



INTERNATIONAL ATOMIC ENERGY AGENCY
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION



INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
34100 TRIESTE (ITALY) - P.O.B. 586 - MIRAMARE - STRADA COSTIERA 11 - TELEPHONES: 224281/2 3 4 5 6
CABLE: CENTRATOM - TELEX 460392-I

SMR/90 - 44

COLLEGE ON MICROPROCESSORS:

TECHNOLOGY AND APPLICATIONS IN PHYSICS

7 September - 2 October 1981

Bit-slices and Microprogramming - Part I

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U.S.A.

These are preliminary lecture notes, intended only for distribution to participants. Missing or extra copies are available from Room 230.

BIT SLICES AND MICROPROGRAMMING

1) MICRO PROGRAMMING

2) SIMPLE EXAMPLE

3) ALU SLICE AND EXAMPLE } → 168/E LECTURE #1

4) SEQUENCER

5) SOFTWARE

REFERENCE:

CERN SCHOOL OF COMPUTING

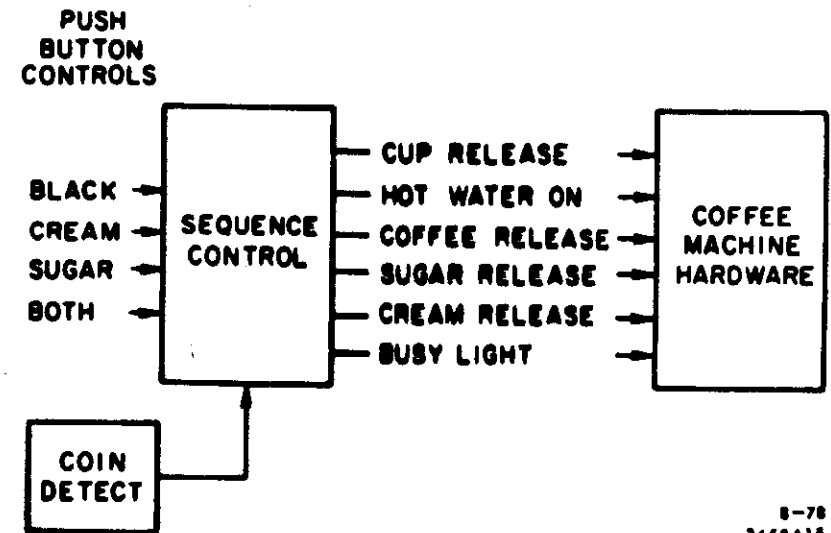
JADWINSIN, POLAND 1978

R KUNZ 6 LECTURES

ALSO 1980 SCHOOL

EXAMPLE OF SEQUENCING PROBLEM

COFFEE VENDING MACHINE

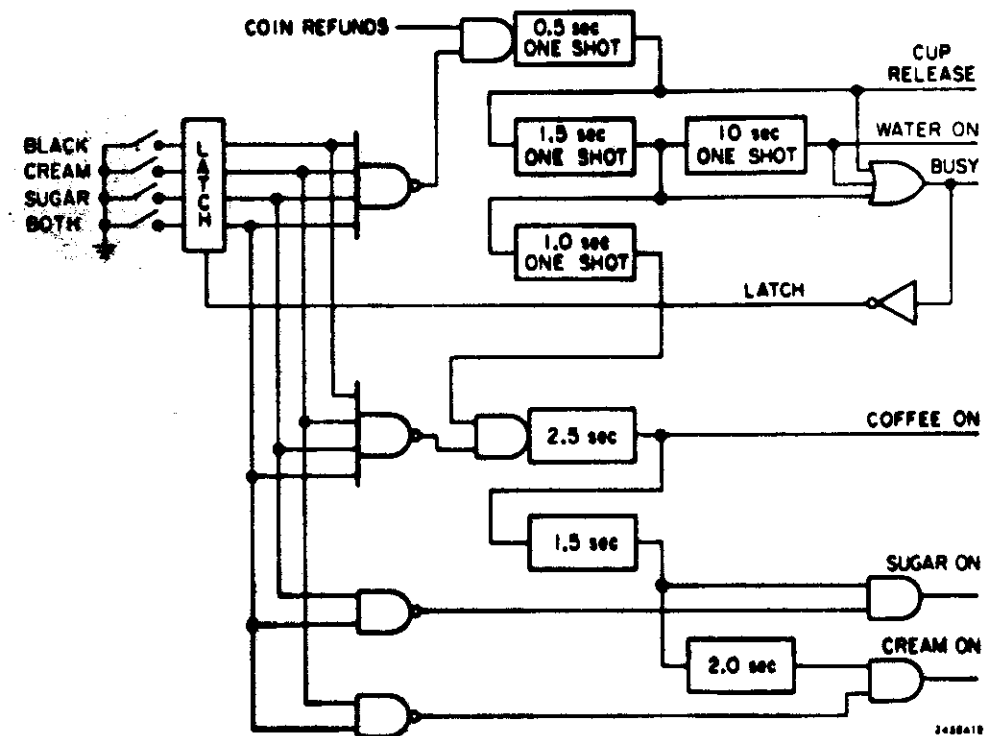


STEP NUMBER	C U P R E L E A S E	C O F F E E W A T E R	S U G A R R E L E A S E	C R E A M R E L E A S E	B U S Y L I C H T	COMMENTS
1	X				X	START
2					X	X = ALL SEQUENCES
3					X	S = SUGAR SEQUENCES
4					X	C = CREAM SEQUENCES
5		X			X	
6		X			X	
7		X	X		X	
8		X	X		X	
9		X	X		X	
10		X	X		X	
11		X	X		X	
12		X	X	S	X	
13		X	X	S	X	
14		X	X	S	X	
15		X	X	C	X	
16		X	X	C	X	
17		X	X	C	X	
18		X	X	C	X	
19		X	X		X	
20		X	X		X	
21		X	X		X	
22		X	X		X	
23		X	X		X	
24		X	X		X	STOP

