J. F. McELROY.

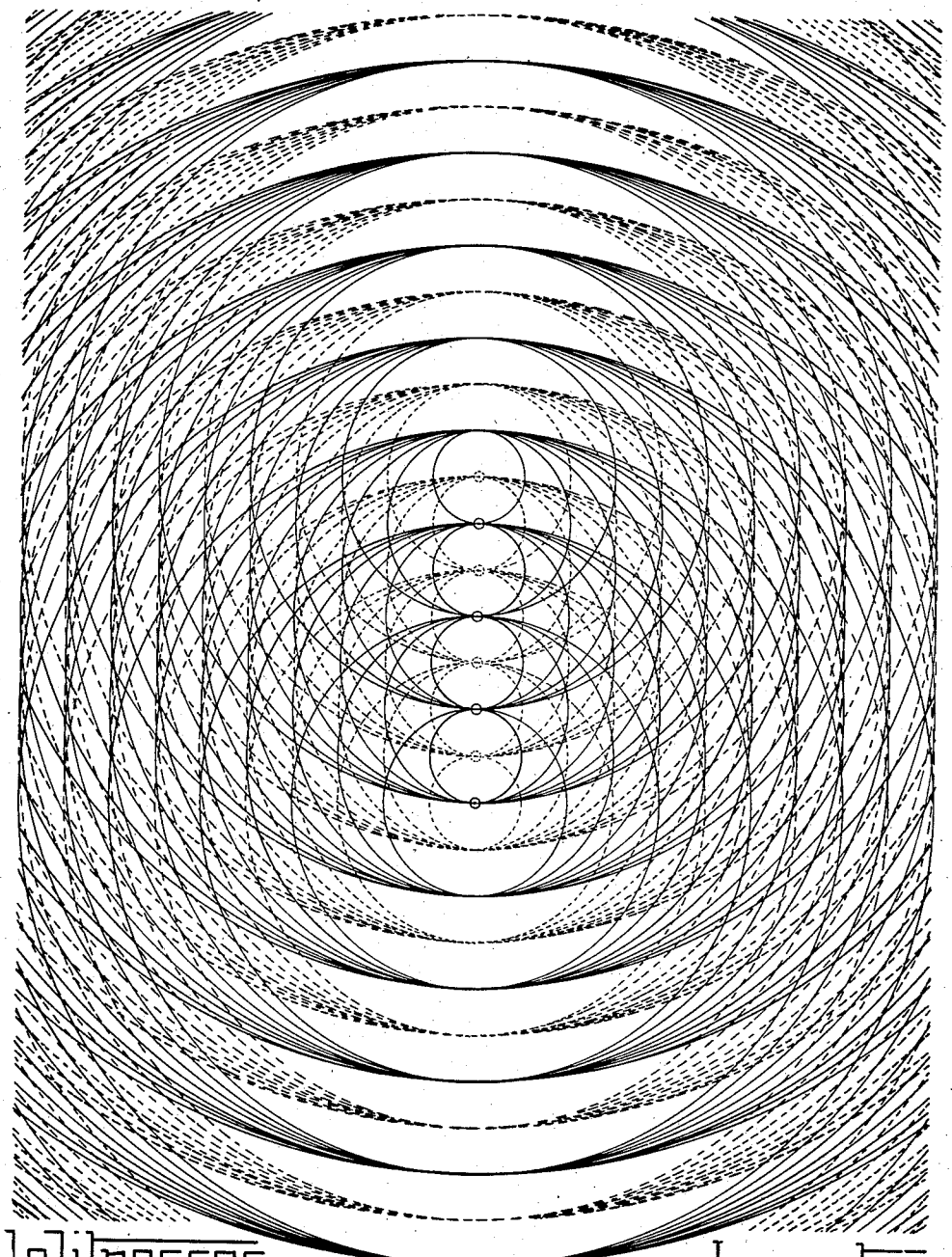
WIRELESS TELEGRAPHY.

APPLICATION FILED OCT. 4, 1905.

992,791.

Patented May 23, 1911.

3 SHEETS—SHEET 1.



Witnesses

L. T. Shaw

M. A. Moder

Fig. 1

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James F. McElroy

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3 SHEETS—SHEET 2.

Fig. 5.

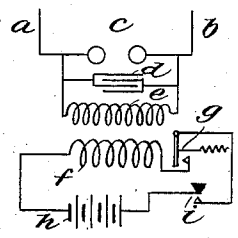
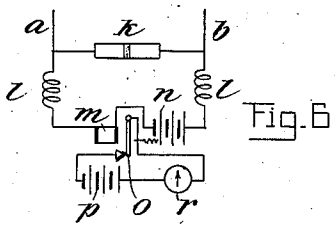


Fig. 6.



