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PULSED-TYPE MAGNETRON OSCILLATOR

RAYTHEON

TENTATIVE DATA

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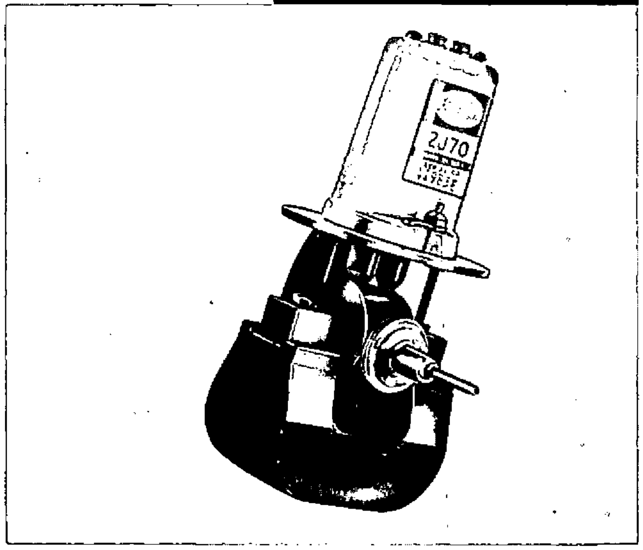
TYPE 2J70



The RK2J70 is a fixed-frequency, pulsed-type oscillator operating in the frequency region of 3030 to 3110 Mc with a minimum peak power output of 20 kw. It is an integral magnet, coaxial output type tube requiring forced air cooling.

GENERAL PRECAUTIONS

Reliable operation and maximum magnetron life will be achieved only if the over-all radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This technical data should be used as a guide for equipment designers rather than the MIL-E-1B purchase specifications.

There are many problems peculiar to magnetrons in general which must be given special consideration in system design. These problems are discussed in detail on the following pages. If for any reason it is desired to operate the RK2J70 under conditions other than those recommended in this technical data sheet, the company's Magnetron Applications Engineering Group should be consulted.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater

Heater Voltage — Preheat	6.3 V ± 10%
Heater Current @ 6.3V	1.10 — 1.40 A
Minimum Preheat Time	3 minutes

Maximum Ratings

The values specified below must not be exceeded under any service condition. The ratings are limiting values above which the serviceability of any tube may be impaired. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

Heater Voltage	7.0 V
Peak Anode Voltage	7.5 kv
Peak Anode Current	15 a
Peak Anode Power Input	100 kw
Average Anode Power Input	200 W
Anode Temperature	120°C
Pulse Duration	2.0 μs
Duty Cycle	.002
Frequency Change Due to Change of Steady State Temp.	.07 Mc/°C
VSWR	1.5/1
Pulling @ VSWR = 1.5/1	13 Mc

Typical Operation

Heater Voltage (operating)	6.3 V
Pulse Duration	1.0 µs
Pulse Recurrence Rate . .	1000 pps
Peak Anode Voltage . . .	7.0 kv
Peak Anode Current . . .	8.0 a
Peak Power Output . . .	25 kw
Frequency	3030 - 3110 Mc

MECHANICAL

Mounting Position	Any
Overall Dimensions . . .	See Outline Dwg.
Net Weight	3¾ lbs
Cooling	Forced Air
Output Coupling	See Outline Dwg.

DETAILED ELECTRICAL INFORMATION

HEATER

The cathode must be preheated at Ef = 6.3 V ± 10% for a period of at least 3 minutes prior to the application of anode high voltage. For operation at conditions different than those under typical operation, the manufacturer must be consulted for a heater schedule. Heater current surges in excess of 6 amps cannot be tolerated.

STARTING NEW TUBE

Aging of the RK2J70 is rarely necessary. If, however, some instability is observed in a new magnetron, it is recommended that it be seasoned under the prevailing conditions of oscillation until it stabilizes and normal operation is attained.

PULSE CHARACTERISTICS

The smooth peak of a pulse is defined as the maximum value of a smooth curve through the average of the fluctuation over the top portion of the pulse. The pulse width is the time interval between the two points on the current pulse at which instantaneous current is 50 percent of the smooth peak. (True only for approximately rectangular waveshapes.) The rise time is the time interval between points of 20 and 85 percent of the smooth peak. Figure 1 shows graphically the definitions mentioned.

