Visit by S. A. Brenton to Westinghouse Co. Sharon Works, USA on 7 Dec. 1956

K129

SHELL FORM TRANSFORMER DESIGN BY 705 DIGITAL COMPUTER

Input: Performance data and guarantees on six I.B.M cards.

Description: Stored program on tape. When in operation, program transferred from tape onto drum. Program called from drum into memory of main frame, portion at a time as needed. Calculated data accumulated in permanent storage area, printed at intervals as a check or delayed until final calc. sheet is printed. Complete program will require approximately 5 to 7 minutes machine time.

Output: Design information, such as calc. sheet, D-Spec. info, L-Spec. info., temperature calc., cost, losses, etc---

All discrete values. Even though floating point numbers are used as input data, all output data will be in conventional terms. (Forms such as calc. sheet will be spaced and titled as per conventional manner.) Numbers will be rounded to nearest $\frac{1}{8}$, $\frac{1}{4}$, 1 inch, --etc. as required.

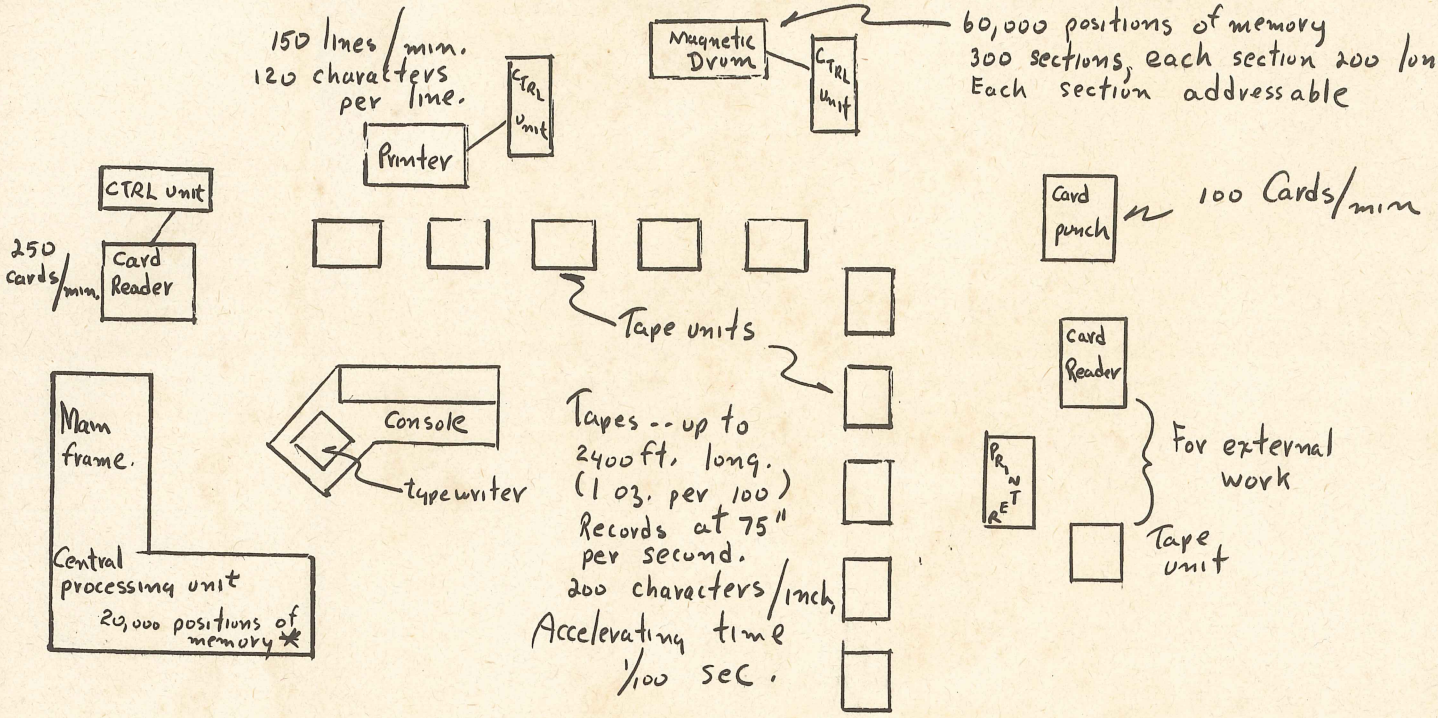
Reiterative program ---- repetition of portions of program until guaranteed values are met. Output data can be on punched cards, printed forms, or on tape for later printing.

N. Chackan, Jr

See attached printout

Outline diagrams supplied (now missing)

General Layout and Description



All data to be processed by various components, whether it be numerical calculations or sorting of records, must pass through the core memory of the main frame. Exceptions: Cards to tape, tape to cards, tape to printer.

* 20,000 characters, alpha numeric (numbers, letters, marks, etc.) -- stored in any sequence to form any size field. Once stored, data retained until a new record is inserted in the same location.

Method of operation

Step 1: Instructions into memory

Instructions can be taken from cards (13 per card) or tapes (or combination of both) and stored into the memory of the main frame. Memory now has an instruction area and a storage area to accumulate answers.

Step 2: Input variables

Input variables read from cards into Input area of main frame.

Step 3: Transfer to beginning instruction (automatically), perform calculations, print answers.

INPUT CARD NO. 1 - [Ident.-XX]

Card Columns	Title	Description - Data	Example	No. Digits
1 to 3	Problem No.	Alphanumeric	001	3
4 to 7	Date	Alphanumeric	0439	4
8 to 16	Shop Order	Alphanumeric	SO 11 R5877	9
17 to 20	Shop Date	Alphanumeric	B822	4
21 to 27	L-Spec.	Alphanumeric	L537297	7
28 to 34	D-Spec.	Alphanumeric	D522446	7
35 to 44	Customer	Alphanumeric	Penna. Pwr.	10
45	Oil Pres. Code		0	1
46	Cooling Code		0	1
47	No. Phases	Numeric--Unsigned 1 or 3	3	1
48 to 57	Frequency	Floating Point Signed **	5260000000+	10
58 & 59	No. Wdgs.	Numeric--Unsigned 2 digits	03	2
60 & 61	Temp. Rise	Numeric--Unsigned	55	2
62	Feature 1		1	1
63	Feature 2			1
64	Feature 3			1
65	Feature 4			1
67 to 71	Identification	Division Identification-Alphanumeric	LP 001	5
73 to 80	Card Identification		A1	

**Column No. 57 only must be signed.

Alphanumeric--numbers, letter, symbols, or mixture.

INPUT DATA CARDS NO. 2, 3, & 4

Card Columns	Title	Description - Data	Example	No. Digits
1 to 10	V.A. Rating	Numeric--Floating Point (2)		10
11 to 20	Load V.A. Rating	Numeric--Floating Point (2) (Guar. Position)		10
21	Y-Delta Code	Alphanumeric Y or D		1
22 to 23	Auto, Regular Wdg. Code	Alphabetic	AU	2
24 to 27	BIL Line	Numeric-KV-Unsigned	0350	4
28 to 31	BIL Neutral	Numeric-KV-Unsigned	0110	4
32 to 35	App'd. Test	(last digit nonumeric -- Alphanumeric & 2xN, 140K		4
36 to 45	Normal Volts	Floating Point--Numeric (2)		10
46 & 47	No. of + Taps	Numeric--Unsigned (3)	03	2
48 to 57	%/100 + Tap Range	Floating Point--Numeric (2),(4)		10
58 & 59	NL or UL Code	Alphanumeric NL, UL, or (2)	NL	2
60 & 61	No. of (-) taps	Numeric--Unsigned	00*	2
62 to 71	%/100 (-) tap range	Floating Point--Numeric (2)(4)		10
72 & 73	F.C. or R.C. Code	Alphanumeric F.C. or R.C. (5)	R.C.	02
76 to 80	Wdg. & Card Ident.	HV-2--2nd Card, HV Wdg. LV-3--3rd Card, LV Wdg. TV-4--4th Card, TV Wdg.	HV-A2 LV-A3 TV-A4	4

NOTE: If no TV, insert blank card (card identification - only).

* If no taps, 00 must be inserted here.

(2) Columns 10, 20, 45, 57 and 71 must be signed.

(3) 00 if none or if on cards.

(4) Ten 0's if none or if on cards, must be signed.

(5) Must be 00 signed, if no taps.

Note: For singel phase, line voltages are to be inserted.

