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Expandable, angularly adjustable intervertebral cages

Abstract

The embodiments provide various interbody fusion spacers, or cages, for insertion between adjacent vertebrae. These intervertebral cages can restore and maintain intervertebral height of the spinal segment to be treated, and stabilize the spine by restoring sagittal balance and alignment. The cages may have a first, insertion configuration characterized by a reduced size at each of their insertion ends to facilitate insertion through a narrow access passage and into the intervertebral space. The cages may be expanded to a second, expanded size once implanted. In their second configuration, the cages are able to maintain the proper disc height and stabilize the spine by restoring sagittal balance and alignment. The intervertebral cages are configured to be able to adjust the angle of lordosis, and can accommodate larger lodortic angles in their second, expanded configuration. Further, these cages may promote fusion to further enhance spine stability by immobilizing the adjacent vertebral bodies.

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References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
1802560	12/1930	Kerwin	N/A	N/A
1924695	12/1932	Olson	N/A	N/A
1965653	12/1933	Kennedy	N/A	N/A
2077804	12/1936	Morrison	N/A	N/A
2115250	12/1937	Bruson	N/A	N/A
2121193	12/1937	Hanicke	N/A	N/A
2170111	12/1938	Bruson	N/A	N/A
2173655	12/1938	Neracher et al.	N/A	N/A
2229024	12/1940	Bruson	N/A	N/A
2243717	12/1940	Moreira	N/A	N/A
2381050	12/1944	Hardinge	N/A	N/A
2388056	12/1944	Hendricks	N/A	N/A
2485531	12/1948	William et al.	N/A	N/A
2489870	12/1948	Dzus	N/A	N/A
2570465	12/1950	Lundholm	N/A	N/A
2677369	12/1953	Knowles	N/A	N/A
2706701	12/1954	Hans et al.	N/A	N/A
2710277	12/1954	Shelanski et al.	N/A	N/A
2826532	12/1957	Hosmer	N/A	N/A
2900305	12/1958	Siggia	N/A	N/A
2977315	12/1960	Scheib et al.	N/A	N/A
3091237	12/1962	Skinner	N/A	N/A
3112743	12/1962	Cochran et al.	N/A	N/A
3115804	12/1962	Johnson	N/A	N/A
3228828	12/1965	Romano	N/A	N/A
3312139	12/1966	Di Cristina	N/A	N/A

3486505	12/1968	Morrison	N/A	N/A
3489143	12/1969	Halloran	N/A	N/A
3648294	12/1971	Shahrestani	N/A	N/A
3698391	12/1971	Mahony	N/A	N/A
3717655	12/1972	Godefroi et al.	N/A	N/A
3760802	12/1972	Fischer et al.	N/A	N/A
3800788	12/1973	White	N/A	N/A
3805775	12/1973	Fischer et al.	N/A	N/A
3811449	12/1973	Gravlee et al.	N/A	N/A
3842825	12/1973	Wagner	N/A	N/A
3848601	12/1973	Ma et al.	N/A	N/A
3855638	12/1973	Pilliar	N/A	N/A
3867728	12/1974	Stubstad et al.	N/A	N/A
3875595	12/1974	Froning	N/A	N/A
3889665	12/1974	Ling et al.	N/A	N/A
3964480	12/1975	Froning	N/A	N/A
3986504	12/1975	Avila	N/A	N/A
4013071	12/1976	Rosenberg	N/A	N/A
4052988	12/1976	Doddi et al.	N/A	N/A
4091806	12/1977	Aginsky	N/A	N/A
4105034	12/1977	Shalaby et al.	N/A	N/A
4130639	12/1977	Shalaby et al.	N/A	N/A
4140678	12/1978	Shalaby et al.	N/A	N/A
4141087	12/1978	Shalaby et al.	N/A	N/A
4175555	12/1978	Herbert	N/A	N/A
4205399	12/1979	Jamiolkowski et al.	N/A	N/A
4208511	12/1979	Jamiolkowski et al.	N/A	N/A
4236512	12/1979	Aginsky	N/A	N/A
4249435	12/1980	Smith et al.	N/A	N/A
4262665	12/1980	Roalstad et al.	N/A	N/A
4262676	12/1980	Jamshidi	N/A	N/A
4274163	12/1980	Malcom et al.	N/A	N/A
4275717	12/1980	Bolesky	N/A	N/A
4312337	12/1981	Donohue	N/A	N/A
4312353	12/1981	Shahbabian	N/A	N/A
4313434	12/1981	Segal	N/A	N/A
4341206	12/1981	Perrett et al.	N/A	N/A
4349921	12/1981	Kuntz	N/A	N/A
4350151	12/1981	Scott	N/A	N/A
4351069	12/1981	Ballintyn et al.	N/A	N/A
4352883	12/1981	Lim	N/A	N/A
4369790	12/1982	McCarthy	N/A	N/A
4399814	12/1982	Pratt et al.	N/A	N/A
4401112	12/1982	Rezaian	N/A	N/A
4401433	12/1982	Luther	N/A	N/A
4409974	12/1982	Freedland	N/A	N/A
4440921	12/1983	Allcock et al.	N/A	N/A
4449532	12/1983	Storz	N/A	N/A

4451256	12/1983	Weikl et al.	N/A	N/A
4456005	12/1983	Lichty	N/A	N/A
4462394	12/1983	Jacobs	N/A	N/A
4463753	12/1983	Gustilo	N/A	N/A
4466435	12/1983	Murray	N/A	N/A
4467479	12/1983	Brody	N/A	N/A
4488543	12/1983	Tornier	N/A	N/A
4488549	12/1983	Lee et al.	N/A	N/A
4494535	12/1984	Haig	N/A	N/A
4495174	12/1984	Allcock et al.	N/A	N/A
4532660	12/1984	Field	N/A	N/A
4537185	12/1984	Stednitz	N/A	N/A
4538612	12/1984	Patrick, Jr.	N/A	N/A
4542539	12/1984	Rowe et al.	N/A	N/A
4545374	12/1984	Jacobson	N/A	N/A
4562598	12/1985	Kranz	N/A	N/A
4573448	12/1985	Kambin	N/A	N/A
4595006	12/1985	Burke et al.	N/A	N/A
4601710	12/1985	Moll	N/A	N/A
4625722	12/1985	Murray	N/A	N/A
4625725	12/1985	Davison et al.	N/A	N/A
4627434	12/1985	Murray	N/A	N/A
4628945	12/1985	Johnson, Jr.	N/A	N/A
4629450	12/1985	Suzuki et al.	N/A	N/A
4630616	12/1985	Tretinyak	N/A	N/A
4632101	12/1985	Freedland	N/A	N/A
4640271	12/1986	Lower	N/A	N/A
4641640	12/1986	Griggs	N/A	N/A
4645503	12/1986	Lin et al.	N/A	N/A
4646741	12/1986	Smith	N/A	N/A
4651717	12/1986	Jakubczak	N/A	N/A
4653489	12/1986	Tronzo	N/A	N/A
4665906	12/1986	Jervis	N/A	N/A
4667663	12/1986	Miyata	N/A	N/A
4686973	12/1986	Frisch	N/A	N/A
4686984	12/1986	Bonnet	N/A	N/A
4688561	12/1986	Reese	N/A	N/A
4697584	12/1986	Haynes	N/A	N/A
4706670	12/1986	Andersen et al.	N/A	N/A
4714469	12/1986	Kenna	N/A	N/A
4714478	12/1986	Fischer	N/A	N/A
4721103	12/1987	Freedland	N/A	N/A
4723544	12/1987	Moore et al.	N/A	N/A
4743256	12/1987	Brantigan	N/A	N/A
4743257	12/1987	Toermaelae et al.	N/A	N/A
4759766	12/1987	Buettner-Janz et al.	N/A	N/A
4760843	12/1987	Fischer et al.	N/A	N/A
4772287	12/1987	Ray et al.	N/A	N/A
4790304	12/1987	Rosenberg	N/A	N/A

4790817	12/1987	Luther	N/A	N/A
4796612	12/1988	Reese	N/A	N/A
4802479	12/1988	Haber et al.	N/A	N/A
4815909	12/1988	Simons	N/A	N/A
4827917	12/1988	Brumfield	N/A	N/A
4834069	12/1988	Umeda	N/A	N/A
4834757	12/1988	Brantigan	N/A	N/A
4838282	12/1988	Strasser et al.	N/A	N/A
4858601	12/1988	Glisson	N/A	N/A
4862891	12/1988	Smith	N/A	N/A
4863476	12/1988	Shepperd	N/A	N/A
4870153	12/1988	Matzner et al.	N/A	N/A
4871366	12/1988	Von et al.	N/A	N/A
4873976	12/1988	Schreiber	N/A	N/A
4878915	12/1988	Brantigan	N/A	N/A
4880622	12/1988	Allcock et al.	N/A	N/A
4888022	12/1988	Huebsch	N/A	N/A
4888024	12/1988	Powlan	N/A	N/A
4889119	12/1988	Jamiolkowski et al.	N/A	N/A
4892550	12/1989	Huebsch	N/A	N/A
4896662	12/1989	Noble	N/A	N/A
4898186	12/1989	Ikada et al.	N/A	N/A
4898577	12/1989	Badger et al.	N/A	N/A
4903692	12/1989	Reese	N/A	N/A
4904261	12/1989	Dove et al.	N/A	N/A
4911718	12/1989	Lee et al.	N/A	N/A
4917554	12/1989	Bronn	N/A	N/A
4932969	12/1989	Frey et al.	N/A	N/A
4940467	12/1989	Tronzo	N/A	N/A
4941466	12/1989	Romano	N/A	N/A
4946378	12/1989	Hirayama et al.	N/A	N/A
4959064	12/1989	Engelhardt	N/A	N/A
4961740	12/1989	Ray et al.	N/A	N/A
4963144	12/1989	Huene	N/A	N/A
4966587	12/1989	Baumgart	N/A	N/A
4968317	12/1989	Toermaelae et al.	N/A	N/A
4969888	12/1989	Scholten et al.	N/A	N/A
4978334	12/1989	Toye et al.	N/A	N/A
4978349	12/1989	Frigg	N/A	N/A
4981482	12/1990	Ichikawa	N/A	N/A
4988351	12/1990	Paulos et al.	N/A	N/A
4994027	12/1990	Farrell	N/A	N/A
4995200	12/1990	Eberhart	N/A	N/A
5002557	12/1990	Hasson	N/A	N/A
5006121	12/1990	Hafeli	N/A	N/A
5011484	12/1990	Breard	N/A	N/A
5013315	12/1990	Barrows	N/A	N/A
5013316	12/1990	Goble et al.	N/A	N/A
5015247	12/1990	Michelson	N/A	N/A

5015255	12/1990	Kuslich	N/A	N/A
5019082	12/1990	Frey et al.	N/A	N/A
5030233	12/1990	Ducheyne	N/A	N/A
5051189	12/1990	Farrah	N/A	N/A
5053035	12/1990	McLaren	N/A	N/A
5055104	12/1990	Ray	N/A	N/A
5059193	12/1990	Kuslich	N/A	N/A
5062849	12/1990	Schelhas	N/A	N/A
5071435	12/1990	Fuchs et al.	N/A	N/A
5071437	12/1990	Steffee	N/A	N/A
5080662	12/1991	Paul	N/A	N/A
5084043	12/1991	Hertzmann et al.	N/A	N/A
5092891	12/1991	Kummer et al.	N/A	N/A
5098241	12/1991	Aldridge et al.	N/A	N/A
5098433	12/1991	Freedland	N/A	N/A
5098435	12/1991	Stednitz et al.	N/A	N/A
5102413	12/1991	Poddar	N/A	N/A
5108404	12/1991	Scholten et al.	N/A	N/A
5114407	12/1991	Burbank	N/A	N/A
5116336	12/1991	Frigg	N/A	N/A
5120171	12/1991	Lasner	N/A	N/A
5122130	12/1991	Keller	N/A	N/A
5122133	12/1991	Evans	N/A	N/A
5122141	12/1991	Simpson et al.	N/A	N/A
5123926	12/1991	Pisharodi	N/A	N/A
5133719	12/1991	Winston	N/A	N/A
5133755	12/1991	Brekke	N/A	N/A
5134477	12/1991	Knauer et al.	N/A	N/A
5139486	12/1991	Moss	N/A	N/A
5147366	12/1991	Arroyo et al.	N/A	N/A
5158543	12/1991	Lazarus	N/A	N/A
5163939	12/1991	Winston	N/A	N/A
5163989	12/1991	Campbell et al.	N/A	N/A
5167663	12/1991	Brumfield	N/A	N/A
5167664	12/1991	Hodorek	N/A	N/A
5169400	12/1991	Muehling et al.	N/A	N/A
5169402	12/1991	Elloy	N/A	N/A
5171278	12/1991	Pisharodi	N/A	N/A
5171279	12/1991	Mathews	N/A	N/A
5171280	12/1991	Baumgartner	N/A	N/A
5176651	12/1992	Allgood et al.	N/A	N/A
5176683	12/1992	Kimsey et al.	N/A	N/A
5176692	12/1992	Wilk et al.	N/A	N/A
5176697	12/1992	Hasson et al.	N/A	N/A
5178501	12/1992	Carstairs	N/A	N/A
5183052	12/1992	Terwilliger	N/A	N/A
5183464	12/1992	Dubrul et al.	N/A	N/A
5188118	12/1992	Terwilliger	N/A	N/A
5192327	12/1992	Brantigan	N/A	N/A
5195506	12/1992	Hulfish	N/A	N/A

5201742	12/1992	Hasson	N/A	N/A
5217462	12/1992	Asnis et al.	N/A	N/A
5217475	12/1992	Kuber	N/A	N/A
5217486	12/1992	Rice et al.	N/A	N/A
5224952	12/1992	Deniega et al.	N/A	N/A
5228441	12/1992	Lundquist	N/A	N/A
5234431	12/1992	Keller	N/A	N/A
5241972	12/1992	Bonati	N/A	N/A
5242410	12/1992	Melker	N/A	N/A
5242447	12/1992	Borzone	N/A	N/A
5242448	12/1992	Pettine et al.	N/A	N/A
5242879	12/1992	Abe et al.	N/A	N/A
5246441	12/1992	Ross et al.	N/A	N/A
5250049	12/1992	Michael	N/A	N/A
5250061	12/1992	Michelson	N/A	N/A
5257632	12/1992	Turkel et al.	N/A	N/A
5263953	12/1992	Bagby	N/A	N/A
5269797	12/1992	Bonati et al.	N/A	N/A
5280782	12/1993	Wilk	N/A	N/A
5285795	12/1993	Ryan et al.	N/A	N/A
5286001	12/1993	Rafeld	N/A	N/A
5290243	12/1993	Chodorow et al.	N/A	N/A
5290312	12/1993	Kojimoto et al.	N/A	N/A
5300074	12/1993	Frigg	N/A	N/A
5303718	12/1993	Krajicek	N/A	N/A
5304142	12/1993	Liebl et al.	N/A	N/A
5306307	12/1993	Senter et al.	N/A	N/A
5306308	12/1993	Gross et al.	N/A	N/A
5306309	12/1993	Wagner et al.	N/A	N/A
5306310	12/1993	Siebels	N/A	N/A
5308327	12/1993	Heaven et al.	N/A	N/A
5308352	12/1993	Koutrouvelis	N/A	N/A
5312410	12/1993	Miller et al.	N/A	N/A
5312417	12/1993	Wilk	N/A	N/A
5314477	12/1993	Marnay	N/A	N/A
5320644	12/1993	Baumgartner	N/A	N/A
5322505	12/1993	Krause et al.	N/A	N/A
5324261	12/1993	Amundson et al.	N/A	N/A
5330429	12/1993	Noguchi et al.	N/A	N/A
5331975	12/1993	Bonutti	N/A	N/A
5334184	12/1993	Bimman	N/A	N/A
5334204	12/1993	Clewett et al.	N/A	N/A
5342365	12/1993	Waldman	N/A	N/A
5342382	12/1993	Brinkerhoff et al.	N/A	N/A
5344252	12/1993	Kakimoto	N/A	N/A
5361752	12/1993	Moll et al.	N/A	N/A
5364398	12/1993	Chapman et al.	N/A	N/A
5370646	12/1993	Reese et al.	N/A	N/A
5370647	12/1993	Graber et al.	N/A	N/A
5370661	12/1993	Branch	N/A	N/A

5370697	12/1993	Baumgartner	N/A	N/A
5372660	12/1993	Davidson et al.	N/A	N/A
5374267	12/1993	Siegal	N/A	N/A
5382248	12/1994	Jacobson et al.	N/A	N/A
5383932	12/1994	Wilson et al.	N/A	N/A
5385151	12/1994	Scarfone et al.	N/A	N/A
5387213	12/1994	Breard et al.	N/A	N/A
5387215	12/1994	Fisher	N/A	N/A
5390683	12/1994	Pisharodi	N/A	N/A
5395317	12/1994	Kambin	N/A	N/A
5395371	12/1994	Miller et al.	N/A	N/A
5397364	12/1994	Kozak et al.	N/A	N/A
5401269	12/1994	Buettner-Janz et al.	N/A	N/A
5407430	12/1994	Peters	N/A	N/A
5410016	12/1994	Hubbell et al.	N/A	N/A
5415661	12/1994	Holmes	N/A	N/A
5423816	12/1994	Lin	N/A	N/A
5423817	12/1994	Lin	N/A	N/A
5423850	12/1994	Berger	N/A	N/A
5424773	12/1994	Saito	N/A	N/A
5425773	12/1994	Boyd et al.	N/A	N/A
5431658	12/1994	Moskovich	N/A	N/A
5441538	12/1994	Bonutti	N/A	N/A
5443514	12/1994	Steffee	N/A	N/A
5449359	12/1994	Groiso	N/A	N/A
5449361	12/1994	Preissman	N/A	N/A
5452748	12/1994	Simmons et al.	N/A	N/A
5454365	12/1994	Bonutti	N/A	N/A
5454790	12/1994	Dubrul	N/A	N/A
5454815	12/1994	Geisser et al.	N/A	N/A
5454827	12/1994	Aust et al.	N/A	N/A
5456686	12/1994	Klapper et al.	N/A	N/A
5458641	12/1994	Ramirez Jimenez	N/A	N/A
5458643	12/1994	Oka et al.	N/A	N/A
5462563	12/1994	Shearer et al.	N/A	N/A
5464427	12/1994	Curtis et al.	N/A	N/A
5464929	12/1994	Bezwada et al.	N/A	N/A
5468245	12/1994	Vargas, III	N/A	N/A
5470333	12/1994	Ray	N/A	N/A
5472426	12/1994	Bonati et al.	N/A	N/A
5474539	12/1994	Costa et al.	N/A	N/A
5480400	12/1995	Berger	N/A	N/A
5484437	12/1995	Michelson	N/A	N/A
5486190	12/1995	Green	N/A	N/A
5496318	12/1995	Howland et al.	N/A	N/A
5498265	12/1995	Asnis et al.	N/A	N/A
5501695	12/1995	Anspach et al.	N/A	N/A
5505710	12/1995	Dorsey, III	N/A	N/A
5507816	12/1995	Bullivant	N/A	N/A

5509923	12/1995	Middleman et al.	N/A	N/A
5512037	12/1995	Russell et al.	N/A	N/A
5514143	12/1995	Bonutti et al.	N/A	N/A
5514153	12/1995	Bonutti	N/A	N/A
5514180	12/1995	Heggeness et al.	N/A	N/A
5520690	12/1995	Errico et al.	N/A	N/A
5520896	12/1995	De et al.	N/A	N/A
5522398	12/1995	Goldenberg et al.	N/A	N/A
5522790	12/1995	Moll et al.	N/A	N/A
5522846	12/1995	Bonutti	N/A	N/A
5522895	12/1995	Mikos	N/A	N/A
5522899	12/1995	Michelson	N/A	N/A
5527312	12/1995	Ray	N/A	N/A
5527343	12/1995	Bonutti	N/A	N/A
5527624	12/1995	Higgins et al.	N/A	N/A
5531856	12/1995	Moll et al.	N/A	N/A
5534023	12/1995	Henley	N/A	N/A
5534029	12/1995	Shima	N/A	N/A
5534030	12/1995	Navarro et al.	N/A	N/A
5536127	12/1995	Pennig	N/A	N/A
5538009	12/1995	Byrne et al.	N/A	N/A
5540688	12/1995	Navas	N/A	N/A
5540693	12/1995	Fisher	N/A	N/A
5540711	12/1995	Kieturakis et al.	N/A	N/A
5545164	12/1995	Howland	N/A	N/A
5545222	12/1995	Bonutti	N/A	N/A
5549610	12/1995	Russell et al.	N/A	N/A
5549679	12/1995	Kuslich	N/A	N/A
5554191	12/1995	Lahille et al.	N/A	N/A
5556431	12/1995	Buettner-Janz	N/A	N/A
5558674	12/1995	Heggeness et al.	N/A	N/A
D374287	12/1995	Goble et al.	N/A	N/A
5562736	12/1995	Ray et al.	N/A	N/A
5562738	12/1995	Boyd et al.	N/A	N/A
5564926	12/1995	Braanemark	N/A	N/A
5569248	12/1995	Mathews	N/A	N/A
5569251	12/1995	Baker et al.	N/A	N/A
5569290	12/1995	McAfee	N/A	N/A
5569548	12/1995	Koike et al.	N/A	N/A
5571109	12/1995	Bertagnoli	N/A	N/A
5571189	12/1995	Kuslich	N/A	N/A
5571190	12/1995	Ulrich et al.	N/A	N/A
5575790	12/1995	Chen et al.	N/A	N/A
5591168	12/1996	Judet et al.	N/A	N/A
5593409	12/1996	Michelson	N/A	N/A
5595751	12/1996	Bezwada et al.	N/A	N/A
5597579	12/1996	Bezwada et al.	N/A	N/A
5601556	12/1996	Pisharodi	N/A	N/A
5601561	12/1996	Terry et al.	N/A	N/A
5601572	12/1996	Middleman et al.	N/A	N/A

5607687	12/1996	Bezwada et al.	N/A	N/A
5609634	12/1996	Voydeville	N/A	N/A
5609635	12/1996	Michelson	N/A	N/A
5609636	12/1996	Kohrs et al.	N/A	N/A
5613950	12/1996	Yoon	N/A	N/A
5618142	12/1996	Sonden et al.	N/A	N/A
5618314	12/1996	Harwin et al.	N/A	N/A
5618552	12/1996	Bezwada et al.	N/A	N/A
5620698	12/1996	Bezwada et al.	N/A	N/A
5624447	12/1996	Myers	N/A	N/A
5626613	12/1996	Schmieding	N/A	N/A
5628751	12/1996	Sander et al.	N/A	N/A
5628752	12/1996	Asnis et al.	N/A	N/A
5632746	12/1996	Middleman et al.	N/A	N/A
5639276	12/1996	Weinstock et al.	N/A	N/A
5643320	12/1996	Lower et al.	N/A	N/A
5645589	12/1996	Li	N/A	N/A
5645596	12/1996	Kim et al.	N/A	N/A
5645597	12/1996	Krapiva	N/A	N/A
5645599	12/1996	Samani	N/A	N/A
5645850	12/1996	Bezwada et al.	N/A	N/A
5647857	12/1996	Anderson et al.	N/A	N/A
5648088	12/1996	Bezwada et al.	N/A	N/A
5649931	12/1996	Bryant et al.	N/A	N/A
5653763	12/1996	Errico et al.	N/A	N/A
5658335	12/1996	Allen	N/A	N/A
5662683	12/1996	Kay	N/A	N/A
5665095	12/1996	Jacobson et al.	N/A	N/A
5665122	12/1996	Kambin	N/A	N/A
5667508	12/1996	Errico et al.	N/A	N/A
5669915	12/1996	Caspar et al.	N/A	N/A
5669926	12/1996	Aust et al.	N/A	N/A
5674294	12/1996	Bainville et al.	N/A	N/A
5674295	12/1996	Ray et al.	N/A	N/A
5674296	12/1996	Bryan et al.	N/A	N/A
5676701	12/1996	Yuan et al.	N/A	N/A
5679723	12/1996	Cooper et al.	N/A	N/A
5681263	12/1996	Flesch	N/A	N/A
5683465	12/1996	Shinn et al.	N/A	N/A
5693100	12/1996	Pisharodi	N/A	N/A
5695513	12/1996	Johnson et al.	N/A	N/A
5697977	12/1996	Pisharodi	N/A	N/A
5698213	12/1996	Jamiolkowski et al.	N/A	N/A
5700239	12/1996	Yoon	N/A	N/A
5700583	12/1996	Jamiolkowski et al.	N/A	N/A
5702391	12/1996	Lin	N/A	N/A
5702449	12/1996	McKay	N/A	N/A
5702450	12/1996	Bisserie	N/A	N/A

5702453	12/1996	Rabbe et al.	N/A	N/A
5702454	12/1996	Baumgartner	N/A	N/A
5707359	12/1997	Bufalini	N/A	N/A
5713870	12/1997	Yoon	N/A	N/A
5713903	12/1997	Sander et al.	N/A	N/A
5716415	12/1997	Steffee	N/A	N/A
5716416	12/1997	Lin	N/A	N/A
5720753	12/1997	Sander et al.	N/A	N/A
5725531	12/1997	Shapiro	N/A	N/A
5725541	12/1997	Anspach et al.	N/A	N/A
5725588	12/1997	Errico et al.	N/A	N/A
5728097	12/1997	Mathews	N/A	N/A
5728116	12/1997	Rosenman	N/A	N/A
5735853	12/1997	Olerud	N/A	N/A
5741253	12/1997	Michelson	N/A	N/A
5741282	12/1997	Anspach et al.	N/A	N/A
5743881	12/1997	Demco	N/A	N/A
5743912	12/1997	Ahille et al.	N/A	N/A
5743914	12/1997	Skiba	N/A	N/A
5749879	12/1997	Middleman et al.	N/A	N/A
5749889	12/1997	Bacich et al.	N/A	N/A
5752969	12/1997	Cunci et al.	N/A	N/A
5755797	12/1997	Baumgartner	N/A	N/A
5755798	12/1997	Papavero et al.	N/A	N/A
5756127	12/1997	Grisoni et al.	N/A	N/A
5762500	12/1997	Lazarof	N/A	N/A
5762629	12/1997	Kambin	N/A	N/A
5766252	12/1997	Henry et al.	N/A	N/A
5772661	12/1997	Michelson	N/A	N/A
5772662	12/1997	Chapman et al.	N/A	N/A
5772678	12/1997	Thomason et al.	N/A	N/A
5776156	12/1997	Shikhman	N/A	N/A
5782800	12/1997	Yoon	N/A	N/A
5782832	12/1997	Larsen et al.	N/A	N/A
5782865	12/1997	Grotz	N/A	N/A
5788703	12/1997	Mittelmeier et al.	N/A	N/A
5792044	12/1997	Foley et al.	N/A	N/A
5797909	12/1997	Michelson	N/A	N/A
5800549	12/1997	Bao et al.	N/A	N/A
5807275	12/1997	Jamshidi	N/A	N/A
5807327	12/1997	Green et al.	N/A	N/A
5810721	12/1997	Mueller et al.	N/A	N/A
5810821	12/1997	Vandewalle	N/A	N/A
5810866	12/1997	Yoon	N/A	N/A
5814084	12/1997	Grivas et al.	N/A	N/A
5820628	12/1997	Middleman et al.	N/A	N/A
5823979	12/1997	Mezo	N/A	N/A
5824084	12/1997	Muschler	N/A	N/A
5824093	12/1997	Ray et al.	N/A	N/A
5824094	12/1997	Serhan et al.	N/A	N/A

