TECHNICAL INFORMATION

WESTERN ELECTRIC 2J51 VACUUM TUBE

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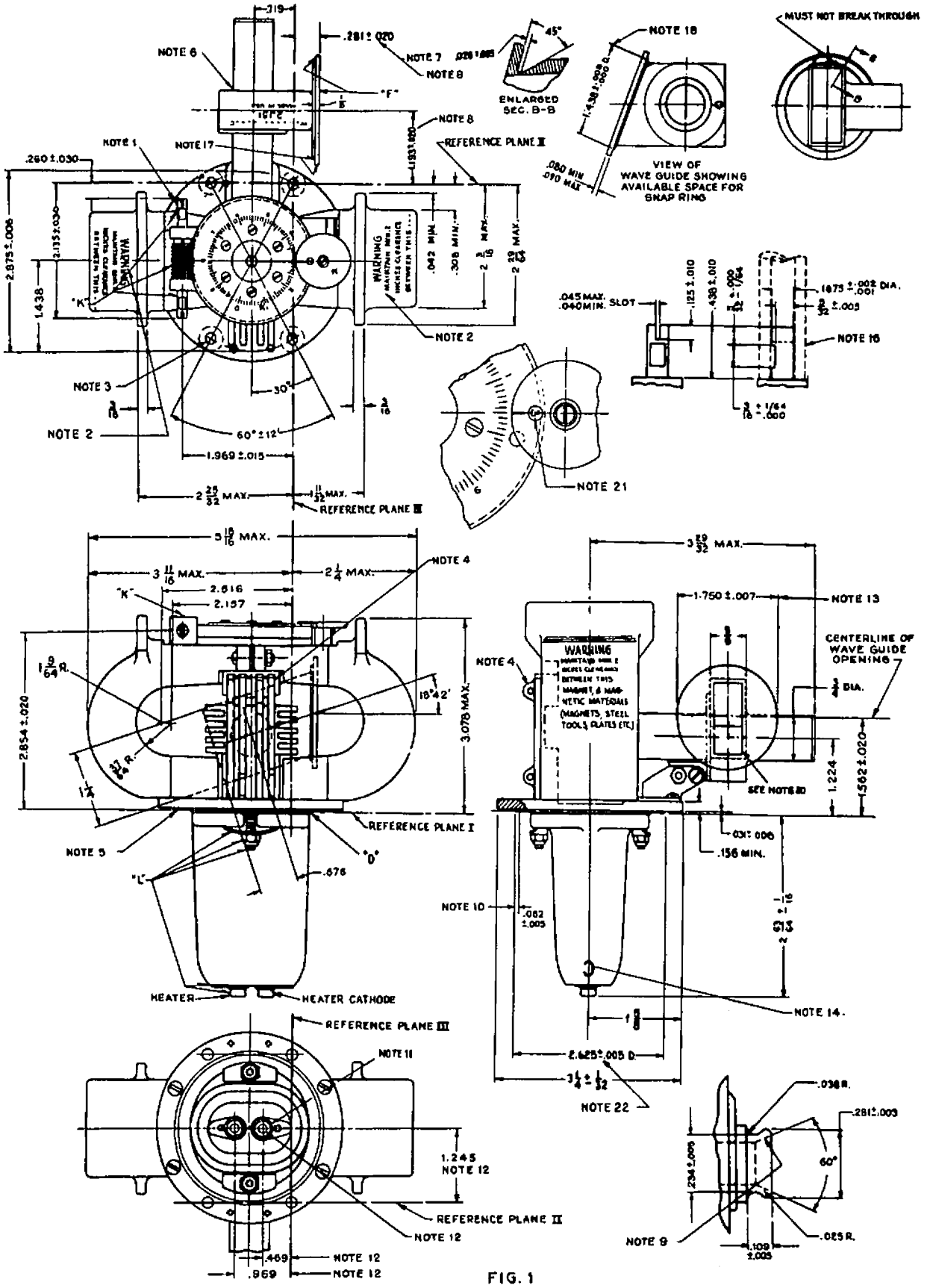

FIG. 1

NOTE: THIS SHEET DOES NOT IMPLY COMMERCIAL AVAILABILITY OF THE TUBE.

