

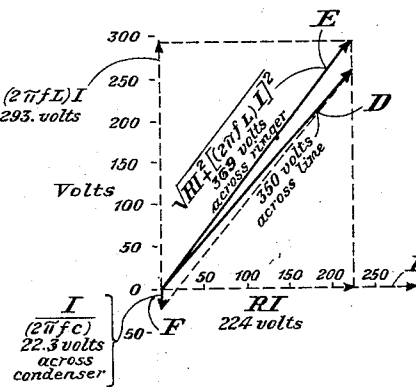
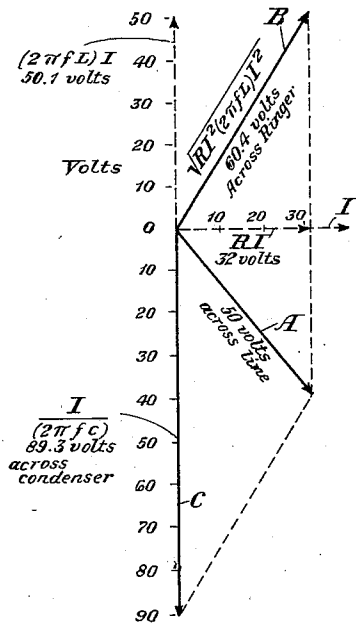
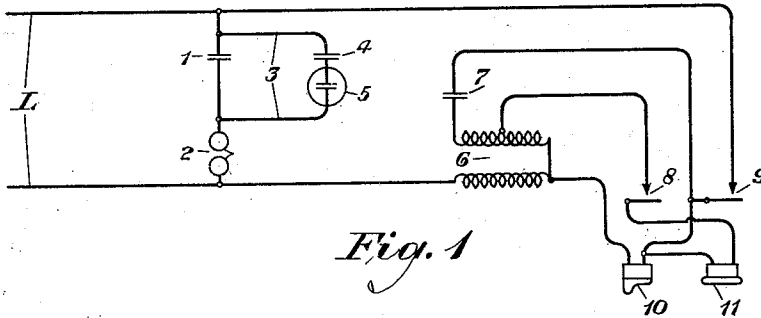
June 28, 1932.

W. H. EDWARDS

1,864,645

TELEPHONE SIGNALING SYSTEM

Filed June 27, 1931



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## UNITED STATES PATENT OFFICE

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## TELEPHONE SIGNALING SYSTEM

Application filed June 27, 1931. Serial No. 547,335.

This invention relates to telephone systems and more particularly to improvements in signaling arrangements associated with such systems.

One of the primary objects of the invention consists in providing at a telephone station a visual signal, such for example as a neon lamp, operated by the ringing voltage applied to the line. A further object of the invention consists in providing improved means for associating the visual signal with the line so that adequate voltage for operating the lamp may be obtained without the use of transformers for stepping up the applied ringing voltage and without the use of relays and separate sources of voltage. Further objects of the invention consist in providing means for so associating the visual signal with the line that false operation thereof may be avoided from dialing impulses and from certain types of testing currents. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

In the arrangements of the invention the visual signal, or neon lamp, is connected directly across the condenser of the usual ringing apparatus connected across the line at the station. The arrangements of the invention thus make use of the resonant effect of the station ringer circuits to obtain from the applied ringing current the high voltage necessary to break down the neon lamp inasmuch as the peak ringing voltage across the condenser is higher than across the ringer and condenser. As impulses set up by the dialing operation, which might cause false operation, are relatively high in frequency there is relatively little voltage drop across the ringing condenser as it is of relatively low impedance to the frequencies having the highest voltage. Accordingly, the arrangements of the invention prevent the visual signal from being operated falsely on the impulses set up by dialing. In the arrangements of the

invention a condenser may also be provided in series with the neon lamp to prevent false operation on insulation and breakdown tests made from the test desk.

The invention may be more fully understood from the following description together with the accompanying drawing in the Figures 1, 2 and 3 of which the invention is illustrated. Fig. 1 is a circuit diagram illustrating a preferred embodiment of the invention. Figs. 2 and 3 are vector diagrams illustrating the principles of operation of the invention.

In Fig. 1 is shown a telephone line L terminating in a subscriber's station. Bridged across the line would be the usual station ringing apparatus comprising the condenser 1 and ringer 2. The subscriber's apparatus comprises the usual induction coil 6, the condenser 7, switchhook contacts 8 and 9, the transmitter 10 and the receiver 11. Bridged directly across the ringing condenser 1 is a circuit 3 including the condenser 4 and the visual signal device 5, which may be a neon lamp. A neon lamp has the characteristic that it requires a certain minimum peak voltage to cause it to break down, which is substantially independent of frequency. In order to obtain the relatively high voltage to cause the tube to break down which in certain commercial neon lamps is approximately 110 volts it is connected directly across the ringing condenser 1 as shown. The tube will break down and operate when alternating ringing current is applied to the line under those conditions. By connecting the neon lamp to the line in the manner shown the arrangements of the invention make use of the resonant effect of the station ringer circuit to obtain from the applied ringing current the high voltage necessary to break down the neon lamp inasmuch as the peak ringing voltage across the condenser is higher than across the ringer and condenser. This will appear

more fully from reference to the vector diagram of Fig. 2.

