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INSTRUMENT FOR DETECTING ELECTRIC OSCILLATIONS.

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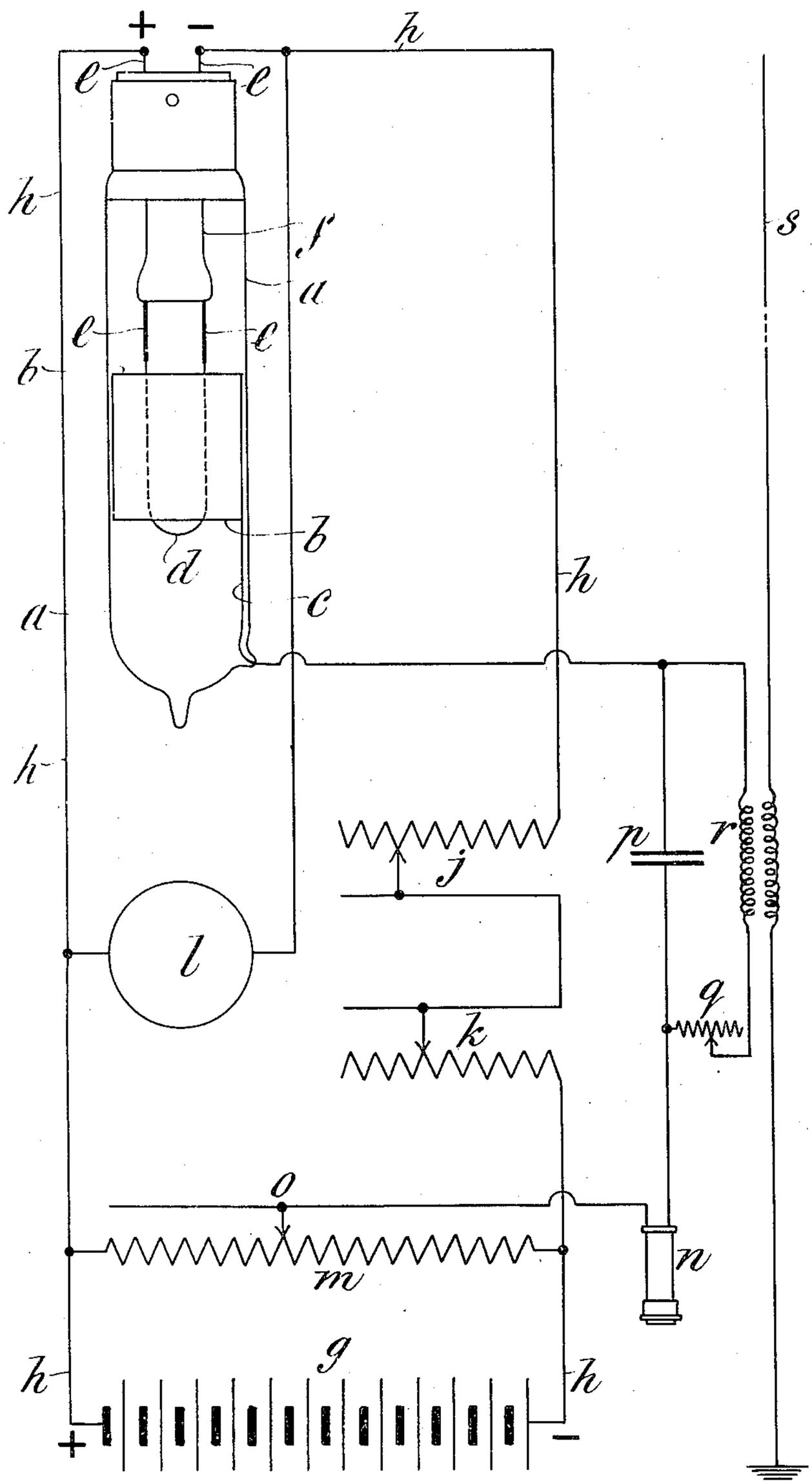

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INSTRUMENT FOR DETECTING ELECTRIC OSCILLATIONS.

954,619. Specification of Letters Patent. Patented Apr. 12, 1910.

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To all whom it may concern:

Be it known that I, JOHN AMBROSE FLEMING, doctor of science, a subject of the King of Great Britain, residing at University College, Gower Street, in the county of London, England, have invented new and useful Improvements in Instruments for Detecting Electric Oscillations, of which the following is a specification.

