

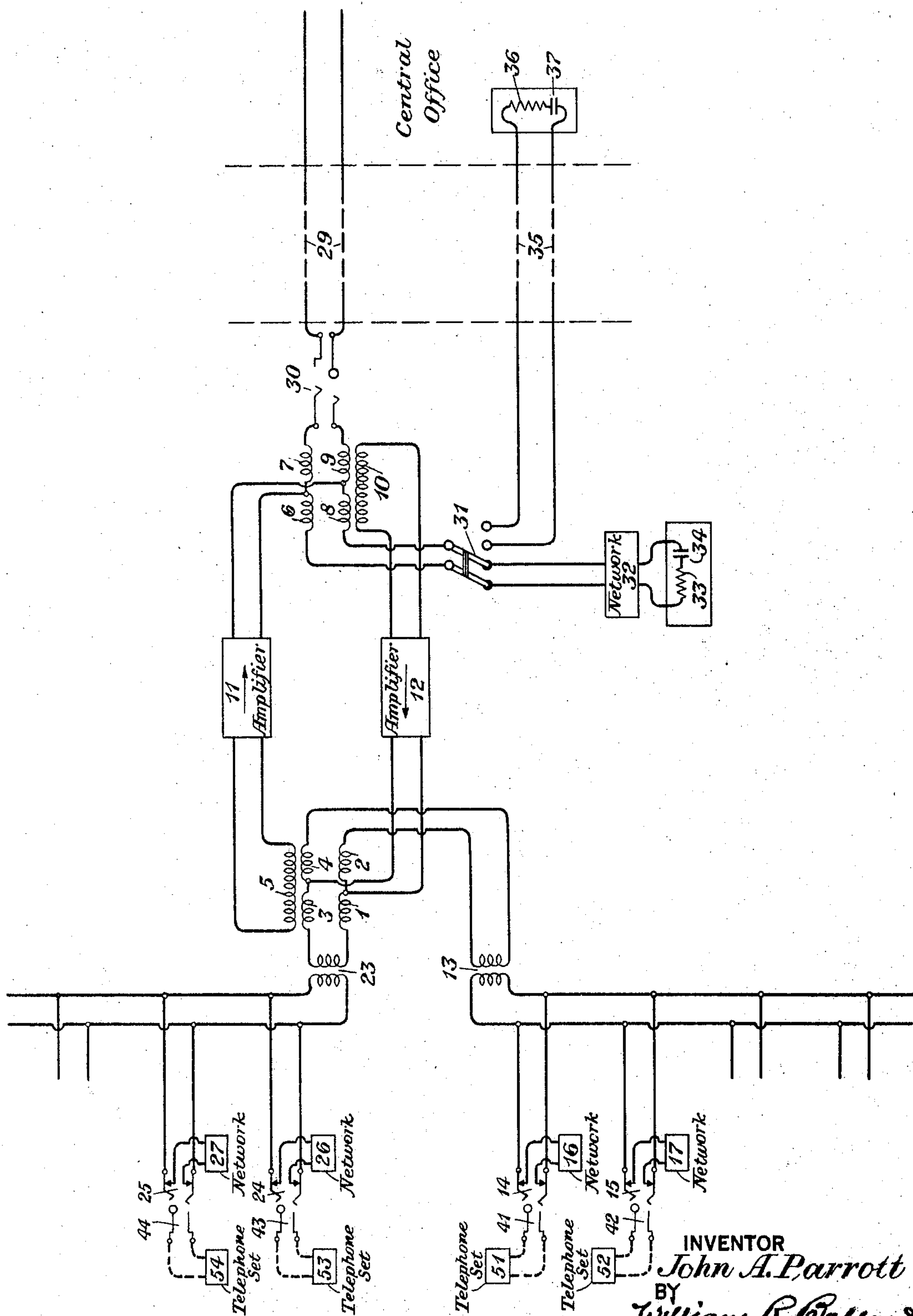
April 18, 1939.

