

Sept. 9, 1924.

1,507,889

A. M. NICOLSON

METHOD AND MEANS FOR REPEATING

Filed March 18, 1918

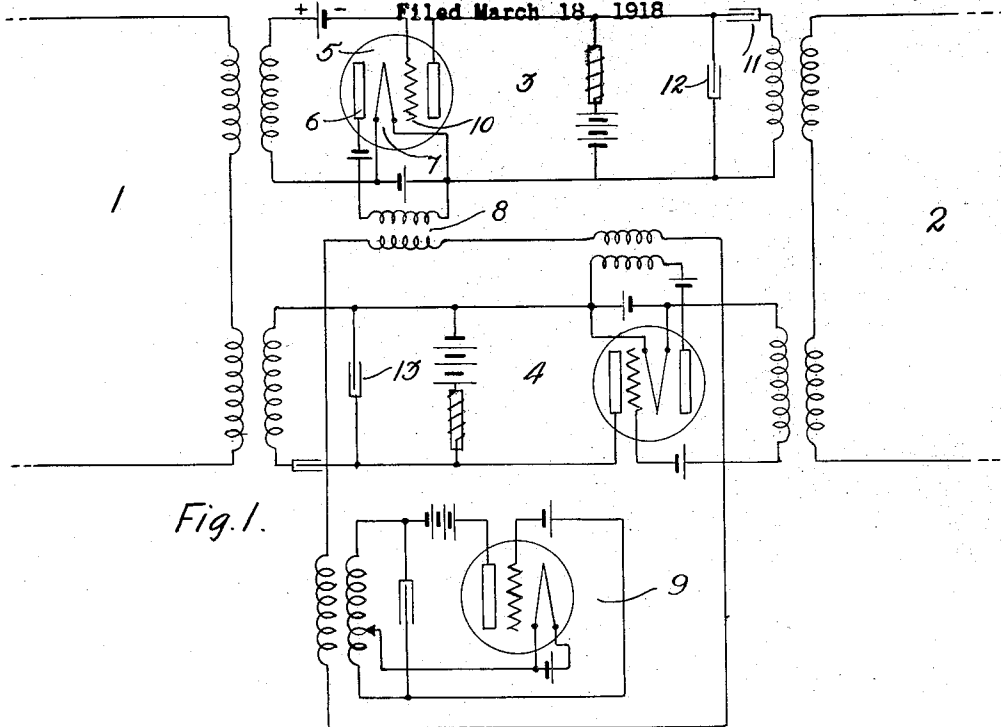


Fig. 1.

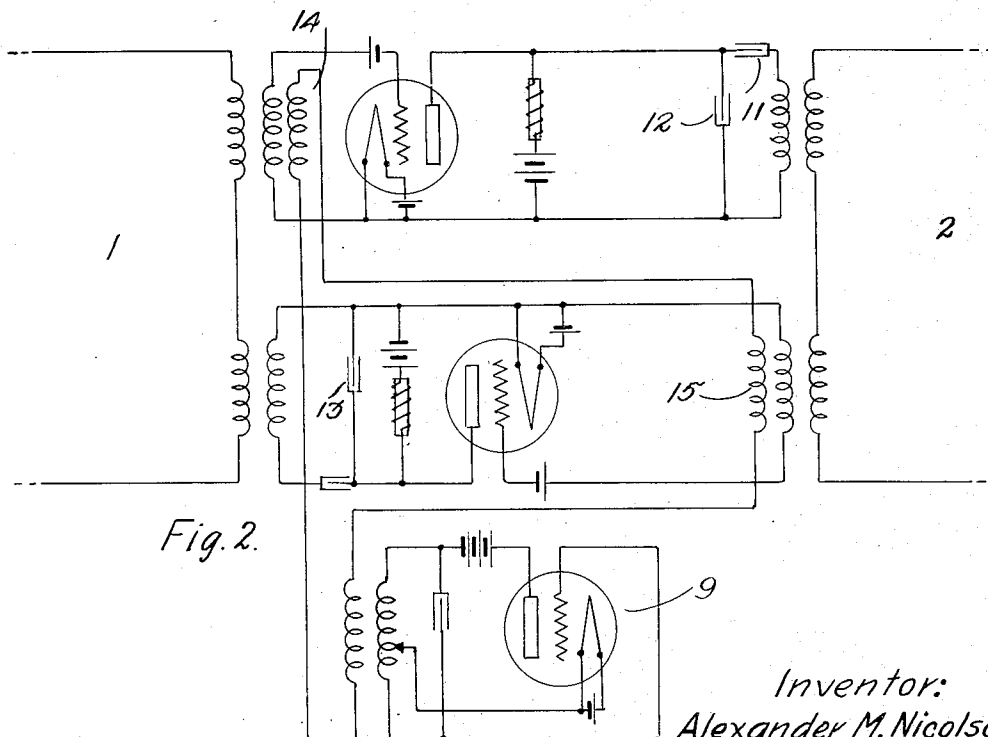


Fig. 2.

