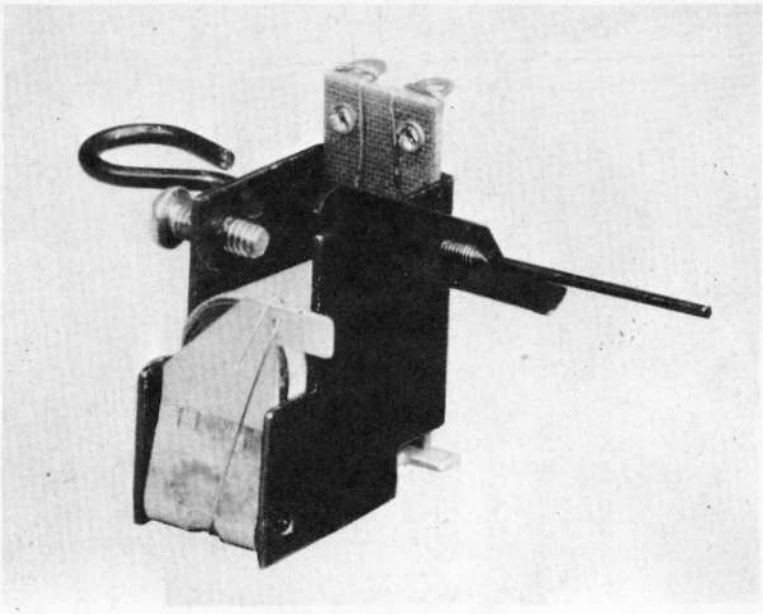
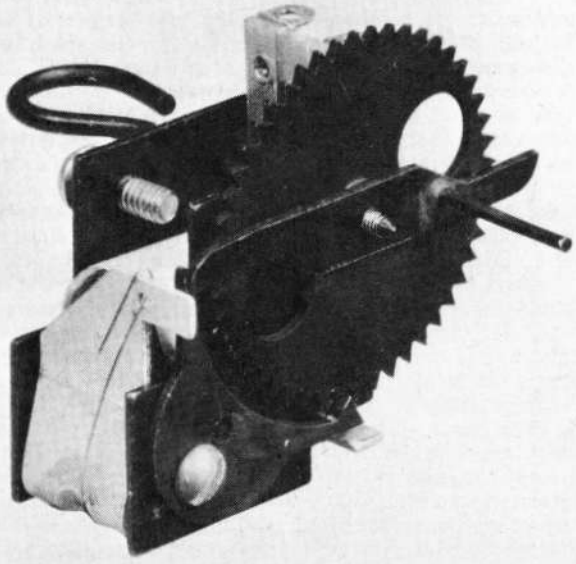


Improving Escapement Reliability and Performance

RX for Escapements

By H. G. Cooper



For Sale: One single channel escapement. $100.

Chances are, you wouldn't beat a path to the door of this advertiser, but this is what a faulty escapement could conceivably cost in plane and equipment loss if the escapement "hangs-up" in the air.

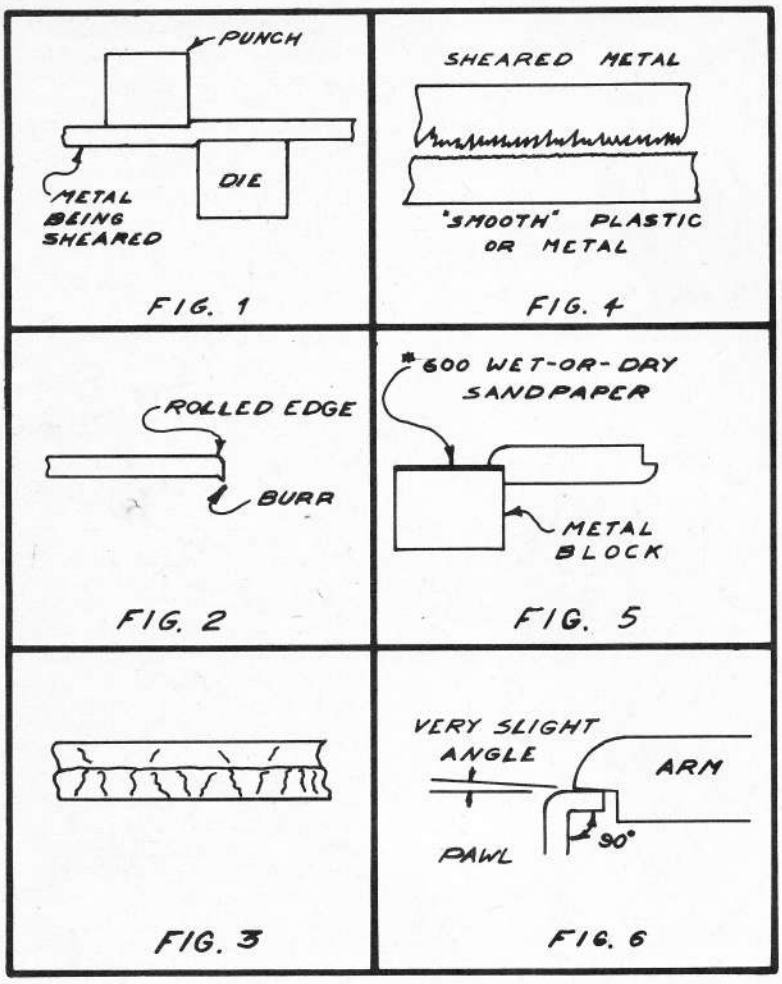
Rubber powered escapements have been the principal actuator for rudder-only flying for many years, and due to the lack of reliable single channel servos, will probably continue in this prominence. It is true that intermittent escapement operation has caused numerous difficulties, but it is similarly true that they have been blamed for more than their share of mishaps.

