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Title..... High Current Tests on the GL-415 with a Low Duty Cycle
..... and Several Water-cooling Devices

By
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Information prepared for.....

Tests made by.....

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Date..... 5-3-41.....

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High Current Tests on the GL-415 with a
Low Duty Cycle and Several Water-Cooling Devices

Vac. Tube Engg. Dept.

May 3, 1941.

Purpose

The purpose of this test was to determine the greatest average current rating of the GL-415 operating on a 10% duty cycle and with several water-cooling schemes.

Procedure

The factory ignitron test set and welding control panel were used to load the GL-415 which was placed in the trailing tube position. The first tube was serial #4 and was run water-cooled at a clamp temperature of 40° C. Then the operation was duplicated except that a clamp also was put on the top portion of the tube which was sandblasted to improve the heat transfer.

A comparison was made with tube #2 which had copper tubing tinned to the clamp surface of the ignitron. This tube also was run under the same routine with a standard 415 clamp on the top half. After this a different 415 was obtained to check the first run because the #4 tube was suspected of failing during a severe run.

In each case the duty cycle was kept 10% with either 60 or 15 cycle welds and various peak currents. Also, all runs were made with 7.5° phasing down.

Results at 10% Duty

Serial Number			No Flashing.		With Seal	
			Maximum	Maximum	Flashing.	Max.
			I _{pk}	I _{avg}	I _{pk}	I _{avg}
4	Clamp	Water-cooled bottom	580	18.4	-	-
4	"	" " bottom & top	580	18.4	-	-
2		Coiled tubing	726	23.1	1640	52
2		" " with top clamp	875	27.8	1640	52
35	Clamp	Water-cooled bottom	726	23.1	1640	52

Present Ratings at 10% Duty, 575 Volts

GL-415	15.1 Amperes Average 475 Amperes Peak
FG-271	34.7 Amperes Average 1090 Amperes Peak

Discussion

When 726 peak amperes was reached the tubes began to show signs of distress. First the glow in the seal grew more intense until it was a rope-like streamer coming clear to the top of the seal. This streamer split several ways as the current advanced until it merged into one cylindrical figure and surrounded the anode lead about two-thirds of the way from the lead to the glass seal. This splitting was true of both tubes first tested, but with serial #35 tube there was the cylindrical glow from the first. At the low currents with this tube there were blank spots in the surface of the glow which filled in lightly at the higher currents.

All in all, this #35 tube seemed to have the best quality. It was tested only because tube #4 was suspected of failure during one of the runs.

With the coiled tubing as a cooler, the #2 tube seemed to be the most satisfactory because it did not have flashes as frequently or as severely in the proposed ranges of current rating. Flashing in it seemed to be augmented, however, when the current was raised past this range. With this coil and a clamp on the top of the ignitron, an additional decrease in flashing was observed, but seemed augmented when the currents were very high.

This improvement, however, did not cure the flashing and was most effective only around 1,000 peak amperes in that, while flashing occurred here, it was not as frequent or intense as with the standard water-cooling clamp. Above this value its effect was not greatly noticeable. Moreover, the #35 tube did just as well without the super-cooling, although it might show up even better with greater cooling.

Conclusions

1. If seal flashing can be eliminated there is a good chance that the 271 rating can be attained with the 415 tube.
2. The entire test was handicapped by the flashing in the seal of all the tubes so that the true effect of better cooling cannot be determined until this flashing is overcome. Also, one tube with standard cooling showed as well as the specially cooled tubes which may be due to the better quality of the tube.
3. The differences among the three tubes indicate that a gassy condition may exist with tubes #2 and #4 although they showed fair in hi pot. It may be that the exhausting of these tubes should be improved.
4. The first two tubes seemed to compare favorably in quality and here the better cooling improved the performance of one tube considerably. However, it does not appear likely that cooling the top of the tube will help raise the rating of the tube, as far as this test indicates.
5. The greatest progress is indicated when the conduction time is lowered, as to 15 cycles used in this test, for at these values the peak current was brought to 1650 without dumping the breaker. Because of the severe flashing on 60-cycle welds and 875 peak amperes, it is doubtful that the tube would have held off at much over 1,000 amperes peak.
6. An anode heater should be tried on these tubes to overcome flashing, if seal design changes do not accomplish the desired result.

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