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(56) **References Cited**

U.S. PATENT DOCUMENTS

5,427,112	A	6/1995	Noren et al.	
5,433,198	A	7/1995	Desai	
5,450,846	A	9/1995	Goldreyer	
5,480,422	A	1/1996	Ben-Haim	
5,487,391	A	1/1996	Panescu	
5,582,173	A	12/1996	Li	
5,657,755	A	8/1997	Desai	
5,662,108	A	9/1997	Budd et al.	
5,687,737	A	11/1997	Branham et al.	
5,718,241	A	2/1998	Ben-Haim et al.	
5,795,303	A	8/1998	Swanson et al.	
5,817,134	A	10/1998	Greenhut et al.	
5,840,025	A	11/1998	Ben-Haim	
5,848,972	A	12/1998	Triedman et al.	
5,868,680	A	2/1999	Steiner et al.	
5,954,665	A	9/1999	Ben-Haim	
6,052,618	A	4/2000	Dahlke et al.	
6,066,094	A	5/2000	Ben-Haim	
6,115,628	A	9/2000	Stadler et al.	
6,188,924	B1	2/2001	Swanson et al.	
6,236,883	B1 *	5/2001	Ciaccio	A61B 5/04525 600/515
6,256,540	B1	7/2001	Panescu et al.	
6,301,496	B1	10/2001	Reisfeld	
6,360,121	B1	3/2002	Shoda	
6,522,905	B2	2/2003	Desai	
6,584,345	B2	6/2003	Govari	
6,847,839	B2	1/2005	Ciaccio et al.	
6,856,830	B2	2/2005	He	
6,892,091	B1	5/2005	Ben-Haim et al.	
6,920,350	B2	7/2005	Xue et al.	
6,941,166	B2	9/2005	MacAdam et al.	
6,959,212	B2	10/2005	Hsu et al.	
6,975,900	B2	12/2005	Rudy et al.	
6,978,168	B2	12/2005	Beatty et al.	
7,016,719	B2	3/2006	Rudy et al.	
7,043,292	B2	5/2006	Tarjan et al.	
7,117,030	B2	10/2006	Berenfeld et al.	
7,123,954	B2	10/2006	Narayan et al.	
7,206,630	B1	4/2007	Tarler	
7,245,962	B2	7/2007	Ciaccio et al.	
7,263,397	B2	8/2007	Hauck et al.	
7,283,865	B2	10/2007	Noren	
7,289,843	B2	10/2007	Beatty et al.	
7,328,063	B2	2/2008	Zhang et al.	
7,505,810	B2	3/2009	Harlev et al.	
7,515,954	B2	4/2009	Harlev et al.	
7,751,882	B1	7/2010	Helland	
7,761,142	B2	7/2010	Ghanem et al.	
7,761,150	B2	7/2010	Ghanem et al.	
7,907,994	B2	3/2011	Stolarski et al.	
7,930,018	B2	4/2011	Harlev et al.	
7,930,020	B2	4/2011	Zhang et al.	
8,165,666	B1	4/2012	Briggs et al.	
8,165,671	B2	4/2012	Freeman et al.	
8,175,702	B2	5/2012	Efimov et al.	
8,521,266	B2 *	8/2013	Narayan	A61B 5/046 600/515
8,594,777	B2	11/2013	Briggs et al.	
8,639,325	B2	1/2014	Efimov et al.	
8,676,303	B2	3/2014	Narayan	
8,700,140	B2	4/2014	Narayan et al.	
8,838,222	B2 *	9/2014	Narayan	A61B 5/046 600/515
8,838,223	B2 *	9/2014	Narayan	A61B 5/046 600/515
2002/0010392	A1	1/2002	Desai	
2003/0236466	A1	12/2003	Tarjan	
2004/0073262	A1	4/2004	Lovett	
2004/0243012	A1 *	12/2004	Ciaccio	A61B 5/04011 600/509
2005/0148892	A1	7/2005	Desai	
2005/0203502	A1	9/2005	Boveja et al.	
2006/0084970	A1	4/2006	Beatty et al.	
2006/0161206	A1 *	7/2006	Efimov	A61B 5/0402 607/5
2007/0055167	A1	3/2007	Bullinga	
2007/0208260	A1	9/2007	Afonso	
2007/0299351	A1	12/2007	Harlev et al.	
2008/0097539	A1	4/2008	Belalcazar et al.	
2008/0109041	A1	5/2008	de Voir	
2008/0114258	A1	5/2008	Zhang et al.	
2009/0069704	A1	3/2009	MacAdam et al.	
2009/0099468	A1	4/2009	Thiagalingam et al.	
2009/0112106	A1	4/2009	Zhang	
2009/0112110	A1	4/2009	Zhang	
2009/0112199	A1	4/2009	Zhang et al.	
2009/0177071	A1	7/2009	Harlev et al.	
2009/0177072	A1	7/2009	Harlev et al.	
2009/0299424	A1	12/2009	Narayan	
2010/0094274	A1	4/2010	Narayan	
2010/0204592	A1	8/2010	Hatib et al.	
2010/0217143	A1	8/2010	Whittington et al.	
2010/0239627	A1	9/2010	Whitekettle et al.	
2010/0298729	A1	11/2010	Zhang et al.	
2010/0305456	A1	12/2010	Brainard, II	
2011/0087121	A1	4/2011	Zhang et al.	
2011/0112425	A1	5/2011	Muhlsteff et al.	
2011/0130801	A1	6/2011	Maskara et al.	
2011/0196249	A1	8/2011	Staeuber et al.	
2011/0251505	A1	10/2011	Narayan	
2011/0257547	A1	10/2011	Zhang et al.	
2011/0282227	A1	11/2011	Zhang	
2012/0232417	A1	9/2012	Zhang et al.	
2012/0283579	A1	11/2012	Briggs et al.	
2013/0006131	A1	1/2013	Narayan et al.	
2013/0150740	A1	6/2013	Narayan et al.	
2013/0150742	A1	6/2013	Briggs et al.	
2013/0226016	A1	8/2013	Narayan et al.	
2013/0331718	A1	12/2013	Narayan et al.	
2014/0066787	A1	3/2014	Narayan et al.	
2014/0073981	A1	3/2014	Narayan et al.	
2014/0114204	A1	4/2014	Narayan et al.	
2014/0228696	A1	8/2014	Narayan et al.	
2014/0276152	A1	9/2014	Narayan et al.	

OTHER PUBLICATIONS

Houben, R.P.M., et al, "Automatic mapping of human atrial fibrillation by template matching", Heart Rhythm, vol. 3, No. 10, Oct. 1, 2006, pp. 1221-1228.

Nademanee, Koonlawee, et al., "A new approach for catheter ablation of atrial fibrillation: mapping of the electrophysiologic substrate", J. Amer.Coll.Cardiol., vol. 43, No. 11, Jun. 2, 2004, pp. 2044-2053.