J. A. PARROTT

2,154,579

TELEPHONE CONFERENCE CIRCUIT

Filed Nov. 20, 1937



INVENTOR
John A. Parrott
BY
William R. Ballard
ATTORNEY

UNITED STATES PATENT OFFICE

2,154,579

TELEPHONE CONFERENCE CIRCUIT

John Angell Parrott, Roslyn, N. Y., assignor to
American Telephone and Telegraph Company,
a corporation of New York

Application November 20, 1937, Serial No. 175,705

10 Claims. (Cl. 179—42)

This invention relates to telephones systems. More particularly, this invention relates to circuits for holding conferences between a plurality of parties. Still more particularly, this invention relates to private branch exchange telephone systems, otherwise known as P. B. X systems, and it relates to arrangements for increasing the number of parties which may be engaged in simultaneous conversation over such systems.

One of the objects of this invention is to increase the number of parties at a P. B. X system which can participate in a conversation or conference.

Another of the objects of this invention is to increase the number of parties to a telephone conference all of which are served by the P. B. X system and at the same time include at least one party to the conference who is not served from the P. B. X system.

This invention will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing showing one embodiment of the invention merely for the purpose or illustration.

In the drawing the reference characters 1, 2, 3, 4 and 5 represent a hybrid coil network and the reference characters 6, 7, 8, 9 and 10 represent a similar hybrid coil network, both of the networks being of well known type and construction. The coil 5 of one of the networks is connected to the terminals common to the equal coils 6 and 7 and 8 and 9 of the other hybrid coil network through a one-way amplifier 11. The coil 10 of the second hybrid coil network is connected to the terminals common to the equal coils 1 and 2 and 3 and 4 of the first-mentioned hybrid coil network through an oppositely directed one-way amplifier 12. These amplifiers 11 and 12 may be of any well known construction.

The terminals at the right of coils 2 and 4 are connected to a step-down transformer 13, the coil of fewer turns of which is connected to a plurality of jacks 14, 15, etc. of any well known type. Only two jacks 14 and 15 are shown at this point for illustration, but it will be clear that four or more jacks may be paralleled to the two just referred to. The terminals at the left of coils 1 and 3 are similarly connected to a step-down transformer 23, the coil of fewer turns of this transformer being connected to a plurality of jacks, two of which are shown merely for the purpose of illustration; although it will be obvious that four or more jacks may be added to the circuit and these would ordinarily be paralleled to jacks 24 and 25 in setting up the circuit of this invention.

The jacks 14, 15, 24, 25, etc. are bridged by fixed networks 16, 17, 26, 27, respectively, and these extend to a common bus. Each of these networks comprises an arrangement of elements of inductance, capacitance and resistance interconnected in such a way as to simulate the impedance of a telephone subscriber's average extension set and circuit. The various subscribers' telephone sets are designated 51, 52, 53, 54, etc. and they may be connected by plugs 41, 42, 43, 44, etc., respectively, to the jacks 14, 15, 24, 25, etc.

As any jack, such as 14, is connected by an appropriate cord circuit to an extension set, such as 51, the corresponding network, in this case network 16, will be disconnected from the circuit of transformer 13 upon the insertion of the plug 41 of the extension set circuit into the jack 14. In other words, either a subscriber's set or a network simulating its average impedance will always be connected to the system at any one of the various positions. Such an arrangement has for its object the maintenance of substantially constant impedance relationships at all times. The impedance conditions during varied operations will be maintained substantially constant whether the maximum number of telephone extensions are being used or not.

The terminals at the right of coils 7 and 9 extend to a jack 30. This jack is employed, as in ordinary P. B. X systems, for connecting the circuits shown in the drawing to a common circuit 29 which leads to a central office or other point. At the central office the modified P. B. X system may be switched either manually or automatically from one subscriber's line to another subscriber's line in any manner well known in the art. The trunk line circuit 29 extending from the central office to jack 30 may also be used for the transmission of ringing and other supervisory signals in any manner known to the art and this feature forms no part of this invention.

The terminals at the left of coils 6 and 8 may be connected by means of a switch 31 or permanently wired to either of two circuits. One of these circuits includes a network 32 simulating the impedance of the line 29 extending between the jack 30 and the central office and still another network 33—34 which is intended to simulate the circuit or circuits at the central office to which the arrangement shown in the drawing may be connected. The network 32 may include, for example, series resistive elements and shunt capacitive elements. The network 33—34 may comprise series resistive and capacitive elements as shown, convenient values of which may

be 600 ohms and 2 mf., respectively. The latter values are given merely by way of example and are therefore not to be considered as the only values suitable for these elements nor are they to be treated as limiting the invention in any way.

