocket-borne radio transmitter for his project, showing quite a few possibilities for further developments.

All launchings were conducted in the late afternoon in perfectly calm weather. The launcher used a 1/4" thick steel rod, 6' long, set in concrete in the ground to give precise control of the rocket's flight path. A scope liberated from an air rifle was mounted on the Altiscope to make late afternoon tracking easier.

It is impossible to find fault with Jerry's research work up to this point. He has organized his tests to give exactly the same ratio of total impulse to weight on each flight. Only the acceleration is allowed to vary. Under drag-free conditions away from the influence of gravity all rockets would reach identical speeds. He has repeated each test enough times to give fairly good average altitudes for each combination.

But Jerry stops here, and that's where he falls down. He hasn't made any tests to determine burnout altitude for the different combinations, and so he doesn't have any indication as to whether differences in altitude occur before burnout, after burnout, or both. He didn't make any graphs of the results, and on the basis of only three flights for each engine-rocket combination he states flatly that for every 100% increase in average acceleration there is a 7% decrease in performance. While his evidence is sufficient to show that there is a decrease in performance, he does not have enough data to attempt to give an exact figure. It would have been more justifiable to state that for every 100% increase in average acceleration it appears that there is approximately a 5% to 10% decrease in performance.

In his display Jerry showed his rocket, an engine, his Altiscope, and his Electro-Launch. On the board behind the equipment he had a brief version of his report posted. Jerry's project didn't place in this year's fair, but he knows what he did wrong, and what he can do to make a better project, and plans on winning next year.

# New Products

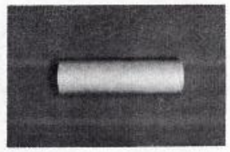
### Astron Sky Hook Kit

See the plans for this sweet flying bird on page 7! Complete kit, with all parts and detailed instructions, Cat. No. 631-K-8 $1.35.

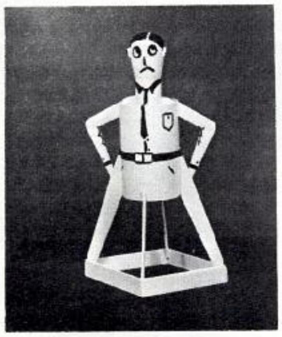
### Astron Cobra Kit

Study the plans on page 8! You'll like this easy-to-build, fun-to-fly cluster bird. Order the Astron Cobra, Cat. No. 631-K-10, $3.50.

### Engine Holder Tubes



BT-20 body tubes in 2-3/4" long sections, especially made for use as engine holder tubes in cluster rockets. You won't have any trouble finding other uses for these. Cat. No. 631-BT-20J, $.10 ea. 3/$.20

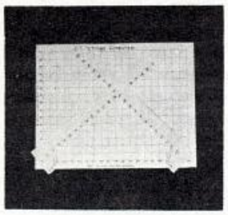


### Astron Space Man Kit
**(Formerly Called Man in Space)**

The "most different" model rocket kit, the Astron Space Man is available only because so many of you asked us to sell it. Add the Space Man to <u>your</u> rocket collection. Flies with all single-stage Series I engines, use 1/2A.8-2 for first flights. Kit is complete with all parts and easy-to-follow instructions (but no engines). Cat. No. 631-K-9 $ .75

### Wind Tunnel Plans

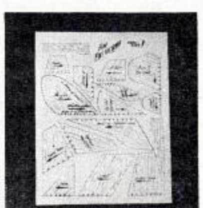

Full plans for building a wind tunnel to measure rocket stability. Instructions for motor and hand powered versions, finding center of pressure, etc. A good project for clubs and experienced modelers Cat. No. 631-TR-5 $ .25



### 2-D Altitude Computer

Instructions and charts for making a simple, reliable altitude computer for use with Altiscopes, etc. Easily built with materials from around your house. Gives altitudes quickly and easily from data given by tracking stations. Cat. No. 631-AC-1 $ .25

### Fin Pattern Sheet



Fourteen different popular fin designs, all tried and proven, printed full size on heavy index stock. Simply cut out and trace around pattern to transfer design to balsa. A must for the model rocket designer. Cat. No. 631-PP-2 $.25 ea., 3 / $.50

### Space Man Nose Cone

Replacement nose cone for the Man in Space rocket, made from select balsa. Lightweight, ideal for use with your own special Odd Ball design. 1.8" long by .9" max. diameter. Fits body tube BT-20. Cat. No. 631-BNC-20P $.25 ea. 3/$.50

# Idea Box Contest

Got a special idea or method to make model rocket building or flying easier or more enjoyable? Or an easy way to make better models? If you've got ideas that could be helpful to other rocketeers, send them in to the IDEA BOX CONTEST, c/o Estes Industries, Box 227, Penrose, Colorado, 81240. You may be one of the lucky ones to win one of these big prizes!

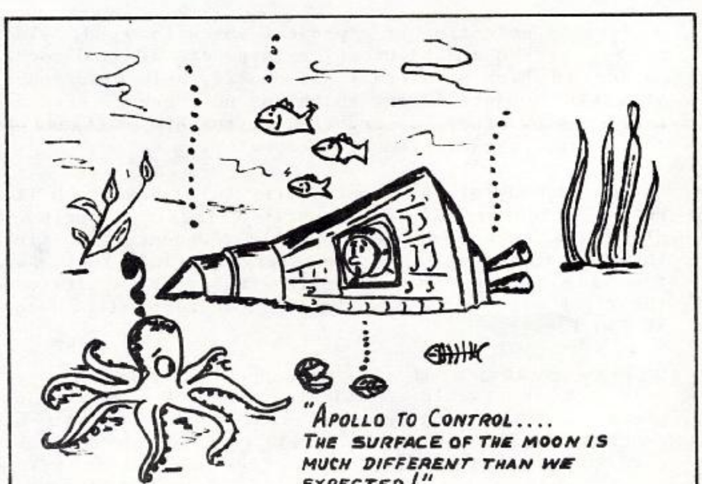
1st Prize--$50 in merchandise credit.
2nd Prize--$25 in merchandise credit.
3rd Prize--$10 in merchandise credit.
4th Prize-- $5 in merchandise credit.
5th through 10th Prizes--Astron Sky Hook kits.

Winning ideas will be published in the <u>Model Rocket News</u>, so send yours in today!

## Win FREE Merchandise!

<u>CONTEST RULES</u>

1) All entries must be presented on 8-1/2" x 11" paper.
2) Each entry must have been tested to assure that it is practical.
3) Sufficient information must accompany each entry to permit judges to try the idea.
4) The decision of the judges is final.
5) Entries must be postmarked no later than midnight, December 31, 1963.
6) If the same idea is submitted by more than one person, entries of that idea will also be judged first on date of postmark, and then on neatness of entry and completeness of explanation. Only the best entry of the idea will be considered for a prize.
7) All entries become the property of Estes Industries, Inc., and no entries will be returned.



# NOTES FROM THE BOSS


After watching some of the younger members of the Astron Rocket Society struggle and strain to get their rockets ignited and launched, and then reading letters from some of you fellows who have similar problems, it appears that some comments on rocket ignition are in order. For safety and professional appearance, there's no way to beat all-electrical ignition, provided you know how to use electrical ignition.

Most problems with direct ignition are a result of lack of care in forming and installing the igniter. When winding the igniter it is important to make a neat, evenly spaced coil. No part of the wire should touch against another, and the wire must not loop back over itself.

When the igniter is inserted into the engine, the wires leading to the coil should come out on directly opposite sides of the nozzle. The coil must touch the propellant grain if the engine is to ignite, so it must be inserted as far as it will go. (But don't push too much wire into the nozzle and short the igniter against itself!) When the kleenex is tamped into the nozzle it should be directly between the wires leading to the coil to keep them as far apart as possible. The kleenex must be tamped in hard enough to keep the igniter tightly in place.

