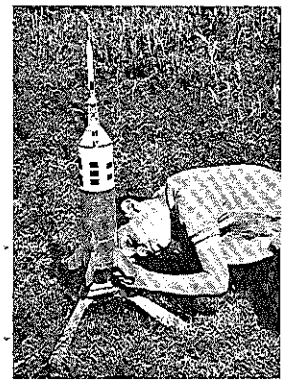
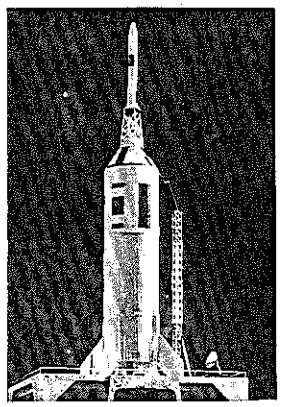
# American Rocketeer

Vol. 3 No. 1 Published by Centuri Engineering Co. Phoenix, Arizona


## 1/45 th Scale APOLLO Little Joe II
## A BREAKTHROUGH IN KIT DESIGN





Actual Photos of Centuri's LITTLE JOE II

Wayne Scoville admires Little Joe model

The real, full-sized Little Joe II is a solid rocket booster designed and produced by the Convair Division of General Dynamics for the NASA Manned Spacecraft Center Apollo Program. Its specific purpose was the man-rating of the Apollo Escape Tower System which will pull the three moon-bound astronauts to safety in the event of a catastrophic Saturn V booster failure.

The real Apollo-Little Joe II used a cluster of up to seven ALGOL ID solid propellant motors. The resulting combined total thrust is 860,000 pounds, which makes it the most powerful all solid propellant rocket ever flown in the United States.

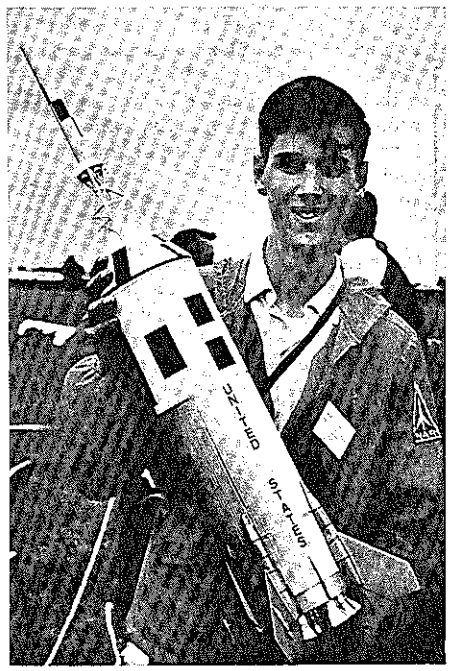
The name Apollo-Little Joe II is really quite deceiving. It is only "little" when compared to today's 396 foot Saturn V moon rocket. It is actually 3 feet larger in diameter and only 7 feet shorter than our country's first manned space vehicle, the Mercury-Atlas used to put John Glenn, Scott Carpenter, Wally Schirra, and Gordon Cooper up in Earth orbit.

### AL KIRCHNER JR. WINS $50 R & D AWARD

Al Kirchner Jr., of Bethpage, New York, wins $50 top R & D Merchandise Certificate Award for helping CENTURI develop the fabulous Apollo-Little Joe II kit. Al sent us both his 1/30 scale award winning "F" powered model and all the scale substantiation data he obtained from NASA and General Dynamics/Convair.

Al is well recognized by all rocketeers as the U.S.A.'s number one expert when it comes to modeling Little Joe. He has spent many hundreds of hours over a period of several years in scale research, in building, and in constantly improving his models to achieve this reputation.

Al is presently completing his first year in college at the University of Notre Dame in Indiana. He will get one of the first kits off the assembly line and we hope to publish his critique and comments on the CENTURI Apollo-Little Joe II kit in the very next AMERICAN ROCKETEER issue.



*Al Kirchner and His 1/30th Scale Apollo - Little Joe At Naram - 9*

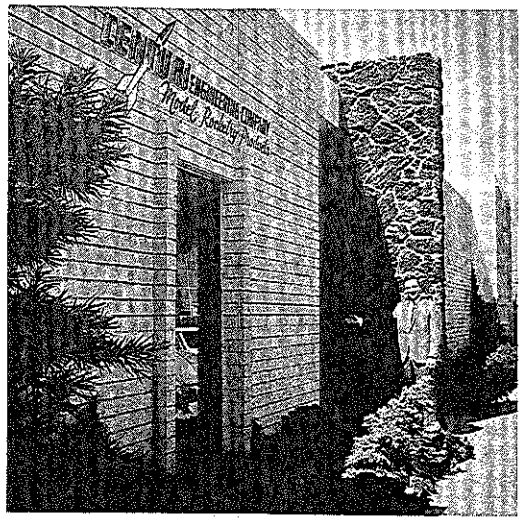
**LEROY PIESTER**
**Centuri's President**

Centuri Engineering Company, a leader in Model Rocketry, was started in 1962 by its founder and President, Leroy Piester, together with his wife Betty. While still in college, Mr. Piester was caught up in the Space Age and began working on small lightweight sounding rockets. In 1953, he started development work on non-metallic miniature rocket engines, and a year later fired the first successful MINI-MAX engine.

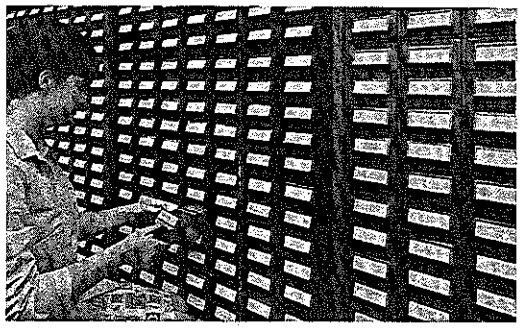
Work continued on these engines for several years. Then in October of 1957, the Russians launched their first Sputnik and the race for Space was on. The U.S. accelerated its Space Program and with that also came a boundless youthful enthusiasm to build amateur rockets, mixing their own rocket fuel and loading it into metal pipes. Many serious accidents followed and efforts were made by lawmakers to eliminate this type of non-professional rocket activity. However, it was soon apparent that laws outlawing such activity failed to eliminate the accidents.

Concerned by this problem, Mr. Piester, an Industrial Engineer, set out to create safe educational model rocketry materials for "Space Minded" youngsters and applied his experience to small operating models. In 1962 he formed Centuri Engineering Company, and with his wife Betty plus the support of thousands of model rocketeers, built the business into one of the nation's leading manufacturers of model rocketry products.

Located in Phoenix, CENTURI's main plant is at 3053 W. Fairmount, in the Eaton Industrial Square, as shown in the map. When you are in the Phoenix area, stop in to say "hello". The folks here at CENTURI would like to meet you.



**MAIN ENTRANCE TO PLANT**
**Home of Centuri Engineering**



**CUSTOMER ADDRESS FILES**
**Your Name is Here, Too**

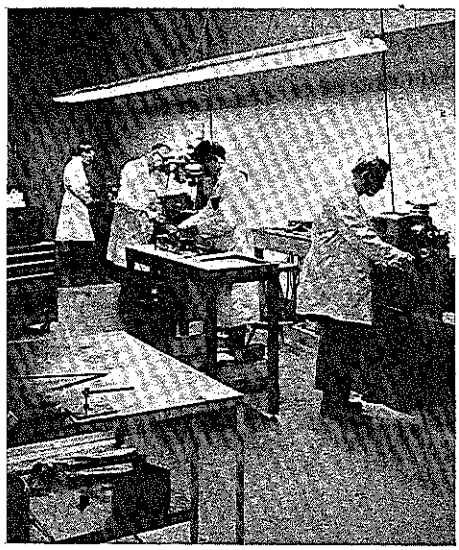
**CATALOG PREPARATION**
**Assembly of Current Catalogs**

**Packaging Rocket Kits**

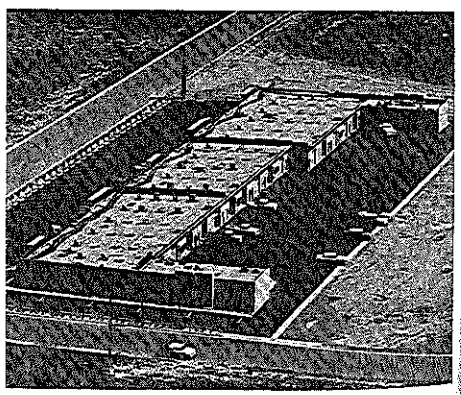
**ORDER PROCESSING**
**Where Your Order is Received**

**INTRODUC**
**ENGINEERING**
**MODEL RO**

**3053 W. Fairmount Ave.**



**MACHINE SHOP**
**Mass Production Tool Development**



**Aerial View of Plant**

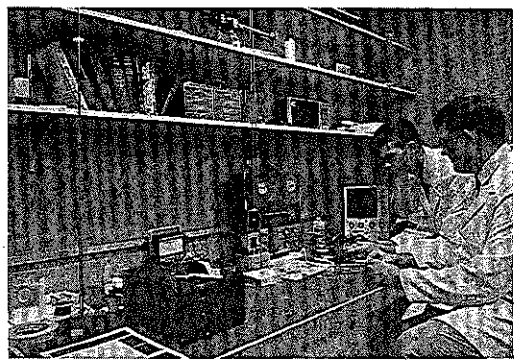
**SHIPPING**
Orders are Packed for Shipment

**DESIGN AND ART PRODUCTION**
The American Rocketeer, Catalogs & Rocket Kits Created Here

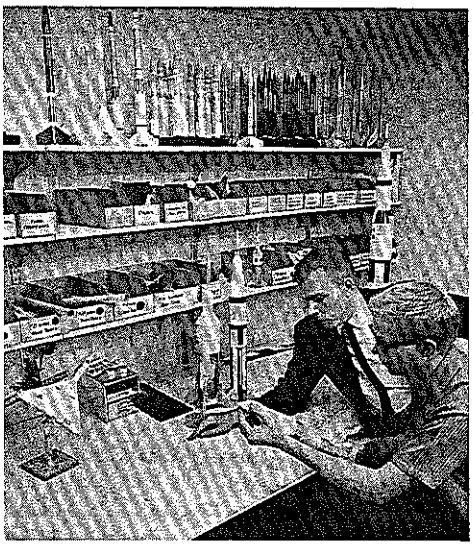
**NG CENTURI**
**COMPANY**
**ET PLANT**

Phoenix, Arizona 85017

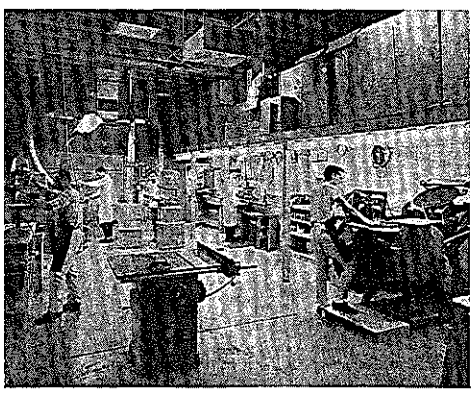
**ELECTRICAL**
Assembling Ignition Devices



