L. DE FOREST.

WIRELESS TELEGRAPH TUNING DEVICE.

APPLICATION FILED JAN. 20, 1906.

926,934.

Patented July 6, 1909.

2 SHEETS—SHEET 1.

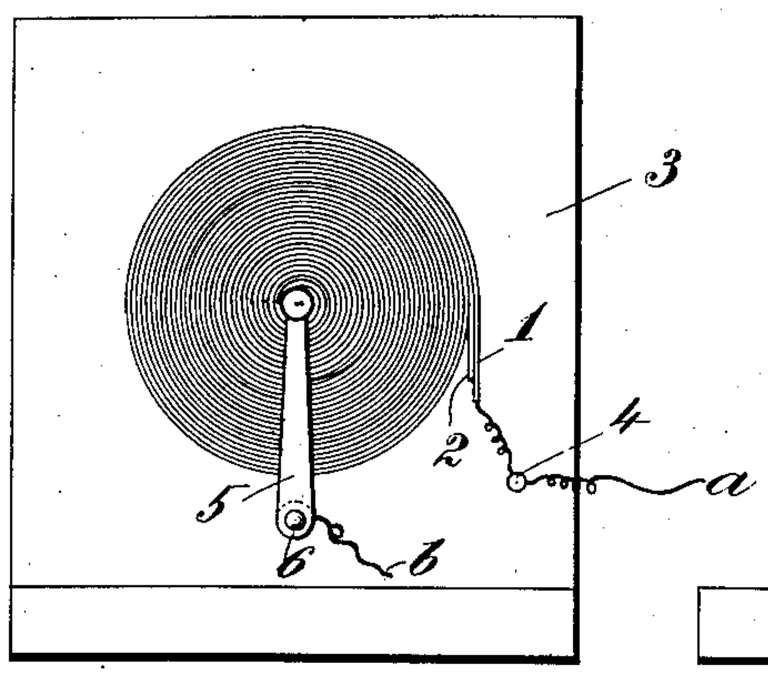

Fig. 1.

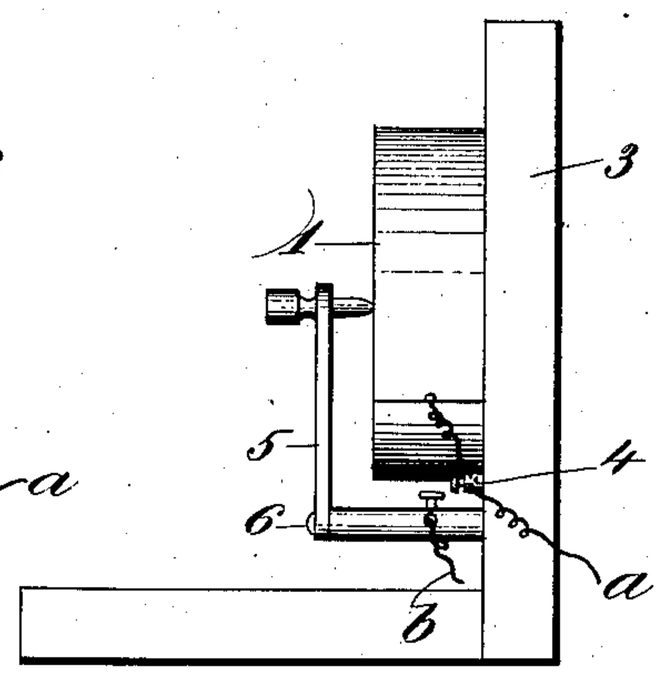

Fig. 2.