If the igniter is installed so that no part of it touches another (so electric current will have to travel all the way through the wire and heat the coil rather than "short out" and bypass the coil), and with the coil all the way into the nozzle and in contact with the propellant grain (so heat from the coil will reach the propellant), the igniter will be good.

However, there are some other steps which must be taken if the engine is to ignite. Every time a rocket is put on the launcher the jaws of the microclips must be cleaned with an emery board or a piece of sandpaper to give a good connection with the igniter. The clips are attached as far up into the nozzle as possible so the current has less wire to heat and will heat the wire faster and hotter. The clips must not be allowed to touch each other or no current will reach the igniter. If the length of the nichrome igniter between the two clips is too great, the launcher may not have the power to heat the wire enough, or the wire may burn in two outside the nozzle before the coil has gotten hot enough to ignite the engine.

With the nichrome installed and connected correctly, the engine will ignite if the launcher's power supply has enough "oomph." For launchers such as the Electro-Launch which use size D cells, four size D PHOTOFLASH batteries such as Ray-O-Vac are recommended. Ordinary flashlight batteries do not have enough power. Six volts is the minimum voltage for rocket launchers, and twelve or eighteen volts will give even faster and more dependable ignition.

To test the launcher to see if it has enough power, place the microclips about 1-1/2" apart on a piece of nichrome wire. Press the firing switch. If the nichrome glows bright red, the launcher has enough power to ignite a model rocket engine.

A well installed nichrome igniter on a suitable launching system will give very good results. Misfires will almost disappear, and your rocketry activities will be much more enjoyable.

# LETTER SECTION

After purchasing your Astron Ranger kit, building it, and flying it several times, I have reached several conclusions. First, it performs beautifully, especially with a fair - sized payload. Second, twice out of the four times I have flown it (using B.8-4 engines every time), with the electric/Jetex system described in the plans, one of the engines has ignited just enough later than the others (or just enough earlier) to cause the rocket to veer off in one direction, in one case contrary to a brisk wind. While I realize that slight irregularity in ignition is unavoidable with this system, I feel that in future editions of the kit instructions you should include a warning to fly this model in an especially large field.

Third, as a result of the veering flight of the rocket described above I once had to chase the darned thing through a field of wet cow manure; fifty feet of soft, damp sand; a fair-sized stream; and under a barbed-wire fence. Then I had to come back. Another run through such an obstacle course, all the time dreading that the rocket might come down in one of several large trees nearby, would hardly be worth the $3.75 the kit cost. For this reason I recommend that in future kits of this size and power, a pair of streamers be used instead of two 17-inch parachutes. That thing drifted a half a mile on a calm day!

David Randall
Dayton, Ohio

After reading your letter, we have come to the conclusion that we are glad Colorado has a nice dry climate and we don't live on a cow ranch! I'd suggest that you either cut a hole about two inches in diameter in the center of your parachute or tape the chute partly closed. This will allow the rocket to descend to earth faster, but with a softer landing than a streamer would give.

-----Vernon Estes

. . .Can you tell me about a good recovery system for booster stages? A couple of days ago, I was watching a top stage going up, and the booster came whizzing down. It wasn't supposed to be stable by itself, but, to tell the truth, it was a lot more stable than the top stage, and it missed me by less than a yard! That whiz-thunk sort of shook me up, and I would like to do something about it. So, if you know how to recover a booster stage, please tell me.

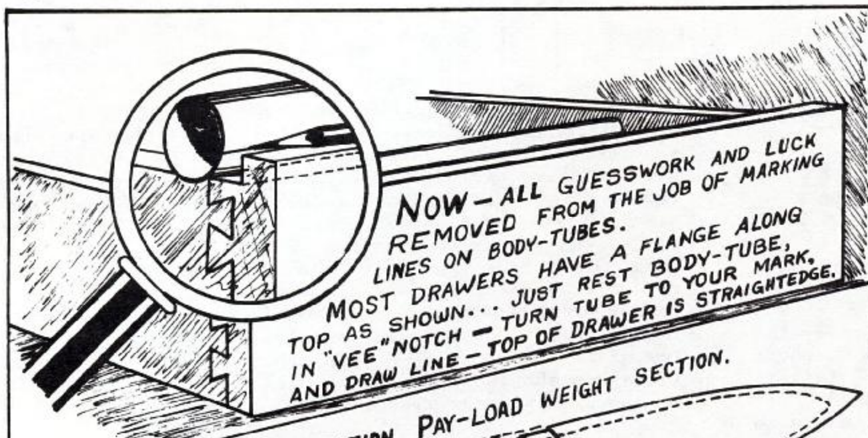
Robert Owen
Tulsa, Oklahoma

Designing a booster to be unstable by itself is the best recovery system I've seen yet. Normally the following procedure will result in a booster that tumbles every time the upper stage separates from it. The first step is to find the center of gravity (balance point) of the booster with everything but fins in place. Draw a fin pattern, cut it out, and balance it on a straight edge. The edge of the fin that is to be glued to the body must be at a 90° angle to the straight edge. In an unstable booster the balance point will match or be up to 1/4 inch ahead of the booster's center of gravity. Generally the double-swept fin and similar types which stick out straight away from the body will be best. Fins with a lot of sweep-back will not work. With the upper stage in place, the entire rocket's center of gravity should be far enough forward to stabilize the whole rocket on the upward flight, but when the upper stage separates from the booster, the booster will tumble back if the center of the fin is at the right point in relation to the stage's center of gravity.

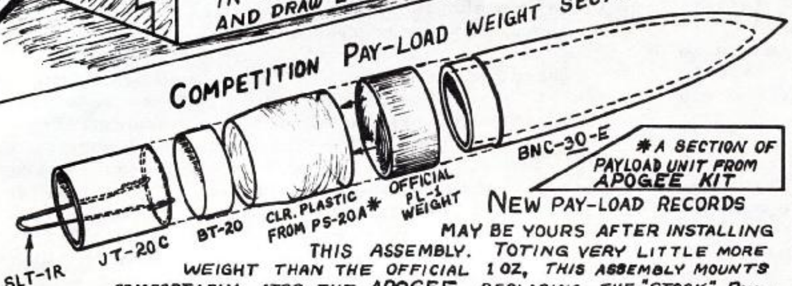
-----Vernon Estes

. . .I am a boy 54 years old, but still like to build rockets and fly them. I would like to know if any of your other customers are older folks, and would like to hear from them if so.

Herbert Wilson
Box 25
Milton, Ky.

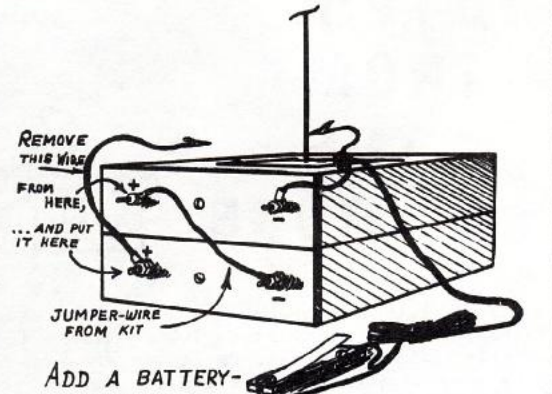


NOW — ALL GUESSWORK AND LUCK REMOVED FROM THE JOB OF MARKING LINES ON BODY-TUBES.
MOST DRAWERS HAVE A FLANGE ALONG TOP AS SHOWN... JUST REST BODY-TUBE, IN "VEE" NOTCH — TURN TUBE TO YOUR MARK, AND DRAW LINE — TOP OF DRAWER IS STRAIGHTEDGE.




