(No Model.)

J. S. STONE.

TELEPHONE CIRCUIT.

No. 507,568. Patented Oct. 31, 1893.

Fig. 1.

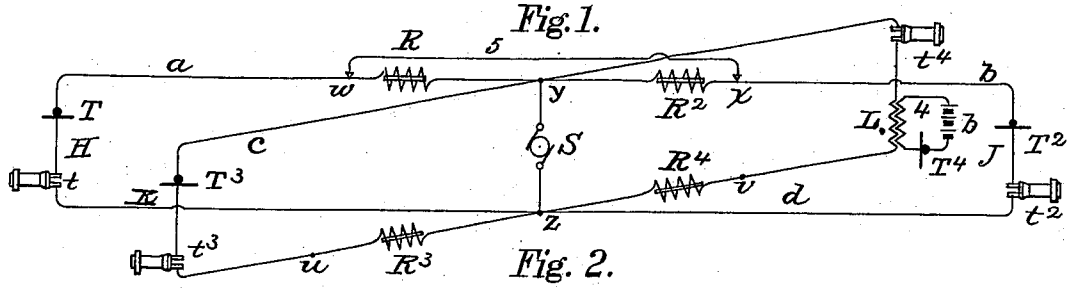


Fig. 2.

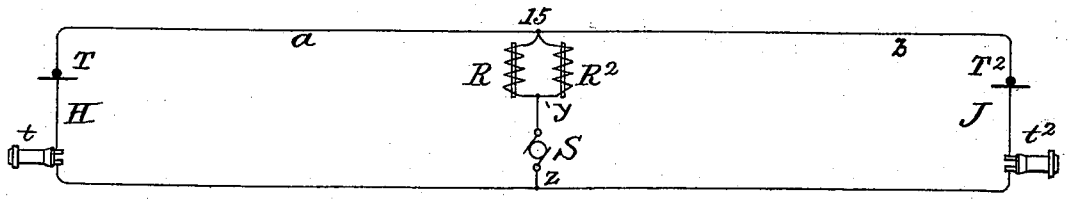


Fig. 3.

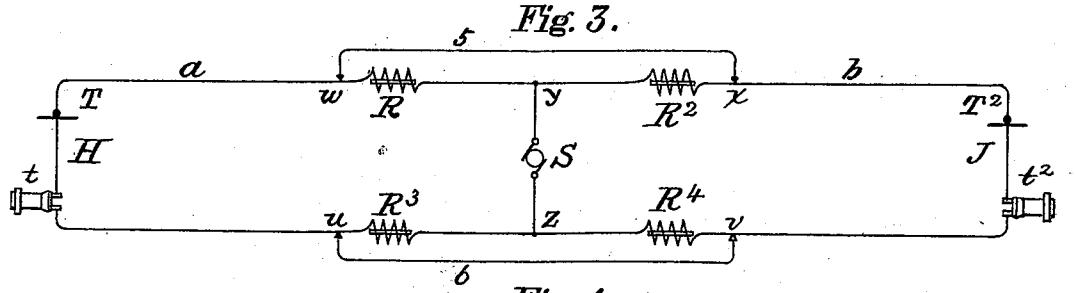
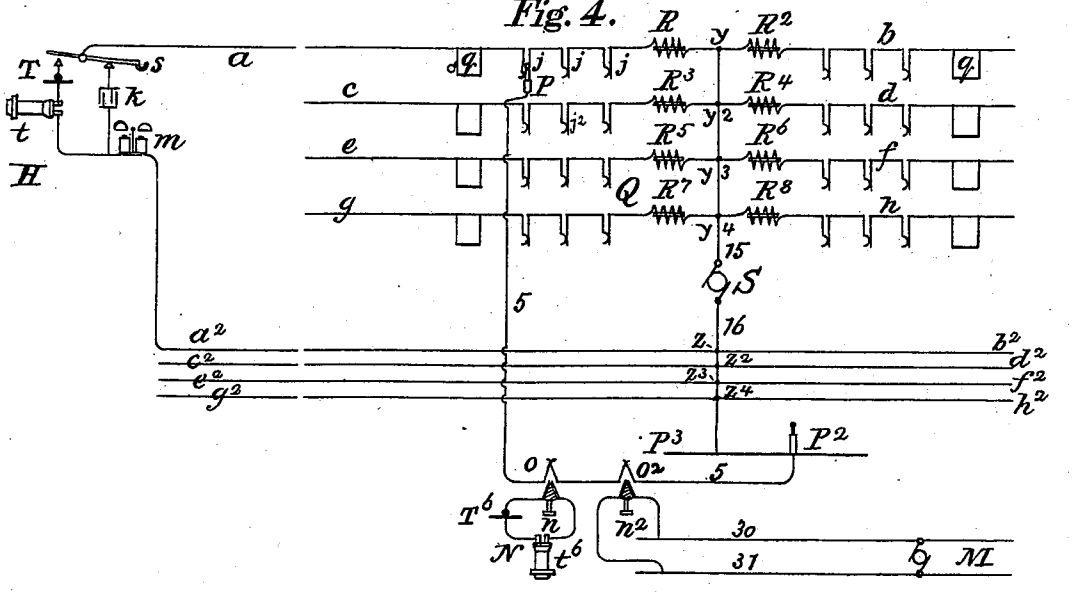


Fig. 4.



