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PROVISIONAL SPECIFICATION.

"Improved Means or Apparatus for Detecting or Indicating Light Waves, Hertzian Waves and other Radiations".

We, JAGADIS CHUNDER BOSE, Professor at the Presidency College, Calcutta, India, and SARA CHAPMAN BULL of 168 Brattle Street, Cambridge, Massachusetts, United States of America, Widow, do hereby declare the nature of this invention to be as follows:—

This invention has reference to means or apparatus for detecting or indicating light waves, Hertzian waves and other radiations.

The apparatus to which the present invention relates, when arranged for use with light waves, may be regarded as an artificial retina. By suitably modifying the arrangement, however, as hereinafter described, it may be used as a coherer or detector of Hertzian waves for the purposes of wireless or other telegraphy, or for the reception of other radiations.

In the apparatus to which the present invention relates, a sensitive substance is employed which has a varying electrical resistance under the action of varying intensity of light waves, Hertzian waves and other radiations.

The inventor has found that certain substances, when exposed to Hertzian waves, light waves or other radiations, have the property of presenting a decreasing resistance to the passage of an electric current as the intensity of said radiation increases; also that other substances have the opposite property, namely they present an increasing resistance to the passage of electricity as the intensity of the radiation increases. We style substances of the former class "positive," and substances of the latter class "negative."

The positive or negative effect is, we believe, due to a distortion of the molecular structure of the substances under the action of the radiation impressed thereon.

Both classes of substances, when suitably disposed, as for example in the instrument hereinafter described, will respond to, and may be caused to indicate light waves, Hertzian waves or other radiations, by means of a galvanometer or other suitable electrical indicating or recording apparatus.

In order, however, that the apparatus to which this invention relates shall work to the best advantage, it is desirable that the molecular distortion, whether positive or negative, produced by the light waves or other radiation, shall not only be readily detected and indicated, but also that the molecular structure of the substances shall return to its normal state upon the cessation of the impressed radiation.

We have found that certain substances have this additional property.

Substances possessing or caused to possess this property of molecular recovery give a characteristic curve (expressing the relation between an increasing impressed E.M.F. and the resultant current passing through the sensitive substance) which is not straight, but either convex or concave to the axis of E.M.F. and in which the return curve with a decreasing E.M.F. when taken slowly, approximately coincides with the former curve. We may mention as examples of substances which possess the property of self-recovery and give a characteristic curve of the kind just described, galena and tellurium these being positive in sense above defined. Also brominated iodated, chlorinated or fluorinated

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lead or tin, that is to say lead or tin in a condition such as can be obtained by exposing it to the vapors of Br, I., Cl., or Fi; also potassium, allotropic silver (namely silver in a form such as may be obtained by reducing silver chloride by zinc or by electrolysis), all these substances being of the negative class. We may use these substances for the purposes of the present invention, but it will be understood that they are merely given by way of example, and that the invention is not limited to apparatus in which they are employed.

According to the present invention we may also use as the sensitive agent of the apparatus a sensitive substance, positive or negative in the sense above defined, which does not of itself give a charasteristic curve of the kind described, and therefore does not possess the property that its molecular structure returns to its normal state upon the cessation of the impressed radiation, and we may, by subjecting or exposing such substance to the action of various mechanical or other agencies, impart to said substance the molecular recovering property in question. For example we may subject or expose the sensitive agent to annealing, to heat, to mechanical treatment, to increase or reduction of pressure, to the stimulating or depressing action of gases or vapors, as for example NH_3 or CO_2, to the occlusion of gases in the sensitive substance, to electrolysis, to washing with various fluids; or we may obtain the result by creating a vacuum in a receptacle containing the sensitive substance and adjusting said vacuum until the critical point is obtained; or we may obtain the desired result by adjusting the E.M.F. till the critical point is reached.

We will describe apparatus embodying the invention but it will be understood that this is merely typical and that the invention is not limited thereto.

According to one way of carrying out the invention, two horizontal arms of electrically conducting material are mounted upon a pivot at a point intermediate between them. The inner extremities of the arms are bifurcated and carry contacting pieces of a suitable positive or negative substance sensitive to light waves, Hertzian waves or other radiations and giving or caused to give the characteristic curve before mentioned and thus having the property of molecular recovery above described, such for example as the positive substances galena ar tellurium. One of the contact pieces may be cylindrical in shape and of uniform dimensions; the other piece may taper to a point. The two contacts are normally held together by a spring suitably disposed between the arms, the pressure of which can be regulated with great delicacy by means of a micrometer screw provided for the purpose. The arms are insulated from each other except at the point of contact of the sensitive material by any suitable means. The arms and their spring are fitted in a tube of ivory or other insulating material this being in turn inserted in the tubular extension of a hemispherical or other suitably shaped open metallic casing which may conveniently constitute a reflector.