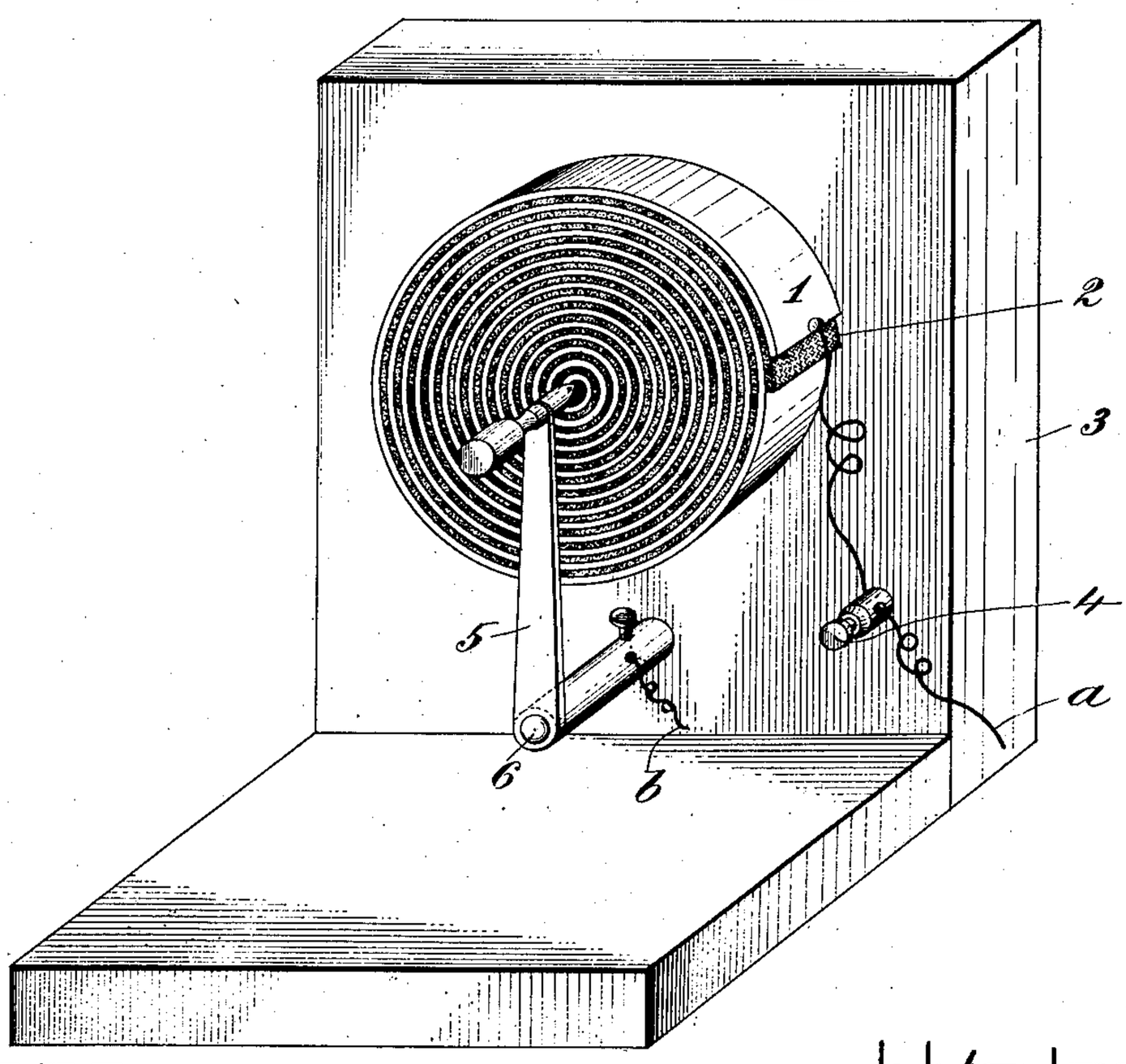

Fig. 3.

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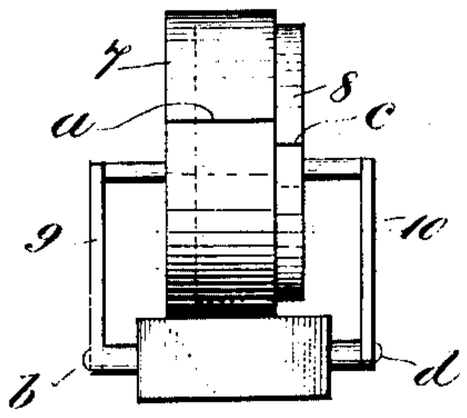

Fig. 4.

