June 13, 1939. J. SLEPIAN 2,162,518

RECTIFIER

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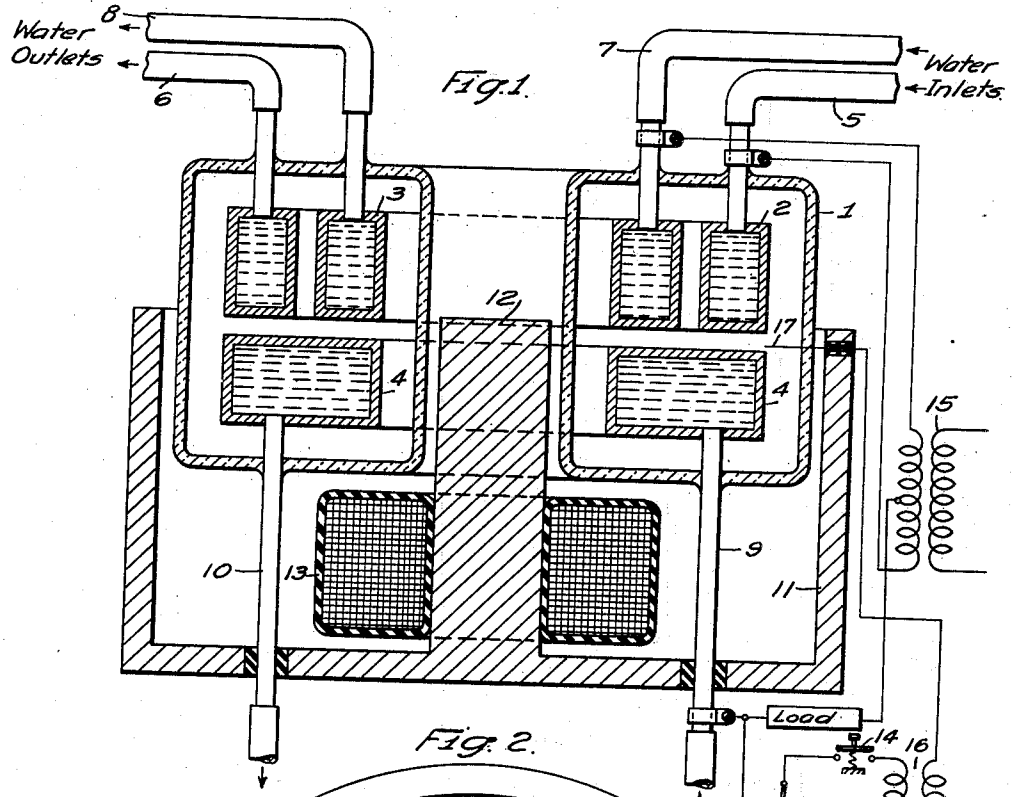


Fig. 1.

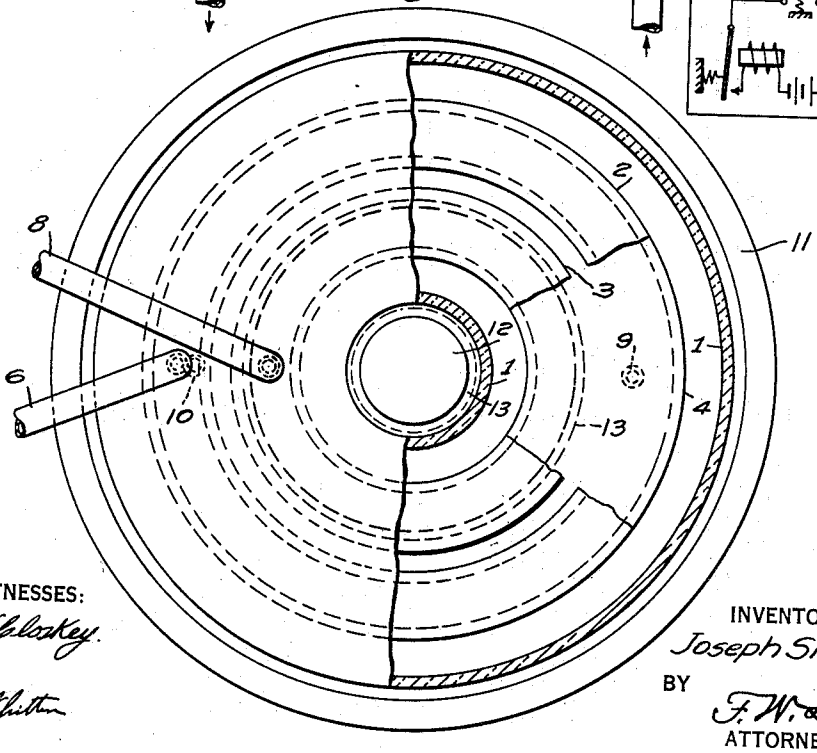


Fig. 2.

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RECTIFIER

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1 Claim. (Cl. 250—27.5)

This invention relates to discharge devices, and particularly to a gaseous discharge device used as a rectifier.

