

No. 838,273.

PATENTED DEC. 11, 1906.

R. RANKIN.
ELECTRIC WAVE FORM TRACER.
APPLICATION FILED AUG. 23, 1905.

Fig. 1.

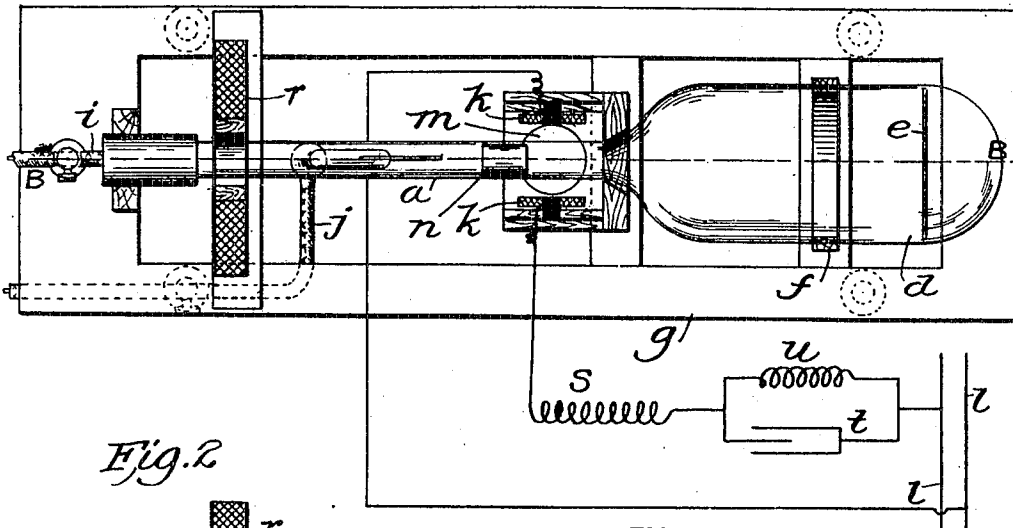


Fig. 2.

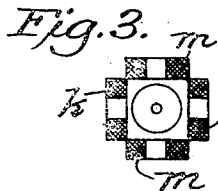
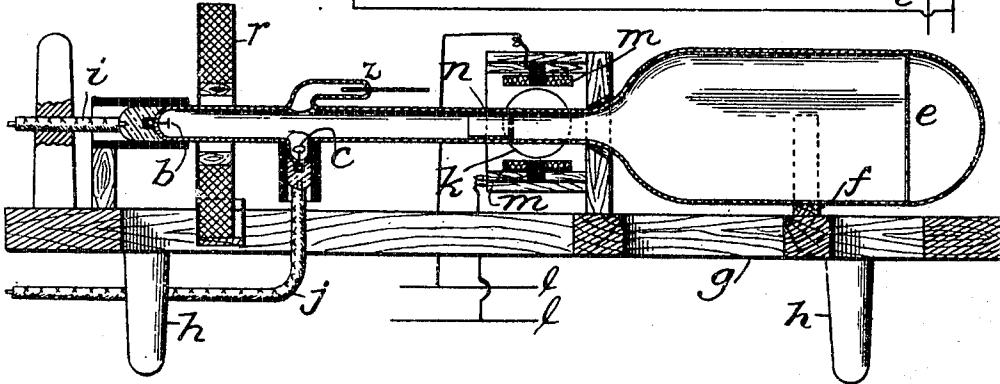
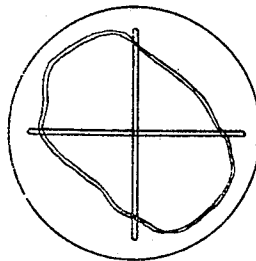


Fig. 4.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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ELECTRIC-WAVE-FORM TRACER.

No. 838,273.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, ROBERT RANKIN, a citizen of the United States, residing in Ithaca, in the county of Tompkins and State of New York, have invented certain new and useful Improvements in Electric-Wave-Form Tracers, of which the following is a description, reference being had to the accompanying drawings.

My invention relates to improvements in devices for determining the characteristics of electric waves; and the object of my improvement is to provide a device of the class referred to which shall be simple in construction, accurate in its results, and practical upon a commercial scale.

In the drawings, Figure 1 is a top plan view of my new wave-form tracer. Fig. 2 is a central sectional view on line B B of Fig. 1, and Figs. 3 and 4 show details hereinafter referred to.

a is a tube hermetically sealed the gas-pressure in which is approximately one-tenth of a millimeter of mercury. It is advantageous to use a low gas-pressure, because the pencil of rays generated, as hereinafter described, is not subjected to diffusion by interference with the gas molecules. The tube *a* is formed with a bulb *d* at one end, and this bulb rests in a U-shaped cradle *f*, mounted upon the base-board *g*, of wood or other suitable material. This base-board *g* rests upon legs *h*, of hard rubber or other suitable insulating material.

In the tube *a* are mounted two plates *b* and *c*, which are connected, respectively, by the conductors *i* and *j* with a Wimshurst or Holtz electrostatic machine, (not shown,) and by this connection a current of about five ten-thousandths of an ampere is set up. The plates *b* and *c* resemble the plates of an ordinary Crookes tube, and hereinafter the plate *b* will be called the "anode" and plate *c* the "cathode."

