

Oct. 19, 1943.

A. H. INGLIS

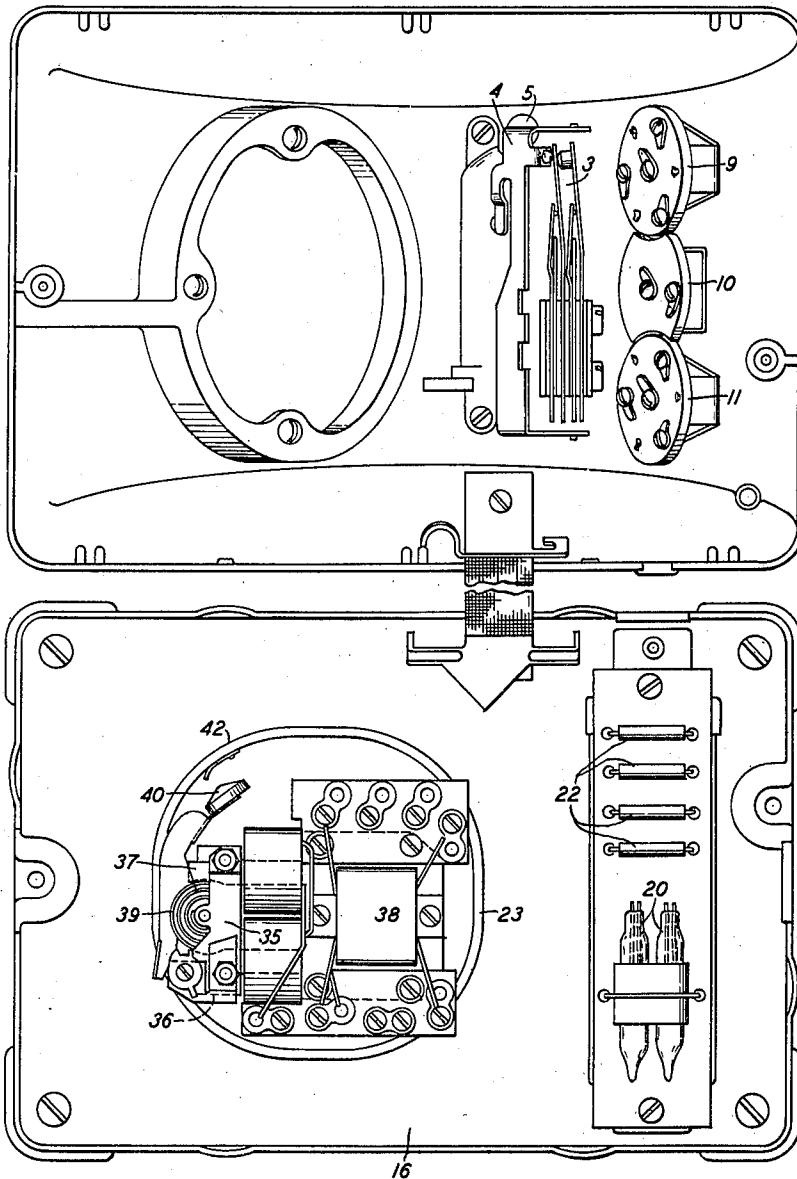
2,332,448

TELEPHONE SYSTEM

Filed Oct. 22, 1940

3 Sheets-Sheet 1

FIG. 1



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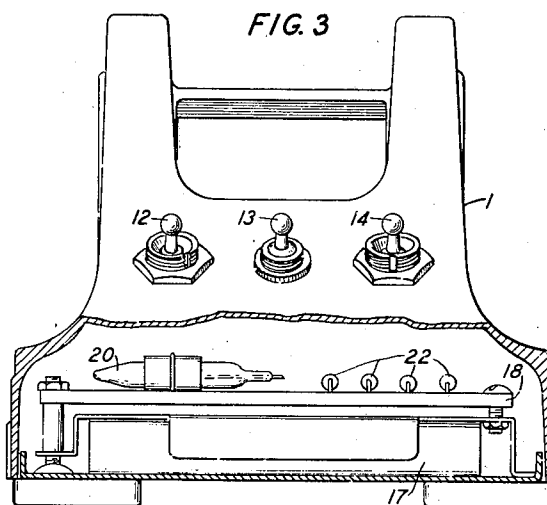
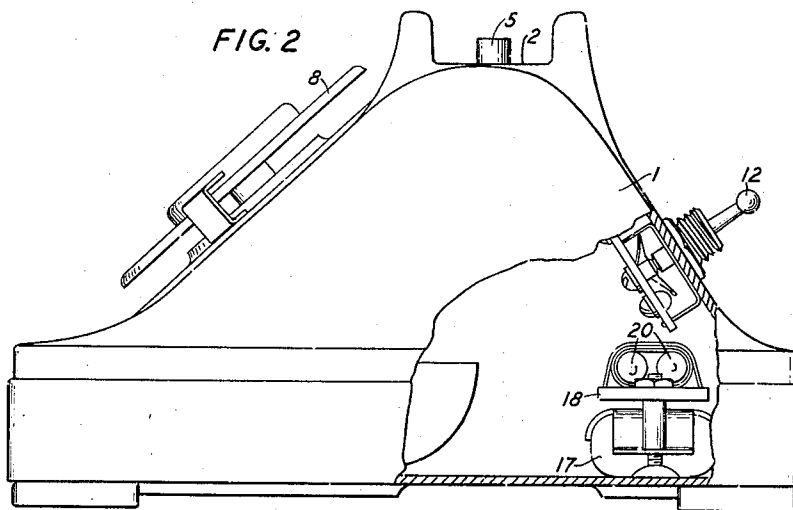
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3 Sheets-Sheet 2



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TELEPHONE SYSTEM

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2,332,448

TELEPHONE SYSTEM

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Application October 22, 1940, Serial No. 362,205

8 Claims. (Cl. 177-7)

This invention relates to telephone systems and particularly to improvements in subscribers' telephone equipments.

The objects of the invention are to improve the ringing equipment in subscribers' telephone sets, to provide greater flexibility in the sound output of the ringer when the subscriber is called, and to effect other improvements in telephone systems.

Heretofore arrangements have been proposed in which when a subscriber is called, ringing signals were gradually increased in sound intensity until the subscriber answers by means of equipment whereby the ringer gongs are normally mechanically damped so that when first actuated they emit a subdued sound and whereby as the ringing current continues a bimetallic heater element functions to mechanically and gradually lessen the damping of the ringer gong so as to gradually increase the sound output thereof.

It is a feature of the applicant's invention to avoid mechanical damping means for ringers in subscriber's telephone equipments to gradually increase the sound intensity by providing a ringer operative to increase its sound intensity in response to an increase in the applied ringing current and by providing a separate means associated with said ringer for gradually increasing the operating voltage across the ringer from an alternating current source of constant voltage at a central office. This increase in voltage causes the increased flow of current through the ringer.

It is another feature of the applicant's invention to provide such separate means consisting of a resistance element having negative resistance-current characteristics, such as a boron or so-called thermistor element for example, which increases in temperature as a constant voltage is applied across it to produce a gradual increase in voltage across and current through the element. Thus a ringer in series with this element which operates with a sound intensity that increases with increase in current will be controlled to increase the sound intensity accordingly.

