Nov. 10, 1925. 1,560,726

W. T. POWELL

TELEPHONE SUBSTATION CIRCUIT

Filed July 24, 1923 2 Sheets-Sheet 1

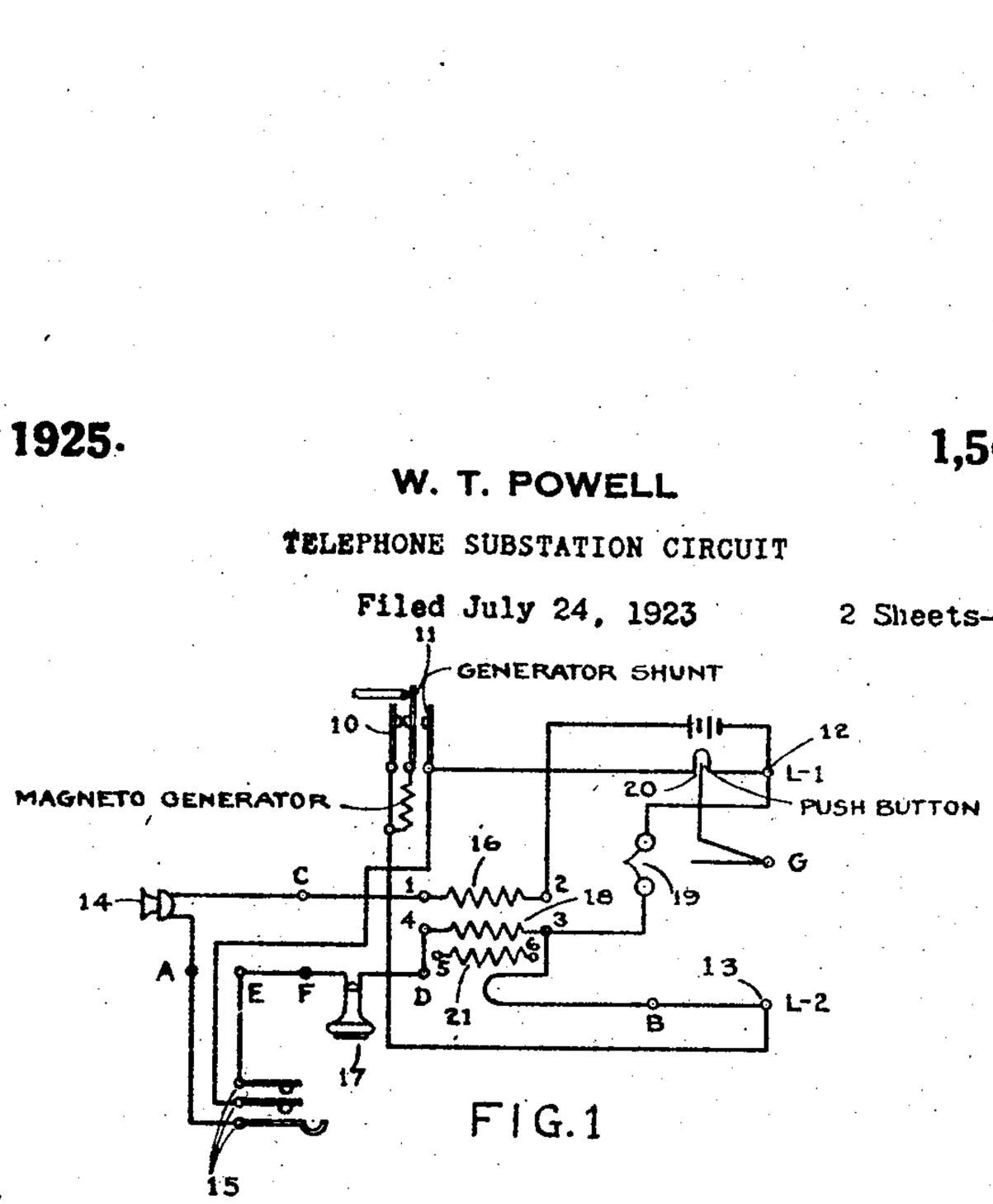


FIG. 1

