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TESTS OF BRACKET AND COIL INSULATION - MAGNETS A-1, B-1, G-10, AND G-11 AFTER APRIL 1971 SHUTDOWN

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June 1971

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U.S. Department of Energy

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AGS DIVISION TECHNICAL NOTE

No. 85

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B-1, G-10, AND G-11 AFTER APRIL 1971 SHUTDOWN

(Continuation of Study Recommended
AGS Tech Note No. 70, 1969)

During the routine inspection of the bracket insulation of magnet A-1, the micarta at the upstream bracket was found to be carbonized. This condition has occurred in the past. This type of failure of the micarta has resulted in charring of the magnet coil insulation and necessitated replacement of the magnet coil. Similar failures had been reported most recently in AGS Tech Note No. 70, and recommendations for replacement of the micarta with mica-Kapton had been made.

In November 1969, a trial installation of three mica sheets (NEMA grade 9) with two films of Kapton, (polyimide) between the mica sheets, was substituted for the micarta. These materials were selected because of high radiation resistance, good electrical insulation, and fire resistance. This assembly was installed on the end and front brackets of G-11 magnet. This magnet is in a high radiation area. The reading on June 3rd near this magnet was 3100 MR over a month after shutdown. The mica-Kapton sandwich under the upstream bracket was removed for inspection and test. After 1-1/2 years service, visual inspection showed no changes. Electrical tests showed it to be as good as new micarta. All tests are reported in the Appendix.

Coil 283 at A-1 had a charred area about 1 in. by 3-1/2 in. under the micarta at the upstream bracket. Tests were made on the coil insulation in place and on the micarta after removal. These are reported in the Appendix. Compared with magnet B-1, the A-1 coils were very low in insulation resistance.

The results of the above inspections and tests were reviewed by Messrs. Czaja, Dryden, Gefers, Grisoli, Plotkin and Rutan, and the following recommendations are being put into effect:

- 1) The bracket insulation on magnets for possible high radiation areas shall be mica sheet Kapton film (a sandwich built up of three sheets of 35 mil NEMA No. 9 mica sheet with inorganic binder, with two films of Kapton--polyimide--between).
- 2) This insulation shall be installed at the upstream bracket and the first two brackets along the side of the magnet.
- 3) These sheets shall be cut larger than the present micarta so as to provide, if possible 3/4 in. additional creepage, on all sides, to the metal pad.
- 4) When making up the sandwich, the separate sheets shall be wiped clean and inspected for holes or foreign particles.
- 5) After the coils have been assembled on the magnet, surface and volume insulation resistance tests shall be measured following the procedure on Fig. 2 and Sheet No. 1 in the Appendix. The tests shall be made at locations 1A and B, 2, 5, 8A and B Fig. 1. This will serve as a bench mark for later after service tests.

APPENDIX

In this Appendix the test procedures for insulation resistance and results of recent tests are included.

The tests of surface and volume insulation resistance were adopted in 1965 (Figs. 1 and 2) as a convenient procedure to quickly determine the approximate condition of the magnet coil insulation on coils installed on magnets and in place in the ring. It is a rough test, but will usually indicate degraded insulation. These tests have the advantage that the electrodes are small and the megger is portable.

On Sheet No. 1 tests of two coils on magnet A-1 are compared with two coils on magnet B-1. The differences are very marked. Although at present we do not have a definite value for rejecting magnet coils in service, the fact that the surface of coil 283 was burned prompted the decision to remove and replace these coils.

Work will be done to determine if standards can be established so that the serviceability of the other coils can be decided.

On Sheet No. 2 the data of tests on micarta, unused, from service (G-10), burned A-1, and the mica-Kapton trial insulation, is reported. The exceptionally high insulation resistance tests of the mica after a year and a half in service in a high radiation area showed it equivalent to the unused micarta, and also the micarta from G-10 from a relative low radiation area. These results prompted the recommendations in the early part of this report.

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SUBJECT: SCHEMATIC COIL MOUNTING - MAIN MAGNET - BRACKET INSULATION SPACERS

