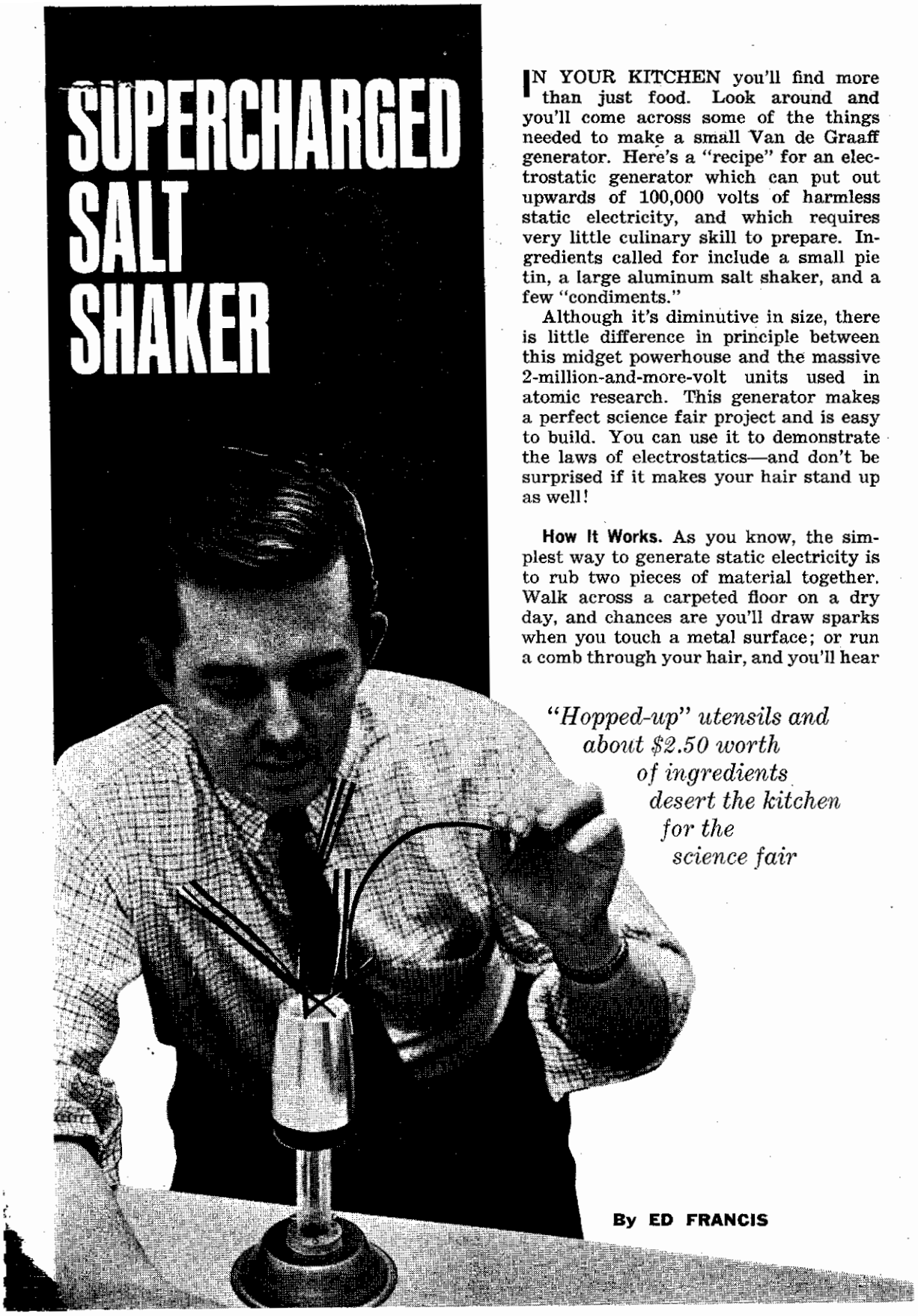
SUPERCHARGED SALT SHAKER

"Hopped-up" utensils and about $2.50 worth of ingredients desert the kitchen for the science fair