In the vector diagram of Fig. 2 certain values will be assumed, for purposes of illustration, as an example of conditions applying on a dial telephone line with which it is desired to connect a neon lamp ringing signal in accordance with the arrangements of the invention. The values assumed for ringing frequencies are:

V=voltage across line at station=50 volts R. M. S.

L=inductance of ringer at  $10\frac{1}{6} \sim = 39.5$  henries.

R=effective resistance of ringer at  $19\frac{1}{6} \sim = 3000$  ohms.

C=capacity of condenser=1.0 microfarads.

The total impedance Z across the line is determined as follows:

$$Z = \sqrt{[2\pi fL - \frac{1}{2\pi fc}]^2 + R^2}$$

$$Z = \sqrt{[2\pi 19.17 \times 39.5 - \frac{1}{2\pi 19.17 \times 1.0 \times 10^{-6}}]^2 + (3000)^2}$$

$$Z = \sqrt{[4750 - 8300]^2 + (3000)^2}$$

$$Z = \sqrt{(-3550)^2 + (3000)^2}$$

$$Z = 4650 \text{ ohms.}$$

$$I = \frac{V}{Z} = \frac{50}{4650} = .01075 \text{ amperes.}$$

contacts at relatively slow speed is such that oscillations of relatively high frequency and voltage are produced across the line at the station. Assuming a frequency of 200 cycles for these oscillations, which is of course only representative inasmuch as there is a wide range of frequencies in the oscillations produced under different station conditions, the following values are obtained.

Vd=voltage across line due to dialing=350 volts effective.

Ld=inductance of ringer at 200  $\sim = 8.35$  henries.

Rd=effective resistance of ringer at 200  $\sim = 8000$  ohms.

C =capacity of condenser=1.0 microfarads.

Obtaining the total impedance across the line in a manner similar to that described

Referring to Fig. 2, which is a vector diagram showing the voltage drops across the various portions of the circuit, it will be seen from vector A that if the neon lamp is connected across the line it will receive a voltage of 50 volts R. M. S. which ordinarily is insufficient to break it down inasmuch as approximately 78 volts effective or 110 volts peak is required for this purpose. It will appear from vector B that if the neon lamp were connected across the ringer it would obtain 60.4 volts effective due to the combined drop across the resistance and inductive reactance of the ringer. It will appear from vector C, however, that if the neon lamp were connected across the condenser in accordance with the arrangements of the invention that the condensive reactance drop amounts to 89.3 volts effective. This is sufficient to break down and operate the neon lamp as the maximum instantaneous voltage is approximately 126 volts.

It has been pointed out that the arrangements of the invention will prevent false operation from dialing impulses. This will be more readily understood from the vector diagram of Fig. 3, in discussing which certain values for circuit conditions will be assumed for purposes of illustration. Under dialing conditions the make and break of the dial

heretofore, it appears that

$$Zd = 12,600 \text{ ohms}$$

$$Id = \frac{Vd}{Zd} = .028 \text{ amperes.}$$

Referring to the vector diagram of Fig. 3 showing the voltage drop across various portions of the circuit under dialing conditions, it will be seen from vector D that if the neon lamp is connected across the line the voltage of 350 volts would be sufficient to break it down and operate it falsely. Likewise it will appear from vector E that if the neon lamp were connected across the ringer the combined resistance and reactance drops would amount to 369 volts, which would operate the lamp falsely. However, if the lamp is connected across the 1.0 mf. condenser in accordance with the arrangements of the invention it will appear from vector F that the condensive reactance drop amounts to only 22.3 volts effective or 31.5 volts maximum instantaneous which is insufficient to operate the lamp. Accordingly, the arrangements of the invention will prevent the signal lamp from operating falsely on impulses due to dialing.

The condenser 4 of Fig. 1 in series with the lamp will serve to prevent continued false operation of the lamp on the usual insula-

tion and breakdown test made from the test desk.

A further use of the signaling arrangements of the invention might arise in connection with low-voltage code calling or auxiliary signaling systems in which 48 volt, 60 cycle alternating current is sent over telephone wiring to operate 60 cycle telephone ringers. A maximum value of approximately 48 volts is desirable from a protection standpoint, but is insufficient to operate commercial neon lamps directly. However, by connecting the neon lamp in the resonant ringer circuit across the terminals of the condenser or the ringer, whichever has the highest voltage, the neon lamp can be operated satisfactorily.

While the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claim.

What is claimed is:

A telephone line terminating at a subscriber's station, ringing apparatus comprising a condenser and a ringer bridged across said line at said station, and a signaling circuit connected directly across said condenser, said signaling circuit including a condenser and a cold cathode discharge tube.

In testimony whereof, I have signed my name to this specification this 26th day of June, 1931.

WILLIAM H. EDWARDS

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