

Aug. 10, 1926.

1,595,159

O. B. JACOBS

TELEPHONE REPEATER SYSTEM

Filed August 25, 1921

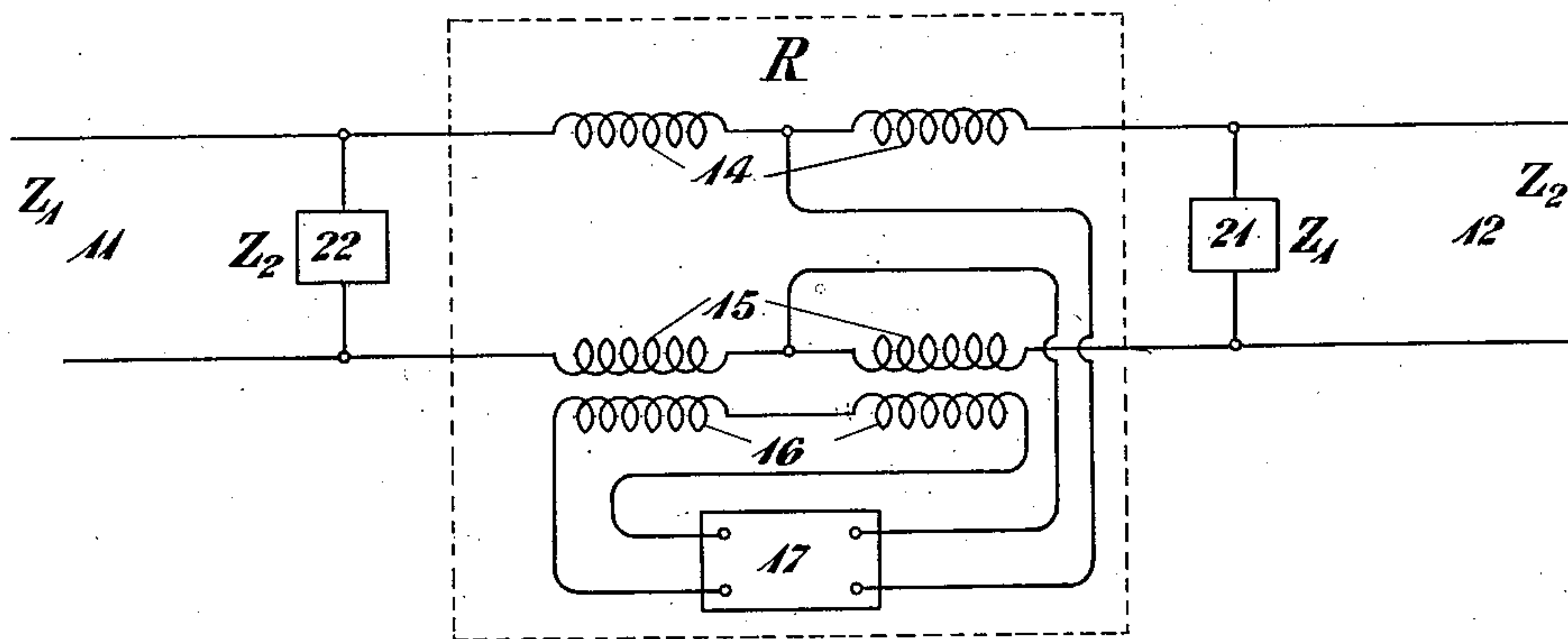


Fig. 1

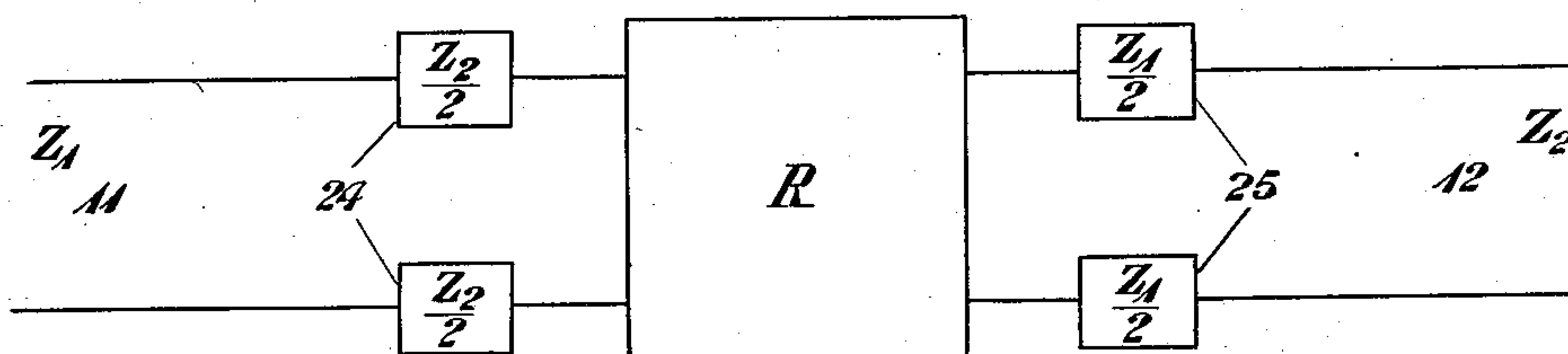


Fig. 2

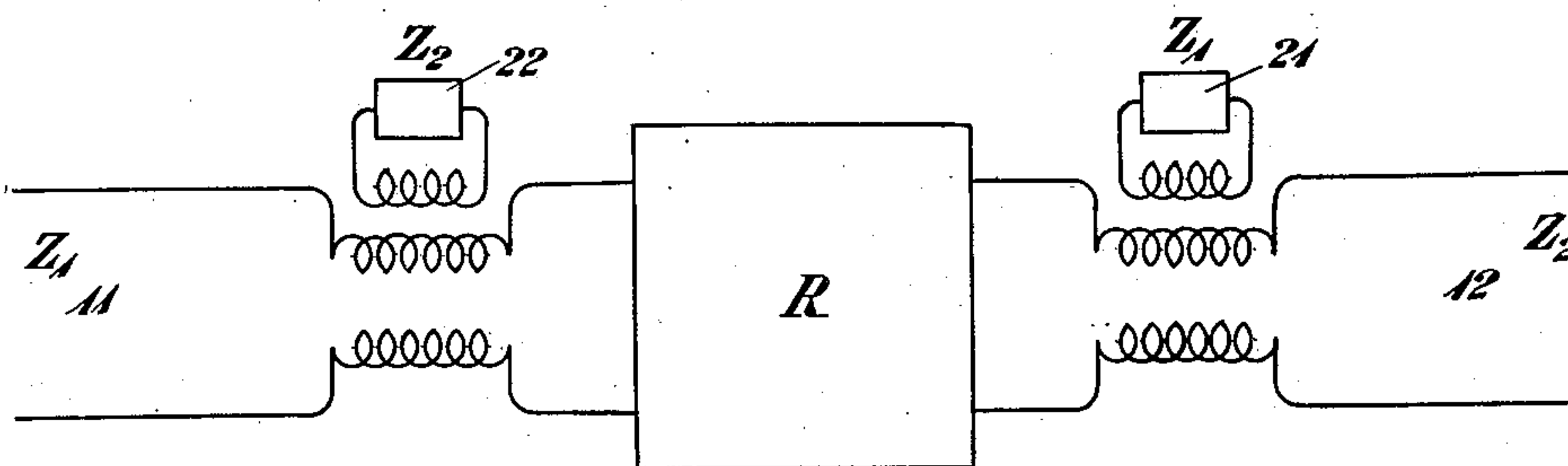


Fig. 3

INVENTOR
O. B. Jacobs
BY *[Signature]*
ATTORNEY

UNITED STATES PATENT OFFICE

OLIVER B. JACOBS, OF MORRIS PLAINS, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE REPEATER SYSTEM.

Application filed August 25, 1921. Serial No. 495,334.

This invention relates to a repeater for telephone circuits, and one of its objects is to provide a new and improved repeater system adapted for operation between lines of different characteristic impedances. Another object of my invention is to provide a repeater with a single repeating element, or series of repeating elements, to operate between two lines, the necessary balancing being provided by suitable networks associated with the lines.

The invention will be better understood by reference to the following specification and the accompanying drawing, in which Figure 1 is a diagram of a circuit connection embodying my invention and Figs. 2 and 3 are modifications thereof.

