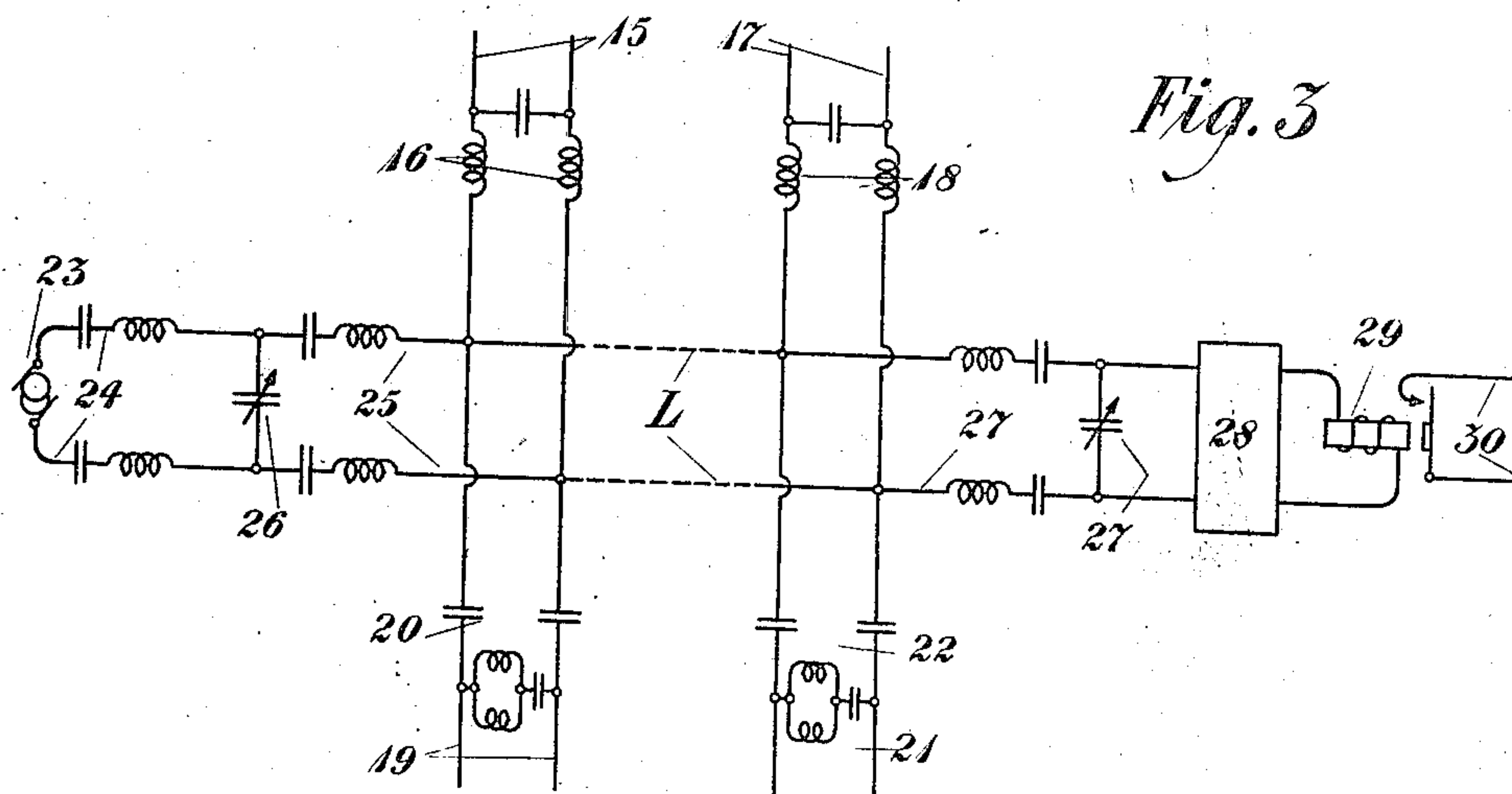
