(No Model.)

2 Sheets—Sheet 1.

J. S. STONE.

TELEPHONE CIRCUIT.

No. 508,255. Patented Nov. 7, 1893.

Fig. 1.

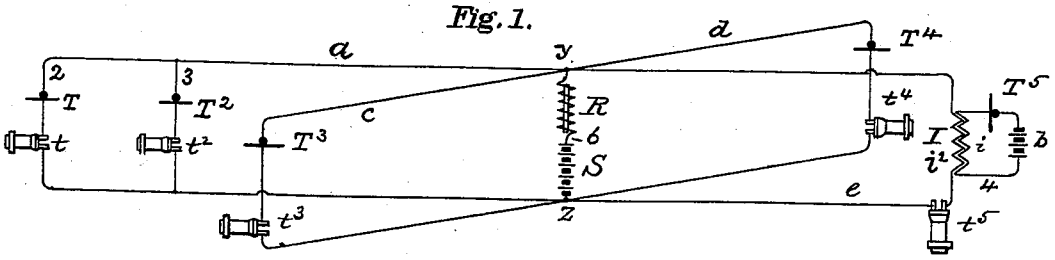


Fig. 2.

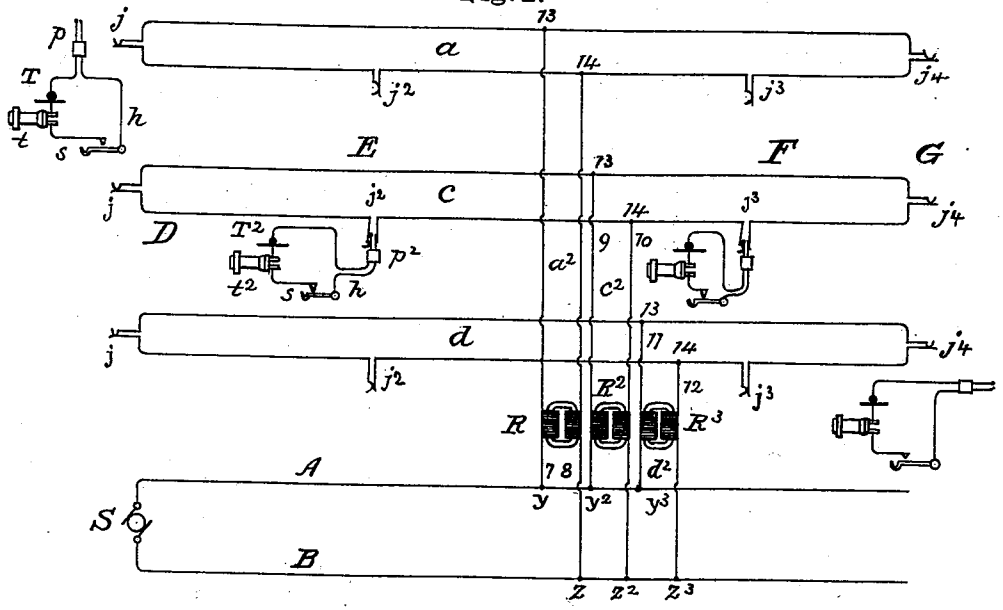
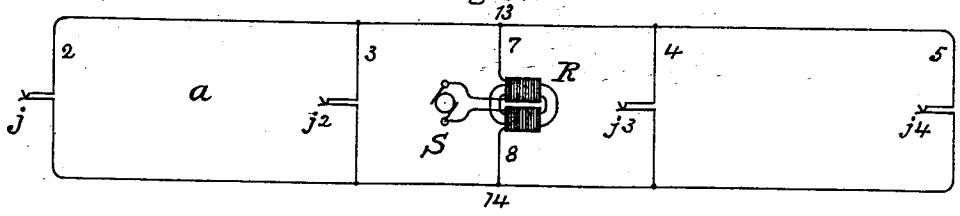


Fig. 3.



Attest.

Victor M. Berthold

Geo. Willis Pierce

Inventor.

J. S. Stone

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

J. S. STONE.

TELEPHONE CIRCUIT.

No. 508,255. Patented Nov. 7, 1893.

Fig. 4.

