OPERATING INSTRUCTIONS

FOR

TYPE 869-A PULSE GENERATOR

FORM 607-H

GENERAL RADIO COMPANY

CAMBRIDGE 39 MASSACHUSETTS

NEW YORK CHICAGO LOS ANGELES

U. S. A.

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FOR
TYPE 869-A PULSE GENERATOR

1.0 DESCRIPTION

The Type 869-A Pulse Generator is an instrument for producing d-c pulses, of either positive or negative polarity. The length of the pulse may be set to any value between 0.3 and 70 microseconds, and the amplitude is adjustable by means of a panel control. Several output impedances are available, selection being made by a panel switch.

A complete synchronizing circuit is provided, to enable the repetition rate to be controlled directly from any a-c source of from 5 to 25 volts, and 20 to 4000 cycles frequency. A synchronizing signal is available at the panel for controlling the sweep circuit of an oscillograph.

The instrument may be operated from any 115- or 230-volt, 50-60 cycle line. It is completely shielded against r-f leakage, and may be used to modulate standard-signal generators with output voltage levels as low as one microvolt.

2.0 GENERAL OPERATION

2.1 Synchronizing Circuit

In order that a microsecond pulse be visible on the screen of an oscillograph it is necessary to synchronize the oscillograph sweep and the pulse so that the pulse always appears at the same point on the screen. The pulse width may be only 0.3 microsecond, therefore the pulse must be synchronized with the sweep in the order of .03 microsecond, or better, if a clear image is to be obtained.

The input signal is amplified in a single pentode tube (V-1) and then applied to a half-wave rectifier tube (V-2). At this point the resultant signal is brought out to the SYNC terminals on the panel, where it may be used to control an oscillograph sweep. By successive differentiation, in three amplifying stages, (V-3) and (V-4), the resultant signal is in the form of a pulse of approximately ten microseconds, and has a very steep wavefront. This signal is then applied to a cathode-follower tube (V-4) and the resulting positive pulse is used to trigger the two pulse-forming gas triodes.

The shape of this triggering pulse is substantially independent of the operating frequency over the range between 20 - 4000 cycles.

In order that the position of the pulse may be changed with respect to the time-base sweep of an oscillograph, a phase shift network is provided in the synchronizing circuit just ahead of the diode. The signal on the SYNC terminals does not have this phase shift. By changing the position of this phase control (R-5) the pulse appearing on the screen of an oscillograph may be moved across the screen.

A panel switch (S-1) provides two ranges of phase shift so that adequate control is possible over the entire frequency range.

2.2 Pulse Forming Circuit

Two Type 884 gas triodes, (V-6) and (V-7), are employed in the pulse-forming circuit and are coupled to a single Type 6L6 tube (V-9), which is used as the output amplifier. A d-c voltage (whose amplitude is limited by the VR-150 tube, V-8) is impressed across the two gas triodes in series. The first gas triode (V-6) is triggered directly from the trigger-circuit impulse. This raises the

grid voltage of the output amplifier to a maximum positive value. When the second gas triode (V-7) is triggered through a time-delay circuit, which determines the pulse width, the amplifier grid becomes negative. This time delay is introduced by means of an RC circuit, consisting of a three-position range switch and three variable resistors mounted on the same control shaft. The two gas triodes are triggered through a diode (V-5) in order to prolong tube life by preventing the flow of reverse currents in the grid circuit.

2.3 Output Amplifier

The output amplifier (V-9) is a 6L6 tube and is arranged to deliver either positive or negative pulses to the output. An impedance switch introduces one of four resistors in the cathode circuit for positive pulses, or the plate circuit for negative pulses.

The amplitude of the output pulse is set by a screen voltage control (R-38). The grid of this amplifier tube is normally biased to cut-off. When the tube (V-6) is triggered, the grid swings into its positive region, or plate current saturation. When tube (V-7) is triggered, the grid voltage returns to its cut-off point.

Thus it will be seen that V-9 is alternately driven from plate-current cut-off to plate-current saturation. This effect helps to maintain a flat top on the pulse and to eliminate any spurious resonances that may be introduced by the gas triodes.

