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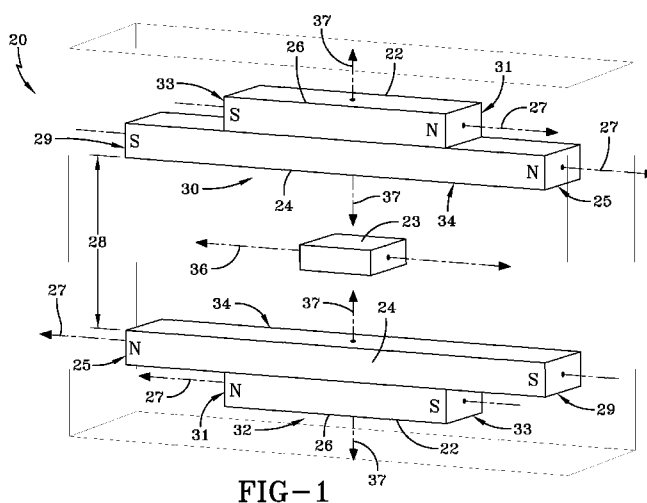


FIG-1

(57) Abstract: A linear motion sensor has two pairs of opposed spaced apart stacks of two simple two-pole bar magnets. Each stack has one shorter outer magnet and one longer inner magnet, with the outer magnets centered on the inner magnets. The poles of the magnets are oriented the same in each pair, but opposite with respect to the other pair. The shape of the magnets results in the magnetic fields produced by each pair of magnets being substantially outside of the magnets themselves, so that the load line for the combined magnets is above the knee in its B/H material demagnetization curve. The pairs of magnets define a gap therebetween in which a magnetic field sensor is mounted for travel. The shorter magnets are about one half the length of the longer magnets such that the magnetic field in the gap varies substantially linearly as the sensor moves along the gap.

A. CLASSIFICATION OF SUBJECT MATTER**G01B 7/14(2006.01)i, G01D 5/12(2006.01)i, G01R 33/02(2006.01)i, G01B 7/004(2006.01)i**

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords:sensor, position, magnet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2007-0096723 A1 (RYAN W. RIEGR et al.) 03 May 2007 See the whole document	1-20
A	WO 95-10020 A1 (THE GOVERNMENT OF THE UNITED STATES OF AMERICA, REPRESENTED BY THE SECRETARY OF THE NAVY) 13 April 1995 See the whole document	1-20
A	US 2007-0103343 A1 (MARIO RECIO et al.) 10 May 2007 See the whole document	1-20
A	WO 02-21080 A1 (CTS CORPORATION) 14 March 2002 See the whole document	1-20
A	US 5642043 A1 (KO CLYDE et al.) 24 June 1997 See the whole document	1-20
A	US 2006-0061353 A1 (KURT ETHERINGTON et al.) 23 March 2006 See the whole document	1-20



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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007-0096723 A1	03.05.2007	US 7355389 B2	08.04.2008
WO 95-10020 A1	13.04.1995	CA 2173223-A1	13.04.1995
		DE 69425063 D1	03.08.2000
		DE 69425063 T2	02.11.2000
		EP 0721563 A1	13.10.1999
		EP 0721563 A1	17.07.1996
		EP 0721563 A4	28.01.1998
		EP 0721563 B1	28.06.2000
		JP 09-505393 A	27.05.1997
		JP 9505393 T	27.05.1997
		KR 10-0308460 B1	02.07.2002
		US 5475304 A1	12.12.1995
US 2007-0103343 A1	10.05.2007	US 2007-103343 A1	10.05.2007
		US 7215112 B1	08.05.2007
WO 02-21080 A1	14.03.2002	CA 2399328-A1	14.03.2002
		EP 1008835 A1	14.06.2000
		EP 1008835 B1	16.04.2003
		EP 1317655 A1	11.06.2003
		EP 1332279 A2	06.08.2003
		EP 1332279 B1	22.10.2008
		JP 03-455706 B2	25.07.2003
		JP 04-022146 B2	12.12.2007
		JP 2000-180114 A	30.06.2000
		JP 2004-508562 A	18.03.2004
		JP 2004-508562 T	18.03.2004
		JP 2005-500197 A	06.01.2005
		JP 3455706 B2	14.10.2003
		US 2002-0175676 A1	28.11.2002
		US 2003-0112003 A1	19.06.2003
		US 6211668 B1	03.04.2001
		US 6304078 B1	16.10.2001
		US 6426619 B1	30.07.2002
		US 6515473 B2	04.02.2003
		US 6809512 B2	26.10.2004
		WO 02-38930 A2	16.05.2002
		WO 02-38930 A3	16.05.2002
US 5642043 A1	24.06.1997	EP 0378402 A1	18.07.1990
		EP 0378402 B1	06.04.1994
		EP 0592849 A1	20.04.1994
		EP 0592849 B1	03.04.1996
		JP 02-264814 A	29.10.1990
		US 05642043A A	24.06.1997
		US 2001-0005803 A1	28.06.2001
		US 2002-0035423 A1	21.03.2002
		US 5036275 A1	30.07.1991

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2010/036826

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		US 5210490 A1	11.05.1993
		US 5216364 A1	01.06.1993
		US 5369375 A1	29.11.1994
		US 5619133 A1	08.04.1997
		US 5811967 A1	22.09.1998
		US 6356075 B1	12.03.2002
		US 6418363 B2	09.07.2002
		US 6470248 B2	22.10.2002
US 2006-0061353 A1	23.03.2006	EP 1548408 A2	29.06.2005
		EP 1548408 A3	11.04.2007
		US 2005-0134257 A1	23.06.2005
		US 6992478 B2	31.01.2006
		US 7088096 B2	08.08.2006