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O. J. LODGE, A. MUIRHEAD & E. E. ROBINSON.

RECEIVER FOR WIRELESS TELEGRAPHY.

APPLICATION FILED JULY 28, 1902.

NO MODEL.

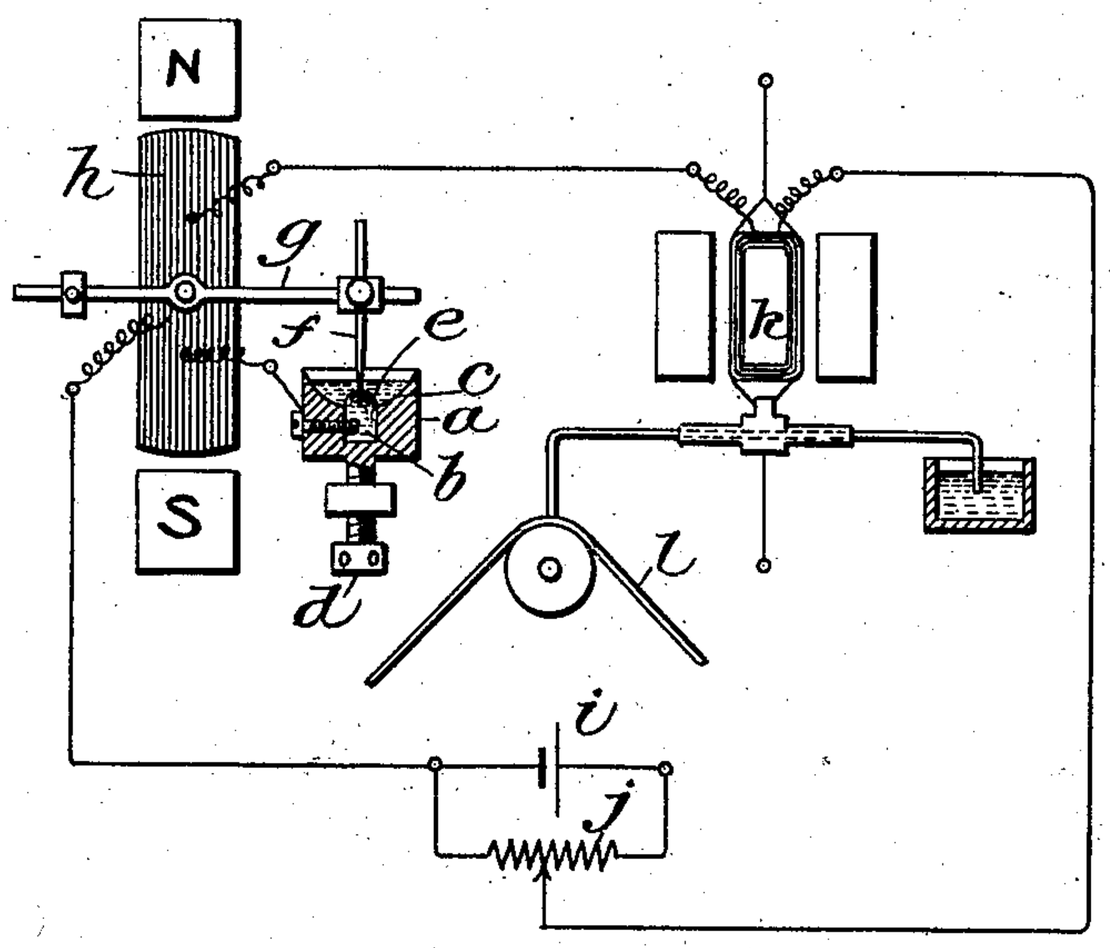

Fig. 1.