By ED FRANCIS



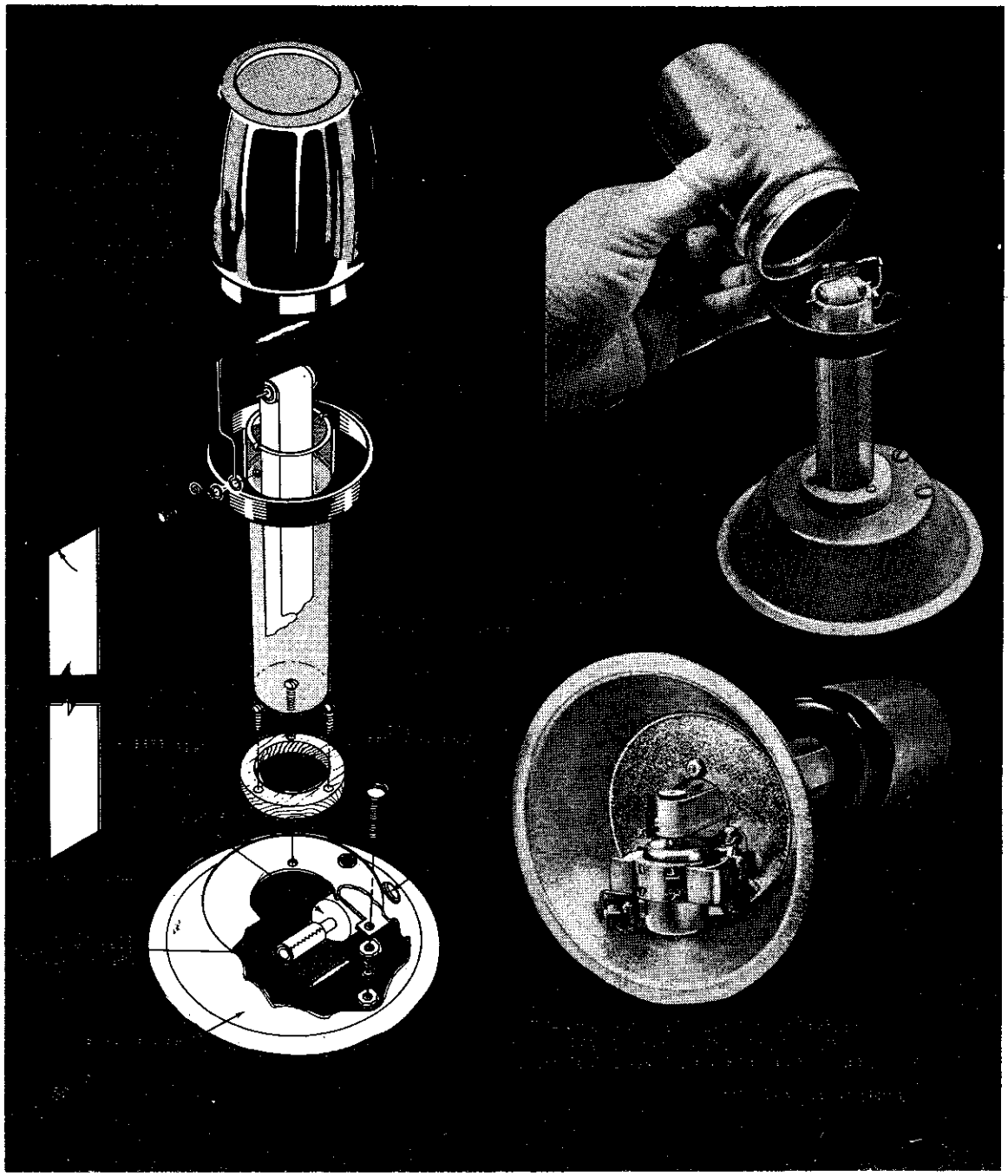
IN YOUR KITCHEN you'll find more than just food. Look around and you'll come across some of the things needed to make a small Van de Graaff generator. Here's a "recipe" for an electrostatic generator which can put out upwards of 100,000 volts of harmless static electricity, and which requires very little culinary skill to prepare. Ingredients called for include a small pie tin, a large aluminum salt shaker, and a few "condiments."