The voltage rate of rise boundaries are currently under investigation; it is anticipated they will be published at some later date in a supplementary data sheet. Too fast a rate of rise will lead to moding. The ripple on the top of the current pulse must be kept at a minimum to avoid pushing effects which will tend to widen the spectrum. The trailing edge or decay time of the voltage pulse must be as short as possible to obtain optimum performance and high operating efficiencies. Excessive backswing may cause instability and/or noise. The backswing should not exceed 20 percent of the applied pulse.

For optimum pulse shaping, the magnetron, pulse transformer, and pulse line must be treated as a unit. Careful tailoring of the pulse line in any application is recommended.

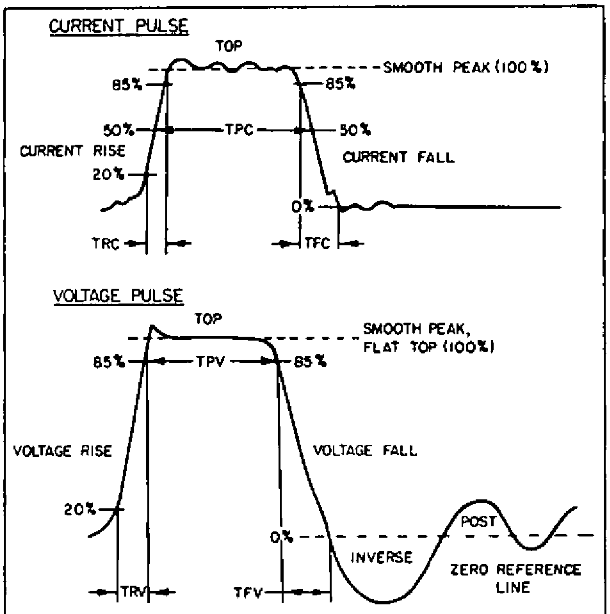


FIG. 1

LOAD DIAGRAM

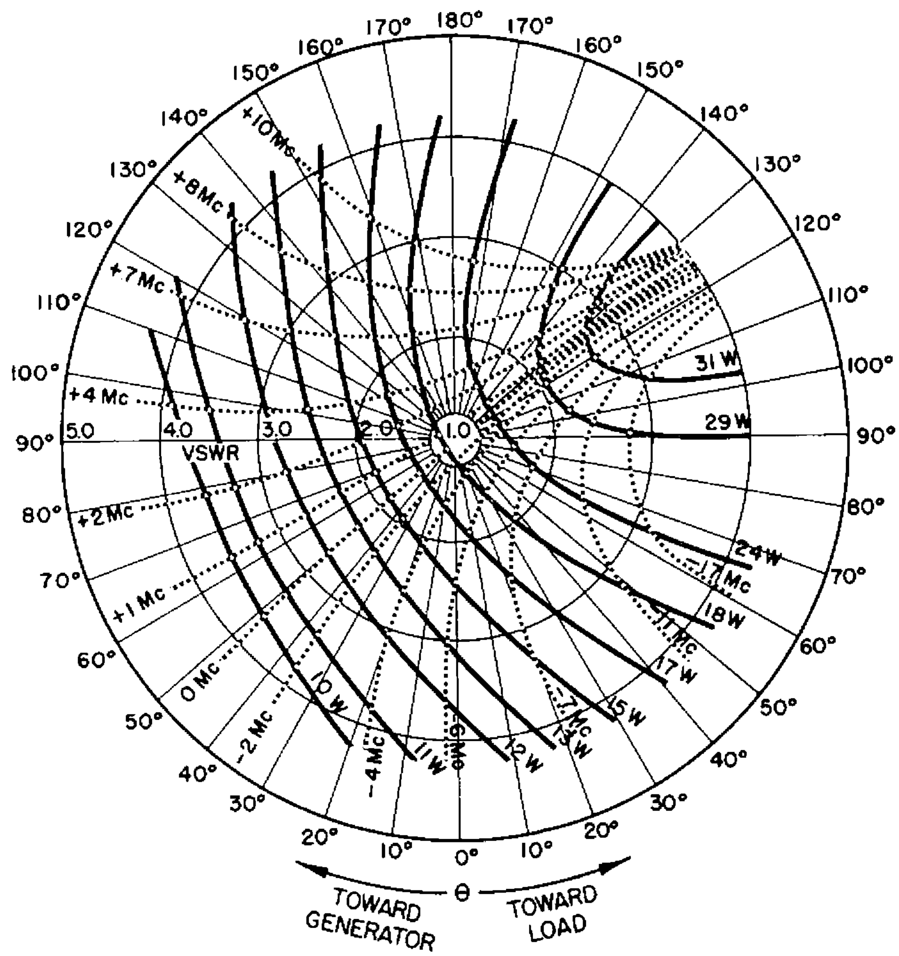
Fig. 2 is a load diagram of a typical RK2J70 magnetron. The contours of constant power output and frequency change are related to voltage standing-wave ratios introduced by mismatched loads at various phase positions. Values of VSWR as high as 4:1 are plotted, but operation with ratios greater than 1.5:1 is not recommended.