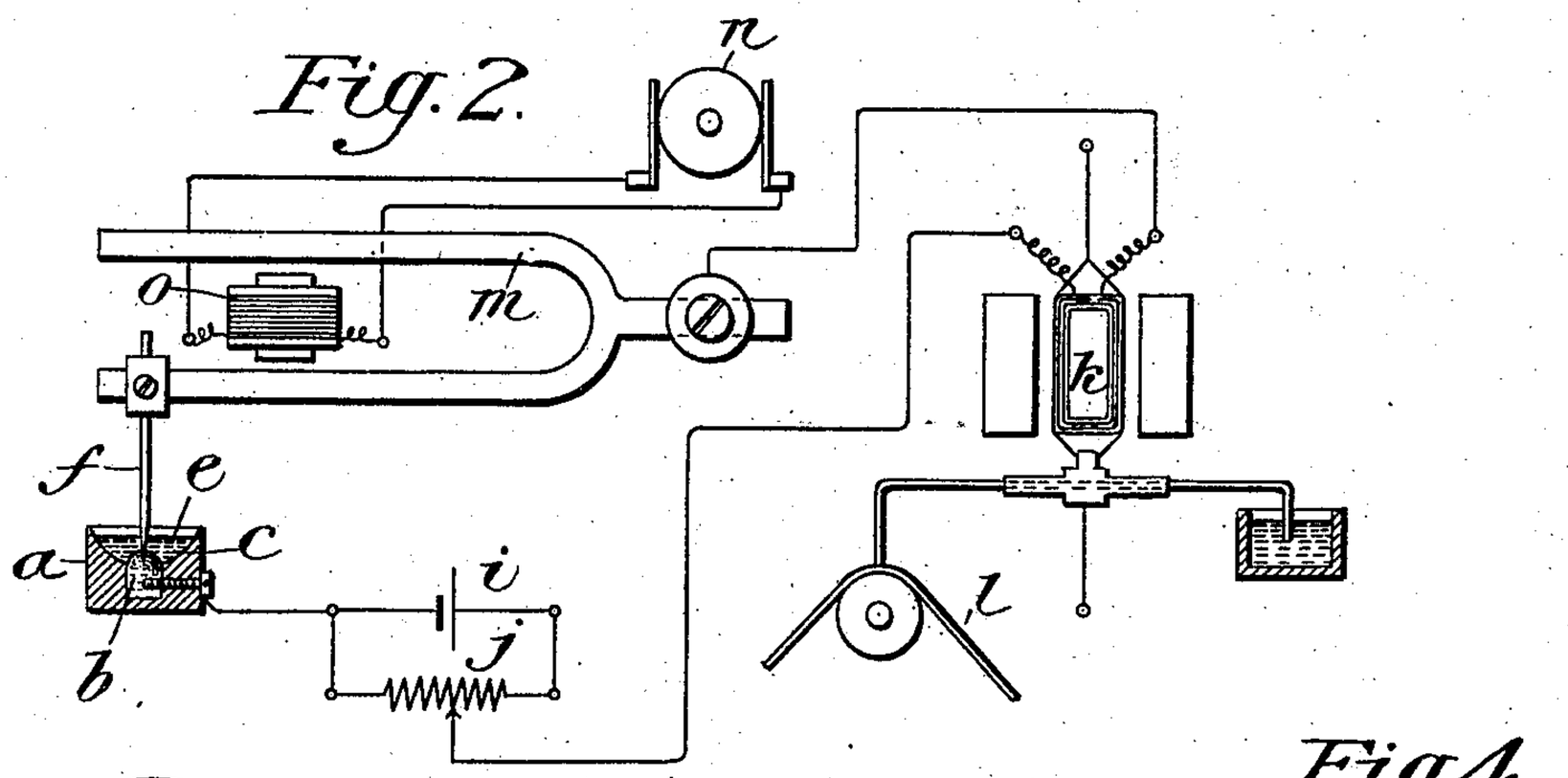

Fig. 2.