figure CMC8L

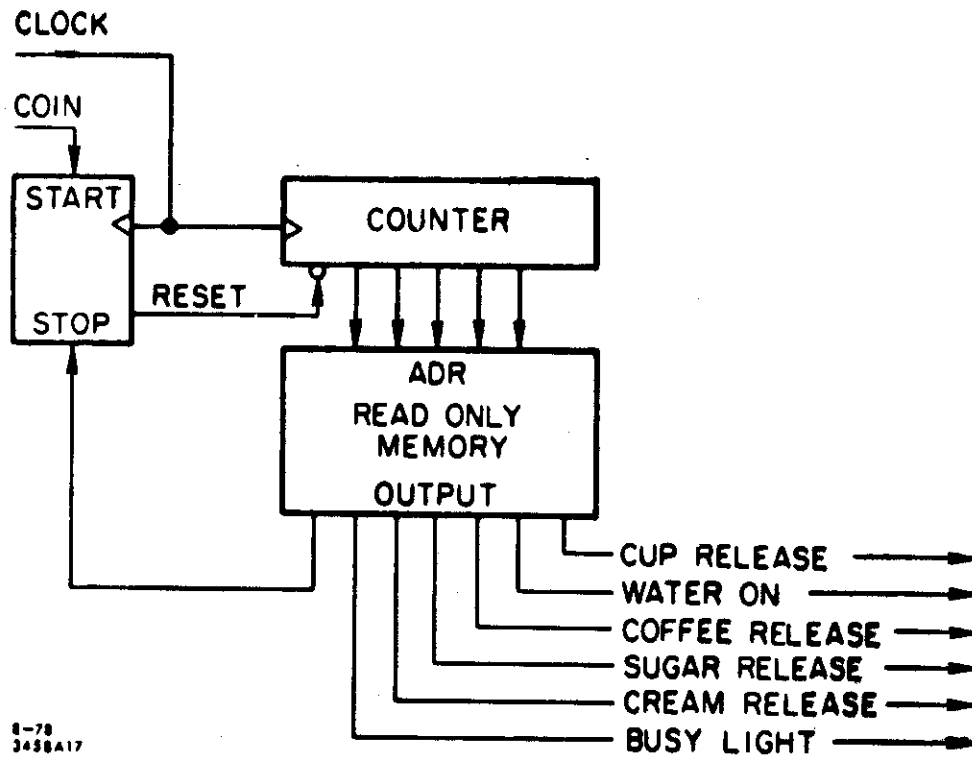
3.

RANDOM LOGIC IMPLEMENTATION OF COFFEE VENDING MACHINE



4.

SIMPLE SEQUENCER



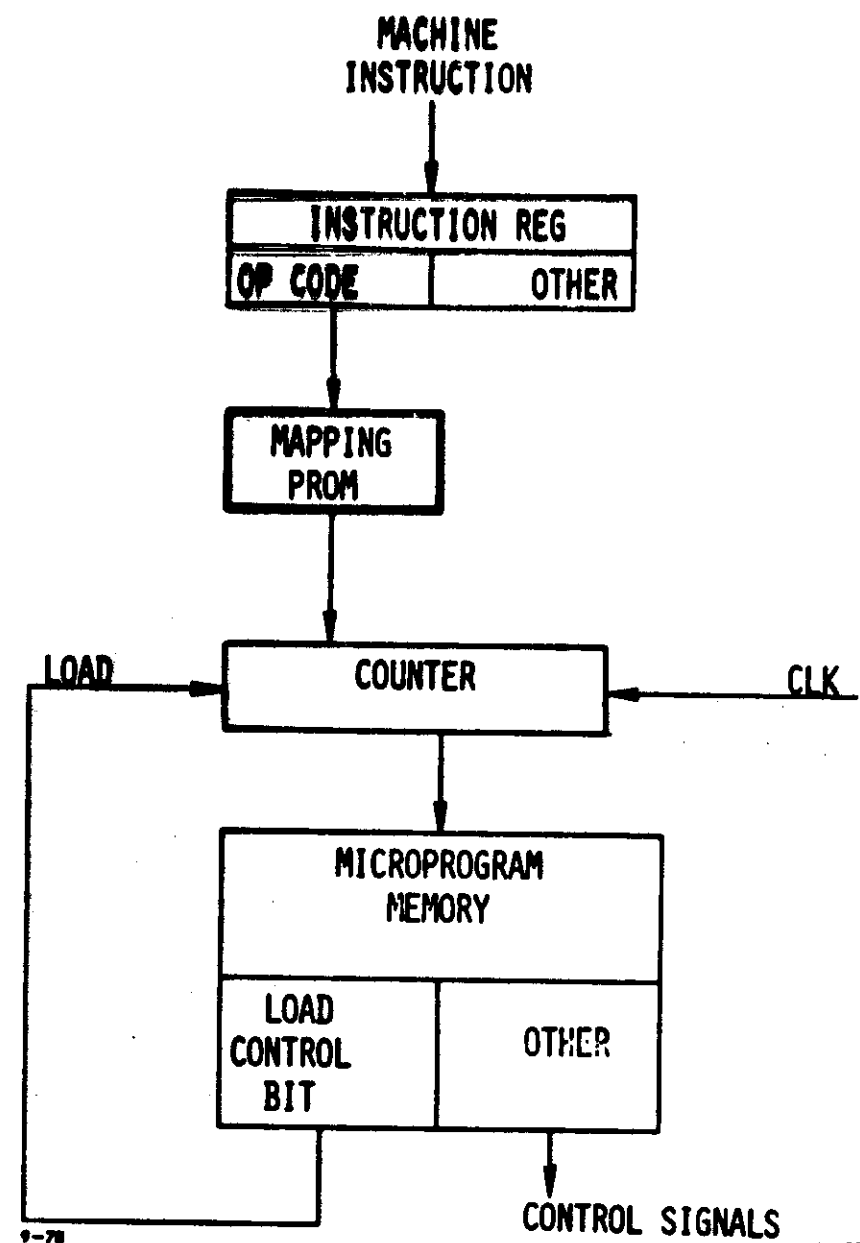
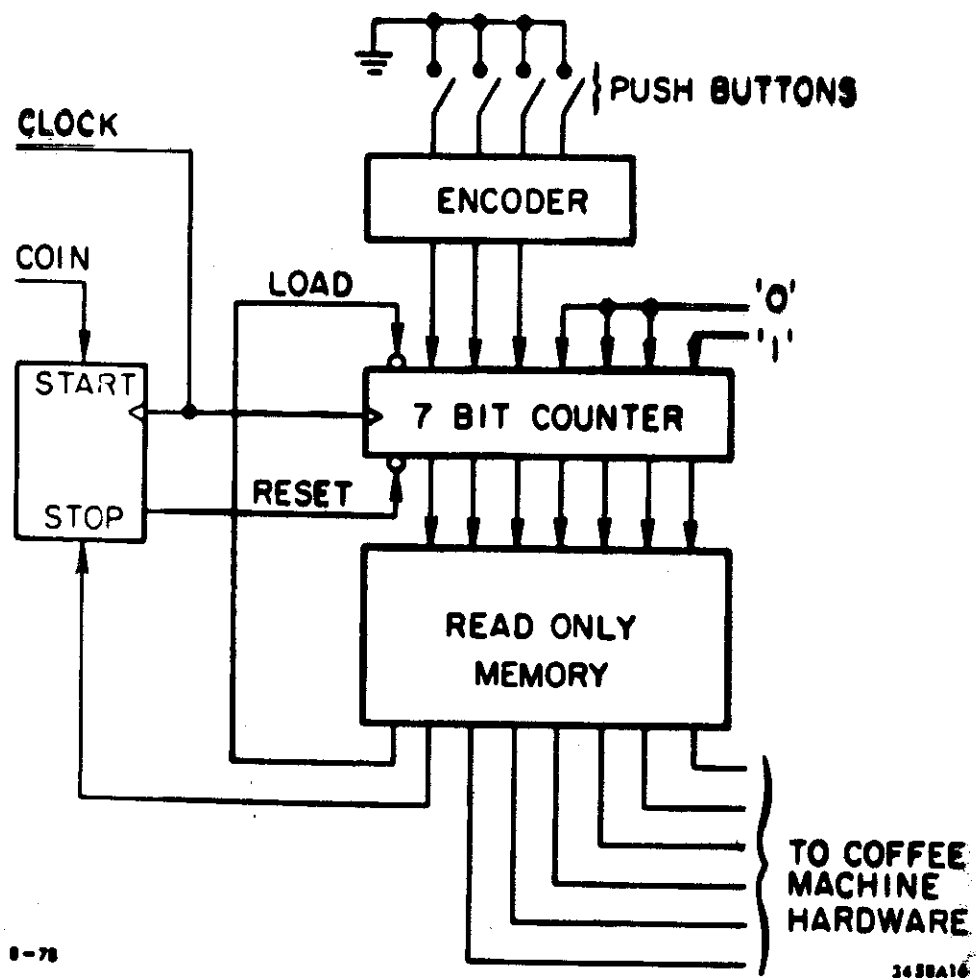
8-78
3458A17