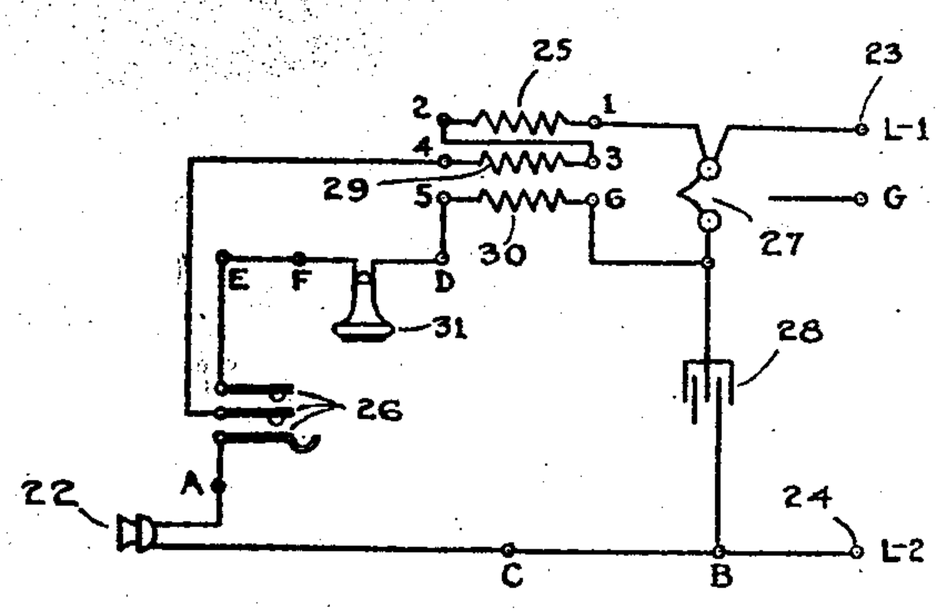


FIG. 2

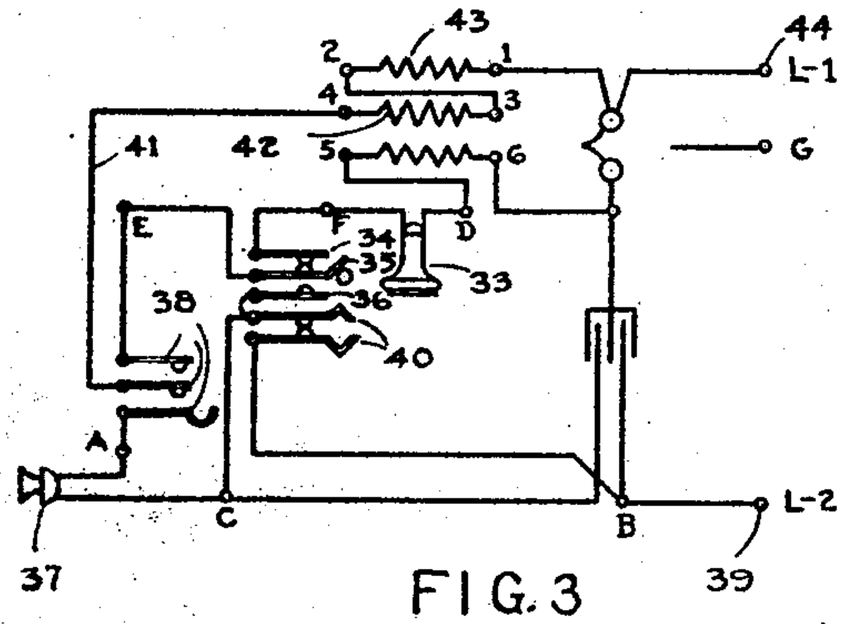


FIG. 3

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TELEPHONE SUBSTATION CIRCUIT

