

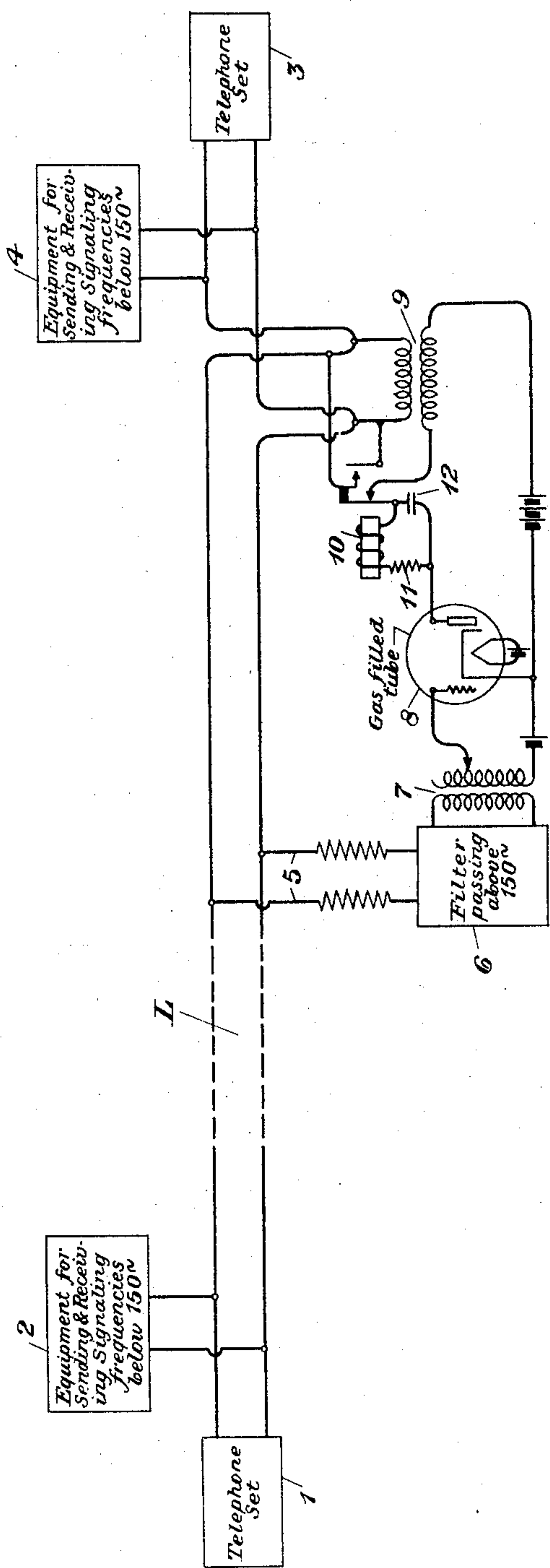
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PROTECTIVE DEVICE

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PROTECTIVE DEVICE

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This invention relates to telephone systems and more particularly to the association of arrangements with such systems for preventing acoustic shocks to operators and subscribers connected to such systems.

Certain types of telephone lines are exposed to excessive voltages from external sources such as adjacent power lines. This results not only in damage to equipment but also in serious acoustic shocks to telephone operators and subscribers. Heretofore, arrangements have been provided to protect the operators by placing a two-element cold cathode gas-filled tube in shunt with the operator's receiver. The constants of a tube of this type are such that the gas ionizes when the voltage across the receiver rises to harmful values. This ionization of the tube causes the impedance of the tube to be greatly reduced and hence effectively places a short circuit across the receiver throughout the duration of the excessive voltage, effectively preventing acoustic shock to the operator. Such an arrangement has the objection that it does not protect the subscriber and requires protective apparatus for each operator who has access to the exposed line. This might result in the provision of protective apparatus for ten or more operators, although only one or two lines are exposed. To overcome such objections, arrangements have also been proposed whereby the protective apparatus would be placed on a telephone line in such a manner that both the operator and subscriber would be protected and so that the number of protective devices would be in direct proportion to the number of exposed lines. Such devices might be shunted across the telephone line near the point where it enters the office. It has been found that such devices must operate on voltages as low as 10 or 15 volts. These devices would have the disadvantage that they would not permit 20-cycle or 135-cycle ringing or direct current telegraph, normally operating at voltages in excess of 15 volts, so it is obvious that such devices could not be used on lines upon which such signaling is superimposed.

The arrangements of the invention are particularly designed to overcome the above mentioned difficulties and, when associated with a telephone line, will not only prevent acoustic shocks but will allow the use of signaling currents such as 20 or 135-cycle signaling currents, which have operating voltages in excess of 15 volts. The operation of the arrangements of the invention is based on the fact that the signaling currents, which should not be interfered

with but which may have potentials greater than 10 volts, are all at comparatively low frequencies, for example, below 150 cycles, whereas the excessive voltages which are to be guarded against normally contain many components having higher frequencies as well as low frequencies. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

In the drawing is shown a circuit diagram embodying a preferred form of the invention.

