No. 711,131. Patented Oct. 14, 1902.

H. SHOEMAKER.

ART OF TRANSMITTING INTELLIGENCE.

(Application filed Aug. 9, 1902.)

(No Model.)

Fig 1.

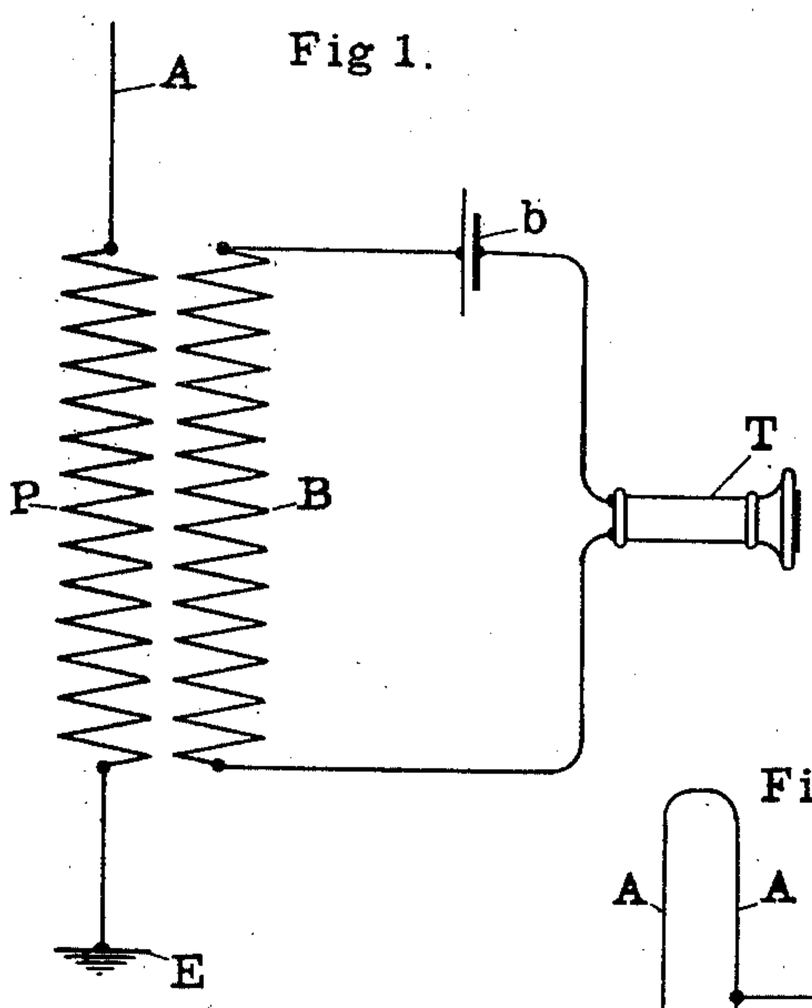


Fig 2.