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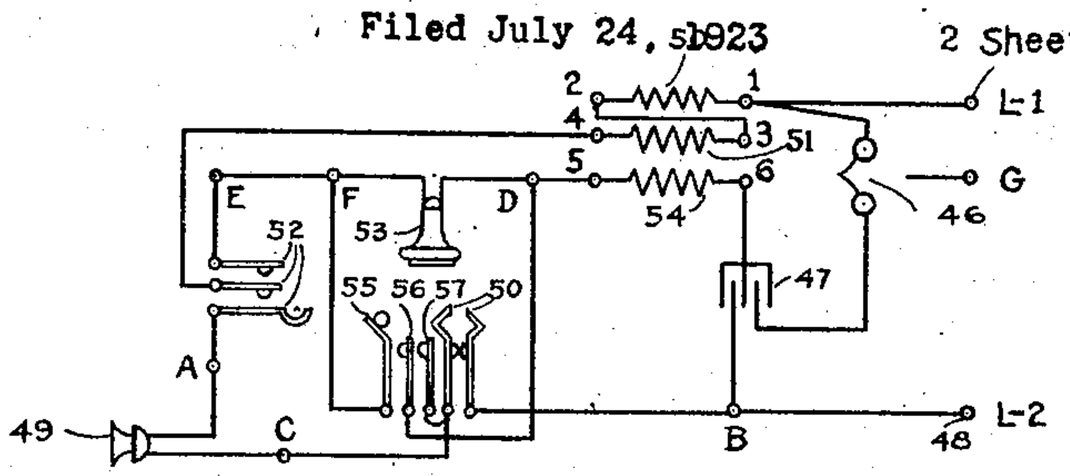