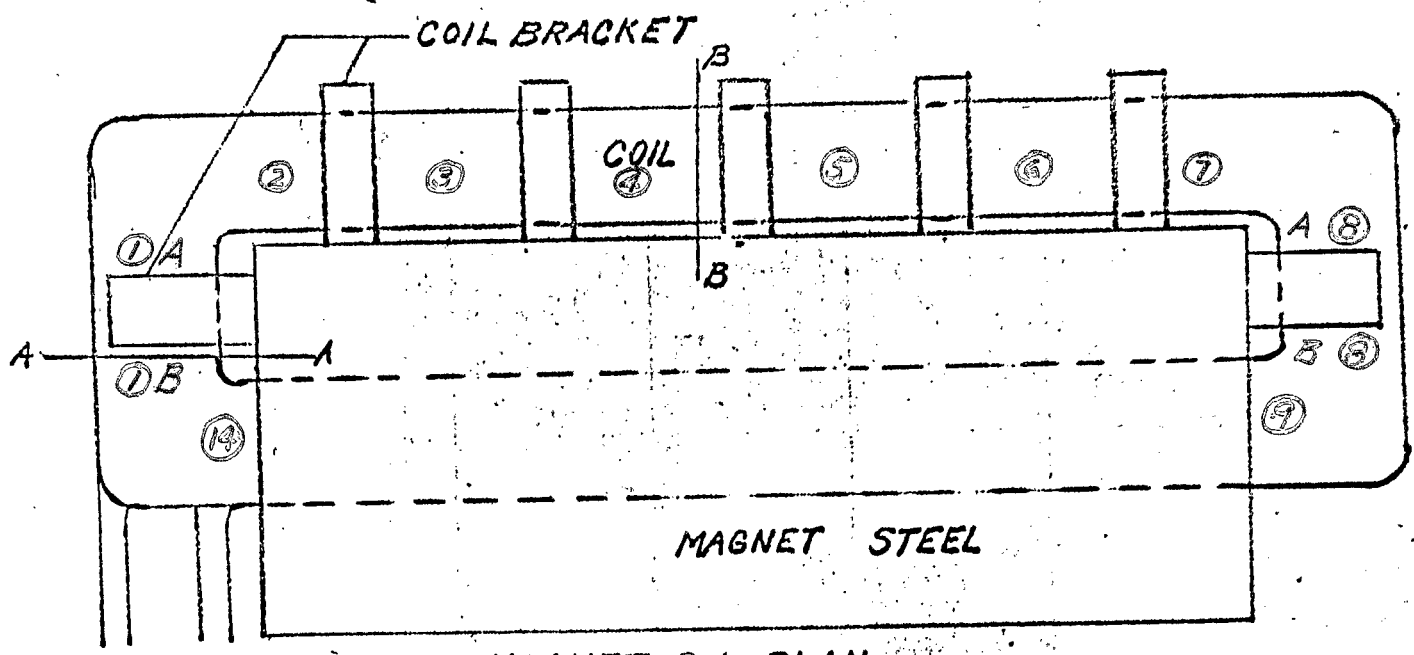
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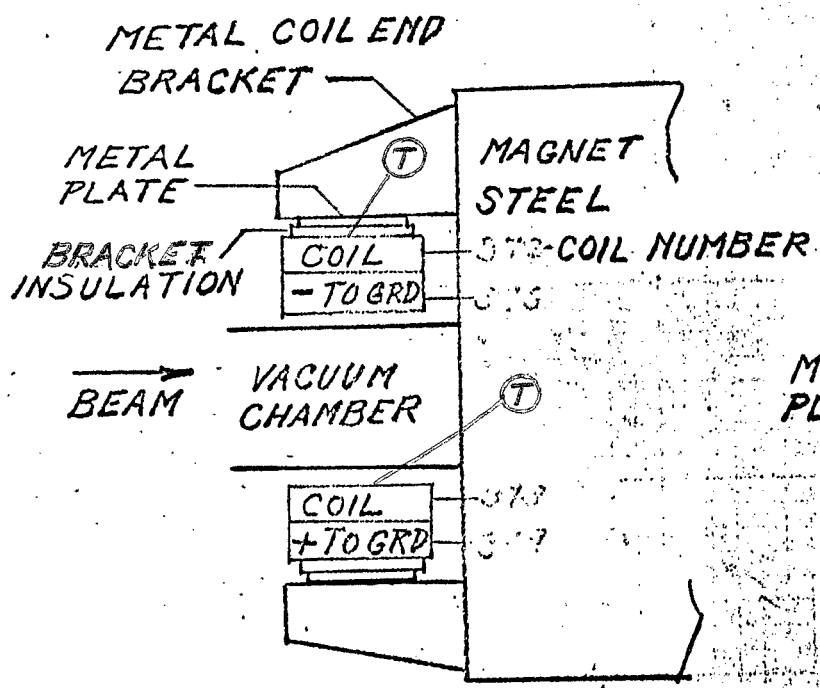
JOB NO.