Another feature of the applicant's invention is to provide an arrangement at a subscriber's station whereby the rate of the gradually increasing sound intensity of the ringer may be altered manually at will. For example, some subscribers may desire a ringer arrangement whereby the ringer will operate with a gradual increase in intensity over a considerable time period before it attains its full value, whereas other subscribers may desire ringers that increase the

sound intensity to the full volume within a comparatively short period of time, while still other subscribers may desire different timing periods during which the ringer will attain its full volume at different periods of day or night to meet specific requirements. To this end elements having correspondingly different non-linear resistance characteristics are provided in the form of individual capsules or other suitable units and means in the subscriber's telephone set are also provided whereby such capsules may be inserted, removed or interchanged to cause the ringers to perform in accordance with requirements desired at the moment by the subscriber. Such capsules may take the form of individual structures, for example, such as a glass container in which the resistance elements are enclosed and which are provided with metallic end caps to which the elements are electrically connected. These capsules may be inserted between clamps connected in circuits with the ringer.

It is another feature of the applicant's invention to provide, in conjunction with the arrangement for gradually increasing the sound intensity of the ringer, arrangements whereby the sound intensity may be changed and held at any one of several constant values, for example, the subscriber may desire a constant low sound of the ringers or an intermediate sound or a sound of high intensity at different periods of the day or night.

It is another feature of the applicant's invention to provide in a telephone set manually operated mechanism such as switches for adjusting and controlling the insertions and removals in the circuits for the ringer of the resistance elements having negative resistance characteristics or the pure resistance elements to produce the desired sound intensities required.

