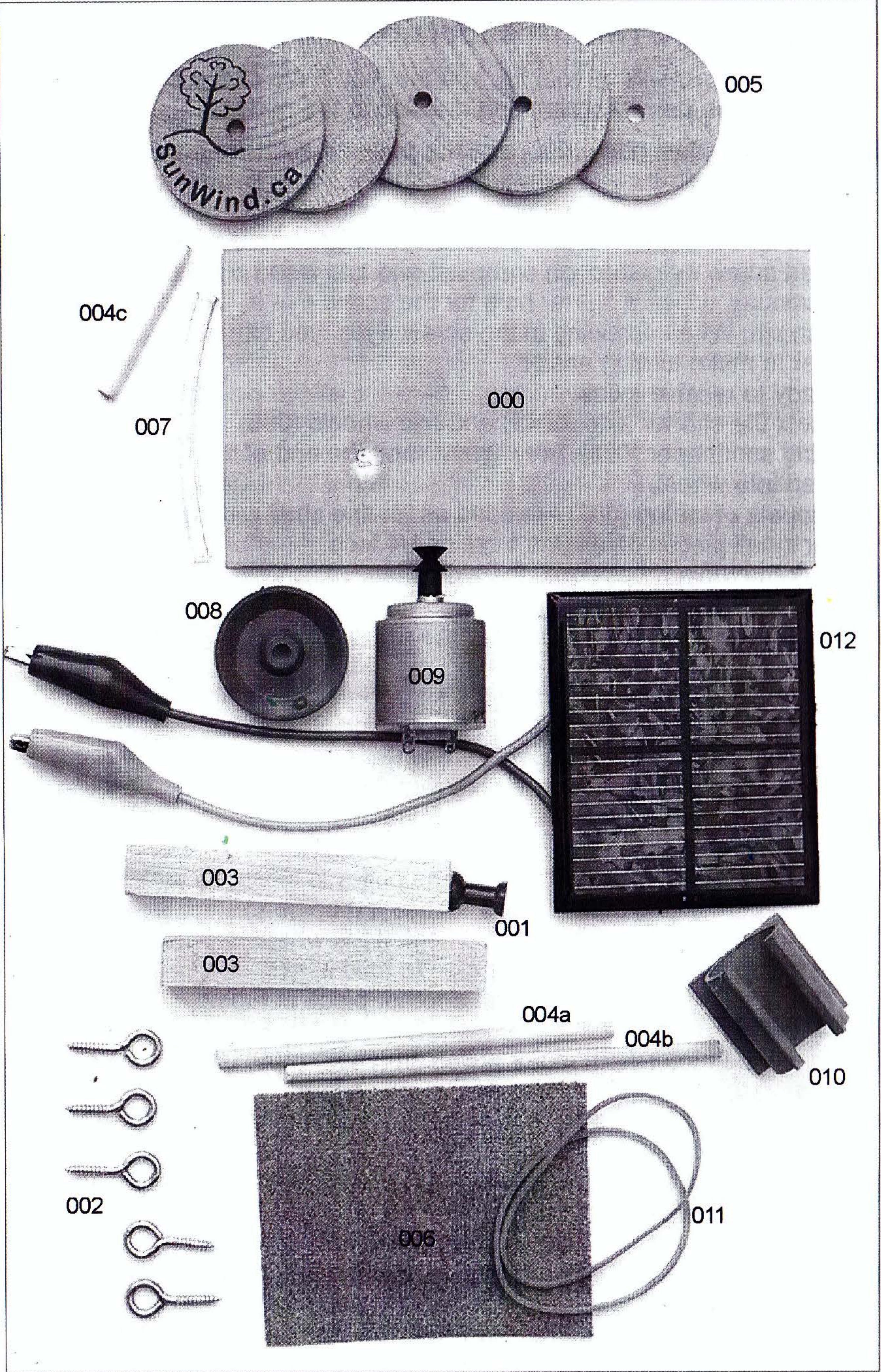
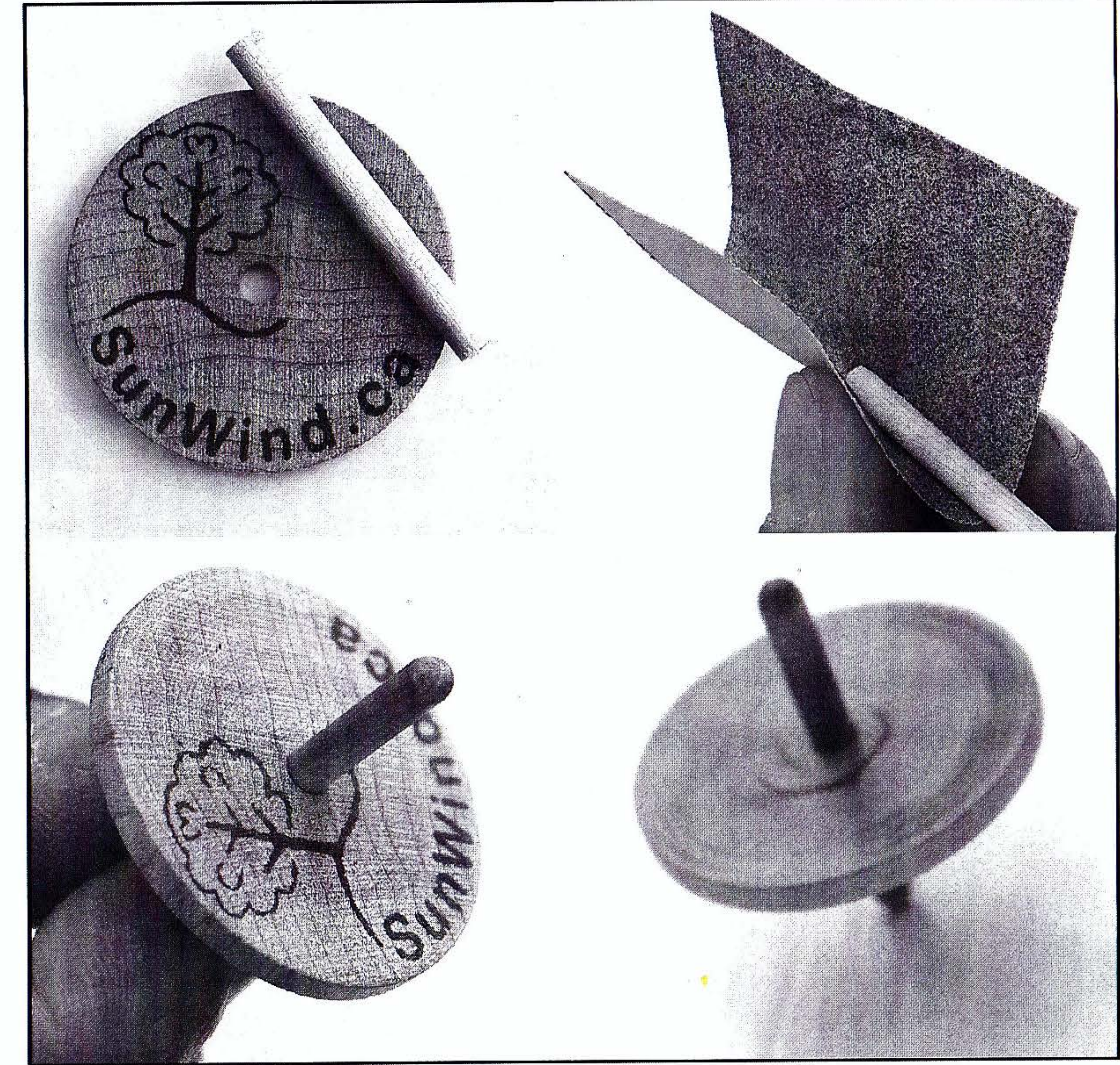


SUNNYSIDE UP PARTS LIST

- 000 - Coroplast frame - to hold the solar panel, motor and axles
(can be any recycled item, or wood, or other toy perhaps)
- 001 - Push pin - for marking holes, and creating starter holes in wood
- 002 - Screw eyes (5) - to hold axle/shafts
- 003 - Wood block (2) - to firmly hold screw eyes
- 004a - Shorter axle shaft - holds two wheels
- 004b - Longer axle shaft - holds driven pulley as well as two wheels
- 004c - Tweazle stick (see The Making of a Tweazle)
- 005 - Wooden wheels (5 - one spare) - to transfer energy from driven axle to ground (which reacts by pushing car forward)
- 006 - Sandpaper - to sand dowels (and wood blocks if you want)
- 007 - Tubing - to be cut into four 1 cm or 1/4 inch pieces as in-line shaft retainers
- 008 - Pulley - driven pulley transfers force from drive-belt to axle.
- 009 - Motor - converts electrical energy into mechanical energy (spinning shaft with motor pulley)
- 010 - Motor mounting clip - to hold motor firmly to body.
- 011 - Elastic bands (2 - one spare) - drive belt to transfer energy from motor pulley to driven pulley
- 012 - Solar panel with alligator clip test leads - to produce electricity from sunlight

