No. 767,996. PATENTED AUG. 16, 1904.

J. S. STONE.

SPACE TELEGRAPHY.

APPLICATION FILED FEB. 15, 1904.

NO MODEL.

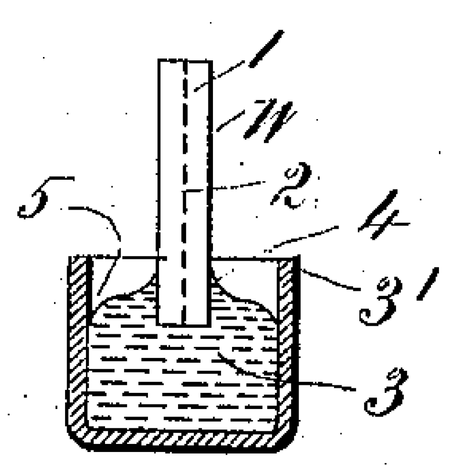

Fig. 1.

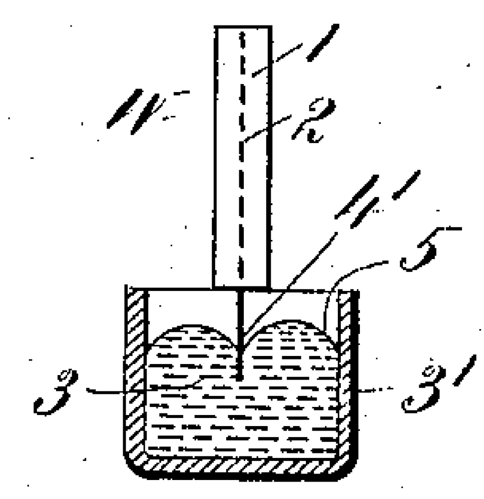

Fig. 2.