In the drawing is shown a telephone line L which may be exposed to excessive voltages from external sources such as adjacent power lines. This line might connect the two telephone sets 1 and 3. Associated with each telephone set is the apparatus such as 2 and 4, for sending and receiving signaling frequencies below 150 cycles. Bridged across the telephone line by the circuit 5 would be a high pass filter 6, passing only frequencies above 150 cycles. Associated with the filter 6 by means of the transformer 7 would be the input circuit of a gas-filled tube 8. It is a well known property of tubes of this type that as long as the grid is sufficiently negative with respect to the cathode, ionization does not take place and the plate-to-cathode impedance is very high. However, when this negative potential is reduced to a value even slightly below the critical value, ionization takes place, permitting large currents to flow between the cathode and plate and reducing the plate-to-cathode impedance to very small values. It is also well known that this ionization will persist without regard to subsequent grid potentials until the plate potential is very materially reduced or interrupted. The plate circuit of this tube includes the primary winding of a transformer 9, the secondary of which is shunted across the telephone line in the manner shown. The constants of transformer 9 are such that when the impedance across the primary winding is very large the shunting effect of the secondary winding on the telephone line will be very small, but when the impedance across the primary is small the shunting effect of the secondary will be large.

The plate circuit of the tube also includes a resistance 11, the winding of a relay 10, and a normally made contact of such relay, all in series. The purpose of the resistance is to limit the current flow during ionization in order to safeguard the tube. The relay 10 also has a set of normally open contacts and the armature and contacts are so arranged that the nor-

mally open contacts are always closed when the normally closed contacts are open. The alternating current impedance of the resistance and relay winding is shunted by a condenser 12.

5 The normally open contacts are shunted across the telephone line.

When an excessive voltage is applied to the telephone line L, the high-frequency components thereof pass through the filter and reduce the negative potential of the grid, causing the gas in the tube to be ionized and hence changing the impedance across the primary of the output transformer 9 from a very high to a very low value. This effectively places an electromagnetic short circuit on the telephone line, preventing the production of acoustic shock and restoring the grid potential to normal. Ionization continues in the tube and the resultant flow of plate current causes the operation of relay 10, which places a mechanical short circuit across the telephone line and then opens the plate circuit of the tube, causing de-ionization to take place and the tube to return to normal. The relay 10 then releases, first closing the plate circuit and then removing the mechanical short circuit from the telephone line.

If the excessive voltage has not been dissipated in the meantime, the above cycle of operation will be repeated until such dissipation has been completed. The period of the cycle may be changed by changing the operate and release times of the relay, since the operate time of the electromagnetic short circuit is independent of relay times. It is pointed out that the gas-filled tube 8 will operate only on one-half of the impressed wave, but the device may be modified for full wave operation by the use of two tubes in push-pull relationship or one tube with two grids so connected.

While the invention has been disclosed as embodied in certain specific forms 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 claims.

What is claimed is:

1. A transmission line and a protective device associated therewith, said protective device comprising a circuit bridged across said line, a filter in said circuit designed to pass currents of frequencies above those ordinarily used for signaling over said line and to attenuate and practically extinguish currents of such signaling frequencies, a gas filled thermionic tube having its input connected to said circuit, and a transformer having its primary winding in the plate circuit of said tube and its secondary winding in shunt across said telephone line.

2. A transmission line and a protective device associated therewith, said protective device comprising a circuit bridged across said line, a filter in said circuit designed to pass currents of frequencies above those ordinarily used for signaling over said line and to attenuate and practically extinguish currents of such signaling fre-

quencies, a gas filled thermionic tube having its input connected to said circuit, and means controlled by said tube when operated for placing a magnetic short circuit across said telephone line.

3. A transmission line and a protective device associated therewith, said protective device comprising a circuit bridged across said line, a filter in said circuit designed to pass currents of frequencies above those ordinarily used for signaling over said line and to attenuate and practically extinguish currents of such signaling frequencies, a gas filled thermionic tube having its input connected to said circuit, and a transformer having its primary winding in the plate circuit of said tube and its secondary winding in shunt across said telephone line, the constants of said transformer being such that when the impedance across the primary is large the shunting effect of the secondary on the telephone line will be small and when the impedance across the primary is small the shunting effect of the secondary will be large.

4. A transmission line and a protective device associated therewith, said protective device comprising a circuit bridged across said line, a filter in said circuit designed to pass currents of frequencies above those ordinarily used for signaling over said line and to attenuate and practically extinguish currents of such signaling frequencies, a gas filled thermionic tube having its input connected to said circuit, a transformer having its primary winding in series in the plate circuit of said tube and its secondary winding connected in shunt across said telephone line, whereby when said tube operates a magnetic short circuit will exist across said line, a relay in series in the plate circuit of said tube, and means controlled by said relay for closing a mechanical short circuit across said telephone line and for opening said plate circuit.

5. A transmission line and a protective device associated therewith, said protective device comprising a circuit bridged across said line, a filter in said circuit designed to pass currents of frequencies above those ordinarily used for signaling over said line and to attenuate and practically extinguish currents of such signaling frequencies, a gas filled thermionic tube having its input connected to said circuit, a transformer having its primary winding in series in the plate circuit of said tube and its secondary winding connected in shunt across said telephone line, whereby when said tube operates a magnetic short circuit will exist across said line, a relay having its winding connected in said plate circuit in series with a normally closed contact of said relay, and a set of normally open contacts for said relay for controlling a mechanical short circuit across said telephone line, the armature and contacts of said relay being so arranged that the normally open contacts are always closed when the normally closed contacts are open.

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