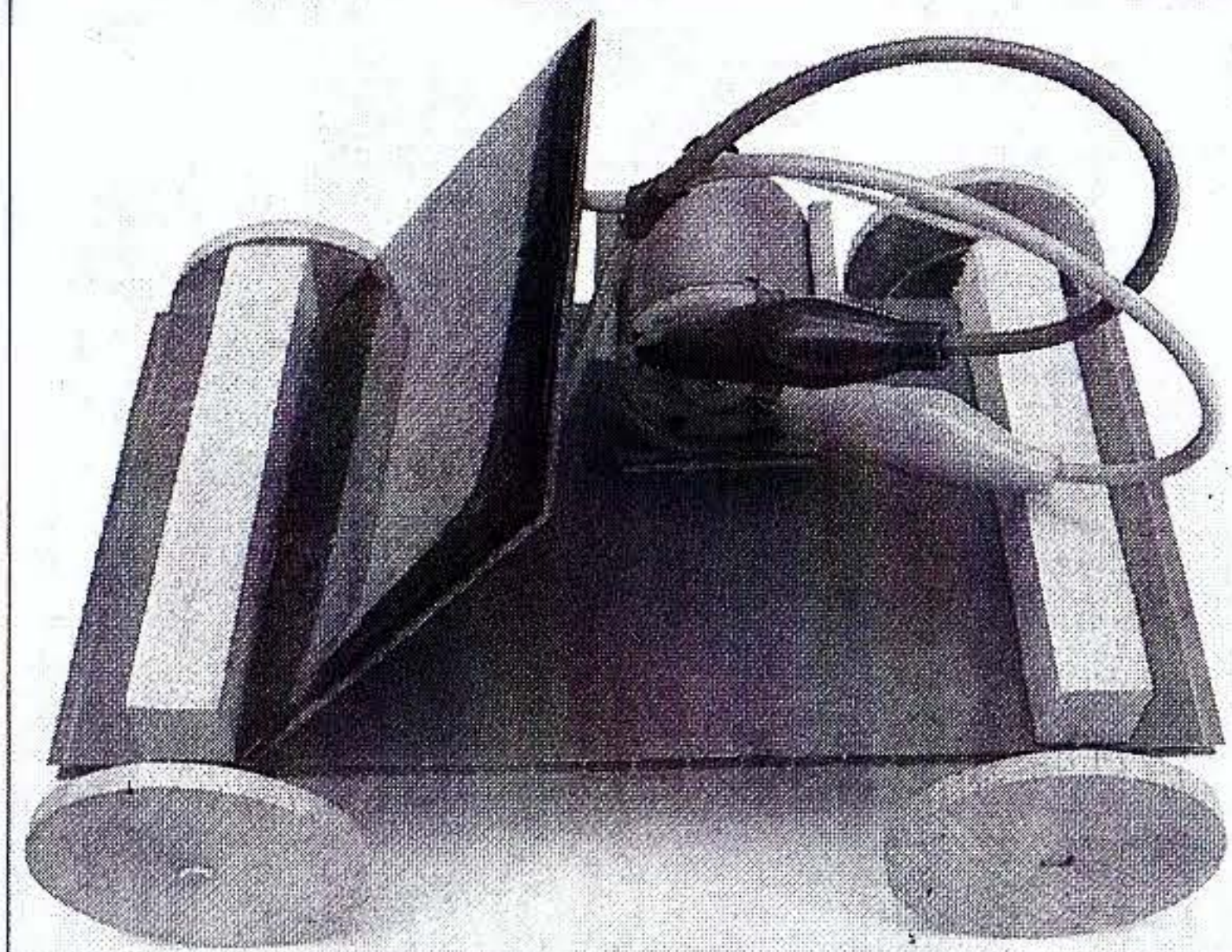
The Making of a Tweazle
Educational artifact for studying spin



