Nov. 26, 1935. J. F. COOK, JR 2,022,406

PROTECTIVE DEVICE IN AMPLIFIER CIRCUIT

Filed July 7, 1931

Fig. 2

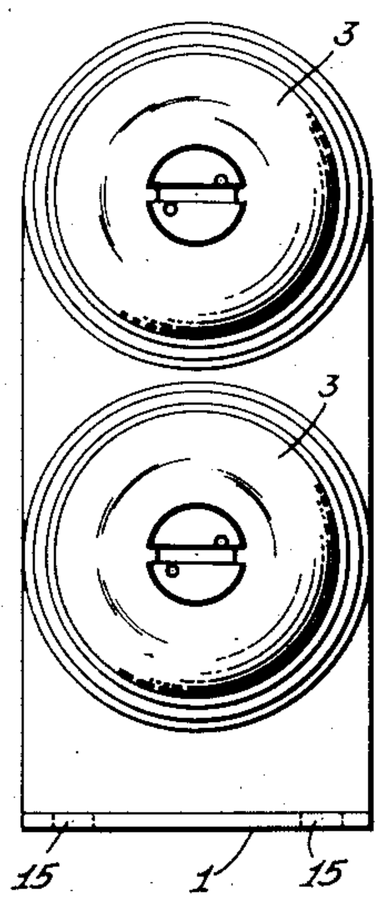


Fig. 3

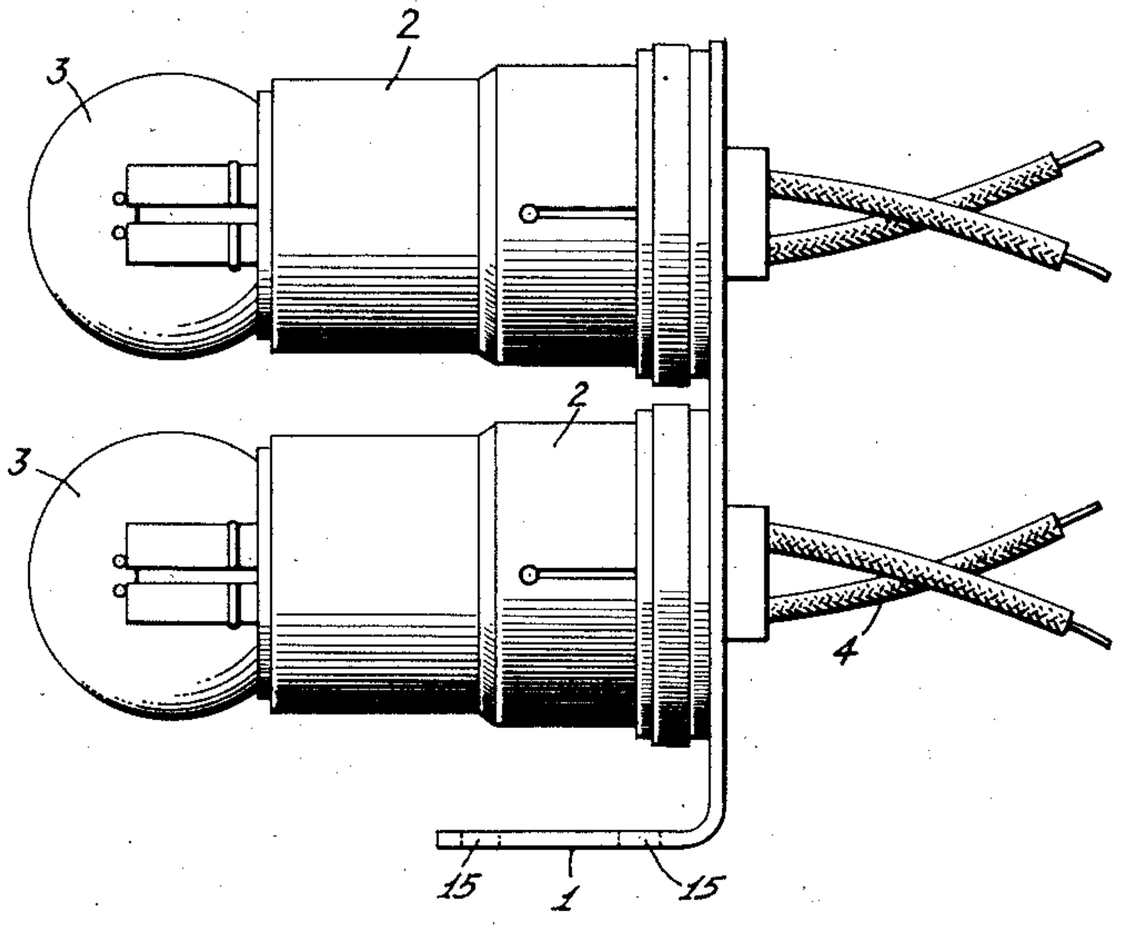
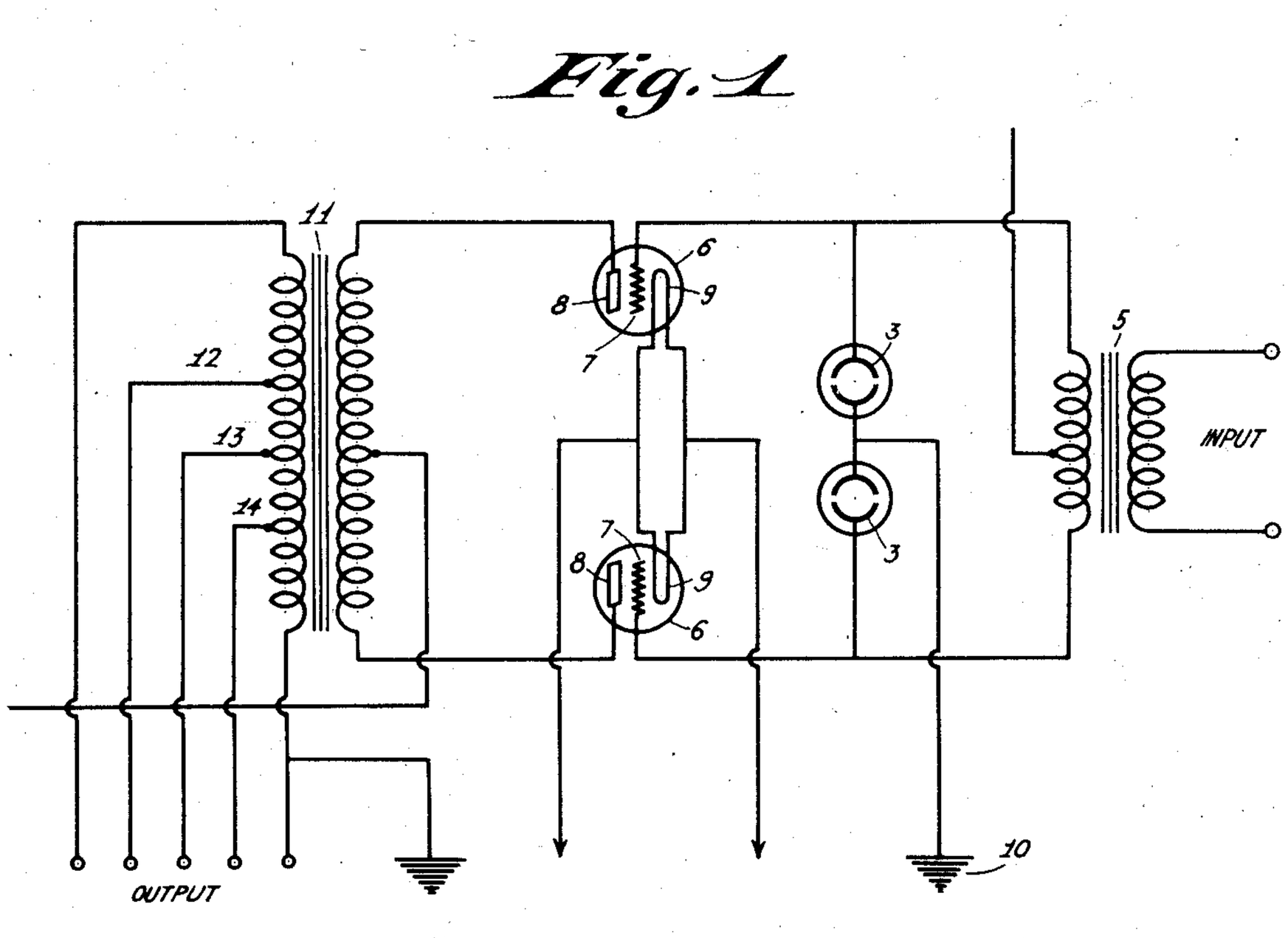


Fig. 1



INVENTOR
JOSEPH F. COOK Jr.
BY W. G. Grove
ATTORNEY

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PROTECTIVE DEVICE IN AMPLIFIER CIRCUIT

Joseph Francis Cook, Jr., West Roxbury, Mass., assignor to Radio Corporation of America, a corporation of Delaware

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3 Claims. (Cl. 179—171)

This invention relates to an improved amplifier circuit, and more particularly to improvements in power amplifier circuits.

The object of the invention is to provide a proper means of protecting a power amplifier circuit from building up high frequency, high voltage surges which build up in the plate and grid circuits of amplifiers.

Another object of this invention is to provide adequate protection to the apparatus used in an amplifier circuit such as transformer windings, local wiring, etc. The present invention is of particularly great importance in large power amplifier circuits, for the reason that interruption of service in such cases usually affects a large group of users.

Broadly, the invention consists of placing a neon lamp or other gas discharge tube in an amplifier circuit in such a manner that if a surge or oscillation is set up in the circuit to be protected, such surges and oscillations are suppressed thus preventing the building up of surges which are liable to result in damage to the transformer windings, and the associated wiring.

