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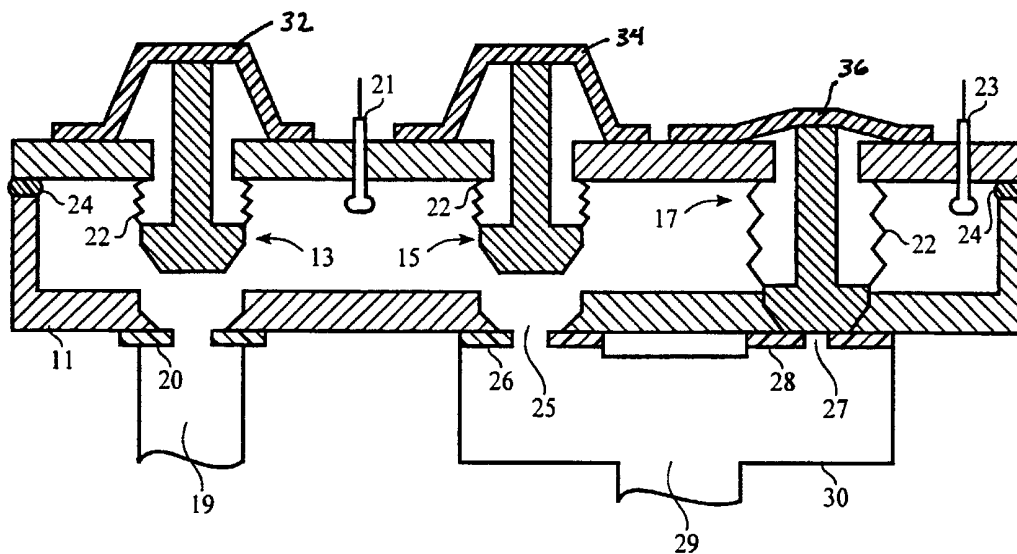
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(54) Title: MINIATURE PULSATILE FLOW CONTROLLER



(57) Abstract: A method of controlling gaseous mass flow using a miniature flow controller comprising a fluid inlet (19) and a fluid outlet (29), with the inlet pressure exceeding the outlet pressure. The outlet (29) has orifices (25, 27) defined in a crystalline silicon membrane, along crystal planes of the silicon, so that the geometry of the orifices (25, 27) is precisely known. The inlet (19) and outlet (29) are sealed by poppets (13, 15, 17) upon command of a device controller (31) through energization of shape retentive membranes (32, 24, 36). Rapid actuation of the poppets results in a pulse mode of operation of the valve. By recording pressure and temperature in the chamber as the poppets are actuated, mass flow rate of a gas through the outlet orifice is computed.



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# INTERNATIONAL SEARCH REPORT

International application No.  
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**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) : F16K 31/02  
US CL : 137/487.5

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 137/487.5, 1, 8, ; 251/129.05

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,706,703 A (TAKEUCHI et al.) 17 November 1987, see entire document.	1 - 2 -
A	US 5,038,821 A (MAGET) 13 August 1991, see entire document.	1 - 2
A	US 5,176,358 A (BONNE et al.) 05 January 1993, see entire document.	1 - 2
A	US 5,417,235 A (WISE et al.) 23 May 1995, see entire document.	1 - 2
A	US 5,487,378 A (ROBERTSON et al.) 30 January 1996, see Col. 11, lines 21 - 40.	1 - 2
A	US 6,032,689 A (TSAI et al.) 07 March 2000, see entire document.	1 - 2

Further documents are listed in the continuation of Box C.       See patent family annex.

<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y, P	US 6,062,256 A (MILLER et al.) 16 May 2000, see entire document.	1 - 2