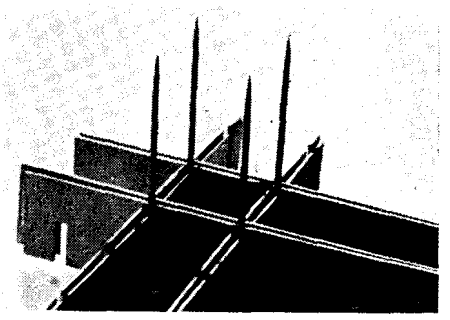
Applications of Corona Effects



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WHEN the voltage between a sharp and blunt conductor in air is raised sufficiently, there will be, prior to arcover, an electrical discharge from the sharp point, measurable as a small electric current and visible as a faint blue glow between the electrodes. It is caused by ionization of the air.

For a particular application, it was desired to turn off corona discharge without switching the main voltage. Since strong corona phenomena depend upon a nonuniform field distribution, the corona can be affected by altering electrode geometry. For example, it can be stoppped by enlarging the point.

A more practical way is to surround the needle with a ring and apply a small voltage between needle and ring, diverting sufficient of the lines of force from needle tip to the ring to inhibit corona. Such a device constitutes a corona triode and has the properties of a thermionic tube, but does not require a heater.

► Equipment — Apparatus shown in Fig. 1 comprises a needle fixed in a collet chuck to allow interchange. The hemispherical knob electrode of 10-em diameter is so mounted that the distance from the needle can be altered and the changes measured directly on a built-in micrometer. Covering the needle and insulated from it is a conducting electrode with smooth exposed blunt surface. This part is made with several different throat diameters and forms the grid. Location of the grid relative to the fixed needle tip can be accurately determined.

Figure 2 shows a conventional triode circuit and the corresponding corona triode circuit. Measured gains of 3 have been observed but there has been no attempt to develop a cascade amplifier using corona triodes. The fact that positive and negative corona can be employed gives the designer greater freedom than with conventional amplifiers.

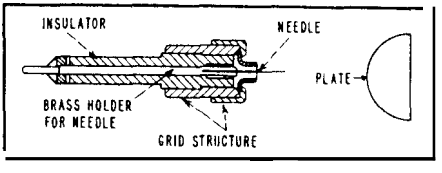
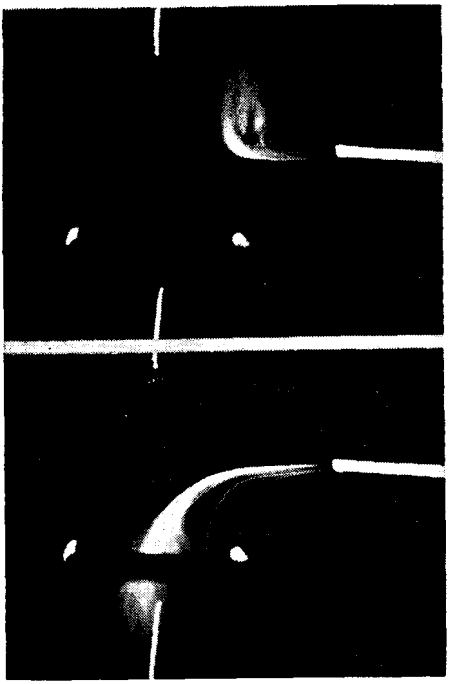


FIG. 1—Corona wind triode assembly

► **Corona Wind**—When a source of



Effect of varying grid potential. With low voltage (top) high voltage (bottom)

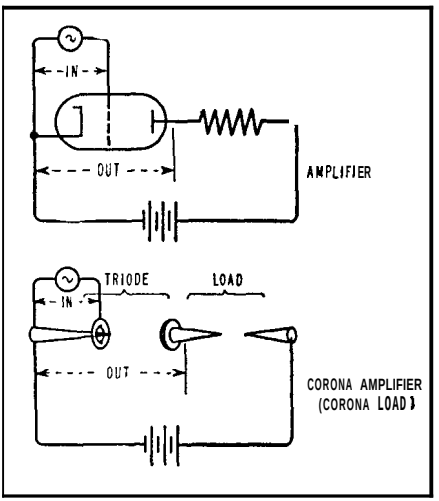


FIG. 2—Comparison of conventional triode and corona triode amplifier circuits

smoke is interposed between electrodes, the direction of flow is determined by grid potential. The photographs show that corona wind blows the smoke upwards (towards the negative electrode) when the grid potential is low. The device has been set up vertically in this experiment. At a high grid value, the wind drives the smoke downwards. An alternating potential applied to the grid causes an alternating air movement. Even with a single pair audible output can be observed for high frequencies.

.Loudspeaker—To provide a sufficient radiating area, a stack of corona triodes is arranged on a half-inch matrix. Method of assembling the needles is shown in the photograph. The grid comprises 16 gage wire soldered in a mesh of half-inch squares. The two needle stacks are separated by about 2 cm and aligned so the line joining opposite needle tips passes through the middle of the grid rectangle.

Surrounding the grid and needle assembly is a baffle to ensure better matching of the speaker to the acoustic load at low frequencies. Experimental versions of the loudspeaker show limitations in linearity. A push-pull version gives decided improvement.

Measured acoustic power under conditions of minimum distortion is about 0.1 milliwatt per sq cm. Electrical power is about 50 mw per sq cm at 12 kv d-c.