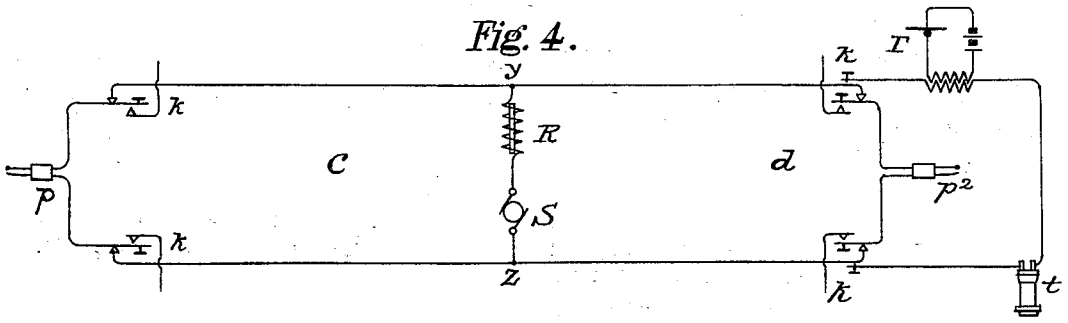


Fig. 5.

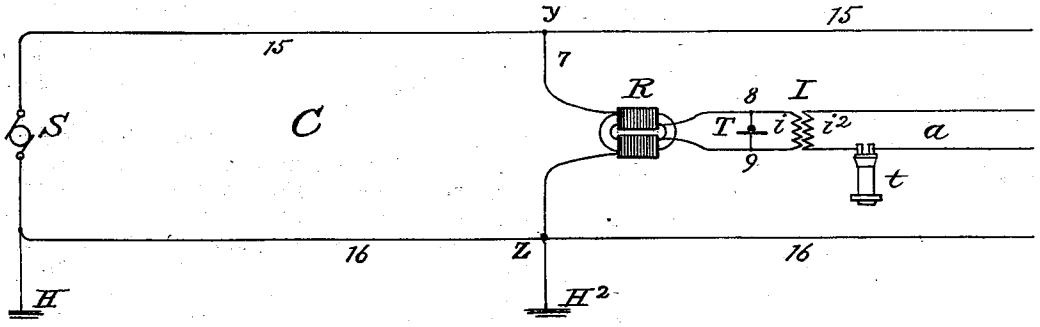
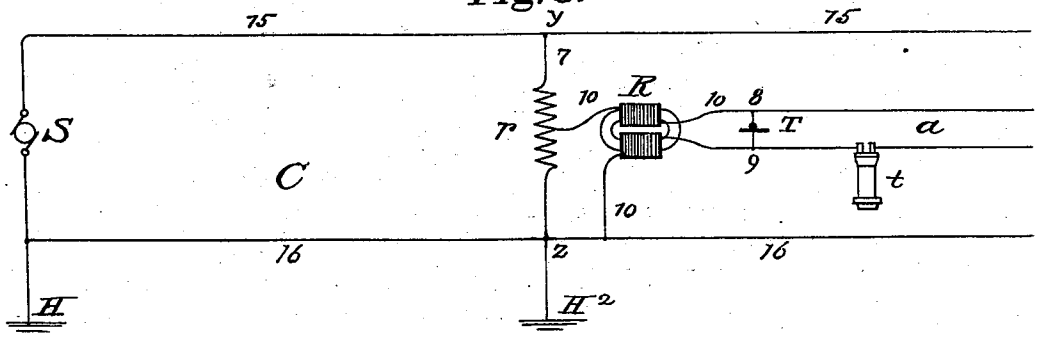


Fig. 6.



Attest.
Joseph A. Gately
Geo. Willis Pierce

Inventor.
John S. Stone

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

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. 508,255, dated November 7, 1893.

Application filed January 31, 1893. Serial No. 460,333. (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 primary or secondary voltaic 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 usual practice has been to so arrange the said source and its connections that when used by any circuit, or by any two circuits connected for conversation the generator 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 also 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. It has also been proposed heretofore to connect two telephone circuits arranged for conversation with a common branch containing a battery, and to interpose between the battery and the connected telephone circuits a high resistance. A system of this character is described in Letters-Patent No. 346,708, granted August 3, 1886, to C. A. Bell. In this case the resistance employed must be so high that the greater part of the electrical disturbances caused by the transmitter are confined to the telephone circuit; and since the presence of the resistance in the common branch proportionately diminishes the totality of current supplied to the telephone circuit, it becomes necessary to use a much larger battery than would otherwise be necessary. In a system of this character it is of course necessary to employ a battery as the current generator, and for the reason just given the operation of the system involves a very considerable waste of power. My present invention however comprises an organization of circuits and included impedence appliances, in which this condition ceases to be indispensable; which organization while capable of being readily adapted to the central office plan of telephone exchange, as well as others, lends itself with special facility to factory or hotel systems by which I mean systems in which a number of stations can establish and hold communication with one another without the aid of a central station apparatus and operator. For a system of this kind my invention is particularly useful, as it enables all stations to utilize a single source of electrical energy, either a battery or other generator, placed wherever most convenient.