When the apparatus is intended to be used for the reception of light waves, the open casing above mentioned may be enclosed in a wooden or other shell of spherical or other form which may for convenience be made in sections adapted to be connected together by any suitable means. A chamber is thus constituted, in the wall of which a lens may be placed.

A female thread is provided for the micrometer screw at a suitable point of the tubular extension above mentioned, the micrometer screw passing down through or escaping the end of the insulating tube and bearing upon the upper contact carrying arm. The micrometer screw should have an insulating head. By turning the micrometer screw the pressure of the spring may be adjusted with great nicety to adjust the force of contact between the sensitive contacts.

Wires preferably insulated lead respectively from the arms and pass out through a cork or other plug fitted in the end of the tubular extension. By means of these wires the arms and contacts may be connected up in the circuit of an electric battery or other source of electricity in which a sensitive galvanometer or other electric indicating or recording apparatus is interposed.

The sensitive contacts may project to any desired extent into the chamber constituted by the wooden or other casing before described.

The insulating tube with the arms and contacts may be movable in the tubular extension in which they are fitted for the purpose of focussing the contacts with respect to the lens employed.

By placing an ordinary glass lens in the opening in the wall of the said chamber opposite the sensitive contacts of the instrument and by throwing light upon this lens an immediate response is observed in the galvanometer, the needle of which is deflected in accordance with the spectral properties of the light thrown upon the sensitive contacts or artificial retina. With a glass lens the instrument will detect and record lights not only some way beyond the violet, but also in regions far below the infra-red, in the invisible of electric radiation. We may thus style the apparatus a "tejometer" (Sanscrit tej = radiation), or universal radiometer.

Instead of using an ordinary glass lens as above described, we may use a water lens, and in this case the range of what we may term the "spectral vision" of the instrument may be reduced to a level which more nearly corresponds to that of the human eye, the water lens absorbing the naturally invisible radiations before they reach the sensitive substances of the instrument corresponding to the retina *viva*.

By removing the metallic casing and its extension and the lens carrying casing before mentioned the instrument may be used as a detector or so called coherer for wireless or other telegraphy or other radiations.

The apparatus hereinbefore described has or is caused to have the property of molecular recovery, that is to say, that the molecular distortion produced in the sensitive contacts by a wave or radiation caused to impinge thereon ceases upon the cessation of the wave or radiation, and leaves the molecules in *in statu quo ante*.

Dated this 14th. day of September 1901.

MEWBURN, ELLIS & PRYOR,
70 Chancery Lane, London. W.C.,
Chartered Patent Agents.

COMPLETE SPECIFICATION.

"Improved Means or Apparatus for Detecting or Indicating Light Waves, Hertzian Waves and other Radiations."

We, JAGADIS CHUNDER BOSE, Professor at the Presidency College, Calcutta, India, and SARA CHAPMAN BULL, of 168, Brattle Street, Cambridge, Massachusetts, United States of America, Widow, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement;—

This invention has reference to means or apparatus for detecting or indicating light waves, Hertzian waves and other radiations.

The apparatus to which the present invention relates, when arranged for use with light waves, may be regarded as an artificial retina. By suitably modifying the arrangement, however, as hereinafter described, it may be used as a coherer or detector of Hertzian waves for the purposes of wireless or other telegraphy, or for the reception of other radiations.

The inventor has found that certain substances, when exposed to Hertzian waves, light waves or other radiations, have the property of presenting a decreasing resistance to the passage of an electric current as the intensity of said radiation increases; also that other substances have the opposite property, namely they present an increasing resistance to the passage of electricity as the intensity

of the radiation increases. We style substances of the former class "positive," and substances of the latter class "negative."

The positive or negative effect is, we believe, due to a distortion of the molecular structure of the substances under the action of the radiation impressed thereon.

Both classes of substances, when suitably disposed, as for example in the instrument hereinafter described, will respond to, and may be caused to indicate light waves, Hertzian waves, or other radiations, by means of a galvanometer or other suitable electrical indicating or recording apparatus. The distortion produced by the impression of a radiation upon many sensitive substances, however, has the result of producing a permanent distortion; until this distortion is removed the receiver cannot respond to fresh action of radiation.