5.

PROGRAM ADDRESS	BIT NUMBER						
	0	1	2	3	4	5	
0	0	0	0	0	0	0	IDLE
1	0	0	0	0	0	0	
2	0	0	0	0	0	0	START
3	0	0	0	0	0	0	
4	0	0	0	0	0	0	1 = SIGNAL ON
5	0	0	0	0	0	0	
6	0	0	0	0	0	0	0 = SIGNAL OFF
7	0	0	0	0	0	0	
8	0	0	0	0	0	0	1 = DON'T CARE
9	0	0	0	0	0	0	
10	0	0	0	0	0	0	
11	0	0	0	0	0	0	
12	0	0	0	0	0	0	
13	0	0	0	0	0	0	
14	0	0	0	0	0	0	
15	0	0	0	0	0	0	
16	0	0	0	0	0	0	
17	0	0	0	0	0	0	
18	0	0	0	0	0	0	
19	0	0	0	0	0	0	
20	0	0	0	0	0	0	
21	0	0	0	0	0	0	
22	0	0	0	0	0	0	
23	0	0	0	0	0	0	
24	0	0	0	0	0	0	
25	0	0	0	0	0	0	
26	0	0	0	0	0	0	
27	0	0	0	0	0	0	
28	0	0	0	0	0	0	
29	0	0	0	0	0	0	
30	0	0	0	0	0	0	
31	0	0	0	0	0	0	

STOP
LOCATIONS 25-31
ARE NOT USED

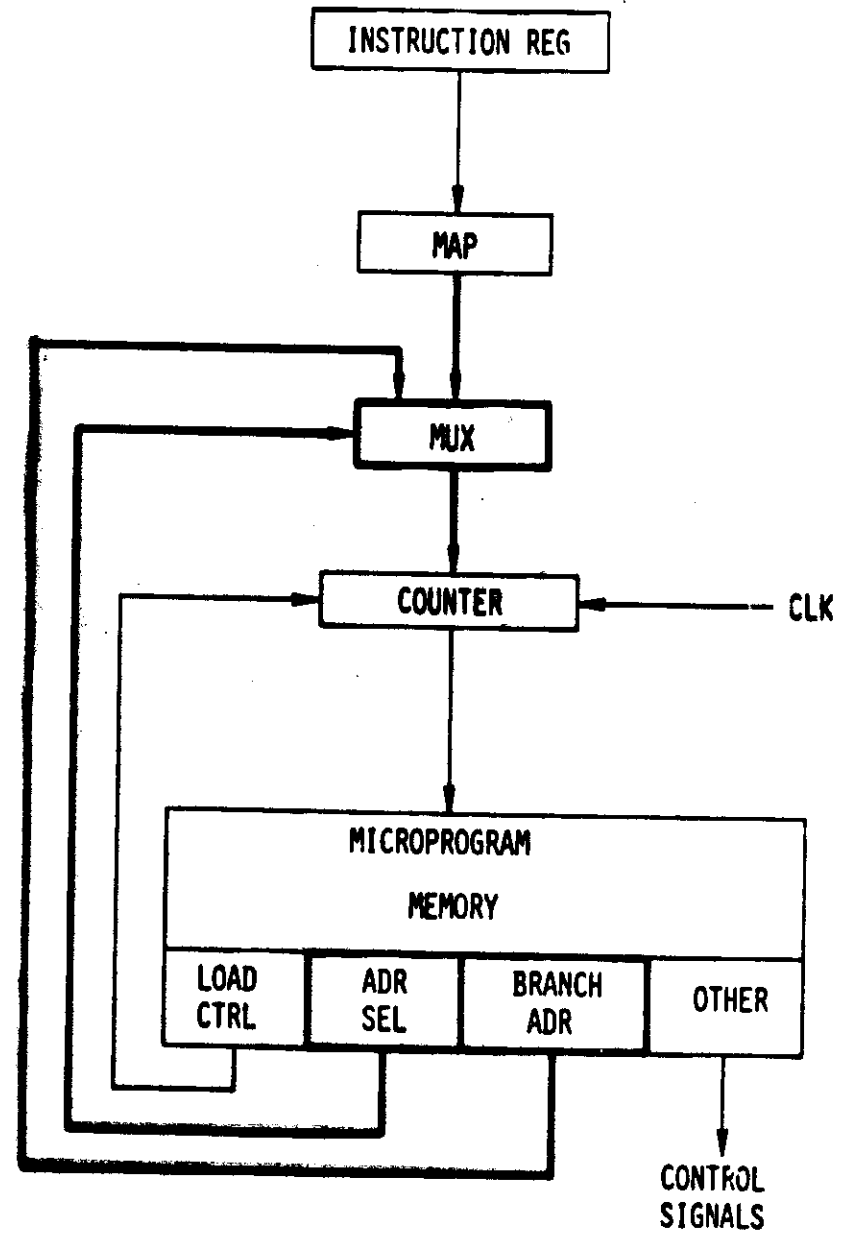
6.