2.4 Power Supply

The power supply for the instrument consists of a conventional high-voltage rectifier (V-12) to supply the positive potential, and a 6.3-volt heater supply. In addition to this, there is a negative voltage source consisting of the rectifier (V-11), which provides the necessary bias voltage. Because of the operation of the cathode of V-6 at voltages above ground, it is necessary to provide a separate heater winding for this tube.

Regulation is applied to the bias supply to reduce the effects of line-voltage variations on the pulse width.

The instrument is provided for operation from any a-c source of 115 or 230 volts, 50 to 60 cycles. Power required is approximately 60 watts.

2.5 Mechanical Details

The mechanical construction of the instrument is such that all tubes are available on top of the chassis when it is removed from the cabinet. The instrument is completely shielded against r-f leakage and may be used with standard-signal generators at levels as low as one microvolt. The a-c line plug, the input, and the synchronizing terminals are provided with r-f filters to insure against leakage at these points.

The pulse output terminal is a GR Type 774 Concentric Shielded Plug. A GR Type 774-R2 Patch Cord should be used to connect the pulse generator with the signal generator with which it is used. This provides continuous shielding against r-f leakage.

The instrument is provided with a-c line fuses conveniently available at the rear, without the necessity of removing the instrument from the cabinet.

3.0 OPERATING PROCEDURE

3.1 Auxiliary Equipment Required

The Type 869-A Pulse Generator is intended primarily for pulsing standard-signal generators. The only additional equipment needed for proper operation is a driving oscillator whose output voltage should be between the limits of 5 to 20 volts. Its frequency range may be between 20 and 4000 cycles. An oscillograph is neces-

sary to view the pulse. This should be arranged to be synchronized with the oscillator that is used to operate the pulse generator.

Some phase shift adjustment is preferable on the oscillograph in order that a wider range of phase control may be attained. The phase shift controls of the Type 869-A are intended to be used as vernier controls, and may not cover a complete wide range of audio frequencies, especially if the oscillograph introduces appreciable phase shift.

3.2 Testing Procedure

Apply an a-c voltage to the input terminals of the proper frequency and amplitude. Connect the SYNC terminals to the oscillograph. The pulse output may then be viewed on the screen of the oscillograph by connecting the output terminal of the pulse generator directly to the vertical plates of the oscillograph. By selection of a sweep speed in proportion to the period of the pulse, and by manipulation of the phasing control, a pulse should become visible on the screen of the oscillograph. This pulse will be observed to have an upward or downward displacement from the zero axis, depending on the polarity of the output switch setting.

The amplitude control on the pulse generator may be used to set the amplitude of the pulse to any desired value between zero and maximum. This has no effect on the shape of the pulse with respect to steepness of the wave front or flatness of the top of the pulse. If it is desired to measure the amplitude of the output pulse, a peak-response vacuum-tube voltmeter, such as the GR Type 726-A, may be used. The open-circuit output voltage characteristics are given in Table I.

3.3 General

When operating the pulse generator, it is merely necessary to set the controls for the desired pulse width and amplitude, and the instrument may remain in this position continuously. When switching between points on the output switch, transients may be set up which will interfere with the normal operation of the gas triodes. This effect is not serious and will be noted by a lack of synchronism of the pulse with the driving frequency. When this condition is ob-

TABLE I

PEAK OUTPUT VOLTS - OPEN CIRCUIT

PULSE POLARITY	POSITIVE				NEGATIVE				OPERATING
OUTPUT SETTING	20 KΩ	1000 Ω	500 Ω	100 Ω	100 Ω	500 Ω	1000 Ω	20 KΩ	FREQUENCY
RANGE A	90	80	70	20	18	80	150	300	500 ~
RANGE B	100	90	80	20	18	90	170	300	500 ~
RANGE C	100	80	80	20	18	90	180	300	500 ~

For other operating frequencies, the voltages will be approximately within 20% of the values given above. In general, the open circuit output voltage will tend to decrease as the pulse width and operating frequency increase.

served, it is merely necessary to rotate the pulse-range switch over one or two of its positions and return. This will enable the gas tubes to resume their normal operation.

