

June 4, 1929.

A. C. DICKIESON

1,715,645

ELECTRICAL SIGNALING

Filed Oct. 30, 1926

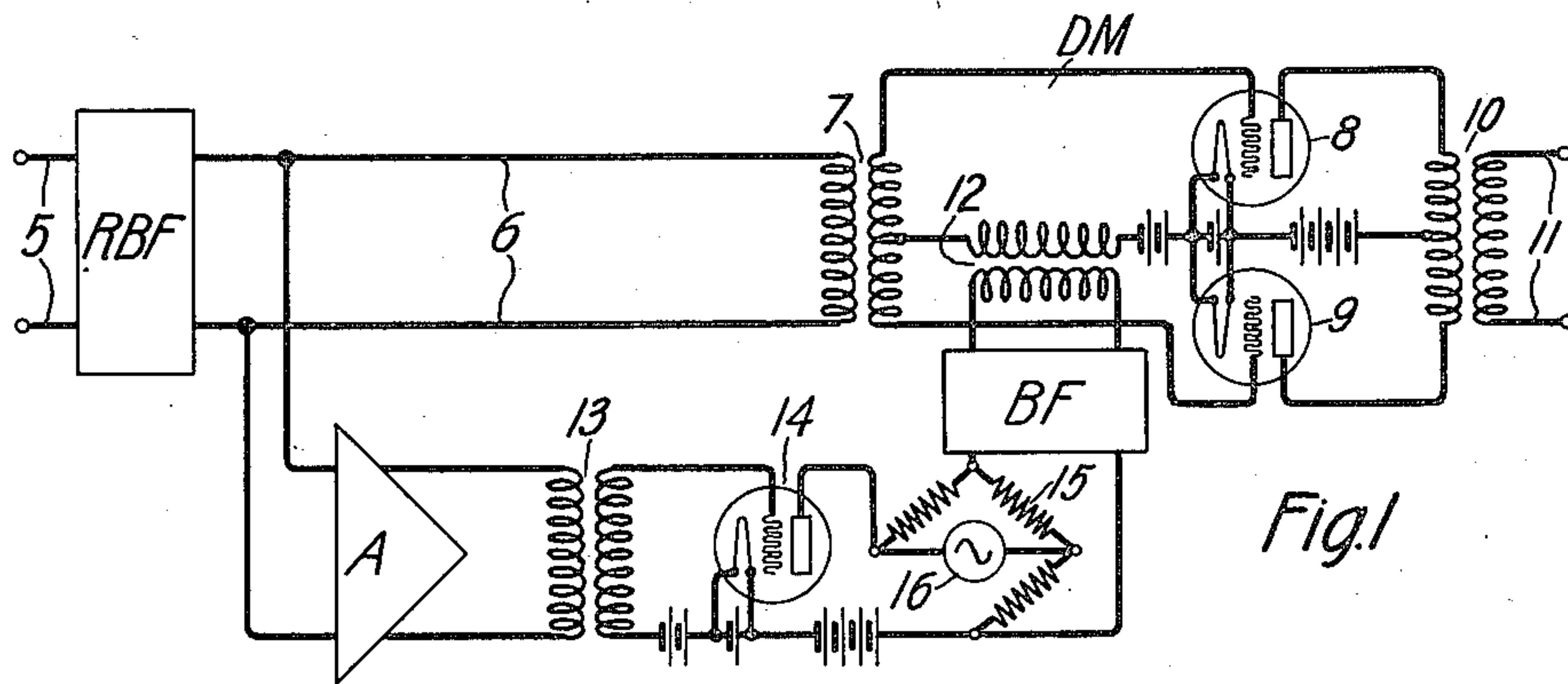


Fig. 1

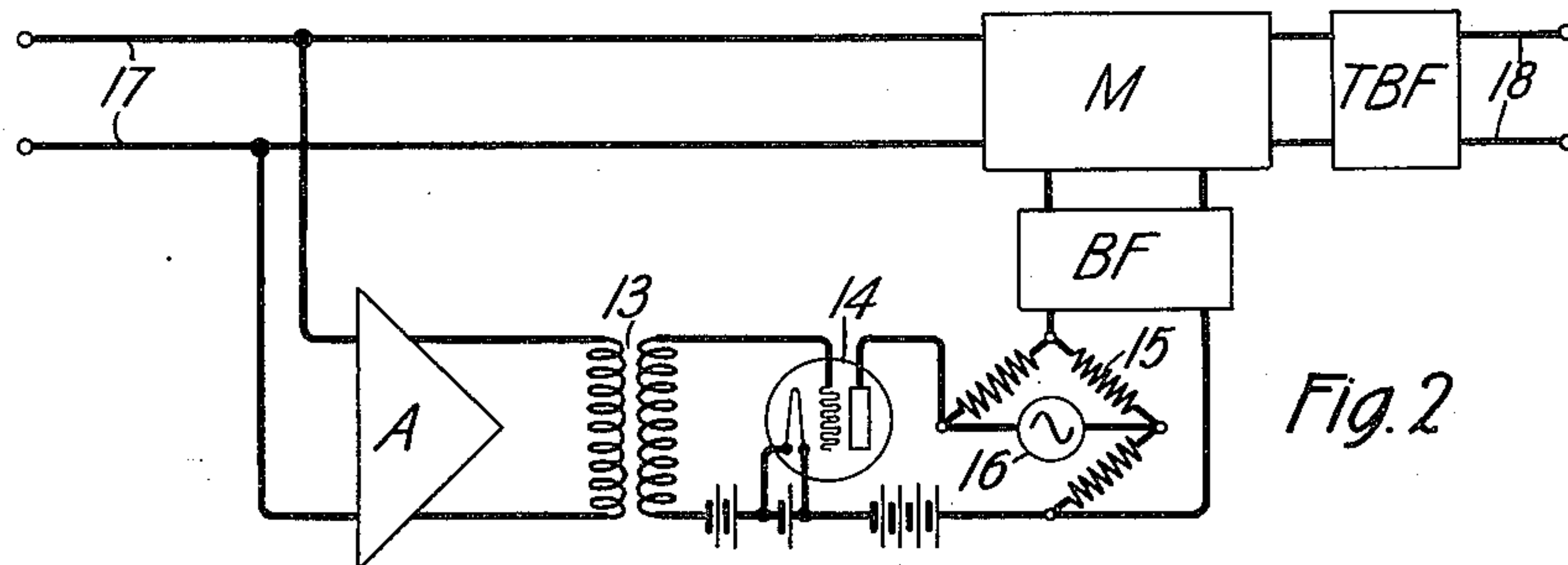


Fig. 2

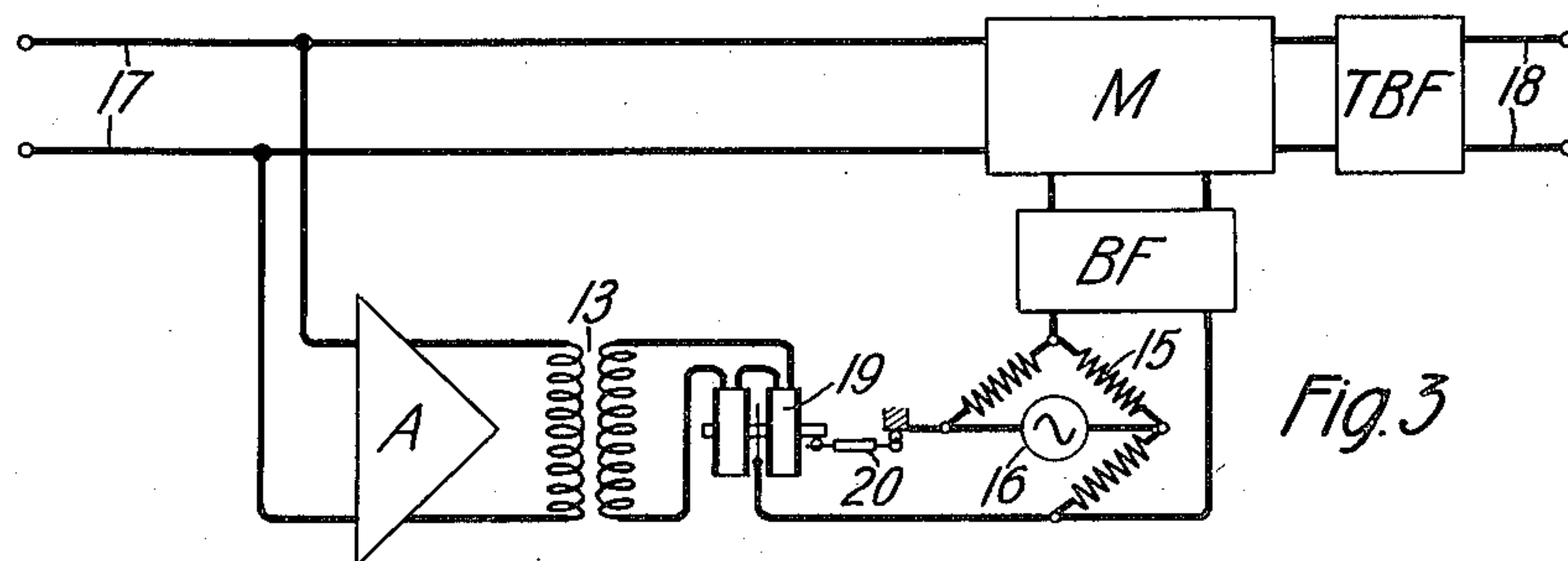


Fig. 3

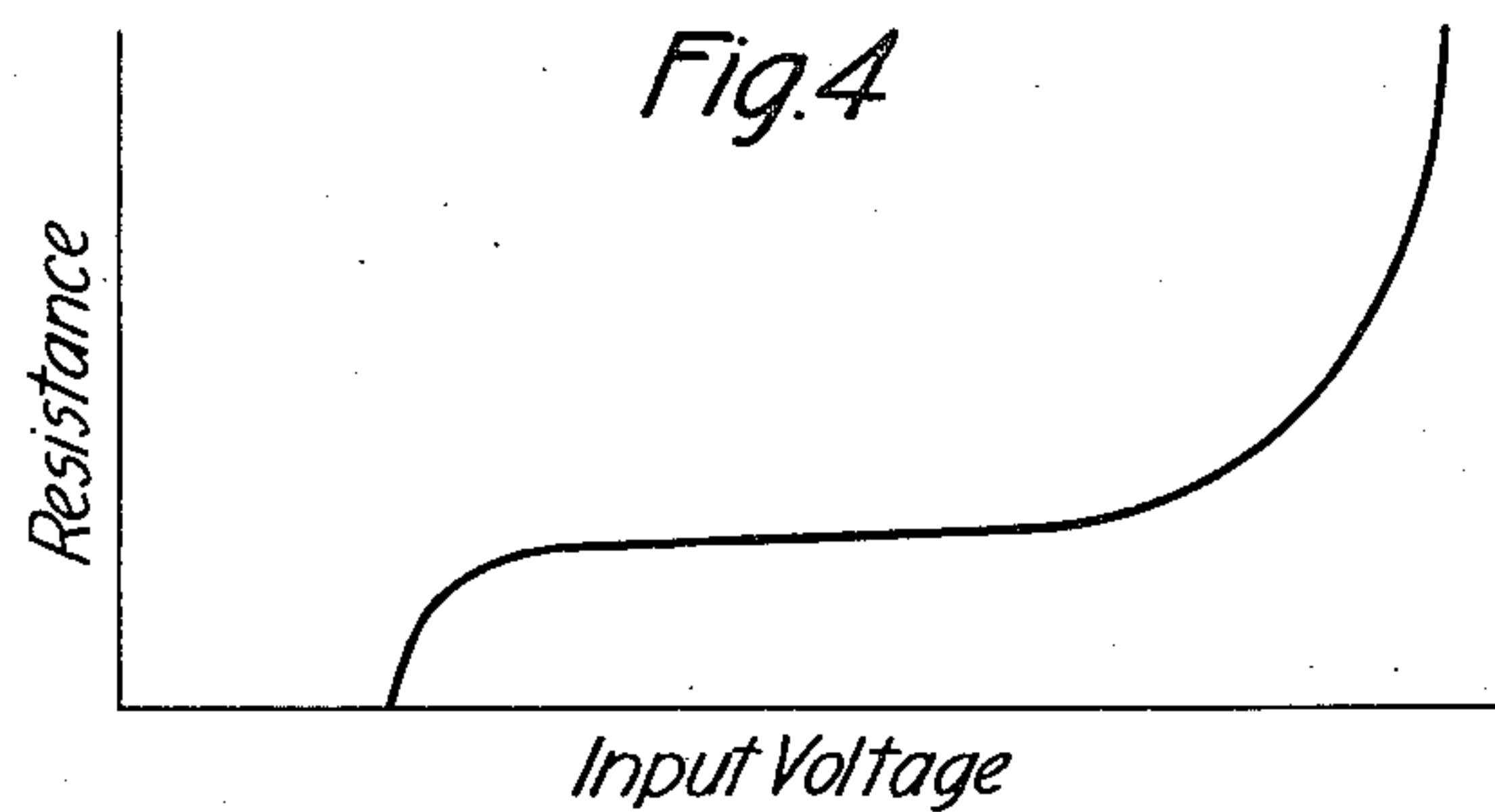


Fig. 4

Inventor:
Alton C. Dickieson
by *W. Griggs*
Attorney.

UNITED STATES PATENT OFFICE.

ALTON C. DICKIESON, OF BROOKLYN, NEW YORK, ASSIGNOR TO BELL TELEPHONE LABORATORIES INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

ELECTRICAL SIGNALING.

Application filed October 30, 1926. Serial No. 145,169.

This invention relates to electrical signaling and particularly to carrier current telephony.

An object of the invention is to reduce disturbances in carrier current telephone systems.

