

COMPANY CONFIDENTIAL

September 6, 1957

Exchange Memo # 28

I/O Memo # 6

SUBJECT: A Multi-Control Delay and Sequencing System

BY: J. K. Crawford

PROPOSAL: A Central Timing System which will eliminate the need for Single Shots.

REASON: A more accurate and flexible timing system is needed and the transistorized version of the Single Shot is not available in the range of accuracy required.

OBJECTIVES: To provide an accurate and flexible delay system with a wide range of duration which can be used to fulfill the requirements of many individual delay units.

DISCUSSION

The objectives are accomplished in the following manner:

1. One or more oscillators are used to drive a pulse counter. If the accuracy warrants it the driving oscillator may be clamped off when not in use assuring that the oscillators will start in proper synchronism. Thus, the pulse counter and clamped oscillator constitute an accurate means of time measurement.
2. By starting the operation with high frequency drive pulses and reducing the frequency of the drive pulse at fixed points, a wide range of durations can be covered while maintaining the accuracy at all points. Thus, the use of more than one drive frequency facilitates the use of a smaller counter with the consequent reduction in components.
3. The use of a counter permits sequential counter outputs during a delay operation. Thus, sequential or concurrent delays can be considered as one delay with sequential outputs during that delay.
4. Operation of the delay counter is dependent upon some external condition requesting that delay. That same external condition can gate the counter outputs. The counter outputs can then be classified in accordance with the conditions requesting the delay. Thus, one delay system can satisfy the requirements of numerous unrelated individual delay units.
5. Presetting the counter at the start of a delay operation permits selection of operating speed and total duration.
6. The skip or repeat of certain sequential outputs can be accomplished by externally setting the counter triggers during a delay operation.
7. The total duration of a delay can be selected by having external conditions gate the counter outputs terminating the delay operation.

Detailed operation with reference to the attached diagram.

1. Note the operation of the E Delay trigger. When a delay is requested by line F, the delay trigger comes ON, the counter clamp is removed

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and the counter starts counting the input pulses. The delay trigger is turned off by a pre-determined counter output and clamps the counter to zero again. A reset is not required. The line Plus on Delay (line P) goes plus when the delay request (line F) turns On the Delay trigger and goes minus when the counter turns OFF the Delay Trigger. Thus, in its simplest form, the delay counter can replace a Single-Shot with greater accuracy and of any desired duration.

2. The duration of delay requirements varies so widely that a counter large enough to cover the necessary range would be unreasonable in size. The number of stages can be reduced by using more than one driving speed and automatically switching to a slower drive speed at specific points. The number of drive speeds and the actual speeds involved are best determined to fit the specific application. If the additional accuracy is worthwhile, a clamped oscillator can be used to supply the drive pulses. The attached diagram shows a drive speed of 4 us for the first 512 us period and then a change over to a drive speed of 400 us for the next 51 ms. Thus enabling a counter of reasonable size to time delays over a wide range of duration.
3. The delay system enables many sequential outputs (line J, K, and L) to be taken during a delay operation. Thus, one delay with sequenced outputs can replace several consecutively operating Single-Shots.
4. Any number of Delay Triggers can be used with one counter. The Delay trigger outputs are ored together to control the counter clamp. Whenever any Delay trigger comes ON the clamp is removed and the counter starts counting the input pulses. Each delay trigger has its own Plus on Delay lines (line P and Q). The sequential outputs can be gated by these lines to produce Gated Sequential Outputs (lines M and N.) Thus, the one counter can be used to time numerous unrelated delays which would otherwise require individual Single-Shots.
5. It may be desirable to preset (lines A and B) a number into the counter at the start of a delay operation. This permits external conditions to select the speed of operation and to select the total duration of a delay. A form of selection can also be accomplished by presetting past specific sequential outputs when desired. Thus, external conditions can select the operating speed and the total duration of a delay.
6. The sequential outputs of a delay are like the steps of a program. The nature of the delay determines which program by turning ON or OFF certain of the counter triggers (line B) at specific timings, the program can be controlled by external conditions to skip or repeat certain

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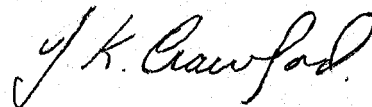
of the program steps. Thus, external conditions can control the skip or repeat of certain phases of the delay operation.

7. The delay trigger turnoff time can be selected externally (lines C and D) thus permitting additional selection of the total duration time and permitting a form of selection by omitting specific sequential outputs.

SUMMARY

This is a description of a Multi-Control Delay and Sequencing System. It can replace many Single-Shots with the advantages listed below.