In order that the apparatus to which this invention relates shall work to the best advantage, it is desirable that the molecular distortion, whether positive or negative, produced by the light waves or other radiation, shall not only be readily detected and indicated, but also that the molecular structure of the substances shall return rapidly to its normal state upon the cessation of the impressed radiation.

We have found that certain substances have this additional property:

Substances possessing this property of molecular recovery give a characteristic curve (expressing the relation between an increasing impressed E. M. F. and the resultant current passing through the sensitive substance) which is not straight, but either convex or concave to the axis of E.M.F. in which the return curve with a decreasing E. M. F. when taken slowly, approximately coincides with the former curve. We may mention as examples of substances which possess the property of self-recovery and give a characteristic curve of the kind just described, galena and tellurium, these being positive in sense above defined. Also brominated, iodated, chlorinated or fluorinated lead or tin, that is to say lead or tin in a condition such as can be obtained by exposing it to the vapors of Br., I, Cl, or F; also potassium, allotropic silver (namely silver in a form such as may be obtained by reducing silver chloride by zinc or by electrolysis), all these substances being of the negative class. We may use these substances for the purposes of the present invention, but it will be understood that they are merely given by way of example, and that the invention is not limited to apparatus in which they are employed.

The apparatus to which the present invention relates comprises contacting members composed of a sensitive substance or substances, positive or negative in the sense above mentioned, possessing the property of rapidly and automatically recovering from the effect of an impressed radiation upon the cessation thereof. These contacting members are mounted on or carried by suitable arms or supports and arranged in such manner as to be capable of being connected up in an electric circuit with a battery or other source of electricity and an electrical indicating or recording device, so that when exposed to electrical disturbances, light waves, Hertzian waves or other electric disturbances, the variation of electrical conductivity produced in said contacts by the impressed radiation shall be indicated or recorded by said indicating and recording device. By reason of the nature of the sensitive substance of which the said contacting members are composed as before described, the molecular distortion produced by the impressed radiation on said contacts rapidly and automatically disappears upon the cessation of said radiation, the contacts returning rapidly to their normal sensitive condition ready for the reception and detection of fresh radiations.

The invention will be understood from the following description of one form of instrument or apparatus embodying the same, reference being had to the accompanying drawings. It will be understood that the instrument described and illustrated is given by way of example and that the invention is not limited to the exact details of construction described and shown.

In the drawings Figure 1 is a diagrammatic view showing the instrument

partly in longitudinal section connected up in an electric circuit with a galvanometer as hereinafter described.

Figure 2 is a part longitudinal section of the instrument showing the contact carrying arms, contacts and mechanism of the instrument.

Figure 3 is a vertical section on the line *a—b* of Figure 2.

1, 2 are horizontal arms of electrically conducting material mounted upon a pivot 3 at a point intermediate between them. For this purpose the arms 1, 2 each carry hinge or pivot cheeks 8, 9 of insulating material. The inner extremity of each arm 1, 2 is bifurcated and in the respective bifurcations are fitted contacting pieces 4, 5 of a suitable positive or negative substance sensitive to light waves, Hertzian waves or other radiations and giving the characteristic curve before mentioned and thus having the property of molecular recovery above described, such for example as the positive substances galena or tellurium. As shown the contact pieces 4, 5 may be cylindrical in shape, one of them may be of uniform dimensions while the other piece may taper to a point. The contacts 4, 5 are normally held together by a spring 6 disposed between the arms 1, 2 and the pressure of which can be regulated with great delicacy by means of a micrometer screw 7 provided for the purpose. The pivoted arms 1, 2 and their spring are fitted in a tube 10 of ivory or other insulating material, this being in turn inserted in the tubular extension 11 of a hemispherical or other suitably shaped open metallic casing 12 which may conveniently constitute a reflector.

The tube 10 carries a pin 10^a engaging in a bayonet slot 11^a of the extension 11, to enable the tube 10 to be readily inserted and secured in said extension, or any other suitable means may be provided with the same object as will be readily understood. The part 12 of the instrument may be enclosed as shown in a wooden or other shell 12^a, 12^b of spherical or other form and which may for convenience be made in sections adapted to be connected together by pins fitting into suitable holes as shown. A chamber 12^c is thus constituted. A hole is provided in the section 12^b of this chamber in which a lens may be placed as hereinafter described.

By means of the insulating cheeks 8, 9, tube 10 and insulating bearing surface 14 of the spring 6, the conducting arms 1, 2 are insulated from exterior objects and from each other except at the point of contact of the sensitive contacts 4, 5.