NEW PAY-LOAD RECORDS MAY BE YOURS AFTER INSTALLING THIS ASSEMBLY. TOTING VERY LITTLE MORE WEIGHT THAN THE OFFICIAL 1 OZ, THIS ASSEMBLY MOUNTS COMFORTABLY ATOP THE APOGEE, REPLACING THE "STOCK" PAY-LOAD SECTION, AND NOSE CONE. HOWEVER, ANY HIGH-PERFORMANCE BIRD WITH A BT-20 BODY-TUBE SHOULD GIVE THIS UNIT A REAL RIDE!

CONSTRUCTION IS NORMAL, EXCEPT FOR SWELLING THE PLASTIC SECTION, AND FOR HOLLOWING THE NOSE CONE. TO FIT PL-1, YOU MUST HEAT PLASTIC TUBE WITH HOT WATER — AND IMMEDIATELY WORK PL-1 INTO TUBE-END AND FARTHER, TO A DEPTH OF 5/8". YOU MAY HAVE NEED TO REHEAT TUBE TO GET THIS DEPTH. ONCE STRETCHED, TUBE WILL "HOLD" THE NEW I. D. AND YOU NEED ONLY TO WORK PL-1 BACK AND FORTH A FEW TIMES TO INSURE SMOOTH REMOVAL AND REPLACEMENT FOR AN OFFICIAL WEIGH-IN. THE NOSE CONE IS CAREFULLY SPLIT DOWN IT'S CENTER-LINE — THEN HOLLOWED WITH GOUGE AND KNIFE. TRY FOR A 3/32" WALL THICKNESS EXCEPT FOR NOSE AREA AS SHOWN. WHEN HALVES ARE GLUED TOGETHER, THE SHOULDER IS TRIMMED TO 1/4" AND SANDED TO BECOME A PRESS-FIT INTO PLASTIC TUBE, "SEATING" ON PL-1. ONE MORE THING, ALLOW 1/4" OF TUBING TO PROTRUDE ON EACH SIDE OF PL-1 — YOUR PLASTIC TUBE SHOULD MEASURE 7/8" IN LENGTH. GLUE SLT-1R, JT-20C, BT-20 & PLASTIC TUBE AS A UNIT — PL-1 AND NOSE CONE PRESS INTO PLACE.

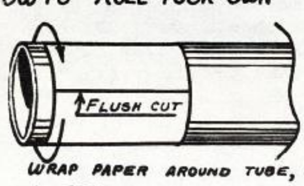



ADD A BATTERY-PACK TO YOUR ELECTRO-LAUNCH AND GAIN EXTRA-PUNCH AND LONGER BATTERY LIFE.
JUST THE THING FOR YOUR CLUB-LAUNCHER AND AN ALL-DAY SHOOT.

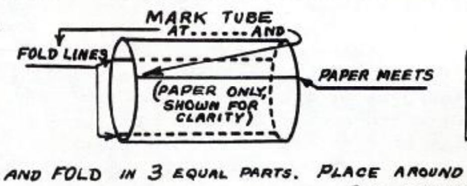
ATTACHMENT IS SIMPLE — JUMPER WIRE COMES WITH PACK KIT — ASSEMBLE UNIT AS INSTRUCTED — COAT TOP OF PACK WITH WHITE GLUE AND CLAMP PACK TO BOTTOM OF ORIGINAL ELECTRO-LAUNCH. ALLOW TO SET OVERNIGHT. A HEAVY BOOK, IRON, OR STACK OF MAGAZINES WILL DO NICELY, IN PLACE OF CLAMPS. WARNING! BATTERY POLARITY MUST BE CORRECT FOR UNIT TO WORK.

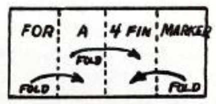
# THE IDEA BOX

## HOW TO "ROLL-YOUR-OWN" FIN-MARKER.... THAT IS.



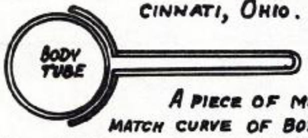




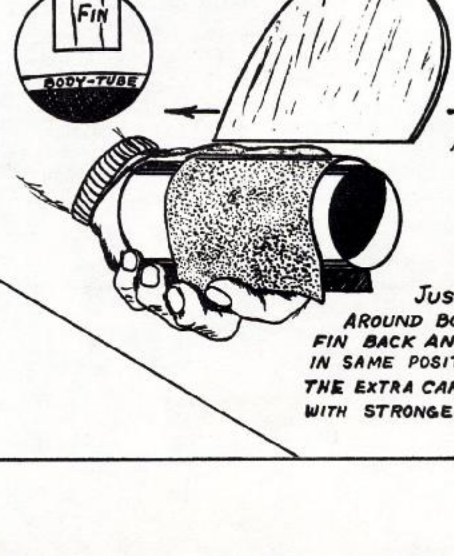

WRAP PAPER AROUND TUBE, AND CUT FLUSH. THEN REMOVE AND FOLD IN 3 EQUAL PARTS. PLACE AROUND TUBE AGAIN AND MARK AT BOTH FOLDS AND WHERE PAPER MEETS. FOUR FINS CAN BE MARKED AS EASILY. OUR THANKS TO YOU, TERRY DUFF OF DES MOINES, IOWA FOR THIS IDEA

FINS CAN BE A PROBLEM... TO KEEP 'EM PERPENDICULAR TO BODY-TUBE WHILE GLUE DRIES. .... NOT SO, FOR DALE JACKSON OF CINCINNATI, OHIO... WHO SHARES HIS IDEA SHOWN HERE.




A PIECE OF METAL 1/2" WIDE, BENT TO MATCH CURVE OF BODY-TUBE — WITH A SLOT LONG ENOUGH TO RECEIVE FIN TO BE FITTED, MAKES THIS TOOL... NO DIAMENSIONS ARE SHOWN, AS THERE ARE MANY BODY-TUBE SIZES IN USE. THIS TOOL COULD BE A USEFUL ADDITION TO YOUR RANGE-KIT.

FROM DEAN BLACK OF BRIGHAM CITY, UTAH, WE GET THIS METHOD OF SANDING THE GLUE-EDGE OF FINS, TO MATCH CURVE OF THE BODY TUBE TO WHICH THEY ARE TO BE ATTACHED.




JUST HOLD SANDPAPER AROUND BODY-TUBE — PASSING FIN BACK AND FORTH ON GRIT IN SAME POSITION AS IT WILL OCCUPY. THE EXTRA CARE WILL REWARD YOU WITH STRONGEST POSSIBLE JOINT.

BE SURE TO ENTER THE "REALLY BIG" **IDEA BOX CONTEST!**

SEE ALL DETAILS ON PAGE 4

# Sky Hook

First cut a body tube 7" long. Then glue the engine block in place 2-9/16" from the rear of the body tube. To do this, first mark an empty engine casing 2-9/16" from one end. Place a large dab of glue on the end of your little finger, reach through the end of the body tube as far as possible, and spread the glue around the inside of the tube. Insert the engine block into the end of the tube, and holding the empty engine casing by the end with the mark on it, quickly push the engine block forward until the mark on the engine casing is even with the end of the body tube. Remove the engine casing immediately.

Cut out the fins, mark the tube to space them correctly, and glue them in place. Cut two slits in the forward end of the body, one below the other, 3/4" and 1" from the end of the tube. Insert one end of the shock cord through the two slits from the inside, and glue. Glue the launch lug in place. Attach the screw eye to the nose cone. Assemble the parachute and tie the ends of the shroud lines to the screw eye. Tie the free end of the shock cord to the screw eye.