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 impedences, and in parallel with a plurality of telephone transmitter and receiver circuits for the purpose of inter-communication; and second, the use of a common current generator in series with several relatively high 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 resistance or retardation appliances, the other receiving telephones remaining unaffected.

My present invention concerns chiefly the first of the above plans; and the consideration of the second is reserved for a separate

application for patent, filed contemporaneously herewith.

In the arrangement of the circuits my system bears a certain resemblance to that described in Letters-Patent No. 346,708, above referred to; but the underlying principles of operation of the two systems are essentially different. I employ electro-magnetic inertia, not to render the current in the telephone circuits practically constant (which is the office of the high resistance) but to steady it against the rapid vibrations of the telephone circuits. It follows, that in my system, it is possible to use effectively a dynamo or magneto-electric generator as a source of current, and also that, where a battery is employed, a much smaller number of cells will suffice to supply the telephone lines.

In the drawings which illustrate and form a part of this specification, Figure 1 is a diagram exemplifying generally the said first plan of arrangement. Figs. 2 and 3 are diagrams showing the practical application of the principles outlined by Fig. 1, to factory or hotel systems. Fig. 4 shows an application of the same arrangement to a common battery exchange system. Fig. 5 is a diagram indicating the use of a low potential light or power circuit as a source of transmitter current, and Fig. 6 is a diagram showing the similar use of a high potential lighting circuit for the same purpose.

In Fig. 1, S is a current generator common to the several circuits *a c d* and *e*, each of which may be closed through one, two or more branches; the branches 2 and 3 of circuit *a* being an example of such subdivision. In the branches 2 and 3 of circuit *a* and in the other circuits at any desired point, are telephone transmitters T, T^2, T^3, T^4, T^5, and their receivers *t*, t^2, t^3, t^4, and t^5 which may be of any ordinary and well known type.

R is a relatively high impedence appliance in series with the said generator, and in the present instance located between the points of divergence *y z* of the external circuits. An impedence appliance or retardation coil is employed, since by its use an equivalent effect can in any case be exercised with a much less amount of real or actual resistance than otherwise would be required, and since therefore a much less amount of energy is wasted in overcoming resistance. If a battery is the source of current, and satisfactory results have been obtained heretofore by means of a resistance when a battery is employed as the source of current, and when the system has but two circuits; but if a dynamo be employed as the common current generator and if the system is composed of more than two circuits, an electro magnetic resistance or impedence becomes necessary.

It is evident that, in the arrangement represented in this diagram, the common current generator S is in series with the impedence R, and in parallel with the several telephone circuits and branches *a c d e* and the branches 2, 3, &c. This impedence placed, as described, in series with the generator before the several circuits branch therefrom, determines for any two working circuits that the major portion of the drop in potential shall be in or close to the said generator, and provides that a substantially stable current shall be delivered to the said two circuits, which current undergoes during operation a constant change in its distribution. The impedence R may be placed actually within the current generator itself or on either or both sides thereof.

The most advantageous conditions for the operation of this system are: (*a*) when the impedences of the instruments the transmitting and receiving telephones and line conductors of the several circuits composing the system are approximately equal; (*b*) when the impedence of the common generator circuit is high compared to the total resistance or impedence of each of the individual lines, and their respective transmitters and receivers.

In operation the current from the generator S delivered at the points *y* and *z*, divides itself between the several circuits according to the well established law of derived circuits, so that substantially like currents flow through the several circuits. Now when conversation is being exchanged between any two stations on different circuits, or different parallel branch circuits, the rise and fall of resistance in the sending circuit, consequent upon the operation of its transmitter will cause a corresponding rise and fall of current in the receiving circuit, the flux in the receiving circuit being determined by the rise of resistance in the sending circuit; and the ebb in the receiving circuit, by the fall of resistance in the sending circuit. That is to say: each of the two circuits in communication is a shunt of the other with respect to the generator and its resistance; and therefore as the resistance of that one which at any moment is the transmitting circuit is varied by the operation of its transmitter, the current of that one which at the same moment is the receiving circuit is correspondingly varied; the said circuit having diverted to it a greater than its normal proportion of the total current on the rise, and receiving a less than its normal share on the fall of resistance in the transmitting circuit. Such a variation of current in the receiving circuit will of course affect and operate the receiving telephone included therein, which thus is enabled to reproduce the original sounds which through the agency of the transmitter disturbed the normal resistance of the transmitting circuit. When the receiving circuit in turn becomes a transmitting circuit, the operation is, of course, reversed. The entire operation consists in fact in causing by means of a suitable transmitting instrument variations of resistance in one of two telephone circuits connected in parallelism with one another, and with a current generator having

