

June 24, 1930.

J. W. MILNOR ET AL
DUPLEX TELEGRAPH SYSTEM

1,766,919

Filed Oct. 30, 1928

Fig. 1.

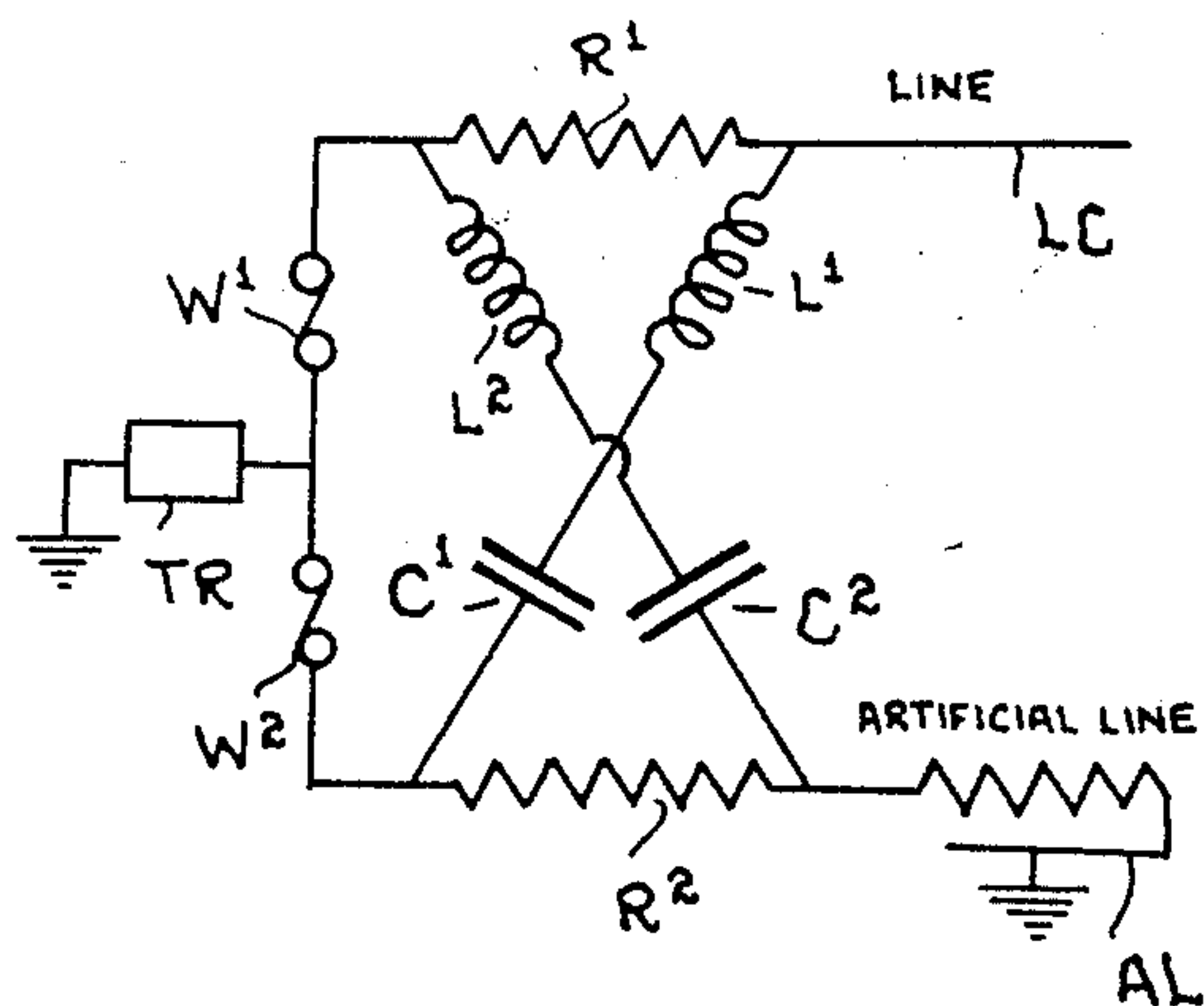


Fig. 1a.

