No. 754,058. PATENTED MAR. 8, 1904.

R. A. FESSENDEN.

SIGNALING BY ELECTROMAGNETIC WAVES.

APPLICATION FILED AUG. 8, 1903.

NO MODEL.

FIG. 1.

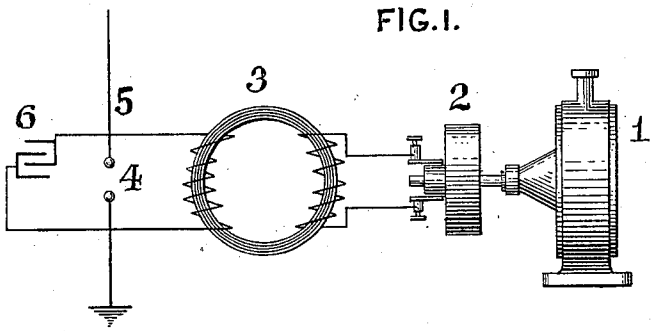
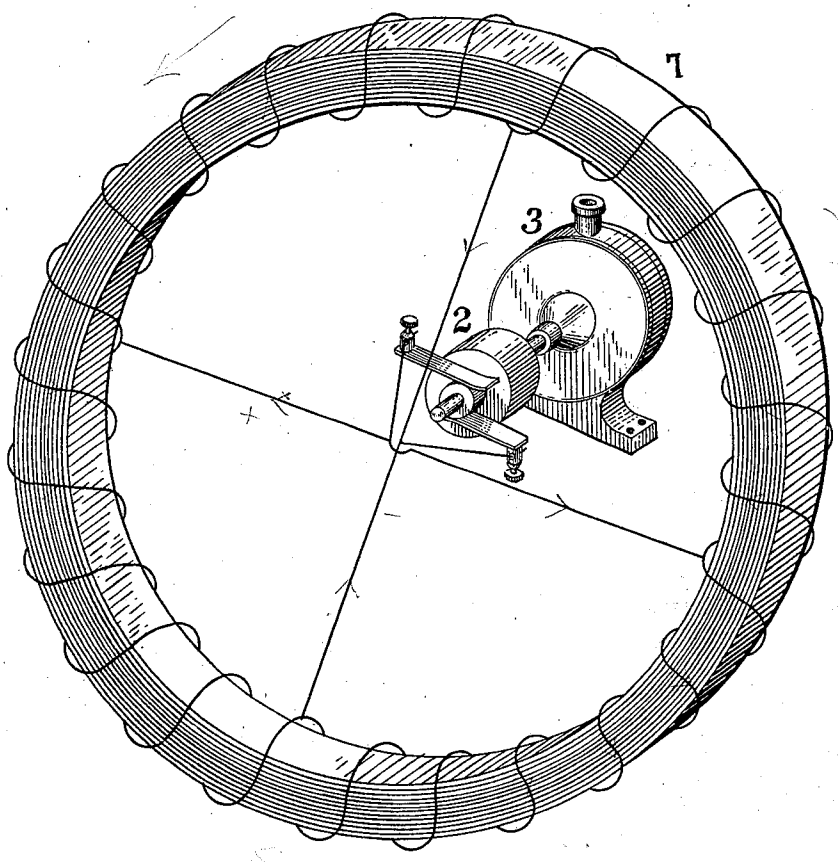


FIG. 2.



WITNESSES:
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No. 754,058. Patented March 8, 1904.

UNITED STATES PATENT OFFICE.

REGINALD A. FESSENDEN, OF FORT MONROE, VIRGINIA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE NATIONAL ELECTRIC SIGNALING COMPANY, OF PITTSBURG, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

SIGNALING BY ELECTROMAGNETIC WAVES.

SPECIFICATION forming part of Letters Patent No. 754,058, dated March 8, 1904.

Application filed August 8, 1903. Serial No. 168,800. (No model.)

To all whom it may concern:

Be it known that I, REGINALD A. FESSENDEN, a citizen of the United States, residing at Fort Monroe, in the county of Elizabeth City and State of Virginia, have invented or discovered new and useful Improvements in Signaling by Electromagnetic Waves, of which improvements the following is a specification.

The invention described herein relates to certain improvements in the generation of electromagnetic waves.

It relates more particularly to the means of actuating the generators for producing the wave, and has reference also to the method described in United States Patent No. 706,737.

In the figures of the drawings forming a part of this specification, Figure 1 is a diagrammatic view illustrating a form of apparatus for the practice of my invention. Fig. 2 is a similar view illustrating another form.

Where a steam-engine is used for actuating a generator, it is not possible to obtain high peripheral speed combined with small circumference of moving parts—*i. e.*, it is not possible to obtain a large number of revolutions per second. In addition at high speeds there is considerable vibration of the moving parts, which is detrimental to the operation of a wireless-telegraph station. By the use of a steam-turbine as a prime mover I am enabled to obtain a large number of revolutions per second, and hence high frequencies when desired—as, for example, in the method of United States Patent No. 706,737. In addition where an alternating current is used in combination with the discharge-gap I am enabled to obtain a very light and portable set and one which does not take up much room. Another advantage is that such a set gives rise to no vibrations sufficient to disturb the operation of the station.