5827289	12/1997	Reiley et al.	N/A	N/A
5833657	12/1997	Reinhardt et al.	N/A	N/A
5836948	12/1997	Zucherman et al.	N/A	N/A
5837752	12/1997	Shastri et al.	N/A	N/A
5846259	12/1997	Berthiaume	N/A	N/A
5848986	12/1997	Lundquist et al.	N/A	N/A
5849004	12/1997	Bramlet	N/A	N/A
5851212	12/1997	Zirps et al.	N/A	N/A
5851216	12/1997	Allen	N/A	N/A
5857995	12/1998	Thomas et al.	N/A	N/A
5859150	12/1998	Jamiolkowski et al.	N/A	N/A
5860973	12/1998	Michelson	N/A	N/A
5860977	12/1998	Zucherman et al.	N/A	N/A
5865846	12/1998	Bryan et al.	N/A	N/A
5865848	12/1998	Baker	N/A	N/A
5871485	12/1998	Rao et al.	N/A	N/A
5873854	12/1998	Wolvek	N/A	N/A
5876404	12/1998	Zucherman et al.	N/A	N/A
5888220	12/1998	Felt et al.	N/A	N/A
5888221	12/1998	Gelbard	N/A	N/A
5888223	12/1998	Bray, Jr.	N/A	N/A
5888224	12/1998	Beckers et al.	N/A	N/A
5888226	12/1998	Rogozinski	N/A	N/A
5888227	12/1998	Cottle	N/A	N/A
5888228	12/1998	Knothe et al.	N/A	N/A
5893850	12/1998	Cachia	N/A	N/A
5893889	12/1998	Harrington	N/A	N/A
5893890	12/1998	Pisharodi	N/A	N/A
5895428	12/1998	Berry	N/A	N/A
5902231	12/1998	Foley et al.	N/A	N/A
5904690	12/1998	Middleman et al.	N/A	N/A
5904696	12/1998	Rosenman	N/A	N/A
5908422	12/1998	Bresina	N/A	N/A
5916228	12/1998	Ripich et al.	N/A	N/A
5916267	12/1998	Tienboon	N/A	N/A
5919235	12/1998	Husson et al.	N/A	N/A
5925056	12/1998	Thomas et al.	N/A	N/A
5925074	12/1998	Gingras et al.	N/A	N/A
5928235	12/1998	Friedl	N/A	N/A
5928244	12/1998	Tovey et al.	N/A	N/A
5931870	12/1998	Cuckler et al.	N/A	N/A
5935129	12/1998	McDevitt et al.	N/A	N/A
5947999	12/1998	Groiso	N/A	N/A
5948000	12/1998	Larsen et al.	N/A	N/A
5954635	12/1998	Foley et al.	N/A	N/A
5954722	12/1998	Bono	N/A	N/A
5954747	12/1998	Clark	N/A	N/A
5957902	12/1998	Teves	N/A	N/A
5957924	12/1998	Toermaelae et al.	N/A	N/A

5961554	12/1998	Janson et al.	N/A	N/A
5964730	12/1998	Williams et al.	N/A	N/A
5964761	12/1998	Kambin	N/A	N/A
5967783	12/1998	Ura	N/A	N/A
5967970	12/1998	Cowan et al.	N/A	N/A
5968044	12/1998	Nicholson et al.	N/A	N/A
5968098	12/1998	Winslow	N/A	N/A
5972015	12/1998	Scribner et al.	N/A	N/A
5972385	12/1998	Liu et al.	N/A	N/A
5976139	12/1998	Bramlet	N/A	N/A
5976146	12/1998	Ogawa et al.	N/A	N/A
5976186	12/1998	Bao et al.	N/A	N/A
5976187	12/1998	Richelsoph	N/A	N/A
5980522	12/1998	Koros et al.	N/A	N/A
5984927	12/1998	Wenstrom et al.	N/A	N/A
5984966	12/1998	Kiema et al.	N/A	N/A
5985307	12/1998	Hanson et al.	N/A	N/A
5989255	12/1998	Pepper et al.	N/A	N/A
5989291	12/1998	Ralph et al.	N/A	N/A
5993459	12/1998	Larsen et al.	N/A	N/A
5997510	12/1998	Schwemberger	N/A	N/A
5997538	12/1998	Asnis et al.	N/A	N/A
5997541	12/1998	Schenk	N/A	N/A
6001100	12/1998	Sherman et al.	N/A	N/A
6001101	12/1998	Augagneur et al.	N/A	N/A
6004327	12/1998	Asnis et al.	N/A	N/A
6005161	12/1998	Brekke	N/A	N/A
6007519	12/1998	Rosselli	N/A	N/A
6007566	12/1998	Wenstrom, Jr.	N/A	N/A
6007580	12/1998	Lehto et al.	N/A	N/A
6010508	12/1999	Bradley	N/A	N/A
6010513	12/1999	Toermaelae et al.	N/A	N/A
6012494	12/1999	Balazs	N/A	N/A
6015410	12/1999	Toermaelae et al.	N/A	N/A
6015436	12/1999	Helmut	N/A	N/A
6019762	12/1999	Cole	N/A	N/A
6019792	12/1999	Cauthen	N/A	N/A
6019793	12/1999	Perren et al.	N/A	N/A
6022350	12/1999	Ganem	N/A	N/A
6022352	12/1999	Vandewalle	N/A	N/A
6030162	12/1999	Huebner	N/A	N/A
6030364	12/1999	Durgin et al.	N/A	N/A
6030401	12/1999	Marino	N/A	N/A
6033406	12/1999	Mathews	N/A	N/A
6033412	12/1999	Losken et al.	N/A	N/A
6036701	12/1999	Rosenman	N/A	N/A
6039740	12/1999	Olerud	N/A	N/A
6039761	12/1999	Li et al.	N/A	N/A
6039763	12/1999	Shelokov	N/A	N/A
6045552	12/1999	Zucherman et al.	N/A	N/A

6045579	12/1999	Hochschuler et al.	N/A	N/A
6048309	12/1999	Flom et al.	N/A	N/A
6048342	12/1999	Zucherman et al.	N/A	N/A
6048346	12/1999	Reiley et al.	N/A	N/A
6048360	12/1999	Khosravi et al.	N/A	N/A
6049026	12/1999	Muschler	N/A	N/A
6053922	12/1999	Krause et al.	N/A	N/A
6053935	12/1999	Brenneman et al.	N/A	N/A
6056763	12/1999	Parsons	N/A	N/A
6063121	12/1999	Xavier et al.	N/A	N/A
6066142	12/1999	Serbousek et al.	N/A	N/A
6066154	12/1999	Reiley et al.	N/A	N/A
6066175	12/1999	Henderson et al.	N/A	N/A
6068630	12/1999	Zucherman et al.	N/A	N/A
6068648	12/1999	Cole et al.	N/A	N/A
6071982	12/1999	Wise et al.	N/A	N/A
6073051	12/1999	Sharkey et al.	N/A	N/A
6074390	12/1999	Zucherman et al.	N/A	N/A
6080155	12/1999	Michelson	N/A	N/A
6080158	12/1999	Lin	N/A	N/A
6080193	12/1999	Hochschuler et al.	N/A	N/A
6083225	12/1999	Winslow et al.	N/A	N/A
6083244	12/1999	Lubbers et al.	N/A	N/A
6090112	12/1999	Zucherman et al.	N/A	N/A
6090143	12/1999	Meriwether et al.	N/A	N/A
6096038	12/1999	Michelson	N/A	N/A
6096080	12/1999	Nicholson et al.	N/A	N/A
6099531	12/1999	Bonutti	N/A	N/A
6102914	12/1999	Bulstra et al.	N/A	N/A
6102950	12/1999	Vaccaro	N/A	N/A
6106557	12/1999	Robioneck et al.	N/A	N/A
6110210	12/1999	Norton et al.	N/A	N/A
6113624	12/1999	Bezwada et al.	N/A	N/A
6113637	12/1999	Gill et al.	N/A	N/A
6113638	12/1999	Williams et al.	N/A	N/A
6113640	12/1999	Toermaelae et al.	N/A	N/A
6117174	12/1999	Nolan	N/A	N/A
6119044	12/1999	Kuzma	N/A	N/A
6120508	12/1999	Gruenig et al.	N/A	N/A
6123705	12/1999	Michelson	N/A	N/A
6123711	12/1999	Winters	N/A	N/A
6126660	12/1999	Dietz	N/A	N/A
6126661	12/1999	Faccioli et al.	N/A	N/A
6126663	12/1999	Hair	N/A	N/A
6126686	12/1999	Badylak et al.	N/A	N/A
6126689	12/1999	Brett	N/A	N/A
6127597	12/1999	Beyar et al.	N/A	N/A
6129762	12/1999	Li	N/A	N/A
6129763	12/1999	Chauvin et al.	N/A	N/A
6132435	12/1999	Young	N/A	N/A

6136031	12/1999	Middleton	N/A	N/A
6139558	12/1999	Wagner	N/A	N/A
6139579	12/1999	Steffee et al.	N/A	N/A
6146384	12/1999	Lee et al.	N/A	N/A
6146387	12/1999	Trott et al.	N/A	N/A
6146420	12/1999	McKay	N/A	N/A
6146421	12/1999	Gordon et al.	N/A	N/A
6147135	12/1999	Yuan et al.	N/A	N/A
6149652	12/1999	Zucherman et al.	N/A	N/A
6152926	12/1999	Zucherman et al.	N/A	N/A
6156038	12/1999	Zucherman et al.	N/A	N/A
6159179	12/1999	Simonson	N/A	N/A
6159211	12/1999	Boriani et al.	N/A	N/A
6159244	12/1999	Suddaby	N/A	N/A
6161350	12/1999	Espinosa	N/A	N/A
6162234	12/1999	Freedland et al.	N/A	N/A
6162236	12/1999	Osada	N/A	N/A
6162252	12/1999	Kuras et al.	N/A	N/A
6165218	12/1999	Husson et al.	N/A	N/A
6165486	12/1999	Marra et al.	N/A	N/A
6168595	12/2000	Durham et al.	N/A	N/A
6168597	12/2000	Biedermann et al.	N/A	N/A
6171610	12/2000	Vacanti et al.	N/A	N/A
6174337	12/2000	Keenan	N/A	N/A
6175758	12/2000	Kambin	N/A	N/A
6176882	12/2000	Biedermann et al.	N/A	N/A
6179794	12/2000	Burras	N/A	N/A
6179873	12/2000	Zientek	N/A	N/A
6183471	12/2000	Zucherman et al.	N/A	N/A
6183472	12/2000	Lutz	N/A	N/A
6183474	12/2000	Bramlet et al.	N/A	N/A
6183517	12/2000	Suddaby	N/A	N/A
6187043	12/2000	Ledergerber	N/A	N/A
6187048	12/2000	Milner et al.	N/A	N/A
6190387	12/2000	Zucherman et al.	N/A	N/A
6190414	12/2000	Young et al.	N/A	N/A
6193757	12/2000	Foley et al.	N/A	N/A
6197033	12/2000	Haid et al.	N/A	N/A
6197041	12/2000	Shichman et al.	N/A	N/A
6197065	12/2000	Martin et al.	N/A	N/A
6197325	12/2000	MacPhee et al.	N/A	N/A
6200322	12/2000	Branch et al.	N/A	N/A
6203565	12/2000	Bonutti et al.	N/A	N/A
6206826	12/2000	Mathews et al.	N/A	N/A
6206922	12/2000	Zdeblick et al.	N/A	N/A
D439980	12/2000	Reiley et al.	N/A	N/A
6213957	12/2000	Milliman et al.	N/A	N/A
6214368	12/2000	Lee et al.	N/A	N/A
6217509	12/2000	Foley et al.	N/A	N/A
6217579	12/2000	Koros	N/A	N/A

6221082	12/2000	Marino et al.	N/A	N/A
6224603	12/2000	Marino	N/A	N/A
6224631	12/2000	Kohrs	N/A	N/A
6224894	12/2000	Jamiolkowski et al.	N/A	N/A
6228058	12/2000	Dennis et al.	N/A	N/A
6231606	12/2000	Graf et al.	N/A	N/A
6235030	12/2000	Zucherman et al.	N/A	N/A
6235043	12/2000	Reiley et al.	N/A	N/A
6238397	12/2000	Zucherman et al.	N/A	N/A
6238491	12/2000	Davidson et al.	N/A	N/A
6241733	12/2000	Nicholson et al.	N/A	N/A
6241734	12/2000	Scribner et al.	N/A	N/A
6241769	12/2000	Nicholson et al.	N/A	N/A
6245107	12/2000	Ferree	N/A	N/A
6248108	12/2000	Toermaelae et al.	N/A	N/A
6248110	12/2000	Reiley et al.	N/A	N/A
6248131	12/2000	Felt et al.	N/A	N/A
6251111	12/2000	Barker et al.	N/A	N/A
6251140	12/2000	Marino et al.	N/A	N/A
6258093	12/2000	Edwards et al.	N/A	N/A
6261289	12/2000	Levy	N/A	N/A
6264676	12/2000	Gellman et al.	N/A	N/A
6264695	12/2000	Stoy	N/A	N/A
6267763	12/2000	Castro	N/A	N/A
6267765	12/2000	Taylor et al.	N/A	N/A
6267767	12/2000	Strobel et al.	N/A	N/A
6277149	12/2000	Boyle et al.	N/A	N/A
6280444	12/2000	Zucherman et al.	N/A	N/A
6280456	12/2000	Scribner et al.	N/A	N/A
6280474	12/2000	Cassidy et al.	N/A	N/A
6280475	12/2000	Bao et al.	N/A	N/A
6287313	12/2000	Sasso	N/A	N/A
6290724	12/2000	Marino	N/A	N/A
6293909	12/2000	Chu et al.	N/A	N/A
6293952	12/2000	Brosens et al.	N/A	N/A
D449691	12/2000	Reiley et al.	N/A	N/A
6296644	12/2000	Saurat et al.	N/A	N/A
6296647	12/2000	Robioneck et al.	N/A	N/A
6302914	12/2000	Michelson	N/A	N/A
6306136	12/2000	Baccelli	N/A	N/A
6306177	12/2000	Felt et al.	N/A	N/A
D450676	12/2000	Huttner	N/A	N/A
6312443	12/2000	Stone	N/A	N/A
6319254	12/2000	Giet et al.	N/A	N/A
6319272	12/2000	Brenneman et al.	N/A	N/A
6331312	12/2000	Lee et al.	N/A	N/A
6332882	12/2000	Zucherman et al.	N/A	N/A
6332883	12/2000	Zucherman et al.	N/A	N/A
6332894	12/2000	Stalcup et al.	N/A	N/A

6332895	12/2000	Suddaby	N/A	N/A
6342074	12/2001	Simpson	N/A	N/A
6346092	12/2001	Leschinsky	N/A	N/A
6348053	12/2001	Cachia	N/A	N/A
6355043	12/2001	Adam	N/A	N/A
6361537	12/2001	Anderson	N/A	N/A
6361538	12/2001	Fenaroli et al.	N/A	N/A
6361557	12/2001	Gittings et al.	N/A	N/A
6364828	12/2001	Yeung et al.	N/A	N/A
6364897	12/2001	Bonutti	N/A	N/A
6368325	12/2001	McKinley et al.	N/A	N/A
6368350	12/2001	Erickson et al.	N/A	N/A
6368351	12/2001	Glenn et al.	N/A	N/A
6371971	12/2001	Tsugita et al.	N/A	N/A
6371989	12/2001	Chauvin et al.	N/A	N/A
6375681	12/2001	Truscott	N/A	N/A
6375682	12/2001	Fleischmann et al.	N/A	N/A
6375683	12/2001	Crozet et al.	N/A	N/A
6379355	12/2001	Zucherman et al.	N/A	N/A
6379363	12/2001	Herrington et al.	N/A	N/A
6387130	12/2001	Stone et al.	N/A	N/A
6398793	12/2001	McGuire	N/A	N/A
6402750	12/2001	Atkinson et al.	N/A	N/A
6409766	12/2001	Brett	N/A	N/A
6409767	12/2001	Perice et al.	N/A	N/A
6413278	12/2001	Marchosky	N/A	N/A
6416551	12/2001	Keller	N/A	N/A
6419641	12/2001	Mark et al.	N/A	N/A
6419676	12/2001	Zucherman et al.	N/A	N/A
6419677	12/2001	Zucherman et al.	N/A	N/A
6419704	12/2001	Ferree	N/A	N/A
6419705	12/2001	Erickson	N/A	N/A
6419706	12/2001	Graf	N/A	N/A
6423061	12/2001	Bryant	N/A	N/A
6423067	12/2001	Eisermann	N/A	N/A
6423071	12/2001	Lawson	N/A	N/A
6423083	12/2001	Reiley et al.	N/A	N/A
6423089	12/2001	Gingras et al.	N/A	N/A
6425887	12/2001	McGuckin et al.	N/A	N/A
6425919	12/2001	Lambrecht	N/A	N/A
6425920	12/2001	Hamada	N/A	N/A
6428541	12/2001	Boyd et al.	N/A	N/A
6428556	12/2001	Chin	N/A	N/A
6436101	12/2001	Hamada	N/A	N/A
6436140	12/2001	Liu et al.	N/A	N/A
6436143	12/2001	Ross et al.	N/A	N/A
6440138	12/2001	Reiley et al.	N/A	N/A
6440154	12/2001	Gellman et al.	N/A	N/A
6440169	12/2001	Elberg et al.	N/A	N/A
6443989	12/2001	Jackson	N/A	N/A

6447518	12/2001	Krause et al.	N/A	N/A
6447527	12/2001	Thompson et al.	N/A	N/A
6447540	12/2001	Fontaine et al.	N/A	N/A
6450989	12/2001	Dubrul et al.	N/A	N/A
6451019	12/2001	Zucherman et al.	N/A	N/A
6451020	12/2001	Zucherman et al.	N/A	N/A
6454806	12/2001	Cohen et al.	N/A	N/A
6454807	12/2001	Jackson	N/A	N/A
6458134	12/2001	Songer et al.	N/A	N/A
6461359	12/2001	Tribus et al.	N/A	N/A
6468277	12/2001	Justin et al.	N/A	N/A
6468279	12/2001	Reo	N/A	N/A
6468309	12/2001	Lieberman	N/A	N/A
6468310	12/2001	Ralph et al.	N/A	N/A
6471724	12/2001	Zdeblick et al.	N/A	N/A
6475226	12/2001	Belef et al.	N/A	N/A
6478029	12/2001	Boyd et al.	N/A	N/A
6478796	12/2001	Zucherman et al.	N/A	N/A
6478805	12/2001	Marino et al.	N/A	N/A
6482235	12/2001	Lambrecht et al.	N/A	N/A
6485491	12/2001	Farris et al.	N/A	N/A
6485518	12/2001	Cornwall et al.	N/A	N/A
D467657	12/2001	Scribner	N/A	N/A
6488693	12/2001	Gannoe et al.	N/A	N/A
6488710	12/2001	Besselink	N/A	N/A
6489309	12/2001	Singh et al.	N/A	N/A
6491626	12/2001	Stone et al.	N/A	N/A
6491695	12/2001	Roggenbuck	N/A	N/A
6491714	12/2001	Bennett	N/A	N/A
6491724	12/2001	Ferree	N/A	N/A
6494860	12/2001	Rocamora et al.	N/A	N/A
6494883	12/2001	Ferree	N/A	N/A
6494893	12/2001	Dubrul et al.	N/A	N/A
6498421	12/2001	Oh et al.	N/A	N/A
6500178	12/2001	Zucherman et al.	N/A	N/A
6500205	12/2001	Michelson	N/A	N/A
6506192	12/2002	Gertzman et al.	N/A	N/A
6508839	12/2002	Lambrecht et al.	N/A	N/A
6511471	12/2002	Rosenman et al.	N/A	N/A
6511481	12/2002	Von et al.	N/A	N/A
6512958	12/2002	Swoyer et al.	N/A	N/A
D469871	12/2002	Sand	N/A	N/A
6514256	12/2002	Zucherman et al.	N/A	N/A
6517543	12/2002	Berrevoets et al.	N/A	N/A
6517580	12/2002	Ramadan et al.	N/A	N/A
6520907	12/2002	Foley et al.	N/A	N/A
6520991	12/2002	Huene	N/A	N/A
D472323	12/2002	Sand	N/A	N/A
6527774	12/2002	Lieberman	N/A	N/A
6527803	12/2002	Crozet et al.	N/A	N/A

6527804	12/2002	Gauchet et al.	N/A	N/A
6530930	12/2002	Marino et al.	N/A	N/A
6533791	12/2002	Betz et al.	N/A	N/A
6533797	12/2002	Stone et al.	N/A	N/A
6533818	12/2002	Weber et al.	N/A	N/A
6540747	12/2002	Marino	N/A	N/A
6544265	12/2002	Lieberman	N/A	N/A
6547793	12/2002	McGuire	N/A	N/A
6547795	12/2002	Schneiderman	N/A	N/A
6547823	12/2002	Scarborough et al.	N/A	N/A
6551319	12/2002	Lieberman	N/A	N/A
6551322	12/2002	Lieberman	N/A	N/A
6554831	12/2002	Rivard et al.	N/A	N/A
6554833	12/2002	Levy et al.	N/A	N/A
6554852	12/2002	Oberlander	N/A	N/A
6558389	12/2002	Clark et al.	N/A	N/A
6558390	12/2002	Cragg	N/A	N/A
6558424	12/2002	Thalgott	N/A	N/A
6562046	12/2002	Sasso	N/A	N/A
6562049	12/2002	Norlander et al.	N/A	N/A
6562072	12/2002	Fuss et al.	N/A	N/A
6562074	12/2002	Gerbec et al.	N/A	N/A
6575919	12/2002	Reiley et al.	N/A	N/A
6575979	12/2002	Cragg	N/A	N/A
6576016	12/2002	Hochshuler et al.	N/A	N/A
6579291	12/2002	Keith et al.	N/A	N/A
6579293	12/2002	Chandran	N/A	N/A
6579318	12/2002	Varga et al.	N/A	N/A
6579320	12/2002	Gauchet et al.	N/A	N/A
6579321	12/2002	Gordon et al.	N/A	N/A
6582390	12/2002	Sanderson	N/A	N/A
6582431	12/2002	Ray	N/A	N/A
6582433	12/2002	Yun	N/A	N/A
6582437	12/2002	Dorchak et al.	N/A	N/A
6582441	12/2002	He et al.	N/A	N/A
6582453	12/2002	Tran et al.	N/A	N/A
6582466	12/2002	Gauchet	N/A	N/A
6582467	12/2002	Teitelbaum et al.	N/A	N/A
6582468	12/2002	Gauchet	N/A	N/A
6585730	12/2002	Foerster	N/A	N/A
6585740	12/2002	Schlapfer et al.	N/A	N/A
6589240	12/2002	Hinchliffe	N/A	N/A
6589249	12/2002	Sater et al.	N/A	N/A
6592553	12/2002	Zhang et al.	N/A	N/A
6592624	12/2002	Fraser et al.	N/A	N/A
6592625	12/2002	Cauthen	N/A	N/A
6595998	12/2002	Johnson et al.	N/A	N/A
6596008	12/2002	Kambin	N/A	N/A
6599294	12/2002	Fuss et al.	N/A	N/A
6599297	12/2002	Carlsson et al.	N/A	N/A

6602293	12/2002	Biermann et al.	N/A	N/A
6607530	12/2002	Carl et al.	N/A	N/A
6607544	12/2002	Boucher et al.	N/A	N/A
6607558	12/2002	Kuras	N/A	N/A
6610066	12/2002	Dinger et al.	N/A	N/A
6610091	12/2002	Reiley	N/A	N/A
6610094	12/2002	Husson	N/A	N/A
6613050	12/2002	Wagner et al.	N/A	N/A
6613054	12/2002	Scribner et al.	N/A	N/A
6616678	12/2002	Nishtala et al.	N/A	N/A
6620196	12/2002	Trieu	N/A	N/A
6623505	12/2002	Scribner et al.	N/A	N/A
6626943	12/2002	Eberlein et al.	N/A	N/A
6626944	12/2002	Taylor	N/A	N/A
6629998	12/2002	Lin	N/A	N/A
6632224	12/2002	Cachia et al.	N/A	N/A
6632235	12/2002	Weikel et al.	N/A	N/A
6635059	12/2002	Randall et al.	N/A	N/A
6635060	12/2002	Hanson et al.	N/A	N/A
6635362	12/2002	Zheng	N/A	N/A
RE38335	12/2002	Aust et al.	N/A	N/A
D482787	12/2002	Reiss	N/A	N/A
6641564	12/2002	Kraus	N/A	N/A
6641582	12/2002	Hanson et al.	N/A	N/A
6641587	12/2002	Scribner et al.	N/A	N/A
6641614	12/2002	Wagner et al.	N/A	N/A
6645213	12/2002	Sand et al.	N/A	N/A
6645248	12/2002	Casutt	N/A	N/A
6648890	12/2002	Culbert et al.	N/A	N/A
6648893	12/2002	Dudasik	N/A	N/A
6648917	12/2002	Gerbec et al.	N/A	N/A
6652527	12/2002	Zucherman et al.	N/A	N/A
6652592	12/2002	Grooms et al.	N/A	N/A
D483495	12/2002	Sand	N/A	N/A
6655962	12/2002	Kennard	N/A	N/A
6656178	12/2002	Veldhuizen et al.	N/A	N/A
6656180	12/2002	Stahurski	N/A	N/A
6660004	12/2002	Barker et al.	N/A	N/A
6660037	12/2002	Husson et al.	N/A	N/A
6663647	12/2002	Reiley et al.	N/A	N/A
6666890	12/2002	Michelson	N/A	N/A
6666891	12/2002	Boehm et al.	N/A	N/A
6669698	12/2002	Tromanhauser et al.	N/A	N/A
6669729	12/2002	Chin	N/A	N/A
6669732	12/2002	Serhan et al.	N/A	N/A
6673074	12/2003	Shluzas	N/A	N/A
6676663	12/2003	Higueras et al.	N/A	N/A
6676664	12/2003	Al-Assir	N/A	N/A
6676665	12/2003	Foley et al.	N/A	N/A

6679833	12/2003	Smith et al.	N/A	N/A
6679915	12/2003	Cauthen	N/A	N/A
6682535	12/2003	Hoogland	N/A	N/A
6682561	12/2003	Songer et al.	N/A	N/A
6682562	12/2003	Mart et al.	N/A	N/A
6685706	12/2003	Padget et al.	N/A	N/A
6685742	12/2003	Jackson	N/A	N/A
6689125	12/2003	Keith et al.	N/A	N/A
6689152	12/2003	Balceta et al.	N/A	N/A
6689168	12/2003	Lieberman	N/A	N/A
6692499	12/2003	Toermaelae et al.	N/A	N/A
6692563	12/2003	Zimmermann	N/A	N/A
6695842	12/2003	Zucherman et al.	N/A	N/A
6695851	12/2003	Zdeblick et al.	N/A	N/A
6699246	12/2003	Zucherman et al.	N/A	N/A
6699247	12/2003	Zucherman et al.	N/A	N/A
6706070	12/2003	Wagner et al.	N/A	N/A
6709458	12/2003	Michelson	N/A	N/A
6712819	12/2003	Zucherman et al.	N/A	N/A
6716216	12/2003	Boucher et al.	N/A	N/A
6716247	12/2003	Michelson	N/A	N/A
6716957	12/2003	Tunc	N/A	N/A
6719760	12/2003	Dorchak et al.	N/A	N/A
6719761	12/2003	Reiley et al.	N/A	N/A
6719773	12/2003	Boucher et al.	N/A	N/A
6719796	12/2003	Cohen et al.	N/A	N/A
6723096	12/2003	Dorchak et al.	N/A	N/A
6723126	12/2003	Berry	N/A	N/A
6723127	12/2003	Ralph et al.	N/A	N/A
6723128	12/2003	Uk	N/A	N/A
6726691	12/2003	Osorio et al.	N/A	N/A
D490159	12/2003	Sand	N/A	N/A
6730126	12/2003	Boehm et al.	N/A	N/A
6733093	12/2003	Deland et al.	N/A	N/A
6733460	12/2003	Ogura	N/A	N/A
6733532	12/2003	Gauchet et al.	N/A	N/A
6733534	12/2003	Sherman	N/A	N/A
6733535	12/2003	Michelson	N/A	N/A
6733635	12/2003	Ozawa et al.	N/A	N/A
6740090	12/2003	Cragg et al.	N/A	N/A
6740093	12/2003	Hochschuler et al.	N/A	N/A
6740117	12/2003	Ralph et al.	N/A	N/A
D492032	12/2003	Muller et al.	N/A	N/A
6743166	12/2003	Berci et al.	N/A	N/A
6743255	12/2003	Ferree	N/A	N/A
6746451	12/2003	Middleton et al.	N/A	N/A
6749560	12/2003	Konstorum et al.	N/A	N/A
6752831	12/2003	Sybert et al.	N/A	N/A
6755837	12/2003	Ebner	N/A	N/A
6755841	12/2003	Fraser et al.	N/A	N/A

