

R. BOWN.
RADIOCIRCUITS.
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1,433,599.

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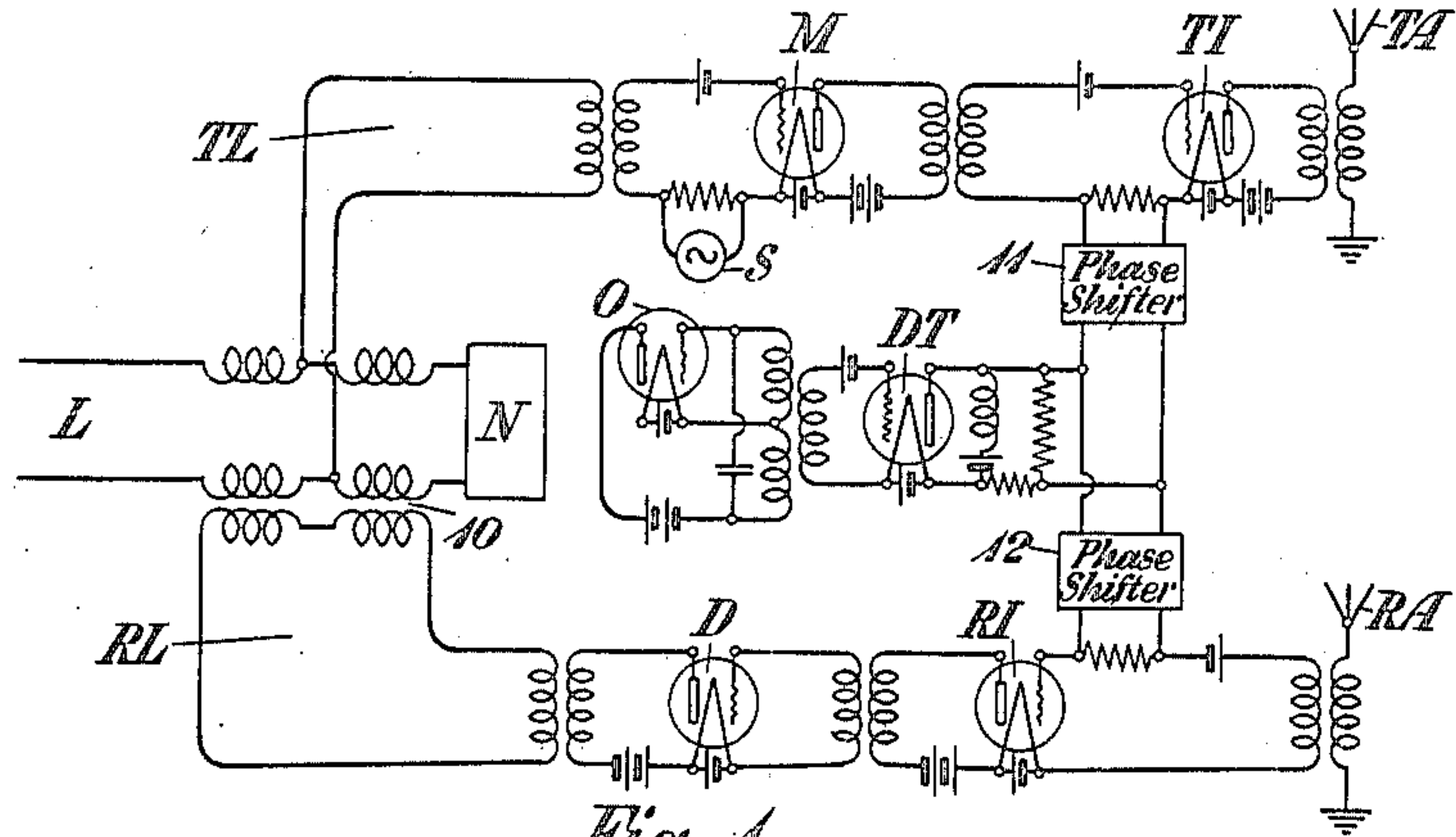