A ringer unit suitable for use in connection with arrangements of this kind may be of the type disclosed in the copending application of E. Dickten and H. C. Harrison, Serial No. 362,204, filed October 22, 1940.

With this arrangement of the applicant's invention the armature will strike the gong with an intensity that increases with increase in the current applied and the sound intensity may be regulated from a soft pleasing sound to a more arresting sound of greater volume while the time during which the increasing sound intensity takes place may be varied by the characteristics of the elements that may be inserted and interchanged in the telephone set or the sound in-

tensity may be changed to different constant volumes as required.

This invention has been illustrated in the accompanying drawings in which:

Figs. 1, 2 and 3 show various views of a subscriber's telephone set arranged in accordance with applicant's invention.

Fig. 1 is an interior view of the housing and the bottom plate showing the location of the various instruments located therein;

Fig. 2 is a side view of the set with a portion broken away to show the control switches and resistance elements;

Fig. 3 is a rear view of the set showing the exterior portions of the switches;

Fig. 4 is a diagram showing a telephone circuit in which the applicant's invention has been incorporated;

Fig. 5 shows a modified circuit of a portion of the applicant's invention as applied to a telephone circuit;

Figs. 6, 7 and 8 show various curves relating to the functioning of the applicant's invention; and

Fig. 9 shows a type of thermistor element and its mounting.

Referring now to the drawings, the telephone set consists of the housing 1 having a cradle portion 2 in which the usual handset, not shown, may be placed to control switching contacts 3 through the medium of a cradle member 4 acted upon by a plunger 5 so that when the handset is resting in the cradle, switching contacts 3 are opened to disconnect the telephone set from the central office line and when the handset is removed the contacts 3 are closed to connect the telephone circuit to the line. At the front of the housing is mounted the usual dial mechanism 8. Inside the housing at the rear thereof are mounted the switches 9, 10 and 11 having control levers 12, 13 and 14, respectively extending outside of the housing. These switches are of the type in which the levers 12 and 14 may be moved in three different positions to close separate connections and the switch 10 is of the type in which the lever 13 may be moved in one direction to close a single connection. The housing 1 rests on the bottom plate 16 in which are mounted on the inside thereof condenser 17 and on a mounting plate 18 as shown two thermistor elements 20 and four resistance elements 22. On the bottom plate is also mounted a ringer 23 of the type suitable for use in connection with the present disclosure. In place of the arrangements of these thermistors 20 as shown in Fig. 1, the arrangement may be arranged in accordance with that shown in Fig. 9 namely a thermistor element 25 may be enclosed in a vessel or capsule 26 having metal caps 27 and 28 to which the terminals of the thermistor element are connected. This capsule may be inserted between the clips 29 and 30 which may be mounted on the mounting plate 18. It is evident that more than one of these capsules may be employed if required and that capsules having thermistor elements of different characteristics may be inserted and replaced by other elements to provide for different requirements. With regard to the ringer 23, it may be of such construction as to change its sound intensity with changes in current passing through it. The ringer may consist of the rotor or armature 35 consisting of a permanent magnet of soft iron poles which is rotatable within the pole-pieces 36 and 37 of the stator consisting of a laminated structure on which the energizing

coil 38 is mounted. Normally the armature is held in a neutral position by the spiral spring 39 and is provided with a clapper 40 operating on the gong 42. When the coil is energized by alternating current the armature will be acted upon to move alternately in opposite directions to cause the clapper to act on the gong. The sound output will depend on the force with which the clapper strikes against the gong. This force depends on the magnitude of the current passing through the coil. It is evident therefore that as the sound intensity depends on the current applied to the coil various effects may be produced by changes in the current supplied. This change in sound intensity is illustrated by curve 43 in Fig. 6 which represents the increase in sound intensity as measured by decibels for various voltages applied to the ringer. The thermistor characteristics may be illustrated by the curve 46 as shown in Fig. 7. This curve indicates how the resistance decreases with the passage of time and the consequent increase in current through the elements.

