


ELECTRO- LAUNCH

Instructions

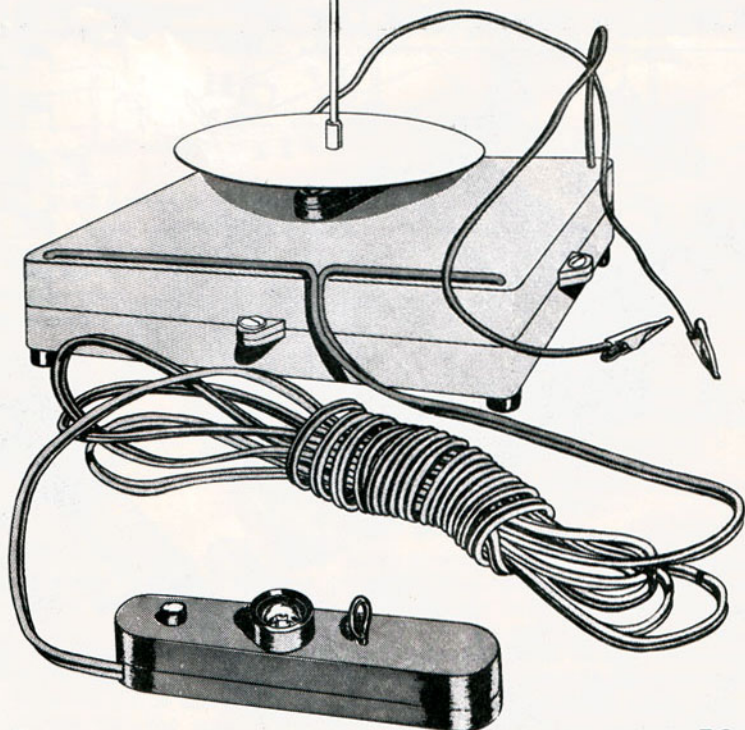


Industries, Inc. 

Devoted to Safety and Education in Rocketry

Box 227,

Penrose, Colorado



FS - 1

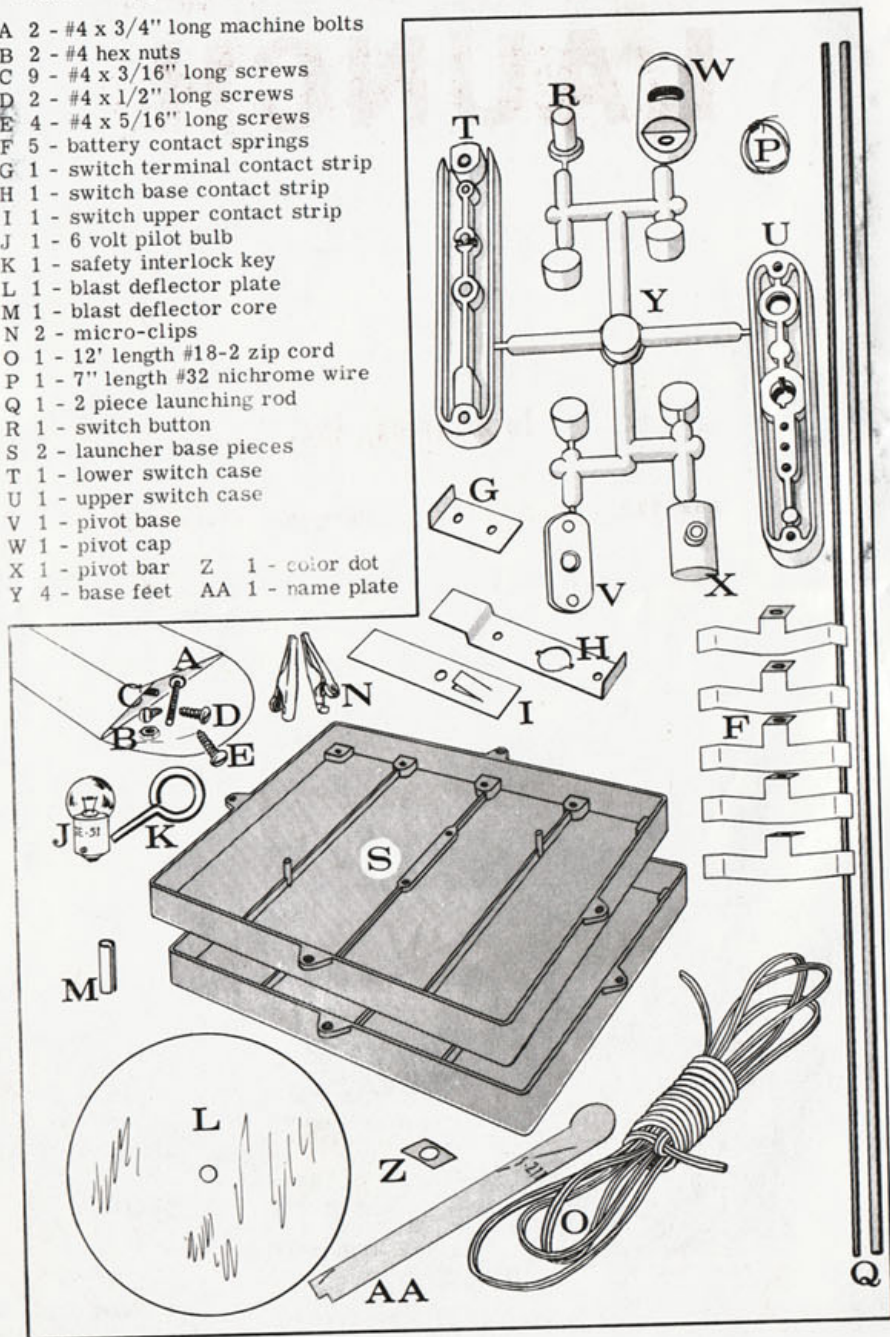
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Parts List

Your new Electro-Launch kit consists of the following parts as illustrated here. Check to be sure your kit is complete then begin construction, following each step in order and checking it off as it is finished.