A female thread is provided at a suitable point of the extension 11 to receive the micrometer screw 7, this screw passing down through or escaping the end of the insulating tube 10 and bearing upon the upper arm 1. The micrometer screw should be provided with an insulating head. By turning the screw 7 the pressure of the spring 6 may thus be adjusted with great nicety in order to adjust the force of contact between 4 and 5.

Wires 15, 16, preferably insulated wires, lead respectively from the arms 1, 2 and pass out through a plug 17 of cork or other insulating material fitted in the end of the extension 11. By means of these wires the arms 1, 2 and contacts 4, 5 may be connected up in the circuit of an electric battery or other source of electricity 18, in which circuit a sensitive galvanometer 19 for example a dead beat d'Arsonval galvanometer is interposed as an indicator. Instead of a galvanometer, other suitable electric indicating or recording apparatus may be used.

The contacts 4, 5 may project to any desired extent into the chamber 12^c according to the focus of the lens fitted in the opening therein or for other purpose. The tube 10 with the arms 1, 2 may be movable in the extension 11 for the purpose of focussing the contacts 4, 5 with respect to the lens employed.

By placing an ordinary glass lens 13 in the opening in the wall of the case section 12^b opposite the sensitive contacts 4, 5 of the instrument and by throwing light upon this lens an immediate response is observed in the galvanometer, the needle of which is deflected in accordance with the spectral properties of the light thrown upon the sensitive contacts or artificial retina. With a glass lens,

the instrument will detect and record lights not only all kinds of visible lights, but also others in regions far below the infra-red, in the invisible regions of electric radiation. We may thus style the apparatus a "tejometer" (Sanscrit "tej-" = radiation), or universal radiometer.

Instead of using an ordinary glass lens as above described, we may use a water lens, and in this case the range of what we may term the "spectral vision" of the instrument may be reduced to a level which more nearly corresponds to that of the human eye, the water lens absorbing the naturally invisible radiations before they reach the sensitive substances of the instrument corresponding to the retina viva.

By removing the metallic and wooden casings and lens, the instrument may be used as a detector or so-called coherer for wireless telegraphy or other radiations.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed we declare that what we claim is:—

1. Apparatus for detecting or indicating electrical disturbances, light waves, Hertzian waves or other radiations comprising contacting members of a sensitive substance or substances which will give a characteristic curve of the kind hereinbefore specified and positive or negative in the sense defined, said contacting members carried by suitable supports and arranged in such manner as to be capable of being connected up in an electric circuit with a source of electricity and an electric indicating or recording device, substantially as described.

2. In apparatus of the kind specified in Claim 1, and comprising sensitive contacts of the character therein stated, means for holding said contacts together and means for adjusting their force of contact, substantially as described.

3. In apparatus of the kind specified in Claim 1 and comprising sensitive contacts of the character therein stated the combination with said sensitive contacts of conducting arms or devices carrying same means for holding said contacts together, means for adjusting force of contact of said contacts and means for insulating said conducting arms or devices from each other except at the point of contact of said contacting members and from external objects, substantially as and for the purpose specified.

4. In apparatus of the kind specified in Claim 1 and comprising sensitive contacts of the character therein stated, the combination with said sensitive contacts of conducting arms carrying same, said arms being pivotted together, a spring tending to hold said contacts together, a micrometer screw or equivalent means adapted to adjust the force of said spring and therefore the force of contact of said contacting pieces, means for insulating said arms from each other except at the contacting point of said contacts and an insulating tube or sheath containing said arms, substantially as described.

5. In apparatus for detecting light waves the employment in combination with sensitive contacts of the character and arranged in the manner specified in Claims 1, 2, 3 or 4, of a glass lens or a water lens disposed to direct light rays upon said sensitive contacts, substantially as described.

6. In apparatus for detecting light waves, contacting members of sensitive substance or substances which will give a characteristic curve of the kind hereinbefore specified and positive or negative in the sense defined, said contacting members being in combination with conducting arms carrying same, said arms being pivotted together, a spring tending to hold said conducting arms together, a micrometer screw adapted to adjust the force of said spring and therefore the force of contact of said contacting pieces, an insulating tube in which said arms and spring are fitted, means for insulating said arms from each other, a chamber into which said contacting members project and a glass or a water lens disposed in said chamber to direct light rays on said contacts substantially as described.

7. In apparatus of the kind specified in the preceding claims, sensitive contacting members of galena, tellurium, potassium, allotropic silver, or brominated, iodated, chlorinated or fluorinated lead or tin substantially as described.

