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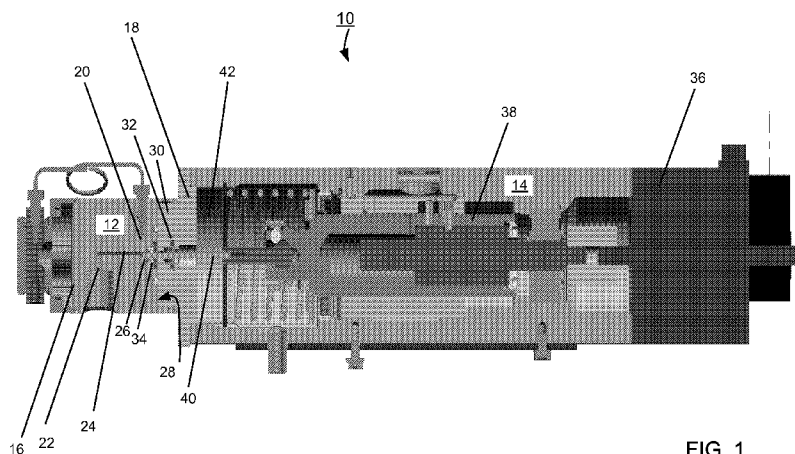


FIG. 1

(57) Abstract: Disclosed is a system and method of cooling a pump head by transferring heat to the actuator body, which is joined to the pump head via a support plate. In some embodiments the heat transfer is accomplished by means of two conductive plates, one placed on either side of the support plate between it and the pump head and actuator body. In some embodiments the heat transfer is controlled by a thermoelectric device. Also disclosed is a second system and method of cooling fluid to move through a pump head by pre-chilling it.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 12/28246

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - F04B 53/08 (2012.01)
USPC - 417/366

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)
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USPC - 417/366; 73/23.35, 23.42; 210/167.32, 175, 176, 188, 198.2, 656, 659

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST (PGPB, USPT, EPAB, JPAB); Google (Patents, Scholar, Web)
Search Terms: Pump, head, cool, chill, reduce, lower, temperature, actuator, support, plate, thermal, heat, opposite, transmit, transfer, pressure, pre-chill, pre-cool, conductive, pair, two, multiple, many, plural, thermoelectric, interior, inside, within, internal, plunger, insulat

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X =====	US 6,294,088 B1 (ALLINGTON et al.) 25 September 2001 (25.09.2001) Fig. 3-5; col 23, ln 36-59	14, 18 =====
Y =====		15 =====
A		1-13, 16-17, 28
X =====	US 5,180,293 A (HARTL et al.) 19 January 1993 (19.01.1993) Fig. 3; col 1, ln 7-28, col 3, ln 17-64	14, 18, 30-32 =====
Y =====		19-27, 29, 33-42, 45-47 =====
A		1-13, 16-17, 28
X =====	US 5,393,434 A (HUTCHINS et al.) 28 February 1995 (28.02.1995) Fig. 1-6; col 1, ln 8-11, col 4, ln 44 to col 5, ln 36, col 8, ln 33 to col 9, ln 68	14, 18 =====
Y =====		19-27, 29, 45-47 =====
A		1-13, 16-17, 28
Y	US 5,625,152 A (PANDORF et al.) 29 April 1997 (29.04.1997) Fig. 2A; col 6, ln 24 to col 7, ln 23	15
Y	US 4,990,250 A (HELLINGER) 05 February 1991 (05.02.1991) Abstract; Fig. 4; col 8, ln 27-56, col 9, ln 25-33	33-44

Further documents are listed in the continuation of Box C.

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

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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	US 4,813,987 A (CHUNG et al.) 21 March 1989 (21.03.1989) Fig. 2; col 3, ln 32 to col 4, ln 7	43-44
Y	US 2003/0215341 A1 (MAIEFSKI et al.) 20 November 2003 (20.11.2003) Abstract; Fig. 1-3;	20-23
=====	Para [0029]-[0030]	=====
A		28
Y	US 2002/0083733 A1 (ZHANG et al.) 04 July 2002 (04.07.2002) Fig. 2, 6-7; Para [0049], [0052]	26
A	US 2010/0241076 A1 (RUSH et al.) 23 September 2010 (23.09.2010) Fig. 1A-2C; Para [0024- [0029], [0032]-[0035]	1-13, 16-17
A	US 2005/0115242 A1 (CONRAD) 02 June 2005 (02.06.2005) Fig. 1; Para [0014]-[0016]	1-13, 16-17