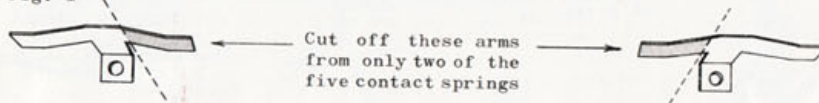
- A 2 - #4 x 3/4" long machine bolts
- B 2 - #4 hex nuts
- C 9 - #4 x 3/16" long screws
- D 2 - #4 x 1/2" long screws
- E 4 - #4 x 5/16" long screws
- F 5 - battery contact springs
- G 1 - switch terminal contact strip
- H 1 - switch base contact strip
- I 1 - switch upper contact strip
- J 1 - 6 volt pilot bulb
- K 1 - safety interlock key
- L 1 - blast deflector plate
- M 1 - blast deflector core
- N 2 - micro-clips
- O 1 - 12' length #18-2 zip cord
- P 1 - 7" length #32 nichrome wire
- Q 1 - 2 piece launching rod
- R 1 - switch button
- S 2 - launcher base pieces
- T 1 - lower switch case
- U 1 - upper switch case
- V 1 - pivot base
- W 1 - pivot cap
- X 1 - pivot bar
- Z 1 - color dot
- Y 4 - base feet
- AA 1 - name plate



ASSEMBLY INSTRUCTIONS

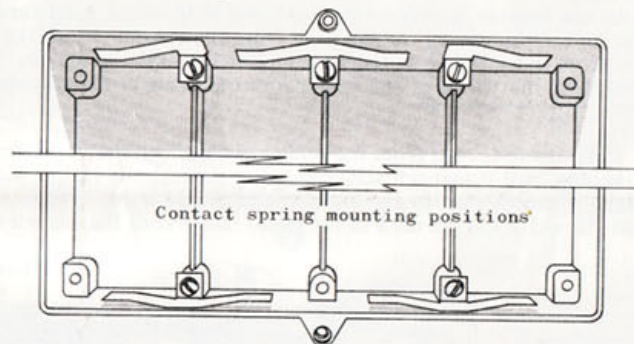
- (1) Separate the plastic parts from the "tree" and carefully trim any excess plastic from the edges of the parts with a sharp knife. Smooth any rough edges with extra fine sandpaper or an emery board. Sand or trim the center stub on the outside of the launcher base pieces so it is no more than 1/32" high.
- (2) Cut the left arm from one of the battery contact springs and the right arm from another with a pair of scissors or tin snips as shown in figure 1.

Fig. 1



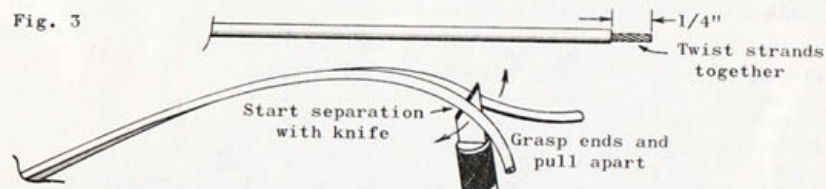
Mount all five contact springs in one of the launcher base pieces in the positions shown in fig. 2. When mounting the springs position them so their hole is over the hole in the base and then insert a #4 x 3/16" screw just far enough to keep the parts from falling out.

Fig. 2



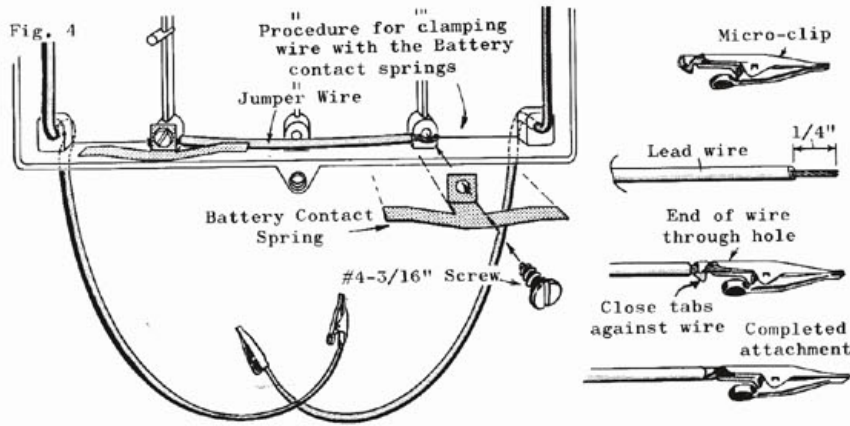
- (3) Work a fingernail or knife blade in between the two halves of the #18-2 zip cord at one end and separate the two leads for a distance of 24 inches by pulling the two halves away from each other. Cut a piece 17 inches long from one lead and a 3-1/4 inch long piece from the other. Strip off 3/8 inch of the insulation from each end of each of the wires and twist the copper to form a neat, compact end.

Fig. 3



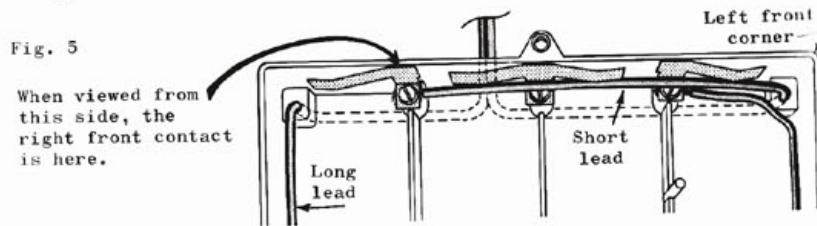
- (4) Place the ends of the 3-1/4" piece of wire under the two rear battery contact springs as shown in fig. 4, press the wire against the wall of the base and tighten the screws to make contact with the wire and hold it in place.
- (5) Slide one end of the 17" wire under the left front battery contact and tighten the screw. Poke the other end of this wire into the left rear corner hole from the inside and pull it thru. (If necessary the corner holes may be reamed out with the point of a knife blade to allow the wire to be pulled thru more easily.) The wire should run along the sides of the base. Attach a

micro-clip to the free end of this wire by folding the tabs at the rear of the clip down tightly over the exposed wire.



