



General Explanation of Steppers and Decades

- A stepper is a six stage ring counter. It has the following associated with it:
- 1) Stepper program pulse input terminal
 - 2) Six stepper program pulse output terminals, one associated with each stage of the stepper.
 - 3) A group of decades (of from 0 to 5, depending upon the stepper and the settings of the decade associator switches. The n (n=0,....,5) decades of each group are interconnected by a direct carry-over circuit (there is no delayed carry-over circuit) enabling them to count (not accumulate) $10^n - 1$ pulses.
 - 4) Stepper clear switch
 - 5) Stepper direct input terminal
 - 6) Stepper clear direct input terminal
 - 7) Each decade has a direct input terminal.

The operation of a stepper and its associated equipment is as follows:

At the end of the initial clear each stepper is left on the 1st stage and each decade is cleared to 0.

Suppose a program pulse is received on a stepper program pulse input terminal. One addition time later a program pulse is emitted from the program pulse output terminal corresponding to the stage the stepper is on at the time it is emitted and a program pulse is sent to the units decade of the group of associated decades.

Whenever a group of decades counts to the number set on those decade switches corresponding to the position of the stepper, one addition time later these decades are cleared to zero and the stepper is either stepped to the next position, or if it is on the position set on its stepper clear switch) cleared to the first position. Though the decades will count either program pulses or digit pulses, any pulse which might cause this clearing and stepping action must be a program pulse.

The decades count both the pulses supplied to the associated stepper's program pulse input terminal (with a one addition time delay) and those supplied to the decade direct input terminals. No set-up is permissible which might lead to pulses being supplied to a decade from both sources simultaneously, or from a decade direct input terminal and a carry-over from a previous decade simultaneously.

An example illustrating a common application of a stepper in programming will show how items 1 through 4 operate together. Consider stepper D, and suppose that decades 12 and 13 are associated with it and that its stepper clear switch is set to 4. Then four two-digit numbers (n_1, \dots, n_4) may be set up on the decade switches, each number associated with the corresponding stage (1,....,4) of the stepper and hence with the corresponding program pulse output terminals (D_{10}, \dots, D_{40}). Whenever a program pulse is received on D_1 a pulse is emitted from one of the output terminals (one addition time later). The first n_1 pulses received on D_1 are emitted from D_{10} ; the next n_2 pulses received on D_1 are emitted from D_{20}, \dots the last n_4 pulses received on D_1 are emitted from D_{40} , and the stepper and its associated decades are then left in their original state, ready to repeat the process. The time schedule of these operations is as follows:

Program Pulse	Operation
0	Input program pulse (to D_1)
1	Output program pulse emitted (from D_{10}, \dots, D_{40}) Decade stepped to next stage
2	In case the decades register the number set up on the decade switches, all decades (associated with stepper D) are cleared to zero and the stepper (D) is stepped to the next stage or (if it is on the position 4) it is cleared to the first stage.

To disassociate a decade from its stepper pull out gate tube 63 in the stepper plug-in unit. See block diagram PX-8-304.

Terminals A1, B1,.....K1	Stepper program pulse input terminals
Terminals A ₁₀ ,.....K ₁₀	Stepper program pulse output terminals associated with Stage 1
A ₂₀ ,.....K ₂₀	Stage 2.....
A ₅₀ ,.....K ₅₀	Stage 6

One addition time after a program pulse is supplied to an input terminal (such as D_1) a program pulse is emitted from the output terminal corresponding to the stage the stepper is on at the time it is emitted (thus if the stepper is at position 4, when the pulse is emitted it comes from D_{40}), and a unit is added to the contents of the associated decades.

Terminals A_{40i},.....K_{40i} Stepper clear direct input terminals.

A pulse supplied to this terminal will clear the stepper to the first position. If a clearing pulse and a stepping pulse arrive at the same time, the stepper will be cleared, not stepped.

Stepper Terminals
 A1,.....K1 Stepper program pulse input terminals
 A₁₀,.....K₁₀ Stepper program pulse output terminals
 A₂₀,.....K₂₀ Stepper direct input terminals
 A_{40i},.....K_{40i} Stepper clear direct input terminals
 Decade Terminals
 A10,.....B10 Decade direct input terminals
 B10,.....C10
 C10,.....D10
 D10,.....E10

MOORE SCHOOL OF ELECTRICAL ENGINEERING
UNIVERSITY OF PENNSYLVANIA

MASTER PROGRAMMER FRONT PANEL NO. 1

MATERIAL	ITEM	QUANTITY
Drawn by: J. EBELSACK	Checked by: DEC 15 1944	Approved by:
DEC. 1944		PX-8-301