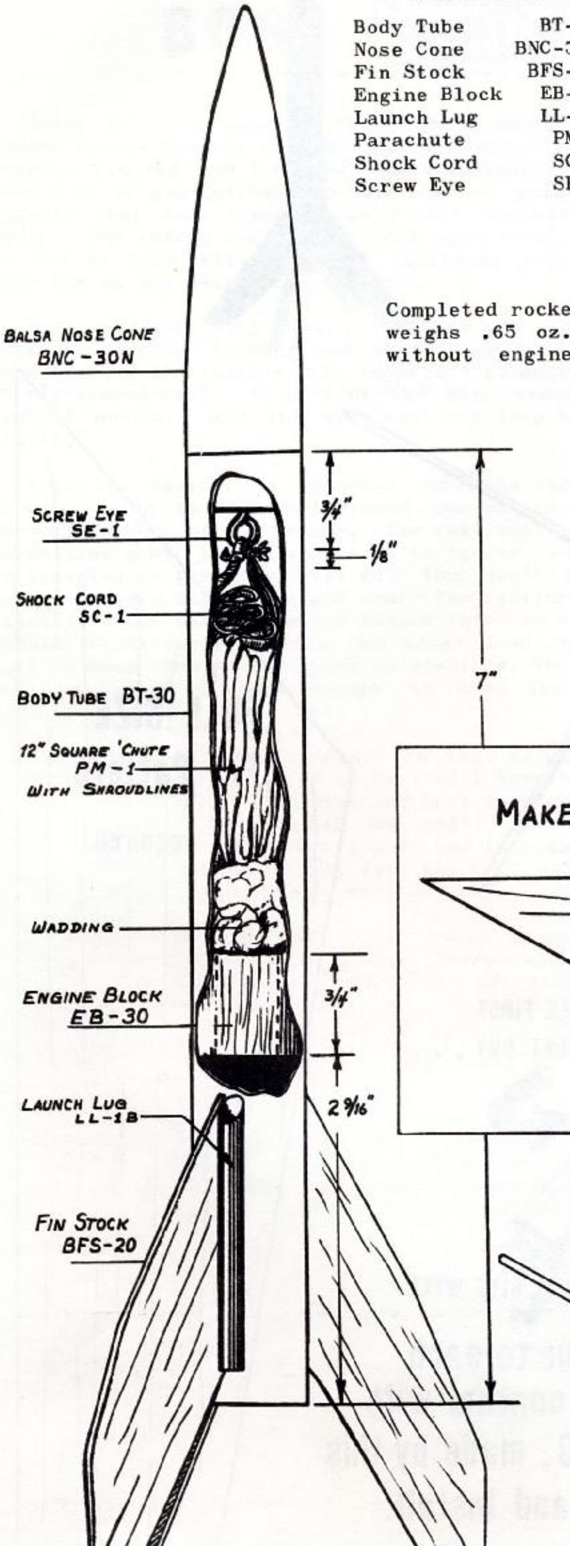
Sand all balsa surfaces, and paint the rocket the desired colors. To fly the Sky Hook, pack flameproof cotton or rock wool down against the engine block from the top. The wadding should fill at least 1-1/4" of the tube. Pack the parachute in on top of the wadding, with the shroud lines and shock cord over the 'chute. Put the nose cone in place. Wrap tape around the engine until it makes a tight friction fit inside the body. Install the nichrome igniter, and the Sky Hook is ready to launch.

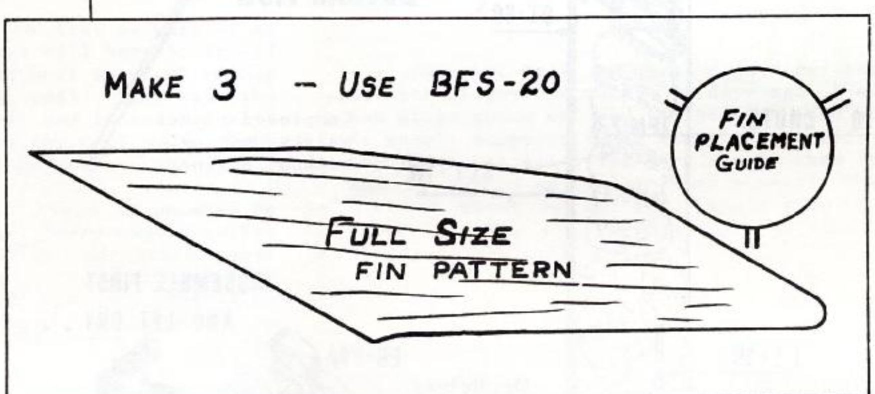
Available in easy to build kit form, complete with all parts and detailed instructions. Order the Astron Sky Hook, Cat. No. 631-K-8, $1.35. Shipping weight, 5 oz.

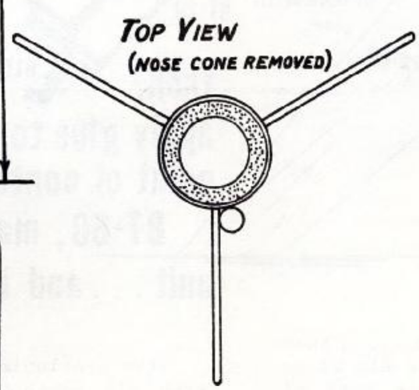
PARTS LIST

| | |
|---|---|
| Body Tube | BT-30 |
| Nose Cone | BNC-30N |
| Fin Stock | BFS-20 |
| Engine Block | EB-30 |
| Launch Lug | LL-1B |
| Parachute | PM-1 |
| Shock Cord | SC-1 |
| Screw Eye | SE-1 |

Completed rocket weighs .65 oz., without engine.