Fig. 1 shows a steam-turbine 1, connected to a revolving pole alternating generator 2, operating a transformer 3, which, with the spark-gap 4, is in operative relation to the sending-conductor 5. 6 is a condenser.

Fig. 2 shows a form of sending-conductor of the same type as that described in United States application, Serial No. 167,242, in which the electromagnetic waves are formed by magnetic oscillations and not by the discharge of a vertical conductor. It consists of a horizontally-placed anchor-ring 7, formed of a number of convolutions of wire wrapped around a core, which may be of iron very finely laminated. In case the case has sufficient stiffness the core may be omitted, as the presence of iron is not absolutely essential and as in some cases the operation is better if the iron be omitted. The convolutions or strips of wire forming the anchor-ring are divided into a number of parallel circuits whose terminals run radially to the center of the ring, where they are attached to a charging source for producing oscillations in them. The oscillations may be produced by means of a spark-gap and condenser; but in the case here shown they are produced by a high-frequency dynamo 2, operated by a steam-turbine 3.

It is characteristic of my improvement that high peripheral speed with small circumference of moving parts can be obtained. A fundamental and radically new effect is obtained by employing a prime mover having a constant torque to operate a generator-armature having a small diameter—as, for example, two feet—and a high peripheral speed—as, for example, ten miles per minute: If the pole pieces have a width of one-twentieth ($\frac{1}{20}$) of an inch, we can obtain a periodicity of one hundred thousand per second, the number of revolutions per second of the armature being eight thousand per minute. With a reciprocating engine giving six hundred revolutions per minute the diameter of the armature would have to be two hundred and sixty feet to give the same number of periods per second with the same width of pole-pieces. As it is not practicable mechanically to make the width of the pole-pieces very much smaller than one-twentieth ($\frac{1}{20}$) of an inch in width, this means that the high periodicities necessary for the transmission by energy of electromagnetic waves by this method is rendered

practicable by the combination herein described, and the size of the apparatus is kept within reasonable limits. The efficiency of this combination is very much greater than other methods—for example, the commonly-used induction-coil. A high-frequency dynamo of the type described in Patent No. 706,737, dated August 12, 1902, which gave a periodicity of twenty thousand per second per mile a minute of peripheral speed, had a measured efficiency of eighty (80) per cent. The efficiency of a steam-turbine adapted for use in this combination is equal to that of the best reciprocating steam-engine of equal power. An additional peculiar advantage in this connection is the fact that with a high number of revolutions per second a change in the load of the dynamo produces an infinitesimal variation of speed compared with that produced on an engine having a moderate number of revolutions per second. This is for the reason that the fly-wheel effect is proportional to the product of the masses of the fly-wheels by the square of the number of revolutions per second. Hence with engines having equal fly-wheel effects the change in speed produced by change of load will be inversely proportional to the number of revolutions per second. Hence with this combination there will be a much smaller change in periodicity when signals are sent, and the dynamo will not be thrown out of resonance. Another very important advantage is that where a low number of revolutions is used, necessitating a much larger number of poles to get the same frequency, a given change in angular velocity will extend over a much larger number of periods, and hence the interference with the resonance will be much greater than when a large number of revolutions per minute is employed. In addition the torque is very much more uniform.

The term "sending-conductor" as used herein is employed to indicate all of the circuits of the sending-station from top to bottom if grounded, or if not grounded from one extreme end to the other extreme end, including all apparatus in series with the circuits. This definition of the term "sending-conductor" has been employed in prior patents granted to me, particularly Patent No. 706,737, granted August 12, 1902.

What I claim is—

1. In a system for the transmission of energy by electromagnetic waves the combination of an electric generator a sending-conductor operatively connected to the generator and a steam-turbine directly connected to the generator.

2. In a system for the transmission of energy by electromagnetic waves the combination of a high-frequency electric generator a sending-conductor operatively connected to the generator and a prime mover having a constant torque.

3. In a system for the transmission of energy by electromagnetic waves the combination of an electric generator a sending-conductor operatively connected to the generator and a turbine directly connected to the generator.

4. In a system for the transmission of energy by electromagnetic waves the combination of a high-frequency electric generator a sending-conductor operatively connected to the generator and a steam-turbine directly connected to the generator.

5. In a system for the transmission of energy by electromagnetic waves the combination of a prime mover having a constant torque, an electric generator and a sending-conductor operatively connected to the generator.

6. In a system for the transmission of energy by electromagnetic waves the combination of a prime mover having a constant torque, an electric generator and a sending-conductor operatively connected to the generator so as to directly generate electromagnetic waves.

7. In a system for the transmission of energy by electromagnetic waves the combination of an electric generator a sending-conductor operatively connected to the generator and a prime mover having a constant torque and a high angular velocity.

8. In a system for the transmission of energy by electromagnetic waves the combination of an electric generator a sending-conductor operatively connected to the generator and a prime mover having a constant torque and a high angular velocity and directly connected to the generator.

In testimony whereof I have hereunto set my hand.

REGINALD A. FESSENDEN.

Witnesses:
WM. H. DE LACY,
FINIS D. MORRIS.