INPUT DATA CARD NO. 5

Card Columns	Title	Description - Data	Example	No. Digits
1 to 4	Induce Test	Last Digit Non-Numeric		4
5 to 14	Fe. Loss	Floating Point--Numeric		10
15 to 24	Total Loss	Floating Point--Numeric		10
25 to 34	H-L Imp.*	Floating Point--Numeric		10
35 to 44	H-T Imp.*	Floating Point--Numeric		10 **
45 to 54	L-T Imp.*	Floating Point--Numeric		10 **
55 & 56	OA Noise**			02
57 to 66	Fan & Pump Loss	Floating Point--Numeric		10
70 to 80	Card Ident.	Loss, Imp. A5		10

* All Impedances on HV KVA Base

NOTE: All floating point input data must be signed---units digit.

** Limit will be inserted in columns 41, 42, 43, 44 on Card 6.

INPUT DATA CARD NO. 6

Card Columns	Title	Description-Data	Example	No. Digits
1 to 10	Exciting Current	Floating Point--Numeric		10
11 to 20	Limiting Dim. Length	Floating Point--Numeric		10
21 to 30	Limiting Dim. Width	Floating Point--Numeric		10
31 to 40	Limiting Dim. Height	Floating Point--Numeric		10
41 to 42	H-T Imp.	Limit - Numeric		
42 to 43	L-T Imp.	Limit - Numeric		
71 to 80	Card Identification	LIM_b Dim-6	LIM_b Dim-6	9

CODE

1 Column 70.07.0 ↓ Cooling Code	Type of Cooling	Feature 2 Code 70.13.0 ↓ Loading Code	Type of Loading
0	OA	0 *	Straight OA or OW Straight FOA or FOW
1	OA/FOA	1	100, 133%
2	OA/FOA/FOA	2	100, Future 133%
3	FOA	3	100, 133, 167%
4	OA/FA	4	100, Future 133, Future 167%
5	OA/FA/FOA	5	100, 133, Future 167%
6	OA/FA/FA	8	100, 125%
7	OW	9	100, Future 125%
8	FOW	6	100, 125, 167%
9		7	100, Future 125%, Future 167%

*0 --- No other ratings to be considered.

Primary rating is only rating.

Features (On Card No. 1)

Column		Data - Description
62	1	D - means taps are to be calc. C - means taps are on cards. *
63	2	
64	3	
65	4	

Series Parallel Auto Code

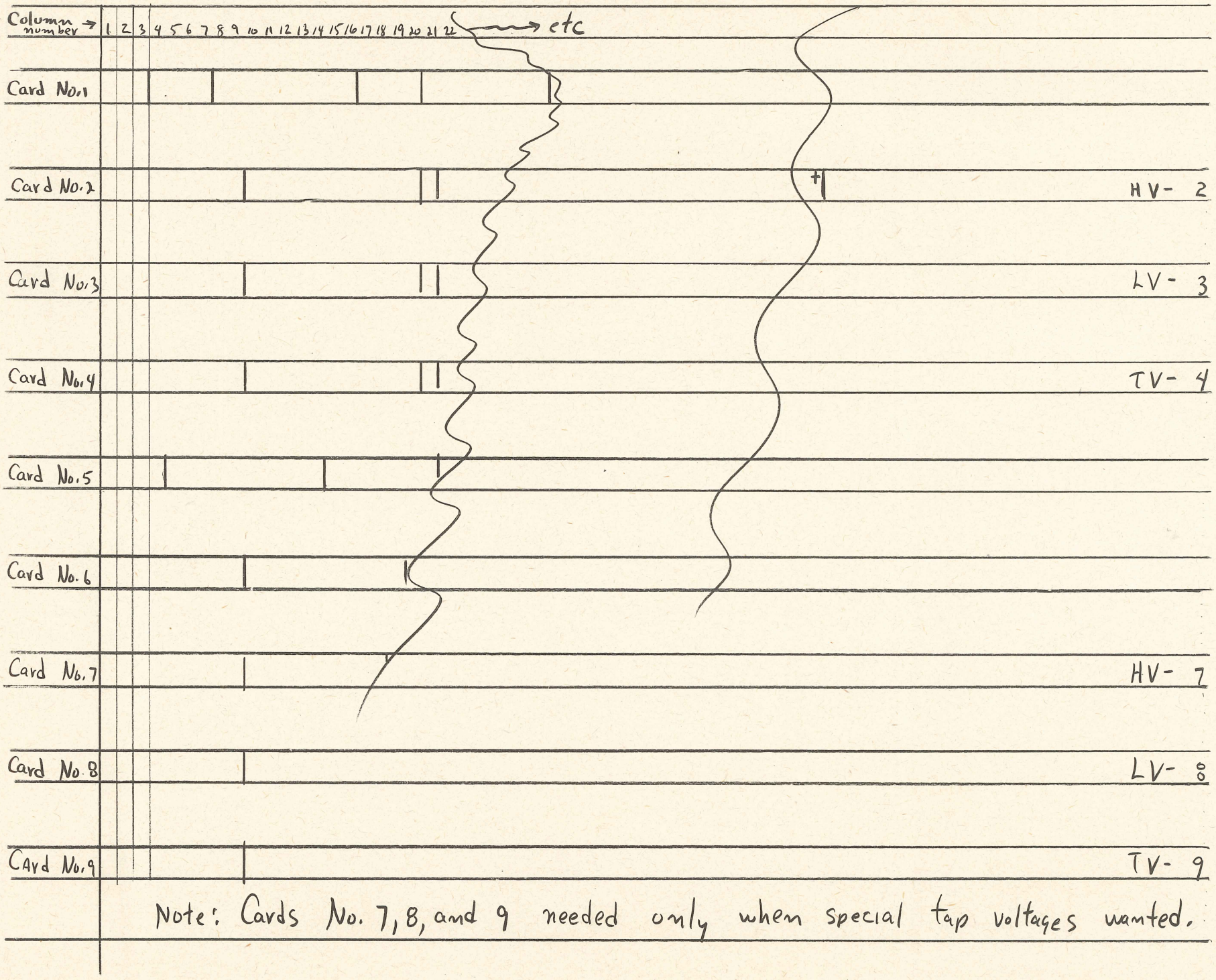
AU = Auto

RW = Regular Winding

SP = Series Parallel

* Must be one of the other, not both---intermixing not permitted.

INPUT DATA FORM (SAMPLE- REDUCED)



Note: Cards No. 7, 8, and 9 needed only when special tap voltages wanted.

Floating Point Numbers (As adopted)

A number can be represented by 10 digits, a characteristic portion and a mantissa. The characteristic, first two numbers, represents the power of 10 + 51 that the mantissa, next 8 significant figures, is raised.
The system in use recognizes a characteristic of 51 as 1, 52 as 10, 53 as 100, 50 as .1, 49 as .01, etc.