FIG. 4

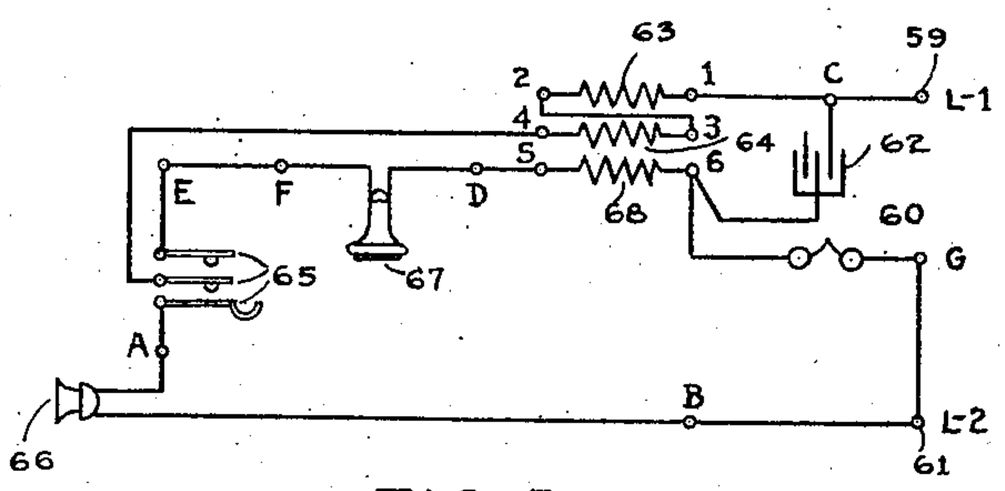


FIG. 5

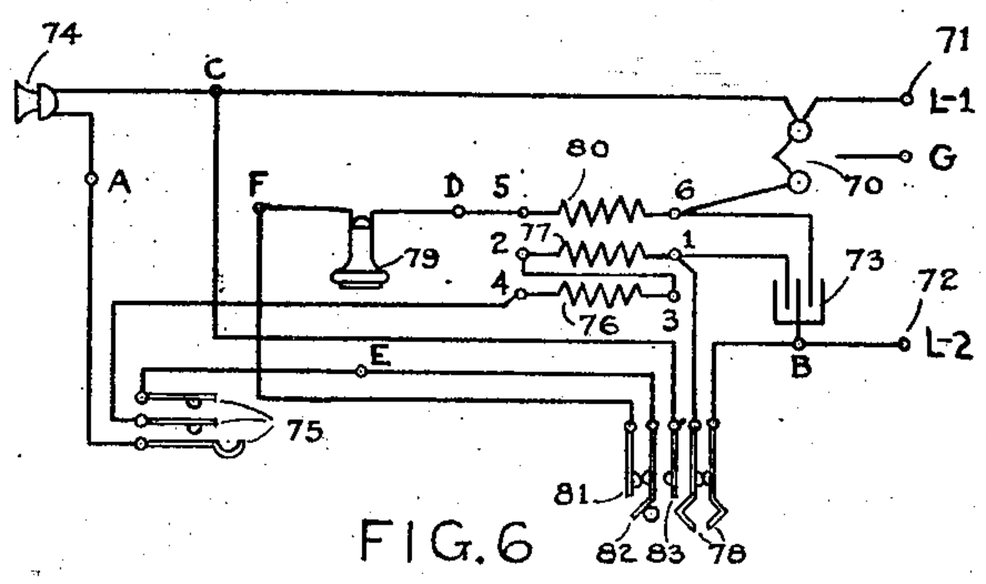


FIG. 6

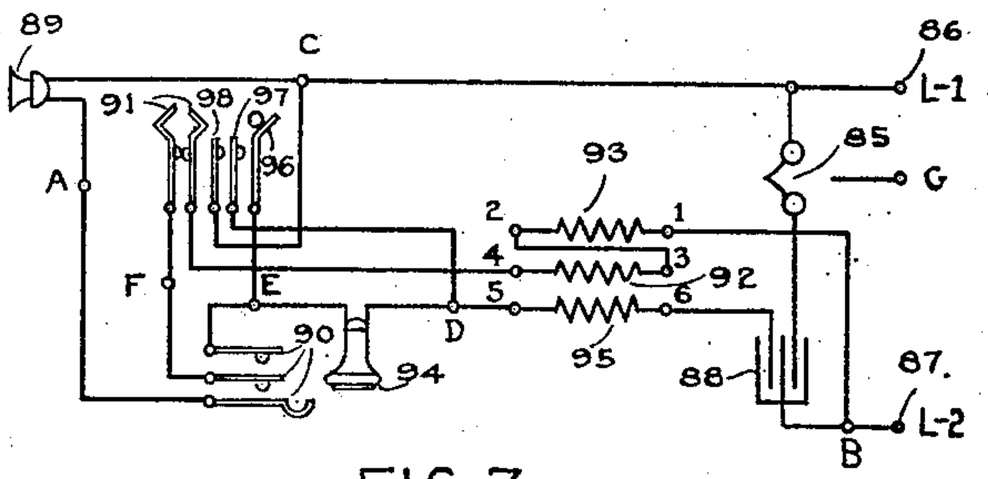


FIG. 7

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE SUBSTATION CIRCUIT.

Application filed July 24, 1923. Serial No. 653,466.

*To all whom it may concern:*

Be it known that I, WINFRED T. POWELL, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Telephone Substation Circuits, of which the following is a full, clear, concise, and exact description.

The present invention relates to telephone substation circuits and has for its purpose the provision of circuits which may be readily converted from local battery to common battery operation.

It is frequently desirable in a telephone system installed for local battery operation to arrange the telephone instruments so that they may be readily converted from the local battery operation to the common battery operation. It is also desirable to arrange these substation circuits so that they may be converted for use in an automatic telephone system merely by interconnecting certain terminals and by incorporating a dial sender or impulse transmitter. In such an arrangement it is essential that the impulses generated by the dial sender do not pass through the microphone transmitter; it is also essential that the circuits be so arranged that room noises, commonly known as, "side tone" should be reduced to a minimum and in addition it is essential that a relatively low voltage should be maintained at all times across the impulse springs of the impulse transmitter or dial sender. It is also necessary in such an arrangement that standard hook-switches and standard dial shunt spring combinations be employed.

One feature of this invention resides in the novel arrangement of the circuits for common battery telephone operation. An additional feature of the invention resides in the novel arrangement of substation circuits to incorporate the dial sender or impulse transmitter.

Fig. 1 represents a substation circuit arranged for local battery or magneto operation. Fig. 2 shows the circuits of Fig. 1 converted for common battery method of operation. Fig. 3 shows the circuit of Fig. 1 converted for use in a common battery telephone system in which a so-called make-break type of dial shunt spring combination is employed. Fig. 4 shows a similar common battery automatic telephone substation circuit in which a so-called three spring make dial shunt spring combination is used. Fig. 5 shows the circuit of Fig. 1 arranged for side tone reduction in a common battery telephone system. Fig. 6 shows a substation circuit arrangement for common battery telephone systems arranged for side tone reduction and provided with a make-break dial shunt spring combination. Fig. 7 is a substation circuit arrangement having a three-spring make dial shunt spring combination and also an arrangement for side tone reduction.