or being associated serially with a relatively high impedence, and in virtue thereof enabling the said resistance variations to determine corresponding variations of current of very considerable magnitude in the other of the said two circuits, and thereby to actuate a suitable receiving instrument included in the said other circuit. It will be observed that this method of operation is directly opposed to former methods, in which the object has uniformly been by keeping the internal resistance of the common generator as low as possible, to prevent the variations of resistance in one circuit from varying the current in others; and in which instead of balancing any two parallel circuits against one another and providing that an increased resistance in either shall determine an increase of current in the other; and that a decreased resistance in either shall determine a decreased current in the other it has been usual to transfer the variations of either to the other by induction coils, or else by serially uniting the two circuits concerned and their current generator.

The generator S may be common to a large number of circuits.

The transmitter T^5 of circuit *e* is shown as being included together with the primary helix *i* of an induction coil I in the circuit 4 of a local battery *b*, and as being adapted thereby to act upon the main circuit *e* inductively, through the secondary helix i^2 of the coil, which is included therein. This is merely to show that circuits having the old and ordinary transmitter connections are readily associated with other circuits of the system worked upon the plans described herein. That such association can be easily attained is highly advantageous since it sometimes happens that a particular circuit by reason of greatly differing length or resistance or from other conditions, is not conveniently adapted to work with apparatus connected as described herein in which case it can be arranged in the ordinary way, and its transmitter will operate by throwing upon the compound circuit through its induction coil voice currents which vary the normal current of the line and to which the distant receiver will respond.

In Fig. 2 the mode of applying the invention to a factory or hotel system is shown. S is the common generator shown as being a magneto electric or dynamo electric machine. A and B are two main conductors therefor, and *a c* and *d* are independent talking circuits extending between all stations D E F G and provided at each with springjacks or plugsockets *j* serially connected so that any two stations can introduce their respective apparatus into any desired circuit and communicate reciprocally. At each of the stations the telephone apparatus may for this purpose be arranged in a loop *h* having a terminal loop plug *p* adapted to be inserted in the jacks *j* and thereby to connect the transmitting and receiving telephones T and *t* to the desired circuit; the telephone when not in use may be hung on the hookswitch *s*. Button switches may of course be substituted if desired for the plug and spring jack switches shown.

Each of the telephone circuits *a c* and *d* are permanently connected by paired conductors to the current generator mains. Circuit *a* for example is connected with the said mains by the conductors 7 and 8 of the double conductor parallel connection a^2; circuit *c* by the two wires 9 and 10 of c^2; and circuit *d* by the wires 11 and 12 of d^2.

R R^2 and R^3 are retardation coils or impedences of sufficient apparent resistance to fully individualize the respective circuits.

In operation each station would be furnished with some suitable alarm or call and when called would respond on some given circuit; let us suppose *c*.

Assuming that the operator at station F has answered on *c* by inserting his plug *p* into his jack on that circuit the operator at the calling station say E also loops his apparatus into the same circuit, and converse. Moreover while two stations are communicating on one circuit, two or more other stations may in like manner be in operation on a second circuit and a third set on a third, there being no interference between the several circuits by reason of the determining impedences R, R^2 and R^3; the operation of each compound circuit consisting in the variation and redistribution of such portion of the total current as is normally in virtue of the presence of the retardation coils R assigned thereto.

In the above system, wherein the several circuits have jacks or plug sockets in series, the station apparatus when connected being also in series, the contacts of the jacks or switches *j* must necessarily be closed. But the several circuits may, as shown, in Fig. 3 have their plugsockets or springjacks *j* j^2 j^3 j^4 included in bridges or cross branches 2 3 4 5 and in that case the contacts of the said jacks or switches are normally separated.

