CIRCUITS incorporated into electronic devices differ, to some extent, from the circuits of radio receiving or public address equipment. These circuit deviations require careful consideration.

Most industrial electronic systems are characterized by the absence of radio frequency currents and voltages, with the possible exception of induction welding and heating equipment. In such systems, the frequencies applied are within the limits of the audio frequency spectrum. Electronic circuits, then, may be considered as a special form of the conventional audio frequency amplifier, altered to meet specific needs.

The audio frequency system concept may be more clearly visualized if we remember that reactions occurring in the electronic system result from the real movement which is under its control. For example, the photocontrol responds to the passage of an object between a photocathode and a light source. An appreciable period of time is required for this travel by the scanned object, resulting in a response of like rate by the photocontrol system. From this, it is clear that the functional period of the photocontrol lies somewhere in the lower audio frequency spectrum.

Despite the basic audio frequency character of the electronic control, certain electrical system variations occur to place such a system in a classification somewhat removed from the usual audio frequency system. Where, in conventional audio frequency systems, dynamic coupling, usually of the resistance-capacitance or transformer type, is employed, the electronic system conventionally utilizes direct coupling. The necessity for this particular deviation lies in the fact that direct coupling lends itself admirably to the high voltage negative biasing required for thyatron tube grid control.

Two forms of direct coupling often utilized in electronic systems are shown in the schematic circuits of Fig. 1. The coupling system in Fig. 1a has been subject to considerable discussion, and is normally utilized in the conventional electronic circuit system. With this type of coupling, the thyatron grid is variable with respect to the cathode. That is, if the control grid of the pentode 1 is positive with respect to its cathode, the thyatron grid is negative with respect to its cathode.

In the instance of Fig. 1b, however, the cathode of thyatron 2 is variable with respect to the grid, the latter electrode being electrically constant. Here, if the control grid of pentode 1 is positive with respect to its cathode, the cathode of thyatron 2 is negative with respect to the grid, or, the grid is positive with respect to the cathode. This is the exact opposite of the operation provided by the circuit in Fig. 1a.

In the circuits of Fig. 1, Es is the pentode circuit plate supply voltage. It should be observed that this voltage, through the operation of the pentode circuits, provides the high negative grid-to-cathode bias required to maintain the thyatron dark, or non-conductive.

Further, the circuit of Fig. 1b is rarely applied in modern electronic systems, because of the difficulties encountered in providing adequate circuit shielding against external disturbances. This arises from the fact that the cathode is the sensitive electrode of the thyatron. The cathode of the thyatron is normally heated by power applied to its heater terminals from a transformer winding. Thus, leakages, resistive or electrostatic, occurring between this winding and others located on the same transformer core leg, are introduced in series with the pentode plate circuit, since the plate circuit power for this pentode is also supplied by the same transformer. Resistive leakage introduces an ac-ripple voltage into the thyatron grid circuit in this manner. External disturbance voltages are introduced here electrostatically. In direct contrast, the cathode of the thyatron in Fig. 1a is returned to no-voltage, or ground level through the relatively low resistance of the voltage divider.

Dynamically-coupled circuits in electronic systems differ from those usually employed in radio and public address systems in that tube grid bias voltages are often avoided. The tube under consideration is operated in a normally saturated manner. An example of such operation is given in the circuit and graph of Fig. 2. In Fig. 2a, the control grid of the pentode 2 is normally at zero volts with respect to the cathode. Under these conditions,