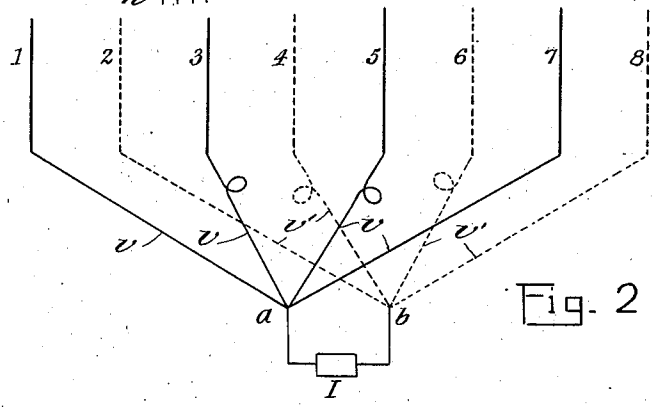


Fig. 2

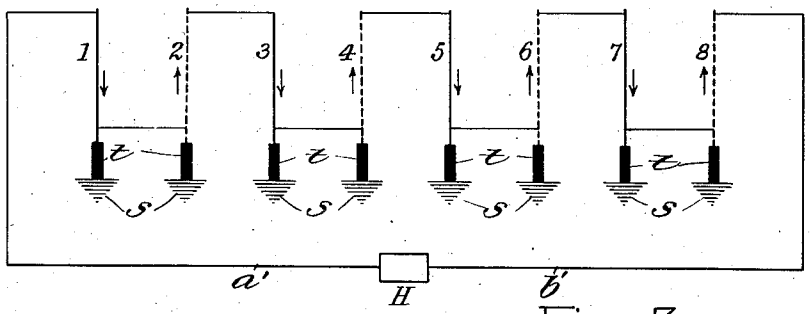


Fig. 3

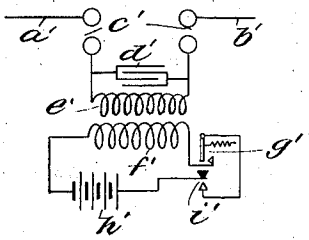


Fig. 7.

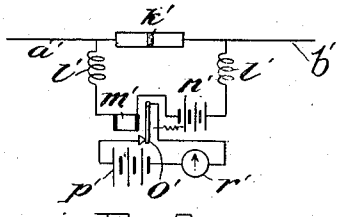


Fig. 8.