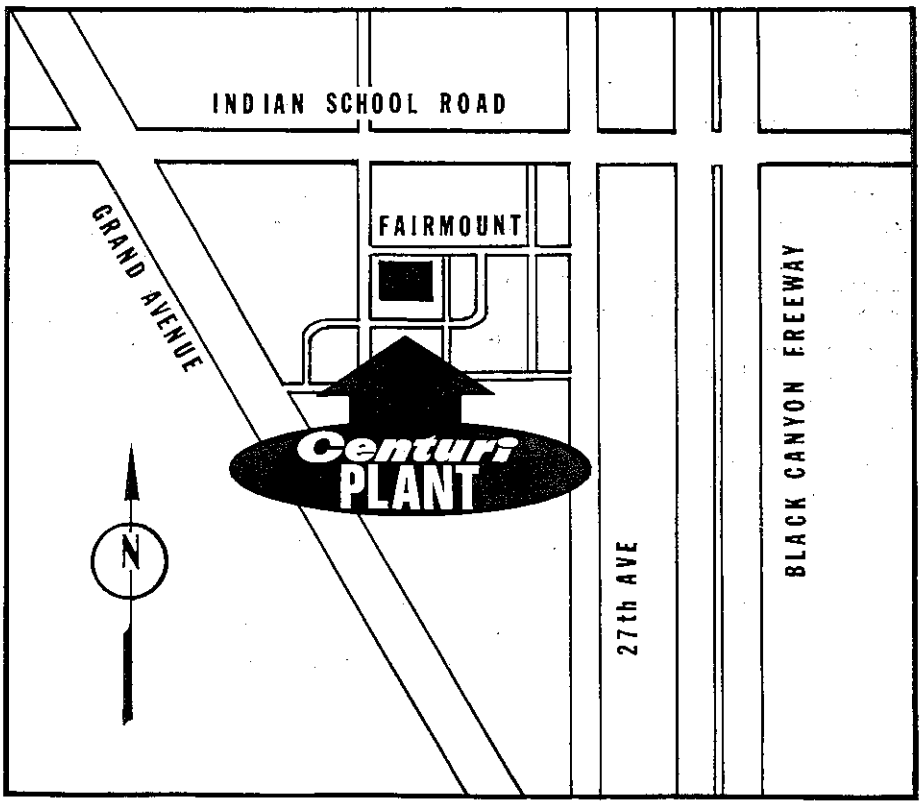
**RESEARCH AND DEVELOPMENT**
As Always, Looking for New Ideas



**EXPERIMENTAL MODEL BUILDING**
Where Ideas Become Reality



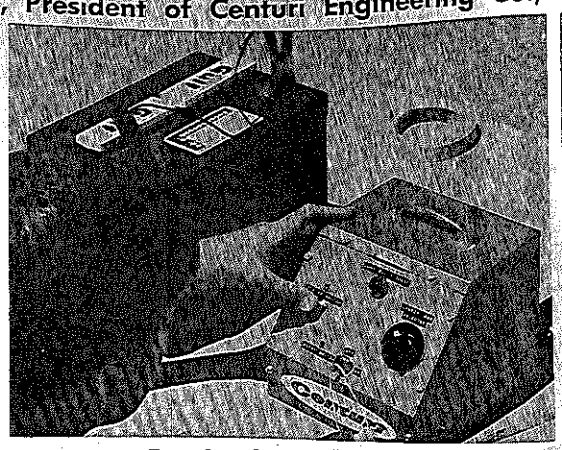
Nose Cone and Launcher Production



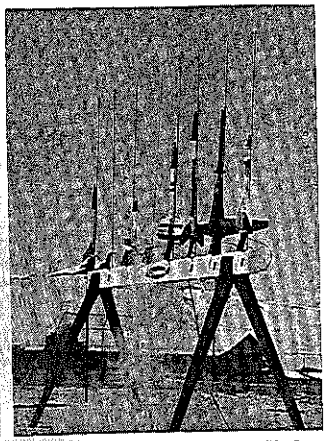
# BUILDING A CLUB LAUNCH RACK AND FIRING PANEL

Written by Leroy E. Piester, President of Centuri Engineering Co., Inc. 

MOUNTING ROCKETS



5-4-3-2-1...

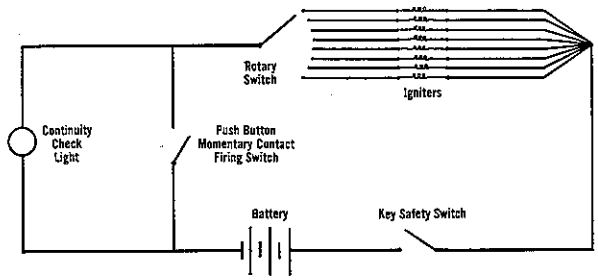


BLAST-OFF!

This report is a condensed version of CENTURI's Technical Information Report TIR-23. It is presented here as a service to our customers because we felt it would benefit the largest number of Model Rocketeers interested in the competitive and educational advantages of club membership.

A launch control center allows your club to operate in a safe, smooth, organized manner. It is a must for conducting contests and also is useful for staging impressive demonstrations for spectators.

## THE IGNITION CIRCUIT & HOW IT WORKS




Eight rockets are placed on the launch rack at one time, and the micro-clips hooked up to their igniters. By turning the Rotary Switch in the Firing Panel, one specific igniter circuit is chosen. The Key Switch is closed, thereby allowing current to flow through the outside circuit loop which includes the pilot light and the igniter. However, due to the high resistance of the pilot light, very little current is permitted to flow through this particular circuit. Of course, if the light glows, there is "continuity" in the circuit which means that the micro-clip attachments to the igniter wire are good.

Now, when you're ready to launch, you press the Firing Switch. Then the current, taking the line of least resistance, flows full strength through the igniter wire. As a result, the wire quickly heats up to the temperature which ignites the rocket propellant. After this launch, simply click the Rotary Switch to the next number and you're ready to fire the next rocket. You will note that unless the appropriately named "Safety" Key was inserted and turned ON, that the firing circuit could not be completed.

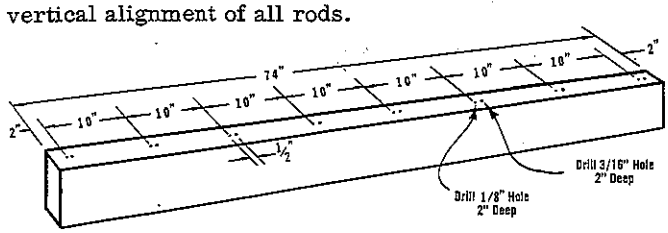
## BUILDING THE LAUNCH RACK

There are many ways to build a club launch rack. Our plan is for an 8 rod unit on sawhorse legs which will be sturdy enough to last a long time and can handle all types of model rockets. The sawhorse legs raise the rockets high enough for spectators to see easily and also provides an additional safety factor since the rod tips are always above eye level.

An 8 rod launch rack will allow very efficient operation for clubs up to about 15 members. As your club grows in size you will eventually have to construct another 8 rod launcher. This will greatly increase launch rate efficiency since the two units can be kept a short distance apart which allows safe loading of rockets on one rack, while launchings are simultaneously occurring on the other. This is called "DUAL AREA LAUNCHING" and it is quite popular with large clubs. In a future issue of the AMERICAN ROCKETEER we will show you how to make a slight modification to your Firing Panel which will allow it to control both 8 rod launch racks and simultaneously and automatically improve the safety of your launchings.

## LAUNCH RAIL LAYOUT AND DRILLING

The launch rail is made from a 74" long wooden 2 by 4. So that you'll be able to also launch rockets requiring the larger 3/16" diameter rod, it is suggested that holes for both 1/8" and 3/16" size rods be drilled as shown. Using a drill press rather than a hand drill will help insure vertical alignment of all rods.




## SAWHORSE LEGS

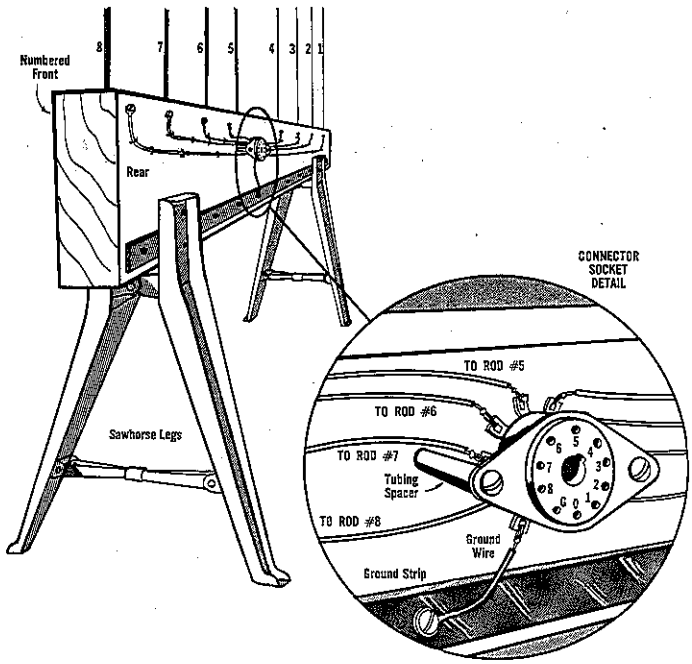
The "all steel" set of sawhorse legs used on the launch rail shown in our photos can be found in hardware and lumber stores for about $6.50 a pair. These have a built-in self-locking clamp to grip the 2 by 4 rail. A cheaper, though not as sturdy, alternative is to use the type into which you insert your own wooden 2 by 4 legs.

## PAINTING AND NUMBERING

To protect the rail from warping, cracking, and getting dirty, paint the entire 2 by 4 with two or more coats of high-gloss enamel paint. Then, so that both contestants and spectators can identify the rocket about to be launched, number each rod position (numbers 1 through 8 -- see photo). Either use the pressure-sensitive metal house numbers available at most hardware stores or paint the numbers on by hand with a stencil.

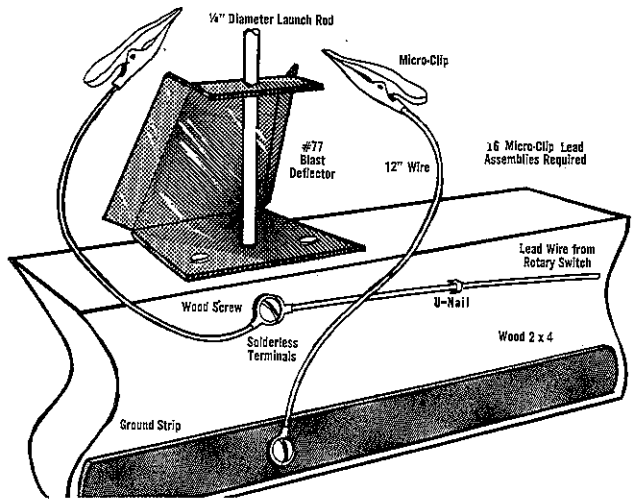
## LAUNCH RAIL MAIN WIRING

Install the connector socket in the center of the 2 by 4. Solder the lead wire from each launch rod to the identically numbered socket lug as shown. Obtain a 1/32" thick strip of aluminum (or copper) which is 72" long and about 3/8" to 3/4" wide from a local metal shop. Use an electric drill and 1" long wood screws to fasten this aluminum (or copper) ground strip in place. Connect and solder a short wire from any of the remaining spare socket lugs to the metal ground strip.