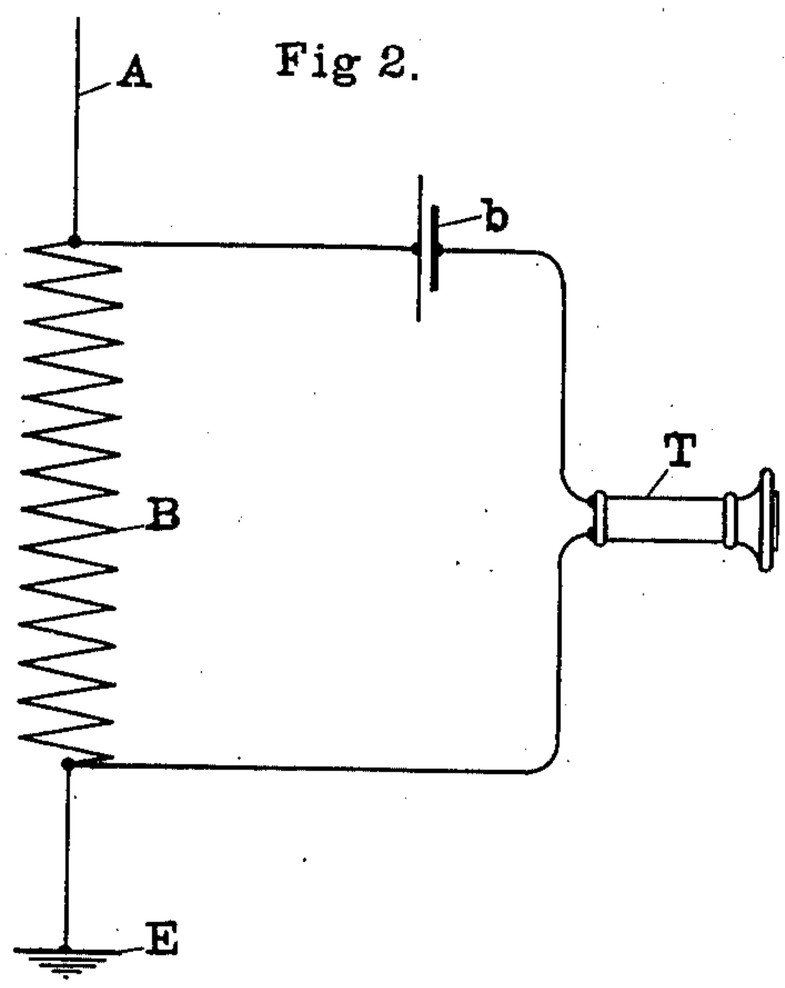


Fig 3.

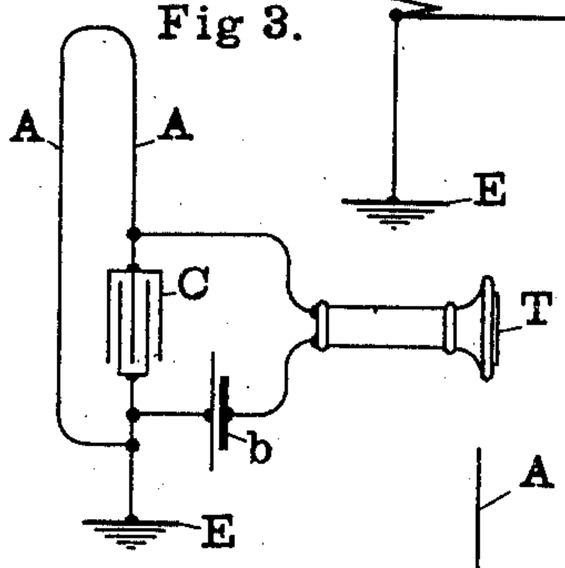


Fig 4.