Fig. 1

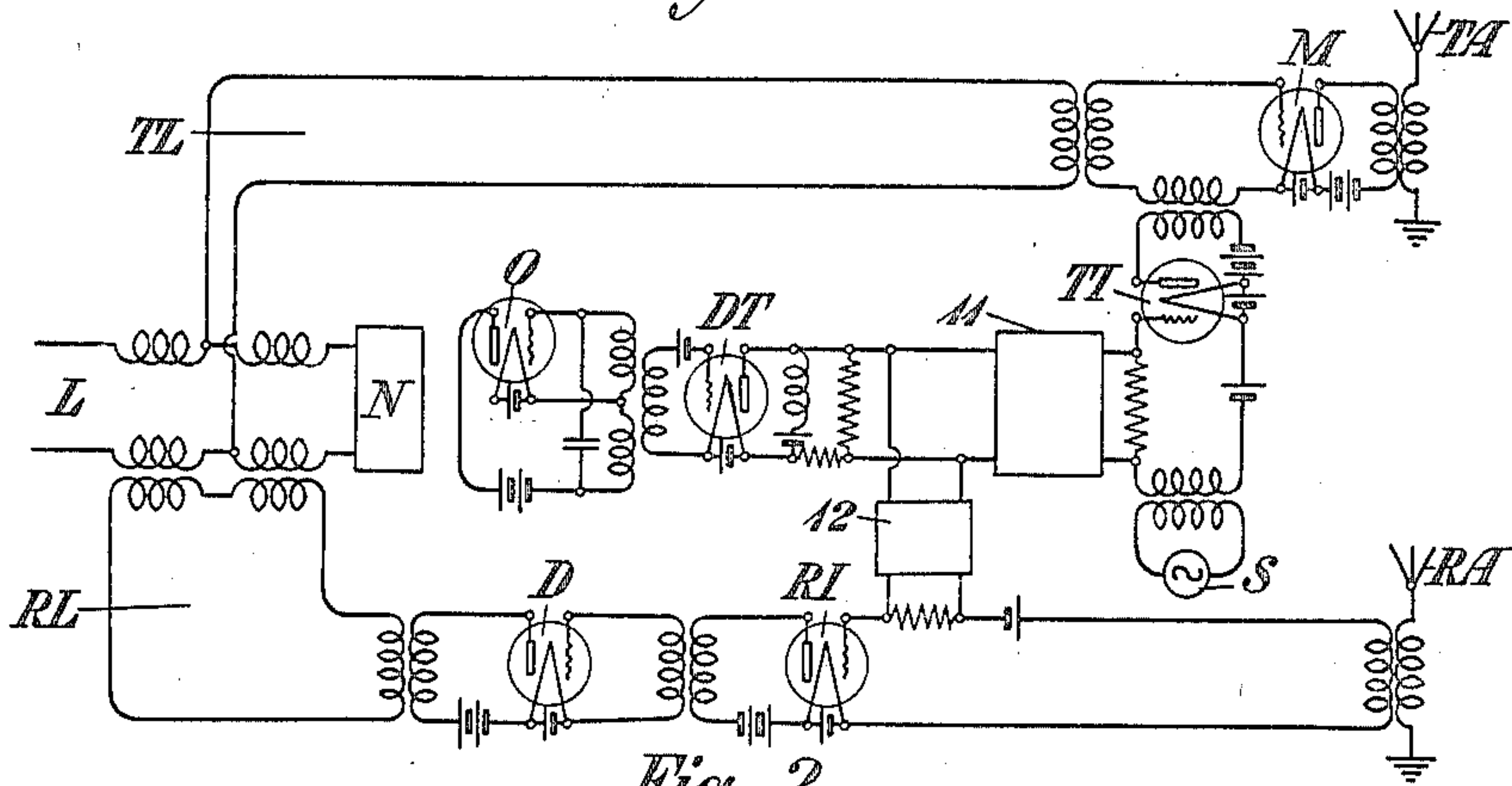


Fig. 2

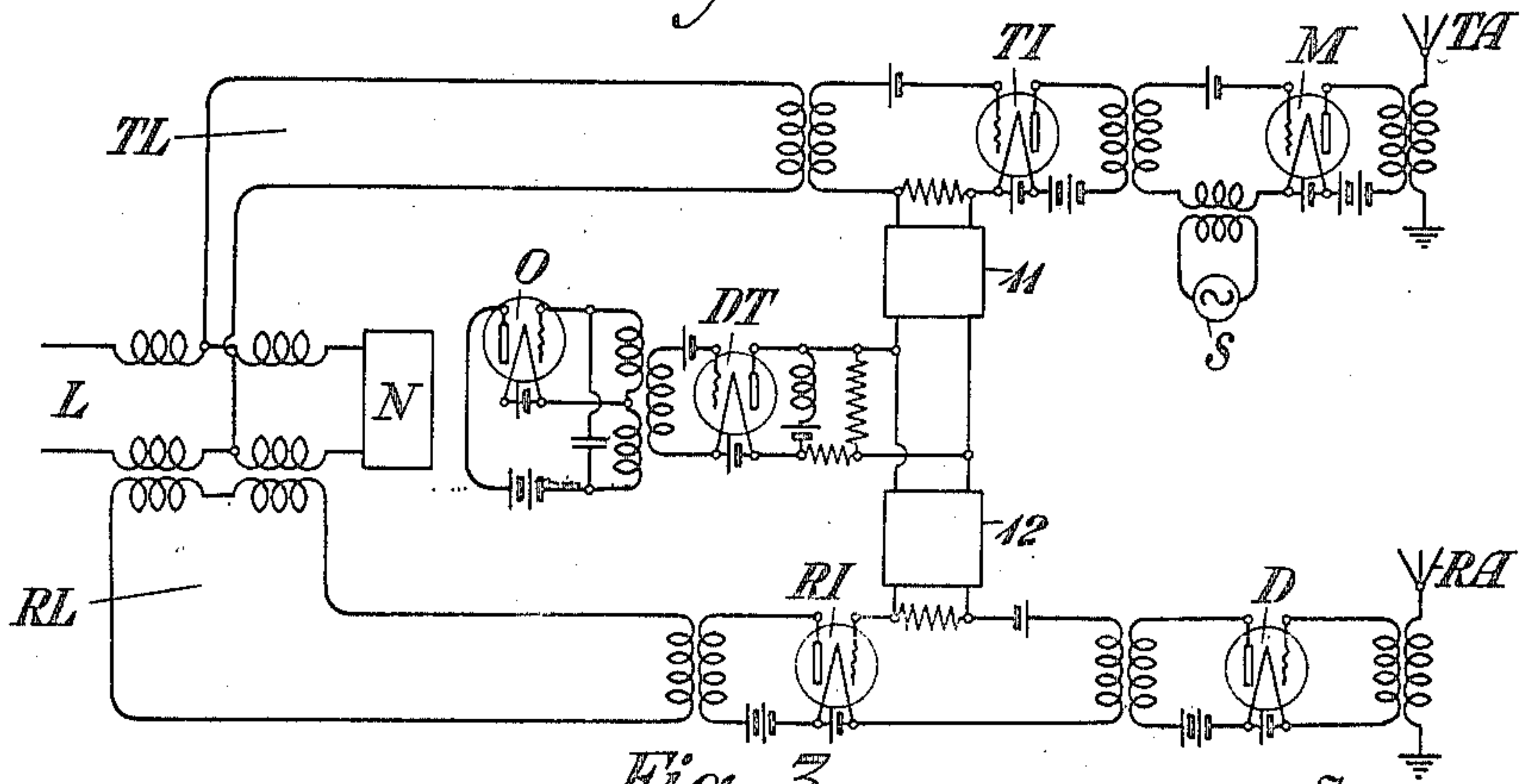


Fig. 3

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UNITED STATES PATENT OFFICE.

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RADIOCIRCUIT.

Application filed July 2, 1921. Serial No. 482,213.

To all whom it may concern:

Be it known that I, RALPH BOWN, residing at East Orange, in the county of Essex, and State of New Jersey, have invented certain Improvements in Radiocircuits, of which the following is a specification.

This invention relates to signaling circuits, and more particularly to signaling circuits of the radio type.

Where it is desired to simultaneously send and receive in a radio system, as is necessary in the case of radio telephony, it has been customary to separate the oppositely directed transmission by employing some or all of the following principles: (a) separation by selectivity,—that is, the employment of different carriers for transmitting and receiving; (b) separation by balance,—that is, the transmitting circuit is rendered at least partially conjugate with respect to the receiving circuit; (c) by geographically separating the transmitting and receiving antenna of a particular station, so that the sending energy from the transmitting antenna will produce a minimum effect upon the receiving antenna.

For the most efficient operation, all three of these principles should be employed simultaneously. This is usually possible in the case of a shore station. In the case of a ship set, however, geographical separation of the sending and receiving antennæ is impossible, and it has been customary, therefore, to rely entirely upon separation by selectivity and balance.

In accordance with the present invention, it is proposed to introduce another method of separation in which differentiation between the sending and receiving channels will be obtained upon a time basis by associating the sending and receiving radio channels alternately with the local low frequency line or other type of signaling circuit. Preferably, this switching may take place at a frequency higher than the signaling frequencies and lower than the radio frequencies involved. As a means for controlling the commutating or switching operation, advantage is taken of the switching function of a vacuum tube, which has the desirable characteristic of substantial absence of inertia as compared with mechanical switching means.

In considering a pair of interconnecting radio stations, it is desirable to apply the

method of high frequency switching or commutating to but one of the stations, as, for example, to a ship station, for it will usually be found that at one of the stations equivalent results may be obtained by separating the receiving and transmitting antennæ. By applying the scheme to but one of the interconnecting stations, the necessity of commutating at a plurality of stations in synchronism is obviated.