COOLING

Anode operating temperatures below 100°C are recommended, although temperature as high as 120°C may be tolerated at the risk of somewhat shortened tube life. The point at which the anode temperature should be monitored is indicated on the tube outline drawing.

2J70

LOAD DIAGRAM



I_b = 8 PEAK AMPS.

Prr = 1000

tpc = 1 usec.

FIG 2

FREQUENCY DRIFT

After operation of the 2J70 is initiated, its temperature rises with time until thermal equilibrium is reached. During this transient period, the geometry of the tube changes slightly and is attended by a small frequency change or drift. If the tube temperature is changed after thermal equilibrium has been established, the operating frequency will also change until thermal equilibrium is again attained and tube geometry stabilizes. The frequency change between two equilibrium positions will not exceed 0.07 Mc/°C.

LOAD AND LINE LENGTH CONSIDERATIONS

If an oscillator is loaded by an electrically long transmission line which is terminated by an impedance different from that of the line, the impedance of the load will be a periodic function of frequency. Operation of the oscillator under these conditions gives rise to phenomena collectively termed "long-time effects." Although these phenomena are usually associated with an electrically long transmission line, they can also be exhibited by a short line terminated by a sufficiently mismatched impedance. In any case, the extent to which the long-time effect is exhibited depends upon the amount of coupling between the load and oscillator as well as the degree of mismatch in the line. Figure 3 shows the relation between the VSWR and the line length with respect to the critical condition of skip. This skip condition occurs when the tube is changing frequency (thermal drift) and causes breaks in the ordinarily smooth drift curve. This condition is not too serious in the RK2J70 because the tube is not tunable. Of far more serious consequence, however, is the broadening and deterioration of the spectra caused by this phenomena. It may, in some cases, permit spectra of two frequencies to appear simultaneously. By operating into loads specified under the region of recommended operation in Fig. 3, satisfactory operation should be obtained. In this region no significant broadening of the spectrum will take place, although, for close control of bandwidth, the VSWR should be kept as low as possible.

More detailed information on the theories and remedies of long-line effects are available upon request.

RF RADIATION FROM CATHODE

The RK2J70 is designed to minimize the generally negligible radiation from the cathode stem. It is not possible, however, to guarantee that the radiation will be negligible; and in particularly critical environments, shielding of the stem may be necessary to avoid radiation difficulties.

OPERATING CHARACTERISTICS

Fig. 4 is a plot of peak power output and peak anode voltage, as a function of anode current.