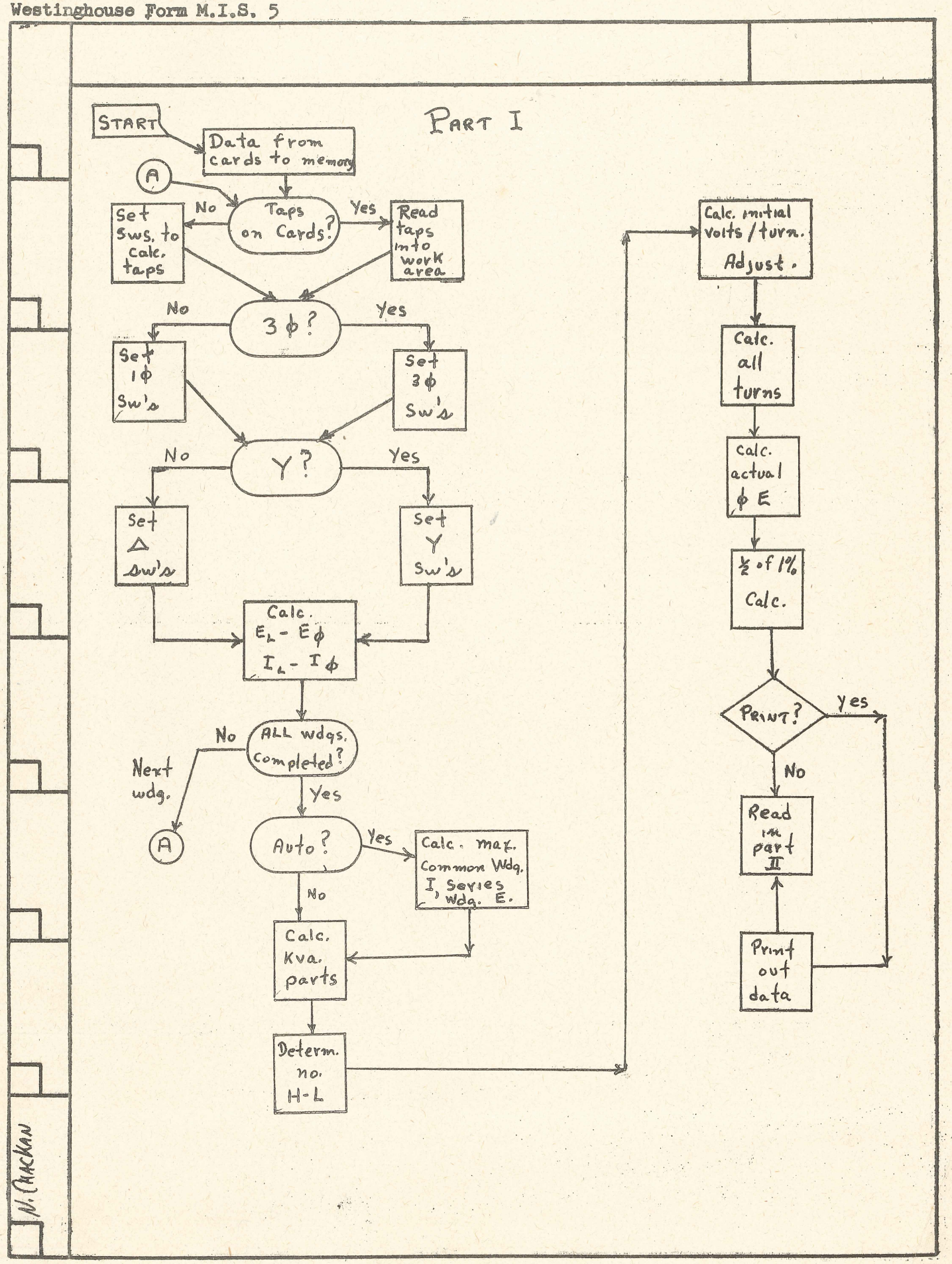
Example:

10 digits in length

1	=	51100000000^{+} ← last digit signed
10	=	52100000000^{+}
-60	=	52600000000^{-}
.1	=	$\underbrace{50}_{\text{Characteristic}}\underbrace{100000000}_{\text{Mantissa}}{}^{+}$

Range: 10^{+49} — 10^{-51}

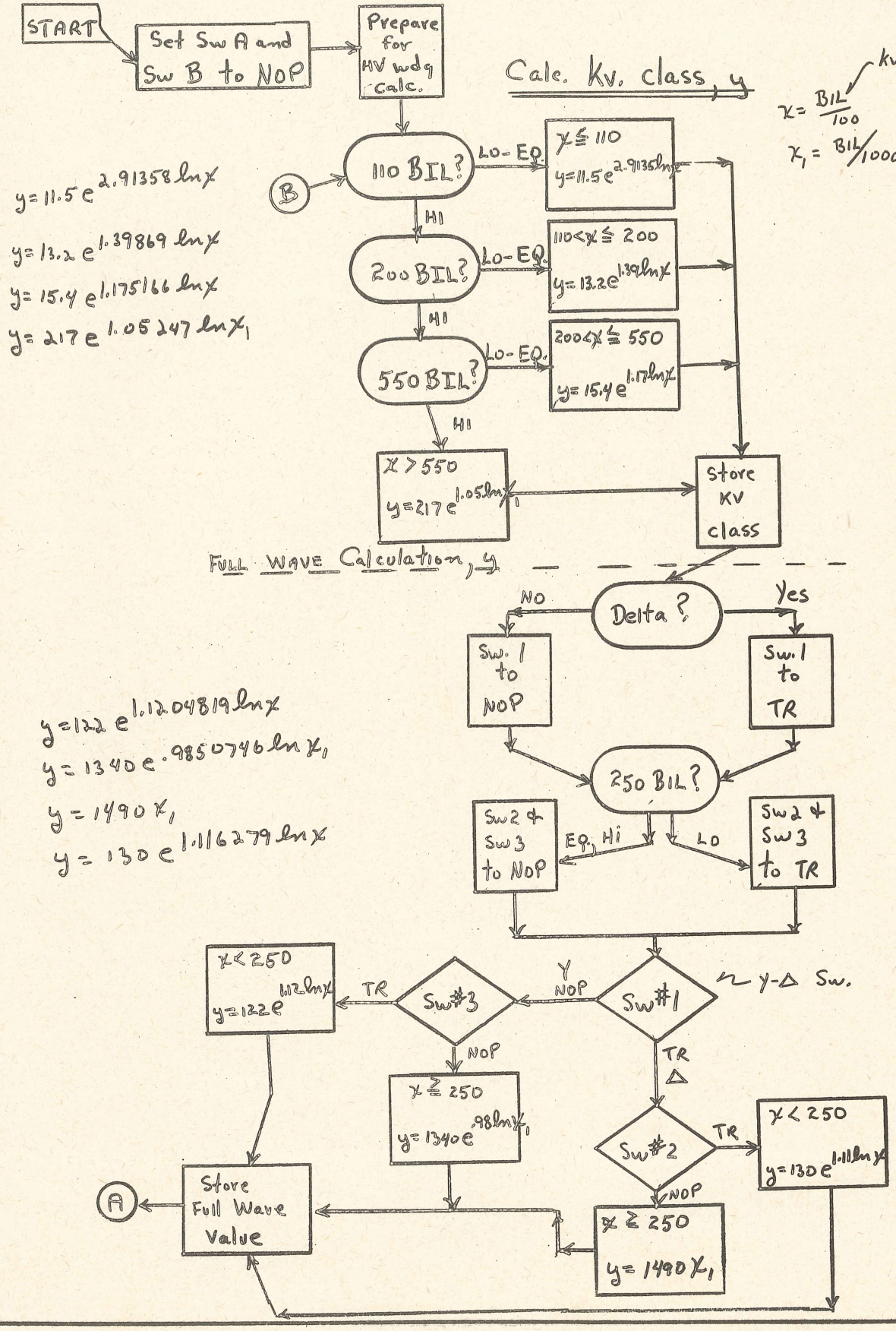
SKETCH SHEET FOR PRINTS
Westinghouse Form M.I.S. 5