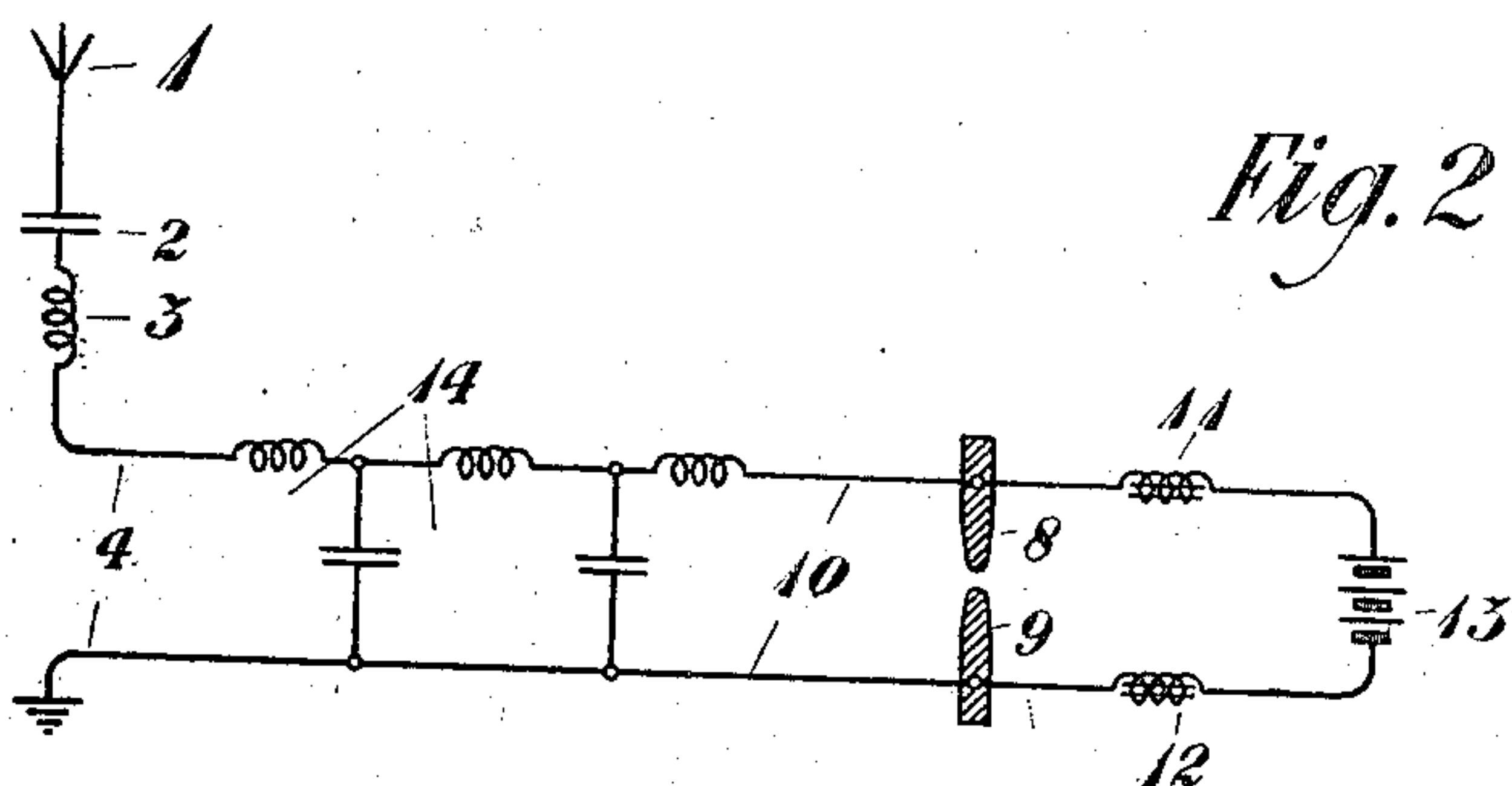