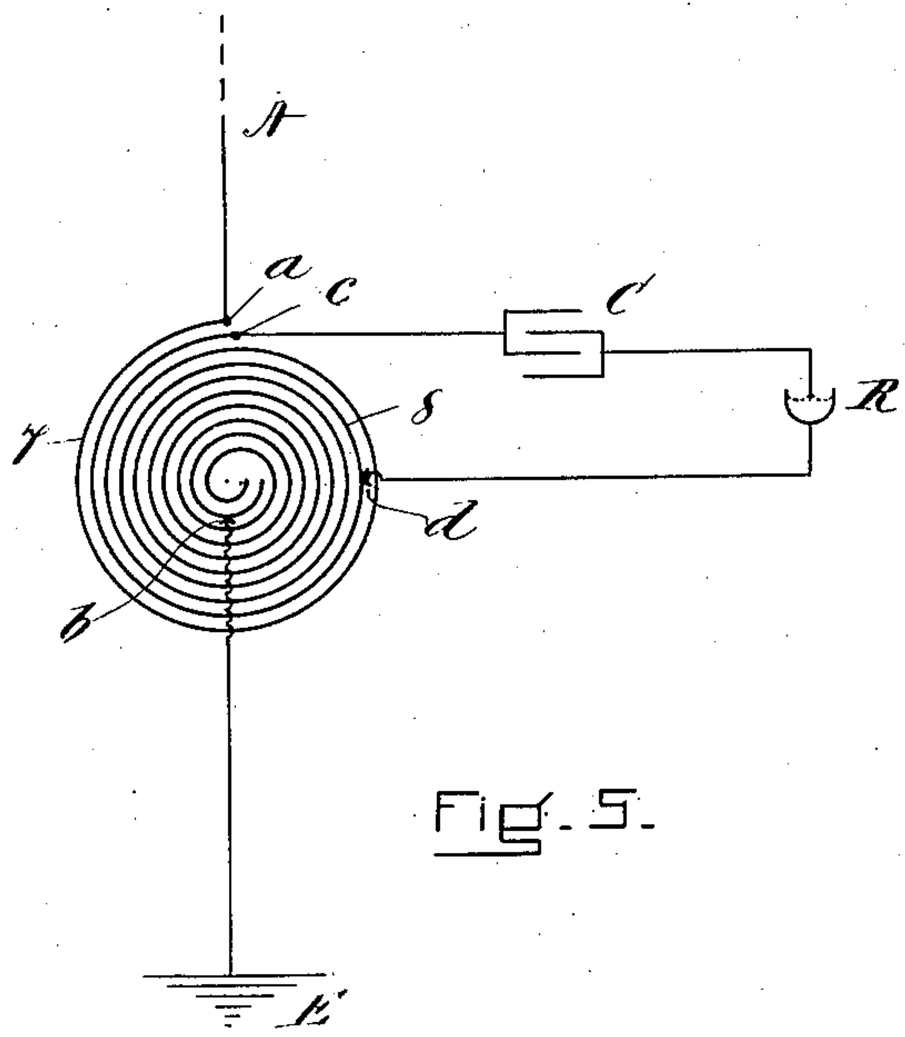

Fig. 5.

