TECHNICAL INFORMATION

WESTERN ELECTRIC 1B42 VACUUM TUBE

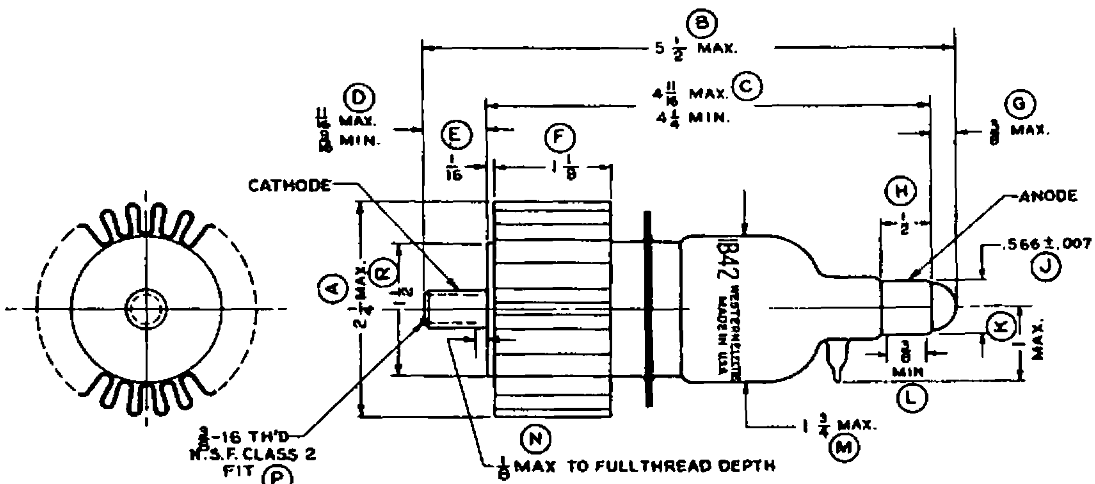

FIG. 1

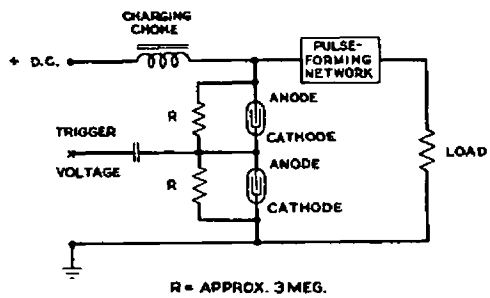

FIG. 2

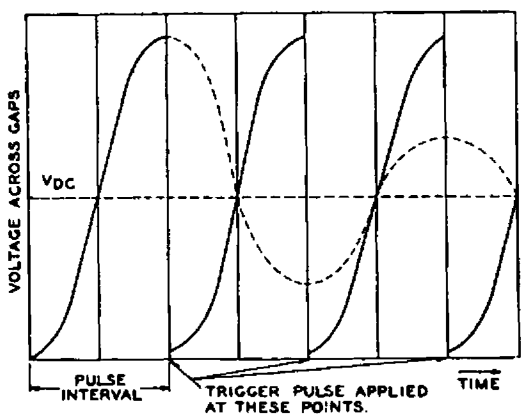

FIG. 3

CLASSIFICATION

The 1B42 vacuum tube is a hydrogen argon filled spark gap modulator tube with a mercury sponge cathode. It is best suited for operation as a triggered gap in circuits similar to the one shown in Figure 2. Two or more 1B42 tubes may be used in series in this type of circuit.

MOUNTING AND COOLING

The tube should be mounted in a vertical position with the cathode end down, and should be firmly supported by the stud at the cathode end. The axis of the tube should not deviate more than 30° from the vertical during operation.

Connection to the anode terminal should be made with a flexible lead so that no strain is placed upon the terminal.

The temperature of the metal adjacent to the cathode terminal must not exceed 150°C, a condition which requires free circulation of air through the radiator fins. Under conditions of very high dissipation within the tube or high ambient temperature it may be necessary to use forced air cooling, in which case the air should be directed over the radiator fins, and prevented as much as possible from cooling the glass portion of the tube.

OPERATION AND CHARACTERISTICS

The characteristics of this tube are such that it will stand off voltages as high as 5700 volts and after having been broken down by a trigger pulse of the proper shape and amplitude will conduct currents up to 300 amperes for short intervals of time at repetition rates from 160 pps to 1600 pps.

The trigger pulse may take a number of different forms but a convenient and easily obtained type of pulse is a damped oscillation with a relatively high decrement. The fundamental frequency of such an oscillation may vary over a range of 0.1 to 0.5 megacycles. If the maximum amplitude of the trigger pulse is 10.0 kv or more for a two tube circuit or 15.0 kv or more for a three tube circuit there is possibility of ionizing all the gaps simultaneously thereby making lower starting voltages possible. If a unidirectional trigger pulse is used, the starting voltages required are in general higher than in the case of the oscillatory type of pulse.

When the nominal trigger pulse is applied to the tubes in a circuit such as the one shown in Figure 2 and the d-c voltage raised continuously from zero, the tube will begin to operate when the d-c voltage reaches a maximum value of 6.5 kVdc for a two tube circuit and a maximum value of 8.5 kVdc for a three tube circuit. These values are called the starting voltages. Hence it is necessary that the d-c power supply have regulation such

NOTE: This tube is obsolete and manufacturing facilities are no longer available.

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that the no-load voltage applied to the tubes is at least 6.5 kVdc for a two tube circuit and at least 8.5 kVdc for a three tube circuit. This will assure that in the case of interruption of the trigger voltage, supply voltage or both, the tubes will start upon return to normal conditions.

