

March 3, 1942.

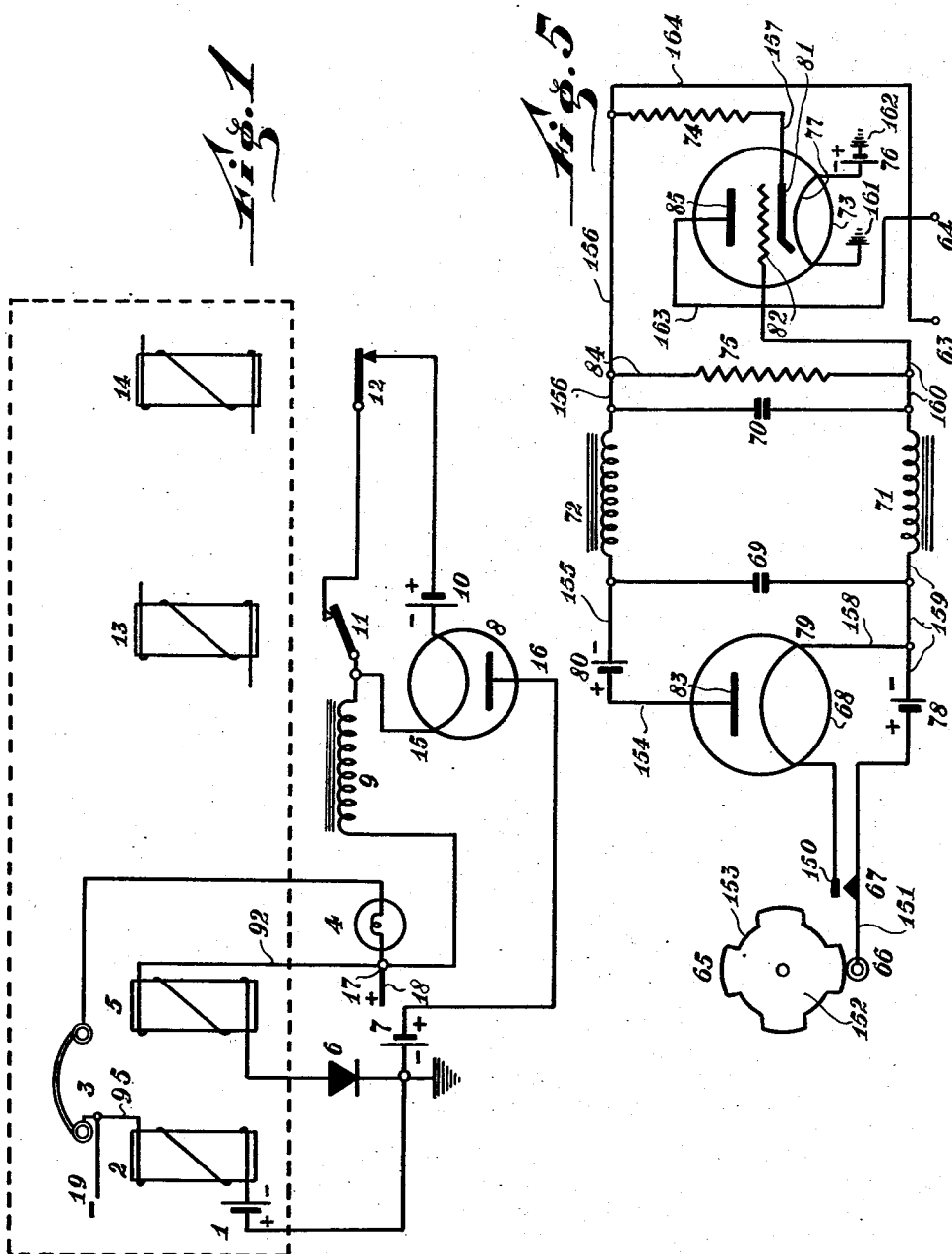
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2,275,352