## TYPICAL INDIVIDUAL LAUNCH ROD WIRING

At each position install a launch rod, #ID-77 blast deflector, and a pair of micro-clips as shown. Firmly tightening all screws completes the construction of the launch rack.

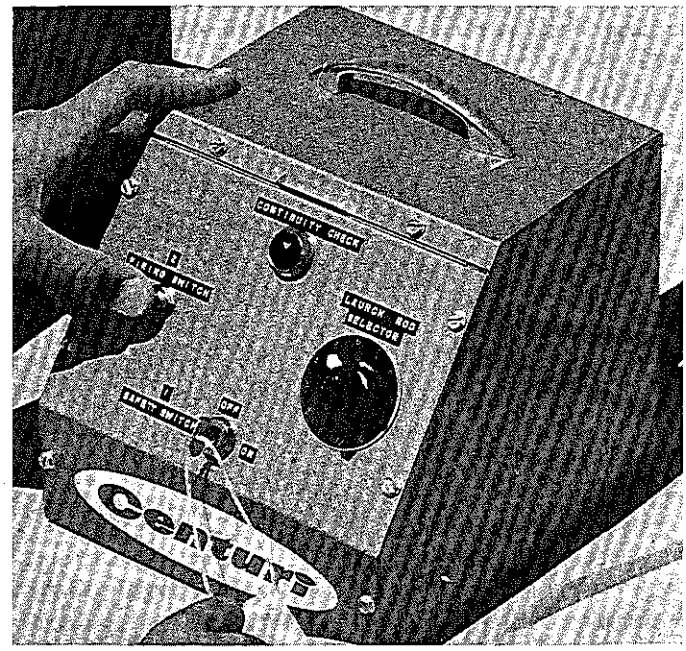



## ASSEMBLING THE FIRING PANEL

The Firing Panel is the most essential part of the launch complex system. It means that the control of all launches is the sole responsibility of just one person and the disorganized random launchings inherent in using many individual self-contained launchers is prevented. Both rocketeers and spectators are always aware of exactly which rocket is being launched and the panel itself has internal safety devices which prevent the unintentional firing of a rocket. In keeping with this safety philosophy the launch rack and panel, of course, should be roped off from spectators.

The panel we have chosen to illustrate is quite basic and only includes absolutely necessary devices. Some clubs will like to add a Voltmeter and Ammeter for occasionally checking battery power.

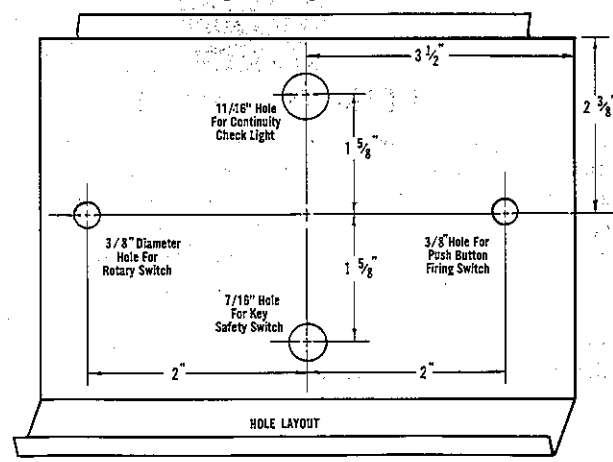
## A COMPLETED FIRING PANEL



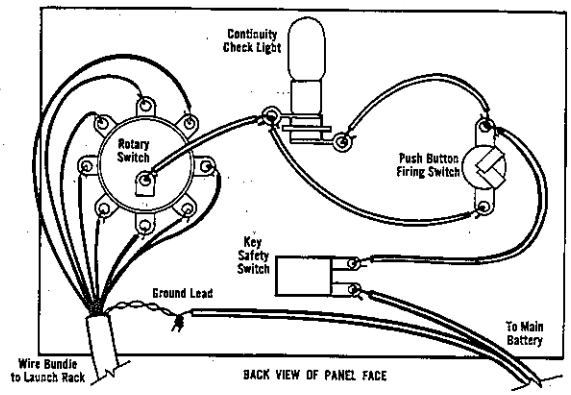

## FRONT PANEL ASSEMBLY

First, lay out and punch (cut or drill out) the holes in the panel face as shown below. A local sheet metal shop can do a perfect job of punching these holes for you, but they will charge about $4.

Next, mount the indicated components onto the face using a crescent wrench or pair of pliers.

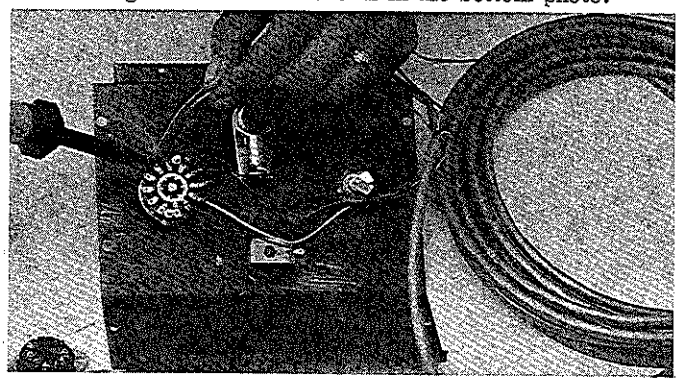


## PANEL WIRING DIAGRAM




## WIRING THE ROTARY SWITCH

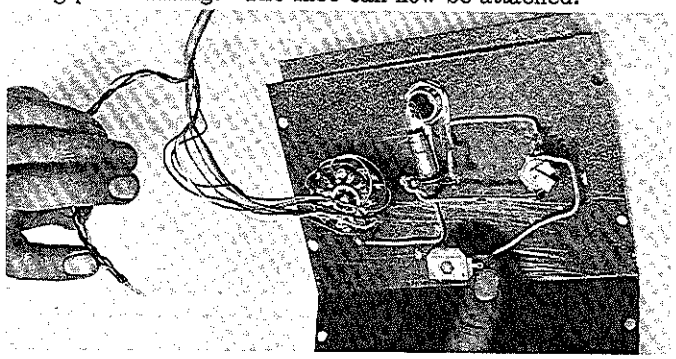
First, strip the insulation from all 12 leads in the wire bundle. Then solder one lead each to the first 8 rotary positions as shown. The remaining 4 wires are braided together and their exposed ends are twisted together to form the "ground" lead as shown in the bottom photo.



Next, the Continuity Light, Push Button Firing Switch, and Safety Key Switch are wired into the circuit.

## COMPLETING THE PANEL FACE WIRING

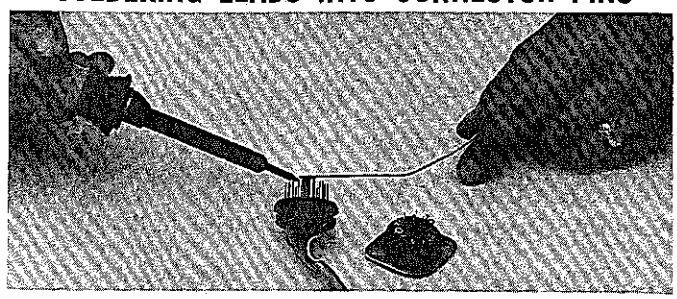
Finally, connect the ground lead and key switch point shown to the two battery power leads. This completes the firing panel wiring. The face can now be attached.



## CONNECTOR PLUG WIRING

Slip the plug cover over the wire bundle, then strip 1/2" of the insulation off each of the 12 wires. The wires are color coded and both the Rotary Switch and connector pin plug terminals are numbered. For example, if the red wire is connected to position #1 of the Rotary Switch, then the red wire at the other end has to be soldered into pin #1 of the connector plug. The four ground leads are then soldered into the pin number which corresponds to the socket hole used for the launch rail "ground strip connection". Lastly, the plug cover should be snapped onto the pin plug and the screws thoroughly tightened.

## SOLDERING LEADS INTO CONNECTOR PINS



## OBTAINING A POWER SUPPLY

The best source of strong current for your launcher is a 12 volt car battery. Hooking up directly to a car guarantees a battery which will be in a good state of charge, and requires no additional money. Even if the launch site is inaccessible to a car, it is a simple process to remove the battery and carry it to the desired spot along with all the other equipment. The alternative is to spend the money for a car battery and a trickle charging device to keep power up between launchings -- or you can take the battery to your local gas station for a quick pre-launch charge which usually costs about one dollar.

## PARTS LIST

Cabinet Parts
- Metal Cabinet (Bud #C15846H)
- Chrome carrying handle
- Clamp for wire bundle strain relief

Panel Face Components
- Safety Key Switch
- Continuity Check Light and 12 volt Bulb
- Push Button Firing Switch
- Rotary Switch (Mallory #32112J) and numbered face

Wire Bundle Assembly
- 25 feet of 12 conductor cable (Belden #8427)
- Plug, Socket, and Cover (11 pin) (Amphenol #77 M1P11)
- 7/8" long, 1/8" diameter aluminum launch lugs and 1½" long wood screws to support Socket on Launch Rail

Launch Rail Parts
- 20 feet of #18 hookup wire, 13 solderless terminals
- 56" long aluminum (or copper) ground strip
- 8 pressure sensitive numbers, 8 metal blast deflectors
- 8 one piece launch rods (1/8" diameter by 36" long)
- 25 insulated U-Nails (to tie down and arrange lead wires)

Micro-Clip Lead Assemblies
- 16 micro-clips, 16 feet of #18 hookup wire
- 16 solderless terminals, 16 one inch long wood screws

Main Battery Leads
- 20 feet of Battery Cable, 2 heavy duty Battery Clips

**THE ABOVE COMPONENTS ARE NOW AVAILABLE AS A COMPLETE PACKAGE**

**$39.50** **CAT. NO. CLR-1**

Includes pre-punched front panel face and pre-assembled micro-clip leads.

### ALSO REQUIRED

- 74" long wooden 2 by 4, Sawhorse legs, Paint
- Soldering iron and solder
- Pliers suitable for stripping and crimping
- One large and one small Screwdriver

# SPACE TEASERS

These problems are presented to challenge your thinking. The next AMERICAN ROCKETEER will present correct solutions and some new SPACE TEASERS for you. At the same time we will publish the names of the first ten persons who send in the correct answers (showing their step-by-step solutions) to SPACE TEASERS #1. Deadline is June 15th and be sure to include your name, age, and address.

a) First, a sample problem to get you started! How fast are you moving when riding the Disneyland rocket which makes one complete revolution every 3 seconds? Your rocket ship is 15 feet from the center point.