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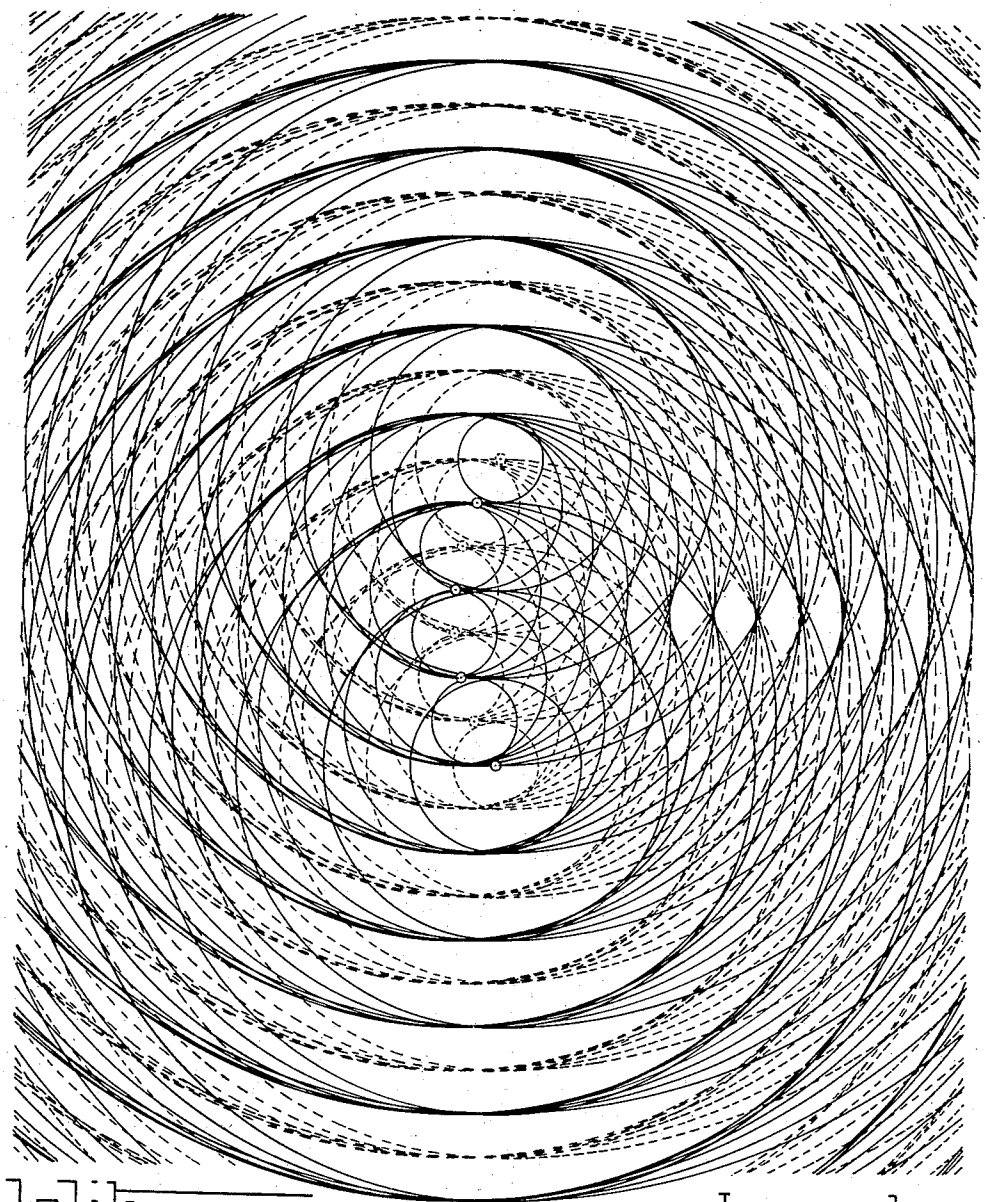
3 SHEETS—SHEET 3.



Witnesses
L. L. Shaw
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Fig. 4

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UNITED STATES PATENT OFFICE.

JAMES F. McELROY, OF ALBANY, NEW YORK.

WIRELESS TELEGRAPHY.

992,791. Specification of Letters Patent. Patented May 23, 1911.

Application filed October 4, 1905. Serial No. 281,234.

To all whom it may concern:

Be it known that I, JAMES F. McELROY, a citizen of the United States, residing at Albany, in the county of Albany and State of New York, have invented certain new and useful Improvements in Wireless Telegraphy, of which the following specification and accompanying drawings illustrate the invention in a form which I now regard as the best out of the various forms in which it may be embodied.

Figure 1 illustrates diagrammatically the essential character of my invention and indicates the manner in which the transmitted or received waves act upon each other with reference to the arrangement of the respective conductors or antennæ. Figs. 2 and 3 illustrate the manner of connecting a sending or receiving station in multiple and in series respectively with the conductors or antennæ. Fig. 4 is a diagrammatic illustration of the manner in which the waves act upon each other when the conductors or antennæ are arranged in the arc of a circle. Figs. 5 and 6 are diagrammatic illustrations showing the connections with the sending and receiving apparatus respectively as employed with the antennæ arranged as shown in Fig. 2. Figs. 7 and 8 are diagrammatic illustrations showing the connection with the sending and receiving apparatus respectively as employed with the antennæ arranged as shown in Fig. 3.

My invention relates to wireless telegraphy and particularly to the arrangement of a plurality of sending and receiving conductors with respect to the wave length of the transmitted impulses.

More particularly I provide, for purposes of sending, and likewise for receiving messages, a series of elevated conductors arranged in the general direction in which it is desired to transmit electric waves and spaced a distance apart equal to substantially one-half of the length of the transmitted wave. Thus, if we compare electric waves to a series of water waves extending outwardly in a series of circles from the point of disturbance, each one of my transmitting conductors would represent the center of a series of waves of a given length and I arrange a line of such conductors a distance apart equal to one-half of the wave length, so that every other conductor would be at the peak of the wave and the alternate conductors each at the depression of the wave. The former set of conductors, namely those at the peaks of the waves, may be designated as positive and the alternate ones, namely, those at the depression of the waves, may be designated as negative. In transmitting, each one of the conductors will be the center of a series of outgoing electric waves alternately positive and negative. In Fig. 1 I have indicated the results which will follow from the superposition of such a series of waves from a series of conductors arranged in a straight line coincident with the line in which it is desired to transmit the message.