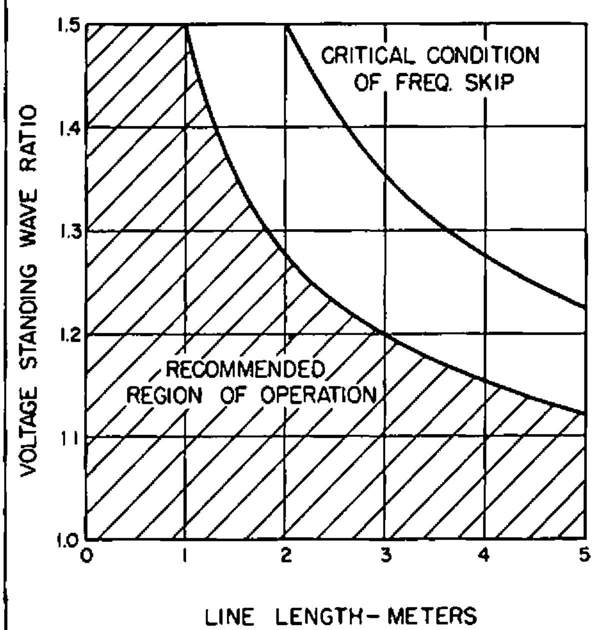


FIG. 3

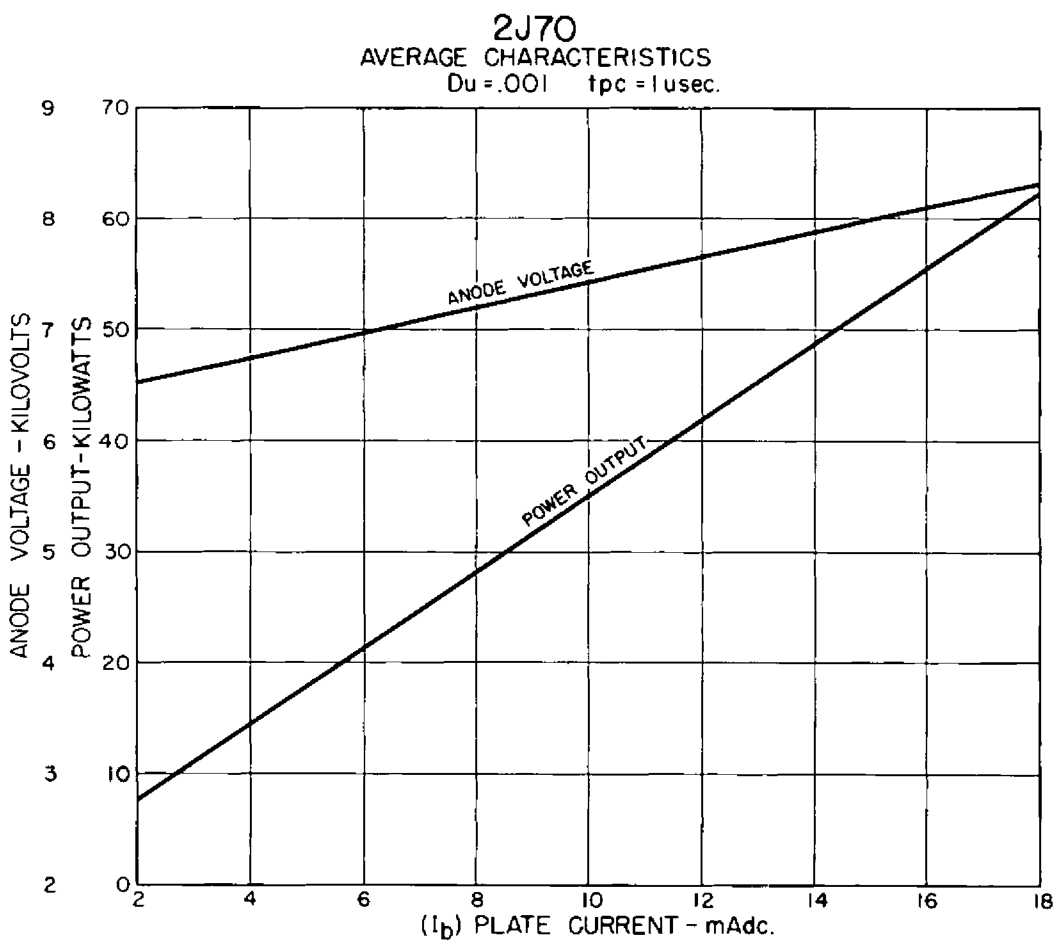


FIGURE 4

DETAILED MECHANICAL INFORMATION

OUTLINE DRAWING

The detailed mechanical dimensions are given in Fig. 5. These dimensions should be used in designing the mechanical layout rather than those of a sample tube.

INSTALLATION AND HANDLING PRECAUTIONS

Unnecessary jarring or rough handling of the tube must be avoided. Although a packaged magnetron appears to have great structural strength, the internal structure is delicate and involves critical alignment of parts. In particular, the center conductor of the coaxial output should not be subjected to sharp blows or excessive strains that may destroy its fragile metal to glass seal.

ELECTRICAL CONNECTIONS

Electrical connections are made to the frame of the tube and to the two jacks mounted on the glass cathode bushing insulating boot. The positive high voltage should be "grounded" to the tube, preferably at the mounting plate. The two jacks serve as the heater and cathode connectors. The jack nearest the letter "C" on the insulating boot is common to heater and cathode; the other is of course, the remaining heater connector.

NOTES:

1. The jack holes shall be within a radius of .023 of the location specified but shall be spaced .500 ± .010 with respect to each other. The center line of the holes shall be perpendicular to ref. plane "A" within 3°.
2. Leads (2) shall be flexible and slack.
3. Pyrex glass, porcelain, or approved equivalent.
4. Gasket may be omitted by cementing the base to the plate.
5. Indicate common cathode connection by letter "C" on this surface.
6. Heater pipe and seal off teats shall not touch inside wall of base.
7. Any portion of the assembly extending above this surface shall be within a 1.109 R. of true center of the plate.
8. Hex-head banana locking 19/32 LG. .169 ± .005 hole.
9. Common cathode connection.
10. Areas between and including these planes shall be painted with a black, heat-resistant, noncorrosive paint.
11. Protective black coating over magnet.
12. This dimension applies to adapter.
13. Center line of lead shall be concentric with adapter within .020.
14. Pressure plate surface to be flat within .010 for .500 from outer edge.
15. Output cylinder shall be noncorrosive material or painted black plated min. 20 M.S.I. silver or 10 M.S.I. gold.
16. Periphery of countersunk hole or head of #8-32 screw may extend into .191-.195 dia. holes on ref. plane "B".

