

March 4 , 1924.

1,485,773.

L. ESPENSCHIED

RADIO CALLING OR SIGNALING

Filed Sept. 12, 1921

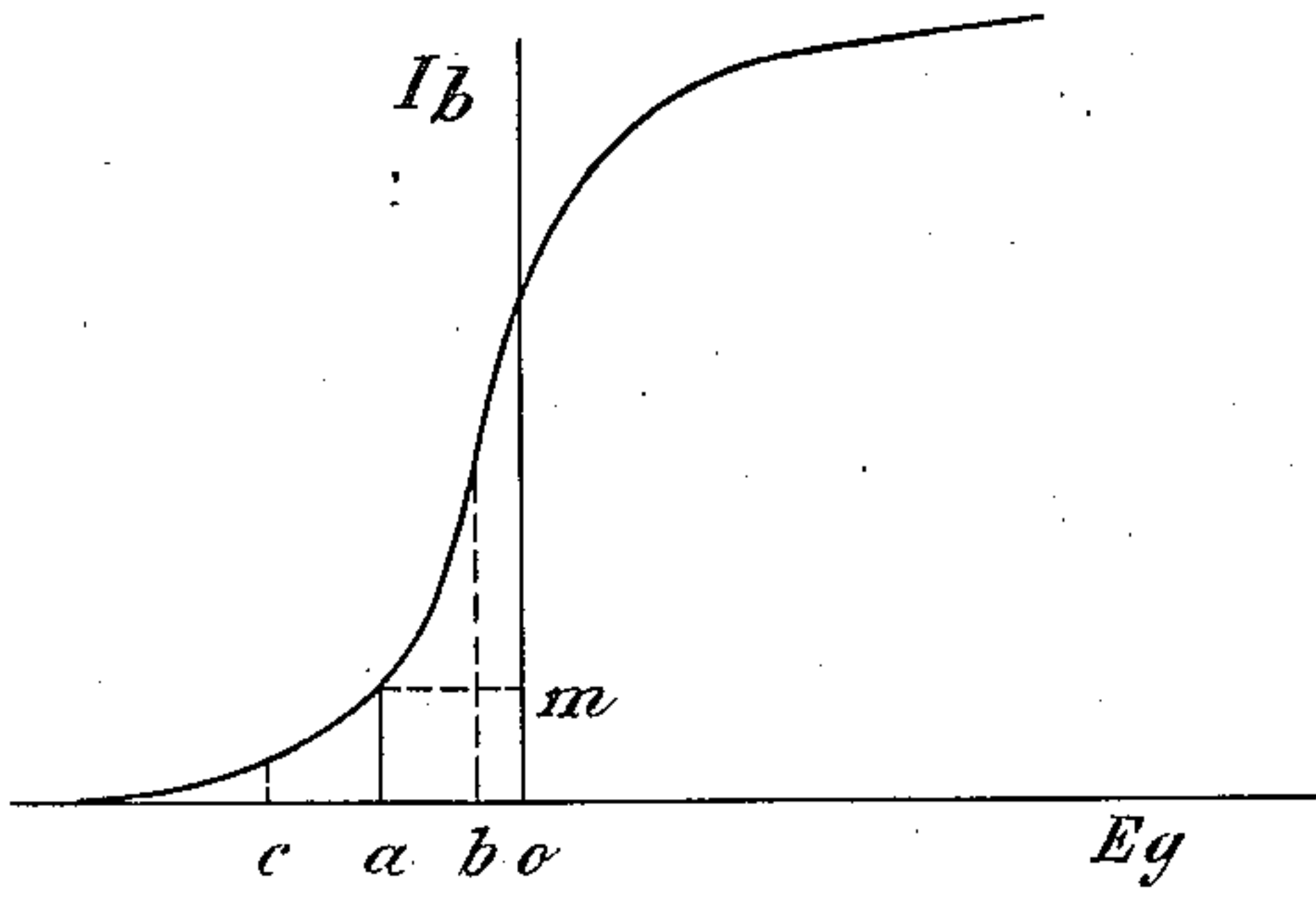
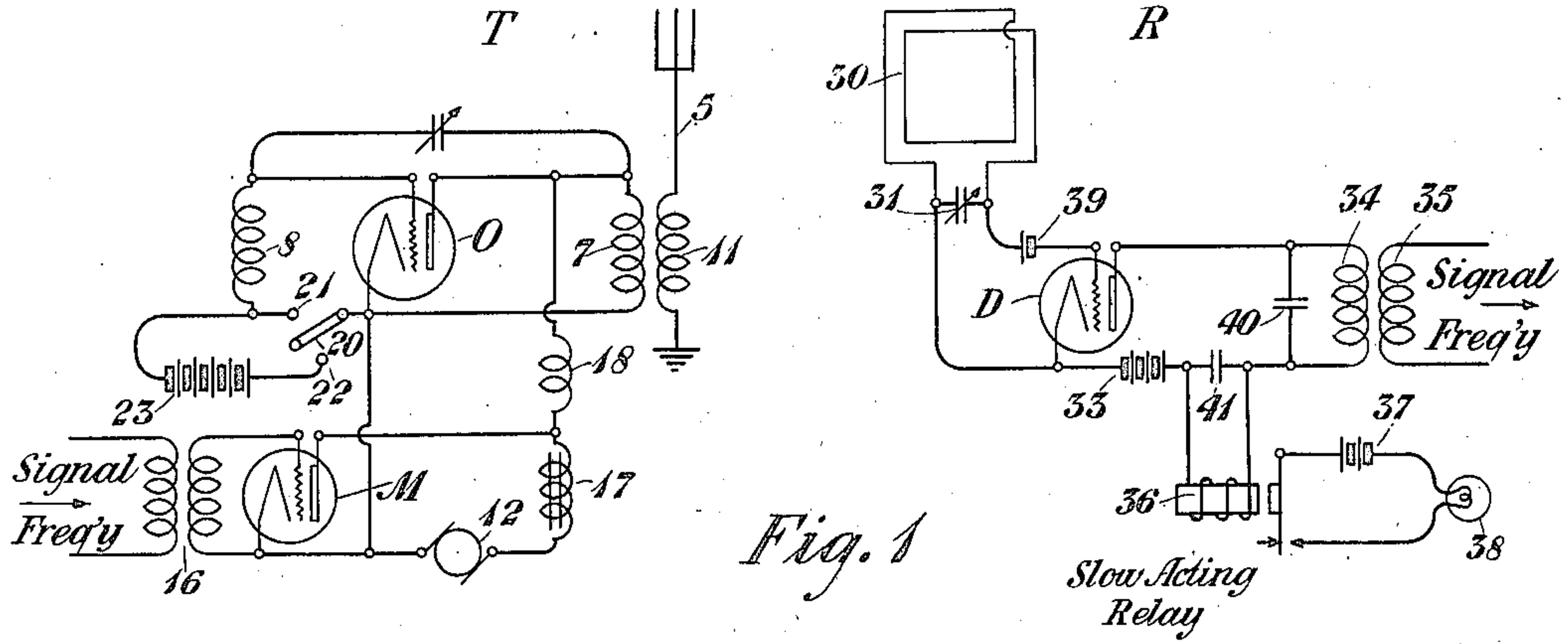


