

No. 739,271.

PATENTED SEPT. 15, 1903.

F. J. GREEN.

APPARATUS FOR POLARIZATION OF HERTZIAN WAVES.

APPLICATION FILED JAN. 29, 1903.

NO MODEL.

2 SHEETS—SHEET 1.

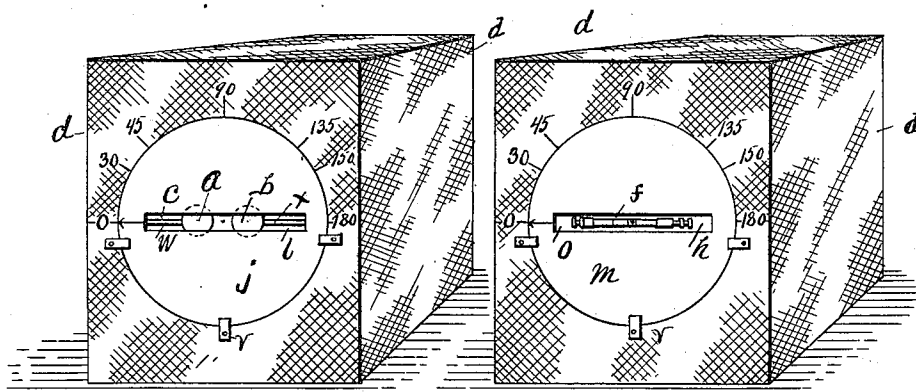


Fig. 1.

TRANSMITTER

No. 1	
" 2	
" 3	
" 4	
" 5	
" 6	
" 7	
" 8	
" 9	
" 10	

Fig. 2.

RECEIVER

m		=	o
		=	o
		=	o
		=	R
		=	R
		=	R
		=	o
		=	o
		=	o
		=	o

Fig. 3.

WITNESSES.

O. B. Baumgardner
M. O. Stuehle

INVENTOR.

Francis J. Green
By Maxwell S. Wright

his Attorney

No. 739,271.

PATENTED SEPT. 15, 1903.

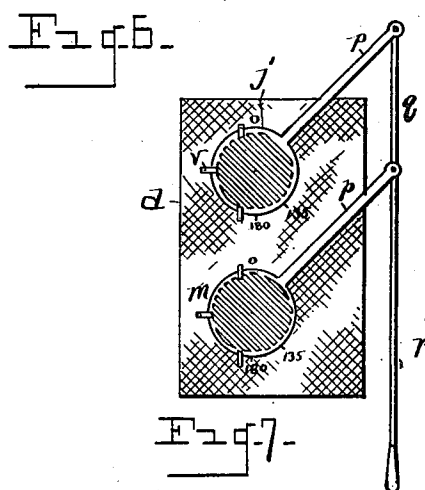
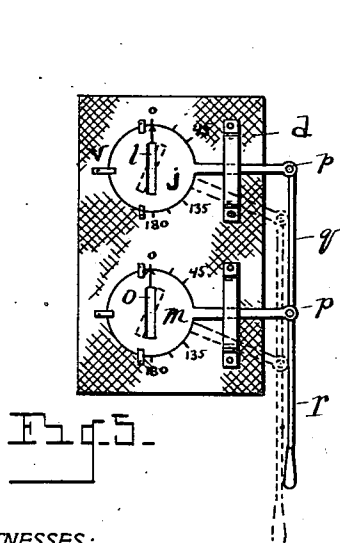
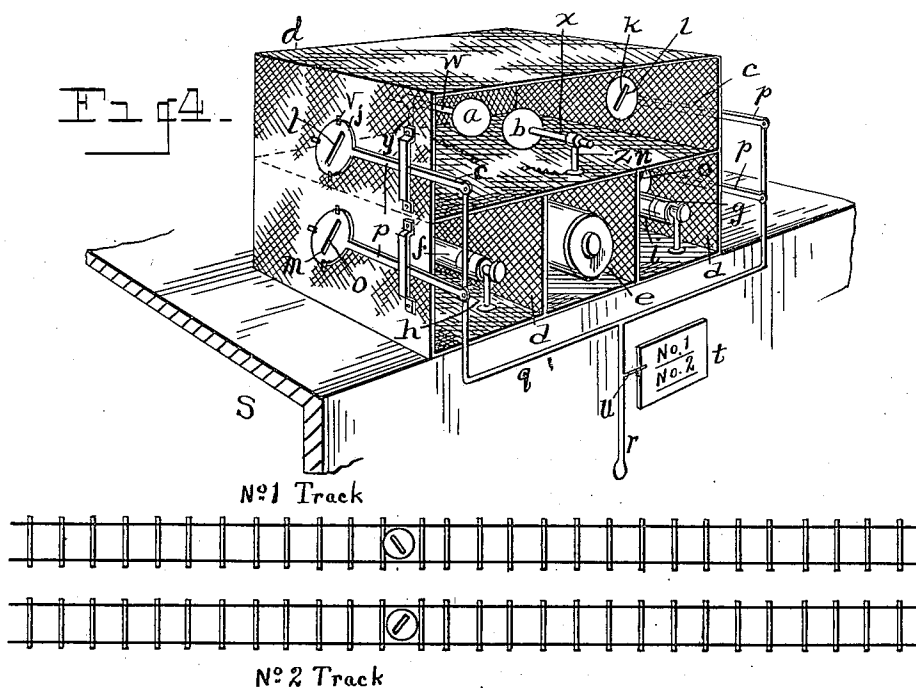
F. J. GREEN.

