311.61
311.70

PBM PBM
~~PSJ~~
CWH
JNM
RHBE

GENERAL ELECTRIC
COMPANY
SCHENECTADY, N. Y., U. S. A.

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Title Welding Control Ignitrons Effect of Thermal Capacity on Ratings

By

Vac. Tube Engg. Dept. Div.

Information prepared for

Tests made by

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Date 11-7-40

DA-505000

Welding Control Ignitrons

Effect of Thermal Capacity on Ratings

Vac. Tube Engg. Dept. November 7, 1940.

It has been observed that the small FG-271 tube, when operating at short spots and low average currents, can control almost as much current as the large FG-258-A tube. It would, therefore, appear that the higher peak current rating of the FG-258-A at normal long spots is due more to this tube's greater mass than to its greater cross-section, cooling area, and volume.

The thought that our welding control tubes could have higher ratings if they had greater thermal capacity was confirmed mathematically by the Engineering General Department (see DF-26560). Among other things, these calculations indicate that the FG-235-A inner cylinder temperature rises 75° C during a rated 60-cycle conduction period. This is obviously a very important factor since a rise of 75° C above a water temperature of 40° C gives a total temperature in the glow discharge range.

This report outlines the results of preliminary tests made on the effect of increased mass on FG-271 current-carrying ability. The particular "heavy" FG-271 referred to was made by soft soldering a copper cooling coil to the inner cylinder and casting about 3 pounds of tin around the coil and cylinder.

Results

The attached curve sheet plots the peak current that can be handled at different spot lengths. The following tabular comparison is taken from these curves.

At 60-cycle spots the various tubes will handle under phase controlled conditions:

FG-271 rating	950	amperes	
FG-271 test on std tube	1950	"	1 arcback in 300 cycles
FG-258-A rating	3500	"	
FG-271 test on heavy "	5300+	"	No arcbacks
FG-258-A test on std "	7300	"	1 arcback in 300 cycles

Comment

The heavy FG-271 tube operated well above the FG-258-A rating (at low average currents). This again demonstrates the importance of close spacings for pressure and ionization control. The close FG-271 spacing more than overcame the FG-258-A advantages of greater condensing area, greater cross-section and greater volume. In other words, tremendous instantaneous

pressure and ionization exist in the FG-271 when great currents flow and great blasts of mercury are produced. These can be tolerated because the limited condensing area operates through such small distances.

Conclusions

It should be possible to produce a tube having much higher rating than the FG-258-A by combining:

1. Greater thermal capacity
2. Close spacings
3. Large condensing area
4. Large volume.

A theoretical limit of about 40,000 amperes peak would appear to be possible at 440 volts rms based on the Kingdon-Lawton arcback data. We should, therefore, be able to reach at least the 15,000 amperes which is the next standardized step above the FG-258-A.

Such a tube should not require larger cylinders, headers or anode seals than the present FG-258-A. It would, therefore, involve a minimum of tool expense.

The application of these design principles to our smaller tubes (FG-271 and FG-235-A) should allow their use at much higher ratings.

Suggested Program

Since there is need for a tube having higher capacity than the FG-258-A, these design principles should be worked out in this size of tube and proved in service for as long a period as possible. During this time the FG-235-A and FG-271 should be changed as little as possible, which will save Engineering and Factory time so badly needed for production operations at present.

JHH:HT

J. H. Hutchings

J H Hutchings
Nov 7, 1940

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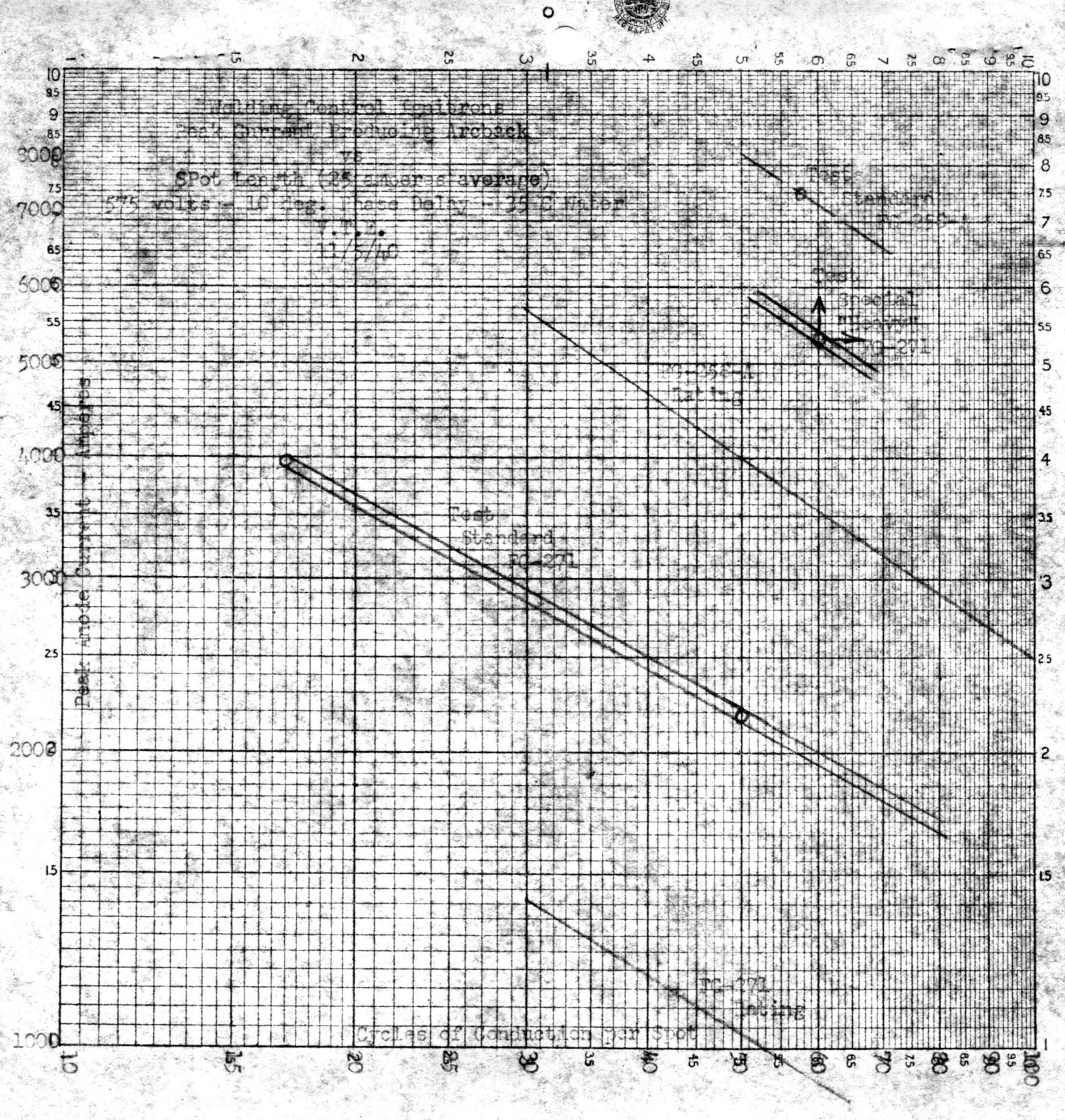
Welding Control Equipment
Peak Current Precycling Arcback
vs
Spot Length (25 cycles average)
575 volts - 10 deg. Phase Delay - 25 C Water
11/5/40
Peak Standard FO-275
Peak Standard FO-275
Peak Standard FO-275
Peak Standard FO-275
Peak Amperes under Current Amperes
Cycles of Conduction per Spot