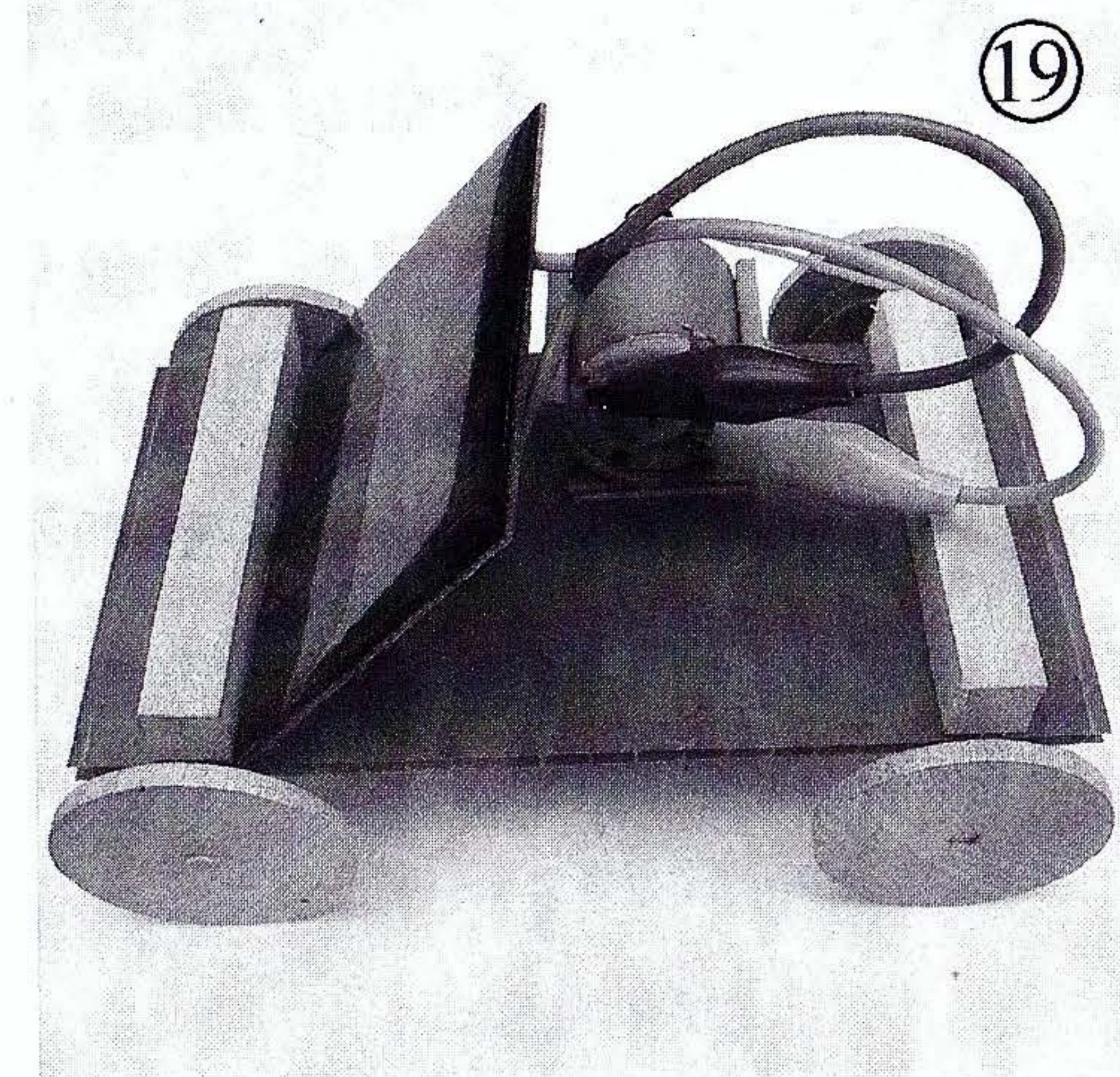
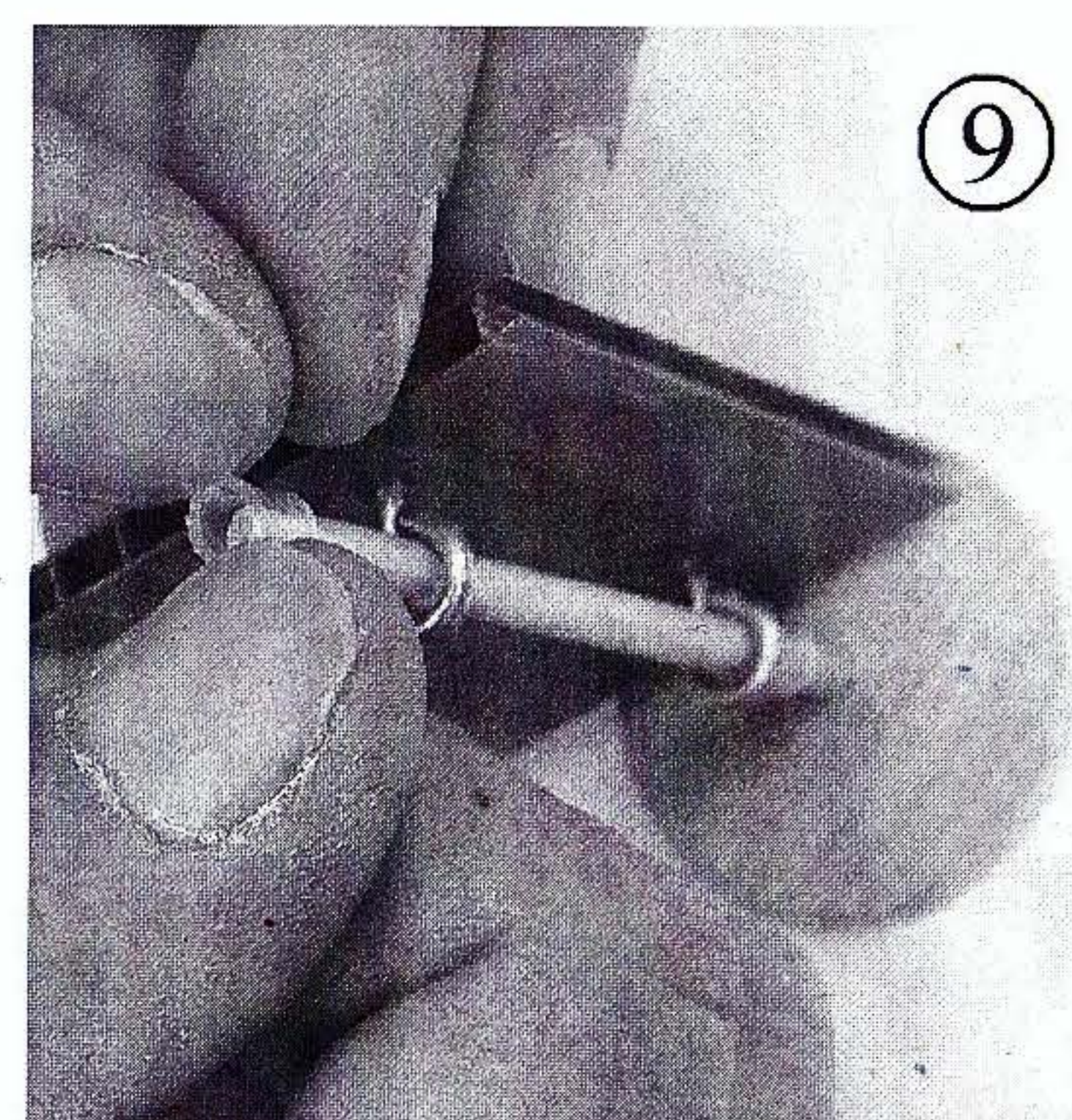
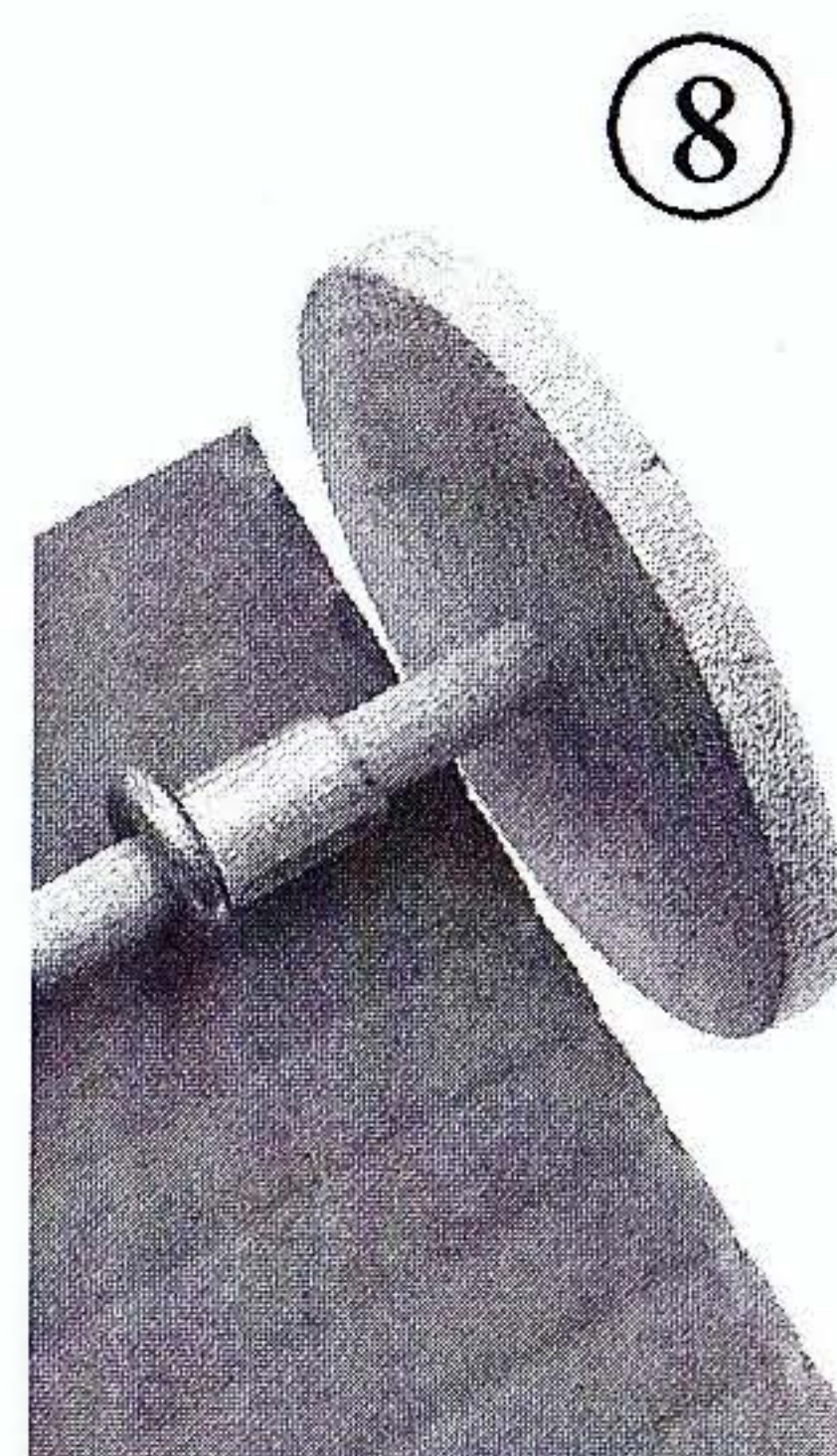
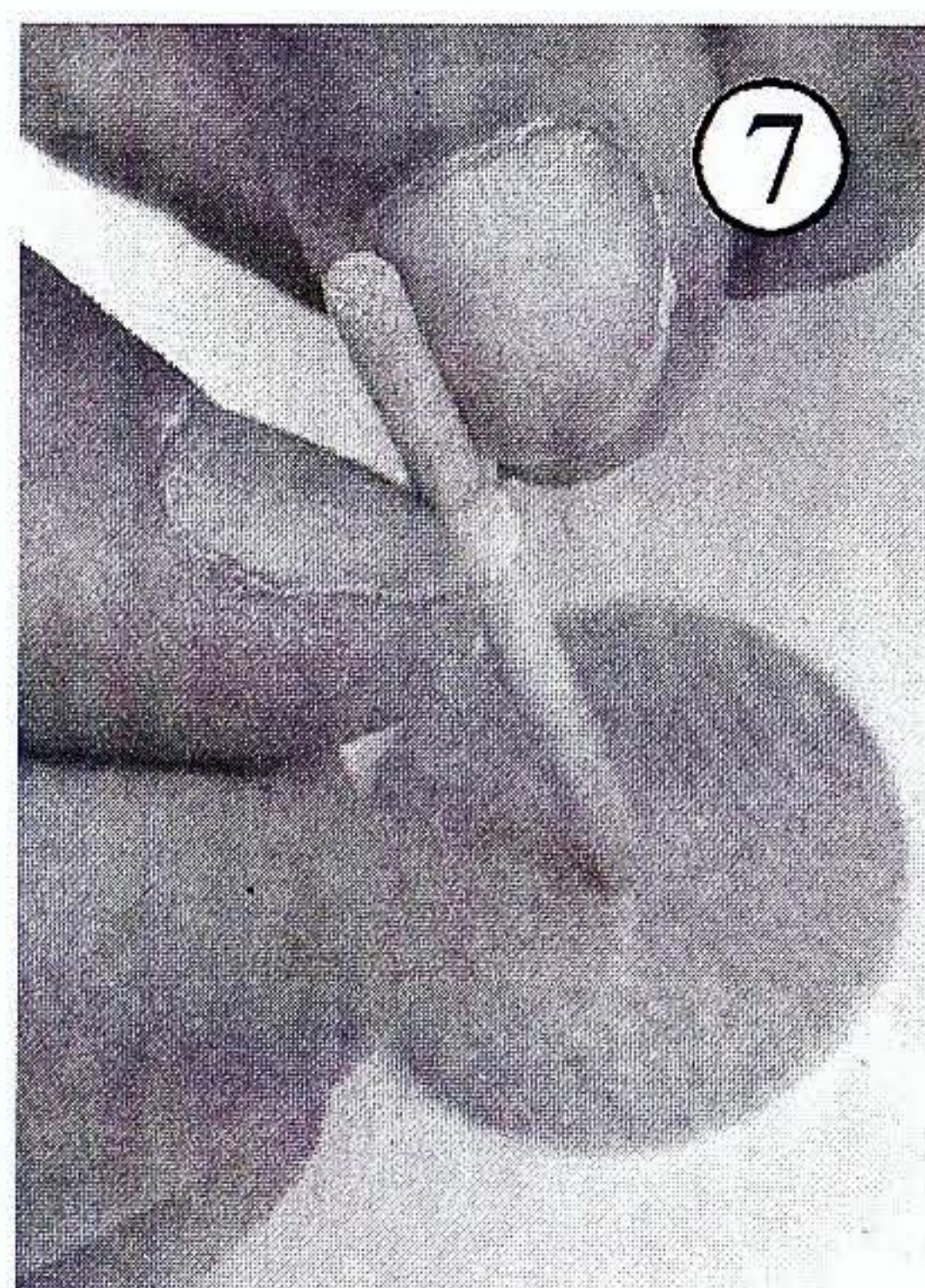
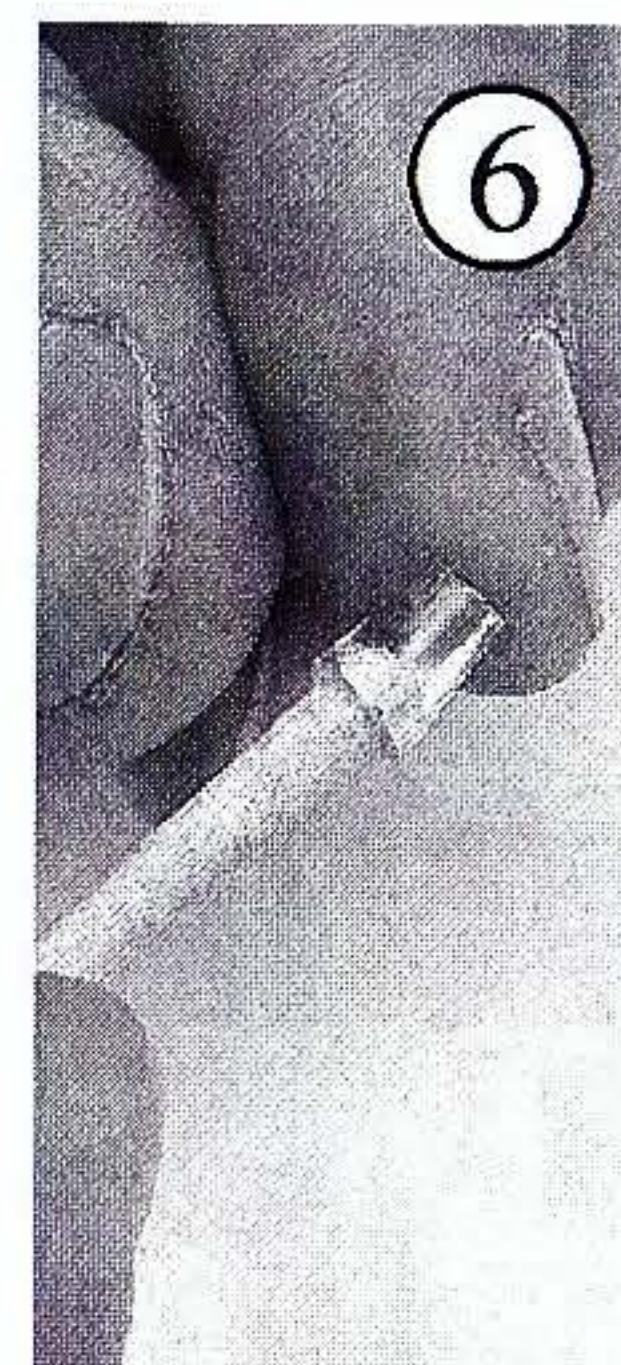