N. CHACKAN

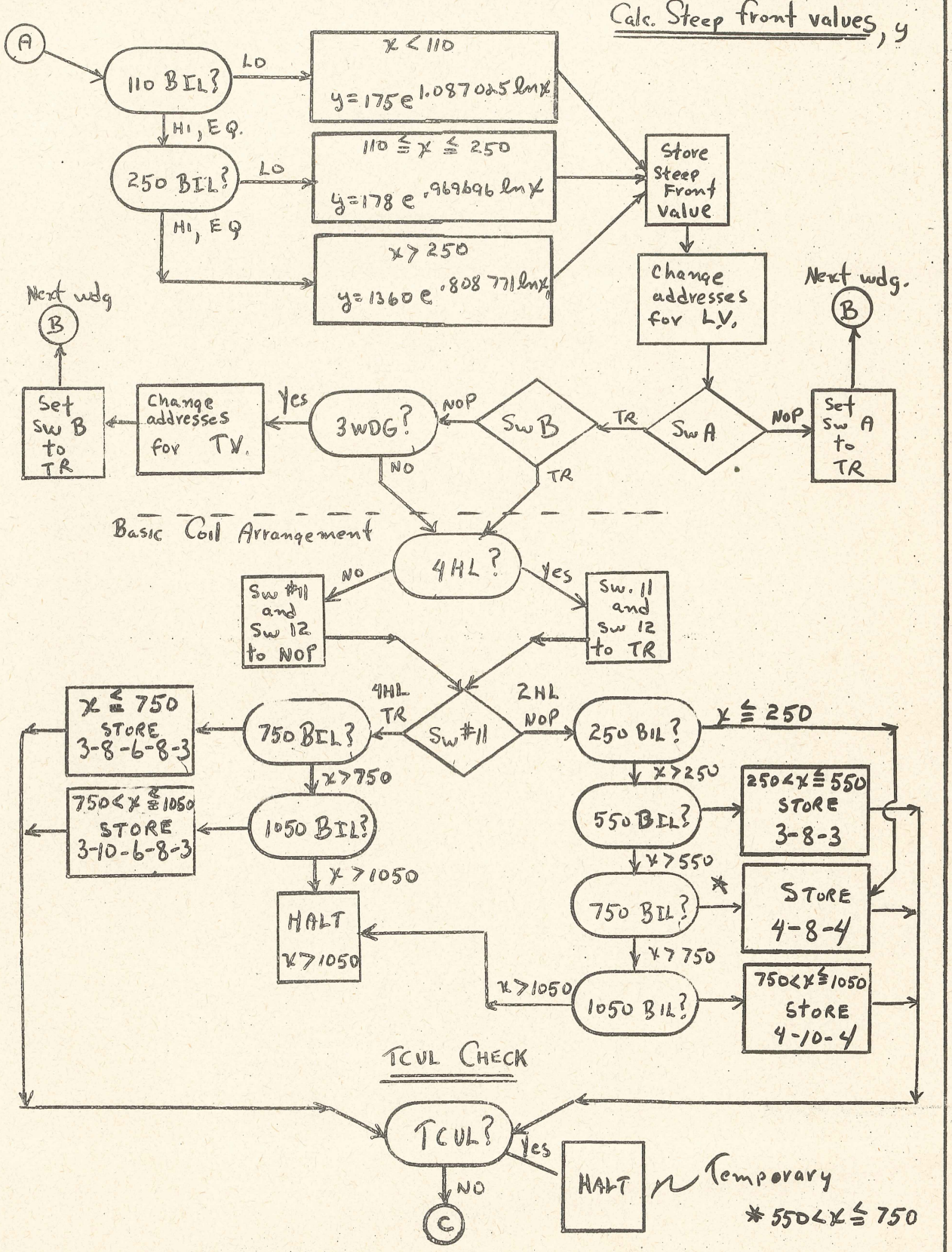
SKETCH SHEET FOR PRINTS
Westinghouse Form M.I.S. 5

PART II page 1



SKETCH SHEET FOR PRINTS
Westinghouse Form M.I.S. 5

PART II page 2



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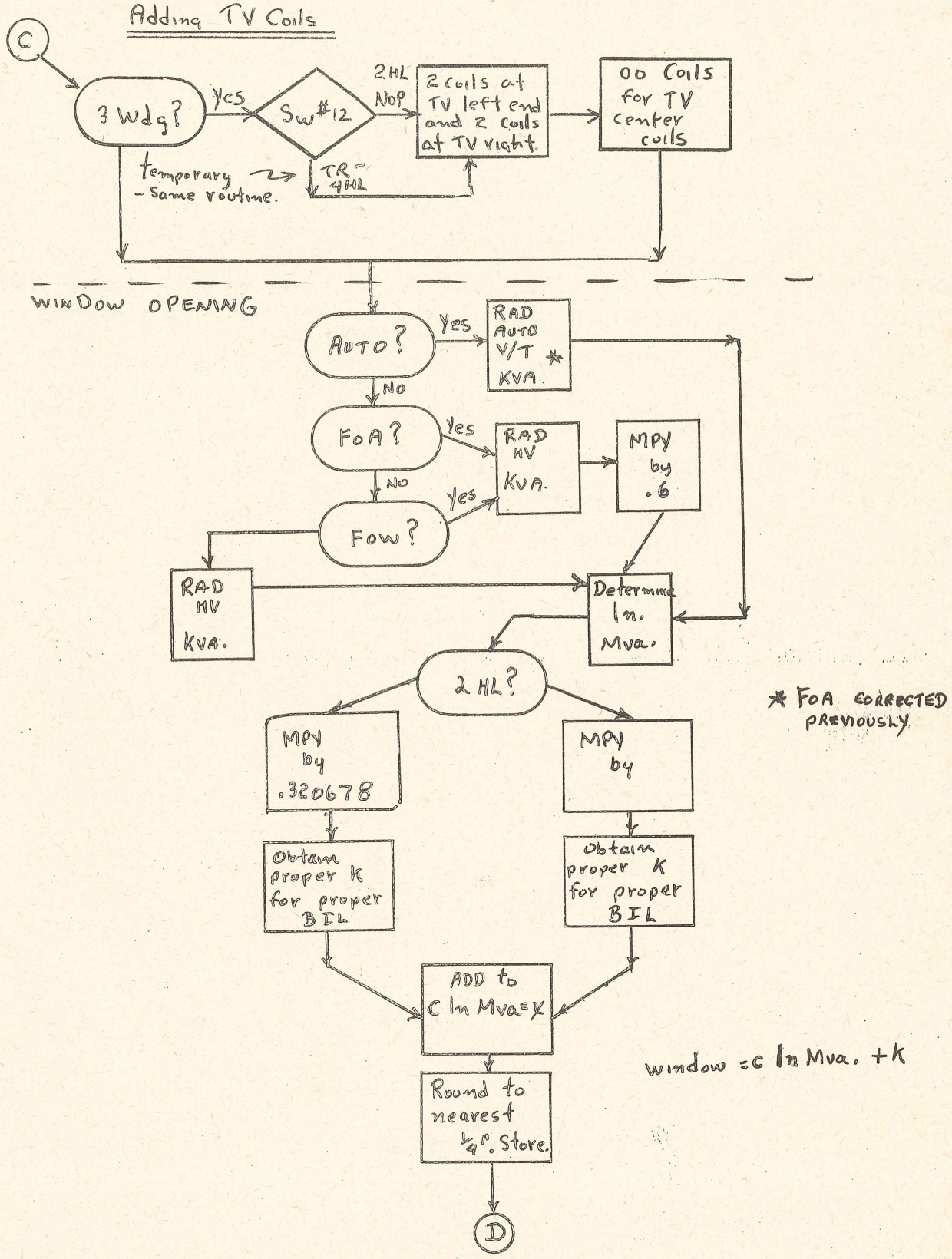
SKETCH SHEET FOR PRINTS
Westinghouse Form M.I.S. 5

PART II page 3

Adding TV Coils



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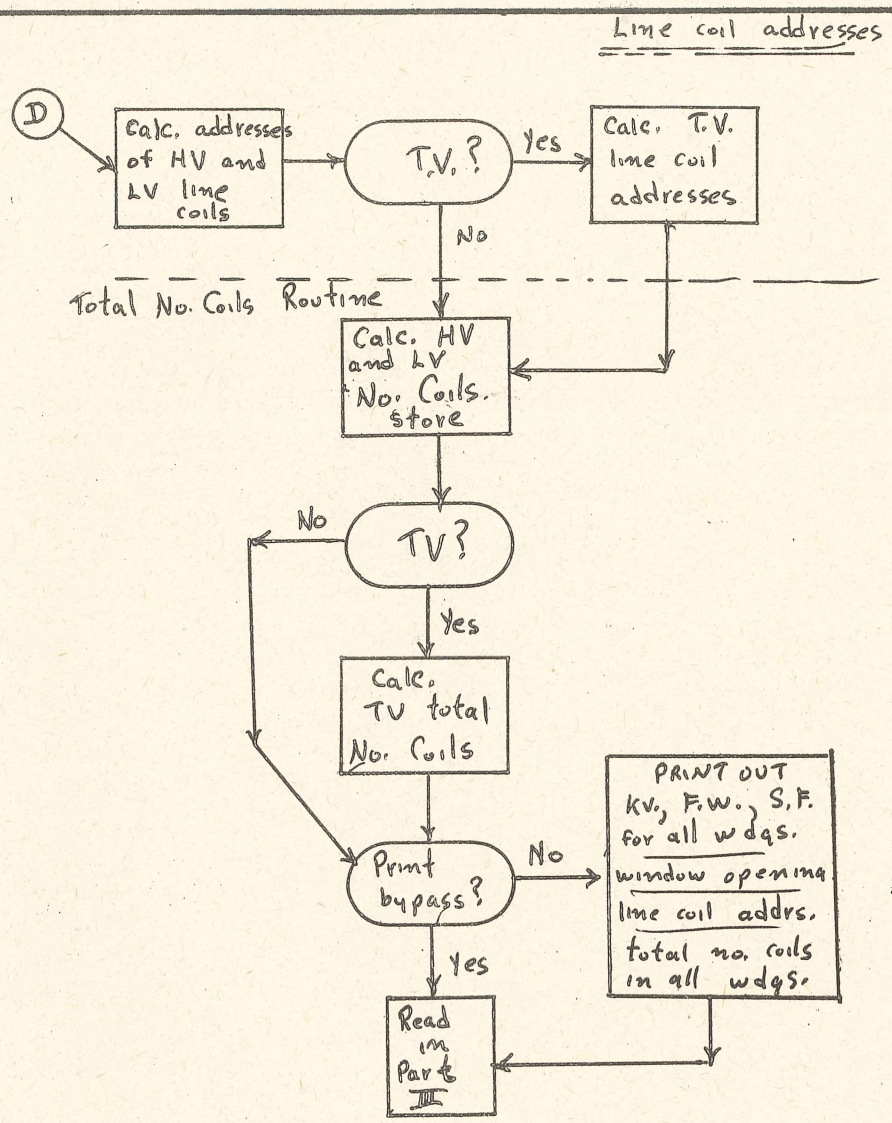
SKETCH SHEET FOR PRINTS
Westinghouse Form M.I.S. 5