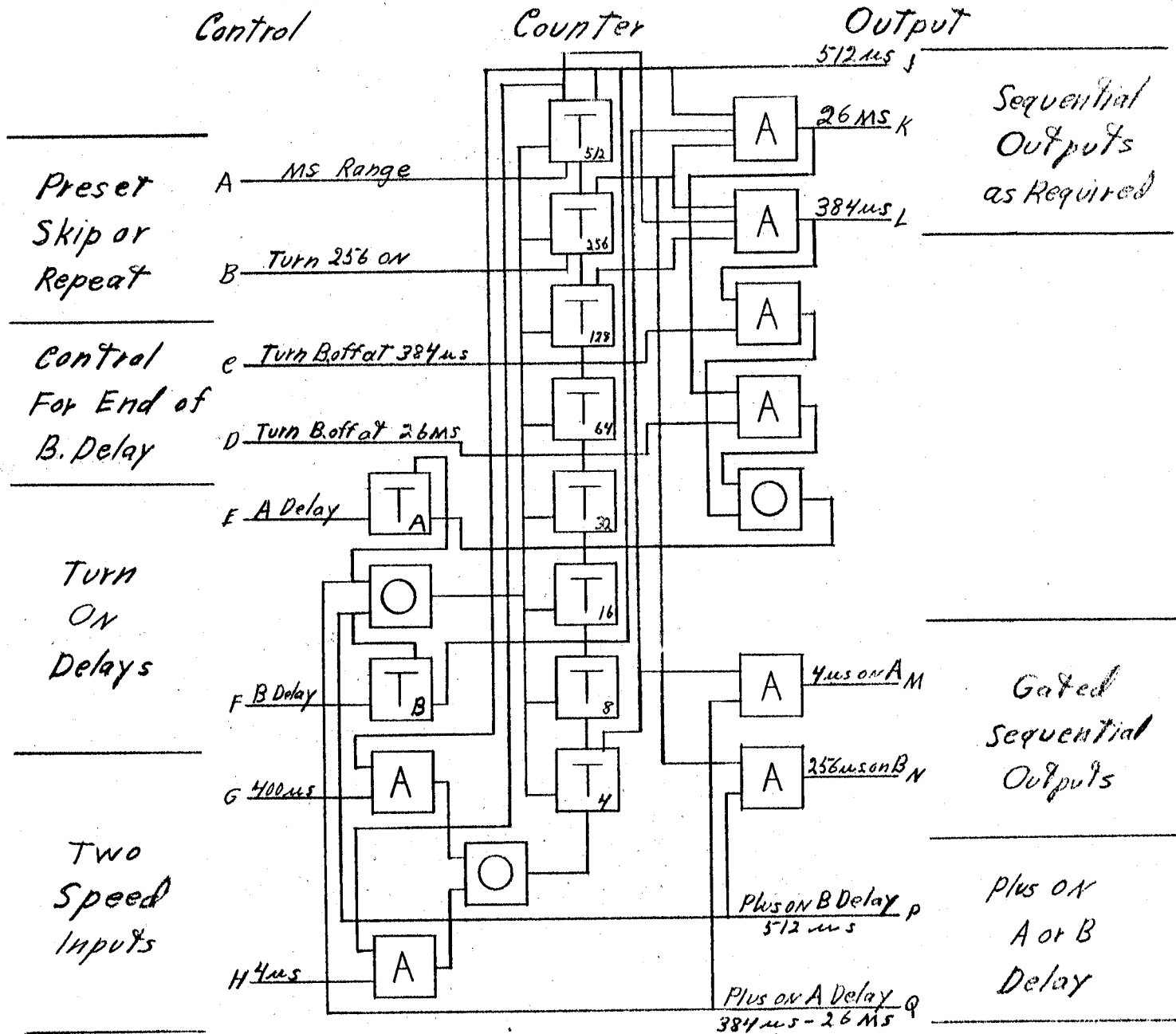
1. Replaces a Single-Shot with greater accuracy.
2. Replaces a Single-Shot with a greater range of duration.
3. Sequential counter outputs enable one delay to replace several consecutively operating Single Shots.
4. One delay counter with the outputs gated by the nature of the delay can replace many individually operating Single -Shots.
5. Presetting the counter permits external control over the operating speed and the total duration of the delay.
6. Turning ON or OFF the counter triggers permits external conditions to control the skip or repeat of certain phases of the delay operation.
7. The turnoff time of the Delay trigger can be externally selected to facilitate additional control over the total duration and the sequential outputs.



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Multi-Control Delay and Sequencing System



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