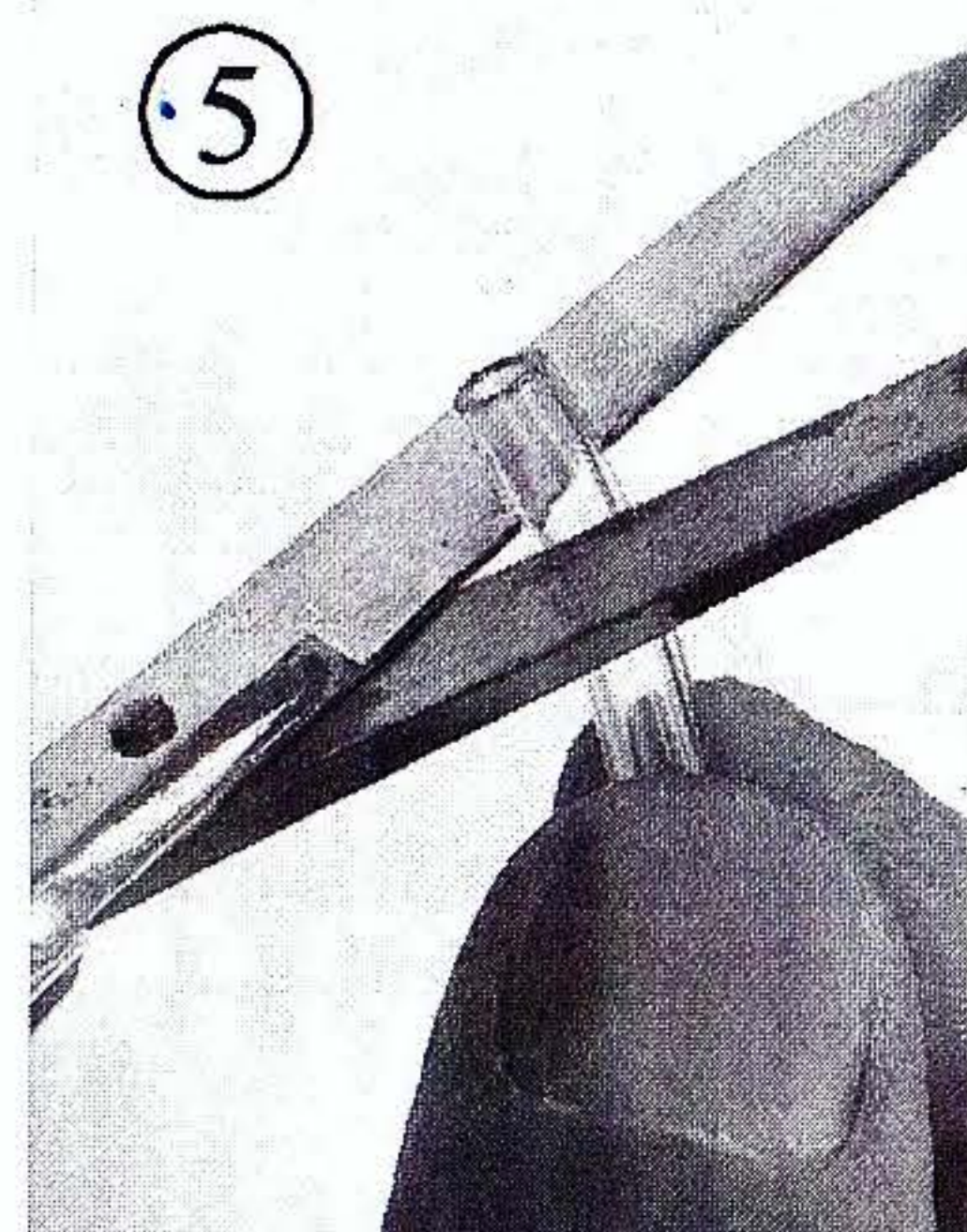
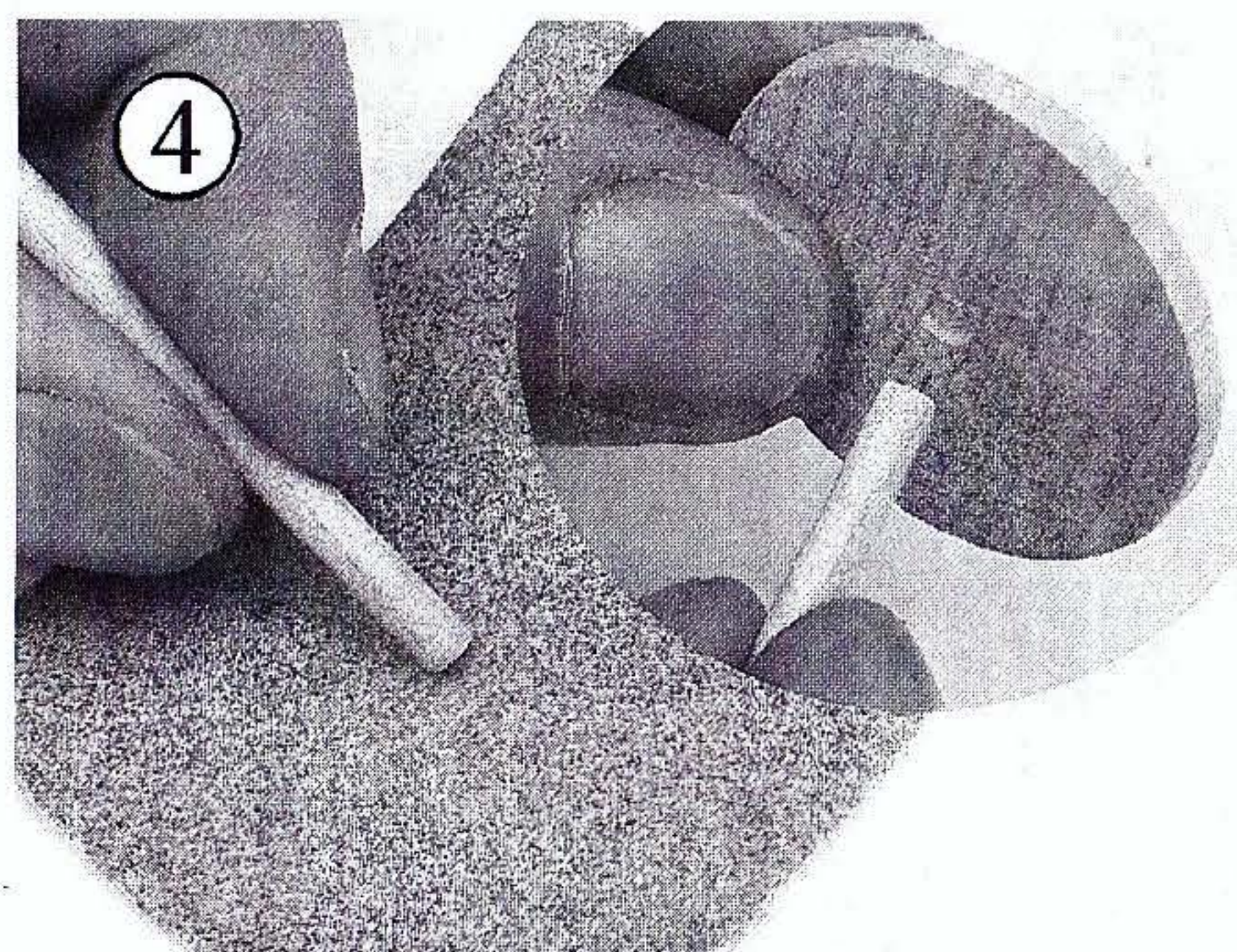
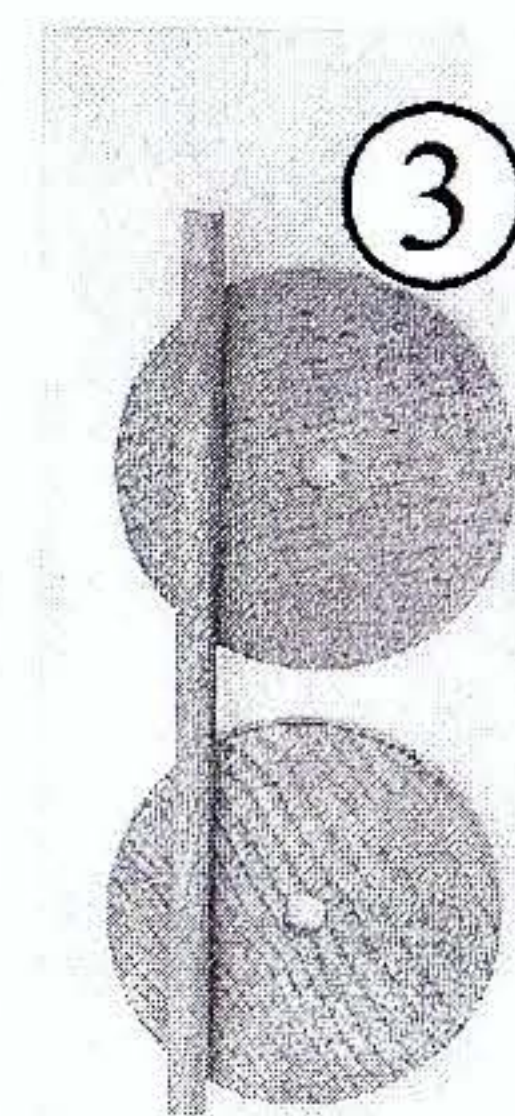
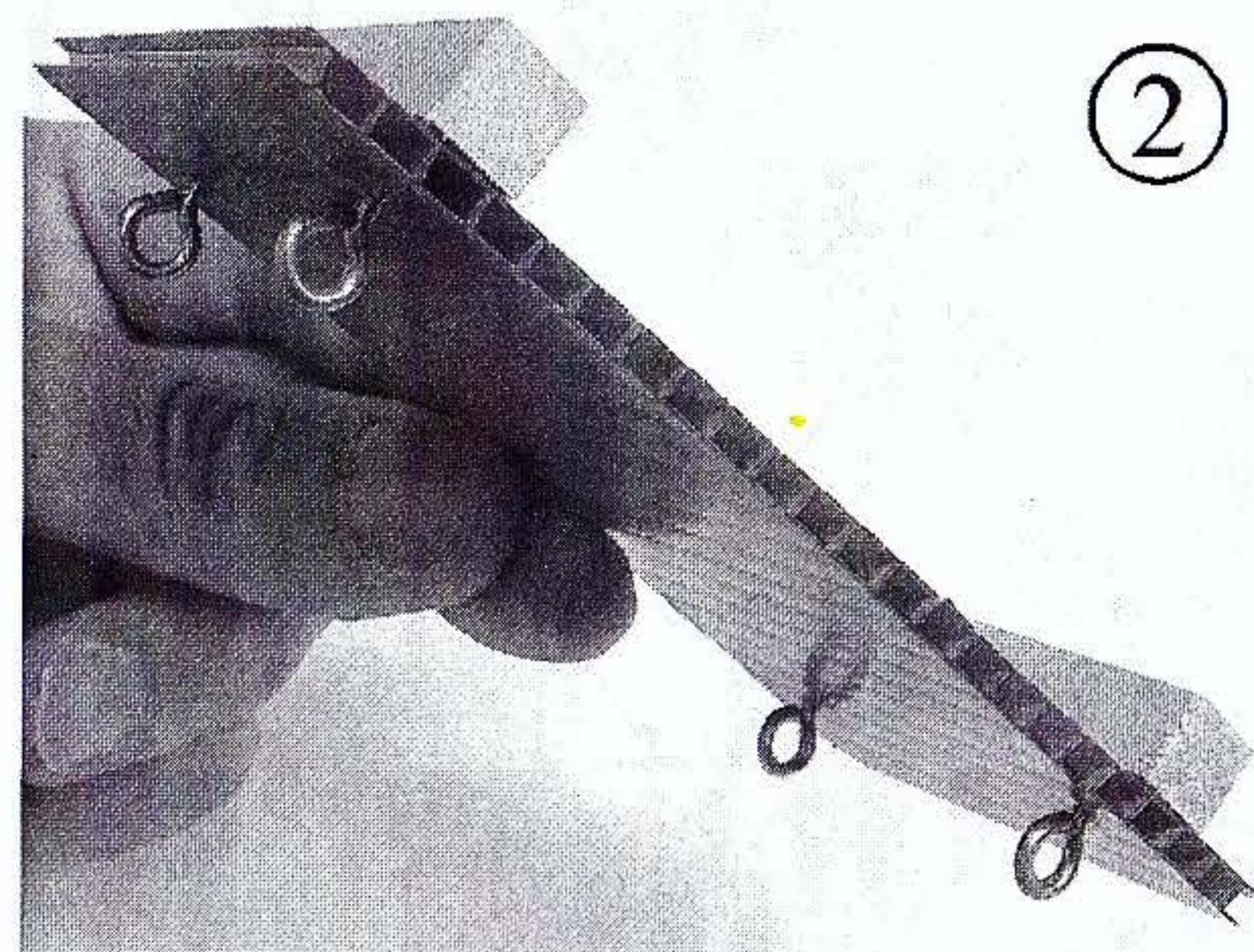
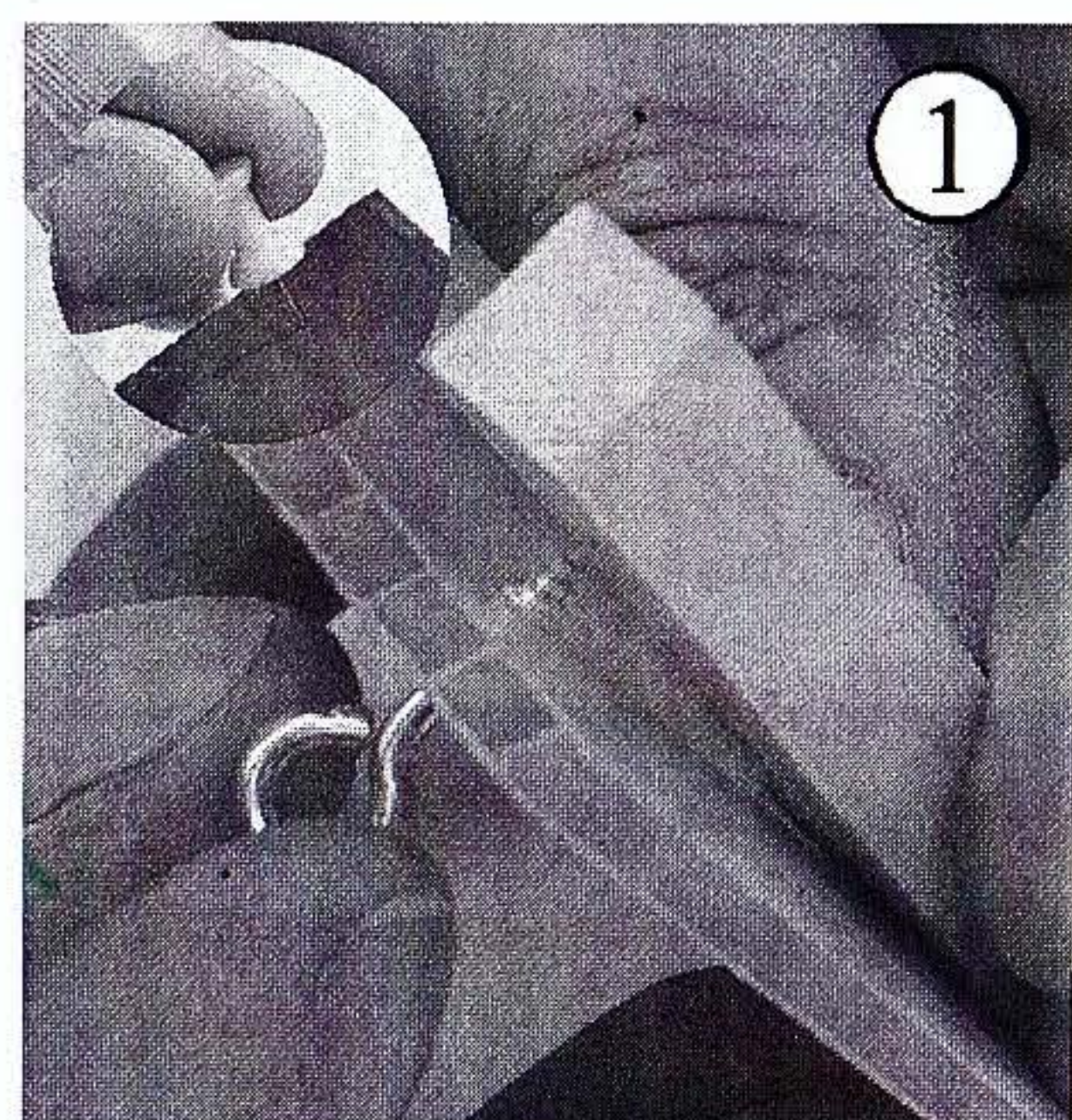
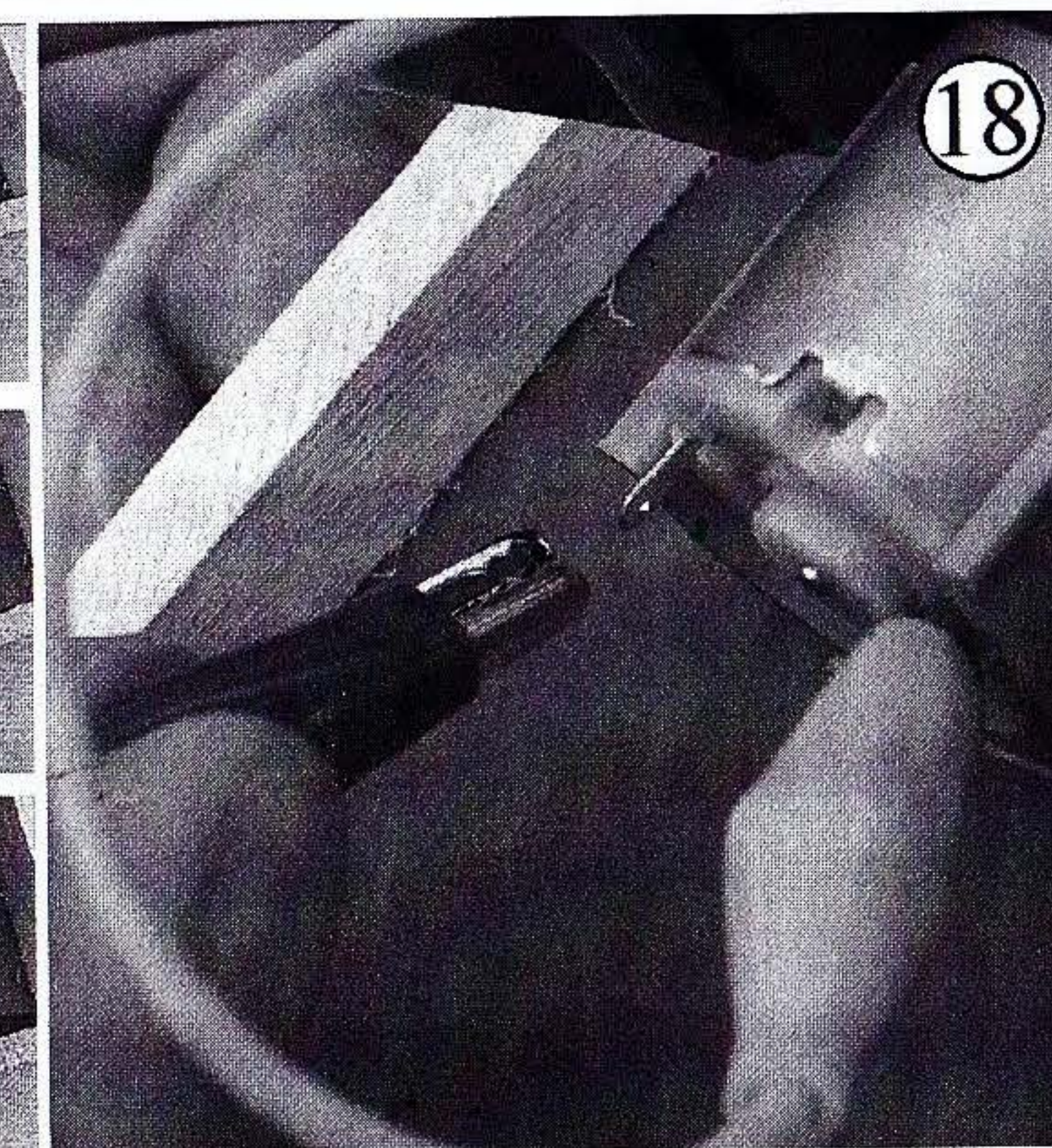