D492775	12/2003	Doelling et al.	N/A	N/A
D493533	12/2003	Blain	N/A	N/A
6758673	12/2003	Fromovich et al.	N/A	N/A
6758847	12/2003	Maguire	N/A	N/A
6758861	12/2003	Ralph et al.	N/A	N/A
6758862	12/2003	Berry et al.	N/A	N/A
6761720	12/2003	Senegas	N/A	N/A
6764491	12/2003	Frey et al.	N/A	N/A
6764514	12/2003	Li et al.	N/A	N/A
D495417	12/2003	Doelling et al.	N/A	N/A
6770075	12/2003	Howland	N/A	N/A
6773460	12/2003	Jackson	N/A	N/A
6780151	12/2003	Grabover et al.	N/A	N/A
6783530	12/2003	Levy	N/A	N/A
6790210	12/2003	Cragg et al.	N/A	N/A
6793656	12/2003	Mathews	N/A	N/A
6793678	12/2003	Hawkins	N/A	N/A
6793679	12/2003	Michelson	N/A	N/A
6796983	12/2003	Zucherman et al.	N/A	N/A
6805685	12/2003	Taylor	N/A	N/A
6805695	12/2003	Keith et al.	N/A	N/A
6805697	12/2003	Helm et al.	N/A	N/A
6805714	12/2003	Sutcliffe	N/A	N/A
6808526	12/2003	Magerl et al.	N/A	N/A
6808537	12/2003	Michelson	N/A	N/A
6814736	12/2003	Reiley et al.	N/A	N/A
6814756	12/2003	Michelson	N/A	N/A
6821298	12/2003	Jackson	N/A	N/A
6824565	12/2003	Muhanna et al.	N/A	N/A
6830589	12/2003	Erickson	N/A	N/A
6835205	12/2003	Atkinson et al.	N/A	N/A
6835206	12/2003	Jackson	N/A	N/A
6835208	12/2003	Marchosky	N/A	N/A
6840941	12/2004	Rogers et al.	N/A	N/A
6840944	12/2004	Suddaby	N/A	N/A
6852126	12/2004	Ahlgren	N/A	N/A
6852127	12/2004	Varga et al.	N/A	N/A
6852129	12/2004	Gerbec et al.	N/A	N/A
6855167	12/2004	Shimp et al.	N/A	N/A
6863668	12/2004	Gillespie et al.	N/A	N/A
6863672	12/2004	Reiley et al.	N/A	N/A
6863673	12/2004	Gerbec et al.	N/A	N/A
6866682	12/2004	An et al.	N/A	N/A
6875215	12/2004	Taras et al.	N/A	N/A
6878167	12/2004	Ferree	N/A	N/A
6881228	12/2004	Zdeblick et al.	N/A	N/A
6881229	12/2004	Khandkar et al.	N/A	N/A
6883520	12/2004	Lambrecht et al.	N/A	N/A
6887243	12/2004	Culbert	N/A	N/A
6887248	12/2004	McKinley et al.	N/A	N/A

6890333	12/2004	Von et al.	N/A	N/A
6893464	12/2004	Kiester	N/A	N/A
6893466	12/2004	Trieu	N/A	N/A
6899716	12/2004	Cragg	N/A	N/A
6899719	12/2004	Reiley et al.	N/A	N/A
6899735	12/2004	Coates et al.	N/A	N/A
D506828	12/2004	Layne et al.	N/A	N/A
6902566	12/2004	Zucherman et al.	N/A	N/A
6905512	12/2004	Paes et al.	N/A	N/A
6908465	12/2004	Von et al.	N/A	N/A
6908506	12/2004	Zimmermann	N/A	N/A
6916323	12/2004	Kitchens	N/A	N/A
6921403	12/2004	Cragg et al.	N/A	N/A
6923810	12/2004	Michelson	N/A	N/A
6923811	12/2004	Carl et al.	N/A	N/A
6923813	12/2004	Phillips et al.	N/A	N/A
6923814	12/2004	Hildebrand et al.	N/A	N/A
6929606	12/2004	Ritland	N/A	N/A
6929647	12/2004	Cohen	N/A	N/A
6936071	12/2004	Marnay et al.	N/A	N/A
6936072	12/2004	Lambrecht et al.	N/A	N/A
6942668	12/2004	Padget et al.	N/A	N/A
6945973	12/2004	Bray	N/A	N/A
6945975	12/2004	Dalton	N/A	N/A
6946000	12/2004	Senegas et al.	N/A	N/A
6949100	12/2004	Venturini	N/A	N/A
6949108	12/2004	Holmes	N/A	N/A
6951561	12/2004	Warren et al.	N/A	N/A
6952129	12/2004	Lin et al.	N/A	N/A
6953477	12/2004	Berry	N/A	N/A
6955691	12/2004	Chae et al.	N/A	N/A
6962606	12/2004	Michelson	N/A	N/A
6964674	12/2004	Matsuura et al.	N/A	N/A
6964686	12/2004	Gordon	N/A	N/A
6966910	12/2004	Ritland	N/A	N/A
6966912	12/2004	Michelson	N/A	N/A
6969404	12/2004	Ferree	N/A	N/A
6969405	12/2004	Suddaby	N/A	N/A
D512506	12/2004	Layne et al.	N/A	N/A
6972035	12/2004	Michelson	N/A	N/A
6974479	12/2004	Trieu	N/A	N/A
6979341	12/2004	Scribner et al.	N/A	N/A
6979352	12/2004	Reynolds	N/A	N/A
6979353	12/2004	Bresina	N/A	N/A
6981981	12/2005	Reiley et al.	N/A	N/A
6997929	12/2005	Manzi et al.	N/A	N/A
7004945	12/2005	Boyd et al.	N/A	N/A
7004971	12/2005	Serhan et al.	N/A	N/A
7008431	12/2005	Simonson	N/A	N/A
7008453	12/2005	Michelson	N/A	N/A

7014633	12/2005	Cragg	N/A	N/A
7018089	12/2005	Wenz et al.	N/A	N/A
7018412	12/2005	Ferreira et al.	N/A	N/A
7018415	12/2005	McKay	N/A	N/A
7018416	12/2005	Hanson et al.	N/A	N/A
7018453	12/2005	Klein et al.	N/A	N/A
7022138	12/2005	Mashburn	N/A	N/A
7025746	12/2005	Tal	N/A	N/A
7025787	12/2005	Bryan et al.	N/A	N/A
7029473	12/2005	Zucherman et al.	N/A	N/A
7029498	12/2005	Boehm et al.	N/A	N/A
7037339	12/2005	Houfburg	N/A	N/A
7041107	12/2005	Pohjonen et al.	N/A	N/A
7044954	12/2005	Reiley et al.	N/A	N/A
7048694	12/2005	Mark et al.	N/A	N/A
7048736	12/2005	Robinson et al.	N/A	N/A
7060068	12/2005	Tromanhauser et al.	N/A	N/A
7060073	12/2005	Frey et al.	N/A	N/A
7063701	12/2005	Michelson	N/A	N/A
7063702	12/2005	Michelson	N/A	N/A
7063703	12/2005	Reo	N/A	N/A
7063725	12/2005	Foley	N/A	N/A
7066960	12/2005	Dickman	N/A	N/A
7066961	12/2005	Michelson	N/A	N/A
7069087	12/2005	Sharkey et al.	N/A	N/A
7070598	12/2005	Lim et al.	N/A	N/A
7070601	12/2005	Culbert et al.	N/A	N/A
7074203	12/2005	Johanson et al.	N/A	N/A
7074226	12/2005	Roehm et al.	N/A	N/A
7081120	12/2005	Li et al.	N/A	N/A
7081122	12/2005	Reiley et al.	N/A	N/A
7083650	12/2005	Moskowitz et al.	N/A	N/A
7087053	12/2005	Vanney	N/A	N/A
7087055	12/2005	Lim et al.	N/A	N/A
7087083	12/2005	Pasquet et al.	N/A	N/A
7089063	12/2005	Lesh et al.	N/A	N/A
7094239	12/2005	Michelson	N/A	N/A
7094257	12/2005	Mujwid et al.	N/A	N/A
7094258	12/2005	Lambrecht et al.	N/A	N/A
7101375	12/2005	Zucherman et al.	N/A	N/A
7114501	12/2005	Johnson et al.	N/A	N/A
7115128	12/2005	Michelson	N/A	N/A
7115163	12/2005	Zimmermann	N/A	N/A
7118572	12/2005	Bramlet et al.	N/A	N/A
7118579	12/2005	Michelson	N/A	N/A
7118580	12/2005	Beyersdorff et al.	N/A	N/A
7118598	12/2005	Michelson	N/A	N/A
7124761	12/2005	Lambrecht et al.	N/A	N/A
7125424	12/2005	Banick et al.	N/A	N/A

7128760	12/2005	Michelson	N/A	N/A
7135424	12/2005	Worley et al.	N/A	N/A
7153304	12/2005	Robie et al.	N/A	N/A
7153305	12/2005	Johnson et al.	N/A	N/A
7153306	12/2005	Ralph et al.	N/A	N/A
7153307	12/2005	Scribner et al.	N/A	N/A
D536096	12/2006	Hoogland et al.	N/A	N/A
7156874	12/2006	Paponneau et al.	N/A	N/A
7156875	12/2006	Michelson	N/A	N/A
7156876	12/2006	Moumene et al.	N/A	N/A
7156877	12/2006	Lotz et al.	N/A	N/A
7163558	12/2006	Senegas et al.	N/A	N/A
7166107	12/2006	Anderson	N/A	N/A
7172612	12/2006	Ishikawa	N/A	N/A
7175625	12/2006	Culbert	N/A	N/A
7179293	12/2006	McKay	N/A	N/A
7179294	12/2006	Eisermann et al.	N/A	N/A
7189242	12/2006	Boyd et al.	N/A	N/A
7201751	12/2006	Zucherman et al.	N/A	N/A
7204851	12/2006	Trieu et al.	N/A	N/A
7207991	12/2006	Michelson	N/A	N/A
7211112	12/2006	Baynham et al.	N/A	N/A
7214227	12/2006	Colleran et al.	N/A	N/A
7217291	12/2006	Zucherman et al.	N/A	N/A
7217293	12/2006	Branch, Jr.	N/A	N/A
7220280	12/2006	Kast et al.	N/A	N/A
7220281	12/2006	Lambrecht et al.	N/A	N/A
7223227	12/2006	Pflueger	N/A	N/A
7223292	12/2006	Messerli et al.	N/A	N/A
7226481	12/2006	Kuslich	N/A	N/A
7226482	12/2006	Messerli et al.	N/A	N/A
7226483	12/2006	Gerber et al.	N/A	N/A
7235101	12/2006	Berry et al.	N/A	N/A
7238204	12/2006	Le et al.	N/A	N/A
7241297	12/2006	Shaolian et al.	N/A	N/A
7244273	12/2006	Pedersen et al.	N/A	N/A
7250060	12/2006	Trieu	N/A	N/A
7252671	12/2006	Scribner et al.	N/A	N/A
7267683	12/2006	Sharkey et al.	N/A	N/A
7267687	12/2006	McGuckin, Jr.	N/A	N/A
7270679	12/2006	Istephanous et al.	N/A	N/A
7276062	12/2006	McDaniel et al.	N/A	N/A
7282061	12/2006	Sharkey et al.	N/A	N/A
7291173	12/2006	Richelsoph et al.	N/A	N/A
7300440	12/2006	Zdeblick et al.	N/A	N/A
7306628	12/2006	Zucherman et al.	N/A	N/A
7309357	12/2006	Kim	N/A	N/A
7311713	12/2006	Johnson et al.	N/A	N/A
7316714	12/2007	Gordon et al.	N/A	N/A
7318840	12/2007	McKay	N/A	N/A

7320689	12/2007	Keller	N/A	N/A
7320708	12/2007	Bernstein	N/A	N/A
7322962	12/2007	Forrest	N/A	N/A
7326211	12/2007	Padget et al.	N/A	N/A
7326248	12/2007	Michelson	N/A	N/A
7335203	12/2007	Winslow et al.	N/A	N/A
7351262	12/2007	Bindseil et al.	N/A	N/A
7361140	12/2007	Ries et al.	N/A	N/A
7371238	12/2007	Soboleski et al.	N/A	N/A
7377942	12/2007	Berry	N/A	N/A
7383639	12/2007	Malandain	N/A	N/A
7400930	12/2007	Sharkey et al.	N/A	N/A
7406775	12/2007	Funk et al.	N/A	N/A
7410501	12/2007	Michelson	N/A	N/A
7413576	12/2007	Sybert et al.	N/A	N/A
7422594	12/2007	Zander	N/A	N/A
7434325	12/2007	Foley et al.	N/A	N/A
7442211	12/2007	De et al.	N/A	N/A
7445636	12/2007	Michelson	N/A	N/A
7445637	12/2007	Taylor	N/A	N/A
7470273	12/2007	Dougherty-Shah	N/A	N/A
D584812	12/2008	Ries	N/A	N/A
7473256	12/2008	Assell et al.	N/A	N/A
7473268	12/2008	Zucherman et al.	N/A	N/A
7476251	12/2008	Zucherman et al.	N/A	N/A
7485134	12/2008	Simonson	N/A	N/A
7488326	12/2008	Elliott	N/A	N/A
7491237	12/2008	Randall et al.	N/A	N/A
7500991	12/2008	Bartish et al.	N/A	N/A
7503920	12/2008	Siegal	N/A	N/A
7503933	12/2008	Michelson	N/A	N/A
7507241	12/2008	Levy et al.	N/A	N/A
7517363	12/2008	Rogers et al.	N/A	N/A
7520888	12/2008	Trieu	N/A	N/A
7547317	12/2008	Cragg	N/A	N/A
7556629	12/2008	Von et al.	N/A	N/A
7556651	12/2008	Humphreys et al.	N/A	N/A
7569054	12/2008	Michelson	N/A	N/A
7569074	12/2008	Eisermann et al.	N/A	N/A
7572279	12/2008	Jackson	N/A	N/A
7575580	12/2008	Lim et al.	N/A	N/A
7575599	12/2008	Villiers et al.	N/A	N/A
7578820	12/2008	Moore et al.	N/A	N/A
7588574	12/2008	Assell et al.	N/A	N/A
7601173	12/2008	Messerli et al.	N/A	N/A
7608083	12/2008	Lee et al.	N/A	N/A
7611538	12/2008	Belliard et al.	N/A	N/A
7618458	12/2008	Biedermann et al.	N/A	N/A
7621950	12/2008	Globerman et al.	N/A	N/A
7621960	12/2008	Boyd et al.	N/A	N/A

7625377	12/2008	Veldhuizen et al.	N/A	N/A
7625378	12/2008	Foley	N/A	N/A
7625394	12/2008	Molz et al.	N/A	N/A
7637905	12/2008	Saadat et al.	N/A	N/A
7641657	12/2009	Cragg	N/A	N/A
7641670	12/2009	Davison et al.	N/A	N/A
7641692	12/2009	Bryan et al.	N/A	N/A
7647123	12/2009	Sharkey et al.	N/A	N/A
7648523	12/2009	Mirkovic et al.	N/A	N/A
7655010	12/2009	Serhan et al.	N/A	N/A
7666186	12/2009	Harp	N/A	N/A
7666226	12/2009	Schaller	N/A	N/A
7666266	12/2009	Izawa et al.	N/A	N/A
7670354	12/2009	Davison et al.	N/A	N/A
7670374	12/2009	Schaller	N/A	N/A
7674265	12/2009	Smith et al.	N/A	N/A
7674273	12/2009	Davison et al.	N/A	N/A
7682370	12/2009	Pagliuca et al.	N/A	N/A
7682400	12/2009	Zwirkoski	N/A	N/A
7686807	12/2009	Padget et al.	N/A	N/A
7691120	12/2009	Shluzas et al.	N/A	N/A
7691147	12/2009	Guetlin et al.	N/A	N/A
7699878	12/2009	Pavlov et al.	N/A	N/A
7703727	12/2009	Selness	N/A	N/A
7704280	12/2009	Lechmann et al.	N/A	N/A
7708778	12/2009	Gordon et al.	N/A	N/A
7717944	12/2009	Foley et al.	N/A	N/A
7722530	12/2009	Davison	N/A	N/A
7722612	12/2009	Sala et al.	N/A	N/A
7722674	12/2009	Grotz	N/A	N/A
7727263	12/2009	Cragg	N/A	N/A
7731751	12/2009	Butler et al.	N/A	N/A
7740633	12/2009	Assell et al.	N/A	N/A
7744599	12/2009	Cragg	N/A	N/A
7744650	12/2009	Lindner et al.	N/A	N/A
7749270	12/2009	Peterman	N/A	N/A
7762995	12/2009	Eversull et al.	N/A	N/A
7763025	12/2009	Ainsworth	N/A	N/A
7763028	12/2009	Lim et al.	N/A	N/A
7763038	12/2009	O'Brien	N/A	N/A
7763055	12/2009	Foley	N/A	N/A
7766930	12/2009	Dipoto et al.	N/A	N/A
7771473	12/2009	Thramann	N/A	N/A
7771479	12/2009	Humphreys et al.	N/A	N/A
7785368	12/2009	Schaller	N/A	N/A
7789914	12/2009	Michelson	N/A	N/A
7794463	12/2009	Cragg	N/A	N/A
7799032	12/2009	Assell et al.	N/A	N/A
7799033	12/2009	Assell et al.	N/A	N/A
7799036	12/2009	Davison et al.	N/A	N/A

7799080	12/2009	Doty	N/A	N/A
7799081	12/2009	McKinley	N/A	N/A
7799083	12/2009	Smith et al.	N/A	N/A
7803161	12/2009	Foley et al.	N/A	N/A
D626233	12/2009	Cipoletti et al.	N/A	N/A
7814429	12/2009	Buffet et al.	N/A	N/A
7819921	12/2009	Grotz	N/A	N/A
7824410	12/2009	Simonson et al.	N/A	N/A
7824429	12/2009	Culbert et al.	N/A	N/A
7824445	12/2009	Biro et al.	N/A	N/A
7828807	12/2009	Lehuec et al.	N/A	N/A
7828849	12/2009	Lim	N/A	N/A
7837734	12/2009	Zucherman et al.	N/A	N/A
7846183	12/2009	Blain	N/A	N/A
7846206	12/2009	Oglaza et al.	N/A	N/A
7850695	12/2009	Pagliuca et al.	N/A	N/A
7850733	12/2009	Baynham et al.	N/A	N/A
7854766	12/2009	Moskowitz et al.	N/A	N/A
7857832	12/2009	Culbert et al.	N/A	N/A
7857840	12/2009	Krebs et al.	N/A	N/A
7862590	12/2010	Lim et al.	N/A	N/A
7862595	12/2010	Foley et al.	N/A	N/A
7867259	12/2010	Foley et al.	N/A	N/A
7874980	12/2010	Sonnenschein et al.	N/A	N/A
7875077	12/2010	Humphreys et al.	N/A	N/A
7879098	12/2010	Simmons, Jr.	N/A	N/A
7887589	12/2010	Glenn et al.	N/A	N/A
7892171	12/2010	Davison et al.	N/A	N/A
7892249	12/2010	Davison et al.	N/A	N/A
7901438	12/2010	Culbert et al.	N/A	N/A
7901459	12/2010	Hodges et al.	N/A	N/A
7909870	12/2010	Kraus	N/A	N/A
7909874	12/2010	Zielinski	N/A	N/A
7918874	12/2010	Siegal	N/A	N/A
7922719	12/2010	Ralph et al.	N/A	N/A
7922729	12/2010	Michelson	N/A	N/A
7927373	12/2010	Parsons et al.	N/A	N/A
7931674	12/2010	Zucherman et al.	N/A	N/A
7931689	12/2010	Hochschuler et al.	N/A	N/A
7935051	12/2010	Miles et al.	N/A	N/A
7938832	12/2010	Culbert et al.	N/A	N/A
7938857	12/2010	Garcia-Bengochea et al.	N/A	N/A
7942903	12/2010	Moskowitz et al.	N/A	N/A
7947078	12/2010	Siegal	N/A	N/A
7951199	12/2010	Miller	N/A	N/A
7955391	12/2010	Schaller	N/A	N/A
7959675	12/2010	Gately	N/A	N/A
7963967	12/2010	Woods	N/A	N/A

7963993	12/2010	Schaller	N/A	N/A
7967864	12/2010	Schaller	N/A	N/A
7967865	12/2010	Schaller	N/A	N/A
7985231	12/2010	Sankaran	N/A	N/A
7993377	12/2010	Culbert et al.	N/A	N/A
7993403	12/2010	Foley et al.	N/A	N/A
7998176	12/2010	Culbert	N/A	N/A
8007535	12/2010	Hudgins et al.	N/A	N/A
8012207	12/2010	Kim	N/A	N/A
8012208	12/2010	Lechmann et al.	N/A	N/A
8012212	12/2010	Link et al.	N/A	N/A
8021424	12/2010	Beger et al.	N/A	N/A
8021426	12/2010	Segal et al.	N/A	N/A
8025697	12/2010	McClellan et al.	N/A	N/A
8034109	12/2010	Zwirkoski	N/A	N/A
8034110	12/2010	Garner et al.	N/A	N/A
8038703	12/2010	Dobak et al.	N/A	N/A
8043293	12/2010	Warnick	N/A	N/A
8043381	12/2010	Hestad et al.	N/A	N/A
8052754	12/2010	Froehlich	N/A	N/A
8057544	12/2010	Schaller	N/A	N/A
8057545	12/2010	Hughes et al.	N/A	N/A
8062375	12/2010	Glerum et al.	N/A	N/A
8075621	12/2010	Michelson	N/A	N/A
8097036	12/2011	Cordaro et al.	N/A	N/A
8100978	12/2011	Bass	N/A	N/A
8105382	12/2011	Olmos et al.	N/A	N/A
8109972	12/2011	Zucherman et al.	N/A	N/A
8109977	12/2011	Culbert et al.	N/A	N/A
8114088	12/2011	Miller	N/A	N/A
8118871	12/2011	Gordon	N/A	N/A
8128700	12/2011	Delurio et al.	N/A	N/A
8128702	12/2011	Zucherman et al.	N/A	N/A
8133232	12/2011	Levy et al.	N/A	N/A
8147549	12/2011	Metcalf et al.	N/A	N/A
8177812	12/2011	Sankaran	N/A	N/A
8187327	12/2011	Edidin et al.	N/A	N/A
8187332	12/2011	McLuen	N/A	N/A
8192495	12/2011	Simpson et al.	N/A	N/A
8202322	12/2011	Doty	N/A	N/A
8206423	12/2011	Siegal	N/A	N/A
8216312	12/2011	Gray	N/A	N/A
8216314	12/2011	Richelsoph	N/A	N/A
8216317	12/2011	Thibodeau	N/A	N/A
8221501	12/2011	Eisermann et al.	N/A	N/A
8221502	12/2011	Branch, Jr.	N/A	N/A
8221503	12/2011	Garcia et al.	N/A	N/A
8226691	12/2011	McDonnell	N/A	N/A
8231675	12/2011	Rhoda	N/A	N/A
8231681	12/2011	Castleman et al.	N/A	N/A

8236029	12/2011	Siegal	N/A	N/A
8236058	12/2011	Fabian et al.	N/A	N/A
8241328	12/2011	Siegal	N/A	N/A
8241358	12/2011	Butler et al.	N/A	N/A
8241361	12/2011	Link	N/A	N/A
8241364	12/2011	Hansell et al.	N/A	N/A
8246622	12/2011	Siegal et al.	N/A	N/A
8257440	12/2011	Gordon et al.	N/A	N/A
8257442	12/2011	Edie et al.	N/A	N/A
8262666	12/2011	Baynham et al.	N/A	N/A
8262736	12/2011	Michelson	N/A	N/A
8267939	12/2011	Cipoletti et al.	N/A	N/A
8267965	12/2011	Gimbel et al.	N/A	N/A
8273128	12/2011	Oh et al.	N/A	N/A
8273129	12/2011	Baynham et al.	N/A	N/A
8282641	12/2011	Lopez et al.	N/A	N/A
8287599	12/2011	McGuckin, Jr.	N/A	N/A
8292959	12/2011	Webb et al.	N/A	N/A
8303663	12/2011	Jimenez et al.	N/A	N/A
8313528	12/2011	Wensel	N/A	N/A
8317866	12/2011	Palmatier et al.	N/A	N/A
8323345	12/2011	Sledge	N/A	N/A
8328812	12/2011	Siegal et al.	N/A	N/A
8328852	12/2011	Zehavi et al.	N/A	N/A
8337559	12/2011	Hansell et al.	N/A	N/A
8343193	12/2012	Johnson et al.	N/A	N/A
8343222	12/2012	Cope	N/A	N/A
8353961	12/2012	McClintock et al.	N/A	N/A
8361154	12/2012	Reo	N/A	N/A
8366777	12/2012	Matthis et al.	N/A	N/A
8377098	12/2012	Landry et al.	N/A	N/A
8382842	12/2012	Greenhalgh et al.	N/A	N/A
8394129	12/2012	Morgenstern et al.	N/A	N/A
8398712	12/2012	De et al.	N/A	N/A
8398713	12/2012	Weiman	N/A	N/A
8403990	12/2012	Dryer et al.	N/A	N/A
8409282	12/2012	Kim	N/A	N/A
8409290	12/2012	Zamani et al.	N/A	N/A
8409291	12/2012	Blackwell et al.	N/A	N/A
8414650	12/2012	Bertele et al.	N/A	N/A
8425559	12/2012	Tebbe et al.	N/A	N/A
8435298	12/2012	Weiman	N/A	N/A
8444697	12/2012	Butler et al.	N/A	N/A
8454617	12/2012	Schaller et al.	N/A	N/A
8454698	12/2012	De et al.	N/A	N/A
8465524	12/2012	Siegal	N/A	N/A
8470043	12/2012	Schaller et al.	N/A	N/A
8480715	12/2012	Gray	N/A	N/A
8480742	12/2012	Pisharodi	N/A	N/A
8480748	12/2012	Poulos	N/A	N/A

8486109	12/2012	Siegal	N/A	N/A
8486148	12/2012	Butler et al.	N/A	N/A
8491591	12/2012	Sebastian	N/A	N/A
8491653	12/2012	Zucherman et al.	N/A	N/A
8491657	12/2012	Attia et al.	N/A	N/A
8491659	12/2012	Weiman	N/A	N/A
8506635	12/2012	Palmatier et al.	N/A	N/A
8518087	12/2012	Lopez et al.	N/A	N/A
8518120	12/2012	Glerum et al.	N/A	N/A
8523909	12/2012	Hess	N/A	N/A
8523944	12/2012	Jimenez et al.	N/A	N/A
8535380	12/2012	Greenhalgh et al.	N/A	N/A
8545567	12/2012	Krueger	N/A	N/A
8551092	12/2012	Morgan et al.	N/A	N/A
8551094	12/2012	Von et al.	N/A	N/A
8551173	12/2012	Lechmann et al.	N/A	N/A
8556978	12/2012	Schaller	N/A	N/A
8556979	12/2012	Glerum et al.	N/A	N/A
8568481	12/2012	Olmos et al.	N/A	N/A
8579977	12/2012	Fabian	N/A	N/A
8579981	12/2012	Lim et al.	N/A	N/A
8591583	12/2012	Schaller et al.	N/A	N/A
8591585	12/2012	McLaughlin et al.	N/A	N/A
8597330	12/2012	Siegal	N/A	N/A
8597333	12/2012	Morgenstern et al.	N/A	N/A
8597360	12/2012	McLuen et al.	N/A	N/A
8603168	12/2012	Gordon et al.	N/A	N/A
8603170	12/2012	Cipoletti et al.	N/A	N/A
8603177	12/2012	Gray	N/A	N/A
8623088	12/2013	Tohmeh et al.	N/A	N/A
8623091	12/2013	Suedkamp et al.	N/A	N/A
8628575	12/2013	Muhanna et al.	N/A	N/A
8628576	12/2013	Triplett et al.	N/A	N/A
8628577	12/2013	Jimenez	N/A	N/A
8628578	12/2013	Miller et al.	N/A	N/A
8632595	12/2013	Weiman	N/A	N/A
8636746	12/2013	Jimenez et al.	N/A	N/A
8641764	12/2013	Gately	N/A	N/A
8663329	12/2013	Ernst	N/A	N/A
8663331	12/2013	McClellan et al.	N/A	N/A
8668740	12/2013	Rhoda et al.	N/A	N/A
8672977	12/2013	Siegal et al.	N/A	N/A
8679161	12/2013	Malandain et al.	N/A	N/A
8679183	12/2013	Glerum et al.	N/A	N/A
8685095	12/2013	Miller et al.	N/A	N/A
8685098	12/2013	Glerum et al.	N/A	N/A
8696751	12/2013	Ashley et al.	N/A	N/A
8702757	12/2013	Thommen et al.	N/A	N/A
8702798	12/2013	Matthis et al.	N/A	N/A
8709086	12/2013	Glerum	N/A	N/A