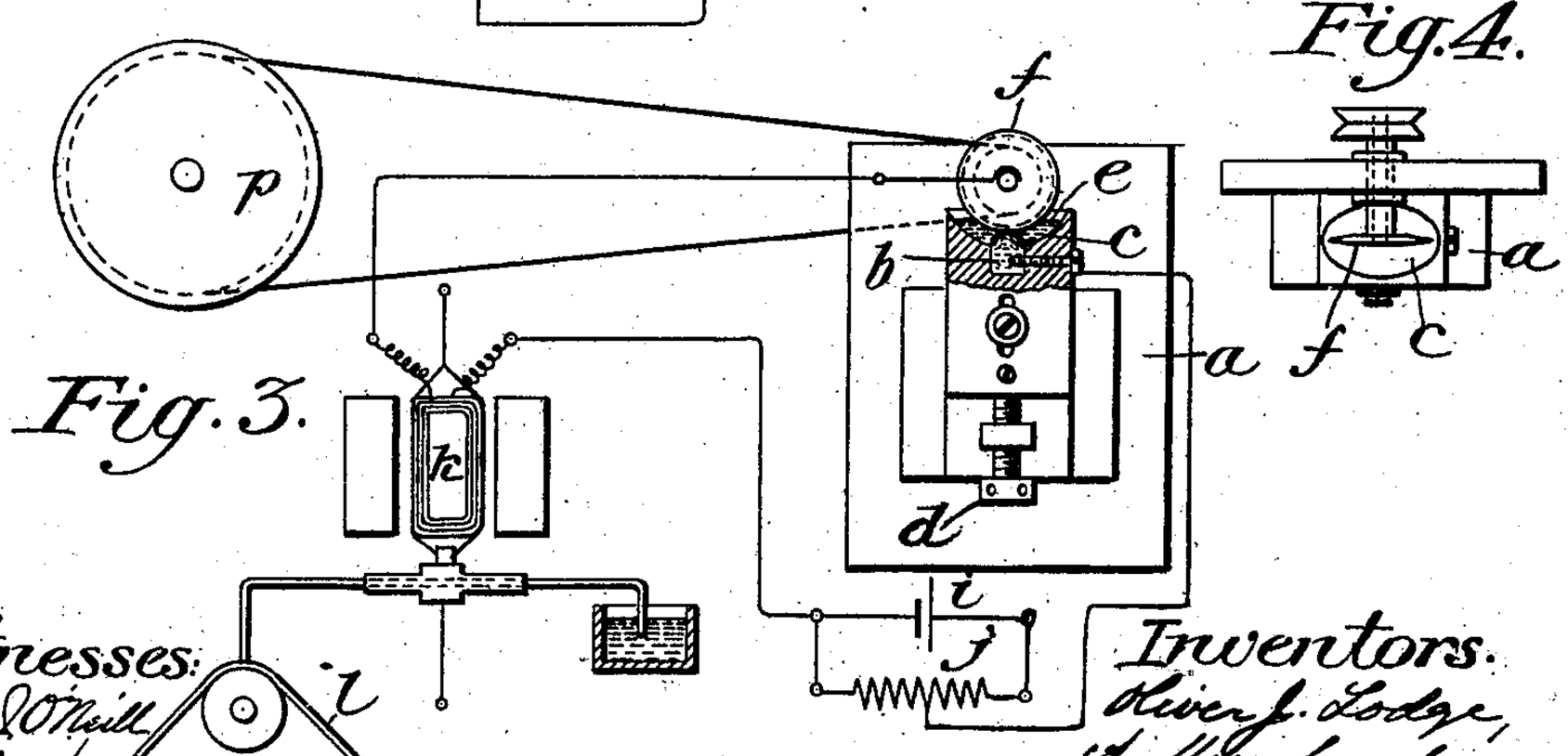

Fig. 3.

Fig. 4.

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No. 762,829. Patented June 14, 1904.

UNITED STATES PATENT OFFICE.

OLIVER JOSEPH LODGE, OF BIRMINGHAM, ALEXANDER MUIRHEAD, OF SHORTLANDS, AND EDWARD ERNEST ROBINSON, OF BIRMINGHAM, ENGLAND.

RECEIVER FOR WIRELESS TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 762,829, dated June 14, 1904.