CALL NOTIFYING SIGNALING DEVICE FOR ENGAGED TELEPHONES

Filed Jan. 22, 1941

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

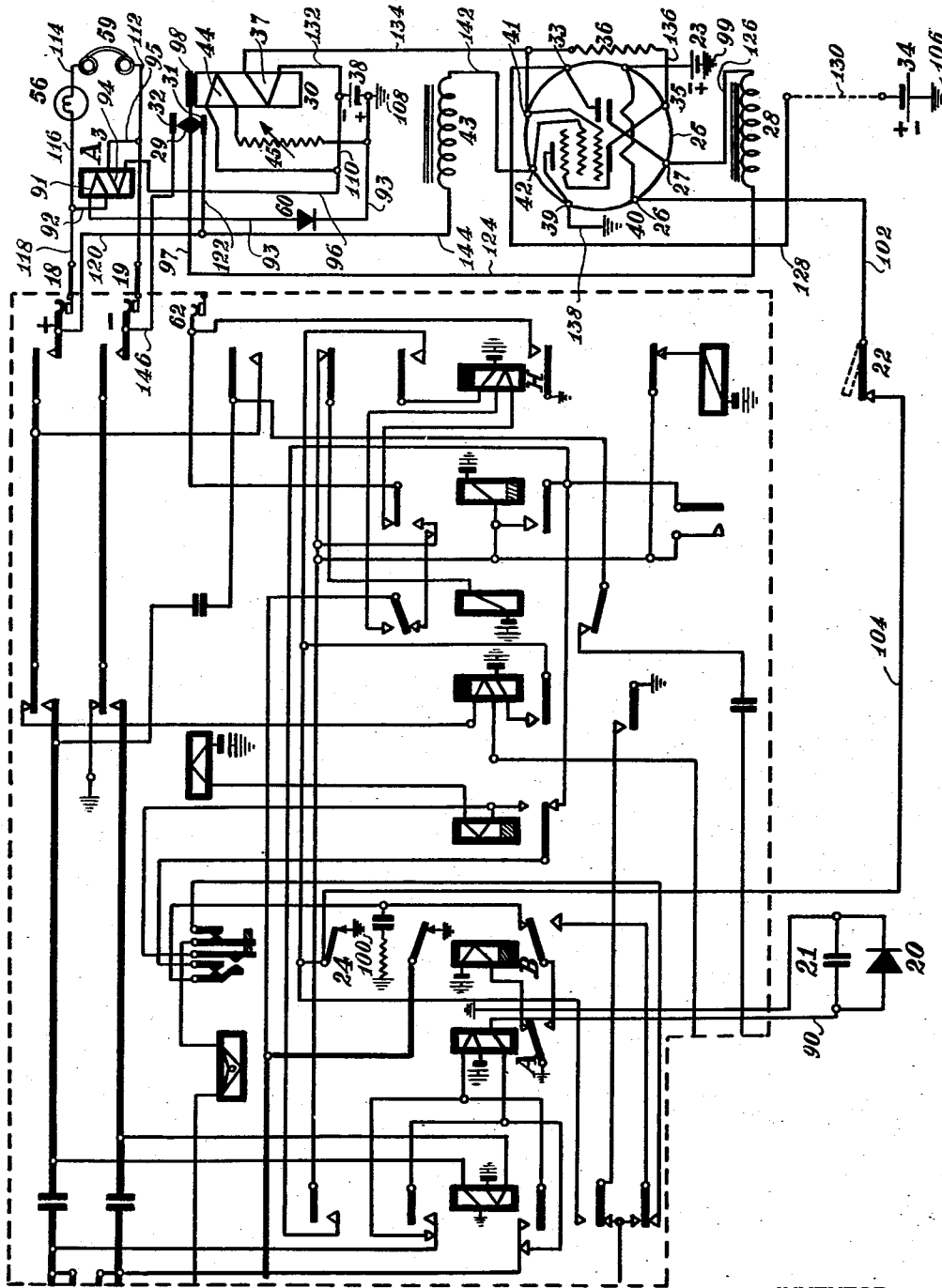


Fig. 2

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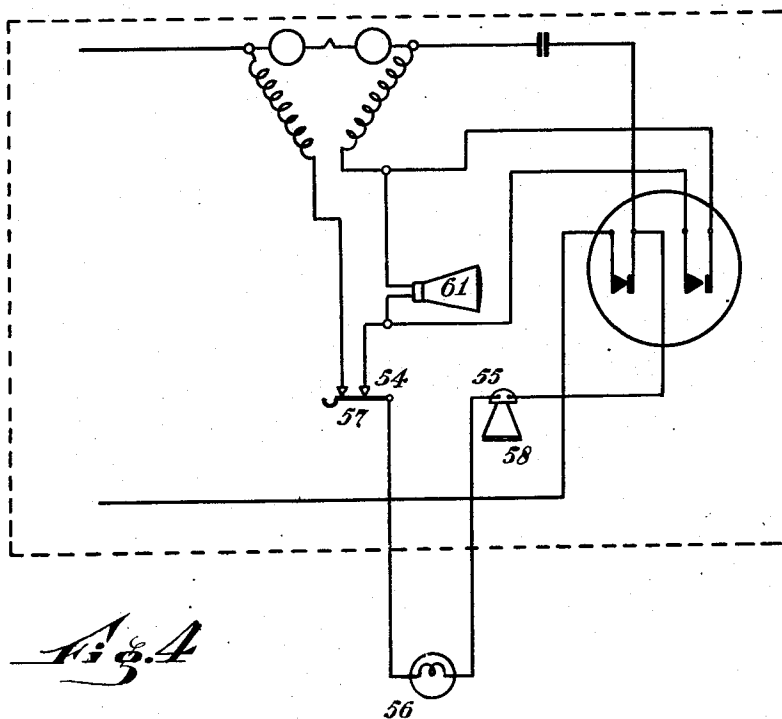
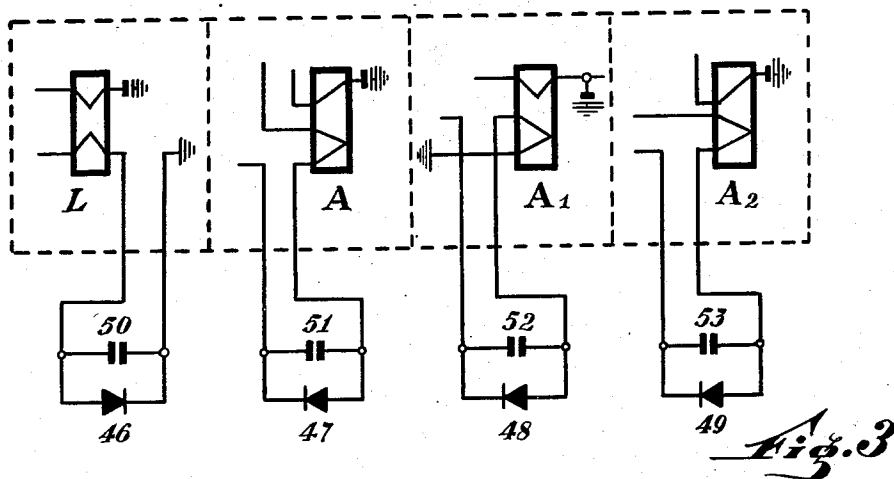
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UNITED STATES PATENT OFFICE

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CALL NOTIFYING SIGNALING DEVICE FOR
ENGAGED TELEPHONESAristides Ernesto Durante, Buenos Aires,
ArgentinaApplication January 22, 1941, Serial No. 375,509
In Argentina July 23, 1940

23 Claims. (Cl. 179-84)

The present invention relates to telephone systems, especially automatic and semi-automatic systems, and more particularly to an ancillary signaling device adapted to be incorporated in such systems.

Broadly speaking, the purpose of the present invention is to permit a signal to be made at an engaged receiving station, without interfering with the communication of said station, and preferably in response to an attempt to call the engaged number.

Prior to the present invention, no device was known whereby the aforesaid purpose could readily be achieved, and the lack of such a device is obviously a defect of semi-automatic telephony. In manual telephone systems, it is possible with the assistance of the exchange staff, to advise a subscriber whose line is engaged that another call is pending or being attempted, but this service is considered as one of emergency for operating reasons which will be obvious to those skilled in the art, and therefore must be kept at the lowest possible minimum.

In modern semi-automatic systems, such as those in which the caller dials the number he wishes to call, not even the above-mentioned possibility obtains, so that at the present time, an engaged telephone may be practically considered as isolated, owing to the lack of a routine means of intended call notification. The present want of such a service considerably reduces the usefulness of the telephone, since the necessity for waiting for an important call, as for example, a long distance call, compels the subscriber to refrain from using his instrument, because he is unaware of the exact time when the privileged call will be made.

The telephone companies themselves are also affected by this same cause. The incessant repetition of calls to engaged receivers causes unnecessary wear and tear of the mechanical parts, seekers, selectors, discs, and the like, and to this wastage must be added the cost represented by the diversion of the time of the exchange staff consequent upon enquiries as to whether the instrument called is really engaged or is out of order.

Again, the repetition of waste calls tends to increase the danger of overloading, which materialises when the number of simultaneous calls exceeds the square root of the number of subscribers grouped in the same section. Furthermore, in connection with long distance calls, the telephone companies are faced with another grave difficulty, which is due to the delay in establishing the

terminal connections, because the instruments of the caller and/or the callee are engaged at the time. In some cases, notice is given of the time when the call is expected to come through, but it cannot be doubted that such advance notices of calls must give rise to a multitude of technical and economical difficulties.

The present invention is intended, when incorporated in telephone equipment, to overcome all the above difficulties in a simple and efficient manner; and to enable what may be denominated a "notification of call" service to be rendered, preferably automatically, whenever an engaged instrument is called, whatever may be the cause of the engagement, and at whatever phase thereof the second call is made. The "notification of call" signal of this invention is visible and is intended merely to advise the engaged station that that subscriber is being called, and said subscriber may continue the call he is making, or break it off in order to allow the notified incoming call to be effected. He may also, after finishing his own call, make a fresh one himself, irrespective of whether the "notification of call" signal has ceased to operate or is still continuing. If, for instance, said subscriber has requested a long distance call, he may continue to make and receive local or other calls, because when the company's call to establish the long distance connection is made, the subscriber will have his attention called thereto by the notification of call signal, and can then immediately interrupt the call on which he is engaged to allow the notified call to be effected. On the other hand, a caller, hearing the audible "engaged" signal in his receiver, will know that his call has been notified to the callee, and that the latter will under normal conditions, clear his line within a reasonable time.

Since the "notification of call" signal is, as stated above of a visible character, no consequential acoustic perturbation will be engendered in the telephone diaphragms of the interconnected instruments, nor will the power or quality of the transmission be prejudicially affected, in spite of the fact that both the voice current and the signal current share the same twin wire circuit which connects the subscribers' stations with the exchange.

The improvement proposed by the present invention does not involve any change whatever in the fundamental conditions of semi-automatic telephony, since it does not call for any earth connections in the telephone stations, or connections of any kind whatsoever between the individual circuits of different subscribers. Further-

more, there will be no possibility of abnormal coupling between two or more lines belonging to subscribers, such as would give rise to false or erroneous notifications of call, because, such notifications are, as has been explained, confined exclusively to the circuit of that subscriber whom it is desired to advise.

The "notification of call" signal, properly so called, consists in the lighting up of a small lamp suitably located in the receiving apparatus. The lighting may be continuous or intermittent without, even in the latter case, producing any effect whatsoever on the mechanical selection parts. The luminous device is connected in series with the microphone, and it is cut out together with the latter, so as not to be affected by the current actuating the bell.

The duration of the "notification of call" signal will be determined by the caller responsible therefor, and if several such signals are made simultaneously to a given receiving station, such station will continue to receive the notification of call signal until all the callers desirous of making connection with said station, have ceased calling.

The installation of the proposed service will be found very economical for the telephone companies, because, in addition to utilizing without any change or modification whatever, the ordinary telephone lines for transmission of the signal, all the other elements constituting the device, both those which are added to the exchange plant, and those which are incorporated in the subscribers' stations, are of standard production and very low cost.

The principal object of the present invention is, therefore, to provide, in a telephone system, means for making signals to a person using a receiving station which is engaged or in operation.

A further object of the present invention is to provide, in an automatic or semi-automatic telephone system, means adapted to give continuous or intermittent luminous signals to persons using engaged receivers, without connecting such receivers to earth or other circuits.

Another object of the present invention is to provide, in an automatic or semi-automatic telephone system, means adapted to give continuous or intermittent luminous signals whereby to advise the person using an engaged station that a third party wishes to establish communication with said engaged station.

A still further object of the present invention is to provide in an automatic or semi-automatic telephone system, means incorporable in said system and adapted to give notification of call to stations in operation, said means utilizing the engaged lines proper to said stations to cause lighting up of a small signal lamp installed in each of said stations.