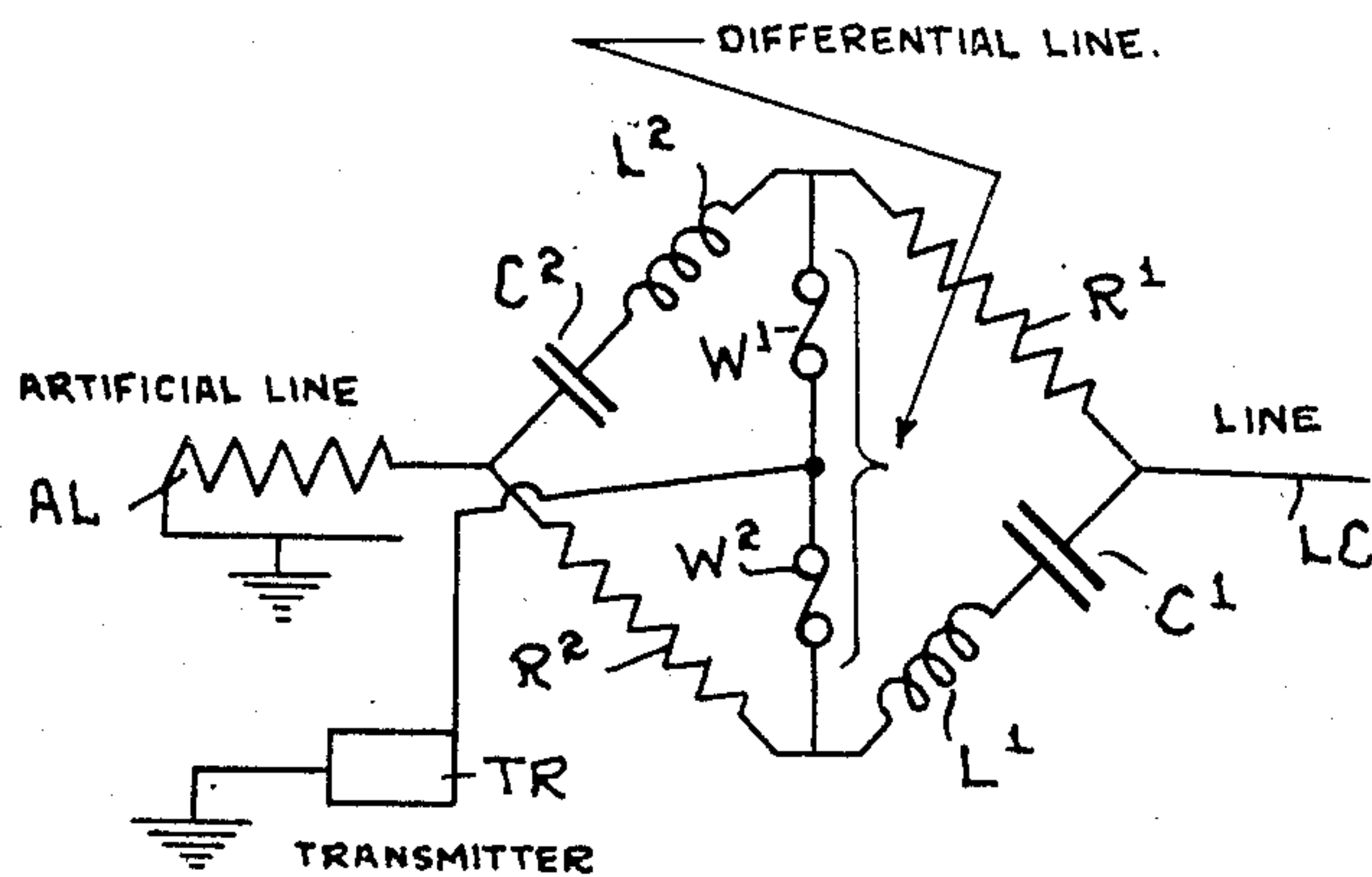


Fig. 2.