APPARATUS FOR POLARIZATION OF HERTZIAN WAVES.

APPLICATION FILED JAN. 29, 1903.

NO MODEL.

2 SHEETS—SHEET 2.



WITNESSES:
W. B. P. P. P.
M. L. Simmons

Francis J. Green INVENTOR.
 BY *Newell S. Wright* ATTORNEY.

UNITED STATES PATENT OFFICE.

FRANCIS J. GREEN, OF DETROIT, MICHIGAN, ASSIGNOR TO THE AMERICAN ENGINEERING COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF SOUTH DAKOTA.

APPARATUS FOR POLARIZATION OF HERTZIAN WAVES.

SPECIFICATION forming part of Letters Patent No. 739,271, dated September 15, 1903.

Application filed January 29, 1903. Serial No. 141,008. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS J. GREEN, a citizen of the United States, residing at Detroit, county of Wayne, State of Michigan, have invented a certain new and useful Improvement in Apparatus for the Polarization of Hertzian Waves, of which the following is a specification, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to certain novel apparatus for the polarization of Hertzian waves, and has for its object means for causing emitted signals (emitted from wireless signaling mechanism) to be received only by companion receiving mechanism.

My invention consists of the construction, combination, and arrangement of devices hereinafter described and claimed, and illustrated in the accompanying drawings, in which—

Figure 1 is a view in perspective showing the application of my invention as applied to a transmitting mechanism. Fig. 2 is a similar view showing the application of my invention as applied to a receiving mechanism. Fig. 3 is a diagrammatic illustration showing different positions of the openings in the revolving screens in front of the transmitting and receiving mechanisms. Fig. 4 is a view in perspective showing the application of my invention to transmitting and receiving mechanisms as more particularly applied to a railway signaling device. Fig. 5 is a front elevation of one end of the apparatus shown in Fig. 4. Fig. 6 is a diagrammatic illustration showing the application of the principles embodied in my invention to railroad signaling. Fig. 7 is an end elevation illustrating a modification of the invention.

I have shown in the accompanying drawings and have hereinafter described certain features of my invention as applied to railway signaling, some features thereof being substantially embodied in my application for United States Letters Patent, filed January 9, 1903, Serial No. 138,343.

One purpose of my invention is to provide apparatus whereby trains running upon parallel tracks may give and receive only certain desired signals, the signals being conveyed to

