No. 767,997. PATENTED AUG. 16, 1904.

J. S. STONE.

SPACE TELEGRAPHY.

APPLICATION FILED FEB. 15, 1904.

NO MODEL.

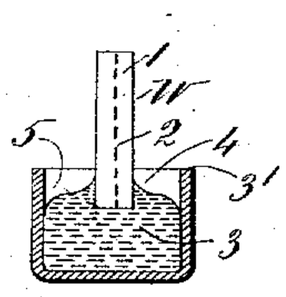

Fig. 1.

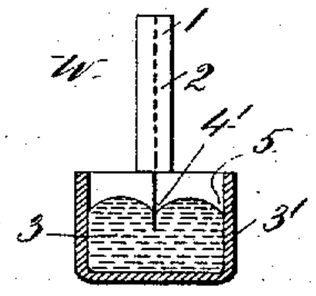

Fig. 2.

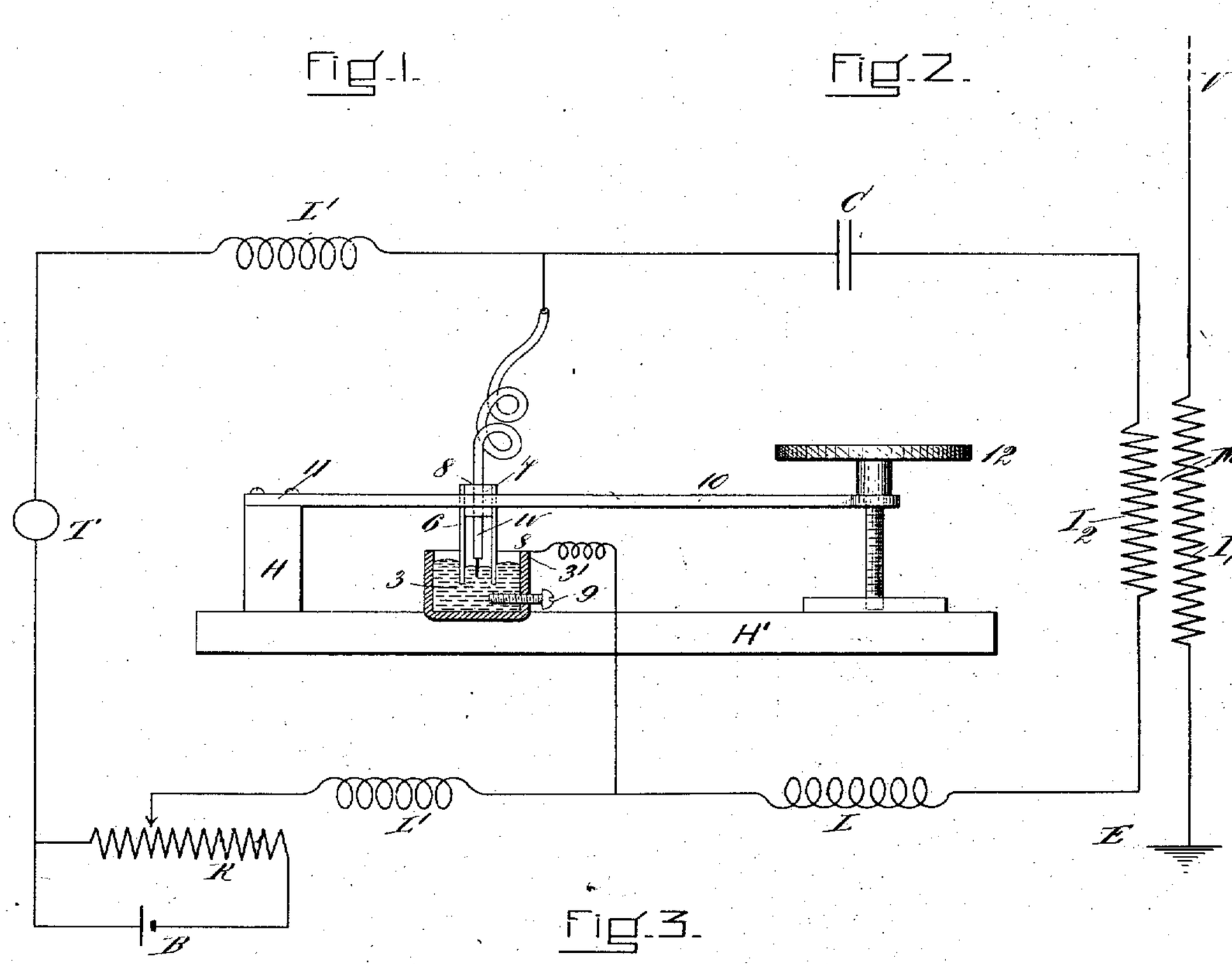

Fig. 3.