Although it's diminutive in size, there is little difference in principle between this midget powerhouse and the massive 2-million-and-more-volt units used in atomic research. This generator makes a perfect science fair project and is easy to build. You can use it to demonstrate the laws of electrostatics—and don't be surprised if it makes your hair stand up as well!

How It Works. As you know, the simplest way to generate static electricity is to rub two pieces of material together. Walk across a carpeted floor on a dry day, and chances are you'll draw sparks when you touch a metal surface; or run a comb through your hair, and you'll hear

things snap, crackle, and pop. While this static electricity is commonplace, it is no different from that produced by the little Van de Graaff generator "cooked up" here. A hollow insulating column held in place by a pie-plate base supports a salt-shaker dome. Within the base, a small toy motor drives a rubber belt around a plastic pulley.

When two dissimilar substances are rubbed together, they become electrostatically charged. The one with the higher dielectric constant usually takes on a positive charge, and the other takes on a negative charge. Plastic materials generally have a higher dielectric constant than rubber, and if this is the case with the materials you select, the plastic will become positively charged by giving off electrons to the rubber. But regardless of which material is positive and which material is negative, the rubber



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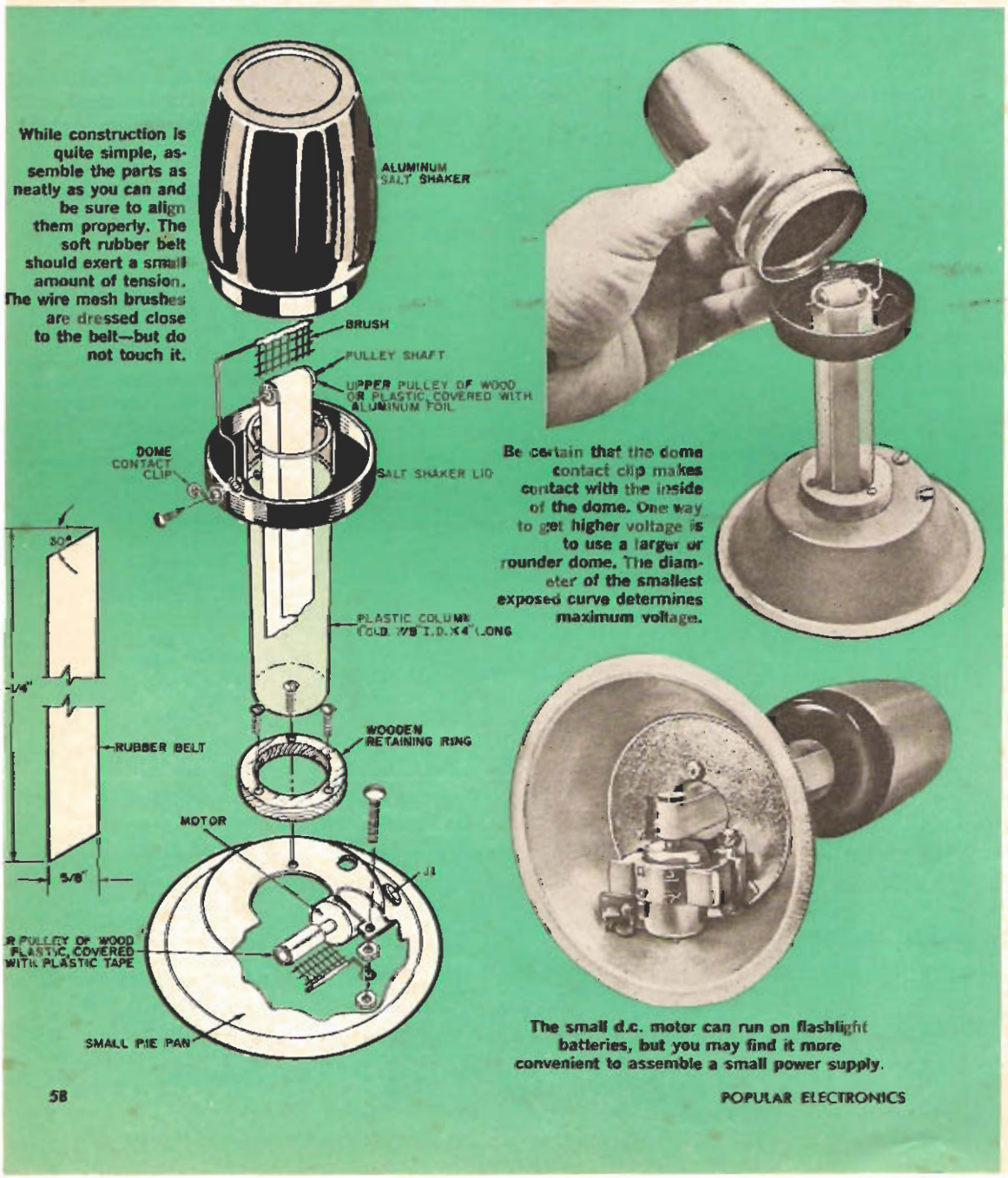
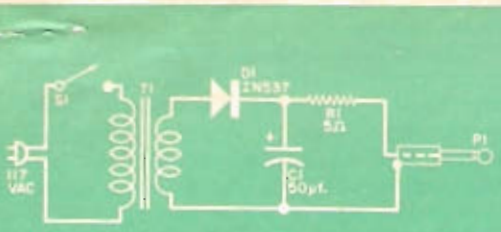