Local oscillations in an amplifier circuit cause undesirable results which is known as "motor-boating",—a low frequency oscillation with very high frequency components due to the wave form of the voltage induced. When using large power tubes in either a one-sided transformer, or in a push-pull circuit, the extent that oscillations may be set up is such that transformer windings and other associated parts of the wiring may break down, because when such voltages are set up in the grid circuit power is supplied which causes insulation puncture to be followed up by power arcs.

The so-called "motor-boating" mentioned above is probably due to grid emission, and while the phenomenon is not generally understood a possible explanation thereof is that a charge is built up around the grid of the tube which causes it to "block", or, in effect, the charge increases the negative potential on the grid. When this occurs, the plate current cannot flow. If this condition prevails for any length of time, the space charge is reduced at a very great rate, causing a rapid building up of plate current with the resultant induced high voltage in the plate windings. The periodic repetition of this action causes "motor-boating" and the setting up of oscillations.

The magnitude of the charge around the grid varies directly with the pressure of internal gases existing for any reason. The frequency of oscillations or "motor-boating" is probably controlled by gas pressure, internal interelectrical capacities and external circuit constants.

The present invention is adapted to eliminate voltages resulting from any cause, which would be greater than the negative bias on the grid of the tube. As discussed above surges and oscillations cause the grid to go positive, hence, to provide proper protection, in such cases, the invention provides a neon tube having a normal breakdown voltage not greater than 110 percent of the grid bias at which the tube is working connected in the circuit so that the grid voltage is not impressed on the gas discharge tube. It is to be understood that the protective device may be placed in the plate circuit, however, a more effective protection of the circuit is obtained when the neon tube is placed in the grid circuit, than when placed in the plate circuit, although the higher the plate circuit impedance, the more effective the protective gas discharge tube becomes.

Other objects and features of the invention will be apparent from the following detailed specification when read in connection with the drawing, in which,

Figure 1 is a portion of an amplifier circuit in which in accordance with the invention protective lamps are provided;

Figure 2 is a plan view of a convenient mounting of a pair of protective lamps; and,

Figure 3 is an end view of the mounting shown in Figure 2.

In Figure 1, a pair of space discharge tubes 6, 6 are shown connected in push-pull. Each of tubes 6, 6 includes a grid element 7, an anode 8 and a cathode 9. The output circuit of the push-pull arrangement includes an output transformer 11, the secondary of which is provided with taps 12, 13 and 14 for obtaining various impedance values. The input circuit of the push-pull arrangement includes an input transformer 5 across the secondary of which there is connected in accordance with the present invention a pair of protective lamps or neon tubes 3, 3 in series, the common point of which is grounded at 10. The various anode, cathode and biasing sources have been purposely omitted in the drawing in order to more clearly present the invention.

Referring to Figures 2 and 3, two protective lamps or neon tubes 3, 3 are shown mounted in standard sockets 2, 2. The sockets are of well known construction and are adapted to be mounted on the upright portion of an L frame 1 which may be suitably held in position by screws or

rivets adapted to be passed through holes 15, 15 in the base plate of frame 1. Suitable leads 4, 4 are provided for the various connections to the tube sockets.

It will be seen that in the arrangement shown in Figure 1 should surges or oscillations be set up in the circuit, they will be suppressed by the protective tubes 3, 3 inserted across the input of the amplifier tubes before any damage results to the amplifier circuit.

It has been found that with an output tube capable of delivering an undistorted output of approximately 4000 to 5000 milliwatts and a voltage amplification of 3.8, when the plate current is about 55 milliamperes, and 450 volts are impressed on the plate and 84 volts grid bias, a neon lamp which becomes effective at about 90 volts is the best type of gas discharge tube for proper protection.

While the invention has been shown in connection with a push-pull amplifier circuit it is to be clearly understood that the invention is applicable also to amplifier circuits comprising single tubes in which case the protective tube is connected across the input of the tube.

I claim:

1. In an amplifier system, a space discharge device having an input circuit and an output circuit, grid biasing means in said input circuit, circuit protective means comprising gas discharge means connected across said input circuit, said means being adapted to suppress voltages set up in said system greater than the negative bias on the input of the space discharge device.

2. In an amplifier system a pair of space discharge devices each thereof being provided with an anode, a cathode and at least one grid electrode, push-pull input and output circuits therefor, means for biasing the grid electrode of each of said devices to thereby control their operating characteristics, circuit protective means comprising a gas discharge path connected effectively across the input circuit, said path being adapted to discharge at a slightly greater potential than the bias potential applied to said devices whereby said system is protected from high voltage surges.

3. In a high power amplifier system which includes at least one space discharge device provided with an input circuit and an output circuit and wherein the said space discharge device is biased at a predetermined potential so as to control the characteristics thereof, means for protecting the amplifier and associated circuits and elements from the effects of abnormally high voltage surges and the like which comprise a normally non-conductive electrical path shunted across the input circuit, said path having a predetermined breakdown voltage and being arranged so as to by-pass damaging high voltage surges when the voltage surges exceed a predetermined value to thereby prevent such voltage surges from passing through the portions of the amplifying system liable to be damaged, the normally non-conductive electrical path being adapted to breakdown at a voltage which is slightly greater than the biasing voltage of the discharge device.

JOSEPH F. COOK, JR.