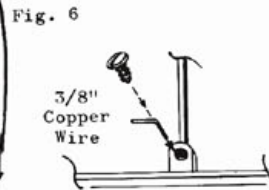
□ (6) Poke the shorter lead from the split end of the main cord through the hole in the left front corner of the base from the outside. Pull the wire on through, slide it under the right front contact and tighten the screw. Position the wire against the walls of the base below the arms of the battery contact springs.

□ (7) Poke the long lead from the main cord through the right front hole from the outside, pull it through and push it out through the right rear corner hole. Attach a micro-clip to the exposed end of this wire. Press all wires flat against the walls and corners of the base. Make sure that no wires inter-



fer with the contacts. Tighten the screw on the front center contact and check to be sure all the other screws are tight.

NOTE: If the screws in any part of the launcher are tightened too much they may strip the plastic out of the hole. Once the screws are firmly in place do not force them any farther. If you should goof and strip a hole, it may be repaired by bending a 3/8" long piece of #20 copper wire (1/32" in diameter) to a 90° angle at the middle, inserting one end into the hole and driving the screw in again.



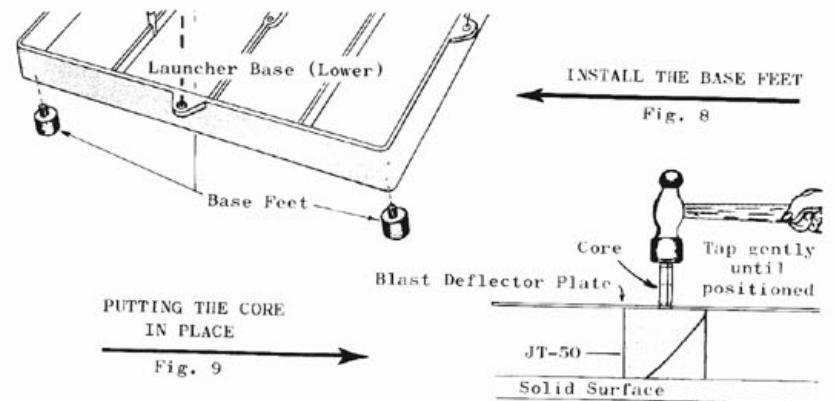
□ (8) Place the base end (the end that does not have the hole) of the lower section of the launching rod into the hole in the pivot bar and force the two pieces together firmly. Slide the pivot cap down the rod to seat it against the pivot bar. Place the pivot base under this assembly and insert the #4 x 3/4" machine bolts through the holes in the ends of the pivot base and cap. Position the pivot over the upper launcher base half (the half that is wired) and press the bolts through the holes in the base. Anchor the pivot assembly

with the two #4 hex nuts on the inside of the launcher base, tightening them until the rod can be moved only with firm pressure.

NOTE: If the pivot is too loose, take the pivot assembly apart, place two 3/8" x 1/2" pieces of typing paper in the pivot base so that they will provide a "shim" between the base and the pivot bar.

Reassemble the pivot unit. If it is now too tight, disassemble the pivot and remove one shim. Reassemble the pivot and test the fit again.

□ (9) Press the four base feet into the four corner holes of the lower half of the launcher base (the half that is not wired). If the feet are loose a small amount of plastic cement will hold them securely.



□ (10) Center the blast deflector plate over a support such as a roll of masking tape, a stage coupler or a brick so that there is an open space below the center of the plate. Position the blast deflector core over the center hole in the plate and tap lightly with a hammer to force it halfway through (so one half of the core projects on each side of the deflector plate).

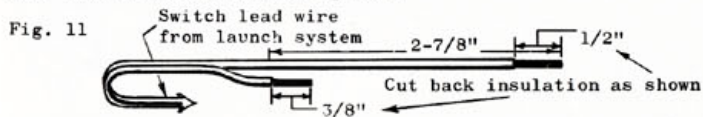
Fig. 10

□ (11) Place two size D photoflash cells in the far left channel of the upper launcher half so their center positive terminals face forward (toward the one-armed contact spring). Position the other two cells in the far right channel so that their center positive terminals face rearward (away from the single-arm contact spring). Check the illustration to be sure you have done this correctly. Do not place the batteries in the center channels!

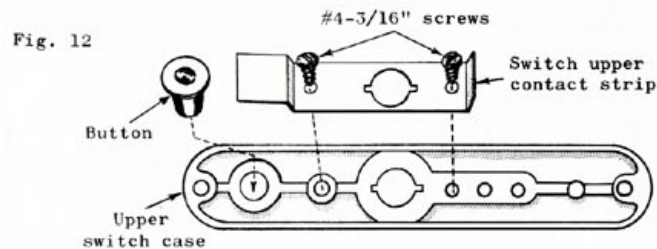
□ (12) Place the lower base piece over the upper piece so the tabs at the ends fit together. Lock the base closed with four 5/16" screws inserted from the large hole to the small hole in each pair of tabs. Slide the blast deflector down the rod and mount the upper half of the rod in the hole in the lower half.

LAUNCH CONTROL HOOKUP

□ (13) Trim the ends of your switch lead wire so one is 2-7/8" longer than the other. Strip off 3/8" of the insulation from the end of the short lead and 1/2" of insulation from the long lead.