The positive waves are indicated by full lines and the negative ones by dotted lines. An examination of Fig. 1 will show that along a general axis coincident with the line in which the conductors are arranged the waves from the several centers of transmission will coincide, there being a coöperation of all the positive conductors so that their effects are added together and there will occur a similar coöperation and addition of effect at the negative points. This result is due to the fact that the length of the wave is so calculated with respect to the distance apart of the several conductors or, vice versa, the conductors are so spaced with respect to the length of the wave, that a positive wave transmitted from any one conductor as a center will arrive at the next positive conductor at the right instant to coincide with the producing of a positive wave at the said next positive conductor and so on. Considering the superposition of these waves in a line at right angles to the axis of transmission it will be manifest that the waves will exactly neutralize each other instead of coöperating, there being at any given point along such transverse axis an equal number of positive and negative waves as indicated by the full and dotted lines respectively. By this arrangement the transmission will be directed along the axis coincident with the axis of the conductors and in no other direction, since in all other directions the waves exactly neutralize or interfere with one another as distinguished from their coöperative effect along the axis of transmission. Similarly at the receiving point electric waves of the right length will combine their inductive effects upon the several receiving conductors, the positive conductors being all at wave-peaks simultaneously and the negative

conductors at wave-depressions simultaneously. In consequence there will be induced—say an upward electric current at all the positive conductors and a downward electric current at all the negative conductors and by establishing the proper electrical connections between the conductors so that the charges from all the elevated wires will reach the receiving apparatus at the same instant a current will be produced between the two sets of elevated wires that will act upon the receiving instruments.

The conductors may be connected either in series or in multiple. In Fig. 2 I have shown the manner of connecting the conductors in multiple. All of the positive conductors 1, 3, 5, and 7, are connected to the same point *a* by means of conductors of equal lengths and the negative conductors 2, 4, 6, and 8, being similarly connected by equal conductors to the point *b*. The instrument I will be connected in circuit between these two points *a* and *b*. It will be a transmitting instrument at one end and a receiving instrument at the other end. By making the connection to the common points aforesaid of equal or like character all of the positive conductors will produce their effect at the point *a* simultaneously and the negative conductors will likewise simultaneously produce their effects at the point *b*. Conversely the transmitting effects from *a* and *b* will reach the several conductors simultaneously.

When transmitting apparatus are used with the conductors or antennæ shown in Fig. 2, their connections may be made, as an example, like those shown in Fig. 5. In this figure, *a* and *b* respectively represent the teminals from which the conductors *v*, *v'* radiate to the respective antennæ; *c* indicates the spark gap which produces the oscillations in the antennæ, *d* is a condenser for providing the requisite capacity so that oscillations of definite frequency may be generated, *e* and *f* are respectively a secondary and primary of an induction coil or transformer for producing the alternating currents in the transmitting circuit, and the primary *f* of this transformer or induction coil may be included in the circuit with an interrupter *g*, a battery *h*, and a sending key *i*.

In Fig. 6, *k* indicates a suitable wave responsive device, such as a coherer, connected between the leads *a* and *b*. *m* indicates the coil of the relay, having an armature *o*, and *n* is a battery for operating the relay in connection with the wave responsive device *k*. Suitable inductances or choke coils *l*, *l* are inserted at each side of the coherer for preventing the received oscillations from reaching the relay. The armature *o* is adapted to close a circuit containing a battery *p*, an indicator *r*, by which the signals are made visibly or audibly apparent. I do not wish to be understood as being limited to these particular forms of sending and receiving apparatus, for any devices for this purpose known to the art may be employed.

In Fig. 3 the several conductors are connected in series, the top of a positive conductor 1 being connected to the top of the succeeding negative conductor 2 so that an upward impulse in conductor 1 will coöperate with a downward impulse in conductor 2. The remaining conductors will be connected in like manner, the connection being somewhat analogous to a "wave" winding in the armature of a dynamo, the several positive and negative phases of the waves corresponding to the alternate north and south poles of a field magnet and the several conductors corresponding to the induced wires of the armature.

In my arrangement I prefer to insulate the transmitting and receiving conductors from the earth so that they are independent of the earth's variable static charge.

The letter *t* indicates suitable insulating bases for supporting the antennæ, and which rest upon the earth or other surface *s*.