Optional power supply can be installed next to the motor if you use a large enough pie plate as a base, or you can mount it in a box. Construction and parts are not critical.

POWER SUPPLY PARTS LIST

C1—60-μf., 50-volt electrolytic capacitor
D1—1N537 diode or equivalent
P1—Miniature phone plug
R1—5-ohm, 1-watt resistor
S1—S.p.s.t. switch
T1—6.3-volt filament transformer
Misc.—Line cord, small chassis or box, 3' cable

belt transfers the charge deposited on it to the dome, until a certain maximum charge is reached. This charge is dependent upon the roundness of the dome—it's usually on the order of 30,000 volts per inch of diameter of the smallest curve or point. Therefore, if you want to build up high voltage, use a large diameter ball without any ripples, points, or other small projections.

The wire mesh brushes at top and bottom merely aid the flow of electrons to or from the dome and the base, depending upon which is positive and which is negative. You can use flashlight batteries to power the motor, or you can build a small half-wave-rectifier power supply to convert the line voltage to 6 volts d.c., and eliminate the batteries.

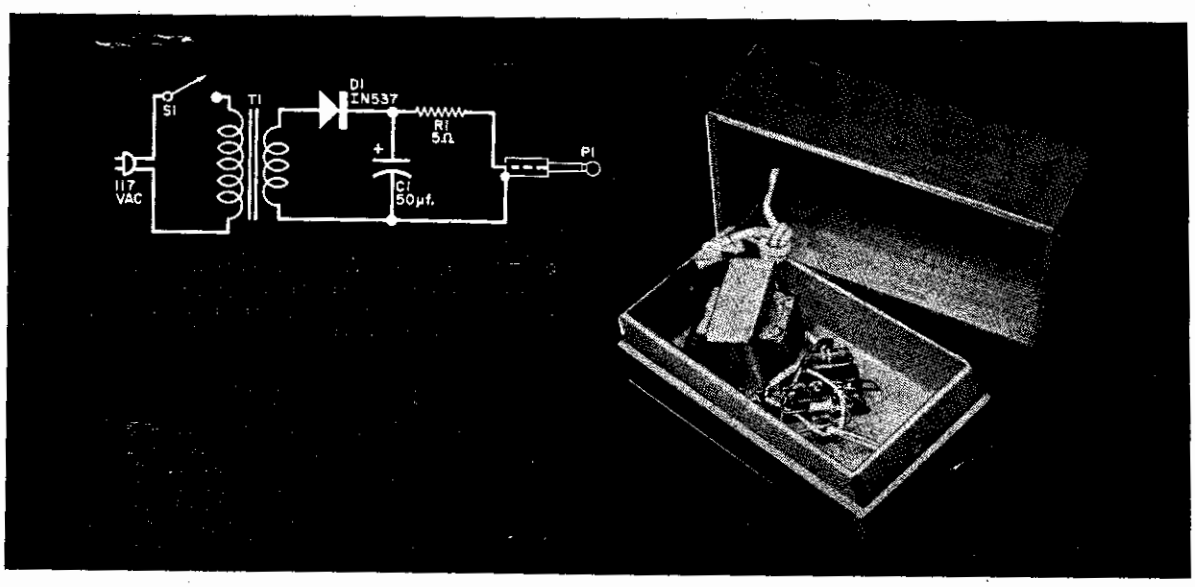
BILL OF MATERIALS

1—Miniature hobby motor (Lafayette "Super Micro-Motor" or equivalent)
1—Large aluminum salt shaker
1—⅛" x 11¼" piece of sheet rubber
1—Small pie-plate base
1—4" long x 1"-o.d. x ⅞"-i.d. plastic column
2—¼"-long x ⅝"-diameter plastic rods (to serve as pulleys)
1—1⅞"-o.d. x 1"-i.d. wood retaining ring, made from 5/16" stock
1—1½"-long x 1/16"-diameter brazing rod (for pulley shaft)
2—⅜" x ⅜" bronze screen brushes
1—Miniature phone jack (J1)
Misc.—Plastic electrical tape, #18 copper wire, aluminum foil, cement, nuts, bolts, etc.

Construction. Most people associate the Van de Graaff generator with a huge ball-shaped metal dome, but the shape of the metal dome need not be perfectly round as long as it has no sharp edges or small curves. An inexpensive large-size aluminum salt shaker with a plastic lid can be used with excellent results. The plastic lid is a good electrical insulator and prevents corona discharge from the small diameters of the threaded end of the salt shaker.

The column is made from a 4" length of 1"-o.d. Lucite, Plexiglass, or polystyrene tubing. The inside diameter must be wide enough (about ⅞") to pass the rubber belt. You might try obtaining a large pill vial from your druggist to serve as the column. The small pie tin should be large enough to keep the structure from toppling over.