Application filed July 28, 1902. Serial No. 117,306. (No model.)

To all whom it may concern:

Be it known that we, OLIVER JOSEPH LODGE, residing at Birmingham, in the county of Warwick, ALEXANDER MUIRHEAD, residing at Shortlands, in the county of Kent, and EDWARD ERNEST ROBINSON, residing at Birmingham, in the county of Warwick, England, subjects of His Majesty the King of Great Britain, have invented new and useful Improvements in Receivers for Wireless Telegraphy, of which the following is a specification.

Our invention relates to detectors or receivers such as are employed in systems of wireless or ethereal telegraphy.

In coherers as hitherto constructed it has been customary to depend on the imperfect contact due to the natural film of oxid or other material which exists on most metals and which acts as the intervening layer, preventing full conduction between a pair of metal pieces brought into light contact in some random or unmetrical manner. Sometimes a contact between a spring pressing lightly on a point has been utilized, as disclosed by us in the prior patent, No. 674,846, granted to one of us. More usually the accidental light and imperfect contact between the particles in an assemblage of metal filings, as suggested by Branly, has been employed. In each case the electrical disturbance due to the impact of ethereal waves has resulted in "coherence" and increased conductivity in the coherer, and "decoherence" has been occasioned by agitation or tapping. All coherers depending upon imperfect or light contact between bodies are subject to variation of sensitiveness and require frequent adjustment or renewal.

According to our present invention we propose to dispense with the use of imperfect contacts in the construction of detectors or receivers and to use a thin film of some insulating material to separate the conducting masses which compose the detector or receiver of ethereal waves and to obtain in a definite manner the light pressure desirable when the maximum sensitiveness is required. To this end we employ as the insulating-film a thin layer of paraffin-oil or similar insulating substance interposed between two metallic or conducting surfaces and frequently renewed, and for the pressure we depend on the hydrostatic pressure of a column of liquid, preferably employing mercury or other conducting fluid as one of the two conductors, the other one being solid and plunged to a given depth in the mercury or its equivalent. To apply the film of oil, a layer of oil is placed upon the mercury, so that when the solid metal, preferably in the form of a platinum or iron point or a metallic wheel, is immersed to a small depth into the mercury it carries down with it a superficial film of oil. When the platinum or iron point or wheel is immersed into the mercury, the depth of immersion must be slight, so that there may be as little capacity as possible between the two conductors, the insulating-film employed acting as a perfect insulator or dielectric between the two. The smaller the capacity of the detector or receiver the more sensitive it will be to the ethereal waves. The immersion of the point or wheel, as we have hereinbefore explained, is for the purpose of obtaining a desirable thin and sensitive film. Although it is feasible to receive signals without actual immersion of the point or wheel into the mercury, yet the insulating-film in such instance would necessarily be considerably thicker, requiring more battery-power to break it down, which is correspondingly undesirable. For this reason we prefer to obtain a thinner film by immersion, making use of the hydrostatic pressure of the mercury for that purpose and enabling us to use much lower voltage. We find that so long as a feeble voltage is applied (say three-tenths of a volt or less) the film is strong enough permanently to resist the passage of a current, but that whenever the electromotive force rises to, say, one volt or more, as it does at once for an instant if a spark has occurred in the neighborhood or if electric waves have been received from a distant station, then the film is broken down, easy conduction is caused, and a signal is recorded. To restore the continuity of the film again, motion is sufficient, and one of the simplest

plans is to withdraw the metal point from the mercury into the supernatant layer of oil and immediately thereafter to plunge it back into the mercury. This withdrawal and reimmersion is very easily accomplished automatically either by mechanical or electrical means or by the action of the current which the broken-down film itself transmits or otherwise, the reimmersion of the point following instantly on the cessation of the current by the restoration of the film. Obviously this motion may be effected in any appropriate manner, whether by rotation or translation or vibration. For instance, the immersed conductor might be the rim of a rotating wheel, or it might be supported on a vibrating body, such as the prong of a tuning-fork, or it might be simply depressed into the mercury and withdrawn therefrom by attachment to the siphon-recorder coil or other moving part affected electromagnetically by the signaling-current. The passage of a comparatively strong momentary current across the broken-down film is no detriment, since the film being liquid can be completely and certainly renewed. The metal used should be clean, free from any film of its own, and not liable to amalgamate with mercury.