FIGURE 1 NOTES

NOTE 1
TO INCREASE FREQUENCY, DRIVE THIS END OF WORM SHAFT IN COUNTERCLOCKWISE DIRECTION.
COMPLETE FREQUENCY RANGE COVERED IN APPROX. 125 TURNS.
THE TUNING MECHANISM SHALL OPERATE SMOOTHLY OVER THE ENTIRE MECHANICAL RANGE WHEN SUBJECTED TO TORQUE OF 1 1/2 INCH-POUNDS APPLIED AT THE WORM SHAFT.
IN EQUIPMENT NO LESS THAN 1 1/2 INCH-POUNDS NOR MORE THAN 2 1/2 INCH POUNDS SHALL BE APPLIED AT DRIVE SHAFT.
THE GEAR AND WORM THREADS MUST BE FREE FROM CORROSION, PAINT AND OTHER IMPERFECTIONS.

NOTE 2 WARNING
MAINTAIN MIN. 2 INCHES CLEARANCE BETWEEN THIS MAGNET, & MAGNETIC MATERIALS (MAGNETS, STEEL TOOLS, PLATES, ETC.)

NOTE 3
FOUR .193"±.003" DIA. HOLES. 7/32" MIN. CLEARANCE AROUND FOUR HOLES AT BASE PLATE. THIS CLEARANCE TO BE FREE FROM BLACK FINISH.

NOTE 4
FOUR MAGNET SHUNTS
FOR NUMBER OF MAGNET SHUNTS TO BE RETAINED SEE TECHNICAL INFORMATION.
TO REMOVE SURPLUS, GRIP FIRMLY AT TABS WITH SUITABLE PLIERS AND PULL AWAY FROM TUBE.

NOTE 5
ANY PORTION OF THE ASSEMBLY EXTENDING BELOW THIS SURFACE SHALL BE WITHIN A 1-7/64" RADIUS ON THE TRUE CENTER OF THE PLATE.

NOTE 6
ALL JOINTS IN THE WAVE GUIDE ASSEMBLY SHALL BE VACUUM TIGHT SO THAT THE WAVE GUIDE FLANGE MAY BE USED TO PROVIDE A HERMETIC SEAL AT SURFACE (F)(SEE TEST SPEC.)

NOTE 7
THE ± .020" TOLERANCE OF .281" DIMENSION INCLUDES ANGULAR AS WELL AS LATERAL DEVIATIONS OF THE SURFACE.

NOTE 8
THESE DIMENSIONS DEFINE RELATION OF SURFACE (F) TO RESPECTIVE HOLES.

NOTE 9
THIS COUNTERSINK SHALL BE CAPABLE OF ACCEPTING A CONE HAVING A 60° INCLUDED ANGLE AND A BASE DIAMETER OF .234" AND SHALL REJECT A SIMILAR CONE HAVING A BASE DIAMETER OF .254".

NOTE 10
WITH 1/16" SEAT RESTING ON A PLANE SURFACE, THE FLATNESS OF THE SEAT SHALL BE SUCH THAT A .010" THICKNESS GAUGE 1/8" WIDE SHALL NOT PASS UNDER.

NOTE 11
HEXHEAD BANANA PIN JACK 19/32" LONG HOLE .169"±.005" DIA.

NOTE 12
THE JACK HOLES SHALL BE WITHIN A RADIUS OF .023" OF THE SPECIFIED LOCATION BUT SHALL BE SPACED .500" ± .010" WITH RESPECT TO EACH OTHER. THE CENTERLINES OF THE JACK HOLES SHALL BE PERPENDICULAR TO MOUNTING PLATE WITHIN 3°.

NOTE 13
THIS DIAMETER SHALL BE CONCENTRIC WITH OPENING IN WAVE GUIDE WITHIN .010".

NOTE 14
"C" INDICATES ADJACENT JACK IS THE COMMON HEATER-CATHODE CONNECTION.

NOTE 15
ALL METAL SURFACES COVERED BY BLACK FINISH EXCEPT SURFACES (D) AND (F), DRIVE AND STOP MECHANISM (K), SURFACE AROUND HOLES AS SPECIFIED IN NOTE 3, PARTS ASSOCIATED WITH GLASS INSULATOR (L), AND SHUNTS.

NOTE 16
IT SHALL BE POSSIBLE FOR A SLEEVE .195" I.D. X .406" O.D. X 1" LONG TO PASS OVER ENDS OF SHAFT TO FACE OF WORM BRACKET.

NOTE 17
BLACK FINISH MAY BE OMITTED FROM THE EDGES AND BACK OF WAVE GUIDE.

NOTE 18
THIS DIAMETER SHALL BE CONCENTRIC WITH THE DIAMETER OF THE FLANGE WITHIN .005".

NOTE 19
ON GOVERNMENT ORDERS THE INITIAL ISSUE OF THIS DRAWING AND ALL SUBSEQUENT CHANGES ARE SUBJECT TO APPROVAL BY THE SERVICES.