It will be understood that the letters A, B, C, D, E and F refer to a series of terminals appearing in the cabinet of the wall telephone or in the bell box, while the characters $L'$ and $L^2$ designate the terminals to which the line circuit conductors are connected. Terminal G is a terminal which is grounded when this telephone is used in a local battery telephone system, otherwise this terminal is disconnected from the remainder of the circuits. The numerals 1, 2, 3, 4, 5 and 6 refer, in all the figures, to the terminals of the windings of an induction coil.

The drawings diagrammatically disclose a three-plate condenser which is made by rolling three strips of tin foil between sheets of paper and placing them in one can. The capacity between any two plates will produce best results for conversation and ringing when it measures approximately one microfarad.

Referring to Fig. 1, 10 designates the well known magneto generator which, by the closure of the shunt springs 11 in operation, is bridged from the line terminal 12 to the line terminal 13. The microphone or telephone transmitter 14 is included in a bridge from the line terminal 12, a local battery, winding 16 of the induction coil, transmitter 14, normally open hook switch contacts 15 to the other side of the battery, while the ringer 19 is permanently bridged to a circuit between the line terminals 12 and 13. A push button 20 is provided in order that one party on a rural line can signal another subscriber on the same line without disturbing the operator. It will be noted that the third winding 21 of the induction coil is not used at this time.

When it is desired to convert the magneto

substation circuit of Fig. 1 to common battery operation, the connections between the terminals A and F inclusive are interconnected so that the circuits are arranged in the manner shown in Fig. 2. In this instance the microphone or telephone transmitter 22 is connected in a normally open bridge between the line terminals 23 and 24, which bridge may be traced from terminal 23 through the windings 25 and 29 of the induction coil, through normally open hook switch springs 26, transmitter 22 to the line terminal 24. The ringer 27 is permanently connected in a bridge including condenser 28, between the line terminals 23 and 24. Receiver 31 and winding 30 of the induction coil are included in a third bridge connected at one point between the ringer 27 and the condenser 28 and the other end of this bridge is connected to the hook switch spring 26. It will be noted that the ground terminal G is not connected in the circuits and the third plate of the condenser is ineffective at this time.

When it is desired to connect the telephone of Fig. 1 for common battery automatic telephone operation, the terminals A to F inclusive are interconnected in such a manner as to produce the circuit arrangement shown in Fig. 3. It will be noted that Fig. 3 is similar to the circuits of Fig. 2 except that the circuit including the receiver 33 is open at the shunt springs 34 and 35 during the operation of the dial sender.

In this arrangement also the operation of the dial sender closes the shunt springs 35 and 36 which places the telephone transmitter 37 in shunt with the impulse circuit which shunt circuit is completed at the hook switch spring 38. The mentioned impulse circuit extends from the terminal 39, impulse springs 40, shunt springs 36 and 35, hook switch springs 38, conductor 41, windings 42 and 43 of the induction coil to the line contact 44.

In this instance it will be noted that the third plate of the condenser is connected to the conductor extending between the transmitter 37 and the impulse springs 40. In this modification the ground terminal plate is disconnected.

In Fig. 4 the circuits of Fig. 1 are converted for use in an automatic common battery telephone system where a dial sender having a three-spring make dial shunt combination is employed. In this arrangement the ringer 46 is permanently bridged in a circuit from line terminal 45 through condenser 47 to the other line terminal 48. The telephone transmitter 49 is connected in a normally open bridge from the line terminal 45, through the windings 50 and 51 of the induction coil in series, through the hook switch springs 52, the transmitter 49, impulse springs 50 of the dial sender to the line terminal 48. The receiver 53 is included in a third bridge extending from the third plate of the condenser 47, through a winding 54 of the induction coil to the hook switch spring 52.

It will be noted that the three shunt springs 55, 56 and 57 are normally out of engagement, but when the dial sender is operated these three shunt springs come into engagement so that the springs 55 and 56 complete a shunt circuit about the receiver 53 to prevent "clicks" due to the operation of the impulse springs 50 from being heard in the receiver. The closing of the contact springs 55 and 57 complete a shunt about the transmitter so that the impulses do not pass through the telephone transmitter.

