A Cold Cathode Rectifier

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The cold cathode rectifier presented at the Science Exhibit sponsored by the A.A.A.S. at St. Louis last holidays, and in May, 1936, before the physics section of the Illinois Academy of Science, at Quincy, Illinois, has been very much improved as an efficient device for the rectification of comparatively high alternating voltages. The rectifier makes use of Hittorf's principle of limiting the development of Crookes' dark space. As made at this writing (Nov. 6, 1936), with electrodes of about 10 sq. cm. each, the rectifier transmits 30 ma. on half wave rectification, and about 50 ma. on full wave rectification. This is for 25,000 alternating volts.

The set-up in complete form is shown in Figure 1. There are four essential parts: (1) a 50,000 volt transformer (Thordarson) with a split grounded secondary (Two 25,000 volt transformers in parallel will answer.); (2) a cold cathode rectifier with its three special electrodes; (3) a large-diametered discharge tube MM, styled the load; and (4) a 5-inch DuMont oscillograph. (This item in the present demonstration was omitted.)

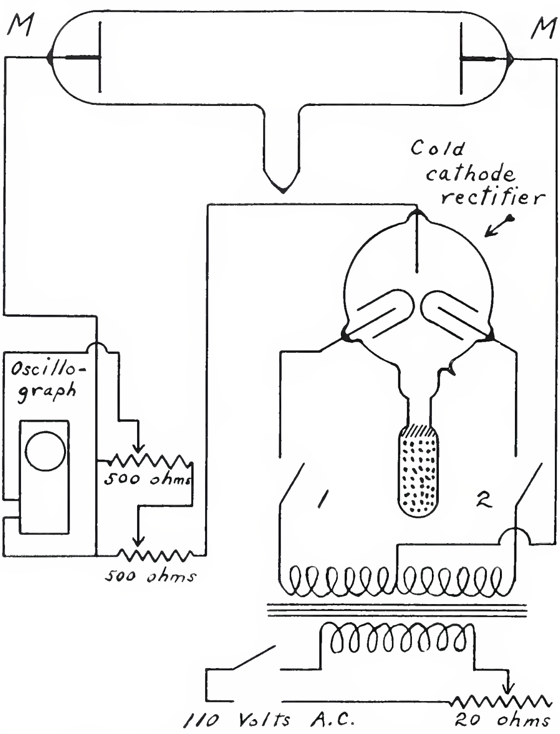

Fig. 1. Complete set-up for both half and full wave rectification.

In addition to these, rheostats and switches are needed as shown in the figure.

To operate, close the 110 volt switch to primary. Then with the vacuum in the rectifier in the Geissler stage (the vacuum is readily regulated to any degree by the charcoal-in-liquid-air control) close switch 1. The discharge in MM is alternating, i.e., either electrode is cathode and anode alternatingly. Now open switch 1 and close switch 2. The discharge through MM is the same as before but now passes through the right hooded electrode in the rectifier. Thus one gets an alternating discharge (25,000 volts) through MM on closing either switch 1 or switch 2. If next both switches are closed simultaneously, the discharge will not pass through MM, but rather through the rectifier from one hooded electrode to the other. The above phenomena are for a *low vacuum* in the rectifier.

Now for the rectifying action. By the charcoal-in-liquid-air control, the vacuum in the rectifier is *increased* (the gas pressure is reduced) until Crookes' dark space *extends beyond* the confines of the hood surrounding each of two electrodes (Fig. 1). When this stage is reached, the electrode that is hooded can serve as anode only; i.e., the current passes in one direction only. If now switch 1 is closed the discharge through MM shows distinct polarity—one end is anode and the other cathode. The unidirectional characteristics of the discharge are very distinct. On opening switch 1 and closing switch 2, the same characteristics, with polarity unchanged, appear in MM, but now, as above, the discharge passes through the right hooded electrode.

On closing both switches simultaneously the alternating discharges can no longer pass through the rectifier from hooded electrode to hooded electrode (because of the extended Crookes' dark space) and are forced to pass through MM as full wave rectification. That nearly twice the energy (in milliamperes) now passes through MM is evinced by the discharge through it becoming distinctly brighter. Thus a cold cathode may be employed in the rectification of a high potential alternating current.

The above phenomena were demonstrated during the presentation of this paper.