specific tracks upon which the locomotives may be running, thereby preventing any interference or confusion of signals emitted and received by wireless-telegraphy apparatus upon locomotives running on different or adjacent tracks. Certain features of my invention, however, I would particularly have it understood are capable of wider application than simply to railway signaling, and I would have it understood that I contemplate as coming within the scope of my invention any and all uses to which my improved apparatus may be applied. Some of its features, for example, may be applied to commercial wireless telegraphy. As illustrated in the accompanying drawings, *a b* represent the secondary terminals of a wireless-telegraphy transmission apparatus, said terminals and the secondary circuit being located in a chamber *c*, formed by suitable walls *d*, preferably of wire netting or gauze, although I do not in my present invention limit myself to any particular construction of said walls, as they may consist of any suitable material or structure. The induction-coil of the transmission mechanism is indicated at *e*, also inclosed by suitable walls. The coherers of two receiving mechanisms are indicated at *f* and *g*, said coherers being also inclosed within suitable walls, forming receiving-chambers *h* and *i*. For railway signaling apparatus I locate at opposite ends of the terminal transmission-chamber *c* rotatable disks, (indicated at *j* and *k*,) each of said disks being provided with an elongated slot or opening, (indicated at *l*,) At the outer ends of the receiving-chambers *h* and *i* are also located rotatable disks *m* and *n*, each provided with an elongated orifice *o*. Any suitable means may be employed to rotate said disks, respectively. I have shown, for example, each disk provided with a lever, (indicated at *p*,) said lever being connected by a connecting-rod *q* with an operating arm or handle *r*, so that the disks may be simultaneously and immediately actuated. Any suitable support for the mechanism is indicated at *s*. For the more ready adjustment of said disks the support may be provided with an indicator *t* and the arm *r* with a finger *u*, the indicator *t*, for example, being con-

5 constructed to indicate the adjustment of the disks for track No. 1 or for track No. 2. The disks may be held in place in any suitable manner—as, for example, by clips *v*. I do not
 10 limit myself to connecting the disks so as to be actuated simultaneously; neither do I limit myself to the employment of rotatable disks at opposite ends of the transmission-chamber nor to plural receiving mechanisms nor to
 15 the employment of plural rotatable disks at the forward and rear ends of the receiving-chamber. I have shown in Fig. 4 disks at the front and rear ends of the transmission-chamber and of the receiving-chambers in
 20 order that signals may be transmitted and received in and from opposite directions; but it will be evident that my invention will be applicable for other uses if, for instance, a transmitting-chamber was provided with but
 25 a single disk and a single receiving-chamber with a corresponding disk. It will be obvious, however, that for railway and other signaling apparatus it is desirable to have the plural chambers and disks arranged so as to transmit
 30 and receive signals from various directions, as for purposes more definitely defined in my application above referred to. Said disks, with their elongated orifices, are for the polarization of Hertzian waves. It will be seen that
 35 the transmitting apparatus is thus inclosed in walls, while in front and at the rear of the spark-gap between the terminals *a b* are the circular revolving disks, which serve as polarizing-screens, said disks or screens being
 40 made of suitable material, each screen or disk being provided with an elongated opening or orifice of suitable length and width. The screens or disks, with their elongated orifices, are so made that by revolving the same
 45 said orifices can be made to keep different angles to the spark-gap plane. As shown, the two terminals *a b* consist of suitable metal balls, each connected with brass rods *w x*, located in a horizontal plane; said rods supported upon vertical standards *yz*, electrically connected with the induction-coil *e*. The disks or screens are so arranged that the center of the spark-gap is opposite the longitudinal center of the opening in the corresponding
 50 screens. The coherers of the receiving mechanisms are also inclosed in suitable walls, the coherers being located in the horizontal planes and so placed that their centers are opposite the longitudinal center of the opening in the corresponding screen or disk.
 55

60 In order to fully understand the operation of the mechanism above described, let it be considered that a horizontal position of the opening in one of the screens or disks is zero, which is also in the plane of the spark-gap in that position, the screen being revolvable to bring said opening longitudinally to a vertical position or ninety degrees and to an opposite horizontal position or one hundred and eighty degrees. In Fig. 3 I have
 65 illustrated various positions of the openings of the screens or disks of the transmitter