It is an object of this invention to provide means whereby the discharge will not become stationary on any one spot of either electrode.

It is a further object of this invention to provide a discharge device in which the discharge will be caused to move continually and progressively over the surface of the electrodes.

It is a further object of this device to provide a discharge device with annular electrodes and with means for causing the discharge to move repeatedly around the annulus.

It is a further object of this invention to provide an annular tube with annular electrodes and to establish a radial magnetic field across the gap.

It is a further object of this invention to provide water cooling means for the electrodes in such a tube.

Other objects of the invention and details of the structure employed will be apparent from the following description and accompanying drawing, in which:

Figure 1 is a central vertical sectional view; and

Fig. 2 is a plan view partly in section and partly broken away.

In the drawing, a glass envelope 1 is shown of annular shape filled with any desired gas such as argon or mercury vapor, and containing a pair of anodes 2 and 3, each of annular form, and a single cathode 4 below them and also of annular form. A water inlet 5 and a water outlet 6 provides for the water cooling of the anode 2. Similarly, an inlet 7 and an outlet 8 provides for the water cooling of the anode 3. The cathode is water cooled by an inlet 9 and an outlet 10. Each of the inlet or outlet conduits is sealed to the glass of the envelope 1 where it passes through the envelope walls and each of the water conduits is connected by a coiled rubber hose to the pump or other water supply. The coiled rubber in the water conduit provides insulation in a way familiar in the art.

The annular tube 1 is surrounded by a cup 11 of iron or other magnetic material which has a central spindle 12 of the same material. A coil 13 wound on the spindle 12 is supplied with direct current which may be from an independent direct-current source or may be from the rectified current supplied by the device. The source of power for the rectified current is the transformer 15, the secondary of which has its terminals connected to the anodes 2 and 3. As illustrated, the connection is made to the pipes 5 and 7. The midpoint of the secondary of the transformer 15 is connected to the cathode 4. The connection is illustrated as made to the pipe 9.

A Tesla coil 16 is connected at one extremity to the pipe 9 and so to the cathode 4. The other extremity of the Tesla coil is connected to a needle point 17 inside the tube 1 and close to the cathode 4.

In the operation of the device, to start, the button 14 is pushed rendering the Tesla coil active and causing sparks between the needle point 17 and the cathode 4. Interrupted current in the primary of the Tesla coil induces high potentials in the secondary, thus yielding the desired sparks. This establishes a cathode spot on the cathode and then the voltages impressed upon the anodes 2 and 3 are rectified by the action of the anodes and the cathode 4.

The voltage delivered by the transformer 15 to the anodes does not exceed 212 volts r. m. s. across the whole secondary. Thus the maximum voltage between the cathode 4 and the negative anode never exceeds 300 volts. This is not sufficient to establish a reverse current of substantial amount. When the anode becomes negative in the ionized atmosphere in the tube 1, it attracts positive ions. Thus there is built up around the negative anode a sheath of space charge which presents a great obstacle to current through the tube to that anode. Electrons from the negative anode do not neutralize said space charge because the anode being cold delivers very few electrons. The current to establish said sheath does not exceed a few milliamperes. The same reason explains why current does not flow from the positive anode to the negative one. There the current is always from the positive anode to the cathode 4.

In order that powerful currents may be handled by the device without damage, the anodes are water cooled by water through the inlets 5 and 7 which emerges through the outlets 6 and 8. A similar supply of water cools the cathode 4.

An arc current flow between the anode 2 and the cathode 4 when the potential impressed by the transformer 15 is in the direction to make the anode 2 positive. The arc thus formed will not be stationary nor will it play erratically over the surface of anode and cathode, but, because of the magnetic field between the spindle 12 and the wall 11 of the cup, the arc will rotate about the spindle 12 as a center traversing the annular gap between the anode 2 and the cathode 4 at a speed which will depend upon the current strength in the arc and upon the magnetic field. The an-

nulus which constitutes the space occupied by the said gap is thus all occupied at one time or another by the arc.

When the potential induced in the secondary of the transformer 15 reverses, the cathode spot on the cathode 4 will persist, but the current will now flow to the anode 3. The arc will continue to rotate, traveling around the annular gap in the same way as when the current passed between the anode 2 and the cathode 4.

The heating effect of the arc at the surface of the cathode is not great because the arc does not remain in any one spot long enough to produce any substantial effect. Thus the cathode and anodes are kept cool and do not melt or waste away as would happen if the arc were not caused to rotate.

Many modifications of the details of this device and many analogous applications of the principle here explained will occur to those skilled in the art. I do not intend the specific illustration and description of one embodiment of this invention to be considered as a limitation. No limitation is intended unless it is required by the prior art or expressed in the claim.

I claim as my invention:

A rectifier comprising an envelope having a gaseous atmosphere, a hollow annular cathode and two hollow annular anodes spaced therefrom within said envelope, all said electrodes being substantially coaxial, cooling means connected to each of said electrodes, and means for producing a substantially radial magnetic flux across the space intermediate said anodes and cathode.

JOSEPH SLEPIAN.