Another object of the present invention within the aforesaid field, is to cause an automatic "notification of call" signal to be made at engaged stations, whenever the final selectors thereof are actuated by subscribers desirous of communicating with said engaged stations.

Another object of the present invention is to give, by utilizing thermionic valves for gradually increasing the electric voltage in the telephone circuits, a localised, luminous "notification of call" signal, which shall be inaudible to the person using the engaged station, and visible only to those persons with whose stations other non-engaged subscribers wish to communicate.

Another object of the present invention is, by

utilizing pentode thermionic valves, relays and rectifiers for injecting in series with the flow of the normal telephone electric energy, another flow of energy of the same kind, to give a "notification of call" signal to engaged stations, in such a manner that the subscriber of said engaged station shall have the option of attending to the notifications, continuing the pending conversation or interrupting the latter, and himself starting fresh ones. These and other objects and advantages of the present invention will become apparent in the course of the following detailed description of a preferred embodiment thereof.

In the drawings:

Fig. 1 is a diagram of a primary embodiment of the present invention shown applied to a fundamental telephone mechanism of an indeterminate kind.

Fig. 2 is a circuit diagram of a final Stowger selector model 21,052-E, showing the added (new) signaling parts placed outside a broken line delimiting said selector.

Fig. 3 is a diagram showing the impedance relays which supply the energy to a subscriber's line in the aforesaid Stowger semi-automatic telephone system, a portion of the added (new) parts being likewise shown outside a delimiting broken line.

Fig. 4 is a diagram of a standard receiving station, in which the luminous local signaling device is shown outside a delimiting broken line.

Fig. 5 is a diagram of a central oscillator of very low frequency, adapted to provide an intermittent "notification of call" signal, if desired.

The ancillary signaling device which is the subject-matter of the present invention, can be incorporated with but slight modifications to any telephone equipment, either already existing or about to be installed, since said device is applied to certain basic parts common to all telephone systems.

In Fig. 1, the essential parts of my novel auxiliary signaling device are shown, for purposes of explanation, in connection with a typical automatic telephone circuit non-specific as to system, the principal parts of which circuit are marked off by a broken line.

The telephone circuit properly so called, comprises a feeder battery 1, impedance relay 2, the subscriber's receiving station 3, the "notification of call" signal lamp 4, impedance relay 5, and a dry rectifier 6. In every case, the final selector comprises a penultimate relay 13 and an ultimate relay 14. The added novel assembly according to the present invention, is constituted by a battery 7, an electronic valve 8, impedance 9, rectifier 6, battery 10, a normally open contact 11 and a normally closed contact 12.

Said contacts 11 and 12 are operatively associated with said penultimate and said ultimate relays, respectively, so that when said relays 13 and 14 are energised, the contacts 11 and 12 will be moved from their normal position to an operative position as hereinafter more particularly explained.

If the subscriber's receiving station 3 is engaged at the time when another station is attempting to call such subscriber, the final selector comprising relays 13 and 14 will be actuated by the operation of the other station's calling means. The function of the ultimate relay 14 is to give the call signal to a disengaged station, so that, if station 3 is engaged, relay 13 will be operated by an incoming call, but relay

14 will not be so operated. Excitation of relay 13 causes contact 11 to move from its normally open position to a closed position in which it establishes a local booster exciting circuit extending from the positive pole of battery 10, through the normally closed contact 12, the actuated contact 11, filament 15 of the electronic valve 8 to the negative pole of said battery 10. Establishment of this circuit energises the electronic valve 8, the plate 16 and filament 15 of which are connected in the circuit of the "notification of call" signaling lamp 4, so that the voltage in the circuit of said lamp is gradually boosted as the electronic valve heats up. The boosting is effected by the establishment, on energisation of said valve 8, of a "notification" circuit extending from the negative pole of battery 7 in series with the feeder battery 1, relay 2, receiving station 3, signaling lamp 4, conductor 17, impedance 9, filament 15 and plate 16 to the positive pole of battery 7. The signaling lamp 4 is rated so that it will not light at the normal operating voltage in the receiver circuit, but will glow only when the voltage has been boosted a pre-determined amount, as just explained. The valve 8 is designed to reach boosting point shortly after actuation of the penultimate relay 13, and when said valve 8 reaches that point, the lamp 4 will glow, indicating that an attempt is being made to connect with the engaged station.

The boosting current, or "notification" current, as it may be called, introduces no acoustic perturbations in the communication established or on the point of being established with the receiving station 3, since the thermal inertia of filament 15 supplies the requisite energy in a gradual manner, without producing rapid audible surges in the circuits or rapid audible displacements of the telephonic diaphragms which are put in circuit.

Continuing the consideration of the example under discussion, it will be noticed that a dry blocking rectifier 6 has been included in the local circuit. The reason for its inclusion is that otherwise, relay 5 would, on operation of the "notification of call" means, be deenergized owing to the establishment of a circuit extending from the negative pole of battery 7, through relay 5, conductor 17, impedance 9, valve 8, to the positive of battery 7, which circuit is in direct opposition to the circuit which should normally be established from the negative pole of the feeder battery 1, through relay 2, receiving station 3, "notification of call" lamp 4, and relay 5 to the positive pole of battery 1. Such deenergisation of relay 5 would cause serious functional disturbance in the automatic or semi-automatic telephone system, and therefore, similar dry rectifiers must be installed in series with all the relays supplying positive potential to a subscriber's line, in whatever condition of its operative phase, and for every interconnection train individually considered.

If the assumption made in the foregoing does not hold, that is to say, if the final selector finds the called station disengaged, operation of the "notification of call" signaling means will be stopped in the following manner. When the selector commences to operate, energisation of the penultimate relay 13, will as before cause contact 11 to close, thereby initiating the energisation of valve 8. But since on termination of the last series of calling impulses, the selector finds the station called disengaged, the ultimate relay 14 will immediately operate, generally to cause the call signal to be made, and said relay, on operating

will actuate normally closed contact 12, moving it to open position thus breaking the energising circuit of valve 8, the arrangement being such, that said energising circuit is broken before the valve has reached boosting condition, so that the "notification of call" lamp 4 is not caused to glow.

It will thus be seen that the function of the final selector in connection with the ancillary signaling means of the present invention, is both to cause automatic operation of said ancillary means if the station called is engaged, and to cut out said ancillary means if said station is disengaged, in order to avoid a continuous and false notification of call produced by the final selector's own signaling equipment which establishes the effective communication.

The novel ancillary signaling device according to the present invention can, as has already been stated, be incorporated in any telephone system. It can, for example, be readily incorporated in the Strowger, rotary 7B, Siemens and Halskey, Automatic Electric Company, Standard Electric, R. A. T., and the like automatic or semi-automatic equipments.

Purely by way of example, and in order that the practical application of the present invention may be more clearly understood, the incorporation thereof in a standard Strowger type automatic telephone equipment will now be described with particular reference to Figs. 2, 3 and 4.

Within the thick broken line of Fig. 2 is shown the circuit arrangement of a Strowger type final selector model 21052E, in which B is the liberator relay which operates all the time the selector is actuated, and H is the wiper control relay which operates only if the selected subscriber's line, indicated by the reference numerals 18, 19, is free.

A rectifier 20, for example a selenium rectifier type 7B6A1 is added in series with the positive return 90 of the line relays A, and is shunted by a condenser 21, suitably of 0.5 mf., to allow the engaged and call signal impulses to pass. Similarly, as shown in Fig. 3, the subscriber's line circuit relay L, the relay A of the first and second selectors, the repeater relay A₁ and the relay A₂ of the third and fourth selectors, have rectifiers 46, 47, 48 and 49 respectively added in series with their positive return leads, said rectifiers being shunted by condensers 50, 51, 52 and 54 respectively for the purpose already indicated. All said rectifiers are preferably type 7B6A1 selenium rectifiers and the condensers have each a capacity of 0.5 mf.

The lines 18 and 19 extend to a specific subscriber's station, which comprises an impedance relay A₃, the receiving station 59 and, according to the present invention, the "notification of call" lamp 56. The relay A₃ comprises a winding 91 corresponding to the impedance relay 5 of Fig. 1, having one end connected to a changeover contact device represented in Fig. 2 by the conductor 92, whereby said end is always connected to the line which is at positive potential, the other end of said winding 91 being connected by conductor 93 to the positive pole of the office battery 38, which corresponds to the battery 1 of Fig. 1, and, as previously stated, and in accordance with the present invention, a dry rectifier 60 is connected in series between said other end of winding 91 and the positive pole of said battery 38, said rectifier 60 corresponding to the rectifier 6 of Fig. 1.