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No. 767,997. Patented August 16, 1904.

UNITED STATES PATENT OFFICE.

JOHN STONE STONE, OF CAMBRIDGE, MASSACHUSETTS, ASSIGNOR TO WILLIAM W. SWAN, TRUSTEE, OF BROOKLINE, MASSACHUSETTS.

SPACE TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 767,997, dated August 16, 1904.

Application filed February 15, 1904. Serial No. 193,592. (No model.)

To all whom it may concern:

Be it known that I, JOHN STONE STONE, a citizen of the United States, and a resident of Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Space Telegraphy, of which the following is a specification.

This invention relates to space or wireless telegraphy by electromagnetic waves in the form of electroradiant energy; and it relates more particularly to methods of making electroreceptive devices which are adapted to utilize in their operation the dissipative energy of the electrical oscillations or oscillatory electric currents developed by electromagnetic waves in the circuits in which such devices are included. Electroreceptive devices of such character have long been known for detecting and measuring the energy of electromagnetic waves, and they are generally known as "bolometers." In my application Serial No. 119,211, filed August 11, 1902, I have described the application of such electroreceptive devices to selective electric signaling and have therein claimed the same broadly. In my application Serial No. 182,628, filed November 25, 1903, I have described and claimed a specific form of such electroreceptive device and a particular form of space-telegraph receiving system in which the same may be employed. In said applications I have pointed out that in order to be rapidly responsive to changes in thermal condition—*i. e.*, in order to be sensitive—the fine wires or strips of such bolometers should be of small thermal time constant compared to the thermal time constants of the bolometers heretofore used for experimental purposes, and that in order to be of such small thermal time constant the fine wires or strips should be of small mass—*i. e.*, of small length and small section—should be of a material of low specific heat and that the heat insulation of the fine wires or strips should not be too perfect. I have also pointed out that for greater efficiency the bolometer fine wires or strips should be of high-resistance temperature coefficient and of high specific resistance. I have also shown that as the oscillatory electric currents developed in the receiving-conductors of space-telegraph systems are of small amplitude it is necessary to employ some means whereby the currents developed in the receiving system by electromagnetic waves may be amplified in order that an appreciable amount of energy may be dissipated in the bolometer wire or strip without making the latter of excessively-high resistance. For amplifying the currents developed in the receiving system by electromagnetic waves of a definite predetermined frequency I have described a resonant circuit or a group of resonant circuits attuned to such frequency. The resonant circuits strongly oppose the development therein of currents of frequencies different from that to which they are attuned, so that by means of such resonant circuits the bolometer fine wires or strips are protected from extraneous electrical forces which might otherwise destroy them.

The present invention may be best understood by having reference to the drawings which accompany and form a part of this specification and which illustrate an apparatus whereby the herein-described method of making an electric receptive device adapted for use in receiving space-telegraph signals may be conveniently carried out. My invention, however, is broader than mere apparatus and is capable of being carried into effect in a variety of ways, while the particular apparatus herein illustrated forms no part of the present invention, having been claimed in my application Serial No. 193,591, filed simultaneously herewith.

In the drawings, Figures 1 and 2 illustrate, respectively, the first and second stages in the formation of the bolometer herein described, and Fig. 3 represents the completed bolometer and its accessory apparatus connected in a space-telegraph receiving system.

In the figures, W represents a short length of wire known as "Wollaston" wire, greatly magnified. The method devised by Dr. Wollaston for producing this wire consists in incasing a fine platinum wire in silver, reducing the composite wire so formed, and then

dissolving away the silver casing with warm nitrous acid. In this way wire of diameter as small as one fifty-thousandth of an inch was produced, as fully set forth in the *Encyclopædia Britannica* in an article entitled "Wire," to which all those wishing to practice my invention are referred for further details concerning the manufacture of wire suitable for use in the bolometer herein described, although such wire has long been in commercial use and may be obtained and, in fact, is usually obtained before the silver casing has been removed. As a wire suitable for use in the bolometer herein described I recommend those sizes of Wollaston wire in which the diameter of the inner wire is between .0001 inch and .00002 inch.