The transmitting and receiving apparatus which may be used at H with the apparatus of Fig. 3 are indicated in Figs. 7 and 8. In Fig. 7, *a'* and *b'* represent respectively the leads connected with the antennæ, *c'* indicates two spark gaps which are in series with said leads. *d'* is a suitable condenser having the necessary capacity to regulate the oscillations produced in the antennæ; *e'* and *f'* are respectively the secondary and primary of a transformer or induction coil, and in series with the primary *f*, an interrupter *g'*, sending key *i*, and battery *d'* are included.

In Fig. 8, *k'* indicates a suitable wave responsive device, such as a coherer, connected between the leads *a'* and *b'*. Connected in parallel with this coherer but in series with each other are the choke coils *l' l'*, the magnet *m'* and battery *n'*. The magnet *m'* operates a suitable relay *o'* in circuit with the indicator *r'* and battery *p'*.

In the arrangement which I have shown in Fig. 1 there will be not only a definite direction given to the transmitted message, but the system will also be practically independent of any other waves of a different length, or waves of the same length coming from any other direction. It is not, however, absolutely perfect in the latter respect, since it is possible to conceive of waves of shorter length arriving diagonally and of such length that their positive and negative points will coincide with the respective conductors of the system, although their wave length is not the same as that for which the system is normally adapted. In order to eliminate this chance of interference I may arrange the conductors in the arc of a cir-

cle, as shown in Fig. 4, instead of in a straight line. By this arrangement there will be the same coinciding effects in one specified direction which I have already described, as will be evident from an inspection of the figure showing the several positive and negative waves superposed upon each other. The coöperative effect will be along a line parallel to a tangent to the arc in which the conductors are arranged. This will be the axis of transmission, while on either side of such axis the waves will interfere with and neutralize one another. It is impossible, however, that any wave coming in a direction angular to the axis of transmission will find the respective conductors coincident with the positive and negative points of the wave because with respect to such a wave the spacing of the conductors will not be uniform. In the arrangement of Fig. 4 a connection of the positive conductors in multiple with one another may be provided for by wires of equal length brought to the center of the arc in which the conductors lie, while the negative conductors may be connected in multiple in like manner and the two centers of connection joined with the receiving or transmitting instruments, as already described.

My invention is not concerned with the particular character of the instrument employed for transmission, or for receiving. I merely indicate an instrument in Fig. 2 at I connected in circuit between the points *a* and *b* and in Fig. 3 a similar instrument H will be connected at a point in the series circuit. These instruments will be of any kind suitable for exciting or producing electric waves at the transmitting station and for detecting or receiving them at the receiving station. Therefore, I have merely made a diagrammatic indication of such instrument. My invention is concerned with the relation between a series of transmitting and receiving conductors and the electric waves transmitted from one to the other.

What I claim as new and desire to secure by Letters Patent is:

1. In a system of transmission by electric waves, a terminal apparatus comprising a series of two or more antennæ separated by a distance equal to one wave length of the transmitted waves, and electrically connected together, and a series of two or more antennæ separated by one wave length and arranged alternately with the antennæ of the first series, and station apparatus in circuit with the two sets of antennæ.

2. In a system of transmission by electric waves, a terminal apparatus comprising a series of antennæ insulated from the earth and separated by one wave length of the transmitted waves, a similar series of antennæ insulated from the earth and separated by one wave length and arranged intermediate and at equal distances from the antennæ of the first series, and station apparatus connected in circuit with the respective antennæ.

3. In a system of transmission by electric waves, terminal apparatus comprising a series of antennæ insulated from the earth and alternating with a series of antennæ also insulated from the earth, the said antennæ being located in the line of desired transmission and spaced apart substantially equal to one-half the length of the transmitted waves, and means for simultaneously exciting each series of antennæ with electrical oscillations of opposite sign.

4. In a system of transmission by electric waves, a terminal apparatus comprising antennæ insulated from the earth, means for producing a series of electric waves having their positive portions coincident and also having their negative portions coincident in the direction of desired transmission but non-coincident in other directions, the electric instrument in circuit having its leads connected with the ends of said antennæ.

5. In a system of transmission by electric waves, a terminal apparatus comprising antennæ, means for producing a series of electric waves having their positive portions coincident and also having their negative portions coincident in the direction of desired transmission but non-coincident in other directions, the electric instrument in circuit having its opposite leads connected with the ends of alternate antennæ.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses, the fifth day of September, 1905.

JAMES F. McELROY.

Witnesses:
BEULAH CARLE,
WILLIAM A. MORRILL, Jr.