The relay A₃ further comprises a second wind-

ing 94, one end of which is connected to a change-over device, represented in Fig. 2 by the conductor 95, to the line which is at negative potential, and the other end of which is connected by conductor 96 to the negative pole of office battery 38. Said second winding 94 of Fig. 2 corresponds to the impedance relay 2 of Fig. 1.

Those skilled in the art will be aware that if the lines 18 and 19 are normally at the polarities shown in Fig. 2, these polarities will remain unchanged when an incoming call is effected, but will be reversed, by the action of a relay, known as the "D" relay, not shown in the drawings, when an outgoing call is effected. That is to say, with reference to Fig. 2, that line 18 would become negative and line 19 positive. As a consequence of this, the change-over devices 92 and 95 operate to change over the connection of winding 91 to line 19 and of winding 94 to line 18.

This behavior of the relay A₃ necessitates the inclusion in the ancillary signaling device, of automatic reversing means as will hereinafter be made clear.

Continuing the comparison of Figs. 1 and 2, the voltage boosting diode 8 of Fig. 1, is shown in Fig. 2 as enclosed in a common housing or envelope 25 with a pentode to be presently described, and comprises a plate 33 and a cathode 27 adapted to be indirectly heated by a filament 26 common to the diode and the pentode. The reason for adopting this form for the diode is that the pentode is required for the reversal means mentioned above, and there is available on the market a suitable valve identified as type 25A7. It should, however, be borne in mind that the use of such a combined valve is not necessary and that other valve arrangements leading to the same results may be adopted, as is apparent from Fig. 1, where the diode is shown separately.

If the connections shown in Fig. 1 be considered with the behavior of relays 2 and 5, as hereinbefore explained, in mind, it will be apparent that if the polarity of the lines 18 and 19 as indicated in said Fig. 1, is reversed, the plate-cathode circuit of the diode would be short-circuited, since the change-over device 95 would then make connection with line 18 to which conductor 17 is connected. Under these conditions the lamp 4 would not be brought to glowing point.

To overcome this difficulty, reversal means are provided as shown in Fig. 2, for reversing the connections of the diode plate-cathode circuit simultaneously with the reversal of the connections of windings 91 and 94 consequent on a reversal in the polarity of the lines 18 and 19. Said reversal means comprise essentially the aforesaid pentode and a reversing relay indicated generally by the reference numeral 30. Said relay 30 includes a fixed contact 31 connected to the wiper of line 18 and a fixed contact 32 connected to the wiper of line 19. Between said fixed contacts 31 and 32, extends a movable arm 97 provided with a double contact 29 adapted alternately to contact with the fixed contacts 31 and 32, said arm 97 being spring urged towards the contact 32 and being further provided with an armature 98. The relay 30 further comprises a winding 37 one end of which is connected to the negative pole of office battery 38, and the other end of which is connected to the positive pole of said battery through the pentode and a general earth connection 40 as hereinafter explained. Relay 30 likewise includes a second winding 44 magnetically in opposition to the winding 37 and

connected across the office battery 38 in series with a variable resistance 45. Preferably each of said windings 37 and 44 has a resistance of 1,000 ohms and the variable resistance 45 is of 100,000 ohms. The arrangement is such that if the current circulating in winding 37 does not exceed that circulating in winding 44, the armature 98 is not attracted and the double contact 29 is in electrical connection with the upper fixed contact 32, and when the current in winding 37 exceeds that flowing in the winding 44 the armature 98 is attracted whereby the movable arm 97 is moved into the position shown in the drawings in which the double contact 29 is electrically connected to the lower fixed contact 31.

The purpose of the variable resistance is to secure correct adjustment of the conditions just indicated, in a manner which will be explained hereinafter.

The unbalanced condition of relay 30 is achieved by means of the aforementioned pentode, which comprises a cathode 35 connected through a resistance, preferably of 500 ohms, indicated by the reference numeral 36, to one end of winding 37 of relay 30, a plate 39 connected through a general earth connection 40 to the positive pole of the office battery 38, thus completing the cathode-plate circuit of said pentode. The pentode further comprises a control grid 41 connected to the negative end of resistance 36 and an accelerating grid 42 connected through an impedance 45 to the wiper of line 18.

The common heating filament 26 of the double valve 25 is connected in a series circuit similar to the series circuit for the cathode-filament 15 of the diode 8 of Fig. 1. In the arrangement shown in Fig. 2, however, one of the normally open contacts, 24, of the liberating relay B is utilized to take the place of the normally open contact 11 associated with the penultimate relay 13 of Fig. 1. The normally closed additional contact 12 of Fig. 1 associated with the ultimate relay 14, is, in Fig. 2, shown as a normally closed contact 22 operatively associated with the wiper control relay H. The battery 23 of Fig. 2 corresponds to the battery 10 of Fig. 1, and is in series with the contacts 24 and 22 through the two earth connections 99 and 100. Consequently whenever relay B (Fig. 2) is actuated, the energising circuit for the heating filament 26 of the double valve 25 is established from the negative pole of battery 23, through filament 26, conductor 102, normally closed added contact 22 conductor 104 to the contact 24 which is closed owing to energisation of its actuating relay B, through the earth connections 100 and 99 to the positive of battery 23. This energising series circuit persists so long as relay B is actuated, unless relay H is also actuated. Actuation of relay H only occurs if the line 18, 19 is disengaged, and, in operating, relay H opens the normally closed added contact 22 to break said series circuit. As stated above, the arrangement is such that, if line 18, 19 is disengaged, relay H operates to break the said series circuit before the diode portion of the double valve 25 is brought into boosting condition by heating of the filament 26.

It should be clearly understood that, although in the example of Fig. 2, the diode 26, 27, 33, is contained in the same envelope as the pentode 35, 39, 41, 42, it is completely independent thereof as regards its functions in the ancillary signaling means, and the two valves may be embodied, if desired, as two physically separate entities. Indeed, as hereinbefore indicated, the pentode and

its associated instrumentalities is required only when, as in the Strowger equipment, the polarity of the specific subscriber's lines 18, 19 is adapted to be changed or inverted in response to operation of other parts of the equipment.

When energised, the diode 27, 33, establishes a boosting circuit for injecting a boosting voltage in the local circuit of the receiving station 59, said local circuit including, according to the present invention the signaling lamp 56.

In the example of Fig. 2, with the lines 18, 19 at the potentials indicated therein, in which condition said lines will be when disengaged or when the receiving station 59 is called from another station, said boosting circuit extends from the negative pole of battery 34, through its earth connection 106, earth connection 108, the positive pole of battery 38, the negative pole of battery 38, conductors 110 and 96 to one end of winding 94 of relay A, the other end of which is connected to line 19 between the receiving station 59 and the wiper for said line, by the change-over device 95, by conductor 112, receiving station 59, conductor 114 signaling lamp 56, conductor 116 and portion 118 to line 18, by the wiper thereof, conductor 20, lead 122, fixed lower contact 31, double contact 29, movable arm 97, conductor 124, impedance 28, conductor 126 cathode 27, plate 33, conductors 128 and 130 to the positive pole of battery 34, thus causing glowing of the signaling lamp 56 if the diode is allowed to reach boosting condition.

It will be noted that the establishment of this circuit depends upon whether the double contact 29 is in contact with the lower fixed contact 31. This position of said contacts is ensured by over-excitation of winding 37 of relay 30, which is brought about by means of the pentode in the following manner.

The main output circuit of the pentode extends, as hereinabove briefly indicated, from the negative pole of battery 38, by conductor 132, winding 37, conductor 134, resistance 36, conductor 136, cathode 35, plate 39, conductor 138, earth connection 40, earth connection 108 to the positive of battery 38. When the filament 26 is energised, the pentode allows current to circulate in the circuit just described, thus energising winding 37 at battery potential in opposition to winding 44 which is also at battery potential, as already explained. The pentode, however, includes the accelerating grid 42 which is connected through conductor 142, impedance 43, and conductors 144 and 120 to line 18. Now, when the polarity conditions of lines 18 and 19 are as shown in the drawings, that is to say when line 18 is positive, the accelerating grid 42 will also be positive and consequently allows the full exciting current for winding 37 to pass through the pentode, thus allowing the winding 37 to overcome the balancing effect of winding 44, which receives a reduced current owing to the presence of the high resistance 45. Relay 30 then operates to attract armature 98 and bring the double contact 29 into electrical connection with the lower fixed contact 31, thus fulfilling the necessary condition for the establishment of the boosting circuit as hereinbefore traced.