Drill a hole in the center of the shaker lid which is the same size as the outside diameter of the tubing, and cement the cover in place about an inch down from what will now become the top of the column. Drill holes in the pie-plate base to mount the motor, and the jack (*J1*) for the batteries or power supply. Bolt the retaining ring made from about 3/16" wood stock to the pie pan. Do not cement the column to this ring, at least not until after you have aligned the belt, and then only if you have to. The hole in the center of the pan is only as large as the inside diameter of the tube, and



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The wire mesh brushes at top and bottom merely aid the flow of electrons to or from the dome and the base, depending upon which is positive and which is negative. You can use flashlight batteries to power the motor, or you can build a small half-wave-rectifier power supply to convert the line voltage to 6 volts d.c., and eliminate the batteries.

BILL OF MATERIALS

1—Miniature hobby motor (Lafayette "Super Micro-Motor" or equivalent)
1—Large aluminum salt shaker
1—5⅛" x 11¼" piece of sheet rubber
1—Small pie-plate base
1—4" long x 1"-o.d. x ⅞"-i.d. plastic column
2—¾"-long x ⅜"-diameter plastic rods (to serve as pulleys)
1—1⅞"-o.d. x 1"-i.d. wood retaining ring, made from 5/16" stock
1—1⅛"-long x 1/16"-diameter brazing rod (for pulley shaft)
2—⅜" x ⅝" bronze screen brushes
1—Miniature phone jack (J1)
Misc.—Plastic electrical tape, #18 copper wire, aluminum foil, cement, nuts, bolts, etc.

Construction. Most people associate the Van de Graaff generator with a huge ball-shaped metal dome, but the shape of the metal dome need not be perfectly round as long as it has no sharp edges or small curves. An inexpensive large-size aluminum salt shaker with a plastic lid can be used with excellent results. The plastic lid is a good electrical insulator and prevents corona discharge from the small diameters of the threaded end of the salt shaker.

The column is made from a 4" length of 1"-o.d. Lucite, Plexiglass, or polystyrene tubing. The inside diameter must be wide enough (about ⅞") to pass the rubber belt. You might try obtaining a large pill vial from your druggist to serve as the column. The small pie tin should be large enough to keep the structure from toppling over.