The method of giving to the platinum wire, which forms the fine wire of the bolometer herein described, the requisite short length, and consequently the desired small mass, in virtue of which the temperature of such fine wire may be appreciably elevated by small amounts of energy, is as follows: The Wollaston wire is immersed to any desired depth in a bath of mercury or mercury alloy 3, contained in a vessel 3′, such as an iron thimble. Inasmuch as mercury wets silver the meniscus formed with the silver coating 1 of the platinum wire 2 is concave, as shown at 4. This, as is well understood, is caused by capillary attraction and by the adhesion of the mercury to the silver. When mercury does not wet a metal—*i. e.*, when the metal is not soluble in mercury—the meniscus is convex, as shown at 5, where the mercury contacts the walls of the iron thimble. The effect of the mercury or the mercury alloy on the silver coating of the platinum wire is to form an amalgam therewith—*i. e.*, to dissolve the silver away from the platinum wire—thus exposing the platinum wire from the upper end of the concave meniscus 4 in Fig. 1 to the lower end of the convex meniscus 4′ in Fig. 2, formed by the mercury in contact with the platinum wire 2. It is a fact that mercury does not wet platinum—*i. e.*, does not dissolve it—so that its meniscus therewith is convex, as shown at 4′, Fig. 2, and it is also a fact that platinum has a greater specific gravity than mercury, so that the fine platinum wire is not forced out of the mercury. The length of the platinum wire from which the silver casing has been dissolved by the process above described, and which is thereby rendered effective as a bolometer fine wire, is very short, indeed, being, in fact, equal approximately to the sum of the lengths of the concave meniscus 4 and the convex meniscus 4′.

Although I have specially referred to Wollaston wire in this specification as a desirable means for obtaining the electrical conductor of small mass, yet I do not wish to confine myself to such specific means, because any wire or strip of small mass and of a metal not soluble in mercury or mercury alloy—*i. e.*, not wetted by the same—incased in a conductor soluble in the mercury or mercury alloy—*i. e.*, wetted by the same—can be substituted for the Wollaston wire, provided the specific gravity of the incased conductor be such that it will not be forced out of the mercury or mercury alloy. Gold possesses these characteristics, and therefore a composite wire formed of gold incased in silver or other ductile metal soluble in mercury or mercury alloy may be employed.

In Fig. 3 is shown a practicable embodiment of this invention. In this figure, H is a frame supporting an iron thimble 3′ or other vessel of a material not soluble in mercury, containing mercury or an alloy or amalgam thereof, 3. 9 is a screw threaded into the thimble 3′, whereby the level of the mercury in the thimble may be elevated or depressed. 10 is a flat spring rigidly attached to the frame H at point 11 and bearing upwardly at its extreme end upon the flange of a micrometer-screw 12, threading into the base H′, whereby the spring 10 may be depressed or elevated without lost motion. 6 is a glass tube rigidly attached to the spring 10 and containing a length of Wollaston wire W in its silver jacket. 7 is a stopper by which the Wollaston wire is sealed into the upper end of the tube. The tube 6 is desirable to protect the bolometer-wire from terrestrial vibration. 8 8 are conductors by which the bolometer fine wire or strip is connected in the resonant circuit C 8 8 L I_2. M is a step-down transformer by which said resonant circuit is associated with the elevated conductor V. I_1 and I_2 are respectively the primary and secondary windings of transformer M. R is a resistance, B is a battery, and T is a signal-indicating device, preferably a telephone-receiver connected across the bolometer-wire, and L′ L′ are choking-coils connected between the bolometer and the signal-indicating device T.

After the silver casing has been dissolved from the platinum wire, as above described, the length, and consequently the mass, of the platinum wire may be still further reduced by means of the micrometer-screw 12. The relative position of the screw 12 and the wire W with respect to the point of application of the spring 10 to the frame H permits an exceedingly-fine adjustment of the length, and consequently the mass of the bolometer fine wire, as the movement of the wire may by these means be made any desired fraction of the translational movement of the screw.

I do not wish to be limited to the form of apparatus herein described, as it is obvious that many changes may be made therein without departing from the spirit of my invention. For example, the micrometer-screw may be operatively connected with the vessel containing the mercury, so that the adjust-

ment of the mass of the bolometer fine wire or strip may be made without moving the wire or strip, but by moving the mercury with respect to said wire or strip. While I have herein specifically referred to the screw 12 as a "micrometer-screw," I desire to be understood as meaning thereby any screw of small pitch, whereby a considerable rotational movement is required to produce an appreciable translational movement. While I have described a particular form of spring for overcoming the lost motion of the screw 12, it will be understood that this form is merely one of many forms of spring which will accomplish this result.