8709088	12/2013	Kleiner et al.	N/A	N/A
8715284	12/2013	Culbert	N/A	N/A
8715351	12/2013	Pinto	N/A	N/A
8721723	12/2013	Hansell et al.	N/A	N/A
8728160	12/2013	Globerman et al.	N/A	N/A
8728166	12/2013	Schwab	N/A	N/A
8740954	12/2013	Ghobrial et al.	N/A	N/A
8753398	12/2013	Gordon et al.	N/A	N/A
8758349	12/2013	Germain et al.	N/A	N/A
8758441	12/2013	Hovda et al.	N/A	N/A
8764806	12/2013	Abdou	N/A	N/A
8771360	12/2013	Jimenez et al.	N/A	N/A
8777993	12/2013	Siegal et al.	N/A	N/A
8778025	12/2013	Ragab et al.	N/A	N/A
8795366	12/2013	Varela	N/A	N/A
8795374	12/2013	Chee	N/A	N/A
8801787	12/2013	Schaller	N/A	N/A
8801792	12/2013	De et al.	N/A	N/A
8808376	12/2013	Schaller	N/A	N/A
8828085	12/2013	Jensen	N/A	N/A
8845638	12/2013	Siegal et al.	N/A	N/A
8845728	12/2013	Abdou	N/A	N/A
8845731	12/2013	Weiman	N/A	N/A
8845732	12/2013	Weiman	N/A	N/A
8845733	12/2013	O'Neil et al.	N/A	N/A
8845734	12/2013	Weiman	N/A	N/A
8852242	12/2013	Morgenstern et al.	N/A	N/A
8852243	12/2013	Morgenstern et al.	N/A	N/A
8852279	12/2013	Weiman	N/A	N/A
8864833	12/2013	Glerum et al.	N/A	N/A
8888853	12/2013	Glerum et al.	N/A	N/A
8888854	12/2013	Glerum et al.	N/A	N/A
8894711	12/2013	Varela	N/A	N/A
8894712	12/2013	Varela	N/A	N/A
8900235	12/2013	Siegal	N/A	N/A
8900307	12/2013	Hawkins et al.	N/A	N/A
8906098	12/2013	Siegal	N/A	N/A
8920506	12/2013	McGuckin, Jr.	N/A	N/A
8926704	12/2014	Glerum et al.	N/A	N/A
8936641	12/2014	Cain	N/A	N/A
8940049	12/2014	Jimenez et al.	N/A	N/A
8940050	12/2014	Laurence et al.	N/A	N/A
8940052	12/2014	Lechmann et al.	N/A	N/A
8961609	12/2014	Schaller	N/A	N/A
8968408	12/2014	Schaller et al.	N/A	N/A
8979860	12/2014	Voellmicke et al.	N/A	N/A
8979929	12/2014	Schaller	N/A	N/A
8986387	12/2014	To et al.	N/A	N/A
8986388	12/2014	Siegal et al.	N/A	N/A
8986389	12/2014	Lim et al.	N/A	N/A

9005291	12/2014	Loebl et al.	N/A	N/A
9017408	12/2014	Siegal et al.	N/A	N/A
9017413	12/2014	Siegal et al.	N/A	N/A
9039767	12/2014	Raymond et al.	N/A	N/A
9039771	12/2014	Glerum et al.	N/A	N/A
9044334	12/2014	Siegal et al.	N/A	N/A
9044338	12/2014	Schaller	N/A	N/A
9060876	12/2014	To et al.	N/A	N/A
9066808	12/2014	Schaller	N/A	N/A
9078767	12/2014	McLean	N/A	N/A
9089428	12/2014	Bertele et al.	N/A	N/A
9095446	12/2014	Landry et al.	N/A	N/A
9095447	12/2014	Barreiro et al.	N/A	N/A
9101488	12/2014	Malandain	N/A	N/A
9101489	12/2014	Protopsaltis et al.	N/A	N/A
9101491	12/2014	Rodgers et al.	N/A	N/A
9101492	12/2014	Mangione et al.	N/A	N/A
9107766	12/2014	McLean et al.	N/A	N/A
9113853	12/2014	Casey et al.	N/A	N/A
9119730	12/2014	Glerum et al.	N/A	N/A
9155631	12/2014	Seifert et al.	N/A	N/A
9237956	12/2015	Jensen	N/A	N/A
9254138	12/2015	Siegal et al.	N/A	N/A
9259326	12/2015	Schaller	N/A	N/A
9271846	12/2015	Lim et al.	N/A	N/A
9277928	12/2015	Morgenstern Lopez	N/A	N/A
9282979	12/2015	O'Neil et al.	N/A	N/A
9283092	12/2015	Siegal et al.	N/A	N/A
9295562	12/2015	Lechmann et al.	N/A	N/A
9314348	12/2015	Emstad	N/A	N/A
9320610	12/2015	Alheidt et al.	N/A	N/A
9320615	12/2015	Suedkamp et al.	N/A	N/A
9326866	12/2015	Schaller et al.	N/A	N/A
9333091	12/2015	Dimauro	N/A	N/A
9358123	12/2015	Remington et al.	N/A	N/A
9387087	12/2015	Tyber	N/A	N/A
9387313	12/2015	Culbert et al.	N/A	N/A
9402732	12/2015	Gabelberger	N/A	N/A
9402739	12/2015	Weiman et al.	N/A	N/A
9408712	12/2015	Siegal et al.	N/A	N/A
9414923	12/2015	Studer et al.	N/A	N/A
9414934	12/2015	Cain	N/A	N/A
9414936	12/2015	Miller et al.	N/A	N/A
9433510	12/2015	Lechmann et al.	N/A	N/A
9439776	12/2015	Dimauro et al.	N/A	N/A
9439777	12/2015	Dimauro	N/A	N/A
9445825	12/2015	Belaney et al.	N/A	N/A
9445918	12/2015	Lin et al.	N/A	N/A
9445919	12/2015	Palmatier et al.	N/A	N/A

9463099	12/2015	Levy et al.	N/A	N/A
9474623	12/2015	Cain	N/A	N/A
9492288	12/2015	Wagner et al.	N/A	N/A
9510954	12/2015	Glerum et al.	N/A	N/A
9522070	12/2015	Flower et al.	N/A	N/A
9532884	12/2016	Siegal et al.	N/A	N/A
9566165	12/2016	Lee et al.	N/A	N/A
9566167	12/2016	Barrus et al.	N/A	N/A
9579215	12/2016	Suedkamp et al.	N/A	N/A
9592129	12/2016	Slivka et al.	N/A	N/A
9597197	12/2016	Lechmann et al.	N/A	N/A
9662223	12/2016	Matthis et al.	N/A	N/A
9662224	12/2016	Weiman et al.	N/A	N/A
9675470	12/2016	Packer et al.	N/A	N/A
9717601	12/2016	Miller	N/A	N/A
9724207	12/2016	Dimauro et al.	N/A	N/A
9730803	12/2016	Dimauro et al.	N/A	N/A
9730806	12/2016	Capote	N/A	N/A
9750552	12/2016	Stephan et al.	N/A	N/A
9750618	12/2016	Daffinson et al.	N/A	N/A
9788962	12/2016	Gabelberger	N/A	N/A
9788963	12/2016	Aquino et al.	N/A	N/A
9788971	12/2016	Stein	N/A	N/A
9801639	12/2016	O'Neil et al.	N/A	N/A
9801640	12/2016	O'Neil et al.	N/A	N/A
9801729	12/2016	Dimauro et al.	N/A	N/A
9801734	12/2016	Stein et al.	N/A	N/A
9808351	12/2016	Kelly et al.	N/A	N/A
9808353	12/2016	Suddaby et al.	N/A	N/A
9814589	12/2016	Dimauro	N/A	N/A
9814590	12/2016	Serhan et al.	N/A	N/A
9833334	12/2016	Voellmicke et al.	N/A	N/A
9839528	12/2016	Weiman et al.	N/A	N/A
9839530	12/2016	Hawkins et al.	N/A	N/A
9848991	12/2016	Boehm et al.	N/A	N/A
9872779	12/2017	Miller et al.	N/A	N/A
9895236	12/2017	Voellmicke et al.	N/A	N/A
9907670	12/2017	Deridder et al.	N/A	N/A
9924978	12/2017	Thommen et al.	N/A	N/A
9925060	12/2017	Dimauro et al.	N/A	N/A
9931223	12/2017	Cain	N/A	N/A
9931226	12/2017	Kurtaliaj et al.	N/A	N/A
9937053	12/2017	Melkent et al.	N/A	N/A
9949769	12/2017	Serhan et al.	N/A	N/A
9962272	12/2017	Daffinson et al.	N/A	N/A
9974664	12/2017	Emerick et al.	N/A	N/A
9980823	12/2017	Matthis et al.	N/A	N/A
9980825	12/2017	Nichols et al.	N/A	N/A
9993350	12/2017	Cain	N/A	N/A
10004607	12/2017	Weiman et al.	N/A	N/A

10034772	12/2017	Glerum et al.	N/A	N/A
10058433	12/2017	Lechmann et al.	N/A	N/A
10085843	12/2017	Dimauro	N/A	N/A
10092417	12/2017	Weiman et al.	N/A	N/A
10098759	12/2017	Weiman	N/A	N/A
10137009	12/2017	Weiman et al.	N/A	N/A
10143569	12/2017	Weiman et al.	N/A	N/A
10166117	12/2018	Daffinson et al.	N/A	N/A
10182831	12/2018	Marnay et al.	N/A	N/A
10219915	12/2018	Stein	N/A	N/A
10238500	12/2018	Rogers et al.	N/A	N/A
10265191	12/2018	Lim et al.	N/A	N/A
10285820	12/2018	Greenhalgh	N/A	N/A
10307254	12/2018	Levy et al.	N/A	N/A
10363142	12/2018	McClintock et al.	N/A	N/A
10376372	12/2018	Serhan et al.	N/A	N/A
10393563	12/2018	Lee et al.	N/A	N/A
10398563	12/2018	Engstrom	N/A	N/A
10398566	12/2018	Olmos et al.	N/A	N/A
10405986	12/2018	Kelly et al.	N/A	N/A
10405989	12/2018	O'Neil et al.	N/A	N/A
10420651	12/2018	Serhan et al.	N/A	N/A
10426632	12/2018	Butler et al.	N/A	N/A
10433971	12/2018	Dimauro et al.	N/A	N/A
10433974	12/2018	O'Neil	N/A	N/A
10433977	12/2018	Lechmann et al.	N/A	N/A
10449056	12/2018	Cain	N/A	N/A
10449058	12/2018	Lechmann et al.	N/A	N/A
10470894	12/2018	Foley et al.	N/A	N/A
10492918	12/2018	Dimauro	N/A	N/A
10492924	12/2018	Stein et al.	N/A	N/A
10500062	12/2018	Marchek et al.	N/A	N/A
10512489	12/2018	Serhan et al.	N/A	N/A
10537436	12/2019	Maguire et al.	N/A	N/A
10548741	12/2019	Suedkamp et al.	N/A	N/A
10555817	12/2019	Dimauro et al.	N/A	N/A
10575959	12/2019	Dimauro et al.	N/A	N/A
10583013	12/2019	Dimauro et al.	N/A	N/A
10583015	12/2019	Olmos et al.	N/A	N/A
10624758	12/2019	Slivka et al.	N/A	N/A
10639164	12/2019	Dimauro et al.	N/A	N/A
10639166	12/2019	Weiman et al.	N/A	N/A
10682241	12/2019	Glerum et al.	N/A	N/A
10743914	12/2019	Lopez et al.	N/A	N/A
10758371	12/2019	Hessler et al.	N/A	N/A
10842644	12/2019	Weiman et al.	N/A	N/A
10888433	12/2020	Frasier et al.	N/A	N/A
10966840	12/2020	Voellmicke et al.	N/A	N/A
10973652	12/2020	Hawkins et al.	N/A	N/A
11051954	12/2020	Greenhalgh et al.	N/A	N/A

11103362	12/2020	Butler et al.	N/A	N/A
11426286	12/2021	Spetzger	N/A	N/A
11622868	12/2022	Hawkins et al.	N/A	N/A
11752009	12/2022	Melchor	N/A	N/A
2001/0011174	12/2000	Reiley et al.	N/A	N/A
2001/0016741	12/2000	Burkus et al.	N/A	N/A
2001/0016775	12/2000	Scarborough et al.	N/A	N/A
2001/0037126	12/2000	Stack et al.	N/A	N/A
2001/0039453	12/2000	Gresser et al.	N/A	N/A
2001/0056302	12/2000	Boyer et al.	N/A	N/A
2002/0001476	12/2001	Nagamine et al.	N/A	N/A
2002/0010070	12/2001	Cales et al.	N/A	N/A
2002/0026195	12/2001	Layne et al.	N/A	N/A
2002/0026244	12/2001	Trieu	N/A	N/A
2002/0029084	12/2001	Paul et al.	N/A	N/A
2002/0032462	12/2001	Houser et al.	N/A	N/A
2002/0032483	12/2001	Nicholson et al.	N/A	N/A
2002/0035400	12/2001	Bryan et al.	N/A	N/A
2002/0037799	12/2001	Li et al.	N/A	N/A
2002/0045942	12/2001	Ham	N/A	N/A
2002/0055740	12/2001	Lieberman	N/A	N/A
2002/0055781	12/2001	Sazy	N/A	N/A
2002/0068974	12/2001	Kuslich et al.	N/A	N/A
2002/0072801	12/2001	Michelson	N/A	N/A
2002/0077701	12/2001	Kuslich	N/A	N/A
2002/0082608	12/2001	Reiley et al.	N/A	N/A
2002/0087152	12/2001	Mikus et al.	N/A	N/A
2002/0087163	12/2001	Dixon et al.	N/A	N/A
2002/0099444	12/2001	Boyd et al.	N/A	N/A
2002/0107519	12/2001	Dixon et al.	N/A	N/A
2002/0107573	12/2001	Steinberg	N/A	N/A
2002/0120335	12/2001	Angelucci et al.	N/A	N/A
2002/0138078	12/2001	Chappuis	N/A	N/A
2002/0143331	12/2001	Zucherman et al.	N/A	N/A
2002/0151976	12/2001	Foley et al.	N/A	N/A
2002/0161444	12/2001	Choi	N/A	N/A
2002/0165612	12/2001	Gerber et al.	N/A	N/A
2002/0169471	12/2001	Ferdinand	N/A	N/A
2002/0172851	12/2001	Corey et al.	N/A	N/A
2002/0173841	12/2001	Ortiz et al.	N/A	N/A
2002/0173851	12/2001	McKay	N/A	N/A
2002/0183848	12/2001	Ray et al.	N/A	N/A
2002/0191487	12/2001	Sand	N/A	N/A
2002/0193883	12/2001	Wironen	N/A	N/A
2002/0198526	12/2001	Shaolian et al.	N/A	N/A
2003/0006942	12/2002	Searls et al.	N/A	N/A
2003/0014113	12/2002	Ralph et al.	N/A	N/A
2003/0014116	12/2002	Ralph et al.	N/A	N/A
2003/0023305	12/2002	McKay	N/A	N/A
2003/0028250	12/2002	Reiley et al.	N/A	N/A

2003/0028251	12/2002	Mathews	N/A	N/A
2003/0032963	12/2002	Reiss et al.	N/A	N/A
2003/0040796	12/2002	Ferree	N/A	N/A
2003/0040799	12/2002	Boyd et al.	N/A	N/A
2003/0045937	12/2002	Ginn	N/A	N/A
2003/0050644	12/2002	Boucher et al.	N/A	N/A
2003/0063582	12/2002	Mizell et al.	N/A	N/A
2003/0069593	12/2002	Tremulis et al.	N/A	N/A
2003/0069642	12/2002	Ralph et al.	N/A	N/A
2003/0073998	12/2002	Pagliuca et al.	N/A	N/A
2003/0074075	12/2002	Thomas et al.	N/A	N/A
2003/0078667	12/2002	Manasas et al.	N/A	N/A
2003/0108588	12/2002	Chen et al.	N/A	N/A
2003/0130664	12/2002	Boucher et al.	N/A	N/A
2003/0135275	12/2002	Garcia et al.	N/A	N/A
2003/0139648	12/2002	Foley et al.	N/A	N/A
2003/0139812	12/2002	Garcia et al.	N/A	N/A
2003/0139813	12/2002	Messerli et al.	N/A	N/A
2003/0171812	12/2002	Grunberg et al.	N/A	N/A
2003/0171814	12/2002	Muhanna et al.	N/A	N/A
2003/0187431	12/2002	Simonson	N/A	N/A
2003/0187506	12/2002	Ross et al.	N/A	N/A
2003/0191414	12/2002	Reiley et al.	N/A	N/A
2003/0191489	12/2002	Reiley et al.	N/A	N/A
2003/0191531	12/2002	Berry et al.	N/A	N/A
2003/0195518	12/2002	Cragg	N/A	N/A
2003/0195547	12/2002	Scribner et al.	N/A	N/A
2003/0195630	12/2002	Ferree	N/A	N/A
2003/0208122	12/2002	Melkent et al.	N/A	N/A
2003/0208203	12/2002	Lim et al.	N/A	N/A
2003/0208220	12/2002	Worley et al.	N/A	N/A
2003/0208270	12/2002	Michelson	N/A	N/A
2003/0220643	12/2002	Ferree	N/A	N/A
2003/0220648	12/2002	Osorio et al.	N/A	N/A
2003/0220695	12/2002	Sevrain	N/A	N/A
2003/0229350	12/2002	Kay	N/A	N/A
2003/0229372	12/2002	Reiley et al.	N/A	N/A
2003/0233096	12/2002	Osorio et al.	N/A	N/A
2003/0233102	12/2002	Nakamura et al.	N/A	N/A
2003/0233145	12/2002	Landry et al.	N/A	N/A
2003/0233146	12/2002	Grinberg et al.	N/A	N/A
2004/0006391	12/2003	Reiley	N/A	N/A
2004/0008949	12/2003	Liu et al.	N/A	N/A
2004/0010251	12/2003	Pitaru et al.	N/A	N/A
2004/0010263	12/2003	Boucher et al.	N/A	N/A
2004/0010318	12/2003	Ferree	N/A	N/A
2004/0019354	12/2003	Johnson et al.	N/A	N/A
2004/0019359	12/2003	Worley et al.	N/A	N/A
2004/0024408	12/2003	Burkus et al.	N/A	N/A
2004/0024409	12/2003	Sand et al.	N/A	N/A

2004/0024410	12/2003	Olson et al.	N/A	N/A
2004/0024463	12/2003	Thomas et al.	N/A	N/A
2004/0024465	12/2003	Lambrecht et al.	N/A	N/A
2004/0030387	12/2003	Landry et al.	N/A	N/A
2004/0034429	12/2003	Lambrecht et al.	N/A	N/A
2004/0049190	12/2003	Biedermann et al.	N/A	N/A
2004/0049223	12/2003	Nishtala et al.	N/A	N/A
2004/0049270	12/2003	Gewirtz	N/A	N/A
2004/0059333	12/2003	Carl et al.	N/A	N/A
2004/0059337	12/2003	Hanson et al.	N/A	N/A
2004/0059350	12/2003	Gordon et al.	N/A	N/A
2004/0059418	12/2003	McKay et al.	N/A	N/A
2004/0068269	12/2003	Bonati et al.	N/A	N/A
2004/0073213	12/2003	Serhan et al.	N/A	N/A
2004/0082953	12/2003	Petit	N/A	N/A
2004/0083000	12/2003	Keller et al.	N/A	N/A
2004/0087947	12/2003	Lim et al.	N/A	N/A
2004/0088055	12/2003	Hanson et al.	N/A	N/A
2004/0092948	12/2003	Stevens et al.	N/A	N/A
2004/0092988	12/2003	Shaolian et al.	N/A	N/A
2004/0093083	12/2003	Branch et al.	N/A	N/A
2004/0097924	12/2003	Lambrecht et al.	N/A	N/A
2004/0097930	12/2003	Justis et al.	N/A	N/A
2004/0097932	12/2003	Ray et al.	N/A	N/A
2004/0097941	12/2003	Weiner et al.	N/A	N/A
2004/0097973	12/2003	Loshakove et al.	N/A	N/A
2004/0098131	12/2003	Bryan et al.	N/A	N/A
2004/0102774	12/2003	Trieu	N/A	N/A
2004/0102784	12/2003	Pasquet et al.	N/A	N/A
2004/0102846	12/2003	Keller et al.	N/A	N/A
2004/0106940	12/2003	Shaolian et al.	N/A	N/A
2004/0116997	12/2003	Taylor et al.	N/A	N/A
2004/0117022	12/2003	Marnay et al.	N/A	N/A
2004/0127991	12/2003	Ferree	N/A	N/A
2004/0133124	12/2003	Bates et al.	N/A	N/A
2004/0133229	12/2003	Lambrecht et al.	N/A	N/A
2004/0133279	12/2003	Krueger et al.	N/A	N/A
2004/0133280	12/2003	Trieu	N/A	N/A
2004/0138748	12/2003	Boyer et al.	N/A	N/A
2004/0143284	12/2003	Chin	N/A	N/A
2004/0143332	12/2003	Krueger et al.	N/A	N/A
2004/0143734	12/2003	Buer et al.	N/A	N/A
2004/0147129	12/2003	Rolfson	N/A	N/A
2004/0147877	12/2003	Heuser	N/A	N/A
2004/0147950	12/2003	Mueller et al.	N/A	N/A
2004/0148027	12/2003	Errico et al.	N/A	N/A
2004/0153064	12/2003	Foley et al.	N/A	N/A
2004/0153115	12/2003	Reiley et al.	N/A	N/A
2004/0153156	12/2003	Cohen et al.	N/A	N/A
2004/0153160	12/2003	Carrasco	N/A	N/A

2004/0158206	12/2003	Aboul-Hosn et al.	N/A	N/A
2004/0158258	12/2003	Bonati et al.	N/A	N/A
2004/0167561	12/2003	Boucher et al.	N/A	N/A
2004/0167562	12/2003	Osorio et al.	N/A	N/A
2004/0167625	12/2003	Beyar et al.	N/A	N/A
2004/0172133	12/2003	Gerber et al.	N/A	N/A
2004/0176775	12/2003	Burkus et al.	N/A	N/A
2004/0186052	12/2003	Iyer et al.	N/A	N/A
2004/0186471	12/2003	Trieu	N/A	N/A
2004/0186482	12/2003	Kolb et al.	N/A	N/A
2004/0186528	12/2003	Ries et al.	N/A	N/A
2004/0186570	12/2003	Rapp	N/A	N/A
2004/0186573	12/2003	Ferree	N/A	N/A
2004/0186577	12/2003	Ferree	N/A	N/A
2004/0193271	12/2003	Fraser et al.	N/A	N/A
2004/0193277	12/2003	Long et al.	N/A	N/A
2004/0210231	12/2003	Boucher et al.	N/A	N/A
2004/0210310	12/2003	Trieu	N/A	N/A
2004/0215344	12/2003	Hochschuler et al.	N/A	N/A
2004/0220580	12/2003	Johnson et al.	N/A	N/A
2004/0220668	12/2003	Eisermann et al.	N/A	N/A
2004/0220669	12/2003	Studer	N/A	N/A
2004/0220672	12/2003	Shadduck	N/A	N/A
2004/0225292	12/2003	Sasso et al.	N/A	N/A
2004/0225296	12/2003	Reiss et al.	N/A	N/A
2004/0225361	12/2003	Glenn et al.	N/A	N/A
2004/0230191	12/2003	Frey et al.	N/A	N/A
2004/0230309	12/2003	Dimauro et al.	N/A	N/A
2004/0243229	12/2003	Vidlund et al.	N/A	N/A
2004/0249377	12/2003	Kaes et al.	N/A	N/A
2004/0249461	12/2003	Ferree	N/A	N/A
2004/0249466	12/2003	Liu et al.	N/A	N/A
2004/0254520	12/2003	Porteous et al.	N/A	N/A
2004/0254575	12/2003	Obenchain et al.	N/A	N/A
2004/0254643	12/2003	Jackson	N/A	N/A
2004/0254644	12/2003	Taylor	N/A	N/A
2004/0260300	12/2003	Gorensek et al.	N/A	N/A
2004/0260397	12/2003	Lambrecht et al.	N/A	N/A
2004/0267271	12/2003	Scribner et al.	N/A	N/A
2004/0267367	12/2003	O'Neil	N/A	N/A
2005/0004578	12/2004	Lambrecht et al.	N/A	N/A
2005/0010292	12/2004	Carrasco	N/A	N/A
2005/0010293	12/2004	Zucherman et al.	N/A	N/A
2005/0010298	12/2004	Zucherman et al.	N/A	N/A
2005/0015148	12/2004	Jansen et al.	N/A	N/A
2005/0015152	12/2004	Sweeney	N/A	N/A
2005/0019365	12/2004	Frauchiger et al.	N/A	N/A
2005/0027360	12/2004	Webb et al.	N/A	N/A
2005/0033295	12/2004	Wisnewski	N/A	N/A
2005/0033440	12/2004	Lambrecht et al.	N/A	N/A

2005/0038431	12/2004	Bartish et al.	N/A	N/A
2005/0038515	12/2004	Kunzler	N/A	N/A
2005/0038517	12/2004	Carrison et al.	N/A	N/A
2005/0043737	12/2004	Reiley et al.	N/A	N/A
2005/0043796	12/2004	Grant et al.	N/A	N/A
2005/0043800	12/2004	Paul et al.	N/A	N/A
2005/0054948	12/2004	Goldenberg	N/A	N/A
2005/0055097	12/2004	Grunberg et al.	N/A	N/A
2005/0060036	12/2004	Schultz et al.	N/A	N/A
2005/0060038	12/2004	Lambrecht et al.	N/A	N/A
2005/0065519	12/2004	Michelson	N/A	N/A
2005/0065609	12/2004	Wardlaw	N/A	N/A
2005/0065610	12/2004	Pisharodi	N/A	N/A
2005/0069571	12/2004	Slivka et al.	N/A	N/A
2005/0070908	12/2004	Cragg	N/A	N/A
2005/0070911	12/2004	Carrison et al.	N/A	N/A
2005/0070913	12/2004	Milbocker et al.	N/A	N/A
2005/0071011	12/2004	Ralph et al.	N/A	N/A
2005/0080443	12/2004	Fallin et al.	N/A	N/A
2005/0080488	12/2004	Schultz	N/A	N/A
2005/0085912	12/2004	Arnin et al.	N/A	N/A
2005/0090443	12/2004	Michael John	N/A	N/A
2005/0090833	12/2004	DiPoto	N/A	N/A
2005/0090852	12/2004	Layne et al.	N/A	N/A
2005/0090899	12/2004	DiPoto	N/A	N/A
2005/0096745	12/2004	Andre et al.	N/A	N/A
2005/0102202	12/2004	Linden et al.	N/A	N/A
2005/0107880	12/2004	Shimp et al.	N/A	N/A
2005/0113919	12/2004	Cragg et al.	N/A	N/A
2005/0113927	12/2004	Malek	N/A	N/A
2005/0113928	12/2004	Cragg et al.	N/A	N/A
2005/0118228	12/2004	Trieu	N/A	N/A
2005/0118550	12/2004	Turri	N/A	N/A
2005/0119657	12/2004	Goldsmith	N/A	N/A
2005/0119662	12/2004	Reiley et al.	N/A	N/A
2005/0119750	12/2004	Studer	N/A	N/A
2005/0119751	12/2004	Lawson	N/A	N/A
2005/0119752	12/2004	Williams et al.	N/A	N/A
2005/0119754	12/2004	Trieu et al.	N/A	N/A
2005/0124989	12/2004	Suddaby	N/A	N/A
2005/0124992	12/2004	Ferree	N/A	N/A
2005/0124999	12/2004	Teitelbaum et al.	N/A	N/A
2005/0125066	12/2004	McAfee	N/A	N/A
2005/0130929	12/2004	Boyd	N/A	N/A
2005/0131267	12/2004	Talmadge	N/A	N/A
2005/0131268	12/2004	Talmadge	N/A	N/A
2005/0131269	12/2004	Talmadge	N/A	N/A
2005/0131406	12/2004	Reiley et al.	N/A	N/A
2005/0131409	12/2004	Chervitz et al.	N/A	N/A
2005/0131538	12/2004	Chervitz et al.	N/A	N/A

