NASA TECH BRIEF

Coincident Switch Closing Reduces Error in Motor-Driven Timer

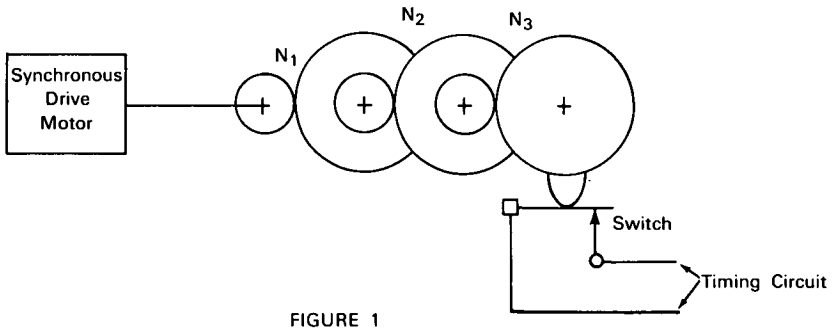

FIGURE 1

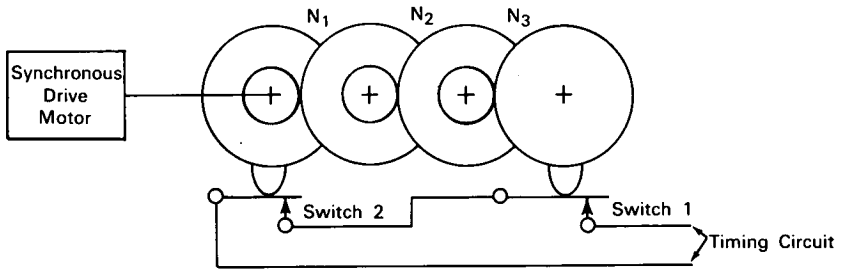

FIGURE 2

The problem: Conventional motor-driven timing devices depend on a gear train to time a cam that closes and opens a switch. Because of the inherent lag-lead nature of the last member of a gear train, the cam dwell angle is affected and the precise moment of switch closure varies in proportion to the lag-lead factor.

The solution: The extension of the timing circuit to include a second switch actuated in time with the first but driven directly at a speed x times faster than the first.

How it's done: A conventional electromechanical timing device is shown in figure 1. In this configuration, the switch closure variable can be expressed in terms of cam dwell angle θ (the angular period during which the cam holds the switch closed) in degrees, or time ($T = N_1N_2N_3\theta/360A$ minutes) where: $N_1N_2N_3$ are the gear ratios. A is the speed in revolutions per minute of the drive motor. By extending the timing circuit to include an additional switch and cam as shown in figure 2, the timing error T is appreciably reduced. By synchronizing the cams so that switch 1 closes prior to a closure of switch 2 and remains closed

(continued overleaf)

during that closure of switch 2, the circuit closure variable is limited to that occurring in switch 2. This amounts to $T = \theta/360A$ minutes, the gear-train effect having been removed. Although switch 2 will close more times per unit time interval than switch 1 due to the effect of the gear train, overall timing function remains in switch 1.

Notes:

1. This method could be used to provide precision timing over a range of intervals limited only by the availability of gear train configurations and drive motor speeds.
2. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Jet Propulsion Laboratory
   4800 Oak Grove Drive
   Pasadena, California, 91103
   Reference: B63-10143

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

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(JPL-182)