DEPT. OR PROJECT: LATION SPACERS

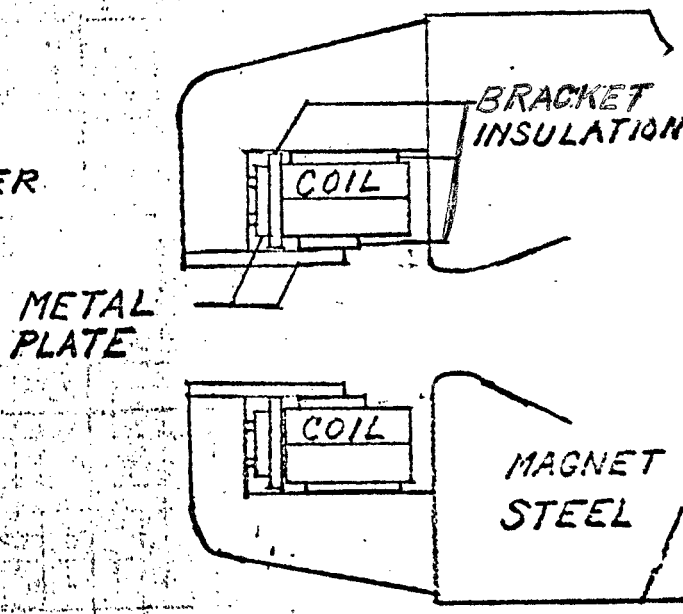
TEST LOCATION ①, ① - WHEN COILS ARE ASSEMBLED - TOP SURFACE OF TOP COIL AND TOP SURFACE OF TOP LOWER COIL



MAGNET COIL PLAN

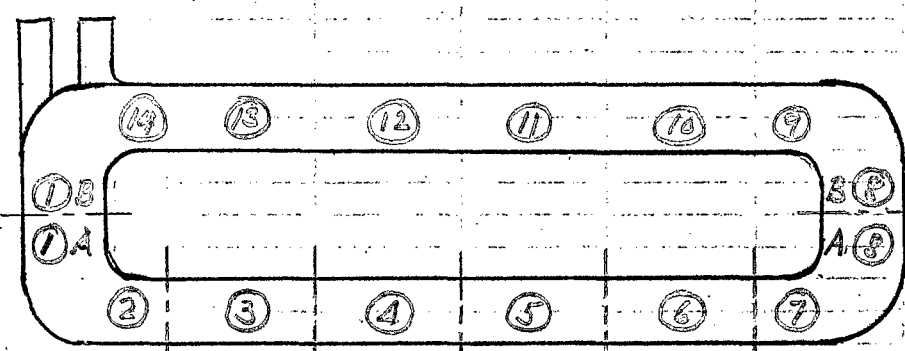
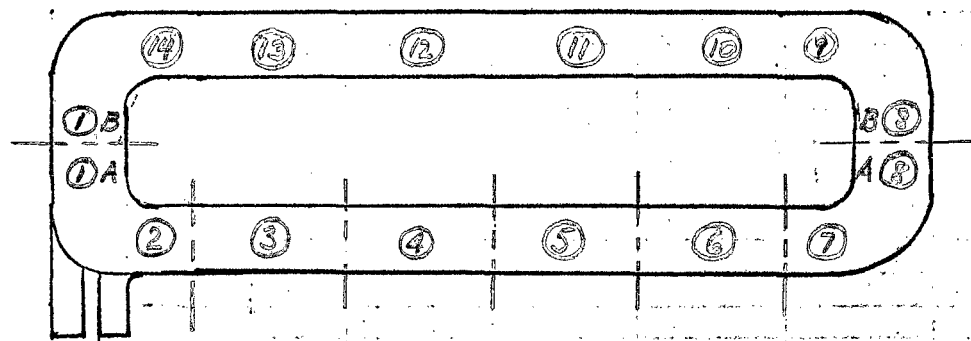


ELEVATION AT A-A



ELEVATION AT B-B

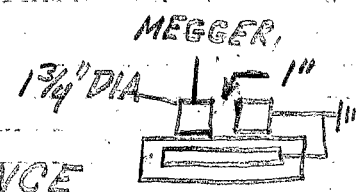
INSULATION TEST - MAIN MAGNET COILS
LOCATION OF TEST ELECTRODES - ①
WHEN COILS ARE NOT ASSEMBLED ON MAGNET
LIST COIL NO., - POSITION, - SURFACE (TOP OR BOTTOM)



PROCEDURE - SURFACE INSULATION RESISTANCE

VOLUME INSULATION RESISTANCE

TEST - MEGGER - 1000, 2500, 5000 VOLTS

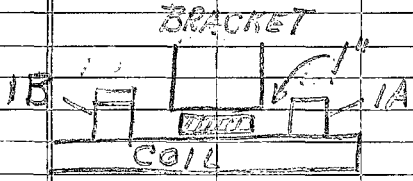
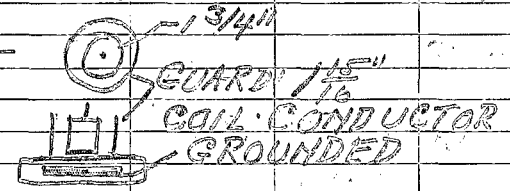


