HAM NEWS
TUBES

TWO-TUBE DIFFERENTIAL KEYER

By S. E. Johnson, Jr., W2FBS

A GOOD-SOUNDING CW SIGNAL usually results from a transmitter keying system that applies and removes the keying voltages with a smooth waveform, without sharp peaks that can result in key clicks and thumps; or chirps from too-slow application of these keying voltages.

W2FBS describes here a vacuum-tube screen grid keying system that will key tetrode or pentode power amplifier stages in 20 to 300-watt transmitters. It will provide the following functions:

1. Keyed screen grid voltage for a power amplifier, with adjustable keying waveform;
2. Negative screen grid voltage when the key is open to cut off amplifier plate current;
3. Adjustment of screen voltage to the power amplifier to set the r.f. power output of that stage to the optimum level;
4. Negative blocking bias voltage with which to cut off an oscillator or mixer when the screen grid keying function is idle;
5. Adjustable negative bias voltage for the r.f. power amplifier.

This keyer contains a series screen voltage keyer tube, a control triode tube for the keyer tube, a diode-connected tube section to apply the blocking bias, and a 200-volt negative bias power supply.

Function of the keyer timewise is shown in the waveform chart, Fig. 1. When keying starts, screen voltage rises from a negative value to the operating value for the amplifier tube each time the key is pressed. The negative blocking bias on the oscillator or mixer grid is removed at the instant the key is pressed, and remains off until keying stops. The blocking bias then returns gradually, cutting off the oscillator or mixer shortly after keying of the amplifier screen grid stops. The oscillator or mixer thus will continue to operate during normal sending, but stops when the operator stops sending briefly to listen for incoming signals.

A 6BL7-GT TWIN TRIODE is the screen grid keyer tube as shown in the schematic diagram, Fig. 2. Both sections are connected in parallel, thus reducing its internal resistance to less than 1,000 ohms at zero control grid bias. The screen voltage of one, two or three small transmitting pentode tubes (807, 1625, 6146, 6L6-GC, 7581, GL-829B, etc.) thus can be controlled. Screen grid current flows from the cathode to screen grid of this amplifier tube, then to the cathode of the keyer tube, through this tube to the plate, and to the high voltage supply of 400 volts.

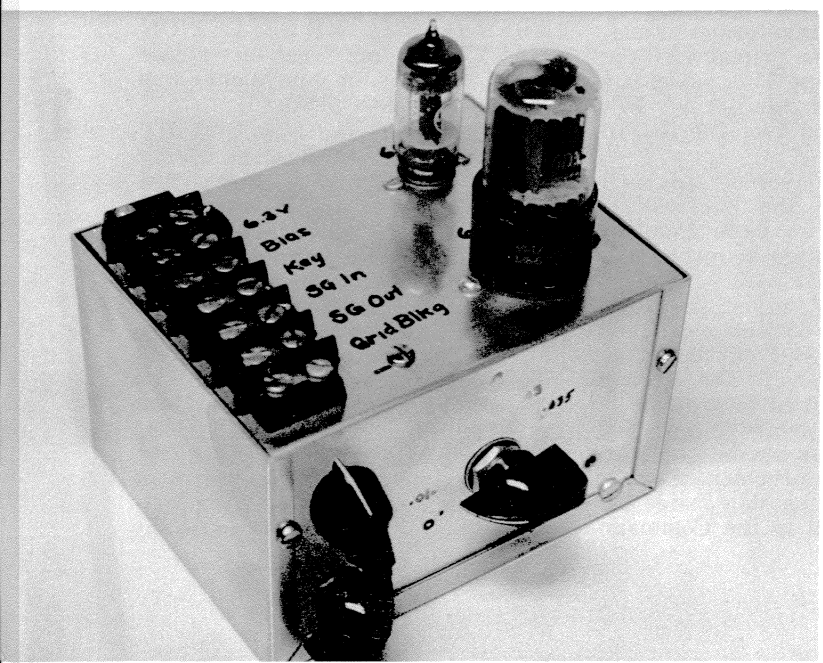
Section one of a 12AU7-A twin triode serves as a control tube for the grid bias voltage applied to the 6BL7-GT. With the key open, grid pin 7 has minus 90 volts applied, but the cathode, pin 8, is at minus 110 volts. This 12AU7-A section thus draws plate current through the 100,000-ohm resistor and potentiometer, R_1. This holds the control grid in the 6BL7-GT sufficiently negative with respect to its cathode, so that no plate current (and r.f. amplifier screen grid current) flows.

About minus 100 volts is applied to the amplifier screen grid from the keyer bias supply through the 47,000-ohm, 2-watt resistor. At the same time, a minus 100 volts is applied to the oscillator or mixer control grid through the diode-connected section two of the 12AU7-A triode.

When the key is closed, cathode pin 8 of the 12AU7-A is grounded, and the minus 90 volts on control grid pin 7 cuts off plate current flow through this section. This causes the plate, pin 6, of this 12AU7-A section, and the control grids of the 6BL7-GT, pins 1 and 4, to rise to a positive voltage determined by the setting of R_3, the "Amplifier Screen Voltage Control." The 6BL7-GT then conducts, and the cathodes, pins 3 and 6, rise to a positive value approaching the positive voltage applied to pins 1 and 4.

Since closing the key also removes the negative voltage from the plate (pin 1) of the diode-connected 12AU7-A section, negative blocking bias no longer is presented to the grid circuit of the oscillator or mixer in the transmitter and it can operate. Capacitor C_4 in the cathode of the 12AU7-A diode-connected section prevents this bias from reappearing during the brief intervals the key is open between characters. But C_4 charges through R_4 and the blocking bias to returns in from ½ to 1½ seconds after keying stops.

The setting of potentiometer R_3 adjusts the positive voltage applied to the control grids of the 6BL7-GT, and thus the voltage drop through it. This permits setting the screen voltage applied to the r.f. power amplifier tube (or tubes), when the key is closed, to the positive value which results in the desired r.f. power output. This feature is most helpful when only a portion of the normal power output of the trans-



TOP VIEW showing keyer constructed by W2FBS in a Minibox. Heater voltage for the 6BL7-GT in this model was obtained from one of two 6.3-volt windings on filament transformer T_1, with 6.3 volts fed into other winding. Only 6 terminals were thus needed on strip TS_1 for external connections.

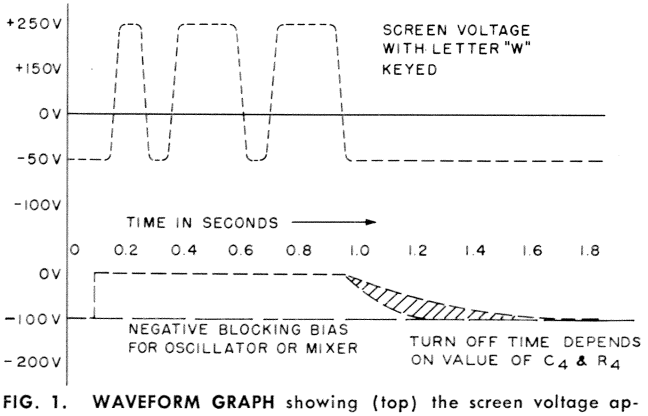


FIG. 1. WAVEFORM GRAPH showing (top) the screen voltage applied to the transmitter power amplifier when the letter "W" is keyed. Peak voltage will be from plus 25 to 300 volts, depending upon setting of R_3. Bottom graph shows sharp rise of negative blocking voltage for oscillator or mixer control grid from minus 100 to 0 volts, and slow decrease back to minus 100 volts after keying is stopped.