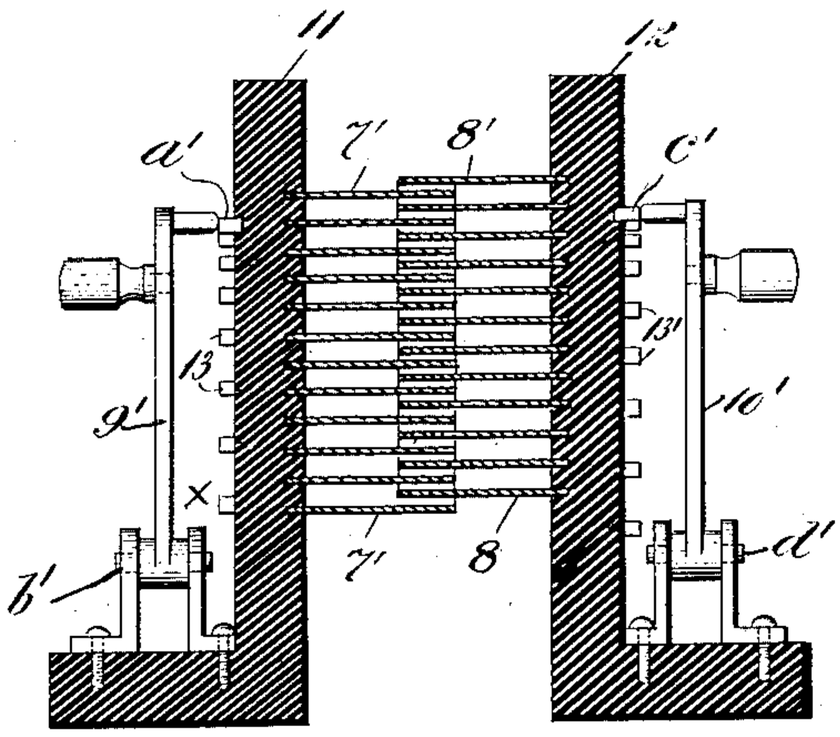

Fig. 6.

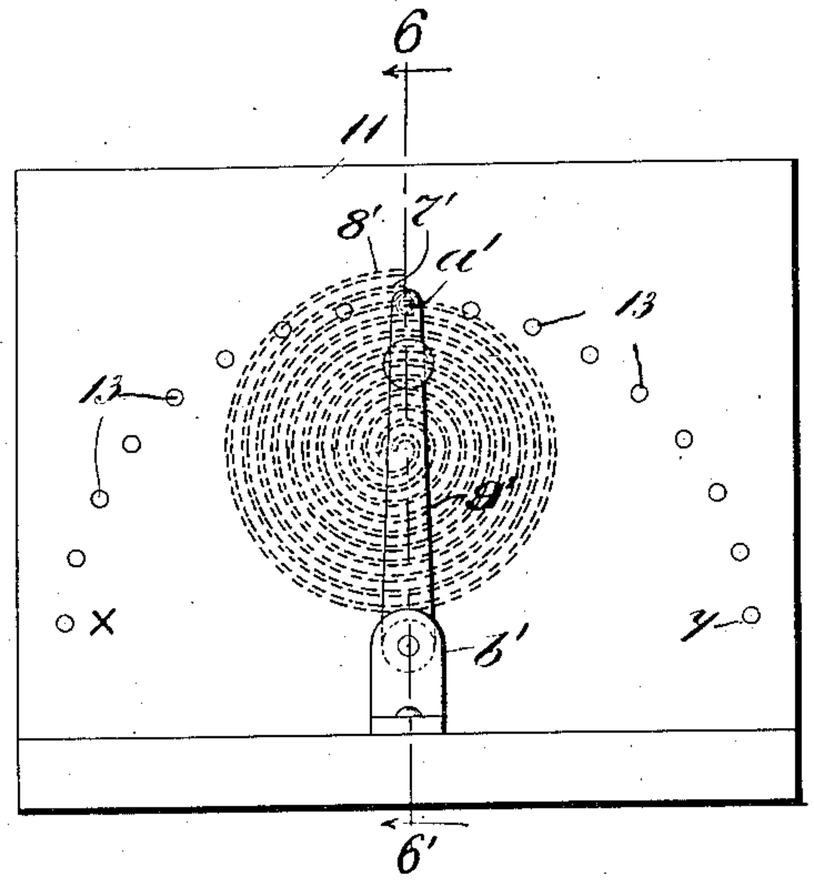

Fig. 7.