Inventor:
Alexander M. Nicolson.
by *J. R. Roberts* Att'y.

UNITED STATES PATENT OFFICE.

ALEXANDER M. NICOLSON, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

METHOD AND MEANS FOR REPEATING.

Application filed March 18, 1918. Serial No. 223,222.

To all whom it may concern:

Be it known that I, ALEXANDER M. NICOLSON, a subject of the King of Great Britain, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Methods and Means for Repeating, of which the following is a full, clear, concise, and exact description.

This invention relates to method and means for repeating in which weak impulses received at a repeating station are to be repeated and sent out upon the line in amplified form. Such a repeating means may be inserted in a telephone line, for instance, and in this case it is necessary that the repeater transmit currents in both directions over the line to provide for the two-way transmission of signals.

It is an object of the present invention to provide for such two-way repeating.

A repeating element such as a vacuum tube repeater is inherently a unilateral conductor and in order to provide for bilateral repeating, it has been proposed to use either (a) two repeaters connected in opposition between the line sections or (b) a single repeater which is reversibly connected between the line sections. The first expedient is open to objection because the input of one repeater being connected to the output of the other, causes a useless and, in fact, objectionable circulation of power at the repeating station to take place, resulting in some instances in singing or howling due to the generation of audible frequency currents. This objection has been previously overcome by various schemes which depend for their operation upon simulating or modifying the impedance of the telephone line. The scheme under (b) is objectionable because of the use of switch contacts which must be opened and closed.

The present invention aims to provide for two-way repeating without involving the necessity of simulating or modifying the line impedance or of reversing the pointing of a unilateral repeating element, or of using switching means to prevent transmission through a repeating path.

To this end use is made of two vacuum tube repeaters connected in opposition between the two line sections and of the fact that such repeaters may be rendered inoperative by temporarily assigning a sufficiently high negative potential to the con-

trol electrode of the repeater. This serves to reduce the space current within the vacuum tube substantially to zero. A positive potential on the control electrode, however, permits the vacuum tube to remain operative.

Another object of the invention is to automatically reduce the transmission efficiency of the repeating paths independently of the current to be repeated.

In accordance with the invention a generator of alternating current is oppositely connected to the two repeaters so that the repeaters are alternately rendered inoperative at a frequency which is the frequency delivered by the generator. One repeater is thus rendered inoperative when the other is operative, so that a local circulation of power is prevented. Either repeater, however, is always in condition to repeat the incoming impulses, due to the fact that the repeater is rendered inoperative at a frequency which is above audibility, and to this end the generator delivers a frequency of the order of 25,000 cycles, although it may be more or less than this value.

Further objects and advantages of the invention will be apparent from the following detailed description of the invention taken in connection with the drawings, in which Fig. 1 shows a two-way repeating system in which the currents supplied by the generator are applied to an auxiliary electrode within the vacuum tube repeater; and Fig. 2 is a modification of Fig. 1, in that the generator delivers its potential to the usual input electrode of the repeater.

Referring to Fig. 1, the line sections 1 and 2 have provided therebetween the vacuum tube repeater paths 3 and 4 connected in opposition. The repeater path 3 includes a vacuum tube repeater 5 of the audion type which is provided with an auxiliary electrode 6 between which and the usual filament 7 is connected the secondary winding of a repeating coil 8, the primary winding of which is in circuit with any suitable generator 9 of alternating current. Currents coming in over the line 1 vary the potential of the control electrode 10 of repeater 5 with respect to its filament 7, thereby varying the space current in the output side of this repeater, these variations being transmitted through the comparatively large condenser 11 and transmitted to the line 2. When the generator 9 supplies

a wave which makes the auxiliary electrode 6 negative with respect to the filament 7, the space current within the repeater 5 is reduced substantially to zero and this repeater is thereby rendered inoperative. When the generator 9 supplies a wave which makes the auxiliary electrode 6 positive with respect to the filament 7, the repeater 5 is in condition to repeat current from the line 1 to the line 2. The frequency supplied by the generator 9 will be of the order of 25,000 cycles. The times when the repeater 5 is inoperative do not interfere with this repeater being always in a condition to transmit current from the line 1 to the line 2.