INSULATION RESISTANCE - MAGNET COILS - MAGNETS A-1 & B-1

PROCEDURE - SURFACE RESISTANCE -



VOLUME RESISTANCE -



COIL NO	TEST LOCATION (SEE FIG 1)	SURFACE RES			VOLUME RES		
		1000V	2500V	5000V	1000V	2500V	5000V
A-1 283	1A	.4	.4	.3	4.0	2.6	2.7
NO MICARTA	2	1.2	.8	.6	2.5	3.7	3.0
TOP OF TOP	1B	.4	.3	.25	2.0	2.1*	2.4*
	14	60.	7.	3.3	9.0	7.0	5.0*
A-1 300	1A	.5	.3	.2*	2.0	1.7	2.5
TOP OF BOTTOM	2	1.2	.3	.3*	3.0	3.0*	2.7*
	1B	.3	.2	.2*	3.0	2.2	2.5
	14	.4	.35	.25	4.8	3.7*	3.0*

* VISIBLE SPARKING AT ELECTRODE OR GUARD

COIL 283
 BURNED AREA ABOUT 1" x 3/8" ON TOP EDGE UNDER MICARTA UPSTREAM
 END MICARTA ALSO BURNED (SEE DATA SHEET NO 2) COIL SURFACES
 BROWNED
 A-1 HAD BEEN IN A FORMER RADIATION AREA B-1 NOT A HOT AREA

FOR COMPARISON

B-1 518	1A	8000	25000	45000	8000	17000	27000
TOP OF TOP	14				10000	20000	30000
	1B	10000	15000	27000	15000	20000	30000
B-1 526	1A	8000	17000	15000	8000	12000	7500
TOP OF BOTTOM	2	10000	25000	50000			
	1B	1200	350	75			
	14				9000	22000	30000

B-1 COIL SURFACE VERY GOOD NO DISCOLORATION

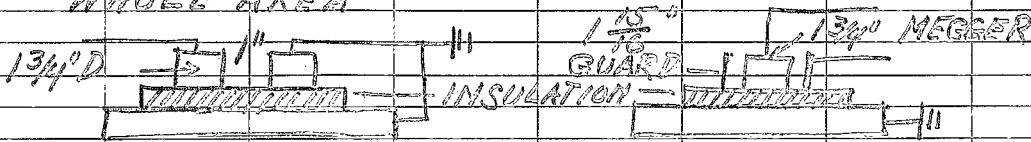
RADIATION LEVEL 6/3/71 COIL 283 - 35 MR
 B-1 MAGNET 20 MR

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E. R. Taylor
E. J. G. G. G.

TESTS OF BRACKET INSULATION PADS

INSULATION MOUNTED ON GROUNDED PLATE COVERING WHOLE AREA



SPECIMEN

SURFACE RESISTANCE VOLUME RESISTANCE
1000V 2500V 5000V 1000V 2500V 5000V
MEG OHMS MEG OHMS

UNUSED MICARTA -

LONG - 1/8" THICK

TEST AT CENTER

ALONG EDGE

SHORT-AT CENTER 1/8"

∞	∞	26.000	∞	∞	30.000
15000	12000	22.000			
∞	50000	17.000	∞	100.000+	25.000

A-1 UPSTREAM BRACKET
COIL 283 - BURNED SIDE
IN CONTACT WITH COIL
CENTER

400	400	3.80	1400	1200	1200
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SURFACE IN CONTACT
WITH BRACKET - CENTER

∞	∞	100.000	∞	∞	100.000
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NEAR BURNED CORNER

			∞	100.000	50.000+
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* SPARKING AND SMOKING AT 5000V

MICARTA - FROM G-10
UPSTREAM - TEST
AT CENTER
NEAR EDGE

∞	∞	100.000	∞	∞	∞
∞	∞	4.5000	∞	∞	100.000

MICA-KAPTON - G-11
UPSTREAM IN SERVICE
SINCE NOV 1969 CENTER
NEAR EDGE

∞	∞	100.000+	∞	∞	100.000+
∞	∞	100.000+	∞	∞	100.000+

MICA-KAPTON - SURFACE NO NOTICEABLE CHANGE

RADIATION MEASUREMENTS JUNE 3, 1971

A-1	35 MR
B-1	20 MR
G-10	30 MR
G-11	3100 MR
G-1	600 MR

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