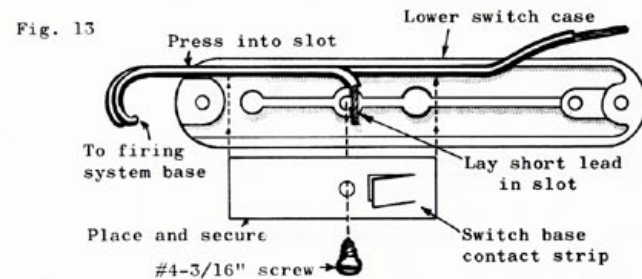


□ (14) Insert the switch button into place in the upper switch case piece from the inside. Lay the switch upper contact strip in place as shown and secure it with two #4 x 3/16" screws.



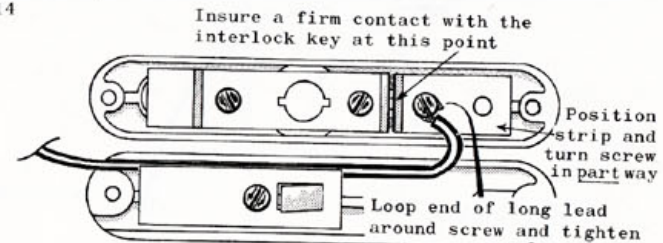
Insert button, then lay contact strip in place. Install screws.

□ (15) Press the wire down into the slot at the end of the lower switch case with the short lead up and position the wires so the end of the insulation on the short lead is even with the notch in the center strip of the case. Force the exposed wire on the short lead into the notch, position the switch base contact strip over it and anchor it down with a #4 x 3/16" screw.



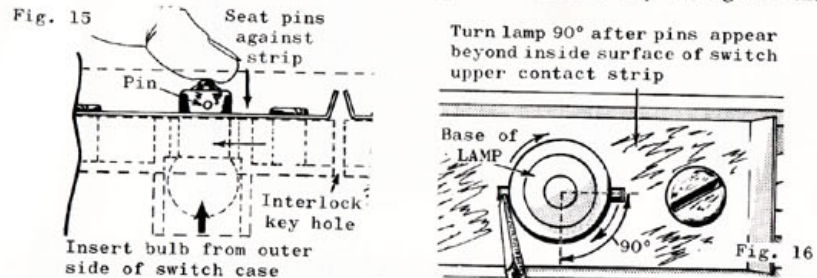
□ (16) Position the switch terminal contact strip in the upper switch case. Insert a 3/16" screw part of the way into the hole. Hook the exposed wire on the long lead around the screw as close in to the shaft as possible and tighten the screw to anchor the wire and contact strip down securely. Make sure all the wire is under the screw with no loose pieces hanging out.

Fig. 14



□ (17) Insert the safety interlock key into its hole from the outside of the upper switch case piece. Check the inside of the case to be sure both contacts touch the end of the key. If they do not, bend them inward until both make a firm contact with the key, but do not bend them far enough to touch each other when the key is removed.

□ (18) Push the pilot light into its hole. If necessary, reposition the switch upper contact strip until the bulb can be pressed all the way through so the



pins on its base project beyond the contact strip. Turn the bulb so its base are 90° away from the slots in the contact strip and press the end of the base to seat the pins against the contact strip.

□ (19) Place the upper switch case over the lower case. Secure the two pieces together with the two #4 x 1/2" screws in the holes at the ends of the case pieces.

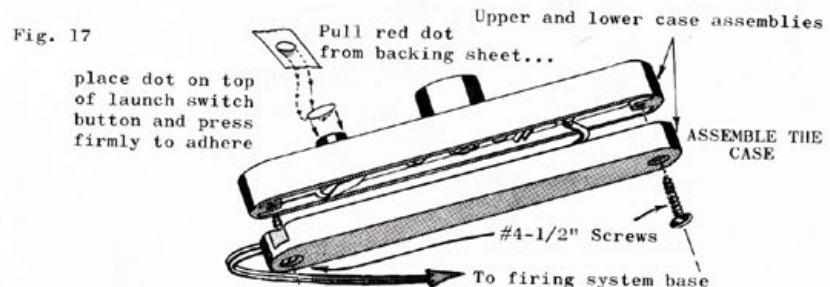
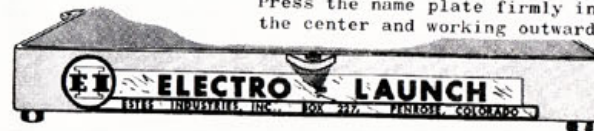
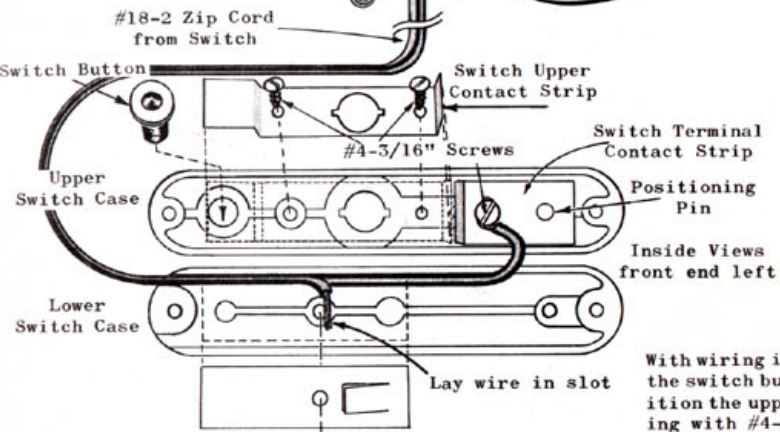
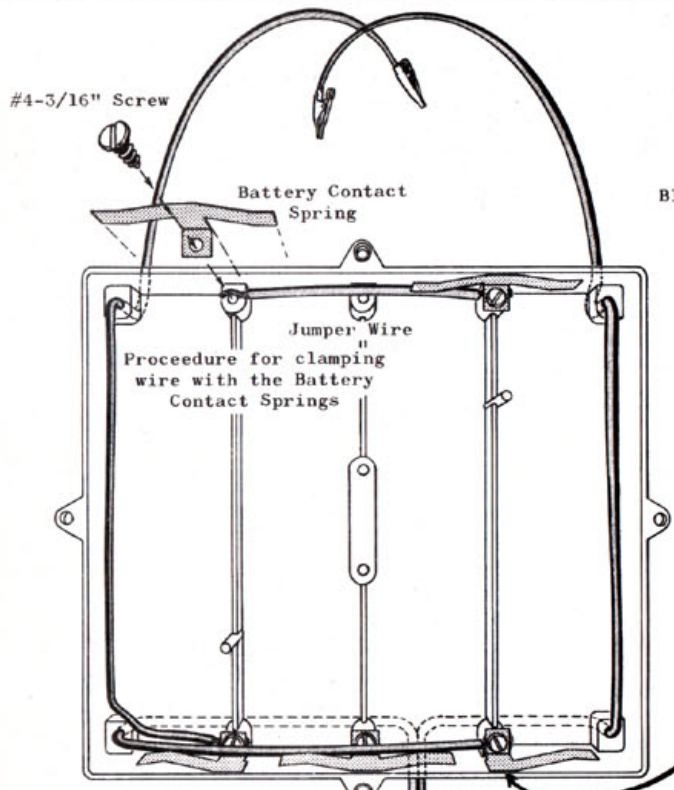