A description will not be made of the functioning of the applicant's invention in connection with the circuit diagram shown in Fig. 4. The telephone circuit consists of the usual handset 50, switching contacts 51, induction coil 52, dial 53 and a ringer 54 of the type suitable for use in this arrangement in series with a condenser 55 and the tip and ring conductors T56 and R57 to a central office which is indicated diagrammatically in sufficient detail to illustrate the application of ringing current from an alternating or direct current source 59 by the operation of a key 60 or by the application of ringing current from source 59 at intervals by the operation of key 61 which connects the source at intervals through an interrupter 62. The control of the operation of the ringer 54 to regulate its sound intensity is effected by the switches 9, 10 and 11, resistances 63, 64, 65 and 66 and thermistor element 67 in various manners as will be hereinafter described.

If reference is first made to Fig. 8, the curve 70 indicates the increase in sound intensity as measured by decibels with the passage of time, when a steady alternating current is applied by the operation of key 60 from the source 59. If key 61 is operated and the current from source 59 is interrupted by the interrupter 62 the operation of the ringer 54 will be intermittent and due to these intervals between the application of ringing current, the volume as measured in decibels of the ringer will increase in intensity at a much slower rate as for example is indicated by the curve 71. Such and various other controls over the operation of ringers may be exercised by the manipulation of keys 9, 10 and 11 and may be outlined as follows: It may be desired, for example, to have the sound intensity of a constant volume but comparatively low in tone, or of a medium or higher toned steady sound intensity may be required. On the other hand it may be required to have the sound start immediately upon the operation of the control switches and the application of the ringing current with a low sound intensity that increases in volume with the passage of time or it may be required that the starting be delayed for some short period after the ringing current has been applied. This latter type of control may be required in case, for example, for secretarial extensions or similar arrangements where a call is to be answered by a secretary only in the

event that the party at the main station does not answer the call immediately. With these various types of controls in mind, detailed descriptions will now be made. If a low constant sound intensity is required, the switch 9 may be operated to establish a connection at contact 73 and switch 11 may be operated to establish a connection at contact 74. Thus a circuit for the ringer is extended from the ring conductor R57, condenser 55, ringer 54, resistance 64, contact 73 of switch 9, contact 74 of switch 11, back to the tip conductor T56. In this case the resistance 64 is comparatively high and in series with the ringer and consequently the ringer will operate with a low intensity at a constant volume when ringing current from source 59 is applied at the central office by the operation of key 60. If a medium constant volume is desired, the switch 9 is operated to establish a connection at contact 75 and switch 11 is operated to establish a connection at contact 74. In this case the circuit for the ringer 54 extends through the resistance 63, contact 75 of switch 9, contact 74 of switch 11. As the resistance 63 is somewhat lower than 64, the ringer will operate with a constant volume of medium intensity. If a high constant volume is required, the switch 9 will be operated to establish a connection at contact 75 and the switch 11 will remain to establish a connection at the contact 74. In this case the circuit for the ringer 54 extends through the ringer directly through contact 76 at switch 9 and contact 74 at switch 11 without any resistance in series and will consequently produce a sound of higher intensity. In case a sound intensity increasing with time and starting immediately is required, the switch 11 is operated to establish a connection at contact 73 and the switch 10 is operated to close a connection at contact 79. A circuit for the ringer now extends through the thermistor element 67, contact 73 of the switch 11 to the line and another connection is established in parallel of the thermistor 67 through resistance 65 and contact 79 of switch 10. Thus the thermistor 67 is shunted by resistance 65 which is of a rather high resistance so as to produce a sound intensity that increases with time, for example in accordance with the curve 70 of Fig. 8 and the operation of the ringers starts immediately upon the application of the ringing current from source 59. If it is desired that the volume should increase with time but with a delay in starting for a short period after the application of the current from source 59, switch 11 is operated to establish a connection at contact 80. In this case the circuit for the ringer is extended through thermistor element 67, resistance 66 and contact 80 of switch 11. As the resistance 66 is comparatively low but in series with the thermistor 67, there will be a short delay in starting the operation of the ringer after the current has been applied at source 59. Intermittent ringing current is applied from the central office by the operation of key 61 and if the thermistor element 67 is inserted in series with the ringer directly through resistance 66 or over the resistance 65 in shunt of the thermistor element 67 the ringer will operate intermittently and the volume will increase with time at a lower rate than when a steady ring is applied, somewhat along the lines as indicated by the curve 71. It is evident that these resistance values mentioned may be varied and that the switches 9, 10 and 11 may be

manipulated differently at different periods of the night or day as desired by the subscriber to secure corresponding sound effects from the ringer.