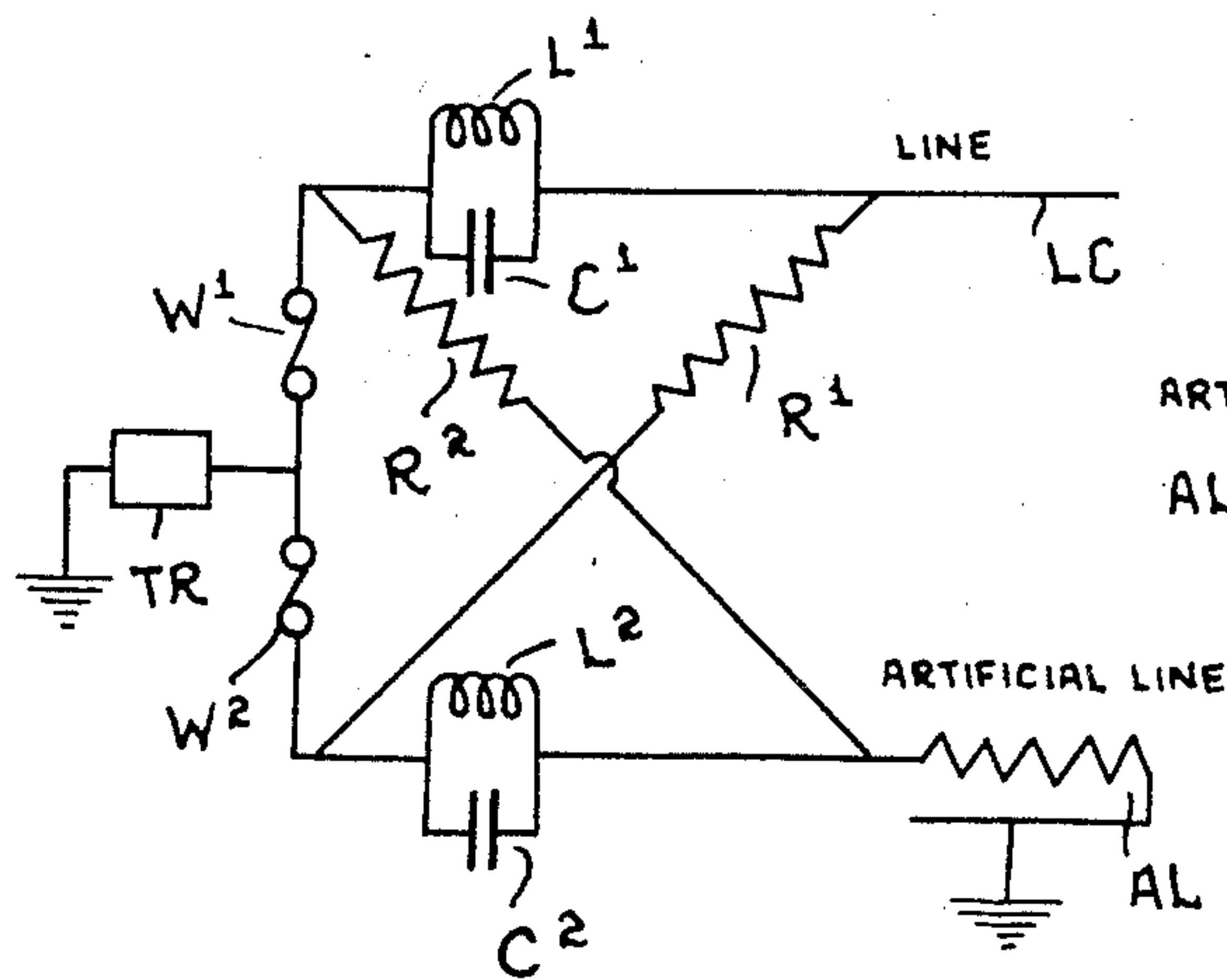