For middle frequency operation, the pulse width in microseconds may be read directly from the scale. At frequencies above 1000 cycles, the pulse width will, in general, be somewhat less than that indicated on the scale. Below 1000 cycles the readings of the dial are approximately correct. When operating at extremely low repetition rates, or frequencies, it is advisable to have the controlling-oscillator voltage high. This is necessary in order to stabilize the pulse with the sweep frequency. On higher frequency operation, proper degree of synchronism will be obtained with lower input voltages. No harm will result from placing an over-voltage on the input terminals of the pulse generator, but it may cause a double image to be visible on the screen. This will be immediately recognized by a series of multiple pulses in place of the single pulse normally found.

4.0 ADJUSTMENT AND MAINTENANCE

4.1 Scale Adjustments

There are individual adjustments provided for each scale range of the PULSE WIDTH microseconds scale. Should it become necessary to replace either gas triode, it is merely necessary to readjust these controls to bring the calibration into agreement with the scale readings. Replacement of any of the other tubes will not change the calibration of this scale.

Certain gas triodes show aging characteristics such that they may require adjustment of the heater voltage for proper operation. It has been found that new tubes usually require lower heater voltage. As the tube ages it is sometimes necessary to increase this voltage in order to obtain optimum performance. Adjustment R-55 is provided for this purpose. Faulty gas tube operation may be observed by any of the following characteristics: the pulse may show spurious resonances at both ends of the pulse, the pulse generator may refuse to operate at the higher frequencies; or the steepness of the wavefront may become impaired. When any of these characteristics are observed, it is suggested that the setting of R-55 be changed. Should this fail to correct the difficulty, a new Type 884 Gas Triode should be tried in position V-6 and successively in V-7.

SPECIFICATIONS

Repetition Rate: 20 to 4000 cycles. Pulses longer than 10 microseconds are limited to a maximum frequency of 1000 cycles.

Input Voltage: Between 5-10 volts are required for normal operation. For improved stability at the lowest frequencies, this may be increased to a maximum of 30 volts.

Input Voltage Waveform: This is not critical, and may vary from a sine wave to a triangular wave. Care must be taken, however, to keep this signal reasonably free from power supply hum voltage.

Synchronizing Output: A highly distorted sine wave appears across the synchronizing output terminals, of approximately -160 and +50 peak volts. This may be used to control the high-speed sweep circuit of an oscillograph, that has been provided with suitable triggering amplifiers.

Phasing Controls: Panel controls are provided to permit adjustable phasing of the output pulse, with respect to the voltage obtained at the synchronizing output terminals, over a limited range.

Pulse Width: The output pulse is continuously adjustable over three ranges. These are 0.3-3.0, 3-10, and 10-70 microseconds, respectively. The calibration of these controls is approximately correct over the entire frequency range.

Pulse Amplitude Control: A panel control permits the pulse amplitude to be adjusted from zero to maximum, with a negligible effect upon the pulse waveform.

Pulse Waveform: The pulse is essentially flat-topped, and has an effective rise time of 0.1 microsecond for pulse widths less than 10 microseconds. For longer pulses, the rise time is less than 10% of the pulse width.

Output Selector: A panel switch permits any one of four impedances to be inserted in the output amplifier, and also provides either positive or negative pulses.

Output Amplitude: The maximum pulse amplitude depends upon the setting of the output switch, and is given in Table I, page 3.

Effective Output Impedances:

Positive

Impedance Setting	20 KΩ	1000 Ω	500 Ω	100 Ω
Output Impedance	350 Ω	350 Ω	350 Ω	100 Ω

Negative

Impedance Setting	100 Ω	500 Ω	1000 Ω	20 KΩ
Output Impedance	100 Ω	500 Ω	950 Ω	11,000 Ω

These values are approximate, and will change with the load applied, due to the limiting action of the output amplifier.

Power Supply: Either 115 or 230 volts, 50-60 cycles may be used. A variation of ±10% in the supply voltage will cause a minor variation in the output pulse amplitude, and will generally tend to change the pulse width. For optimum performance, operation at the 115- or 230-volt value is recommended. Power input is 60 watts.

Accessories Supplied: A seven-foot line connector cord, one Type 774-R2 Patch Cord, and spare fuses are supplied.