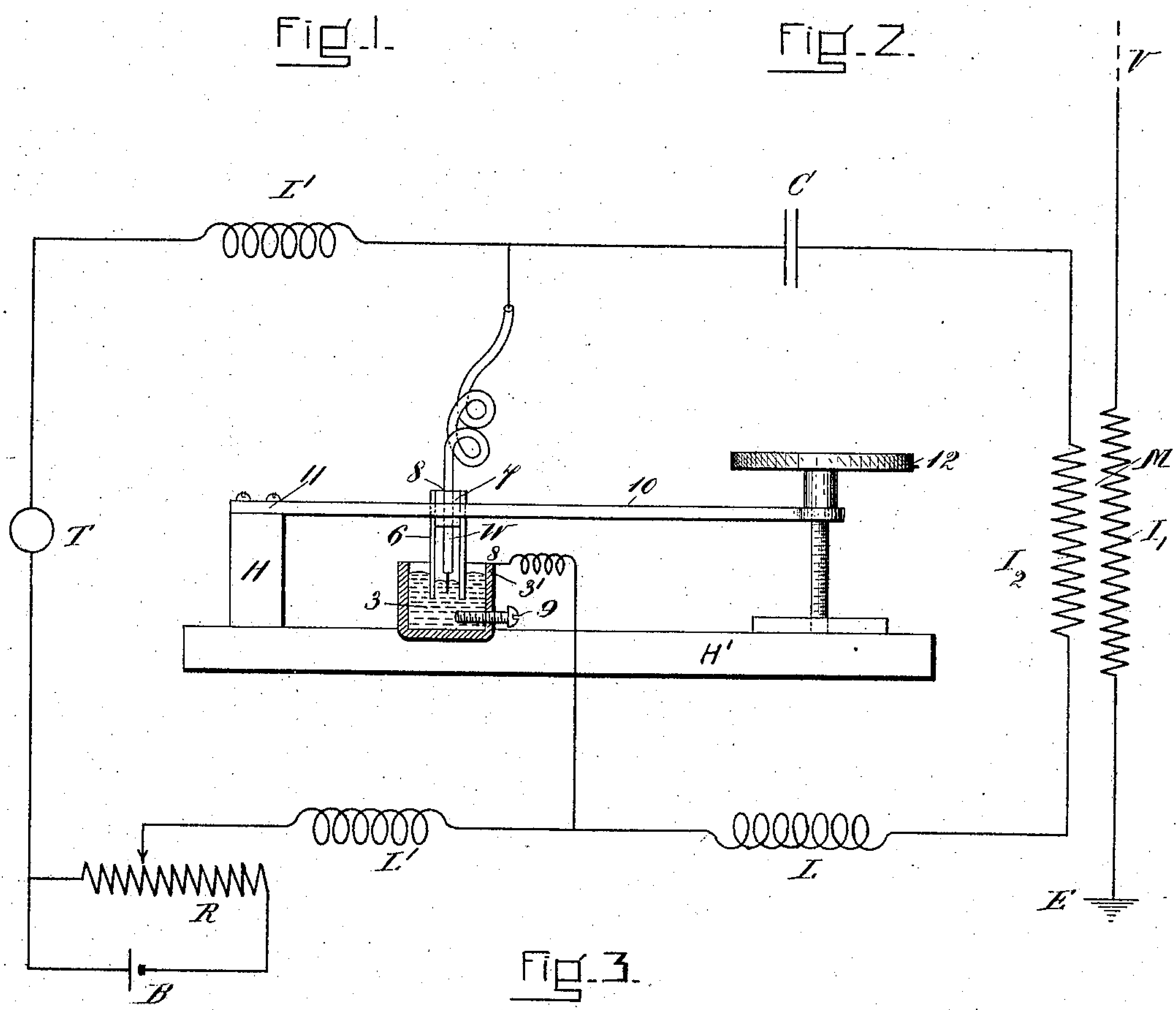

Fig. 3.

WITNESSES:
Brainerd T. Judkins
G. Adelaide Higgins.

INVENTOR:
John Stone Stone
by Alex P. Browne
attorney

No. 767,996. 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. 767,996, dated August 16, 1904.

Application filed February 15, 1904. Serial No. 193,591. (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 a certain new and useful Improvement 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 electroreceptive or electric translating devices 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 be not 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 one embodiment of an improved form of electroreceptive device produced by the method described and claimed in my application Serial No. 193,592, 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 adjustment 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 screws 12 as a micrometer-screw, I desire it 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. A receiving apparatus for space-telegraph signals comprising a platinum wire or strip of small mass, a casing of silver surrounding one end of said wire or strip and a mass of mercury or mercury alloy making electrical contact with the other end of said wire or strip.

2. A receiving apparatus for space-telegraph signals comprising a wire or strip of small mass and of a metal insoluble in mercury or mercury alloy, a casing of a metal soluble in mercury or mercury alloy surrounding one end of said wire or strip and a mass of mercury or mercury alloy making electrical contact with the other end of said wire or strip.

3. A receiving apparatus for space-telegraph signals comprising a platinum wire or strip of small mass, a casing of silver surrounding one end of said wire or strip, a mass of mercury or mercury alloy making electrical contact with the other end of said wire or strip and a micrometer-screw operatively connected to the platinum wire or strip whereby the wire or strip may be moved with respect to the mass of mercury or mercury alloy.

4. A receiving apparatus for space-telegraph signals comprising a platinum wire or strip of small mass, a casing of silver surrounding one end of said wire or strip, a mass of mercury or mercury alloy making electrical contact with the other end of said wire or strip and means for effecting a relative movement between the wire or strip and the mercury or mercury alloy.

5. A receiving apparatus for space-telegraph signals comprising a wire or strip of small mass and of a metal insoluble in mercury or mercury alloy, a casing of a metal soluble in mercury or mercury alloy surrounding one end of said wire or strip, a mass of mercury or mercury alloy making electrical contact with the other end of said wire or strip, and a micrometer-screw operatively connected to the wire or strip whereby the wire or strip may be moved with respect to the mass of mercury or mercury alloy.

6. A receiving apparatus for space-telegraph signals comprising a wire or strip of small mass and of a metal insoluble in mercury or mercury alloy, a casing of a metal soluble in mercury or mercury alloy surrounding one end of said wire or strip, a mass of mercury or mercury alloy making electrical contact with the other end of said wire or strip and means for effecting a relative movement between the wire or strip and the mercury or mercury alloy.

7. A receiving apparatus for space-telegraph signals comprising a vessel containing a conducting liquid, a wire or strip of small mass and of a metal insoluble in said liquid making electrical contact with said liquid, a casing of metal soluble in said liquid surrounding said wire or strip, means for conveying electrical oscillations to said wire or strip whereby its normal temperature may be varied, and a micrometer-screw for effecting a relative movement between the wire or strip and the liquid.

8. A receiving apparatus for space-telegraph signals comprising a metallic wire or strip of small mass adapted to be heated by the dissipative energy of the electrical oscillations passing therethrough, a bath of conducting liquid making electrical contact therewith, and a micrometer-screw for effecting a relative movement between the wire or strip and the liquid.

9. A receiving apparatus for space-telegraph signals comprising a metallic wire or strip of small mass a bath of conducting liquid making electrical contact therewith, a micrometer-screw for effecting a relative movement between the wire or strip and the liquid, and means for overcoming the lost motion of said micrometer-screw.

10. A receiving apparatus for space-telegraph signals comprising a metallic wire or strip of small mass, adapted to be heated by the dissipative energy of the electrical oscillations passing therethrough, a bath of conducting liquid making electrical contact therewith, and a micrometer-screw operatively connected with said wire or strip for moving the wire or strip with respect to said liquid.