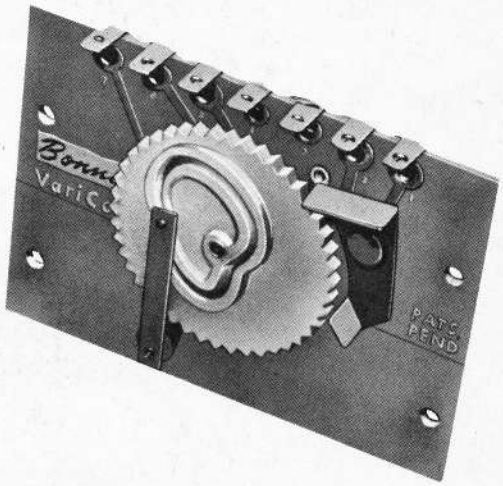
We are getting the best dollar value for our limited budgets in the many fine escapements on the market today. There is no such thing as a "bad" escapement----they all work just as you get them from your hobby dealer. But, we can't expect a manufacturer to deliver $20 - $30 worth of merchandise for the $5.95 to $12.95 prices we pay at the hobby shop counter or mail order house. But---with a little bench work we can increase the performance so that we can obtain complete reliability with each flight.

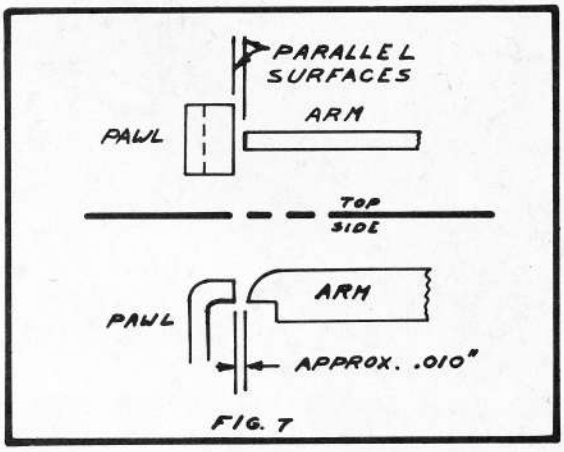
Let's look at the various types of escapements and see what makes them tick. The escapement is an electro-mechanical device which is powered by the torque (twist) of a loop of rubber. A pawl or clapper is pulled against the pole piece of an electro-magnet when direct current energy is applied to the winding of the magnet. This allows the actuating arm, which is connected directly to the rubber band, to swing from a neutral stop on the pawl to an actuate stop. The arm will stay on the actuate stop as long as energy is applied to the coil. When this flow of energy is removed, a spring pulls the pawl back against a stop and allows the arm to proceed to the next neutral position.

When there are two neutral stops and two actuate stops (actuate in one direction, neutral, actuate in the other direction, second neutral), the escapement is called an SN type, regardless of the number of claws on the arm (2 or 4), or the number of claws on the pawl or clapper.

Other escapements of the compound type have up to four claws on the arm for actuate positions and another claw for neutral position. The pawl has one claw for actuate stops against the actuate claws of the arm, and one claw to stop the neutral claw of the arm. The actuate claws of the arm must always pass the neutral claw of the pawl as the arm rotates from neutral clear around to the next (and only) neutral. Since compound escapements give many controls in sequence before returning to neutral, it is necessary to slow down the speed of rotation so that the pilot can apply the proper number of pulses to get the desired control, such as 1= Right; 2 = Left; 3 = Up; 4=Down, etc. varying in pulse-response according to







By following these simple steps you can eliminate escapement failure

various escapements. The slow-down device is a star-wheel attached to the arm or driven by a gear attached to the arm. The action of a rocker arm against the star wheel acts as a governor. The faster the escapement tries to rotate, the more resistance the star wheel offers to this rotation. Naturally, the star wheel robs the rubber motor of some of its power, but this is negligible, assuming that all other parts of the system are "go."