When the polarity of lines 18 and 19 is reversed owing to a call emanating from the specific station, the change-over device 95 will, as previously described, connect winding 94 to the conductor 116 and disconnect it from conductor 112. Similarly, the change-over device 92 will disconnect the winding 91 from conductor 116 and connect it to conductor 112. In these circum-

stances, the boosting circuit after leaving winding 94, will extend by conductor 116, signaling lamp 56, conductor 114, receiving station 59 conductor 112, line 19, the wiper thereof and conductor 146 to the upper fixed contact 32. For the completion of this circuit, it is therefore a necessary condition that the double contact 29 be in electrical connection with said upper fixed contact 32, and this condition is realized by reason of the fact that on the reversal of the polarity of line 18, the polarity of the accelerating grid 42 is likewise reversed, that is to say said grid becomes negative. Therefore, the accelerating grid 42 will oppose the flow of current through the pentode, and reduce the energization of the winding 37 sufficiently to re-establish magnetic balance in relay 30 and thereby allow the movable arm 97 to move upwardly and bring the double contact 29 into electrical connection with the upper fixed contact 32.

Reverting to the diode, it will be observed that, owing to the inclusion in conductor 97 of the rectifier 60, the otherwise possible abnormal circuit through winding 91 cannot be established for the reasons set forth in connection with relay 5 and rectifier 6 of Fig. 1.

The proper adjustment of the relay 30 is a matter of considerable importance in relation to the correct operation of the reversal means, and will now be described. In adjusting relay 30, the corresponding final selector is disconnected from the rest of the automatic plant, and the normally open contact 24 is closed by hand, whereby the exciting circuit for filament 26 is established as hereinbefore explained, and the double valve 25 is caused to operate. As soon as the double valve 25 reaches steady working conditions, which occurs a few seconds after energization of said filament, the variable resistance 45 is adjusted until the moving arm 97 brings the double contact 29 into electrical connection with the upper fixed contact 32 under the action of its spring urging means. As a check to the adjustment thus made, the respective wipers of the lines 18, 19 are brought into contact with said lines, and, if the lines 18, 19 are at the polarities shown in the figure, relay 30 should operate immediately to attract armature 98 and move the movable arm 97 into position to connect electrically the double contact 29 with the lower fixed contact 31. The polarity of the lines 18 and 19 is then reversed, so that the accelerating grid 42 is given a negative potential, whereupon, if the variable resistance 45 has been correctly adjusted, relay 30 will be de-energized and allow movable arm 97 to return to its normal position bringing double contact 29 into engagement with the upper fixed contact 32. Should this not occur, the variable resistance 45 must be readjusted until the above-mentioned results are obtained.

Fig. 4 shows in greater detail a typical subscriber's station, in which the ancillary signaling lamp 56 is illustrated as interposed between the end 54 of the disconnecter arm 57 and one terminal 55 of the microphone 58, so that said lamp 56 is operable only when said disconnecter arm 57 bridges the associated contacts of the microphone feeding circuit. It will be noted, however, that under these conditions, the lamp 56 is also in series with the receiver 61. If while said subscriber's station is engaged, during which time the disconnecter arm bridges said associated contacts, no other station attempt to call the specific station, the lamp 56 will be traversed by current but the voltage will be sufficient only to maintain

the lamp below glowing point. When, however, such a call is attempted, and the ancillary "notification of call" means of the present invention operates, the voltage in the circuit of lamp 56 is boosted so as to cause said lamp to glow, but, owing to the fact that the increase in voltage is effected in a gradual manner by reason of the thermo-regulation of the diode, the tensorial increase in the voltage will not cause rapid displacements of the diaphragm of the receiver 61, so that no interference of an acoustic nature is caused.

In connection with the description of Fig. 2, it will be observed that whereas the relay H may properly be considered the ultimate relay of the selector, the relay B one of the contacts of which has been utilized as the normally open contact 11 of Fig. 1, cannot, in the Strowger example be considered as a penultimate relay. The term "penultimate" was used for clearness in connection with Fig. 1, and it is to be understood that the relay with which the normally open contact in the filament series circuit is associated, is, in the general case, a relay anterior to the ultimate relay, and will be so designated in the appended claims.

It is also to be understood that the reversing means described in connection with Fig. 2, is not exclusively adapted for use with the Strowger equipment. It must be included in any telephone system in which the polarity of the specific subscriber's lines, such as the lines 18 and 19, is subject to reversal in response to operation of other parts of the equipment.

The embodiments of the present invention so far described permit only of non-interrupted glowing of the ancillary signaling lamp during effective boosting operation of the boosting device. It may, however, be thought advisable to have the signaling lamp glow intermittently during any given period of effective boosting, because a winking light is more likely to catch the eye than a steady glow. Alternatively, the possibility of intermittent glowing of said signaling lamp, may be made to serve a highly useful purpose, by arranging for such intermittent glowing to be causable only from certain selected stations, as for example, operators' stations at the exchange, thus permitting subscribers to receive, in addition to the "notification of call" signals, signals of a differentiated character having a pre-arranged relationship with some other condition affecting the line or the service, as, for instance, in cases where a time limit is imposed on conversations, that said time limit is about to expire. Obviously, the instrumentalities may be so arranged that the "notification of call" signal is intermittent and the other signal continuous, or only one type of signal may be used, for instance, only the intermittent signal, in which event means may be provided for altering the frequency or the number of flashes in a train so as to differentiate between the meaning of the signals.

It is consequently within the scope of the present invention to provide means incorporable in the ancillary signaling means, for producing intermittency in the glowing of the signal lamp at the receiving stations. One convenient embodiment of such means is diagrammatically illustrated in Fig. 5.

In designing apparatus for imparting intermittency to the signals, steps must be taken to avoid the production of two possible objectionable results, namely, in the first place, acoustic disturbances in the two intercommunicated stations when one or both is called by a third station,

and in the second place, abnormal operation of the semi-automatic telephone selector mechanism which might prevent the person using the station which receives the signal, from establishing an intercommunication other than necessarily the one to which the notified call refers.

These two objectionable features have been successfully avoided, in accordance with the present invention, by the provision of a central generating plant for the whole of an automatic or semi-automatic telephone exchange, said plant being designed to supply, through a distribution net-work, pulsating electric energy in the final selectors to the diodes, having the following characteristics: the pulsations approximate as closely as possible to sinusoidal impulses, and are of exceedingly low frequency which shall be sufficient to displace very slowly the telephone diaphragms of the stations affected, but incapable of actuating the selector relays of the automatic equipment. Secondly, the pulsations consist of semi-cycles separated by intervals sufficiently long to prevent the vibrating diaphragms from being brought to a steady state of vibration thereby, which might enable the human ear to fuse the impulses into an impression of parasitic noise.

Fig. 5 shows, as a general case, a suitable set-up of such a central oscillator. The values of the resistances, impedances and the like will, of course, vary with the capacity values of the particular exchange in which the oscillator is to be installed, but the determination of the appropriate values for any particular case is held to lie well within the powers of those skilled in the art, so that further discussion thereof is deemed superfluous.

The oscillator of Fig. 5 comprises a thermionic valve 68, the filament 79 of which is connected across a battery 78 through an interruptor device comprising a fixed contact 150 and a movable contact 67, carried by an arm 151 adapted to be oscillated so as to move contact 67 between open and closed positions. Conveniently, said arm 151 may have at its end remote from contact 67 a roller or follower 66 held in engagement with the edge of a disc like member 152, which edge has a plurality of wide projecting teeth 65 separated by a plurality of wide slots 153. The arrangement is such that when roller 66 is in contact with a tooth, the interruptor is in the open position and when said roller is in contact with the bottom of a slot, the interruptor is in closed position. Said disc is adapted to be rotated in one direction by suitable means, as by an electric motor (not shown).