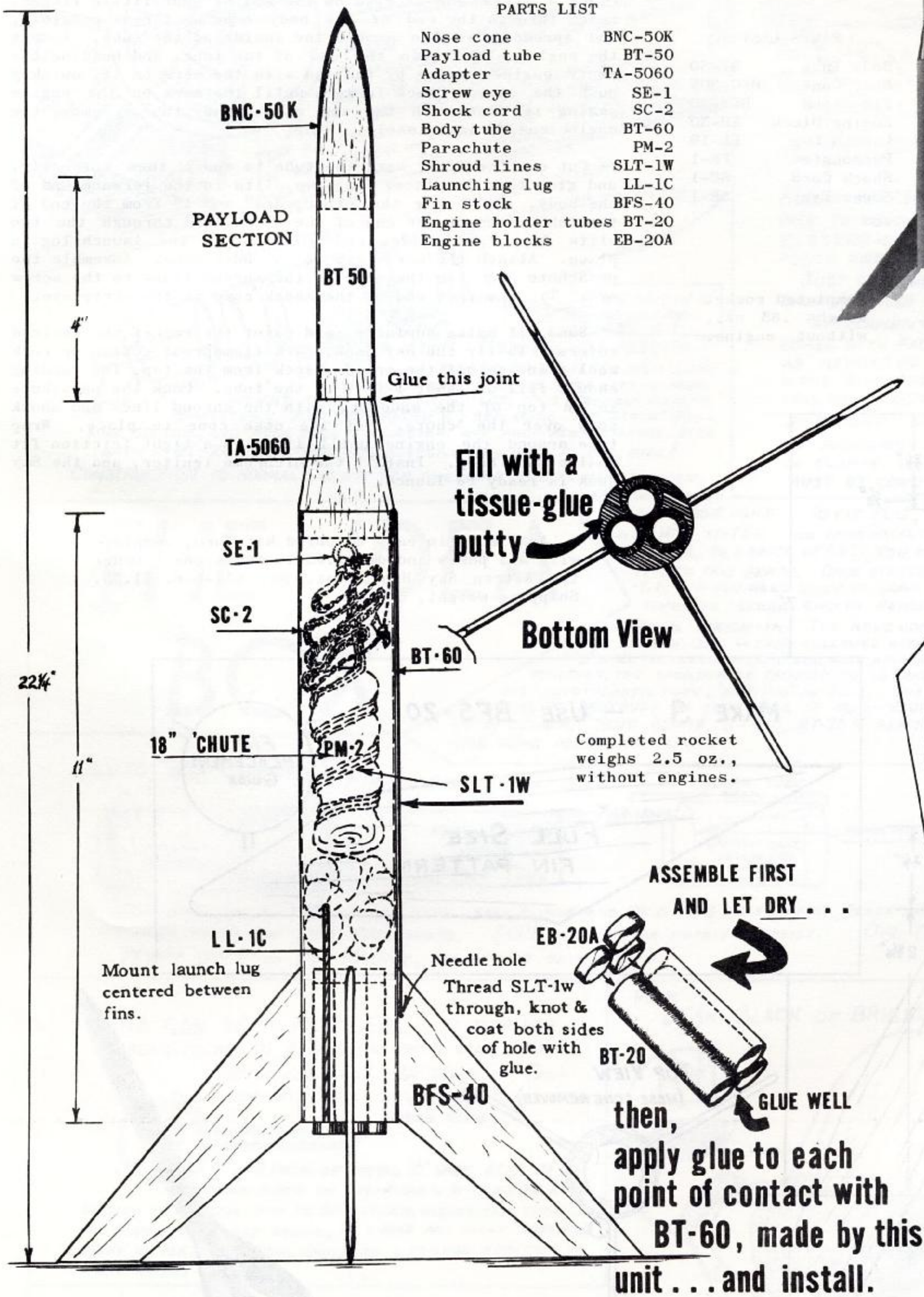



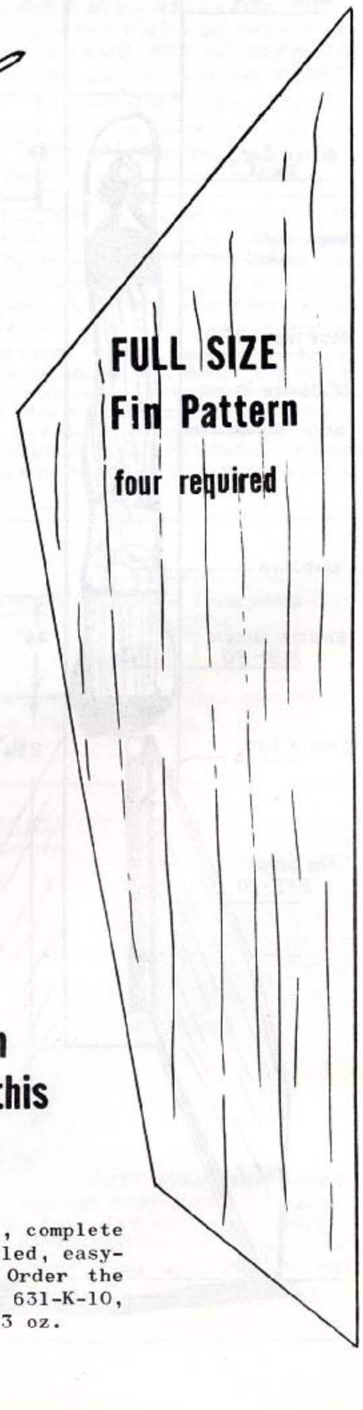

# the COBRA

PARTS LIST

| | |
|---|---|
| Nose cone | BNC-50K |
| Payload tube | BT-50 |
| Adapter | TA-5060 |
| Screw eye | SE-1 |
| Shock cord | SC-2 |
| Body tube | BT-60 |
| Parachute | PM-2 |
| Shroud lines | SLT-1W |
| Launching lug | LL-1C |
| Fin stock | BFS-40 |
| Engine holder tubes | BT-20 |
| Engine blocks | EB-20A |




Completed rocket weighs 2.5 oz., without engines.




Glue engine holder assembly together first . . . then glue into end of body tube with the engine blocks on the inside. Use standard procedures for the rest of the rocket. Shock cord is attached to one end of a 13" piece of shroud line, other end of line is glued to hole in fin. Read the technical report on cluster rockets before building and flying the Cobra.

Also available as a kit, complete with all parts and detailed, easy-to-follow instructions! Order the Astron Cobra, Cat. No. 631-K-10, $3.50. Shipping weight, 13 oz.

# Estes Industries Technical Report TR-6

# Cluster Techniques for Model Rockets



A common technique in the development of rockets to carry large payloads is the use of a cluster of smaller engines to obtain a high thrust level. Typical of this method are NASA's Little Joe, Saturn, and Nova launch vehicles.

Clustering can be used with model rockets to give excellent results. However, if this method is to be used successfully, the rocketeer must use the right techniques and apply them correctly.

Experience has shown that with present techniques clusters of more than 4 engines are not practical. While rockets using more engines have been flown, they are not very reliable. The techniques described in this report have been developed and used almost entirely for clusters of three engines. These methods may, however, be adapted to 2 or 4 engines without too much difficulty.

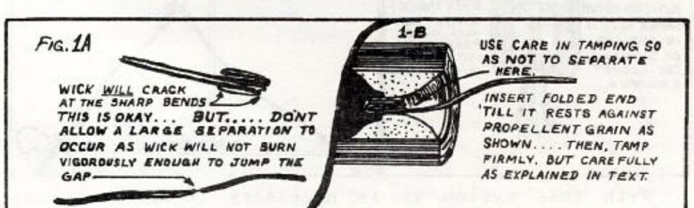
## IGNITION

One of the first questions a rocketeer asks when he starts learning about clustering is "How do I ignite all the engines?" There are several methods of doing this, each of them quite satisfactory when used correctly.

## THE JETEX SYSTEM

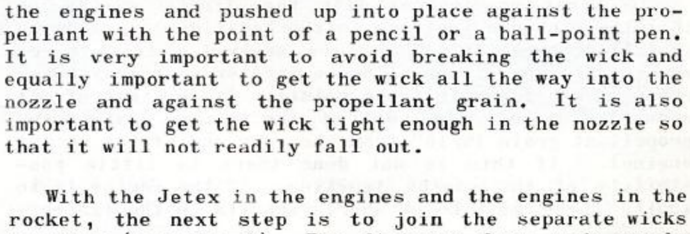
The oldest method for igniting a cluster of model rocket engines is the Jetex system. Equal lengths of Jetex wick are inserted into the nozzles of the engines. The free ends of the wick are twisted together and a length of nichrome wire is wrapped around the wick to ignite it.

If the Jetex wick has been installed correctly, it will burn up the different strands and ignite the individual engines at about the same time. Before trying this system, though, it is important to understand all the precautions which must be taken.




Three 2-1/3 inch lengths of Jetex wick are cut. One end of each piece of wick is folded 5 to 7 times as in the illustration. Be careful not to break any of the coating from the wire, or the wick will not burn evenly. These pieces of wick are inserted into the nozzles of the engines and pushed up into place against the propellant with the point of a pencil or a ball-point pen. It is very important to avoid breaking the wick and equally important to get the wick all the way into the nozzle and against the propellant grain. It is also important to get the wick tight enough in the nozzle so that it will not readily fall out.

With the Jetex in the engines and the engines in the rocket, the next step is to join the separate wicks together (see fig. 2). The distance from each nozzle to the point where the wicks are twisted together must be equal and must be as short as possible.