In general, the commutating or switching operation may take place at three different points, (a) in the audio frequency part of the system before modulation in the transmitting channel and after demodulation in the receiving channel; (b) in the radio frequency part of the system after modulation in the transmitting channel and before demodulation in the receiving channel, and (c) in the circuits leading to the carrier frequency source for supplying the modulator and demodulator.

The invention may now be more fully understood from the following description, when read in connection with the accompanying drawings, Figures 1, 2 and 3 of which illustrate the circuit arrangements embodying the three different methods of commutating, just referred to.

Referring to Fig. 1, L designates a low frequency signaling circuit such as a telephone line, associated with the transmitting channel TL and receiving channel RL of a radio system through a hybrid coil 10, similar to that used in connection with telephone repeaters. The line L is balanced at low frequencies by means of a suitable network or artificial line N, so that, as regards low frequencies, the transmitting and receiving channels TL and RL may be rendered conjugate. A modulator M, which may be of the well-known vacuum tube type, is included in the transmitting channel TL between the connection of the channel with the line L and the transmitting antenna TA. The modulator M may be supplied with carrier currents of radio frequency from a suitable source S. The receiving channel RL includes a detector or demodulator D, which may be of the well-known vacuum tube type. While this detector may be supplied with a locally generated carrier frequency for beating with the received signal band in accordance with the homodyne method of receiving, as here shown, the detector is of the

simple non-homodyne type employed where the carrier frequency is radiated with the side bands. The input circuit of the detector is associated with the receiving antenna RA.

In case the receiving antenna is not screened against energy from the transmitting antenna TA, it will be apparent that a singing circuit will be established somewhat analogous to that of a 22 repeater circuit from the antenna TA to the antenna RA through the detector D of the receiving channel RL, through the partially unbalanced hybrid coil 10 into the transmitting channel TL and through the modulator M back to the transmitting antenna. Singing of this character may be prevented, however, by alternately rendering the transmitting and receiving channels inoperative at a rate sufficiently high to be above audibility, yet sufficiently low to permit free transmission of the radio frequency during the operative interval of the channel. In order to render the two channels alternately inoperative, a transmitting interrupter TI is interposed between the modulator M and the transmitting antenna TA of the transmitting channel and a similar interrupter RI is interposed between the receiving antenna RA and the detector D of the receiving channel. These interrupters constitute vacuum tubes having their grid circuits normally provided with static potentials of such polarity and value that the tubes will not transmit currents unless the static potential on the grid is changed.

In order to alternately change the static grid potentials of the two interrupters TI and RI, a source of alternating current O is provided. This alternating current source may be, for example, the well-known vacuum tube oscillator. The alternating current from this oscillator may be passed through a distorting tube DT of the well-known type which is so arranged as to render the alternating waves supplied by the oscillator flat topped. These flat topped alternating waves are supplied to the grid circuits of the interrupters TI and RI through suitable phase shifters 11 and 12. By properly connecting the circuits and adjusting these phase shifters, the alternating wave may be caused to produce opposite effects simultaneously upon the two interrupters TI and RI, so that when one is rendered operative, the other will be inoperative. For example, if a wave of proper polarity is superposed on the normal potential in the grid circuit of the tube TI, the tube may be caused to operate upon the straight amplifying portion of its characteristic during the flat topped interval of the supplied wave, so that the modulated radio frequency will be freely transmitted through the interrupter TI to the antenna TA. The tube RI

will at the same moment have a pulse of current supplied to its grid, of such a character as to prevent transmission. The next succeeding half-wave will be in the opposite direction, however, and will shift the operating point of the tube RI to the amplifying portion of its characteristic, so that the received radio oscillations will be free to be passed through the interrupter and impressed upon the detector D. Transmitting and receiving will, therefore, take place alternately at a high frequency rate determined by the frequency of the oscillator O. This frequency, as previously stated, should preferably be above audibility and below the frequency of the carrier employed for radio signaling.

Instead of including commutating or interrupting devices at the points indicated in Fig. 1, these devices may be included in the carrier supply source as indicated in Fig. 2. In this case, the transmitting interrupter TI, which is in all respects similar to the interrupter TI of Fig. 1, is interposed between the radio frequency carrier source S and the modulator M, so that the carrier frequency is applied to the modulator at successive intervals each time an alternation of the proper sign is applied to the device TI to render the same operative. The receiving interrupter RI will be connected between the detector and the carrier source, regardless of whether the source is supplied locally or is transmitted from the distant sending station. In the latter case, since the carrier is received by the antenna RA and applied from the antenna to the detector D, the receiving interrupter RI, which is in all respects similar to the corresponding device of Fig. 1, will be included directly between the receiving antenna RA and the detecting tube. The arrangement of the devices TI and RI is such that they will be operative alternately, as described in connection with Fig. 1, and hence the station will alternately transmit and receive at a frequency determined by the oscillator O.

