

ESTES INDUSTRIES Rocket Plan No. 10

LI'L AUGIE

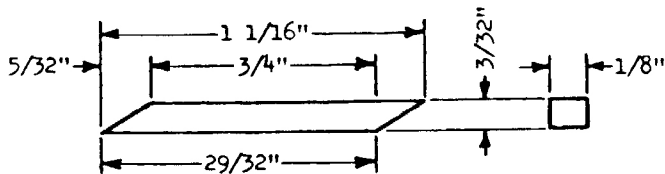
Li'l Augie is a novelty rocket combining the principles of multi-staging and ducted propulsion. Li'l Augie takes off in a conventional manner, and then, when the lower engine burns out, the upper engine is ignited, expelling the lower engine, and fires down through the tube, accelerating the gases in the tube and drawing more air in through the vents at the joint. This rocket shows an unusual advantage over conventional two stage rockets: There is only one part of the rocket to recover after the shot.

The first step in building Li'l Augie is to cut the body tubes to length, cut out the fins, and make the four spacers. The fins can be made from either 1/16" or 3/32" balsa, but since 3/32" is used for the spacers, the same thickness would be the most convenient for fins. The spacers are glued to the upper body tube, and the assembly is set aside to dry. While the glue is drying, cut the engine holder notch in the lower body tube, glue the fins in place, and attach a launching lug. Next, punch a hole in the upper body tube between spacers, 1/4" from the rear of the body tube. Use the engine holder to find the position for the upper hole, punch it, and put the holder in place. Apply glue over the upper quarter of the engine holder, apply the gauze, and then spread a little more glue over the gauze. Sand the spacers evenly until they make a snug fit inside the larger body tube, then glue the two sections together, with a 3/4" overlap, as indicated in the drawing. Make sure the engine holder matches the notch, so that it will be possible to lift it enough to replace upper engines.

Hollow the nose cone base to conserve space. Attach the screw eye to the nose cone, and the shock cord to the body tube. Then complete the assembly of the recovery system, sand the balsa parts, and paint.

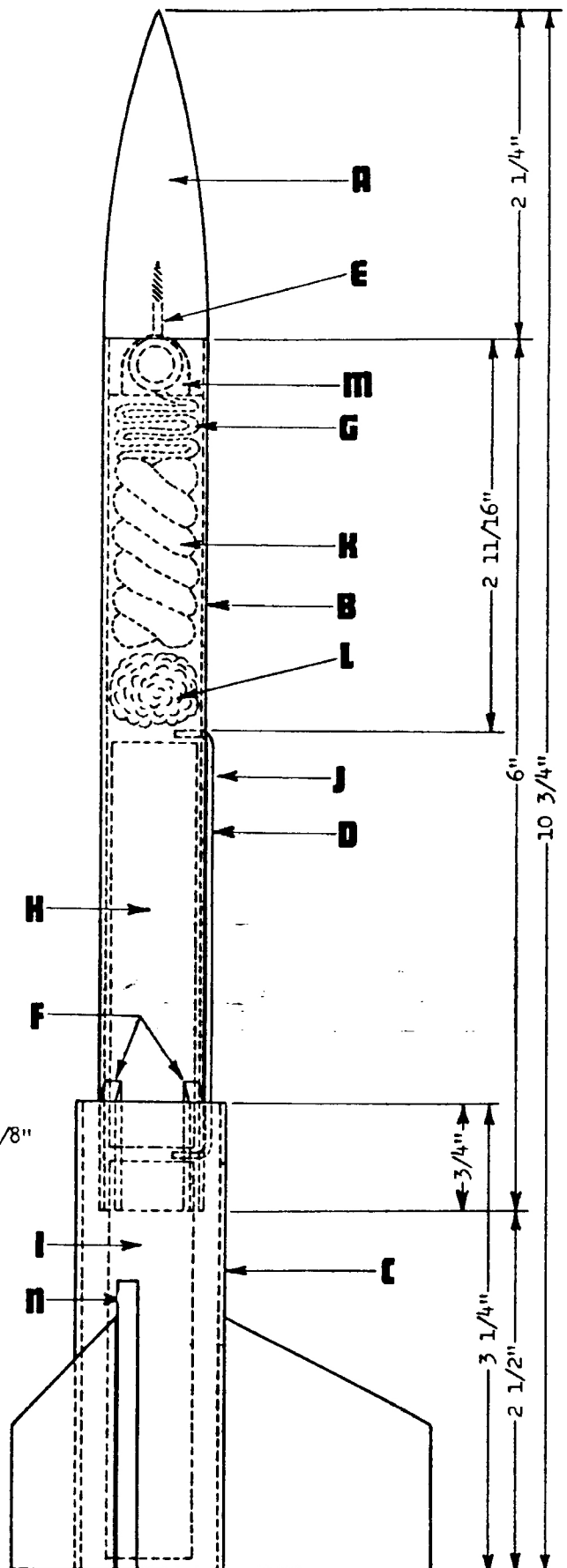
To fly Li'l Augie it is necessary to prepare the lower engine by building it up around the base to center it in the tube. To do this, glue strips of 3/32" balsa to its sides as in the drawing.