The other circuit to which the terminal at the left of windings 6 and 8 may be connected may include a cable pair 25 similar to the pair 29 connected to jack 30. The cable pair 25 may be terminated at the central office in a network 36—37 similar to the network 33—34. Either of the two circuits extending to switch 31 will balance the hybrid coil arrangement 6—7—8—9—10 against the circuit extending between jack 30 and the central office.

The circuit described hereinabove differs from the ordinary P. B. X circuit in several respects: (1) It includes amplifiers 11 and 12 which are not found in the ordinary P. B. X system. (2) One of the pairs of windings of the hybrid coil arrangement at the left, as for example, windings 2 and 4, are connected to a transformer 13 and to the telephone extension sets or equivalent networks connected to the transformer 13 instead of to an ordinary balancing network. (3) The other of the pairs of windings of the hybrid coil arrangement at the left is connected to a plurality of parallel extension telephones or equivalent networks through a step-down transformer 23 and not to but a single telephone extension. These are some of the departures of the arrangement of this invention from the prior art P. B. X system.

Telephone currents coming in from the central office over conductors 29 pass over the winding 10 to the amplifier 12. Here they are amplified and are then transmitted through the windings 1, 2, 3 and 4. At these windings the currents divide approximately equally, half of the currents flowing through transformer 13 to the various extension telephones connected to jacks 14, 15, etc., the remaining currents flowing through transformer 23 to the telephone extension sets connected to jacks 24, 25, etc.

Outgoing telephone currents pass over winding 5, through amplifier 11 to the points common to windings 6 and 7 and 8 and 9 and then over jack 30 and over the cable pair 29 extending to the central office. These currents are then transmitted to the subscriber's set to which the central office circuit is switched.

The arrangement described will readily permit twelve (or more) P. B. X extension telephones to be connected simultaneously in parallel arrangement to a subscriber's telephone set (or sets) reached over a trunk connection from jack 30. These circuits are then suitable for a telephone conference between all of these various parties. The grade of transmission for the twelve (or more) parties with the circuit described will be commercially satisfactory, but the transmission can be improved with better balance between the two sides of each hybrid coil network. This arrangement represents a substantial improvement over former circuits which provided satisfactory communication between only two stations and permitted transmission though of poorer grade when a third party was added.

The amplifiers 11 and 12 are inserted into the circuit for the purpose of compensating for the loss introduced by the numerous bridged extension telephones. With the arrangement illustrated and described, it will be observed that the low side of each of the transformers 13 and

23 is connected to a group of the telephone extension circuits. The transformers 13 and 23 act to reduce and practically eliminate reflection losses between the amplifiers and the buses to which the extension stations are connected.

The various extension telephone sets 51, 52, 53, 54, etc., and the lines connecting these sets to the buses would ordinarily be of the same design and manufacture. However, if these sets differ appreciably from each other or if lines vary considerably in length or in other properties, these deviations may be compensated by appropriate changes in the elements of the networks 16, 17, 26, 27, etc., and by suitable traffic operating practices to assure connection of each type extension to the proper jack.

In the arrangement illustrated in the drawing, it is desirable that equal numbers of extension telephone sets, or their equivalent networks, be connected to the two bus-bars. Obviously, the latter may be accomplished by other means than described hereinabove. For example, instead of the jacks and associated networks shown in the drawing, the bus connected to transformer 23 might be bridged by jacks so arranged that when plugged into, contacts would close, which connect an appropriate network to the bus associated with transformer 13. This might be employed for all of the jacks or for only those jacks to be used for special extension circuits which, for example, are appreciably longer than the average or have different transmission characteristics.

The hybrid coil transformers are illustrated as of the three-winding type. It will be clear that such transformers are not indispensable in carrying out the principles of this invention. Obviously any other hybrid arrangement having equivalent properties may be inserted into the system in place of the three-winding transformers shown.