If all these preceding steps have been taken carefully and correctly, it is time to wrap a length of nichrome wire around the twisted portion of the wick, being careful the wire does not short-circuit against itself. Then put the rocket on the launcher, attach the microclips to the nichrome on opposite sides of the loop around the wick, give the countdown, and launch.

Ninety nine and 44/100ths percent of all cluster ignition failures are due to lack of care in installing the igniters. If the rocket veers off course during powered flight, chances are that one engine ignited earlier or later than another or failed to ignite at all. Since few people are 100% accurate all of the time, it is necessary to build cluster rockets with an extra large margin of stability to counteract the effects of imbalanced thrust.

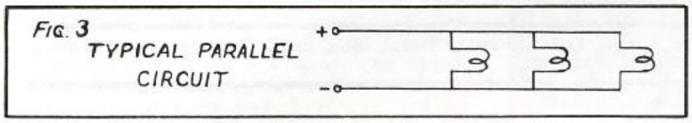
Because of the difficulty in igniting all three engines at exactly the same instant, this system is not recommended for use with 1/2A or smaller engines, nor is it recommended for use with Series II engines. Rockets with the small Series I engines are more apt to go off course if there is any difference in their firing time, while the takeoff acceleration with Series II engines is apt to pull the wick out of the nozzle of any unignited engine, making ignition of all three engines a very rare occurance.

The particular disadvantages of the Jetex system led to a search for other, more practical means. While no perfect systems have been developed nor appear likely to be developed, there are two other systems in use, each with its own advantages and disadvantages which enable the rocketeer to use the system which best fits his needs.

## THE DIRECT ELECTRICAL SYSTEM

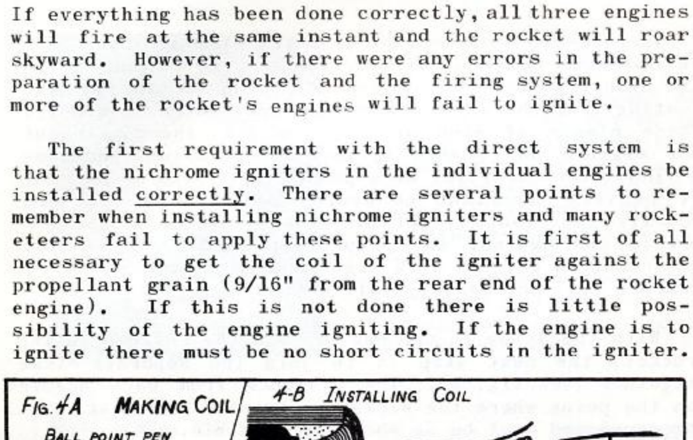
The direct electrical system is potentially the most reliable of all methods of cluster ignition. However, it also requires the most care of any system. If proper care is not exercised, it can be completely frustrating.

In this system the engines are prepared with standard nichrome igniters. The igniters are connected in parallel to the firing system so that when the launch switch is pressed current flows to all igniters at once.




If everything has been done correctly, all three engines will fire at the same instant and the rocket will roar skyward. However, if there were any errors in the preparation of the rocket and the firing system, one or more of the rocket's engines will fail to ignite.

The first requirement with the direct system is that the nichrome igniters in the individual engines be installed correctly. There are several points to remember when installing nichrome igniters and many rocketeers fail to apply these points. It is first of all necessary to get the coil of the igniter against the propellant grain (9/16" from the rear end of the rocket engine). If this is not done there is little possibility of the engine igniting. If the engine is to ignite there must be no short circuits in the igniter.

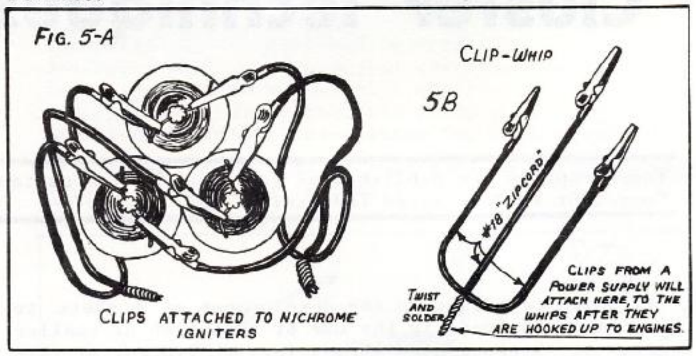



The loops of the coil must be spread far enough apart so there will be no possibility of one part touching another, even with the kleenex tamped in place. The parts of the nichrome leading to the coil must come out on opposite sides of the nozzle with the kleenex tamped in between them.

Even if the nichrome igniters are installed with the coil touching the propellant grain and no short circuits anywhere in the igniter, the battle is not quite won. After the engines are installed in the rocket it is necessary to connect the igniters in parallel to the firing system (See figures 3 and 5.) The microclips must be connected as far up into the nozzle as possible to give a minimum length of nichrome between them. Under no circumstances should the microclips be allowed to touch each other.

This writer has experienced the best success with this ignition system by fabricating a "whip" as illustrated and attaching the microclips to the igniters before placing the rocket on the launcher. The jaws of the clips are first cleaned carefully with sandpaper to assure a good electrical connection. The clips are then attached to the igniters, a clip from one whip to one end of the igniter, a clip from the other whip to the other end of the igniter. With the clips in place, pieces of masking tape are applied at all points where there is any possibility of the clips touching each other.

With this maze of wires in place, the rocket is gently placed on the launcher, and the leads from the firing system are attached to the remaining leads of the whips. The firing system used with this method of ignition has to have plenty of electrical power. A 12 volt car battery in good condition will provide the necessary power provided that no more than 18 feet of #18 two conductor wire is used between the battery and the rocket and provided all connections, including those to the battery, are good. Flashlight cells will not provide enough current. (If all wiring, etc. is done carefully, 12 or more size D photoflash batteries in series will normally provide enough power to ignite the rocket.)

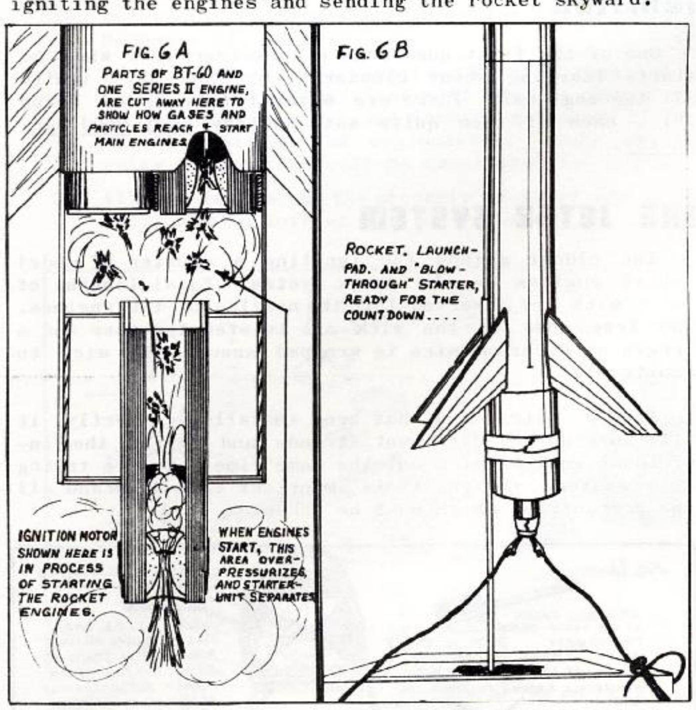



If all steps have been carried out correctly, the rocket can be launched. One of the main advantages of this system is that it can be used successfully with all types of engines, Series I and Series II.