NOTE 20
THE OPENING IN THE WAVE GUIDE SHALL BE ENCLOSED BY A DUST COVER WHEN THE TUBE IS NOT IN USE.

NOTE 21
NUMBER APPEARING ON GENEVA INDICATES THE NUMBER OF REVOLUTIONS OF HELICAL GEAR.
WITH THE GENEVA AND GEAR SET AT 3 AND ZERO RESPECTIVELY THE FREQUENCY OF THE TUBE IS 9000 ± 25 MC UNDER OSCILLATION 3 ON TEST SPECIFICATION LTP-16802.

NOTE 22
SOLDERED JOINTS IN BASE PLATE WITHIN THIS DIA. SHALL BE VACUUM TIGHT SO THAT BASE PLATE MAY BE USED TO PROVIDE A HERMETIC SEAL.

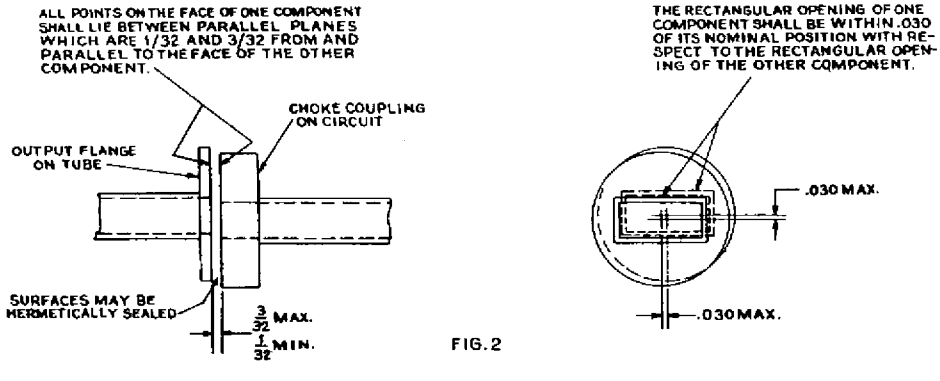

FIG. 2

CLASSIFICATION

The 2J51 vacuum tube is a magnetron oscillator the frequency of which is determined by internal resonant circuits. The frequency may be varied by an external adjustment over a range of 8500 to 9600 megacycles. The tube is designed for the generation of peak power up to 80 kilowatts under conditions of pulsed operation. It has an equi-potential cathode with a 6.3 volt, 1.0 ampere heater.

The output circuit is designed so that the tube, when loaded by a matched waveguide, will operate at a fairly uniform level of power and frequency pulling over the band. The tube is equipped with permanent magnets to supply the maximum field required for operation. Four magnetic shunts are provided to adjust the strength of the field downward. If not required, these shunts should be removed before the tube is installed. Forced air cooling is required for normal operation.

DIMENSIONS, MOUNTING AND CONNECTIONS

Figure 1 shows the principal external dimensions and the arrangement of heater, cathode and output leads. One end of the heater is connected to the cathode internally. Since this cathode lead is pulsed at high voltage the input connections must be adequately isolated. The connections should be flexibly mounted.

The tube should be mounted only from the circular flange to which the glass protective boot is attached but may be operated in any orientation. The flange has a circular bead to facilitate pressurizing. No direct connection is made to the output circuit of the tube. Figure 2 shows the output coupling and gives limits controlling the placement of the components.

Care should be exercised in the handling of the tube. The tube envelope is soft copper and may be easily distorted. Distortion may result in loss of vacuum or impairment of electrical characteristics. The warning note on the magnets should be heeded. No more than the maximum torque as specified in Note 1 of Figure 1 should be applied to the tuning mechanism.

COOLING

The temperature of the tube envelope must not exceed 150°C. Failure to provide adequate cooling will adversely affect the life of the tube. The rate of air circulation required will depend upon total dissipation and the efficiency of heat interchange between the tube structure and circulated air. A blower delivering 50 cubic feet of air per minute directed at the point indicated in Figure 3 and uniformly distributed over the cooling fins provides adequate cooling under conditions of maximum value of average power input when the ambient conditions are 50°C temperature and 760 mm. Hg. pressure.

