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MONSANTO CHEMICAL COMPANY
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T.R.10.

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HIGH-FREQUENCY PULSE GENERATOR

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HIGH-FREQUENCY PULSE GENERATOR

INTRODUCTION

The purpose of this work was to develop a high-frequency pulse generator that could be used in conducting research on high-rate trigger pairs and scaler circuits. The need for an instrument of this type arose because there was no parallel commercial instrument having a pulse recurrence frequency over approximately 200,000 pulses per second.

SUMMARY

The high-frequency pulse generator provides a pulse recurrence frequency range of 10,000 to 2,500,000 pulses per second. Both positive and negative pulses are available. The amplitude of both pulses can be adjusted by a single pulse-height control. A linear amplifier, which provides amplification of the input sine wave, is also available. The input for the instrument is derived from a General Radio, Type 700A, beat frequency oscillator. The device has been found to be stable within the required frequency range as long as the input signal has an amplitude of at least 5 volts. If the input signal is less than 5 volts, the output pulses will divide at approximately 100 kc. owing to the distortion amplifier not being properly overdriven.

The high-frequency pulse generator has made it possible to develop trigger pairs and scaler circuits that will follow and count evenly spaced pulses up to 1.5 million per second.

It is believed that a pulse generator having a recurrence frequency greater than 2.5 m. pulses per second can be developed by modifying the amplifier circuits and employing cathode-follower output.

GENERAL DESCRIPTION

Reference is made to the block diagram shown as Figure 1. The pulse generator consists of two 6AK5 broad-band amplifiers. Series peaking is employed in these circuits and is so arranged that frequencies up to 4 mc. per second will be amplified. This amplifier has two outputs. One goes to a distortion amplifier and the other goes to a cathode follower. The distortion amplifier is a 6AK5 operating with low screen voltage so it can easily be overdriven. The distortion amplifier is followed by two 6J6 high-rate trigger pairs in cascade. A positive pulse output is obtained from a variable resistance in the cathode of the second trigger pair and a negative pulse is obtained from a variable resistance in the plate circuit.

The other broad-band amplifier output is fed to a cathode follower, a vacuum-tube volt meter tube and a 6AG7 broad-band, linear amplifier. The vacuum-tube volt meter allows the amplitude of the signal applied to both the distortion amplifier and linear amplifier to be monitored. It can therefore be determined when the linear amplifier is driven to a point where distortion will result and when the distortion amplifier is receiving sufficient drive to operate properly.

The operation of the instrument is as follows. A sine wave in the frequency range 10,000 to 2,500,000 cps is introduced into the linear amplifier. The amplitude of the sine wave is increased sufficiently to overdrive the distortion amplifier resulting in a square wave output. This square wave is coupled to the trigger pairs where it is changed to a positive pulse in the cathode and a negative pulse at the plate. The negative pulse output is taken across the plate load resistance and the positive pulse output is taken across the cathode load resistance. The resulting maximum pulse width is approximately 0.7 microseconds and the maximum negative pulse height is approximately 18 volts while the positive pulse height is approximately 13.5 volts.

When the wave length of the square wave applied to the trigger pair becomes less than 1.4 microseconds, the mode of operation of the trigger pair gradually changes from a true trigger pair to an amplifier. This change results in a decrease in the output pulse amplitude owing to (1) distributed capacity shunting and (2) shift in the zero reference axis caused by the positive and negative periods becoming equal.

It has previously been mentioned that the broad-band amplifier has two outputs. When it is desired to use the pulse generator as a linear amplifier, the output of the broad-band amplifier can be switched from the distortion amplifier to the linear amplifier.

The pulse generator has a built-in, electronically regulated, power supply. The system consists of the necessary transformers, full wave rectifier tube, filter circuit and degenerative regulating circuit. It will be noted that the grid of the amplifier tube is coupled to the output through a voltage regulator tube. This type of circuit provides a means of coupling the fluctuations in the voltage output of the regulated power supply directly to the grid of the d.c. amplifier; thus the feedback factor is increased and improved regulation results. The voltage regulator tube used in this application must be specially chosen for stability and good voltage regulation characteristics.

A complete circuit diagram of the pulse generator will be found in Figure 2.

PULSE GENERATOR

PHYSICAL DESCRIPTION

The pulse generator is housed in a metal dust cover 22" x 14 3/4" x 10 3/4" having a gray crackle finish, as shown in Figure 3. The front panel of the dust cover is fastened directly to the inside chassis and the unit as a whole can be removed from the dust cover. The top of the dust cover has a hinged lid to permit easy access to the tubes.

The following components appear on the front panel: power switch; pilot light; fuse holder; input-Amphenol Socket 83-1R; d.c. voltmeter having two scales; voltmeter range switch; amplifier output-

Amphenol Socket 83-1R; pulse output, consisting of two Amphenol Sockets 83-1R, one for the positive pulse and one for the negative pulse; sensitivity control; switch for change to amplitude or pulse output; pulse height control.

The electrical components of the pulse generator are mounted on the metal chassis that is fastened to the front panel. The vacuum tubes and transformers are mounted on the upper side of the chassis as shown in Figure 4. All other components and connections are mounted on the lower side as shown in Figure 5. The components of the power supply are separated from the remainder of the system by wing shields, both on the upper and lower sides of the chassis, see Figures 4 and 5. The power switch, pilot light and wiring are separated from the input circuit by wing shields as shown in Figure 5. In the voltage-regulator-tube coupling circuit the control tube, 6AG5, is surrounded by the two series tubes, 6AQ5, and the voltage-regulator tubes, OA2 and OB2 as can be seen in Figure 4. The circuit is designed in this manner to keep the leads from the control tube as short as possible to minimize stray field pick-up and the resulting instability.

Philip E. Ohmart

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FIG. 1

PULSE GENERATOR

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Fig. 3

Fig. 5

Fig. 4

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HIGH-FREQUENCY PULSE GENERATOR

1. The following correction should be made on Figure 2, schematic diagram of the high-frequency pulse generator.
 - (a) 280 microhenry chokes in the plate circuit of the 6AK5 tubes and the 90 and 280 microhenry chokes in the plate circuit of the 6AG7 tube should be changed to variable inductances. These are adjusted to give an essentially flat response to 4 mcs.
 - (b) The choke in the plate circuit of the first 6J6 trigger pair should be 2.5 millihenries instead of 2.5 microhenries as shown.
 - (c) The filaments of the 6AK5, 6J6, 6AL5 and 6AG7 tubes are lighted from a filament transformer which is not shown.
2. The following corrections should be made in the SUMMARY:
 - (a) Delete the last sentence in the first paragraph and add the following: "If the input signal is greater than 3 volts the unit will double-pulse at approximately 100 kc. The voltmeter in the high-frequency pulse generator should register approximately 9 volts for proper operation."
 - (b) Change the frequency range in line 2 of the first paragraph to "50,000 to 2,500,000."
3. The work of constructing and testing the high-frequency pulse generator was performed by Mr. John Hutchinson.

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