To get you started you'll need to know the basic circular motion relation:

Velocity = Radius times Angular Velocity

$$V = R \times \omega$$

where angular velocity (as denoted by the Greek letter $\omega$ called omega) is in radians per second. It is found by dividing revolutions per second by $2\pi$ which is the number of radians in a 360 degree circle.

Thus,

$$V = (15 \text{ ft}) \times \left(\frac{1 \text{ revolution}}{3 \text{ seconds}}\right) \times \left(\frac{2\pi \text{ radian}}{\text{revolution}}\right)$$

$$\boxed{V = 31.4 \ \frac{\text{feet}}{\text{second}}}$$

b) How fast is the rocket ship ride moving in terms of miles per hour?

Now you need to know that:

1 mile = 5,280 feet
1 hour = 60 minutes
1 minute = 60 seconds

or,

$$V = \left(31.4 \ \frac{\text{ft}}{\text{sec}}\right) \times \left(\frac{\text{mile}}{5280 \text{ ft}}\right) \times \left(\frac{60 \text{ sec}}{\text{min}}\right) \times \left(\frac{60 \text{ min}}{\text{hour}}\right)$$

$$\boxed{V = 21.4 \ \frac{\text{miles}}{\text{hour}}}$$

c) How fast is 31.4 feet per second in terms of meters per second? The only additional information needed is:

1 meter = 3.281 feet

thus,

$$V = \left(31.4 \ \frac{\text{feet}}{\text{second}}\right) \times \left(\frac{\text{meter}}{3.281 \text{ feet}}\right)$$

$$\boxed{V = .956 \ \frac{\text{meter}}{\text{second}}}$$

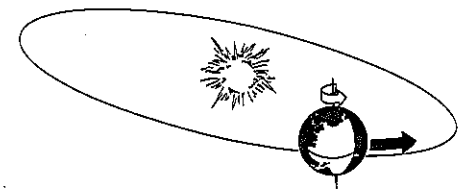
The above should provide enough information to complete the following two SPACE TEASERS.

1. a) If you are standing at the Earth's equator, how fast in miles per hour are you moving relative to the center?

   b) What is the velocity in feet per second?

   c) What is the velocity in meters per second?

   The diameter of the Earth is 7930 miles.



2. a) The Earth moves around the Sun in almost a perfect circular orbit. The distance to the Sun is 93 million miles. What is the Earth's orbital velocity in miles per hour as it goes around the Sun?

   b) What is this velocity in feet per second?

   c) What is the velocity in meters per second?

   d) How many seconds in one year?

## MODEL ROCKET CARTOONS REQUESTED

Starting with next issue of the AMERICAN ROCKETEER we intend to publish one or more cartoons related to model rocketry. If you have had any humorous experiences in rocketry or can think of some clever ideas which could be adapted to cartoons, please send them in with a preliminary sketch to:

Tom Cameron
Art Director

A $5.00 merchandise certificate will be given for each cartoon chosen for publication and your name will be included with the cartoon.

All ideas submitted become the property of Centuri Engineering Company and cannot be returned. In the event of identical cartoon ideas, the one bearing the earliest postmark will receive the award.

## PUBLISHER'S NOTE

The AMERICAN ROCKETEER is published by Centuri Engineering Company for its Customers and Friends to further acquaint them with the hobby of Model Rocketry and the new products and services it offers. It is sent free of charge to all CENTURI customers from whom a substantial order has been received within the past six months. Remember that your continued support makes this newsletter possible.

Our Editor requests that news clippings, photos, club news, and articles be sent to:

American Rocketeer Publications
Centuri Engineering Company
P.O. Box 1988
Phoenix, Arizona 85001

You can tell your fellow rocket club members and friends that additional copies of this issue or back issues of AMERICAN ROCKETEER may be obtained by writing to the above address. Send 25¢ for each copy to cover handling and postage.

## NEW 1968 CATALOG AVAILABLE SOON

Lately, we've received many requests for CENTURI's new 1968 catalog. Publication of the all new '68 issue has been held up so we could include the many new products which are being readied by our R & D Dept. This catalog will include five fantastic super-scale models with 3 and 4 engine cluster power, including the SATURN family of missiles.

Our brand new 1968 catalog, 96 pages big, will be ready by early summer. If you've ordered from CENTURI recently, you'll automatically receive your free copy in the mail. An order from you now will insure that your name is on our catalog mailing list.

# New Centuri Products

## The New LASER-X SPACE PROBE

DIE CUT BALSA FINS
**DECALS**
20" PARACHUTE

**$2.75**

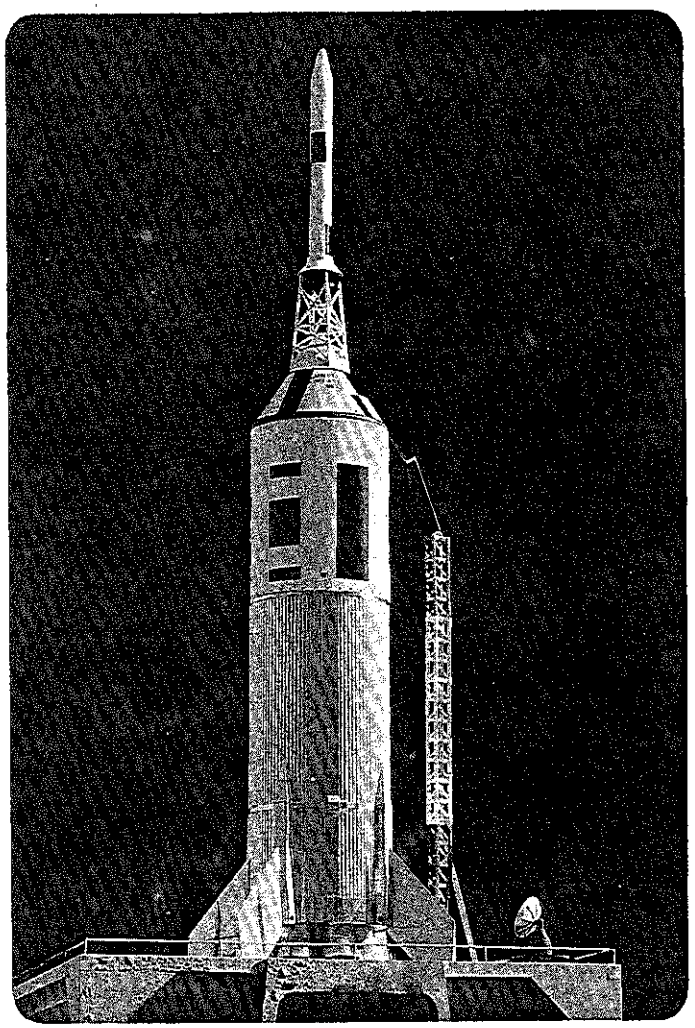
*CAT. NO. KC-50*

**Specifications**
Length------21.5"
Diameter ---1.35"
Net. Wt. --1.75 oz.

**Recommended Engines**
½A. 8-2 A. 8-3
B. 8-4

Centuri's new Laser-X is the first in a series of new improved kits. It incorporates die-cut parts for quick, easy assembly. The futuristic appearance of the Laser-X, and its large size result in exceptionally realistic lift-offs and after reaching maximum altitude, the colorful parachute is ejected for a safe return.

## APOLLO LITTLE JOE II



**$12.95** CAT. NO. KS-8 — LAUNCHER, GANTRY, AND ENGINES NOT INCLUDED

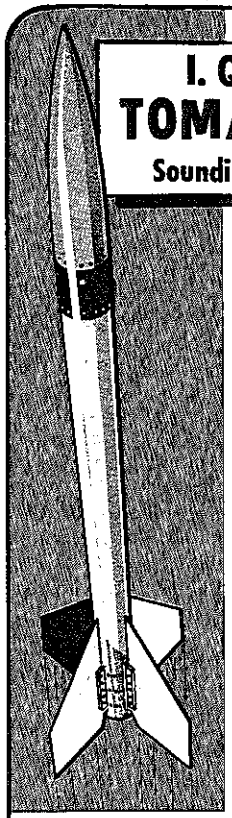
| RECOMMENDED ENGINES | SPECIFICATIONS |
|---|---|
| Three A. 8-3's | Length .....23.4" |
| Three B. 8-2's | Diameter .....3.4" |
| Three B. 8-4's | Net Weight .....5.5 oz. |

**FEATURES**

1. Complete historical data sheet with photos.
2. Molded plastic capsule and tower.
3. Real corrugated aluminized skin.
4. Pre-printed roll patterns and detail markings.
5. Pre-shaped balsa fins and plastic fin fairings.
6. Removable engine nozzle assembly.
7. Two colorful plastic parachutes.

**AVAILABLE JUNE 15th**
**Order Now! First come first served**

# New Centuri Products



## I. Q. S. Y. TOMAHAWK
**Sounding Rocket**

1/10th SCALE MODEL

- AUTHENTIC MARKINGS
- HI ALTITUDE FLIGHTS
- PARACHUTE RECOVERY
- ACCURATE SCALE

**Scale Detail by G. Harry Stine**

$2.25 Postpaid

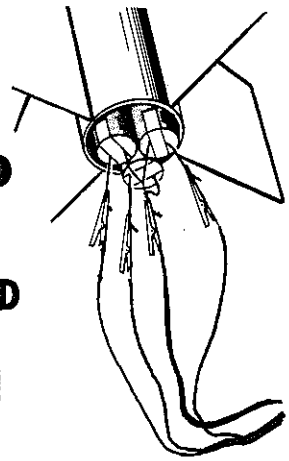
Catalog No. KC-40

SPECIFICATIONS
Length----20"
Diam. ----.906"
Net. Wt. --1.15 oz.

Recommended Engines
A. 8-3 B. 8-4

Easy-to-build Scale Model. Excellently proportioned. Top winner at NARAM-9. Exact scale detail and assembly instructions provided. Flights over 1200 ft. with 'B' engine. Recovers safely with colorful 16" parachute.

## CLUSTER CLIP WHIP for CLUSTERED ENGINE IGNITION

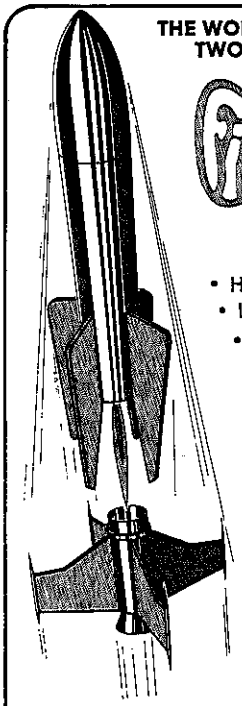


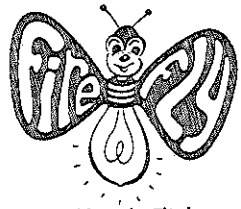
The Clip Whip is used in a Model Rocket ignition circuit to distribute the electrical battery current evenly between two or more rocket engines for their simultaneous ignition. Necessary for Apollo-Little Joe II and Defender kits.