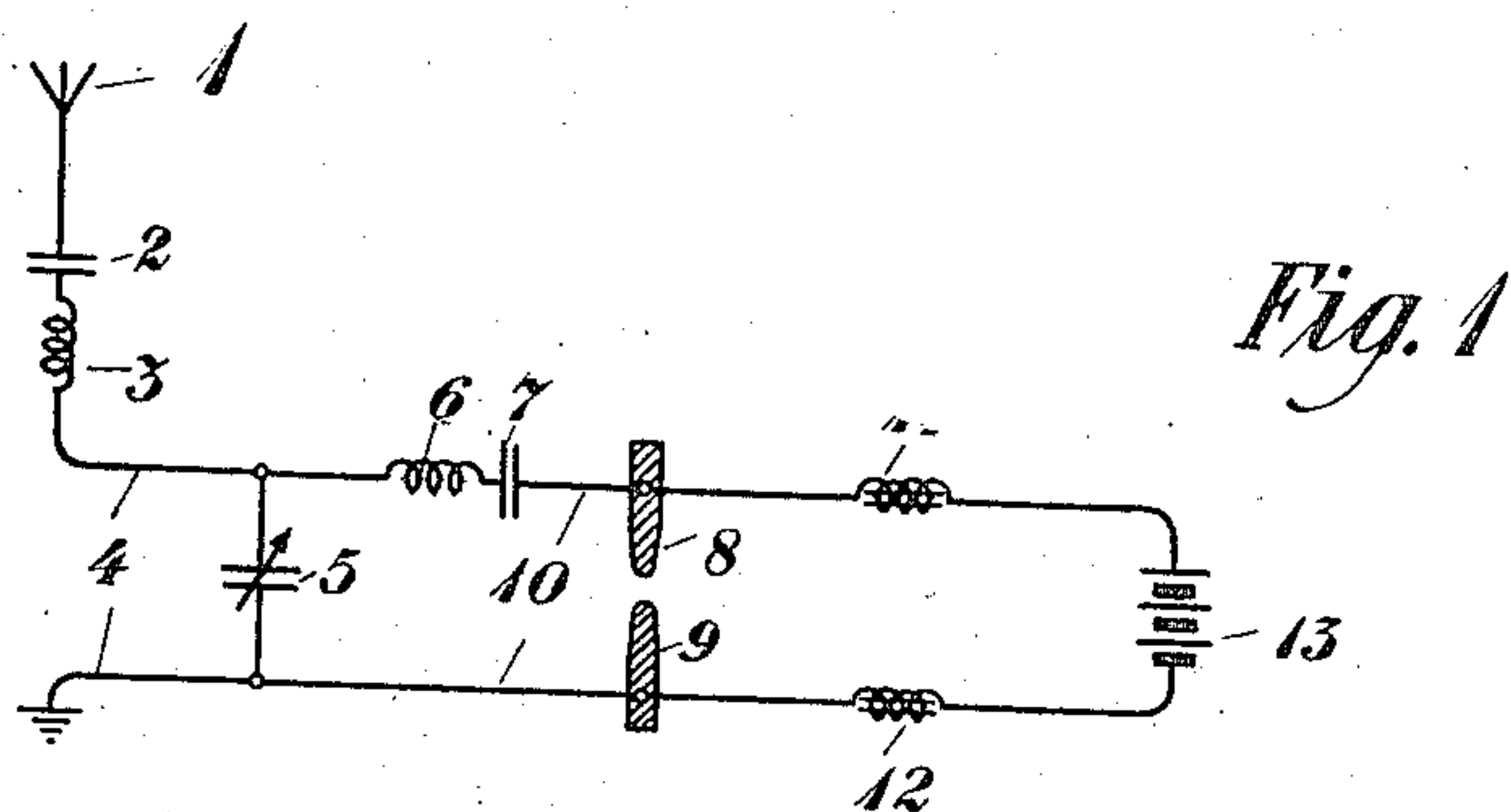


