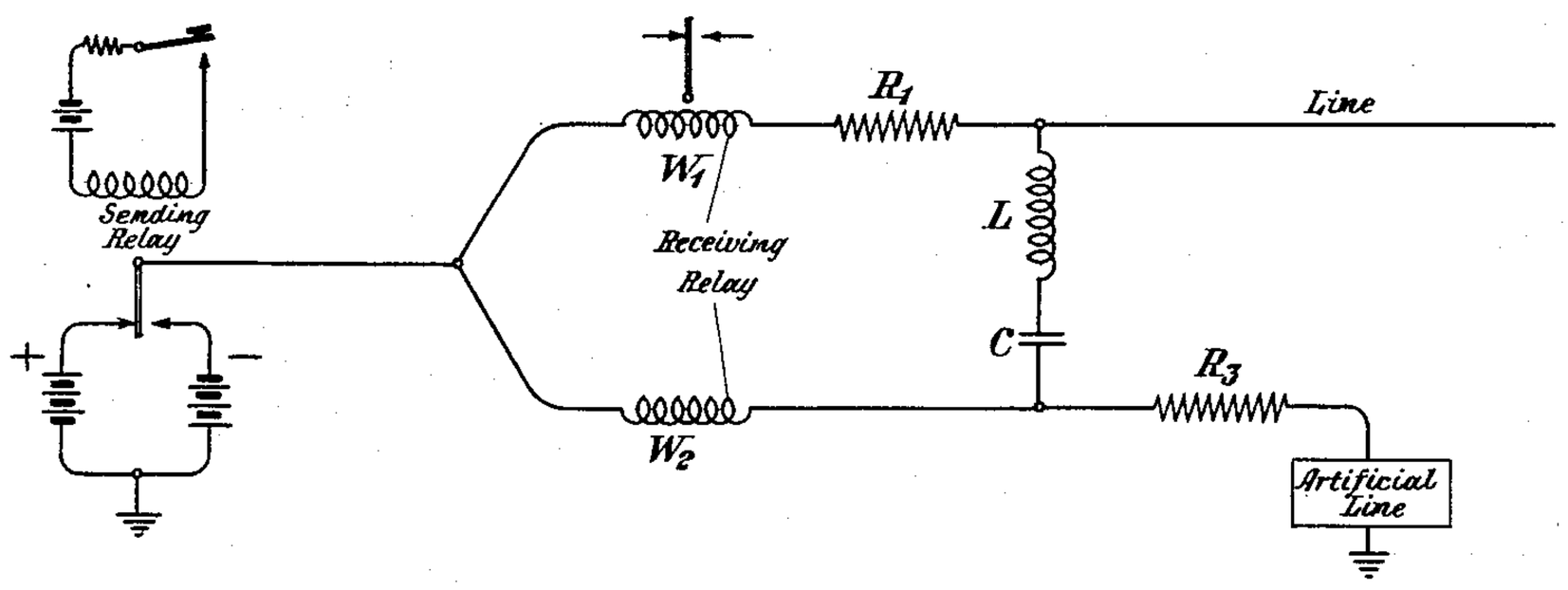
April 24, 1928. 1,666,965

J. HERMAN

DIFFERENTIAL DUPLEX TELEGRAPH REPEATER

Filed June 26, 1926



INVENTOR
J. Herman

BY

ATTORNEY

Patented Apr. 24, 1928. 1,666,965

UNITED STATES PATENT OFFICE.

JOSEPH HERMAN, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

DIFFERENTIAL DUPLEX TELEGRAPH REPEATER.

Application filed June 26, 1926. Serial No. 118,693.

This invention relates to grounded direct current telegraph systems, and more particularly to the differential duplex repeater circuits employed in such systems.

The object of the invention is to provide improved arrangements for reducing interference with telegraph systems from alternating current power transmission systems.

It has been the practice heretofore to employ resonant shunts connected across the receiving relay windings of telegraph systems of the class to which the invention relates. These shunt circuits are tuned to the frequency of the interfering power currents, offering a low impedance to these currents and a high impedance to the signaling currents.