I claim—

1. The method of making a bolometer wire or strip of small mass which consists in immersing the lower end of a length of platinum wire incased in silver in a bath of mercury or mercury alloy, thereby causing the mercury or mercury alloy to form a concave meniscus with the silver casing, dissolving away that part of the silver casing which is wetted by the mercury or mercury alloy until the mercury or mercury alloy forms a convex meniscus with the inner platinum wire, and thereby exposing a length of platinum wire equal approximately to the sum of the lengths of the concave meniscus and the convex meniscus.

2. The method of making a bolometer wire or strip of small mass which consists in immersing in a bath of mercury or mercury alloy, the lower end of a length of wire or strip of a material not soluble in mercury or mercury alloy and incased in a material which is soluble in mercury or mercury alloy, thereby causing the mercury or mercury alloy to form, first, a concave meniscus with the material of the casing, and second, a convex meniscus with the inner wire, and thereby dissolving away a portion of the material of the casing equal approximately in length to the sum of the lengths of the concave meniscus and the convex meniscus.

3. The method of making a bolometer comprising a wire or strip of small mass which consists in immersing in a bath of mercury or mercury alloy, the lower end of a length of wire or strip of a material not soluble in mercury or mercury alloy and incased in a material which is soluble in mercury or mercury alloy, thereby causing the mercury or mercury alloy to form, first, a concave meniscus with the material of the casing, and second, a convex meniscus with the inner wire, thereby dissolving away a portion of the material of the casing equal approximately in length to the sum of the lengths of the concave meniscus and the convex miniscus, and finally immersing the resulting fine wire or strip still further in the mercury or mercury alloy, or partially withdrawing it therefrom.

4. As an improvement in the art of making a bolometer comprising a fine wire or strip of small mass adapted for use as a receiver for space-telegraph signals, the method herein described of dissolving away the desired amount of the silver casing of a Wollaston wire by means of mercury or an alloy of mercury.

5. As an improvement in the art of making a bolometer comprising a fine wire or strip of small mass adapted for use as a receiver for space-telegraph signals, the method herein described of dissolving away the desired amount of the outer casing of a composite wire by immersing the composite wire in a conducting liquid in which the inner wire is insoluble and then adjusting the length of the resulting wire by still further immersing it in said conducting liquid, or partially withdrawing it therefrom.

6. As an improvement in the art of making an electroreceptive device for space-telegraph signals adapted to utilize in its operation the dissipative energy of the electrical oscillations developed by electromagnetic waves in a receiving system, the method herein described of immersing in a conducting liquid a wire or strip of a material insoluble in said liquid and incased in a material which is soluble in said liquid, thereby dissolving away a portion of the outer casing of said wire or strip, and finally regulating the length of said wire or strip thereby exposed from said outer casing.

7. As an improvement in the art of making an electroreceptive device for space-telegraph signals adapted to utilize in its operation the dissipative energy of the electrical oscillations developed by electromagnetic waves in a receiving system, the method herein described of dissolving away the desired amount of the outer casing of a composite wire by means of mercury or an alloy of mercury.

8. As an improvement in the art of making an electroreceptive device for space-telegraph signals adapted to utilize in its operation the dissipative energy of the electrical oscillations developed by electromagnetic waves in a receiving system, the method herein described of dissolving away the desired amount of the outer casing of a composite wire by immersing said composite wire in a conducting liquid in which the outer casing of said composite wire is soluble and regulating the length of the inner wire thereby exposed from said outer casing by means of a micrometer-screw.

9. The method of receiving space-telegraph signals which consists in absorbing the energy of electromagnetic signal-waves by an elevated conductor, thereby creating electrical oscillations in said elevated conductor, conveying said electrical oscillations at increased current to a resonant circuit attuned to the frequency of the waves the energy of which is to be received, amplifying said electrical oscillations by means of said resonant circuit, and utilizing the dissipative energy of the electrical oscillations so amplified by said reso-

nant circuit to vary the normal temperature, and thereby the dissipative resistance, of an electroreceptive device comprising a fine wire or strip immersed in a conducting liquid.

10. The method of receiving space-telegraph signals which consists in absorbing the energy of electromagnetic signal-waves by an elevated conductor, thereby creating electrical oscillations in said elevated conductor, conveying said electrical oscillations to a resonant circuit attuned to the frequency of the waves the energy of which is to be received, amplifying said electrical oscillations by means of said resonant circuit, and utilizing the dissipative energy of the electrical oscillations so amplified by said resonant circuit to vary the normal temperature, and thereby the dissipative resistance, of an electroreceptive device comprising a fine wire or strip immersed in a conducting liquid.