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UNITED STATES PATENT OFFICE.

LEE DE FOREST, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO DE FOREST RADIO TELEPHONE CO., A CORPORATION OF NEW YORK.

WIRELESS-TELEGRAPH TUNING DEVICE.

No. 926,934. Specification of Letters Patent. Patented July 6, 1909.

Application filed January 20, 1906. Serial No. 296,931.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented a new and useful Improvement in Wireless-Telegraph Tuning Devices, of which the following is a specification.

My invention relates to wireless telegraph systems, more particularly, receiving systems, and has for its objects certain new and improved apparatus and circuit arrangements whereby an antenna or its associated circuit, or both, may be attuned to a given frequency which, in a receiving system, is that of the electromagnetic waves intended to affect the responder included in said associated circuit.

For the purpose of more fully disclosing my invention I have illustrated in the drawings accompanying and forming a part of this specification several forms of apparatus and circuit arrangements which in practice I have found well adapted for realizing the above stated objects; but it is to be understood that I do not limit myself to the particular forms of apparatus and circuit arrangements disclosed inasmuch as many modifications may be made therein without departing from the spirit of my invention.

In the drawings, Figure 1 is a front elevation of a wireless telegraph tuning device: Fig. 2 is a side elevation thereof; Fig. 3 is a perspective view of the device shown in Figs. 1 and 2; Fig. 4 is a side elevation of a modification; Fig. 6 is a sectional view of another modification taken on the line 6—6 of Fig. 7; Fig. 7 is a side elevation of the device shown in Fig. 6 and Fig. 5 is a diagram showing one way in which the devices illustrated in Figs. 4 and 6 may be employed.

It is possible to enhance the distributed capacity effect of a flat spiral tuning device such as shown in my U. S. Letters Patent No. 852,381, dated April 30, 1907, by using, instead of a wire, a flat strip or ribbon, preferably of copper or brass wound tightly upon itself to form a spiral, the convolutions of which may be separated by a thin ribbon of silk insulation or a thin coating of cellulose acetate. A flat spiral so formed of thinly insulated metallic ribbon is much more efficient than a flat spiral formed of thinly insulated wire because of the increased distributed capacity effect, and either of said flat spirals is much more effective than the simple solenoidal or helical tuning coils now commonly employed for tuning wireless telegraph circuits, even when said coils are closely wound and consist of small, thinly-insulated wire, while a solenoidal tuning coil having the same number of turns of large, heavily insulated wire is not at all efficient.

The tuning device shown in Figs. 1, 2 and 3 may be made by winding a long copper or brass ribbon 1 of, say, 100 feet in length, into a spiral with a thin silk ribbon 2 between the conductors and securing the spiral to a suitable support 3 of insulating material. In lieu of the ribbon insulation 2, I may coat the metallic ribbon 1 with a thin layer of any suitable insulating compound, such as cellulose acetate. One terminal of the spiral, herein shown as the outer terminal, may be brought out to a binding post 4 and an adjustable connection may be made with the spiral by means of the contact arm 5, pivoted to the support at 6, or by any other means suitable for the purpose. The two leads *a* and *b*, connected in the present case to the binding post 4 and pivot 6, serve to connect the spiral to an antenna or to a circuit associated with said antenna.

For the sake of avoiding confusion in the drawings, the parts are not shown to scale, but it will be understood from the foregoing description that the several spires of all the tuning devices herein described are so close together that the movement of the adjustable contact devices across the face of said spirals varies the amount of metallic ribbon included in a circuit connected to *a* and *b* in a continuous manner, and hence varies the distributed capacity and distributed inductance of such circuit in like manner.

The spiral ribbon tuning device shown in Figs. 1, 2 and 3, may be employed for attuning an antenna or its associated circuit and it may be employed also in lieu of the wire spirals in the wireless telegraph receiving systems described in my Patent No. 852,381 referred to above.