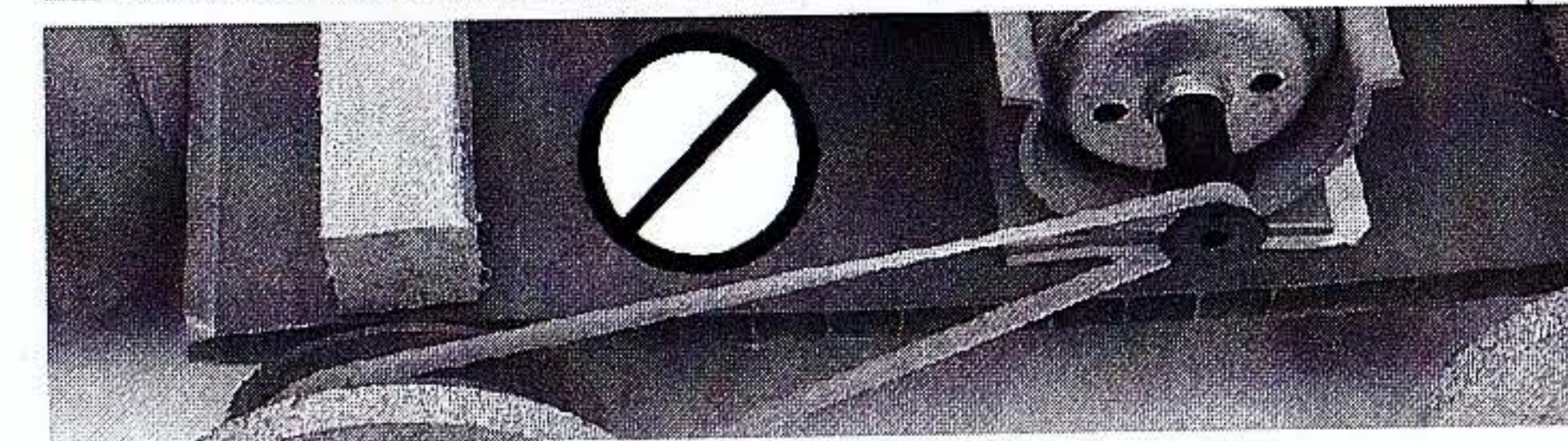
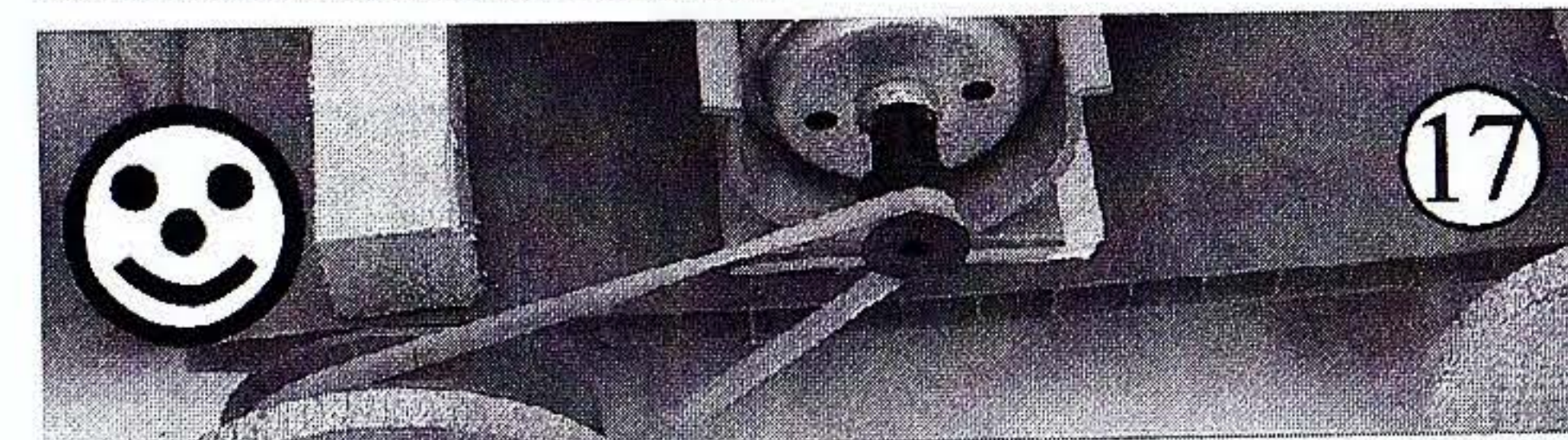
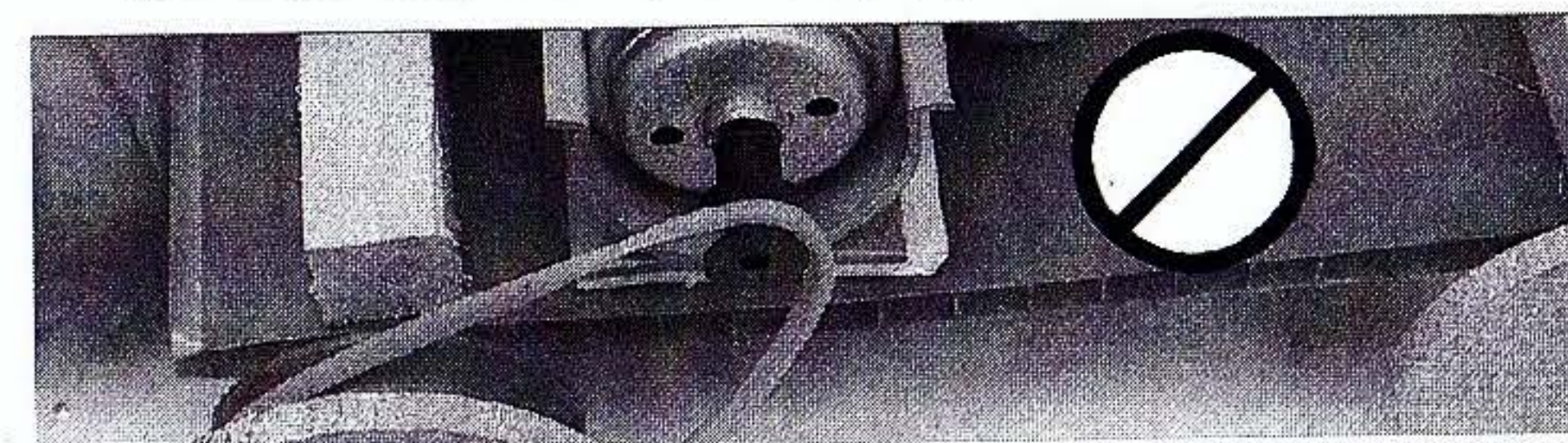
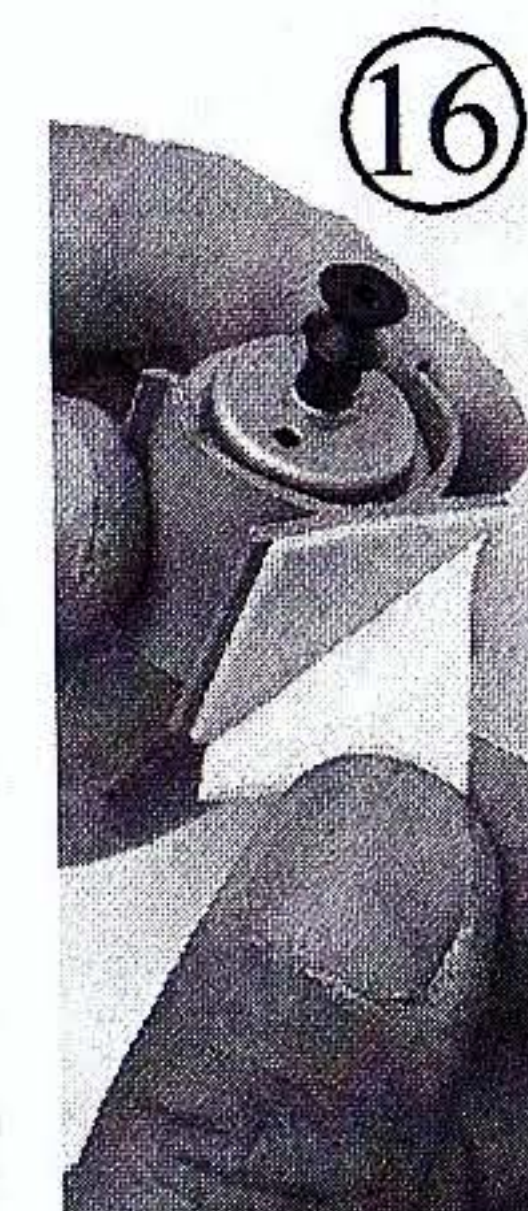
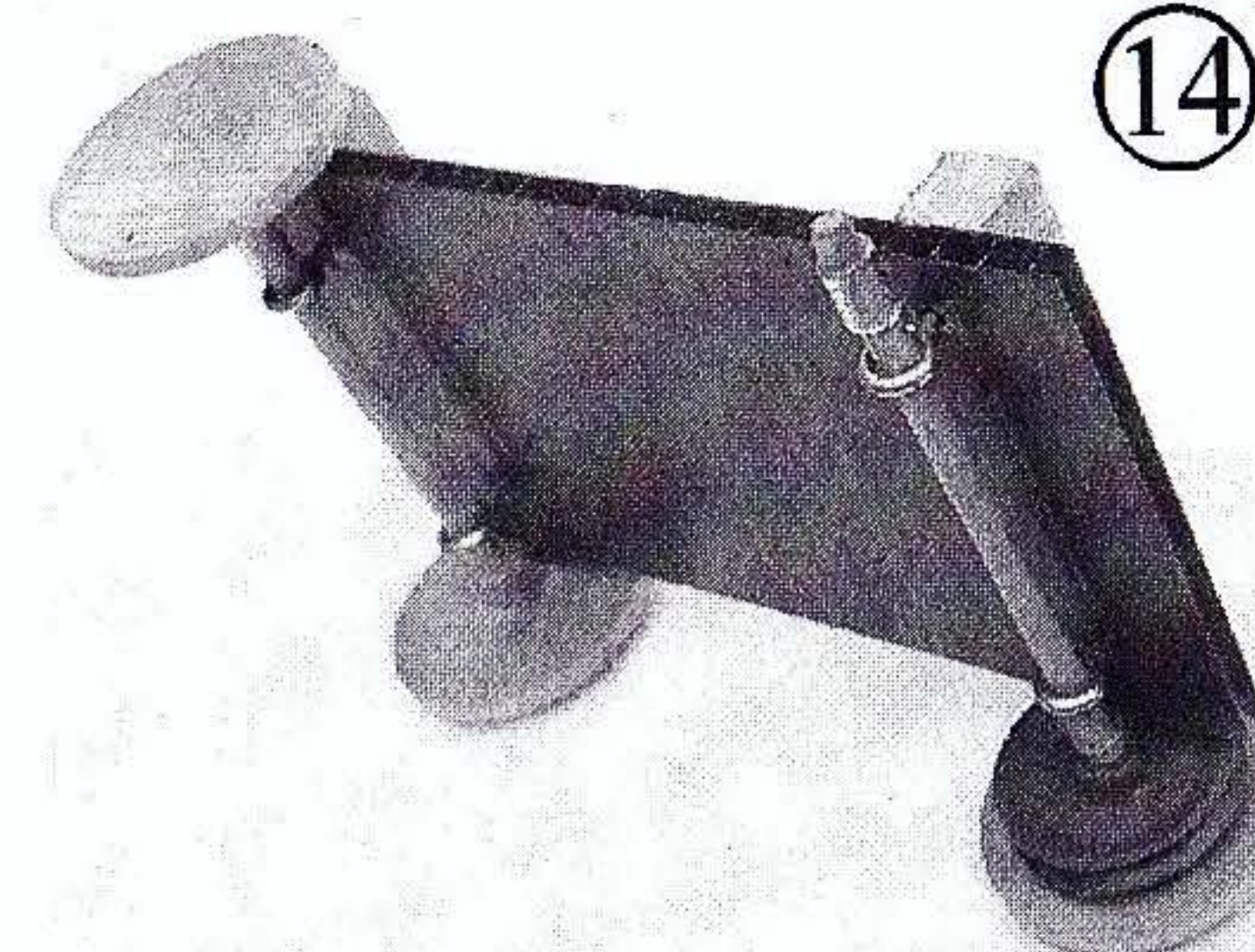