SEQUENTIAL CONTROL

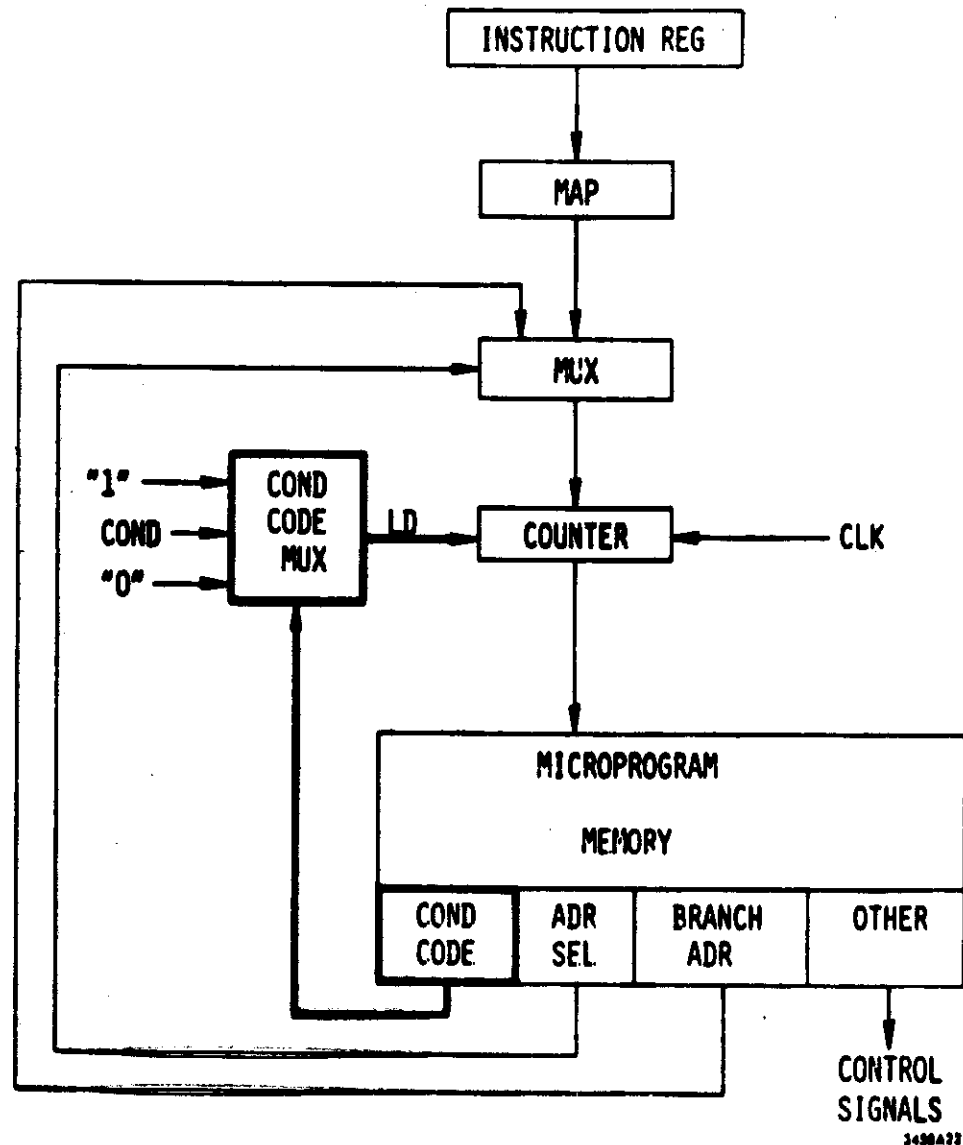
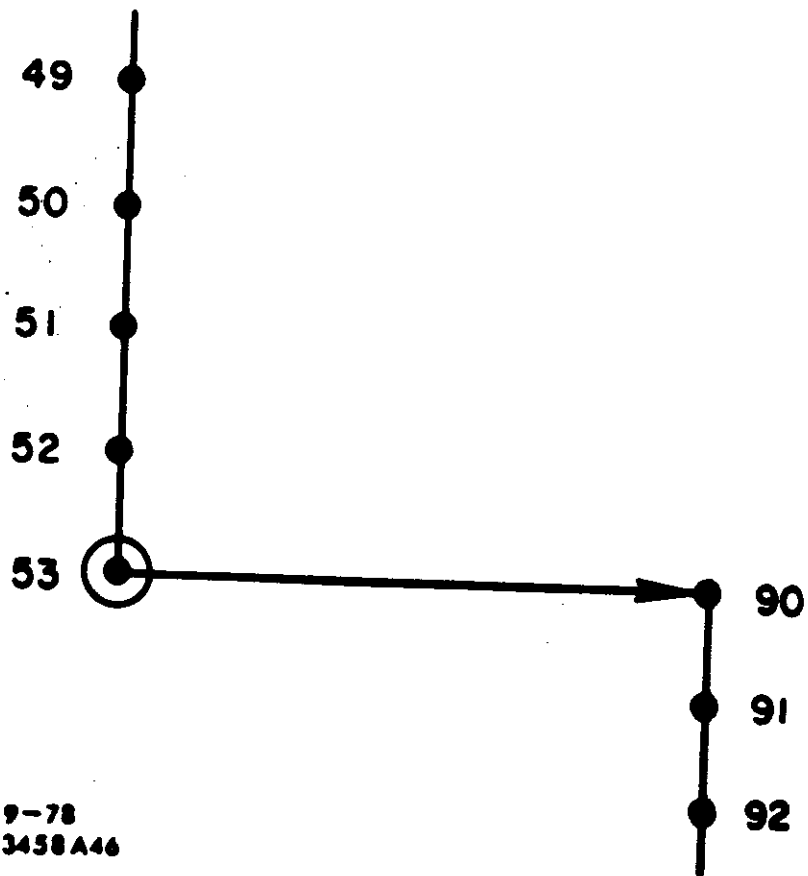
50 ●
51 ●
52 ●
53 ●

9.



10.