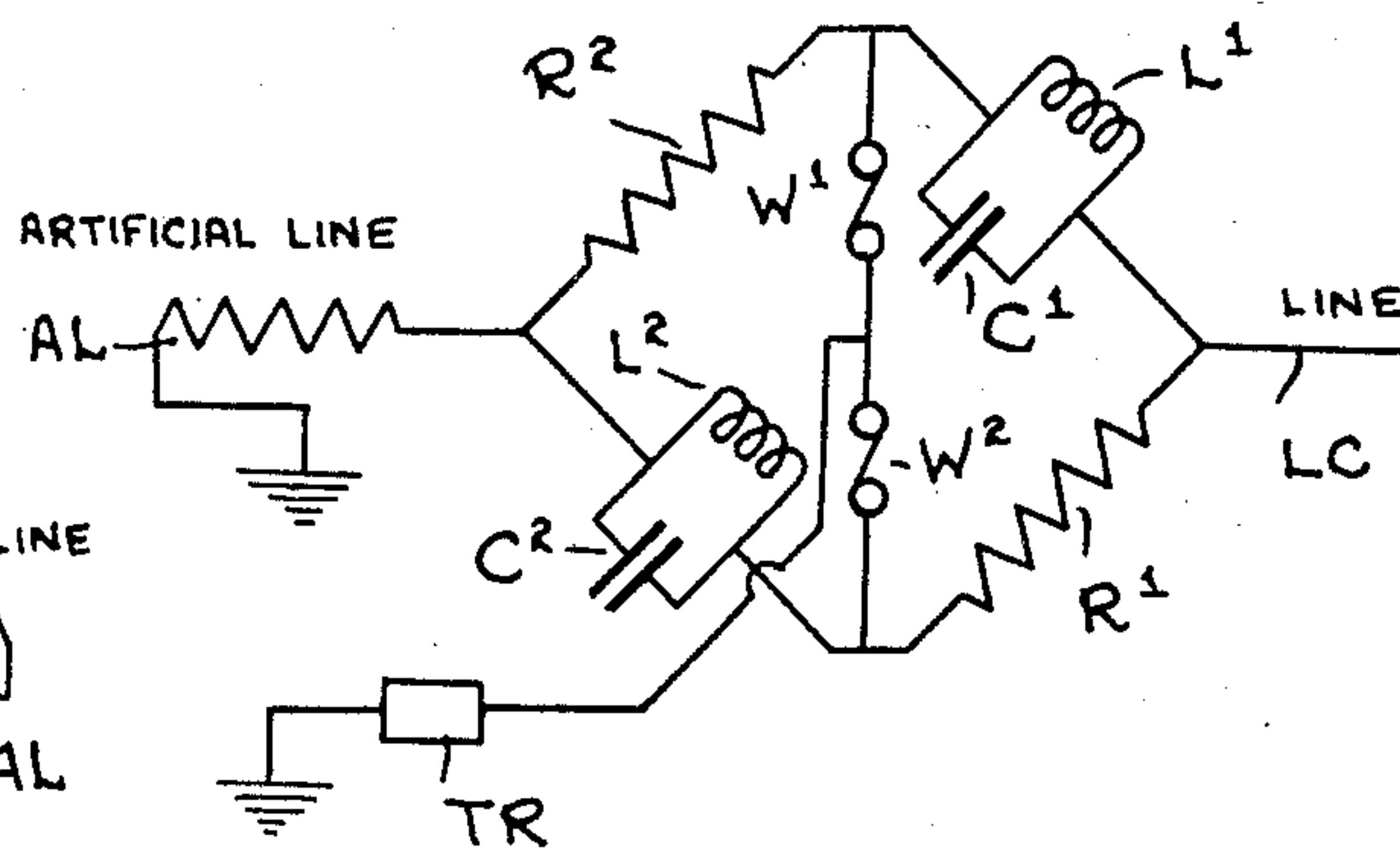