2005/0131540	12/2004	Trieu	N/A	N/A
2005/0131541	12/2004	Trieu	N/A	N/A
2005/0137595	12/2004	Hoffmann et al.	N/A	N/A
2005/0142211	12/2004	Wenz	N/A	N/A
2005/0143734	12/2004	Cachia et al.	N/A	N/A
2005/0143763	12/2004	Ortiz et al.	N/A	N/A
2005/0149022	12/2004	Shaolian et al.	N/A	N/A
2005/0149030	12/2004	Serhan et al.	N/A	N/A
2005/0149034	12/2004	Assell et al.	N/A	N/A
2005/0149191	12/2004	Cragg et al.	N/A	N/A
2005/0149194	12/2004	Ahlgren	N/A	N/A
2005/0149197	12/2004	Cauthen	N/A	N/A
2005/0154396	12/2004	Foley et al.	N/A	N/A
2005/0154463	12/2004	Trieu	N/A	N/A
2005/0154467	12/2004	Peterman et al.	N/A	N/A
2005/0159819	12/2004	McCormack et al.	N/A	N/A
2005/0165398	12/2004	Reiley	N/A	N/A
2005/0165420	12/2004	Cha	N/A	N/A
2005/0165484	12/2004	Ferree	N/A	N/A
2005/0171539	12/2004	Braun et al.	N/A	N/A
2005/0171541	12/2004	Boehm et al.	N/A	N/A
2005/0171552	12/2004	Johnson et al.	N/A	N/A
2005/0171608	12/2004	Peterman et al.	N/A	N/A
2005/0171610	12/2004	Humphreys et al.	N/A	N/A
2005/0177173	12/2004	Aebi et al.	N/A	N/A
2005/0182412	12/2004	Johnson et al.	N/A	N/A
2005/0182413	12/2004	Johnson et al.	N/A	N/A
2005/0182414	12/2004	Manzi et al.	N/A	N/A
2005/0182418	12/2004	Boyd et al.	N/A	N/A
2005/0187556	12/2004	Stack et al.	N/A	N/A
2005/0187559	12/2004	Raymond et al.	N/A	N/A
2005/0187564	12/2004	Jayaraman	N/A	N/A
2005/0197702	12/2004	Coppes et al.	N/A	N/A
2005/0197707	12/2004	Trieu et al.	N/A	N/A
2005/0203512	12/2004	Hawkins et al.	N/A	N/A
2005/0216018	12/2004	Sennett	N/A	N/A
2005/0216026	12/2004	Culbert	N/A	N/A
2005/0216081	12/2004	Taylor	N/A	N/A
2005/0216087	12/2004	Zucherman et al.	N/A	N/A
2005/0222681	12/2004	Richley et al.	N/A	N/A
2005/0222684	12/2004	Ferree	N/A	N/A
2005/0228383	12/2004	Zucherman et al.	N/A	N/A
2005/0228397	12/2004	Malandain et al.	N/A	N/A
2005/0234425	12/2004	Miller et al.	N/A	N/A
2005/0234451	12/2004	Markworth	N/A	N/A
2005/0234452	12/2004	Malandain	N/A	N/A
2005/0234456	12/2004	Malandain	N/A	N/A
2005/0240182	12/2004	Zucherman et al.	N/A	N/A
2005/0240189	12/2004	Rousseau et al.	N/A	N/A
2005/0240193	12/2004	Layne et al.	N/A	N/A

2005/0240269	12/2004	Lambrecht et al.	N/A	N/A
2005/0251142	12/2004	Hoffmann et al.	N/A	N/A
2005/0251149	12/2004	Wenz	N/A	N/A
2005/0251260	12/2004	Gerber et al.	N/A	N/A
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2005/0256576	12/2004	Moskowitz et al.	N/A	N/A
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2005/0261695	12/2004	Cragg et al.	N/A	N/A
2005/0261781	12/2004	Sennett et al.	N/A	N/A
2005/0267471	12/2004	Biedermann et al.	N/A	N/A
2005/0273166	12/2004	Sweeney	N/A	N/A
2005/0277938	12/2004	Parsons	N/A	N/A
2005/0278023	12/2004	Zwirkoski	N/A	N/A
2005/0278026	12/2004	Gordon et al.	N/A	N/A
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2005/0283238	12/2004	Reiley	N/A	N/A
2005/0287071	12/2004	Wenz	N/A	N/A
2006/0004326	12/2005	Collins et al.	N/A	N/A
2006/0004457	12/2005	Collins et al.	N/A	N/A
2006/0004458	12/2005	Collins et al.	N/A	N/A
2006/0009778	12/2005	Collins et al.	N/A	N/A
2006/0009779	12/2005	Collins et al.	N/A	N/A
2006/0009845	12/2005	Chin	N/A	N/A
2006/0009851	12/2005	Collins et al.	N/A	N/A
2006/0015105	12/2005	Warren et al.	N/A	N/A
2006/0015119	12/2005	Plassky et al.	N/A	N/A
2006/0030850	12/2005	Keegan et al.	N/A	N/A
2006/0030872	12/2005	Culbert et al.	N/A	N/A
2006/0030933	12/2005	Delegge et al.	N/A	N/A
2006/0030943	12/2005	Peterman	N/A	N/A
2006/0032621	12/2005	Martin et al.	N/A	N/A
2006/0036241	12/2005	Siegal	N/A	N/A
2006/0036244	12/2005	Spitler et al.	N/A	N/A
2006/0036246	12/2005	Carl et al.	N/A	N/A
2006/0036256	12/2005	Carl et al.	N/A	N/A
2006/0036259	12/2005	Carl et al.	N/A	N/A
2006/0036261	12/2005	McDonnell	N/A	N/A
2006/0036323	12/2005	Carl et al.	N/A	N/A
2006/0036324	12/2005	Sachs et al.	N/A	N/A
2006/0041258	12/2005	Galea	N/A	N/A
2006/0041314	12/2005	Millard	N/A	N/A
2006/0045904	12/2005	Aronson	N/A	N/A
2006/0058790	12/2005	Carl et al.	N/A	N/A
2006/0058807	12/2005	Landry et al.	N/A	N/A
2006/0058880	12/2005	Wysocki et al.	N/A	N/A
2006/0064101	12/2005	Arramon	N/A	N/A
2006/0064102	12/2005	Ebner	N/A	N/A
2006/0064171	12/2005	Trieu	N/A	N/A

2006/0064172	12/2005	Trieu	N/A	N/A
2006/0069436	12/2005	Sutton et al.	N/A	N/A
2006/0069439	12/2005	Zucherman et al.	N/A	N/A
2006/0069440	12/2005	Zucherman et al.	N/A	N/A
2006/0074429	12/2005	Ralph et al.	N/A	N/A
2006/0079908	12/2005	Lieberman	N/A	N/A
2006/0084867	12/2005	Tremblay et al.	N/A	N/A
2006/0084977	12/2005	Lieberman	N/A	N/A
2006/0085002	12/2005	Trieu et al.	N/A	N/A
2006/0085009	12/2005	Truckai et al.	N/A	N/A
2006/0085010	12/2005	Lieberman	N/A	N/A
2006/0089642	12/2005	Diaz et al.	N/A	N/A
2006/0089646	12/2005	Bonutti	N/A	N/A
2006/0089654	12/2005	Lins et al.	N/A	N/A
2006/0089715	12/2005	Truckai et al.	N/A	N/A
2006/0089718	12/2005	Zucherman et al.	N/A	N/A
2006/0089719	12/2005	Trieu	N/A	N/A
2006/0095045	12/2005	Trieu	N/A	N/A
2006/0095046	12/2005	Trieu et al.	N/A	N/A
2006/0095134	12/2005	Trieu et al.	N/A	N/A
2006/0095138	12/2005	Truckai et al.	N/A	N/A
2006/0100622	12/2005	Jackson	N/A	N/A
2006/0100706	12/2005	Shadduck et al.	N/A	N/A
2006/0100707	12/2005	Stinson et al.	N/A	N/A
2006/0106381	12/2005	Ferree et al.	N/A	N/A
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2006/0106459	12/2005	Truckai et al.	N/A	N/A
2006/0111715	12/2005	Jackson	N/A	N/A
2006/0111728	12/2005	Abdou	N/A	N/A
2006/0111785	12/2005	O'Neil	N/A	N/A
2006/0119629	12/2005	An et al.	N/A	N/A
2006/0122701	12/2005	Kiester	N/A	N/A
2006/0122703	12/2005	Aebi et al.	N/A	N/A
2006/0122704	12/2005	Vresilovic et al.	N/A	N/A
2006/0129244	12/2005	Ensign	N/A	N/A
2006/0136062	12/2005	Dinello et al.	N/A	N/A
2006/0136064	12/2005	Sherman	N/A	N/A
2006/0142759	12/2005	Amin et al.	N/A	N/A
2006/0142765	12/2005	Dixon et al.	N/A	N/A
2006/0142776	12/2005	Shinkichi	N/A	N/A
2006/0142858	12/2005	Colleran et al.	N/A	N/A
2006/0142864	12/2005	Cauthen	N/A	N/A
2006/0149136	12/2005	Seto et al.	N/A	N/A
2006/0149229	12/2005	Kwak et al.	N/A	N/A
2006/0149237	12/2005	Markworth et al.	N/A	N/A
2006/0149252	12/2005	Markworth et al.	N/A	N/A
2006/0149379	12/2005	Kuslich et al.	N/A	N/A
2006/0149380	12/2005	Lotz et al.	N/A	N/A
2006/0149385	12/2005	McKay	N/A	N/A
2006/0155379	12/2005	Heneveld et al.	N/A	N/A

2006/0161162	12/2005	Lambrecht et al.	N/A	N/A
2006/0161166	12/2005	Johnson et al.	N/A	N/A
2006/0167547	12/2005	Suddaby	N/A	N/A
2006/0167553	12/2005	Cauthen et al.	N/A	N/A
2006/0173545	12/2005	Cauthen et al.	N/A	N/A
2006/0178743	12/2005	Carter	N/A	N/A
2006/0178745	12/2005	Bartish et al.	N/A	N/A
2006/0178746	12/2005	Bartish et al.	N/A	N/A
2006/0184192	12/2005	Markworth et al.	N/A	N/A
2006/0184247	12/2005	Edidin et al.	N/A	N/A
2006/0184248	12/2005	Edidin et al.	N/A	N/A
2006/0190083	12/2005	Arnin et al.	N/A	N/A
2006/0190085	12/2005	Cauthen	N/A	N/A
2006/0195102	12/2005	Malandain	N/A	N/A
2006/0195103	12/2005	Padget et al.	N/A	N/A
2006/0195191	12/2005	Sweeney et al.	N/A	N/A
2006/0200139	12/2005	Michelson	N/A	N/A
2006/0200164	12/2005	Michelson	N/A	N/A
2006/0200239	12/2005	Rothman et al.	N/A	N/A
2006/0200240	12/2005	Rothman et al.	N/A	N/A
2006/0200241	12/2005	Rothman et al.	N/A	N/A
2006/0200242	12/2005	Rothman et al.	N/A	N/A
2006/0200243	12/2005	Rothman et al.	N/A	N/A
2006/0206116	12/2005	Yeung	N/A	N/A
2006/0206207	12/2005	Dryer et al.	N/A	N/A
2006/0212118	12/2005	Abernathie	N/A	N/A
2006/0217711	12/2005	Stevens et al.	N/A	N/A
2006/0229627	12/2005	Hunt et al.	N/A	N/A
2006/0229629	12/2005	Manzi et al.	N/A	N/A
2006/0235403	12/2005	Blain	N/A	N/A
2006/0235412	12/2005	Blain	N/A	N/A
2006/0235423	12/2005	Cantu	N/A	N/A
2006/0235521	12/2005	Zucherman et al.	N/A	N/A
2006/0235531	12/2005	Buettner-Janz	N/A	N/A
2006/0241643	12/2005	Lim et al.	N/A	N/A
2006/0241663	12/2005	Rice et al.	N/A	N/A
2006/0241770	12/2005	Rhoda et al.	N/A	N/A
2006/0247634	12/2005	Warner et al.	N/A	N/A
2006/0247771	12/2005	Peterman et al.	N/A	N/A
2006/0247781	12/2005	Francis	N/A	N/A
2006/0253120	12/2005	Anderson et al.	N/A	N/A
2006/0254784	12/2005	Hartmann et al.	N/A	N/A
2006/0264896	12/2005	Palmer	N/A	N/A
2006/0264939	12/2005	Zucherman et al.	N/A	N/A
2006/0265067	12/2005	Zucherman et al.	N/A	N/A
2006/0265075	12/2005	Baumgartner et al.	N/A	N/A
2006/0265077	12/2005	Zwirkoski	N/A	N/A
2006/0271049	12/2005	Zucherman et al.	N/A	N/A
2006/0271061	12/2005	Beyar et al.	N/A	N/A
2006/0276897	12/2005	Winslow et al.	N/A	N/A

2006/0276899	12/2005	Zipnick et al.	N/A	N/A
2006/0276901	12/2005	Zipnick et al.	N/A	N/A
2006/0276902	12/2005	Zipnick et al.	N/A	N/A
2006/0282167	12/2005	Lambrecht et al.	N/A	N/A
2006/0287727	12/2005	Segal et al.	N/A	N/A
2006/0293662	12/2005	Boyer et al.	N/A	N/A
2006/0293663	12/2005	Walkenhorst et al.	N/A	N/A
2006/0293753	12/2005	Thramann	N/A	N/A
2007/0006692	12/2006	Phan	N/A	N/A
2007/0010716	12/2006	Malandain et al.	N/A	N/A
2007/0010824	12/2006	Malandain et al.	N/A	N/A
2007/0010826	12/2006	Rhoda et al.	N/A	N/A
2007/0010844	12/2006	Gong et al.	N/A	N/A
2007/0010845	12/2006	Gong et al.	N/A	N/A
2007/0010846	12/2006	Leung et al.	N/A	N/A
2007/0010848	12/2006	Leung et al.	N/A	N/A
2007/0010886	12/2006	Banick et al.	N/A	N/A
2007/0010889	12/2006	Francis	N/A	N/A
2007/0032703	12/2006	Sankaran et al.	N/A	N/A
2007/0032790	12/2006	Aschmann et al.	N/A	N/A
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2007/0043361	12/2006	Malandain et al.	N/A	N/A
2007/0043362	12/2006	Malandain et al.	N/A	N/A
2007/0043363	12/2006	Malandain et al.	N/A	N/A
2007/0043440	12/2006	William et al.	N/A	N/A
2007/0048382	12/2006	Meyer et al.	N/A	N/A
2007/0049849	12/2006	Schwardt et al.	N/A	N/A
2007/0049934	12/2006	Edidin et al.	N/A	N/A
2007/0049935	12/2006	Edidin et al.	N/A	N/A
2007/0050034	12/2006	Schwardt et al.	N/A	N/A
2007/0050035	12/2006	Schwardt et al.	N/A	N/A
2007/0055201	12/2006	Seto et al.	N/A	N/A
2007/0055236	12/2006	Hudgins et al.	N/A	N/A
2007/0055237	12/2006	Edidin et al.	N/A	N/A
2007/0055246	12/2006	Zucherman et al.	N/A	N/A
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2007/0055265	12/2006	Schaller	N/A	N/A
2007/0055266	12/2006	Osorio et al.	N/A	N/A
2007/0055267	12/2006	Osorio et al.	N/A	N/A
2007/0055274	12/2006	Appenzeller et al.	N/A	N/A
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2007/0055277	12/2006	Osorio et al.	N/A	N/A
2007/0055278	12/2006	Osorio et al.	N/A	N/A
2007/0055281	12/2006	Osorio et al.	N/A	N/A
2007/0055284	12/2006	Osorio et al.	N/A	N/A
2007/0055300	12/2006	Osorio et al.	N/A	N/A
2007/0055377	12/2006	Hanson et al.	N/A	N/A
2007/0060933	12/2006	Sankaran et al.	N/A	N/A
2007/0060935	12/2006	Schwardt et al.	N/A	N/A

2007/0067034	12/2006	Chirico et al.	N/A	N/A
2007/0067035	12/2006	Falahee	N/A	N/A
2007/0068329	12/2006	Phan et al.	N/A	N/A
2007/0073292	12/2006	Kohm et al.	N/A	N/A
2007/0073399	12/2006	Zipnick et al.	N/A	N/A
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2007/0093689	12/2006	Steinberg	N/A	N/A
2007/0093897	12/2006	Gerbec et al.	N/A	N/A
2007/0093899	12/2006	Dutoit et al.	N/A	N/A
2007/0093901	12/2006	Grotz et al.	N/A	N/A
2007/0093906	12/2006	Hudgins et al.	N/A	N/A
2007/0118222	12/2006	Lang	N/A	N/A
2007/0118223	12/2006	Allard et al.	N/A	N/A
2007/0123891	12/2006	Ries et al.	N/A	N/A
2007/0123892	12/2006	Ries et al.	N/A	N/A
2007/0129730	12/2006	Woods et al.	N/A	N/A
2007/0135922	12/2006	Trieu	N/A	N/A
2007/0142843	12/2006	Dye	N/A	N/A
2007/0149978	12/2006	Shezifi et al.	N/A	N/A
2007/0150059	12/2006	Ruberte et al.	N/A	N/A
2007/0150060	12/2006	Trieu	N/A	N/A
2007/0150061	12/2006	Trieu	N/A	N/A
2007/0150063	12/2006	Ruberte et al.	N/A	N/A
2007/0150064	12/2006	Ruberte et al.	N/A	N/A
2007/0161992	12/2006	Kwak et al.	N/A	N/A
2007/0162005	12/2006	Peterson et al.	N/A	N/A
2007/0162127	12/2006	Peterman et al.	N/A	N/A
2007/0162132	12/2006	Messerli	N/A	N/A
2007/0162138	12/2006	Heinz	N/A	N/A
2007/0167945	12/2006	Lange et al.	N/A	N/A
2007/0168036	12/2006	Ainsworth et al.	N/A	N/A
2007/0168038	12/2006	Trieu	N/A	N/A
2007/0173939	12/2006	Kim et al.	N/A	N/A
2007/0173940	12/2006	Hestad et al.	N/A	N/A
2007/0178222	12/2006	Storey et al.	N/A	N/A
2007/0179612	12/2006	Johnson et al.	N/A	N/A
2007/0179615	12/2006	Heinz et al.	N/A	N/A
2007/0179616	12/2006	Braddock et al.	N/A	N/A
2007/0179618	12/2006	Trieu et al.	N/A	N/A
2007/0185578	12/2006	O'Neil et al.	N/A	N/A
2007/0191953	12/2006	Trieu	N/A	N/A
2007/0191954	12/2006	Hansell et al.	N/A	N/A
2007/0191959	12/2006	Hartmann et al.	N/A	N/A
2007/0197935	12/2006	Reiley et al.	N/A	N/A
2007/0198023	12/2006	Sand et al.	N/A	N/A
2007/0198025	12/2006	Trieu et al.	N/A	N/A
2007/0203491	12/2006	Pasquet et al.	N/A	N/A
2007/0208423	12/2006	Messerli et al.	N/A	N/A
2007/0208426	12/2006	Trieu	N/A	N/A

2007/0213717	12/2006	Trieu et al.	N/A	N/A
2007/0213737	12/2006	Schermerhorn et al.	N/A	N/A
2007/0213826	12/2006	Smith et al.	N/A	N/A
2007/0219634	12/2006	Greenhalgh et al.	N/A	N/A
2007/0225706	12/2006	Clark et al.	N/A	N/A
2007/0225726	12/2006	Dye et al.	N/A	N/A
2007/0225807	12/2006	Phan et al.	N/A	N/A
2007/0225815	12/2006	Keith et al.	N/A	N/A
2007/0233074	12/2006	Anderson et al.	N/A	N/A
2007/0233076	12/2006	Trieu	N/A	N/A
2007/0233083	12/2006	Abdou	N/A	N/A
2007/0233089	12/2006	Dipoto et al.	N/A	N/A
2007/0233130	12/2006	Suddaby	N/A	N/A
2007/0233244	12/2006	Lopez et al.	N/A	N/A
2007/0233254	12/2006	Grotz et al.	N/A	N/A
2007/0250167	12/2006	Bray et al.	N/A	N/A
2007/0260245	12/2006	Malandain et al.	N/A	N/A
2007/0260255	12/2006	Haddock et al.	N/A	N/A
2007/0260314	12/2006	Biyani	N/A	N/A
2007/0270823	12/2006	Trieu et al.	N/A	N/A
2007/0270954	12/2006	Wu	623/17.11	A61B 17/8858
2007/0270957	12/2006	Heinz	N/A	N/A
2007/0276373	12/2006	Malandain	N/A	N/A
2007/0276375	12/2006	Rapp	N/A	N/A
2007/0276497	12/2006	Anderson	N/A	N/A
2007/0282443	12/2006	Globerman et al.	N/A	N/A
2007/0282449	12/2006	De et al.	N/A	N/A
2007/0288091	12/2006	Braddock et al.	N/A	N/A
2008/0009877	12/2007	Sankaran et al.	N/A	N/A
2008/0015694	12/2007	Tribus	N/A	N/A
2008/0021556	12/2007	Edie	N/A	N/A
2008/0021557	12/2007	Trieu	N/A	N/A
2008/0021559	12/2007	Thramann	N/A	N/A
2008/0027437	12/2007	Johnson et al.	N/A	N/A
2008/0027438	12/2007	Abdou	N/A	N/A
2008/0027453	12/2007	Johnson et al.	N/A	N/A
2008/0027454	12/2007	Johnson et al.	N/A	N/A
2008/0027544	12/2007	Melkent	N/A	N/A
2008/0027550	12/2007	Link et al.	N/A	N/A
2008/0045966	12/2007	Buttermann et al.	N/A	N/A
2008/0051890	12/2007	Waugh et al.	N/A	N/A
2008/0051902	12/2007	Dwyer	N/A	N/A
2008/0058598	12/2007	Ries et al.	N/A	N/A
2008/0058937	12/2007	Malandain et al.	N/A	N/A
2008/0058944	12/2007	Duplessis et al.	N/A	N/A
2008/0065082	12/2007	Chang et al.	N/A	N/A
2008/0065219	12/2007	Dye	N/A	N/A
2008/0071356	12/2007	Greenhalgh et al.	N/A	N/A

2008/0071380	12/2007	Sweeney	N/A	N/A
2008/0077148	12/2007	Ries et al.	N/A	N/A
2008/0077150	12/2007	Nguyen	N/A	N/A
2008/0077241	12/2007	Nguyen	N/A	N/A
2008/0082172	12/2007	Jackson	N/A	N/A
2008/0097454	12/2007	Deridder et al.	N/A	N/A
2008/0097611	12/2007	Mastrorio et al.	N/A	N/A
2008/0108990	12/2007	Mitchell et al.	N/A	N/A
2008/0108996	12/2007	Padget et al.	N/A	N/A
2008/0119853	12/2007	Felt et al.	N/A	N/A
2008/0119935	12/2007	Alvarez	N/A	N/A
2008/0132934	12/2007	Reiley et al.	N/A	N/A
2008/0133012	12/2007	McGuckin	N/A	N/A
2008/0133017	12/2007	Beyar et al.	N/A	N/A
2008/0140085	12/2007	Gately et al.	N/A	N/A
2008/0147129	12/2007	Biedermann et al.	N/A	N/A
2008/0154377	12/2007	Voellmicke	N/A	N/A
2008/0154379	12/2007	Steiner et al.	N/A	N/A
2008/0161927	12/2007	Savage et al.	N/A	N/A
2008/0167657	12/2007	Greenhalgh	N/A	N/A
2008/0172128	12/2007	Perez-Cruet et al.	N/A	N/A
2008/0177306	12/2007	Lamborne et al.	N/A	N/A
2008/0177312	12/2007	Perez-Cruet et al.	N/A	N/A
2008/0177388	12/2007	Patterson et al.	N/A	N/A
2008/0183204	12/2007	Greenhalgh et al.	N/A	N/A
2008/0188945	12/2007	Boyce et al.	N/A	N/A
2008/0195096	12/2007	Frei	N/A	N/A
2008/0195210	12/2007	Milijasevic et al.	N/A	N/A
2008/0208344	12/2007	Kilpela et al.	N/A	N/A
2008/0221586	12/2007	Garcia-Bengochea et al.	N/A	N/A
2008/0221687	12/2007	Viker	N/A	N/A
2008/0228225	12/2007	Trautwein et al.	N/A	N/A
2008/0229597	12/2007	Malandain	N/A	N/A
2008/0234732	12/2007	Landry et al.	N/A	N/A
2008/0234733	12/2007	Scrantz et al.	N/A	N/A
2008/0243126	12/2007	Gutierrez et al.	N/A	N/A
2008/0243251	12/2007	Stad et al.	N/A	N/A
2008/0243254	12/2007	Butler	N/A	N/A
2008/0249622	12/2007	Gray	N/A	N/A
2008/0249628	12/2007	Altarac et al.	N/A	N/A
2008/0255563	12/2007	Farr et al.	N/A	N/A
2008/0255574	12/2007	Dye	N/A	N/A
2008/0255618	12/2007	Fisher et al.	N/A	N/A
2008/0262619	12/2007	Ray	N/A	N/A
2008/0269904	12/2007	Voorhies	N/A	N/A
2008/0281346	12/2007	Greenhalgh et al.	N/A	N/A
2008/0281364	12/2007	Chirico et al.	N/A	N/A
2008/0281425	12/2007	Thalgott et al.	N/A	N/A
2008/0287981	12/2007	Culbert et al.	N/A	N/A

2008/0287997	12/2007	Altarac et al.	N/A	N/A
2008/0300685	12/2007	Carls et al.	N/A	N/A
2008/0312743	12/2007	Vila et al.	N/A	N/A
2008/0319477	12/2007	Justis et al.	N/A	N/A
2009/0005873	12/2008	Slivka et al.	N/A	N/A
2009/0018524	12/2008	Greenhalgh et al.	N/A	N/A
2009/0030423	12/2008	Puno	N/A	N/A
2009/0048631	12/2008	Bhatnagar et al.	N/A	N/A
2009/0048678	12/2008	Saal et al.	N/A	N/A
2009/0054898	12/2008	Gleason	N/A	N/A
2009/0054911	12/2008	Mueller et al.	N/A	N/A
2009/0054988	12/2008	Hess	N/A	N/A
2009/0054991	12/2008	Biyani et al.	N/A	N/A
2009/0062807	12/2008	Song	N/A	N/A
2009/0069813	12/2008	Von et al.	N/A	N/A
2009/0069895	12/2008	Gittings et al.	N/A	N/A
2009/0076607	12/2008	Aalsma et al.	N/A	N/A
2009/0076610	12/2008	Afzal	N/A	N/A
2009/0088789	12/2008	O'Neil et al.	N/A	N/A
2009/0099568	12/2008	Lowry et al.	N/A	N/A
2009/0105712	12/2008	Dauster et al.	N/A	N/A
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2009/0112217	12/2008	Hester	N/A	N/A
2009/0112320	12/2008	Kraus	N/A	N/A
2009/0112324	12/2008	Refai et al.	N/A	N/A
2009/0131986	12/2008	Lee et al.	N/A	N/A
2009/0157186	12/2008	Magerl	N/A	N/A
2009/0164020	12/2008	Janowski et al.	N/A	N/A
2009/0177281	12/2008	Swanson et al.	N/A	N/A
2009/0177284	12/2008	Rogers et al.	N/A	N/A
2009/0182429	12/2008	Humphreys et al.	N/A	N/A
2009/0192613	12/2008	Wing et al.	N/A	N/A
2009/0198339	12/2008	Kleiner et al.	N/A	N/A
2009/0216234	12/2008	Farr et al.	N/A	N/A
2009/0221967	12/2008	Thommen et al.	N/A	N/A
2009/0222043	12/2008	Altarac et al.	N/A	N/A
2009/0222096	12/2008	Trieu	N/A	N/A
2009/0222099	12/2008	Liu et al.	N/A	N/A
2009/0234364	12/2008	Crook	N/A	N/A
2009/0234389	12/2008	Chuang et al.	N/A	N/A
2009/0234398	12/2008	Chirico et al.	N/A	N/A
2009/0240333	12/2008	Trudeau et al.	N/A	N/A
2009/0240334	12/2008	Richelsoph	N/A	N/A
2009/0240335	12/2008	Arcenio et al.	N/A	N/A
2009/0248159	12/2008	Aflatoon	N/A	N/A
2009/0248163	12/2008	King et al.	N/A	N/A
2009/0275890	12/2008	Leibowitz et al.	N/A	N/A
2009/0276049	12/2008	Weiland	N/A	N/A
2009/0276051	12/2008	Arramon et al.	N/A	N/A
2009/0292361	12/2008	Lopez	N/A	N/A