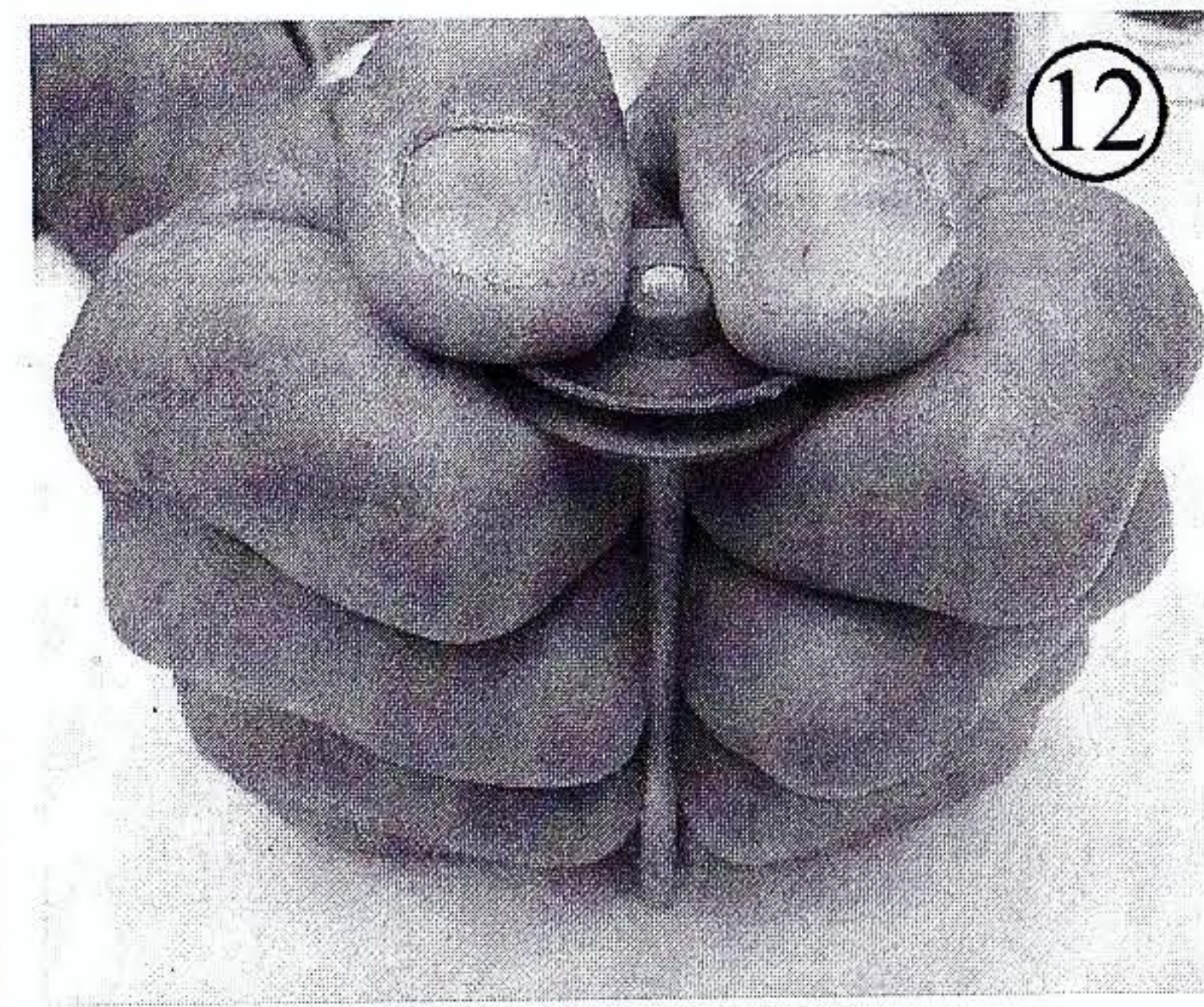
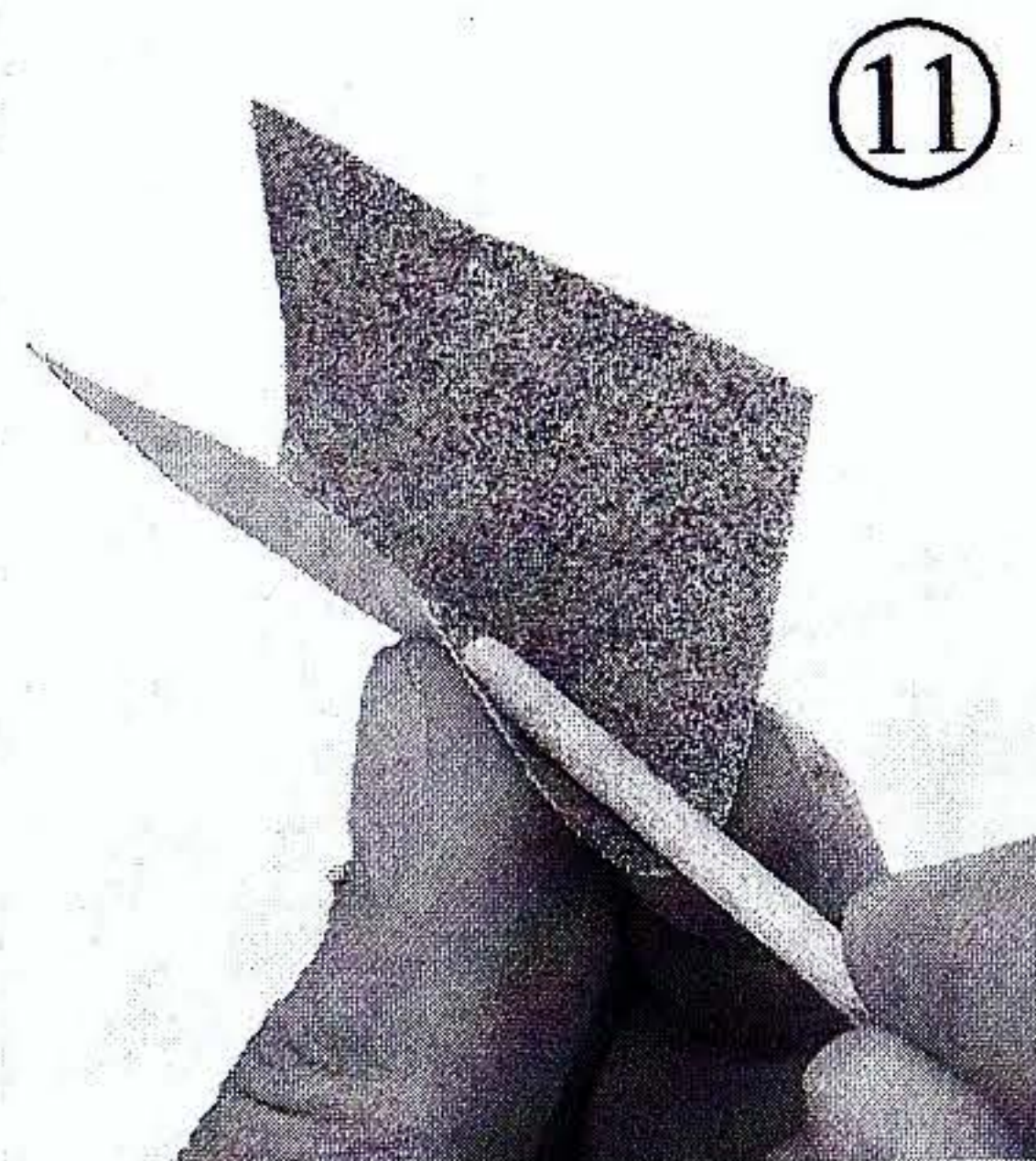
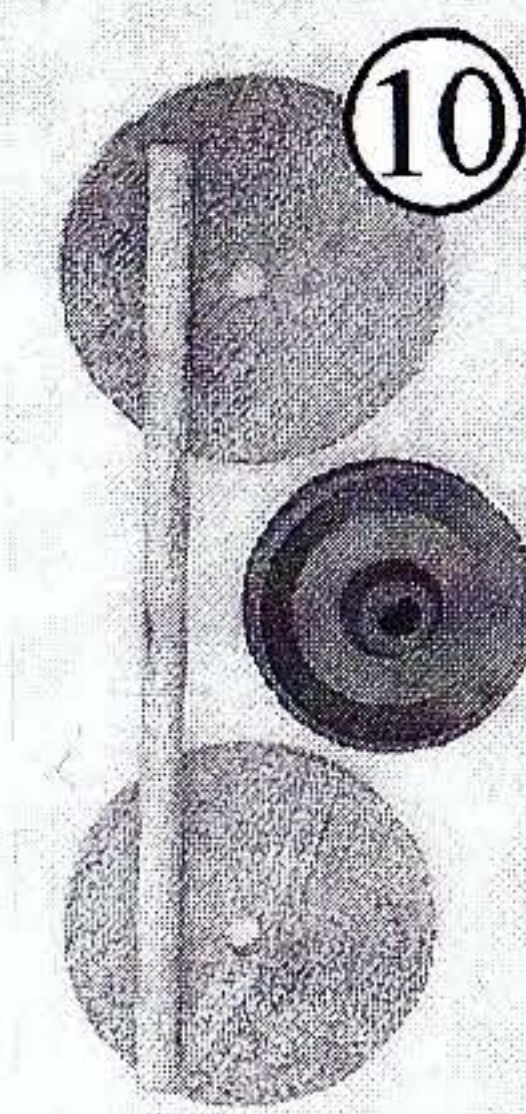
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INSTRUCTIONS (written supplement to the images)

