E. GIRARDEAU.

RADIOTELEGRAPHIC PLANT.

APPLICATION FILED DEC. 1, 1911.

1,151,098. Patented Aug. 24, 1915.

Fig. 1.

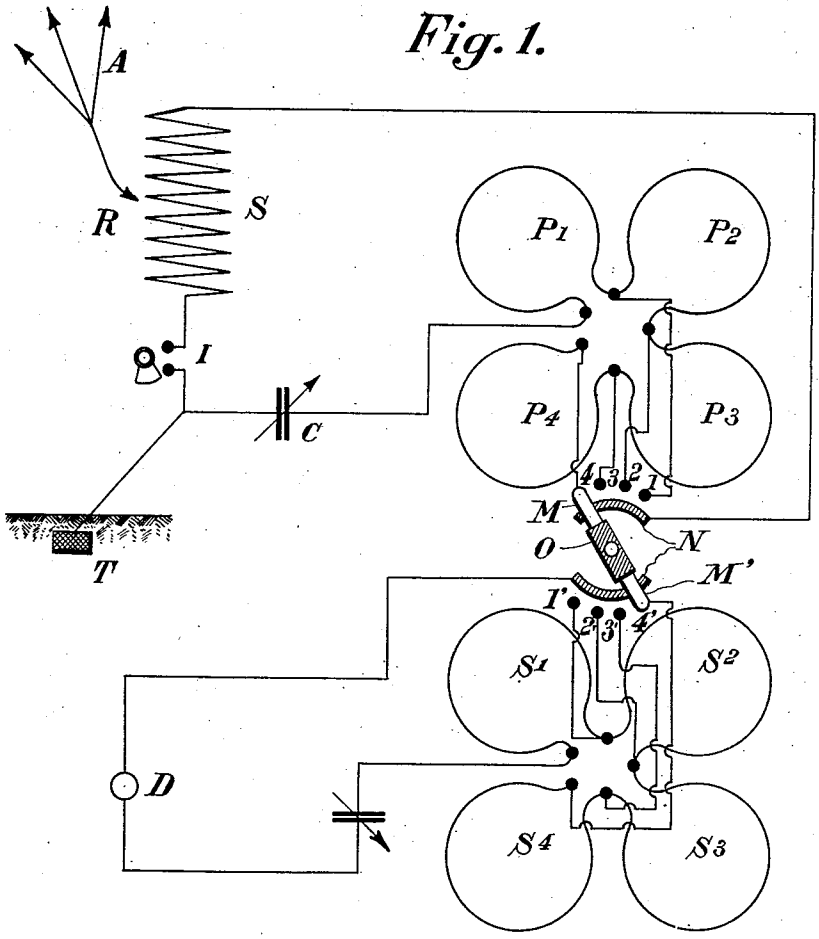
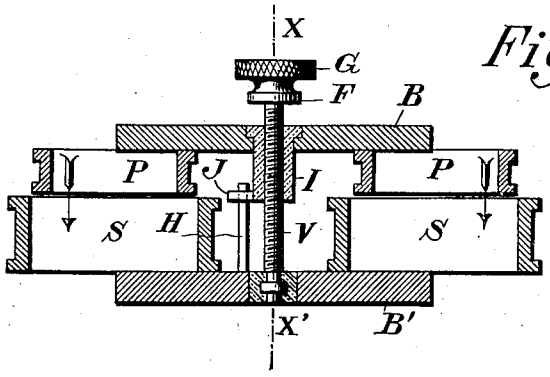


Fig. 2.



Inventor

Emile Girardeau

By Ingur

Attorney

UNITED STATES PATENT OFFICE.

EMILE GIRARDEAU, OF PARIS, FRANCE, ASSIGNOR OF ONE-HALF TO JOSEPH BETHENOD, OF PARIS, FRANCE.

RADIOTELEGRAPHIC PLANT.

1,151,098. Specification of Letters Patent. Patented Aug. 24, 1915.

Application filed December 1, 1911. Serial No. 663,360.