2009/0299478	12/2008	Carls et al.	N/A	N/A
2009/0299479	12/2008	Jones et al.	N/A	N/A
2010/0016905	12/2009	Greenhalgh et al.	N/A	N/A
2010/0016968	12/2009	Moore	N/A	N/A
2010/0016974	12/2009	Janowski et al.	N/A	N/A
2010/0030217	12/2009	Mitusina	N/A	N/A
2010/0040332	12/2009	Van et al.	N/A	N/A
2010/0042218	12/2009	Nebosky et al.	N/A	N/A
2010/0049324	12/2009	Valdevit et al.	N/A	N/A
2010/0057204	12/2009	Kadaba et al.	N/A	N/A
2010/0070036	12/2009	Implicito	N/A	N/A
2010/0076492	12/2009	Warner et al.	N/A	N/A
2010/0076502	12/2009	Guyer et al.	N/A	N/A
2010/0076559	12/2009	Bagga et al.	N/A	N/A
2010/0082109	12/2009	Greenhalgh et al.	N/A	N/A
2010/0094422	12/2009	Hansell et al.	N/A	N/A
2010/0094424	12/2009	Woodburn et al.	N/A	N/A
2010/0094426	12/2009	Grohowski et al.	N/A	N/A
2010/0100098	12/2009	Norton et al.	N/A	N/A
2010/0100183	12/2009	Prewett et al.	N/A	N/A
2010/0106191	12/2009	Yue et al.	N/A	N/A
2010/0106249	12/2009	Tyber et al.	N/A	N/A
2010/0106251	12/2009	Kast	N/A	N/A
2010/0114105	12/2009	Butters et al.	N/A	N/A
2010/0114147	12/2009	Biyani	N/A	N/A
2010/0125334	12/2009	Krueger	N/A	N/A
2010/0174314	12/2009	Mirkovic et al.	N/A	N/A
2010/0179594	12/2009	Theofilos et al.	N/A	N/A
2010/0185289	12/2009	Kirwan et al.	N/A	N/A
2010/0185290	12/2009	Compton et al.	N/A	N/A
2010/0185292	12/2009	Hochschuler et al.	N/A	N/A
2010/0191241	12/2009	McCormack et al.	N/A	N/A
2010/0191334	12/2009	Keller	N/A	N/A
2010/0191336	12/2009	Greenhalgh	N/A	N/A
2010/0204737	12/2009	Bae et al.	N/A	N/A
2010/0204795	12/2009	Greenhalgh	N/A	N/A
2010/0204796	12/2009	Bae et al.	N/A	N/A
2010/0211107	12/2009	Muhanna	N/A	N/A
2010/0211176	12/2009	Greenhalgh	N/A	N/A
2010/0211182	12/2009	Zimmermann	N/A	N/A
2010/0217269	12/2009	Landes	N/A	N/A
2010/0222884	12/2009	Greenhalgh	N/A	N/A
2010/0234849	12/2009	Bouadi	N/A	N/A
2010/0241231	12/2009	Marino et al.	N/A	N/A
2010/0249935	12/2009	Slivka et al.	N/A	N/A
2010/0256768	12/2009	Lim et al.	N/A	N/A
2010/0262240	12/2009	Chavatte et al.	N/A	N/A
2010/0268231	12/2009	Kuslich et al.	N/A	N/A
2010/0268338	12/2009	Melkent et al.	N/A	N/A
2010/0274358	12/2009	Mueller et al.	N/A	N/A

2010/0280619	12/2009	Yuan et al.	N/A	N/A
2010/0286777	12/2009	Errico et al.	N/A	N/A
2010/0292700	12/2009	Ries	N/A	N/A
2010/0298938	12/2009	Humphreys et al.	N/A	N/A
2010/0305700	12/2009	Ben-Arye et al.	N/A	N/A
2010/0305704	12/2009	Messerli et al.	N/A	N/A
2010/0324607	12/2009	Davis	N/A	N/A
2010/0324683	12/2009	Reichen et al.	N/A	N/A
2010/0331845	12/2009	Foley et al.	N/A	N/A
2010/0331891	12/2009	Culbert et al.	N/A	N/A
2011/0004216	12/2010	Amendola et al.	N/A	N/A
2011/0004308	12/2010	Marino et al.	N/A	N/A
2011/0004310	12/2010	Michelson	N/A	N/A
2011/0009970	12/2010	Puno	N/A	N/A
2011/0015747	12/2010	McManus et al.	N/A	N/A
2011/0029082	12/2010	Hall	N/A	N/A
2011/0029083	12/2010	Hynes et al.	N/A	N/A
2011/0029085	12/2010	Hynes et al.	N/A	N/A
2011/0029086	12/2010	Glazer et al.	N/A	N/A
2011/0040332	12/2010	Culbert et al.	N/A	N/A
2011/0046674	12/2010	Calvosa et al.	N/A	N/A
2011/0066186	12/2010	Boyer et al.	N/A	N/A
2011/0071527	12/2010	Nelson et al.	N/A	N/A
2011/0082552	12/2010	Wistrom et al.	N/A	N/A
2011/0093076	12/2010	Reo et al.	N/A	N/A
2011/0098531	12/2010	To	N/A	N/A
2011/0098628	12/2010	Yeung et al.	N/A	N/A
2011/0098818	12/2010	Brodke et al.	N/A	N/A
2011/0112586	12/2010	Guyer et al.	N/A	N/A
2011/0130838	12/2010	Morgenstern Lopez	N/A	N/A
2011/0144692	12/2010	Saladin et al.	N/A	N/A
2011/0144753	12/2010	Marchek et al.	N/A	N/A
2011/0153020	12/2010	Abdelgany et al.	N/A	N/A
2011/0159070	12/2010	Jin et al.	N/A	N/A
2011/0160773	12/2010	Aschmann et al.	N/A	N/A
2011/0160866	12/2010	Laurence et al.	N/A	N/A
2011/0172716	12/2010	Glerum	N/A	N/A
2011/0190816	12/2010	Sheffer et al.	N/A	N/A
2011/0190891	12/2010	Suh et al.	N/A	N/A
2011/0230971	12/2010	Donner et al.	N/A	N/A
2011/0238072	12/2010	Tyndall	N/A	N/A
2011/0251690	12/2010	Berger et al.	N/A	N/A
2011/0270261	12/2010	Mast et al.	N/A	N/A
2011/0276142	12/2010	Niemiec et al.	N/A	N/A
2011/0282459	12/2010	McClellan et al.	N/A	N/A
2011/0307010	12/2010	Pradhan	N/A	N/A
2011/0313465	12/2010	Warren et al.	N/A	N/A
2011/0319899	12/2010	O'Neil et al.	N/A	N/A
2011/0319998	12/2010	O'Neil et al.	N/A	N/A

2011/0320000	12/2010	O'Neil et al.	N/A	N/A
2012/0004726	12/2011	Greenhalgh et al.	N/A	N/A
2012/0004732	12/2011	Goel et al.	N/A	N/A
2012/0006361	12/2011	Miyagi et al.	N/A	N/A
2012/0010715	12/2011	Spann	N/A	N/A
2012/0022654	12/2011	Farris et al.	N/A	N/A
2012/0029636	12/2011	Ragab et al.	N/A	N/A
2012/0029639	12/2011	Blackwell et al.	N/A	N/A
2012/0035730	12/2011	Spann	N/A	N/A
2012/0071977	12/2011	Oglaza et al.	N/A	N/A
2012/0071980	12/2011	Purcell et al.	N/A	N/A
2012/0083887	12/2011	Purcell et al.	N/A	N/A
2012/0083889	12/2011	Purcell et al.	N/A	N/A
2012/0109319	12/2011	Perisic	N/A	N/A
2012/0123546	12/2011	Medina	N/A	N/A
2012/0136443	12/2011	Wenzel	N/A	N/A
2012/0150304	12/2011	Glerum et al.	N/A	N/A
2012/0150305	12/2011	Glerum et al.	N/A	N/A
2012/0158146	12/2011	Glerum et al.	N/A	N/A
2012/0158148	12/2011	Glerum et al.	N/A	N/A
2012/0191204	12/2011	Bae et al.	N/A	N/A
2012/0197299	12/2011	Fabian, Jr.	N/A	N/A
2012/0197403	12/2011	Merves	N/A	N/A
2012/0197405	12/2011	Cuevas et al.	N/A	N/A
2012/0203290	12/2011	Warren et al.	N/A	N/A
2012/0209383	12/2011	Tsuang et al.	N/A	N/A
2012/0215262	12/2011	Culbert et al.	N/A	N/A
2012/0215315	12/2011	Hochschuler et al.	N/A	N/A
2012/0215316	12/2011	Mohr et al.	N/A	N/A
2012/0253395	12/2011	Linares	N/A	N/A
2012/0253406	12/2011	Bae et al.	N/A	N/A
2012/0277869	12/2011	Siccardi et al.	N/A	N/A
2012/0277877	12/2011	Smith et al.	N/A	N/A
2012/0283837	12/2011	Bae et al.	N/A	N/A
2012/0310350	12/2011	Farris et al.	N/A	N/A
2012/0310352	12/2011	Dimauro et al.	N/A	N/A
2012/0323327	12/2011	McAfee	N/A	N/A
2012/0330421	12/2011	Weiman	N/A	N/A
2013/0006362	12/2012	Biedermann et al.	N/A	N/A
2013/0023937	12/2012	Biedermann et al.	N/A	N/A
2013/0053966	12/2012	Jimenez et al.	N/A	N/A
2013/0060337	12/2012	Petersheim et al.	N/A	N/A
2013/0073044	12/2012	Gamache	N/A	N/A
2013/0079790	12/2012	Stein et al.	N/A	N/A
2013/0085574	12/2012	Sledge	N/A	N/A
2013/0109925	12/2012	Horton et al.	N/A	N/A
2013/0110240	12/2012	Hansell et al.	N/A	N/A
2013/0116791	12/2012	Theofilos	N/A	N/A
2013/0123924	12/2012	Butler et al.	N/A	N/A
2013/0123927	12/2012	Malandain	N/A	N/A

2013/0138214	12/2012	Greenhalgh et al.	N/A	N/A
2013/0144387	12/2012	Walker et al.	N/A	N/A
2013/0144388	12/2012	Emery et al.	N/A	N/A
2013/0150906	12/2012	Kerboul et al.	N/A	N/A
2013/0158667	12/2012	Tabor et al.	N/A	N/A
2013/0158668	12/2012	Nichols et al.	N/A	N/A
2013/0158669	12/2012	Sungarian et al.	N/A	N/A
2013/0173004	12/2012	Greenhalgh et al.	N/A	N/A
2013/0190875	12/2012	Shulock et al.	N/A	N/A
2013/0190876	12/2012	Drochner et al.	N/A	N/A
2013/0190877	12/2012	Medina	N/A	N/A
2013/0197647	12/2012	Wolters et al.	N/A	N/A
2013/0204371	12/2012	McLuen et al.	N/A	N/A
2013/0218276	12/2012	Fiechter et al.	N/A	N/A
2013/0231747	12/2012	Olmos et al.	N/A	N/A
2013/0238006	12/2012	O'Neil et al.	N/A	N/A
2013/0253585	12/2012	Garcia et al.	N/A	N/A
2013/0261746	12/2012	Linares et al.	N/A	N/A
2013/0261747	12/2012	Geisert	N/A	N/A
2013/0268077	12/2012	You et al.	N/A	N/A
2013/0274883	12/2012	McLuen et al.	N/A	N/A
2013/0310937	12/2012	Pimenta	N/A	N/A
2013/0310939	12/2012	Fabian et al.	N/A	N/A
2013/0325128	12/2012	Perloff et al.	N/A	N/A
2014/0018816	12/2013	Fenn et al.	N/A	N/A
2014/0039622	12/2013	Glerum et al.	N/A	N/A
2014/0039626	12/2013	Dale	N/A	N/A
2014/0046333	12/2013	Johnson et al.	N/A	N/A
2014/0046446	12/2013	Robinson	N/A	N/A
2014/0052259	12/2013	Garner et al.	N/A	N/A
2014/0058512	12/2013	Petersheim	N/A	N/A
2014/0058513	12/2013	Gahman et al.	N/A	N/A
2014/0067073	12/2013	Hauck	N/A	N/A
2014/0081267	12/2013	Orsak et al.	N/A	N/A
2014/0086962	12/2013	Jin et al.	N/A	N/A
2014/0094916	12/2013	Glerum et al.	N/A	N/A
2014/0094917	12/2013	Salerni	623/17.16	A61F 2/447
2014/0100662	12/2013	Patterson et al.	N/A	N/A
2014/0107790	12/2013	Combrowski	N/A	N/A
2014/0114414	12/2013	Abdou et al.	N/A	N/A
2014/0121774	12/2013	Glerum et al.	N/A	N/A
2014/0128977	12/2013	Glerum et al.	N/A	N/A
2014/0128980	12/2013	Kirschman	N/A	N/A
2014/0135930	12/2013	Georges	N/A	N/A
2014/0135934	12/2013	Hansell et al.	N/A	N/A
2014/0142706	12/2013	Hansell et al.	N/A	N/A
2014/0148904	12/2013	Robinson	N/A	N/A
2014/0163682	12/2013	Lott et al.	N/A	N/A
2014/0163683	12/2013	Seifert et al.	N/A	N/A
2014/0172103	12/2013	O'Neil et al.	N/A	N/A

2014/0172105	12/2013	Frasier et al.	N/A	N/A
2014/0172106	12/2013	To et al.	N/A	N/A
2014/0180421	12/2013	Glerum et al.	N/A	N/A
2014/0188225	12/2013	Dmuschewsky	N/A	N/A
2014/0228959	12/2013	Niemiec et al.	N/A	N/A
2014/0243892	12/2013	Choinski	N/A	N/A
2014/0243981	12/2013	Davenport et al.	N/A	N/A
2014/0249629	12/2013	Moskowitz et al.	N/A	N/A
2014/0249630	12/2013	Weiman	N/A	N/A
2014/0249632	12/2013	Weiman	N/A	N/A
2014/0257486	12/2013	Alheidt	N/A	N/A
2014/0257494	12/2013	Thorwarth et al.	N/A	N/A
2014/0277139	12/2013	Vrionis et al.	N/A	N/A
2014/0277204	12/2013	Sandhu	N/A	N/A
2014/0277464	12/2013	Richter et al.	N/A	N/A
2014/0277473	12/2013	Perrow	N/A	N/A
2014/0277474	12/2013	Robinson et al.	N/A	N/A
2014/0277476	12/2013	McLean et al.	N/A	N/A
2014/0277481	12/2013	Lee et al.	N/A	N/A
2014/0277507	12/2013	Baynham	N/A	N/A
2014/0296983	12/2013	Fauth et al.	N/A	N/A
2014/0303731	12/2013	Glerum	N/A	N/A
2014/0303732	12/2013	Rhoda et al.	N/A	N/A
2014/0336764	12/2013	Masson et al.	N/A	N/A
2014/0343678	12/2013	Suddaby et al.	N/A	N/A
2015/0012097	12/2014	Ibarra et al.	N/A	N/A
2015/0012098	12/2014	Eastlack et al.	N/A	N/A
2015/0045894	12/2014	Hawkins et al.	N/A	N/A
2015/0051701	12/2014	Glerum et al.	N/A	N/A
2015/0057755	12/2014	Suddaby et al.	N/A	N/A
2015/0066145	12/2014	Rogers et al.	N/A	N/A
2015/0088256	12/2014	Ballard	N/A	N/A
2015/0094610	12/2014	Morgenstern et al.	N/A	N/A
2015/0094813	12/2014	Lechmann et al.	N/A	N/A
2015/0094814	12/2014	Emerick et al.	N/A	N/A
2015/0100124	12/2014	Whipple	N/A	N/A
2015/0100128	12/2014	Glerum et al.	N/A	N/A
2015/0112398	12/2014	Morgenstern et al.	N/A	N/A
2015/0112437	12/2014	Davis et al.	N/A	N/A
2015/0112438	12/2014	McLean	N/A	N/A
2015/0173916	12/2014	Cain	N/A	N/A
2015/0182347	12/2014	Robinson	N/A	N/A
2015/0190242	12/2014	Blain et al.	N/A	N/A
2015/0196400	12/2014	Dace	N/A	N/A
2015/0216671	12/2014	Cain	N/A	N/A
2015/0216672	12/2014	Cain	N/A	N/A
2015/0230929	12/2014	Lorio	N/A	N/A
2015/0230932	12/2014	Schaller	N/A	N/A
2015/0238324	12/2014	Nebosky et al.	N/A	N/A
2015/0250606	12/2014	McLean	N/A	N/A

2015/0272743	12/2014	Jimenez et al.	N/A	N/A
2015/0305881	12/2014	Bal et al.	N/A	N/A
2015/0320571	12/2014	Lechmann et al.	N/A	N/A
2016/0015522	12/2015	Arnin	N/A	N/A
2016/0016309	12/2015	Swift et al.	N/A	N/A
2016/0022438	12/2015	Lamborne et al.	N/A	N/A
2016/0038301	12/2015	Wickham	N/A	N/A
2016/0045333	12/2015	Baynham	N/A	N/A
2016/0051373	12/2015	Faulhaber	N/A	N/A
2016/0051374	12/2015	Faulhaber	N/A	N/A
2016/0067055	12/2015	Hawkins et al.	N/A	N/A
2016/0081814	12/2015	Baynham	N/A	N/A
2016/0100951	12/2015	Suddaby et al.	N/A	N/A
2016/0100954	12/2015	Rumi et al.	N/A	N/A
2016/0106551	12/2015	Grimberg et al.	N/A	N/A
2016/0120662	12/2015	Schaller	N/A	N/A
2016/0128843	12/2015	Tsau et al.	N/A	N/A
2016/0199195	12/2015	Hauck et al.	N/A	N/A
2016/0199196	12/2015	Serhan et al.	N/A	N/A
2016/0228258	12/2015	Schaller et al.	N/A	N/A
2016/0235455	12/2015	Wahl	N/A	N/A
2016/0256291	12/2015	Miller	N/A	N/A
2016/0317714	12/2015	Dimauro et al.	N/A	N/A
2016/0367265	12/2015	Morgenstern Lopez	N/A	N/A
2017/0000622	12/2016	Thommen et al.	N/A	N/A
2017/0056179	12/2016	Lorio	N/A	N/A
2017/0095341	12/2016	Smith	N/A	N/A
2017/0100177	12/2016	Kim	N/A	N/A
2017/0100255	12/2016	Hleihil et al.	N/A	N/A
2017/0100260	12/2016	Duffield et al.	N/A	N/A
2017/0119542	12/2016	Logan et al.	N/A	N/A
2017/0128226	12/2016	Faulhaber	N/A	N/A
2017/0209284	12/2016	Overes et al.	N/A	N/A
2017/0216045	12/2016	Dewey et al.	N/A	N/A
2017/0216046	12/2016	Greenhalgh et al.	N/A	N/A
2017/0266015	12/2016	Overes et al.	N/A	N/A
2017/0290674	12/2016	Olmos et al.	N/A	N/A
2017/0290675	12/2016	Olmos et al.	N/A	N/A
2017/0290677	12/2016	Olmos et al.	N/A	N/A
2017/0296352	12/2016	Richerme et al.	N/A	N/A
2017/0367843	12/2016	Eisen et al.	N/A	N/A
2017/0367844	12/2016	Eisen et al.	N/A	N/A
2017/0367845	12/2016	Eisen et al.	N/A	N/A
2018/0028200	12/2017	O'Neil et al.	N/A	N/A
2018/0036141	12/2017	Oneil et al.	N/A	N/A
2018/0071111	12/2017	Sharifi-Mehr et al.	N/A	N/A
2018/0116811	12/2017	Bernard et al.	N/A	N/A
2018/0161175	12/2017	Frasier et al.	N/A	N/A
2018/0193164	12/2017	Shoshtaev	N/A	N/A

2018/0256360	12/2017	Cain	N/A	N/A
2018/0256362	12/2017	Slivka et al.	N/A	N/A
2018/0360616	12/2017	Luu	N/A	N/A
2019/0008654	12/2018	Thommen	N/A	N/A
2019/0021868	12/2018	Ludwig et al.	N/A	N/A
2019/0083276	12/2018	Dimauro	N/A	N/A
2019/0105171	12/2018	Rogers et al.	N/A	N/A
2019/0117409	12/2018	Shoshtaev	N/A	N/A
2019/0133785	12/2018	Georges	N/A	N/A
2019/0142602	12/2018	Olmos et al.	N/A	N/A
2019/0269521	12/2018	Shoshtaev	N/A	N/A
2019/0336301	12/2018	Engstrom	N/A	N/A
2019/0388238	12/2018	Lechmann et al.	N/A	N/A
2020/0008950	12/2019	Serhan et al.	N/A	N/A
2020/0015982	12/2019	O'Neil	N/A	N/A
2020/0030114	12/2019	Cain	N/A	N/A
2020/0060843	12/2019	Evans et al.	N/A	N/A
2020/0078190	12/2019	Rogers et al.	N/A	N/A
2020/0078192	12/2019	Marchek et al.	N/A	N/A
2020/0129308	12/2019	Suedkamp et al.	N/A	N/A
2020/0297506	12/2019	Olmos et al.	N/A	N/A
2020/0315811	12/2019	Cryder et al.	N/A	N/A
2020/0375754	12/2019	Cain	N/A	N/A
2020/0375755	12/2019	Cain	N/A	N/A
2020/0383799	12/2019	Cain	N/A	N/A
2020/0405497	12/2019	Olmos et al.	N/A	N/A
2020/0405500	12/2019	Cain	N/A	N/A
2021/0000160	12/2020	Olmos et al.	N/A	N/A
2021/0177619	12/2020	Voellmicke et al.	N/A	N/A
2021/0322181	12/2020	Predick	N/A	N/A
2021/0353427	12/2020	Butler et al.	N/A	N/A
2022/0015923	12/2021	Shoshtaev	N/A	N/A
2022/0015924	12/2021	Freedman et al.	N/A	N/A
2022/0313450	12/2021	Donohoe et al.	N/A	N/A
2022/0323231	12/2021	Smith et al.	N/A	N/A
2022/0401225	12/2021	Miller	N/A	N/A
2023/0019591	12/2022	Rogers et al.	N/A	N/A
2023/0026598	12/2022	Weiman et al.	N/A	N/A

FOREIGN PATENT DOCUMENTS

Patent No.	**Application Date**	**Country**	**CPC**
2006279558	12/2006	AU	N/A
2005314079	12/2011	AU	N/A
2617872	12/2006	CA	N/A
1177918	12/1997	CN	N/A
1383790	12/2001	CN	N/A
1819805	12/2005	CN	N/A
101031260	12/2006	CN	N/A
101087566	12/2006	CN	N/A

101185594	12/2007	CN	N/A
101631516	12/2009	CN	N/A
101909548	12/2009	CN	N/A
102164552	12/2010	CN	N/A
103620249	12/2013	CN	N/A
104023674	12/2013	CN	N/A
104023675	12/2013	CN	N/A
104042366	12/2013	CN	N/A
104822332	12/2014	CN	N/A
104921848	12/2014	CN	N/A
104939876	12/2014	CN	N/A
105025846	12/2014	CN	N/A
105188582	12/2014	CN	N/A
204971722	12/2015	CN	N/A
105769391	12/2015	CN	N/A
105769392	12/2015	CN	N/A
107205829	12/2016	CN	N/A
107510524	12/2016	CN	N/A
2804936	12/1978	DE	N/A
3023353	12/1980	DE	N/A
3801459	12/1988	DE	N/A
3911610	12/1989	DE	N/A
4012622	12/1990	DE	N/A
9407806	12/1993	DE	N/A
19710392	12/1998	DE	N/A
19832798	12/1998	DE	N/A
20101793	12/2000	DE	N/A
202006005868	12/2005	DE	N/A
202008001079	12/2007	DE	N/A
10357960	12/2014	DE	N/A
0077159	12/1982	EP	N/A
0260044	12/1987	EP	N/A
0270704	12/1987	EP	N/A
0282161	12/1987	EP	N/A
0433717	12/1990	EP	N/A
0509084	12/1991	EP	N/A
0525352	12/1992	EP	N/A
0529275	12/1992	EP	N/A
0609084	12/1993	EP	N/A
0611557	12/1993	EP	N/A
0621020	12/1993	EP	N/A
0625336	12/1993	EP	N/A
0678489	12/1994	EP	N/A
0743045	12/1995	EP	N/A
0853929	12/1997	EP	N/A
1046376	12/1999	EP	N/A
1157676	12/2000	EP	N/A
1283026	12/2002	EP	N/A
1290985	12/2002	EP	N/A
1308132	12/2002	EP	N/A

1374784	12/2003	EP	N/A
1378205	12/2003	EP	N/A
1405602	12/2003	EP	N/A
1532949	12/2004	EP	N/A
1541096	12/2004	EP	N/A
1605836	12/2004	EP	N/A
1385449	12/2005	EP	N/A
1683593	12/2005	EP	N/A
1698305	12/2005	EP	N/A
1829486	12/2006	EP	N/A
1843723	12/2006	EP	N/A
1845874	12/2006	EP	N/A
1924227	12/2007	EP	N/A
1925272	12/2007	EP	N/A
2331023	12/2010	EP	N/A
2368529	12/2010	EP	N/A
2237748	12/2011	EP	N/A
2641571	12/2012	EP	N/A
2699065	12/2013	EP	N/A
2705809	12/2013	EP	N/A
2764851	12/2013	EP	N/A
2777633	12/2013	EP	N/A
2645965	12/2015	EP	N/A
3263072	12/2017	EP	N/A
3366263	12/2017	EP	N/A
3858296	12/2020	EP	N/A
2649311	12/1990	FR	N/A
2699065	12/1993	FR	N/A
2712486	12/1994	FR	N/A
2718635	12/1994	FR	N/A
2728778	12/1995	FR	N/A
2730159	12/1995	FR	N/A
2745709	12/1996	FR	N/A
2800601	12/2000	FR	N/A
2801189	12/2000	FR	N/A
2803741	12/2000	FR	A61F 2/4455
2808182	12/2000	FR	N/A
2874814	12/2005	FR	N/A
2913331	12/2007	FR	N/A
2948277	12/2010	FR	N/A
3026294	12/2015	FR	N/A
2157788	12/1984	GB	N/A
2173565	12/1985	GB	N/A
64-052439	12/1988	JP	N/A
06-500039	12/1993	JP	N/A
06-319742	12/1993	JP	N/A
07-502419	12/1994	JP	N/A
07-184922	12/1994	JP	N/A
07-213533	12/1994	JP	N/A
10-085232	12/1997	JP	N/A

11-089854	12/1998	JP	N/A
2003-010197	12/2002	JP	N/A
2003-126266	12/2002	JP	N/A
2003-526457	12/2002	JP	N/A
2006-501901	12/2005	JP	N/A
2006-516456	12/2005	JP	N/A
2007-054666	12/2006	JP	N/A
2007-530243	12/2006	JP	N/A
2008-507363	12/2007	JP	N/A
2008-126085	12/2007	JP	N/A
2011-509766	12/2010	JP	N/A
2011-520580	12/2010	JP	N/A
2012-020153	12/2011	JP	N/A
2012-508048	12/2011	JP	N/A
4988203	12/2011	JP	N/A
2013-508031	12/2012	JP	N/A
5164571	12/2012	JP	N/A
2014-502867	12/2013	JP	N/A
2015-500707	12/2014	JP	N/A
2015-525652	12/2014	JP	N/A
2017-505196	12/2016	JP	N/A
20-0290058	12/2001	KR	N/A
91/09572	12/1990	WO	N/A
92/04423	12/1991	WO	N/A
92/07594	12/1991	WO	N/A
92/14423	12/1991	WO	N/A
93/04634	12/1992	WO	N/A
93/04652	12/1992	WO	N/A
93/17669	12/1992	WO	N/A
94/04100	12/1993	WO	N/A
95/31158	12/1994	WO	N/A
96/28100	12/1995	WO	N/A
97/00054	12/1996	WO	N/A
97/26847	12/1996	WO	N/A
98/34552	12/1997	WO	N/A
98/34568	12/1997	WO	N/A
99/02214	12/1998	WO	N/A
99/26562	12/1998	WO	N/A
99/42062	12/1998	WO	N/A
99/52478	12/1998	WO	N/A
99/53871	12/1998	WO	N/A
99/60956	12/1998	WO	N/A
99/62417	12/1998	WO	N/A
99/63914	12/1998	WO	N/A
00/12033	12/1999	WO	N/A
00/13620	12/1999	WO	N/A
00/24343	12/1999	WO	N/A
00/67652	12/1999	WO	N/A
00/44288	12/1999	WO	N/A
00/53127	12/1999	WO	N/A

00/67650	12/1999	WO	N/A
00/67651	12/1999	WO	N/A
00/74605	12/1999	WO	N/A
00/76409	12/1999	WO	N/A
01/01893	12/2000	WO	N/A
01/01895	12/2000	WO	N/A
01/10316	12/2000	WO	N/A
01/12054	12/2000	WO	N/A
01/17464	12/2000	WO	N/A
01/80751	12/2000	WO	N/A
01/95838	12/2000	WO	N/A
02/03870	12/2001	WO	N/A
02/17824	12/2001	WO	N/A
02/17825	12/2001	WO	N/A
02/30338	12/2001	WO	N/A
02/43601	12/2001	WO	N/A
02/43628	12/2001	WO	N/A
02/45627	12/2001	WO	N/A
02/47563	12/2001	WO	N/A
02/71921	12/2001	WO	N/A
02/85250	12/2001	WO	N/A
03/02021	12/2002	WO	N/A
03/05937	12/2002	WO	N/A
03/07854	12/2002	WO	N/A
03/20169	12/2002	WO	N/A
03/21308	12/2002	WO	N/A
03/22165	12/2002	WO	N/A
03/28587	12/2002	WO	N/A
03/43488	12/2002	WO	N/A
03/03951	12/2002	WO	N/A
2003/101308	12/2002	WO	N/A
2004/008949	12/2003	WO	N/A
03/59180	12/2003	WO	N/A
2004/030582	12/2003	WO	N/A
2004/034924	12/2003	WO	N/A
2004/062505	12/2003	WO	N/A
2004/064603	12/2003	WO	N/A
2004/069033	12/2003	WO	N/A
2004/078220	12/2003	WO	N/A
2004/078221	12/2003	WO	N/A
2004/080316	12/2003	WO	N/A
2004/082526	12/2003	WO	N/A
2004/098420	12/2003	WO	N/A
2004/098453	12/2003	WO	N/A
2004/108022	12/2003	WO	N/A
2005/027734	12/2004	WO	N/A
2005/032433	12/2004	WO	N/A
2005/039455	12/2004	WO	N/A
2005/051246	12/2004	WO	N/A
2005/081877	12/2004	WO	N/A