Fig. 18 MOUNT THE NAME PLATE

Peel the backing sheet from the name plate. Align the plate carefully with the bottom edge of the plate even with the bottom edge of the launcher base. Press the name plate firmly in place starting from the center and working outward to each end.





Place Switch Base Contact Strip into place indicated by dotted lines and secure with a #4-3/16" Screw

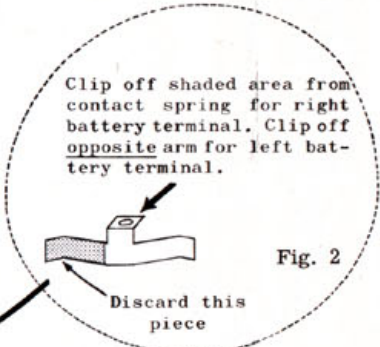
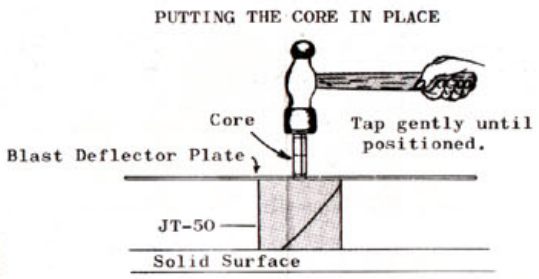
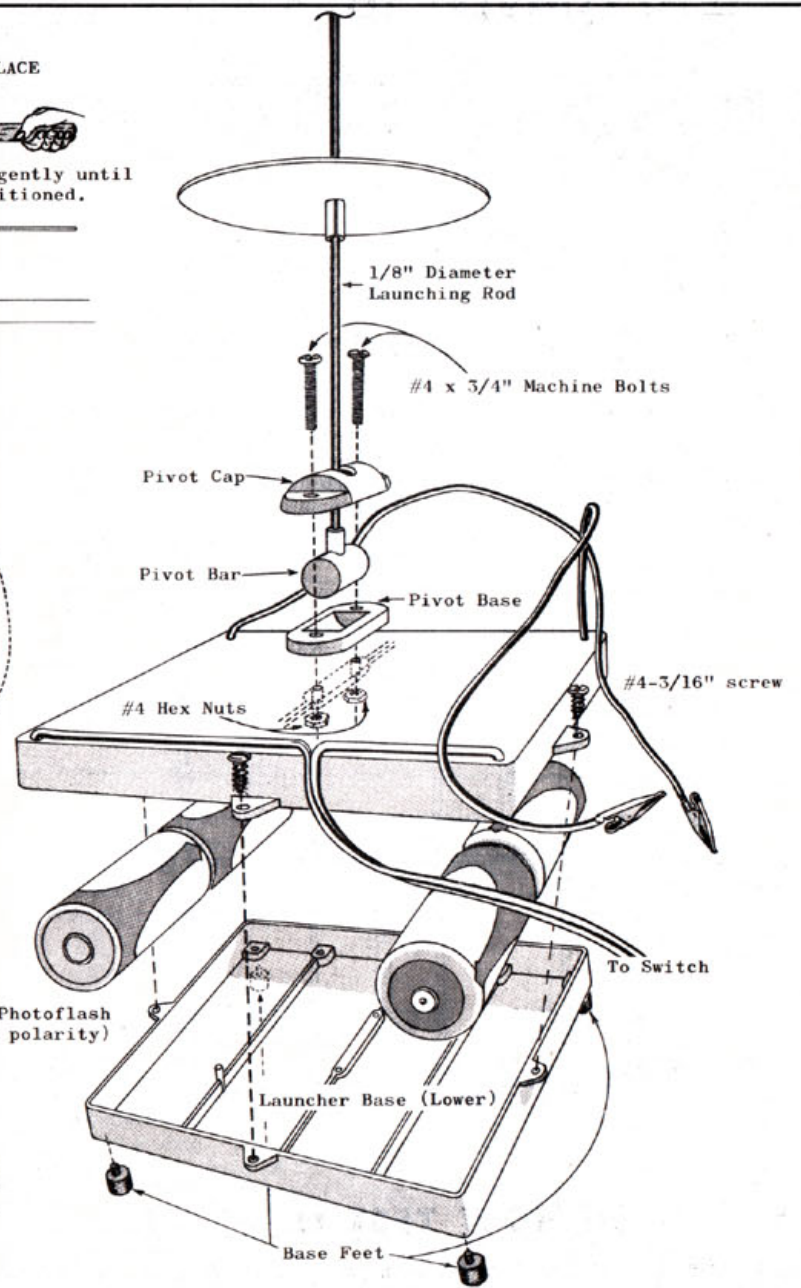


Fig. 2

With wiring in place as pictured, slip the switch button into place and position the upper contact strip, securing with #4-3/16" screws as shown.