Check the contents of your kit, and that you have all the materials shown in the parts diagram and/or listed in the parts list.

- 0 - On the coroplast body (000) use the push pin (001) to mark four locations for screw eye axle-holders (002). You will want your axles to be parallel and running straight ahead - consider this as you mark the holes for the axle holders.
- 1 - Insert screw eyes through coroplast and into wood blocks (003). If necessary, widen a starter hole for the screw eye in the wood with the push pin. When screwing in the screw eyes, you can use a dowel as a lever to make turning easier.
- 2 - Ready to receive axles.
- 3 - Select the shorter axle (004a) and two wheels (005).
- 4 - Using sandpaper (006), very lightly sand the end of the dowel, and insert into wheel.
- 5 - Snippets of tubing (007) are used as "in-line shaft retainers". Cut four small pieces of lengths 1 cm or 1/4 inch.
- 6 - Work the tubing piece onto the axle/shaft.
- 7 - Slide the tubing down the shaft.
- 8 - The "in-line shaft retainer" keeps the wheel from rubbing against the body.
- 9 - With the axle in place through the screw eyes, slide another tubing piece onto the shaft, and mount the second wheel.
- 10 - Select the longer axle (004b), two wheels, and the red pulley (008).
- 11 - The small red pulley may require that the axle be sanded. To keep the dowel round, twist the axle in folded sandpaper. Do not sand off too much - the pulley must grip the axle firmly.
- 12 - Slide the pulley onto the axle. (If the pulley is loose, try jamming a piece of masking tape under it, or use a glue gun.)
- 13 - Attach a piece of tubing and a wheel. If the wheel is loose, you may use wood glue or white paper glue to hold it.
- 14 - Mount the driven axle, slide on another piece of tubing, and the last wheel.
- 15 - Place the motor (with motor pulley attached) (009) into the motor clip (010).
- 16 - The motor clip has a protective layer over the sticky-back. Peel this off when you are ready.
- 17 - With the elastic band drive-belt (011) around the driven pulley and the motor pulley, position the motor clip so that the elastic band has an easy tension - not too loose, and not too tight.
- 18 - Attach the alligator clips of the solar panel (012) to the two metal terminals at the back of the motor. Solar panels produce direct current electricity. Note that reversing the connections at the back of the motor will reverse the direction of the motor's spin.
- 19 - Run in the Sun! Try holding the solar panel on tighter with a small piece of scotch tape or velcro. You can as well, using recycled materials, design a movable holder for the solar panel, to let it turn toward the Sun.