mechanism and of the receiving mechanism and have indicated in the right-hand column of said figure the results when the respective
 70 screens are in the corresponding positions, and, as marked in said right-hand column, *o* indicating no response and the letter *r* indicating a response. Thus when the openings of the two companion screens are in a horizontal po-
 75 sition, as indicated in the first horizontal line or at zero, no result is obtainable. When the openings in the screens are rotated so as to be at an angle of twenty-five degrees, as indicated in the second and third horizontal
 80 lines, the elongated openings extending in parallel planes, no response results. When the openings in accompanying screens are arranged at an angle of forty-five degrees, as indicated in the fourth and sixth horizontal
 85 lines of said figure, a response results. So, also, a response would result when the openings in the screens are any where between forty-five degrees and one hundred and thirty-five degrees and in a parallel plane with each
 90 other. As indicated in the seventh horizontal line of said figure, when the opening of the transmitting-screen is at forty-five degrees and the opening of the companion receiving-screen is at one hundred and thirty-five de-
 95 grees no result is obtained. So, also, if the receiving-screen is placed at forty-five degrees and the transmitter-screen at one hundred and thirty-five degrees, as shown in line 10, no response results. As indicated
 100 in the eighth and ninth horizontal lines of said figure, when one of the disks is in a vertical position and the other is in a horizontal or zero position no response results. These are simply examples of results obtain-
 105 able when the screens are in different positions. I find thus that when these openings are at an angle of twenty-five degrees on either side of the horizontal no perceptible wave is received by the coherer. When the openings
 110 are arranged between thirty and one hundred and fifty degrees in parallel planes, the wave passes freely through the openings of the transmitter and receiver so long as the two openings make with each other an angle of
 115 less than sixty degrees. I also find that under no circumstances is it possible for the wave to be transmitted through an elongated opening such as described or through a series of plural metal bars or wires if these
 120 openings or bars should be parallel in a plane to the axis of the oscillator. So, also, if in front of the receiver were placed a series of bars or a screen constructed with an elongated slot parallel to the axis of the coherer
 125 it would be impossible for the coherer to be actuated by a wave impulse. These results confirm in every particular the experiment described by Hertz in his paper on electrical radiation in *Wiedeman's Annalen*, Vol. 36, page 769. Upon the results that I have obtained, as shown in the seventh and tenth lines of Fig. 3, I have based the application of polarization to the confining of the wave

sent to a certain track upon which the engine carrying the transmitter may be at the time running. For instance, all of the engines running upon track No. 1 have the screens 5 containing the opening set at an angle of forty-five degrees to the horizontal. It will be readily apprehended by referring to line 7 of Fig. 3 that if the transmitters of the engines upon track No. 2 are set at one hundred 10 and thirty-five degrees no signal can be received from one track to the other.

In general it may be stated that Hertzian waves are composed of two parts or forces—the electric and the magnetic. These com- 15 ponent parts and the wave which is formed thereby are exactly similar to light-waves and their component parts and in a great measure are subject to and are governed by the same laws as light. It is also known that the 20 magnetic force is perpendicular to the axis of the oscillator and that the electric force is normal to the magnetic force and that both forces are perpendicular to the direction of propagation, according to Maxwell's theory of 25 light.

As in my former application, above referred to, my present invention contemplates segregating the receiver or receivers from each other and also from the transmitter. This 30 may be done by constructing the inclosing walls of the respective chambers within which the coherers and transmitting mechanisms are located of suitable material to accomplish such segregation, as described in my said ap- 35 plication, such walls being indicated at *d*, as above described. In Fig. 4 it will be understood that the front portion of the case is removed.

In brief, the results obtained by my invention may be thus summarized, First, if before the transmitting and receiving mechanisms of a Hertzian wave apparatus there be placed a metal screen, each screen containing a single rectangular opening or slot, these 45 openings resolve the wave into its component parts; second, if both openings lie in the same plane so long as this plane is inclined at an angle between thirty and one hundred and fifty degrees to the axis of the oscillator the 50 emitted ray will pass through the receiving opening; third, the emitted ray will pass through the receiving opening so long as the planes of the openings are between zero and sixty degrees of each other and between thirty 55 and one hundred and fifty degrees to the axis of the oscillator; fourth, the emitted ray will not pass through the receiving-opening at any angle these openings make with each other greater than sixty degrees; fifth, if the planes 60 of both openings lie in the axis of the oscillator or within thirty degrees to it no response will be received; sixth, these results are the same at whatever angle the axis of the oscillator is placed, always regarding such angle as the 65 zero degree or the horizontal plane.

I do not broadly claim herein an apparatus for simultaneously transmitting and receiv-

ing electric impulses or Hertzian waves simultaneously from different directions and means for segregating the impulses received 70 from different directions at the same location or station, as such subject-matter of invention is broadly claimed in my pending application filed January 9, 1903, Serial No. 138,343.

The improvement herein disclosed and 75 claimed consists in apparatus for sending and receiving signals by means of polarized Hertzian waves.