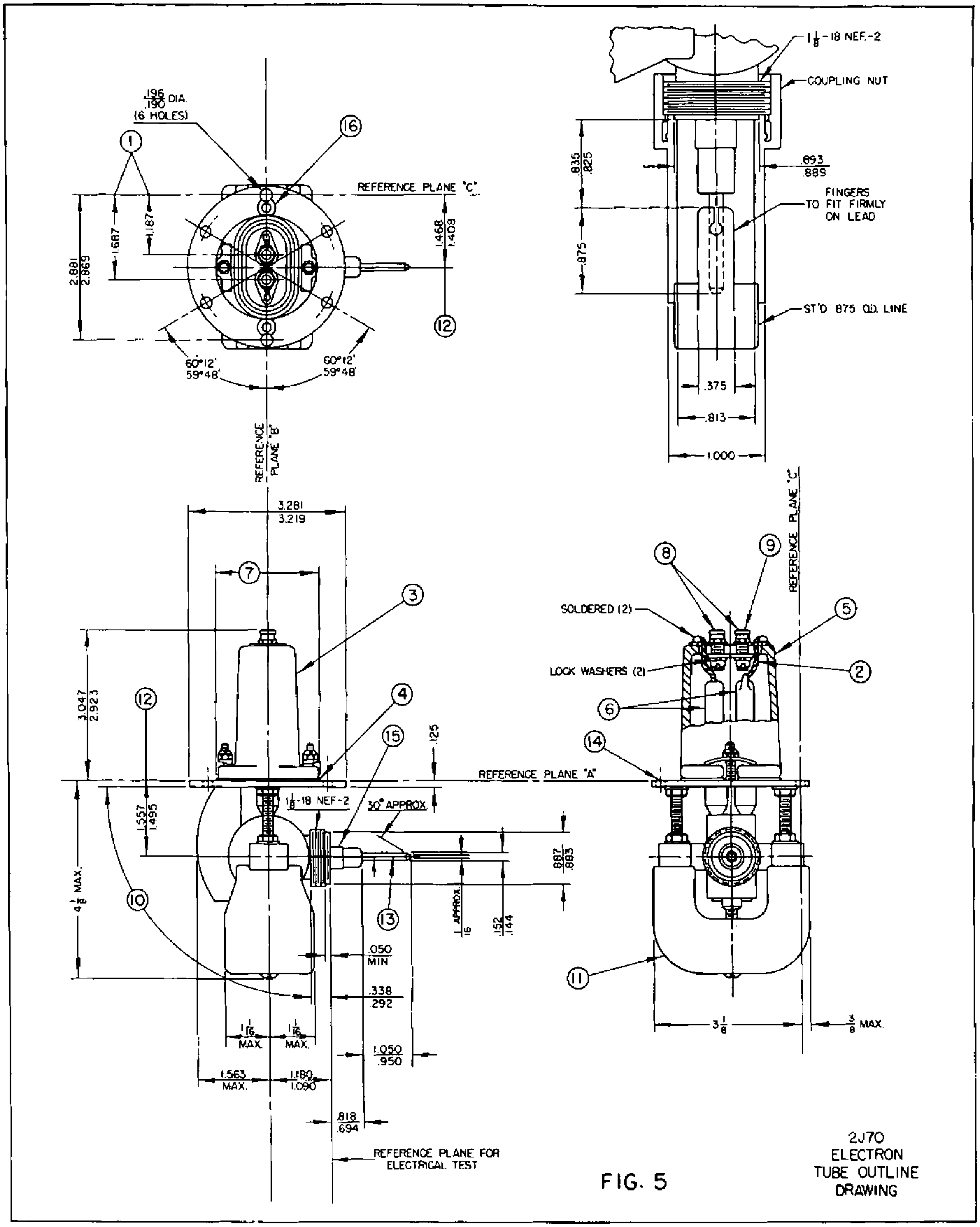


FIG. 5

2J70 ELECTRON TUBE OUTLINE DRAWING