11. A receiving apparatus for space-telegraph signals comprising a metallic wire or strip of small mass, a bath of conducting liquid making electrical contact therewith, a micrometer-screw and means for utilizing a fraction of the translational movement of said screw to produce a relative movement between the wire or strip and the liquid.

12. A receiving apparatus for space-telegraph signals comprizing a metallic wire or strip of small mass, a bath of conducting liquid making electrical contact therewith, a micrometer-screw operatively connected to said wire or strip and means for communicating a fraction of the translational movement of said screw to the wire or strip.

13. A receiving apparatus for space-telegraph signals comprising a spring rigidly supported at one end, a metallic wire or strip of small mass connected to said spring at a point intermediate the ends thereof, a bath of conducting liquid making contact with

said wire or strip and a micrometer-screw for moving the unsupported end of said spring.

14. A receiving apparatus for space-telegraph signals comprising a metallic wire or strip of small mass, a bath of conducting liquid making electrical contact therewith, a micrometer-screw for moving said wire or strip with respect to the bath of conducting liquid and means for overcoming the lost motion of said micrometer-screw.

15. A receiving apparatus for space-telegraph signals comprising a platinum wire or strip of small mass incased in silver, a vessel containing mercury or mercury alloy and means whereby the lower end of said wire or strip may be immersed in said mercury or mercury alloy.

16. A receiving apparatus for space-telegraph signals comprising a vessel containing a conducting liquid, a wire or strip of small mass and of a material not soluble in said liquid, means for conveying electrical oscillations to said wire or strip whereby its dissipative resistance may be varied, a casing of a material soluble in said liquid surrounding said wire or strip and a micrometer-screw operatively connected to said wire or strip whereby the latter may be immersed in said liquid.

17. A receiving apparatus for space-telegraph signals comprising a platinum wire or strip of small mass incased in silver, a vessel containing mercury or mercury alloy, means whereby the lower end of said wire or strip may be immersed in said mercury or mercury alloy and means for regulating the level of the mercury or mercury alloy in the vessel.

18. A receiving apparatus for space-telegraph signals comprising a vessel containing a conducting liquid, a wire or strip of small mass and of a material not soluble in said liquid, a casing of a material soluble in said liquid surrounding said wire or strip, a micrometer-screw operatively connected to said wire or strip whereby the latter may be immersed in said liquid and means for regulating the level of the liquid in the vessel.

19. In a space-telegraph receiving system, an elevated conductor and a resonant circuit associated therewith, in combination with a receiving apparatus for space-telegraph signals comprising a vessel containing a conducting liquid, a wire or strip of small mass and of a metal insoluble in said liquid making electrical contact with said liquid and a casing of a metal soluble in said liquid surrounding said wire or strip.

20. In a space-telegraph receiving system, an elevated conductor and a resonant circuit associated therewith by means of a step-down transformer, in combination with a receiving apparatus for space-telegraph signals comprising a vessel containing a conducting liquid, a wire or strip of small mass and of a metal insoluble in said liquid making electrical contact with said liquid, and a casing of a metal soluble in said liquid surrounding said wire or strip.

21. In a space-telegraph receiving system, a circuit attuned by capacity and inductance to the frequency of the waves the energy of which is to be received, in combination with a receiving apparatus for space-telegraph signals adapted to utilize in its operation the dissipative energy of the electrical oscillations developed by electromagnetic signal-waves in the receiving system and comprising a wire or strip of small mass immersed in a conducting liquid.

22. A receiving apparatus for space-telegraph signals comprising a metallic wire or strip of small mass, a bath of conducting liquid making electrical contact therewith, and a tube surrounding said wire or strip to protect the same from vibration.

23. A receiving apparatus for space-telegraph signals comprising a metallic wire or strip of small mass, a bath of conducting liquid making electrical contact therewith, and means for protecting said wire or strip from vibration.

24. A receiving apparatus for space-telegraph signals comprising a metallic wire or strip of small mass immersed in a bath of conducting liquid, and a tube surrounding said wire or strip and also immersed in said conducting liquid to protect said wire or strip from vibration.

25. In a receiving apparatus for space-telegraph signals, the combination with a bolometer wire or strip having one end immersed in a conducting liquid, of means for 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. 767,996.

It is hereby certified that in Letters Patent No. 767,996, granted August 16, 1904, upon the application of John Stone Stone, of Cambridge, Massachusetts, for an improvement in "Space Telegraphy," errors appear in the printed specification requiring corraction, as follows: In line 128, page 2, the word "screws" should read *screw*; and in line 116, page 3, the word "comprizing" should read *comprising*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of thecase in the Patent Office.

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

[SEAL.]

F. I. ALLEN.
Commissioner of Patents.