Referring to Fig. 1, the transmission lines 11 and 12, between which it is desired to repeat, may be any two lines having different characteristic impedances. These lines are connected by means of the so-called 21 repeater circuit R, this repeater being adapted for repeating a message in two directions with the use of one repeater element. For this connection, the well-known hybrid coil, including the windings 14, 15 and 16, is used, the input terminals of the repeater element 17 being connected across the mid-points of the windings 14 and 15 and the output of said element being connected across the winding 16, or vice versa. An impulse coming from either direction will be impressed on the input of the repeater element. The amplified output in the winding 16 will produce equal effects in the windings 14 and 15 provided the lines 11 and 12 have the same impedance characteristics, and in view of the balanced condition of the windings, no effect will be produced by the winding 16 on the input of the repeater element.

In case, however, the lines 11 and 12 are not similar, this balanced condition will not hold, and the repeater element or amplifier may "sing". In order to make it possible to connect two such different lines with a single repeater element, I connect across the line 11 an impedance network 22, having the same impedance characteristic Z_2 as the line 12, and across the line 12 I connect an impedance 22 having the same characteristic Z_1 as the line 12. Under these conditions the apparent impedance as seen from

the repeater is exactly the same whether viewed in the direction of the line 11 or of the line 12, for in both cases there is seen the impedance resulting from two impedances, Z_1 and Z_2 , connected in parallel.

In Fig. 2 I have shown a modification of the above circuit. Here again the lines 11 and 12 of different impedance characteristics are connected by means of the repeater R, this latter being the same as that shown in more detail in Fig. 1. In this modification, the impedances are made to appear the same whether looking in the one direction or the other, by inserting a network in series with the line on each side. On the one side, a network 24 having an impedance equal to that of the line 12 is inserted and on the other side a network 25 having an impedance equal to that of the line 11 is inserted. Under these conditions, the impedance, when viewed in either direction from the repeater, is equal to $Z_1 + Z_2$. Instead of connecting a single impedance Z_2 on the one side, it is preferable to connect two impedances of $\frac{1}{2}Z_2$, in each line on the one side, and similarly, to connect on the other side two impedances of the value $\frac{1}{2}Z_1$, there being one of these in each conductor. This is for the purpose of maintaining better balance of the lines as a whole with respect to inductive disturbances other than those which may arise in the repeater element.

In Fig. 3 there is shown still a further modification of my invention, in which the impedances 21 and 22 are introduced into the lines 11 and 12 inductively rather than conductively, use being made of the three-coil transformers 31 and 32. This modification has the special advantage that telegraph or other low frequency signals can be passed through the repeaters without encountering the impedance of the networks.

Various other modifications can be made without departing from the spirit of my invention which is as set forth in the appended claims.

What is claimed is:

1. In combination, two lines of different characteristic impedance, a two-way one-repeater circuit connecting said lines, and an auxiliary impedance associated with each line equal to the characteristic impedance of the other line.

2. In combination, two lines of different characteristic impedance, a two-way one-repeater circuit connecting said lines, and an auxiliary impedance connected with each line equal to the characteristic impedance of the other line.

3. In combination, two lines of different impedance characteristics, a two-way one-repeater circuit connecting said lines, an impedance network introduced in series relation in the first line and equal to the impedance of the second line and an impedance network introduced in series relation in the second line equal to the impedance of the first line.

4. In combination, two lines of different impedance characteristics, a two-way one-repeater circuit connecting said lines, an impedance network inductively connected in series of the first line and an impedance network inductively connected in series in the second line.

5. In combination, two lines of different impedance characteristics, a two-way one-repeater circuit connecting said lines, an impedance network inductively connected in series in the first line and equal to the impedance of the second line, and an impedance network inductively connected in series

in the second line and equal to the impedance of the first line.

6. In combination, two lines of different impedance characteristics, a two-way one-repeater circuit connecting said lines, a transformer having its primary connected in series relation in the first line and having in its secondary circuit an impedance equal to the impedance of the second line, and a transformer having its primary connected in series in the second line and having in its secondary circuit an impedance equal to that of the first line.

7. In combination, two lines of different characteristic impedance, a two-way one-repeater circuit connecting said lines, and two auxiliary impedances each in circuit with a respective line and each auxiliary impedance equal to the characteristic impedance of the other line whereby the impedance of each line and its associated impedance element is equalized to the impedance of the other line and its associated impedance element.

In testimony whereof, I have signed my name to this specification this 22nd day of August, 1921.

OLIVER B. JACOBS.