July 8, 1924.

L. ESPENSCHIED
HARMONIC SUPPRESSOR
Filed Sept. 27, 1919

1,500,553



INVENTOR.
L. Espenschied
BY *W. Rose*
ATTORNEY.

UNITED STATES PATENT OFFICE.

LLOYD ESPENSCHIED, OF HOLLIS, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

HARMONIC SUPPRESSOR.

Application filed September 27, 1919. Serial No. 326,737.

To all whom it may concern:

Be it known that I, LLOYD ESPENSCHIED, residing at Hollis, in the county of Queens and State of New York, have invented certain Improvements in Harmonic Suppressors, of which the following is a specification.

This invention relates to transmission systems and more particularly to systems arranged for the multiplex transmission of a plurality of carrier currents.

The development of the art of multiplex transmission wherein a number of carrier channels of communication are superimposed upon the same transmission medium is tending to greatly increase the requirement of the carrier current in respect to its purity of wave form, or in other words, its freedom from harmonics. This is because the presence of harmonics in a system of superimposed carrier channels tends to cause interference as between the channels of lower frequency and those of frequencies representing harmonic multiples thereof. Accordingly it is a general purpose of this invention to provide means whereby harmonics may be suppressed in both radio and wire carrier current transmission systems, and whereby the wave form of the carrier currents transmitted out over the line may be purified. Other and further features and purposes of the invention will appear more fully from the detailed description hereinafter given.

In systems of radio transmission there is available but a single transmission medium and accordingly it is especially important in order to obtain a maximum number of communications in a given frequency zone that the carrier wave employed be of as pure form and as free from harmonics as possible. Certain types of continuous wave generators utilized at present at transmitting stations of a radio system have a pronounced tendency to produce harmonics of the original or fundamental wave. For purposes of illustration it is pointed out that the type of generator or converter employing the well known Poulsen arc is of the type in which harmonics are especially prominent. It has heretofore been the practice to employ the arc generator in combination with a local tuned circuit loosely coupled with the antenna circuit. The type of coupling hereto-

fore employed has been of the inductive type, which, as it comprises an inductance shunted across the circuit, tends to pass the harmonic frequencies almost as readily as the fundamental or desired frequency. It is proposed by the arrangements of this invention to couple the local tuned circuit with the antenna circuit by means of the capacity type of loose coupling. The effectiveness of this type of coupling diminishes with an increase of frequency and accordingly interposes a greater transmission loss for the harmonic frequencies than for the fundamental. An alternative means for coupling the local tuned circuit with the antenna would be to couple the two circuits through a "low pass" filter, which by being designed to readily transmit the desired frequencies and to attenuate and practically extinguish frequencies above such range, would serve to shut out harmonics.

A further feature of the invention consists in providing a means for the elimination of harmonics in a multiplex transmission system employing wire lines as the medium upon which the carrier currents are superimposed. A specific illustration wherein the presence of harmonics would be detrimental to the transmission efficiency of the system would be in the case where a low frequency channel for purposes of signaling was superimposed on a line over which currents for telephonic purposes were being transmitted, as the harmonics of the signaling currents might be within the telephonic range of frequencies. By utilizing a loose capacity type of coupling between the tuned circuits in the branch from which the low frequency signaling currents is transmitted to the line a means is provided by this invention for eliminating harmonics which would otherwise tend to be transmitted over the telephonic selective circuits and interference between the telephone and signaling currents is prevented.

The invention may be more fully understood when taken in connection with the accompanying drawing in the Figs. 1, 2 and 3 of which are illustrated circuit diagrams embodying a preferred form and modifications of the invention.

In Fig. 1 is shown in simplified form arrangements for generating and transmitting high frequency oscillations in a system of

radio transmission in which an antenna 1 is connected to an antenna circuit 4. The circuit 4 may include the tuning devices such as 2 and 3. A local circuit 10 which may be tuned by devices 6 and 7 to be resonant at a desired frequency is shown as including the source 13 of direct current, the inductances 11 and 12, and the electrodes 8 and 9 of the well known Poulsen arc type of generator. The local circuit 10 is loosely coupled to the antenna circuit 4 by means of the capacity 5. The arrangement may be designed so that with respect to certain frequencies, the oscillations generated in circuit 10 may readily be transmitted to circuit 4 and thence propagated in the ether by antenna 1. However the effectiveness or transmission efficiency of the coupling including capacity 5 between circuits 10 and 4 decreases or diminishes as the frequency of the oscillations increases. Accordingly, while frequencies of the fundamental or desired value may readily be transmitted from circuit 10 through the capacity coupling to circuit 4, the higher frequencies, such as the harmonics generated, will not be readily transmitted through the coupling but will be eliminated.