A related object of the invention is to prevent crosstalk and other extraneous disturbances from entering the receiver of such a system when no signals are being received, thus producing the effect of a quiet line.

In carrier current telephony it has been found difficult to exclude noise from the subscriber's receiver during so-called quiescent intervals in a conversation when no signals are being received. During the actual signaling periods the incoming speech is strong enough to overpower the noise, but during a pause in the speech the noise continues to be detected and produces an unpleasant effect upon the subscriber's ear.

One method of overcoming this difficulty is disclosed and claimed in my copending application, Serial No. 145,168 filed October 30, 1926. According to that method, the incoming side band is combined in a demodulator with carrier current from a local oscillator which is operating continuously, but when the side band is cut off during a pause in the conversation the demodulator is blocked by a large negative grid potential and therefore does not transmit noise to the receiver.

According to a feature of the present invention, the carrier current from the local oscillator, which is necessary to the detection of incoming currents, is impressed upon the demodulator only when a side band is received, and is cut off from the demodulator during intervals when no side band is received, so that line noise is not admitted to the receiver during the periods between signals. The invention may also be used to advantage in the transmitting circuit of a carrier system to control the application of carrier current to the modulator when speech is being transmitted.

The invention will be described in connection with the accompanying drawing in which similar reference characters indicate corresponding parts in the several views, and in which:

Fig. 1 is a diagrammatic illustration of a

carrier current receiving circuit embodying the invention;

Fig. 2 is a similar view showing the invention applied to a carrier current transmitting circuit;

Fig. 3 illustrates diagrammatically a modification of the circuit shown in Fig. 2, employing a voice operated relay; and

Fig. 4 is a curve illustrating variations in the contact resistance of the voice operated relay shown in Fig. 3.

In Fig. 1, an incoming carrier transmission line 5 terminates in a receiving band filter RBF connected to the receiving circuit 6. The incoming currents comprise side band components produced by modulating a carrier current with signaling currents such as speech variations, the unmodulated carrier component being suppressed at the distant transmitting terminal, not shown.