Drill a hole in the center of the shaker lid which is the same size as the outside diameter of the tubing, and cement the cover in place about an inch down from what will now become the top of the column. Drill holes in the pie-plate base to mount the motor, and the jack (*J1*) for the batteries or power supply. Bolt the retaining ring made from about 5/16" wood stock to the pie pan. Do not cement the column to this ring, at least not until after you have aligned the belt, and then only if you have to. The hole in the center of the pan is only as large as the inside diameter of the tube, and

does not allow the tube to pass through the pan.

Make the upper pulley from a ¾" length of ⅜"-diameter plastic or wood dowel. Drill a 1/16" hole lengthwise through the center of the dowel and insert a ¾" length of rod cut from 1/16"-diameter brazing wire or piano wire so that it protrudes about 3/16" from each end. Cement a layer of aluminum foil around the pulley. The lower pulley is made from the same material except that it should be drilled for the motor shaft and covered with an even layer of plastic electrical tape.

Cut two notches about 1/16" deep on top of the column to cradle the upper pulley shaft. Then drill a 3/32" hole approximately one-quarter inch below one of the notches for the upper brush bracket and dome contact. Fasten the lower brush in the base on the side of the belt which travels upward.

A wide variety of motors will work with the generator; in fact, almost any miniature, fairly high rpm toy motor will do.

The 11¼" x ⅝" belt can be fashioned from a piece of thin sheet rubber of the type available from surgical supply houses or cut from an old swimming cap. Angle both ends to obtain a long, smooth butt seam. Apply rubber cement—the kind used to fix a flat tire—to each end, and when dry, carefully press the ends together and apply a thin coat of cement over the joint.

After the joint is bonded, install the belt by dropping it down through the tube and engaging both pulleys. Check the belt for proper alignment and tracking. You can do this by running the motor. If the belt doesn't track, shim up the motor where necessary, or cut one of the upper pulley notches deeper. Belt tracking can also be improved by constructing the pulleys with a slight crown or hump in the center.

Both upper and lower brush brackets are made by soldering a small piece of No. 18 copper wire, bent to shape as shown, to a ⅜" x ¾" bronze or other metal window screen material. The dome contact clip, which is also a piece of copper wire bent to shape, should be mounted so as to make contact with the inside of the salt shaker body when assembled. Use a 6 x ½" sheet metal screw to attach the contact and brush to the column.

Adjust both brushes so that they are close to the rubber belt but not touching, and in line with the pulley. Then screw the dome in place. Miniature phone jack *J1* is then mounted on the base and attached to the motor to facilitate the battery or power supply connections.

A small wooden box houses the power supply components. A miniature phone plug on the end of a 3' lead plugs into the pie pan. If you happened to use a large enough pie pan, you might get away with installing the power supply inside the base.

Operation. Some laws of electrostatics can be demonstrated by placing small bits of aluminum foil, paper or sawdust on the metal dome and watching them fly away from the dome as a charge is built up. These bits take off because they gain a like charge. *Like charges repel; unlike charges attract.*

The Indian rope trick, in miniature form, can be duplicated by attaching a few long strands of string or tissue paper to the dome. When the strands take on a charge, they will stand on end as they try to fly away. Touch the strands with your fingers, and they'll lean toward your hand as your body steals the charge.

A jumping ball demonstration can be performed by placing two or three small pith balls inside a small plastic tube, covering the tube with a metal disc, and placing it on top of the dome. As the balls are repelled upward from the dome, they will cling to the metal disc on top and then fall back to the dome. This action repeats itself until the disc approaches the potential of the dome.

To send corona discharge into the air, bend a piece of stripped hookup wire so that it will sit on top of the dome with one end pointed up. This end should be filed to a sharp point. Douse the lights, turn on the unit, and sit back and watch man-made lightning in miniature being produced. Another indication of the presence of corona is the peculiar smell of ozone which is usually generated.

Moisture and dirt in the column and dust on the dome will rob your unit of its prowess. So keep it clean. -30-