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Review of Research and Development in Fluid Logic Elements

A report has been prepared that reviews, historically and critically, the present state of research and development in multistate fluid elements. The report concludes that the development of fluid amplifiers is at the crossroads in that there are elements with very high gain and poor switching speed, and other elements with very high switching speed and poor gain. The former elements have been conventionally classed as active, while the latter have been classed as passive. In the light of recent advances, however, this distinction has become less meaningful. It is now anticipated that there will be a synthesis of active and passive principles so that speed may be combined with adequate gain.

The report considers four classes of multistate elements:

1. Multilevel with memory
2. Multilevel without memory
3. Multioutput with memory
4. Multioutput without memory

Tests have shown that the only satisfactory elements which could be built were in classes 3 and 4. The class 3 element found at least one useful application, the asynchronous shift register, but was relatively slow. The class 4 element has, however, been shown to be a powerful logic element with a capacity for high speed and an insensitivity to small geometric variations not found in any other class of element. Tests carried out on class 4 elements suggest that operation at very low Reynolds numbers should be possible although insufficient quantitative data have been obtained to show what the lower limit might be.

It appears from these conclusions that future investigations should involve class 4 elements used in conjunction with amplifiers of moderate gain. Tests should be conducted on complex circuits to determine system reliability and speed. A parallel effort should be made to determine the scope of recent concepts in bionics in which it appears that limitations of speed may be overcome by asynchronous polymorphic logic in much the same manner that the brain apparently overcomes these limitations. Majority logic and variable threshold logic elements may be synthesized from the basic fluid elements that have been developed. It is now conceivable that miniature fluid elements may be integrated to form thousands of interconnecting "neurons" to perform that quasi-digital type of logic now associated with the brain. If this should prove feasible, the state of the art would be one step closer to the adaptive machine having high-order artificial intelligence.

Note:

Additional details are contained in: *Research and Development in Fluid Logic Elements,* by T. Reader, Sperry Rand Corporation, NASA CR-61029, December 1964. Copies are available from:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D. C. 20546.

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Category 01