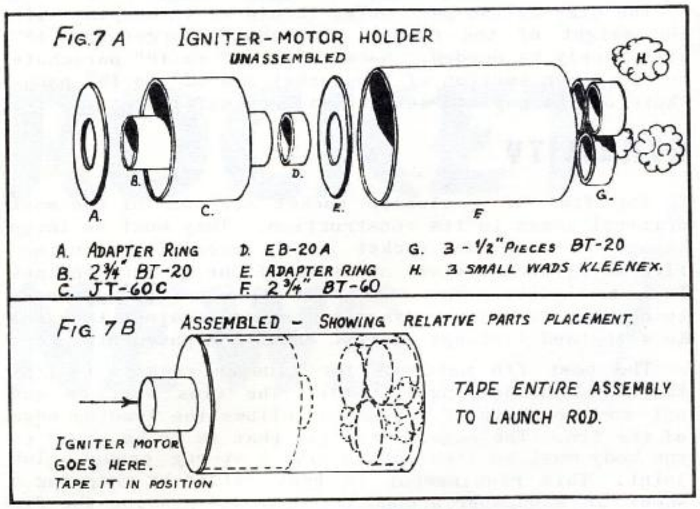
## THE IGNITER MOTOR SYSTEM

The third system is reliable only when used with Series II engines. This method, known as the igniter motor system, uses a single 1/4A.8-0 engine in a special holder, secured to the launcher, to ignite the cluster of B3 engines in the same way that a lower stage ignites an upper stage.

The workings of this system can be seen in figure 6. The 1/4A engine is mounted in the center of a tube of the same diameter as the rocket's body. The tube with the igniter motor is taped to the launcher, and the rocket is lowered into position so that the rocket's body fits exactly over the top of the tube holding the igniter motor. The 1/4A engine is ignited electrically, fires for about .15 second, and then the forward wall of the propellant charge ruptures, hurling hot gases and particles up into the nozzles of the cluster, igniting the engines and sending the rocket skyward.




With this system it is necessary to allow an unobstructed path for the ignition gases from the igniter motor to the nozzles of the cluster. Only Series II engines can be used in the rocket itself, since the nozzles of other engines are too small to give reliable ignition. It is also important to be sure that the igniter motor and its holder are securely fastened to the launcher.




## TYPES OF ENGINES

Since there are so many different engines available to the modeler, the selection of the best one to use in his cluster rocket can become difficult. If maximum performance is desired from a single stage rocket and the Jetex ignition system is used, the proper engine type will generally be the B.8-4. If a 3 engine cluster rocket weighs under 4.5 ounces with engines in place, B.8-6 engines may be used.

To determine whether a particular set of engines is satisfactory for use in your rocket, use the Rocket Engine Selection Chart in the Estes catalog. Maximum thrust and total impulse for one engine are multiplied by the number of engines to provide the figures for the cluster. The same procedure should be followed with the maximum rocket weights.

The use of Series II engines gives certain advantages. The high takeoff acceleration stabilizes the rocket quickly, generally resulting in a straighter and higher flight than is obtained with Series I engines. Payload capability is also increased considerably.

## LAUNCHERS

Because of their greater weight and sometimes imbalanced thrust, cluster rockets put considerably more strain on the launcher than do smaller rockets. The standard Electro-Launch is recommended for rockets weighing up to 6 ounces using either the Jetex or the igniter motor systems for ignition. However if the base of the launcher is weighted down with a pair of bricks and the two-piece rod is soldered together, rockets weighing up to 9 ounces may be launched. If, in addition, a 48" length of 1/8" or larger piano wire or other steel rod is substituted for the two piece rod, rockets weighing up to 16 ounces may be launched safely.

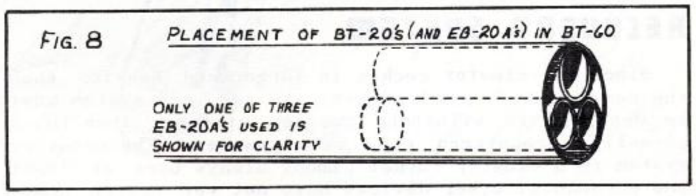
Generally a rod longer and thicker than that needed for single engine rockets is preferable for launching cluster rockets. The thicker rod is less apt to bend or whip as the rocket ascends, and the longer rod will guide the rocket farther, giving the rocket higher speed and greater stability when it leaves the rod. Rockets launched from heavier and longer rods are less apt to veer off course due to imbalanced thrust and will weathercock less due to their greater airspeed when they leave the rod.

## ENGINE RETAINING

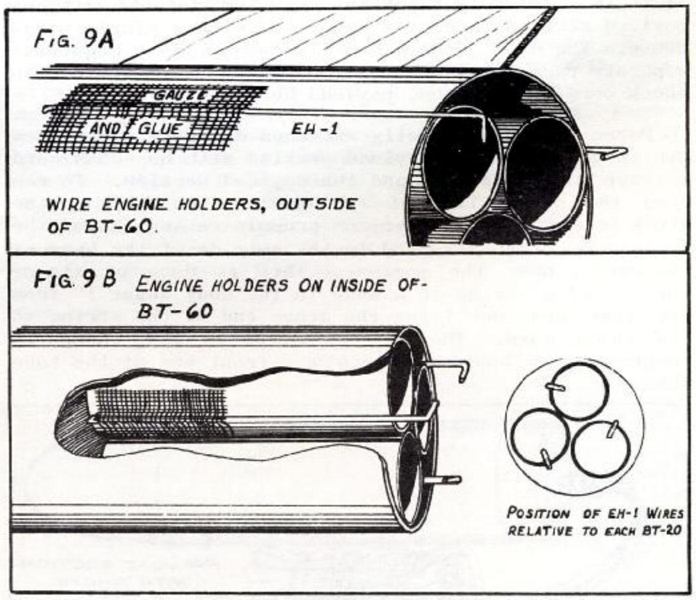
The method of holding the engines is important in any cluster rocket. Not only must the engines be held securely, but they must be aligned with the axis of the rocket so they work as a unit and exert all their thrust in propelling the rocket rather than work against each other. In addition, the engine retaining system must seal the rear of the rocket so the ejection charge or upper stage ignition charge cannot leak out without doing its job.

There are two main systems for holding the engines. In the one, the functions of positioning, aligning, and sealing are built into the rocket. In the other, the engines are glued or taped together to align them.

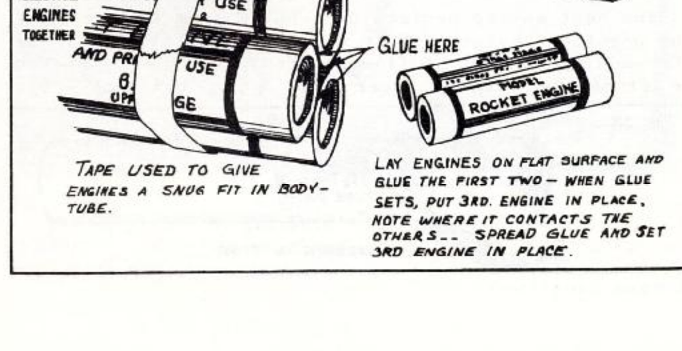
In the first system body tubes just larger than the outside diameter of the engine (BT-20) are glued together and are glued inside the rocket's body (BT-60). These are positioned to handle the alignment of the engines. The spaces between the tubes are then filled with a fillet material such as tissue paper and glue, balsa putty, etc.



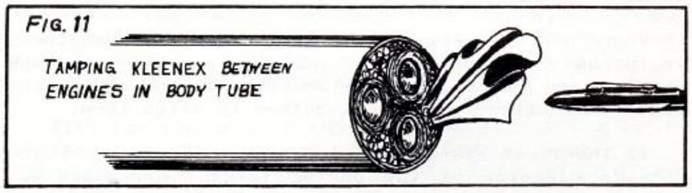

To keep the engines from moving forward during acceleration or backwards at ejection, they must make a tight friction fit in the holder tubes. This may be accomplished by wrapping the engine with tape until it takes considerable effort to push it into position. The other alternative is to use wire engine holders as shown in fig. 9. These make the replacement of engines considerably easier. They must, however, be positioned carefully so they do not interfere with the fins.