Fig. 2

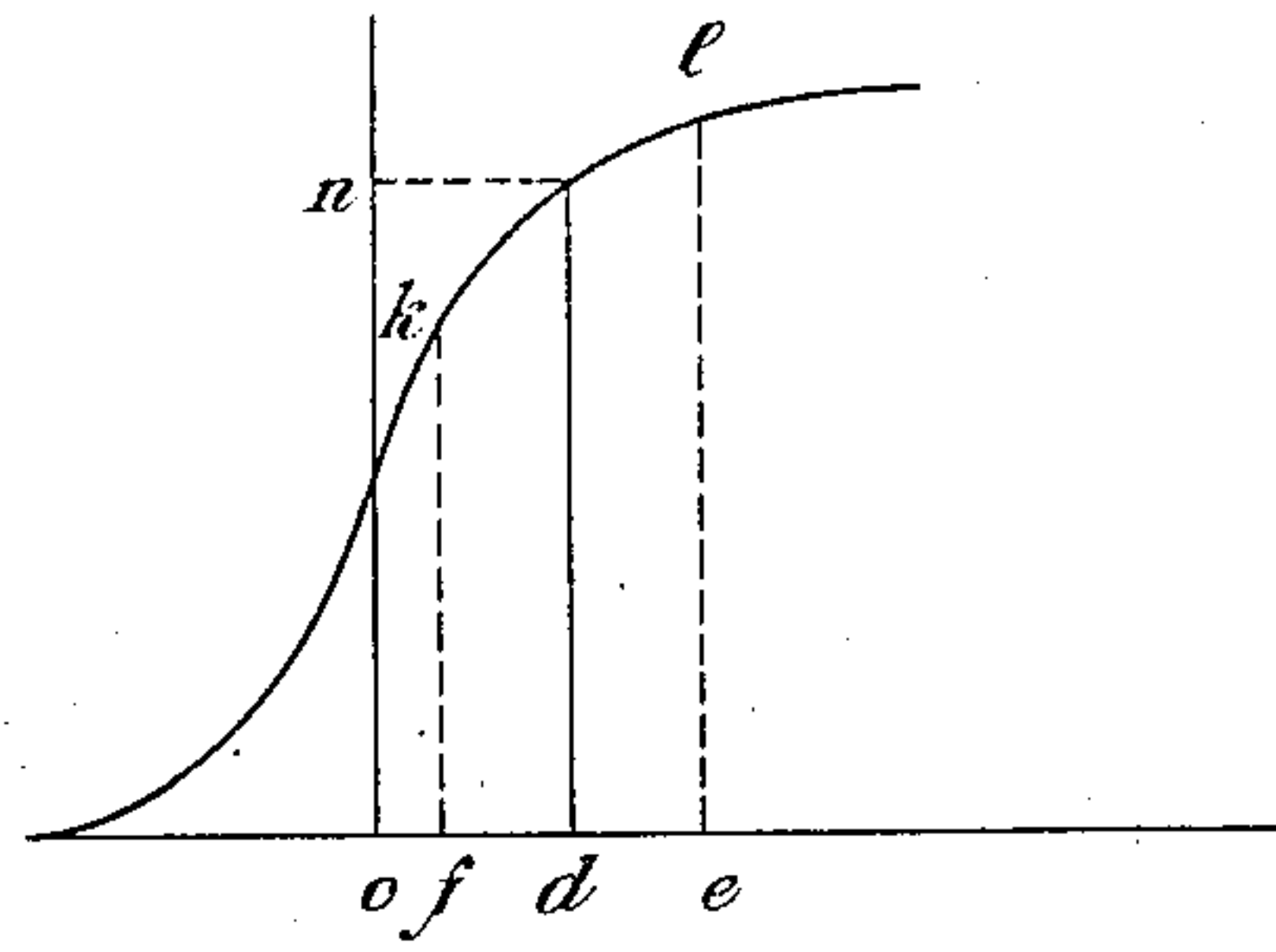


Fig. 3

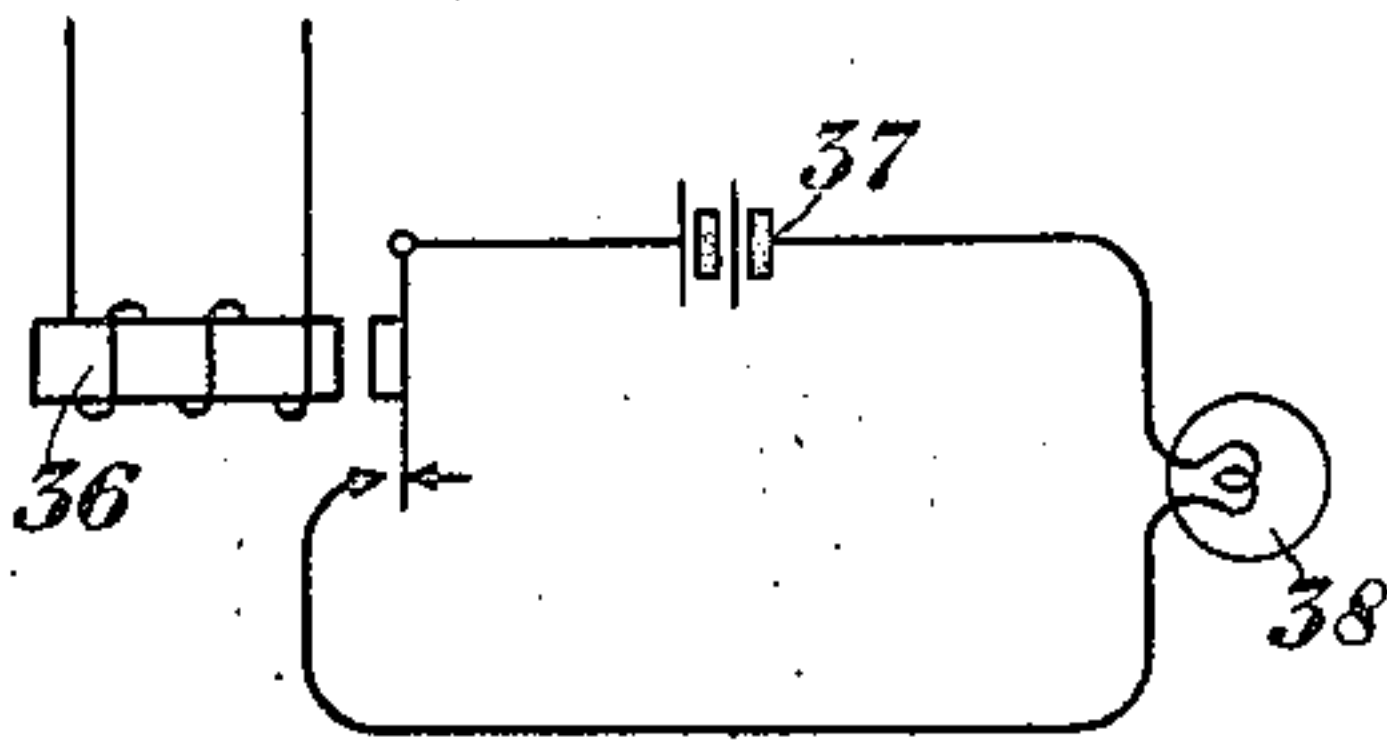


Fig. 4

INVENTOR
L. Espenschied
BY *J. E. Folsom*
ATTORNEY

Patented Mar. 4, 1924.

1,485,773

UNITED STATES PATENT OFFICE.

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

RADIO CALLING OR SIGNALING.

Application filed September 12, 1921. Serial No. 500,034.

To all whom it may concern:

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

This invention relates to methods and means for maintaining communication between two radio stations, and in particular to methods and means for calling or signaling the operator at a remote station. Its object is to permit convenient and reliable calling of such stations. A further object is to provide an arrangement for this purpose which will not require the constant personal attention of an operator.

In brief, the invention consists in using what may be termed the "carrier-off" method, that is, the transmitting station transmits a carrier wave continuously on which a message may from time to time be impressed. When it is desired to call a station, the transmission is suppressed and, as a result, certain operations take place at the receiving station giving some audible or visible signal suitable for calling the attention of the attendant.

The invention will be better understood by reference to the following specification and accompanying drawing in which Figure 1 represents diagrammatically a transmitting station T adapted to cooperate with a receiving station R. Figs. 2 and 3 are characteristics of the detector at the receiver station R and illustrate more clearly the method of operation of the invention. Fig. 4 shows a modification of a portion of the receiver station of Fig. 1. Referring particularly to Fig. 1, the transmitting station T comprises a radiating antenna 5 with which is associated any suitable form of oscillation generator. For the purposes of illustration only, I have shown a vacuum tube generator comprising the well-known three-electrode tube O, this letter suggesting its function as an oscillator. Connected from the filament to the plate of this tube is an inductance 7 and connected from filament to grid is an inductance 8, these two inductances being inductively related to each other, whereby power is transferred from the output circuit to the input circuit. Also, in order to definitely determine the period of oscillations of the generator, there is con-

nected a condenser 9 from the grid to the plate. The antenna is shown as associated with the oscillator by means of the winding 11 adjacent to the winding 7. Power is supplied to the vacuum tube by means of a generator 12. The combination of elements, as thus described, constitutes an efficient generator of oscillations.

