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(54) Title: X-RAY REDUCTION SYSTEM

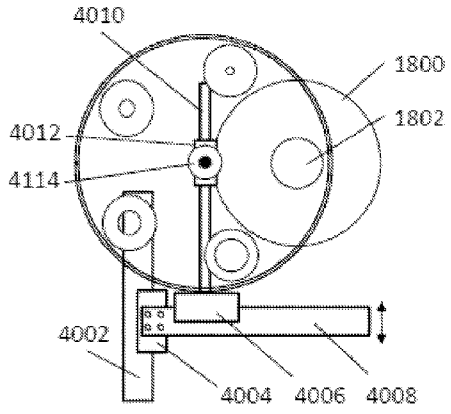

Figure 41B

(57) Abstract: A multiple frames imaging system is disclosed with capability of differential x-ray exposure of different input areas of an image intensifier or other x-ray detector. Collimators are provided to control the amount of radiation in various regions of the image and image processing is provided to provide the display of images of different qualities. Motion methods are provided to move the collimators to produce optimal image frames.

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A. CLASSIFICATION OF SUBJECT MATTER
IPC (2015.01) G21K 1/02, G21K 5/04, A61N 5/10

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)
IPC (2015.01) G21K

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)
Databases consulted: THOMSON INNOVATION, Esp@cenet
Search terms used: X-ray, collimator, aperture/slit/hole, thickness, disk/plate, filament, adjustable, rotatable, translatable, moving.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7983391 B2 Machan et.al. 19 Jul 2011 (2011/07/19) The entire document.	1,6,9,10,17,21,24, 25,30
Y	The entire document.	2-5,7,8,11-16,18-20, 22,23,31-37
X	US 5305363 A Burke et.al. 19 Apr 1994 (1994/04/19) The entire document.	38-40
Y	US 2010/0119036 A1 Muller 13 May 2010 (2010/05/13) The entire document.	1-37
Y	US 4970398 A Scheid 13 Nov 1990 (1990/11/13) The entire document.	1-25,30-37

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"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)
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"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 Jan 2015	26 Jan 2015
Name and mailing address of the ISA: Israel Patent Office Technology Park, Bldg.5, Malcha, Jerusalem, 9695101, Israel Facsimile No. 972-2-5651616	Authorized officer SIGALOV Olga Telephone No. 972-2-5651781

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2014/063371

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 2003/0016790 A1 Grodzins et.al. 23 Jan 2003 (2003/01/23) Paragraphs [0059]-[0064], claims 1-4, figs. 3A-3B	26-29
X	US 5604353 A Gibson et.al. 18 Feb 1997 (1997/02/18) Column 5, lines 58-60, column 6, lines 13-14, column 7, lines 10-11, figs. 4, 8.	41,42
Y	Column 5, lines 58-60, column 6, lines 13-14, column 7, lines 10-11, figs. 4, 8.	43,44

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet):

* This International Searching Authority found multiple inventions in this international application, as follows:

Invention/s 1	A multiple frame imaging system comprising a collimator that comprises a pair of plates mounted in planes parallel to detector input surface plane, each plate has an elongated aperture; and means for moving each one of said plates independently in its plane.	Claim/s 1-25,30-37
Invention/s 2	A collimator system comprising a round collimator comprising aperture that allows radiation to pass through, an outer annulus that reduces the radiation passing through at an amount depending on the material and the thicknes of said outer annulus and an inner annulus between said aperture and said outer annulus, said inner annulus having changing thickness; and a means for moving said collimator in 2-dimensional plane.	Claim/s 26-29
Invention/s 3	A multiple frame imaging system comprising an multiple filaments or x-ray tubes or multiple rotating/translating cathodesand/or anodes.	Claim/s 38-40
Invention/s 4	A variable aperture collimator system comprising a round aperture and an aperture changing mechanism. The aperture changing mechanism comprises a radiation transparent body with a plurality of radiation attenuating disks, each disk having diameter similar to the diameter of said round aperture and an aperture of a diameter smaller than the diameter of said round aperture.	Claim/s 41-44