Includes FREE Technical Information Report TIR-51 on "Clustered Rocket Ignition".

**CCW-1 - - - 3 Engine Clusters - - $ .95**
**CCW-2 - - - 4 Engine Clusters - - $1.25**

## THE WORLD'S SMALLEST TWO-STAGE ROCKET






- Hi Altitude Flights
- Launch Many Times
- Streamer Recovery

$1.50

No. KA-6
Shipping Wt. 8 oz.

Length----- 9.0"
Dia.------ .906"
Net. Wt.- 0.90 oz

Recommended Engines

| Booster | Sustainer |
|---|---|
| ¼A.8-OS | ¼A.8-4S |
| ½A.8-OS | ½A.8-4S |

Real 2-stage operation!!! The Firefly streaks nearly out of sight, then returns by colorful streamers. Booster tumble recovers. Fly top stage by itself with ¼ or ½A. 8-4S engines. Complete with decals.

## BatRok

***Payload Carrier Rocket***

- BAT-LIKE DESIGN
- PAYLOAD CAPSULE
- PARACHUTE RECOVERY

Easy to build!! Carry your payload in clear plastic capsule. Study acceleration effects on insect life with assured parachute return. Complete with decals and 12" chute.

SPECIFICATIONS
Length------12.0"
Body Dia.---.760"
Net. Wt.-----0.80 oz.

$1.95
Cat. No. KB-8

Recommended Engines
A-8-3
B-8-4

Centuri


## SUPERBOND GLUE
**FAST DRYING**

The most perfect glue ever developed for model rockets. Sets much faster than white glue. Unbelievable strength. Use on balsa wood, paper and fabric. Sands extremely well.

**GL-100 1¼ OZ. BOTTLE 40c**

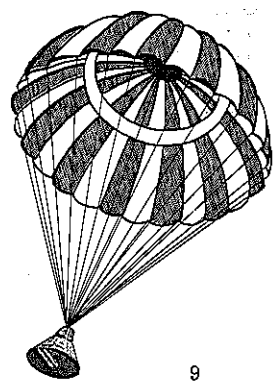
## NEW! APOLLO PARACHUTES

Includes two color canopy, shroud lines, tape discs, and complete instructions showing how to assemble, fold, and pack into model rockets.

**Big 24" Canopy Diameter**

CP-24 Red & White
CP-24A Black & Yellow
**50c ea.**

**Also new CP-16B (Red & Yellow 16" Canopy)**



# ROCKET CLUB NEWS

## CITY OF WEST COVINA PARKS AND RECREATION DEPT. SPONSORS CLUB

In January, 1967 Dane Boles approached the City of West Covina's Recreation Supervisor, Andres Hunter, as the representative of a special interest group seeking support and assistance from their city's Recreation Department. Mr. Hunter and School District members were greatly impressed with a series of demonstration launchings and as a result Dane was assigned as a part-time Recreation Leader in charge of model rocketry activities.

With the assistance of James (Buzz) Hauk, another Recreation Leader experienced in directing modeling and radio clubs, they worked on developing the club's structure, safety regulations, equipment procurement, and a place to hold meetings.

In order to find a suitable launch site that would meet California's restrictive model laws, Dane and Buzz approached Captain Dale Andrus, Fire Prevention Officer for the City of the West Covina Fire Department. Largely through his efforts they ended up with an ideal site in a valley surrounded on all sides by hills, the tops of which are used "for tracking stations".

*WCMRS MEMBERS NORM WOOD AND JIM GRINSTEAD PREPARE MODEL*

Thus, in March of 1967, the West Covina Model Rocket Society functioning under the motto "Safety, Education, and Recreation in Model Rocketry" came into official existence. The club by-laws call for the strictest safety and enforcement of State and Local city model rocket regulations.

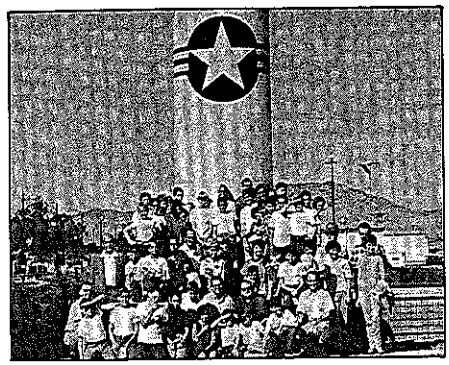
The WCMRS was given its own clubhouse which they painted, installed work benches, book shelves, a wind tunnel and many colorful posters of Rockets and Satellites donated by local aerospace companies (and, of course, a CENTURI Banner).

In just a year the club has grown by leaps and bounds to its present size of 120 members. Individual membership in the National Association of Rocketry is stressed for liability insurance purposes.

They have already conducted the two biggest model rocket events in Southern California. The West Covina Model Rocket Regional Championships were held in the summer of 1967 in which 60 rocketeers from 8 different cities took part. Their Model Rocket Winter Invitational was held in Dec., 1967. Almost 100 rocketeers representing 12 different cities participated and spectator attendance reached 600.

Trophies for the winners were donated by three local Aerospace firms (Aerojet General, General Dynamics, and Electro-Optical Systems).

Through the efforts of Miss Teri Pond -- a Recreation Department Supervisor put in charge of special events and news releases -- the club has appeared on NBC, CBS, and the KTTV television network. The club has also been featured several times in the Los Angeles Times and also in two local newspapers, the Tribune and the Sentinel.



*FIELD TRIP TO MARCH AFB*

The range equipment for the club consists of a 22 pad launch rack with a main arming console and individual firing boxes for each pad. The City of West Covina provides tables and chairs and also furnishes a truck to carry equipment to the launch site.

Funds for new equipment are earned from a food and soda pop concession run by parents on launch days.

The club has been on tours of both March Air Force Base, and a missile firing destroyer. Future tours will include a trip to Goldstone -- NASA's deep space tracking station in the Mojave Desert, and an overnight stay at Vandenburg Air Force Base in California to observe a real rocket launch.

Another event which won great support by both parents and rocketeers was the overnight desert camp-out. Arrival and a late afternoon launch is followed by a friendly Bar-B-Que and a star gazing session led by amateur astronomer Sid Sheridan. The climax of the evening is a series of spectacular night launches by model rockets carrying specially constructed tracking lights in the payload section. A truly rewarding recreation experience for the 70 people who attended.

Dane Boles and Buzz Hauk are to be congratulated for their tremendous achievement.

## 1968 PITTSBURGH SPRING CONVENTION BREAKS PREVIOUS RECORDS

Over 200 model rocketeers attended the Third Annual Spring Convention held the weekend of March 16. Technical discussion groups were even more extensive this year and covered Club Organization, Construction Techniques, Boost Glider Technology, Model Rocket Math, and Scale Building. Over 250 rockets were submitted for safety check on Friday night. To the discouragement of all, heavy rains all day Saturday and Sunday morning forced cancellation of all flights.

Centuri Engineering unveiled its new Apollo-Little Joe II and Laser-X kits at Pittsburgh along with Technical Information Report TIR-30 on Model Rocket Stability.

This year three special Lecture-Demonstrations not specifically related to models were given. The first was a "History of Rocketry" presented by Bob Atwood, Secretary of the NAR. The second was on Nuclear Rocket Engines by Dr. Howard Arnold, Program Manager of the NERVA project at Westinghouse's Astro-Nuclear Laboratory. This excellent lecture covered all the basic fundamentals and potential advantages of Nuclear engines over today's existing liquid Oxygen, liquid Hydrogen engines. Dr. Arnold's review of Westinghouse's proposal for a manned mission to Mars using NERVA engines was received with much enthusiasm. The last special lecture was on Missile Guidance principles by Mr. Jack Thompson of the American Optical Company.

It is gratifying indeed to the entire staff at CENTURI to realize that many of these young boys went to considerable effort and expense in order to travel to Pittsburgh from many states away. WHY -- to learn! If anyone wants to predict who will be our country's prominent scientists of the future, we think we know where to start looking.

# CALIFORNIA—AEROSPACE CAPITAL OF AMERICA LAUNCHES SPACE CLUBS OF AMERICA

Model rocketry forms the basis for a new space age aid-to-education organization entitled SPACE Clubs of America. Headquartered in California, SPACE is staffed by volunteers from aerospace firms currently engaged in the development of space systems and hardware.

Club members engage in model rocketry and the construction of other space-age hardware under the supervision of scientists from aerospace firms. Studies of outer space, space exploration, our National Space Program and the construction of astronomical observatories add to the program spearheaded by model rocketry.

Advisors for the first seven chartered SPACE Clubs represent our nation's top space industries. They include scientists from Philco-Ford's Space and Re-entry Division, Hughes Aircraft, North American Rockwell, and the Missile Systems Division of both McDonnell Douglas Corporation and Atlantic Research Corporation.

SPACE Clubs are now organized in Junior and Senior High Schools, Boys' Clubs, and YMCA's. Space-age activities in these clubs range from model rocketry to building man-carrying air cushion vehicles, space simulators, and to launching high altitude instrumented weather recording balloons.

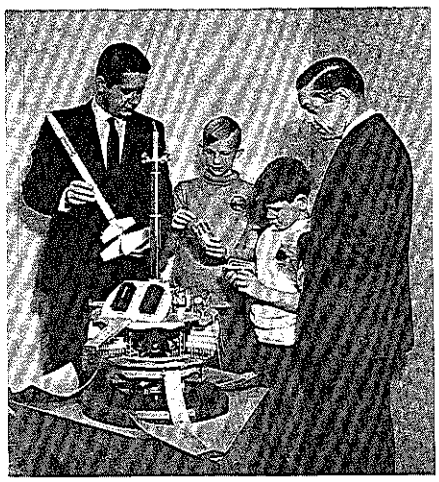
David Ross originator of the program says model rocketry has provided the key to the SPACE Club success. Instant enthusiasm is generated in club members and advisors by model rockets and this feeling is carried over into other related space oriented activities. Other factors that make SPACE Clubs a success is its basic goal of space age aid-to-education, the ease with which a SPACE Club can be formed and the fact that SPACE Clubs are designed for the age group "where the action is" -- 10 to 18 years.

One of the chief aims of the SPACE Clubs of America is to make it easy for adult volunteers to form affiliated model rocket clubs. A simplified system is used to register new SPACE Clubs and provide insurance coverage for model rocketry activity. The lowest cost-per-member $500,000 liability insurance coverage is available through the SPACE Clubs of America. These outstanding features make SPACE Clubs a natural for Boys' Clubs, YMCA's, and city recreation departments.