PART II page 4



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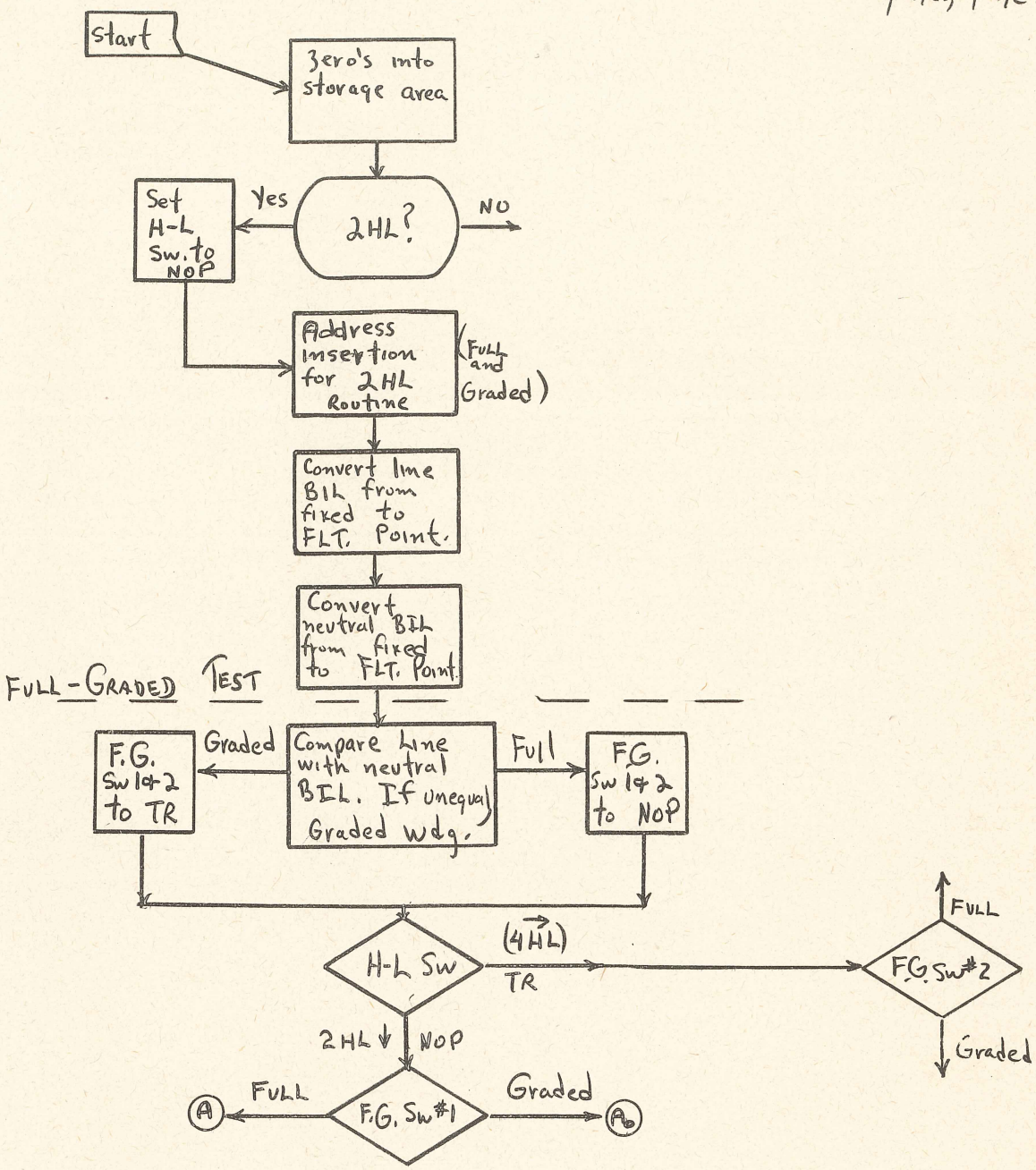
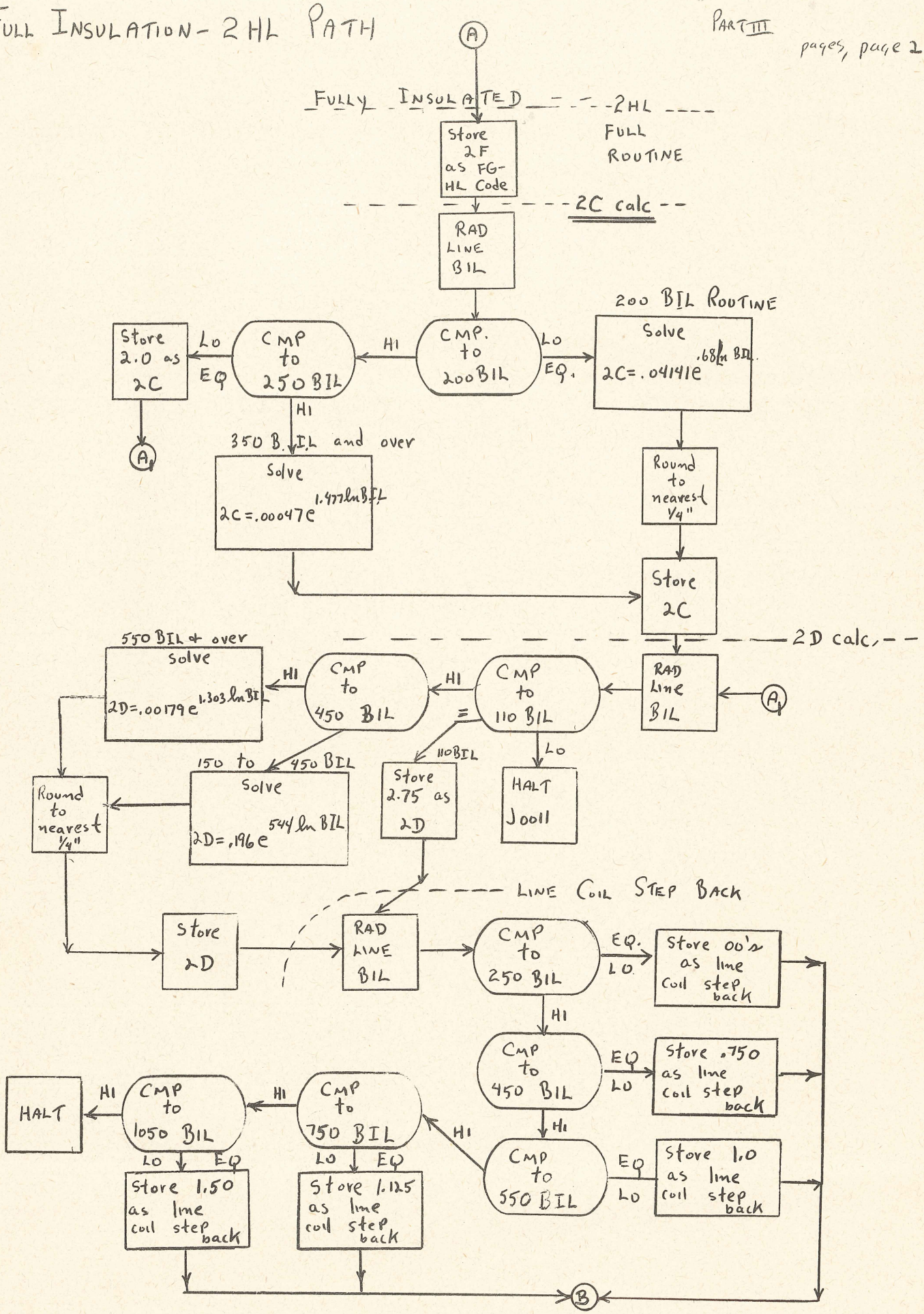
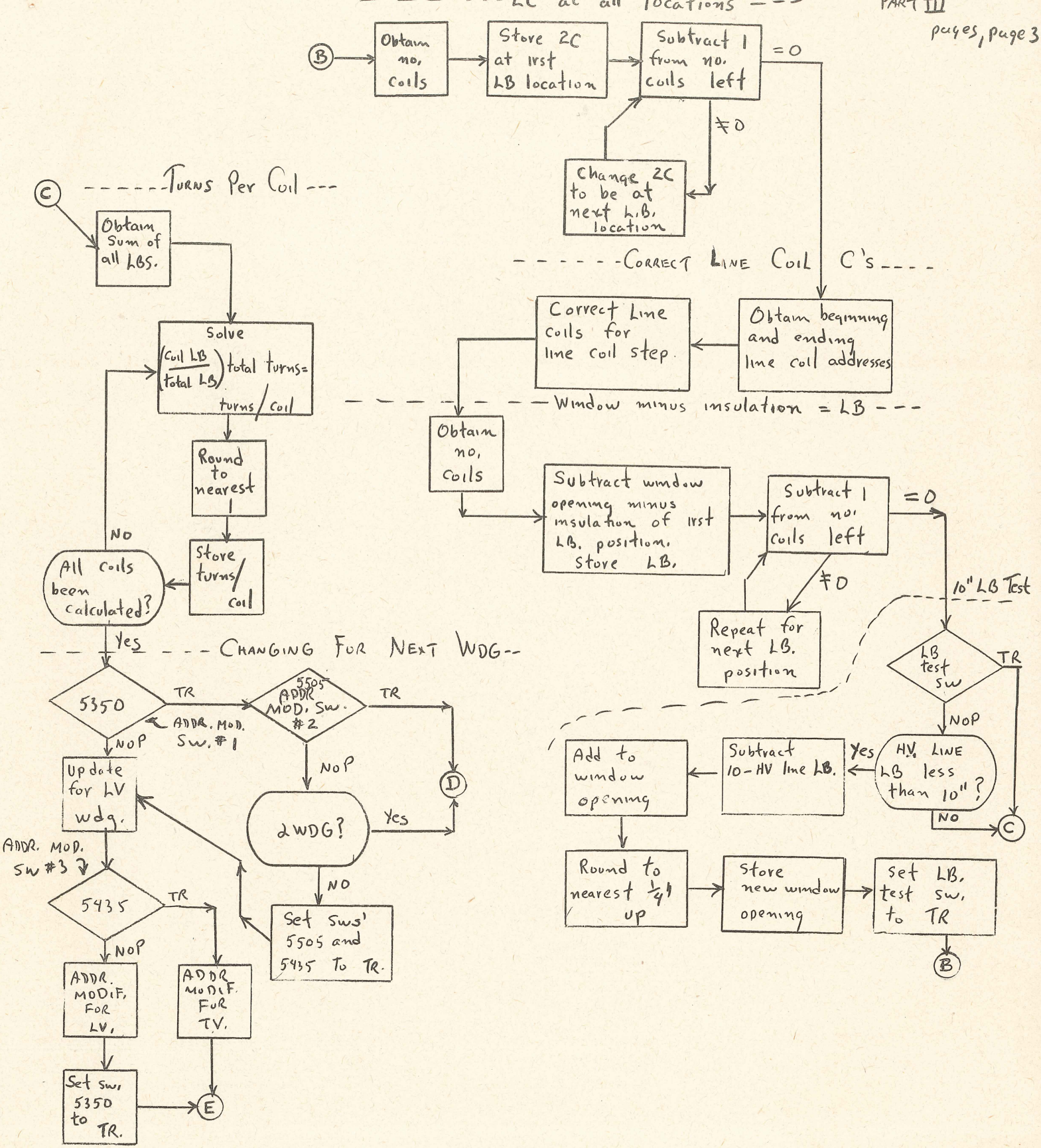
PART III