Tubes Supplied with Instrument:

2 - Type 6H6
1 - Type 6AC7
1 - Type 6X5-GT/G
1 - Type VR-150-30
1 - Type 6SN7-GT
2 - Type 884
1 - Type 6SC7
1 - Type 6ZY5G
1 - Type VR-105-30
1 - Type 6L6

PARTS LIST

Resistors

R-1	= 1 MΩ	R-30	= 100 kΩ
R-2	= 150 kΩ	R-31	= 100 kΩ
R-3	= 27 kΩ	R-32	= 470 kΩ
R-4	= 27 kΩ	R-33	= 100 kΩ
R-5	= 500 kΩ	R-34	= 470 kΩ
R-6	= 5.6 Ω	R-35	= 10 MΩ
R-7	= 100 kΩ	R-36	= 47 Ω
R-8	= 470 kΩ	R-37	= 47 MΩ
R-9	= 5.6 kΩ	R-38	= 500 kΩ
R-10	= 270 kΩ	R-39	= 23.5 kΩ
R-11	= 100 kΩ	R-40	= 18 Ω
R-12	= 220 kΩ	R-41	= 20 kΩ
R-13	= 56 kΩ	R-42	= 1 kΩ
R-14	= 3900 Ω	R-43	= 510 Ω
R-15	= 1 MΩ	R-44	= 100 Ω
R-16	= 41 kΩ	R-45	= 220 Ω
R-17	= 47 Ω	R-46	= 100 kΩ
R-18	= 33 Ω	R-47	= 470 Ω
R-19	= 10 Ω	R-48	= 200 Ω
R-20	= 10 kΩ	R-49	= 200 Ω
R-21	= 100 Ω	R-50	= 200 Ω
R-22	= 100 kΩ	R-51	= 100 kΩ
R-23	= 15 kΩ	R-52	= 100 kΩ
R-24	= 200 kΩ	R-53	= 4.7 kΩ
R-25	= 22 kΩ	R-54	= 6.8 Ω
R-26	= 18 Ω	R-55	= 10 Ω
R-27	= 1 MΩ	R-56	= 82 kΩ
R-28	= 560 kΩ	R-57	= 56 Ω
R-29	= 100 kΩ	R-58	= 470 kΩ
		R-59	= 680 kΩ

Tubes

V-1 = RCA Type 6AC7
V-2 = RCA Type 6H6
V-3 = RCA Type 6SC7
V-4 = RCA Type 6SN7-GT
V-5 = RCA Type 6H6
V-6 = RCA Type 884
V-7 = RCA Type 884
V-8 = RCA Type VR-150-30
V-9 = RCA Type 6L6
V-10 = RCA Type VR-105-30
V-11 = RCA Type 6ZY5-G
V-12 = RCA Type 6X5-GT/G

Condensers

C-1	= 0.0002 μf	C-23	= 0.007 μf
C-2	= 0.0002 μf	C-24	= 0.0005 μf
C-3	= 0.03 μf	C-25	= 0.000075 μf
C-4	= 0.0002 μf	C-26	= 0.02 μf
C-5	= 20 μf	C-27	= 0.003 μf
C-6	= 0.0002 μf	C-28	= 0.001 μf
C-7	= 0.0002 μf	C-29	= 0.05 μf
C-8	= 1.0 μf	C-30	= 0.02 μf
C-9	= 0.01 μf	C-31	= 0.007 μf
C-10	= 0.5 μf	C-32	= 20 μf
C-11	= 0.01 μf	C-33	= 10 μf
C-12	= 20 μf	C-34	= 20 μf
C-13	= 0.005 μf	C-35	= 20 μf
C-14	= 0.0001 μf	C-36	= 20 μf
C-15	= 0.03 μf	C-37	= 20 μf
C-16	= 0.001 μf	C-38	= 120 μf
C-17	= 0.004 μf	C-39	= 0.001 μf
C-18	= 0.005 μf	C-40	= 0.001 μf
C-19	= 0.03 μf	C-41	= 0.01 μf
C-20	= 0.00025 μf	C-42	= 0.01 μf
C-21	= 0.000150 μf	C-43	= 0.0001 μf
C-22	= 0.0004 μf		

Inductors

L-1	= 2.1 mh	L-4	= 2.1 mh
L-2	= 2.1 mh	L-5	= 20 μh
L-3	= 2.1 mh	L-6	= 20 μh

Switches

S-1	= DPDT	SWRW-1430-1
S-2	=	SWRW-15
S-3	=	SWRW-16
S-4	= DPST	SWT-333NP

Miscellaneous

T-1 = 365-448
P-1 = 6.3 volts, 2LAP-939 - Mazda 44
F-1 = 0.8 amp. Slow Blow 3AG For 115 v
F-2 = 0.8 amp. Slow Blow 3AG operation.
F-1 = 0.4 amp. Slow Blow 3AG For 230 v
F-2 = 0.4 amp. Slow Blow 3AG operation

