OPERATING INSTRUCTIONS

ELECTROSTATIC GENERATOR

CENCO Catalog #78688

1. INTRODUCTION

The Electrostatic Generator is a convenient source of high-voltage static electricity. Derived from the well-known Van de Graaff prototype, it is designed to demonstrate in the classroom the generation of high-voltage, static electricity. The generator can produce up to 250,000 volts for operation of gas-filled tubes.

2. DESCRIPTION

2.1 General: Inside the ends of a vertical, nonconducting, hollow column are two pulleys mounted on horizontal roller bearings. An insulating belt connects the pulleys. The shaft of the lower pulley extends outside the column where it is coupled to the shaft of an electric motor. In operation, the motor turns the lower pulley to drive the belt. A metal "comb" is mounted near each pulley in such a fashion that the teeth of the comb point directly at the pulley and are approximately 1/8 inch away from the place where the belt runs over the pulley.

The comb near the lower pulley is attached to a heavy, well-grounded metal base with which it makes electrical contact. The comb near the top pulley is mounted onto a horizontal insulating member fixed to the top of the column.

Electrical contact is made between the upper comb and a collector sphere, which is a removable sphere that fits over the top of the column and rests on three small supports attached to the outside of the column. An auxiliary sphere, smaller than the collector sphere, is attached to a vertical rod which is mounted through a universal joint onto the metal base. The center of the auxiliary sphere is at the same height above the metal base as the center of the mounted collector sphere. A binding post, mounted onto the metal base next to the rod, connects the grounded terminal of the cord to the base. The post can also be used as an auxiliary grounding post.

Central Scientific Company

11222 MELROSE AVENUE · FRANKLIN PARK, ILLINOIS 60131 (312) 451-0150

2.2 Principle of Operation: As the belt travels at high speed over the pulleys, the lower comb sprays electrons onto the outer surface of the belt. The belt carries these electrons up the column and inside the collector sphere toward the teeth of the upper comb. Electrons in the comb, repelled by the electrons approaching on the belt, migrate from the comb by way of the metal strip connecting the comb and the collector sphere and distribute themselves evenly over the outside of the sphere. By losing electrons to the sphere, the comb becomes positively charged with respect to the approaching surface of the belt and the comb causes the electrons on the belt to jump onto the comb.

By this process, the large sphere continuously acquires electrons from the upward-moving section of the belt until it is charged to its maximum value (250,000 volts with normal separation of the two spheres) or is discharged by an external object, such as the auxiliary sphere mounted on the base.

After the belt loses its electrons to the upper comb, its charge becomes positive with respect to ground. The positively charged section of the belt travels downward toward the lower pulley and comb. The potential difference between the positive section of the belt and the grounded lower comb causes electrons to jump from the comb onto the belt and thus start a new charging cycle. Electrons lost from the comb are immediately replaced from ground. The electron transfer between the belt and the combs can be seen as a continuous sparking, or corona discharge.

3. SETTING UP THE APPARATUS

Place the open end of the collector sphere over the top of the column and lower it until it rests on the three small supports attached to the outside of the column. Be sure the sphere makes contact with the metal strip attached to the upper comb.

Place the open end of the small, auxiliary sphere over the vertical rod. The hole in the top of the sphere should match the threaded hole in the top of the rod. Screw the auxiliary sphere onto the rod.

Plug the line cord into a 115-V AC three-prong outlet. If an adapter is used, ground the generator by fastening one end of an auxiliary grounding cord to the binding post on the base and connecting the other end to a suitable ground, such as a water pipe. An excellent grounding cord is included in the Patch Cord Assortment, CENCO #84098.

4. OPERATION

Many interesting experiments can be performed with the Electrostatic Generator. Consult the attached SEP,

> "Electrostatic Induction," Selective Experiments in Physics, CENCO #71996-11.

After the unit has been properly assembled, grounded and connected, it may be operated. The on-off switch is located on the rear edge of the metal base. Turn the switch on to start the drive motor. The belt will begin to charge the collector sphere.

Discharge, evidenced by sparks and crackling noises, will take place periodically between the two spheres. The frequency and intensity of the discharge can be varied by adjusting the distance between the two spheres. This can be done by applying pressure to a side of the rod by means of a wand made of insulating material -- a meter stick or a wooden ruler is suitable. Always keep the wand closer to the collector sphere than any portion of your body. The rod holding the auxiliary sphere can be removed by unscrewing it from the base. This feature allows the operator to hold the rod and sphere in his hand and walk around the unit. Before removing the rod, ground it by clamping a grounded wire between the two knurled nuts and the binding post on the base.

To enhance the visibility of the spark effect produced by the electrons' discharge, operate the unit in a darkened room.

Upon completion of the demonstration, switch off the unit and bring the auxiliary sphere in physical contact with the collector sphere until no evidence of discharge is detected.

The dielectric breakdown voltage of air is 3×10^6 volts per meter. The actual voltage at which discharge occurs between the two spheres is, therefore, the distance between the spheres (expressed in centimeters) multiplied by the breakdown voltage. Thus, if the separation between the spheres was 10 centimeters at the time of discharge, the voltage on the collector sphere was 300,000 volts.

CAUTION: DO NOT OPERATE THIS UNIT NEAR EQUIPMENT SUCH AS A LEAF-TYPE ELECTROSCOPE WHICH MIGHT BE DAMAGED BY A STRONG ELECTROSTATIC FIELD.

5. MAINTENANCE

5.1 General: If the apparatus is in constant use, it may become necessary to clean the belt, pulleys and column. Wash them, using only grit-free soap, pure water and a clean, soft cloth. Dry-wiping or wiping with a gritty cloth will scratch the plastic column. Grease and oil deposits may be removed by using a soft cloth wet with methanol or kerosene, followed immediately by washing with soap and water. Never use razor blades or other sharp instruments to remove deposits.

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Keep the spheres free from dust and dirt. Always unplug the unit before cleaning it or replacing parts.

5.2 Belt and Pulley Replacement: To gain access to the belt and pulleys, lift off the collector sphere and remove the top comb. Do not damage the metal strip which electrically connects the sphere to the top comb. Pull the top pulley up and out of the slots on the top edge of the column and slide the belt off the pulley. Be sure that the lower comb does not damage the belt. Remove the screws at the base of the column; lift the column off and store it in a safe place. Remove three set screws, two holding the lower pulley assembly bearings in place and one in the center of the pulley under the wool. Remove the shaft from the pulley and replace the belt. To reassemble, perform the procedure in reverse order.

6. REPLACEMENT PARTS AND ACCESSORIES

Description	CENCO Catalog #
Replacement Belt	00271-62
Patch Cord Assortment	84098
Electrostatic Accessories Set	71899