The commutating devices TI and RI may also be included in the low frequency part of the circuit, as illustrated in Fig. 3. In this case, the transmitting interrupting tube TI is connected between the input of the modulator M and the connection of the transmitting channel TL to the low frequency line, so that the signaling currents are applied to the modulator at successive high frequency intervals determined by the oscillator O. The receiving interrupter or commutator RI is included between the output circuit of the detector D and the connection of the receiving channel RL with the line L. The detected low frequency currents applied in the output circuit of the detector D will, therefore, be interruptedly supplied during successive intervals, deter-

mined by the oscillator O, to the line L. As before, the interruptions in the transmitting and receiving channels take place alternately, so that the station will successively transmit and receive at a frequency dependent upon the frequency of the oscillator O.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated, without departing from the spirit of the invention as defined in the following claims:

What is claimed is:

1. In a radio signaling system, a transmitting antenna and a receiving antenna, transmitting apparatus associated with said transmitting antenna, said transmitting apparatus comprising a source of signaling current and a source of carrier current, a vacuum tube commutator included between the transmitting antenna and one of said sources, receiving apparatus associated with the receiving antenna comprising circuits for translating received radio frequencies into low frequency signals, a vacuum tube commutator included in said receiving apparatus, and means for causing said commutators associated with the transmitting and receiving apparatus to commute alternately.

2. In a radio signaling system, a transmitting antenna and a receiving antenna, transmitting apparatus associated with said transmitting antenna, said transmitting apparatus comprising a source of signaling current and a source of carrier current, a vacuum tube commutator included between the transmitting antenna and one of said sources, receiving apparatus associated with the receiving antenna comprising circuits for translating received radio frequencies into low frequency signals, a vacuum tube commutator included in said receiving apparatus, and a source of alternating current for supplying said vacuum tube commutators, said source rendering said transmitting and receiving commutators alternately operative.

3. In a radio signaling system, a transmitting antenna and a receiving antenna, transmitting apparatus associated with said transmitting antenna, said transmitting apparatus comprising a source of signaling current and a source of carrier current, a commutator operating without mechanical inertia included between the transmitting antenna and one of said sources, receiving apparatus associated with the receiving antenna comprising circuits for translating received radio frequencies into low frequency signals, a commutator operating without mechanical inertia included in said receiving

ing apparatus, and means for causing said commutators associated with the transmitting and receiving apparatus to commute alternately.

4. In a radio signaling system, a transmitting antenna and a receiving antenna, a low frequency signaling circuit, a transmitting channel interconnecting said low frequency circuit and transmitting antenna, a receiving channel inter-connecting said low frequency circuit and receiving antenna, commutators operating without mechanical inertia included in said transmitting and receiving channels, and means to cause said commutators to commute alternately.

5. In a radio signaling system, a transmitting antenna, a receiving antenna, a low frequency signaling circuit, a transmitting channel interconnecting said low frequency signaling circuit and said transmitting antenna, a receiving channel interconnecting said low frequency circuit and said receiving antenna, vacuum tube commutators included in said transmitting and receiving channels, respectively, and means to render said vacuum tube commutators operative alternately.

6. In a signaling system, a transmitting antenna, a receiving antenna and a low frequency signaling circuit, a transmitting channel interconnecting said low frequency signaling circuit and said transmitting antenna, a receiving channel interconnecting said low frequency signaling circuit with said receiving antenna, vacuum tube commutating devices included in said transmitting and receiving channels, respectively, and a source of alternating current for alternately energizing said vacuum tube commutators.

7. In a signaling system, a transmitting antenna, a receiving antenna, a low frequency signaling circuit, a transmitting channel interconnecting said low frequency signaling circuit and said transmitting antenna, a receiving channel interconnecting said low frequency signaling circuit with said receiving antenna, vacuum tube commutating devices included in said transmitting and receiving channels, respectively, a source of alternating current and connections between said source and said vacuum tube commutators, said connections being so arranged that an alternating impulse of one sign will render one of said commutators operative, and an alternating impulse of the opposite sign will render the other commutator operative.

In testimony whereof, I have signed my name to this specification this 30th day of June 1921.

RALPH BOWN.