For further information to this exciting new organization send a stamped, self-addressed envelope to:

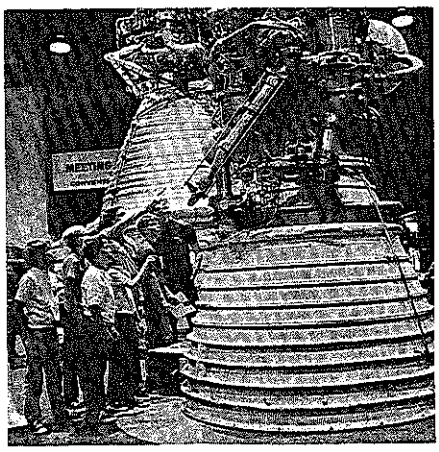
SPACE Clubs of America
Box 615
Costa Mesa, California 92627

**SPACE CLUB MEMBERS**

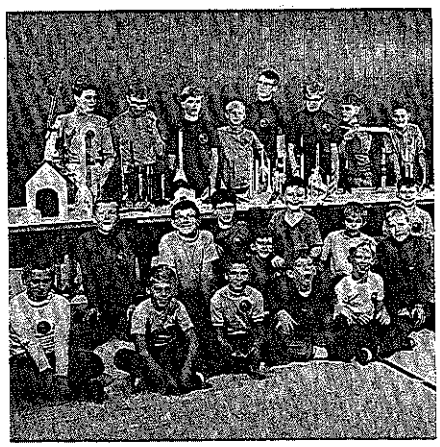


**Space Scientist Dr. Daniel Tompkins (right) describes Life Detecting Mars Probe**

**Payloader II launch preparation**



**SPACE Club members view the engines which power the Saturn V Moon Rocket**



**Harbor Area Boys' Club Space Team**

# BASIC RULES FOR SCALE MODEL ROCKET LIFT-OFF PHOTOGRAPHY

In the last issue of the AMERICAN ROCKETEER we featured Don Sahlin's beautiful Lift-Off sequence photos from the movie "TIME PIECE". Our first thought upon seeing them was "wouldn't it be great if we could get realistic pictures like that of our own rockets". Obviously, the best way to find out how to go about it was to write Don and ask him for his expert advice.

The following rules arrived recently from Don. We read them, thought about them for awhile, and then tried them out ourselves. We're more than happy with the dramatic improvement it makes in our own photos. We are presenting his basic rules here and hope you can take advantage of the techniques he has developed and perfected.

1. For realism, position camera down low so that it looks up to the rocket. Thus the picture appears to be taken by "scale" people far away and on the ground -- rather than by a giant who is taller than the rocket.

2. Always have sky in the background -- preferably cloudless. This eliminates any background objects which will give clues to the actual small size of the rocket.

3. Spend a little time building a simple, but realistic, launch tower. Making an umbilical connection and support structure really adds a lot too. Having various dummy antenna rods in the picture also helps to draw attention away from the launch rod.

4. Be sure that the rocket is rotated around on the launch rod to a point where the rocket hides the rod. If the rod and launch lug show up prominently in the picture, everyone will know the pictures are just of a model rocket.

5. If possible, use a cloud filter that will darken the sky for black and white photography, as contrast is markedly improved.

6. Morning and late afternoon light are the best for lighting as they highlight and give the bird three-dimensional relief. Noontime is always bad, as no shadows exist.

7. Obtaining that "perfect" picture of the rocket just as it clears the tower is virtually impossible with a still camera. There just isn't enough time to react so precisely -- especially with fast lift-offs. It's trial and error and you'll have to launch it several times to make sure you catch it. With slower heavier rockets your chances are obviously better, but even then use a camera that has a fast shutter speed -- ideally a 1000th of a second.

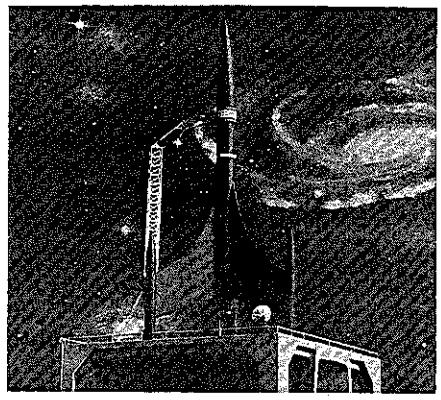
8. For 16mm motion picture photography close the focal plane shutter almost all the way down. This helps sharpen every frame if you want to lift one out to be printed.

9. Always use a tripod for motion picture filming and it even helps for still shots of rockets, that is, unless you are attempting to track it.

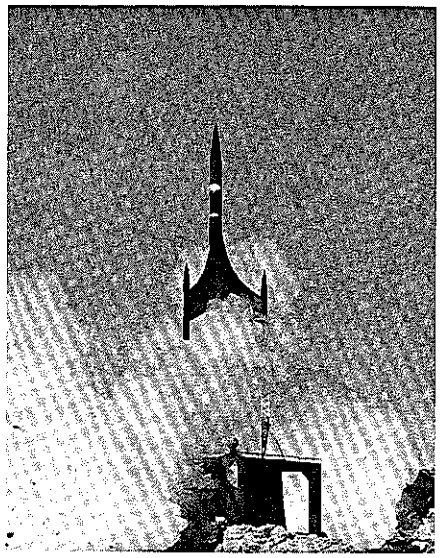
10. Use a high contrast film like PLUS-X for black and white still work.

We followed Don Sahlin's basic rules and obtained these photos of one of our experimental model designs.

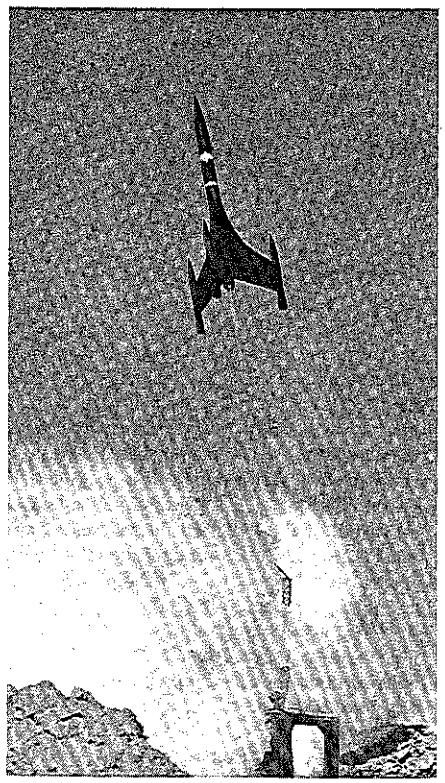
If you decide to try some lift-off photography using Don's techniques, please send us 5 by 7 glossy prints of your best shots. We will send you a free LASER-X kit if we publish your shot in the next issue of the AMERICAN ROCKETEER.



PRE-DAWN COUNTDOWN



THE INSTANT OF LIFT-OFF



ONWARD TO EARTH ORBIT

## CENTURI WANTS YOUR CLUB NEWS

Yes, here at CENTURI we really do want to hear about your club's activities. Even if your club is small, we're keenly interested in hearing about your launchings, demonstrations, field trips, and meetings. If you have a club bulletin or newsletter, please put CENTURI on your mailing list. Have newspaper stories, photos, or other publicity appeared about your group? If so, please send us a copy.

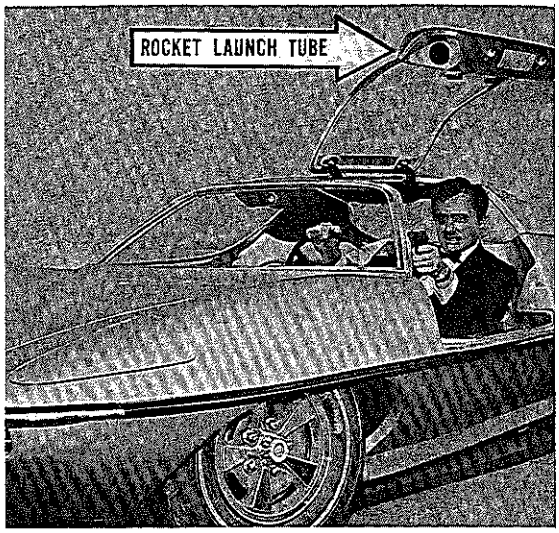
As you can see from this issue of CENTURI's AMERICAN ROCKETEER, we really intend to include lots of club news. We urge your group to take advantage of the new Club Classified Section.

In addition to experimenting with the free Club Classifieds, we are also altering our policy on awards for each main section club news actually used. Instead of the straight $10 Merchandise Certificate of the past, we are changing to a $5 Merchandise Certificate for each article published in the main section. In addition, however, we will give $2 for each photo we use with the article.

We hope this change motivates you to learn more about the basic principles of good photography and composition.

Let us know what you want! Your comments and criticisms will determine the eventual format of the AMERICAN ROCKETEER. We don't know how many of you caught our error in last issue's crossword puzzle, but only one wrote us about it. I won't tell you what it was, but we'll offer a free FIREFLY kit to the first three earliest post-marked answers.

# CENTURI'S ROCKETS ASSIST SPIES FROM U.N.C.L.E.




NAPOLEON SOLO IN ACTION

APRIL DANCER AND CAR BUILDER GENE WINFIELD

Remember last season's T.V. shows -- "The Man and the Girl from U.N.C.L.E.? Well, now we can finally reveal the closely guarded secret of the rocket system used in the SPY car driven by stars Napoleon Solo (Robert Vaughn) and April Dancer (Stephanie Powers). The heat-seeking rockets fired from the gull-wing car doors were really just MINI-MAX "F" powered model rockets of standard cardboard and balsa construction. The studio's Special Effects Department beautifully faked the heat seeking trajectories and warhead explosions.

CENTURI President, Leroy Piester, designed and built them himself for his friend Gene Winfield, Manager of the Phoenix AMT Corporation, Speed and Custom Division, where the car was built for the U.N.C.L.E. series.

Besides the rockets, this aerodynamic low slung coupe was also loaded with many other advanced technological features. Among these were twin flame throwers on the front end, twin lasers, supercharged exhaust, bullet-proof shield, high speed braking parachute, and retractable water propulsion units for amphibious operation.

Electronic gear consisted of a video communications center, a digital computer, radar tracking screen, and an infra-red television system. All this -- and a fantastic speed potential!

The opportunity to go along on a shakedown cruise in the SPY car was politely refused by Mr. Piester. He did this upon discovering that no one as yet had analytically verified whether or not the subsonic center of pressure at small angles-of-attack was one body diameter behind the center of gravity. Jumping in and going around the Phoenix International Raceway test track at 200 miles an hour would admittedly be a rather unscientific way of checking aerodynamic pitch and yaw stability. Any safety conscious model rocketeer knows that!

# CLUB CLASSIFIEDS

Advisor Yang J. Kim for the Raindeer Rocket Club, P.O. Box 1157, Bartow, Florida 33830, informed us they are looking for some area competition. The name for the club is appropriate as all their rockets have red nose cones.

Roger Stein of the Medway, Ohio Starblazers announced that a membership drive contest is on. Contact Roger at 56 Oaklawn Ave., Medway, Ohio 45341, for more information. Their newsletter presented a ranking system and requirements for I Candidate Rocketeer, II Beginning Rocketeer, III 2nd Class Rocketeer, and IV First Class Rocketeer. Certain types of rockets must be successfully flown and exams passed to progress from rank-to-rank.

The VINELAND HIGH ROCKET CLUB of Vineland, New Jersey had a very nice 2½ page article printed about their club in the Vineland Times Journal. They started with 6 members and jumped to 24 in less than a year.