The filter RBF selectively transmits currents of the frequencies assigned to the receiving circuit 6 and suppresses currents of all other frequencies which may be present on the line 5. This filter, and each of the other filters shown in the drawing, may be of the type disclosed in U. S. Patent No. 1,227,113 to G. A. Campbell, issued May 22, 1917.

The receiving circuit 6 is coupled to the input of a balanced wave combining device or demodulator DM by means of a transformer 7. The demodulator DM comprises a pair of three-electrode space discharge tubes 8 and 9 having divided input and output circuits each including a common branch conductor. The demodulator is provided with the usual sources of electrical energy to properly polarize the grid electrodes, to heat the cathodes, and furnish anode-cathode current, respectively. The output circuits of the tubes 8 and 9 are coupled by means of a transformer 10 to a low frequency line 11 which may be an ordinary subscriber's telephone line.

The operation of the balanced demodulator is well understood, and will not be described in detail. When carrier current is impressed upon the common branch of the input circuits, for example through transformer 12, the incoming side band is combined with the carrier current and the low frequency products of demodulation are im-

pressed through the transformer 10 upon the low frequency line 11. According to the invention, however, the carrier current is supplied to the demodulator only when the side band is actually being received from the distant terminal.

The invention provides a branch circuit including an amplifier A having its input circuit connected across the receiving circuit 6 and its output circuit coupled by means of a transformer 13 to a sensitive response circuit including a three-electrode space discharge tube rectifier 14. The sensitive response circuit including the rectifier tube 14 is of the type disclosed in my copending application Serial No. 145,170 filed October 30, 1926, in which the space discharge path of the tube 14 is included in one arm of a Wheatstone bridge 15. As described in that application, the grid or control electrode of the rectifier tube 14 is given a negative bias of such a value that large changes in the plate resistance of the tube result from minute changes in the negative grid potential. The Wheatstone bridge is balanced when no side band is received in the circuit 6 so that carrier current from the source 16 will not flow through the transformer 12 at such time.

When a side band is received in the circuit 6 a portion of the incoming current passes into the branch circuit and is amplified by the amplifier A and applied to the input circuit of the tube 14. The potential thus applied to the grid of the tube 14 produces a substantial change in the plate resistance of the tube and unbalances the Wheatstone bridge. Carrier current from the source 16 is therefore impressed through the transformer 12 upon the common branch of the input circuits of the demodulator DM and is combined with the side band in the demodulator to detect the signal. A band filter BF may be included in the output circuit of the Wheatstone bridge to suppress currents of all frequencies other than the carrier frequency. The amplitude of the carrier current from the source 16 is not proportional to the incoming side band, but the circuit may be so adjusted that for all incoming amplitudes above a low margin the amount of carrier current released is substantially constant. Increased sensitivity is obtained by amplifying the side band in the amplifier A before it is applied to the sensitive response circuit.

Fig. 2 illustrates the invention as applied to a carrier telephone transmitting circuit. The operation of this circuit is substantially the same as that shown in Fig. 1, except that the input currents comprise speech variations instead of the side band, and the carrier current is supplied to the wave combining device or modulator M under the control of the speech currents. A portion of

the speech currents impressed upon the low frequency line 17 is amplified in the amplifier A and impressed upon the sensitive response circuit in the manner described above. A small portion of the incoming speech currents releases a large carrier current from the oscillator 16, and this carrier current is combined with the speech currents in the modulator M. Of the components of modulation appearing in the output circuit of the modulator M, the transmitting band filter TBF suppresses all but one side band which it passes to the outgoing transmission line 18.

