in contrast with negative, or the ground, terminal T2.

Timing of the machine

Now, how are these timed currents used to energize the relays and circuits of Simon? This is shown in the timing chart of Fig. 3; it is not altogether complete, but most of the operation of the machine is indicated there, and it will be understandable to readers who have followed the partial diagrams in earlier instalments of this series. Let

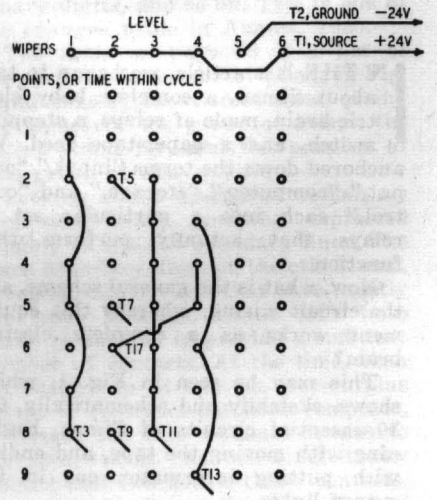

Fig. 2—How the 6-level stepping switch that activates the relay banks is wired.

us go through the timing chart of Fig. 3 and the diagrams of Fig. 1 and see what we can tell from them.

At time 1, there is a red O on the first row, and a red X on the second row, and a red line connects them. This means that at time 1, we read through holes in the paper tape (which at this time is still) and we pick up the corresponding program relays (see Circuit 2 in Fig. 1). At time 2, similarly interpreting the red line, we read through the positioned contacts of program relays to select the receiving register, and pick up its entrance relay, which is held up until time 8 (see Circuit 3). We also optionally (if there is a hole in position 5 on the tape) pick up RR1 (reset relay No. 1), which action resets the input register by interrupting its hold current (see Circuits 5 and 6). At time 3, all that happens is that we move tape (see Circuit 1), and drop out the program relays. At time 4, we read through tape again and pick up the program relays once more, for they are the relays in which the information from the tape is always immediately put (see Circuit 2). Also at time 4, we read through the hold contact of the selected entrance relay and pick up the matching reset relay, which resets the receiving register by interrupting its hold current (see Circuits 3 and 4). At time 5, we read through contacts of the program relays, and pick up the input registers 1 and 2, storing there a number or operation (see Circuit 6). At time 6, we move tape and drop out the program relays. At time 7, we read through holes in the paper tape, and pick up the program relays once more (see Circuit 2), this time to select the sending register.

At time 8, we transfer information (see Circuit 9). We read through, from the source:

1. contacts of the program relays which select a sending register (these relays were energized at time 7);
2. contacts of that sending register (held up by continuous current);
3. the bus;
4. the contacts of the receiving register's Entrance Relay (which have been closed and have been held from time 2 to 8);
5. and the coils of the selected receiving register, to ground.

And at time 9, we move tape preparatory to the next cycle, and drop out the program relays and entrance relay.

Independently of this main sequence of events, computing takes place in Circuit 8. The computer consists of three registers CR1, CR2, CR3 which take in numbers, and a fourth register CR4 which takes in an operation. Suppose that on previous cycles, these registers have been filled with the desired information, and that CR4 is the last one so filled. Then by means of T11, current is passed through the contacts of those four registers. To avoid back circuits, however, the computer is connected only at time 8 to the fifth computer register, CR5, which stores results (see Circuits 8 and 7)

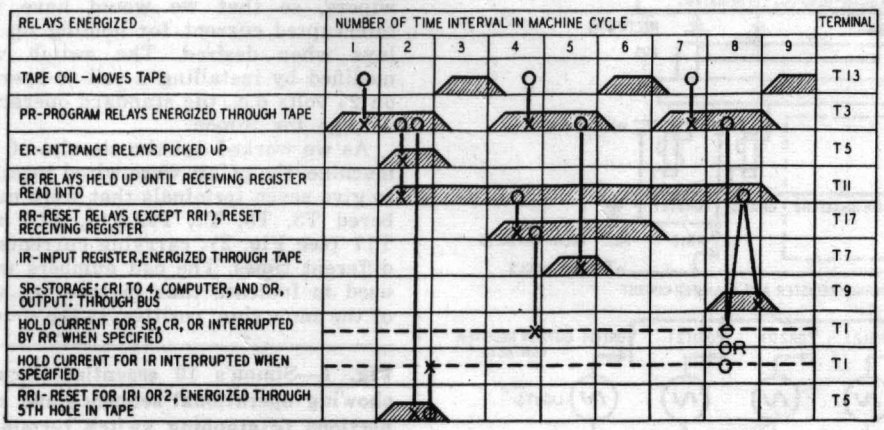

Fig. 3—Timing chart, showing how operations are carried through the machine.

Storing and transferring

The two things that are the first order of business in an electric brain are to store information and to transfer information. In Simon, information is stored in any one of 16 registers, each capable of holding two binary digits. Information is transferred as pulses of current along a two-line bus. The 16 registers of Simon and the codes used for "calling" them (either to transmit information they hold or to receive and store information) are:

Register	Code	Entrance Relay	Reset Relay
IR1	0000	none	RR1
IR2	0001	none	RR1
SR1	0010	ER3	RR3
SR2	0011	ER4	RR4
SR3	0100	ER5	RR5
SR4	0101	ER6	RR6
SR5	0110	ER7	RR7
SR6	0111	ER8	RR8
CR1	1000	ER9	RR9
CR2	1001	ER10	RR10
CR3	1010	ER11	RR11
CR4	1011	ER12	RR12
CR5	1100	none	RR12
OR1	1101	ER14	RR14
OR2	1110	ER15	RR15
OR3	1111	ER16	RR16

In the last article and in previous articles, we told most of the story about the input, output, and storage registers of Simon. The computer registers, however, require some more explanation here.

Computer registers

The computer of Simon consists of relays and wiring by means of which information is operated on and changed into other information. Simon's computer registers (abbreviation CR) are: CR 1 to 3, which take in numbers; CR4, which takes in the operation; CR5, which gives out the result; and CR 6 to 9, which help in the operations involving arithmetical carrying and were recently added.

Simon at present writing has nine operations built into it. For Simon to perform any one of these operations, he must be instructed. How do we instruct him? These operations also have certain codes, and here are the codes and the names of the operations:

No.	Code	Operation
1	0000	Add, No Carry;
2	0001	Negate, No Carry; Fours Complement
3	0010	Greater Than
4	0011	Selection
5	0100	Logical AND
6	0101	Logical NOT; Threes Complement
7	0110	Logical OR
8	1000	Add, Subject to Carry from Previous Addition
9	1001	Negate, Subject to Carry from Previous Negation