Fig. 2a.



Inventors
J. W. MILNOR
W. D. CANNON
By
Eugene C. Brown
Their Attorney.

UNITED STATES PATENT OFFICE

JOSEPH W. MILNOR, OF MAPLEWOOD, AND WILLIAM D. CANNON, OF METUCHEN, NEW JERSEY, ASSIGNORS TO THE WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

DUPLEX TELEGRAPH SYSTEM

Application filed October 30, 1928. Serial No. 316,018.

This invention relates to a duplex telegraphic system and in particular to a duplex system provided with means to reduce or eliminate the effect of disturbing currents upon the receiving instruments.

An object of this invention is to devise a system for excluding from the receiving relay circuit disturbing currents induced into the line conductor by neighboring power circuits and the like.

A further object of this invention is to provide a telegraph system wherein means are provided for excluding disturbing currents from the receiving relay circuit and provision is also made for duplex transmission over the receiving conductor without disturbing the receiving relay.

It has been proposed to eliminate inductive disturbances in a simple telegraph circuit by connecting the receiving relay in a Wheatstone bridge in which two opposite arms comprise tuned circuits and the remaining arms comprise resistance elements balanced against the tuned arms. Such an arrangement is disclosed in U. S. patent to Blakeney et al., No. 874,826, issued December 24, 1907. The present invention involves an adaptation of the above arrangement to a duplex system for the simultaneous transmission and reception of signals.

The invention is illustrated in the accompanying drawing in which like parts in the various figures are indicated by the same reference characters.

Figure 1 illustrates one form of the invention;

Figure 1^a illustrates the circuit of Figure 1 arranged in a different manner for the purpose of explaining its operation.

Figure 2 illustrates a third form of the invention, and

Figure 2^a illustrates the circuit of Figure 3 arranged in a different manner for the purpose of explaining its operation.

Referring to the drawing, LC indicates

a line conductor over which telegraphic messages are to be received and transmitted. The line conductor is subject to disturbing currents induced therein by neighboring power circuits and the like.

In Figure 1, a circuit is completed from the line conductor LC through a resistance R^1 , through two windings W^1 and W^2 of a receiving relay, through resistance R^2 , and through an artificial line AL to ground. The operating windings W^1 and W^2 of the receiving relay are connected in series, and a transmitter TR is connected at one terminal to a point between the windings W^1 and W^2 and at the other terminal to the ground. A tuned path, including inductance coil L^1 and a condenser C^1 , is connected in shunt to resistance R^1 and windings W^1 and W^2 . In a like manner, a tuned path, including inductance coil L^2 and condenser C^2 , is connected in shunt to windings W^1 and W^2 ; and resistance R^2 . By reference to Figure 1^a, it will be seen that the resistance R^1 and R^2 , and the two tuned paths, constitute, respectively, the arms of a Wheatstone balance with the receiving relay circuit connected in the bridge of the balance.

The operation of Figures 1 and 1^a, is as follows:

The two tuned arms of the bridge are adjusted to resonance with the disturbing currents, which are usually alternating currents of 25 or 60 cycles frequency induced by neighboring power lines. Resistance R^1 is adjusted in value to equal the resonant impedance of the tuned arm including coil L^1 and condenser C^1 . Also, resistance R^2 is adjusted in value to equal the resonant impedance of the tuned arm including condenser C^2 and coil L^2 . Under the foregoing conditions, the bridge will be balanced with respect to the disturbing currents, and the receiving relay will not be operated thereby. However, for incoming telegraphic signals the tuned arms of the bridge will not be bal-

anced by the resistance arms, and signal currents will flow through windings W^1 and W^2 of the relay and effect its operation. Upon transmitting signals from transmitter TR, the transmitted current flows through windings W^1 and W^2 in opposite directions and, therefore, the receiving relay will not be operated. Artificial line AL is adjusted in impedance to produce a balanced relation between transmitter TR and the receiving relay. In other words, transmitter TR is in conjugate relation with the receiving relay.