In the second system the engines are first glued or taped together, and then inserted into the rocket body. It is usually easier to obtain and maintain correct alignment by gluing the engines together than by taping them together. Enough tape is then wrapped around the outside of this group of engines to give a very tight



friction fit inside the rocket body. Finally, facial tissue or similar paper is tamped tightly into all holes around and between the engines to seal the rear of the rocket and control the ejection gases. (See fig. 11.)



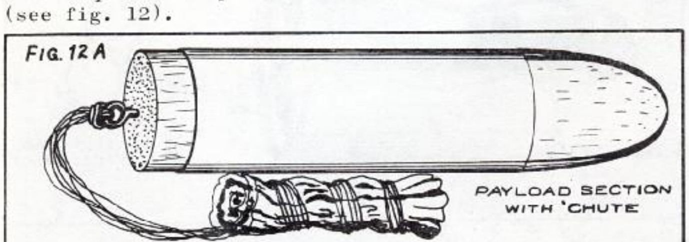

Some experiments with mounting engines in cluster rockets at an angle to create spin have been tried. However, it appears that spin fins are more effective and more reliable.

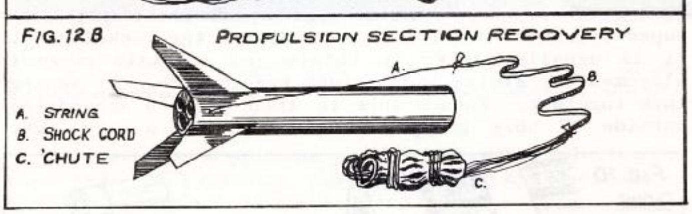
## RECOVERY SYSTEM

Since the cluster rocket is larger and heavier than the conventional model rocket, its recovery system must be designed to withstand greater stresses than those normally encountered in a model rocket. The recovery system in a cluster rocket almost always uses at least one parachute; other devices have not yet proven practical. Generally two parachutes are used on rockets with large payload sections, one parachute on rockets with no payload section or just a small one.

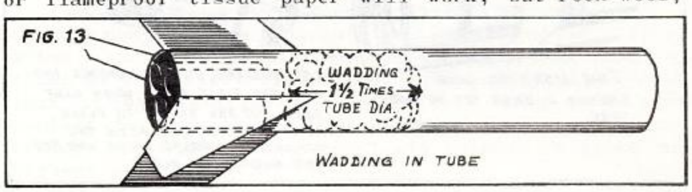
On rockets with large payload sections two parachutes give more reliable recovery, since there is no possibility of the heavy payload section breaking the shock cord at ejection and no possibility of its snapping back and tangling in the parachute of the lower section if it is completely separate. Cluster rockets without payload sections are best recovered with a single parachute. The nose cone alone is too small to require a separate parachute, and will not put the strain on a shock cord that a 4 oz. payload section would.

Parachutes are normally attached directly to a screw eye in the base of a payload section with no shock cord between the parachute and the payload section. To reduce the possibility of fin breakage on landing the shock cord on the lower or propulsion section of the rocket is often attached to the outside of the body of the rocket near the engines. This is done by gluing one end of a string in a hole in the body about 1" from the rear end and tying the other end of the string to the shock cord. The string should be long enough to reach up the body and into the front end of the tube (see fig. 12).




The best way to protect parachutes from the heat of the ejection charge is to use wadding and plenty of it. The wadding should be flameproofed. Flameproof cotton or flameproof tissue paper will work, but rock wool, available from most lumber yards, gives the best results. Pack enough wadding into the rocket to fill it for a distance equal to at least 1-1/2 times the diameter of the body. The wadding whould be fairly tight against the sides of the tube to give an effective seal.

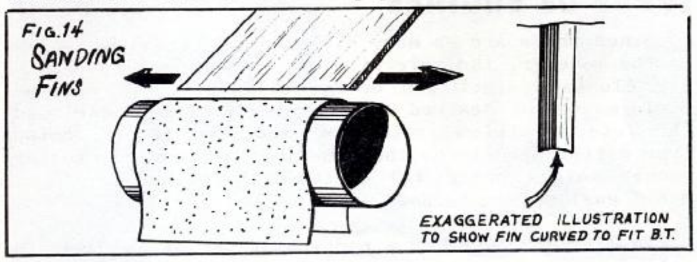



The size of the parachutes should be in keeping with the weight of the rocket. Parachutes larger than 18" will rarely be needed. Normally a 16" to 18" parachute on the lower section of the rocket and 12" to 16" parachute on the payload section will be sufficient.

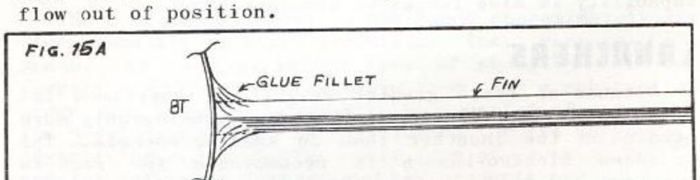
## STABILITY

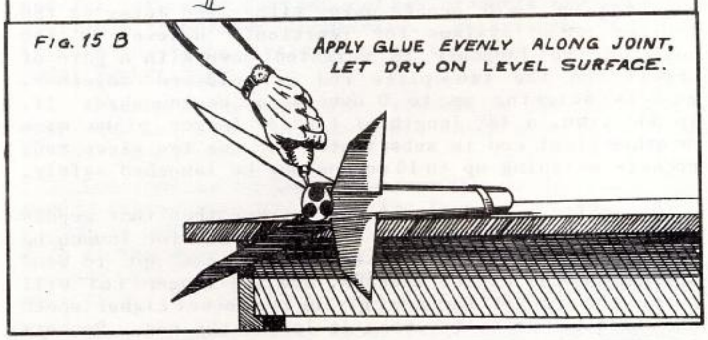
The fins of a cluster rocket are one of the most critical areas in its construction. They must be large enough to keep the rocket stable even if the engines fire at different times and even if one or more engines fail to ignite. The fins must also be strong enough to hold up to all aerodynamic stresses against them and to withstand landings against rocks and pavement.

The best fin material for cluster rockets is 1/8" thick balsa sheeting (BFS-40). The fins must be cut out so the grain of the balsa follows the leading edge of the fin. The edge of the fin that is to be glued to the body must be straight to give a strong enough glue joint. This requirement is best filled by wrapping a sheet of sandpaper around the body and passing the fin forward and back on the sandpaper several times.




When the fin positions have been marked on the body tube and the fins sanded, they can be glued in place. For best results, apply only a very thin line of glue along the inside edge of the fin. Press the fin into position against the body, and hold it in place for a couple of minutes. Then repeat this procedure with the other fins. After the glue has dried, reinforce each joint by applying a fillet of glue in the corner between fin and body as in fig. 15. The rocket should be balanced on its side (but no pressure should be put on the fins themselves) while the glue dries so it will not flow out of position.




Stability in a model rocket depends on many things, including location of center of gravity, body diameter, nose cone shape, positioning of fins, shape of fins, and surface smoothness. To obtain proper stability in a cluster rocket it is best to make the fins larger than would appear necessary. The center of pressure of a cluster rocket must be at least 1/2 the body diameter behind the rocket's center of gravity (see Technical Report TR-1). If the rocket's stability is tested by the string method described in TR-1, it is best to have at least a 20° margin of stability.