What I claim as my invention is—

1. A system of wireless telegraphy for rail- 80 way and marine signaling and other purposes, comprising a transmitter and receiver, and means for transmitting waves of any desired angle of polarization, means for varying such angle of polarization and for excluding from 85 the receiver all polarized waves excepting those of such predetermined angle of polarization.

2. A system for the transmission of signals by Hertzian waves, comprising a transmitter 90 and a receiver, the latter being provided with an adjustable analyzer, substantially as set forth.

3. A system for the transmission of signals by Hertzian waves, comprising a transmitter 95 and receiver, each being provided with an adjustable polarizer.

4. An apparatus for transmitting and receiving signals by Hertzian waves, comprising a transmitter arranged as a companion to a 100 receiver, said transmitter and receiver being constructed and adapted to polarize and analyze Hertzian waves of any desired angle of polarization, substantially as set forth.

5. An apparatus for the production of Hertzian waves, comprising a transmitter provided 105 with a plurality of polarizers, each adapted to produce Hertzian waves of the same angle of polarization, substantially as set forth.

6. A wireless railway signaling system, 110 comprising transmitting and receiving apparatus constructed to transmit and receive Hertzian waves of any angle of polarization.

7. A wireless railway signaling system, comprising adjustable apparatus constructed 115 and adapted to produce, transmit, and receive Hertzian waves of different angles of polarization and to exclude Hertzian waves of substantially different angles of polarization, sub- 120 stantially as set forth.

8. A Hertzian-wave railway signaling system, comprising a plurality of receivers, means 125 for segregating the receivers, one from the other, means whereby each receiver will only respond to Hertzian waves of predetermined angle of polarization, and means whereby the transmitter may produce waves of any desired angle of polarization, substantially as set forth.

9. A Hertzian-wave system of danger-sig- 130 nals for railroads comprising means whereby a signal may be received from various directions, means for transmitting a signal to a desired receiver only, and means whereby other

receivers within the influence of the transmitted Hertzian wave may be cut out or segregated.

10. In a wireless telegraph system employing polarized Hertzian waves as a means of communication, adjustable means for imparting any desired angle of polarization to the waves.
11. In an apparatus for the polarization of Hertzian waves, a transmitter provided with a rotatable polarizing-screen, a receiver provided with a rotatable polarizing-screen, and means whereby both of said screens may be simultaneously actuated.
12. In an apparatus for the polarization of Hertzian waves, a transmitter-chamber provided with a transmitting mechanism, rotatable polarizing-screens at the outer extremities of said chamber, and means whereby said screens may be simultaneously actuated.
13. In an apparatus for the polarization of Hertzian waves, a transmitter-chamber provided with a transmitting mechanism, rotatable polarizing-screens at the outer extremities of said chamber, means whereby said screens may be simultaneously actuated, and indicating mechanism to indicate the adjustment of the screens.
14. In an apparatus for the polarization of Hertzian waves, a transmitter-chamber provided with transmitting mechanism, receiver-chambers provided with receiving mechanism, an induction-coil the secondary of which is electrically connected with the terminals of the transmitting mechanism, a chamber in which said induction-coil is isolated, said transmitter-chamber provided with rotatable polarizing-screens at opposite extremities and the outer extremities of said receiver-chamber provided with rotatable polarizing-screens.
15. In a wireless telegraph system, an apparatus for the production of Hertzian waves, a polarizing-screen and means for varying the adjustment of the openings in the screen with relation to the axis of the oscillator.
16. In a wireless telegraph or signaling system, means for producing Hertzian waves of variable angles of polarization, and means for causing a receiver to respond only to waves of any such angle of polarization.
17. In a wireless telegraph or signaling system, an apparatus comprising means for producing and transmitting in opposite directions Hertzian waves of similar and of any desired angle of polarization, and a plurality of receivers, each adapted to receive from opposite directions and analyze waves of any desired angle of polarization, and to exclude waves of substantially different angles of polarization.
18. A wireless signaling apparatus constructed and adapted to simultaneously send and receive Hertzian waves of substantially the same and of any predetermined angle of polarization, substantially as set forth.
19. In a wireless signaling system, a transmitter provided with an adjustable polarizer, substantially as set forth.
20. In a wireless system of telegraphy or signaling, the combination of apparatus constructed and adapted to simultaneously send and receive Hertzian waves polarized to any desired angle, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

FRANCIS J. GREEN.

Witnesses:

N. S. WRIGHT,
M. M. STRUBLE.