The plate 83 of valve 68 is connected in series with an impedance 72 and a resistance 74 to the indirectly heated cathode 81 of a triode valve 73, these connections including conductors 154, 155, 156 and 157 and a battery 80 the positive of which is connected to said plate and the negative of which is connected to said impedance 72 and to a shunting condenser 69 connected across the diode. The negative end of filament 79 of said diode 68 is connected by conductor 158 to a lead 159 connecting the negative of battery 78 to one end of an impedance 71, the other end of which is connected by conductor 160 to the grid 82 of the triode 73. The ends of the impedances 71 and 72 remote from the diode are shunted by a condenser 70 and a resistance 75 connected between conductors 156 and 160. One end of the heating element 77 of the triode 73 is connected to earth at 161 and the other end is connected to the negative of a battery 76, the positive of which

is connected to earth at 162. The plate 85 of the triode is connected by conductor 163 to one output terminal 64 of the oscillator and the end of the resistance remote from the cathode 81 is connected by conductor 164 to a second output terminal 63. When the oscillator is applied to a Strowger equipment provided with the ancillary signaling means according to the present invention, said output terminals 63 and 64 are connected respectively to the conductor 128 and the positive of battery 34 in lieu of the direct connection made by conductor 130. Those skilled in the art will readily appreciate that it is easy to arrange for conductor 128 (Fig. 2) to be connected to the positive of battery 34, alternately by conductor 130 and through the oscillator, if it is desired to use continuous and intermittent signals in the same equipment.

The resistances 74 and 75 are so chosen or adjusted that the residual current flowing through the triode 73, when only said triode is energized and without positive bias on the grid 82, does not exceed five percent. of the total current capacity of the valve. The speed of disc 152 should be adjusted so that the periods of opening and closing of the interruptor lie between one-and-one-half and two seconds.

The operation of the intermittency device is as follows: When the filament of the diode 68 is lit by closure of contacts 67 and 150 in response to engagement of roller 66 with a tooth 65 of disc 152, said valve 68 acts as a modulator of the power amplifying triode 73. The thermal inertia of filament 79 will determine in a continuously progressive manner the gradual establishment, without sudden alterations in tensorial values, of a circuit extending from the negative pole of battery 80, by conductor 155, impedance 72, resistance 74, conductor 157, the cathode 81, grid 82, conductor 160, impedance 71, conductors 159 and 158 to filament 79, and thence, by plate 83 and conductor 154 to the positive of battery 80. A small portion of the current supplied by battery 80 and flowing in conductor 156, will be diverted through conductor 84 and resistance 75, but if the value of this resistance has been properly chosen, this diversion will not affect the operation of the device.

The continuously progressive positive biasing of the grid 82 in the manner just described, until the necessary amplitude has been reached, allows another current to flow between the cathode 81 and the plate 85 of the triode 73. This current will be of greater amplitude than that flowing between the cathode and the grid 82, said amplitude being determined by the characteristics of the valve 73, but the wave form of the modulated current will be substantially that of the signal impressed on the grid 82. This form is thermally determined by filament 79 and in practice corresponds to the conditions necessary for successful operation outlined above.

From the foregoing it will be clear that when the intermittency device is connected in the circuit of the ancillary signaling means as explained above, the pulsating current produced by the intermittency device will be impressed on the diode 37, 33 (Fig. 2) and consequently on the signaling lamp 56 at the subscriber's station, so that operation of the ancillary means will cause periodic glowing and extinction of lamp 56. Since the pulsations are transmitted to the subscriber's circuit through the medium of the diode specifically associated with the specific final selector, it follows that there is no danger of acoustic disturb-

ances being originated by connection of the intermittency device when emitting its peak amplitude, to the equipment, as the diode always initiates a cycle proper to the specific station to which it is connected thus regulating the passage of the central impulse.

On the other hand care should be taken that the amplitude of the central impulse is limited to the value just necessary to cause glowing of the signaling lamp, otherwise disturbances may be set up in the operation of the selectors. In practice, the aforesaid limit will be found satisfactory in this regard, particularly owing to the substantially sinusoidal form of the impulse, which if it were suddenly applied would on ceasing provoke an inverse impulse from the various reactances connected in the circuit, of sufficient strength to cause abnormal operation of the selectors.

While the present invention has been described with reference to a particular embodiment thereof, I do not intend to be limited thereto, but only in so far as is specified in the appended claims.

I claim:

1. In a semi-automatic telephone system comprising a plurality of stations each including calling means for calling any other station and receiving means for receiving communications from any one other station at a time, said calling means including an audible call signaling means at each station, final selector means specifically and operatively associated with each station and including an ultimate relay energisable only when the corresponding specific station is disengaged, and an anterior relay energizable at all times by actuation of the calling means of another station, and said receiving means including a receiving station and a local circuit for said receiving station comprising a feeder battery, an impedance relay winding connected between one side of said battery and one side of said receiving station, and a second impedance relay winding connected between the other side of said battery and the other side of said receiving station, ancillary "notification of call" signaling means including a series circuit comprising a normally open contact operatively associated with said anterior relay, a normally closed contact operatively associated with said ultimate relay, an energising battery and a voltage boosting device, and an ancillary circuit including an impedance connected between one side of said boosting device and a point between said second impedance relay winding and said receiving station, a notification of call signaling lamp connected in series between said point and said receiving station, an ancillary battery connected at one pole to the other side of said boosting device and at the other pole to a point between said second impedance relay winding and said feeding battery, whereby, on operation of said anterior relay, said boosting device is energised to boost the voltage in said local circuit to a value effective to cause glowing of said signaling lamp, and upon subsequent energisation of said ultimate relay by reason of the disengaged condition of the specific station associated therewith, said normally closed contact is actuated to open the series circuit and thereby prevent boosting of the voltage in the local circuit.

2. In a semi-automatic telephone system comprising a plurality of stations, each including calling means for calling any other station, and receiving means for receiving communications from any one other station at a time, said calling means including an audible call signaling means at each station, final selector means specifically and oper-

actively associated with each station and including an ultimate relay energizable only when the corresponding specific station is disengaged, and an anterior relay energizable at all times by actuation of the calling means of another station, and said receiving means including a receiving station and a local circuit for said receiving station comprising a feeder battery, an impedance relay winding connected between one side of said battery and one side of said receiving station, and a second impedance relay winding connected between the other side of said battery and the other side of said receiving station, ancillary "notification of call" signaling means including a series circuit comprising a normally open contact operatively associated with said anterior relay, a normally closed contact operatively associated with said ultimate relay, an energising battery and an electronic voltage boosting device having a filament connected in said series circuit and a plate, and an ancillary circuit including an impedance connected between the end of said filament remote from said energising battery and a point between said second impedance relay winding and said receiving station, a notification of call signaling lamp connected in series between said point and said receiving station, an ancillary battery connected at one pole to said plate and at the other pole to a point between said second impedance relay winding and said feeding battery, whereby, on operation of said anterior relay winding in response to a call from another station, said boosting device is energised to boost the voltage in said local circuit in a smooth and gradual manner to a value effective to cause glowing of said signal lamp, and upon subsequent energisation of said ultimate relay by reason of the disengaged condition of the specific station associated therewith, said normally closed contact is actuated to open the series circuit and thereby prevent boosting of the voltage in the local circuit.

3. In a semi-automatic telephone system comprising a plurality of stations each including calling means for calling any other station and receiving means for receiving communications from any one other station at a time, said calling means including an audible call signaling means at each station, final selector means specifically and operatively associated with each station and including an ultimate relay energizable only when the corresponding specific station is disengaged, and an anterior relay energizable at all times by actuation of the calling means of another station, and said receiving means including a receiving station and a local circuit for said receiving station comprising a feeder battery, an impedance relay winding connected between one side of said battery and one side of said receiving station, and a second impedance relay winding connected between the other side of said battery and the other side of said receiving station, ancillary "notification of call" signaling means including a series circuit comprising a normally open contact operatively associated with said anterior relay and adapted to be closed on excitation of said anterior relay in response to actuation of the calling means of another station, a normally closed contact operatively associated with said ultimate relay and adapted to be opened on excitation of said ultimate relay in response to actuation of the calling means of another station while the specific station is in disengaged condition, an energising battery and a voltage boosting device, and an ancillary circuit including an impedance connected between one side of said boosting device and a point between

said second impedance relay winding and said receiving station, a notification of call signaling lamp connected in series between said point and said receiving station, an ancillary battery connected at one pole to the other side of said boosting device and at the other pole to a point between said second impedance relay winding and said feeding battery, and a dry rectifier connected in series with said second impedance relay winding and said ancillary battery, whereby, on operation of said anterior relay, said boosting device is energised to boost the voltage in said local circuit to a value effective to cause glowing of said signaling lamp, and upon subsequent energisation of said ultimate relay by reason of the disengaged condition of the specific station associated therewith, said normally closed contact is actuated to open said series circuit and thereby prevent boosting of the voltage in the local circuit, and said second impedance relay winding is prevented from being de-energised consequent upon energisation of said boosting device.