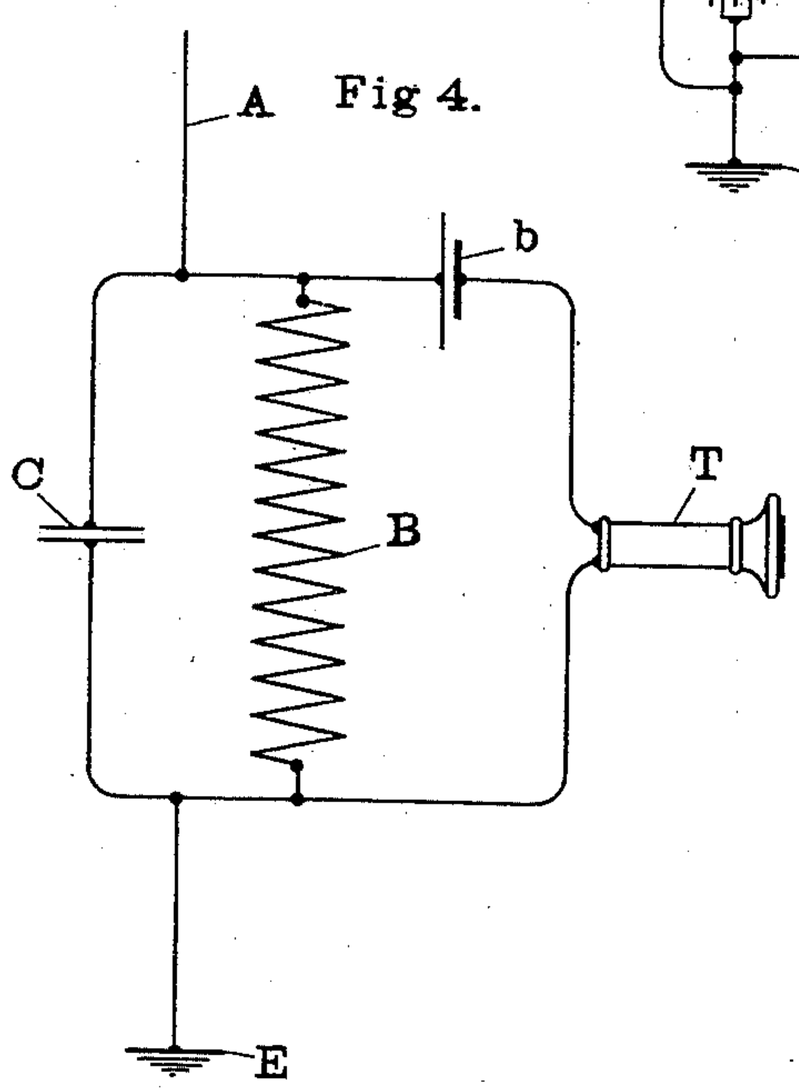
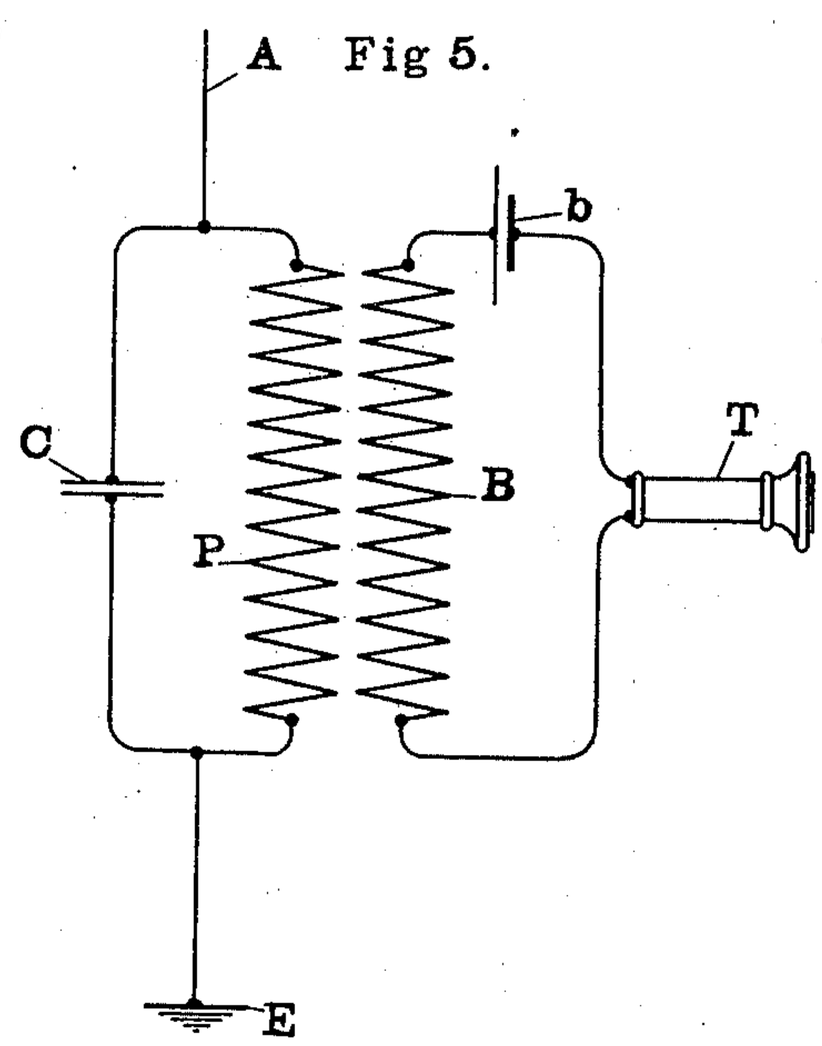


Fig 5.



