A Cold Cathode Rectifier (demonstration)

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This rectifier makes use of Hittorf's principle of limiting the expansion of Crookes dark space. Alternating voltages up to 12,000 have been rectified by it. The phenomenon was made visible: (a) by observing the trace of the discharge through the vacuum tube MM (styled the load), (b) by simultaneously observing the trace of the wave-form with a cathode ray oscillograph, and (c) by watching the changing Crookes dark space within the rectifier itself as the vacuum in it became higher and higher due to the charcoal-liquid air control.

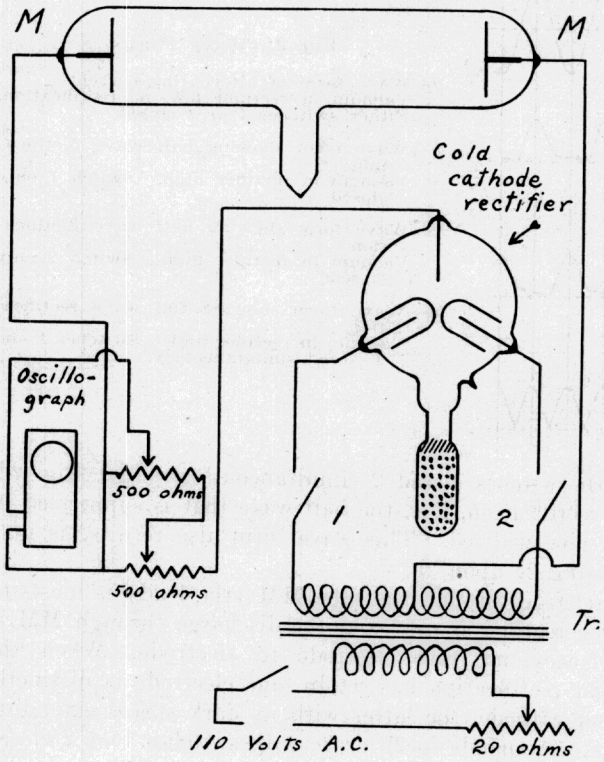

Fig. 1. — Complete set-up for both half and full wave rectification.

The set-up in complete form is shown in Fig. 1. There are four essential parts,—

(1) A 12,000 volt transformer (Thordarson) with a grounded secondary.

(2) The cold cathode rectifier with its three electrodes.

(3) A long large diametered discharge tube MM, the load.

(4) A 5-inch DuMont oscillograph (complete).

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

Fig. 2a shows form of trace on oscillograph when the vacuum in the rectifier is *low*, and switch 1 alone is closed. There is no evidence of rectification, the alternating current passing with equal ease in either direction. The same type of curve results when switch 2 alone is closed.

If now the vacuum in the rectifier is made high by means of the charcoal-liquid air control and the switch 1 alone is closed, we get Fig. 2b, which shows half wave rectification. When switch 2 alone is closed we get Fig. 2c, which also shows half wave rectification, only that the half waves are shifted along the axis by a half period.

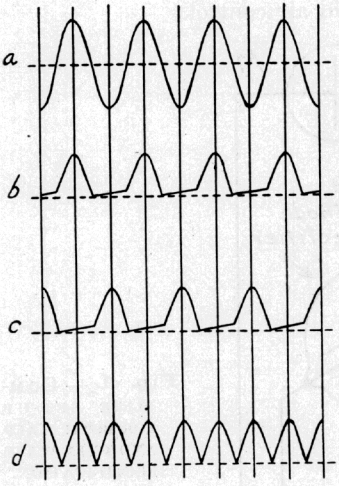

Fig. 2.—Wave Forms.

a—Wave form of alternating current. Vacuum in rectifier low, no rectification. Either switches 1 or 2 closed.

b—Wave form showing half wave rectification. Vacuum in rectifier high. Switch 1 only closed.

c—Wave form showing half wave rectification. Vacuum in rectifier high. Switch 2 only closed.

d—Wave form showing full wave rectification. Vacuum in rectifier high. Switches 1 and 2 closed simultaneously.

On closing both switches 1 and 2 simultaneously, we get Fig. 2d, which is full wave rectification, i. e., the half wave that is suppressed in Fig. 2b (or 2c) is now utilized. This wave form also results, as may be seen, by superposing 2c upon 2b.

The visible discharge through the tube MM (the load) is most interesting. When the rectifier is soft, and the discharge through MM is unrectified, the striae extend from electrode to electrode. When the rectifier is hard, and rectification has set in, one electrode is distinctly anode, and the other cathode, the latter with its dark spaces extending out in front. This corresponds to 2b or 2c with switches 1 or 2 closed respectively.

Visually one can not distinguish between the discharges through MM on closing either switches 1 or 2, but when 1 and 2 are closed simultaneously (as for full wave rectification, Fig. 2d) the discharge through MM appears distinctly brighter, since more electrical energy is now forced through it.

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