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Title Investigation of GL-846 Power Output

By

Electronic Tube Engineering Div.

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72186

INVESTIGATION OF GL-846 POWER OUTPUT

PURPOSE:

It is the purpose of this data folder to investigate the GL-846 test for oscillation power output (JAN-F6d(2)). Such investigation was undertaken because of the difficulties encountered by the testing section in consistently obtaining sufficient power output. Further, in view of satisfactory characteristic and other static tests, it was felt that tube quality was being maintained.

TEST PROCEDURE:

Twenty-one representative GL-846 tubes were chosen for the test. Complete static tests showed these tubes covering the usual range of values between limits. The tubes were first tested in the water cooled tube test set in Building 269. This is a conventional Colpitts oscillator operating at 1100 KC. The oscillator is loaded into parallel 862's, diode-connected and filament voltage controlled. Water temperature was read; thermometers and water flow was metered. In the test of water cooled tubes the total power output (as called for in the JAN specification) is found by subtracting the power dissipated in the water from the total input. The water is heated chiefly by plate dissipation, also by a portion of the grid driving power and filament input. The heating effect of grid drive was neglected in this investigation but heating due to the filament was considered. A curve of static plate dissipation versus temperature change was taken. Particular attention was paid to meter, thermometer, and water flow calibration. Test data taken in Building 269 are recorded in Table 1.

When these first tests showed that it was difficult to get sufficient output, a separate oscillator was built in an effort to improve the circuit efficiency. The usual tests for parasitics, etc. had been made on the factory test set with no results. This separate oscillator was quite compact and was mounted on the tube buggy, the buggy being wheeled into the test cubicle for application of power. Power output results were identical to those previously obtained.

A recently rebuilt test set in Building 37 was next tried. An air cooled strap resistor comprised the load. The tubes were found to give several hundred watts less than in Building 269 possibly because of the difficulty in determining and holding water flow and temperatures. Test data taken in Building 37 are also recorded in Table 1.

TABLE 1

Tests	(1) Gas	(2) Ic Cutoff-Ec	(3) Ib	(4) Grid Ic	(5) If	(6) Im	(7) Pwr. Output	
Units	uA	volts	amps.	amps.	amps.	amps.	kw	
Limits	(80 max)	(250/190)	(1.85/ 0.95)	(0.28/ 0.12)	(53/48.5)	(0.7/ 0.3)	(4.5 min) #269	#37
Tube#								
1807	17	198	1.05	0.21	49.0	0.400	4.50	4.20
1896	10	228	1.00	0.18	50.0	0.440	4.55	*
1856	10	194	1.00	0.18	50.8	0.380	4.40	4.10
1801	12	225	1.05	0.18	49.5	0.320	4.40	4.10
1848	10	235	1.40	0.21	49.5	0.380	4.30	4.10
1850	10	225	0.85	0.15	48.9	0.390	4.30	4.20
1697	30	230	1.03	0.22	51.0	0.350	4.30	4.10
1638	28	225	0.92	0.20	51.0	0.460	4.10	*
1717	8	200	0.98	0.21	51.0	0.360	4.30	4.00
1817	10	235	1.00	0.19	50.0	0.340	4.40	*
1876	10	205	1.00	0.20	50.0	0.380	4.50	4.20
1881	18	202	1.00	0.19	50.0	0.390	4.35	4.20
1576	10	210	1.00	0.18	51.0	0.330	4.30	4.00
1852	10	215	1.00	0.20	49.5	0.310	4.20	4.00
1900	10	205	0.97	0.20	50.0	0.500	4.50	4.00
1902	18	210	0.96	0.18	50.0	0.490	4.50	4.30
1889	12	205	1.00	0.20	50.0	0.430	4.45	4.10
1712	13	215	0.96	0.20	50.5	0.380	4.50	4.40
1655	13	230	1.00	0.20	51.8	0.370	4.30	4.10
1605	12	215	0.96	0.20	50.0	0.350	↷	4.00
1906	10	210	0.96	0.20	50.0	0.380	4.30	4.00

* No data taken
↷ Kicks off
(1) Grid current - gas test
(2) Negative grid voltage for plate current cutoff
(3) Plate current; grid & plate positive
(4) Grid current; " " "
(5) Filament current at rated voltage
(6) Emission - diode connection
(7) Oscillation power output

In order to further check the results of our tests, arrangements were made to submit 6 representative tubes to the Naval Research Lab., Anacostia, D.C. On the basis of our previous data, the 6 tubes were selected as 2 of the best, 2 of the lowest and 2 average tubes. The test circuit used at NRL is Hartley, operating at 18.4 megacycles. The coil is resonated by distributed and interelectrode capacitances, there being no external tank capacitor. Thermometers were placed in the water lines 7" from the tube jacket.

The flow gauge and thermometers were checked along with the circuit meters and frequency. No grid supply was available so it was necessary to measure the heating effect of the filament since a curve of static plate dissipation against temperature change was not easily taken. An average of three trials showed that 420 of the 550 filament watts heated water. Power dissipation in the water was now calculated for each tube by the formula:

$$P_W = 0.263 \quad N(\Delta T)$$

where,

P_W = power in KW
N = flow in US gallons per minute
ΔT = temperature change in degrees C

Taking into account the heating due to the filament, total power output was now calculated as:

$$Po = EbIb * 0.42 - Ew$$

where,

Po = total power output in KW
EbIb = power input in KW

An 846 taken from NRL stock was first tested in this oscillator. Mr. Fetsch indicated that the tube had been manufactured before 1934. This tube gave a total power output of 4.53 KW. The tests at NRL were witnessed by Messrs. Fetsch, Walker, Gainer, and Couch and the writer.

POWER OUTPUT READINGS

Tube#	In #269 3-17-44	In #37 4-1-44	N.R.L. 4-7-44
1817	4.4	--	4.52
1876	4.6	4.2	4.67
1576	4.2	4.0	4.46
1852	4.3	4.0	4.46
1902	4.5	4.3	4.55
1889	4.4	4.1	4.55

CONCLUSION:

Tests in Building 269 and those taken at NRL show that with careful adjustment and attention to detail some GL-846 tubes meet the JAN specification of 4.5 KW total output. The tests also show that tube quality has been maintained. However, the conditions under which these tests were made are much too difficult and time consuming for production tests. A revision of the test specification would in no way indicate a reduction in tube quality. A lower power output limit

should be established to be consistent with the tube design. It is recommended that the limit be reduced to 4.0 KW to allow for normal tube variation and to facilitate production testing.

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April 14, 1944