To all whom it may concern:

Be it known that I, EMILE GIRARDEAU, engineer, a citizen of the Republic of France, residing at Paris, in the Republic of France, have invented certain new and useful Improvements in Radiotelegraphic Plants, for which application has been made in France December 1, 1910.

A receiver for radiotelegraphic plants ought to possess theoretically the following properties, viz:—

1. It ought to be adapted to be tuned for waves of various lengths while preserving always the same sensitiveness whichever may be the length of the wave.

2. It ought to permit the maximum of syntony after the tuning with the corresponding station has been once effected to be obtained.

3. It ought to comprise as few regulating devices as possible.

4. It ought to require as little space as possible.

Practically the simultaneous realization of all these conditions presents great difficulties owing to the fact that, in order to attain a sufficient syntony, an induction jigger with separate windings has to be used, although this jigger offers certainly from a good many points of view much greater complications than the jigger with simple winding used for shunting. However it is evident, that the construction of a single jigger is much simpler than the construction of two, one of which then must be provided with a device permitting the changing of their relative positions.

This invention relates to a new receiver which particularly offers in the most complete form all the properties hereinbefore enumerated. This improved apparatus is based upon the following principles: In a normal receiver post with induction jigger, this jigger, considered by itself, constitutes a converter without iron having a determined dispersion coefficient σ. On the other hand if χ designates the ratio of the coefficient of the apparent self-induction of the antenna with regard to the coefficient of self-induction of the primary winding of the jigger, it is clear that the coefficient of the real coupling between the two circuits, the primary and the secondary of the receiver system, is equal to:

$$\rho = \sqrt{\frac{1-\sigma}{1+\chi}}$$

This equation is the result of the following development: If the respective coefficients of self-induction of one of the n primaries P_1, P_2, P_3, . . . P_n is designed l_1, and of one of the n secondaries S_1, S_2, S_3, . . . S_n, l_2, and l_0, is the apparent self-inductance of the antenna (considered as a circuit oscillating with concentrated capacity) and m is the coefficient of the mutual induction between a primary and the corresponding secondary, it will be seen that the total primary self-induction is l_0+nl_1 and the total secondary induction is nl_2. The total mutual induction is measured by $n\ m$ and the following equation may be written out in accord with the well known definitions used in the theoretical study of high frequency currents:

$$\rho^2 = \frac{n^2m^2}{(nl_1+l_0)nl_2}$$

or

$$\rho^2 = \frac{m^2}{l_1l_2+\frac{l_0l_2}{n}}$$

or

$$m^2 = (1-\sigma)l_1l_2$$

σ is the dispersion coefficient, well known and used in the study of transformers and induction motors.

Further development results in the following equation:

$$\rho^2 = \frac{1-\sigma}{1+\frac{l_0}{l_1n}}$$

and finally

$$\rho = \sqrt{\frac{1-\sigma}{1+\chi^2}}$$

In order to adapt the apparatus to the various lengths of waves between 0 and a maximum, the coupling coefficient must be varied between zero and the maximum.

In order to tune the primary and secondary circuits according to the lengths of the waves received it is absolutely necessary to act upon the values of self inductance of the two windings of the jigger; if with this object in view bobbins with sliding contacts are used, as is generally the case, it follows that the minimum dispersion coefficient σ corresponding to each length of wave is very variable. In order to attain in each case the same maximum value of ρ it therefore is necessary to act upon χ according to the formula hereinbefore stated; this is however not very rational. According to this invention this inconvenience is avoided by subsituting for the single jigger, generally used, a certain number of jiggers, the primary and secondary windings of which are respectively connected in series; according to the wave length of the sender station the number of such jiggers is varied by means of a suitable commutator and in applying the formula as above one can easily verify whether the coupling coefficient remains constant whichever may be the number of jiggers coupled for a given number of χ.

In the accompanying drawings a diagram of connections and a coupling apparatus for the jigger is shown by way of example.

Figure 1 shows the apparatus with four jiggers. Fig. 2 illustrates a modified construction permitting of the easy and simultaneous regulation of all the jiggers in very wide limits.