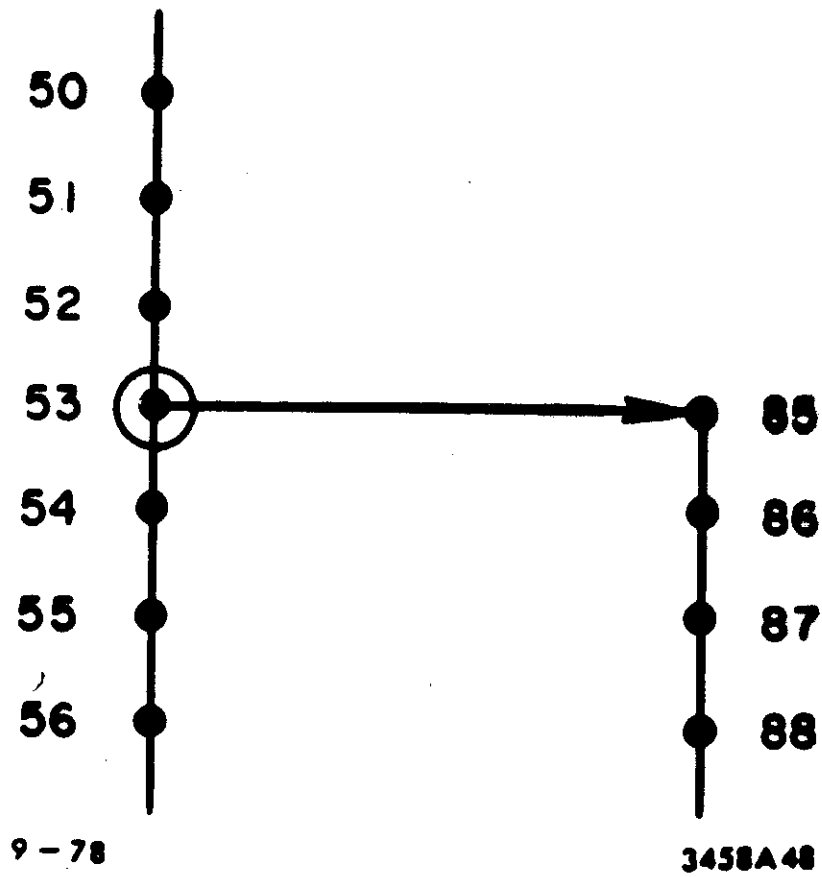
JUMP



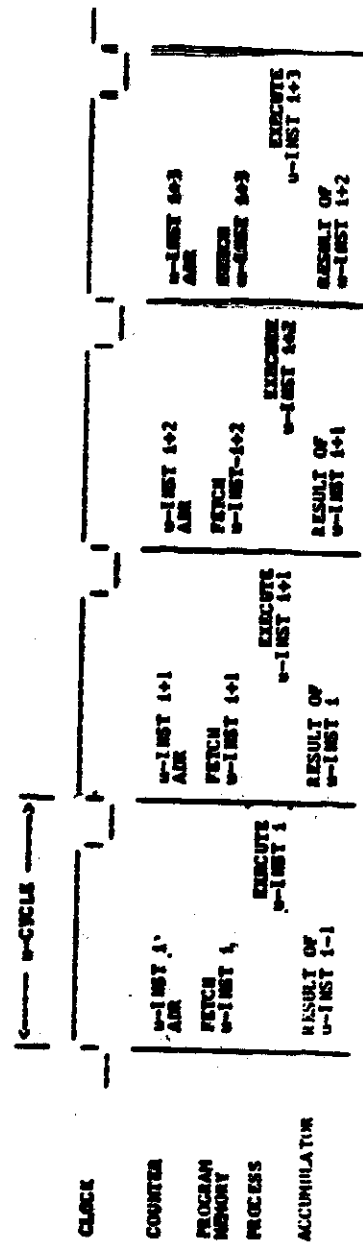
11.

12.