11. The method of producing intelligible signals transmitted by electromagnetic signal-waves which consists in amplifying the electrical oscillations resulting from said electromagnetic signal-waves by means of a circuit attuned by capacity and inductance to the frequency of said waves and utilizing the dissipative energy of the amplified electrical oscillations to produce variations in the dissipative resistance of an electroreceptive device comprising a fine wire or strip immersed in a conducting liquid.

12. The method of making a bolometer fine wire or strip of small mass, which consists in immersing the lower end of a length of wire or strip of one material incased in a casing of a different material in a bath of conducting liquid in which said wire or strip is insoluble and in which said casing is soluble and which will form a concave meniscus with the material of the casing and a convex meniscus with the material of the wire or strip, thereby causing the formation successively of a concave meniscus between the liquid and the casing and a convex meniscus between the liquid and the inner wire or strip, and thereby exposing from said casing a length of the inner wire or strip equal approximately to the sum of the lengths of the concave meniscus and the convex meniscus.

13. The method of making a bolometer wire or strip of small mass, which consists in immersing the lower end of a length of composite wire in a bath of conducting liquid, thereby causing the successive formation of a concave meniscus between the liquid and the casing and a convex meniscus between the liquid and the inner wire of said composite wire, and thereby exposing from the outer casing of the composite wire a length of the inner wire equal approximately to the sum of the lengths of the concave meniscus and the convex meniscus.

14. The method of producing an adjustable bolometer wire or strip, which consists in immersing one end of such wire or strip in a conducting liquid and varying the extent of such immersion.

In testimony whereof I have hereunto subscribed my name this 11th day of February, 1904.

JOHN STONE STONE.

Witnesses:
BRAINERD T. JUDKINS,
G. ADELAIDE HIGGINS.

Corrections in Letters Patent No. 767,997.

It is hereby certified that in Letters Patent No. 767,997, granted August 16, 1904, upon the application of John Stone Stone, Cambridge, Massachusetts, for an improvement in "Space Telegraphy," errors appear in the printed specification requiring correction, as follows: On page 2, line 56, the comma after the word "short" should be stricken out; in line 107, a comma should be inserted after the word "receiver"; and in line 120, a comma should be inserted after the word "mass"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of July, A. D., 1905.

[SEAL.]

F. I. ALLEN,
Commissioner of Patents.

nant circuit to vary the normal temperature, and thereby the dissipative resistance, of an electroreceptive device comprising a fine wire or strip immersed in a conducting liquid.

10. The method of receiving space-telegraph signals which consists in absorbing the energy of electromagnetic signal-waves by an elevated conductor, thereby creating electrical oscillations in said elevated conductor, conveying said electrical oscillations to a resonant circuit attuned to the frequency of the waves the energy of which is to be received, amplifying said electrical oscillations by means of said resonant circuit, and utilizing the dissipative energy of the electrical oscillations so amplified by said resonant circuit to vary the normal temperature, and thereby the dissipative resistance, of an electroreceptive device comprising a fine wire or strip immersed in a conducting liquid.

11. The method of producing intelligible signals transmitted by electromagnetic signal-waves which consists in amplifying the electrical oscillations resulting from said electromagnetic signal-waves by means of a circuit attuned by capacity and inductance to the frequency of said waves and utilizing the dissipative energy of the amplified electrical oscillations to produce variations in the dissipative resistance of an electroreceptive device comprising a fine wire or strip immersed in a conducting liquid.

12. The method of making a bolometer fine wire or strip of small mass, which consists in immersing the lower end of a length of wire or strip of one material incased in a casing of a different material in a bath of conducting liquid in which said wire or strip is insoluble and in which said casing is soluble and which will form a concave meniscus with the material of the casing and a convex meniscus with the material of the wire or strip, thereby causing the formation successively of a concave meniscus between the liquid and the casing and a convex meniscus between the liquid and the inner wire or strip, and thereby exposing from said casing a length of the inner wire or strip equal approximately to the sum of the lengths of the concave meniscus and the convex meniscus.

13. The method of making a bolometer wire or strip of small mass, which consists in immersing the lower end of a length of composite wire in a bath of conducting liquid, thereby causing the successive formation of a concave meniscus between the liquid and the casing and a convex meniscus between the liquid and the inner wire of said composite wire, and thereby exposing from the outer casing of the composite wire a length of the inner wire equal approximately to the sum of the lengths of the concave meniscus and the convex meniscus.

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