INTERNATIONAL SEARCH REPORT
Information on patent family members

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Patent document cited search report	Publication date	Patent family member(s)	Publication Date
US 5305363 A	19 Apr 1994	US 5305363 A	19 Apr 1994
		DE 4425021 A1	09 Feb 1995
		DE 4425021 B4	26 Jan 2006
		DE 69213202 D1	02 Oct 1996
		DE 69213202 T2	23 Jan 1997
		DE 69221280 D1	04 Sep 1997
		DE 69221280 T2	04 Dec 1997
		DE 69221281 D1	04 Sep 1997
		DE 69221281 T2	04 Dec 1997
		DE 69322303 D1	14 Jan 1999
		DE 69322303 T2	20 May 1999
		DE 69323049 D1	25 Feb 1999
		DE 69323049 T2	27 May 1999
		DE 69326496 D1	28 Oct 1999
		DE 69326496 T2	03 Feb 2000
		DE 69411520 D1	13 Aug 1998
		DE 69411520 T2	05 Nov 1998
		DE 69505926 D1	17 Dec 1998
		DE 69505926 T2	08 Apr 1999
		DE 69518870 D1	26 Oct 2000
		DE 69518870 T2	01 Mar 2001
		DE 69521108 D1	05 Jul 2001
		DE 69521108 T2	15 Nov 2001
		EP 0550981 A1	14 Jul 1993
		EP 0550981 B1	30 Jul 1997
		EP 0550982 A1	14 Jul 1993
		EP 0550982 B1	30 Jul 1997
		EP 0550983 A1	14 Jul 1993
		EP 0550983 B1	28 Aug 1996
		EP 0564292 A2	06 Oct 1993
		EP 0564292 A3	15 Mar 1995

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2014/063371

Patent document cited search report	Publication date	Patent family member(s)	Publication Date
		EP 0564292 B1	02 Dec 1998
		EP 0564293 A1	06 Oct 1993
		EP 0564293 B1	22 Sep 1999
		EP 0601717 A1	15 Jun 1994
		EP 0601717 B1	13 Jan 1999
		EP 0657915 A1	14 Jun 1995
		EP 0657915 B1	08 Jul 1998
		EP 0676911 A1	11 Oct 1995
		EP 0676911 B1	20 Sep 2000
		EP 0701391 A1	13 Mar 1996
		EP 0701391 B1	11 Nov 1998
		EP 0715333 A1	05 Jun 1996
		EP 0715333 B1	30 May 2001
		EP 1087419 A2	28 Mar 2001
		EP 1087419 A3	07 Jan 2004
		JP H05275038 A	22 Oct 1993
		JP 3451557 B2	29 Sep 2003
		JP H05275036 A	22 Oct 1993
		JP 3455917 B2	14 Oct 2003
		JP H0684488 A	25 Mar 1994
		JP 3517664 B2	12 Apr 2004
		JP H0613008 A	21 Jan 1994
		JP 3559974 B2	02 Sep 2004
		JP H07282989 A	27 Oct 1995
		JP 3610375 B2	12 Jan 2005
		JP H0622947 A	01 Feb 1994
		JP 3622057 B2	23 Feb 2005
		JP H06223749 A	12 Aug 1994
		JP 3723904 B2	07 Dec 2005
		JP H0888093 A	02 Apr 1996
		JP 3726145 B2	14 Dec 2005

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2014/063371

Patent document cited search report	Publication date	Patent family member(s)	Publication Date
		JP H07201489 A	04 Aug 1995
		JP 4028601 B2	26 Dec 2007
		JP H08222395 A	30 Aug 1996
		US 5200985 A	06 Apr 1993
		US 5241577 A	31 Aug 1993
		US 5268955 A	07 Dec 1993
		US 5274690 A	28 Dec 1993
		US 5291538 A	01 Mar 1994
		US 5384820 A	24 Jan 1995
		US 5438605 A	01 Aug 1995
		US 5475729 A	12 Dec 1995
		US 5493599 A	20 Feb 1996
		US 5581591 A	03 Dec 1996
US 7983391 B2	19 Jul 2011	US 2010272238 A1	28 Oct 2010
		US 7983391 B2	19 Jul 2011
		US 2011075805 A1	31 Mar 2011
		US 8693628 B2	08 Apr 2014
US 2010/0119036 A1	13 May 2010	US 2010119036 A1	13 May 2010
		US 8130901 B2	06 Mar 2012
		CN 101668483 A	10 Mar 2010
		CN 101668483 B	15 Feb 2012
		EP 2139398 A1	06 Jan 2010
		FI 20070221 A	20 Sep 2008
		FI 122093 B	31 Aug 2011
		JP 2010533507 A	28 Oct 2010
		JP 5220774 B2	26 Jun 2013
		KR 20090127423 A	11 Dec 2009
		KR 101160791 B1	27 Jun 2012
		WO 2008113715 A1	25 Sep 2008

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2014/063371

Patent document cited search report	Publication date	Patent family member(s)	Publication Date
US 4970398 A	13 Nov 1990	US 4970398 A	13 Nov 1990
		CA 2008845 A1	05 Dec 1990
		EP 0403135 A2	19 Dec 1990
		EP 0403135 A3	27 Feb 1991
		IL 94414 D0	10 Mar 1991
		JP H0382984 A	08 Apr 1991
US 2003/0016790 A1	23 Jan 2003	US 2003016790 A1	23 Jan 2003
		US 7010094 B2	07 Mar 2006
		AT 384965 T	15 Feb 2008
		AT 541226 T	15 Jan 2012
		AU 2003291288 A1	03 Jun 2004
		AU 2003291288 B2	03 Dec 2009
		CA 2504500 A1	27 May 2004
		CA 2504500 C	10 Jan 2012
		CN 1441914 A	10 Sep 2003
		CN 1268940 C	09 Aug 2006
		CN 1556921 A	22 Dec 2004
		CN 1318841 C	30 May 2007
		CN 101379415 A	04 Mar 2009
		CN 101379415 B	17 Jul 2013
		DE 60132556 D1	13 Mar 2008
		DE 60132556 T2	29 Jan 2009
		DK 1254384 T3	02 Jun 2008
		DK 1558947 T3	27 Feb 2012
		EP 1254384 A1	06 Nov 2002
		EP 1254384 B1	23 Jan 2008
		EP 1269166 A2	02 Jan 2003
		EP 1558947 A2	03 Aug 2005
		EP 1558947 B1	11 Jan 2012