4. In a telephone system comprising a plurality of stations, means for establishing intercommunication between any two stations at a time, said means including a first wire and a second wire connected to each station and specific thereto, and means in said system for inverting the polarity of said wires, ancillary "notification of call" signaling means including a signaling lamp located at each station and connected in series with said wires, booster means connected to said wires and adapted to inject a gradually increasing boosting voltage in the circuit of said lamp in response to an attempt to establish communication between a station of the system and a specific station, and inverter means adapted to invert the connections of said booster means to said wires on the occurrence of an inversion of the polarity of said wires.

5. In a telephone system, ancillary signaling means according to claim 4, in which said inverter means is adapted automatically to invert the connections of said booster means to said wires on the occurrence of an inversion in the polarity of said wires.

6. In a telephone system comprising a plurality of stations, means for establishing intercommunication between any two stations at a time, said means including a first wire having one potential and a second wire having an opposite potential, each station having one such first wire and one such second wire connected and specific thereto, and means in said system for inverting the polarity of said wires in response to the occurrence of pre-determined conditions in said system, ancillary "notification of call" signaling means including a signaling lamp located at each station and connected in series with said wires, booster means connected to said wires and adapted to inject a gradually increasing voltage to boost the voltage in the circuit of said lamp in response to an attempt to establish communication between a station of said system and a specific station, and automatic inverter means including an office battery having a negative pole and an earthed positive pole, an inverter relay comprising an energising winding one end of which is connected to the negative pole of said battery, a balancing winding magnetically balancing out said energising winding under normal conditions and connected across said office battery, a movable arm having an armature adapted to be attracted on energisation of said inverter relay, a double contact on said movable

arm having an upper and a lower sides, an upper fixed contact located in the path of the upper side of said double contact, a lower fixed contact located in the path of the lower side of said double contact, means normally urging said movable arm towards said upper fixed contact to cause electrical engagement thereof with said upper side, said arm being connected to one side of said booster device, said lower contact being connected to said first wire, and said upper contact being connected to said second wire, and thermionic means having a cathode connected to the other end of said energising winding, an earthed plate, and an accelerating grid connected in series with an impedance to said first wire, whereby said thermionic means controls the flow of current in said energising winding in response to change of polarity of said accelerating grid consequent upon inversion of the polarity of said wires, to determine attraction and liberation of said armature and thereby selection of the wire to which said booster device is connected.

7. In a telephone system comprising a plurality of stations, means for establishing intercommunication between any two stations at a time, said means including a first wire having one potential and a second wire having an opposite potential, each station having one such first wire and one such second wire connected and specific thereto, and means in said system operative to invert the polarity of said wires in response to the occurrence of a pre-determined condition in said system, ancillary "notification of call" signaling means including a signaling lamp located at each station and connected in series with the wires specific to the station, booster means connected to said wires and adapted to inject a boosting voltage in the circuit of said lamp in response to an attempt to establish communication between a station of the system and another specific station thereof, and automatic inverter means including an office battery having a negative pole and an earthed positive pole, an inverter relay comprising an energising winding one end of which is connected to the negative pole of said battery, a balancing winding magnetically balancing out said energising winding under normal conditions and connected across said office battery in series with a resistance, an upper fixed contact and a lower fixed contact, a movable arm, a double contact on said movable arm having an upper side and a lower side, said arm extending between said upper and said lower contacts and having a normal position in which the upper side of the double contact is in electrical engagement with said upper fixed contact, and an attracted position in which said lower side of the double contact is in electrical engagement with said lower fixed contact, said arm being adapted to be moved from its normal to its attracted position upon effective energisation of said energising winding, and being connected to one side of said boosting device, said lower contact being connected to said first wire and said upper contact being connected to said second wire, and a pentode having an earth connected plate, a cathode in series with a cathode grid, an accelerating grid and a control grid, a resistance having a positive end connected to said cathode and a negative end connected to said control grid and to the other end of said energising winding, said accelerating grid being connected through an impedance to said first wire, whereby on inversion of the polarity of said wires, the polarity

of said accelerating grid is changed to control the flow of current to said energising winding and thereby cause movement of said arm from one of its positions to the other to change the connections of said boosting device to said wires.

8. In a Strowger type telephone system comprising a plurality of stations, a final selector operatively associated with each station by means including a first station wire and a second station wire of invertible polarities and a wiper in each wire adapted to connect the respective wire to the respective final selector, an office battery having an earthed positive pole and a negative pole, each station including a receiver connected across said first and second wires an impedance relay having a positive winding one end of which is connected to the positive pole of the office battery and the other end of which is adapted to be connected to the wire having positive polarity, and a negative winding connected at one end to the negative pole of said office battery and adapted to be connected at its other end to the wire having negative polarity, said final selector including a liberator relay having operatively associated therewith a normally open contact adapted to be closed on energisation of said liberator relay, a wiper control relay and a normally closed contact operatively associated with said wiper control relay and adapted to be opened on energisation of said wiper control relay, ancillary signaling means including a lamp located at and in series with the receiver of each station, boosting means adapted to inject a boosting voltage in the circuit of said lamp and comprising a series energising circuit including said normally open contact and said normally closed contact, a boosting device adapted to be energised by said series circuit and having one side connected through said office battery to said negative winding, and another side adapted to be connected to the wire having positive potential, and inverter means including an upper fixed contact connected to one of said wires and a lower fixed contact connected to the other wire, a double contact connected to said other side of boosting device and having a normal position establishing connection with said upper contact and an operated position establishing connection with said lower contact, relay means including an energising winding and adapted on effective energisation to move said double contact from the normal to the operated position, and thermionic control means for controlling the energisation of said energising winding and including an accelerating grid connected to one of said wires, whereby an energisation of said liberator relay the series circuit is established to energise the boosting device and said thermionic control means acts to cause said relay to ensure connection of said other side of the boosting device to the wire having positive potential at the time, and on energisation of said wiper control relay said series circuit is broken and said ancillary signaling means rendered inoperative.

9. In a Strowger type telephone system, ancillary signaling means according to claim 8, in which the booster device is a diode having a plate connected through said office battery to said negative winding, and a cathode connected to said double contact through an impedance.

10. In and for a telephone system comprising a plurality of stations each including a receiver circuit, ancillary signaling means including a lamp connected in series in said receiver circuit and booster means for injecting a boosting voltage in

said receiver circuit for causing glowing of said lamp, means for producing intermittency in the glowing of said lamp during continued excitation of said booster means, said intermittency producing means comprising a diode having a plate and a filament, an energizing circuit for the filament including a battery having a negative pole connected to one end of the filament and a positive pole, and an interruptor comprising separable contacts in series between the positive of said battery and the other end of the filament and means for causing separation and closure of said contacts, a triode having an anode, a cathode connected to the plate of the diode by a series connection including a resistance, an impedance and a second battery, a grid connected to the negative end of the filament through a second impedance, a pair of output terminals one of which is connected to said anode and the other of which is connected to a point between said resistance and the first mentioned impedance, said intermittency producing means including a condenser connected between the ends of the impedances proximate to said diode and a second condenser connected between the ends of the impedances remote from said diode, and a resistance connected across said second condenser, said output terminals being adapted to be connected between the booster means and the receiver circuit to cause pulsation of the injected boosting voltage and thereby intermittent glowing of said lamp.

11. In a telephone system comprising a plurality of stations operatively associated for voluntary selective intercommunication between any two stations, each station including means for calling another selected station, means adapted on establishment of intercommunication between two stations to render ineffective the calling means of the other stations with regard to said intercommunicated station during persistence of the intercommunication, ancillary means, including visible signaling means at each station, operatively associated with the system, and means including a thermionic valve controlled circuit for energizing the signaling means, and adapted to enable a signal to be made from any non-intercommunicated station to any intercommunicated station during the period of intercommunication.

12. In a telephone system comprising a plurality of stations operatively associated for voluntary selective intercommunication between any two stations, each station including means for calling another selected station, means adapted on establishment of intercommunication between two stations to render ineffective the calling means of the other stations with regard to said intercommunicated stations during persistence of the intercommunication, ancillary means, including visible signaling means at each station, operatively associated with the system, means including a thermionic valve having a filament circuit controlled by a relay responsive to an incoming call, and a plate circuit associated with the signaling means to energize the latter upon completion of said filament circuit.