In Fig. 3, S as usual is the generator and R the impedence. Two stations to communicate with each other have only to switch or plug into the same circuit. For a calling system any of the usual methods and apparatus may be employed.

In Figs. 5 and 6 the same principles are shown as being applied to telephone circuits of any kind or arrangement; and the source of transmitter current S, is the regular generator of a light or power circuit C.

Referring to Fig. 5, C is the regular lighting circuit and 15 and 16 the main conductors thereof. The circuit is grounded at H at the generating station. From the point *y* on conductor 15 a conductor 7 leads through a retardation coil or electromagnetic resistance R and through the primary helix *i* of an ordinary transmitter induction coil I to earth at H^2; it may also connect at *z* with the other

main 16. The telephone t and secondary helix i^2 of the induction coil I are in series in the telephone circuit a; and the current varying transmitter T connects the points 8 and 9, shunting the primary helix and varying the amount of current which is allowed to circulate through the said primary helix for the operation of the telephone circuit. Any number of telephone circuits may in this way be connected with a lighting or power supply circuit.

The above refers to connections used with low potential circuits. If the light or power circuit be a high potential circuit, (see Fig. 6,) the supply branch 7 is led from the point y on main conductor 15 through a high resistance r to the point z on the return conductor 16, and also to earth at H^2. From any suitable point, on the said resistance a conductor 10 leads through a suitable impedence R and through the telephone circuit to be supplied to the return main 16. The transmitter T is bridged between points 8 and 9 on opposite sides of the telephone circuit, external to the impedence R.

In a common battery exchange system operated at the present time, the members of the several pairs of connection cords have the battery included between them, but to prevent interference between different pairs of circuits are working from the same battery at the same time, it has as already indicated been found necessary to keep the internal resistance of the battery and the resistance of its leads very low. As shown in Fig. 4 my invention can be applied to this work also.

As in the foregoing instances S is the common generator and R the relatively high impedence, c and d are the double conductors of one pair of cord connections, the two cords ending respectively in jack plugs p and p^2 whereby they may be enabled to unite any two lines, and the generator is bridged between the cord conductors at the points y and z. T and t are the operator's telephones, and k the ringing telephone keys arranged, as usual. Other pairs of double conductor cords similarly fitted, are connected with the same generator, but will require independent electromagnetic resistance. By my invention it thus appears that in factory systems the battery or other current generator may be centralized and located at any point in the system, or at some distance from it, if desired; and that in any system the battery may be replaced by a dynamo or magneto generator.

In practically operating the system and apparatus as described above, I have obtained good results by employing a western electric three hundred watt, six volt continuous current generator having a normal speed of two thousand four hundred revolutions per minute, and having commutator bars.

Having now described the said invention, I claim—

1. In a telephone system the combination substantially as hereinbefore described, of a common current generator for the transmitters of said system; a number of telephone circuits of approximately equal resistance or impedence in parallel with the said generator; and a relatively high inductance device connected in series with the said common generator.

2. The combination in a telephone system, of a number of parallel double conductor telephone circuits each including transmitting and receiving instruments; a common current generator for the transmitters of said circuits; and a section of conductor common to the said telephone circuits, and including the said generator, the impedence of the said common section being high, relatively to that of each of the telephone circuits, and their included instruments.

3. A telephone system comprising a plurality of telephone circuits extending to substations and including receiving and transmitting telephones; a magneto electric or dynamo electric generator, common to the said circuits, connected in parallel therewith, and supplying current for the transmitters thereof; and an electro-magnetic resistance, of a magnitude, high relatively to that of each of the said circuits, and their included instruments, in series with the said generator, whereby a stable operating current is delivered to the said circuits substantially as described.

4. A dynamo electric generator; a main circuit therefor; a telephone transmitter deriving its operating current from the said main by means of a branch circuit; a relatively high electro magnetic resistance or retardation coil interposed in the said branch circuit between the said transmitter and the main circuit; and a telephone circuit connected directly or inductively with said branch and adapted to be operated by said transmitter; substantially as described.

5. In a factory or hotel system of telephones, the combination of a plurality of telephone circuits extending between a number of stations, a telephone transmitter and receiver at each station; and switching devices for connecting them with any of the said circuits; a transmitter current supply generator for all of the said telephone circuits included in a common supply circuit; feed connections extending from the said common supply circuit to the said telephone circuits; and an electromagnetic resistance impedence or retardation coil interposed in each feed connection; substantially as and for the purposes specified.

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.