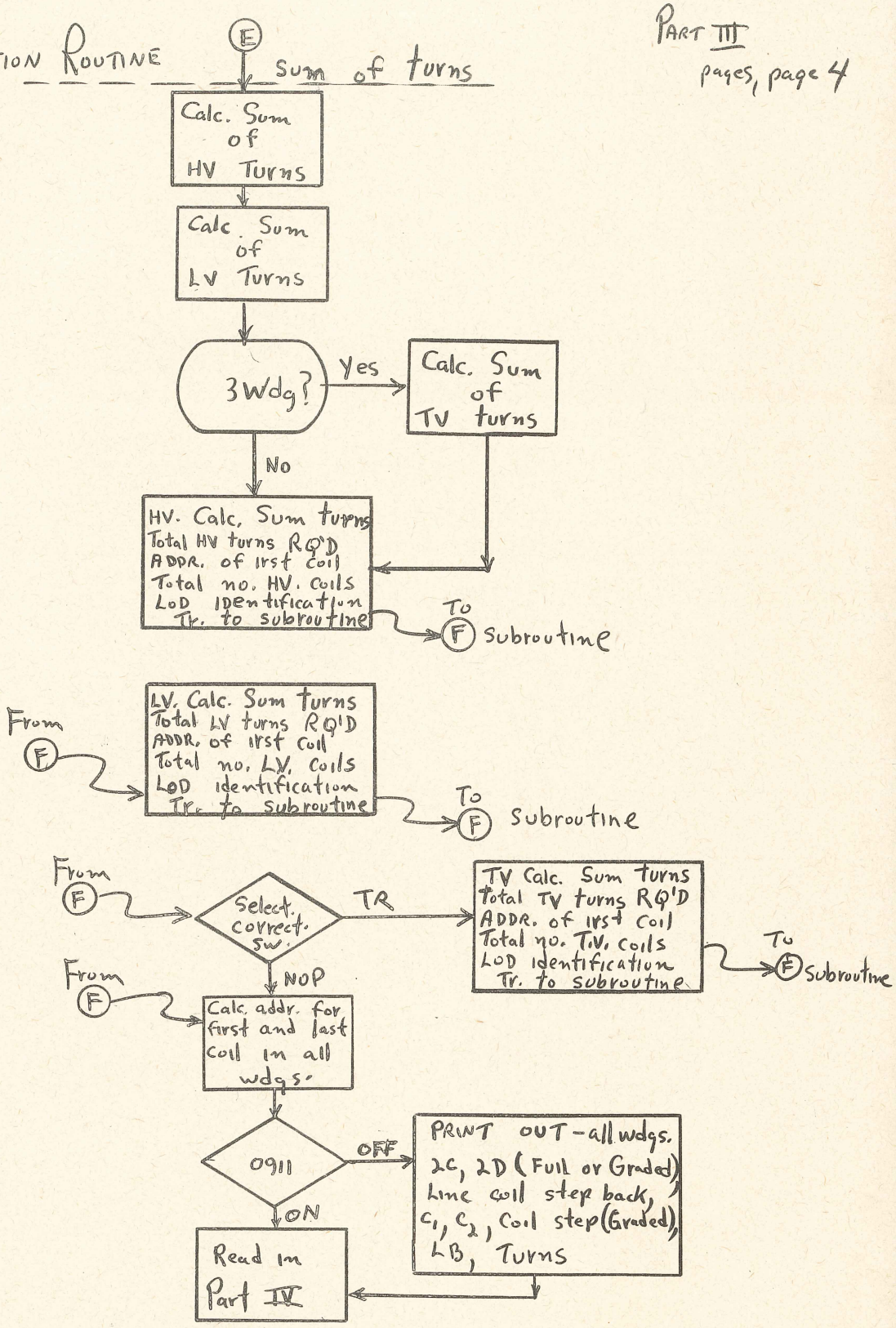

Start
Zero's into storage area
2HL?
Yes
NO
Set H-L Sw. to NOP
Address insertion for 2HL Routine
(Full and Graded)
Convert Ime BIL from fixed to FLT. Point.
Convert neutral BIL from fixed to FLT. Point.
FULL-GRADED TEST
Compare Line with neutral BIL. If unequal Graded wdg.
Graded
Full
F.G. Sw 1&2 to TR
F.G. Sw 1&2 to NOP
H-L Sw
(4HL)
TR
FULL
F.G. Sw#2
Graded
2HL
NOP
FULL
Graded
F.G. Sw#1
A
A