In order to transmit messages, it is necessary to modulate the carrier wave generated by the oscillator O with the message to be transmitted. For this purpose there is bridged across the terminals of the power line a vacuum tube M, this letter indicating its function as a modulator. The plate and filament of this tube M are directly connected across the power line, and from the filament to the grid there is connected the secondary of a transformer 16 on the primary of which may be impressed the message to be transmitted and marked as signal frequency. In such a circuit it is desirable to include a choke coil 17 adjacent to the generator 12 and an inductance 18 between the oscillator tube and the modulator tube. For the purposes of my invention I have included a switching mechanism 20 in the grid circuit of the oscillator tube. Normally, this switch is closed to the terminal 21, under which conditions oscillations are produced. Under certain circumstances, however, the switch 20 may set on a terminal 22 which then includes in the grid circuit a battery 23 to impress a high negative voltage on the grid of the oscillator tube, this voltage being of such a magnitude as to completely suppress oscillations.

The receiving station comprises a suitable receiving antenna, which is here shown as a loop antenna 30, although it is understood that this is for illustrative purposes only, and any other appropriate form of receiving device may be used. Across the terminals of the loop antenna is connected a variable condenser 31 adapted for tuning the receiving station to the carrier frequency by which signaling is to be carried on. Across the condenser 31 is connected any suitable detecting device. I have in this case shown a vacuum tube detector D, which, in the output, is supplied with power from a battery 33, and which further includes in the output circuit an inductance 34, this inductance comprising the primary of a transformer, the secondary 35 of which is connected to a

receiver for the message, such as a telephone receiver. In this output circuit there is also included a slow acting relay 36, the function and operation of which will be described hereinafter. A local circuit, containing battery 37 and signal lamp 38, is controlled by the armature of this relay 36, and in this figure the circuit is shown as normally open when the front contact is closed.

10 In detectors in general, and for vacuum tubes in particular, there is a normal space current flowing through the device. Upon the receipt of high frequency oscillations there is a change in the average value of this
15 current, this change being in addition to that which constitutes the low frequency message to be received. This is better illustrated by the characteristic of a vacuum tube of Fig. 2, in which abscissæ represent
20 the voltage impressed on the grid and ordinates represent the current flowing from plate to filament. For a tube with such a characteristic it is, as a rule, desirable, when using it as a detector, to operate it at the
25 portion of the characteristic which has substantial curvature. By the introduction of a battery, such as 39, in the grid circuit, it is possible to bring the normal point of operation of the tube to the point indicated
30 by *a* of Fig. 2, and the normal space current flowing through the tube is given by the ordinate *o m*. Upon the reception of high frequency signals, the voltage amplitude of which, when impressed on the grid,
35 may be represented by *a b* of Fig. 2, there is an increase of current as the grid becomes more positive and a decrease as it becomes more negative, the magnitudes of the currents under these conditions being shown
40 by the ordinates at the points *b* and *c*. The average value of the space current, however, is no longer equal to *o m*, but, for the particular case illustrated, is substantially larger than *o m*, and the difference in this
45 average value of the space current may be utilized in the relay 36 to operate certain mechanism.

The operation of the system is as follows: Normally, the switch 20 at the transmitter station is closed to the terminal 21,
50 so that oscillations are being emitted continuously from the station T. These high frequency waves picked up by the antenna R are impressed on the grid of the detector
55 and give an increase in the average space current, this increase being sufficient to cause the relay 36 to draw its armature to the front contact, thus opening the local circuit containing the lamp 38. If the operator
60 at station T desires to call the operator at station R, the switch 20 is thrown to the contact 22, whereupon oscillations immediately cease. The space current through the detector D thereupon decreases, and this decrease is sufficient to release the armature of

the relay 36, thus lighting the lamp 38, or operating such other signal mechanism as may be inserted in its place. Having called the attention of the operator at the station R, the switch 20 is returned to the terminal
70 21, whereupon oscillations are again transmitted, and the lamp 38 is extinguished. Signal frequency currents may now be impressed through the transformer 16 on the modulator M and a suitable message sent
75 out to station R. During the transmission of such signal frequencies, there are fluctuations in the space current of the detector D, as is apparent from the form of the characteristic of Fig. 2. These variations, how-
80 ever, are comparatively rapid, and their effect on the relay 36 is eliminated by making this latter a slow acting relay which will respond only in case the oscillations drop to substantially zero value for an appreciable
85 length of time.