When it is desired to convert the circuit arrangement of Fig. 1 to a common battery arrangement in which side tones or room noises are reduced to a minimum, the terminals A to F are interconnected in a manner to produce the circuit arrangement of Fig. 5. The ringer 60 is permanently bridged across the line terminals 59 and 61 in a circuit including the condenser 62. In the present modification, one of the plates of the condenser remains disconnected and the terminal G is also not connected to ground. The telephone transmitter is bridged across the line terminals 59 and 61 in a normally open bridge extending from the terminal 59, through windings 63 and 64, hook switch springs 65, telephone transmitter 66, line terminal 61. The telephone receiver 67 is included in a conductor connected at one end at a point on the conductor between the condenser 62 and the ringer 60, and the other end of the receiver circuit is connected to the hook switch springs 65.

When the substation circuit of Fig. 1 is to be converted into the common battery automatic telephone type having the make-break dial sender and also arranged for side tone reduction, the terminals A to F inclusive are interconnected to produce the circuit arrangement in Fig. 6. This arrangement is similar to the circuits of Fig. 5 except that it is modified to incorporate the dial sender having a make-break shunt spring combination. The ringer 70 is permanently bridged between line terminals 71 and 72 in a circuit including the condenser 73 while the telephone transmitter 74 is connected in a normally open bridge extending from the line terminal 71 through the hook switch springs 75, windings 76 and 77 of the induction coil, impulse springs 78 to line terminal 72. The receiver 79 is connected in a bridge including the winding 80 of the induction coil which bridge is connected to the conductor extending between the ringer 70 and the condenser 73. The receiver bridge extends through the normally closed shunt springs 81 and 82 of the dial sender

to the hook switch springs 75. It will be noted that when the dial sender is operated, the receiver circuit is opened so that the dial "clicks" are not heard in the receiver. The operation of the dial sender also closes contact springs 82 and 83 which complete a shunt circuit about the telephone transmitter 74.

When it is desired to convert the telephone circuits of Fig. 1 for common battery automatic telephone operation with side tone reduction and employing a three spring make shunt dial sender the terminals A to F inclusive are interconnected to produce a circuit arrangement such as is shown in Fig. 7. In this instance also the ringer 85 is permanently connected to the line terminals 86 and 87 through the condenser 88 and the telephone transmitter 89 is connected in a normally open bridge traceable from line terminal 86 through the telephone transmitter 89, hook switch contacts 90, impulse springs 91, windings 92 and 93 of the induction coil to terminal 87. The receiver 94 is included in a bridge with the winding 95 of the induction coil. This bridge is connected at one end to the third plate of the condenser 88 and at its other end to one of the hook switch springs 90. It will be noted that the dial shunt springs 96, 97 and 98 are normally open. When, however, the dial is operated these three springs come into engagement to close shunt circuits about the receiver 94 and the telephone transmitter 89.

What is claimed is:—

1. In a telephone substation circuit, a telephone transmitter, a receiver, a signal, a three-plate condenser, an impulse transmitter having impulse springs, a telephone line including two conductors, a signaling bridge across said conductors including said signal and two of said condenser plates, a second bridge across said line conductors including said telephone transmitter and said impulse springs, a third bridge including said receiver connected across said first and said second bridges, and a circuit including said impulse springs, said third plate and one of said first mentioned plates of said condenser.

2. In a telephone substation circuit, a telephone transmitter, a receiver, a signal, a three-plate condenser, an impulse transmitter having impulse springs, a telephone line including two conductors, a signaling bridge across said conductors including said signal and two of said condenser plates, a second bridge across said line conductors including said telephone transmitter and said impulse springs, a third bridge including said receiver connected across said first and said second bridges, a circuit including said impulse springs, said third plate and one of said first mentioned plates of said condenser, and means for disabling said telephone transmitter.

3. In a telephone substation circuit, a telephone transmitter, a receiver, a signal, a three-plate condenser, an impulse transmitter having impulse springs, a telephone line including two conductors, a signaling bridge across said conductors including said signal and two of said condenser plates, a second bridge across said line conductors including said telephone transmitter and said impulse springs, a third bridge including said receiver connected across said first and said second bridges, a circuit including said impulse springs, said third plate and one of said first mentioned plates of said condenser, and means for disabling said receiver and said telephone transmitter.