2005/094297	12/2004	WO	N/A
2005/112834	12/2004	WO	N/A
2005/112835	12/2004	WO	N/A
2005/115261	12/2004	WO	N/A
2006/017507	12/2005	WO	N/A
2006/044920	12/2005	WO	N/A
2006/047587	12/2005	WO	N/A
2006/047645	12/2005	WO	N/A
2006/058079	12/2005	WO	N/A
2006/058281	12/2005	WO	N/A
2006/060420	12/2005	WO	N/A
2006/063083	12/2005	WO	N/A
2006/065419	12/2005	WO	N/A
2006/066228	12/2005	WO	N/A
2006/072941	12/2005	WO	N/A
2006/078972	12/2005	WO	N/A
2006/081843	12/2005	WO	N/A
2006/108067	12/2005	WO	N/A
2006/118944	12/2005	WO	N/A
2007/009107	12/2006	WO	N/A
2007/022194	12/2006	WO	N/A
2007/028098	12/2006	WO	N/A
2007/048012	12/2006	WO	N/A
2007/067726	12/2006	WO	N/A
2007/084427	12/2006	WO	N/A
2007/119212	12/2006	WO	N/A
2007/124130	12/2006	WO	N/A
2008/005627	12/2007	WO	N/A
2008/011378	12/2007	WO	N/A
2008/044057	12/2007	WO	N/A
2008/064842	12/2007	WO	N/A
2008/070863	12/2007	WO	N/A
2008/103781	12/2007	WO	N/A
2008/103832	12/2007	WO	N/A
2009/064787	12/2008	WO	N/A
2009/092102	12/2008	WO	N/A
2009/124269	12/2008	WO	N/A
2009/143496	12/2008	WO	N/A
2009/147527	12/2008	WO	N/A
2009/152919	12/2008	WO	N/A
2010/011348	12/2009	WO	N/A
2010/068725	12/2009	WO	N/A
2010/075451	12/2009	WO	N/A
2010/075555	12/2009	WO	N/A
2010/088766	12/2009	WO	N/A
2010/121002	12/2009	WO	N/A
2010/136170	12/2009	WO	N/A
2010/148112	12/2009	WO	N/A
2011/013047	12/2010	WO	N/A
2011/046459	12/2010	WO	N/A

2011/046460	12/2010	WO	N/A
2011/060087	12/2010	WO	N/A
2011/079910	12/2010	WO	N/A
2011/119617	12/2010	WO	N/A
2011/142761	12/2010	WO	N/A
2011/150350	12/2010	WO	N/A
2012/009152	12/2011	WO	N/A
2012/027490	12/2011	WO	N/A
2012/028182	12/2011	WO	N/A
2012/030331	12/2011	WO	N/A
2012/089317	12/2011	WO	N/A
2012/103254	12/2011	WO	N/A
2012/122294	12/2011	WO	N/A
2012/129197	12/2011	WO	N/A
2012/135764	12/2011	WO	N/A
2013/006669	12/2012	WO	N/A
2013/023096	12/2012	WO	N/A
2013/025876	12/2012	WO	N/A
2013/043850	12/2012	WO	N/A
2013/062903	12/2012	WO	N/A
2013/082184	12/2012	WO	N/A
2013/148176	12/2012	WO	N/A
2013/149611	12/2012	WO	N/A
2013/158294	12/2012	WO	N/A
2013/173767	12/2012	WO	N/A
2013/184946	12/2012	WO	N/A
2014/014610	12/2013	WO	N/A
2014/018098	12/2013	WO	N/A
2014/026007	12/2013	WO	N/A
2014/035962	12/2013	WO	N/A
2014/088521	12/2013	WO	N/A
2014/116891	12/2013	WO	N/A
2014/144696	12/2013	WO	N/A
2015/004660	12/2014	WO	N/A
2015/013479	12/2014	WO	N/A
2015/022039	12/2014	WO	N/A
2015/048997	12/2014	WO	N/A
2016/069796	12/2015	WO	N/A
2016/118246	12/2015	WO	N/A
2016/127139	12/2015	WO	N/A
2017/040881	12/2016	WO	N/A
2017/066226	12/2016	WO	N/A
2017/136620	12/2016	WO	N/A
2018/078148	12/2017	WO	N/A
2021/179011	12/2020	WO	N/A

OTHER PUBLICATIONS

Machine translation of FR-2803741-A1. (Year: 2024). cited by examiner
Brochure for PERPOS PLS System Surgical Technique by Interventional Spine, 2008, 8 pages. cited by applicant

Brooks et al., “Efficacy of Supplemental Posterior Transfacet Pedicle Device Fixation in the Setting of One- or Two-Level Anterior Lumbar Interbody Fusion”, Retrieved Jun. 19, 2017, 6 pages. cited by applicant
Bruder et al., Identification and characterization of a cell surface differentiation antigen on human osteoprogenitor cells. 42nd Annual Meeting of the Orthopaedic Research Society. p. 574, Feb. 19-22, 1996, Atlanta, Georgia. cited by applicant
Bruder et al., Monoclonal antibodies reactive with human osteogenic cell surface antigens. Bone. Sep. 1997; 21(3):225-235. cited by applicant
Burkoth et al., A review of photocrosslinked polyanhydrides: in situ forming degradable networks. Biomaterials. Dec. 2000; 21 (23): 2395-2404. cited by applicant
Cambridge Scientific News, FDA Approves Cambridge Scientific, Inc.'s Orthopedic Wisorb (TM) Malleolar Screw [online], Jul. 30, 2002 [retrieved on Oct. 14, 2003]. Retrieved from the Internet <URL: http://www.cambridgescientificinc.com>. cited by applicant
Carrino, John A., Roxanne Chan and Alexander R. Vaccaro, “Vertebral Augmentation: Vertebroplasty and Kyphoplasty”, Seminars in Roentgenology, vol. 39, No. 1 Jan. 2004: pp. 68-84. cited by applicant
Cheng, B.C., Ph.D., Biomechanical pullout strength and histology of Plasmapore® XP coated implants: Ovine multi time point survival study. Aesculap Implant Systems, LLC, 2013, 12 pages. cited by applicant
Chiang, “Biomechanical Comparison of Instrumented Posterior Lumbar Interbody Fusion with One or Two Cages by Finite Element Analysis”, Spine, Sep. 2006, pp. E682-E689, vol. 31(19), Lippincott Williams & Wilkins, Inc. cited by applicant
Chin, “Early Results of the Triage Medical Percutaneous Transfacet Pedicular BONE-LOK Compression Device for Lumbar Fusion”, Accessed online Jul. 10, 2017, 10 pages. cited by applicant
CN Office Action Mailed on Apr. 24, 2020 for ON Application No. 201780040910. cited by applicant
US 5,545,827, 10/1995, Aust (withdrawn) cited by applicant
Medco Forum, “Percutaneous Lumbar Fixation Via PERPOS PLS System Interventional Spine”, Sep. 2008, vol. 15, No. 37. cited by applicant
Medco Forum, “Percutaneous Lumbar Fixation via PERPOS System From Interventional Spine”, Oct. 2007, vol. 14, No. 49. cited by applicant
Mendez et al., Self-curing acrylic formulations containing PMMA/PCL composites: properties and antibiotic release behavior. J Biomed Mater Res. Jul. 2002;61 (1):66-74. cited by applicant
Morgenstern R; “Transforaminal Endoscopic Stenosis Surgery—A Comparative Study of Laser and Reamed Foraminoplasty”, in European Musculoskeletal Review, Issue 1, 2009. cited by applicant
Nguyen et al., Poly(Aryl-Ether-Ether-Ketone) and its Advanced Composites: A Review, Polymer Composites, Apr. 1987, vol. 8, No. 2, pp. 57-73. cited by applicant
Niosi, “Biomechanical characterization of the three-dimentional kinematic behaviour of the Dynesys dynamic stabilization system: an in vitro study”, Eur Spine J (2006) 15: pp. 913-922. cited by applicant
Osteoset Registered DBM Pellets (Important Medical Information) [online], Nov. 2002 [retrieved on Oct. 14, 2003]. Retrieved from the Internet <URL: http://www.wmt.com/Literature>. cited by applicant
Polikeit, “The Importance of the Endplate for Interbody Cages in the Lumbar Spine”, Eur. Spine J., 2003, pp. 556-561, vol. 12. cited by applicant
ProMap TM EMG Navigation Probe. Technical Brochure Spineology Inc, Dated May 2009. cited by applicant
Regan et al., Endoscopic thoracic fusion cage. Atlas of Endoscopic Spine Surgery. Quality Medical Publishing, Inc. 1995; 350-354. cited by applicant

Shin, “Posterior Lumbar Interbody Fusion via a Unilateral Approach”, Yonsei Medical Journal, 2006, pp. 319-325, vol. 47(3). cited by applicant
Siddiqui, “The Positional Magnetic Resonance Imaging Changes in the Lumbar Spine Following Insertion of a Novel Interspinous Process Distraction Device”, Spine, vol. 30, No. 23, pp. 2677-2682, 2005. cited by applicant
Slivka et al., In vitro compression testing of fiber-reinforced, bioabsorbable, porous implants. Synthetic Bioabsorbable Polymers for Implants. STP1396, pp. 124-135, ATSM International, Jul. 2000. cited by applicant
Sonic Accelerated Fracture Healing System/Exogen 3000. Premarket Approval. U.S. Food & Drug Administration. Date believed to be May 10, 2000. Retrieved Jul. 23, 2012 from <http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMA/pma.cfm?id=14736#>. 4 pages, 2012. cited by applicant
Spine Solutions Brochure—Prodisc 2001, 16 pages. cited by applicant
Stewart et al., Co-expression of the stro-1 anitgen and alkaline phosphatase in cultures of human bone and marrow cells. ASBMR 18th Annual Meeting. Bath Institute for Rheumatic Diseases, Bath, Avon, UK. Abstract No. P208, p. S142, 1996. cited by applicant
Timmer et al., In vitro degradation of polymeric networks of poly(propylene fumarate) and the crosslinking macromer poly(propylene fumarate)-diacrylate. Biomaterials. Feb. 2003; 24(4):571-7. cited by applicant
U.S. Appl. No. 61/009,546, filed Dec. 28, 2007 Rodgers. cited by applicant
U.S. Appl. No. 61/140,926, filed Dec. 26, 2008 Spann. cited by applicant
U.S. Appl. No. 61/178,315, filed May 14, 2009 Spann. cited by applicant
U.S. Appl. No. 60/424,055, filed Nov. 5, 2002, entitled Method and apparatus for spinal fixation. cited by applicant
U.S. Appl. No. 60/397,588, Method and apparatus for spinal fixation, filed Jul. 19, 2002. cited by applicant
U.S. Appl. No. 61/675,975, Expandable Implant, filed Jul. 26, 2012. cited by applicant
U.S. Appl. No. 60/942,998, Method and Apparatus for Spinal Stabilization, filed Jun. 8, 2007. cited by applicant
United States Disctrict Court, Central District of California, Case No. 1 :10-CV-00849-LPS, *Nuvasive, Inc.*, vs., *Globus Medical, Inc.*, Videotaped Deposition of: Luiz Pimenta, M.D., May 9, 2012, 20 pages. cited by applicant
U.S. Appl. No. 09/558,057, filed Apr. 26, 2000, entitled Bone Fixation System. cited by applicant
U.S. Appl. No. 60/794,171, filed Apr. 21, 2006, entitled Method and Apparatus for Spinal Fixation. cited by applicant
Vandorpe, “Biodegradable Polyphosphazenes For Biomedical Applications”, The Handbook of Biodegradable Polymers, edited by Domb et al., Hardwood Academic Press, 1997, pp. 161-182. cited by applicant
Vikram Talwar, “Insertion loads of the X STOP Interspinous Process Distraction System Designed to Treat Neurogenic Intermittent Claudication”, Eur Spine J. (2006) 15: pp. 908-912. cited by applicant
Walsh et al., Preparation of porous composite implant materials by in situ polymerization of porous apatite containing epsilon-caprolactone or methyl methacrylate. Biomaterials. Jun. 2001; 22(11): 1205-12. cited by applicant
Zimmer.com, Longer BAK/L Sterile Interbody Fusion Devices. Date believed to be 1997. Product Data Sheet.Zimmer. Retrieved Jul. 23, 2012 from <http:/ catalog.zimmer.com/contenUzpc/products/600/600/620/S20/S045. html>, 2 pages. cited by applicant
Zucherman, “A Multicenter, Prospective, Randomized Trial Evaluating the X STOP Interspinous Process Decompression System for the Treatment of Neurogenic Intermittent Claudication”, Spine,

vol. 30, No. 12, pp. 1351-1358, 2005. cited by applicant
[No Author Listed] Porocoat® Porous Coating, Depuy Synthes Companies, 2015, 2 pages, webpage, accessed Jul. 5, 2016, <https://emea.depuysynthes.com/hcp/hip/products/qs/porocoat-porous-coating-emea>. cited by applicant
Alfen et al., “Developments in the area of Endoscopic Spine Surgery”, European Musculoskeletal Review 2006, pp. 23-24, Thessys(Trademark), Transforaminal Endoscopic Spine Systems, joi max Medical Solutions. cited by applicant
Allcock, “Polyphosphazenes”, The Encyclopedia of Polymer Science, vol. 13, pp. 31-41, Wiley Intersciences, John Wiley & Sons, (1988). cited by applicant
Cohn et al., Biodegradable PEO/PLA block copolymers, Journal of Biomaterials Research, vol. 22, pp. 993-1009, 1988. cited by applicant
Cohn, “Polymer Preprints”, ACS Division of Polymer Chemistry, vol. 30(1), 1989, p. 498, (e.g. PEO/PLA). cited by applicant
Edeland, H.G., “Some Additional Suggestions For An Intervertebral Disc Prosthesis”, J of Bio Medical Engr., vol. 7(1) pp. 57-62, Jan. 1985. cited by applicant
European Search Report EP03253921 dated Nov. 13, 2003, 4 pages. cited by applicant
Flemming et al., Monoclonal anitbody against adult marrow-derived mesenchymal stem cells recognizes developing vasculature in embryonic human skin. Developmental Dynamics. 1998; 212:119-132. cited by applicant
Folman, Posterior Lumbar Interbody Fusion for Degenerative Disc Disease Using a Minimally Invasive B-Twin Expandable Spinal Spacer, Journal of Spinal Disorders & Techniques, 2003, pp. 455-460, vol. 16(5). cited by applicant
Fuchs, “The use of an interspinous implant in conjuction with a graded facetectomy procedure”, Spine vol. 30, No. 11, pp. 1266-1272, 2005. cited by applicant
Gore, “Technique of Cervical Interbody Fusion”, Clinical Orthopaedics and Related Research, Sep. 1984, pp. 191-195, No. 188. cited by applicant
Gray's Anatomy, Crown Publishers, Inc., 1977, pp. 33-54. cited by applicant
Ha, S. W. et al., Topographical characterization and microstructural interface analysis of vacuum-plasma-sprayed titanium and hydroxyapatite coatings on carbon fibre-reinforced poly(etheretherketone), J. Mater. Sci.: Materials in Medicine, 1997, v. 8, pp. 891-896. cited by applicant
Haas, Norbert P., New Products from AO Development [online], May 2002 [retrieved on Oct. 14, 2003], Retrieved from the Internet <URL: http://www.ao.asif.ch/development/pdf_tk_news_02.pdf>. cited by applicant
Hao et al., Investigation of nanocomposites based on semi-interpenetrating network of [L-poly (epsilon-caprolactone)]/[net-poly (epsilon-caprolactone)] and hydroxyapatite nanocrystals. Biomaterials. Apr. 2003; 24(9): 1531-9. cited by applicant
Harsha et al., Tribo performance of polyaryletherketone composites, Polymer Testing (21) (2002) pp. 697-709. cited by applicant
Haynesworth et al., Cell surface antigens on human marrow-derived mesenchymal cells are detected by monoclonal antibodies. Bone. 1992; 13(1):69-80. cited by applicant
Heller, “Poly (Otrho Esters)”; Handbook of Biodegradable Polymers; edited by Domb; et al; Hardwood Academic Press; 1997; pp. 99-118. cited by applicant
Hitchon et al., Comparison of the biomechanics of hydroxyapatite and polymethylmethacrylate vertebroplasty in a cadaveric spinal compression fracture model. J Neurosurg. Oct. 2001;95(2 Suppl):215-20. cited by applicant
Hoogland et al., “Total Lumar Intervertebral Disc Replacement: Testing a New Articulating Space in Human Cadaver Spines-24 1”, Annual ORS, Dallas, TX, Feb. 21-23, 1978, 8 pages. cited by applicant
Hunt, “Expandable Cage Placement Via a Posterolateral Approach in Lumbar Spine

Reconstructions", Journal of Neurosurgery: Spine, Sep. 2006, pp. 271-274, vol. 5. cited by applicant
International Patent Application No. PCT /US2013/029014, International Search Report dated Jul. 1, 2013, 7 pages. cited by applicant
Iprenburg et al., "Transforaminal Endoscopic Surgery in Lumbar Disc Herniation in an Economic Crisis—The TESSYS Method", US Musculoskeletal, 2008, p. 47-49. cited by applicant
Japanese Office Action for Application No. 2013-542047, issued Sep. 8, 2015 (12 pages). cited by applicant
Japanese Office Action for Application No. 2016-135826, issued Jun. 6, 2017, (7 pages). cited by applicant
Joshi, Ajeya P., M.D. and Paul A. Glazer, M.D., "Vertebroplasty: Current Concepts and Outlook for the Future", 2003, (5 pages), From: http://www.orthojournalhms.org/html/pdfs/manuscript-15.pdf. cited by applicant
Kambin et al., "Percutaneous Lateral Discectomy of the Lumbar Spine: A Preliminary Report", Clin. Orthop,: 1983, 174: 127-132. cited by applicant
Kandziora, Frank, et al., "Biomechanical Analysis of Biodegradable Interbody Fusion Cages Augmented with Poly (propylene Glycol-co-Fumaric Acid)," Spine, 27(15): 1644-1651 (2002). cited by applicant
Kemnitzer et al., "Degradable Polymers Derived From The Amino Acid L-Tyrozine", The Handbook of Biodegradable Polymers, edited by Domb, et al., Hardwood Academic Press, 1997, pp. 251-272. cited by applicant
Khoo, "Minimally Invasive Correction of Grade I and II Isthmic Spondylolisthesis using AxiaLIF for L5/S1 Fusion", pp. 1-7, Rev B Sep. 15, 2008. cited by applicant
King., "Internal Fixation for Lumbosacral Fusion", The Journal of Bone and Joint Surgery, J. Bone Joint Surg. Am., 1948; 30: 560-578. cited by applicant
Kotsias, A., Clinical trial of titanium-coated PEEL cages anterior cervical discectomy and fusion. [Klinishe Untersuching zum Einsatz von titanbeschichteten Polyetheretherketon—Implantaten bei der cervikalen interkorporalen fusion]. Doctoral thesis. Department of Medicine, Charite, University of Medicine Berlin, 2014, 73 pages. (German language document/Engl. summary). cited by applicant
Krbec, "Replacement of the Vertebral Body with an Expansion Implant (Synex)", Acta Chir Orthop Traumatol Cech, 2002, pp. 158-162, vol. 69(3). cited by applicant
Kroschwitz et al., eds., Hydrogels. Concise Encyclopedia of Polymer Science and Engineering. Wiley and Sons, pp. 458-459, 1990. cited by applicant
Lendlein et al., AB-polymer networks based on oligo(epsilon-caprolactone) segments showing shape-memory properties. Proc Natl Acad Sci US A. Jan. 30, 2001; 98(3):842-7. Epub Jan. 23, 2001. cited by applicant
Link SB Charite Brochure—Intervertebral Prosthesis 1988, 29 pages. cited by applicant
Mahar et al., "Biomechanical Comparison of Novel Percutaneous Transfacet Device and a Traditional Posterior System for Single Level Fusion", Journal of Spinal Disorders & Techniques, Dec. 2006, vol. 19, No. 8, pp. 591-594. cited by applicant
Malberg. M.I., MD; Pimenta, L., MD; Millan, M.M., MD, 9th International Meeting on Advanced Spine Techniques, May 23-25, 2002, Montreux, Switzerland. Paper #54, Paper #60, and E-Poster #54, 5 pages. cited by applicant
McAfee et al., Minimally invasive anterior retroperitoneal approach to the lumbar spine: Emphasis on the lateral BAK. Spine. 1998; 23(13): 1476-84. cited by applicant

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This is a continuation of U.S. patent application Ser. No. 15/635,480 filed Jun. 28, 2017, which claims benefit of U.S. Provisional Application No. 62/355,577, filed Jun. 28, 2016, the entirety of which is herein incorporated by reference.

FIELD
(1) The present disclosure relates to orthopedic implantable devices, and more particularly implantable devices for stabilizing the spine. Even more particularly, the present disclosure is directed to expandable, angularly adjustable intervertebral cages that allow expansion from a first, insertion configuration having a reduced size to a second, implanted configuration having an expanded size. The intervertebral cages are configured to adjust and adapt to lodortic angles, particularly larger lodortic angles, while restoring sagittal balance and alignment of the spine.
BACKGROUND
(2) The use of fusion-promoting interbody implantable devices, often referred to as cages or spacers, is well known as the standard of care for the treatment of certain spinal disorders or diseases. For example, in one type of spinal disorder, the intervertebral disc has deteriorated or become damaged due to acute injury or trauma, disc disease or simply the natural aging process. A healthy intervertebral disc serves to stabilize the spine and distribute forces between vertebrae, as well as cushion the vertebral bodies. A weakened or damaged disc therefore results in an imbalance of forces and instability of the spine, resulting in discomfort and pain. A typical treatment may involve surgical removal of a portion or all of the diseased or damaged intervertebral disc in a process known as a partial or total discectomy, respectively. The discectomy is often followed by the insertion of a cage or spacer to stabilize this weakened or damaged spinal region. This cage or spacer serves to reduce or inhibit mobility in the treated area, in order to avoid further progression of the damage and/or to reduce or alleviate pain caused by the damage or injury. Moreover, these type of cages or spacers serve as mechanical or structural scaffolds to restore and maintain normal disc height, and in some cases, can also promote bony fusion between the adjacent vertebrae.
(3) However, one of the current challenges of these types of procedures is the very limited working space afforded the surgeon to manipulate and insert the cage into the intervertebral area to be treated. Access to the intervertebral space requires navigation around retracted adjacent vessels and tissues such as the aorta, vena cava, dura and nerve roots, leaving a very narrow pathway for access. The opening to the intradiscal space itself is also relatively small. Hence, there are physical limitations on the actual size of the cage that can be inserted without significantly disrupting the surrounding tissue or the vertebral bodies themselves.
(4) Further complicating the issue is the fact that the vertebral bodies are not positioned parallel to one another in a normal spine. There is a natural curvature to the spine due to the angular relationship of the vertebral bodies relative to one another. The ideal cage must be able to accommodate this angular relationship of the vertebral bodies, or else the cage will not sit properly when inside the intervertebral space. An improperly fitted cage would either become dislodged or migrate out of position, and lose effectiveness over time, or worse, further damage the already weakened area.
(5) Thus, it is desirable to provide intervertebral cages or spacers that not only have the mechanical strength or structural integrity to restore disc height or vertebral alignment to the spinal segment to be treated, but also be configured to easily pass through the narrow access pathway into the intervertebral space, and then accommodate the angular constraints of this space, particularly for

larger lodortic angles.

BRIEF SUMMARY

(6) The present disclosure describes spinal implantable devices that address the aforementioned challenges and meet the desired objectives. These spinal implantable devices, or more specifically intervertebral cages or spacers, are configured to be expandable as well as angularly adjustable. The cages may have expansion or adjustment mechanisms that allow the cage to change size and angle as needed, with little effort. The cages may have a first, insertion configuration characterized by a reduced size at each of their insertion ends to facilitate insertion through a narrow access passage and into the intervertebral space. The cages may be inserted in a first, reduced size and then expanded to a second, expanded size once implanted. In their second configuration, the cages are able to maintain the proper disc height and stabilize the spine by restoring sagittal balance and alignment. It is contemplated that, in some embodiments, the intervertebral cages may also be designed to allow the cages to expand in a freely selectable (or stepless) manner to reach its second, expanded configuration. The intervertebral cages are configured to be able to adjust the angle of lordosis, and can accommodate larger lodortic angles in their second, expanded configuration. Further, these cages may promote fusion to further enhance spine stability by immobilizing the adjacent vertebral bodies.

(7) Additionally, the implantable devices may be manufactured using selective laser melting (SLM) techniques, a form of additive manufacturing. The devices may also be manufactured by other comparable techniques, such as for example, 3D printing, electron beam melting (EBM), layer deposition, and rapid manufacturing. With these production techniques, it is possible to create an all-in-one, multi-component device which may have interconnected and movable parts without further need for external fixation or attachment elements to keep the components together. Accordingly, the intervertebral cages of the present disclosure are formed of multiple, interconnected parts that do not require additional external fixation elements to keep together.

(8) Even more relevant, devices manufactured in this manner would not have connection seams whereas devices traditionally manufactured would have joined seams to connect one component to another. These connection seams can often represent weakened areas of the implantable device, particularly when the bonds of these seams wear or break over time with repeated use or under stress. By manufacturing the disclosed implantable devices using additive manufacturing, one of the advantages is that connection seams are avoided entirely and therefore the problem is avoided.

(9) Another advantage of the present devices is that, by manufacturing these devices using an additive manufacturing process, all of the components of the device (that is, both the intervertebral cage and the pins for expanding and blocking) remain a complete construct during both the insertion process as well as the expansion process. That is, multiple components are provided together as a collective single unit so that the collective single unit is inserted into the patient, actuated to allow expansion, and then allowed to remain as a collective single unit in situ. In contrast to other cages requiring external expansion screws or wedges for expansion, in the present embodiments the expansion and blocking components do not need to be inserted into the cage, nor removed from the cage, at any stage during the process. This is because these components are manufactured to be captured internal to the cages, and while freely movable within the cage, are already contained within the cage so that no additional insertion or removal is necessary.