My invention has reference to that type of electrical oscillation detector described by me in the United States patent specification No. 803684 dated 7th November 1905.

In this specification I described an oscillation detector subsequently called an oscillation valve or glow lamp detector, which consists of an electric glow lamp of the ordinary type, but having within the glass bulb a metal plate or cylinder carried on an insulated terminal sealed through the glass. When the filament is rendered incandescent by an electric current, it emits negative ions or corpuscles or electrons and these ionize the residual gas in the bulb, and give to the space a unilateral conductivity by which negative electricity can pass from the hot filament to the cold insulated plate or cylinder within the bulb, but not in the opposite direction. I employed this device as an electric wave detector in radiotelegraphy by connecting the insulated plate or cylinder to one terminal of an oscillation transformer inserted in the receiving circuit of the radiotelegraphic apparatus, and the other terminal of this oscillation transformer was connected through a galvanometer or telephone to the negative terminal of the filament.

I have discovered after many experiments that tungsten in various forms and particularly in a form in which it is employed as the filament in a glow lamp is highly efficient for this purpose since the amount of negative electricity emitted at the highest possible working temperature may be from ten to twenty times as great as that emitted by carbon in an ordinary carbon filament. I am unable to explain the reason of this superiority; it is not merely that a tungsten filament can be raised to a higher temperature than a carbon filament, for metals such as tantalum which are closely analogous to tungsten and which can be raised to an equally high temperature are not much superior to carbon at any temperature at which they can be worked in practice. I have also discovered that a cylinder of carbon acts better as the cold conductor in the bulb than the metallic cylinders heretofore employed. I construct such a metallic or semi-metallic filament glow lamp with a tubular glass bulb and a cylinder of carbon sealed into the bulb, surrounding but not touching the filament, and connected to a platinum wire sealed through the glass. Furthermore, I employ this glow lamp as an oscillation detector as follows:—The filament is rendered incandescent by an insulated battery having in series with it a rheostat or variable resistance for controlling the current. Across the terminals of this battery I place another high resistance having a sliding contact in it, so as to make contact with any desired point on this resistance.

In using this detector in wireless telegraphy the receiving circuit must comprise a closed circuit having inductance and containing a condenser. If the telegraphy is conducted by electric waves it is necessary also to connect an antenna either directly or indirectly with this condenser circuit. I then connect the insulated cylinder included within the bulb of the lamp with one plate of the condenser in the oscillation circuit, and I connect the other plate of this condenser with the sliding contact on the resistance across the glow lamp battery terminals. In this circuit I also include a telephone or current detecting instrument. A current then flows from the battery through the filament rendering it incandescent, and also in virtue of the emission of negative electricity from the filament a current flows from it through the vacuous space to the metal cylinder and through the telephone or other current detector. The conductivity of this vacuous space or ionized rarefied gas is a function of the electromotive force acting to drive the current through it. I find that if the position of the sliding contact on the resistance across the terminals of the battery is so adjusted that corresponding thereto the conductivity curve of the ionized gas has a very sudden change in curvature, the superposition of an oscillatory potential difference between the filament and cylinder upon the steady potential difference causes very sudden changes in the current strength

through the telephone and therefore an emission of sound provided that the steady potential difference is of the necessary critical value. The arrangement described is therefore a very sensitive detector of oscillations in the condenser circuit to which the glow lamp is attached and therefore can serve as an electric wave detector in inductive or radiotelegraphy, since the sound in the telephone or indication of the equivalent current detector can be controlled from the transmitting end and cut up into Morse or other signals as required, to transmit by electric waves or magneto electric induction intelligence to a distance.

In the drawing accompanying and forming a part of this specification, I have illustrated one embodiment of my invention. Referring to this drawing it will be seen that in carrying my invention into effect I employ a tubular form of glass bulb *a* which may be an inch or more in diameter and five or six inches in length. In this I insert a cylinder *b* of carbon which is sprung into the glass tube so as to fit the walls tightly. This cylinder has a platinum wire *c* twisted or welded to it which is sealed through the glass, so as to make an external electrical connection. The bulb *a* should have a good vacuum such as is usually employed with lamps having metallic filaments. The metallic filament *d* is formed of tungsten in the form used as a filament in ordinary glow lamps and is connected to conductors *e* carried on a glass tubular stem *f* sealed into the bulb. The filament *d* should be of such a length that it is entirely covered by the metal cylinder *b*. It is convenient to have the filament of such length and thickness that the voltage required to bring it to incandescence at which its duration may not be less than several hundred hours, is of the order of 18 volts or so.