Install the pilot lamp (see text) and carefully put the upper and lower cases together and secure with the two #4-1/2" screws installed through the countersunk holes found on the underside of the lower case.



Use size D Photoflash Cells (note polarity)

TO CONVERT TO 12 VOLTS

When the Electro-Launch is used by a club for launching the entire group's rockets it is sometimes desirable to use 12 volts in the electrical system to prolong battery life and give extra-positive ignition for an extended period. Since batteries produce less power when they are cold, a twelve-volt system is also recommended for use at temperatures below 40° F.

Your Electro-Launch has been designed for quick and easy conversion to 12 volt operation. Here's how to do it:

- 1) Open the launcher base. Remove the jumper wire that connects the two rear battery contact springs. Retighten all screws.
- 2) Replace the 6 volt pilot bulb with a 12 volt pilot bulb (#AL-12 or G. E. type 53).
- 3) Mount eight size D photoflash batteries in the base so the center positive terminals on the two batteries in the far left compartment face forward, the positive terminals on the two batteries in the left center compartment face rearward, the positive terminals on the batteries in the right center compartment face forward and the terminals on the batteries in the far right compartment face rearward. Check the illustration to see how this is done. Close the launcher base and the conversion is complete.

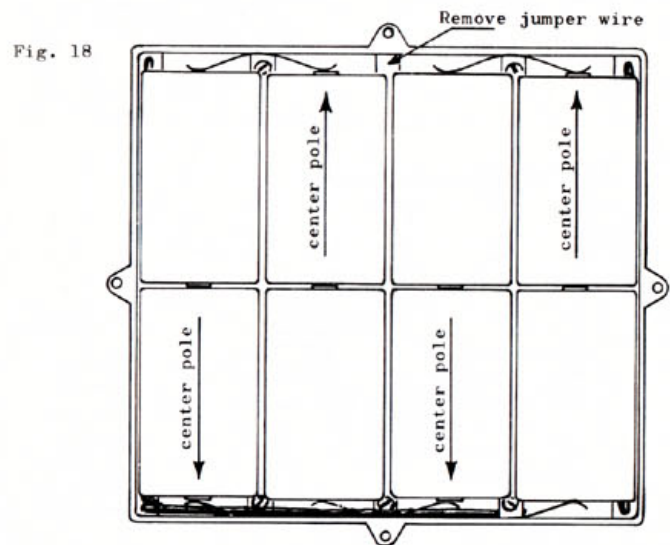


Fig. 18

NOW TEST IT

Connect the two micro-clips to the nichrome wire so there is about two inches of the wire between the clips. (Do not hold the nichrome in your hand when the second clip is being connected.) Insert the safety interlock key into its hole. The pilot light should glow. Press the launch button. The nichrome wire should heat and glow red hot and the pilot light should go out. If the system does not function correctly, check the following list of problems and their causes to find the cure:

PROBLEM	CAUSE	CURE
Pilot light does not glow, nichrome does not heat.	Bad connections in the wiring, batteries dead or not installed correctly, micro-clips dirty, leads broken, safety interlock not making contact.	Check all connections, check batteries in a flashlight, check battery position, clean clips and touch them together to see if pilot lights, insert key in hole completely.
Pilot light glows, but nichrome does not heat.	Launch switch does not make contact, weak batteries or poor battery connections.	Check switch wiring, check battery strength, check battery contact springs.
Nichrome heats, but the pilot light does not glow	Pilot light not installed correctly, light burned out.	Clean contact surfaces on bulb and socket, replace pilot bulb.
Nichrome heats as soon as clips are connected to it, even with safety interlock out.	Short circuit in switch, incorrect wiring in base of launcher.	Rewire switch carefully, rewire launcher base--following instructions.
Nichrome heats when the key is inserted without pressing launch button.	Switch contact strips bent, loose wire pieces in switch box.	Straighten switch contact strips, clean out inside of box.
Lamp glows when key is not in place	Short circuit across interlock contacts.	Bend contacts so a connection can be made only by the interlock key.

If the correct batteries (size D photoflash) are used in the Electro-Launch and it has been wired correctly, it will function correctly from the first. The above chart will be useful, however, in tracing down any problems which may arise later. With proper care, your Electro-Launch will give you perfect service for countless flights.

PREPARING FOR LAUNCHING

IGNITION: Model rockets should be launched by electrical systems only. Electrical igniters are supplied with all engines sold by Estes Industries. These igniters consist of a nichrome wire with an extra high resistance section in the middle. Surrounding this high resistance area and extending out slightly along the leads of the igniter is a plastic coating which serves as electrical insulation to prevent the igniter from touching itself and short circuiting. In addition, the coating will burn when it is heated to 1100° F. The igniter is installed in the model rocket engine so its coating touches the end of the propellant grain. When an electrical current of 2 amperes or more passes through the igniter the high resistance area heats to 1100°, igniting the coating which in turn ignites the engine immediately.