The repeater path 4 is similar to the repeater path 3, except that the generator 9 is oppositely connected to these two repeater paths, whereby one repeater is permitted to remain operative while the other one is rendered inoperative. This insures that a local circulation of power between the repeaters will be prevented. If it is desired to prevent the high frequency delivered by the generator 9 from being sent out upon the line, the condenser 12 in shunt to the output side of the repeater 5 and a similar condenser 13 for the other repeater may be provided. These condensers have a comparatively small capacity and while preventing the passage of currents of relatively low frequencies which are to be repeated, these condensers permit the passage of currents of the frequency delivered by the generator 9 and thereby prevent such current from being transmitted to either of the lines 1 or 2.

The arrangement in Fig. 2 is substantially the same as that above described, the only difference being that the generator 9 by means of the coils 14 and 15 delivers its potential directly between the usual cathode and control electrode of the repeater.

Although the invention has been set forth with especial reference to its application to the repeating of voice frequency currents it is of course also applicable to the repeating of currents of other frequencies, whether higher or lower. It is understood that the invention is not limited to the particular circuit arrangements set forth herein, but is capable of embodiment in many and widely varied arrangements within the scope of the appended claims.

What is claimed is:

1. A two-way repeating system comprising two lines, two repeater paths connected in opposition therebetween, and means supplying electromotive forces for rendering said repeater paths substantially inoperative in cyclic order.

2. A two-way repeating system comprising two lines, two repeater paths connected in opposition therebetween, and means sup-

plying electromotive forces for rendering said repeater paths substantially inoperative in cyclic order at a frequency which does not interfere with the transmission of signals.

3. A two-way repeating system comprising two lines, two repeater paths connected in opposition therebetween, each of said paths comprising a vacuum tube repeater, and means acting electrically upon the discharge paths of said tubes for rendering said tubes substantially inoperative in cyclic order.

4. A repeating system comprising a line, repeating means therefor adapted to repeat waves in substantially the same form as received, and means supplying electromotive forces for periodically rendering said repeating means inoperative while repeating.

5. A repeating system comprising a line, two-way repeating means, energizing means adapted to supply direct current therefor, and means for reducing the current from said energizing means substantially to zero while leaving said energizing means connected in circuit, for preventing a local circulation of power through said repeating means.

6. The method of operating a repeater energized by direct current which comprises repeating in opposite directions with said repeater and preventing a local circulation of the power at the repeater by reducing the energizing direct current therefor to a small value at such times as permits the normal repeating operation and while leaving the energizing circuit connected to the repeater.

7. A two-way repeating system comprising two lines, two vacuum tube repeaters pointing in opposite directions between said lines, means for supplying space current for said tubes, and means for reducing substantially to zero the space current within said tubes.

8. A two-way repeating system comprising two lines, two vacuum tube repeaters pointing in opposite directions between said lines, means for supplying space current for said tubes, and means for cyclically reducing substantially to zero the space current within said tubes.

9. A two-way repeating system comprising two lines, two vacuum tube repeater paths pointing in opposite directions therebetween, and means for supplying a negative potential to an electrode within one or the other of said tubes.

10. A two-way repeating system comprising two lines, two vacuum tube repeater paths pointing in opposite directions therebetween, and means for varying the efficiency of one of said paths with respect to the other, said means comprising a generator coupled to said paths.

11. In a repeating system, the combination of two vacuum tube repeater paths the output side of each of which is coupled to the input side of the other, and means for
5 increasing the efficiency of one of said paths with respect to the other, said means comprising a source of current in common to said paths.

12. In a repeating system, the combination of two vacuum tube repeater paths the output side of each of which is coupled to the input side of the other, and a generator of alternating current oppositely connected to said paths.

13. A repeater system comprising a line, an amplifier for handling the transmission of current in one direction through said line, another amplifier for handling the transmission of current in the other direction through said line, means supplying electromotive forces for cyclically changing the efficiency of said amplifiers at a rapid rate, whereby the transmission of relatively low frequency current is possible, said means
20 operating to render one of said amplifiers substantially inoperative when the other is operative, whereby a local circulation of current through said amplifiers is prevented.

14. The combination of two lines, two re-

peater paths oppositely and permanently connected therebetween, and means comprising a source of electromotive force acting on one of said paths for reducing the transmission efficiency of said path at intervals
30 occurring at a frequency of a higher order of magnitude than the frequency to be transmitted.

15. A two-way repeating system comprising two lines, two repeater paths oppositely and permanently connected therebetween, connections for supplying energizing current to said paths and means independent of the current to be repeated for automatically reducing to a small value the current for one of said paths when the other path is
40 operative.

16. A two-way repeating system comprising two lines, two vacuum tube repeater paths oppositely connected therebetween, and means for automatically supplying a
50 negative potential to an electrode within a tube in each of said paths for rendering one of said paths inoperative when the other is operative.

In witness whereof, I hereunto subscribe my name this 12th day of March, A. D. 1918.

ALEXANDER M. NICOLSON.