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UNITED STATES PATENT OFFICE.

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ART OF TRANSMITTING INTELLIGENCE.

SPECIFICATION forming part of Letters Patent No. 711,131, dated October 14, 1902.

Application filed August 9, 1902. Serial No. 119,030. (No model.)

To all whom it may concern:

Be it known that I, HARRY SHOEMAKER, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Art of Transmitting Intelligence, of which the following is a specification.

My invention relates to an improvement in the art of signaling electrically, more particularly by means of electroradiant energy which is impressed upon the natural media and which causes manifestations at the receiving-stations.

My invention comprises a method of receiving signals represented by electroradiant energy by causing such energy to change the resistance of a material in virtue of a magnetic field caused by such energy. Of such materials many are well known in the electrical arts, though bismuth is a good example of the same.

My invention consists of a method of rendering intelligible transmitted electroradiant energy by causing such energy at the receiving-station to cause a varying magnetic field in which is placed a material having the property of changing its resistance under the influence of magnetism and producing a signal or recording a message by the changes of resistance of such material.

My invention consists, further, of a method of rendering intelligible transmitted electroradiant energy by causing such energy in the receiving-circuits to vary, either directly or indirectly, the resistance of a material which is not in the nature of an imperfect electrical contact, but rather in the nature of a continuous conductor of relatively low resistance or great conductivity as compared with the imperfect electrical contacts known in the art of wireless signaling.

By the use of bismuth or other materials which change their resistance when in a magnetic field I am enabled to construct a receiving device for wireless signaling systems in which the received electroradiant energy causes, directly or indirectly, a change in the resistance of such material, and the change of such resistance is caused to control a local circuit to produce a signal or record a message. The use of such material is distinctly different from the use of imperfect contacts now well known in the art as coherers and the like, which in general manifest great and sudden changes in resistance and are more or less uncertain in their action.

By employing bismuth or other similar material and subjecting it to the varying magnetic field due to received electroradiant energy there is attained a smooth variation in the resistance of a circuit, which renders the receiver certain in its operation, in marked contrast with the operation of the imperfect electrical contacts heretofore employed in wireless signaling systems.

Besides bismuth it is to be understood other materials may be used which have the same property—namely, that of changing resistances when in a magnetic field. I have found that iron, and even copper, behaves similarly to the bismuth when placed in a magnetic field.

Reference is to be had to the accompanying drawings, in which—

Figure 1 is a diagrammatic view of the receiving-circuits of a wireless signaling system in which a bismuth conductor is placed in the field generated by received energy within a winding in series with the aerial conductor. Fig. 2 is a diagrammatic view in which the bismuth or like material is connected in series with the aerial conductor. Fig. 3 is a diagrammatic view in which a loop of bismuth or like material is used for the aerial conductor and comprises in these two aerial conductors bismuth or other material which are connected at their tops. Fig. 4 is a modified arrangement of the circuits of a receiving device in which by proper proportions of the electrical constants of the circuit the magnetic field produced by the arriving energy is very great compared with the amount of such energy. Fig. 5 is similar to Fig. 4, except that the bismuth or other material is placed in the field generated by a winding through which an abnormal amount of current flows under the influence of a certain amount of received energy.