The circuit shown in Fig. 3 is similar to that shown in Fig. 2 except that the sensitive response circuit comprises a voice operated relay 19 having a contact device 20, this relay being of the type disclosed in U. S. Patent No. 1,579,887 to E. J. Pratt, issued April 6, 1926. The sensitive response circuit per se is claimed in my copending application Serial No. 145,171 filed October 30, 1926. The contact device 20 is included in one arm of the Wheatstone bridge 15. The contact resistance characteristics of the relay 19 are illustrated graphically by the curve of Fig. 4, in which the ordinates represent the resistance and the abscissæ represent the input voltage. The contact resistance characteristics are such that the resistance is negligible up to a certain desired low input voltage below the voice range, then increases and remains substantially constant over a fairly wide range of voltages, and beyond the upper limit of the range it again increases rapidly. When no speech currents are received in the low frequency line 17, the relay 19 does not operate and the Wheatstone bridge is balanced so that no carrier current is impressed upon the modulator M from the oscillator 16. When speech is received in the line 17, however, a part of the speech current is impressed upon the relay 19 via amplifier A. This relay thereupon starts to operate and the contact resistance increases rapidly, unbalancing the bridge and permitting carrier current to flow from the oscillator 16 to the modulator M.

The invention is capable of other modifications and adaptations not specifically referred to but included within the scope of the appended claims.

What is claimed is:

1. In a signaling system, a continuously operable wave combining device, means for supplying waves to said device, a source of waves of different frequency adapted to be supplied to said device for combination with other waves impressed on said device, and means responsive to said first mentioned waves to cause said source to supply waves to said device.

2. In a carrier current signaling system, a wave combining device, means for supply-

ing waves to said device, a wave generator effectively disconnected from said device but adapted to supply waves to said device to be combined with other waves impressed
5 on said device, and means responsive to said first mentioned waves to connect said generator effectively to said device.

3. In a carrier current signaling system, a continuously operable wave combining device, means for supplying modifying waves
10 to said device, a source of waves of carrier frequency, means for amplifying a portion of said modifying waves, and means responsive to the amplified waves to cause said
15 source to supply waves of carrier frequency to said device.

4. In a carrier wave signaling system, a wave combining device, means for supplying modifying waves to said device, a balanced bridge including a source of waves
20 of carrier frequency, and means responsive to said modifying waves for unbalancing said bridge to effectively connect said source of waves to said device.

25 5. In a carrier current signaling system, a circuit for receiving incoming signal modulated waves, a demodulator in said circuit, a source of waves of carrier frequency, and means responsive to said incoming waves
30 to cause said source to supply waves of carrier frequency to said demodulator.

6. In a carrier current signaling system, a circuit for receiving incoming signal modulated waves, a demodulator in said circuit,
35 a carrier wave oscillator effectively disconnected from said demodulator, and means responsive to said incoming waves for effectively connecting said oscillator to said demodulator.

40 7. In a carrier current signaling system, a circuit for receiving incoming signal modulated waves, a demodulator in said circuit, a source of sustained carrier waves effectively disconnected from said demodulator, and

means responsive to said incoming waves for
45 connecting said source effectively to said demodulator.

8. In a carrier current signaling system, a circuit for receiving incoming signal modulated waves, a demodulator in said circuit, a
50 source of sustained waves of carrier frequency, means for amplifying a portion of said incoming waves, and means responsive to the amplified waves to cause said source to supply waves of carrier frequency to said
55 demodulator.

9. In a carrier current signaling system, a circuit for receiving incoming signal modulated waves, a demodulator in said circuit, a balanced bridge including a carrier wave oscillator, and means responsive
60 to said incoming waves for unbalancing said bridge to connect said oscillator effectively to said demodulator.

10. In a carrier current signaling system, a circuit for receiving incoming signal modulated waves, a demodulator in said circuit, a balanced bridge including a source of sustained waves of carrier frequency, and
65 means responsive to said incoming waves for unbalancing said bridge to cause said source to supply waves of carrier frequency to said demodulator.

11. In a carrier current signaling system, a circuit for receiving incoming signal modulated waves, a demodulator in said circuit, a balanced bridge including a source of sustained waves of carrier frequency, means
75 for amplifying a portion of said incoming waves, and means responsive to the amplified waves for unbalancing said bridge to cause said source to supply waves of carrier frequency to said demodulator.

In witness whereof, I hereunto subscribe my name this 22nd day of October, A. D.,
1926.

ALTON C. DICKIESON.