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2014/063371

Patent document cited search report	Publication date	Patent family member(s)	Publication Date
		EP 1949139 A2	30 Jul 2008
		EP 2275839 A2	19 Jan 2011
		EP 2275839 A3	02 Nov 2011
		ES 2298220 T3	16 May 2008
		ES 2379653 T3	30 Apr 2012
		HK 1080947 A1	19 Oct 2012
		IL 168371 A	31 Aug 2011
		IL 213892 D0	31 Jul 2011
		IL 213892 A	31 Jul 2013
		JP 2006505805 A	16 Feb 2006
		JP 2011017709 A	27 Jan 2011
		JP 2011085593 A	28 Apr 2011
		KR 20100119813 A	10 Nov 2010
		KR 101171598 B1	10 Aug 2012
		KR 20050071663 A	07 Jul 2005
		MX PA05004803 A	17 Nov 2005
		NO 20052685 A	03 Jun 2005
		NO 20052685 D0	03 Jun 2005
		NZ 539824 A	30 Nov 2007
		NZ 562090 A	30 Apr 2009
		PT 1254384 E	30 Apr 2008
		PT 1558947 E	05 Mar 2012
		RU 2005117607 A	27 Oct 2005
		RU 2334219 C2	20 Sep 2008
		RU 2008120694 A	10 Dec 2009
		RU 2418291 C2	10 May 2011
		SI 1558947 T1	31 May 2012
		UA 90081 C2	12 Apr 2010
		US 6459761 B1	01 Oct 2002
		US 2004086078 A1	06 May 2004
		US 7099434 B2	29 Aug 2006

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2014/063371

Patent document cited search report	Publication date	Patent family member(s)	Publication Date
		US 7218704 B1	15 May 2007
		US 2007269005 A1	22 Nov 2007
		US 7505556 B2	17 Mar 2009
		US 2008111080 A1	15 May 2008
		US 7538325 B2	26 May 2009
		US 2007098142 A1	03 May 2007
		US 7551715 B2	23 Jun 2009
		US 2011075808 A1	31 Mar 2011
		US 8194822 B2	05 Jun 2012
		US 2009175412 A1	09 Jul 2009
		US 8325871 B2	04 Dec 2012
		US 2002094059 A1	18 Jul 2002
		US 2003165211 A1	04 Sep 2003
		US 2004256565 A1	23 Dec 2004
		US 2005105665 A1	19 May 2005
		US 2005117683 A1	02 Jun 2005
		US 2006251211 A1	09 Nov 2006
		US 2008211431 A1	04 Sep 2008
		US 2009257555 A1	15 Oct 2009
		US 2012236990 A1	20 Sep 2012
		US 2013039453 A1	14 Feb 2013
		US 2013343520 A1	26 Dec 2013
		WO 0159485 A1	16 Aug 2001
		WO 0159485 A9	24 Oct 2002
		WO 0173415 A2	04 Oct 2001
		WO 0173415 A3	27 Jun 2002
		WO 03012414 A1	13 Feb 2003
		WO 03075037 A1	12 Sep 2003
		WO 2004043740 A2	27 May 2004
		WO 2004043740 A3	14 Apr 2005
		WO 2007051092 A2	03 May 2007

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2014/063371

Patent document cited search report	Publication date	Patent family member(s)	Publication Date
		WO 2007051092 A3	23 Aug 2007
		WO 2008121820 A2	09 Oct 2008
		WO 2008121820 A3	04 Dec 2008
US 5604353 A	18 Feb 1997	US 5604353 A	18 Feb 1997
		AU 6383996 A	09 Jan 1997
		CN 1192821 A	09 Sep 1998
		CN 1147876 C	28 Apr 2004
		DE 69619671 D1	11 Apr 2002
		DE 69619671 T2	12 Sep 2002
		DK 0832491 T3	17 Jun 2002
		EP 0832491 A1	01 Apr 1998
		EP 0832491 A4	29 Jul 1998
		EP 0832491 B1	06 Mar 2002
		JP H11502933 A	09 Mar 1999
		JP 3069865 B2	24 Jul 2000
		KR 100256849 B1	15 May 2000
		WO 9642088 A1	27 Dec 1996