INSTALLING THE IGNITER: Estes igniters are supplied in strips of three. Cut the igniters apart (scissors will work) midway between the coated sections. Bend the igniter at the middle as shown in figure 19 and push it into the engine as far as it will go. To operate properly the igniter must touch the

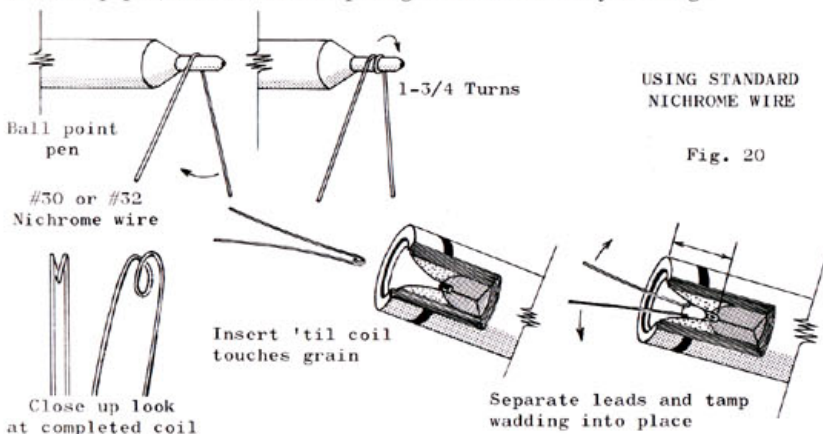
propellant grain. Wad up a 1" square of kleenex and place it into the nozzle between the igniter leads. Be sure the igniter leads do not cross or touch each other. Tamp the wad into the nozzle with a pen or pencil to hold it and the igniter firmly in place.

TWO EASY STEPS TO INSTALL ESTES IGNITERS



An alternate form of igniter may be made from a 2-3/8" length of #30 or #32 nichrome wire. Form the wire into a small coil with two leads as shown. This can be done most easily by winding it 1-3/4 times at the middle around a small rod or form such as the point of a ball point pen.

Once the igniter has been shaped correctly it is inserted into the nozzle of the rocket engine. In a standard engine the coil will go in approximately 6/10" from the rear of the engine casing. The end of the coil must touch the propellant grain ahead of the nozzle. Separate the leads on the igniter so that they come out on opposite sides of the nozzle and do not cross over each other. Secure the igniter in place by tamping a small wad of soft paper (facial tissue or toilet paper) into the nozzle opening as in the cut-away drawing.



After installing the igniter, secure the rocket engine in the rocket body. The method of securing the engine varies with different models, but it is important to make sure that the engine is held in place securely on all rockets which use parachute or streamer recovery. Prepare the model's recovery system according to the instructions in its plans.

Slide the rocket's launching lug over the end of the launching rod and lower the rocket down onto the blast deflector plate. Be sure the rocket slides freely on the rod. Check to be sure the safety interlock key is out of the panel before attempting to attach the micro-clips to the igniter. Connect the clips to the igniter leads as far up into the nozzle as possible without having the clips or the igniter leads touch each other. If the clips are attached too far out on the igniter leads the nichrome will heat slowly and may not get hot enough to ignite the engine. Make sure that the rocket is free to move upward without catching on any part of the electrical system.

If the rocket rests too low on the launcher so that it is difficult to attach the micro-clips properly, it may be raised slightly. The most common ways of doing this are by slipping a 2 inch piece of soda straw down the rod ahead of the rocket to hold it up or by placing a clothes pin on the rod about two inches above the blast deflector.

After connecting the igniter step back and insert the safety interlock key into the panel. If the pilot light glows the connection to the igniter is good and the rocket is ready to launch. If the light does not glow, remove the key and check the micro-clips to be sure they are clean and attached securely to the igniter. If the bulb still will not light, check the batteries and wiring.

ALWAYS . . .

REMOVE THE SAFETY KEY FROM THE PANEL
BEFORE CONNECTING THE MICRO-CLIPS!

NOTE: The information given below mentions ELECTRO-LAUNCH where ever reference is made to firing systems. However, the same basic principles apply to other systems be they home designed or commercial units.

LAUNCHING THE ROCKET

When launching rockets with the Electro-Launch always follow standard safety rules and precautions. For greater realism and safety, a countdown should always be given when firing a rocket. After the micro-clips have been connected to the igniter and everyone is back at least ten feet away from the launcher, insert the safety interlock and begin the count: "Panel is armed, time is running at T minus 5--4--3--2--1--Launch!" Depress the switch button at "launch" and hold it down until the engine ignites. If the batteries are fresh ignition will be almost instantaneous. As the batteries get weak there will be a slight delay between the time the switch is depressed and the engine ignites (cold batteries will also cause a delay).

After each launching check the contact surfaces of the micro-clips to be sure they are clean. If they are dirty the deposit layer may be removed with a fingernail file, emery board, knife blade or piece of sandpaper. Do not bend the contacts on the clips, as they will not grip the nichrome properly if they are. Bent contacts may be straightened with a pair of needle nose pliers.

CAUTION: The Electro-Launch is designed for launching only lightweight, cardboard and balsa model rockets. The length of the lead wires is not sufficient to safely launch rockets or rocket engines which make use of substantial metal parts.

The Electro-Launch may be used "as is" for launching model rockets that weigh up to 6 oz. For heavier models the base should either be weighted down with a pair of bricks or bolted to a two foot square piece of plywood. In addition, for rockets weighing over 9 ounces the two pieces of the launching rod should be soldered together or replaced with a 48" length of 1/8" piano wire. Under no circumstances should rockets weighing over one pound be launched.

NOTE: To prolong battery life always remove the interlock key during any delay in the countdown; if the pilot light is left on for too long a time it will drain the batteries. When the Electro-Launch system is functioning properly it will ignite an engine within one second from the time the launch switch is depressed. If it is necessary to hold the button down for more than two seconds to ignite the engine, remove the key, check igniter installation, micro-clip connections and the batteries themselves to find the cause of the problem. Repeated heavy drains on the batteries should be avoided.