It will be understood that the two one-way amplifiers illustrated may of course be replaced by any two-way amplifier well known in the art. If desired, the amplifier may be of a type such that when amplification of telephonic or other currents flowing in one direction is taking place, the flow of currents in the opposite direction will be suppressed or prevented.

While this invention has been shown and described in certain particular arrangements merely for the purpose of illustration, it will be obvious that the invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. The combination of two groups of parallel-connected telephone sets, first and second three-winding transformers, two of the windings of the first transformer interconnecting the two groups of sets, a one-way amplifier connecting the third winding of the transformer to the midpoints of two of the windings of the second transformer, a second oppositely directed one-way amplifier connecting the third winding of the second transformer to the midpoints of said two windings of the first transformer, a trunk circuit connected to said two windings of the second transformer, and a network connected to said two windings of said second transformer to balance the trunk circuit.

2. The combination of two groups of telephone extension sets, the sets of each group being connected in parallel relationship, a hybrid

coil network formed of three mutually coupled windings, two transformers each having one of its windings connected to a common pair of the windings of the hybrid coil network, the remaining winding of each transformer being connected to one of the groups of extension sets, a remote telephone set, said remote telephone set being connected to the midpoints of the common pair of windings of the hybrid coil network for transmitting telephone currents simultaneously to all of the extension sets, said remote telephone set being connected to the third winding of the hybrid coil network for receiving telephone currents simultaneously from all of said extension sets.

3. A system for providing a conference circuit between a plurality of telephone extension circuits with one or more remote telephone circuits, comprising a plurality of networks, each simulating a telephone extension circuit, means for paralleling all of said extension circuits or their corresponding simulating networks into two groups, two hybrid coil transformers, the two groups of extension circuits being connected to one of said hybrid coil transformers to balance each other, a trunk circuit to which any one of the remote telephone circuits may be connected, a network simulating the trunk circuit, said latter network and said trunk circuit being connected to the other of said hybrid coil transformers to balance each other, and amplifying means coupling the two hybrid coil transformers.

4. The combination of two transformers, two one-way oppositely directed amplifiers interconnecting said transformers, two groups of parallel connected telephone circuits connected to one of the transformers so that the groups of telephone circuits will balance each other, and a telephone line connected to the other transformer, thereby permitting simultaneous two-way communication with good quality over said telephone line and over all of the telephone circuits.

5. A telephone conference circuit comprising two groups of parallel connected telephone circuits, a telephone line, means for coupling said line to all of said telephone circuits, said means including two transformers, one of said transformers interconnecting the two groups of tele-

phone circuits in balanced relation, an amplifier coupling both transformers, the other of said transformers coupling the telephone line to the amplifier.

6. The combination of claim 5 characterized by the addition of a plurality of networks each corresponding to one of the telephone circuits, and means for connecting each of said networks to the parallel circuit with which it is associated upon the disconnection therefrom of the corresponding telephone circuits.

7. In a telephone conference system, the combination of two substantially equal groups of telephone subscribers' circuits, a transformer coupling said two groups of circuits, a trunk circuit, and means including a two-way amplifier for coupling the trunk circuit with the transformer.

8. A telephone conference system having, in combination, a plurality of groups of two-way telephone subscribers' circuits, means including a transformer for coupling all of said circuits to each other, a main circuit over which telephone currents may flow in opposite directions, and means including an amplifier for coupling said main circuit with said transformer coupling means, telephone currents flowing over the main circuit being amplified by said amplifier before being received by said subscribers' circuits, telephone currents flowing in said subscribers' circuits being amplified by said amplifier before being transmitted over said main circuit.

9. The combination set forth in claim 8 including, in addition, a plurality of networks each simulating one of said subscribers' circuits, and means responsive to the removal of any of said subscribers' circuits for substituting the corresponding network therefor.

10. A telephone conference system comprising a hybrid network, two bus-bars, two groups of telephone sets, each group of said telephone sets being connected to one of said bus-bars, two two-winding transformers connected respectively between said bus-bars and said hybrid network, a remote telephone line and a two-way repeater coupled between said hybrid network and said remote telephone line, said two winding transformers reducing the reflection losses between said repeaters and said bus-bars.

JOHN A. PARROTT.