8. In combination with apparatus of the kind specified in the preceding claims and comprising sensitive contacts of the character stated, a galvanometer or other electrical indicating or recording device and a battery or other source of electricity substantially as described.

9. Apparatus for receiving or receiving and indicating light waves constructed arranged and adapted for operation substantially as described and illustrated in the accompanying drawings.

10. The apparatus substantially as described and illustrated in the accompanying drawings in its adaptation for the reception of Hertzian waves and other radiations other than light rays, substantially as described.

Dated this 16th. day of June, 1902.

MEWBURN ELLIS & PRYOR.
70 & 72, Chancery Lane, London, W.C.
Chartered Patent Agents.

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ROSE & *another's* COMPLETE SPECIFICATION. *(1 SHEET)*

Fig. 1.

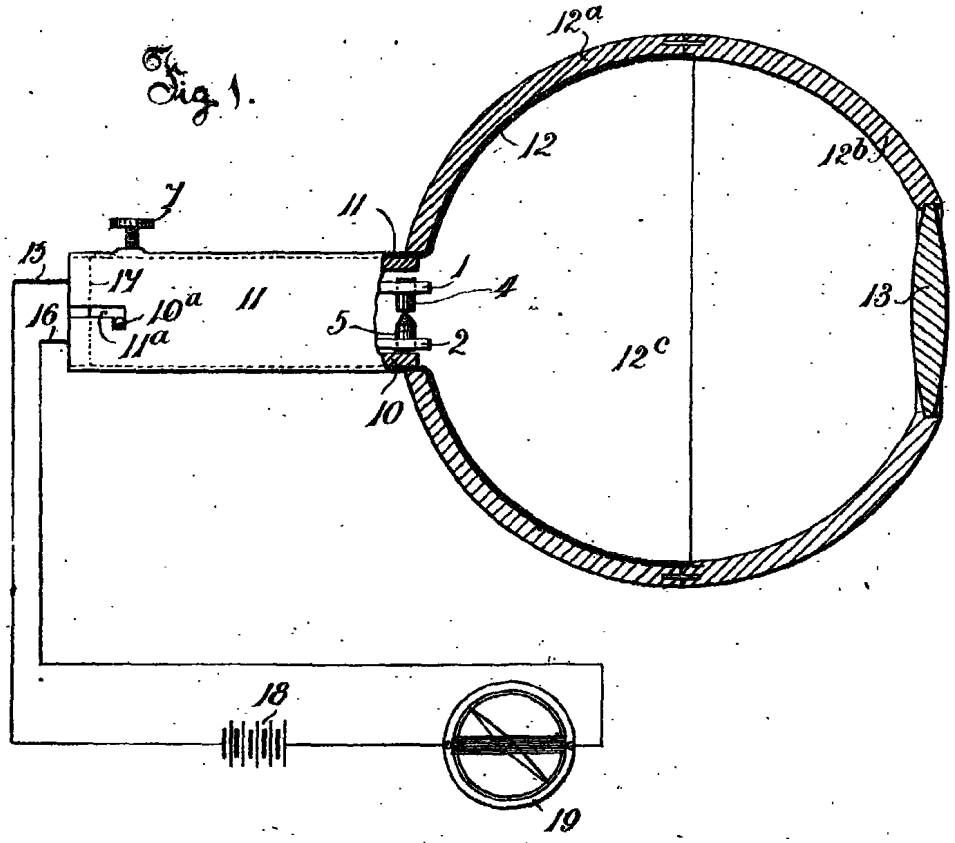


Fig. 3.

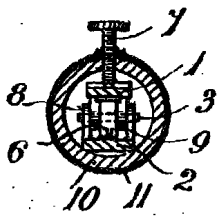
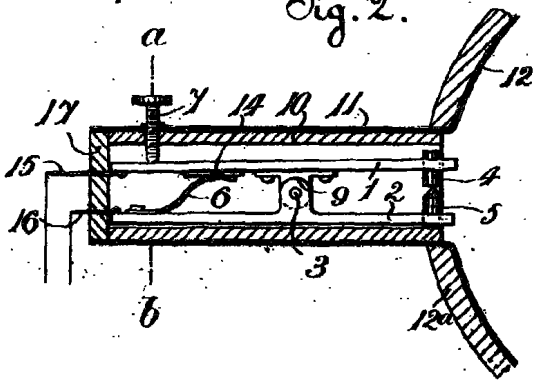


Fig. 2.



[This Drawing is a reproduction of the Originalon a reduced scale]