The circuit shown in Figure 2 contains a resonance charging feature in that when the circuit is operating under proper conditions the peak voltage across the switching tubes is about twice the d-c supply voltage. If the resonant frequency of the charging choke and the network capacitance in series is 1/2 the pulsing frequency, switching will take place at the peak of the first oscillation as shown in Figure 3, the voltage across the gaps dropping to approximately 150 volts as the network energy is discharged into the load. The dashed curve shows the excursion of the voltage across the gaps if triggering should not take place. When the pulse forming network is matched to the load impedance only half the network voltage will appear across the load in the case of a square pulse. Hence with the doubling feature a voltage which approaches the d-c supply voltage appears at the load. In practical circuits the ratio of peak voltages across the load to d-c supply voltage may vary from .7 to .95.

In some applications several different repetition rates may be required. If such is the case the resonant circuit may be designed for the lowest required repetition rate. Then as the repetition rate is increased above the resonant value the voltage across the gaps will not build up each cycle as shown in Figure 3 but will instead, build up more nearly linearly. This is due to the fact that the current flowing in the charging inductance at the beginning of each charging cycle is no longer zero as in the case of resonance charging but has an appreciable value. The initial rate of rise of voltage across the network capacitance is then proportional to this initial value of charging current. When the repetition rate is several times that necessary for resonance, the charging current is practically d-c and the rate of rise of the condenser voltage is practically constant. For this reason this type of operation is termed "linear charging". Just as in the case of resonance charging the peak value of the voltage across the gaps just before triggering is approximately twice the d-c supply voltage.

The use of diode charging in which a diode is connected in series with the charging inductance in order to hold the voltage of the network at its maximum value for a considerable time before the gaps are triggered is not recommended. The reason for this is that the 1B42 spark gap tube is not designed to hold off steady voltages but only to hold off voltages of the wave form produced by resonant or linear charging circuits.

When using spark gap tubes in resonance charging circuits the trigger voltage should be applied to the spark gap tubes before the d-c power supply is turned on. This prevents the doubling of a very high no-load voltage of the power supply which might occur during the initial pulses.

If the circuit is operating under normal conditions and the d-c supply voltage is raised, a point will be reached at which both gaps will pass over to a continuous arc. The maximum peak voltage above which this will occur is approximately 5.7 kv per gap. For repetition rates above 1200 pps or peak currents above 200 amperes, the maximum peak voltage per gap should not exceed 5.0 kv.

In order to prevent damage to tubes or circuits if arcing occurs, an overload relay in the d-c supply lead should be provided. This relay should be set to trip at about 50% greater than normal current and should interrupt the primary circuit of the high voltage d-c supply when operated.

If under normal conditions the d-c supply voltage is lowered it will reach a value at which intermittent action will take place. The point below which intermittent action takes place is called the minimum peak voltage. Its maximum value is 9.0 kv for a two gap circuit and 10.5 kv for a three gap circuit.

The range of voltage between the minimum peak voltage and the maximum peak voltage is called the operating range. As is evident from the above, this range is greater for a three gap circuit than for a two gap circuit. The full operating range may be obtained only when the voltage is divided equally among the gaps and when sufficient trigger voltage is supplied to the junction points between the spark gap tubes through individual coupling condensers.

In the interval between pulses when the network capacitance is being charged, the trigger coupling condensers are also being charged through the resistors in the voltage dividing network. The charging currents to these condensers must flow through the resistors in the voltage dividing network and unless the time constants of the coupling condensers and dividing resistors are properly selected, the voltages appearing across the spark gap tubes will be unequal. This will result in the reduction of the upper limit of the operating range for the 1B42 tubes from the maximum value.

If the load is not properly matched to the pulse shaping network, a small amount of reverse current may flow through the tube immediately following each main forward current pulse. Or if the load occasionally "arcs over", then large amounts of reverse current may flow during those periods. Either operating condition will materially shorten the life of the tubes. The inverse current pulse following the main forward curren pulse should not exceed five amperes peak nor last for longer than the forward pulse duration.

RATINGS AND CHARACTERISTICS

	Max.	Nom.	Min.
*Peak voltage per gap	5.7 kv	5.0 kv	-
**Peak voltage across two gaps	-	-	9.0 kv
**Peak voltage across three gaps	-	-	10.5 kv
**Starting voltage for two gaps	6.5 kVdc	-	-
**Starting voltage for three gaps	8.5 kVdc	-	-
§ Trigger voltage for two gaps	-	10.0 kv	8.0 kv
§ Trigger voltage for three gaps	-	15.0 kv	13.0 kv
Trigger frequency	0.5 Mc	-	0.1 Mc
*Peak current	300 a	-	80 a
*Repetition rate	1500 pps	-	160 pps
Pulse duration	6.1 us	-	0.25 us
Duty cycle	0.0012	-	-
Product of repetition rate and peak current	3×10^5	-	-
Coulombs per pulse	0.00128	-	-
Average current	0.250 A	-	-
†Inverse current	-	-	-
Temperature	150 °C	-	-40 °C

*The maximum peak voltage per gap must be reduced to 5.0 kv for repetition rates above 1200 pps or peak currents above 200 amperes. Prefiring may take place during the first three minutes of operation.

**The values of minimum peak voltage and starting voltage are based on a minimum value for the trigger voltage of 10.0 kv for a two tube circuit and a minimum value of 15.0 kv for a three tube circuit.

§ This is the trigger voltage at the tube sockets with the spark gap tubes removed but with equivalent capacities substituted.

†The inverse current pulse following the main current pulse should not exceed 5 amperes peak nor last for longer than the forward pulse duration.