ROCKET STABILITY

The Electro-Launch is "safe" only for launching well designed rockets. A rocket which is not stable is unsafe. For a rocket to be stable it must be built with fins large enough and far enough back on the body to keep it pointed straight ahead at all times similar to an arrow. The principles of rocket stability are explained in detail in Estes Industries' Technical Report TR-1. All rockets should be checked for stability before flying, and rockets which are of questionable stability or are unstable should not be flown.

Sometimes, however, an experimental "test" rocket of a radical design must be flight tested to determine its stability characteristics. In this case extra safety precautions must be taken. All spectators should be kept at least 100 feet away from the launcher and a five foot high barricade should be provided between the launcher and the firing officer. One simple way of making such a barricade is to park a car in a suitable isolated location. Then set up the launcher on one side of the car and run the lead wires under the car. Set the launcher as far away from the car as possible. When launching the "test" rocket crouch behind the car away from the launcher. If the rocket is not stable or is erratic in flight the barricade will provide a considerable measure of protection.

Even with the barricade, however, unstable rockets will present a certain amount of hazard. Flights of rockets which are known to be unstable must be avoided under all circumstances. Test carefully before flying.

CONTESTS

For extra enjoyment with your Electro-Launch, try a spot landing contest. Set up a flag or marker a short distance from the launcher and see who can land his model closest to the spot. Let each contestant aim the launcher for himself, adjusting the rod to bring the model back "on target." Follow the rules of not launching more than 25° from the vertical and having the rocket deploy its recovery system at an altitude of 50 feet or more--you'll be surprised at how much skill it takes to land your bird close-in.

With two Electro-Launches you can hold drag races. Place the launchers near each other. The two contestants then prepare their own rockets, set them up on the launchers and pick up the control panels. The judge gives the countdown, and at "Launch" each rocketeer hits his button. Give one point for the first rocket off the pad, one point for the rocket reaching the highest altitude and one point for the rocket that stays up the longest. The rocketeer with the most points wins the race.

Parachute and boost-glide duration contests are also lots of fun--and useful. Simply time each rocket from lift-off to touch-down with the sweep second hand of a watch or with a stop watch. The rocket that stays in the air the longest wins. By seeing how different models perform you can get lots of ideas for improving your own birds--and come up with a winning record.

HOW IT WORKS

When electricity flows through a normal conductor it always produces heat. The problem in rocket launching is to develop enough heat in one specific conductor--the igniter--to bring the part of the propellant grain that it touches to a temperature of 550° F.

In any electrical circuit there are three factors which affect the flow of electricity. These are electromotive force, current and resistance. Electromotive force, which is the potential work to be done by the electricity, is

measured in volts. Current, which is the rate of flow of the electricity, is measured in amperes. Resistance, which is present in all normal conductors, is an obstruction to electric flow which requires the electricity to work to get through it. This is measured in ohms.

Ohm's law states that the current in any electric circuit is equal to the voltage divided by the resistance:

$$I = \frac{E}{R}$$

where: E = electromotive force in volts
R = resistance in ohms

Thus if we have a source of electromotive force of six volts acting through a resistance of 1-1/2 ohms, the current in the circuit will be 4 amperes.

A typical size D photoflash battery will produce 1.5 volts and approximately 12 amperes when a heavy copper wire is connected between its terminals. (This should be avoided as it can discharge the battery very rapidly.) The internal resistance of the battery is found to be 0.125 ohms by the formula above. The lead wire used in the Electro-Launch has a measured resistance of 0.16 ohms and two inches of #32 nichrome wire (the typical length of an igniter) will have a resistance of 1.32 ohms.

Adding all the resistances in the circuit together we find that the entire system has a resistance of 1.98 ohms. Following Ohm's Law we then divide 6 volts by 1.98 to determine the amount of current which will flow through the circuit--3.03 amperes.

Experiments have shown that a current of about 2.5 amperes is necessary to heat the nichrome enough for reliable ignition. Thus the Electro-Launch will have sufficient power to ignite the engine when the launch button is depressed. (With fresh batteries the internal resistance of the individual cells is about 0.1 ohm, resulting in more current through the circuit.)

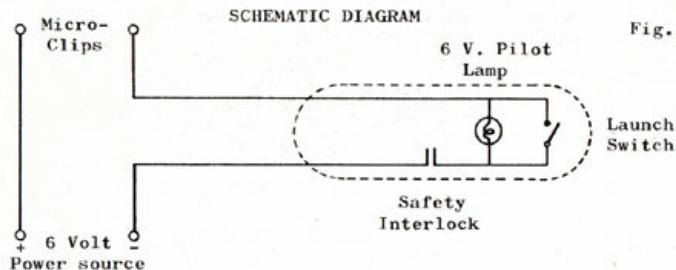


Fig. 21

From the circuit diagram it can be seen that when the safety interlock key is inserted the electricity will flow through both the igniter and the pilot lamp. This is known as a "series" circuit. The resistance of the bulb used is 30 ohms. To determine how much current is flowing in the circuit we again add all the resistances to obtain a total of 31.98 ohms. By dividing 6 volts by 31.98 ohms we find that the current flowing is 0.1875 amperes--not nearly enough to ignite the engine.

Obviously, then, since any increase in resistance will cause a decrease in current, we need to keep the resistance of the circuit as low as possible to obtain faster, more reliable ignition. If the micro-clips are dirty they will present an extra resistance at the contacts, slowing or preventing ignition completely. But if we shorten the amount of nichrome between the clips we also decrease the resistance, giving us more current and faster ignition.

What happens when we convert the system to 12 volts? Although we add 0.5 ohms resistance (the sum of the internal resistances of the four batteries), our total is still only 2.48 ohms. Dividing 12 volts by 2.48 ohms we find that the current is increased to 4.84 amperes, resulting in extra-fast ignition. These same principles can be applied to evaluating the effects of other voltages and different lengths of nichrome.

