224 D
MIT

EB

Differential Analyzer

FBH
HMM

Interviews: WW RBF

TBA

AEB

AUG 9 1942

Visit in Boston

Thursday, March 12, 1942

WW spends an hour with the differential analyzer group. They put the machine through its paces, setting up a problem from the beginning and producing the complete solution, both in graphical and tabular form. (Sheets attached.) Ten to twelve of the integrators have been in use so far. There is every present hope that the machine will attain an accuracy of one part in 10,000, for which it was designed.

Professor Caldwell informs WW that they have been warned by the M.I.T. administration that it will be necessary for them to suspend all operations on the new differential analyzer on September 1, 1942. Under normal circumstances this machine would carry out a considerable volume of research for commercial companies, the pay for this largely supporting the uses of the machine for pure science. The big commercial laboratories, however, have completely suspended their own long range research and development programs, and the budget of M.I.T. faces so difficult a situation this year that Compton feels he must drop many activities. They are, for example, closing up their cyclotron and their high voltage laboratory. The differential analyzer will undoubtedly be needed for important war research problems; and in WW's opinion, M.I.T. would be completely justified in asking the N.D.R.C. for a grant to continue the shakedown and adjustment of the instrument, holding the group together and keeping the facilities available for war research. Since they have been so bitterly (and so unfairly) criticized for their large government contracts, Compton is not willing to accept any further N.D.R.C. contracts; and particularly would not be willing to ask for money to finish up an M.I.T. development, since this request could easily be misconstrued.

It seems to WW a disastrous thing, both from the point of view of the war and from the point of view of science, to have this machine locked up at the present time. He therefore informally inquires whether approximately $25,000, plus whatever M.I.T. could chuck in, would keep the group together and the development proceeding over a period of two years subsequent to September 1, 1942. Professor Caldwell promises to look into this situation and write.

Attached to RF diary

$$\text{Torque} = J\frac{d^2\theta_o}{dt^2} = T$$ $K_o\theta$

$$T + A\frac{dT}{dt} = K_o\theta + K_i\frac{d\theta}{dt}$$ – Control Equation

where θ_o = ~~me~~ angle of output shaft
θ = Error angle = $\theta_i - \theta_o$
θ_i = angle of input shaft
J = inertia of output shaft

In this particular case

$$\frac{K_o}{J} = \omega_n^2$$

$$K/J = 2\delta\omega_n = \omega_n \qquad \delta = 0.5$$

$$A = \alpha/\omega_n = 0.25/\omega_n \qquad \alpha = 0.25$$

δ is ordinarily called the damping coefficient
α is a measure of the response delay.

The scale of the abscissa is $(\omega_n t)$
The ordinate is in radians and represents the response to a unit error at $t=0$, obtained by holding the output shaft out until steady-state is reached and then releasing it at $t=0$

This record is discontinuous at two points.

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03	-00036
04	-00051
05	-00082
06	-00140
07	-00229
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16	-01570
17	-01734
18	-02008
19	-02419
20	-02800
21	-03137
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24	-03903
25	-04070
26	-04280
27	-04447
28	-04616
29	-04801
30	-04944
31	-05077
32	-05182
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35	-05508
36	-05619
37	-05893
38	-06035
39	-06144
40	-06215
41	-06260
42	-06289
43	-06307
44	-06214
45	-06311
46	-06304
47	-06293
48	-06272
49	-06249
50	-05107
51	-06176
52	-06126
53	-06058
54	-05980
55	-05923

Break.

56	-05794
57	-05734
58	-05669
59	-05561
60	-05473
61	-05358
62	-05247
63	-04862

Break

64	-04879
65	-04899
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67	-04939
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72	-05008
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03	-05052
04	-05047
05	-05043
06	-05037
07	-05029

March 12, 1942
New Differential Analyzer

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A solution of a servo-mechanism control equation.