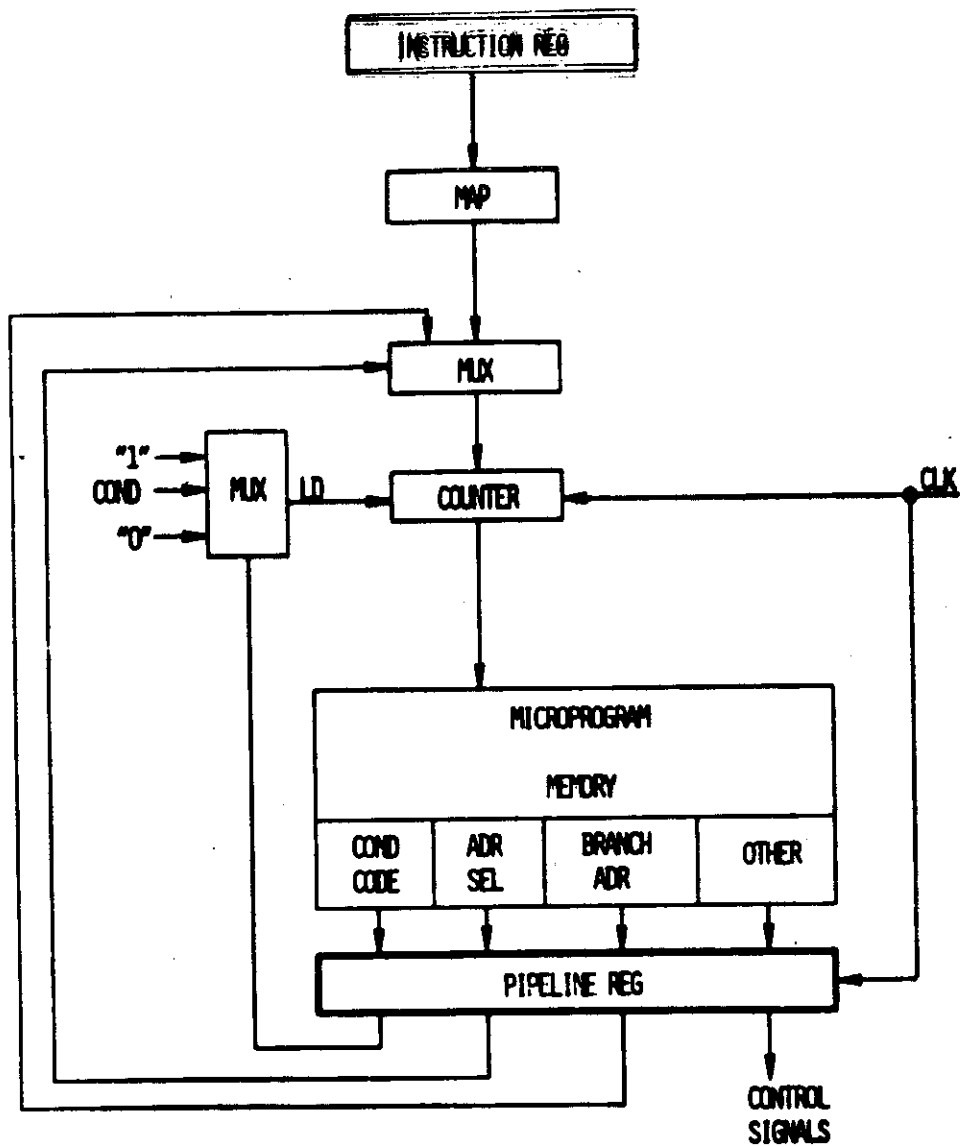
CONDITIONAL JUMP



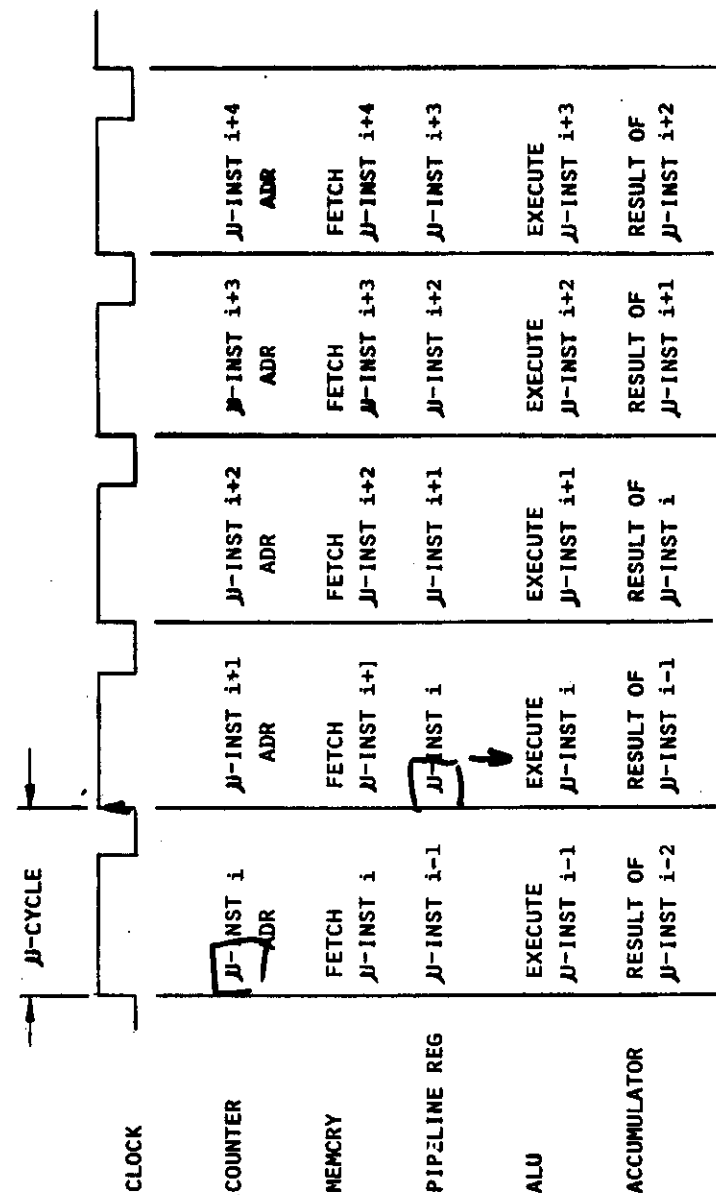
13.



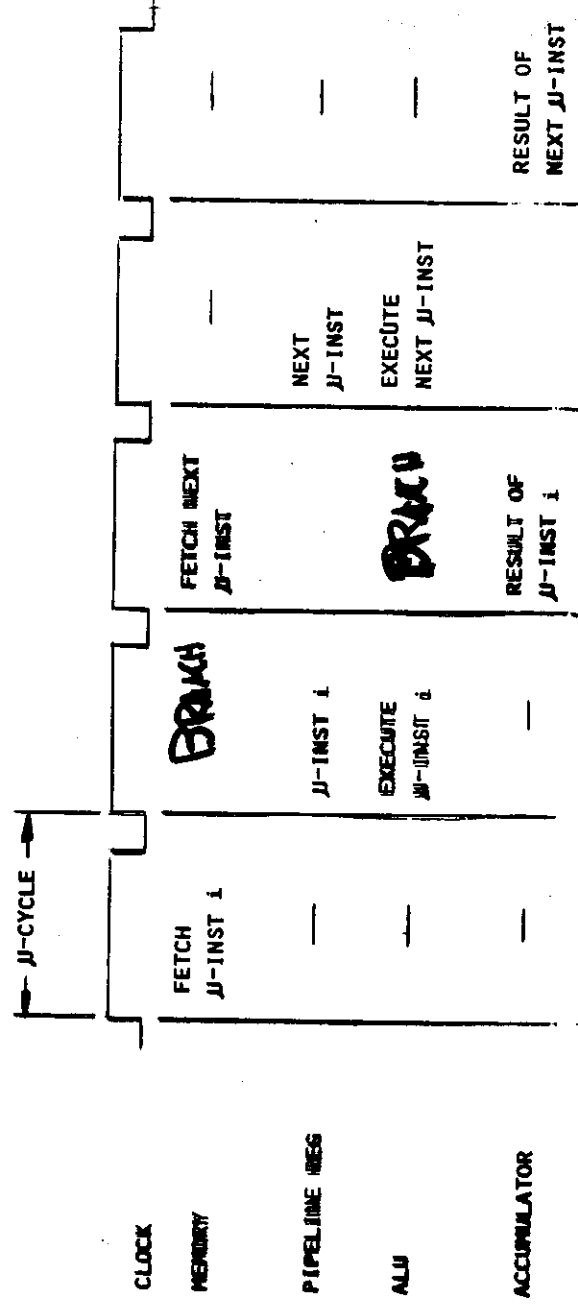
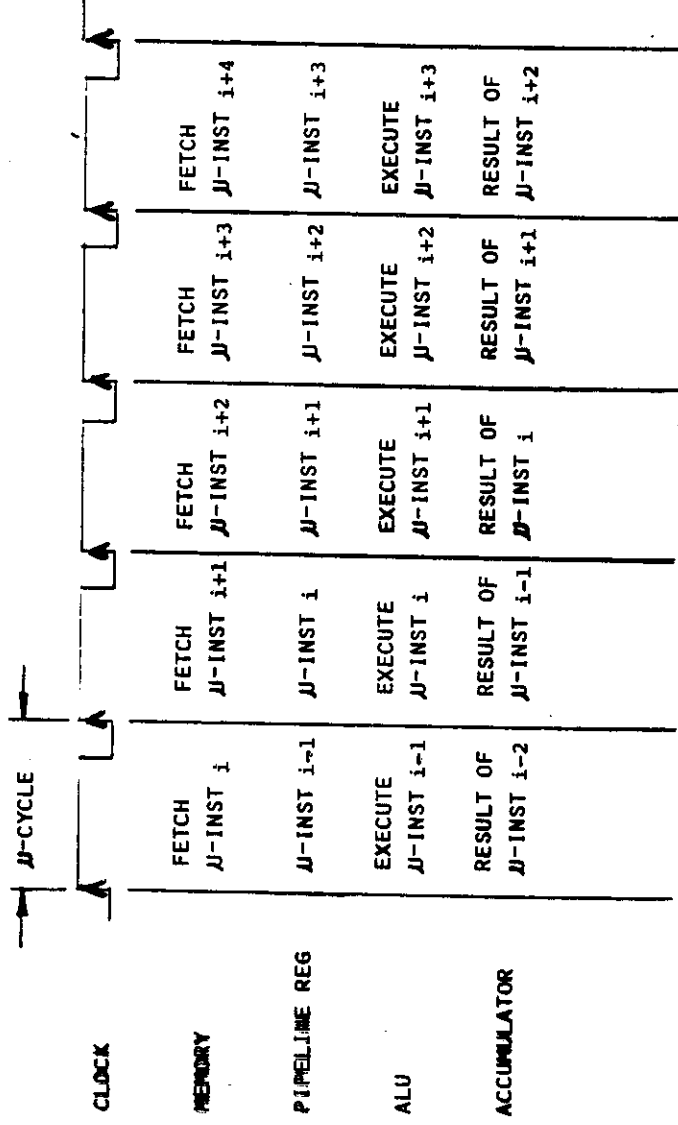
14.