While the detector has been described as one in which the space current is larger during the reception of continuous waves, it is apparent that there may be cases in which
90 the reverse will occur. In Fig. 3, for example, a similar characteristic is shown to that of Fig. 2. However, in this case, advantage is taken for detection purposes of the upper curve of the characteristic. By
95 means of a suitable battery 39, the tube may be brought for normal operation to the point indicated by *d* of Fig. 3, and the normal space current will be given by the ordinate *o n*. Upon the receipt of high frequency
100 signals of amplitude *d e*, the current will fluctuate between the values *e l* and *f k*, and the average space current will be less than *o n*. For such a detector it is obvious that the relation of the front and back
105 contacts of the relay 36 should be reversed. I have shown this in Fig. 4, in which, during the continuous reception of waves, the space current is reduced, and the armature of the relay is on its back contact. Upon
110 the suppression of the carrier wave the increase in the space current closes the signal circuit through the front contact.

One of the advantages of using the change in the direct current component
115 through the detector rather than the signal energy itself is that the former generally represents a larger energy change than the latter. It has been common in the art heretofore to call a remote station by sending
120 trains of waves and detecting these in the same manner as the message to be transmitted later, but, under the best circumstances, the energy of such signals as received is exceedingly small, and my invention
125 has as one of its purposes that of taking advantage of the relatively slight change in current which occurs with detectors of the type illustrated.

It is to be understood that the specific

circuits which I have shown are for illustrative purposes only, for it is obvious that many changes may be made in the type of transmitting station and in the type of receiving station and in the particular call signal mechanism without departing from the spirit and scope of my invention. For example, it would be convenient to have a code by which to call any one of a plurality of stations. Such calls could be emitted by appropriate operation of the switch 20 and only the particular station called need respond.

What is claimed is:

1. In a high frequency radio signaling system comprising a transmitting and a receiving station and employing a carrier current which is appropriately modulated for signaling, the method of calling, which consists in sending the pure carrier waves continuously from the transmitter and interrupting these waves when calling.

2. In a high frequency radio signaling system comprising a transmitting and a receiving station and employing a carrier current which is appropriately modulated for signaling, the method of calling, which consists in sending the pure carrier waves continuously from the transmitter, interrupting these waves when calling, receiving said waves continuously at the receiving station and operating a signal at the receiving station upon the interruption of the waves from the transmitter.

3. In a high frequency radio signaling system, a transmitting station and a receiving station adapted for the continuous transmission and the reception of a carrier wave, the system being adapted for signaling by modulation of said carrier wave, means for calling the receiving station comprising means for interrupting the transmission of

carrier waves and a signaling device at the receiving station operated by the cessation of said waves.

4. In a high frequency radio signaling system, a transmitting station and a receiving station adapted for the continuous transmission and reception of carrier waves and comprising a generator and a detector, normal signaling apparatus at the receiving station and a call signal at the receiving station operated by change in the average current through the detector when signals are received and are not received and means at the transmitting station to interrupt the transmission of waves when the receiving station is to be called.

5. In a high frequency radio signaling system, a transmission station comprising an oscillation generator and normally adapted to transmit carrier waves continuously, a receiving station comprising a detector, a call signal at the receiving station normally unoperated, a relay controlling said signal and itself controlled by changes in the average current flowing through the detector when carrier waves are received and are not received.

6. In a high frequency radio signaling system, a transmission station comprising an oscillation generator and normally adapted to transmit carrier waves continuously, a receiving station comprising a vacuum tube detector, a call signal at the receiving station normally unoperated, a relay controlling said signal and itself controlled by changes in the average current flowing through the vacuum tube when carrier waves are received and are not received.

In testimony whereof, I have signed my name to this specification this 9th day of September, 1921.

LLOYD ESPENSCHIED.