In the manufacture of escapements there are two main processes employed in nearly all of the units on the market today. The first process is shearing of the metal (or punching) for the frames, pawls, arms, etc. As you can see (Fig. 1), the action of punching or shearing is similar to the downward action of scissors shearing a piece of paper, except there is no slicing action, since the punch moves straight into the die. Since the cutting edges of the punch and die can never remain perfectly sharp and aligned, we find that one side of a sheared piece of metal is rolled and the other side is hooked into a sharp burr (Fig. 2). Most manufacturers remove this burr by tumbling the pieces in a barrel filled with abrasive material.

If the imperfectly matched punch and dies move further toward each other, as in Fig. 1, they will proceed to tear the metal apart, which in addition to the hook-like burr, will leave a surface along the shear line which will look like Fig. 3. This sheared roughness, which cannot be removed by high-production manufacturing techniques, is the heart of our "hung escapement" problem. In all of the escapements examined in the preparation of this article, either the pawl or the arm (or both) was fabricated of sheared metal, and the sheared surface was in contact with a plastic or smooth metal surface, or another sheared surface as in Fig. 4.

Close examination under a magnifying glass or jeweler's loup will show that the sheared metal is like a crude file, and that it is trying to cut away the material with which it is in contact. This filing action is mechanical resistance or friction, which prevents the adjacent parts from sliding smoothly over each other. To make your escapements perform with the precision of a fine watch will require some small reworking chores. Any sheared edge in contact with any other working part must be polished. Fig. 5 shows the polishing process. Remove some of the "sharpness" from #600 wet-or-dry sandpaper by rubbing one sheet against the other. Place the paper on a smooth metal block and gently move the sheared surface back and forth over the paper until the shear lines are removed and the metal takes on a polished lustre. You must be extremely careful to keep your polishing operation parallel to the original shear line, although a very slight angle, as shown in Fig. 6 is permissable.

Check the swing clearance and parallelism (Fig. 7) and true them up by filing the end of the arm with a fine needle file. With compound escapements it may be necessary to rework the star wheel as well as the previously described polishing operations on the pawl. Some escapements with plastic star wheels, especially those manufactured several years ago, havy tiny burrs at the edges that might hang up with the rocker arm. These burrs are easily removed with a sharp X-Acto blade. Other compounds that use a gear drive to the star wheel do not seem to have star wheel "hang-up" problems.

Some escapements with extra light springs tend to hold the pawl against the electro-magnetic pole piece in spite of the springs' efforts to return the pawl to neutral position. This condition is due to residual magnetism within the magnet. It can often be cured by placing a thin piece of cellophane tape on the end of the pole piece between it and the pawl. Since this tape will slightly reduce the throw of the pawl,

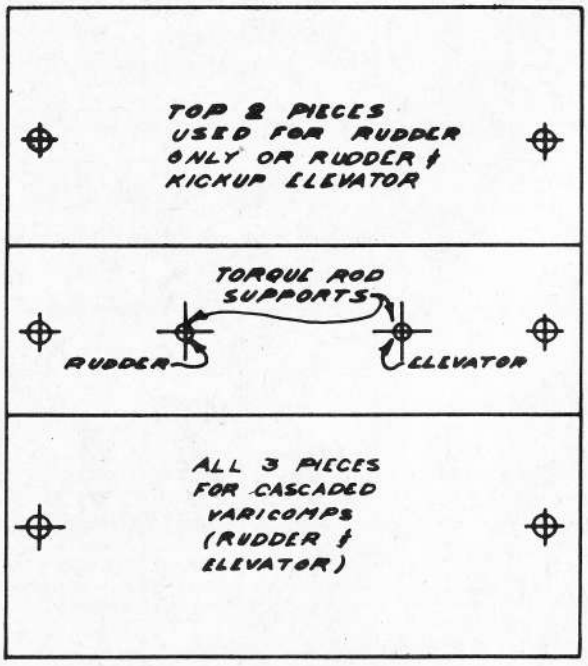
(Continued on page 29)

