Mr. Alexander

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GROUP ON ELECTRONIC DIGITAL

COMPUTING MACHINE COMPONENTS

Description of R.C.A. Selectron (Memory Tube) Built by J. A. Rajchman of Princeton Laboratories

R. D. Huntoon

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DESCRIPTION OF RCA SELECTRON (MEMORY TUBE) BUILT BY J. A. RAJCHMAN OF PRINCETON LABORATORIES

R. D. HUNTOON

The selectron is an electronic memory device for use in digital computer mechanisms. The tube as now constructed is cylindrical, about 3" diameter by 5" high and has 40 leads through its press. The tube stores $(64)^2$ elements by controlling 32 selector grid wires

The active control grid of the tube consists of 64+ vertical rods and 64+ horizontal circular discs arranged to form a matrix of $(64)^2$ possible square cells through which electrons can pass on the way to the plate. The design of the tube is such that rods and discs which bound the four sides of any particular cell must <u>all</u> be positive for electrons to pass through that cell. A single negative side will cut off the entire cell. The design also reduces cross modulation between nearly adjacent cells.

For simplicity, we may represent the control grid array 1aid out on a flat plane, as shown in Figure 1, it being understood that in the actual tube the grid is in the form of concentric cylinders.

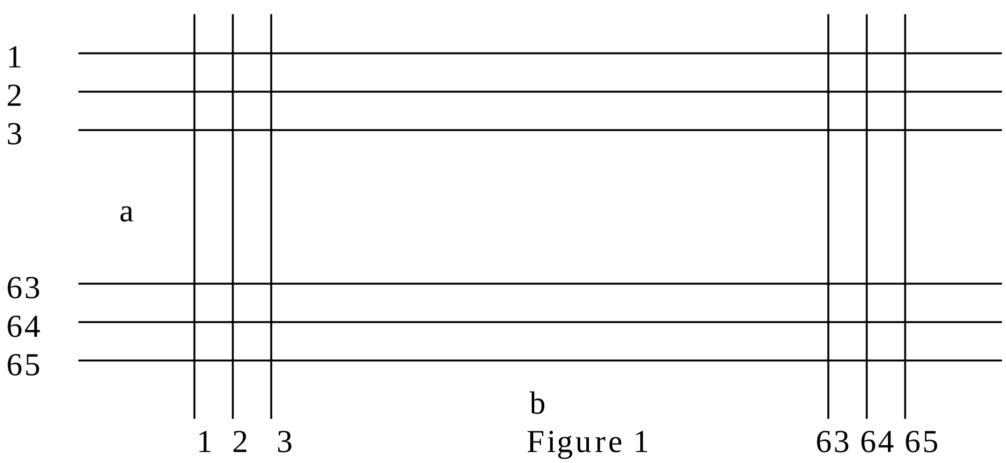

Figure 1

All grid wires "a" are independent and all grid wires "b" are independent, Potentials can be set at will on all the 130 wires, When all four wires bounding A square are connected to positive voltage, electrons can pass that square.

It is not necessary that all the leads from the grid wires be brought through the press to give the necessary contro1.

If we consider the "a" wires alone, for example, there will be 65 wires to inc1ude the 64 squares in one line. Grid #1 can be connected to grid #65 so that there are only 64 leads to be considered. If we arrange two sets of 8 terminals numbered 1, 2, 3... 8 and 1', 2', 3' ... 8', making 16 terminals in all, and if we connect them 64 leads to them according to the following system

Grid No.	Terminal No.	Grid No.	Terminal No	Grid No.	Terminal No.	Grid No.	Terminal No.
1	1	17	1	33	1	49	1
2	1'	18	3'	34	5'	50	7'
3.	2	19	2	35	2	51	2
4	2'	20	4'	36	6'	52	8'
5	3	21	3	37	3	53	3
6	1'	22	3'	38	5'	54	7'
7	4	23	4	39	4	55	4
8	2'	24	4'	40	6'	56	8'
9	5	25	5'	41	5	57	5
10	1'	26	3'	42	5'	58	7'
11	6	27	6	43	6	59	6
12	2'	28	4'	44	6'	60	8'
13	7	29	7	45	7	61	7
14	1'	30	3'	46	5'	63	7'
15	8	31	8	47	8	63	8
16	2'	32	4'	48	6'	64	8'

we find that by impressing the proper potentials on the 16 leads, we can make any desired pair of grid wires positive, with all others negative

The 16 leads can be controlled by 6 flip flops which have $2^6 = 64$ possible states. Thus 12 flip flops will be used to control a selectron or several selectrons in paralle1.

The actual form of the tube is shown in Figure 2, which shows only a segment of the structure. The drawing is not to scale since there obviously not 64 segments around the circle as shown. Likewise, details of mounting and connections are not shown. The drawing represents a part of a transverse section through the tube.