SPACER DETAIL
(Make Four)



PARTS LIST

A.	Nose cone	BNC-30E
B.	Body tube	BT-30
C.	1" dia. tube (engine mailing tube)	
D.	Engine holder	EH-1
E.	Screw eye	SE-1
F.	Fin stock and joint spacers	BFS-30
G.	Shock cord	SC-1
H.	Upper engine	Series I
I.	Lower engine	Series II
J.	Gauze reinforcing	GR-2
K.	Streamer	SM-1
N.	Launching lug	LL-1B

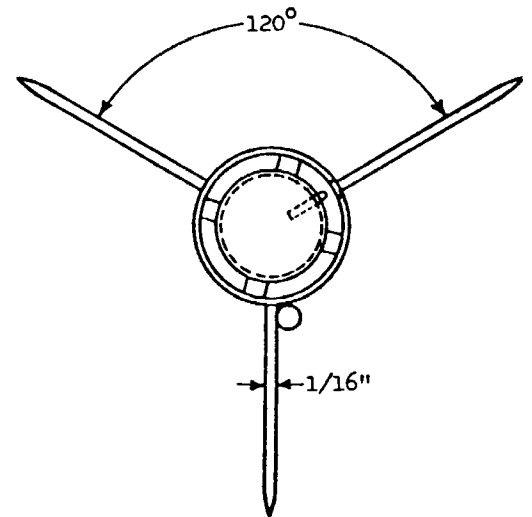
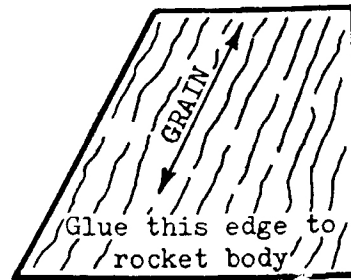


Prepare the upper engine for multi-stage firing as described in technical report TR-2 by inserting a small piece of jetex wick into its nozzle as in the drawing at right. Then load it into the rocket, making sure the engine holder will prevent it from traveling either forward or backwards. Then place an igniter in the booster engine, and load it in place so that the forward portion of the engine fits into the lower end of the small body tube. The lower engine must fit very freely so the slightest pressure will expell it from the augmenter tube.

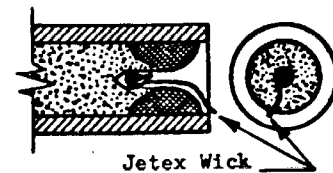
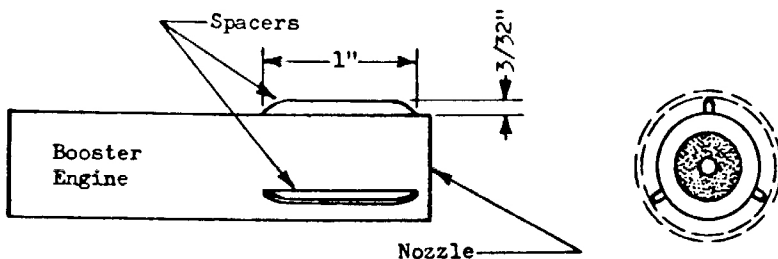
In operation, the lower engine boosts the rocket off of the launcher, and accelerates it to an air speed of around 150 miles per hour. Then as the engine reaches burnout, the forward wall of the combustion chamber ruptures, expelling hot gases and burning particles forward into the nozzle of the upper engine, at the same time providing gas pressure to expell the booster engine out the rear of the rocket. Then the upper engine fires, and its exhaust gases pass down the length of the lower body tube, which has now become an augmenter tube. The air speed of the rocket, combined with the pump effect of the exhaust gases forcing the air in the augmenter tube out the rear, brings more air into the augmenter tube, which is in turn accelerated and expelled from the rear of the rocket. In this way the rocket develops its thrust during the second phase of its flight.

With the addition of a payload capsule and a parachute, Li'l Augie makes an excellent rocket for high altitude payload shots. For even higher performance, try experimenting with an enlarged intake, obtained by bellng out the upper end of the augmenter tube before cutting the notch.

Recommended engines for the first flight of Li'l Augie are a Series II booster and a 1/2A.8-4 upper engine. Later altitude shots with B.8-6 engines in the upper section will provide even greater performance.



BOOSTER ENGINE PREPARATION DETAIL



Cut three spacers from scrap balsa fin stock, round all edges, and glue to engine casing. With spacers affixed, booster engine should slide smoothly and easily into lower body tube.

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BODY TUBE COUPLING DETAIL