SOLAR POWER

Solar Power begins its journey 1,000,000 years ago at the heart of the sun where matter is being converted to energy at a sub-atomic level.

When it reaches the surface of the Sun, which glows at 5800 K, it is emitted as electromagnetic radiation, sunlight, and begins its 8-1/2 minute journey at the speed of light to our Earth. Solar Energy is about 6 - 7 % ultraviolet light, 42% visible light, and 51% infra-red light.

The Sun's energy reaches the surface of the Earth with a power of one kilowatt per square metre (1.1 horsepower per square yard).

The Earth

Our clock time is measured by the Earth's rotation; at noon we are facing the sun directly.

Photovoltaic cells in solar panels convert some sunlight directly into electricity using silicon semiconductors. Photons of light energy excite electrons near an electrostatic field inside a solar cell, causing some electrons to jump over. While only about 12 - 15% efficient, this sunlight induced flow of electrons is immediate.

By attaching wires to the electrical poles of the cell we can use this current to power a motor, channeling the energy through coiled wires on the motor's shaft, creating electromagnets; which, surrounded by permanent magnets, create attracting and repelling forces resulting in rotational motion.

When this mechanical energy is transferred by the motor pulley through a drive belt to a driven pulley on an axle, it causes the wheel to push against the Earth. The Earth pushes back with an equal and opposite force, and the car starts to roll. As we are all aware, a steady stream of sunlight keeps everything going.

The SUN

$$MC^2=E$$