(10) In some embodiments, the cages can be made with an engineered cellular structure that includes a network of pores, microstructures and nanostructures to facilitate osteosynthesis. For example, the engineered cellular structure can comprise an interconnected network of pores and other micro and nano sized structures that take on a mesh-like appearance. These engineered cellular structures can be provided by etching or blasting to change the surface of the device on the nano level. One type of etching process may utilize, for example, HF acid treatment. In addition, these cages can also include internal imaging markers that allow the user to properly align the device and generally facilitate insertion through visualization during navigation. The imaging

marker shows up as a solid body amongst the mesh under x-ray, fluoroscopy or CT scan, for example.
(11) Another benefit provided by the implantable devices of the present disclosure is that they are able to be specifically customized to the patient's needs. Customization of the implantable devices is relevant to providing a preferred modulus matching between the implant device and the various qualities and types of bone being treated, such as for example, cortical versus cancellous, apophyseal versus central, and sclerotic versus osteopenic bone, each of which has its own different compression to structural failure data. Likewise, similar data can also be generated for various implant designs, such as for example, porous versus solid, trabecular versus non-trabecular, etc. Such data may be cadaveric, or computer finite element generated. Clinical correlation with, for example, DEXA data can also allow implantable devices to be designed specifically for use with sclerotic, normal, or osteopenic bone. Thus, the ability to provide customized implantable devices such as the ones provided herein allow the matching of the Elastic Modulus of Complex Structures (EMOCS), which enable implantable devices to be engineered to minimize mismatch, mitigate subsidence and optimize healing, thereby providing better clinical outcomes.
(12) In one exemplary embodiment, an expandable spinal implant is provided. The expandable spinal implant may comprise a body having an upper plate and a lower plate connected together by an elastically deformable hinge, each of the plates including an inner ramped surface, the implant further having a channel for receiving a lever pin. The implant may further comprise a lever pin comprising a shaft having at one end a keyed surface, the lever pin further having at an opposed end an enlarged, shaped head, the shaped head further including an exterior adjustment surface that cooperates with the ramped surfaces of the plates upon rotation to urge the plates apart. The body and the pin may be manufactured by an additive production technique, with the lever pin being manufactured to reside inside but still be rotatable within the body of the cage. The enlarged, shaped head of the lever pin may have an oblong cross-section. Further, the upper and lower plates may be tapered at the first, leading end. In some embodiments, the expandable spinal implant may be a PLIF cage. The expandable spinal implant may have a first configuration wherein the plates are parallel to one another, and a second configuration wherein the plates are locked together and are angled relative to one another. In the second configuration, the implant adjusts the angle of lordosis, and restores the sagittal balance and alignment of the spine.
(13) In another exemplary embodiment, an expandable spinal implant is provided. The spinal implant may comprise a body having an upper plate and a lower plate connected by an elastically deformable hinge, each of the plates including an inner adjustment surface and a cavity, the implant further having a channel for receiving an actuator pin. The actuator pin may comprise a shaft having at one end a keyed surface, and extending into a pin tip at an opposed end, the pin having a notch at the tip, and an exterior adjustment surface that cooperates with the inner adjustment surfaces of the plates upon rotation to urge the plates apart. The body and the actuator pin may be manufactured by an additive production technique, with the actuator pin being manufactured to reside inside but still be rotatable within the body of the cage. The pin tip may be configured to nest within the cavities of the upper and lower plates, while the notch of the pin tip may be configured to mate with the cavities of the upper and lower plates. In some embodiments, the expandable spinal implant may be a PLIF cage, and the inner adjustment surface can comprise a ramped surface. The expandable spinal implant may have a resting state configuration in which the plates are angled relative to one another, an insertion configuration wherein the plates are parallel to one another, and an expanded configuration wherein the plates are locked together and are angled relative to one another. In the second configuration, the implant adjusts the angle of lordosis, and restores the sagittal balance and alignment of the spine.
(14) Although the following discussion focuses on spinal implants, it will be appreciated that many of the principles may equally be applied to other structural body parts requiring bone repair or bone fusion within a human or animal body, including other joints such as knee, shoulder, ankle or finger

joints.
(15) It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the disclosure. Additional features of the disclosure will be set forth in part in the description which follows or may be learned by practice of the disclosure.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several embodiments of the disclosure and together with the description, serve to explain the principles of the disclosure.
(2) FIG. **1** illustrates a perspective view of an exemplary embodiment of an expandable intervertebral cage in accordance with the present disclosure.
(3) FIG. **2**A illustrates an anterior view of the intervertebral cage of FIG. **1**.
(4) FIG. **2**B illustrates a lateral view of the intervertebral cage of FIG. **1**.
(5) FIG. **2**C illustrates a posterior view of the intervertebral cage of FIG. **1**.
(6) FIG. **2**D illustrates a cranial-caudal view of the intervertebral cage of FIG. **1**.
(7) FIG. **2**E illustrates an isometric view of the intervertebral cage of FIG. **1**.
(8) FIG. **3** illustrates an exploded view of the intervertebral cage of FIG. **1** and associated lever pin.
(9) FIG. **4** illustrates a cross-sectional view of the intervertebral cage of FIG. **1** and associated lever pin in its manufactured position.
(10) FIGS. **5**A and **5**B illustrate cross-sectional views of the intervertebral cage of FIG. **1**, in which FIG. **5**A shows a side cross-sectional view and FIG. **5**B shows a perspective cross-sectional view.
(11) FIGS. **6**A-**6**H illustrate a method of expanding the intervertebral cage of FIG. **1**, in which FIGS. **6**A, **6**C, and **6**F illustrate lateral views of the cage over the course of expansion, FIGS. **6**B, **6**D, and **6**G illustrate cross-sectional views of the cage over expansion, and FIGS. **6**E and **6**H illustrate anterior views of the cage over the course of expansion.
(12) FIG. **7** illustrates a perspective view of another exemplary embodiment of an expandable intervertebral cage and associated inner actuator pin in accordance with the present disclosure.
(13) FIG. **8**A illustrates an anterior view of the expandable intervertebral cage and actuator pin of FIG. **7**.
(14) FIG. **8**B illustrates a lateral view of the expandable intervertebral cage and actuator pin of FIG. **7**.
(15) FIG. **8**C illustrates a posterior view of the expandable intervertebral cage and actuator pin of FIG. **7**.
(16) FIG. **8**D illustrates a cranial-caudal view of the expandable intervertebral cage and actuator pin of FIG. **7**.
(17) FIG. **8**E illustrates an isometric view of the expandable intervertebral cage and actuator pin of FIG. **7**.
(18) FIG. **9** illustrates an exploded view of the expandable intervertebral cage and inner actuator pin of FIG. **7**.
(19) FIG. **10**A illustrates the intervertebral cage with the actuator pin of FIG. **7** in its manufactured position.
(20) FIG. **10**B illustrates a partial cross-sectional view of the intervertebral cage and the inner actuator pin of FIG. **10**A.
(21) FIGS. **11**A and **11**B illustrate partial cross-sectional views of the intervertebral cage of FIG. **7**, in which FIG. **11**A shows a side cross-sectional view and FIG. **11**B shows a perspective cross-sectional view.

(22) FIGS. **12**A and **12**B illustrate a planar and perspective view, respectively, of the inner actuator pin of FIG. **9**.
(23) FIGS. **13**A-**13**L illustrate a method of compressing and expanding the intervertebral cage of FIG. **7**, in which FIGS. **13**A, **13**C, **13**E, **13**G, **13**I, and **13**K illustrate lateral views of the cage over the course of expansion, while FIGS. **13**B, **13**D, **13**F, **13**H, **13**J, and **13**L illustrate cross-sectional views of the cage over the course of expansion.

DETAILED DESCRIPTION

(24) The present disclosure provides various spinal implant devices, such as interbody fusion spacers, or cages, for insertion between adjacent vertebrae. The devices can be configured for use in either the cervical or lumbar region of the spine. In some embodiments, these devices are configured as PLIF cages, or posterior lumbar interbody fusion cages. These cages can restore and maintain intervertebral height of the spinal segment to be treated, and stabilize the spine by restoring sagittal balance and alignment. The cages may have a first, insertion configuration characterized by a reduced size at each of their insertion ends to facilitate insertion through a narrow access passage and into the intervertebral space. The cages may be inserted in a first, reduced size and then expanded to a second, expanded size once implanted. In their second configuration, the cages are able to maintain the proper disc height and stabilize the spine by restoring sagittal balance and alignment. It is contemplated that, in some embodiments, the intervertebral cages may also be designed to allow the cages to expand in a freely selectable (or stepless) manner to reach its second, expanded configuration. The intervertebral cages are configured to be able to adjust the angle of lordosis, and can accommodate larger lodortic angles in their second, expanded configuration. Further, these cages may promote fusion to further enhance spine stability by immobilizing the adjacent vertebral bodies.
(25) Additionally, the implantable devices may be manufactured using selective laser melting (SLM) techniques, a form of additive manufacturing. The devices may also be manufactured by other comparable techniques, such as for example, 3D printing, electron beam melting (EBM), layer deposition, and rapid manufacturing. With these production techniques, it is possible to create an all-in-one, multi-component device which may have interconnected and movable parts without further need for external fixation or attachment elements to keep the components together. Accordingly, the intervertebral cages of the present disclosure are formed of multiple, interconnected parts that do not require additional external fixation elements to keep together.
(26) Even more relevant, devices manufactured in this manner would not have connection seams whereas devices traditionally manufactured would have joined seams to connect one component to another. These connection seams can often represent weakened areas of the implantable device, particularly when the bonds of these seams wear or break over time with repeated use or under stress. By manufacturing the disclosed implantable devices using additive manufacturing, connection seams are avoided entirely and therefore the problem is avoided.
(27) Another advantage of the present devices is that, by manufacturing these devices using an additive manufacturing process, all of the components of the device (that is, both the intervertebral cage and the pins for expanding and blocking) remain a complete construct during both the insertion process as well as the expansion process. That is, multiple components are provided together as a collective single unit so that the collective single unit is inserted into the patient, actuated to allow expansion, and then allowed to remain as a collective single unit in situ. In contrast to other cages requiring external expansion screws or wedges for expansion, in the present embodiments the expansion and blocking components do not need to be inserted into the cage, nor removed from the cage, at any stage during the process. This is because these components are manufactured to be captured internal to the cages, and while freely movable within the cage, are already contained within the cage so that no additional insertion or removal is necessary.
(28) In some embodiments, the cages can be made with a portion, or made entirely, having an engineered cellular structure that includes a network of pores, microstructures and nanostructures

to facilitate osteosynthesis. For example, the engineered cellular structure can comprise an interconnected network of pores and other micro and nano sized structures that take on a mesh-like appearance. These engineered cellular structures can be provided by etching or blasting to change the surface of the device on the nano level. One type of etching process may utilize, for example, HF acid treatment. In addition, these cages can also include internal imaging markers that allow the user to properly align the cage and generally facilitate insertion through visualization during navigation. The imaging marker shows up as a solid body amongst the mesh under x-ray, fluoroscopy or CT scan, for example.

(29) Another benefit provided by the implantable devices of the present disclosure is that they are able to be specifically customized to the patient's needs. Customization of the implantable devices is relevant to providing a preferred modulus matching between the implant device and the various qualities and types of bone being treated, such as for example, cortical versus cancellous, apophyseal versus central, and sclerotic versus osteopenic bone, each of which has its own different compression to structural failure data. Likewise, similar data can also be generated for various implant designs, such as for example, porous versus solid, trabecular versus non-trabecular, etc. Such data may be cadaveric, or computer finite element generated. Clinical correlation with, for example, DEXA data can also allow implantable devices to be designed specifically for use with sclerotic, normal, or osteopenic bone. Thus, the ability to provide customized implantable devices such as the ones provided herein allow the matching of the Elastic Modulus of Complex Structures (EMOCS), which enable implantable devices to be engineered to minimize mismatch, mitigate subsidence and optimize healing, thereby providing better clinical outcomes.

(30) Turning now to the drawings, FIG. **1** shows an exemplary embodiment of an expandable, adjustable intervertebral cage **10** of the present disclosure. The cage **10** may comprise a unitary body or housing **16** having a pair of plates, one upper **20** and one lower **22**, which may be tapered at their free ends at the first, leading end **12** of the cage **10**. These plates **20**, **22** are connected by an elastically deformable hinge **26** at the terminal ends of the plates near the cage's second, trailing end **14**, and can be expanded as shown in FIG. **1**. The hinge **26** is defined by elastic-plastic joint areas **28** that may be formed using selective cutouts at the second, trailing end **14**.

(31) As FIGS. **2**A-**2**E show, in the first, reduced size configuration the plates **20**, **22** lie parallel to one another. As FIG. **3** shows, the body **16** of the intervertebral cage **10** cooperates with a lever pin **40** to spread and block the expansion of the upper and lower plates **20**, **22**. As mentioned above, the devices of the present disclosure may be manufactured in such a way that the processing of all components into the final assembled device is achieved in one step by generative/additive production techniques (e.g., selective laser melting (SLM) or other similar techniques as mentioned above). FIG. **4** illustrates an exemplary manufacturing configuration showing how the cage **10** and the lever pin **40** can be manufactured nested together under such a technique. The pin **40** may comprise a shaft **46** on which there is a keyed feature **48** that functions to rotate and lock the lever pin **40**. The pin **40** extends into an enlarged, shaped tip **50** that also includes an external adjustment surface **54**. This tip **50** may be configured with an oval or oblong cross-sectional shape.

(32) FIGS. **5**A and **5**B show the interior of the body **16** of the intervertebral cage **10**. An opening **32** to a channel **30** is provided at the second, trailing end **14** for receiving the lever pin **40**. Further, the plates **20**, **22** have upper and lower adjustment surfaces **34**, **36** that interact with the adjustment surface **54** of the lever pin **40**, as will be described in more detail below.

(33) FIGS. **6**A-**6**F illustrate the process of adjusting the expandable intervertebral cage **10** during implantation. In its initial insertion stage, the expandable cage **10** may have a compressed, reduced size whereby the upper plate **20** and lower plate **22** are parallel to one another. This creates the most tapered and slim profile to facilitate insertion, which is particularly beneficial to traverse the narrow access path to the implant site. In some embodiments, the terminal ends of the plates **20**, **22** near the first, leading end **12** can also include a bevel or taper, if desired. The plates **20**, **22** may each include flat external surfaces to contact and press against the endplates of the vertebral bodies.

(34) The lever pin **40**, which may be manufactured to reside within the body **16** of cage **10** in a first insertion configuration, does not interfere with the plates **20**, **22**, and can be considered in a non-active state at this point. After the cage **10** has been properly inserted into the intervertebral or intradiscal space, the cage **10** may be adjusted/expanded by activating the lever pin **40**. In use, movement of the plates **20**, **22** is realized by levering the intervertebral cage **10** open, thereby causing the body **16** to be elastically and partially plastically deformed.
(35) As shown in FIGS. **6**C-**6**E, partial rotation of the lever pin **40** in the direction of the arrows causes the adjustment surface **54** of the shaped portion of the lever pin **40** to press against the adjustment surfaces **34**, **36** of the upper and lower plates **20**, **22**. This spreads the plates **20**, **22** and expands the first, leading end **12** of the cage **10** into an intermediate position. When the lever pin **40** is rotated a full 90 degrees, as shown in FIGS. **6**F-**6**H, then the plates **20**, **22** may be fully expanded and the cage **10** may be in its second, expanded configuration. The elastic-plastic joint areas **28** of the hinge **26** have been partially plastically deformed at this stage, and the cage **10** may be considered fully adjusted and in a blocked position.
(36) As mentioned above, the intervertebral cages of the present disclosure are configured to be able to allow insertion through a narrow access path, but are able to be expanded and angularly adjusted so that the cages are capable of adjusting the angle of lordosis of the vertebral segments. By being able to partially plastically deform at the hinge **26**, the cages can accommodate and adapt to larger angles of lordosis. Additionally, the cages can restore sagittal balance and alignment of the spine, and can promote fusion to immobilize and stabilize the spinal segment.
(37) FIG. **7** shows another exemplary embodiment of an expandable intervertebral cage and associated inner actuating pin of the present disclosure. As shown in greater detail in FIGS. **8**A-**8**E, similar to the previous cage **10**, this cage **110** may also comprise a housing or body **116** having an upper plate **120** and lower plate **122** attached at their terminal ends at an elastically deformable hinge **126**. This deformable hinge **126** resides at the second, trailing end **114** of the body **116**, while the free ends of the upper and lower plates **120**, **122** are at the first, leading end **112** of the body **116** of the cage **110**. In some embodiments, the free ends of the plates **120**, **122** may be tapered or beveled to facilitate insertion. As with the previous embodiment, the intervertebral cage **110** may be formed with a cooperative inner actuator pin **140** in an additive manufacturing technique as previously described. Unlike intervertebral cage **10**, however, the intervertebral cage **110** of the present embodiment is biased to be in an open or expanded configuration at rest.
(38) As mentioned above, in the intervertebral cage **110**, the resting state of the cage **110** may be an open or expanded position. In other words, the cage **110** may be manufactured so that the plates **120**, **122** are biased to be in an open/lordotic position. Prior to insertion, the plates **120**, **122** can be squeezed together using the actuator pin **140**, which can press the plates **120**, **122** together and hold them in this first, reduced size configuration so as to facilitate insertion of the cage **110**. While the plates **120**, **122** are held shut, the plates can be elastically and partially plastically deformed. After insertion, the plates **120**, **122** can be released and automatically open to a certain amount due to the stored elastic energy at the hinge **126**. Lastly, the plates **120**, **122** can be actively opened to their second, final configuration and locked in place using the inner actuator pin **140**.
(39) FIG. **9** illustrates the expandable intervertebral cage **110** with the inner actuator pin **140**. As mentioned, the pin **140** can function to hold shut the upper and lower plates **120**, **122** in order to keep that first, insertion end **112** of the cage **110** in a reduced size for ease of insertion. Later, the pin **140** may be actuated to spread apart the plates **120**, **122** and lock them into position.
(40) FIGS. **10**A and **10**B show the intervertebral cage **110** and its associated inner actuator pin **140** in its manufacturing configuration. Similar to cage **10** and pin **40** above, the processing of all the components into the final assembly can be achieved in one step by generative/additive production techniques (e.g., selective laser melting SLM). Accordingly the inner actuator pin **140** may be manufactured so as to reside within the interior of the intervertebral cage **110**, which is itself a unitary body **116**, yet the inner actuator pin **140** can still be moveable and rotatable with respect to

the cage **110**. As understood, this is possible with additive production techniques that allow the manufacturing of multi-component systems to be achieved in a way that these components can interact with one another, be articulating, and not require external fixation elements. In this case, the inner actuator pin **140** may be used to hold the plates **120**, **122** of the cage **110** together and keep them from spreading apart. The same pin **140** may also be used to spread apart the plates **120**, **122** after insertion, as will be described in greater detail below.

(41) As mentioned above, the implantable devices of the present disclosure may be manufactured in such a way that the processing of all components into the final assembled device is achieved in one step by generative/additive production techniques (e.g., selective laser melting (SLM) or other similar techniques as mentioned above). It should be noted how the benefits of generative/additive production techniques may be utilized here to provide a multi-component assembly with interactive components that do not require any additional external fixation elements to maintain these subcomponents intact and interacting with one another. As can be seen, the entire assembly of cage **10**, **110** plus lever pin **40**, **140** may be produced altogether as one unit having movable internal parts.

(42) As previously mentioned, devices manufactured in this manner would not have connection seams whereas devices traditionally manufactured would have joined seams to connect one component to another. These connection seams can often represent weakened areas of the implantable device, particularly when the bonds of these seams wear or break over time with repeated use or under stress. By manufacturing the disclosed implantable devices using additive manufacturing, one of the advantages with these devices is that connection seams are avoided entirely and therefore the problem is avoided.

(43) In addition, by manufacturing these devices using an additive manufacturing process, all of the components of the device (that is, both the intervertebral cage and the pins for expanding and blocking) remain a complete construct during both the insertion process as well as the expansion process. That is, multiple components are provided together as a collective single unit so that the collective single unit is inserted into the patient, actuated to allow expansion, and then allowed to remain as a collective single unit in situ. In contrast to other cages requiring external expansion screws or wedges for expansion, in the present embodiments the expansion and blocking components do not need to be inserted into the cage, nor removed from the cage, at any stage during the process. This is because these components are manufactured to be captured internal to the cages, and while freely movable within the cage, are already contained within the cage so that no additional insertion or removal is necessary.

(44) FIGS. **11**A and **11**B illustrate the cage **110** and pin **140** in greater detail. As shown, the cage **110** may comprise upper plate **120** connected to lower plate **122** at their terminal ends by an elastic-plastic hinge **126**, which may be defined by an elastic-plastic joint region **128** at a second, trailing end **114** of the cage **110**. The cage may **110** further include an opening **132** leading into a channel **130** for receiving the inner actuator pin **140**. The upper plate **120** may have in its underside a ramped surface or adjustment surface **134**, while the lower plate **122** may have in its interior a ramped surface or adjustment surface **136**. Upper plate **120** may further include a cavity or notched region **158** for receiving the actuator pin **140** to hold the plates **120**, **122** together. Likewise, the lower plate **122** may further include a cavity or grooved region **168** for receiving the actuator pin **140** to hold the plates **120**, **122** together.

(45) Details of the inner actuator pin **140** may be seen from FIGS. **12**A and **12**B. The inner actuator pin **140** may comprise a shaft **146** on which there is a keyed feature **148** that functions to rotate the actuator pin **140**. The actuator pin **140** may also include an external adjustment surface **154** that cooperates with the adjustment surfaces of the upper and lower plates **120**, **122**. The actuator pin **140** may terminate in a tip **150** having a notch or groove **152**. This pin tip **150** may be configured to interfere with the cavity **158** of the upper plate **120** and the cavity **168** of the lower plate **122** to hold the plates **120**, **122** together. The notch **152** can enable locking of the plates **120**, **122** relative

to one another.
(46) FIGS. **13**A-**13**H illustrate a method of adjusting the expandable intervertebral cage **110**. In its pre-insertion stage, the cage **110** may have an open position in which the plates **120**, **122** are angled relative to one another, and whereby the inner actuator pin **140** is not engaged with the cavities **158**, **168** of the plates **120**, **122**, as shown in FIGS. **13**A and **13**B. In FIGS. **13**C and **13**D, still in a pre-insertion stage, the plates **120**, **122** can now be pressed into a closed position such that the plates **120**, **122** are parallel to one another and the first, leading end **112** of the cage **110** is in a reduced size to ease insertion through the narrow access path of the intervertebral/intradiscal space. The plates **120**, **122** may be fully closed and held together when the pin **140** is moved inside the body **116** such that the pin tip **150** is inserted in the cavities **158**, **168** of the plates, as shown in FIGS. **13**E and **13**F. In this compressed configuration, with the plates **120**, **122** held tightly together, the cage **110** may then be inserted into the intervertebral space/intradiscal space.
(47) After insertion, the cage **110** may be expanded using the same internal actuator pin **140**. As shown in FIGS. **13**G and **13**H, the plates **120**, **122** can be released from its compressed configuration by withdrawing the actuator pin **140** from the cavities **158**, **168** of the plates **120**, **122**. Residual elastic energy retained by the elastic joint areas **128** will urge the plates **120**, **122** away from each other in a partial open position. In other words, the release of the actuator pin **140** allows the plates **120**, **122** to spring back towards its natural resting position where the plates **120**, **122** are space apart at their free ends. Then, as shown in FIGS. **131** and **13**J, the actuator pin **140** may be rotated by a full 90 degrees, which will then expand open the plates **120**, **122** relative to one another. This 90 degree rotation of the pin **140** causes the adjustment surfaces of the pin **140** and the plates **120**, **122** to interfere and counteract one another, exerting force against the plates **120**, **122**, and spreading them apart as shown. Once the plates **120**, **122** have been fully expanded, the actuator pin **140** may be fully inserted by moving the tip **150** forward so that the plates **120**, **122** remain locked in position. As shown in FIGS. **13**K and **13**L, the notch **152** of the actuator pin **140** may be inserted into the cavities **158**, **168** of the plates to keep these plates **120**, **122** firmly locked in their expanded position. Thus, the actuation of the internal actuator pin **140** that is manufactured inside the intervertebral cage **110** can be made to interfere with the adjustment surfaces of the upper and lower plates **120**, **122**, causing partial plastic deformation of the elastic joint areas **128** of the hinge **126**, and causing the cage **110** to be in a second, expanded configuration.
(48) As with the previous cage, the intervertebral cage **110** of the present disclosure is configured to be able to allow insertion through a narrow access path, but is able to be expanded and angularly adjusted so that the cage is capable of adjusting the angle of lordosis of the vertebral segments. By being able to partially plastically deform at the hinge **126**, the cage can accommodate and adapt to larger angles of lordosis. Additionally, the cage can effectively restore sagittal balance and alignment of the spine, and can promote fusion to immobilize and stabilize the spinal segment.
(49) With respect to the ability of the expandable cages **10**, **110** to promote fusion, many in-vitro and in-vivo studies on bone healing and fusion have shown that porosity is necessary to allow vascularization, and that the desired infrastructure for promoting new bone growth should have a porous interconnected pore network with surface properties that are optimized for cell attachment, migration, proliferation and differentiation. At the same time, there are many who believe the implant's ability to provide adequate structural support or mechanical integrity for new cellular activity is the main factor to achieving clinical success, while others emphasize the role of porosity as the key feature. Regardless of the relative importance of one aspect in comparison to the other, what is clear is that both structural integrity to stabilize, as well as the porous structure to support cellular growth, are key components of proper and sustainable bone regrowth.
(50) Accordingly, these cages **10**, **110** may take advantage of current additive manufacturing techniques that allow for greater customization of the devices by creating a unitary body that may have both solid and porous features in one. In some embodiments, the cages **10**, **110** can have a porous structure, and be made with an engineered cellular structure that includes a network of

pores, microstructures and nanostructures to facilitate osteosynthesis. For example, the engineered cellular structure can comprise an interconnected network of pores and other micro and nano sized structures that take on a mesh-like appearance. These engineered cellular structures can be provided by etching or blasting to change the surface of the device on the nano level. One type of etching process may utilize, for example, HF acid treatment.

(51) These same manufacturing techniques may be employed to provide these cages with an internal imaging marker. For example, these cages can also include internal imaging markers that allow the user to properly align the cage and generally facilitate insertion through visualization during navigation. A cage may comprise a single marker, or a plurality of markers. These internal imaging markers greatly facilitate the ease and precision of implanting the cages, since it is possible to manufacture the cages with one or more internally embedded markers for improved visualization during navigation and implantation.

(52) Another benefit provided by the implantable devices of the present disclosure is that they are able to be specifically customized to the patient's needs. Customization of the implantable devices is relevant to providing a preferred modulus matching between the implant device and the various qualities and types of bone being treated, such as for example, cortical versus cancellous, apophyseal versus central, and sclerotic versus osteopenic bone, each of which has its own different compression to structural failure data. Likewise, similar data can also be generated for various implant designs, such as for example, porous versus solid, trabecular versus non-trabecular, etc. Such data may be cadaveric, or computer finite element generated. Clinical correlation with, for example, DEXA data can also allow implantable devices to be designed specifically for use with sclerotic, normal, or osteopenic bone. Thus, the ability to provide customized implantable devices such as the ones provided herein allow the matching of the Elastic Modulus of Complex Structures (EMOCS), which enable implantable devices to be engineered to minimize mismatch, mitigate subsidence and optimize healing, thereby providing better clinical outcomes.

(53) A variety of spinal implants may be provided by the present disclosure, including interbody fusion cages for use in either the cervical or lumbar region of the spine. Although only a posterior lumbar interbody fusion (PLIF) device is shown, it is contemplated that the same principles may be utilized in a cervical interbody fusion (CIF) device, a transforaminal lumbar interbody fusion (TLIF) device, anterior lumbar interbody fusion (ALIF) cages, lateral lumbar interbody fusion (LLIF) cages, and oblique lumbar interbody fusion (OLIF) cages.

(54) Other embodiments of the disclosure will be apparent to those skilled in the art from consideration of the specification and practice of the disclosure provided herein. It is intended that the specification and examples be considered as exemplary only.

Claims

1. An expandable spinal implant comprising: a body having an upper plate and a lower plate, wherein the upper plate is configured to move away from and angulate relative to the lower plate; and a lever pin comprising a shaft and an enlarged head, the enlarged head including an exterior adjustment surface, wherein rotation of the enlarged head with respect to the upper plate causes the enlarged head to move from a first rotational position to a second rotational position, and the second rotational position of the enlarged head causes the enlarged head to urge the upper plate away from the lower plate from a first configuration to a second lordotic configuration, wherein an entirety of the lever pin is contained in the body between the upper and lower plates both when upper plate is in the first configuration and when the upper plate is in the second lordotic configuration, wherein the body has an inner ramped surface, and the exterior adjustment surface is configured to press against the inner ramped surface so as to urge a leading end of the upper plate away from the lower plate from the first configuration to the second lordotic configuration, wherein the exterior adjustment surface is rotationally aligned with the inner ramped surface prior to

rotation of the enlarged head from the first rotational position to the second rotational position, and wherein the upper and lower plates are parallel to each other when the upper plate is in the first configuration.

2. The expandable spinal implant of claim 1, wherein the lever pin is rotatable relative to the upper and lower plates.

3. The expandable spinal implant of claim 1, wherein the body is devoid of connection seams.

4. The expandable spinal implant of claim 1, wherein the enlarged head of the lever pin has an oblong cross-section.

5. The expandable spinal implant of claim 1, wherein the upper and lower plates are tapered at a leading end of the implant.

6. The expandable spinal implant of claim 1, further being configured as a posterior lumbar interbody fusion cage.

7. The expandable spinal implant of claim 1, wherein the plates are locked together when the upper plate is in the second configuration.

8. The expandable spinal implant of claim 7 configured to restore sagittal balance and alignment of a spine when the upper plate is in the second lordotic configuration.

9. The expandable spinal implant of claim 1, wherein the inner ramped surface tapers toward the lower plate as it extends in a direction from the trailing end toward the leading end, and the exterior adjustment surface of the enlarged head is tapered as it extends in a direction toward the leading end.

10. The expandable spinal implant of claim 1, wherein the lever pin has a keyed surface is configured to lock the lever pin.

11. The expandable spinal implant of claim 1, wherein the upper plate pivots relative to the lower plate at a hinge that comprises cutouts in the body at a trailing end of the implant.

12. The expandable spinal implant of claim 1, wherein an entirety of the exterior adjustment surface is tapered as it extends in a direction toward a leading end of the implant.

13. The expandable spinal implant of claim 1, wherein the upper and lower plates are connected together by a deformable hinge.

14. The expandable implant of claim 1, wherein movement of an entirety of the lever pin relative to the upper plate causes the relative movement between the enlarged head and the upper plate.

15. The expandable spinal implant of claim 1, wherein the upper plate has an inner ramped surface, and movement of the enlarged head relative to the upper plate causes the enlarged head to cooperate with the inner ramped surface of the upper plate, thereby urging a leading end of the upper plate to move away from the lower plate from the first configuration to the second lordotic configuration.

16. The expandable implant of claim 15, wherein movement of an entirety of the lever pin relative to the upper plate causes the relative movement between the enlarged head and the upper plate.