The arrangement shown in Figures 2 and 2^a, correspond substantially to the arrangement shown in Figures 1 and 1^a, except that the elements L^1 , C^1 and L^2 , C^2 are connected in parallel with each other to form resonant chokes as the tuned arms of the bridge, instead of in series to form resonant shunts as in Figures 1 and 1^a. In this arrangement also, the tuned arms are adjusted to resonance with the disturbing currents, and the resistance arms R^1 and R^2 are adjusted in value to correspond to the resonant impedances of the corresponding tuned arms. It will be noted that the resistances in Figure 2 will be relatively high as compared with the resistances in Figure 1. The operation of Figure 2 will be readily understood from the operation of Figure 1.

One of the advantages of the invention is its simplicity and its adaptability to standard duplex and multiplex systems already in operation without modification of the telegraph equipment.

We claim:

1. In a telegraph system, the combination of a line conductor subject to disturbing currents, a return path for said line conductor, a balanced Wheatstone bridge connected between said line and return path comprising two opposite resistance arms and two opposite tuned arms in resonance with the disturbing currents, a receiving relay having two operating windings connected in a diagonal of said bridge, and a transmitting circuit connected from a point between said windings and said return path, the transmitted signal current dividing at said receiving relay and flowing equally through said resistance arms in opposite directions and said receiving signal current flowing through said resistance arms and receiving relays in series whereby the receiving relay is responsive to received current and non-responsive to transmitted signal current.

2. In a telegraph system, the combination of a line conductor subject to disturbing currents, a return path for said line, two parallel paths connected between said line and the return path, a receiving relay connected between said paths at equi-potential points with respect to said disturbing currents, and a transmitting circuit connected between said return path and said relay circuit in

conjugate relation with said relay, the transmitted signal current dividing at said receiving relay and flowing equally through said parallel paths in opposite directions.

3. In a telegraph system, the combination of a line conductor subject to disturbing currents, a return path for said line conductor, a balanced Wheatstone bridge connected between said line and return path comprising two opposite resistance arms and two opposite tuned arms in resonance with the disturbing currents, a receiving relay connected in a diagonal of the bridge, and a transmitting circuit connected to said diagonal in conjugate relation to the relay, the transmitted signal current dividing at said receiving relay and flowing equally through said resistance arms in opposite directions.

4. In a duplex telegraph system, the combination of a line conductor subject to disturbing currents, a return path for said line conductor, an artificial line connected to said return path, a Wheatstone bridge connected between the line and the artificial line and comprising two opposite tuned arms tuned to resonance with the disturbing currents and two opposite resistance arms, a receiving relay connected in a diagonal of said bridge, and a transmitting circuit connected to said diagonal in conjugate relation with said relay, said resistance arms being adjusted in value to equal the resonant impedance of the adjacent arms respectively, and said artificial line having an impedance sufficient to produce a duplex balance of the system.

5. In a duplex telegraph system, the combination of a line conductor subject to disturbing currents, a return path for said line conductor, an artificial line connected to said return path, a Wheatstone bridge connected between the line and said return path comprising two opposite tuned arms tuned to resonance with the disturbing currents and two opposite resistance arms, a receiving relay connected in a diagonal of said bridge, and a transmitting circuit connected between the return path and said diagonal in conjugate relation with said relay, said resistance arms being adjusted in value to equal the resonant impedance of the adjacent arms respectively, and said artificial line having an impedance sufficient to produce a duplex balance of the system.

6. In a duplex telegraph system, the combination of a line conductor subject to disturbing currents, a return path for said line conductor, an artificial line connected to said return path, a Wheatstone bridge connected between said artificial line and said line conductor, two opposite arms of said bridge each comprising an inductance and a condenser connected in series and forming tuned circuits resonant to the disturbing current, and the two remaining arms comprising resistance elements equal in value to the resonant

impedances of the adjacent tuned arms respectively, a receiving relay having two operating windings connected in series in a diagonal of said bridge, and a transmitting circuit connected between said return path and
5 a point between said operating windings, said artificial line being of such value that said system is balanced for duplex operation.

10 In testimony whereof we affix our signatures.

JOSEPH W. MILNOR.
WILLIAM D. CANNON.