In applying this glow lamp as a detector in radiotelegraphy I arrange it as follows:— A battery *g* of secondary cells is provided which may conveniently be a dozen or more cells, and wires *h* are brought from the terminals of this battery to the terminals *e* of the filament of the lamp, a variable resistance *j k* being inserted in the circuit. It is convenient to divide this resistance into two, one namely *j* of from say 0 to 120 ohms being for coarse adjustment and the other *k* of from say 0 to 5 ohms being for fine adjustment. By means of these resistances the current of the lamp may be adjusted to have any required value. A voltmeter *l* should also be placed across the terminals of the filament to regulate the voltage. In addition I place across the terminals of the battery *g* a high resistance *m* of the potentiometer type, that is to say, a resistance which may be two or three hundred ohms or more, the terminals of which are connected to the terminals *h* of the battery. A double high resistance telephone *n* (the resistance of each telephone being at least five or six hundred ohms) has one terminal connected to a slider *o* which can make contact with any required point on the resistance *m* and the other terminal connected to one plate of a condenser *p*. The other plate of the condenser *p* is connected with the metal cylinder of the lamp. The condenser *p* is inserted in a circuit possessing inductance, which is directly or inductively connected with a receiving antenna. As shown the circuit connecting the two plates of the condenser *p* contains an adjustable inductance *q* and the secondary of the jigger *r* the primary of which is in the aerial *s*. When electric waves fall upon the receiving antenna they excite oscillations in the condenser circuit and oscillations are thus imposed upon the telephone circuit connecting the metal cylinder or plate in the lamp with the sliding contact and high resistance connected across the terminals of the battery or other source of continuous electric current.

In operating the arrangement, the first step is to bring the filament to a high incandescence at which it would be working approximately at one watt per candle and at which it will have such a temperature, approximately 2800° C., that it will diffuse into the vacuous space negative ions discharged from the incandescent filament. The filament having been rendered incandescent to this temperature, the observer applies the telephone to his ear and if electric wave trains are falling upon the receiving antenna *s*, it will be found that on moving the slider *o* along the potentiometer resistance *m* from one end to the other, there is a certain point at which sounds will be heard in the telephone better than at any other point. The exact position of the slider *o* must be determined by trial for it varies with every valve owing to slight differences in the vacuum and temperature of the filament. The detector above described is suitable as the receiver in radiotelephony, as well as for signals on the Morse or other alphabetic code.

What I claim is:—

1. A rectifier or valve for electric oscillations, having one electrode composed of tungsten.

2. A rectifier or valve for electric oscillations, having one electrode composed of tungsten and one element composed of carbon.

3. A rectifier or valve for electric oscillations, comprising a metallic filament constituting one electrode, means for heating said filament, and a plate of carbon constituting another electrode thereof.

4. A rectifier or valve for electric oscillations, comprising a metallic filament consti-

tuting one electrode, means for heating said filament, and a curved plate of carbon circumferentially situated in relation to the longitudinal axis of said filament.

5. An oscillation valve in which the hot conductor is a filament of tungsten.

6. An oscillation valve comprising a heated electrode in combination with a cold electrode consisting of a mass of carbon.

7. An oscillation valve comprising a heated electrode in combination with a cold electrode consisting of a cylinder of carbon.

8. An oscillation valve in which the hot conductor is a filament of tungsten and the cold conductor is a cylinder of carbon.

9. The combination of an oscillation valve, a source of electricity heating the filament of the valve, a resistance across the terminals of the source, a circuit connected at one end to the cold conductor of the valve and at the other to an adjustable point of the resistance, means for producing oscillations and means for detecting an electric current in the circuit.

10. In combination with an oscillation valve, a source of electric current for energizing the filament thereof, an oscillatory circuit having one terminal connected with one element of said oscillation valve, the other terminal of said oscillatory circuit being adjustably connected with a resistance which is connected with opposite terminals of another element of said valve, and a translating device operatively connected with said circuits for indicating the presence of electric oscillations.

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Witnesses:

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