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JOHN S. STONE, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE AMERICAN BELL TELEPHONE COMPANY, OF SAME PLACE.

TELEPHONE-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 507,568, dated October 31, 1893.

Application filed January 31, 1893. Serial No. 460,334. (No model.)

To all whom it may concern:

Be it known that I, JOHN S. STONE, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Telephone-Circuits, of which the following is a specification.

My present invention relates to centralized systems of current supply for telephone transmitters in which either voltaic primary or secondary batteries, dynamo electric machines, or other current generators such for example as thermo-piles may be employed.

Heretofore when it has been attempted to use a single source of supply for a number of telephone circuits, the practice has been to so arrange the said source and its connections that when used by any circuit, or by any two circuits united for conversation, it has been directly included in such simple or compound circuit; or else to connect the said source of supply in a section of conductor common to the several circuits, whereby it is enabled to develop in each an independent current, adapted to be varied by the operation of the transmitters of such circuit; and to associate with any two circuits, when united for reciprocal communication, an induction coil having its helices included respectively in the two circuits concerned, whereby the current variations set up during, and in consequence of the operation of the transmitters of either circuit are propagated inductively in the other circuit of the united pair. In either case, since it often happens that a number of circuits are in operation and consequently closed through the source, at the same time, it has been found necessary in order to avoid interference between any two circuits or pairs of circuits which are in simultaneous operation, to provide a source of supply having a very low internal resistance; and generally to provide that the resistance of such portions of the conductors leading from the said source, as are included between the points of division on either side shall also be kept as low as possible. My present invention however comprises an organization of circuits and included resistance or impedence appliances, in which this condition ceases to be indispensable, which organization is well adapted to the central station form of exchange as well as others.

By my invention all stations are enabled to utilize a single source of electrical energy—either a dynamo or other generator, but preferably a dynamo machine placed in any convenient location.

The invention may be carried out in two ways, the underlying principles of which are respectively:—first, the use of a common current generator in series with relatively high resistances or impedences, and in parallel with a plurality of telephone transmitter and receiver circuits for the purposes of intercommunication; and, second, the use of a common current generator in series with several relatively high electromagnetic or inductive resistances or impedences, each located in a circuit with telephones, so that any two or more of said telephones may be placed in communication with each other, by paralleling their respective impedence or retardation appliances, the other receiving telephones remaining unaffected.

I have in a separate application for Letters Patent, filed contemporaneously herewith, described arrangements of apparatus and circuits based upon the first of these plans; and my present invention concerns itself mainly with the second.

In the drawings which illustrate and form a part of this specification, Figure 1 is a diagram exemplifying generally the said second arrangement of apparatus and circuits which constitutes the characteristic feature of the invention described herein. Fig. 2 is in substance the same arrangement of connections differently delineated; being in fact a paraphrase of Fig. 1. Fig. 3 is a diagram representing a modification of the plan illustrated by Figs. 1 and 2. Fig. 4 indicates the practical application of the principles illustrated in the foregoing diagrams to an exchange system employing as a source of transmitter current a dynamo common to a number of circuits of the plan of circuits arrangement outlined in Figs. 1, 2 and 3.

In Fig. 1, four variable resistance telephone transmitters T, T^2, T^3, and T^4 and telephone receivers t, t^2, t^3 and t^4 are connected with cir-

cuits *a b c* and *d* and located at stations H, J, K and L respectively. The transmitter T^4 of circuit *d*, is connected through the intermediation of an induction coil and local circuit, and is a departure from the special features of this invention. It is so shown, merely to indicate that the ordinary arrangement of transmitters can readily be associated with my new plans of construction, and operated in connection with other circuits arranged on the plan described in this specification. That such association can easily be arranged is of great advantage, since it not infrequently happens that some particular circuit by reason of its non-uniform length or resistance, or from other special conditions, is not well adapted to work with the other circuits on the principles especially described in this specification; in which event it can be arranged in the ordinary way, as shown, and its transmitter will operate the distant receiver by throwing upon the compound circuit through its induction coil, voice currents which vary the normal current of the line and to which the said distant receiver will respond.