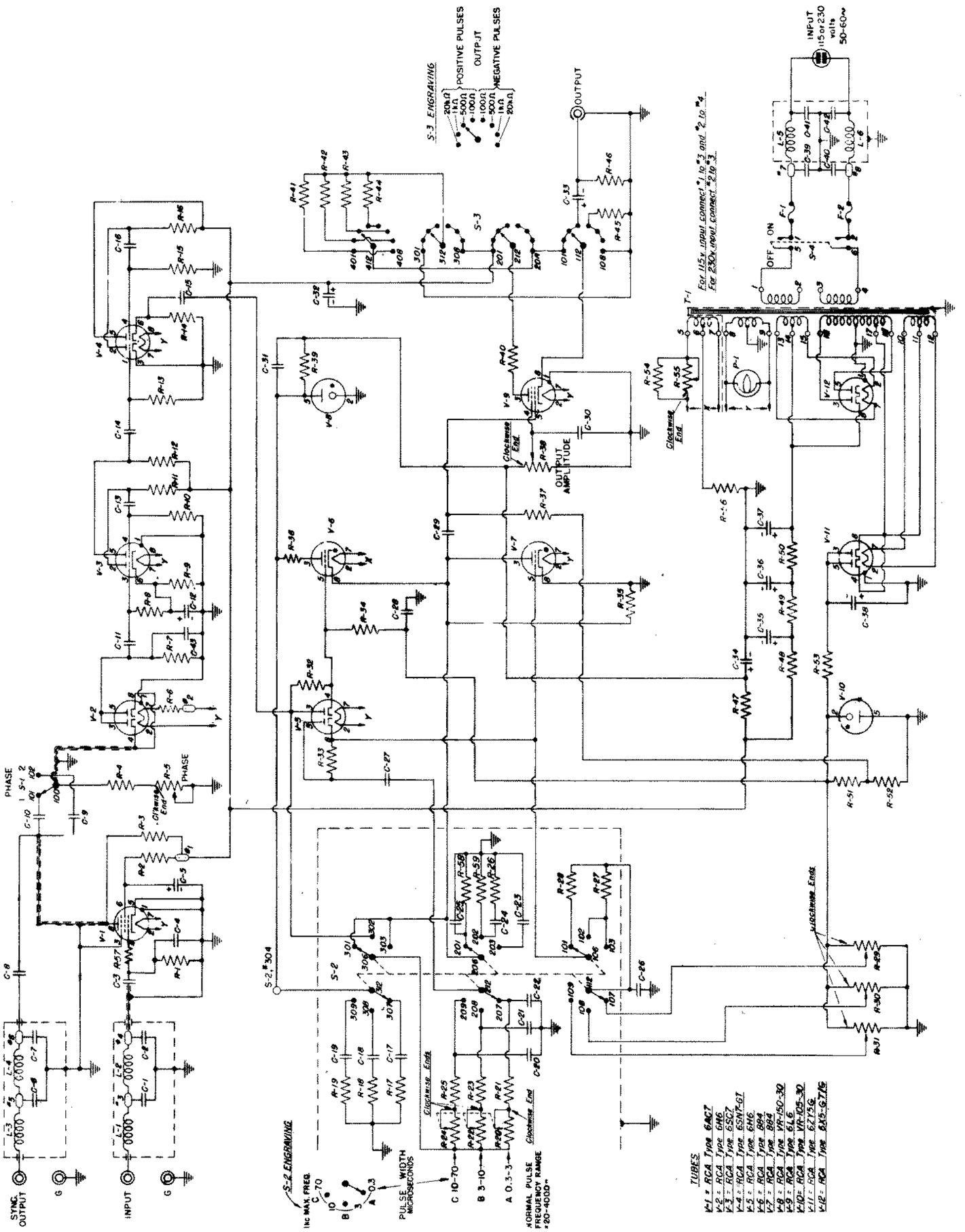

FIGURE 1. Wiring Diagram for Type 869-A Pulse Generator

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