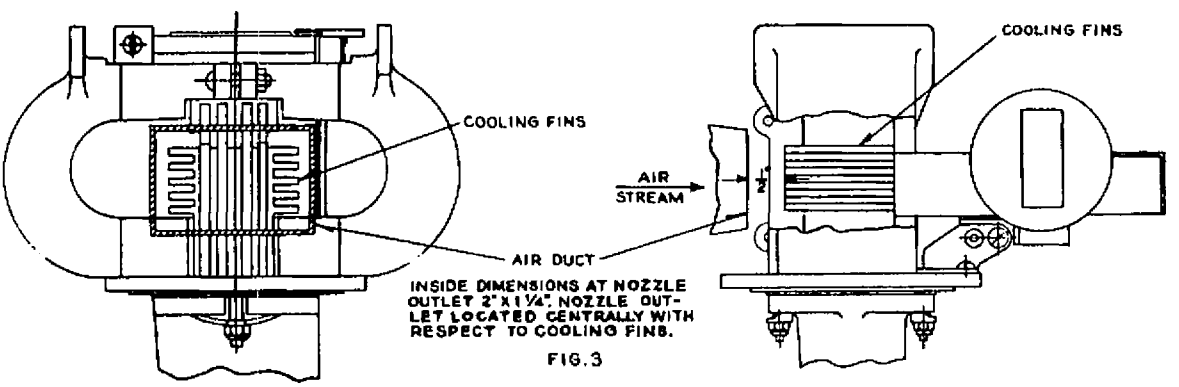

FIG.3

PULSE CHARACTERISTICS

In pulsed operation the tube is energized a small fraction of the time (Duty Cycle) by applied voltage pulses of not more than a few microseconds duration. Frequency modulation in the tube may result from;pulses of varying amplitude; pulses with superimposed ripple; or pulses for which the time of rise or time of fall, or both, occupy too great a portion of the pulse duration. On the other hand, misfiring, or missing lines in the spectrum may result from pulses for which the time of rise is too short, a condition especially likely to occur when the pulse duration is a small fraction of a microsecond. The time of rise of the resulting current pulse should be not less than 0.1 usec.

For operation near the maximum rated pulse power, it is essential that the input circuit be so designed that the energy per pulse delivered to the tube, if sparking occurs, cannot greatly exceed the normal energy per pulse. Pulsers of the discharging network type usually satisfy this requirement.

OPERATION

Prior to application of high voltage, the cathode should be heated at Ef = 6.3 ± 10 per cent for not less than one minute. During high voltage pulsed operation the heater voltage should be varied with input power approximately in accordance with the formula:

$$Ef = 6.3\sqrt{1 - \frac{Pi}{150}}$$

with Ef = 0 for all values of Pi greater than 150. The heater should be protected against input pulse power by an appropriate filter.

A new tube may exhibit initial instability. This is most likely to occur with pulses of long duration and high peak power, and is progressively less severe for shorter pulses and lower peak power. A few minutes of operation is usually sufficient to obtain stable operation.

The initial values of frequency and power output differ slightly from those measured under conditions of thermal equilibrium. Also, an adjustment of the tuning mechanism during operation disturbs the thermal equilibrium so that the frequency does not immediately assume its steady state value for that setting. The thermal drift is about 75 per cent completed within one minute. Its magnitude, in megacycles per megacycle of tuning adjustment varies from about 0.01 at the low frequency end of the range to about 0.06 at the high frequency end.

OPERATING CHARACTERISTICS

Figure 4 shows the frequency and power output at constant Ib of an average tube operating at midband frequency as functions of the load impedance presented at the output flange of the tube. In this diagram standing wave ratio contours are concentric circles, the center of the circles representing a matched line. The circle for s.w.r. = 1.5 is shown. The contours of constant power output and constant frequency remain very similar as the tube is tuned mechanically over the range. They rotate, however, with respect to the impedance diagram, making about one full clockwise rotation between maximum and minimum frequency adjustments.

Figure 5 shows average power output, pulse voltage and pulling factor as functions of frequency under conditions of maximum magnetic field and 14 milliamperes average current. Efficiency is reduced progressively as the magnetic field is reduced by means of the shunts. The dynamic impedance of a typical tube is approximately 150 ohms, and is slightly dependent upon the operating point, accordingly, the threshold voltage is about 2 kv less than the pulse voltage corresponding to a pulse current of 14 amperes.

The performance data given below are based upon typical sets of conditions at midband frequency. Variations can be expected with different tubes and in different systems.

	MAGNETIC FIELD	
	NO SHUNT	TWO SHUNTS
Pulse Current (Amperes)	14.0	12.0
Average Current (Milliamperes)	14.0	12.0
Pulse Voltage (Kilovolts	14.3	12.0
Peak Power Input (Kilowatts)	200	144
Peak Power Output (Kilowatts)	60	40

RATINGS

These ratings apply to each quantity independently. They do not form a set of values at which the tube can operate.