In Fig. 1, A represents the usual aerial conductor, in series with which is connected the winding P, which connects at its lower terminal with earth-plate E. The received radiant energy causes oscillations in the aerial conductor and through the winding P to manifest a magnetic field. Within this field is placed a length of bismuth, preferably in the form of wire B, forming a part of the circuit including the telephone-receiver T and the source of energy *b*. The bismuth B normally has a certain resistance, and there is accordingly a certain current flowing through the telephone-receiver T, producing no sound. Upon the reception of electrical energy, however, the resistance of B varies, due to the magnetic field generated by the winding P, and there results a fluctuation of current through the receiver T, causing a sound to be produced in accordance with the received energy. In this manner the code characters or other signal characters may be read by the ear.

In Fig. 2, A is the usual aerial conductor, in series with which there is connected a bismuth winding B, which connects at its lower terminal with the earth-plate E. The received radiant energy causes oscillations through said conductor B, producing a magnetic field. This magnetic field generated by the winding B causes in the conductor B a change of resistance, which is noted by means of the telephone-receiver T and the source of energy *b*, as in the case of Fig. 1.

In Fig. 3, A A represent two aerial conductors, of bismuth or similar material, which conductors are joined at their upper ends. The left-hand conductor A connects directly to earth-plate E, while the right-hand conductor connects to earth-plate E through condenser C. The condenser C is so large as to be perfectly transparent to the oscillations received in the right-hand conductor A, and in effect, therefore, the right-hand conductor A is connected directly to earth. In shunt to the condenser C, or, what is the same thing, in series with the two conductors A A are connected the telephone-receiver T and the source of energy *b*. In this case the conductors upon the reception of radiant energy are surrounded by a magnetic field, and such field in turn causes a variation of resistance of such conductors A A. There results, therefore, a variation in the resistance of the circuit embracing source of energy *b*, telephone-receiver T, right-hand conductor A, and left-hand conductor A. From such change of resistance there results a variation in the flow of current through the telephone-receiver T, producing a signal, as previously described.

In Fig. 4, A is the usual aerial conductor, between which and the earth-plate E are connected the condenser C and inductance-winding B in parallel relation to each other. The condenser C and this inductance-winding B are so related to each other as to their magnitudes that they form what is known as an "antiresonant" or "closed resonant" circuit for the frequency of oscillations which are received upon the aerial conductor A. When the radiant energy received upon the said conductor A is of a particular frequency, there is set up in the local circuit, embracing the condenser C and the inductance B in series with each other, a current many times greater than that appearing in the aerial conductor itself. This inductance B is composed of bismuth wire. The excessive current flowing through it, due to the relations above stated, causes an abnormally powerful magnetic field to be produced in the vicinity of said winding, resulting in a correspondingly great variation in resistance of the bismuth wire forming the winding of such inductance. The variation in resistance of such bismuth inductance B is recorded then by the telephone-receiver T, with the aid of the source of energy *b*, as described in the previous cases.

In Fig. 5, A is the aerial conductor, between which and the earth-plate E are connected in parallel with each other the condenser C and the primary winding P. The relations of this condenser C and the winding P are the same as described in connection with Fig. 4 for the condenser C and the inductance B. As described in connection with Fig. 4, the winding P will produce an abnormally strong magnetic field due to the antiresonant effect, and within this field is located a bismuth conductor B, as in the case shown in Fig. 1, and the variation of resistance of such conductor B is recorded by the telephone-receiver T with the aid of the source of energy *b*.

I do not wish to be limited to the precise arrangement of circuits as herein described by me, for it is apparent that this system may be applied in many other relations by those skilled in the art. It is broadly new to me to generate a magnetic field by the received electroradiant energy and to cause such field to vary the resistance of certain materials and cause such variation of resistance to control a local circuit to produce a signal or record a message.

It is of course to be understood that in place of telephone-receivers sensitive relays may be employed to control local circuits. Furthermore, the telephone-receivers may be omitted and the primary of a transformer substituted therefor, and in the secondary circuit of such transformer may be placed telephone-receivers or other devices, such as relays and the like. By this arrangement upon a change of resistance in the bismuth or like material there is a large change in the strength of the current in the primary of the transformer, because a large source of energy is used, resulting in a great change in the ampere-turns of the primary of the transformer, and consequently a great change in the potential of the secondary circuit.