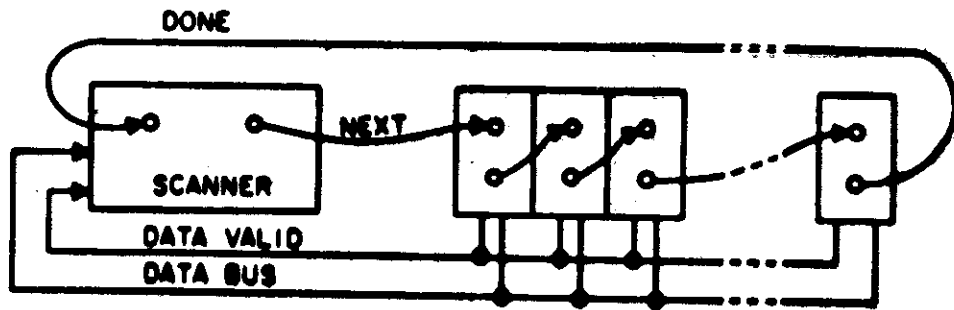
15.



16.



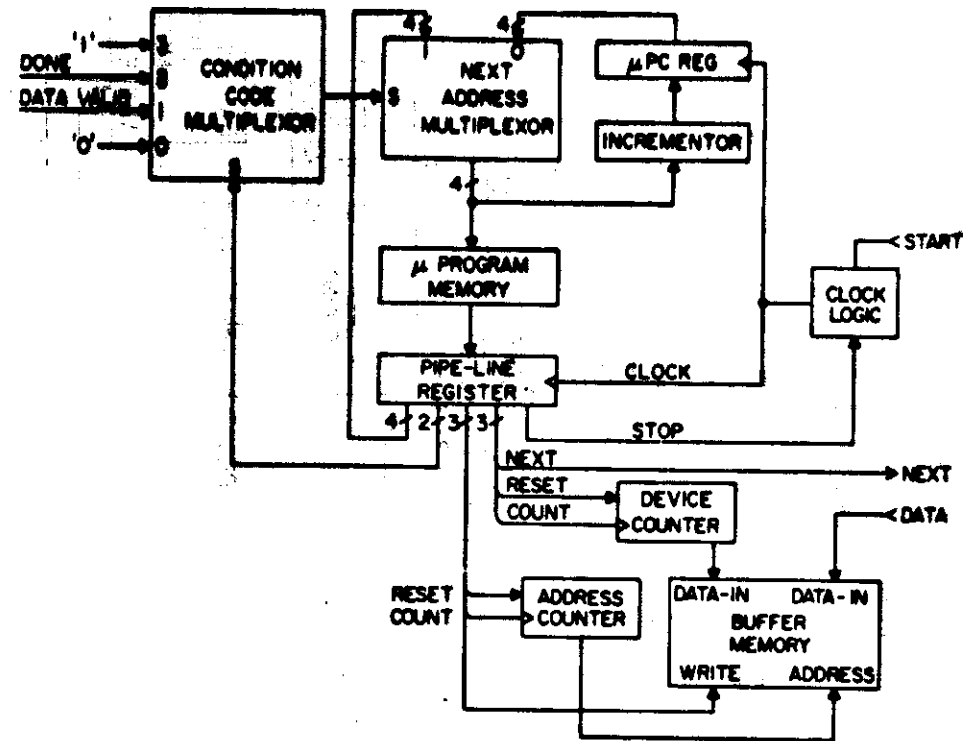
SIMPLE SCANNER



21.

SIMPLE SCANNER

MICROPROCESSOR CIRCUIT



22.

Bits				
0-3	4-5	6-8	9-11	12
Branch Address	Condition Code Multiplier	Buffer Memory Control	Device Counter Control	End

The fields have the following meaning

Bits 0-3: BRANCH ADDRESS for Branch or Jump instruction.

Bits 4-5: CONDITION CODE MULTIPLIER Control

00 CONTINUE next address is PROGRAM COUNTER REGISTER.

01 BRDV If DATA-VALID is '1', next address is from BRANCH ADDRESS.

10 ~~06~~ BRDONE If DONE is '1', next address is from BRANCH ADDRESS.

11 JUMP next address is from BRANCH ADDRESS.

Bit 6: Resets buffer memory ADDRESS COUNTER.

Bit 7: Increments buffer memory ADDRESS COUNTER.

Bit 8: Sends WRITE to buffer memory.

Bit 9: Generates NEXT signal.

Bit 10: Increments DEVICE COUNTER.

Bit 11: Resets DEVICE COUNTER.

Bit 12: Stops Scanner.