RCM TECH DATA NO. 1

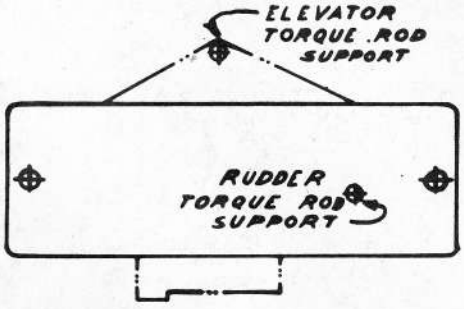
ESCAPEMENTS

SEE REVERSE SIDE FOR MOUNTING LAYOUT

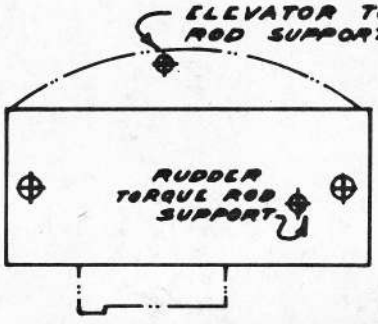
Name and Manufacturer	Price	Function	Voltage	Resistance	Output	Weight	Special Features
SE-2 Citizenship	$8.95	Compound R-L	3V	9 Ohm	Torsion	1/2 Oz.	Very small
Varicomp Bonner Specialties	8.95	Compopnd R-L Quick Blip	3V-4.5V	8 Ohm	Torsion	1 Oz.	Two Varicomps can be cascaded for elevator action
RE Varicomp Bonner Specialties	9.95	Compopnd R-L-U Quick Blip	3V-4.5V	8 Ohm	Torsion	1 Oz.	Kick Elevator on 3rd Position
Mark V Babcock Models	9.49	Compound L-R-U-D Quick Blip	3V	7.5 Ohm	Torsion	1 Oz.	
Mark II Babcock Models	8.49	Compound L-R-U Quick Blip	3V	7.5 Ohm	Torsion	1 Oz.	Kick Elevator on 3rd Position
Translator Ecktronics	9.95	Compound R-L-U Quick Blip	3V	7.5 Ohm	Torsion	1 Oz.	Relayless Quick Blip Kick Elevator on 3rd Position
SN Bonner Specialties	5.95	2 Position Motor Control	3V	8.5 Ohm	Torsion or Push-Pull	1/2 Oz.	
Enginac Ecktronics	5.95	3 Position Motor Control	3V	7.5 Ohm	Torsion or Push-Pull	1/2 Oz.	3 or 2 Position Motor Control
Motor Minder Babcock	4.95	2 Position Motor Control	2V-3V	7.5 Ohm	Torsion or Push-Pull	3/4 Oz.	2 Position Motor Control



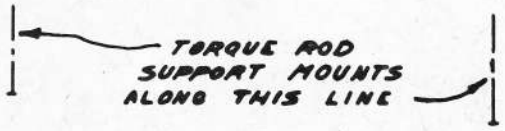
BONNER VARICOMP

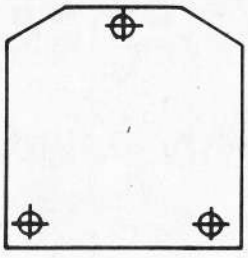


BABCOCK MK. II & MK. V

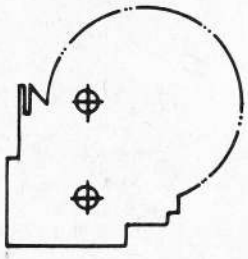


ECTRONICS TRANSLATOR

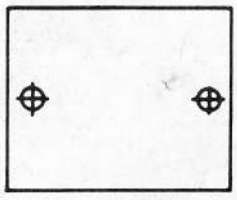




BONNER SN



CITIZENSHIP SE-2



ECKTRONICS ENGINAC

BIII

(Continued from page 17)

be sure to check the swing clearance again. If the tape doesn't do the trick, increase the spring tension very slightly, checking the operation after each change.

If you are one of those RC'ers that installs his escapements permanently, you might find that a test fixture to bench check your unit before installation is a good investment in time and material. After you have reworked your escapement, try it with 1/8" and 1/4" rubber on the bench fixture with radio and batteries. With 1/8" rubber the escapement should operate every time, even to the point where the rubber is almost completely unwound. With 1/4" rubber, the escapement should operate just as reliably. Each movement should be crisp and solid with no skipping and no hesitancy as the pawl slides away from the arm. Escapement pull-in and drop- out can be checked out by using an appropriate potentiometer in the bench test unit. If skipping occurs with the heavier rubber, gently bend the offending claw inward toward the arm. Recheck parallelism and clearance, and recheck on the test fixture.

Now that your escapement is operating reliably, be sure to check the rest of your system for those cold solder joints, binding linkages, and stiff hinges. Your escapement is now the strongest link in the chain-----be sure the other links are just as strong.