	MAX.	MIN.	UNIT
Heater Voltage (Ef)	7.0		Volt
Pulse Current (Ib)	16.0	6.0	Ampere
Peak Power Input (pi)	260		Kilowatt
Average Power Input (Pi)	230		Watt
Duty Cycle	.0012		
Pulse Duration	6.0		Microsecond
Total Time of Oscillation in Any 100 us Interval	6.0		Microsecond
Anode Temperature	150		°C
*TUNING RANGE	9600	8500	Mc/sec

*Voltage varies approximately 11% over the frequency band. Ajustment must be made when the tube is tuned so that current remains within ratings.

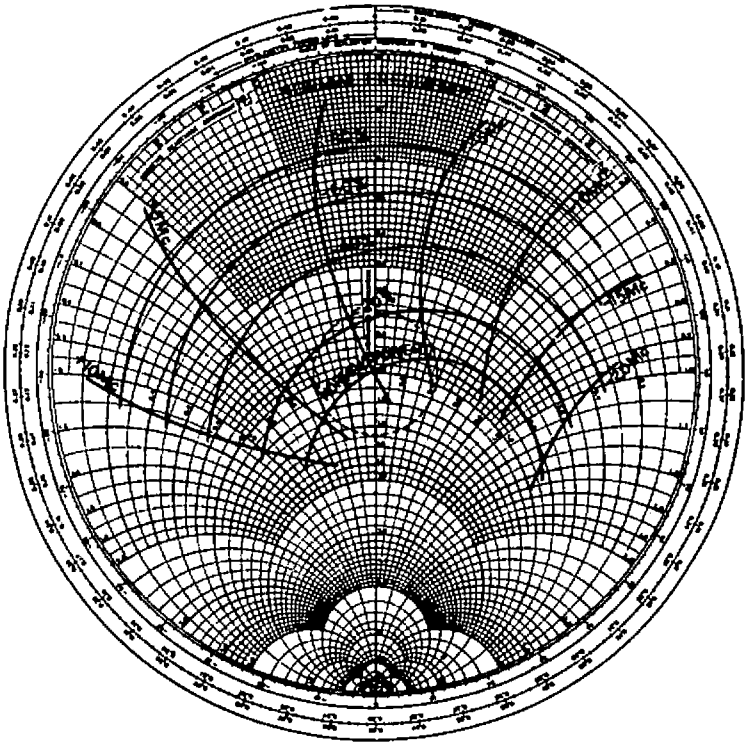

FIG. 4

AVERAGE CHARACTERISTICS
OF
2J51 MAGNETRONS

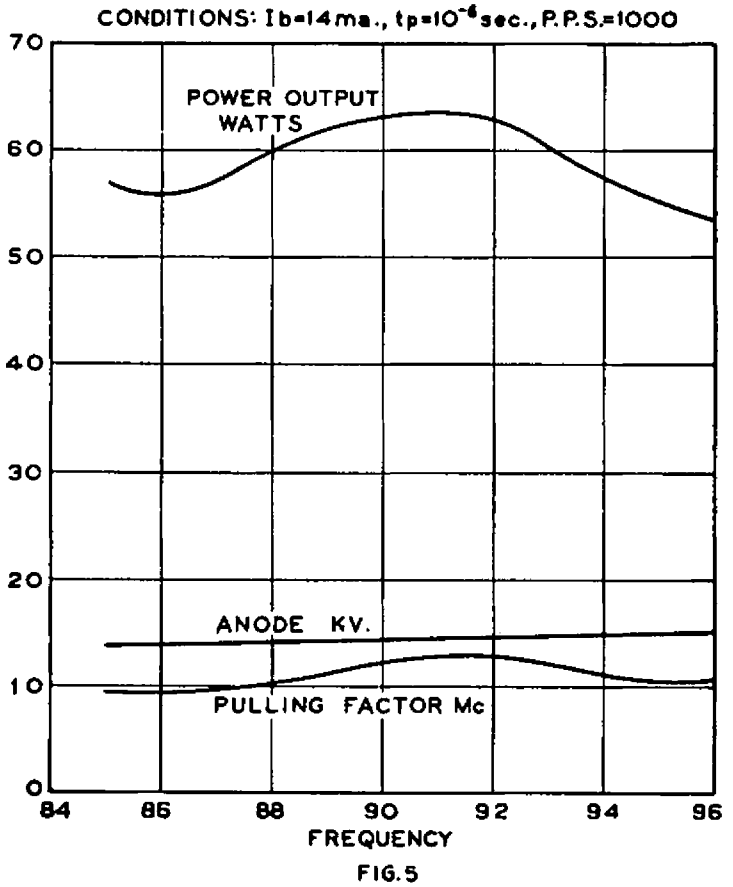

FIG. 5