FULL INSULATION - 2HL PATH

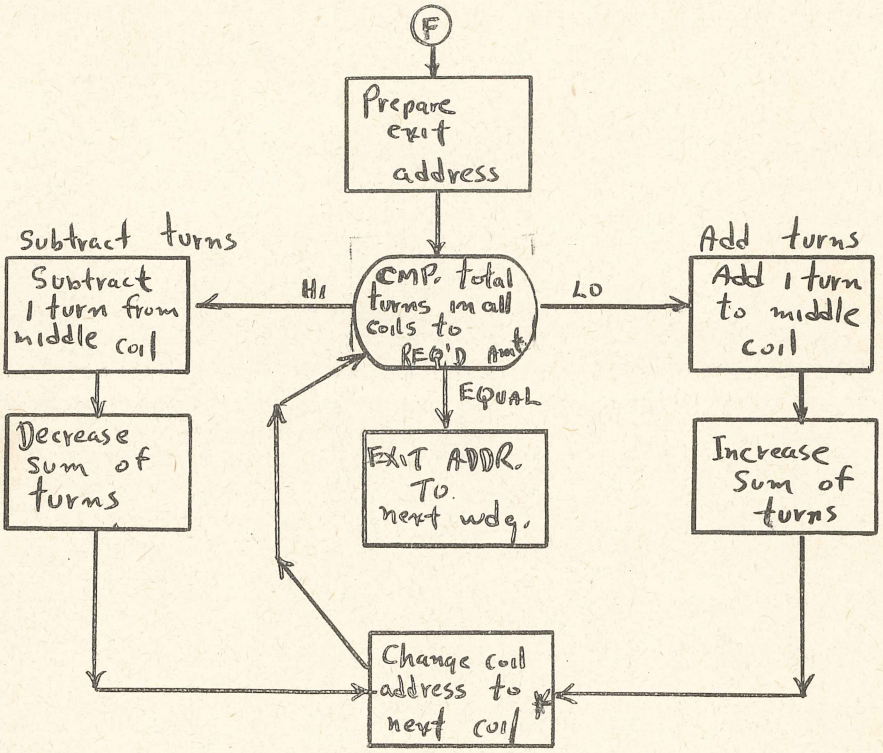



2C at all locations
B
Obtain no. coils
Store 2C at 1rst LB location
Subtract 1 from no. coils left
=0
≠0
Change 2C to be at next L.B. location
Turns Per Coil
C
Obtain Sum of all LBS.
Solve (Coil LB / total LB) total turns = turns/coil
Round to nearest 1
Store turns/coil
All coils been calculated?
NO
Yes
Correct Line Coils
Obtain beginning and ending line coil addresses
Correct Line coils for line coil step.
Window minus insulation = LB
Obtain no. coils
Subtract window opening minus insulation of 1rst LB. position. Store LB.
Subtract 1 from no. coils left
=0
≠0
Repeat for next LB. position
10" LB Test
LB test sw
TR
NOP
HV. LINE LB less than 10"?
Yes
NO
C
Subtract 10-HV line LB.
Add to window opening
Round to nearest 1/4" up
Store new window opening
Set LB. test sw. to TR
B
Changing For Next Wdg
5350
TR
ADDR. MOD. Sw. #1
NOP
5505 ADDR MOD. Sw. #2
TR
NOP
D
2WDG?
Yes
NO
Set Sw's 5505 and 5435 To TR.
Update for LV wdg.
ADDR. MOD. Sw #3
5435
TR
NOP
ADDR. MODIF. FOR LV.
ADDR MODIF. FOR TV.
Set sw. 5350 to TR.
E