R, R^2, R^3, R^4 are impedences offering a relatively high apparent resistance normally connected in the circuits *a b c* and *d* respectively.

S is a common current generator in a section of circuits connecting at *y* and *z* with any number of circuits; and 5 is a conductor whereby when desired, a point *w* on circuit *a*, external to the impedence R may be directly united to a similarly located point *x* on circuit *b*, whereby the high resistance of both of the said circuits may be shunted or short circuited, so far as its special connection with the circuit is concerned. By connecting the conductor as shown, and by thus short circuiting across from *w* to *x* stations H and J are enabled to satisfactorily communicate with each other, while the receivers at K and L remain unaffected. If now the points *u* and *v* on circuits *c* and *d* be similarly united stations K and L are also enabled to communicate without interfering with H and J. The impedences are preferably electro-magnetic, or self-induction coils.

In Fig. 2, but two of the circuits *a* and *b* of Fig. 1 are shown, and the diagram indicates in another way the connection closed round the impedences R and R^2. Their parallel arrangement is thus more clearly brought out, the two circuits being shown as joined at the point 15, and the two impedences as being joined in parallel or multiple arc between the said point 15 and one pole of the generator S. A compound telephone circuit is thus formed, having a bridged source of transmitter current, and two impedences in parallel included also in said bridge. To obtain the best results from a system embodying these features, the following conditions should be observed: first, that the actual or dissipative resistance of each of the several resistance or impedence coils shall be substantially the same; second, that the individual resistance or impedence of the several electromagnetic or other coils R shall be large compared to the total resistance or impedence of any of the circuits (including the apparatus) with which they may be connected; and third, that the apparent resistance or impedence of the transmitters and receivers and their respective circuits shall be approximately equal.

It is evident that the impedences may be placed at either pole of the current generator, or that, if desired, they may, as in Fig. 3 be placed at both poles thereof.

Fig. 4 is a diagram exemplifying the hereinbefore described principles in a central office telephone exchange. Since I contemplate the use of a dynamo machine as a current supply generator, I term the system a "dynamo-exchange-system." In the diagram *a* a^2, *b* b^2, *c* c^2, *d* d^2, *e* e^2, *f* f^2, *g* g^2, and *h* h^2 are respectively the direct and return conductors of a group of metallic telephone circuits extending to substations. One of the circuits only, *a*, and its substation H is fully delineated, the central station ends only of the others being shown. The substations may be arranged as in the "common battery exchange," now in practical operation; an automatic switch *s* controlled as usual by the removal and replacement of the telephone *t* normally uniting the two circuit conductors through a condenser *k* and call bell *m;* but uniting them when the receiver is removed and the line is being used for conversation through the transmitting and receiving telephones T and *t*. The earth, if desired may serve as the common return conductor. Each circuit may be provided at the central station Q with a signal indicator *q* of any preferred construction adapted to respond and to give the call when the switch *s* changes its position and connections on the removal or replacement of the telephone *t*. The conductors *a b c d e f g* and *h* of the several circuits, are each connected at the points *y* y^2 y^3 and y^4 with one pole conductor 15 of a dynamo electric generator S after branching to any number of springjacks or plug sockets *j*, and after passing through the impedence coil R or R^2, &c. The return conductors a^2 b^2 c^2, &c., are united directly with the other pole conductor 16 of the said generator at the points *z* z^2 z^3 and z^4. By this mode of connection, the generator S is enabled to provide currents for signaling from the substations, as well as for the several substation transmitters; but the calling current does not normally circulate in the circuits, because the presence of the condensers *k* maintains the said line conductively discontinuous. A link connection conductor 5, in practice a flexible conductor having plug terminals P and P^2, is employed to connect any two circuits for talking by establishing a short circuit round their respective resistances R; which can be done by inserting the said terminal plugs in plug sockets of the two lines respectively.

P^3 is a conducting base-plate in electrical

connection with the dynamo pole 16, and on it the plugs normally rest the conductor 5 being thereby in normal contact with the said plate; the plugs may be provided with a heel conductor connecting with the said link conductor 5 for this purpose in a manner well understood. The link connection 5 includes separable contacts o o^2, operated in connection with a telephone loop key n and a ringing-key n^2 by means of which the central station operator can listen in, or send outgoing calls at pleasure. The telephone key n when depressed, connects the telephone loop N including the operators transmitting and receiving telephones T^6 and t^6 with the link connection, and calls can thus be answered, and complete connections supervised. The ringing key n^2 when depressed, acts to connect with the said link connection 5, the terminals 30 and 31 of a call generator M for sending outgoing calls. Any number of connection cords 5 may of course be used as required.