In the arrangement shown in the drawings the telephone-receivers are to be of low resistance, so that normally there may be a relatively large current flowing through the

telephone-receiver. In virtue of this slight change in resistance of the material there will be considerable change in the current strength, and therefore considerable change in the ampere-turns in the telephone-receiver.

The bismuth or other material as used in my system may be in the form of a wire. The cross-section of the conductor or wire is such as to permit the use of a considerable current in the circuit of the wave-responsive device, which is, in fact, the wire. Heretofore in wireless signaling systems but very slight amounts of current had been used in the wave-responsive device. In the case of coherers and the like the current has been extremely small, and in the case of other systems employing a metallic conductor as a wave-responsive device the current employed has been extremely small. In my system, however, I am enabled for the first time in the art to employ currents of relatively great magnitude through the wave-responsive device. This is an advantage which is appreciated in view of the considerations named above. In other words, if the telephone-receiver T were of high resistance as compared with the bismuth or like material the slight fluctuation in the resistance of such material would cause but slight effect in the receiver. The bismuth or other material being of relatively low resistance, the telephone-receiver should also be of relatively low resistance.

What I claim is—

1. The method of rendering intelligible transmitted electroradiant energy representing a signal, which consists in varying the resistance of a material by a magnetic field which varies with the transmitted energy, and recording the variations of resistance of said material.

2. The method of rendering intelligible transmitted electroradiant energy representing a signal, which consists in changing the resistance of a material by a magnetic field due to the transmitted energy, and recording the changes of resistance of said material.

3. The method of rendering intelligible transmitted electroradiant energy representing a signal, which consists in changing the resistance of a material by a magnetic force due to the transmitted energy, and producing a signal by the change of resistance of said material.

4. The method of rendering intelligible transmitted electroradiant energy representing messages, which consists in transforming the received electroradiant energy into the energy of electric currents, generating a magnetic field by said currents, subjecting a material to said field to vary its resistance, and recording the resistance changes of said material.

5. The method of rendering intelligible transmitted electroradiant energy representing messages, which consists in transforming the received electoradiant energy into the energy of electric currents, producing a magnetic force by said currents, changing the resistance of a material by said magnetic force, and recording the resistance changes of said material.

6. The method of rendering intelligible transmitted electroradiant energy representing a message, which consists in generating a magnetic field by the received energy, changing the resistance of a material by said magnetic field, and recording the resistance changes of said material by varying the current strength in a circuit of a translating device.

7. The method of transmitting intelligence, which consists in impressing upon the natural media electroradiant energy representing a message, converting the received energy into the energy of electric currents at the receiver, increasing the current component of said energy of electric currents in a closed resonant circuit, generating a magnetic force by the increased current component, varying the resistance of a material by and in accordance with said magnetic force, and recording the resistance changes of said material.

8. The method of rendering intelligible electroradiant energy transmitted through the natural media and representing a signal, which consists in producing a magnetic field by the received energy, changing the resistance of a material by the influence of said magnetic field, and producing a signal by the change of resistance of said material.

9. The method of rendering intelligible electroradiant energy transmitted through the natural media and representing a signal, which consists in producing a magnetic field by the received energy, changing the resistance of a mass of bismuth by the influence of said magnetic field, and producing a signal by the change of resistance of said mass of bismuth.

10. The method of rendering intelligible transmitted electroradiant energy representing a signal, which consists in varying the resistance of a mass of bismuth by a magnetic field which varies with the transmitted energy, and recording the variations of resistance of said mass of bismuth.

11. The method of rendering intelligible transmitted electroradiant energy representing a signal, which consists in generating a magnetic field by the received energy, varying the resistance of a material by said varying magnetic field, and recording the resistance changes of said material.

12. The method of rendering intelligible transmitted electroradiant energy representing a signal, which consists in generating a magnetic force by the received energy, varying the resistance of a mass of bismuth by said magnetic force, and recording the resistance changes of said mass of bismuth.

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