TURNS CORRECTION ROUTINE



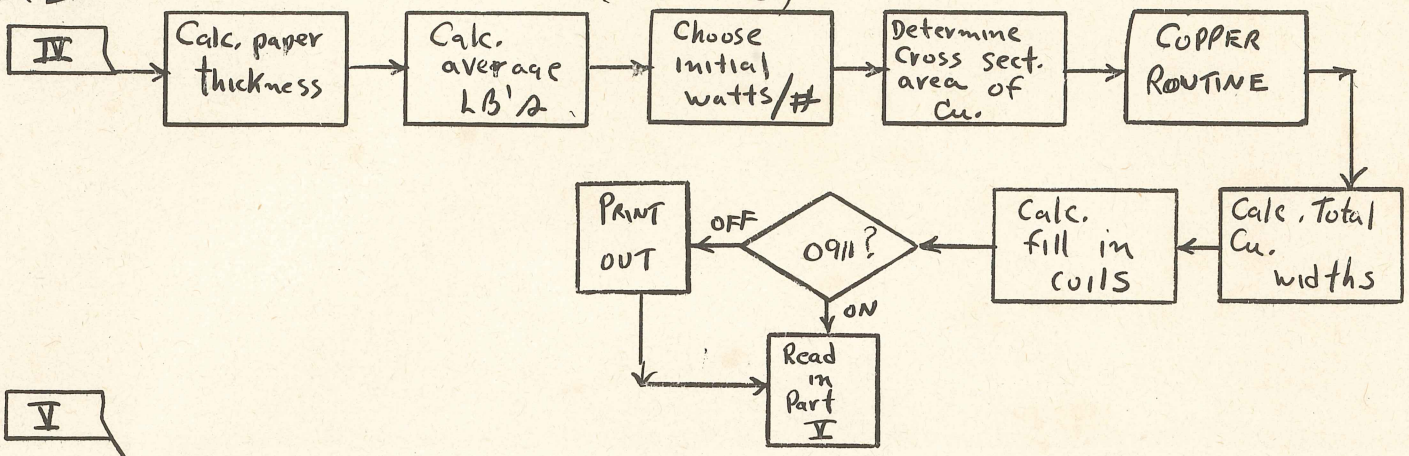
TURN CORRECTION SUBROUTINE

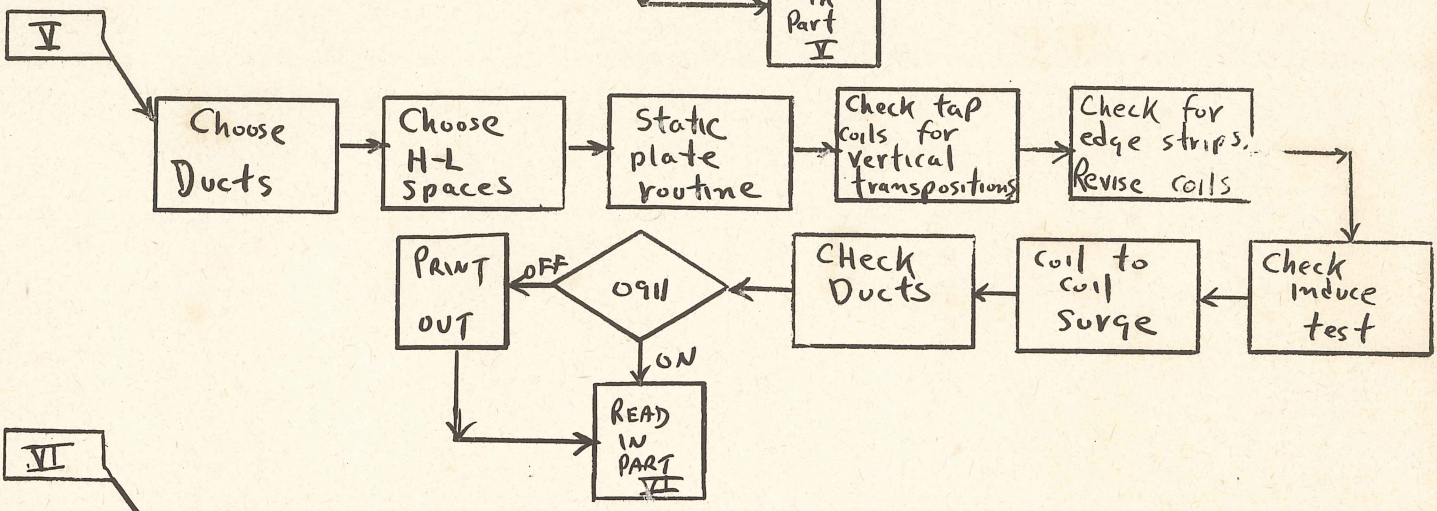


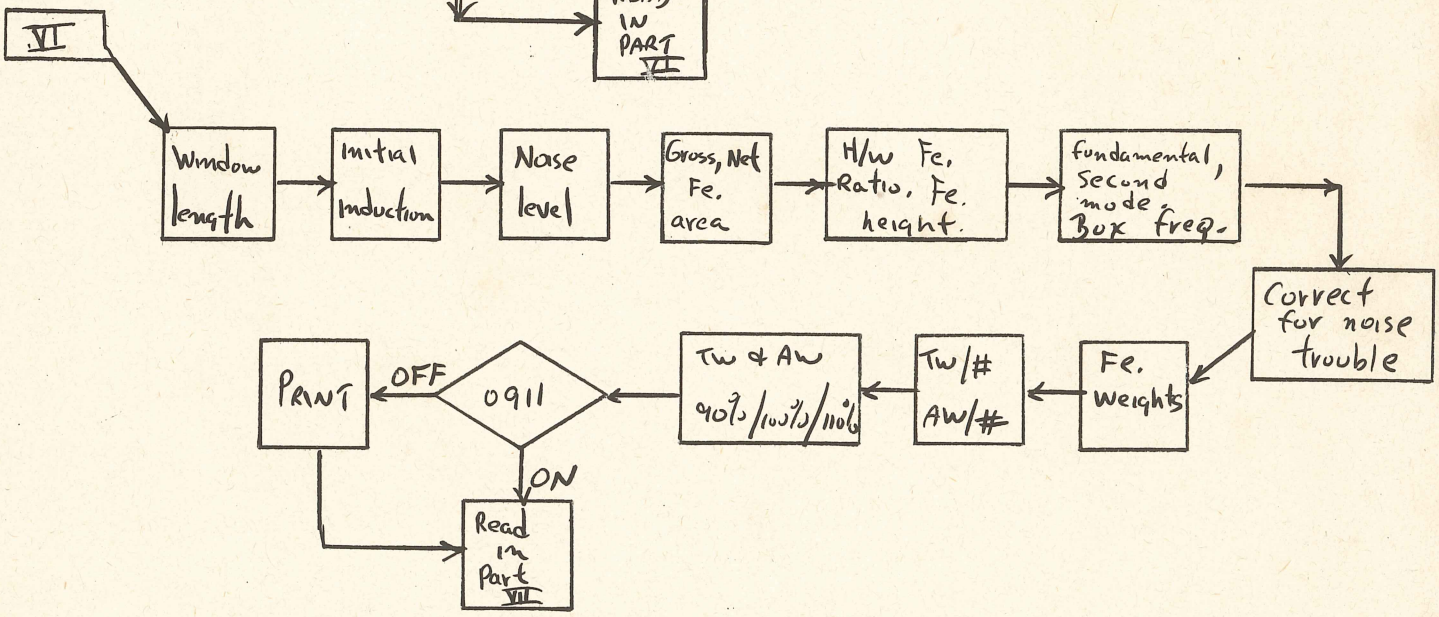
* Alternates from middle 2 coils outward toward line coils until necessary number turns are obtained.

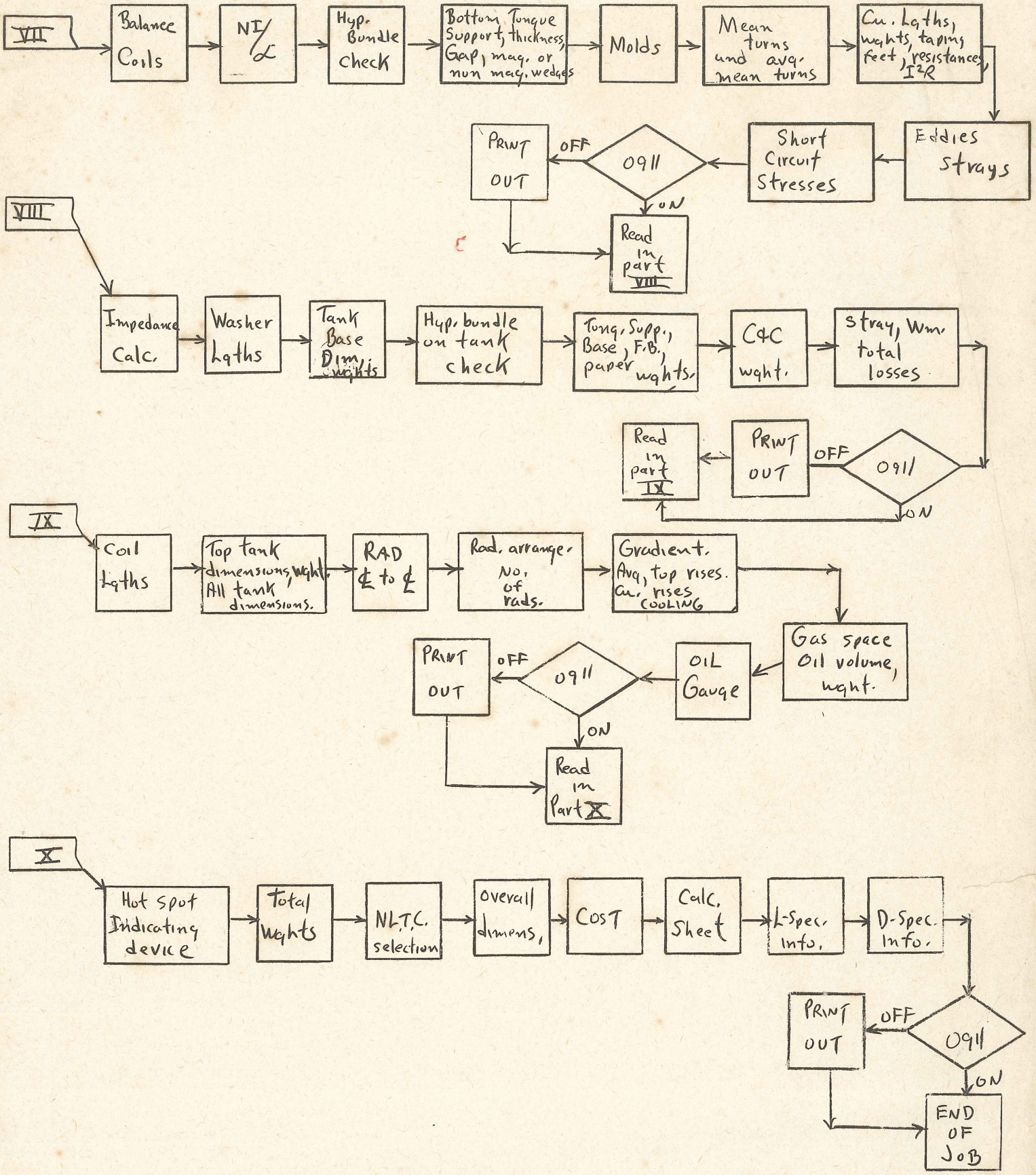
OUTLINE (PER WDG)

PART IV








VII
Balance Coils
NI/L
Hyp. Bundle check
Bottom Tongue Support, thickness, Gap, mag. or non mag. wedges
Molds
Mean turns and avg. mean turns
Cu. Lgths, wghts, taping feet, resistances, I²R
Eddies Strays
Short Circuit Stresses
O911
OFF
ON
PRINT OUT
Read in part VIII
VIII
Impedance Calc.
Washer Lgths
Tank Base Dim. wghts
Hyp. bundle on tank check
Tong. Supp., Base, F.B., paper wghts.
C&C wght.
Stray, Wm. total losses
O911
OFF
ON
PRINT OUT
Read in part IX
IX
Coil Lgths
Top tank dimensions, wght. All tank dimensions.
RAD ℄ to ℄
Rad. arrange. No. of rads.
Gradient. Avg. top rises. Cu. rises COOLING
Gas space Oil volume, wght.
OIL Gauge
O911
OFF
ON
PRINT OUT
Read in Part X
X
Hot Spot Indicating device
Total wghts
NLTC. selection
Overall dimens.
COST
Calc. Sheet
L-Spec. Info.
D-Spec. Info.
O911
OFF
ON
PRINT OUT
END OF JOB