In Fig. 1, the antenna A is connected with the primaries P_1, P_2, P_3, P_4 of the jiggers in question through the intermediary of the self-inductance S, the ground contact T being insured by a conductor in which the condenser C is inserted. The secondaries S_1, S_2, S_3, S_4 are mounted as well as the primaries in series in the circuit of the detector D.

By means of the commutators M, M' it is evidently possible to vary the number of jiggers actually in use, according to the length of wave from the sender station, said commutators M, M' being adapted to be connected with each other in such a manner that the one participates in the movements of the other. Thus, as shown in Fig. 1, the commutators M, M' can be mounted upon an insulated regulator handle o allowing their simultaneous operation, so that the commutator M rests upon the contact 1 when the commutator M' rests upon contact 1' and the commutator M rests upon contact 2 when the commutator M' rests upon contact 2', etc. It is obvious that there can be provided any number (n) of jiggers. As regards the coupling coefficient ρ it can be modified at will if one acts upon σ, that is to say by changing the relative position of the primaries and of the secondaries.

According to Fig. 2 the (n) primary windings are wound around bobbins P which are shown in section; these (n) bobbins are arranged in a circle around the axis X, X' and they are fixed in a frame B. The (n) secondary bobbins S are mounted upon a frame B'. The coupling of the bobbins can be varied within very wide limits if one of the frames is made to turn around the axis X, X' so that the coefficient ρ can exactly attain the value zero. This angular displacement can be replaced by or combined with a movement of translation of one of the frames along the axis X, X'; in this case the diameters of the primary and secondary bobbins will be chosen of different width so as to permit of the bobbins being telescoped one into the other at the end of the movement of translation. The platform B which supports the primaries P is provided with a socket I, which forms a threaded guide for the screw V which can be turned by means of a rifled knob G. A key H extending through a fork J carried by the socket I prevents the rotation of the platform B, and consequently compels the same to execute a vertical movement upon the rotation of the screw V. However, as soon as the platform B arrives at the end of its path it will abut against the shoulder F, and H is at this moment disengaged from the fork J and the platform B turns in a horizontal plane.

The form of execution of the principle of invention hereinbefore described evidently possesses the properties mentioned under numbers 1, 3 and 4.

There is further obtained a very pronounced syntony owing to the great facility with which the coupling can be modified. In the cases where the syntony ought to be pushed to the extreme there can easily be established an intermediary circuit by the adjunction of a simple interrupter. If the interrupter is placed at I (Fig. 1) a loop will be formed if the said interrupter is closed, said loop being composed of the self-inductance S, of the primaries P_2, P_3, P_4 and of condenser C. This loop constitutes an intermediary circuit oscillating between the system of the ground antenna and the series of jiggers, the coupling with the said system being besides easy to regulate by displacing for example the contact R.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:

1. Receiver for radio-telegraphic stations comprising an antenna, a plurality of induction-jiggers having their primaries, consisting of coils separated to such a distance that they have no influence upon each other, arranged in series with each other and their secondaries in series with each other, and means for switching into circuit a greater or

smaller number of induction jiggers according to the waves received from the sender station.

2. Receiver for radio-telegraphic stations comprising a plurality of induction-jiggers, a displaceable frame upon which the primaries of said induction-jiggers are mounted, means for displacing said frame for varying the relative position of the primaries with respect to the secondaries, and means for mechanically coupling the primary and secondary of the transformer so that the number of coils in each can be varied uniformly and simultaneously.

3. In a receiver for radio-telegraphic stations comprising an antenna, a plurality of jiggers having their primaries and their secondaries arranged in series, a self-inductance a part of which connects the primaries of said jiggers with said antenna, a condenser between said jiggers and the ground, and means for grounding a point of the self-inductance for establishing an intermediary circuit comprising self-inductance of the primary jigger windings and said condenser, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

EMILE GIRARDEAU.

Witnesses:
J. BETHENOD,
BARTLEY F. YOST.