In the Fig. 2 is illustrated a modification of the arrangements illustrated in Fig. 1. Similar reference numerals have been used to denote like parts in both figures. The arrangement illustrated in Fig. 2 is the same as that illustrated in Fig. 1 except that the local tuned circuit 10 is coupled to the antenna circuit 4 by means of a filter device 14. This filter, which is commonly termed a "low pass" filter and may be of the type illustrated in U. S. Patents Nos. 1,227,113 and 1,227,114, to George. A. Campbell, is designed to readily transmit a band of frequencies within a desired range but to attenuate and extinguish frequencies above such range, thereby eliminating and suppressing harmonics of the desired current and preventing such harmonics from being transmitted into the antenna circuit 4.

In the Fig. 3 is shown an arrangement for suppressing and eliminating harmonics in a multiplex transmission system employing a wire line L as a medium. As line L may be utilized for the multiplex transmission of currents for different purposes there is associated with line L the telegraph circuits 15 and 17, and the telephone circuits 19 and 21. Included in the telegraph circuits 15 and 17 are the composite sets 16 and 18 adapted to readily transmit currents suitable for telegraphic purposes but which shut out currents suitable for other purposes and thereby prevents such currents from interfering with the telegraph apparatus. Included in the telephone circuits 19 and 21 are the filtering devices 20 and 22

which readily allow the transmission of currents suitable for telephonic purposes but which shut out currents transmitted over the line L for other purposes and thereby prevent such currents from interfering with the telephone apparatus. Associated with one end of line L is the circuit 25, which is coupled to the circuit 24 by means of the capacity type of coupling 26. Circuit 24 includes a source 23 of alternating current of a frequency suitable for purposes of signaling over line L, such for purposes of illustration as current having a frequency in the neighborhood of 133 cycles. The circuits 24 and 25 are tuned by suitable arrangements of inductance and capacity to be resonant to currents of a frequency suitable for signaling, such as 133 cycle currents, and accordingly readily allow the transmission of such currents but serve to attenuate and extinguish currents of other frequencies. Associated with the incoming end of line L is the circuit 27 which is tuned by means of a suitable arrangement of inductance and capacity to be resonant to current of frequencies suitable for signaling purposes such as 133 cycle currents, thereby readily allowing the transmission of such currents but which serves to attenuate and shut out currents of other frequencies. The circuit 27 is coupled loosely through the capacity type of coupling 27 to the input circuit of an amplifier-rectifier 28, which may be of any desirable type. The output circuit of the amplifier-rectifier 28 includes the direct current relay 29 which in turn may control any desirable type of local signaling circuit, such as circuit 30. The capacity type of coupling, such as couplings 26 and 27 may be designed to readily transmit currents of a frequency suitable for signaling. As has already been pointed out the effectiveness of this type of coupling diminishes as the frequency increases and accordingly serves to interpose a greater transmission loss for the harmonic frequencies than for the original or fundamental frequencies. With such an arrangement any of the harmonic frequencies produced by the generator 23 and which being within the telephonic range, would tend to interfere with the telephone circuits associated with line L, will be suppressed and interference between the signaling and telephonic currents will be diminished.

While the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable it is understood that it is capable of embodiment in many and widely varied forms without departing from the spirit of the invention as defined in the appended claim.

What is claimed is:

A telephone line arranged for the multiplex transmission of telephonic currents

and of a current for signaling purposes, a selective circuit associated with the outgoing end of said line and tuned to be resonant to said signaling current, a second circuit
5 tuned to be resonant to said signaling current, means in said second circuit for generating said signaling current, and a loose

capacity coupling between said selective circuit and said second circuit.

In testimony whereof, I, have signed my name to this specification this 25th day of September 1919.

LLOYD ESPENSCHIED.