A modified arrangement of thermistor elements may be made in accordance with the applicant's invention as illustrated in Fig. 5. For example, a pair of thermistor elements 90 and 91 and switches 92 and 93 may be provided in place of the thermistor element 67 in the circuit shown in Fig. 4. In this case the switch 92 may be operated to include either of the thermistor elements 90 or 91 or the switch 93 may be operated to include both thermistor elements 90 and 91 in parallel in the circuit shown in Fig. 4. Thus the operating characteristics of the ringer may be changed in accordance with the negative characteristics of these thermistor elements as connected in the different combinations by the switch 92 or 93. The thermistor element 67 may also readily be changed by having an arrangement as shown in Fig. 9 whereby capsules such as shown in this figure may be interchanged and in which the thermistor elements have different characteristics. Such interchanges may, of course, take place without disturbing any of the permanent connections of the telephone sets and may be made by the operating companies or by the subscribers themselves as desired.

What is claimed is:

1. The combination of a ringer responsive to increasing current to operate with a correspondingly increasing sound intensity, with a source of current and an element having negative resistance characteristics, connectable to said source of current and ringer to cause said ringer to operate at an increasing intensity with time as determined by increase in current through said element from said source.
2. The combination of a ringer having characteristics such that its sound intensity increases proportionally to the increase in operating current applied thereto, with a source of alternating current, a plurality of elements each having a different negative resistance characteristic, switching means for connecting any one of said elements with said ringer and said source of current in series, each of said elements responsive to current from said source for applying to said ringer current that will increase from a minimum to a maximum within its different corresponding time period to cause the ringer to increase its sound intensity accordingly.
3. The combination of a ringer having characteristics such that its sound intensity increases proportionally to the increase in operating current applied thereto, with a source of current, an element having a negative resistance characteristic, whereby resistance decreases at certain rates with time as a certain voltage is applied across it, a resistance connectable across said element to decrease the normal rate of change thereof, a circuit and switching means for connecting said element in parallel with said resistance and in series with said ringer, and means for applying current from said source to said circuit to cause said ringer to respond to increase its sound intensity at the rate determined by said element and said resistance connected across it.
4. The combination of a ringer responsive to increase in current to operate with a sound intensity that increases at a rate corresponding to the rate of increase of current in said ringer, with a source of current, a resistance element having negative resistance characteristics, a resistance

connectable in series with said element, and means for connecting said ringer in series with said element, resistance and source of current to cause said ringer to be actuated a certain interval after the source of current has been applied at a rate increasing with time as determined by the negative characteristics of said element.

5. The combination of a line with a ringer at one end thereof operative to increase its sound volume output in response to a corresponding increase in current passing through it, a source of current of constant voltage connectable to the other end of said line and means having a negative resistance characteristic connected to the line at the same end as the ringer and in series therewith responsive to current from said source when said source is connected to the opposite end of said line for gradually increasing current through said ringer to cause it to change its sound volume output accordingly.

6. The combination of a line with a ringer at one end thereof operative to increase its sound volume output in response to a corresponding increase in current passing through it, a source of current of constant voltage connectable to the other end of said line, and means having a negative resistance characteristic connected to the line at the same end as the ringer and in series therewith responsive to current from said source when said source is connected to the opposite end of the line for applying to said ringer current from said source that will increase from a minimum to a maximum value within a definite time period to cause said ringer to increase its sound volume intensity accordingly within said definite time period.

7. The combination of a line with a ringer at one end thereof having characteristics such that its sound volume output increases proportionally to the increase in operating current applied thereto, a source of current of constant voltage connectable to the other end of said line, a plurality of different resistance units at the same end of the line as the ringer, a circuit and switching means at the same end of the line as the ringer for connecting any resistance unit in series with the ringer in the line, and an element having negative resistance characteristics connectable by said circuit and switching means to the same end of the line as the ringer and in series with a connected resistance unit and the ringer, and responsive to the current from said source when said source is connected to the opposite end of the line for gradually increasing current through the ringer as controlled by said element and modified by the connected resistance unit to cause said ringer to change its sound volume output accordingly.

8. The combination of a line with a ringer at one end thereof operative to increase its sound volume output in response to a corresponding increase in current passing through it, a source of current of constant voltage connectable to the other end of said line, and means having negative resistance characteristics connectable to the line at the same end as the ringer and in series therewith responsive to impulses of current from said source received over said line for gradually increasing the current of said impulses through said ringer causing a change in sound volume output for each succeeding impulse of current.

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