Paul Lewis, 1109 Vinal St., Toledo, Ohio 43605, the technical advisor of the Model Rocket Society of Toledo wrote about the club's computer activities. Any readers interested in computer applications to model rocketry should drop Paul a line. The Society is sponsored by the East Toledo Neighborhood House and Community Center. They already possess a wind tunnel and engine test stands.

Richard Stengel, Secretary of the Lansing Starshooters, 18721 Williams St., Lansing, Illinois 90438, announced that their club will start launching twice a month this year. They hope to send us their first newsletter -- full of good plans -- shortly!

The Model Rocket Space Club, 2330 Eoff St., Wheeling, West Virginia 26003, are looking for new minds --- new ideas --- new members. This is a big club with 127 members. Since mid 1964, when the club started, they have fired 7,934 rockets (who stands there and counts them? - ED). They also publish the Model Rocketeers Snooper on a monthly basis (how about putting CENTURI on your mailing list?).

Tancred Lidderdale, President of the Model Rocket Club of Dalton, 1605 Beverly Drive, Dalton, Georgia 30720, responded recently to our inquiries into their most unusual launching sites. Launchings are held atop the World Carpet Mills building -- in fact in just one corner of it! The width where they fire is 350 feet (a football field is 300 feet) and as a result the problem of rockets drifting over the side has proven to be minor. Their contest launch site is -- believe it or not -- at a local cemetery (do you start your contests at midnight perchance??). Tancred is also editor for the club's very fine technical oriented magazine.

The Beardstown Rocket Research Association was recently founded by Mr. Joe Hamon, Industrial Arts teacher at Beardstown High in Illinois. They sent us a newspaper article written about the club along with one of their printed membership cards. The club emblem is best described as a tiger striped version of the Pink Panther holding a 3 stage bird!

Mark Rausch sent us their first issue of the Barron Model Rocket Association newsletter. The club's mascot is World War I ace Snoopy atop his crashed and smoking dog house which is full of machine gun holes. We should mention that the club is named after their town Barron, Wisconsin -- not after Red ---. Member Fred Broker and his loyal (?) rocket named Eggbert (???) drew some interesting comments. Plans, please!

The WINDSOR PLACE Rocket Society of Allison Park, Pa. held an open house which in spite of rain turned out to be a big neighborhood hit.



Craig Nicolaus of R.C.B.R. Enterprises, Inc. says his club is interested in corresponding "with other kids building rockets over the states". The club started as part of an Aerospace elective last semester. All members are age 13 and they even have a printed membership card. Neither their letter or membership card contained an address so until Craig sends us an address and a state it will be pretty tough getting any correspondence going his way.

The Astro-Modelers Section of the NAR sent us a copy of their well written "IONIC TRAILS". Senior Advisor is Thomas O'Brien, Tarkington Hall, West Lafayette, Indiana (Purdue University). One very interesting project was a semi-scale Saturn I-A powered by 8 C.8-0's clustered around one D motor in the center. They used modified (??) Sure-Shots to ignite it and it has flown perfectly four times. Multi-clustering is not for the novice -- the project was performed by college people with an average of six years of model rocketry experience! (How about sending us some photos?)

Dave Pearson, 45 Park Street, Oxford, Michigan 48051 sent a two-page article on their club -- the Oxford Rocketeers -- which recently appeared in the Oxford Leader. Present age range in membership is from 9 to 50 years. They have printed club stationery featuring a CENTURI Aero-Dart zooming up the side.

Rick Saunders, of Webster, New York, and several friends are interested in starting a club. Before selecting a final name for their club they intend to have a brainstorming session with the help of their newly acquired members.

The AMMA Rocket Club of Monticello sent us a clipping a year ago and they received their National Association of Rocketry Charter. Ed Pearsons NARLETT Section Roster of January '68 finally enabled us to find which state Monticello is in -- it is Indiana and the advisors of the club are Alberta Hands and Ruth Kretcher. Now how about letting CENTURI know what AMMA stands for?

Other women who are acting as adult advisors for sanctioned N.A.R. sections are Ina Margaret Meter of the Apalachiola Valley Section -- Florida, and Susan Woodward of the Hempfield Area Model Rocketeers -- Jeannette, Pa. Thanks girls!

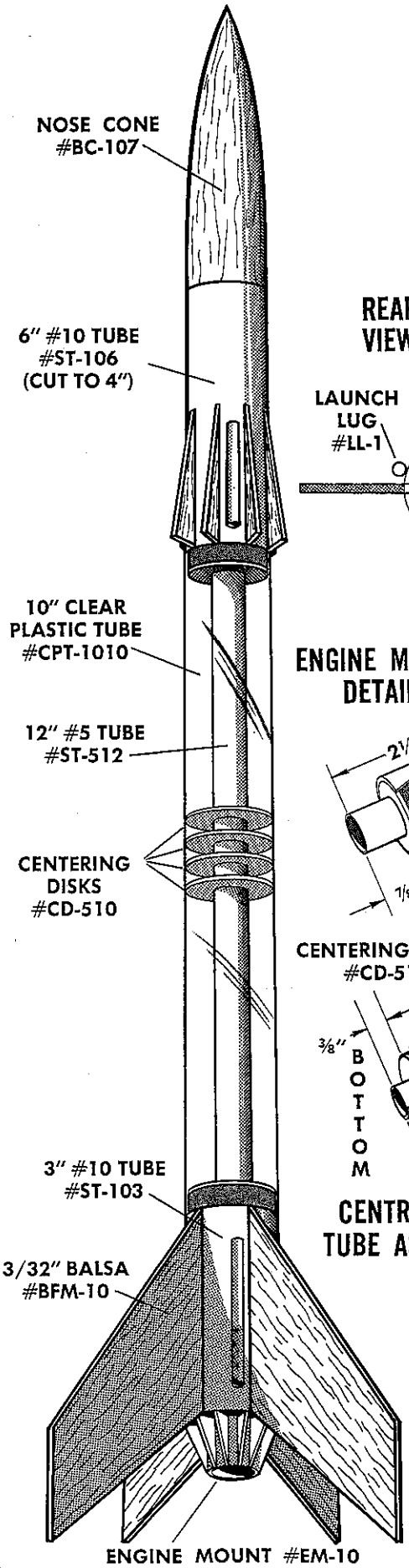
Mark Levy, President of the Polytechnic Rocket Research Society of Baltimore, Maryland, wrote that his club recently had guests Charles Gordon and Howard Galloway of the NAR Star Spangled Banner Section present a talk on the merits of model rocketry. They have toured Westinghouse Electric Corp. as a group and hope to tour as many places dealing with the U.S. Space Program as possible.

Centuri

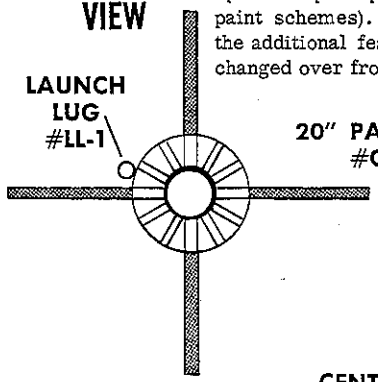
# LASER-244

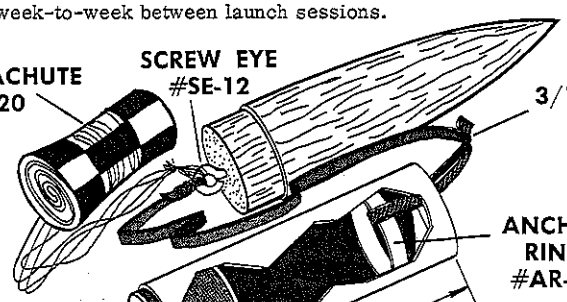
## INSPIRED BY P. B. ZIMMERMAN, AGE 16, WASH., D.C.
## SECOND PLACE WINNER IN CENTURI'S DESIGN CONTEST

To obtain the appearance of an actual LASER optical pumping thrust unit, the ejection gases are passed through the smallest #5 series tube. Lengthwise support and rigidity are provided by the clear plastic #10 tube. In addition, the use of PRO/STRIPE and/or patterns cut from metal plated mylar sheets gives the LASER 244 quite an unusual appearance as it seems parts are floating in space or perhaps invisibly supported by magnetic force fields (see alternate paint schemes). Using PRO/STRIPE on the clear plastic tube section also has the additional feature that the basic design patterns can easily be completely changed over from week-to-week between launch sessions.




REAR VIEW

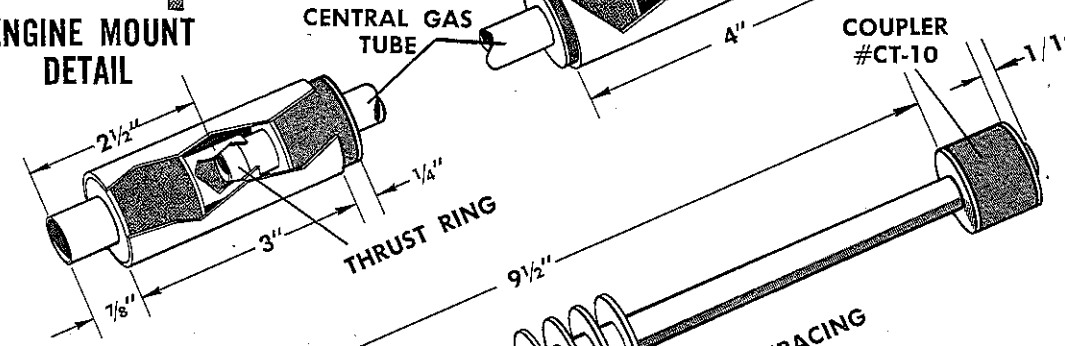


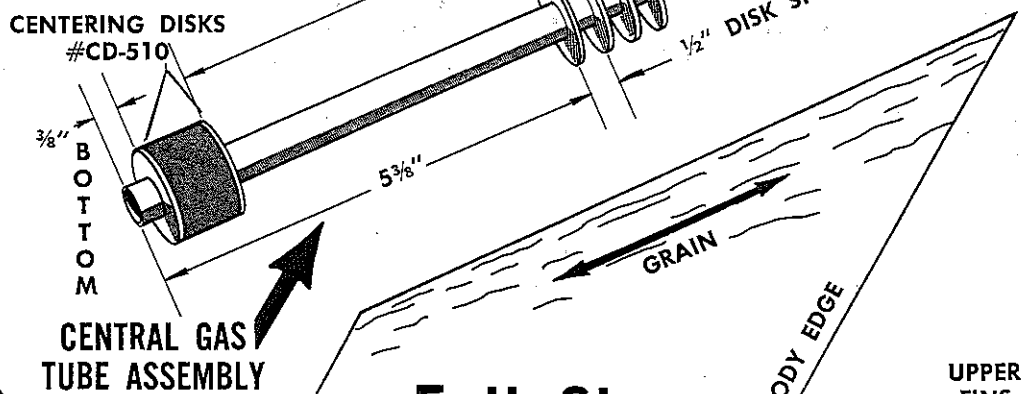







ENGINE MOUNT DETAIL




CENTRAL GAS TUBE ASSEMBLY





UPPER FINS (MAKE 6)



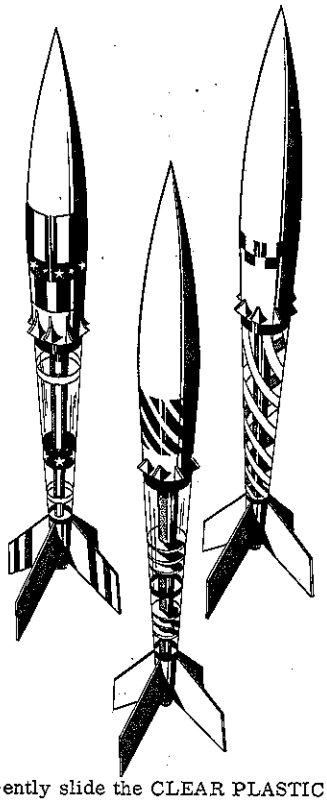
COOLANT FINS (MAKE 12)

| Centuri | LASER-244 | PLAN #2 © 1968 |
|---|---|---|
| DRAWN BY: T.A. Cameron | APPROVED BY: L. Piester | 5/10/68 |

## CONSTRUCTION STEPS

1) Build the ENGINE MOUNT so that the #7 tube extends 7/8" as shown.
2) Glue the four LASER CENTERING DISKS to the #5 tube. Then build the two COUPLER ASSEMBLIES and glue them to the #5 tube as shown.
3) Glue the ENGINE MOUNT flush into one end of the 3" long #10 tube. Then glue the #5 TUBE ASSEMBLY into the other end so it extends 1/4" as shown.

