COMPANY CONFIDENTIAL

PROJECT STRETCH
FILE MEMO NO. 53

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Subject: Time Clock

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In a real-time system, there is a need to be able to refer to the actual time of day, for a number of reasons:

1) To permit control of external processes on the basis of time.
2) To permit the machine to measure elapsed time.
3) To avoid the need to send time data repeatedly over long lines.
4) To permit breaking into programs at specified times.
5) To permit the machine to re-establish conditions automatically when there has been a power interruption, either planned or unplanned.
6) To allow the machine to turn itself off and on automatically when continuous operation is not required.

It is proposed to have two clocks in the machine: a built-in internal clock and an optional external clock.

The internal clock is intended to measure elapsed time over a relatively short time interval, such as a minute or less. It consists of a binary counting register which is automatically stepped down by pulses from a reasonably stable internal oscillator. The register can at any time, by means of instructions, be

a) read out,
b) reset to ones (for continuous time readings), or
c) set to a desired value (for elapsed time indication).

Whenever the register is stepped to zero, a program break-in is initiated, but the register keeps going.

No attempt is made to correct the internal clock for long-term drifts. Only short-term stability is desired.

The counting register might be 20 bits long, driven by an oscillator operating at 16, 384 ($2^{14}$) cycles per second. The fifteenth stage from the right then measures time in seconds. A full cycle would be 64 seconds, or a little over a minute.

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While the DELTA Computer operates on a much faster schedule than the suggested period of 61 microseconds, the finite program time needed to execute a break-in and to set the block again probably does not justify any greater precision in time.

The external clock is a more conventional clock and a completely separate device. It would be driven from an independent supply of energy, guaranteed to be free of interruptions. It would be regulated in a conventional manner to whatever accuracy is desired.

The external clock has a digital read-out which, on request from the computer, enters the current reading over the regular input system. It also has an "alarm" register which can be set to any value of time by the computer using the regular output channels. Whenever the alarm register contents coincide with the clock time, a program break-in signal is sent to the computer. If the power was off on the computer, the coincidence signal would operate the power-on circuits; the computer would start operating at a standard instruction counter setting. The circuit remains closed until the computer power actually goes on.

For convenience, the external clock would probably be calibrated in hours, minutes and seconds. The alarm register would also be settable by hand.

No more than a 12-hour clock is needed unless the computer is to remain off for more than 12 hours with automatic restarting. Otherwise, it is assumed that the computer will be programmed to compute AM-PM, day, week, month, year, and leap year automatically. The computer will also handle all alarm sequencing.

The external clock is also used to provide a reference standard for the internal clock. This overcomes long-term drifts of the internal clock and permits the internal block to be set for elapsed time indication without concern for the lack of continuity.