In Fig. 4, I have shown a very efficient transformer-condenser of which the primary and secondary consist of metallic ribbon spirals constructed as above set forth in connection with Figs. 1, 2 and 3. This transformer-condenser may conveniently be constructed by tightly winding into spiral form two metallic ribbons 7, 8, placed one over the

other and separated by silk or other insulation, and may have its primary and secondary connected to separate circuits at the points *a*, *b*, and *c*, *d*, respectively. In order to apply the adjustable contact feature to the primary and secondary spirals, the two ribbons 7, 8, may be offset, as shown, so that the pivoted contact 9 will make connection with the face of spiral 7 and the contact 10, with face of spiral 8.

In Fig. 5, A represents an antenna grounded at E and including the primary spiral 7. C is a condenser and R is a responder including the secondary spiral 8. By means of the contacts 9 and 10, shown diagrammatically in Fig. 5 by the points *b* and *d*, the antenna system A 7 E and local circuit C 8 R, may each be attuned to the frequency of the waves to be received.

Figs. 6 and 7 show a modification of the transformer-condenser illustrated in Fig. 4, by means of which the mutual inductance and mutual capacity can both be conveniently adjusted. In these figures, the spiral ribbons 7′, 8′ are mounted on insulating supports 11, 12, respectively, into which spiral grooves are cut for holding the spiral ribbons. Contact buttons 13, 13′, are inserted in the back of the supports and are electrically connected in a progressive manner with successive portions of their respective spirals, so that the movement of the contact arms 9′, 10′ over said buttons will vary the amount of ribbon included in the circuits which are connected to the spirals. Thus, for example, the buttons *a*′, *c*′, may be connected with the outer ends of the spirals 7′, 8′, respectively, corresponding to the points *a*, *c*, in Fig. 4, while the buttons *x* and *y* may each be connected to the inner end of spiral 7 and the intermediate buttons on support 11 may each be connected to intermediate points along spiral, so that a movement of the arm 9 from *a*′ to *x* would produce the same effect as the movement thereof from *a*′ to *y*. The buttons 13′ on support 12 may be similarly arranged. By moving the supports 11, 12 away from or toward each other, the two spirals 7′, 8′ which fit into each other, and which are insulated by air or by a thin layer of cellulose acetate if desired, may be separated to a greater or lesser degree, and the mutual inductance and mutual capacity may be correspondingly varied. The diagram shown on Fig. 5, applies to the transformer-condenser illustrated in Fig. 6 as well as to that illustrated in Fig. 4, the points *a*′, *b*′, and *c*′, *d*′, of Fig. 6 corresponding to *a*, *b* and *c*, *d*, respectively, of Fig. 5.

I claim:

1. A wireless telegraph tuning device consisting of a spiral of metallic ribbon and a contact operating transversely across said spiral whereby the capacity and inductance thereof may be varied in a continuous manner.

2. A wireless telegraph tuning device comprising a tightly wound spiral of conducting ribbon, and a movable contact member arranged to move transversely with respect to said spirally wound ribbon for varying the number of effective spires thereof.

3. In a wireless telegraph system, an antenna and a tuning device consisting of a spiral of metallic ribbon serially and adjustably connected therewith and a contact device arranged to be operated across the edges of said spiral.

4. In a wireless telegraph system, an antenna and a tuning device consisting of a spiral of metallic ribbon serially connected therewith and having its distributed capacity and inductance so adjusted that the natural period of said spiral and antenna is equal to that of the waves to be received, in combination with an associated circuit including a tuning device consisting of a spiral of metallic ribbon having its distributed capacity and inductance so adjusted that the natural period of said associated circuit also is equal to that of said waves.

In testimony whereof, I have hereunto subscribed my name this 17th day of Jan. 1906.

LEE DE FOREST.

Witnesses:
PHILIP FARNSWORTH,
LESTER TESTEEK.