In accordance with the invention described hereinafter, I provide a novel circuit arrangement including a resonant shunt which is rendered highly protective against interfering power currents, as described more fully below.

The accompanying drawing shows in diagrammatic form a differential duplex telegraph repeater circuit arranged according to my invention. The telegraph line, the balancing artificial line, the sending relay and the receiving relay are elements old and well understood in the art.

The receiving relay includes the winding W_1 in series with the real line, and the winding W_2 in series with the artificial line. The resonant shunt consists of the inductance L and the capacity C. It has been the usual practice to connect such a resonant shunt directly across the terminals of the receiving relay. With such an arrangement, the amount of protection afforded against interfering currents depends upon the relative impedances of the shunt and of the receiving relay. Since the resonant shunt always has an appreciable resistance even though it is accurately tuned to the frequency of the interfering current, it is not possible with such an arrangement to exclude all interfering current from the relay. By arranging the repeater circuits according to my invention, this objection is overcome and better protection afforded against interfering currents, since the residual interfering currents may be balanced out.

Let it be assumed that the artificial line offers a high impedance in comparison with the direct current resistance of the receiving relay winding W_2 added to the resistance to ground through the batteries associated with the sending relay. With this assumption, the presence of the artificial line may, for the purpose of the first part of this discussion, be neglected. The interfering alternating current flowing into the repeater from the line will divide between the receiving relay windings W_1 and W_2, and there will be a tendency toward neutralization. The resonant circuit LC is effectively in series with the relay winding W_2, and has an effective resistance which may be represented by R_2 at the resonant frequency. A resistance R_1 is connected in series with the receiving relay winding W_1, and the value of this resistance R_1 is chosen equal to R_2. The insertion in the circuit of this resistance R_1 will cause the interfering current to divide equally between the two windings of the receiving relay. The result is that the duplex balance of the repeater system is upset by an amount corresponding to the effect of resistance R_1. Accordingly, a resistance R_3 equal to R_1 must be added to the artificial line. With this arrangement, the only duplex unbalance existing will be a very slight one due to the unsymmetrical connection of the resonant shunt LC with respect to the resistances R_1 and R_3, and it can be disregarded.

It was assumed above that the artificial line offered a high impedance. If, however, the artificial line has a comparatively small impedance to the interfering currents, its presence must be taken into consideration and compensation provided. The resistance R_1 must be made larger than the effective resistance R_2 of the resonant shunt, whereby a larger amount of current will be caused to flow through the resonant shunt than through the resistance R_1. Part of this current will flow into the artificial line, and the balance through the relay winding W_2. Accordingly, by proper adjustment of the value of resistance R_1, the currents flowing in the two windings W_1 and W_2 can be made approximately equal, in order to produce neutralization.

It is thus seen that applicant's simple resonant shunt arrangement permits of the balancing out of the residual interfering currents usually present, and affords suit-

able protection against interference with the repeater from power currents in the telegraph line.

What is claimed is:

1. In a differential duplex telegraph repeater system, a line, an artificial line, a sending relay, a receiving relay having a first winding in series with said line and a second winding in series with said artificial line, a shunt path between said line and said artificial line, said shunt path including an inductance and a capacity of such values that they form a tuned circuit resonant at the frequencies of interfering alternating currents in the line, a first resistance in series with the first winding of the receiving relay, and a second resistance in the artificial line, said first resistance being of such a value that the interfering alternating currents will divide between the two windings of the receiving relay, having no effect upon said relay, and said second resistance being of such a value that a duplex balance of the system is maintained.

2. In a balanced differential duplex telegraph repeater system, a line, an artificial line, a sending relay, a receiving relay having a first winding in series with said line and a second winding in series with said artificial line, a shunt path between said line and said artificial line, said shunt path including an inductance and a capacity of such values that they form a tuned circuit resonant at the frequencies of interfering alternating currents in the line, a resistance in series with the first winding of the receiving relay, and a resistance in the artificial line, said resistances being of such values that the interfering alternating currents will divide between the windings of the receiving relay, having no effect upon the operation of said relay, and the duplex balance of the system is maintained.

In testimony whereof, I have signed my name to this specification this 24th day of June 1926.

JOSEPH HERMAN.