4. In a telephone substation circuit, a telephone transmitter, a receiver, a signal, a three-plate condenser, an impulse transmitter having impulse springs and three shunt springs, a telephone line including two conductors, a signaling bridge across said conductors including said signal and two of said condenser plates, a second bridge across said conductors including said telephone transmitter and said impulse springs, a third bridge including said receiver connected across said first and said second bridges, a circuit including said impulse springs, said third plate and one of said first mentioned plates of said condenser, and means including said three springs for disabling said receiver and said telephone transmitter.

5. In a telephone substation circuit, a telephone transmitter, a receiver, a signal, a three-plate condenser, an impulse transmitter having impulse springs, a telephone line including two conductors, a signaling bridge across said conductors including said signal and two of said condenser plates, a second bridge across said conductors including said telephone transmitter and said impulse transmitter, a third bridge including said receiver connected across said first and said second bridges, a circuit including said impulse springs, said third plate and one of said first mentioned plates of said condenser, and a three-spring hook switch for closing said second and third bridges.

6. In a telephone substation circuit, a telephone transmitter, a receiver, a signal, a three-plate condenser, an impulse transmitter having impulse springs, a telephone line including two conductors, a signaling bridge across said conductors including said signal and two of said condenser plates, a second bridge across said conductors including said telephone transmitter and said impulse springs, a third bridge connected across said first and said second bridges, and means including certain of the plates of said condenser for reducing the potential across said impulse springs.

7. In a telephone substation circuit, a telephone transmitter, a receiver, a signal, a

three-plate condenser, an impulse transmitter having impulse springs, a telephone line including two conductors, a signaling bridge across said conductors including said signal and two of said condenser plates, a second bridge across said conductors including said telephone transmitter and said impulse springs, a third bridge connected across said first and said second bridges, means including certain of the plates of said condenser for reducing the potential across said impulse springs, and other means for disabling said telephone transmitter during the actuation of said impulse springs.

8. In a telephone substation circuit, a telephone transmitter, a receiver, a signal, a three-plate condenser, an impulse transmitter having impulse springs, a telephone line including two conductors, a signaling bridge across said conductors including said signal and two of said condenser plates, a second bridge across said conductors including said telephone transmitter and said impulse springs, a third bridge connected across said first and said second bridges, means including certain of the plates of said condenser for reducing the potential across said impulse springs, and other means for shunting said telephone transmitter during the actuation of said impulse springs.

9. In a telephone substation circuit, a telephone transmitter, a receiver, a signal, an impulse transmitter having impulse springs, a telephone line including two conductors, a signalling bridge including said signal and a capacity across said conductors during the signaling period, a second bridge across said conductors including said impulse springs, means for telephonically associating said receiver and said transmitter with said conductors, and means including a second capacity for reducing the potential across said impulse springs.

10. In a telephone substation circuit, a telephone transmitter, a receiver, a signal, an impulse transmitter having impulse springs, a telephone line including two conductors, a signaling bridge including said signal and a capacity across said conductors during the signaling period, a second bridge across said conductors including said impulse springs, means for telephonically associating said receiver and said transmitter with said conductors, means including a second capacity for reducing the potential across said impulse springs, and means for disabling said receiver during the operation of said impulse springs.

11. In a telephone substation net-work, a telephone transmitter, a receiver, a signal, an impulse transmitter having impulse springs, telephone conductors, a signaling bridge including said signal and a capacity across said conductors during the signaling period, a second bridge across said conductors including said impulse springs, means for telephonically associating said receiver and said transmitter with said conductors, and means including a second capacity for reducing the potential across said impulse springs.

12. In a telephone substation net-work, a telephone transmitter, a receiver, a signal, an impulse transmitter having impulse springs, telephone conductors, a signaling bridge including said signal and a capacity across said conductors during the signaling period, a second bridge across said conductors including said impulse springs, means for telephonically associating said receiver and said transmitter with said conductors, means including a second capacity for reducing the potential across said impulse springs, and means for disabling said receiver during the operating of said impulse springs.

In witness whereof, I hereunto subscribe my name this 11th day of July A. D. 1923.

WINFRED T. POWELL.