In the accompanying drawings, which are diagrammatic representations, Figure 1 shows our new detector or receiver attached to a recorder-coil in the detector or receiver circuit. Fig. 2 shows it attached to a tuning-fork; and Figs. 3 and 4 illustrate the wheel form of it, Fig. 3 being an elevation and Fig. 4 a plan thereof.

Referring generically to the diagrams, one of the conducting surfaces or terminals of the detector or receiver *a* preferably takes the form of a pool of mercury *b*, contained in a trough *c*, the height of which may be adjustable by suitable means—as, for example, an adjustment-screw *d*. *e* represents the layer of paraffin-oil or like fluid insulator. The other conductor, *f*, of the detector or receiver may either be arranged to dip into and out of the mercury through the supernatant fluid insulator or some portion of it may be constantly passing from the fluid insulator into the mercury and from the latter into the insulator again. In the first example this metallic surface *f* may take the form of a dipping-needle, (see Figs. 1 and 2,) and in the second example it may conveniently take the form of a rotating disk. (See Fig. 3.) In each instance it will be seen that the conducting-surface *f* enters the mercury *b* with a film of the fluid insulator *e* adhering to it and that by reason of the motion imparted to such conducting-surface such film is being constantly renewed. The motion given to the part *f* may be obtained from any source and by any suitable instrumentality, either from the detector or receiver circuit itself or extraneously.

Referring now specifically to Fig. 1, *f* is a steel or platinum needle attached to an arm *g*, carried by a recorder-coil *h*—*i. e.*, a rectangular coil of insulated copper wire pivoted or suspended between the poles of a magnet N S. Beneath the needle is placed the trough *c*, containing a pool of mercury *b*. The layer of paraffin-oil *e* is poured upon the mercury *b* and the trough adjusted by means of the screw *d* until the needle-point *f* just enters the mercury *b*. A suitable portion of the voltage of the single cell *i* is applied to the detector or receiver *a* by shunting the cell with a resistance *j* and making connections at one pole of the cell and at an intermediate point on the shunt or in any other convenient way or by employing a cell or source of low voltage. In the figure the cell *i* is shown joined up between the mercury pool *b* of the detector or receiver and one terminal of the coil *k* of a siphon-recorder. The recorder *k* is in series with the recorder-coil *h* and the needle *f* of the detector or receiver connected to one terminal of the latter. So long as the amount of voltage applied to the detector or receiver is about three-tenths of a volt or less the thin film of oil between the needle-point *f* and the mercury *b* will prevent the passage of an appreciable current through the coils *h k;* but on the arrival of ethereal waves from a distance the voltage between the needle-point and the mercury is instantaneously and temporarily increased sufficiently to break down the oil film and allow a current to flow across it from the battery *i*, the result being a deflection of the recorder-coil *k*, producing a signal on the tape *l*, and a deflection of the coil *h* in the direction to raise the needle-point *f* out of the mercury *b*. This withdrawal of the needle-point *f* from the mercury *b* and reimmersion in the same on the cessation of the current through the coil *h* restores the continuity of the thin film between the needle-point and the mercury and prepares the detector or receiver for a succeeding electric wave or signal.

In Fig. 2 the needle-point *f* is shown attached to a vibrating body. The figure shows it so attached to one of the prongs of a tuning-fork *m*, which is kept vibrating by means of an alternating or intermittent current (generated by an alternator *n* or self-acting intermitter as usually arranged) flowing through a bobbin of wire *o*, placed between the prongs of the fork. The vibration of the needle-point *f* in the mercury *b* thus produced restores the continuity of the film of oil immediately after the breaking down of the latter by ethereal waves from a distance or a spark in the neighborhood.