BRANCH ADDRESS

CONDITION CODE MULTIPLIER

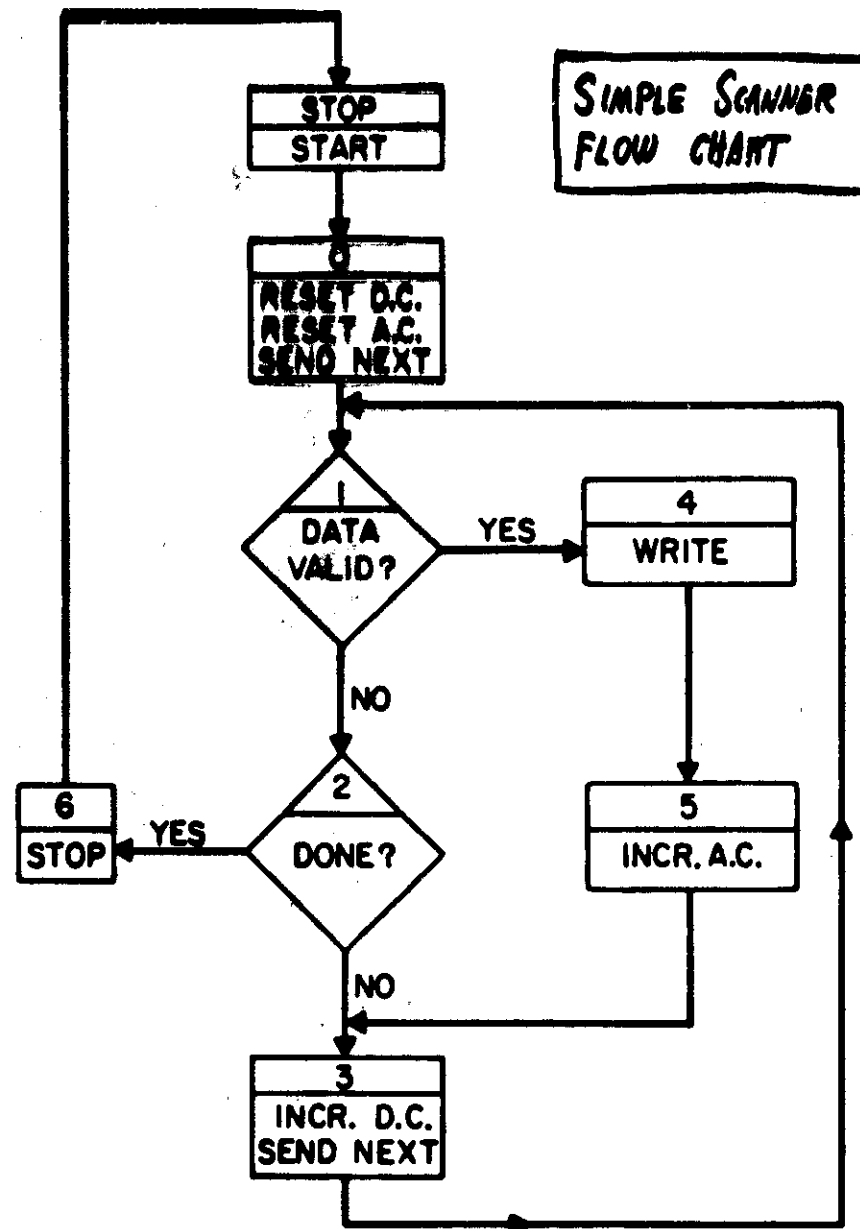
BUFFER MEMORY CONTROL

DEVICE CONTROL

END

table SEMDEF

23.



24.

<u>ADR.</u>	<u>BRANCH ADR</u>	<u>COND MUX.</u>	<u>MEM. CTRL.</u>	<u>DEVICE CTRL</u>	<u>END</u>
0000	XXXX	00	100	101	0
0001	0100	01	000	000	0
0010	0110	10	000	000	0
0011	0001	11	000	110	0
0100	XXXX	00	001	000	0
0101	0011	11	010	000	0
0110	0000	11	000	000	1

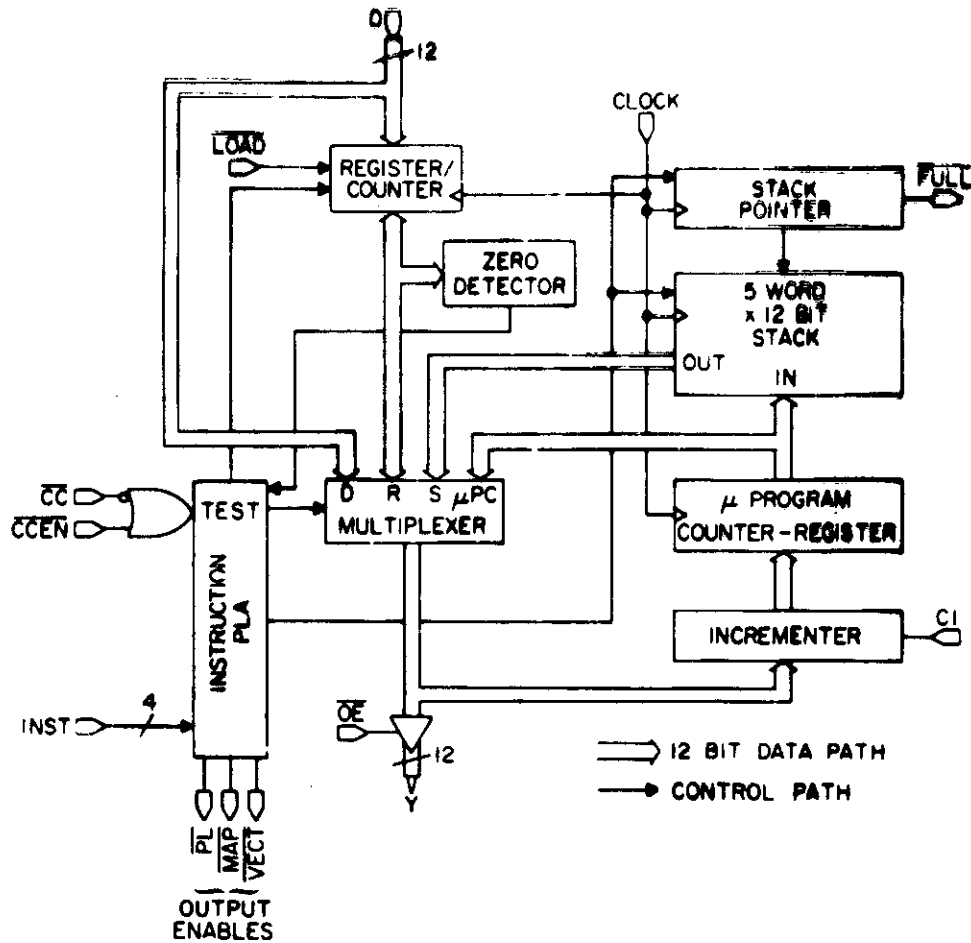
25.

FAMILY ELEMENTS

- ^{DMA} CPU PROCESSING UNIT
- MICROPROGRAM CONTROL
- BIPOLAR MEMORY
- INTERRUPT
- BUS I/O
- DMA
- TIMING
- PROGRAM CONTROL

26.

2910 MICRO-SEQUENCER



TYPICAL IMPLEMENTATION WITH 2910