### ALTERNATE PAINT SCHEMES



4) Gently slide the CLEAR PLASTIC TUBE in place on the assembly. Sand down any spots on the assembly where the plastic tube fits too tight. Remove plastic tube before painting the rocket.
5) Cut the 6" long #10 TUBE down to 4". Do not glue this tube in place until all painting has been completed and the clear plastic tube has been slipped permanently in place.
6) Cut out all balsa parts using the full-size patterns as a guide. Sand, apply 2 coats of filler, and re-sand with fine sandpaper. Be sure that all edges which glue to the body tube are not rounded nor covered with any filler. Then glue the balsa parts and launch lugs in place.
7) Paint the Laser 244 your favorite color. When dry, slip the CLEAR PLASTIC TUBE permanently into place. Next, glue the 4" long #10 TUBE over the top coupler. You will note that slightly less than 1/4" of the upper and lower couplers are showing inside the plastic tube. Thus, 1/4" wide PRO/STRIPE can be used to nicely hide the exposed couplers.
8) Attach the SHOCK CORD to the body with an ANCHOR RING. Lastly, glue a SCREW EYE to the NOSE CONE and connect the CHUTE and SHOCK CORD.

## INTRODUCING REVOLUTIONARY Centuri SHOCK CORD ANCHOR RINGS

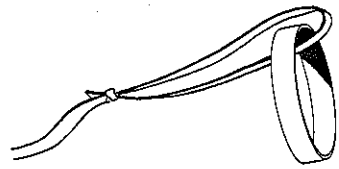
For years we have been trying to find a time-saving method of attaching the shock cord to the body tube. Our featherweight mylar Anchor Rings eliminate the old unsightly slits in the tube and are so thin (.010" thick) that they greatly reduce the possibility of parachute jamming during ejection.

These Anchor Rings, when properly installed, cannot come loose or tear out.

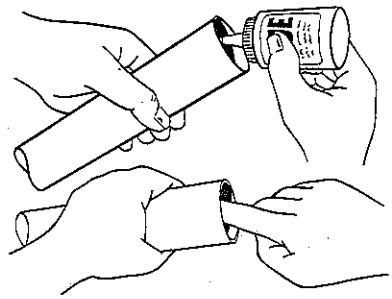
### PRICE LIST

| | |
|---|---|
| Cat. No. AR-7 | 6 for 25¢ |
| Cat. No. AR-8 | 6 for 30¢ |
| Cat. No. AR-10 | 6 for 35¢ |
| Cat. No. AR-13 | 6 for 40¢ |
| Cat. No. AR-16 | 6 for 45¢ |
| Combination Package | (2 of each) |
| Cat. No. AR-1 | 10 for 60¢ |

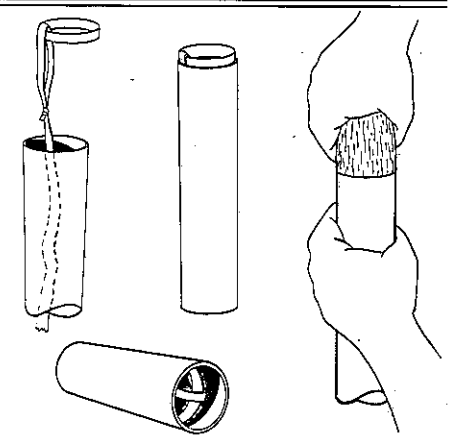
### HOW TO INSTALL SHOCK CORD ANCHOR RINGS



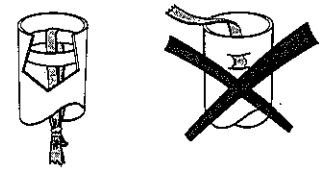
1. Loop shock cord through Anchor Ring. Tie a knot so that the loop is about 1½ inches long. Put a dab of Superbond on the knot.



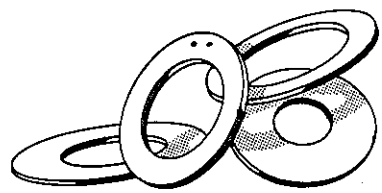
2. Apply a heavy bead of Superbond around the inside of the body tube at the approximate depth of the nose cone base. Smooth glue with finger as shown.



3. Drop shock cord down through the body tube. Insert Anchor Ring until it is just flush with the end of the body tube. Use the nose cone to push the Anchor Ring all the way down. Remove the nose cone immediately, then smooth glue with finger.
4. After drying, put an additional thin film of glue all over the ring with your finger.



## CENTERING DISKS



These precision die-cut rigid paper rings perfectly center a small body tube inside of a large body tube. Useful for making conical paper reduction fittings, engine mounts, and for special effects, such as illustrated in our LASER 244 plan.

### PRICE LIST

For Packages of 10

| Cat. No. | Price | Cat. No. | Price |
|---|---|---|---|
| CD- 5 8 | 25¢ | CD-10 13 | 30¢ |
| CD-5 10 | 25¢ | CD- 7 16 | 35¢ |
| CD-7 10 | 25¢ | CD- 8 16 | 35¢ |
| CD-5 13 | 30¢ | CD-10 16 | 35¢ |
| CD-7 13 | 30¢ | CD-13 16 | 35¢ |
| CD-8 13 | 30¢ | | |

### LARGE CLEAR PLASTIC TUBES FOR LASER-244

| Cat. No. | Length | Prices | |
|---|---|---|---|
| CPT-1010 | 10" | .35 ea | 3/.85 |
| CPT-1018 | 18" | .60 ea | 3/1.35 |

# TECHNICAL INFORMATION REPORTS

## STABILITY OF A MODEL ROCKET IN FLIGHT
## TIR-30

BY JAMES BARROWMAN

Most model rocketeers have heard that a stable rocket flight requires that the center of pressure must lie behind the center of gravity.

What is center of pressure? Why is the rocket balance point called center of gravity? What does the word "stability" really mean? Are there any simple tests which tell you whether or not a new rocket design will be "stable"? How come rockets arc over and head into the wind (weathercock) during thrusting and coasting instead of being blown along with the wind as a feather or piece of paper would?

These and other important questions are fully answered in CENTURI's TIR-30. The report contains a total of 42 illustrations to assist the explanations of the basic principles of model rocket stability. In addition, a section on how the amount of stability can be adjusted to improve altitude performance has been included.

The report was written by Jim Barrowman, an Aerospace engineer at NASA, who uses these same principles in his daily work with aerodynamically stabilized sounding rockets. Jim is the club advisor for the NARHAMS section of the NAR, and also will be NARHAM-10 Contest Director this summer at Wallops Island, Virginia.


**AVAILABLE NOW**

**TIR-30 $.50 Postpaid**

## CALCULATING THE CENTER OF PRESSURE OF A MODEL ROCKET TIR-33

BY JAMES BARROWMAN

Once you have read TIR-30 and learned about the "whys" of stability you will be in a position to appreciate and make use of this report. We feel it is a "must" for the competition minded rocketeer who wants to achieve maximum performance together with an adequate stability margin. This report is the scientific tool which enables you to calculate the exact center of pressure of a model rocket. Fully illustrated, it includes all the necessary equations, design tips, and sample problems, along with graphs which eliminate most of the arithmetic steps.

TIR-33 was also written by Jim Barrowman. In fact, the derivation of the basic equations earned him a first place Senior Division R & D Award at NARAM-8.

Armed with this knowledge you can find the exact balance point for your rocket which will both insure stable flights and permit achievement of maximum possible altitudes. The method of analysis presented in this report will help you determine whether or not additional nose weight is necessary to achieve a stable flight and is particularly helpful in balancing those scale designs which have very little fin area.


**AVAILABLE JUNE 1st**

**TIR-33 — $1.00 Postpaid**

## MODEL ROCKET ALTITUDE PERFORMANCE
## TIR-100

BY DOUGLAS MALEWICKI

Presents easy-to-use graphs for accurately predicting the peak altitudes which can be reached by single stage rockets using ¼A thru F type engines. Also included are graphs for selecting the best delay time to use. No mathematical calculations, whatever, are involved in finding altitudes or engine delay times. These graphs, along with the numerous discussion sections of this report, should be most useful in helping the rocketeer towards a real understanding of how engine power, rocket weight, and aerodynamic drag on various nose and body shapes are interrelated in their affects on performance.

If you are at all interested in competing in the N.A.R. Aerospace Systems and Predicted Altitude events, this report will be an indispensible tool to earn you more points.

Once you have TIR-100 we are sure you will keep it within easy reach for constant use as a design reference. With it you will easily be able to answer more involved questions, such as:

1. Will a given rocket go higher with a B.8 motor or with the faster burning B3 motor?
2. Will an A.8 motor, which has exactly twice the TOTAL IMPULSE of a ½A.8 motor, lift a given rocket exactly twice as high?
3. How much higher does a rocket go on a cold day versus on a hot day? Or, does temperature even make a difference?
4. Will a single engine rocket of a given weight reach higher or lower altitudes than a two engine cluster rocket with exactly twice the lift-off weight? What about a three engine bird that weighs three times as much?
5. Will a B.8 powered bird with a lift-off weight of 1½ ounce go significantly higher if its weight is reduced down to 1.0 ounce?

The answers may surprise you!


**AVAILABLE JULY 1st**

**TIR-100 — $1.00 Postpaid**

To Order Any Of These TECHNICAL INFORMATION REPORTS, enclose payment and mail to:

CENTURI ENGINEERING COMPANY
P. O. Box 1988
Phoenix, Arizona 85001