Between the screen *e*, formed of mica and spread with white powder to make it powerfully fluoresce when struck by the cathode-rays, and the cathode *c* is mounted in the tube a diaphragm *n*, opaque to the cathode-rays and pierced by a small central aperture to permit the passage of a pencil of such rays. Upon each side of the tube *a* is mounted a solenoid *k*, the pair of solenoids *k k* being in series, while above and below the tube *a* are mounted two other solenoids *m m*, which likewise form a pair and are in series with

each other. The axes of the two pairs or sets of solenoids are at right angles to each other and in the same plane, and the solenoids are mounted just beyond the diaphragm *n*. (See Fig. 3.)

ll are lead-wires carrying alternating current the form of the wave of which is unknown. Current is led through a reactance *s* to a divided circuit, in one branch of which is a condenser *t* and in the other branch of which is a reactance *u*, which is in series with the pair of solenoids *k k*, one terminal of which is connected with a terminal of the condenser *t*, and thence back to the lead-wire. Current is also led from the line directly through the pair of solenoids *m m*. The above-described arrangement of condenser *t* and reactances *s* and *u* serves to throttle or damp out the harmonics and permits to pass through the solenoids *k k* a current having a simple sine-wave form.

The current set up by the Wimshurst machine drives the cathode-rays forward through the tube *a* until all are stopped by the opaque diaphragm *n* except a pencil of rays which passes through its central aperture and causes a bright spot of fluorescent light to appear upon the mica screen *e*.

The current from the line passing through the solenoids *k k* causes vertical motion of the spot of light upon the screen *e*, while the current from the line passing through the solenoids *m m* causes horizontal motion of the same spot of light. When the current from the line flows through both sets of solenoids at the same time, the spot of light moves along a path which is the resultant of the motions due to each set of solenoids separately. Such a path is shown in Fig. 4. Knowing that one of the motions is that due to a current having a sine-wave form, the wave form of the other current, or current through the solenoids *m m*, may be determined.

The above apparatus was invented by Braun and improved by Professor Harris J. Ryan, of Cornell University, Ithaca, New York. One of the chief difficulties in the practical use of this instrument arises from the conductivity of the atmosphere around the terminals of the tube at the high voltages required to establish the pencil of cathode-rays. In this connection the following points are to be noticed: First, the voltage required to establish the pencil of rays increases as the gas-pressure of the tube decreases; second, as before stated, it is advantageous to use

a low gas-pressure in the tube in order to prevent diffusion of the pencil of rays; third, the passage of the rays tends to reduce the pressure of the gas, so that after extended use the gas-pressure becomes very low, and the voltage required to establish the pencil of rays must be correspondingly increased, with the result that atmospheric conductivity increases and causes a flickering of the spot of light upon the screen *e*. Heretofore it has been attempted to overcome this evil effect by jacketing the tube *a* between the anode and cathode by means of hard rubber and paraffin; but this jacketing has a corrective effect over only a comparatively short range.

The use of the magnetic coil *r*, placed around the tube *a*, enables the operator to generate the cathode-rays in a tube of very low gas-pressure at a very much lower voltage than that with which it has heretofore been possible to attain the result. Again, the coil *r* produces a remarkable focusing effect upon the cathode-rays, enhancing the brilliancy of the spot of light by forcing more rays through the central aperture in the opaque diaphragm *n*. Hence by the use of the magnetic coil *r* the brilliancy and steadiness of the spot of fluorescent light are greatly increased and the necessity for constant and experienced attention is dispensed with, making the device one capable of industrial and commercial exploitation and use. Furthermore, in case the gas-pressure in the tube *a* rises too high—as, for example, by overheating of the platinum tube *z*—I have found that by the use of a strong magnetic field generated through the coil *r* the gas-pressure will be reduced. Hence a strong magnetic field produced by the coil *r* “restores,” so to speak, the vacuum, although this action is effective only when the vacuum is already high enough to start cathode-rays. The strength of field generated by the coil *r* in the ordinary use of the device is not sufficient to affect noticeably the gas-pressure, however.

What I claim is—

1. In combination in a device of the class described, an apparatus for generating cathode-rays, and means for focusing said rays.
2. In combination in a device of the class described, an apparatus for generating cathode-rays; means for changing the normal

path of said rays; and means for varying the limit of voltage at which said rays may be generated.

3. In combination in a device of the class described, an apparatus for generating cathode-rays; and means for increasing the brilliancy and steadiness of a pencil of said rays.

4. In combination with a vacuum-tube and means for producing cathode-rays therein, a magnetic coil encircling said tube.

5. In combination with a vacuum-tube and means for producing cathode-rays therein; a diaphragm pierced to permit the passage of a pencil of said rays; a screen placed to intercept said pencil of rays; means for deflecting said pencil of rays to cause a spot to trace a path upon said screen; and means for focusing said pencil of rays to increase the brilliancy of said spot.

6. In combination with a vacuum-tube and means for producing cathode-rays therein; a diaphragm pierced to permit the passage of a pencil of said rays; a screen placed to intercept said pencil of rays; means for deflecting said pencil of rays to cause a spot to trace a path upon said screen; and magnetic means for focusing said pencil of rays to increase the brilliancy of said spot.

7. In the combination with a vacuum-tube and means for generating cathode-rays therein; means for changing the normal path of said rays; and means for controlling the pressure of the gas in said tube.

8. In combination with a vacuum-tube and means for generating cathode-rays therein; means for changing the normal path of said rays; and magnetic means for controlling the pressure of the gas in said tube.

9. In combination with a vacuum-tube and means for generating cathode-rays therein; means for changing the normal path of said rays; and means for reducing the pressure of the gas in said tube.

10. In combination with a vacuum-tube and means for generating cathode-rays therein; means for changing the normal path of said rays; and magnetic means for reducing the pressure of the gas in said tube.

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Witnesses:

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