13. In a telephone system comprising a plurality of stations operatively associated for voluntary selective intercommunication between any two stations, each station including means for calling another selected station, means adapted on establishment of intercommunication between two stations to render ineffective the calling means of the other stations with regard to said intercommunicated station during persistence of the

intercommunication, ancillary means, including luminous signaling means at each station, operatively associated with the system, and means including a thermionic valve controlled circuit for energizing the signaling means and adapted to enable a non-interrupted signal to be made from any non-intercommunicated station to any intercommunicated station during the period of intercommunication.

14. In a telephone system comprising a plurality of stations operatively associated for voluntary selective intercommunication between any two stations, each station including means for calling another selected station, means adapted on establishment of intercommunication between two stations to render ineffective the calling means of the other stations with regard to said intercommunicated station during persistence of the intercommunication, ancillary means, including luminous signaling means at each station, operatively associated with the system, means including a thermionic valve having a filament circuit controlled by a relay responsive to an incoming call, and a plate circuit associated with the signaling means to energize the latter upon completion of said filament circuit.

15. In a telephone system comprising a plurality of stations operatively associated for voluntary selective intercommunication between any two stations, each station including means for calling another selected station, means adapted on establishment of intercommunication between two stations to render ineffective the calling means of the other stations with regard to said intercommunicated station during persistence of the intercommunication, automatically operated ancillary means, including luminous signaling means at each station, operatively associated with the system, means including a thermionic valve controlled circuit for energizing the signaling means, and an oscillator in said thermionic valve controlled circuit, and adapted to enable an intermittent signal to be made from any non-intercommunicated station to any intercommunicated station during the period of intercommunication.

16. In a telephone system comprising a plurality of stations operatively associated for voluntary selective intercommunication between any two stations, each station including means for calling another selected station, means adapted on establishment of intercommunication between two stations to render ineffective the calling means of the other stations with regard to said intercommunicated station during persistence of the intercommunication, automatically operated ancillary means, including luminous signaling means at each station, operatively associated with the system, means including a thermionic valve having a filament circuit controlled by a relay responsive to an incoming call, a plate circuit associated with the signaling means to energize the latter upon completion of said filament circuit, and an oscillator interposed in said plate circuit, and adapted to enable an intermittent signal to be made from any non-intercommunicated station to any intercommunicated station during the period of intercommunication.

17. In a semi-automatic telephone system comprising a plurality of stations, each station including calling means for calling any other station, receiving means for receiving communications from any one other station at a time, said calling means comprising signaling means in-

stalled in each station and adapted to be operated on actuation selectively of the calling means of a station to emit a "call" signal, said receiving means being adapted when in operative position, in which intercommunication is established between said receiving means and a selected station, to cut out the signaling means of the station comprising said intercommunicated receiving means, whereby said station is placed in engaged condition and isolated from all other stations except said selected station, ancillary means, including visible "notification of call" signaling means connected to said receiving means, operatively associated with the system, and means including a thermionic valve controlled circuit and adapted, on operation of the calling means of a non-intercommunicated station to call a specific intercommunicated station, to actuate the visible signaling means at said specific intercommunicated station, without connecting the receiving means of said specific station to earth or to other circuits, during persistence of the intercommunication, whereby visible, acoustically non-interfering notification is given at the said specific station that an endeavor is being made to call said specific intercommunicated station.

18. In a semi-automatic telephone system comprising a plurality of stations, each station including calling means for calling any other station, receiving means for receiving communications from any one other station at a time, said calling means comprising signaling means installed in each station and adapted to be operated on actuation selectively of the calling means of a station to emit a "call" signal, said receiving means being adapted when in operative position, in which intercommunication is established between said receiving means and a selected station, to cut out the signaling means of the station comprising said intercommunicated receiving means, whereby said station is placed in engaged condition and isolated from all other stations except said selected station, ancillary means, including visible "notification of call" signaling means connected to said receiving means, operatively associated with the system, and means including a thermionic valve having a filament circuit controlled by a relay responsive to an incoming call, and a plate circuit associated with the signaling means to energize the latter upon completion of said filament circuit, without connecting the receiving means of said specific station to earth or to other circuits, during persistence of the intercommunication, whereby visible, acoustically non-interfering notification is given at the said specific station that an endeavor is being made to call said specific intercommunicated station.

19. In a semi-automatic telephone system comprising a plurality of stations operatively associated by conducting lines for voluntary selective intercommunication between any two stations at a time, each station comprising calling means adapted to call any other station of the system and including audible call signaling means installed in the other stations, receiving means having an inoperative position which said call signaling means is in operable condition and a receiving position in which said receiver is intercommunicated with another station and said call signaling means is cut out, thereby isolating the lines interconnecting the intercommunicated stations from the calling means of all other stations and placing said interconnecting lines

in engaged condition, means incorporable in said system and including actuating means operatively associated with said calling means, and a signal lamp installed at each station, each signal lamp being connected to the line proper to the station at which said signal lamp is installed, said actuating means being adapted to be operated on a call being made by said calling means from a non-intercommunicated station to an intercommunicated station, to transmit energy along the engaged lines of said intercommunicated station to the signal lamp therein installed and including a thermionic valve having a cathode the heating of which is controlled by said calling means to effect said transmission of energy to said signal lamp gradually, whereby to give a visible acoustically non-interfering "notification of call" signal at said intercommunicated station.

20. In a semi-automatic telephone system comprising a plurality of stations, each having calling means for calling another station, call signaling means for signaling calls made from another station and receiving means, said stations being operatively associated for voluntary selective intercommunication between any two stations by means including final selectors operatively associated with said call signaling means, automatic ancillary means including a visible signaling means at each station and operatively associated with the calling means of each station, said automatic ancillary means including a source of energy, and thermionic circuit completing means responsive to the calling means of a calling station to gradually apply energy from said source to actuate the visible signaling means of a selected station if intercommunicated with another station, whenever the final selector of the selected station is actuated by a call from a non-intercommunicated station to said intercommunicated station, whereby at said selected station visible notification is given of the desire of said non-intercommunicated station to establish communication connection with said selected station.

21. In a telephone system comprising a plurality of stations each including a receiver circuit, ancillary signaling means including a lamp connected in series in said receiver circuit and booster means for injecting a boosting voltage in said receiver circuit for causing glowing of said lamp, said booster means comprising a circuit including a source of energy and said lamp, a thermionic valve for completing said circuit, and means responsive to call from a calling station for energizing said thermionic valve to complete said circuit of the booster means.

22. In a telephone system comprising a plurality of stations each including a receiver circuit, ancillary signaling means including a lamp connected in series in said receiver circuit and booster means for injecting a boosting voltage in said receiver circuit for causing glowing of said lamp, said booster means comprising a circuit including a source of energy and said lamp, a thermionic valve for completing said circuit, means responsive to call from a calling station for energizing said thermionic valve to complete said circuit of the booster means, and means for producing intermittency in the glowing of said lamp during continued excitation of said booster means.

23. In a telephone system comprising a plurality of stations each including a receiver circuit, ancillary signaling means including a lamp

connected in series in said receiver circuit and booster means for injecting a boosting voltage in said receiver circuit for causing glowing of said lamp, said booster means comprising a circuit including a source of energy and said lamp, a thermionic valve for completing said circuit, means responsive to call from a calling station for energizing said thermionic valve to complete said circuit of the booster means, means for producing intermittency in the glowing of said lamp during continued excitation of said booster means, said intermittency producing means comprising a diode having a plate and a filament, an energizing circuit for the filament including a battery having a negative pole connected to one end of the filament and a positive pole, an interruptor comprising separable contacts in series between the positive of said battery and the other end of the filament, means for causing separation and closure of said contacts, a triode having an

anode, a cathode connected to the plate of the diode by a series connection including a resistance, an impedance and a second battery, a grid connected to the negative end of the filament through a second impedance, a pair of output terminals one of which is connected to said anode and the other of which is connected to a point between said resistance and the first-mentioned impedance, said intermittency producing means including a condenser connected between the ends of the impedances proximate to said diode and a second condenser connected between the ends of the impedances remote from said diode, and a resistance connected across said second condenser, said output terminals being adapted to be connected between the booster means and the receiver circuit to cause pulsation of the injected boosting voltage and thereby intermittent glowing of said lamp.

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