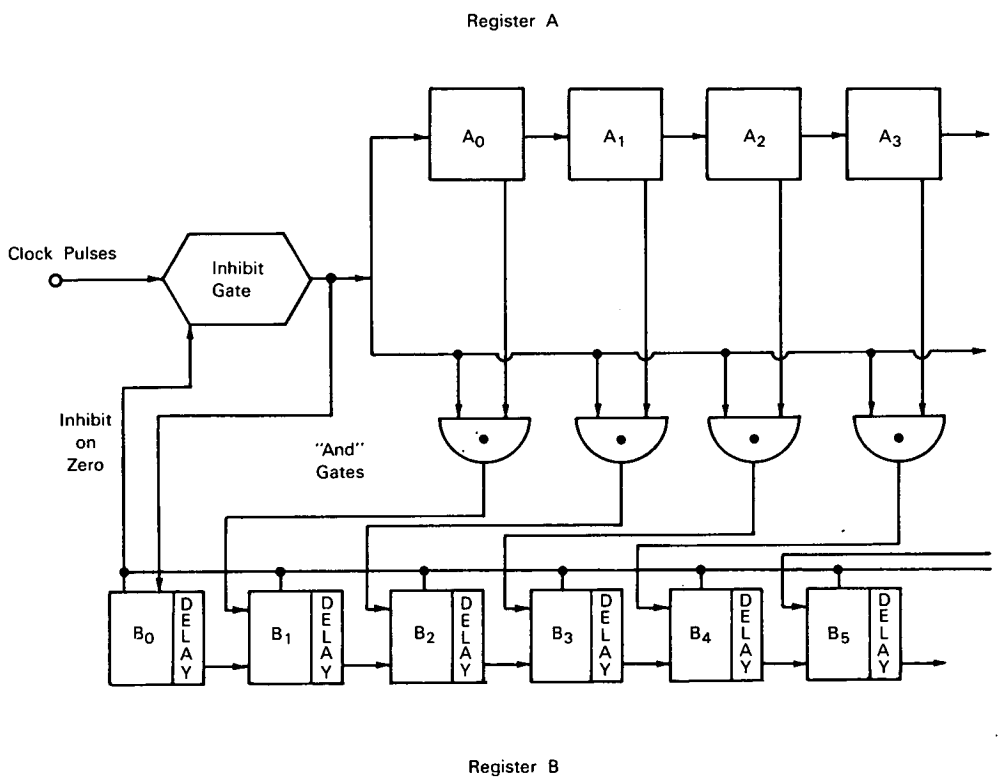
NASA TECH BRIEF

Delayed Ripple Counter Simplifies Square-Root Computation



The Problem: Simplifying the logic circuitry required in a binary computing device to derive the square root of a number. Prior circuitry has used analog methods, combinational logic matrices, or Newton approximation methods. The equipment required was not only complex, but required appreciable power.

The solution: Successively higher numbers are subtracted from a register containing the number out of which the square root is to be extracted. Using the ripple subtract technique, the last number subtracted will be the closest integer to the square root of the number.

How it's done: Register A is an ordinary counter. If it is started at zero, after n clock pulses it will contain the number n. Register B is also a binary counter, but it subtracts rather than adds when it is pulsed. A pulse fed to its first stage subtracts 1 from

(continued overleaf)

its contents, a pulse fed to its second stage subtracts 2 from its contents, a pulse to its third stage subtracts 4 from its contents, and so on. Output of the first stage of register A is fed to the second stage of register B, output of the second stage of register A to the third stage of register B, etc.

The contents of register A are initially set to zero and the contents of register B, the ripple subtract counter, are set to M. The clock pulses sequentially advance register A and at the same time subtract the contents of each stage of register A containing a "1" from the next stage of register B. When the contents of register B reach zero or a negative value, the clock pulses are inhibited and the value of the closest integer to the square root of M is read from register A.

Notes:

1. This circuit could be combined with a small computing device (such as a desk-top calculator that uses ripple adding counters) to provide square-root capabilities.
2. This circuit could be used to speed root mean square computations and to perform coordinate transformations.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B65-10343

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

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