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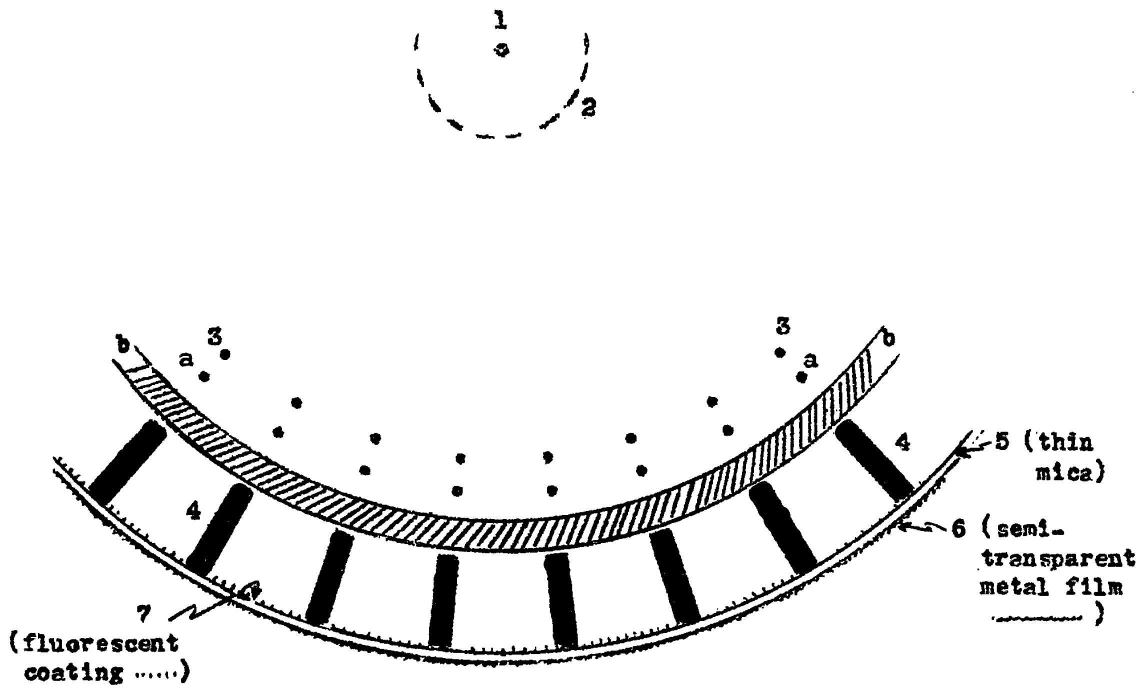


FIGURE 2

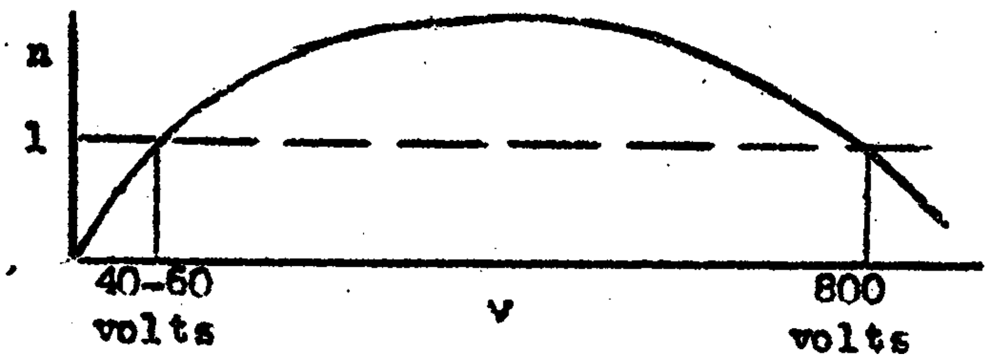
Figure 2

In figure 2, the numbered parts have the following significance:

1 -- emitting cathode
2 -- acce1erating grid
3 -- screen grid to prevent cross modulation between neighboring cells
a -- vertical selectron grid rods corresponding to grids "a" of Figure 1
b -- horizontal rings corresponding to grids "b" of Figure 1
4 -- radia1 shield vanes to confine electron beams and collect secondary emission; all fins connected together at one potential
5 -- thin mica sheet wrapped tight around fins 4
6 -- semi-transparent metallic conducting backing on mica sheet
7 -- fluorescent coating on inside face of mica sheet.

Having seen how any grid rectangle can be opened to the electron stream at will, we proceed to show how the information is stored, read off, and erased at will.

The secondary emission coefficient of the inside of the mica screen has the form



with the ratio crossing unity at about 50 volts and about 800 volts.

If during the time a particular gate is open the back of the mica screen is pulsed to a potential greater than the critical voltage 50 volts, the screen will assume a potential essentially that of the radial fins 4, which can be set at any desired potential, say, 300 volts. As the pulse on the backing plate dies away the screen potential will stay in equilibrium with the radial fins 4. This can be seen as follows: if the potential of the surface falls below the fin potential, it collects the secondary electrons. Since n is greater than unity, the potential of the screen rises toward the fins. If the screen potential is higher than the fins, the secondary electrons are repelled and the screen potential falls to that of the fins. Thus, fin potential is a stable potential for the insulating surface.

There is one other stable potential. If during the time the gate in open the backing plate is pulsed below the critical 50-volt potential the secondary emission ratio falls below unity, and no matter how well the fins collect the secondary electrons the potential of the mica screen will fall because more electrons hit it than are emitted. The potential will fall to zero and stay there, that is, it will fall until no more electrons can reach it. If it goes below zero, leakage will return it to zero. If it goes above zero, electron capture will drop it to zero again.

Thus by properly pulsing the backing plate, the surface in a particular cell can be made either fin potential or zero potential. At fin potential the surface will fluoresce and indicate that the potential is high. At zero potential the surface will not fluoresce indicating zero potential.