In Figs. 3 and 4 the conducting part *f* is shown in the form of a disk or wheel slightly immersed in the mercury *b*. The constant rotation of the wheel, effected by such means as a clockwork-train, (represented diagram-

matically at p,) brings about the restoration of the continuity of the oil film between the wheel and the mercury after the breaking-down action of ethereal waves received from a distance, as in the two former cases, Figs. 1 and 2. The amount of pressure of the mercury upon the disk or wheel is regulated by means of the screw d, fixed beneath the trough which contains the mercury, so as to raise or lower it, and so regulate the immersion.

In Figs. 2 and 3 the circuit connections indicated will be understood without further explanation.

What we claim, and desire to secure by Letters Patent of the United States, is—

1. In combination, in a wave detector or receiver, two conducting-surfaces, a film of fluid insulating material between such surfaces capable of being broken down upon the occurrence of an ethereal wave, and means serving to renew such film.

2. In combination, in a wave detector or receiver, two conducting-surfaces, a film of fluid insulating material between such surfaces, and means serving to impart motion to one of said conducting-surfaces for the purpose of restoring the continuity of said film whenever it is broken down by an ethereal wave.

3. In combination, in a wave detector or receiver, two conducting-surfaces one of which is solid and the other of which is fluid, a film of insulating material between such surfaces capable of being broken down upon the occurrence of an ethereal wave, and means serving to renew such film.

4. In combination, in a wave detector or receiver, two conducting-surfaces one of which is solid and the other of which is fluid, a layer of fluid insulating material upon said fluid conductor, means serving to immerse the solid conductor into the fluid one so that a film of said fluid insulating material is between said conductors, and means serving to renew the last-mentioned film whenever it is broken down by an ethereal wave.

5. In combination, in a wave detector or receiver, two conducting-surfaces one of which is solid and the other of which is mercury, a layer of fluid insulating material upon said mercury, means serving to immerse the solid conductor into the mercury so that a film of said fluid insulating material is between said conductors, and means serving to renew the last-mentioned film whenever it is broken down by an ethereal wave.

6. In combination, in a wave detector or receiver circuit, a battery, a resistance-shunt around said battery, and a wave detector or receiver comprising two conducting-terminals separated by a renewable film of fluid insulating material.

7. In combination, in a wave detector or receiver, two conducting-surfaces, a film of fluid insulating material between such surfaces, and means extraneous from the circuit of said wave detector or receiver, serving to restore the continuity of said film whenever it is broken down by an ethereal wave.

8. In combination, in a wave detector or receiver, two conducting-surfaces, a film of fluid insulating material between such surfaces, a rotary body to which one of said conducting-surfaces is attached, and means to rotate said body whereby the continuity of said film is restored after having been broken down by an ethereal wave.

9. In combination, in a wave detector or receiver, a trough, a pool of mercury forming one terminal of the wave detector or receiver in said trough, a layer of fluid insulating material above said mercury, a disk forming the other terminal of the wave detector or receiver located partly within said mercury and said fluid insulating material respectively, and means to rotate said disk so that the continuity of the said film is restored after having been broken down by an ethereal wave.

10. In an apparatus for communicating electrical signals by means of a producer of ethereal waves, the combination, in the receiver, of two conductors normally kept out of contact by an intervening dielectric, a circuit including said conductors, and a receiving instrument operated by the breaking-down influence of the ethereal waves on the dielectric, substantially as and for the purpose described.

In testimony whereof we have hereunto subscribed our names in the presence of two witnesses.

OLIVER JOSEPH LODGE.
ALEXANDER MUIRHEAD.
EDWARD ERNEST ROBINSON.

Witnesses to the signature of Oliver Joseph Lodge:

ALFRED BRISCOE,
BENJAMIN DAVIES.

Witnesses to the signatures of Alexander Muirhead and Edward Ernest Robinson:

A. J. SPOONER,
J. S. WITHERS.