The entire operation of effectuating a connection may now briefly be summarized as follows: When a substation operator wishes to signal the central station, he removes his telephone from its support, and thereby operates the visible signal of that circuit. The operator at whose section of the switchboard the calls of the special circuit are answered then takes up the left hand plug P of a cord 5, and inserts it in the jack j of the circuit which signaled. The central station operator by depressing the loop key n brings his telephones into the circuit, and the sub- and central station operators are thus enabled to communicate. In order to unite or interconnect the calling and the called lines, the remaining plug P^2 is now inserted into a jack of the circuit wanted; a busy test (the board being of the multiple type) being first made. A convenient busy test is incidental to the connection of any two lines for if the line called be busy, no click in the central office telephone will be heard on touching its jack-frame with the tip of the right hand plug whereas if the said line is at liberty a click will occur and be observed. If the line called be busy its jackframe connection will be broken by the presence of a plug in one of the spring jacks; consequently on touching the tip of the plug P^2 no circuit will be completed. If on the other hand the line is in its normal unemployed condition the touching of the tip of plug P^2 say to the jack-frame of a spring jack j^2 of the circuit c will close a circuit from the jack frame by incoming line c, impedence R^3, point y^2, conductor 15, generator S, point Z, return conductor a^2 to station H, direct conductor a, jack j, plug P conductor 5, operator's telephone t^6 (key n being depressed) and continuing by conductor 5 to the tip of plug P^2. The connection being made, the call can now be sent by depressing the ringing key n^2, which action loops the generator into the circuit.

The system is well adapted for either grounded or metallic circuits, and is practically arranged the same for both.

In actual trials made with circuits and apparatus as described above, good results were reached in the employment of a western electric three hundred watt, six volt continuous current generator, having thirty eight commutator bars, and a normal speed of twenty four hundred revolutions per minute.

I claim—

1. In a system of telephonic circuits and apparatus, the combination of a common current generator; two telephone circuits connected in parallel therewith, and each including a telephone receiver, and a telephone transmitter supplied with current thereby; a relatively high apparent resistance or impedence device in series in each of the said circuits; and means for establishing a short circuit between like points on the said two circuits outside of their respective resistance or impedence devices; whereby is constituted a compound telephone circuit having a source of transmitter current in a bridge between its direct and return conductor; and two impedence devices in parallel also included in said bridge, substantially as described.

2. The combination of a telephone circuit extending between two stations and containing at each a variable resistance transmitter and a receiving telephone; a branch or bridge uniting the direct and return conductors of the said circuit at some intermediate point between the two stations thereof; a transmitter current supplying generator included in said bridge; and two electromagnetic resistance or impedence coils also included in said bridge in multiple arc with each other, and in series with said generator substantially as described.

3. The combination substantially as hereinbefore described, of a common current generator; a number of telephone circuits containing each a transmitting and a receiving telephone extending from substations to said generator, and connected in parallelism with one another to the poles thereof; a relatively high apparent resistance or self-induction device included in each of the said circuits; and link connection or short circuiting devices adapted to electrically unite points on any two of said circuits situated external to their respective resistance or self-induction devices; whereby the said devices of the said two circuits may be placed simultaneously in parallel circuit with each other and in series with the generator for the purposes specified.

4. In a system of telephonic circuits and apparatus the combination of a number of telephone circuits, each including a variable resistance transmitter and a receiver; a transmitter current generator common to and connected in parallel with all of the said circuits; an electromagnetic or self induction device normally included in each circuit and having an apparent resistance or impedence high

relatively to the total resistance or impedence of any of the said circuits; and link or paralleling connection devices adapted to unite any two circuits at points outside of or beyond their respective self induction devices and simultaneously to establish a bridge between their direct and return conductors; to place said self induction devices in parallelism with each other, and in series with the generator in the circuit of said bridge, substantially as described.

5. In a telephone circuit switching system the combination of a series of telephone circuits extending between sub-stations and a central station; and a dynamo machine serving as a common current supply generator therefor included in a section of conductor common to all of the said circuits; with a connection device such as a plug socket or springjack for each circuit; a relatively high self-induction or electromagnetic resistance for each line located between the said plug socket and the dynamo connection thereof; and connection conductors provided with terminal plugs adapted for insertion into the plug sockets of any two lines respectively, and thereby to constitute a compound telephone circuit, having the said dynamo in a bridge thereof, and having the said electromagnetic resistance of both lines also in the same bridge in series with the said dynamo and in parallel with each other, substantially as described

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 18th day of January, 1893.

JOHN S. STONE.

Witnesses:
GEO. WILLIS PIERCE,
FRANK C. LOCKWOOD.